Operating instructions

Gas analyzer

TCD3000 Si

1000-2150-0007-0500
17.10.2024

Contents

1 Preliminary remark

These instructions contain all the necessary details for installation, connection and commissioning as well as important information on maintenance, troubleshooting and user safety. Please read these instructions carefully before commissioning and keep them as part of the product so that they are always easily accessible.

The operating instructions are intended for trained specialist personnel and must be made available to them. All information in this manual applies exclusively to devices with the hardware and firmware versions specified herein. The manufacturer reserves the right to change hardware, firmware, or documentation without prior notice.

These operating instructions apply to the following appliance versions:

- **Type**: TCD 3000 Si
- **Hardware-Version**: 1010-0000-0001-0010
- **Software version**: 0.526
- **Manufacturer**: Archigas GmbH
  Eisenstraße 3
  65428 Rüsselsheim am Main
  Germany

1.1 Symbols used

	Attention, notes on possible dangers
	Additional information and useful tips.
	Caution! Hot surface - risk of burns! Wear protective gloves.
CE	The CE mark indicates that the appliance complies with the EU directives for safety, health protection and environmental protection.

2 Safety instructions

- **Authorised specialist personnel:** All work on and with the appliance may only be carried out by trained specialist personnel authorised by the system operator.
- **Personal protective equipment**: Always wear suitable personal protective equipment when working on the appliance. Despite good workmanship, there is a risk of cutting, so protective gloves are required. Heat protection gloves should be worn due to possible increased surface temperatures. Safety goggles are also required to protect against flying parts caused by residual pressure in the pipe.
- **Intended use:** The device may only be used in accordance with the information in the operating instructions and for the intended applications and ambient conditions.
- **System responsibility:** When integrated into a system, the system manufacturer is responsible for safety and must prepare a risk assessment and the corresponding documentation.
- **Technical standards:** The appliance complies with the current technical standards and regulations and may only be operated in a perfect and safe condition.
- **Property damage and personal injury:** Improper use, incorrect installation or settings can lead to property damage, personal injury or environmental damage.
- **Avoidance of tampering:** Any interventions beyond the described operations may only be carried out by authorised personnel of the manufacturer. Unauthorised modifications are prohibited.
- **Safety markings:** Safety labels and instructions affixed to the appliance must be observed.
- **Protection against damage:** Devices and cables must be effectively protected against damage.
- **Permitted media:** The appliance may only be used for the media specified in the technical data**.**
- **Documentation:** These operating instructions must be read before commissioning the product and kept for the entire period of use.

3 Conformities

The appliance complies with the legal requirements of the relevant EU directives. The CE marking confirms the conformity of the appliance with these directives.

3.1 EU directive conformity

The declaration of conformity can be downloaded from the product page on the Internet. The following directives are fulfilled:

- **2014/30/EU (EMC Directive):** Directive on the harmonisation of the laws of the Member States relating to electromagnetic compatibility
- **2014/35/EU (Low Voltage Directive):** Directive on the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits
- **2011/65/EU (RoHS Directive):** Directive on the use and placing on the market of hazardous substances in electrical and electronic equipment

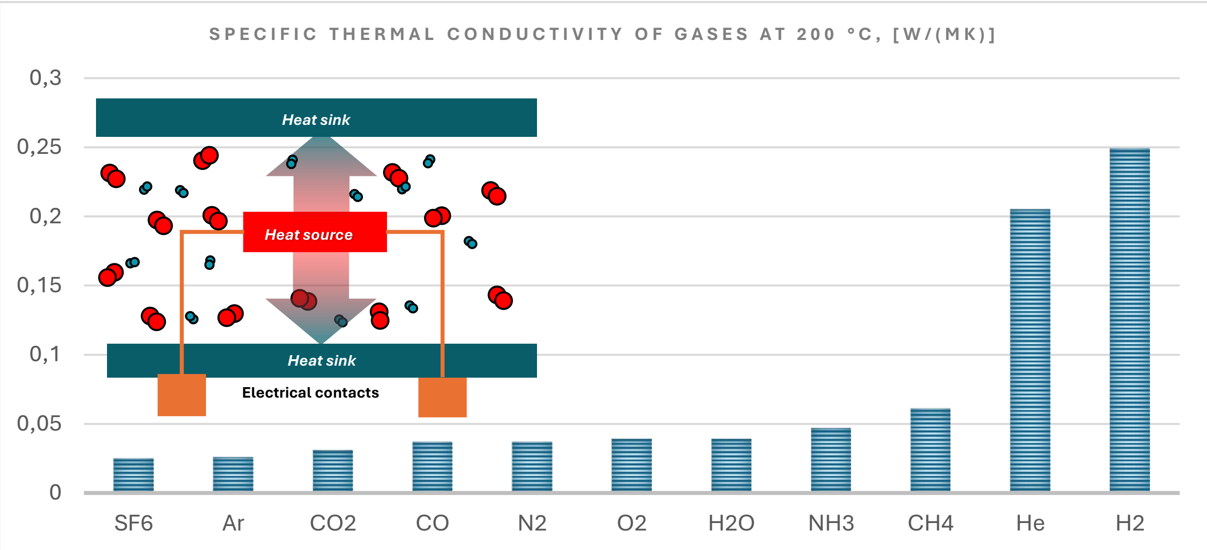
3.2 Namur recommendation

The following recommendation of the standardisation working group for measurement and control technology in the chemical industry (NAMUR) is observed:

- **NE 21**: Electromagnetic compatibility of process and laboratory equipment
- **NE 43**: Signals for transducer faults

4 Product description

The TCD3000 gas analyser uses the principle of thermal conductivity. This method is based on the different ability of gases to conduct heat. The TCD3000 is equipped with a micromechanical sensor that contains an integrated heat source and a sink. As the gas sample flows through, the temperature difference between the source and the sink is measured, which is directly proportional to the thermal conductivity of the gas.



Gases such as hydrogen (H_2) and helium (He), which have the highest thermal conductivity values, can be detected particularly well with the TCD3000. This enables extremely sensitive and accurate determination of their concentrations. The micromechanical sensor offers a fast response time and high precision.

The TCD3000 is suitable for binary gas mixtures consisting of two different gases as well as for quasi-binary gas mixtures. In the case of quasi-binary gas mixtures, the carrier gas either consists of a constant ratio of many gases, such as air, or it is two or more gases with very similar or identical thermal conductivities that are recognised as one gas for the measurement, such as O_2 and H_2O or N_2 and CO.

4.1 Scope of delivery

The scope of delivery consists of:

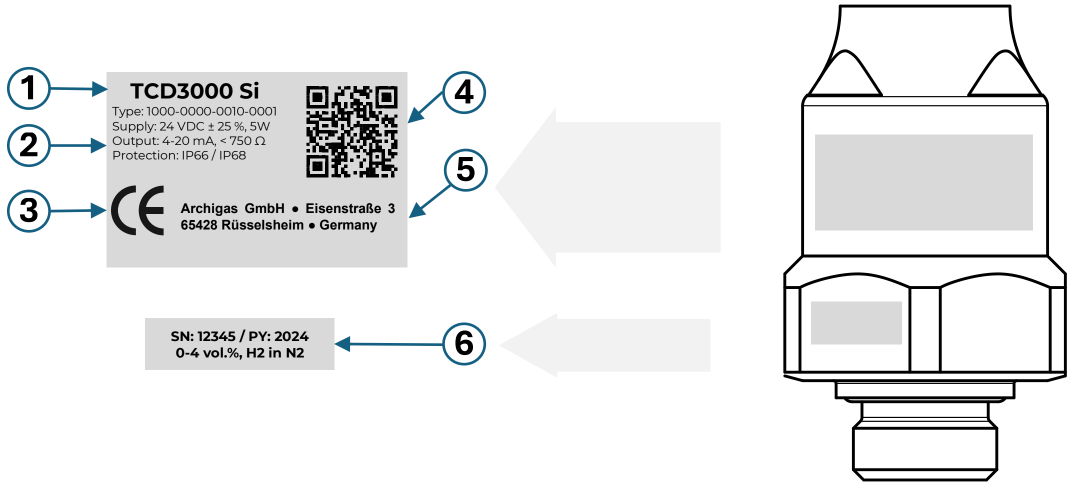
- TCD 3000 Si gas analyser with 3 metre fixed connection cable

Also included in the scope of delivery:

- Calibration certificate for the gas analyser
- Further certificates and accessories, if applicable

4.2 Type plate

The most important information for identifying and using the appliance can be found on the rating plate.



1. Device type,
2. Technical details
3. CE labelling
4. QR code - link to manufacturer's website
5. Manufacturer and place of manufacture
6. Serial number and measuring range

4.3 Area of application

The TCD 3000 Si is suitable for measuring binary and quasi-binary gas mixtures in harsh industrial environments. The most common applications are the monitoring of hydrogen concentration, the control of gas mixtures and the monitoring of gas purity.

The device is suitable for use under high pressure, high humidity and even condensing conditions. It can be used in dynamic areas with very high flow rates as well as in static areas. This allows the device to be used directly in the process without the need for sample preparation.

⚠ Ensure that the device is only exposed to moisture or condensation when powered on. Before shutting down the device, all moisture and condensation residues must be cleared from the process line. **Operating the device in a damp environment while powered off may result in damage or destruction of the device.**

⚠ The TCD3000 Si gas analyzer is not suitable for explosive gas mixtures. For this purpose, exclusively use the TCD3000 SiA.

ⓘ Please refer to the chapters "Specifications" and "Pressure and humidity dependency and compensation" for the exact operating ranges and necessary measures for pressure or humidity compensation.

4.4 Packaging, transport and storage

During transport to the place of use, your appliance has been secured with protective packaging that can withstand the typical transport stresses. The packaging of the device is made of environmentally friendly cardboard and is recyclable. Please dispose of the packaging material in accordance with local regulations.

Upon receipt of the delivery, an immediate inspection for completeness and possible transport damage is required. Any transport damage or concealed defects found must be dealt with accordingly. The packages should be sealed and stored in accordance with the external installation and storage markings until installation.

Unless otherwise specified, packages should only be stored under the following conditions:

- Do not store outdoors
- Store in a dry and dust-free place
- Do not expose to aggressive media
- Protect from sunlight
- Avoid mechanical shocks
- Storage and transport temperature according to chapter "Specifications - Ambient conditions"

5 Assembly

Remove the device from its packaging shortly before installation and carefully inspect it for any damage. Before installation, visually check the sealing points to ensure the device is leak-proof and in perfect condition. Do not use a damaged device, as this may compromise the safety and functionality of the system.

Ensure the system is pressure-free before installing or removing the device to avoid the risk of injury or damage.

The device may become hot during operation and remain so for an extended period after shutdown. Wear appropriate protective gloves to prevent burns when touching or working on the device.

Screw the TCD 3000 Si directly into the process gas line. Use a 41 mm wrench and a torque of 25 Nm to securely fasten the device to the process line. Avoid twisting the device by the cable entry during installation to prevent damage.

After installation, inspect the device again for potential damage and ensure the connection is leak-proof.

The device is designed to be non-serviceable by the customer. Opening the device may void the warranty and compromise safety standards.

5.1 Removal Steps

Before removal, it is crucial to be aware of potentially hazardous process conditions, such as pressure in the container or pipeline, high temperatures, or the presence of aggressive or toxic substances.

Removal should only take place when the system is de-energized.

To remove the device, follow the steps outlined in the "Assembly" and "Electrical Installation" sections in reverse order.

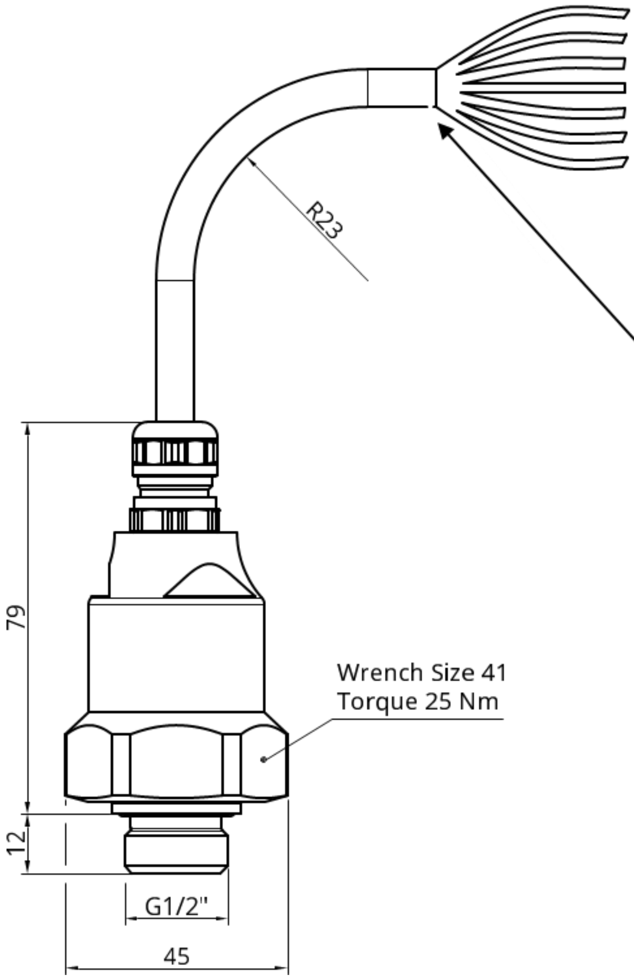
6 Electrical connection

The installation of the device must only be carried out by qualified personnel. All relevant national and international regulations for electrical installations must be followed.

The analyzer comes with a permanently attached 3-meter connection cable (Ø 5.7 mm). The device is designed for fixed installation.

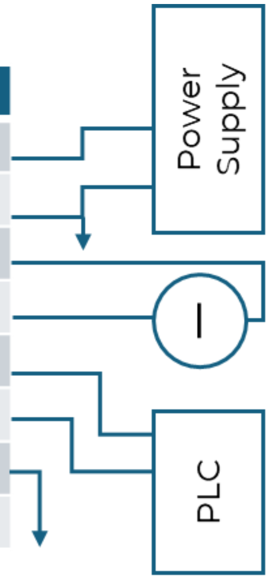
Before beginning work, ensure that the system is de-energized. The supply voltage must comply with SELV (Safety Extra-Low Voltage) or PELV (Protected Extra-Low Voltage) requirements to ensure operational safety.

The TCD3000 Si meets EMC requirements according to NAMUR NE21 and EN 61326-1 standards. The device must be properly grounded to ensure electrical safety and to minimize electromagnetic interference. Grounding is achieved through the shield wire, which should be connected to the power supply ground.



cable colour	cable colour	Signal
	Pink	Supply +24 ±25% VDC
	Blue	GND
	Grey	GND
	Green	4-20 mA, <750 Ω
	Brown	RS485, B
	White	RS485, A
Shield	Shield	must be connected to GND
	Yellow	*Supply +24 ±25% VDC

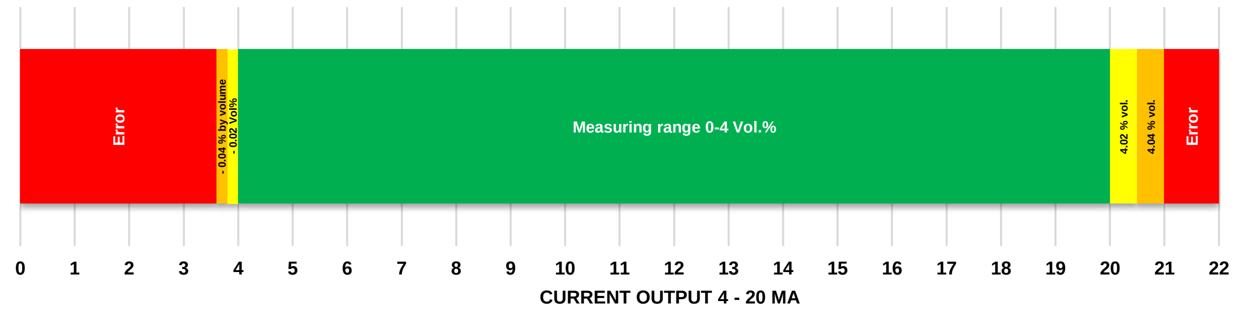
*The yellow wire is an additional 24-V connection that can be used when the power supply over a long distance is required. Please insulate the connection if it is not being used.



7 Analogue output

The 4 - 20 mA output of the TCD3000 Si is designed in accordance with the NAMUR NE 43 standard to take various diagnostic ranges into account.

The current output is adjusted according to the following rules. A measuring range of 0 - 4 vol.% is shown below as an example:



Current range mA	Meaning	Customisation
≤ 3.6	Fatal error / connection error	Output to 3.6 mA
3.6 - 3.8	Low priority Error / maintenance	Output to 3.8 mA
3.8 - 4.0	Measuring range undershot	none
4.0 - 20.0	Measuring range	none
20.0 - 20.5	Measuring range exceeded	none
20.5 - 22.0	Low priority Error / maintenance	Output to 20.5 mA
≥ 22.0	Serious fault / short circuit	Output to 22 mA

8 Serial communication

Using simple commands, you can control the device, set parameters and query important information. Communication can take place either with a PLC control unit or a computer via a USB/RS485 converter.
The TCD3000 Si communicates via the RS485 output with a differential output voltage of 3.3 V. To establish the connection correctly, you should use the following parameters for the serial port:

COM port	Current port number
Speed	38.400
Data	8 bit
Parity	none
Stop bits	1 bit
Flow control	none

Please note that for serial communication via PC, you will need to use a serial terminal or monitoring software. PC software is not included with the product and is outside the scope of our support. Any liability arising from the use of third-party software rests solely with the customer.

8.1 Basic commands

Each command begins with the address of the device, by default **A**, followed by the actual command:

Command	Description and explanation	Example
<address>?	Requests information about the device, including firmware version, serial number and device status.	A?
<address>!	Requests the device to send the current measurement data.	A!
<address>LA@<password>	Administrator login. Enables access to extended rights for configuring and managing the device. The default administrator password is 119977.	ALA@119977
<address>LU@<password>	User login. Switches to user mode, in which only the measured values can be called up.	ALU@123
<address>CP@<new password>	Changes the device password to the specified new password. The password consists of six digits (0-9). Administrator access required.	ACP@123456
<address>CA@<address A-Z>	Changes the device address to the specified new address. Administrator access required.	ACA@B
<address>CR@<value 1-5>	Switches between preset measuring ranges. Up to five measuring ranges can be defined. Administrator access required.	ACR@3
<address>C4mA@<value>	Changes the measuring range to a 4 mA standard value that corresponds to a specific range value in ppm. Administrator access required.	AC4mA@0
<address>C20mA@<value>	Changes the measuring range to a 20 mA standard value that corresponds to a specific range value in ppm. Administrator access required.	AC20mA@40000
<address>MA	Sets the analyser to maintenance mode, in which the device is put into or taken out of maintenance mode.	AMA
<address>O@<value>	Starts the offset calibration and sets the calibration gas (value in ppm) for the calibration. Administrator access required.	AO@0
<address>S@<value>	Starts the span calibration and sets the calibration gas (value in ppm) for the calibration. Administrator access required.	AS@40000

8.2 Feedback

After switching on, restarting the device or entering the command **<address>?** or **<address>LA@<password>** or **<address>LU@<password>** or **<address>CA@<A-Z**>, the following information is displayed:

Example:

A; 199; 526; 240804; 240101; 123; 0x0000:0x01

Explanation:

A	Device address
199	Serial number
526	Firmware version
240804	Parameter version
240101	Date of manufacture YYMMDD
123	Operating hours
0x0000	Device status
0x01	Command status

The following information is displayed for the commands **<address>!**, **<address>O@<value>, <address>S@<value>, <address>S** or **<address>CR@<1-5**>:

Example:

A; 199; 600.000; 0; 4.000; 0x0000:0x01

Explanation:

A	Device address
199	Serial number
600.000	Measured value in millivolts
0	Concentration in ppm
4.000	Current output value in mA
0x0000	Device status
0x01	Command status

8.3 Device status

The device status is displayed through four status registers in hexadecimal form. A status register can contain several bits and, depending on the status of the device, several status bits can be set simultaneously. This means that the analyser can have several statuses at the same time.

Status register	Description
X001	The analyser is in user mode. The measured values can only be called up, changes to the configuration are not possible.
X010	The analyser is in administrator mode. Advanced functions such as calibration and configuration are activated. Access is automatically cancelled after one hour or after a restart.
X100	The analyser is in expert mode. All management and configuration functions are available. This mode is only accessible to the manufacturer.
0XXX	The analyzer is operational. There are no errors or restrictions, and the device is ready to perform measurements.
1XXX	The analyser is in maintenance mode. A calibration is being carried out or is in preparation. During this time, normal operation is restricted. The current output is set to 3.8 mA.
2XXX	The analyzer indicates that it is outside the permissible measurement range. Measurements may be inaccurate, and a calibration or adjustment of the measurement range may be required.
4XXX	The analyzer indicates that the current temperature does not match the set temperature. Measurements can only be performed once the temperature is within the acceptable range.
8XXX	The analyzer is in a fault condition. There is an issue that requires inspection or maintenance before the device can be used again

Examples:

- If the analyser is in user mode (0x0001) and simultaneously in an error state (0x8000), the status code is displayed as the sum of these two values: 0x8001.
- If the analyser is in maintenance mode (0x1000) and administrator mode (0x0010) and the temperature is not yet in the desired range (0x4000), the combined status is 0x5010.

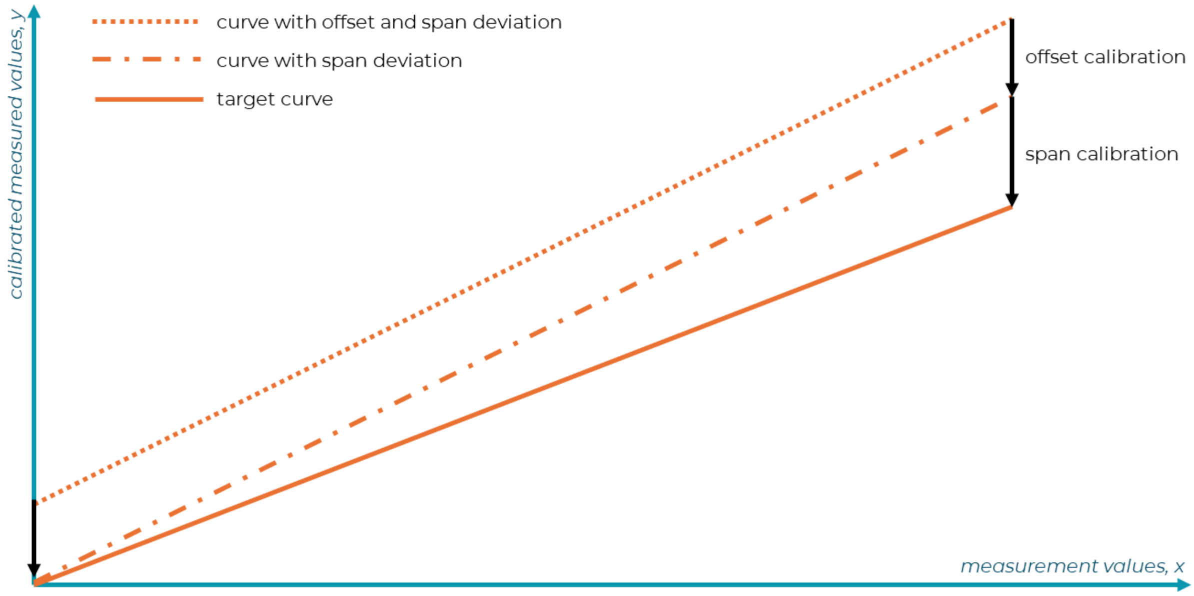
8.4 Command status

The command status register shows the current status of the execution of a command in hexadecimal form. No combinations of status codes can occur, as each command only has one unique status feedback.

Status register	Description
01	The command was executed successfully. No errors occurred and the desired operation was completed.
02	The command was rejected. The user does not have sufficient rights to execute the command.
03	There was an error executing the command. The command could not be processed, possibly due to an error in the format or other problems.
04	The command was denied. The entered parameter is outside the acceptable range, and the command could not be processed.
05	The command was not executed. No matching command was found in the command list, possibly due to incorrect input.
06	Calibration was aborted. The deviation between the measured value and the calibration gas was too large, preventing calibration from continuing.

9 Calibration

The analyser can be set to maintenance mode to perform calibration safely. This freezes the current output at 3.8 mA and prevents malfunctions during operation. Maintenance mode can be deactivated after calibration using the same command to return the analyser to normal operation.



The measuring device uses a linear function to precisely align the normalized and linear concentration measurement with the measurement range:

$y = m \cdot x + b$

Where:

- y: the calibrated concentration measurement,
- m: the slope of the calibration line (also called Span),
- x: the uncalibrated concentration measurement,
- b: the shift of the measurement along the Y-axis (also known as Offset).

This device uniquely stores calibration values y_1, x_1 (calibration gas and measurement for the first calibration point) and y_2, x_2 (calibration gas and measurement for the second calibration point) instead of directly storing the slope m and offset b. From these values, the device dynamically calculates the slope m and offset b during each measurement, providing high flexibility and allowing precise traceability of the calibration process.

9.1 Calibration Intervals

The frequency of calibration depends on the measurement range. The smaller the measurement range, the more frequent the calibrations should be to ensure measurement accuracy.

It is recommended to perform an offset calibration after the first commissioning to compensate for a systematic deviation.

For standard applications, such as measuring 0-4 vol.% hydrogen in nitrogen, we recommend calibration every six months. However, after the first six months of operation, the device generally stabilizes, allowing calibration intervals to be extended. You may adjust these intervals based on the stability and specific requirements of your process.

Offset Calibration:

Offset calibration ensures accurate measurements at the lower end of the measurement range or at zero values. Regular offset calibration is particularly important when precise measurements in low concentration ranges are required.

Span Calibration:

Span calibration should only be considered if there is a significant error in the proportionality of measurements across the entire range or if a process-specific adjustment of the value is needed. Given that the device is generally very stable, the slope of the calibration line remains unchanged over extended periods. As a result, span calibrations are typically rarely needed.

An improper execution of the calibration can lead to faulty measurement results.

9.2 Preparation for Calibration

When calibrating a measuring device, it is essential to ensure the accuracy of the calibration gases used. Both the measurement gas and the background gas must meet the calibration requirements. It is important that the calibration gas matches the device's configuration. For example, a device configured for H_2 in N_2 should not be calibrated with He in N_2, unless a substitute gas calibration is performed (see description below).

Before calibration, check the calibration certificates to confirm that the correct gases are being used. Be aware of any specific conditions or restrictions noted on the certificates.

During calibration, the device should be set to maintenance mode to prevent false alarms in the system. In maintenance mode, the analog output is set to 3.8 mA, preventing the system from detecting a malfunction due to the calibration process.

Ensure the gas signal is stable after the calibration gas is introduced. The time required for stabilization may vary depending on the pneumatic connection and the system's volume.

It is important to confirm that no hazardous concentrations of the measurement gas develop in the system during calibration and that no high pressure is released into the environment.

Calibration should be performed under the same pressure conditions as those in the device's normal operation. Otherwise, measurement discrepancies may occur. If necessary, compensate for pressure effects during calibration to ensure accurate results.

9.3 Offset Calibration

The offset calibration corrects systematic deviations by uniformly adjusting all measurement values, ensuring the entire measurement range is corrected at a fixed point.

Procedure:

1. Ensure you are logged in as an administrator; if not, log in using the appropriate command (e.g., ALA@119977).
2. Confirm that the device is in maintenance mode; if not, activate maintenance mode (e.g., AMA).
3. Introduce a calibration gas with a known concentration (e.g., 2 vol.% H_2 in N_2).
4. Record a stable measurement with the device (e.g., 1.8 vol.%).
5. Send the offset calibration command with the calibration gas concentration (e.g., AO@20000 for 20,000 ppm).
6. Verify the response: check concentration value, device status, and command status.
7. If no further steps are planned, reset the device from maintenance mode (e.g., AMA).

9.4 Span Calibration

Span calibration is used to ensure the proportionality of measurement values across the entire range. It is usually not needed frequently, as the device remains stable and maintains calibration over long periods.

Procedure:

1. Ensure you are logged in as an administrator; if not, log in using the appropriate command (e.g., ALA@119977).
2. Confirm that the device is in maintenance mode; if not, activate maintenance mode (e.g., AMA).
3. Introduce a calibration gas with a known concentration (e.g., 4 vol.% H_2 in N_2).
4. Record a stable measurement with the device (e.g., 4.1 vol.%).
5. Send the span calibration command with the calibration gas concentration (e.g., AS@40000 for 40,000 ppm).
6. Verify the response: check concentration value, device status, and command status.
7. If no further steps are planned, reset the device from maintenance mode (e.g., AMA).

9.5 Substitute Gas Calibration

It is possible to calibrate the measuring device with a different gas than originally intended. This is known as substitute gas calibration. It requires that the exact value for this substitute gas is known.

To ensure the appropriate calibration gas is used, specify the desired calibration gas when ordering the device. The chosen value will be documented in the calibration certificate, allowing for correct calibration.

This method also applies when using the same gas under different conditions, such as varying pressure or humidity levels.

Procedure:

1. Ensure you are logged in as an administrator; if not, log in using the appropriate command (e.g., ALA@119977).
2. Confirm that the device is in maintenance mode; if not, activate maintenance mode (e.g., AMA).
3. Introduce the substitute calibration gas with a known concentration.
4. For example, the device is set for 0-4 vol.% H_2 in N_2.
5. The substitute gas is 5 vol.% He in N_2, which corresponds to an equivalent of 3.8 vol.% H_2 in N_2 according to the calibration certificate. This conversion must be taken from the calibration certificate.
6. Record a stable measurement with the device (e.g., 3.7 vol.% H_2 in N_2).
7. Send the substitute gas calibration command with the equivalent concentration.
8. Based on the calibration certificate for the substitute gas, send the calibration command (e.g., AO@38000 for 3.8 vol.% H_2 in N_2).
9. Verify the response: check concentration value, device status, and command status.
10. If no further steps are planned, reset the device from maintenance mode (e.g., AMA).

10 Cross-sensitivity compensation

Pressure and humidity dependencies are significant cross-sensitivity effects that can influence thermal conductivity measurements. To compensate for these effects, additional measuring equipment such as pressure or dew point sensors can be used by the customer. These sensors enable the influences of pressure and humidity fluctuations to be recognised and corrected, which significantly improves measurement accuracy.

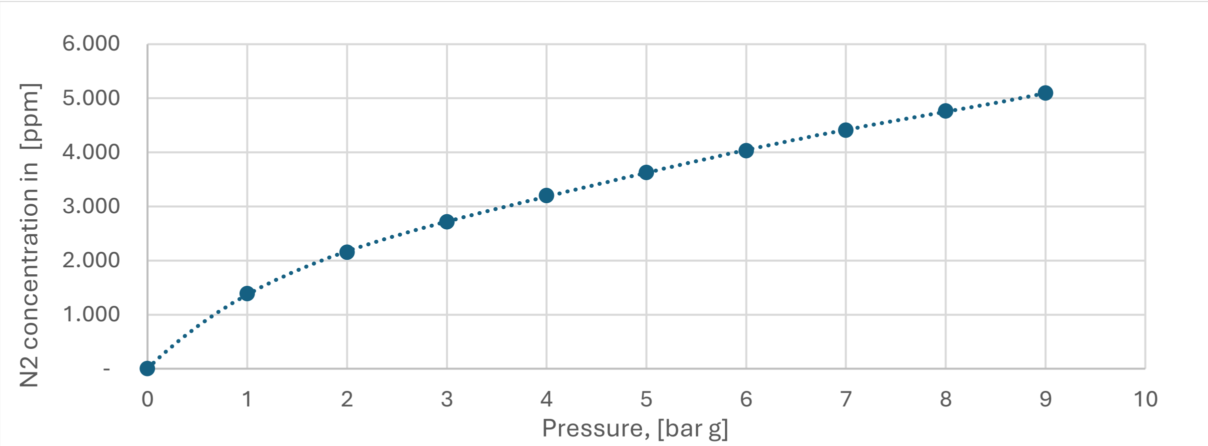
10.1 Pressure

The thermal conductivity of gases is pressure-dependent and varies depending on the thermal conductivity of the gas. Gases with high thermal conductivity values, such as hydrogen (H_2) and helium (He), are more pressure-dependent, while gases with lower thermal conductivity values, such as nitrogen (N_2) and oxygen (O_2), are less pressure-dependent. This dependence is not linear: in the range from atmospheric pressure to 10 bar, the pressure dependence of thermal conductivity is relatively high, but it decreases significantly beyond this point.

There are different methods for pressure correction:

- No compensation: A single calibration at measuring pressure is sufficient if measurements are taken at constant pressure or if the pressure fluctuations are within the tolerance range.
- Pressure compensation for a gas: For example, if 0-4 vol.% H_2 is measured in N_2 and the pressure dependence largely behaves as with pure N_2.
- Pressure compensation over larger measuring ranges: For example, when measuring 0-100 vol.% H_2 in N_2, where various pressure dependencies must be considered.

A specific curve is recorded in the laboratory for the pressure compensation. The calibration compensation algorithm is provided together with the calibration certificate on demand. The following information is for illustrative purposes only.



The pressure dependent and gas specific curve illustrates the impact of pressure change to the ppm-signal.

For pressure compensation in a gas, the pressure-dependent change in concentration $C(p)$ must be calculated using the prevailing pressure. To do this, the pressure p must be entered in [bar abs]:

$$C(p) = a \cdot p^3 - b \cdot p^2 + c \cdot p$$

To obtain the compensated concentration value C_{comp} in [ppm], the calculated pressure-dependent concentration change is subtracted from the uncompensated concentration value C in [ppm] (the measured value of the device):

$$C_{comp} = C - C(p)$$

For gas pairs in which the carrier gas has a higher thermal conductivity than the sample gas (e.g. N_2 in H_2 see Chap. 4), the pressure-dependent change in concentration must be added to the uncompensated concentration value. An increase in pressure is expressed by a reduction in the measured concentration value.

For pressure compensation over a larger measuring range, the change in concentration $C_1(p)$ and $C_2(p)$ of the carrier gas and the target gas must be calculated based on the prevailing pressure:

$$C_1(p) = a \cdot p^3 - b \cdot p^2 + c \cdot p$$

$$C_2(p) = d \cdot p^3 - e \cdot p^2 + f \cdot p$$

The compensated concentration value C_{comp} in [ppm] is calculated with the two concentration changes $C_1(p)$ and $C_2(p)$ in [ppm] and the uncompensated concentration value C in [ppm] is calculated as follows:

$$C_{comp} = \frac{(C - C_2(p)) \cdot 10^6}{C_1(p) - C_2(p)}$$

For gas pairs in which the carrier gas has a higher thermal conductivity than the sample gas (e.g. N_2 in H_2 see Chap. 4), the pressure-dependent changes in concentration $C_1(p)$ and $C_2(p)$ must be used interchanged in the formula.

10.2 Humidity

While powered on, the device is generally resistant to moisture and condensation. However, like all other gases, moisture in the sample is recognised and measured as part of the overall gas mixture. In the laboratory, this influence can be decreased by adjusting the device settings.

For specific device settings or options for humidity compensation, please provide this information already when placing your order or contact the manufacturer directly.

11 Errors and diagnostics

The following table will help you to quickly identify and rectify problems.

Error	*Possible cause*	*Diagnosis and solution*
No signal	No power to the device or defective power supply	Check the power supply and cabling. Ensure that the device is correctly connected and switched on.
Unstable or fluctuating measured values	Contaminated sensor or unstable process conditions	Clean the sensor according to the maintenance instructions. Check the process conditions, e.g. pressure, and ensure that they are stable.
Measured value deviates greatly	Incorrect calibration or pressure and humidity dependencies	Check the calibration and recalibrate if necessary. Ensure that the pressure and humidity corrections are applied correctly.
Indication of an error	Internal fault in the device or defective sensor	Contact technical support.
No or weak signal at the analogue output	Incorrect configuration of the analogue output or defective output	Check the configuration of the analogue output and ensure that it is correct. Test the output with a multimeter to ensure that it is working properly.
Communication via RS485 not possible	Incorrect settings or cabling problems	Check the RS485 settings (baud rate, parity, etc.) and ensure that they are correct. Check the cabling and ensure that all connections are tight and correct.
Calibration fails	Unstable measuring conditions or incorrect calibration gas	Ensure that the measuring conditions are stable and that the calibration gas is in perfect condition. Repeat the calibration according to the instructions.

If none of the above diagnostic and solution steps solve the problem, please contact Archigas GmbH technical support. Please have all relevant information and error messages ready to ensure fast and efficient support.

12 Maintenance and cleaning

⚠ Cleaning with liquids may only be carried out when the sensor is switched on. Otherwise, there is a risk that the sensor will be permanently damaged.

When used as intended, no special maintenance is required during normal operation. If used under difficult conditions (e.g. dirt particles in the process gas), a regular visual inspection of the sintered metal filter is recommended. To clean the filter, the appliance can be immersed in water with the process gas opening up to the type plate.

Cleaning the housing helps to ensure that the rating plate and markings on the appliance remain visible. Please note the following:

ⓘ The appliance must not be opened for cleaning.
Do not use aggressive cleaning agents that could damage the housing, seals or cable. Only use suitable cleaning methods.

12.1 Waste disposal

For disposal of the appliance, please contact the appliance manufacturer. As a rule, the TCD 3000 Si is taken back by the manufacturer for recycling and disposal.

13 Complaints

Instructions for returning goods can be found in the "Contact" section of our website (https://archigas.de/de/kontakts/). Do not return any devices unsolicited. Please contact us first.

If a repair is necessary, proceed as follows:

- Fill out an RMA form for each device
- Indicate any existing contamination
- Pack the device so that it is unbreakable
- Send the completed form with the device

14 Specifications

General technical data	
Installation position	independent
Weight	approx. 500 g
Dimensions	Ø36 x 96 mm³
Protection class	IP68 according to EN 60529
Gas connection	G1/2 inch
Protection	IP66/68
Electrical features	
EMC immunity	NAMUR NE21 (05/2006) / EN 61326-1 (2013)
Electrical safety	EN 61010-1:2010
Management	Cable diameter: max. Ø 5,7 mm Wire cross-section: max. 8 x 0.50 mm²
Electrical inputs and outputs	
Power supply	24 ±25% VDC, < 5 W
Analogue output	4-20 mA potential-bound, RL ≤ 750 Ω
Serial interface	RS485, Baud rate 38400 / Data 8 bit
Measuring ranges	
Number of measuring ranges	5; freely parameterisable
Smallest possible measuring span	0.5 vol.% H_2 in air* or oxygen* or nitrogen
Largest possible measuring span	100 vol.% H_2 in air* or oxygen* or nitrogen
Smallest possible measuring span with suppressed zero point	2 vol.% H_2 in air* or oxygen* or nitrogen
	**Please refer to the SiA for measuring explosive gas mixtures*
Gas inlet conditions	
Sample gas pressure	900 ... 200,000 hPa (absolute)
Sample gas flow	0 ... 10 m/s (higher flow rates on request)
Sample gas temperature	-40 ... +90 °C (up to +120 °C on request)
Sample gas humidity	up to 100 % RH (moisture content may result in measurement errors)
Time behaviour	
Warm-up time	< 1 min.
Reaction time	≤ 30 ms
T90 Time	< 1 s
Measuring behaviour	
Noise	< 10 ppm
Detection limit	< 50 ppm
Measured value drift	< 100 ppm / week
Repeatability	< 100 ppm
Linearity deviation	< 1 % of the current measuring span
Influencing variables	
Ambient temperature	< 50 ppm / 10K
Sample gas pressure at zero point	< 25 ppm / 10 hPa; from 1 MPa < 2 ppm / 10 hPa

Sample gas pressure for deflection gas	< 100 ppm / 10 hPa; from 1 MPa < 10 ppm / 10 hPa
Sample gas flow at zero point	< 25 ppm / m/s
Sample gas flow rate with deflection gas	< 100 ppm / m/s
Accompanying gases	The cross-gas sensitivity depends on the application and must be determined on a case-by-case basis.
Climatic conditions	
Storage and transport	-40 ... +90 °C
Ambient temperature	-40 ... +90 °C
Ambient humidity	up to 100 % RH
Parts in contact with sample gas	
Screw-in housing	Stainless steel 316L
Sintered metal filter	Stainless steel 316L
Sensor	Si, SxNy, epoxy resin, ceramic, Al
Gasket	FKM

15 Measuring components and measuring ranges

Sample gas	Background gas	Basic area	Smallest area
Hydrogen (H_2)	Nitrogen (N_2) or Air	0% – 100%	0% – 0.5%
Oxygen (O_2)	Nitrogen (N_2)	0% – 100%	0% – 15%
Helium (He)	Nitrogen (N_2) or Air	0% – 100%	0% – 0.8%
Carbon dioxide (CO_2)	Nitrogen (N_2) or Air	0% – 100%	0% – 3%
Nitrogen (N_2)	Argon (Ar)	0% – 100%	0% – 3%
Oxygen (O_2)	Argon (Ar)	0% – 100%	0% – 2%
Hydrogen (H_2)	Argon (Ar)	0% – 100%	0% – 0.5%
Helium (He)	Argon (Ar)	0% – 100%	0% – 0.5%
Carbon dioxide (CO_2)	Argon (Ar)	0% – 60%	0% – 10%
Argon (Ar)	Carbon dioxide (CO_2)	40% – 100%	–
Methane (CH_4)	Nitrogen (N_2) or Air	0% – 100%	0% – 2%
Methane (CH_4)	Argon (Ar)	0% – 100%	0% – 1.5%
Argon (Ar)	Oxygen (O_2)	0% – 100%	0% – 3%
Nitrogen (N_2)	Hydrogen (H_2)	0% – 100%	0% – 2%
Oxygen (O_2)	Carbon dioxide (CO_2)	0% – 100%	0% – 3%
Hydrogen (H_2)	Helium (He)	20% – 100%	-
Hydrogen (H_2)	Methane (CH_4)	0% – 100%	0% – 0.5%
Hydrogen (H_2)	Carbon dioxide (CO_2)	0% – 100%	0% – 0.5%
Sulfur hexafluoride (SF_6)	Nitrogen (N_2) or Air	0% – 100%	0% – 2%
Nitrogen dioxide (NO_2)	Nitrogen (N_2) or Air	0% – 100%	0% – 5%
Hydrogen (H_2)	Oxygen (O_2)	0% – 100%	0% – 0.5%
Argon (Ar)	Xenon (Xe)	0% – 100%	0% – 3%
Neon (Ne)	Argon (Ar)	0% – 100%	0% – 1.5%
Krypton (Kr)	Argon (Ar)	0% – 100%	0% – 2%
Extinguishing gas (R125)	Nitrogen (N_2) or Air	0% – 100%	0% – 5%
Deuterium (D_2)	Nitrogen (N_2) or Air	0% – 100%	0% – 0.5%
Deuterium (D_2)	Helium (He)	0% – 100%	0% – 5%