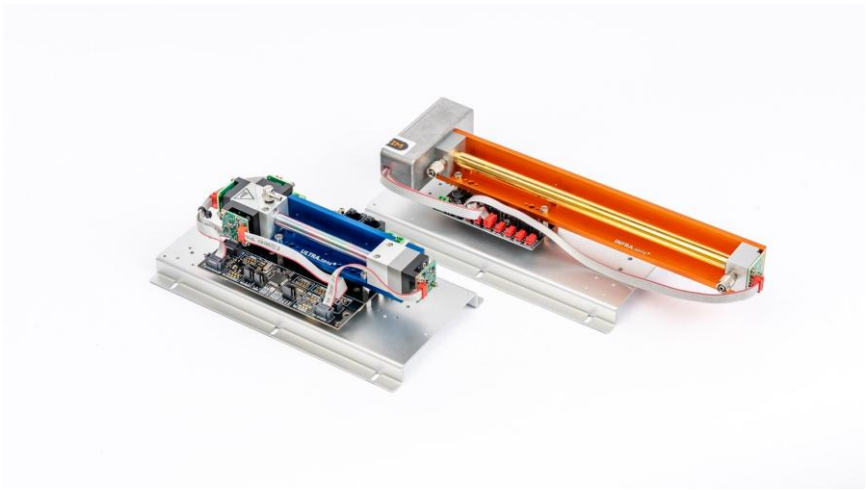
Operating Instructions

OEM Gas Measurement Modules for Continuous Gas Analysis

INFRA.sens® · ULTRA.sens® · KOMBI.sens® · HUMI.sens® · O2.sens · Thermobox · Accessories



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0 About This Manual

This operating manual describes the installation, connection, commissioning, calibration, and maintenance of Wi.Tec gas detection modules. Read it in its entirety before working with the gas detection module, and keep it for the entire service life of the product.

0.1 Validity

Applies to	Models
INFRA.sens® (NDIR)	Standard and compact (ecoLine), analysis cuvettes AK1 through AK550
ULTRA.sens® (NDUV)	with UV-LED, with EDL emitter, processline (corrosion-resistant)
processline	Corrosion-resistant stainless steel design for INFRA.sens and ULTRA.sens
KOMBI.sens®	Combination of INFRA.sens and/or ULTRA.sens
HUMI.sens®, O2.sens, P.sens corrosive	Available as an option for the modules listed above
Housing and electronics	Mounting plate, Thermobox V5; base boards V1.8.x, V1.9.x, IR-compact V2.0.x

Table1 : Scope of this manual

Not covered in this manual: BINOS and the small box (Körber)—separate user manuals are available for these. Product-specific values (measurement range, accuracy, channel assignment) are listed in your module's data sheet; in case of discrepancies, the data sheet takes precedence.

0.2 Target Audience

This manual is intended for integrators and operators who install gas measurement modules in analysis systems, as well as their technical staff. Basic knowledge of electrical engineering and gas measurement technology is required (see Chapter 1.3).

0.3 Related Documents

Document	Content	Reference
Module data sheet	Measurement range, technical specifications, pin assignment	Included with delivery
Quick Start Guide	Quick Guide to Unpacking and Setting Up	Included with delivery
Communication Manual	Protocols: RS232, CAN, Modbus, CANopen; Registers, Status Byte, Device ID	Download (www.witec-sensorik.de)
MARS®-Tool light Manual	Operating the PC software, data logging, calibration on the PC	Download (www.witec-sensorik.de)
Service Manuals	Replacement of components, for trained personnel only	Upon request

Table2 : Applicable documentation

0.4 Presentation Conventions

- Safety instructions are classified by hazard level (Chapter 1.4).
- Instructions consist of prerequisites, numbered steps, and the result.
- Software buttons are shown in bold within square brackets, e.g., **[Write]**.
- Gas measurement channels are labeled CH1 through CH4; the type of gas measured on each channel is indicated on the nameplate (Chapter 3.9).
- Abbreviations are explained in the glossary (Appendix C).

0.5 Revision History

Revision	Date	Change
0.1	10/2026	Pre-release version. Summarizes the previous manuals (Operating Instructions V1.54, Instruction Manual V2.3, Quick Start Guide V001, Manual ecoLine V01).

1 Safety

Read this chapter before commissioning to prevent personal injury and property damage. Wi.Tec-Sensorik develops and manufactures its products in accordance with national and international standards. Proper setup, installation, operation, and maintenance are required for trouble-free operation.

1.1 Intended Use

The gas measurement modules are built-in components for the continuous measurement of gas concentrations in accordance with their specifications in the data sheet. They are intended for use in non-hazardous areas (General Purpose) and are integrated into higher-level analysis systems.

Proper use also requires that you follow these instructions, comply with the environmental and measurement gas conditions (Chapters 5, 6, and 15), and use only replacement parts specified by Wi.Tec-Sensorik.

1.2 Foreseeable Misuse

The following, in particular, is considered improper use:

- Use in potentially explosive areas (Ex zones).
- Measuring explosive gas mixtures (flammable gases mixed with air or oxygen in an ignitable ratio).
- Operation in environments with high, condensing humidity or in highly corrosive atmospheres.
- Operation outdoors without a suitable protective enclosure.
- Operation outside the limits specified in the data sheet (temperature, pressure, flow rate, supply voltage).
- Opening, modifying, or repairing the module, unless described in this manual.

1.3 Operator Qualifications and Responsibilities

- Read all instructions before installing, operating, or maintaining the product.
- Only qualified personnel may install, operate, update, program, and maintain the product.
- Train your staff in installation, operation, and maintenance.
- Install the product in accordance with these instructions and local and national regulations. Electrical and gas connections must be made properly.
- Observe the warning labels on the product and in the package insert.
- Use only replacement parts specified by Wi.Tec Sensors. Parts that look similar may cause malfunctions or fires.
- If you have any questions, contact your authorized Wi.Tec dealer or Wi.Tec Service (Chapter 13).

1.4 Structure of the Safety Instructions

Safety instructions are structured in accordance with ISO 3864-2 / ANSI Z535.6: signal word with symbol, type and source of the hazard, possible consequences, and preventive measures.

Signal Word	Meaning
DANGER	Immediate danger. Failure to comply will result in death or serious injury.
WARNING	Potential danger. Failure to follow these instructions may result in death or serious injury.
CAUTION	Potential hazard. Failure to follow these instructions may result in minor injury.
NOTE	Failure to follow these instructions may result in property damage, destruction of the device, reduced performance, or data loss.
Information	Important information and tips; failure to follow these instructions may result in tasks not being completed successfully.

Table3 : Signal Words

1.5 Basic Safety Instructions

⚠ WARNING

Risk of explosion if used improperly

The gas detection module is not an explosion-proof device. Ignition sources within the module can ignite explosive mixtures.

- Never use the gas detection module in potentially explosive areas (Ex zones).
- Do not measure explosive gas mixtures.

⚠ WARNING

Leakage of toxic or corrosive gases

In the event of leaks, the measured gas can accumulate in and around the gas measurement module. Consequences: poisoning, damage to device components.

- Connect the gas outlet to a ventilation system to prevent gas from escaping into the environment.
- When measuring toxic or corrosive gases, purge the gas measurement module with an inert gas (e.g., nitrogen); collect the purge gas and dispose of it properly via an exhaust line.
- Check for leaks regularly (Chapter 6.6).

⚠ WARNING

Risk of poisoning from hydrogen sulfide (H_2S), e.g., in biogas plants

H_2S is highly toxic even at low concentrations. The odor threshold is 0.02 ppm; higher concentrations numb the sense of smell, so that the gas is no longer detected.

Up to 100 ppm: Fatigue, headaches, irritation of the eyes and mucous membranes. At 500 ppm and above: Life-threatening. Above 1,000 ppm, fatal within a few minutes; above 5,000 ppm, fatal within a few seconds.

- Connect the gas outlet to an exhaust system.
- Before performing maintenance, flush the module's gas path and gas outlet with ambient air or nitrogen for at least 10 minutes until the H_2S concentration is close to 0 ppm.
- Check for leaks regularly.

⚠ WARNING

Risk of carbon monoxide (CO) poisoning

CO is highly toxic even at low concentrations (occupational exposure limit: 30 ppm). Inhaling more than 5,000 ppm can be fatal.

- Connect the gas outlet to an exhaust system.
- Before performing maintenance, purge with ambient air or nitrogen for at least 10 minutes until the CO concentration is close to 0 ppm.
- Check for leaks regularly.



WARNING

Ultraviolet Radiation (ULTRA.sens, KOMBI.sens)

UV LEDs and EDL emitters emit high-energy UV radiation (Risk Group 2 according to DIN EN 62471). Hazard to eyes and skin.

- Do not look directly into the radiation source.
- Wear safety goggles and protective clothing when the light path is open.
- Turn off the radiation source before working on the radiation path.

⚠ WARNING

Modifications to the Device

Modifications and repairs to the gas detection module can endanger personnel, equipment, and the environment. The manufacturer's warranty and product approvals will be void.

- Modify or repair the gas detection module only as described in this manual or in a Wi.Tec service manual.

! NOTE

Electrostatic Discharge (ESD)

The base board, pressure sensor, emitter, and detectors are sensitive to ESD and can be damaged by contact.

▶ Touch the electronics only at ESD-protected workstations and while wearing a grounding wrist strap.

1.6 Warranty and Liability

- Opening, tampering with, or damaging the gas detection module will void the warranty. This also applies to cutting open the Wi.Tec seals on the Thermobox, unless otherwise agreed.
- The warranty is also void in the event of damage caused by aggressive chemicals, contamination, or liquid ingress, as well as in the event of failure to follow these instructions.
- Wi.Tec-Sensorik is not liable for consequential damages, property damage, or personal injury resulting from failure to follow these instructions.

1.7 Conformity

The gas detection modules comply with the requirements of the RoHS Directive 2011/65/EU, including (EU) 2015/863, as well as the REACH Regulation (EC) 1907/2006 and the POP Regulation (EU) 2019/1021. Details are provided in Appendix B.

2 Delivery, Transport, and Storage

2.1 Scope of Delivery

The scope of delivery depends on your order and is documented in the enclosed packing slip. Upon receipt, please check the delivery for completeness using the packing slip. Larger deliveries may be divided into several packages.

The MARS®-Tool light PC software and documentation are available for download (Chapter 9). A USB flash drive is no longer included.

Not included in the scope of delivery and to be provided by the user: 24 VDC power supply (available as an accessory, Chapter 14.3), PC with Windows 10/11, RS232 data cable, and USB/RS232 adapter. Data cables and adapters are only included upon request (see Chapter 14 for part numbers).

2.2 Packaging and Shipping Damage

The modules are shipped individually in cartons with foam inserts, which are packed in a shipping carton. Should transport damage nevertheless occur:

1. Report any externally visible damage immediately upon delivery to the carrier (post office, freight forwarder, parcel service) and have them prepare a damage report.
2. Report any damage not visible from the outside immediately after unpacking.
3. Keep the box and packaging for inspection.
4. Notify Wi.Tec-Sensorik (contact information in Chapter 13).

> **Information**
> Only by following these steps can we and our insurance company process the claim and provide a replacement.

2.3 Unpacking and Acclimatization

1. Remove the module from the packaging. Do not touch the electronics (ESD).
2. Allow the module to reach room temperature before turning it on to prevent condensation from forming.
3. Do not remove the dust caps from the gas connections until immediately before connecting the gas lines.

2.4 Storage

- Store in a dry, dust-free environment in the original packaging. Storage temperature: −20 to 60 °C.
- O2.sens: Store optimally at 15–25 °C. Storage time and temperature reduce the sensor’s service life (Chapter 3.6).
- Auto-Zero Function (AZF): Storage temperature −20 to 60 °C.

3 Measurement Principles and Product Overview

Wi.Tec gas measurement modules use physical measurement methods that have proven themselves in industry and science for decades. Further information can be found in the reference book “Gas Measurement Technology in Theory and Practice.”

3.1 Measurement Components and Measurement Ranges

The table lists all gases and vapors that have been measured to date with Wi.Tec modules, along with their smallest and largest measurement ranges. Additional measurement ranges are available in between. The current list can be found at www.witec-sensorik.de/messtechnik/gase.

Gas Component	Formula	Principle	Smallest measurement range	Wideest measurement range
Ammonia	NH_3	UV	0–500 ppm	0–3,000 ppm
Butane	C_4H_{10}	IR	0–1,000 ppm	0–100 vol.%
Chlorine	Cl_2	UV	0–100 ppm	0–30 vol.%
Chlorine dioxide	ClO_2	UV	0–100 ppm	0–5,000 ppm
Nitrous oxide	N_2O	IR	0–100 ppm	0–100 vol.%
Ethane	C_2H_6	IR	0–1,000 ppm	0–100 vol.%
Moisture	H_2O	capacitive	0–20,000 ppm	–
Hexane	C_6H_{14}	IR	0–1,000 ppm	0–100 vol.%
Hydrocarbons	C_nH_m	IR	0–1,000 ppm	0–100 vol.%
Carbon dioxide	CO_2	IR	0–50 ppm	0–100 vol.%
Carbon monoxide	CO	IR	0–500 ppm	0–100 vol.%
Methane	CH_4	IR	0–1,000 ppm	0–100 vol.%
Ozone	O_3	UV	0–1 ppm	0–5,000 ppm
Propane	C_3H_8	IR	0–1,000 ppm	0–100 vol.%
Oxygen	O_2	EC	0–25 vol.%	0–100 vol.%
Sulfur dioxide	SO_2	UV	0–50 ppm	0–10 vol.%
Sulfur dioxide	SO_2	IR	0–500 ppm	0–10 vol.%
Sulfur hexafluoride	SF_6	IR	0–50 ppm	0–100 vol.%
Hydrogen sulfide	H_2S	UV	0–100 ppm	0–5,000 ppm
Carbon disulfide	CS_2	UV	0–1,000 ppm	0–1 vol.%
Nitric oxide	NO	UV	0–1,000 ppm	0–5,000 ppm
Nitric oxide	NO	IR	0–300 ppm	0–5,000 ppm
Nitric oxide	NO	EC	0–100 ppm	–
Nitrogen dioxide	NO_2	UV	0–100 ppm	0–5,000 ppm

Gas Component	Formula	Principle	Smallest measurement range	Wideest measurement range
Tetrafluoromethane	CF_4	IR	0–30 vol.%	0–100 vol.%
Water vapor	H_2O	IR	0–5,000 ppm	0–5 vol.%
Hydrogen	H_2	WLD	0–5,000 ppm	0–100 vol.%

Table4 : Measurement Components and Possible Measurement Ranges (IR = NDIR, UV = NDUV, EC = electrochemical, WLD = thermal conductivity)

3.2 INFRA.sens® (NDIR)

The INFRA.sens operates using the NDIR (non-dispersive infrared absorption) method in the 2–12 µm spectral range. A MEMS emitter serves as the radiation source: a thin membrane with a heating element that is electrically modulated at 1–10 Hz. At a chip temperature of, for example, 500 °C, it emits broadband radiation from 2 to 12 µm with a peak at 4 µm.

The sample gas flows through the analysis cell at a volume flow rate that is as constant as possible. Opposite the emitter is the detector unit with 2 (dual) or 4 (quad) detector elements. Each measurement detector has an interference filter set at the absorption maximum of the measurement gas; the reference detector measures in a range without significant absorption. With the quad detector, up to 3 gases can be measured simultaneously.

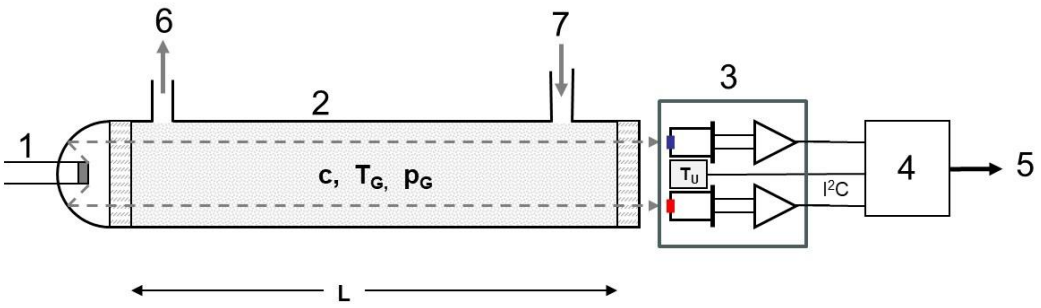


Figure1 : Principle of NDIR measurement with the INFRA.sens: 1 MEMS-IR emitter, 2 analysis cuvette (AK), 3 preamplifier with pyrodetector, 4 base board, 5 signal outputs/interfaces, 6 gas inlet, 7 gas outlet

The concentration c follows the Lambert-Beer law: U_Meas = U_Ref · exp(−α · c · L). For low concentrations or weakly absorbing gases (e.g., CH_4), the cuvette length L is increased; for strongly absorbing gases (e.g., SF_6), it is decreased. This allows for a measurement range from 1 ppm to 100 vol.%.

During factory calibration, each module is exposed to at least 5 gas concentrations. A polynomial is stored in the firmware as a linearization function based on the measured values; the linearization error is then less than ±1% of the full-scale range (FSR).

3.2.1 Analysis Cells

The number in the designation indicates the cuvette length in mm. Corrosion-resistant cuvettes (designation suffix “VA”) are listed in Section 4.4.

Designation	Length	Example	Model
AK1	1 mm	0–100 vol.% CO_2	Aluminum measuring cell, anodized
AK2	2 mm	0–100 vol.% CO	Aluminum measuring cell, anodized
AK5	5 mm	0–100 vol.% CO_2	Aluminum measuring cell, anodized

Designation	Length	Example	Model
AK20	20 mm	0–30 vol.% CH_4 (INFRA.sens)	Stainless steel tube with gold-plated interior
AK50	50 mm	0–10 vol.% CH_4	Stainless steel tube with gold-plated interior
AK100 / AK100G	100 mm	0–5,000 ppm N_2O (INFRA.sens); 0–5,000 ppm NO_2 (ULTRA.sens)	ULTRA.sens: Stainless steel tube with SilcoNert® 2000 coating; INFRA.sens (AK100G): Stainless steel tube with gold coating
AK250 / AK250G	250 mm	0–500 ppm CO (INFRA.sens); 0–50 ppm SO_2 (ULTRA.sens)	ULTRA.sens: Stainless steel tube with SilcoNert® 2000 coating; INFRA.sens (AK250G): Stainless steel tube with gold coating
AK550	550 mm	0–10 ppm SO_2 or 0–1 ppm O_3 (ULTRA.sens)	Stainless steel tube with SilcoNert® 2000 coating

Table5 : Available analysis cuvettes (suffix “G” = gold-coated INFRA.sens cuvette)

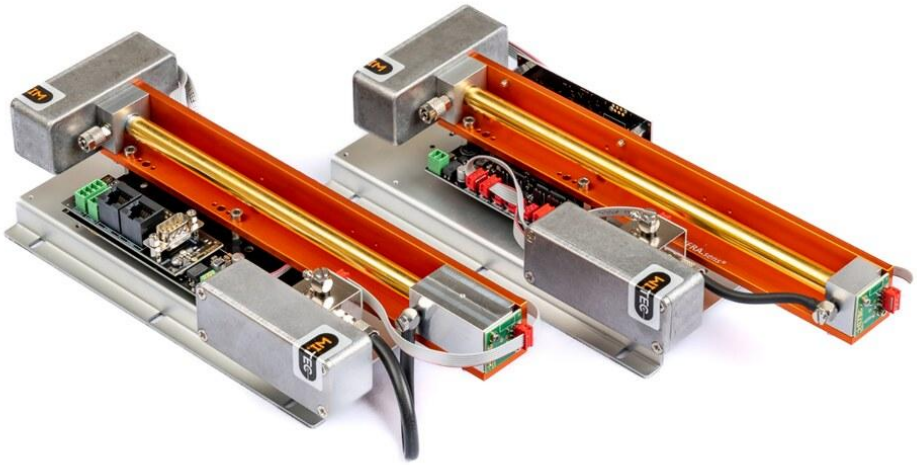


Figure2 : INFRA.sens with three different cuvette lengths

3.2.2 Pressure and Temperature Compensation

Gas pressure and gas temperature affect gas density and thus the reading. The base board measures gas pressure, gas temperature, and ambient temperature and compensates for their effects. Remaining residual errors:

	Temperature	Pressure
Compensation range	5–45 °C	600–1,200 hPa
Zero point	< 1% MBEW / 10 K	No effect
End point	< 1% MBEW / 10 K	< 0.1% of the measured value / 10 hPa

Table6 : Specified residual errors after compensation

3.3 ULTRA.sens® (NDUV)

The ULTRA.sens operates similarly to the INFRA.sens, but in the ultraviolet spectral range from 200 to 450 nm (NDUV method). In this range, NO, NO_2, SO_2, H_2S, Cl_2, and O_3 exhibit very strong absorption bands. Water vapor, CO_2, and hydrocarbons do not interfere in the UV range.

The radiation sources are long-term stable UV LEDs; for NO measurement, there is also an electrode-less gas discharge lamp (EDL) that emits radiation that is nearly selective for NO. A beam splitter couples a defined portion of the radiation to the reference detector. This fully compensates for changes in the source's intensity, e.g., due to aging.

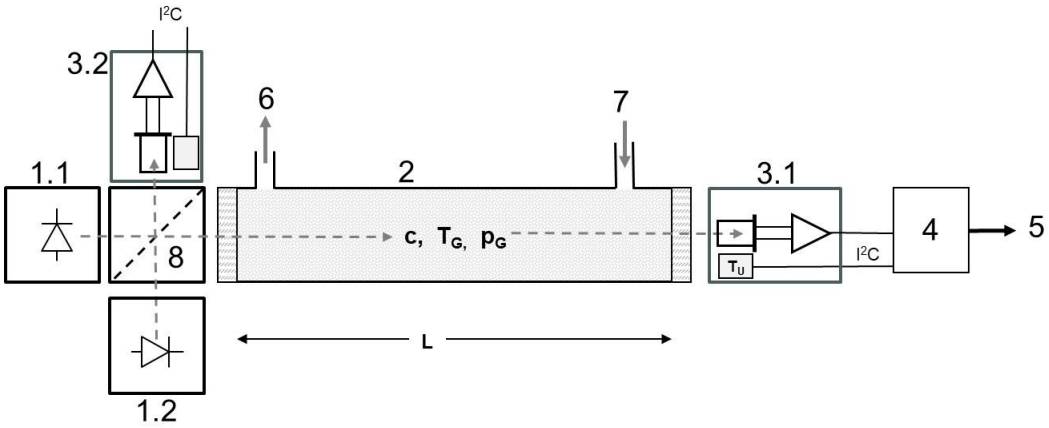


Figure3 : Principle of NDUV measurement with the ULTRA.sens: 1.1 and 1.2 UV LEDs, 2 analysis cuvette, 3.1 measurement detector, 3.2 reference detector, 4 base board, 5 signal outputs/interfaces, 6 gas outlet, 7 gas inlet, 8 beam splitter

The measurement range is adjusted via the cuvette length (AK100 and AK250 as standard) and the selection of the measurement wavelength. Using two different UV LEDs, the ULTRA.sens measures two gases simultaneously, typically SO_2 and NO_2. The NO_2 measurement also serves to compensate for the NO_2 cross-sensitivity to SO_2.

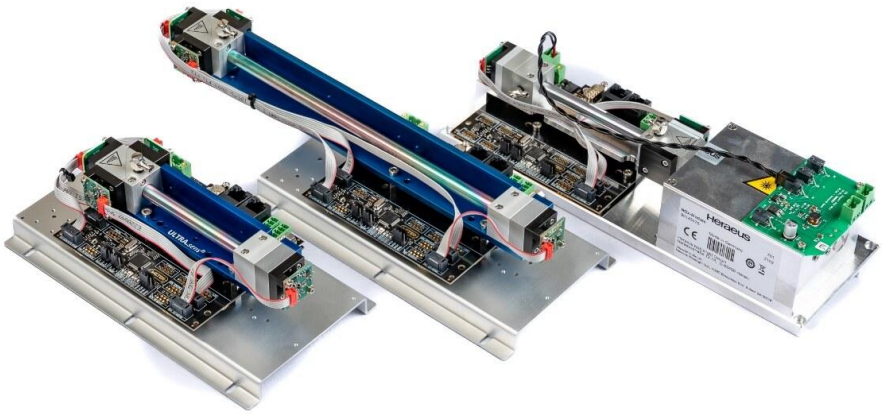


Figure4 : ULTRA.sens models: left, AK100 with 2 measurement channels; center, AK250 with 2 measurement channels; right, AK100 with EDL emitter and 1 measurement channel

3.3.1 ULTRA.sens® / INFRA.sens® processline

The corrosion-resistant processline version is designed for aggressive gases such as Cl_2, H_2S, or high SO_2 concentrations. It is available for ULTRA.sens and INFRA.sens (Chapter 4.4).

In this version, the analysis cuvette is replaced with a process-safe measuring chamber. The standard material is stainless steel 1.4571; other materials such as Hastelloy, PEEK, or PTFE are also available upon customer request.



Figure5 : ULTRA.sens processline

3.4 KOMBI.sens®

The KOMBI.sens combines INFRA.sens and/or ULTRA.sens measurement modules on a single base board. It measures up to 4 gas channels in the IR and/or UV range, e.g., SO_2 and NO_2 (ULTRA.sens) and CO (INFRA.sens). Optional additions include oxygen (O2.sens) and gas humidity (HUMI.sens).



Figure6 : KOMBI.sens consisting of INFRA.sens and ULTRA.sens

3.5 HUMI.sens®

The HUMI.sens measures gas humidity using a capacitive polymer humidity sensor. It is housed in an aluminum block through which 0.1–1.5 l/min of measurement gas flows. Water vapor is absorbed into the hygroscopic polymer layer between two electrodes, altering its dielectric constant; the capacitance increases nearly linearly with humidity. The process is reversible.

> **Information**
> For humidity measurements, we recommend using PTFE tubing or stainless steel piping (Chapter 6.1).

3.5.1 Output Values and Humidity Compensation

The HUMI.sens provides humidity readings in multiple units. All values are available simultaneously and can be retrieved via individual interface commands (Communication Manual) or using the MARS® tool:

Output variable	Unit
Absolute humidity	g/m³
Relative humidity	% RH
H_2O concentration	ppm
Temperature of the humidity sensor	°C

Table7 : Output variables of the HUMI.sens

The humidity value can be used to compensate for the influence of water vapor on the NDIR gas channels CH1 through CH4. Compensation can be linear or quadratic.

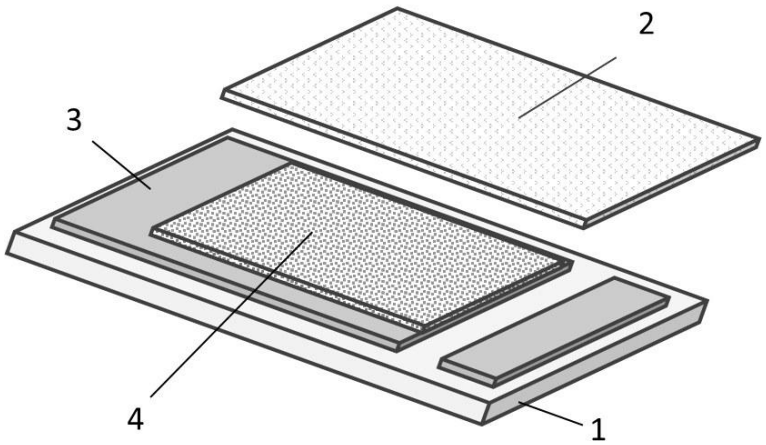


Figure7 : Structure of the polymer humidity sensor: 1 Al_2O_3 ceramic carrier plate, 2 gas-permeable counter electrode, 3 base electrode, 4 sensitive polymer layer

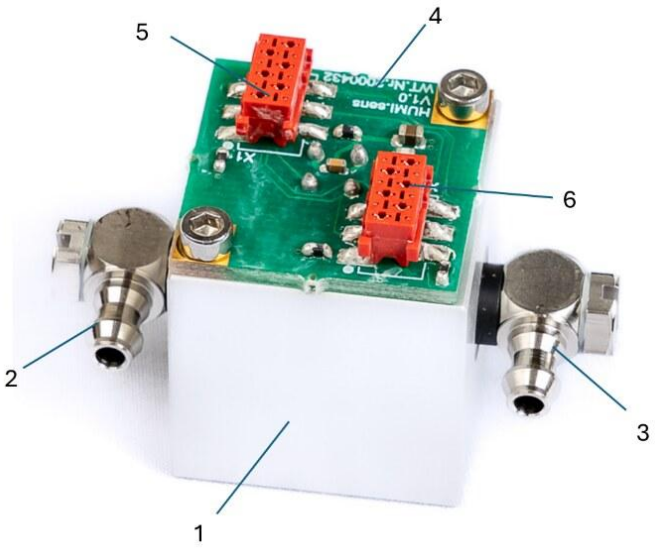


Figure8 : Structure of the HUMI.sens: 1 aluminum block for gas flow, 2 gas inlet, 3 gas outlet, 4 evaluation electronics, 5 6-pin connector for connection to the base board, 6 6-pin connector for connecting the pressure sensor

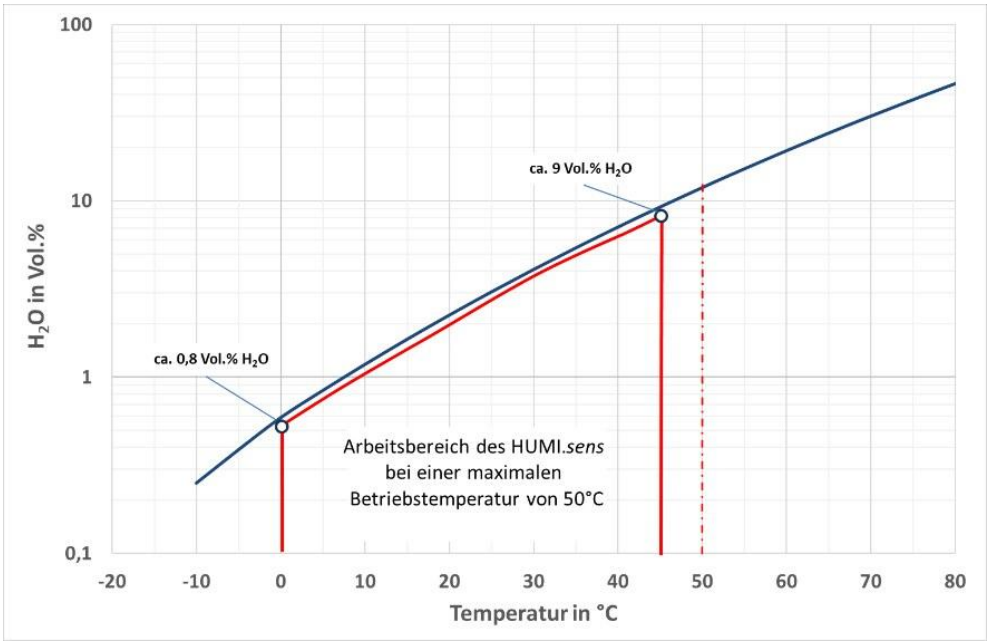


Figure9 : Operating range of the HUMI.sens at a maximum operating temperature of 50 °C

3.6 O2.sens

The O2.sens measures oxygen electrochemically. Oxygen passes through a membrane into the liquid electrolyte, where it reacts; 4 electrons are released per O_2 molecule. The sensor current increases linearly with the O_2 concentration. A more permeable membrane results in shorter response times but a shorter service life.

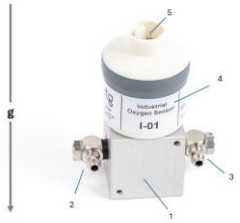


Figure10 : O2.sens with installation orientation (g = direction of gravity): 1 aluminum block, 2 gas inlet, 3 gas outlet, 4 sensor element with M16 thread, 5 electrical connections

3.6.1 Service Life

The service life of the electrochemical O_2 sensor is influenced by electrochemical aging processes as well as the respective operating and environmental conditions.

The nominal service life of the sensor is 2,000,000 vol.%·h O_2 (oxygen concentration in vol.% × operating time in hours). For continuous operation in ambient air containing 20.9 vol.% O_2, this corresponds to approximately 10.9 years.

The actual expected service life under reference conditions ranges from 1 to 6 years, depending on the specific application conditions. The calculated value based on the nominal oxygen load therefore does not represent a guaranteed service life. The service life also includes the sensor's storage time.

Aging may become apparent through an increasing change in sensor sensitivity and, particularly toward the end of the service life, through an accelerated signal decline.

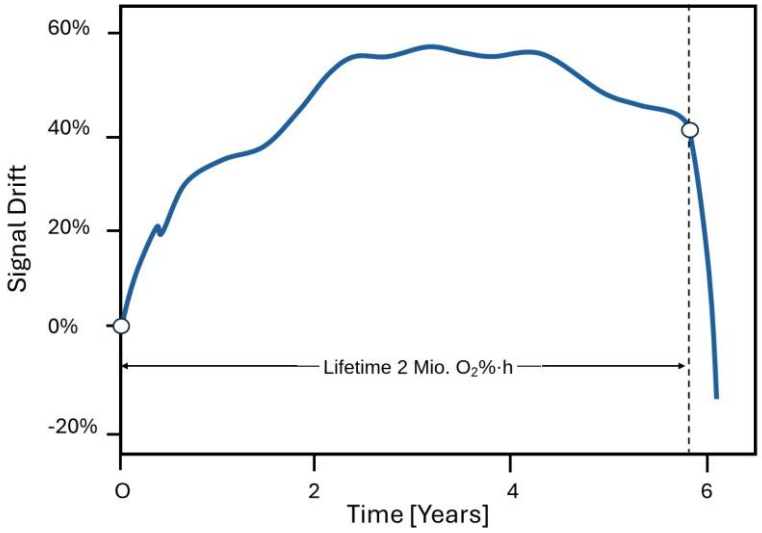


Figure11 : Schematic representation of the signal change of the O_2 sensor over its service life without zero-point and end-point adjustment. The actual signal curve may vary depending on operating conditions.

3.6.2 Influence of Operating Conditions

Service life is influenced in particular by the following factors:

- **Temperature:** Elevated operating temperatures can accelerate electrochemical aging processes and thus reduce service life.
- **Gas humidity:** At low relative humidity, the liquid electrolyte may evaporate more rapidly. In particular, high temperatures combined with dry process gases and increased gas flow rates can shorten the service life. Condensation must be avoided.

- **Oxygen concentration:** An increased oxygen concentration or an increased oxygen partial pressure can increase the electrochemical stress and thereby reduce the service life.
- **Gas composition:** Harmful or corrosive gas components can damage the electrochemical components and lead to premature aging (see table below).

Effect	Gases
No effect	CO_2, CO, H_2S, N_2, Ar, H_2, CH_4, propane
Moderate effect	Cl_2, CFCs, SO_2, NH_3, NO, NO_2
Strong effect	O_3, acetone, MEK

Table8 : Effect of trace gases on the measurement behavior and service life of the O2.sens

3.6.3 Estimation of Service Life

The following characteristic curves show a calculated estimate of the sensor's service life as a function of operating temperature, relative gas humidity, and oxygen concentration.

The calculation is based on a simplified aging model using the Arrhenius equation to describe temperature-dependent aging processes, as well as assumed effects of gas humidity and oxygen concentration.

A reference set of conditions is assumed: an operating temperature of 25 °C, a relative humidity of 50%, and an oxygen concentration of 20.9 vol.% at 1013 hPa. For these conditions, a modeled reference service life of 5 years is assumed.

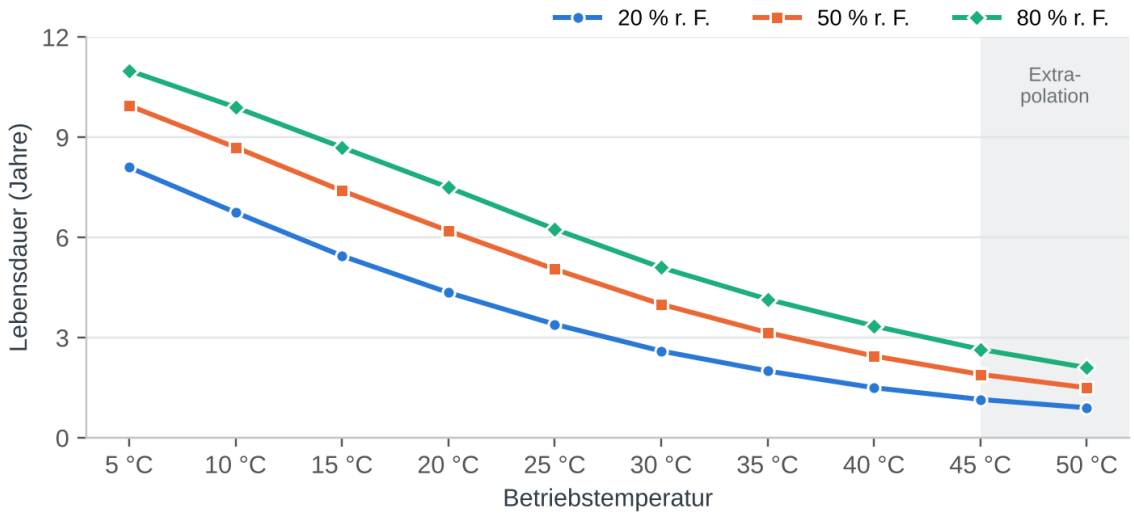


Figure12 : Estimated service life of the O2.sens: Influence of temperature and relative humidity at 20.9 vol.% O_2

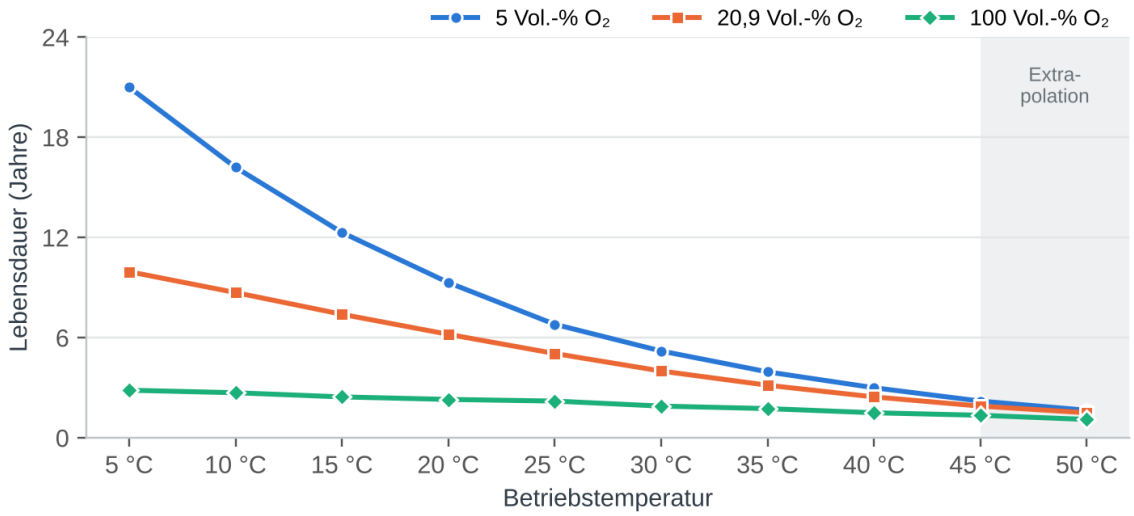


Figure13 : Estimated service life of the O2.sens: Effect of temperature and O_2 concentration at 50% relative humidity

The characteristic curves shown are intended for the comparative evaluation of different operating conditions. The underlying model parameters have not been validated by specific sensor lifespan tests.

The specified service life values are non-binding guidelines and do not represent a guaranteed minimum service life.

! NOTE

Operating Temperature of the O2.sens

The recommended operating temperature range is 15 to 25 °C. The specified maximum operating range is between 0 and 45 °C. Model values above 45 °C represent solely mathematical extrapolations outside the manufacturer's specifications and do not constitute approval for operation in this temperature range.

3.6.4 Installation Position

Install the O2.sens vertically with the measuring surface facing down. This is the only way to ensure that the cathode remains in contact with the electrolyte; air bubbles rise to the top and do not distort the measured value. In a horizontal position, the signal fluctuates.

3.7 P.sens corrosive (absolute pressure sensor 0–1.5 bar)

The P.sens corrosive measures the absolute gas pressure in the measurement gas path. The base board uses the measured pressure to compensate for the effect of pressure on the concentration display (Chapter 3.2.2). It is designed for corrosive measurement gases and is integrated into the module's gas line.

At its core is a piezoresistive absolute pressure sensor with integrated signal conditioning and a digital I²C interface. The sensing cell is built using chip-in-oil technology: The laser-welded stainless steel housing is hermetically sealed and filled with silicone oil. The sensor is housed in a stainless steel housing block (processline version) and is connected to the base board via an adapter board (P.sens connection, see Chapter 7.3).

3.7.1 Variants

Variant	Part No.	Gas connection
P.sens corrosive 0–1.5 bar, hose	2003534	2 × angled screw-in fittings 405 6/4-M5 for 6/4 mm hose
P.sens corrosive 0–1.5 bar, for piping	2003521	2 × SERTO SO 52824-4-M5 swivel fittings for 4 mm outer diameter tubing

Table9 : Variants of the P.sens corrosive

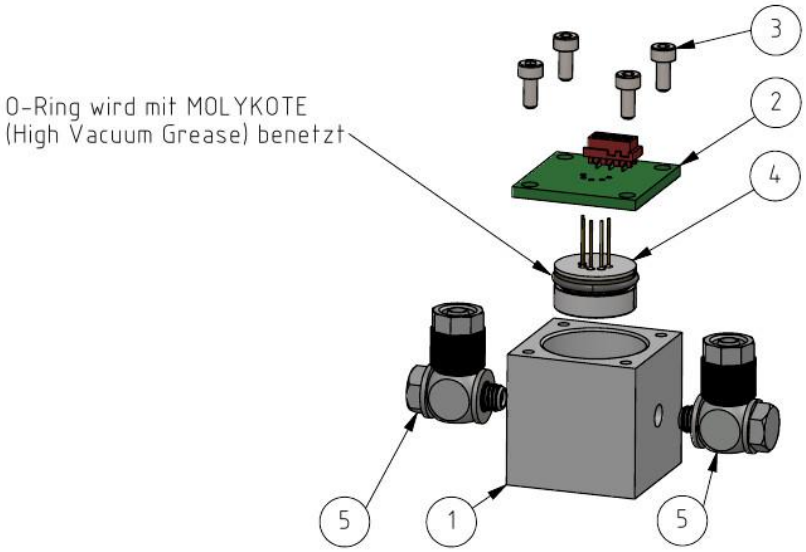


Figure14 : P.sens corrosive, version for 6/4 mm tubing: 1 stainless steel housing block, 2 adapter board, 3 ISO 4762 M2.5 × 6 screws, 4 pressure sensor (stainless steel), 5 angled threaded fitting 6/4-M5

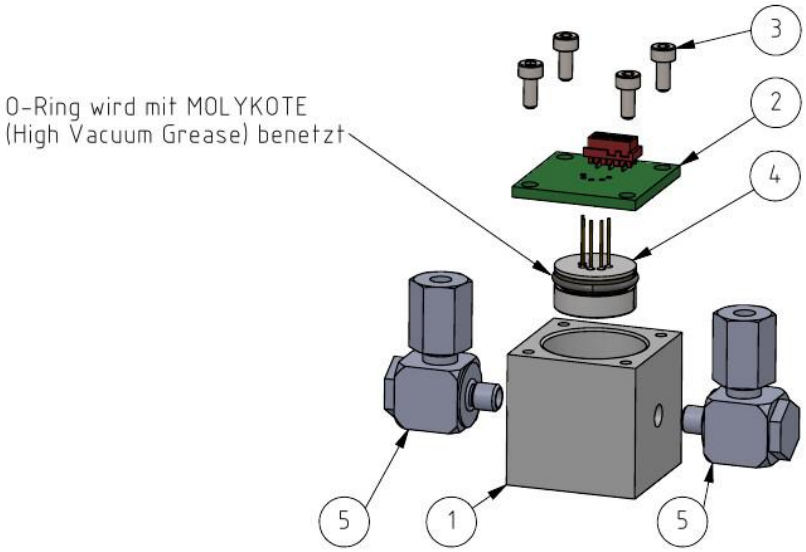


Figure15 : P.sens corrosive, version for piping: 1 stainless steel housing block, 2 adapter board, 3 ISO 4762 M2.5 × 6 screws, 4 pressure sensor (stainless steel), 5 SERTO SO 52824-4-M5 swivel fitting for 4 mm tubing

3.7.2 Technical Specifications of the Pressure Sensor

Feature	Value
Measuring principle	Piezoresistive, chip-in-oil, silicone oil-filled

Feature	Value
Measuring range	0–1.5 bar absolute
Accuracy	Max. ± 0.15% of full scale (linearity, hysteresis, repeatability)
Total Error Band (TEB)	± 0.5% of the full-scale value (0–50 °C); ± 0.7% of the full-scale value (−10–80 °C)
Long-term stability	± 3 mbar (pressure ranges < 1.5 bar)
Overload pressure	4 times the measurement range
Sensor operating temperature	−40–110 °C
Temperature measurement	Integrated, typically ± 2 °C
Interface	I²C, pressure and temperature as 16-bit values; conversion time typically 6 ms
Power supply	1.8–3.6 V via the base board
Materials in Contact with the Medium	Housing block and screw connections: stainless steel; sensor: AISI 316L stainless steel (1.4404 / 1.4435); O-ring: FKM (Viton®)
Cyclic Loading / Vibration / Shock	> 10 million pressure cycles / 20 g (5–2,000 Hz) / 75 g (11 ms)

Table10 : Technical Data of the Pressure Sensor

! NOTE

Damage to the seal

The O-ring between the pressure sensor and the housing block is lubricated with MOLYKOTE High Vacuum Grease. A dry or damaged seal will result in leakage.

- Only trained personnel should remove the pressure sensor.
- Perform a leak test after every service intervention (Chapter 6.6).

3.8 Products in Development

The NO sensor (electrochemical), CALDO.sens®, and MAGNO.sens® will be described in a future revision of this manual.

3.9 Nameplate and Channel Assignment

Each module bears a nameplate. It lists the part number, serial number, device ID, and—for each gas channel (CH1 through CH4)—the gas type and measurement range. You will need the serial number to connect to the PC software and for service inquiries.

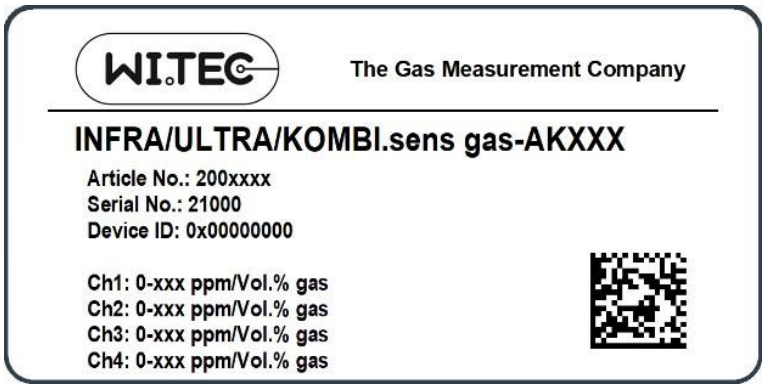


Figure16 : Nameplate (example)

4 Versions

4.1 Mounting Plate

The optical bench and base board are mounted on a mounting plate made of anodized aluminum. The plate has 6 holes for M4 screws.

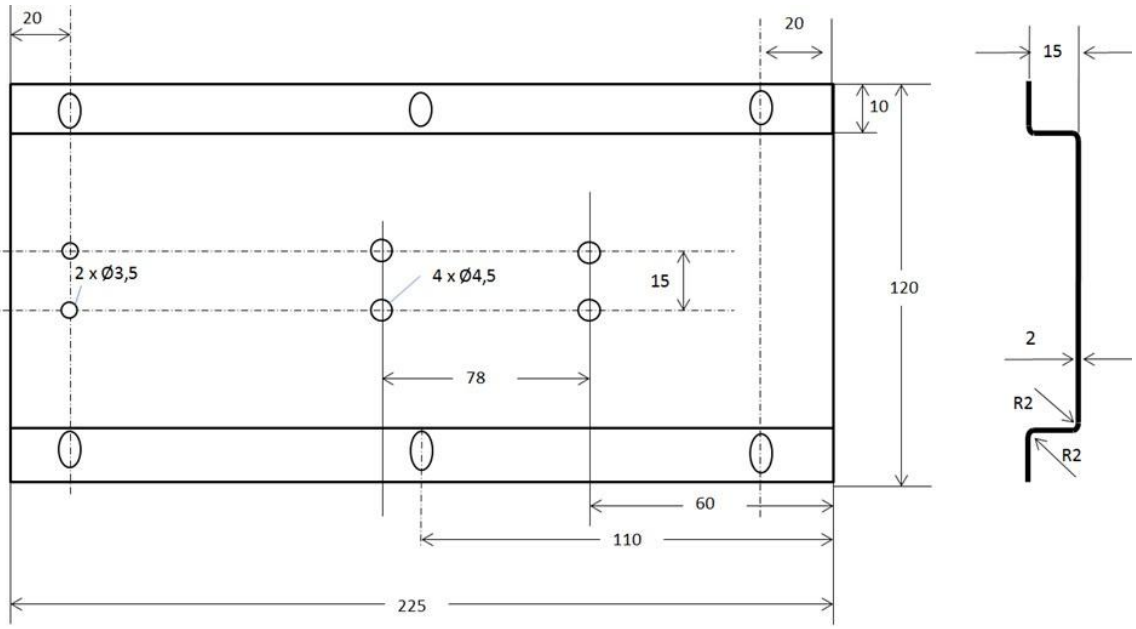


Figure17 : Dimensions of the mounting plate

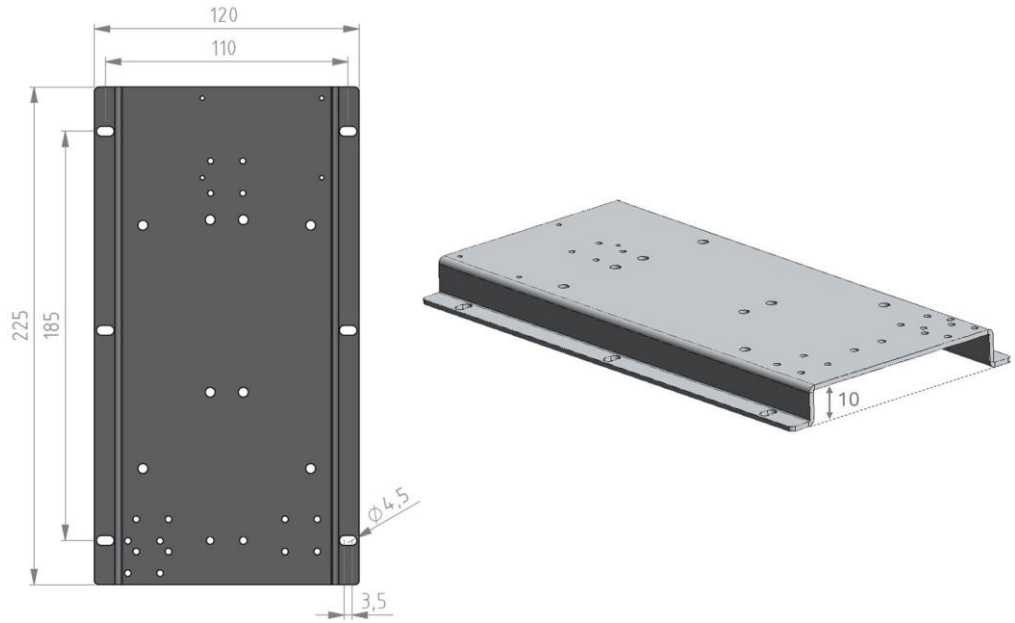


Figure18 : Retaining Plate (Drawing)

4.2 Thermobox V5

The Thermobox is a thermally insulated housing for the gas detection module. It can optionally be heated and temperature-controlled up to 55 °C. When heated, it requires a 24 VDC (15–30 V) power supply with a minimum current of 2 A.

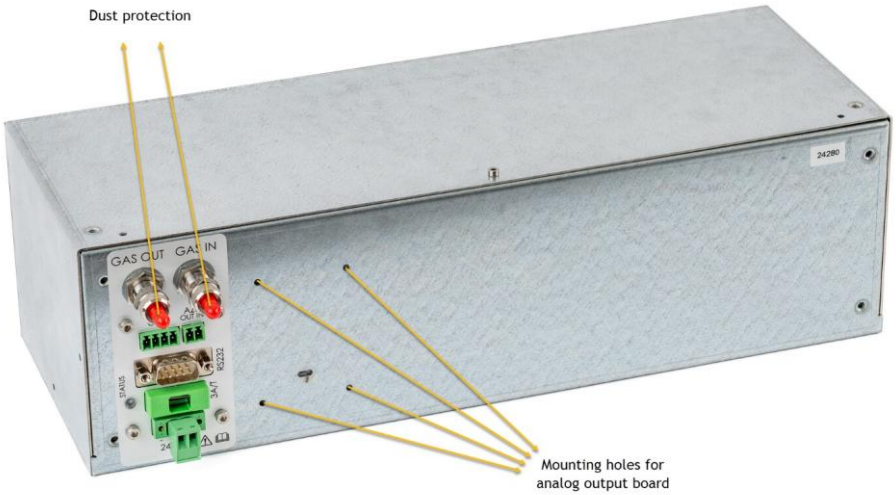


Figure19 : Thermobox V5

The electrical connections of the Thermobox V5 and their pin assignments are described in Sections 7.3.5 and 7.3.6.

Fuse: Use only the ESKA 522.022 G-type fuse insert, 3.15 A, 250 V, as a replacement.

4.2.1 Gas Connections

Model	External gas connection	Internal gas line
Standard	Stainless steel fittings for 4/6 mm hose	FKM hose
Piped (optional)	SERTO SO 51124-4-M5 screw-in fitting for stainless steel tubing with 4 mm outer diameter	Stainless steel piping

Table11 : Gas connections for the Thermobox V5

Feature	SERTO SO 51124-4-M5
Design	Straight screw-in fitting METR
SERTO Part No.	058.1143.080
Outer Pipe Diameter	4 mm
Internal thread	M5 (metric, cylindrical)
Union thread	M8 × 1.0
Wrench sizes	SW 10 / SW 8
Nominal pressure	PN 200 bar
Material	Stainless steel 1.4571

Table12 : Technical Data for the SERTO Fitting (tubed version)

Information

When installing the SERTO fitting, the manufacturer recommends a sealing washer (e.g., SO 40507 METR); it must be ordered separately.

4.2.2 Dimensions and Mounting Holes

The Thermobox V5 is available for both horizontal and vertical installation. M4 threaded holes (max. 4 mm insertion depth) are provided for customer mounting.

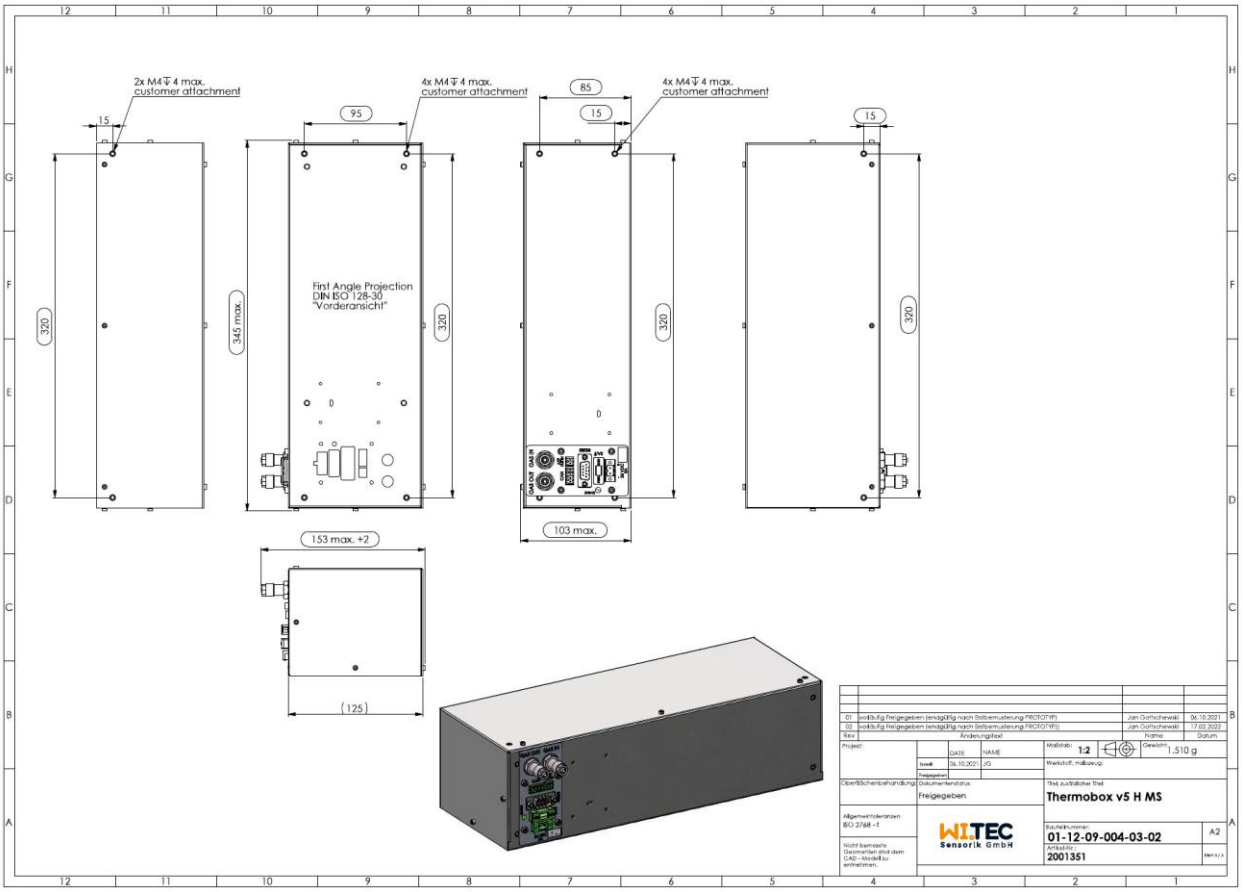


Figure20 : Dimensions and Drilling Pattern for Thermobox V5, Horizontal Version

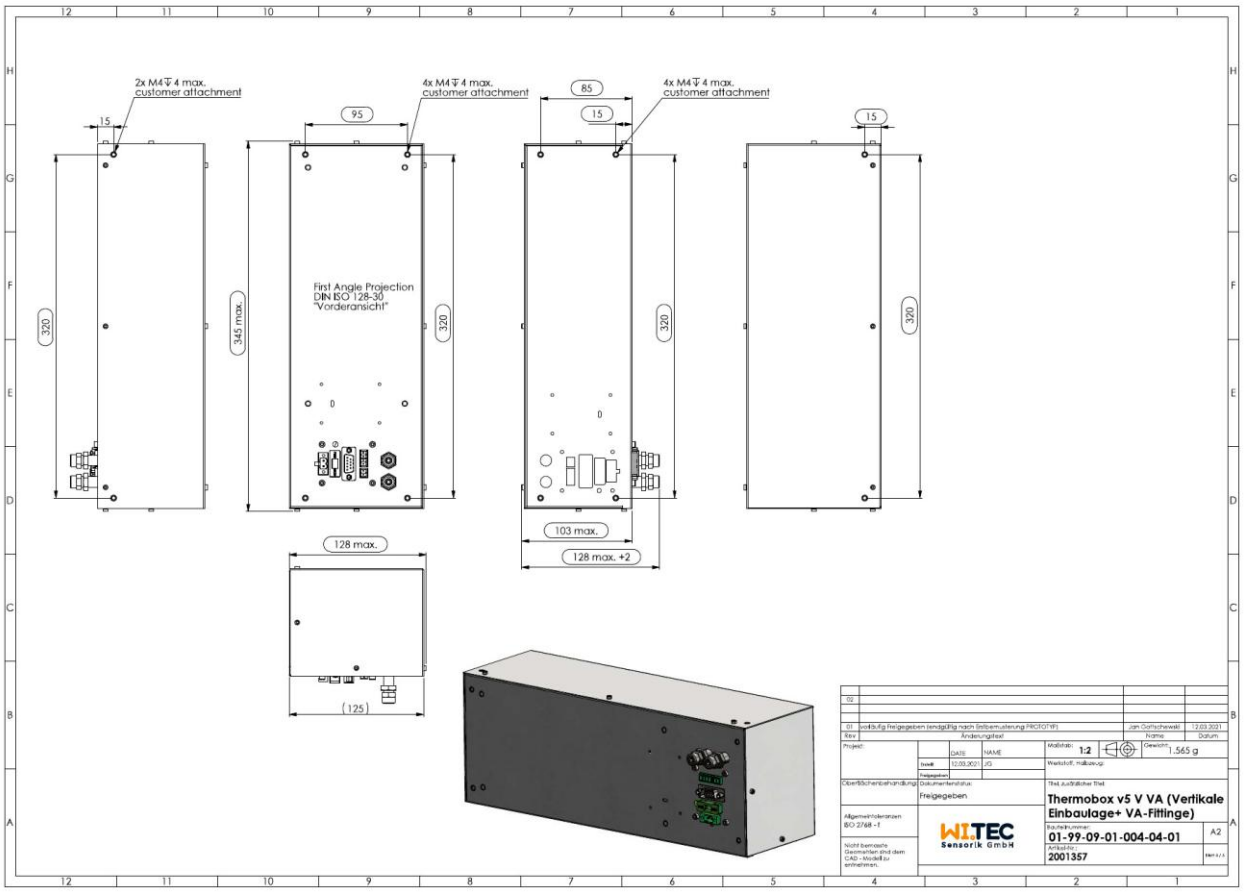


Figure21 : Dimensions and drilling pattern for Thermobox V5, vertical version

> **! NOTE**
>
> **Opening the Thermobox**
>
> Opening the unit will destroy the Wi.Tec seals; the warranty is void unless otherwise agreed.
>
> ▶ The Thermobox may only be opened by trained personnel in accordance with the service instructions and only in a dust-free environment.

4.3 Temperature Control

A stable module temperature improves measurement accuracy. Ideally, the environment or the module itself should be maintained at approximately 40–50 °C, e.g., using the heated thermobox or the optional, factory-installed module heater.

The optical bench (emitter, cuvette, detector) should have no contact with other components—such as housing walls, cables, or heat sources—other than via the mounting plate. Such contact dissipates or transfers heat, creates temperature differences along the measurement bench, and can lead to measurement drift.

Depending on the module and cell, different heating options are used:

Module / Cell	Heating Type	Heating Power
INFRA.sens AK1, AK2, AK5	Direct, localized heating elements	max. 10 W
INFRA.sens AK20	Heating cartridge in an orange anodized bracket	30 W

Module / Cell	Heating Type	Heating Power
INFRA.sens AK100G, AK250G	Jacket heating: additional aluminum body around the cuvette, heated by a heating cartridge	30 W
ULTRA.sens NOx/SO_2 in the Thermobox (TBH)	Pad heater (heating foil as an adhesive pad)	30 W

Table13 : Heating Options

The warm-up time to reach the set temperature is approximately 30 minutes at a starting temperature of 25 °C. At lower starting temperatures, this time increases accordingly.

The heater and heater controller are factory-installed options for the module. They are installed and configured at the factory and cannot be ordered separately.

4.4 Corrosion-Resistant Version (processline)

The processline version is available for the INFRA.sens (IR) and the ULTRA.sens (UV). It is designed for corrosive measurement gases. The analysis cuvette and gas connections are made entirely of 1.4571 stainless steel; the abbreviation “VA” in the cuvette designation stands for the stainless steel version. Other materials, such as Hastelloy, PEEK, or PTFE, are also available upon customer request.

Cuvette	Length	Version / Resistance
AK25VA	25 mm	Stainless steel 1.4571; optionally available with Silcolloy® 2000 (H_2S-resistant up to 5% by volume) or SilcoNert® 2000 (SO_2-resistant up to 20% by volume)
AK50VA	50 mm	Stainless steel 1.4571; optionally available with SilcoNert® 2000 (SO_2-resistant up to 20% by volume)
AK100VA	100 mm	Stainless steel 1.4571
AK200VA	200 mm	Stainless steel 1.4571; ULTRA.sens only

14 Table: Common processline cuvettes

All processline cuvettes are available with two gas connections, both made of stainless steel:

- Direct hose connection 4/6 mm
- Tube connection for 4 mm outer diameter tubing (SERTO screw fitting)

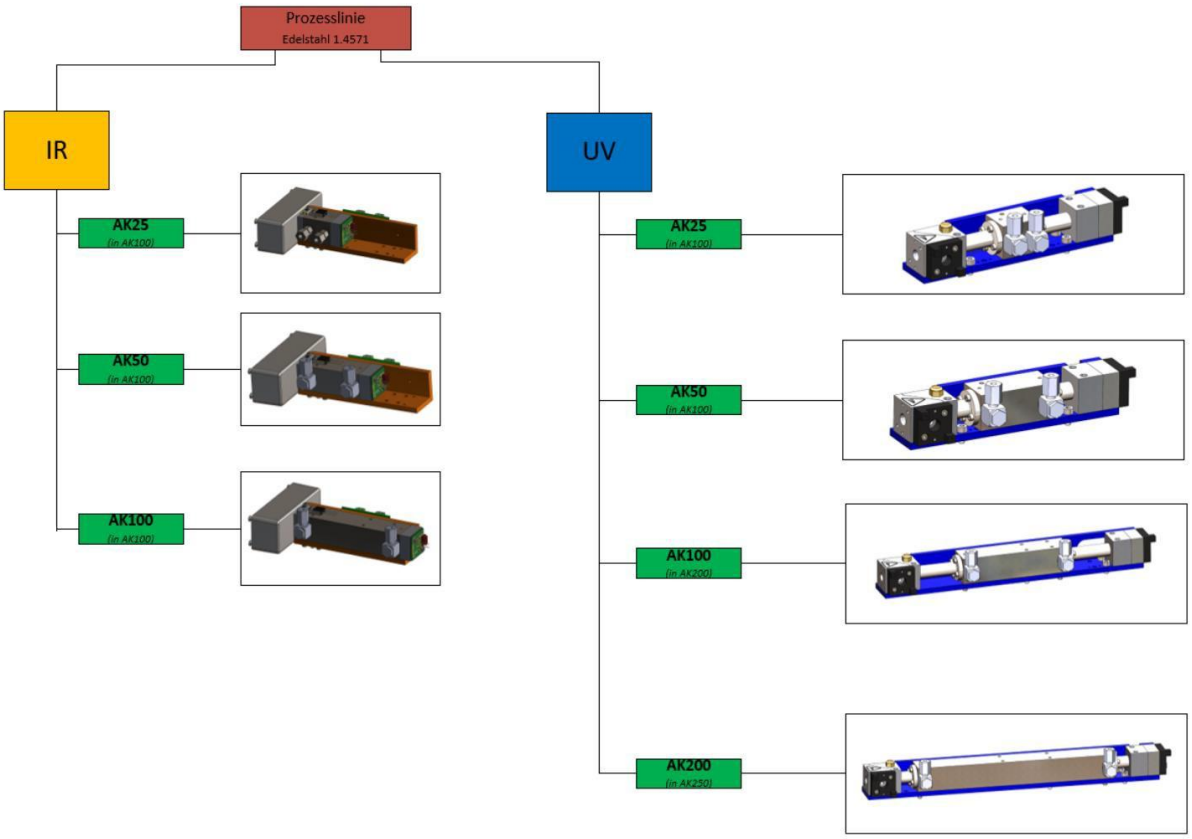


Figure22 : Overview of processline configurations for INFRA.sens (IR) and ULTRA.sens (UV)

4.4.1 Structure of a Process Cell (Example)

The structure of a processline cuvette is explained using the AK100/AK25VA UV process gas cuvette unit (Part No. 2003652) as an example. The actual measurement chamber is a stainless steel block with a 25 mm optical path length (AK25), coated on the inside with Silcolloy® 2000. The measurement gas flows through the block via the side gas connections.

The measurement chamber is sealed on both sides with a quartz window. Quartz is transparent to UV radiation. Each window is sealed gas-tight against the block by an FKM O-ring. The two adapters hold the windows in place and connect the measurement chamber to the light source and detector of the optical bench. The adapters extend the short measurement chamber to the overall length of an AK100 cuvette, allowing it to fit into the standard measurement bench. Each adapter is secured with four M2.5 cylinder head screws.

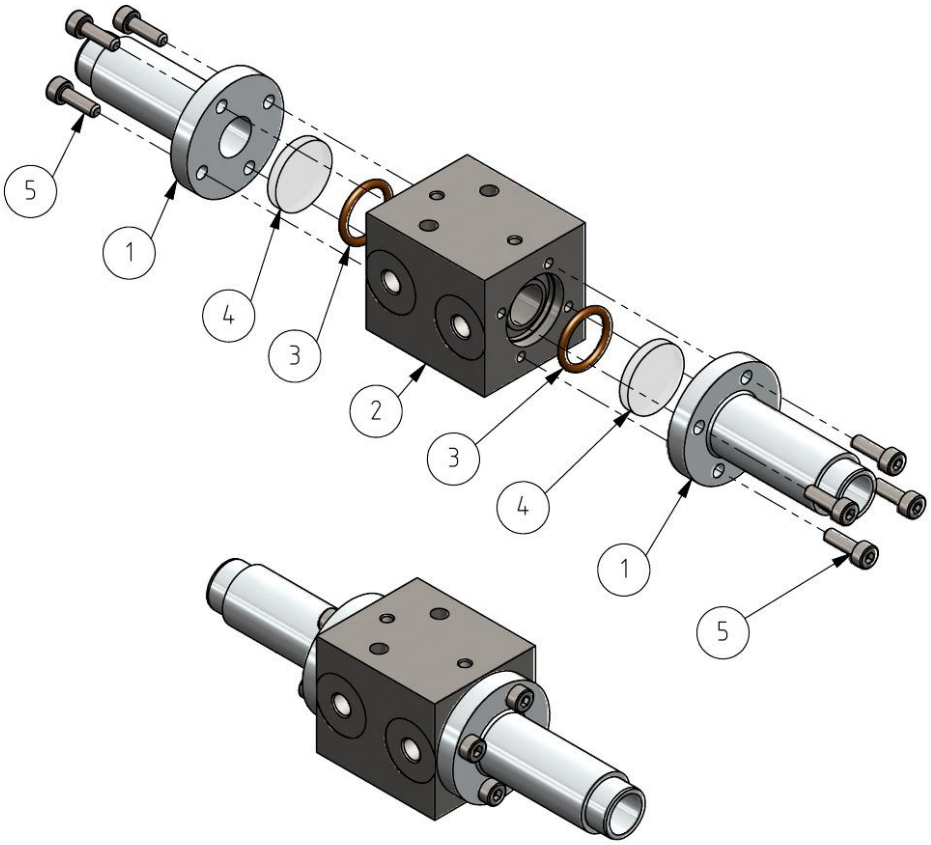


Figure23 : Exploded view and assembly of the AK100/AK25VA UV process gas cuvette unit (Silcolloy® 2000); see Table

Item	Description	Part No.	Quantity
1	AK75 UV Diffuser Adapter (window holder, connection to the optical bench)	2001910	2
2	AK25 Measurement Chamber, Stainless Steel with Silcolloy® 2000	2003649	1
3	FKM O-ring, Ø 9.8 × 1.5 mm	2000717	2
4	Quartz window Ø 14 × 2 mm	2001898	2
5	Cylinder head screw ISO 4762 M2.5 × 8	2000116	8

Table15 : Components of the AK100/AK25VA UV Process Gas Cuvette Unit

The materials of all parts that come into contact with the measurement gas (measurement chamber, coating, O-rings, window) are tailored to the respective measurement gas. Other processline cells are constructed according to the same principle; length, coating, and window material vary depending on the model (e.g., IR-transparent windows for INFRA.sens).

! NOTE

Disassembling the Process Cell

Improper disassembly can damage the window, coating, or seals. This may result in a leak or an inaccurate measurement.

- Do not disassemble the process cuvette yourself. Contact Wi.Tec Service for cleaning or replacement of windows and seals.
- Perform a leak test after every service intervention (see Chapter 6.6).

4.5 Base Boards

Depending on the module type and date of purchase, your gas detection module is equipped with one of the following base boards. The revision number is printed on the circuit board.

Base board	Power Supply	Distinguishing Features	Application
V1.8.x	15–30 VDC	RS232 via 10-pin male header (CON3); external zero-point trigger starting with V1.8.2	Older modules
V1.9.x	15–30 VDC (V1.9.2)	RS232 via 9-pin D-Sub socket (CON3); CAN via RJ45 (X1/X4) and 4-pin (X2/X3)	ULTRA.sens, KOMBI.sens, Thermobox
IR-compact V2.0.x	9–30 VDC	Compact circuit board, connections via 2.54-mm pin headers, labeling directly on the board	INFRA.sens compact / ecoLine

Table16 : Overview of Base Boards

Photos of the base boards showing the location of all connectors can be found in Chapter 7.3.

5 Installation

5.1 Environmental Conditions

Size	Requirements
Ambient temperature	5–45 °C, as constant as possible
Relative humidity	< 95%, non-condensing
Environment	dry, dust-free, no corrosive atmosphere, not outdoors without a protective enclosure
Explosion protection	Only in non-hazardous areas

Table17 : Ambient Conditions for Operation

5.2 Installation

Prerequisite: The installation site meets the environmental conditions; the module is acclimatized (Chapter 2.3).

1. Securely fasten the module using 6 M4 screws through the holes in the mounting plate (dimensions: Section 4.1).
2. Install the module so that the optical bench (emitter, cell, detector) does not come into contact with any other components (e.g., housing walls, cables, heat sources) other than the mounting plate and is not exposed to vibrations. Contacts can transfer heat away from or toward the module and may cause measurement drift (Section 4.3).
3. Determine the installation orientation and do not change it after installation.
4. Align the O2.sens vertically with the measurement surface facing downward (Chapter 3.6).
5. Connect the gas lines (Chapter 6), then make the electrical connections (Chapter 7).

✓ **Result:** The module is mechanically secured and ready for gas connection.

> **Note**
> The installation orientation can shift the zero point. Perform a zero-point adjustment after installation (Chapter 10.4).

6 Gas Connection

6.1 Hoses and Tubes

The gas connections are designed for flexible hoses with an inner diameter of 4 mm and an outer diameter of 6 mm. Use hoses made of Viton or PTFE (Teflon).

! NOTE

Measuring Water Vapor (H_2O)

Hoses made of other materials, such as Viton (FKM), are permeable to water vapor. Due to diffusion through the hose wall, ambient humidity distorts the measured value—especially at low H_2O concentrations.

- Measure water vapor only with PTFE tubing or stainless steel piping.

! NOTE

Modified gas connections

After removing or replacing the fittings, Wi.Tec Sensors can no longer guarantee operation in accordance with specifications.

- Do not modify fittings.
- Contact Wi.Tec Sales for custom gas connections.

For piping with stainless steel tubing (4 mm outer diameter), the Thermobox V5 is available as a pre-wired option with SERTO fittings (Section 4.2.1).

6.2 Flow Direction

The gas inlet is located on the detector side for all modules: on the right for the ULTRA.sens and on the left for the INFRA.sens. The gas outlet is located on the beam side.

The flow direction has no significant effect on measurement accuracy. However, it is strictly defined to ensure reproducible results: The module is calibrated in this direction. Therefore, always connect the measurement gas as described and maintain this direction, even during adjustment and test gas injection.

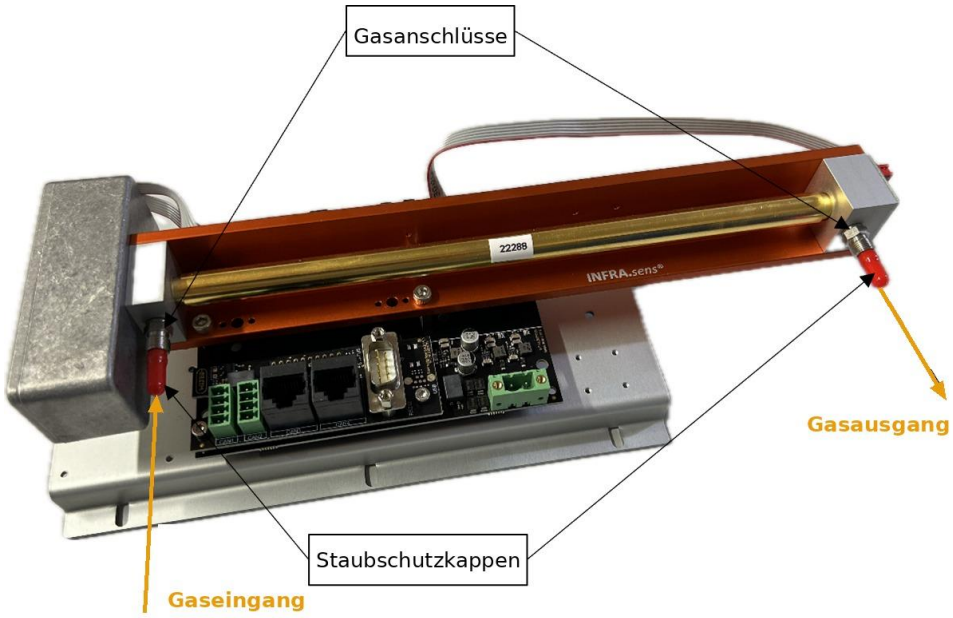


Figure24 : INFRA.sens: Gas inlet on the detector side (left), gas outlet on the beam side (right); gas connections with dust caps

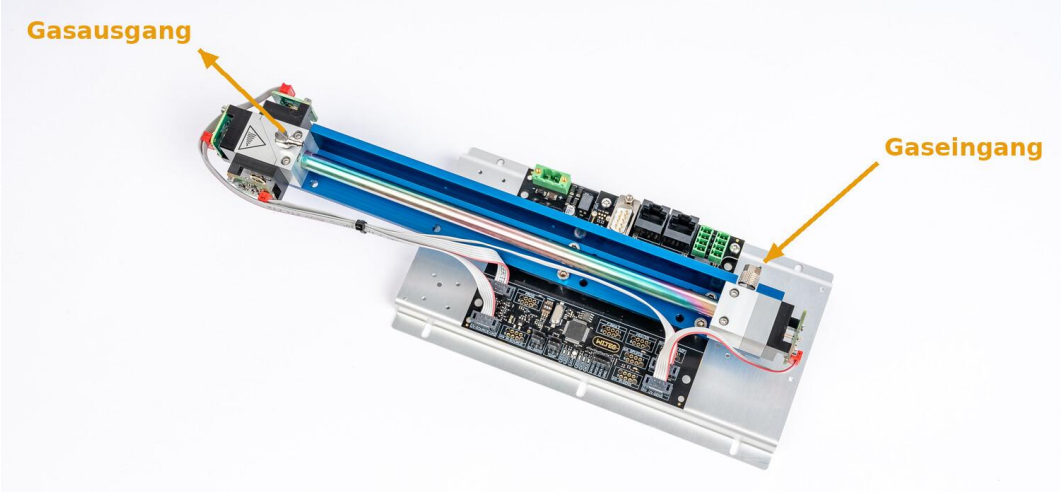


Figure25 : ULTRA.sens: Gas inlet on the detector side (right), gas outlet on the beam side (left)

6.3 Flow

Size	Value
Permissible flow rate	0.1–1.5 L/min
Flow rate at factory calibration	0.7–1 L/min
Flow rate for adjustment	1 l/min (Chapter 10)

Table18 : Flow Rate of the Measurement Gas

Keep the flow rate as constant as possible. Use pumps without pressure pulsations and avoid fluctuating back pressure at the gas outlet. If the flow rate during operation deviates from the calibration flow rate, adjust the zero and endpoints at the operating flow rate.

6.4 Sample Preparation

- Dry the measurement gas: Dew point below 5 °C, e.g., using an electric measurement gas cooler or a Nafion™ tube. The humidity must be stable.
- Filter out particles: Filter fineness < 0.1 µm, e.g., membrane filter. Check and replace filters regularly.
- Maintain stable pressure: within specifications, without fluctuations.

See Appendix A for additional information on sample gas coolers, filters, and flow meters.

6.5 Tubing Length and Response Behavior

Gases such as SO_2 and NO_2 adhere to surfaces. This leads to delayed response and decay (hang-up effect). Use Viton or PTFE tubing, keep lines short, and allow sufficient time during adjustments until the measured value stabilizes.

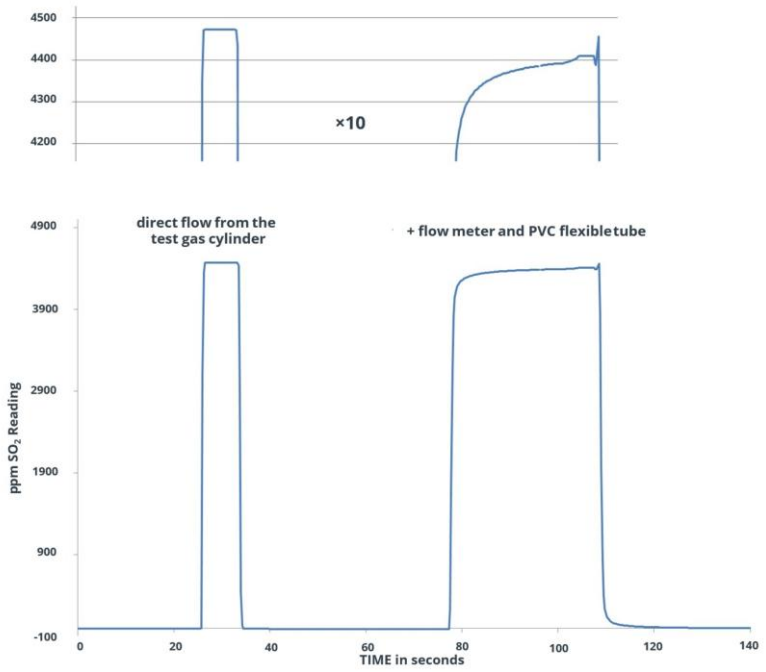


Figure26 : Response behavior with direct gas injection from the test gas cylinder (left) and via a flow meter and PVC tubing (right)

Each meter of tubing increases the dead time—that is, the time it takes for a change in concentration at the start of the tubing to reach the module. The dead time is calculated from the tubing volume and flow rate: $t = \pi \cdot (d/2)^2 \cdot L / Q$. With an inner diameter of 4 mm, each meter of tubing contains 12.6 ml of gas; at a flow rate of 1 l/min, this corresponds to a dead time of approximately 0.75 s per meter.

Hose length (m)	Line volume (ml)	Dead time at 1 l/min (s)
1	12.6	0.8
2	25.1	1.5
3	37.7	2.3
4	50.3	3.0
5	62.8	3.8

Hose length (m)	Line volume (ml)	Dead time at 1 l/min (s)
6	75.4	4.5
7	88.0	5.3
8	100.5	6.0
9	113.1	6.8
10	125.7	7.5
15	188.5	11.3
20	251.3	15.1
30	377.0	22.6
50	628.3	37.7

Table19 : Dead time as a function of hose length (inner diameter 4 mm, flow rate 1 l/min)

Information

These values apply to ideal plug flow. The actual response time (t90) is longer: Additional factors include the volume of the filter, cooler, and cuvette, as well as mixing and gas adhesion to the tubing wall.

The dead time is inversely proportional to the flow rate: at 0.5 l/min, it doubles; at 1.5 l/min, it decreases to two-thirds.

6.6 Leak Test

At Wi.Tec-Sensorik, every gas measurement module undergoes a two-stage leak test: once during assembly and a second time before shipment. Both tests are performed using the automated leak tester LTG550.

Regular testing of the leak rate during operation is not strictly necessary. A leak test is recommended after connection, after mechanical modifications to the gas path, and after a prolonged period of inactivity. Threshold value: pressure drop < 1 mbar/min at 250 mbar overpressure. Nitrogen (N_2) with a purity of 5.0 is recommended as the test gas.

Prerequisite: Gas supply shut off, gas path purged.

1. Seal the gas outlet tightly.
2. Connect nitrogen 5.0 to the gas inlet via a pressure regulator, shut-off valve, and pressure gauge. Alternatively, a hand pump with a pressure gauge may be used, such as a manual blood pressure monitor.
3. Bring the gas path to 250 mbar overpressure and shut off the supply.
4. Monitor the pressure drop over 1 minute.
5. If a leak is detected, check the screw connections and repeat the test.
6. Remove the caps and reconnect the gas lines.

✓ **Result:** The pressure drop is less than 1 mbar/min. The gas line is leak-free.

Information

If you have questions about performing leak tests at the customer's site, Wi.Tec Support is here to help (contact information in Chapter 13).

6.7 Exhaust Gas Discharge

For toxic, corrosive, or flammable measurement gases, vent the exhaust gas through an exhaust line or extraction system (Chapter 1.5). The exhaust line must not generate fluctuating back pressure.

7 Electrical Connection

! NOTE

Incorrect supply voltage or reversed polarity

The base board may be damaged.

- ▶ Check the voltage and polarity before turning on the power.
- ▶ Connect the interfaces first, then turn on the power supply.

7.1 Power Supply

Model	Power Supply	Current Consumption	Power
ULTRA.sens (Base Board V1.9.2)	24 VDC (15–30 V)	< 100 mA	< 3 W
INFRA.sens	24 VDC (range per base board)	< 300 mA	< 9 W
KOMBI.sens	24 VDC (15–30 V)	< 400 mA	< 12 W
Thermobox V5 with heater	24 VDC (15–30 V)	at least 2 A	35 W

20 Table: Power Supply and Current Consumption

Connectors: Base board V1.9.x X5 (Würth 691352710002, 5 mm, 2-pin); IR-compact V2.0.x (Würth 691304100002, 3.5 mm, 2-pin). Pin 1 = +24 V, Pin 2 = GND. 24 VDC plug-in power supplies (60 W, 100–240 VAC) are available as accessories: Part No. 2003262 for Base Board V1.8.x, V1.9.x, and Thermobox; Part No. 2003137 for IR-compact V2.0.x (Chapter 14.3).

7.2 Grounding

The gas measurement modules are operated in a potential-free configuration:

- **Do not** connect the housing components or metallic parts of the modules to the protective conductor (PE).
- Power the modules using an **electrically isolated power supply**.
- **Do not** connect the UB− power line to the GND line of a communication interface (RS232, CAN, Modbus).

! NOTE

Connecting UB− to the GND of the communication interface

If UB− and the interface's GND are connected outside the module, equalizing currents will flow. This partially bypasses the input circuitry of the power supply.

- ▶ Wire UB− and the interface's GND separately.
- ▶ Use only galvanically isolated power supplies.

7.3 Interfaces of the Base Boards

7.3.1 Base Board V1.9.x

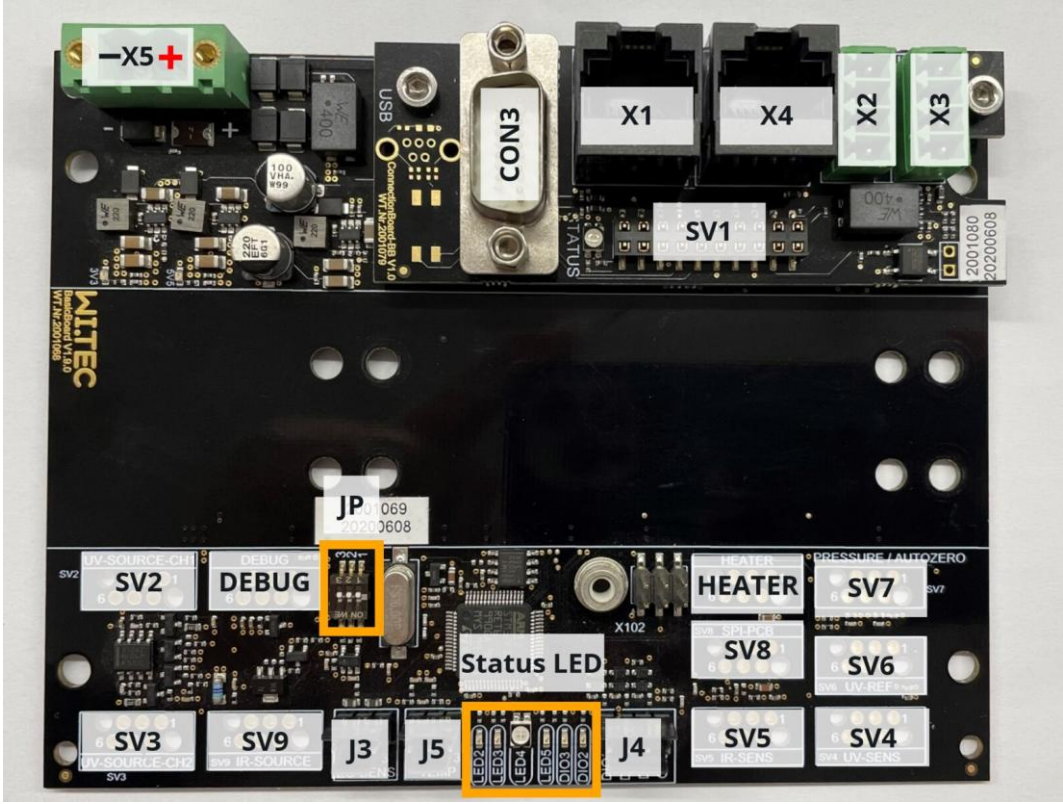


Figure27 : Base Board V1.9.x – Location of Connectors

Connection	Function	Pin Assignment / Note
X5	Power Supply	15–30 VDC; Pin 1 PWR, Pin 2 GND
CON3	RS232	9-pin D-Sub female connector, 115–200 baud; Pin 2 TxD (output), Pin 3 RxD (input), Pin 5 GND
X1, X4	CAN bus (RJ45)	Pin 1 GND, Pin 4 CAN-H, Pin 5 CAN-L; two jacks in parallel for loop-through
X2, X3	CAN bus (4-pin, 3.5 mm)	Pin 1 GND, Pin 2 CAN-L, Pin 3 CAN-H
J3	Electrochemical sensor input (O2.sens)	Pin 1 Signal, Pin 2 GND, Pin 3 GND filter
J4	Digital Inputs/Outputs	Pin 1 DIO1 external zero-point trigger (at least 4 s low), Pin 2 DIO2 not assigned, Pin 3 DIO3 AZF output, Pin 4 GND (Chapter 7.7)
J5	External PT1000 (2-wire)	Pin 1 PT1000_1, Pin 2 GND, Pin 3 PT1000_2
SV7	Pressure/humidity sensor, AZF	P.sens, HUMI.sens, AZF control
SV8	Analog output (optional)	for analog output board (Chapter 14.2)
JP (DIP switch)	O2 Sensor Configuration	For O2 sensor: Switch 1 = 0, 2 = 1, 3 = 0

Connection	Function	Pin Assignment / Note
DEBUG	Programming interface	Firmware update; request cable from Wi.Tec

Table21 : Connections on Base Board V1.9.x

7.3.2 IR-compact Base Board V2.0.x

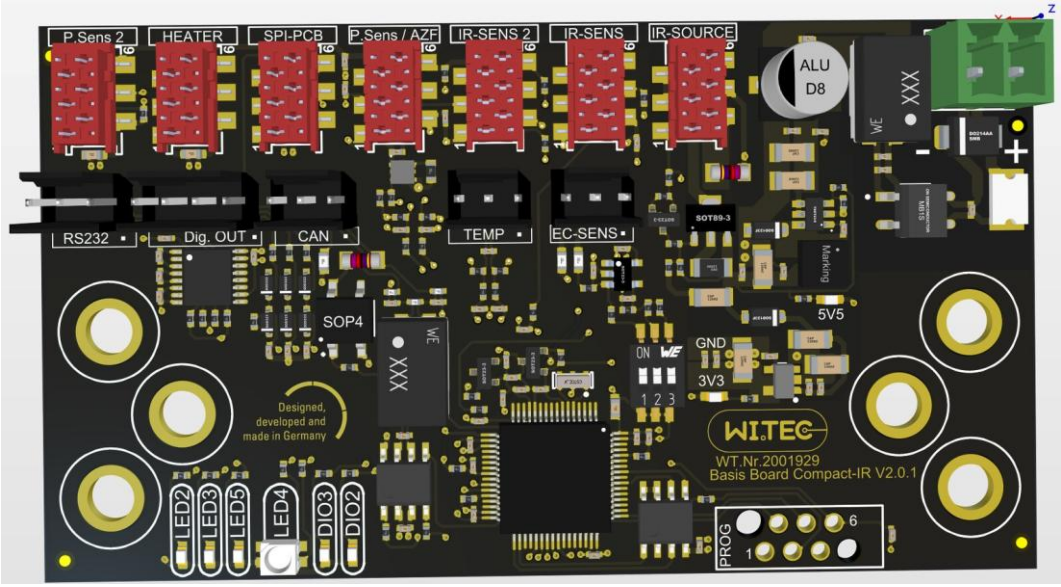


Figure28 : IR-compact V2.0.x base board – the connectors are labeled directly on the circuit board

Connection	Function	Assignment / Note
Power	Power supply	9–30 VDC, 3.5 mm, 2-pin; Pin 1 PWR, Pin 2 GND
RS232	RS232 (2.54 mm, 3-pin)	Pin 1 RxD (input), Pin 2 TxD (output), Pin 3 GND
CAN	CAN bus (2.54 mm, 3-pin)	Pin 1 CAN-L, Pin 2 CAN-H, Pin 3 GND
Dig.OUT	Digital Inputs/Outputs (2.54 mm, 4-pin)	Pin 1 DIO1 external zero-point trigger (at least 4 s low), Pin 2 DIO2 reserved, Pin 3 DIO3 AZF output, Pin 4 GND (Chapter 7.7)
TEMP	External PT1000 (2-wire)	Pin 1 PT1000_1, Pin 2 GND, Pin 3 PT1000_2
EC-SENS	Electrochemical sensor input	Pin 1 Signal, Pin 2 GND, Pin 3 GND filter
P.sens/AZF, P.sens2	Pressure/humidity sensor, AZF	P.sens2 = optional second pressure sensor
SPI PCB	Analog output (optional)	0–10 V / 0–5 V / 0–2 V
DIP switch	EC sensor configuration	For external EC sensor: Switch 1 off, 2 on, 3 off
PROG	Programming interface	Firmware update; request cable from Wi.Tec

Table22 : Connections on the IR-compact V2.0.x Base Board

7.3.3 Base Board V1.8.x

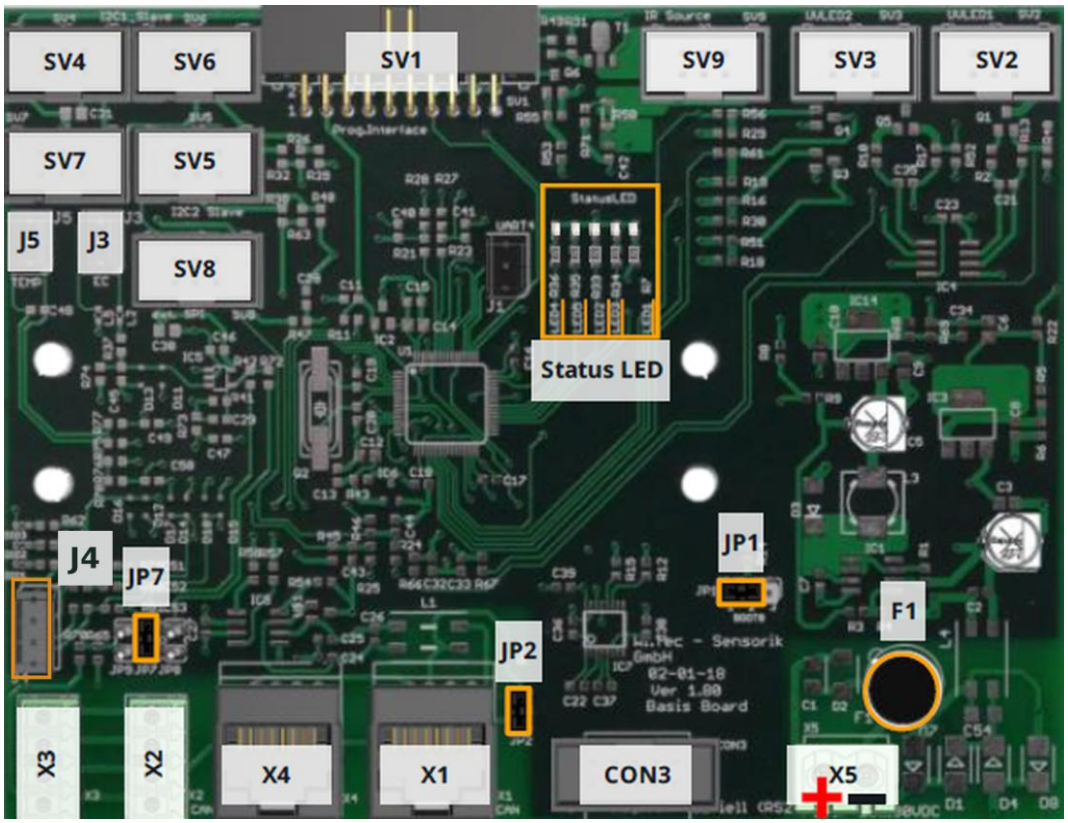


Figure29 : V1.8.x Base Board – Location of Connectors

Connection	Function	Assignment / Note
X5	Power Supply	15–30 VDC
CON3	RS232	10-pin male header (Würth 61201023021, 2.54 mm), 115,200 baud; Pin 3 TxD, Pin 5 RxD, Pin 8 +3.3 V, Pin 9 GND
X1, X4	CAN bus (RJ45)	Pinout as on base board V1.9.x
X2, X3	CAN bus (4-pin)	Pinout as on base board V1.9.x
J3	Electrochemical sensor input (O2.sens)	Pin 1 Signal, Pin 2 GND, Pin 3 GND filter
J4 (as of V1.8.2)	Digital Inputs/Outputs	Pin 1 DO1, Pin 2 DO2, Pin 3 DI1 zero-point trigger (at least 4 s against GND), Pin 4 GND
J5	External PT1000 (2-wire)	Pin 1 PT1000_1, Pin 2 GND, Pin 3 PT1000_2
SV1	Programming interface (ST-LINK)	3.3 V, GND, RESET
SV2, SV3	UV LED 1 / UV LED 2	Control of the UV radiation sources
SV4	UV detector board	Measurement channel
SV5, SV6	UV/IR detector board	Measurement channels
SV7	Pressure/Humidity Sensor (Optional)	P.sens / HUMI.sens Input
SV8	Analog Output (Option)	Analog output board 0–10 V / 0–5 V / 0–2 V

Connection	Function	Assignment / Note
SV9	IR emitter	Pin 1 Control, Pin 2 GND, Pin 3/5 V_Lamp+, Pin 4/6 V_Lamp−
JP1	Jumper	–
JP2	Jumper	Enable the 120 Ω CAN bus terminator
JP7	Jumper	Required for O2 sensor
F1	Fuse	Micro fuse, round, slow-blow (T), 1 A, e.g., ESKA 887.100

Table23 : Connections on Base Board V1.8.x

LED	Meaning
LED1	3.3 V power supply
LED2	System clock, flashes at 1 Hz
LED3	I²C communication with sensors
LED4	Not assigned
LED5	RS232 communication

Table24 : Status LEDs on Base Board V1.8.x

Information

On the V1.8.x base board, the zero-point trigger is on J4 pin 3 (DI1); on V1.9.x and IR-compact V2.0.x, it is on pin 1 (DIO1).

7.3.4 Connector Board MBB V1.0 (Modbus, without Thermobox)

Modules with the Modbus option without a Thermobox are equipped with the MBB V1.0 Connector Board. It provides the Modbus RTU interface (RS485) via two RJ45 jacks and the RS232 interface via a D-Sub jack.

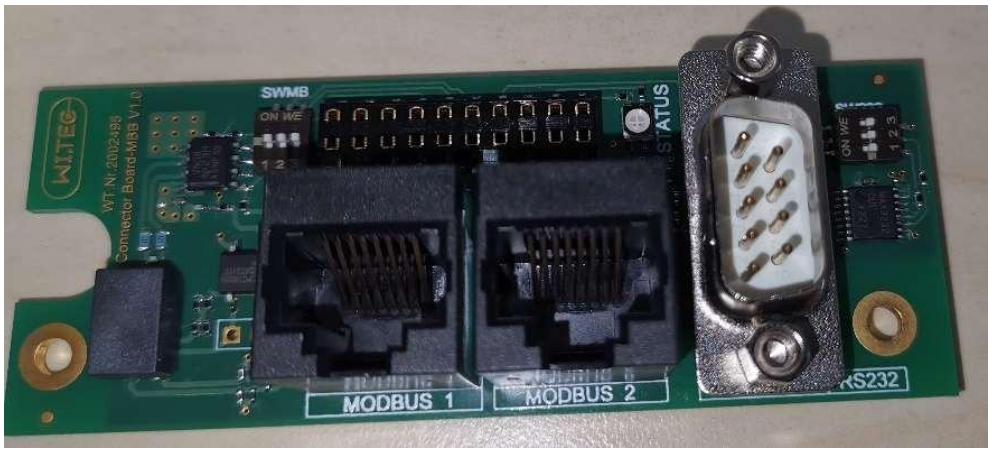


Figure30 : MBB V1.0 Connector Board with the RJ45 jacks MODBUS 1 and MODBUS 2, the RS232 jack, and the DIP switches SWMB and SW232

The two RJ45 jacks, MODBUS 1 and MODBUS 2, are connected in parallel. This allows two analyzers to be connected using a standard patch cable; the control unit (PLC) is connected via the free jack.

Pin (RJ45)	RS485 Signal
1, 2, 3	Not Assigned
4	D1 (A+)
5	D0 (B−)
6	Not Assigned
7	5 VDC – do not connect
8	Common

Table25 : Pin Assignment for the MODBUS 1 and MODBUS 2 RJ45 Jacks

RS232/Modbus Switching: The board has two DIP switches, SWMB (SW1) for Modbus and SW232 (SW2) for RS232. The module detects the switch position each time it is powered on and communicates using the appropriate protocol.

Operating Mode	SWMB (SW1), Pos. 1–3	SW232 (SW2), Pos. 1–3
Modbus	All ON	All OFF
RS232	All OFF	All ON

Table26 : DIP switches for selecting the interface

Bus Termination: For cable lengths of approximately 30 m or longer, a terminating resistor is recommended to prevent reflections. The terminating resistor (150 Ω) integrated on the board is enabled via jumper JP1 or via RS232.

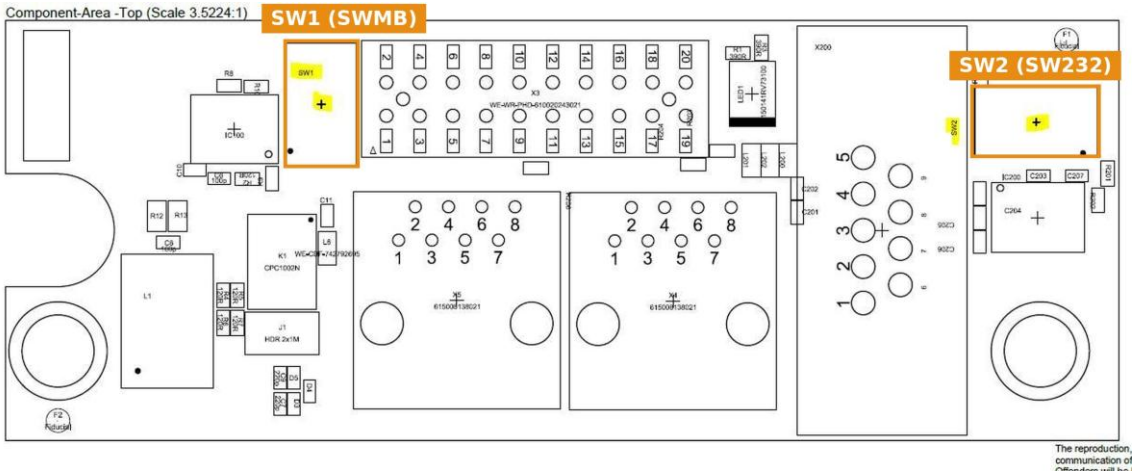


Figure31 : Layout diagram for the MBB V1.0 connector board with DIP switches SW1 (SWMB, Modbus) and SW2 (SW232, RS232)

Information

Factory-set Modbus address: 1. It can be changed via RS232 using the MARS® tool or via Modbus (parameter “Slave ID Update”); restart the module afterward.

Wi.Tec sets the baud rate (9.6 to 115.2 kBd) and parity during manufacturing.

7.3.5 Thermobox V5

For modules in the Thermobox V5, power and communication are handled via the terminal block on the housing.

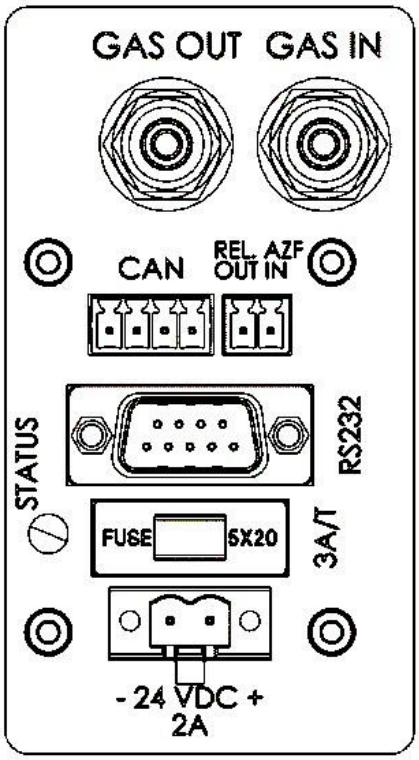


Figure32 : Terminal block of the Thermobox V5

> **Information**
> Pin numbering: For the CAN and REL. AZF/Pump connectors, pin 1 is on the right.

Connection	Pin	Signal	Connector
24 VDC	1	Input +24 VDC (15–30 V, min. 2 A)	Würth Elektronik 691352710002, 5 mm, 2-pin
	2	GND (UB−)	
RS232	2	TxD (Output)	Würth Elektronik 618009221923, 9-pin D-Sub, female connector
	3	RxD (Input)	
	5	GND (Interface)	
CAN	1	GND (Interface)	Würth Elektronik 691366110004, 3.5 mm, 4-pin
	2	CAN-L	
	3	CAN-H	
REL. AZF/Pump	1	Load IN (Load Circuit CPC1002N, Pin 4)	Würth Elektronik 691304100002, 3.5 mm, 2-pin

Connection	Pin	Signal	Connector
	2	Load OUT (Load circuit CPC1002N, Pin 3)	

Table27 : Pin Assignment for the Thermobox V5 Connectors

REL. AZF/Pump: Relay output with a solid-state relay (CPC1002N). The module uses this to activate the Auto-Zero function, e.g., the variants with external 24 V control (AZF eVP, eVV, Chapter 14.1). In the standard configuration, both pins are connected to the relay's load circuit; the connection acts as a switching contact, and power for the load is supplied externally (max. 60 VDC, load current max. 700 mA). On the Thermobox with Modbus connection, the terminal is labeled "AZF SW"; it is functionally identical but wired differently (Chapter 7.3.6).

Connection with 24-VDC power supply (standard case): +24 VDC (UB+) is connected to Load IN (Pin 1). The load, e.g., a pump or valve, is connected between Load OUT (Pin 2) and GND (UB−).

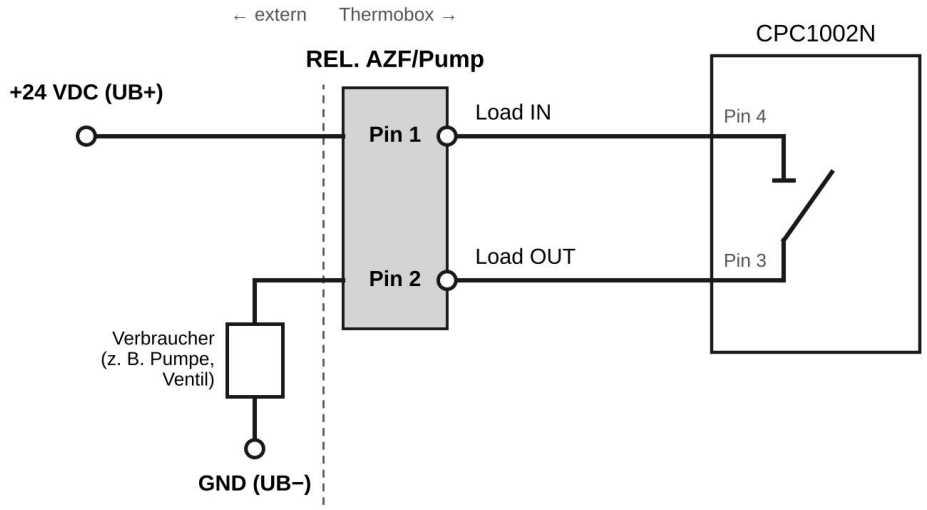


Figure33 : REL. AZF/Pump relay output (Thermobox V5) with 24-VDC power supply: +24 VDC at Pin 1 (Load IN, CPC1002N Pin 4), load connected between Pin 2 (Load OUT, CPC1002N Pin 3) and GND (UB−)

Connection with an **external power supply:** Alternatively, the load can be powered by its own voltage source, e.g., 5 VDC or 12 VDC. In this case, the positive terminal of the external power supply is connected to Load IN (Pin 1). The load also receives its GND from the external power supply, not from the Thermobox's GND (UB−).

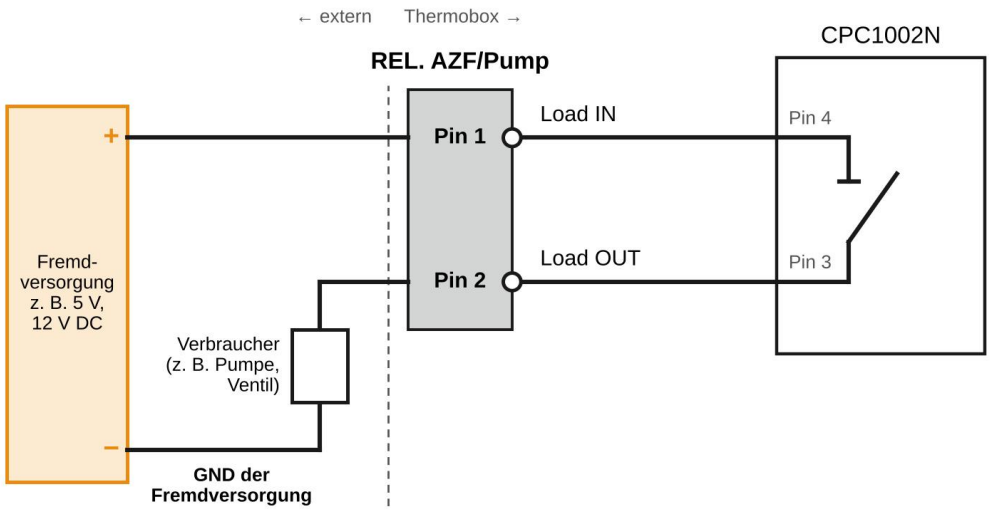


Figure34 : Relay output REL. AZF/Pump (Thermobox V5) with external power supply: Positive terminal to Pin 1 (Load IN), load between Pin 2 (Load OUT) and GND of the external power supply

Connection example with an externally controlled AZF (eVP, eVV): Chapter 14.1.1.

! NOTE

Observe the connection polarity of the relay output

The solid-state relay only switches when connected in the correct direction. Pin 1 is Load IN, Pin 2 is Load OUT.

- Voltage: max. 60 VDC.
- Load current: max. 700 mA.
- If using an external power supply, connect the load's GND to the external power supply.

7.3.6 Thermobox V5 with Modbus Connection

The Thermobox V5 with Modbus option also features MODBUS and Dig-OUT connectors. The CAN, RS232, and 24-VDC power supply connections are the same as on the standard version (Section 7.3.5).

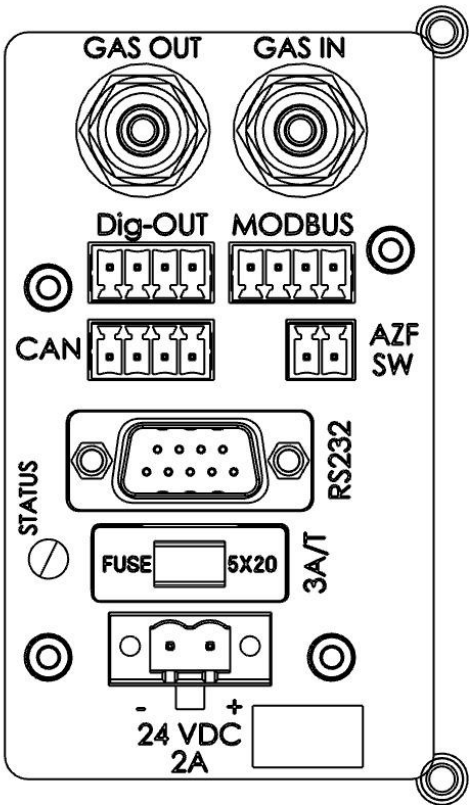


Figure35 : Terminal block of the Thermobox V5 with Modbus connection

> **Information**
> Pin numbering: For the upper connectors (Dig-OUT, MODBUS), Pin 1 is on the left; for the connectors below (CAN, AZF SW), Pin 1 is on the right.

The AZF SW relay output is functionally identical to REL. AZF/Pump, but is wired differently: Pin 1 = +24 V; the load is connected to Pin 2 (Load). Connect the load's GND terminal to GND (UB−) of the 24-VDC power supply.

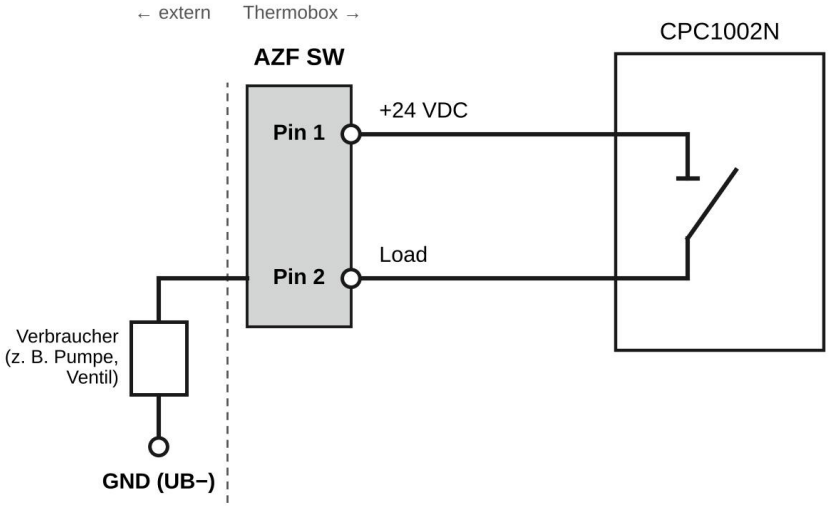


Figure36 : Schematic diagram of the AZF SW relay output (Thermobox V5 with Modbus connection): Pin 1 +24 VDC, Pin 2 Load; load's return line to GND (UB−)

Connection	Pin	Signal
MODBUS	1	GND_M (Modbus ground)
	2	D0 (B−)
	3	D1 (A+)
	4	PE
AZF SW	1	+24 V
	2	Load (switched output, CPC1002N); load GND to GND (UB−)
Dig-OUT	1	DIO1 – external zero-point trigger (at least 4 s low)
	2	DIO2
	3	DIO3
	4	GND

Table28 : Pin Assignment for MODBUS, AZF SW, and Dig-OUT (Thermobox V5 with Modbus Connection)

! NOTE

Do not connect GND_M to ground

Connecting GND_M to ground (PE) compromises the insulation of the Modbus interface (critical insulation failure).

- Never connect GND_M to ground or PE.

Information

If a module in the Thermobox is configured for Modbus, communication via RS232 is no longer possible because the interface selector switch is located inside the Thermobox.

7.4 RS232

Factory setting: 115,200 baud, 8 data bits, 1 stop bit, no parity. The maximum cable length depends on the baud rate:

Baud rate (bit/s)	Max. cable length (typical)
2,400	900 m
4,800	300 m
9,600	152 m
19,200	15 m
57,600	5 m
115,200	2 m

Table29 : Typical RS-232 Cable Lengths Based on Baud Rate

> **Information**
> With the factory setting of 115,200 baud, the RS232 cable length is limited to approximately 2 m. For longer distances, use CAN or Modbus, or install an RS232 isolator/amplifier; use shielded, low-capacitance cables.

7.5 CAN Bus

The two RJ45 jacks (X1, X4) are connected in parallel. This allows you to connect multiple modules using standard patch cables. Protocol and commands: Communication Manual.

Bus termination: A 120 Ω terminating resistor must be active at the first and last devices on the CAN bus. It is integrated into the base boards:

Base board	Terminating resistor 120 Ω
V1.8.x	Enableable via jumper JP2
V1.9.x	Enableable via software
IR-compact V2.0.x	Enableable via software

Table30 : CAN bus termination on the base boards

Parameter	Value / Setting
Supported baud rates	125 kBaud, 250 kBaud, 500 kBaud, 1 MBaud
Node ID or CAN transmit/receive IDs	Configurable via software (MARS® tool via RS232)
Bus termination V1.9.x / V2.0.x	Enableable via software

Table31 : CAN Parameters

The configuration commands are described in the communication manual.

7.6 Modbus RTU (Option)

With the Modbus option, the module communicates via Modbus RTU (RS485, firmware > 5540). Wi.Tec sets the baud rate (9,600 to 115,200 baud) and parity during manufacturing.

- Switching between RS232 and Modbus via DIP switches: Set all SWMB switches to “on” and all SW232 switches to “off” = Modbus; vice versa = RS232. The module detects the setting each time it is powered on.
- Without Thermobox: Connection via one of the two RJ45 jacks on the MBB V1.0 connector board; D1 = A+, D0 = B− (Section 7.3.4).
- With Thermobox: Connection via the 4-pin MODBUS connector on the terminal block (pin assignment: Section 7.3.6).

Register list and data formats: Communication Manual.

7.7 Digital Inputs and Outputs

Signal	Function
DIO1	External zero-point trigger: at least 4 s low (relative to GND) sets the zero point of all gas channels
DIO2	Not used / Reserved
DIO3	Output for controlling the Auto-Zero function (AZF) or external switching output

Table32 : Digital Inputs and Outputs (J4 or Dig.OUT)

7.8 Status LEDs

LED	Meaning
LED2	System clock, flashes at 1 Hz
LED3	I²C communication with sensors
LED4	Detector signal status indicator: green = detector signal above the alarm level, red = detector signal below the alarm level (factory setting 50%)
LED5	RS232 communication
DIO3	AZF on/off

Table33 : Status LEDs on the V1.9.x base boards and IR-compact V2.0.x



Figure37 : Status LEDs (Base Board V1.9.x)

LED4 (status indicator, red/green): This LED indicates whether the detector signal is sufficient. Green means the detector signal is above the alarm level; the module is operating within the normal range. Red indicates that the detector signal has fallen below the alarm level, e.g., due to an aged emitter or a dirty or fogged-up cuvette (Chapter 11).

The alarm level is factory-set to 50%. It can be adjusted using the MARS® Tool (see separate MARS® Tool manual).

8 Commissioning

8.1 Prerequisites

The following conditions must be met for accurate measurement:

1. A dry, non-condensing, and dust-free environment.
2. Protection of ESD-sensitive components (base board, pressure sensor, emitter, detector).
3. Stable measurement gas humidity, e.g., via a measurement gas cooler or Nafion™ tubing.
4. Stable pressure within the specification (pump without pressure fluctuations).
5. Stable flow rate within the specification; calibration is performed at 0.7–1 L/min.
6. Stable module temperature within specifications.
7. Secure mounting and a fixed installation position.
8. Regular adjustment of the zero and end points; the interval depends on the application.
9. Reliable particle filtration < 0.1 µm.

8.2 Initial Commissioning

Prerequisite: The module is acclimatized, installed (Chapter 5), and connected to the gas supply (Chapter 6).

1. Perform a leak test (Chapter 6.6).
2. Connect the data cable to the RS232 port and to the PC (USB-RS232 adapter).
3. Connect the 24 VDC power supply and turn it on.
4. Check whether LED2 is flashing at a rate of 1 Hz.
5. Establish a connection with the PC software and check the measured values (Chapter 9).
6. Operate the module for at least 30 minutes under stable conditions. Warm-up time without heating < 15 min; heated modules take approx. 30 minutes to reach the setpoint temperature (at a starting temperature of 25 °C; longer at lower temperatures, Chapter 4.3). Do not calibrate until the setpoint temperature has been reached.
7. Perform zero-point calibration using zero gas (Chapter 10.4). The appropriate zero gas depends on the measurement gas (Chapter 10.2).

> **Zero gas**
> The zero gas must not contain the measurement component. For CO_2 modules, ambient air is unsuitable as a zero gas because it always contains approximately 400–1000 ppm CO_2. Use nitrogen (N_2) with a purity of 2.8, or preferably 5.0.

✓ **Result:** The module is measuring. The zero point is adjusted to the installation conditions.

The location of the RS232 port depends on the module and housing. The following figures show the three configurations: A – INFRA.sens with IR-compact base board, B – ULTRA.sens with V1.9 base board, C – gas measurement module in the Thermobox.

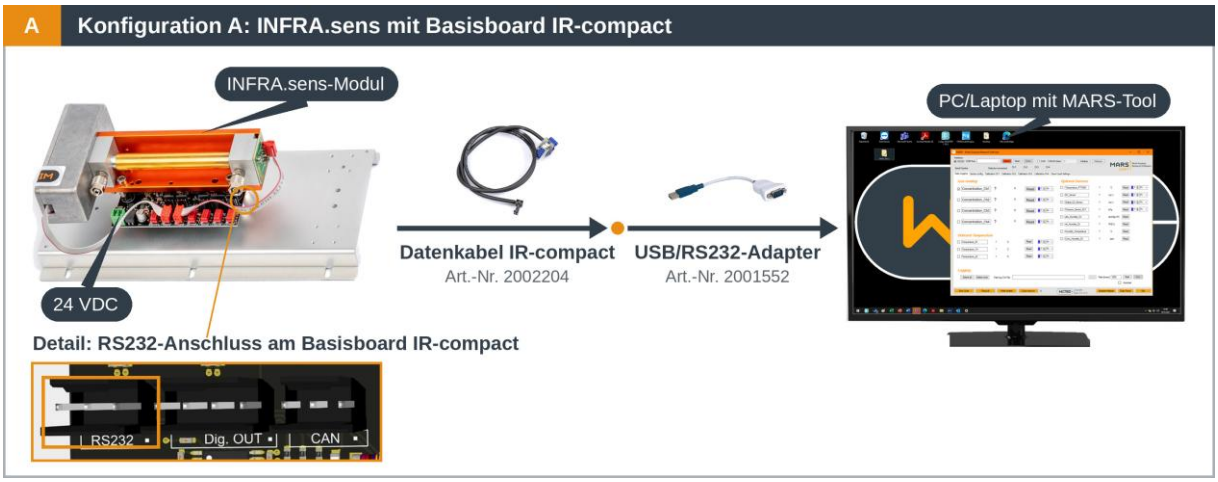


Figure38 : Configuration A: INFRA.sens with IR-compact base board – IR-compact data cable connected to the RS232 port on the base board, USB/RS232 adapter connected to the PC

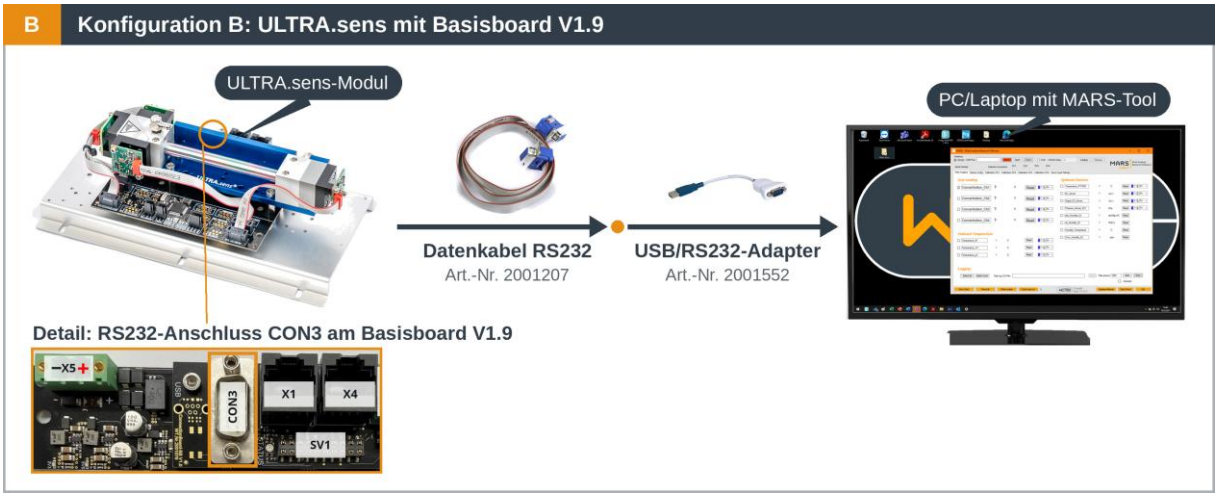


Figure39 : Configuration B: ULTRA.sens with V1.9 base board – RS232 data cable connected to the CON3 D-Sub jack, USB/RS232 adapter connected to the PC

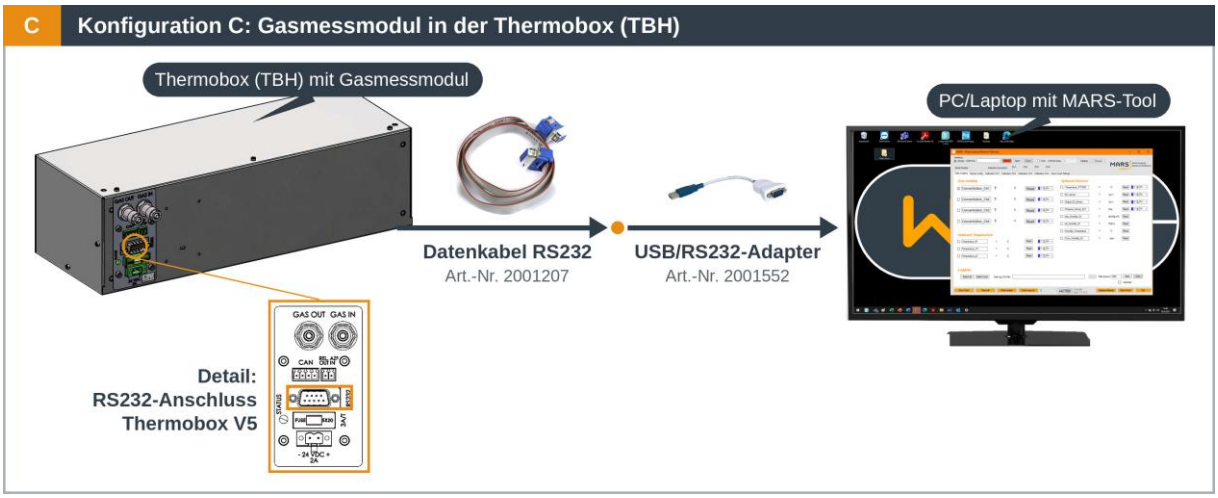


Figure40 : Configuration C: Gas measurement module in the Thermobox (TBH) – RS232 data cable connected to the D-Sub RS232 port on the Thermobox V5, USB/RS232 adapter connected to the PC

9 Software

The MARS®-Tool light software (MARS® = Multi Analysis Research Software) is used to read out measurement values, for data logging, and for calibration on the PC. Operation is described in the separate MARS®-Tool light manual.

9.1 Download and Installation

The latest version of MARS®-Tool light is available for download on the Wi.Tec website: https://www.witec-sensorik.de/downloads/software/. After filling out the form, you will receive the download link via email. A USB flash drive is no longer included.

Figure41 : QR code for the MARS®-Tool light download page

1. Download the software package using the download link.
2. Run the setup file and install MARS®-Tool light on your PC. Administrator privileges are recommended for installation.
3. Connect the USB-RS232 adapter; the corresponding driver must be installed. Check the assigned COM port in Windows Device Manager.
4. Start MARS®-Tool light, select the COM port, and establish a connection to the module.

Prerequisites	Requirements
Operating System	Windows 10 or 11
Interface	USB/RS232 adapter (Part No. 2001552) or CAN-USB adapter (Part No. 2002089)
Cables	RS232 data cable (available by special order only): Part No. 2002204 (IR-compact), 2001207 (V1.9.x and Thermobox), 2000592 (V1.8.x)

Table34 : PC Requirements

9.2 Reading Data Without the MARS® Tool

For simple queries, a terminal program such as HTerm is sufficient. In RS232 mode, the module responds with ASCII characters; the responses are therefore directly readable.

Settings in the terminal program	Value
Interface	COM port of the USB-RS232 adapter
Baud rate	115,200 baud (factory setting)
Data format	8 data bits, no parity, 1 stop bit (8N1)

Table35 : Interface Parameters for a Terminal Program

The commands and response format are described in the communication manual.

For integration into your own control systems (RS232, CAN, Modbus, CANopen), the communication manual describes all commands, registers, the status byte, and the device ID.

10 Calibration

To ensure accurate measurements, the zero point and full-scale point must be checked regularly and adjusted if deviations occur. This chapter describes the gases, procedure, and waiting times. The operating steps on the PC are described in the MARS®-Tool light manual; the commands for your own control systems are described in the communication manual.

10.1 Test and Calibration Intervals

Test	Recommended Interval	Adjust if
Check zero point	Every 24 hours (or automatically with AZF)	Deviation > 2% from the full-scale value
Check endpoint	Weekly	Deviation > 2% from the full-scale value

Table36 : Recommended Test Intervals

The appropriate interval depends on the application, required accuracy, and environmental conditions.

10.2 Zero gas

Gases that do not contain the measured component are suitable as zero gas, e.g., nitrogen (N_2), argon, hydrogen, or purified ambient air. For automatic zero adjustments, we recommend an N_2 cylinder (or another inert gas) with a solenoid valve, e.g., the Auto-Zero function (Chapter 10.7).

Information

The choice of zero gas depends on the measurement gas. Ambient air is suitable only if it does not contain the measurement component. It is unsuitable for CO_2 measurements because it always contains approximately 400–1000 ppm CO_2; in this case, use nitrogen (N_2) with a purity of 2.8, or preferably 5.0.

If the measurement depends on the carrier gas, adjust the zero point channel by channel using the carrier gas for your application (Appendix A.3).

10.3 Test Gas

For endpoint calibration, you need a calibration gas with a known concentration, ideally a certified calibration gas cylinder. The concentration is listed on the label or in the certificate (e.g., 480.00 ppm CO_2). The calibration gas concentration should be close to the upper limit of the measurement range and deviate by no more than 10% from it.

10.4 Zero-point calibration

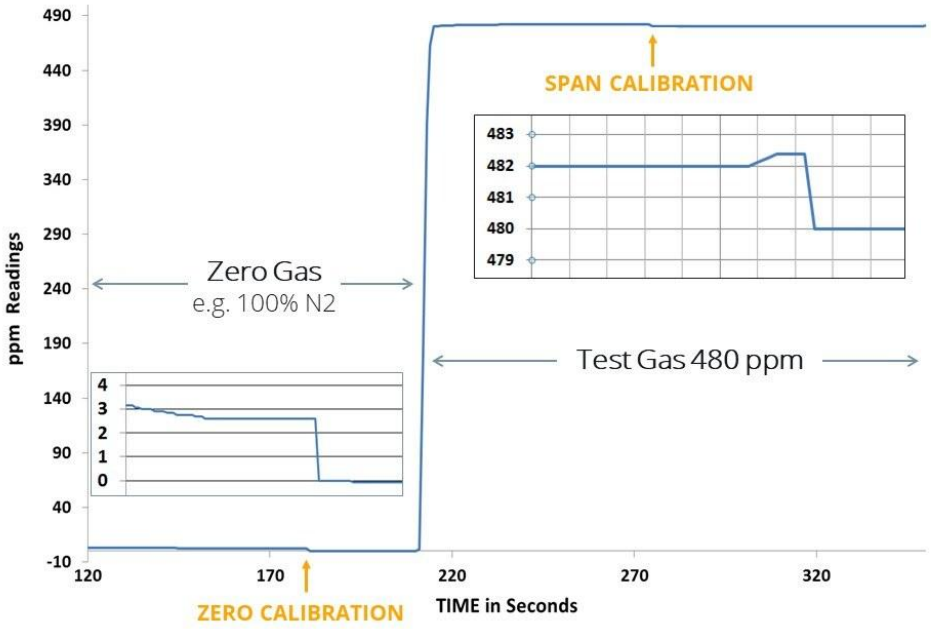


Figure42 : Concentration display curve during zero-point and endpoint calibration

Prerequisite: The module has been operating under stable conditions for at least 30 minutes; heated modules have reached their set temperature.

1. Purge the entire measurement system with zero gas at a flow rate of 1 l/min.
2. Wait until the reading is stable (fluctuation < 1% of the full-scale value).
3. Set the zero point: for all channels simultaneously or channel by channel—using the MARS®-Tool light, via a command through the interface, or with the external zero-point trigger (Chapter 10.6).

✓ **Result:** The concentration display shows 0.00 ppm.

10.5 Endpoint Calibration

Prerequisite: Zero-point adjustment with an inert gas (e.g., N_2) must have been performed immediately prior.

1. Purge the entire measurement system with test gas at a flow rate of 1 L/min.
2. Wait until the reading stabilizes (fluctuation < 1% of the measurement range). For adhering gases such as SO_2 or NO_2, wait longer (Chapter 6.5).
3. Enter the concentration of the test gas for the relevant channel and set the endpoint.
4. Turn off the test gas and switch back to the measurement gas.

✓ **Result:** The reading corresponds to the test gas concentration. The module calculates a correction factor and saves it permanently.

10.6 External Zero Trigger

Without a PC or interface, you can set the zero point via DIO1, the external zero-point trigger: Apply zero gas, allow the display to stabilize, then set DIO1 to Low (GND) for at least 4 seconds. The zero point for all gas channels is set.

10.7 Automatic Zero Adjustment (AZF)

The Auto-Zero function switches to zero gas at adjustable intervals (1 hour to 1 month), purges for a configurable duration, and sets the zero point. The measured value is frozen during purging. AZF is available starting with base board revision 1.8.2 and firmware revision 528. Variants and technical data: Chapter 14.1.

10.8 O2.sens and HUMI.sens

- O2.sens: Zero point (offset) with oxygen-free gas, e.g., N_2; end point with ambient air (20.95 vol.% O_2) or test gas.
- After replacing an O2 sensor, “1.” may appear in the data logging. In this case, the sensor must be reset and recalibrated (O2.sens service manual).

11 Status Messages and Troubleshooting

11.1 Status LED

Meaning of the status LEDs: Chapter 7.8. If LED4 lights up red, the detector signal is below the alarm level (factory setting 50%, adjustable with the MARS® tool). Possible causes and remedies are listed in the fault table (Chapter 11.3).

11.2 Status Byte

The module reports its status via a status byte, which you can read via the interface or in the MARS®-Tool light. It indicates whether the radiation sources are detected and whether their signal level is sufficient.

Bit	Meaning
Bit 0	IR emitter/EDL detected
Bit 2	UV LED 1 detected
Bit 3	UV LED 2 detected
Bit 4	IR emitter/EDL: Signal level too low
Bit 6	UV LED 1: Signal level too low
Bit 7	UV LED 2: Signal level too low
Bit 1, Bit 5	Not used

Table37 : Meaning of the Bits in the Status Byte

Example: CO_2 module without UV cuvette: **0xC7** = IR emitter detected, signal level within normal range (> 50% intensity). **0xCF** = IR emitter detected, signal level below 50%. The complete code table can be found in the communication manual.

11.3 Troubleshooting

Fault	Possible Cause	Solution
No connection to the PC	Wrong COM port, defective cable, RS-232 cable too long, interface set to Modbus	Check the COM port; use the appropriate Wi.Tec data cable (Chapter 14); check the cable length (Chapter 7.4); check the RS232/Modbus DIP switch
LED2 is not flashing	No power or incorrect power supply	Check voltage and polarity (Chapter 7.1)
Measured value drifts	Temperature, pressure, or flow is unstable; condensation; zero point is outdated	Establish conditions as described in Section 8.1; adjust zero point
Measured value fluctuates	Pump pressure pulsation, fluctuating back pressure, interference on the ground	Use a pump without pulsation; check the exhaust line; check the ground connection

Fault	Possible Cause	Solution
Slow response	Hang-up effect, long lines, insufficient flow	Viton/PTFE tubing, shorter lines, increase flow rate (Chapter 6)
LED4 red or signal level < 50% (status byte)	Light source has aged, cuvette is dirty or fogged	Check sample preparation; contact Wi.Tec Service
Lamp not detected (status byte)	Defective lamp or connection	Contact Wi.Tec Service
O2 reading drops sharply	O2.sens has reached the end of its service life (accelerated signal decline)	Replace the sensor element (Chapter 12)
Analog output incorrect	DIP switch or scaling incorrect, output overloaded	Check settings (Chapter 14.2), load ≥ 100 kΩ

Table38 : Faults, Causes, and Remedies

12 Maintenance and Servicing

⚠ WARNING

Toxic gases in the gas path

When working on the gas path, test gas (e.g., H_2S, CO) may escape.

▶ Before any maintenance, flush the gas path and gas outlet with ambient air or nitrogen for at least 10 minutes.

12.1 Maintenance Schedule

Action	Interval	Note
Check and adjust zero point	Every 24 hours or as specified in the AZF	Chapter 10
Check and adjust the endpoint	Weekly	Chapter 10
Check the particulate filter; replace if necessary	Regularly, depending on particulate load	Chapter 6.4
Check the sample gas cooler/condensate drain	Regularly, depending on the application	Appendix A
Leak test	After mechanical modifications to the gas path and after prolonged periods of inactivity; regular testing is not strictly necessary	Chapter 6.6
Replace the O2.sens sensor element	before the end of its service life (typically 1–6 years, Chapter 3.6.1)	Chapter 3.6; trained personnel only

Table39 : Maintenance Schedule

12.2 Replacement of Components

The replacement of components, e.g., the O2.sens sensor element in the Thermobox, is permitted only for trained personnel in accordance with the respective Wi.Tec service manual. Replacement parts: Section 14.3.

13 Service, Returns, and Disposal

13.1 Contact

Wi.Tec-Sensorik GmbH
Schepersweg 41–61
46485 Wesel
Germany
Phone +49 281 206578-20
info@witec-sensorik.de
www.witec-sensorik.de

Please have the serial number and device ID from the nameplate ready when submitting inquiries.

13.2 Returns (RMA)

You can find the RMA form for returns at https://www.witec-sensorik.de/service-retouren/.

Figure43 : QR code for the RMA form (service returns)

1. Fill out the RMA form online.
2. If the module was used to measure toxic or corrosive gases, flush it before shipping. The decontamination declaration is included in the RMA form and must be completed there.
3. Ship the module in its original packaging or with equivalent protection.

13.3 Disposal

The gas detection module is an electronic device and must not be disposed of with household waste. Dispose of it in accordance with local regulations for waste electrical and electronic equipment (WEEE).

For a fee, Wi.Tec will accept returns of gas detection modules and dispose of them properly. Please contact us regarding this (Chapter 13.1); returns are processed via the RMA form (Chapter 13.2).

! NOTE

Disposal of the O2.sens

The electrochemical O2 sensor contains a liquid electrolyte. Wi.Tec does not accept returns of used O2 sensors.

- Dispose of used O2 sensors yourself in accordance with local regulations.
- Do not open the sensors.

14 Accessories and Options

14.1 Auto-Zero Function (AZF)

The AZF is integrated into the module's gas line and automatically performs zero-point calibration (Chapter 10.7). Models with a pump (VP) draw in ambient air as zero gas; models with two valves (VV) switch between the zero gas cylinder and the process gas. With an integrated pressure sensor (P.sens), the AZF also handles pressure compensation.



Figure44 : Auto-Zero Function VP

Model	WT No.	Function
AZF eVP	2001469	Valve/Pump; External 24 V Control
AZF VP	2001467	Valve/Pump; Controlled by the module, adjustment via MARS® tool
AZF VPP	2001149	Valve/Pump/Pressure Sensor (800–1,200 mbar); controlled by the module
AZF eVV	2001470	Valve/Valve; externally controlled, 24 V
AZF VV	2001468	Valve/Valve; controlled by the module, adjustment via MARS® tool
AZF VVP	2001435	Valve/Valve/Pressure sensor (800–1,200 mbar); controlled by the module

Table40 : Variants of the Auto-Zero Function

Feature	AZF VP	AZF VV
Dimensions (H × W × L)	36 × 86.5 × 75 mm (height with piping approx. 60 mm)	Same as VP
Weight	150 g	150 g
Hose connection	4/6 mm	4/6 mm
Zero-point response time	approx. 15 s (depending on flow rate and concentration)	approx. 15 s
Pressure drop	25 mbar at 1 l/min	25 mbar at 1 l/min
Pump	0.35 L/min of blank gas, 300 mbar outlet pressure	–
Valve Kv value	0.1 m³/h (20 °C, 1 bar)	0.1 m³/h

Feature	AZF VP	AZF VV
Materials in contact with the medium	EPDM/PPS; anodized AlMg4.5Mn block	Same as VP
Leak rate	< $1 \cdot 10^{-4}$ mbar·l/s	< $1 \cdot 10^{-4}$ mbar·l/s
Power supply	15–30 VDC; 5 mA (passive), 90 mA (active) (at 24 VDC)	Same as VP
Digital input	2–3 V	2–3 V
Operating temperature / Storage temperature	5–55 °C / −20–60 °C	Same as VP
Atmospheric pressure / Humidity	800–1,200 mbar / 0–95% relative humidity, non-condensing	Same as VP

Table41 : Technical Specifications of the Auto-Zero Function

Information

A safety filter is recommended at the zero gas inlet.

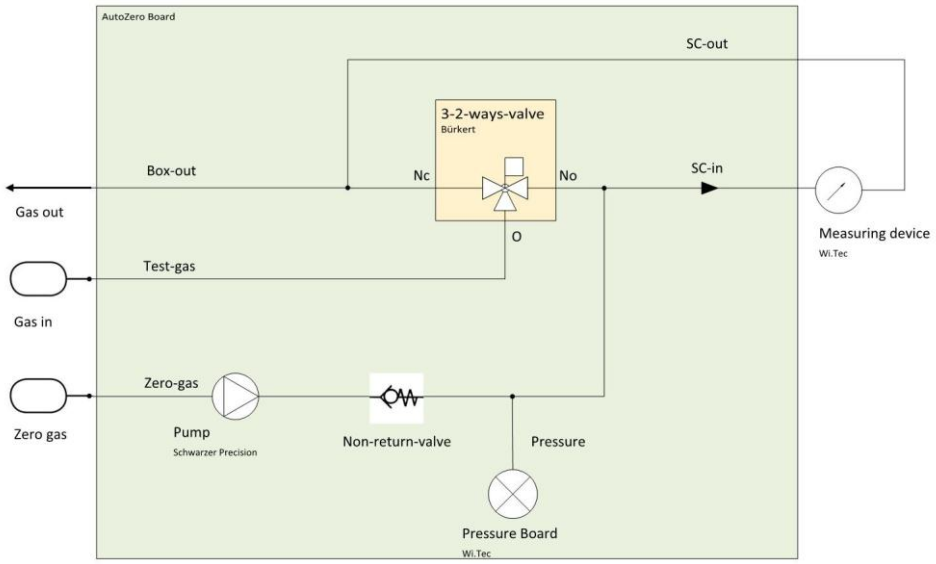


Figure45 : AZF VP Gas Schematic

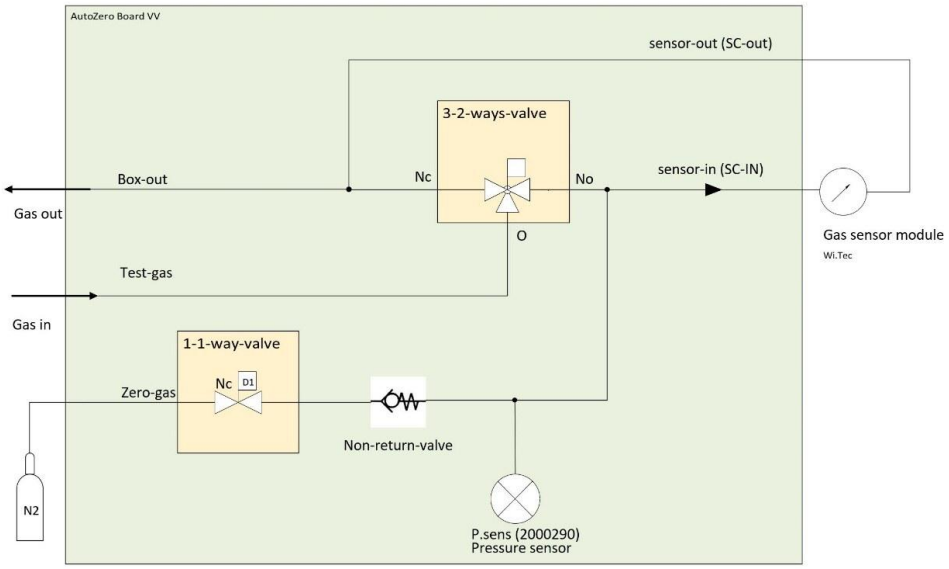


Figure46 : AZF VV gas wiring diagram

14.1.1 Connecting an External AZF to the Thermobox

The AZF eVP and AZF eVV variants are controlled externally with 24 V. On the Thermobox, the relay output REL. AZF/Pump switches the power supply to the AZF (Chapter 7.3.5). The wiring is shown in the following figure.

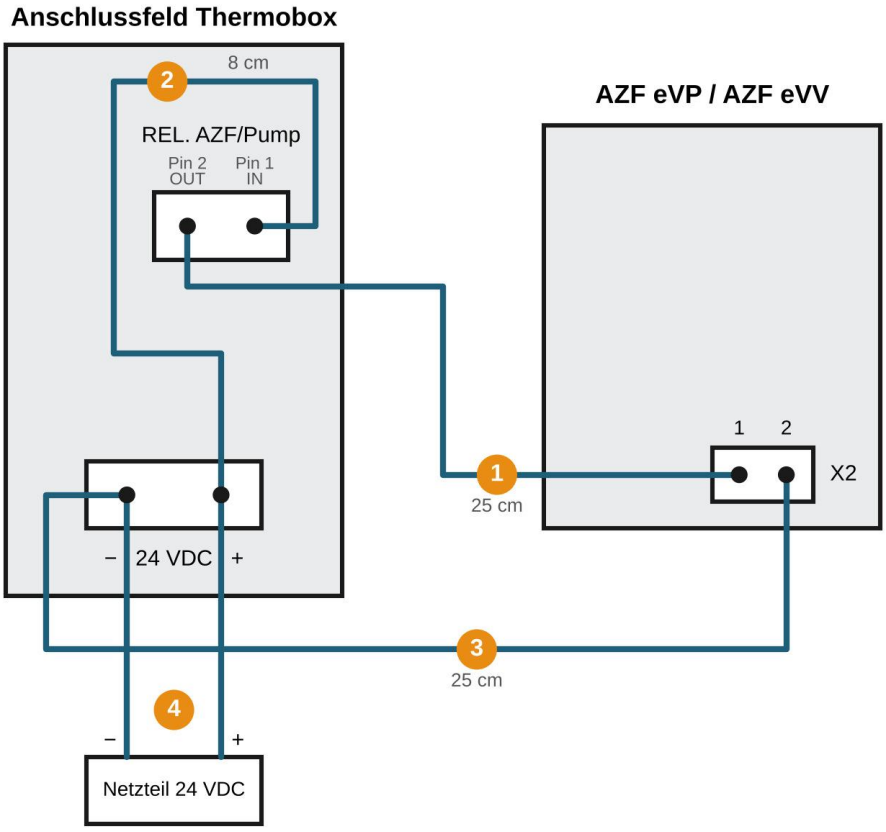


Figure47 : Connecting an AZF eVP/eVV to the Thermobox V5 (schematic)

No.	Cable	Length	Connection
1	Control wire	25 cm	REL. AZF/Pump Pin 2 (Load OUT) → AZF X2 Pin 1
2	Jumper	8 cm	24 VDC + → REL. AZF/Pump Pin 1 (Load IN)
3	Return line	25 cm	AZF X2 Pin 2 → 24 VDC −
4	Power supply	–	24 VDC power supply → 24 VDC connection on the Thermobox

Table42 : Wires for connecting the AZF to the Thermobox

Information

The connection cable (wires 1 through 3) is also available pre-assembled from Wi.Tec: Part No. 2004181.

14.2 Analog Output

The analog output board supplements the digital interfaces with 4 voltage outputs. It is connected to the base board via connector SV1; J1 is the output, and S1 is the DIP switch for the voltage range.

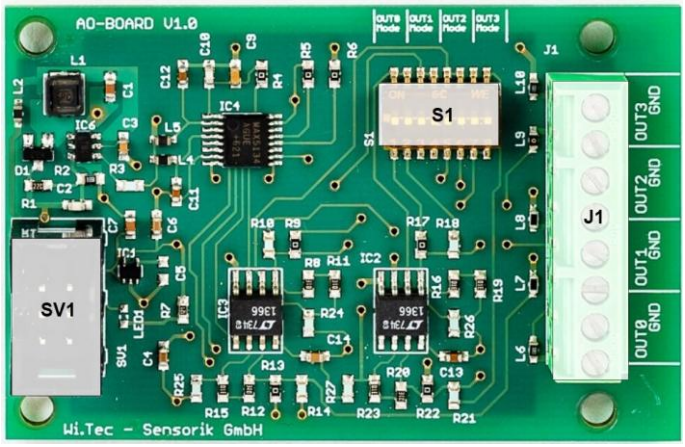


Figure48 : Analog output board with DIP switch S1 and output J1

Output	Gas channel
OUT0	Gas CH1
OUT1	Gas CH2
OUT2	Gas CH3
OUT3	Gas CH4

Table43 : Analog Output Assignment

Channel	DIP switch S1	0–2 V	0–5 V	0–10 V
CH1	Switch 1 / 2	1 / 0	0 / 1	0 / 0
CH2	Switch 3 / 4	1 / 0	0 / 1	0 / 0
CH3	Switch 5 / 6	1 / 0	0 / 1	0 / 0
CH4	Switch 7 / 8	1 / 0	0 / 1	0 / 0

Table44 : Setting the Voltage Range per Channel

! NOTE

Overloading the Analog Outputs

The outputs are not current-limited. Excessive load current will destroy the output driver.

- Maximum continuous current: 10 mA; minimum load resistance: 100 kΩ.

Wi.Tec sets the scaling (e.g., 0–6,000 ppm = 0–10 V) at the time of shipment. It can be changed later using the MARS® Tool (MARS® Tool light manual).

Feature	Value
Connection	6-pin ribbon connector to the base board
Communication	SPI
Outputs	4
Voltage range	0–2 V, 0–5 V, or 0–10 V (DIP switch)
Resolution	16 bits
Min. load resistance	100 kΩ
Update	1 s
Dimensions	65 × 42 mm
Conductor cross-section	AWG 16–30 (1.31–0.051 mm²)
Ambient conditions	0–60 °C, < 80% relative humidity

45 Table: Technical Specifications for Analog Output

14.2.1 Output from HUMI.sens and O2.sens (optional)

Starting with firmware version 5.496, the measured value from a HUMI.sens or O2.sens can be routed to an analog output. Which output is used for this depends on the module type. The gas channel that is normally connected to this output is then no longer output as an analog signal.

Module Type	OUT0	OUT1	OUT2	OUT3
INFRA.sens	Gas-CH1	Gas-CH2	Gas-CH3	**HUMI.sens [ppm] or O2.sens [vol.%]**
ULTRA.sens	Gas-CH1	**HUMI.sens [ppm] or O2.sens [vol.%]**	Gas-CH3	Gas-CH4
KOMBI.sens	Gas-CH1	Gas-CH2	Gas-CH3	Gas-CH4

Table46 : Assignment of analog outputs to external sensors by module type (orange = HUMI.sens/O2.sens)

With the KOMBI.sens, the analog output for HUMI.sens and O2.sens is not available. Only one additional sensor is output analog at a time; if both HUMI.sens and O2.sens are present, please contact Sales to determine which one will be output.

Scaling: By default, the full voltage range (0–10 V, 0–2 V, or 0–5 V, depending on DIP switch S1) corresponds to the following measurement ranges:

Additional sensor	Standard scaling	Example for 0–10 V
HUMI.sens	0–30,000 ppm H_2O	15,000 ppm = 5 V
O2.sens	0–25 vol.% O_2	20.9 vol.% (air) ≈ 8.4 V

Table47 : Standard scaling of the auxiliary sensors at the analog output

The scaling can be changed in the MARS® tool: In the **Config_CH4** (INFRA.sens) or **Config_CH2** (ULTRA.sens) tab, enter the new range under **"Measurement Range Ch4**" or **"Ch2**" and apply the change by clicking **"Write**."

Assigning O2.sens: To route the O2.sens to the analog output, the corresponding measurement type in the Device ID must be set to "External Sensor":

Module Type	Setting in the MARS® tool (Ext. Sensors tab)
INFRA.sens	Measurement Type 4 = External Sensor, then Write
ULTRA.sens	Measurement Type 2 = External Sensor, then Write

Table48 : Assigning O2.sens to the analog output via the Device ID

Information

The operation of the MARS® Tool is described in the separate MARS® Tool light manual.

14.3 Additional Accessories and Replacement Parts

Item	Part No.	Note
24 VDC plug-in power supply for base board V1.8.x, V1.9.x, and Thermobox	2003262	60 W; 100–240 VAC, 50/60 Hz; 2.5 A
24 VDC plug-in power supply for IR-compact V2.0.x base board	2003137	60 W; 2.5 A at 24 V; 100–240 VAC, 50/60 Hz
USB/RS232 adapter	2001552	Chapters 8.2, 9
AZF cable for external version (AZF eVP/eVV) to Thermobox	2004181	Chapter 14.1.1
CAN-USB adapter	2002089	
Adapter plug for CAN-USB adapter, D-Sub 9 to RJ45	2002127	
CAN bus data cable for IR-compact base board, connects directly to CAN-USB adapter	2002205	
RS232 data cable for IR-compact V2.0.x base board	2002204	Available by special order only
RS232 data cable for V1.9.x base board and Thermobox	2001207	Available by special order only
RS232 data cable for base board V1.8.x	2000592	Available by special order only
Particle filter < 0.1 µm with 4/6 mm hose connection, stainless steel fittings	2002325	

Item	Part No.	Note
Particle filter < 0.1 µm with 4 mm pipe fitting, stainless steel fittings	2003570	
O2.sensD Replacement Parts Kit	2003884	Digital O2 sensor
O2.sens Replacement Parts Kit	2003885	Analog O2 Sensor
O2.sensD torque wrench with adapter	2003941	Tool for sensor replacement
O2.sens torque wrench with adapter	2003950	Tool for sensor replacement
O2.sens Cable Set	2003539	

49 : Accessories and Replacement Parts

15 Technical Data

The table lists general data. The specifications in your module's data sheet are authoritative.

Feature	INFRA.sens	INFRA.sens compact	ULTRA.sens
Measurement Principle	NDIR, 2–12 µm	NDIR, 2–12 µm	NDUV, 200–450 nm
Power Supply	24 VDC (per base board)	24 VDC (9–30 V)	24 VDC (15–30 V)
Current consumption	< 300 mA	< 50 mA	< 100 mA
Power consumption	< 9 W	< 1 W	< 3 W
Warm-up time	< 15 min; with heater, approx. 30 min (starting at 25 °C)	< 15 min; with heater, approx. 30 min (starting at 25 °C)	< 15 min; with heater, approx. 30 min (starting at 25 °C)
Dimensions (W × H × D)	350 × 75 × 120 mm	per cuvette, see data sheet	353 × 81.5 × 120 mm
Weight	approx. 600–1,200 g	see data sheet	approx. 720 g
Ambient conditions	5–45 °C, < 95% relative humidity, non-condensing	Same as INFRA.sens	Same as INFRA.sens
Flow rate	0.1–1.5 L/min (calibrated 0.7–1 L/min)	Same as INFRA.sens	Same as INFRA.sens
Gas connection	4/6 mm hose, Viton or PTFE	Same as INFRA.sens	Same as INFRA.sens
Interfaces	RS232, CAN; optional Modbus RTU, analog output	RS232, CAN; optional analog output	RS232, CAN; optional Modbus RTU, analog output
PC Requirements	Windows 10/11	Windows 10/11	Windows 10/11

Table50 : General Technical Specifications

Appendix A – Application Notes

A.1 Sample Preparation

A stable measurement requires dry, particle-free measurement gas at a constant pressure and flow rate (Chapter 6.4). Typical setup: Gas sampling → Particle filter → Measurement gas cooler → Pump → Flow meter → Gas measurement module → Exhaust gas.

A.2 Corrosive Gases

For corrosive gases such as Cl_2, H_2S, or high SO_2 concentrations, use the processline version (stainless steel 1.4571, optionally with Silcolloy® 2000 or SilcoNert® 2000, Chapter 4.4) and stainless steel or PTFE tubing.

A.3 Carrier Gas Dependency

The composition of the carrier gas can affect the reading. Adjust the zero point channel by channel using the carrier gas for your application.

A.4 Cross-Sensitivities

- NDUV: Water vapor, CO_2, and hydrocarbons do not interfere.
- NO_2 exhibits cross-sensitivity to the SO_2 measurement; this is compensated for during simultaneous NO_2 measurement.
- O2.sens: For the influence of carrier gases, see Section 3.6.

Appendix B – Declaration of Conformity

Wi.Tec-Sensorik declares the following for the supplied gas measurement modules (Supplier's Declaration, as of August 5, 2026):

Regulatory Framework	Declaration
RoHS – Directive 2011/65/EU, including (EU) 2015/863	The limit values specified in Annex II are complied with without invoking any exemptions under Annexes III and IV.
REACH – Regulation (EC) No. 1907/2006	No restricted substances as listed in Annex XVII, no substances subject to authorization as listed in Annex XIV; SVHCs on the Candidate List (as of February 4, 2026) do not exceed 0.1% (w/w).
POP – Regulation (EU) 2019/1021	No substances listed in Annex I above the threshold values.
Conflict Minerals – Regulation (EU) 2017/821	Tin, tantalum, tungsten, and gold do not originate from conflict-affected or high-risk areas; due diligence conducted in accordance with the OECD Guidelines.
Packaging	Heavy metal limit of 100 ppm (total Pb, Cd, Hg, Cr VI) complied with.

Table51 : Declared Substance Compliance

The signed declaration is available upon request (contact information in Chapter 13).

Appendix C – Glossary and Abbreviations

Term	Meaning
AK	Analytical cuvette; the number indicates the length in mm (e.g., AK250 = 250 mm)
AZF	Auto-Zero function, automatic zero adjustment
Base board	Evaluation electronics of the gas measurement module
CH1–CH4	Gas measurement channels 1 through 4
Device ID	Identifier for the channel configuration (gas type and measurement method per channel)
EC	Electrochemical
EDL	Electrodeless Discharge Lamp, electrodeless gas discharge lamp
ESD	Electrostatic Discharge
Gas measurement module	Generic term for INFRA.sens, ULTRA.sens, KOMBI.sens, etc.
Calibration	Adjusting the measuring device so that the reading corresponds to the setpoint
Calibration	Determining the deviation between the reading and the setpoint without intervention
MBEW (F.S.)	Full-scale range
MEMS	Micro-electromechanical system
NDIR / NDUV	Non-dispersive infrared or ultraviolet absorption
Blank gas / Test gas	Gas without a measurable component / Gas with a known concentration
P.sens	Pressure sensor
RMA	Return Merchandise Authorization, return number
WLD	Thermal Conductivity Detector