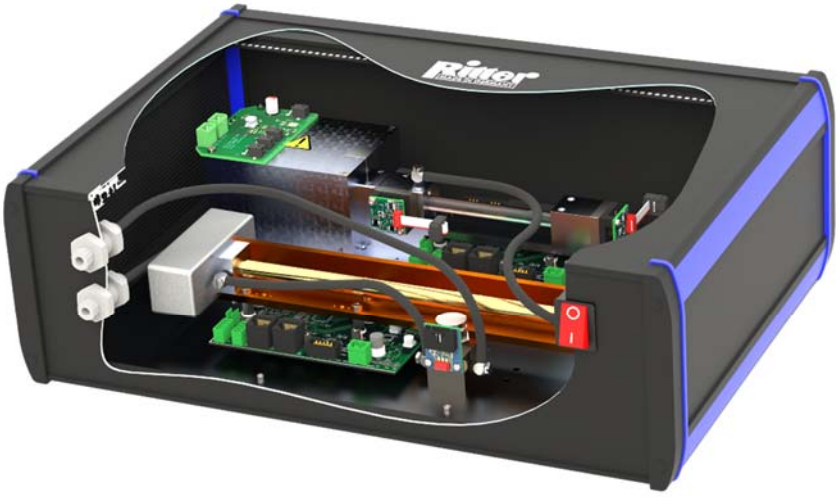

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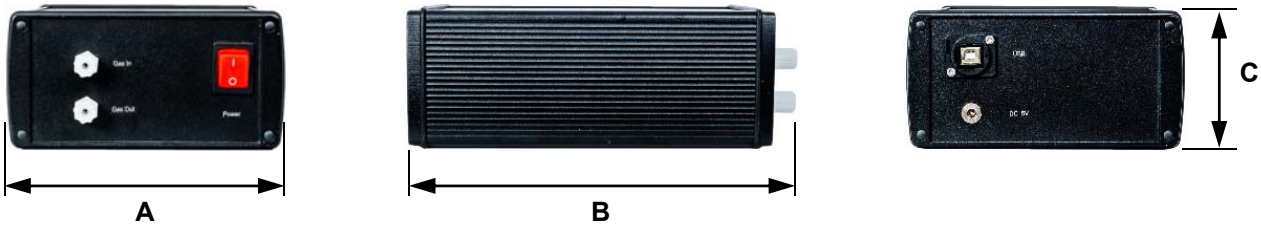
Instruments engineering
Measuring instruments

Content

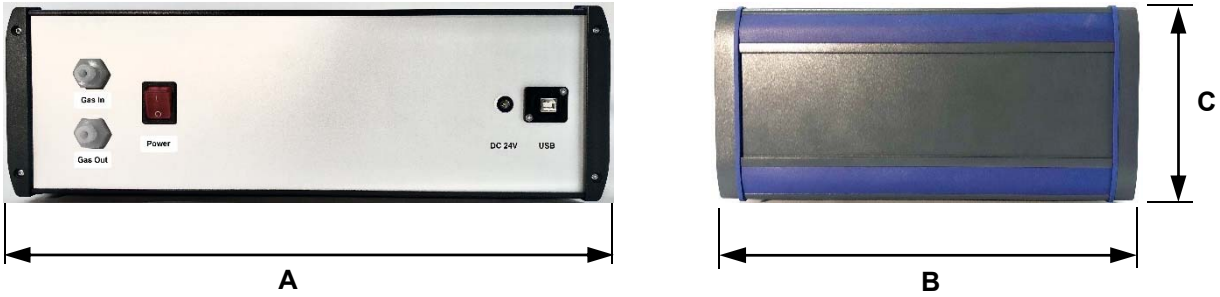
1. General Specifications

1.1. Casing Types

Type 1



Type 2



1.2. Dimensions

	Type 1	Type 2
A	171 mm	444 mm
B	290 mm [1)]	305 mm
C	86 mm	145 mm
Weight, approx. [2)]	2+ kg	6.5 – 8 kg
Connections gas in-/outlet	PVDF screw-type tube connection for tube Ø 4_i / 6_o mm	
Interfaces	USB (Standard) RS232 (Option)	
Power	24 V DC	

[1)] May be larger with cuvettes for ppm measurement ranges
[2)] Depending on type and number of built-in sensor modules

1.3. Assignment of Sensor Types to possible Sensor Combinations

Part 1: Pre-configured sensors, incl. housing type 1 with gas connection fittings, data interface, plug-in power supply - ready for use

Part 2: Pre-configured sensors, incl. housing type 2 with gas connection glands, data interface, fittings, data interface, plug-in power supply - ready for use

Part 3: Individually combinable sensor modules, composition according to customer specification, delivery incl. housing in suitable size according to number and type of modules - ready for use

Part 4: Enclosure for sensor modules, assembled according to customer's specification

Part 5: Options built into the enclosure

Part 6: Accessories / options

Part 1: Pre-configured Sensors
Incl. casing type 1 with gas connection fittings, data port, power supply
Ready for use

Sensor Type: RITTER MultiGas *xxx*	Article No.	Group of Gases IR	Number of Detectable Gases in this Group	Group of Gases UV	Number of Detectable Gases in this Group
xxx = **mono IR1**	**2678**	CO_2 CO N_2O CH_4 C_nH_m CF_4 SF_6	1		
xxx = **duo IR2**	**2742**	CO_2 CO N_2O CH_4 C_nH_m CF_4 SF_6	2		

Sensor Type: RITTER MultiGas *xxx*	Article No.	Group of Gases IR	Number of Detectable Gases in this Group	Group of Gases UV	Number of Detectable Gases in this Group
xxx **= trio IR3**	**2743**	CO_2 CO N_2O CH_4 C_nH_m CF_4 SF_6	3		
xxx **= mono UV1**	**2749**			SO_2 NO_2 O_3 Cl_2 ≤0.5%	1
xxx **= mono UV1 resist**	**2763**			SO_2 Cl_2 ≤30%	1
xxx **= duo UV2**	**2766**			SO_2 ≤0.5% NO_2 O_3 Cl_2 ≤0.5%	2
xxx **= duo IR1+UV1**	**2797**	CO_2 CO N_2O CH_4 C_nH_m CF_4 SF_6	1	SO_2 NO_2 O_3 Cl_2 ≤5%	1
xxx **= trio IR1+UV2**		CO_2 CO N_2O CH_4 C_nH_m CF_4 SF_6	1	SO_2 NO_2 O_3 CL_2 ≤0.5%	2

Part 2: Pre-configured Sensors Incl. casing type 2 with gas connection fittings, data port, power supply Ready for use					
Sensor Type: RITTER MultiGas *xxx*	**Article No.**	**Group of Gases IR**	**Number of Detectable Gases in this Group**	**Group of Gases UV**	**Number of Detectable Gases in this Group**
xxx = **mono UV1 $H_2S \leq 5.000$ ppm**	**2672**			$H_2S \leq 5.000$ ppm	1
xxx = **mono UV1 $H_2S \leq 1\%$**	**2855**			$H_2S \leq 1\%$	1
xxx = **UVRAS**	**2812**			SO_2 NO_2 NO	3
xxx = **duo IR1 + $H_2S \leq 5000$ ppm**	**2959**	CO_2 CO N_2O CH_4 C_nH_m CF_4 SF_6	1	H_2S ≤5000ppm	1
xxx = **duo IR1 + [$H_2S \leq 1\%$ / NO]**	**2960**	CO_2 CO N_2O CH_4 C_nH_m CF_4 SF_6	1	H2S ≤1% NO	1

Part 3: Individually combinable sensor modules Composition according Customer Specification Delivery incl. casing of suitable size according to number and type of modules Ready for use					
Sensor Type: RITTER MultiGas *xxx*	**Article No.**	**Group of Gases IR**	**Number of Detectable Gases in this Group**	**Group of Gases UV**	**Number of Detectable Gases in this Group**
xxx **= Mod IR1**	**2813**	CO_2 CO N_2O CH_4 C_nH_m CF_4 SF_6	1		
xxx **= Mod IR2**	**2814**	CO_2 CO N_2O CH_4 C_nH_m CF_4 SF_6	2		
xxx **= Mod IR3**	**2815**	CO_2 CO N_2O CH_4 C_nH_m CF_4 SF_6	3		

Sensor Type: RITTER MultiGas *xxx*	Article No.	Group of Gases IR	Number of Detectable Gases in this Group	Group of Gases UV	Number of Detectable Gases in this Group
xxx = Mod UV1	2830			SO_2 NO_2 O_3 Cl_2 ≤0.5%	1
xxx = Mod UV1 resist				SO_2 Cl_2 ≤30	1
xxx = Mod UV1 H_2S ≤ 5.000 ppm	2841			H_2S	1
xxx = Mod UV1 H_2S ≤ 1%	2856			H_2S	1
xxx = Mod UV2	2831			SO_2 NO_2 O_3 Cl_2 ≤5%	2
xxx = Mod UVRAS	2917			SO_2 NO_2 NO	3

Part 4: Casings for Sensor Modules assembled according to Customer Specification			
xxx = **Cas-2** (1)	**2817**	Casing type 2	Suitable for multiple modules 444 x 145 x 305 mm
xxx = **Cas-3** (1)	**2818**	Casing type 3	Suitable for multiple modules 464 x 189 x 305 mm
Part 5 Built-in Options			
xxx = **O_2** (2) (3)	**2795**	Oxgen Sensor	0 - 25%
	2767		0 - 100%
xxx = **O_2-resist** (3)	**2824**	Oxygen Sensor H_2S resistant	0.5 - 35%
xxx = **P** (2) (3)	**2771**	Pressure Sensor	800 - 1200 mbar abs. Resolution <1 mbar
xxx = **P-resist** (3)	**2825**	Pressure Sensor H_2S resistant	0.2 - 3.5 bar abs. Resolution 2 mbar
xxx = **H** (2) (3)	**2773**	Humidity Sensor	0 - 100% RH
xxx = **A/O**	**2648**	Analog Voltage Output 0-2V / 0-5V / 0-10V	4 Analog output ports for 4 separate gas concentrations, 16 bit
xxx = **Therm-Cas**	**2954**	Thermostated Casing	Heating and thermo-statting of the sensor casing at 50°C

(1) Casing type depends on the type and number of built-in sensor modules

(2) Not suitable for SO_2, Cl_2, H_2S

(3) Available as supplement to IR or UV sensor only

Casing Type 1

Casing Type 2

Part 6: Accessories / Options			
xxx = **Cal-ZP-N_2**	**2805**	Calibration Gas N_2	For zero-point calibration of all gases
xxx = **Flow-V**	**2806**	Mini Flow Valve	Control of flow rate for calibration gas bottle incl. manometer
xxx = **Cal-CG-Cat1**	**2948**	Calibration with special carrier gas (Ar, H2, He) for gases category 1	Category 1 gases: CO2 , CO<10Vol-%, N2O, CH4, CnHm, CF4, SF6, O3, CL2, NO, NO2, SO2<10Vol-%
xxx = **Cal-CG-Cat2**	**2949**	Calibration with special carrier gas (Ar, H2, He) for gases category 2	Category 2 gases: CO>10Vol-%, H2S, SO2 >10Vol-%
xxx = **Cal-ReCal-Cat1**	**2950**	Calibration for gases category 1	Category 1 gases: CO2 , CO<10Vol-%, N2O, CH4, CnHm, CF4, SF6, O3, CL2, NO, NO2, SO2<10Vol-%
xxx = **Cal-ReCal-Cat2**	**2951**	Calibration for gases category 2	Category 2 gases: CO>10Vol-%, H2S, SO2 >10Vol-%

2. Disadvantages of electrochemical (EC) sensors in comparison to the optical gas sensors »RITTER MultiGas«

- EC sensors become "blind" over time and then display a constant value, usually zero. This suggests misleadingly a stable zero point.
- EC sensors must therefore be replaced preventatively every 0.5 - 2 years, after replacement the sensor must be recalibrated, as the tolerances of EC sensors are relatively high. This causes supplementary additional costs.
- With EC sensors, mutual influence and deterioration occur by different gases, e.g. NO_2 damages the SO_2 sensor and vice versa.
- In many countries (e.g. in China) EC sensors are forbidden by law with governmental inspection and approval measurements, because they show too low values if they are contaminated or aged. The user then receives "false positive" values.
- The lifetime of the EC cells is already reduced during storage; therefore, the storage should only be a few weeks.
- The response time (t_{90}) is relatively long compared to the optical measuring methods - mostly about 30 sec. Optical systems are in the range < 5 sec.
- Due to the measuring principle of the EC sensors there is always a chemical reaction between the test gas and the sensor. By this reaction, small quantities of the test gas components are converted. For example, CO is converted into CO_2. With low quantities of test gas, measurements beyond the gas sensor can therefore be influenced because fewer CO molecules are present in the gas sample.

3. Preventive / Protective Measures regarding the Gas to be measured

Important: Please specify the desired options when ordering

a) Additional tube connection for flushing of the casing

The gas lines inside the casing and the measuring cuvette are gas-tight by means of O-rings and other gas-tight connections. However, as with all connections, a leakage rate, however slight, cannot be ruled out. With an additional tube connection for flushing of the casing, an accumulation of the measuring gas inside the casing can be prevented.

In the case of **toxic or aggressive gases**, a suction line can be connected via this tube connection, which creates a under-pressure inside the housing thus preventing the gas from escaping from the casing.

In case of **ignitable gases (methane, hydrogen, etc.)**, a pressure or suction line can be connected via this tube connection creating an over- or under-pressure inside the casing thus preventing the accumulation of an ignitable gas mixture.

Please note: H2S can be perceived as an unpleasant smell even in the ppb range. Even with an O-ring seal, micro-leaks can occur, which can be extracted by flushing the housing.

b) Heated and thermostatted casing

A condensation of the measuring gas inside of the sensor must be prevented. This is done in general for example by a condensation trap or gas cooler.

Alternatively, the inside of the sensor casing can be heated and thermostatted at 50°C (standard). The heating not only avoids condensation inside of the sensor but ensures constant measurement results as well.

c) Particle filter

Please make sure by use of a suitable filter that no particles are carried into the sensor. These might block the small orifices of the internal fittings. It is recommended to use filters of 5 micron or smaller.

4. Scope of Supply

No. of Items	Item
1	Document folder including … • Calibration Certificate • Data Sheets • Software Manual
1	Sensor in table top casing
1	Power adapter
1	Data acquisition software (on USB memory card)
1	USB connection cable [sensor → computer]
3 m	Viton tubing $Ø_i$ 4 mm / $Ø_o$ 6 mm

5. Setup

1. Unpack all items carefully
2. Install the data acquisition software according to the “RITTER MultiGas Software Manual”. **Don’t start the software at this point in time.**
3. Place the sensor next to the gas source
   Please note: A tube connection between gas source and sensors that is as short as possible allows a small dead space created by the tubing. In turn, a small dead space enables a fast response time of the sensor.
4. Connect the power adapter to socket “DC 24 V” at the rear side of the sensor and to mains.
5. Connect the data acquisition cable to the respective socket at the rear side of the sensor and to the computer:
   a) USB cable to the socket “USB”
   b) RS232 cable to the socket “RS 232” (option)
6. Connect the gas source to the gas inlet port of the sensor by using the provided tubing as follows:
   a) Unscrew the screw cap from the gas inlet port.
   b) Slide the screw cap onto the end of the tube with the thread of the screw cap facing the tube end.
   c) Push the tube onto the cone in the center of the gas inlet port.
   d) Slide the screw cap to the gas inlet port and screw it hand-tightly in place.
7. If applicable: Connect the gas outlet port of the sensor to other components such as gas sampling bags, exhaust tubing etc.
   - The connection of the tube to the gas outlet port takes place in the same way as described above.
8. Switch-on the power switch at the front side of the sensor casing.
9. Start the software and open the COM port(s) of the connected sensor module(s) according to the software manual.

The »RITTER MultiGas« Sensor is now ready for use.

6. Infrared Sensor

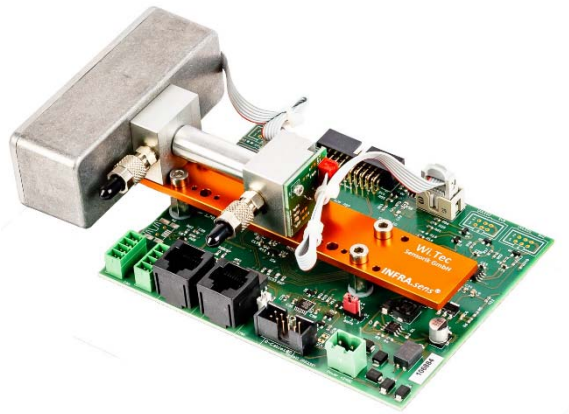
6.1. Description

Gas analysis based on the NDIR technique is an established method to determine the concentrations of gases in complex mixtures. The »RITTER MultiGas« sensors use new optical components for optimal analysis results: Up t
o 3 optical filters analyse the gas which flows through the sensor as one gas stream. The optional oxygen, pressure, and humidity sensors are in-line with the same single gas stream.

The individual internal modules are sealed by means of O-ring connections.

In order to achieve an optimum adaptation to the required measuring range, the lengths of the modular measurement cells (= cuvettes) can be implemented in the range of 5 mm (large measurement range in percentage level) up to 250 mm (small measurement range in ppm level).

Cuvettes with a length ≥ 20 mm are coated with a resistant gold layer in order to improve the reflection properties for



low concentration level detection. Cuvettes used with aggressive gases are gold-coated as well.

The other internal mechanical parts are made out of aluminium, optionally out of stainless steel.

For fast response applications the measuring system delivers a stable result within t_{90} ≈ 3 seconds.

The entire unit can be disassembled for easy maintenance/service.

6.2. Applications

- Biogas / natural gas analysis
- Environmental and Process Measurement
- TOC analysers
- Continuous Emission Monitoring (CEM)
- Elemental analysis
- Industrial gas analysis

6.3. Specifications

General features	
Measurement technology	Innovative NDIR Sensor (non-dispersive infrared sensor)
Detectable gases	CO_2, CO, N_2O, NO, CH_4, C_nH_m *, CF_4, SF_6
Number of simultaneously detectable gases	max. 3 per sensor unit
Measurement ranges	See par. 6.4 or https://www.ritter.de/en/products/sensors#ranges
Flow rate range	1 ltr/d ~ 300 ltr/h For higher flow rates the sensor can be operated in bypass
Max. gas inlet pressure	300 mbar
Pressure loss (without additional optional sensors)	10 @ 100 / 35 @ 200 / 70 @ 300 [mbar @ ltr/h]

Temperature compensation	Yes
Data acquisition software	Yes
Lifetime of IR radiation source	> 40 000 h
Measurement cuvette	Aluminium, with measurement ranges ≤1% gold-plated inside
Cuvette sealing	Viton O-ring
Casing	High-quality table-top casing, aluminium
Dimensions	W x H x L 171 x 86 x 290 mm
Weight	approx. 2 kg
Gas connections	PVDF screw-type tube connection for tube $Ø_i$ 4mm, $Ø_o$ 6 mm

Measuring response	
Linearity error	< ± 1% F.S.
Repeatability	± 0.5% F.S.
Long term stability zero	< ± 2% F.S. / week
Long term stability span	< ± 2% F.S. / month
Temperature influence of zero point	< 1% F.S. / 10K
Temperature influence of span	< 2% F.S. / 10K
Cross sensitivity	< 2% F.S.
Pressure influence	< 1.5% / 10hPa of reading
Warm-up time	2 min
Response time (t_{90})	≈ 3 sec
Sampling frequency by software	≤ 10 Hz
Detection limit (3·σ)	See par. 6.5 or https://www.ritter.de/en/products/sensors#limits
Resolution	0.5 x detection limit
Water vapour	No influence with measurements of CO_2 and CH_4

Electrical features	
Power supply	24 VDC incl. power plug 100 ~ 240 VAC / 24 VDC
Average power consumption	< 1W
Interface	USB (standard), RS232 (option) incl. data transmission cable 1 m
Analogue voltage output (option)	0-2V / 0-5V / 0-10V

Climatic conditions	
Operating temperature	+15 ~ +45 °C
Storage temperature	–20 ~ +60 °C
Operating pressure	800 ~ 1200 hPa (mbar)
Ambient humidity	0 ~ 95% rel. humidity **Condensing inside of sensor must be prevented!**

* Analysis of C_nH_m:
The calibration of sensors for C_nH_m will be performed with propane. Aromatic hydrocarbons are also measured but with a different weighting. This means that the sensitivity of the sensor is significantly smaller with these gases than with other hydrocarbons.

6.4. Table of Measurement Ranges

Range [1)]	CO_2	CO	N_2O	CH_4	C_nH_m	CF_4	SF_6
100 vol. %	x	x	x	x	x	x	x
50 vol. %	x	x	x	x	x		x
30 vol. %		x	x	x	x		x
20 vol. %	x						
10 vol. %	x	x		x	x		
5 vol. %	x	x		x	x		
1 vol. %	x	x		x	x		
5,000 ppm	x	x		x	x		x
2,000 ppm	x	x	x	x	x		
1,000 ppm	x	x	x	x	x		x
500 ppm	x	x	x				
300 ppm			x				
100 ppm	x		x				x
50 ppm	x						x

[1)] Zero to Full Scale (FS) Other ranges on request

6.5. Table of Detection Limits (= 3 σ) in Percent of Full Scale

Range [1]	CO_2	CO	N_2O	CH_4	C_nH_m	CF_4	SF_6
100 vol. %	< 0.1%	< 0.2%	< 0.1%	< 0.1%	< 0.1%	< 0.2%	< 0.1%
50 vol. %	< 0.1%	< 0.2%	< 0.1%	< 0.1%	< 0.1%	< 0.2%	< 0.1%
30 vol. %		< 0.2%	< 0.1%	< 0.1%	< 0.1%	< 0.2%	< 0.1%
20 vol. %	< 0.1%						
10 vol. %	< 0.1%	< 0.2%		< 0.1%	< 0.2%		
5 vol. %	< 0.1%	< 0.2%		< 0.1%	< 0.2%		
1 vol. %	< 0.1%	< 0.2%		< 0.1%	< 0.2%		
5,000 ppm	< 0.1%	< 0.2%		< 0.1%	< 0.2%		
2,000 ppm	< 0.1%	< 0.3%	< 0.1%	< 0.3%	< 0.5%		
1,000 ppm	< 0.1%	< 0.5%	< 0.1%	< 0.5%	< 0.5%		
500 ppm	< 0.1%	< 0.5%	< 0.1%				
300 ppm	< 0.1%		< 0.1%				
100 ppm	< 0.3%		< 0.3%				
50 ppm	< 0.3%						

[1] Zero to Full Scale (FS)

Definition of Detection Limit

The Detection Limit is the smallest measurement value which can be obtained with a specific uncertainty. This uncertainty includes the resolution, noise and stability of the gas sensor for a specific gas and specific measurement range. For evaluation of the detection limit value, several single measurements are taken at the identical measurement conditions. With the obtained single measurement results the standard deviation “Sigma” (σ) is calculated. The values given in the table equal the triple amount of Sigma.

6.6. Recalibrations

The following recalibration intervals are recommended for IR sensors:

- Zero-point: Weekly with inert gas, e.g. Nitrogen
- End-point (full scale): Every 3 months with suitable calibration gas

7. Ultraviolet Sensors

7.1. Description

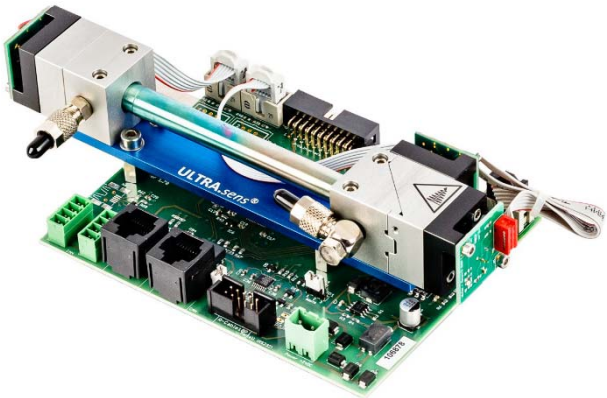
The »RITTER MultiGas« UV sensor is the world's first gas analysis module based on miniaturized UV-LEDs. The stability and lifetime of these UV-LEDs enables high-precision gas analyses down to the ppm range. By using two UV-LEDs two gases can be detected simultaneously. Furthermore, with this approach measuring ranges from ppm to Vol.-% can be realized.

In the spectral range from 200 nm to 500 nm, nitrogen oxides ($NO+NO_2$), aromatic hydrocarbons, hydrogen sulphide, ozone, sulphur dioxide and chlorine can be reliably detected with this new sensor platform.

The entire unit can be disassembled for easy maintenance/service.

The individual internal modules are sealed by means of O-ring connections.

In order to achieve an optimum adaptation to the required measuring range, the lengths of the modular measurement cells (= cuvettes) can be implemented in the range of 5 mm (large measurement range



in percentage level) up to 250 mm (small measurement range in ppm level).

Cuvettes with a length ≥ 20 mm are coated with a resistant gold layer in order to improve the reflection properties for low concentration level detection. Cuvettes used with aggressive gases are gold-coated as well.

The internal mechanical parts are made out of aluminium, optionally out of stainless steel.

For fast response applications the measuring system delivers a stable result within t_{90} ≈ 1-2 seconds.

7.2. Applications

- Biogas / natural gas analysis
- Environmental and Process Measurement
- TOC analysers
- Continuous Emission Monitoring (CEM)
- Elemental analysis
- Industrial gas analysis

7.3. Specifications NDUV Sensor

General features	
Measurement technology	Innovative NDUV Sensor (non-dispersive ultraviolet sensor)
Detectable gases	SO_2, NO_2, O_3, Cl_2, H_2S
Number of simultaneously detectable gases	max. 2
Measurement ranges	See par. 7.5 or https://www.ritter.de/en/products/sensors#ranges
Flow rate range	1 ltr/d ~ 300 ltr/h For higher flow rates the sensor can be operated in bypass

Max. gas inlet pressure	300 mbar
Pressure loss (without additional optional sensors)	10 @ 100 / 35 @ 200 / 70 @ 300 [mbar @ ltr/h]
Temperature compensation	Yes
Data acquisition software	Yes
Lifetime of UV radiation source	> 8 000 h
Measurement cuvette	Stainless steel with silicone coating inside
Cuvette sealing	Viton O-ring
Casing	High-quality table-top casing, aluminium
Dimensions	W x H x L 464 x 189 x 305 mm
Weight	approx. 6.5^{+} kg
Gas connections	PVDF screw-type tube connection for tube $Ø_i$ 4mm, $Ø_o$ 6 mm

Measuring response	
Linearity error	< ± 1% F.S.
Repeatability	± 0.5% F.S.
Long term stability zero N_2	< ± 1% F.S. / 24h
Long term stability span	< ± 1% F.S. / month
Temperature influence of zero point	< 1% F.S. / 10K
Temperature influence of span	< 2% F.S. / 10K
Cross sensitivity	< 2% F.S.
Pressure influence	< 1.5% / 10hPa of reading
Warm-up time	1 min (initial), <60 min for full specification
Response time (t_{90})	1.5 - 15 sec
Sampling frequency by software	≤ 10 Hz
Detection limit (3·σ)	See par. 7.6 or https://www.ritter.de/en/products/sensors#limits
Resolution	0.5 x detection limit

Electrical features	
Power supply	24 VDC incl. power plug 100 ~ 240 VAC / 24 VDC
Supply current (peak)	<0.4 A
Average power consumption	< 7.5 W
Interface	USB as standard, RS232 on request incl. data transmission cable 1 m
Analogue voltage output (option)	0-2V / 0-5V / 0-10V

Climatic conditions	
Operating temperature	+25 ~ +45 °C
Storage temperature	–20 ~ +60 °C
Operating pressure	800 ~ 1200 hPa (mbar)
Ambient humidity	0 ~ 95% rel. humidity Condensing inside of sensor must be prevented!

7.4. Specifications UVRAS Sensor

For the detection of NO an EDL (electrodeless gas discharge lamp) is used. In the EDL, N2 and O2 are converted to NO and produce a selective UV radiation. With this radiation, a cross-sensitivity-free NO measurement is made possible. This method is called UV resonance absorption spectroscopy (UVRAS).

A combination of both the UVRAS and NDUV technology allows the simultaneous gas analysis of NO, NO_2 and SO_2 in the lower ppm range which is particularly important in flue gas analysis (Continuous Emission Monitoring, CEM).

General features	
Measurement technology	UV resonance absorption spectroscopy (UVRAS)
Detectable gases	NO, NO_2, SO_2
Number of simultaneously detectable gases	max. 3
Measurement ranges	See par. 7.5 or https://www.ritter.de/en/products/sensors#ranges
Flow rate range	1 ltr/d ~ 300 ltr/h For higher flow rates the sensor can be operated in bypass
Pressure loss (without additional optional sensors)	10 @ 100 / 35 @ 200 / 70 @ 300 [mbar @ ltr/h]
Temperature compensation	Yes
Data acquisition software	Yes
Lifetime of UV radiation sources	LED > 20 000 h (NO_2, SO_2) EDL> 8 000 h (NO)
Measurement cuvette	Stainless steel with silicone coating inside
Cuvette sealing	Viton O-ring
Casing	High-quality table-top casing type 2, aluminium
Dimensions	W x H x L 464 x 189 x 305 mm
Weight	approx. 6.5^{+} kg

Gas connections	PVDF screw-type tube connection for tube $Ø_i$ 4mm, $Ø_o$ 6 mm
Measuring response	
Linearity error	< ± 1% F.S.
Repeatability	± 0.5% F.S.
Long term stability zero N_2	< 3 ppm / 24h
Long term stability span	< ± 1% F.S. / month
Temperature influence of zero point	< 1% F.S. / 10K
Temperature influence of span	< 2% F.S. / 10K
Cross sensitivities	500 ppm NO_2 < 2ppm 100 ppm SO_2 < 2ppm 100 ppm N_2O < 10ppm 20°C D.P. H_2O < 10ppm
Pressure influence	< 1.5% / 10hPa of reading
Warm-up time	1 min (initial), <60 min for full specification
Response time (t_{90})	1.5 ~ 15 sec
Sampling frequency by software	≤ 10 Hz
Detection limit (3·σ)	See par. 7.6 or https://www.ritter.de/en/products/sensors#limits
Resolution	0.5 x detection limit
Electrical features	
Power supply	24 VDC incl. power plug 100 ~ 240 VAC / 24 VDC
Supply current (peak)	1.5 A
Inrush current	0.2 ~ 0.7 A
Power consumption (peak)	36 W
Interface	USB as standard, RS232 on request incl. data transmission cable 1 m
Analogue voltage output (option)	0-2V / 0-5V / 0-10V
Climatic conditions	
Operating temperature	+5 ~ +40 °C
Storage temperature	–20 ~ +60 °C
Operating pressure	800 ~ 1200 hPa (mbar)
Ambient humidity	0 ~ 95% rel. humidity **Condensing inside of sensor must be prevented!**

7.5. Table of Measurement Ranges

Range [1]	O_3	CL_2	H_2S	NO	NO_2	SO_2
30 vol. %		x				
10 vol. %		x				x
5 vol. %		x				x
1 vol. %		x	x			x
5,000 ppm		x	x	x	x	x
2,000 ppm	x	x	x	x	x	x
1,000 ppm	x	x	x	x	x	x
500 ppm	x	x	x	x	x	x
300 ppm				x	x	x
100 ppm	x	x	x		x	x
50 ppm	x				x	x
10 ppm	x				x	x
1 ppm	x					

[1] Full Scale (FS) Other ranges on request

7.6. Table of Detection Limits (= 3 σ) in Percent of Full Scale

Range [1]	O_3	CL_2	H_2S	NO	NO_2	SO_2
100 vol. %						
50 vol. %						
30 vol. %		< 0.1%				
20 vol. %						
10 vol. %		< 0.1%				< 0.1%
5 vol. %		< 0.1%				< 0.1%
1 vol. %			< 0.1%			
5,000 ppm			< 0.1%			
2,000 ppm	< 0.1%	< 0.1%	< 0.1%	< 0.1%	< 0.1%	< 0.1%
1,000 ppm	< 0.1%	< 0.1%	< 0.2%	< 0.1%	< 0.1%	< 0.1%
500 ppm	< 0.2%	< 0.2%	< 0.3%	< 0.2%	< 0.2%	< 0.1%
300 ppm				< 0.2%	< 0.2%	< 0.1%
100 ppm	< 0.5%		< 0.5%		< 0.5%	< 0.3%
50 ppm	< 0.5%				< 0.5%	< 0.3%
10 ppm	< 0.5%				< 0.5%	< 0.3%

[1] Zero to Full Scale (FS)

Definition of Detection Limit

The Detection Limit is the smallest measurement value which can be obtained with a specific uncertainty. This uncertainty includes the resolution, noise and stability of the gas sensor for a specific gas and specific measurement range. For evaluation of the detection limit value, several single measurements are taken at the identical measurement conditions. With the

obtained single measurement results the standard deviation “Sigma” (σ) is calculated. The values given in the table equal the triple amount of Sigma.

7.7. Recalibrations

The following recalibration intervals are recommended for UV sensors:

- Zero-point:
  - Concentrations < 300 ppm: Every 48 hours with inert gas, e.g. Nitrogen
  - Concentrations ≥ 300 ppm: Every 24 hours with inert gas, e.g. Nitrogen
- End-point (full scale): Every 3 months with suitable calibration gas

8. Options (installed inside of the sensor casing)

8.1. Oxygen Sensor

The oxygen sensor is a sensor module available as option in addition to a RITTER MultiGas NDIR or NDUV sensor. The measured oxygen concentration is displayed in the provided software. There are two versions available:

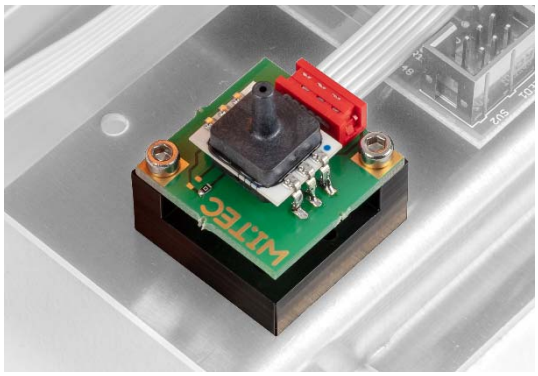
a) For non-aggressive gases

b) For H_2S and similar acid gases

Specifications

- Electrochemical sensor
- Measuring ranges:
  - Standard version 0 – 25% or 0 – 100%
  - H_2S resistant version 0.5 – 35%
- Measurement accuracy ±2% of span (full scale)
- Resolution: < 0.5% of span (full scale)
- Response time (t_{90}): ≈ 15 s; automotive version ≈ 5 s
- Lifetime: approx. 5 years

8.2. Pressure Sensor



A change in gas pressure causes a change in the number of molecules per volume and thus a change in gas density. This density change in turn has a significant influence on the result of the concentration measurement by the sensor. By measuring the gas pressure inside of the sample cell (cuvette), the value of the concentration measurement is compensated / corrected.

The pressure sensor is a sensor module available as option in addition to a RITTER MultiGas NDIR or NDUV sensor. The measured pressure value is displayed in the provided software. There are two versions available:

a) For non-aggressive gases

<u>Specifications</u>

- Measuring range: 800 - 1,200 mbar abs.
- Measurement accuracy ±1% of span (full scale)
- Resolution: <1 mbar
- Response time (t_{90}): 1 s
- Incl. temperature compensation

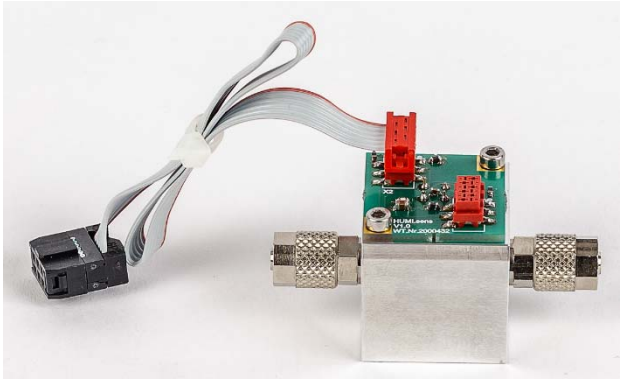
b) For H_2S and similar acid gases

Specifications

- Measuring range: 0.2 – 3.5 bar abs.
- Measurement accuracy ±1% of span (full scale)
- Resolution: 2 mbar
- Response time (t_{90}): 1 s
- Incl. temperature compensation

8.3. Humidity Sensor

The humidity sensor is a sensor module available as option in addition to a RITTER MultiGas NDIR or NDUV sensor. The measured humidity values (absolute and relative) are displayed in the provided software.



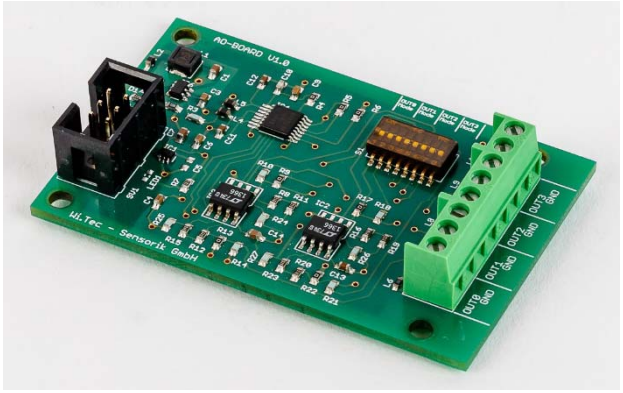
Specifications

- Polymer humidity sensor
- Measuring range: 0-100% rH
- Measurement accuracy ±2% rH of span (full scale)
- Resolution: ±1% RH
- Response time (t_{90}): 12 s
- Incl. temperature compensation
- Indicated values (in software): absolute [% absH] and relative humidity [% rH]

8.4. Analog Voltage Output

For connection to an analog data acquisition device the analog voltage output port provides alternatively the following voltage levels:

- 0 – 2V
- 0 – 5V
- 0 – 10V



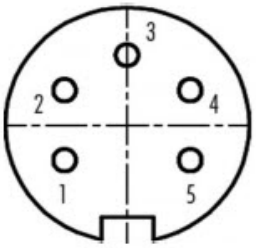
The voltage range is pre-set according to the order and cannot be changed by the user.

The Analog Voltage Output Module allows the simultaneous output of up to 4 different values at 4 separate channels:

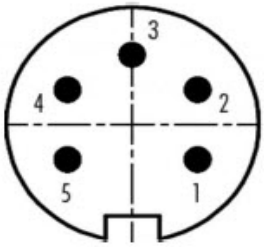
- 3 x gas concentration signals (excluding oxygen sensor)
- 1 x humidity value from humidity sensor

Please note the assignments of the respective gas concentration measurements to the respective channels. These assignments are stated in the Calibration Protocol of the sensor unit.

Assignment of contacts to the channels of the gas concentration measurements at the socket and plug of the Analog Voltage Output:



View to socket



View to plug

Contact No.	Assignment to channel	Wire Colors of Cable
1	channel 1	white
2	channel 2	green
3	channel 3	yellow
4	channel 4	grey
5	ground	brown

The plug is delivered with a cable with open wires to be connected to the analog data acquisition device of the user.