OPERATING INSTRUCTIONS

SIDOR
Extractive Multi-Component Gas Analyser

Installation
Operation
Maintenance

SICK
Sensor Intelligence.

Document information

Product

Product name:	SIDOR
Versions:	Standard version
	CSA version
Software:	Version 1.5, 1.6, 1.7

Document ID

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Manufacturer

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Trademarks

Guarantee Information

Specified product characteristics and technical data do not serve as guarantee declarations.

Glossary

AC	Alternating Current
BImSchV	"Bundes-Immissionschutzverordnung" (Federal Immission Protection Ordinance); administrative regulation for the Federal Air Pollution Control Act of Germany
CSA	Canadian Standards Association (www.csa.ca)
DC	Direct Current
Firmware	Internal software of a hardware device, usually stored in erasable programmable memories (EEPROMs)
IP *XY*	International Protection (also known as Ingress Protection); level of protection as defined in IEC/ EN 60529. The first digit specifies protection against access to hazardous parts and the ingress of objects; the second digit specifies protection against ingress of water.
LED	Light Emitting Diode (small indicating lamp)
LEL	lower explosive limit (least gas concentration that is needed for a flammable gas mixture or vapor to ignite and explode)
NAMUR	an international user association of automation technology in process industries (www.namur.de)
NDIR	Non-dispersive infra-red; name for optical gas analysis methods in the infra-red spectrum range
PC	Personal Computer
RMS	Root-Mean-Square value
TA Luft	"Technische Anleitung zur Reinhaltung der Luft" (technical instructions on air polution prevention); general administrative regulation for the Federal Air Pollution Control Act of Germany; basically, administrative technical instructions on air quality control, defining emission limits and requirements for measuring and monitoring

Warning symbols

- Hazard (general)
- Hazard by voltage
- Hazard in explosion-hazardous locations
- Hazard by explosive substances/mixtures
- Hazard by poisonous substances

Information symbols

- Important technical information for this device
- Important technical information on electric or electronic functions
- Supplementary information
- Link to information at another place
- Nice to know

Warning levels / signal words

WARNING
Risk or hazardous situation which could result in severe personal injury or death.

CAUTION
Hazard or unsafe practice which could result in personal injury or property damage.

NOTICE
Hazard or unsafe practice which could result in property damage.

SIDOR

1 Basic information

Product versions
Primary hazards
Basic operating notes
Intended use
Use in compliance with the examination certificate
User’s responsibility

1.1 Product versions

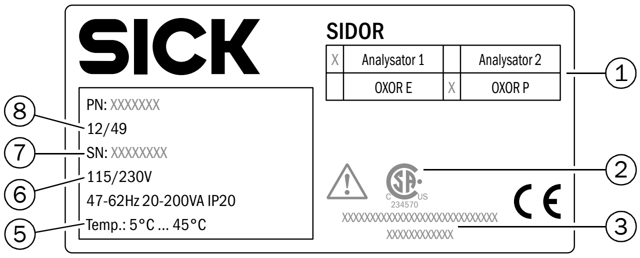
1.1.1 Identification of product version

The gas analyzer SIDOR is available in two versions:

- standard version (available with various specification)
- CSA version

► *To identify the product version:* refer to the nameplate (→ Figure 1) on the rear side of the instrument.

Figure 1 Nameplate (schematic)



1	Built-in analyzer modules (→ page 14, §1.4.1)
2	CSA version mark
3	Manufacturer
5	Allowable ambient temperature during operation
6	Mains voltages (→ page 34, §3.5.4)
7	Serial number
8	Manufacturing date (year/week)

1.1.2 Special features of the CSA version

- For CSA-compliant use, special relay contact ratings are specified (→ page 37, §3.6.3).
- The internal plug connector X24 is fixated with emplastic.

In all other respects, the standard version and the CSA version are identical.

1.2 Primary hazards

WARNING: Explosion hazard
- Do not use SIDOR in explosion-hazardous locations unless additional safety precautions have been taken.

WARNING: Hazards caused by explosive or flammable gases
- Do not the SIDOR for explosive or flammable gases.

WARNING: Mortal/Health danger as a result of a gas leakage
If the analyzer is used to measure poisonous gases:
- Set up appropriate safety precautions.

- Always observe the complete safety notes.

1.3 Basic operating notes

Start-up
- Pay attention to leak tightness (leak test → page 166, § 12.4); check filters, valves, etc.
- Make a calibration after each start-up (→ page 105, § 8).

Operating condition
- Pay attention to fault indications:
  - LED “Function”: red = fault condition (→ page 50, § 5.1) / green = normal condition
  - LED “Service” (yellow) = need for action (→ page 50, § 5.1)
  - LED “Alarm” (red) = measuring value is beyond a limit value (→ page 74, § 7.6.1)
  - observe status messages in the display base line (→ page 56, § 6.1)
- Make calibrations at regular intervals (→ page 108, § 8.2).

When “Alarm” is indicated
- Check the current measuring values. Consider the situation.
- Perform the action which is scheduled at your site for the particular situation.
- If required: Switch-off the “Alarm” indication (“acknowledge” → page 63, § 6.4.2).

In hazardous situations
- Switch-off the system’s emergency switch or mains switch.

SIDOR’s main switch is located on the rear side next to the mains power connector (→ page 34, Figure 5).

Taking out of operation
- *Before taking out of operation:* purge the sample gas path with a dry neutral gas – to prevent condensation in the analyzer’s measuring system (→ page 180, § 14.1).

1.4 Intended use

1.4.1 Purpose of the instrument

A SIDOR gas analyzer measures the concentration of a particular gas in a gas mixture (sample gas). The sample gas flows through the internal measuring system of the analyzer. If the SIDOR is equipped with a second NDIR measuring system and/or an OXOR analyzer module, then the concentration of more than one gas component can be measured simultaneously.

1.4.2 Place of installation

SIDOR gas analyzers are designed for indoor use. Direct influence of the atmospheric weather (wind, rain, sun) could damage the instrument and can strongly reduce the measurement accuracy.

1.4.3 Usage limitations

Application limitations

- The SIDOR gas analyzer shall not be used in explosion-hazardous locations. If the SIDOR is installed in an explosion-hazardous location, additional safety devices shall be provided to fulfill the requirements of explosion-proof installation and operation.
- As a basic principle, the SIDOR standard version and CSA version shall not be used for the measurement of flammable or explosive gases.

> +i If a SIDOR analyzer is used to measure a flammable gas or a gas which can produce a combustible mixture when mixed with air, an explosion risk exists if a leak occurs in the internal gas path of the analyzer.
> For such applications, check which regulations and rules are valid at the place of installation, and if additional safety precautions should be taken (for example, encapsulation and inert gas purging of the enclosure).

Reduction of physical measuring characteristics

In some applications, certain gas components could interfere with the analysis – for example, because a similar measuring effect is produced and this effect can not be eliminated, due to the laws of nature or technical limitations. A consequence could be that the measuring values would shift when the composition of the sample gas has changed, even if the concentration of the measured gas components is still the same.

► *In such cases:* whenever the sample gas composition has changed, make a new calibration, using new test gases which correspond to the new sample gas composition.

► This might not be necessary with if your SIDOR has an automatic compensation for such effects (→ page 21, §2.2.4). Information on this subject will be supplied with your SIDOR. If you are not sure, please contact the manufacturer.

1.5 The user's responsibility

Intended users

The gas analyzer SIDOR should only be operated by skilled persons who, based on their technical training and knowledge as well as knowledge of the relevant regulations, can assess the tasks given and recognize the dangers involved.

Correct use

- Use and operate the SIDOR only as it is described and specified in this manual. The manufacturer is not responsible for any other use.
- Carry out the specified maintenance works.
- Do not remove, add, or change any component in the instrument unless such changes are officially allowed and specified by the manufacturer. Otherwise
  - the instrument might become dangerous
  - the manufacturer's guarantee becomes invalid.

Special local requirements

- In addition to this manual, observe all the local laws, technical rules, and company-internal instructions which are valid at the site where your SIDOR is installed.

Responsibility for poisonous sample gases

> **WARNING: Mortal/Health danger as a result of a gas leakage**
> *If the SIDOR is used to measure poisonous gases:* A defect in the sample gas path can possibly cause an acute danger for humans.
> - Set up appropriate safety precautions.
> - Make sure that these safety precautions are kept.

Exemplary prophylactic safety precautions:

- Appropriate warning indications on the SIDOR
- Appropriate warning indications for the operating room
- Safety instruction of personnel

Preserving the documents

- Keep the Operating Instructions ready for consulting.
- Hand the Operating Instructions over to a new owner.

SIDOR

2 Product description

Principle of operation
User guide
Technology

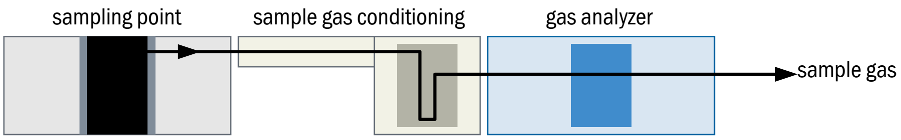
2.1 ## Application principle

SIDOR is an extractive gas analyzer with continuous measuring operation:

- *Extractive gas analysis* means that a certain portion of the gas which is to be analysed is extracted from the total quantity of the gas ("sample gas" from the "sampling point") and is then supplied to the gas analyzer.
- *Continuous measurement* means that a continuous sample gas flow to the gas analyzer is kept, and that the gas analyzers is continuously measuring.
- For most applications, a *sample gas conditioning* is required. Depending on the individual application, suitable devices can be:

particle filters	to protect the gas analyzer's internal system against contamination
heated sample gas lines	to prevent condensation and ice blockages inside the sample gas line
liquid separators	to separate any liquids or condensable components from the sample gas
safety devices	to protect the gas analyzer and the peripheral system against each other (for example, flame arrestors in the gas lines)

Figure 2 Extractive gas analysis



- Projection notes on extractive sample gas supply → page 28, §3.4.1
- Operating conditions for the sample gas supply → page 32, §3.4.2

2.2 Know-how for the SIDOR

2.2.1 Special features

- *Multiple analyzer modules:* A SIDOR can simultaneously measure up to three gas components: one or two NDIR measuring components with the analyzer module SIDOR, and the measuring component O_2 (oxygen) with the analyzer module OXOR-E or OXOR-P.
- *Long-term stability:* The sensitivity of the analyzer module SIDOR is significantly greater than it is in traditional NDIR gas analyzers. That's why it is sufficient for routine calibrations of the NDIR measuring component(s), as a rule, to re-adjust only the zero point.
- *Pressure compensation:* SIDOR is equipped with a built-in pressure sensor which provides for an automatic compensation of the physical influence of unsteady sample gas pressure.
- *Cross-sensitivity compensation:* Common measuring influences of the individual gas components can be compensated for (→ page 21, §2.2.4).
- *Configurable signal connections:* The SIDOR has 8 control inputs and 13 switch outputs which can be freely assigned to a variety of functions (→ page 83, §7.10.2 / → page 81, §7.9.4).
- *Configurable measuring value outputs:* The SIDOR has 4 analog measuring value outputs (0/2/4 ... 20 mA). You can select which measuring component is assigned to the particular output, and you can even use several of these outputs for the same measuring component (→ page 76, §7.8.1). As an option, two output ranges are provided, with adjustable range settings (→ page 77, §7.8.2).
- *Digital data output:* The SIDOR can transmit the measuring values and the status signals via a RS232 interface (→ page 44, §3.10.1).
- *Strip-chart simulation:* The SIDOR can display a running diagram of the previously measured values (→ page 57, §6.2.3).
- *2 zero gases:* For zero-point calibration, two different "zero gas" values can be set as the nominal values. This allows you to calibrate different analyzer modules which require individual zero gases. You can even set negative nominal values to compensate for cross-sensitivity effects (→ page 135, §8.8.6).
- *4 test gases:* For sensitivity calibration, you can set the nominal values of four different test gases. You can also select which test gas is used for a certain measuring component. Moreover, test gas mixtures can be used, to calibrate several measuring components at the same time (→ page 111, §8.3.3).
- *Data storage:* The SIDOR can save a copy of all current settings and all internal data, and restore these settings later (→ page 92, §7.13.1). Even the original factory settings can be restored. Moreover, you can save all individual internal data on a PC and reload them if required (→ page 93, §7.13.2).
- *Remote control:* The SIDOR can be remotely controlled via digital interface – either by using the PC software MARC2000 (→ page 137, §9), by using "AK protocol" commands (→ page 145, §10), or by using a "Modbus" interface (→ page 153, §11).
- *Firmware update:* You can update the internal SIDOR software via interface (→ page 96, §7.14).

2.2.2 Analyzer modules

A SIDOR can simultaneously measure up to three gas components:

1 The basic SIDOR version measures *one* NDIR measuring component, using the SIDOR analyzer module.
2 An expansion of the SIDOR module allows to measure a second NDIR measuring component (option).
3 In addition to the SIDOR module, a SIDOR may include an analyzer module for the measurement of the O_2 concentration (option → page 20, §2.2.3).

Please refer to the instrument tag to see which analyzer modules are included in your SIDOR. This information can also be indicated on the display (→ page 61, §6.3.5).

2.2.3 Analyzer modules for O_2 measurement

OXOR-E (electrochemical cell)

The analyzer module OXOR-E is used for the standard applications of the O_2 analysis.

The OXOR-E analyzer module is an electrochemical cell which is filled with an electrolyte. A PTFE membrane is used to let O_2 molecules diffuse into the sensor. At a metal electrode, the O_2 molecules are chemically transformed. This chemical reaction produces an electric current which is measured.

Because the chemical reaction consumes the electrolyte, the O_2 sensor needs to be replaced after a certain period of use (procedure → page 168, §12.5).

The sensor life also depends on the composition of the sample gas:

- A small O_2 concentration in the sample gas will effect a longer sensor life.
- Aerosols and high SO_2 concentrations will reduce the sensor life.
- Presence of H_2O in the sample gas is advantageous for the life of the electrochemical sensor. Dry (H_2O-free) sample gas might reduce the life.

OXOR-P (paramagnetic measuring cell)

The analyzer module OXOR-P is used for O_2 analysis with advanced requirements.

The OXOR-P analyzer module contains a diamagnetic dumbbell which is suspended in a magnetic field in such a way that it could rotate out of this field. An opto-electrical compensation circuit is used to keep the dumbbell in a defined resting position.

The sample gas flows through the measuring cell. If it contains O_2, then the paramagnetic characteristic of O_2 will change the magnetic field. This causes an adaptation of the opto-electronic compensation, which is read by the software and evaluated as an O_2 concentration change.

The selectivity of the OXOR-P module is based on the extremely high magnetic susceptibility of oxygen. The magnetic characteristics of other gases are so small in the relation that they do not need to be considered, usually. However, if there are sample gas components which also have a relatively high magnetic susceptibility, then measurement errors might occur. There are several methods to compensate for this error effect (→ page 135, §8.8.6).

2.2.4 Cross-sensitivity and gas matrix effect compensation

Physical interferences

It may happen that a particular sample gas component disturbs the analysis of another measuring component – by producing a similar measuring effect or by physically interfering with the analysis. There are applications where this effect cannot be avoided, due to the laws of nature or due to technical limitations. In such cases, the gas analyzer would not only respond to the specific measuring components, but also to the interfering gas component. As a result, the measuring results would be incorrect.

Cross-sensitivity

A cross-sensitivity occurs when the interfering gas component produces an additional measuring effect. The main characteristic of a cross-sensitivity is that the analyzer seems to detect the measuring component even when it is not present in the sample gas (measuring effect at zero-point). A constant concentration of the interfering component will produce a constant “offset” all over the measuring range. When the interfering concentration changes, the offset will change accordingly.

Cross-sensitivity compensation

This effect can be corrected by using the “internal cross-sensitivity compensation” option. This option requires that the SIDOR also measures the interfering component. In the factory, a basic calibration is performed where SIDOR “learns” how these two measurements influence each other. Thereafter the SIDOR software can compensate for the interfering effect and will produce technically corrected measuring values.

In addition, the SIDOR can consider if the cross-sensitivity effect also occurs during a calibration (when test gas mixtures are used) or not (when “pure” test gases are used → page 132, §8.8.3).

- If your SIDOR is working with an automatic compensation, please observe the information in §16.1 (→ page 186).
- To find out whether your SIDOR is working with this option, read §16.1.1 (→ page 186).

2.2.5 Optional equipment

Some use possibilities depend on whether your SIDOR is equipped with a particular option (see following tables). Please observe the individual order and delivery information for your SIDOR.

Table 1 SIDOR options

Option	Function
Built-in gas pump	Delivers sample gas or zero gas.
Condensate sensor	Protects the gas analyzer: The electrical conductivity of a liquid in the gas stream will generate a fault signal and automatically shutdown the gas pump.
Flow sensor	Monitors the gas flow: When the flow drops below the set limit value, the sensor generates a fault signal.

2.3 User Guide for the SIDOR

2.3.1 What must you do?

To measure with the SIDOR, the following works are essential:

2.4 What can you do in addition?

The following SIDOR functions can be used and adapted as required:

2.4.1 If you first wish to learn about the operating functions ...

... you can do the following:

Provisionally start-up the SIDOR

1. Do not install the SIDOR analyzer in the industrial location, but bring it to a place which is comfortable to work in, for example your office. Please leave the SIDOR gas connections closed until final installation is complete.
2. Connect the mains power (→ page 33, §3.5).
3. Start-up the SIDOR (→ page 46, §4.1).

Familiarise yourself with the operating controls

Please read the introduction to the operating principle (→ page 51, §5.3). Have a look at the menu system. You won't do anything wrong if you pay attention to the following:

- Storing a new value requires to press the [Enter] key. Therefore, do not press [Enter], but [Esc] to leave the particular menu. In this way, the status will remain unchanged.
- If you have started a calibration, do not press the [Enter] key when you reach the `Save: Enter` menu point. Press [Esc] instead – because the calibration should not be changed when working with the analyzer in a provisional mode.

> If the SIDOR is equipped with a built-in sample gas pump and you switch on the pump to check its function, please switch it off after a few seconds. It is not recommended to operate the pump when the gas connections are closed.

SIDOR

3 Installation

Enclosure installation
Power supply
Electronic connections

3.1 General safety information

WARNING: Danger in explosion-hazardous locations
The gas analyzer SIDOR is not suitable for the use in explosion-hazardous locations.
► Only use the SIDOR in explosion-hazardous locations when additional safety precautions have been taken.

WARNING: General danger caused by electrical current
► *If you need to open the instrument for installation or maintenance purposes:* First disconnect the instrument from all power sources.
► *If the instrument requires live current when being opened during adjustment or repair:* This work may only be made by specialists who are familiar with the potential risks. If internal components are opened or removed, parts may be exposed which contain current.
► *If any liquid penetrated into the enclosure:* Take the analyzer out of operation and disconnect the power at an external point (for example, pull the power plug). To have the analyzer repaired, report the problem to the manufacturer's service representative or an authorised skilled person.
► *If the instrument can no longer be used safely:* Take the instrument out of operation. Secure it against an unauthorised start-up.
► Never interrupt Protective Earth connections inside or outside the instrument in any way. Any such interruption may lead to the instrument becoming dangerous.

NOTICE:
Before making signal connections (also when connecting plug connectors):
► Disconnect power from the SIDOR and form all devices which are to be connected.
Otherwise the internal electronics could be damaged.

► Do not remove, add, or change any component in the instrument unless such changes are officially allowed and specified by the manufacturer.
Otherwise the manufacturer's guarantee becomes invalid.

3.2 Supply schedule

Unpack and check

1. Open the transport container.
2. Remove the protective packing.
3. Please remove the components carefully out of the case.
4. Check if all required parts have been delivered with your instrument (→ "Supplied components").

CAUTION: Risk of injuries
The enclosure has sharp edges.
► When lifting or carrying the enclosure, please take care that you won't hurt yourself or others.

To protect the internal gas path, the gas connections are closed with stoppers. Please do not remove these stoppers until you connect the gas lines.

Supplied components

- 1 gas analyzer SIDOR, complete
- 4 plug connectors with cable terminals, each can be mechanically coded
- 1 power cable, 2 m long
- 1 Operating Instructions

3.3 Mounting the enclosure

3.3.1 Mounting location, ambient conditions

- *Temperature:* During operation, the specified ambient temperature should be kept and exposure to direct sunlight should be avoided. Otherwise the specified measuring accuracy will not be achieved.
- *Humidity:* The analyzer should be installed in a dry and frost-free place. Condensation – especially inside the analyzer – is not permitted. The permitted relative humidity is 0 ... 90 % at 20 °C (68 °F), non-condensing.
- *Cooling:* Air circulation on the cooling fins of the enclosure should not be blocked.
- *Vibrations:* The installation location should be free of mechanical oscillation and vibration. Especially low frequency vibration (for example, from road traffic or heavy machinery) can disturb the measuring operation. Protect the SIDOR from hard shocks.
- *Inclination:* During operation, the enclosure base should be approximately horizontal. Otherwise the measuring function could be affected.

WARNING: Explosion risk
► Observe usage limitations (→ page 14, § 1.4.3).

3.3.2 Enclosure installation

The enclosure is a 19" chassis (3 HE) for integration in 19" systems (→ page 200, § 18.1). It should be mounted in a standard 19" rack or in a 19" housing.

NOTICE:
The front panel shall not be used as the only fixing of the enclosure.
► Use rack rails to carry the weight of the analyzer.

If another instrument is installed above the SIDOR, with an installation depth which is not significantly smaller, then it is a good idea not to mount the instruments directly one above the other, but to leave a vertical gap of at least 1 height unit. This may improve the conditions of temperature.

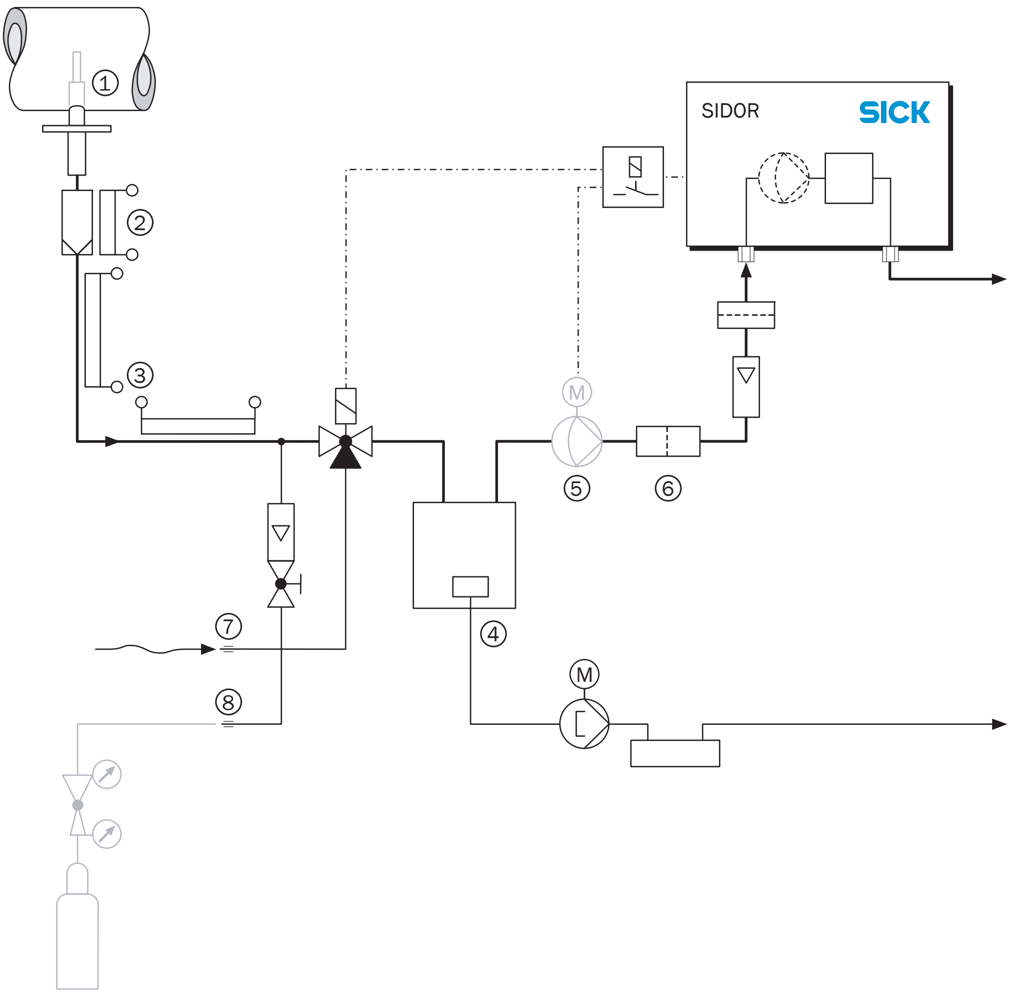
3.4 Sample gas connections

3.4.1 Designing the sample gas delivery

In most cases, the gas analyzer is a component of a measuring system. A suitable design of the entire measuring system is required to achieve trouble-free analysis, good measuring data, and a minimum of maintenance. Important criteria are, for example, correct choice of the sampling point, appropriate devices for sample gas supply and a careful installation. These items are as essential to the success of measurement as the analyzer itself.

The following schedules are examples for a proper sample gas delivery.

Figure 3 Sample gas delivery from an emission source (example)



Legend for Figure 3:

1 *Sampling point:* When extracting the sample gas from large containers or large duct cross sections (for example, chimneys), the gas mixture should be homogeneous at the sampling point. If stratification in the gas flow is expected, you should test the entire cross-section of the gas stream to find the best location of the sampling probe. Please observe the operating instructions of the sampling system.

2 *Dust:* You should always install a dust filter in front of the system to protect the gas analyzer against contamination. Even if the sample gas can be expected to be free of particles, it is a good idea to have a dust filter, so that the system is protected in case of external troubles. – If the sample gas contains condensable components (for example, water vapour – “wet gas”), then a heated filter should be used. There are sampling probes available which include a filter mounted at the tip; in this case, a filter heating is not required.

3 *Heated sample gas line:* Install a heated sample gas line if the temperature around the sample gas line may fall below the freezing point, or if the temperature inside the sample gas line may fall below the dew point of a sample gas component. This will prevent sample gas line from being blocked by ice or condensate.

4 *Sample gas cooler:* In the internal gas path of the analyzer, none of the components in the sample gas should fall below the dew point – because this would cause condensation which makes the gas analyzer unusable. A sample gas cooler can be used to prevent this effect (detailed information → page 190, § 16.3).

5 *Gas pump:* If an external gas pump is installed, then the power supply to this pump should be controlled via an SIDOR switch output (→ page 81, § 7.9.4). As a result, the pump would automatically be switched off as long as the gas analyzer is not ready for measuring operation.

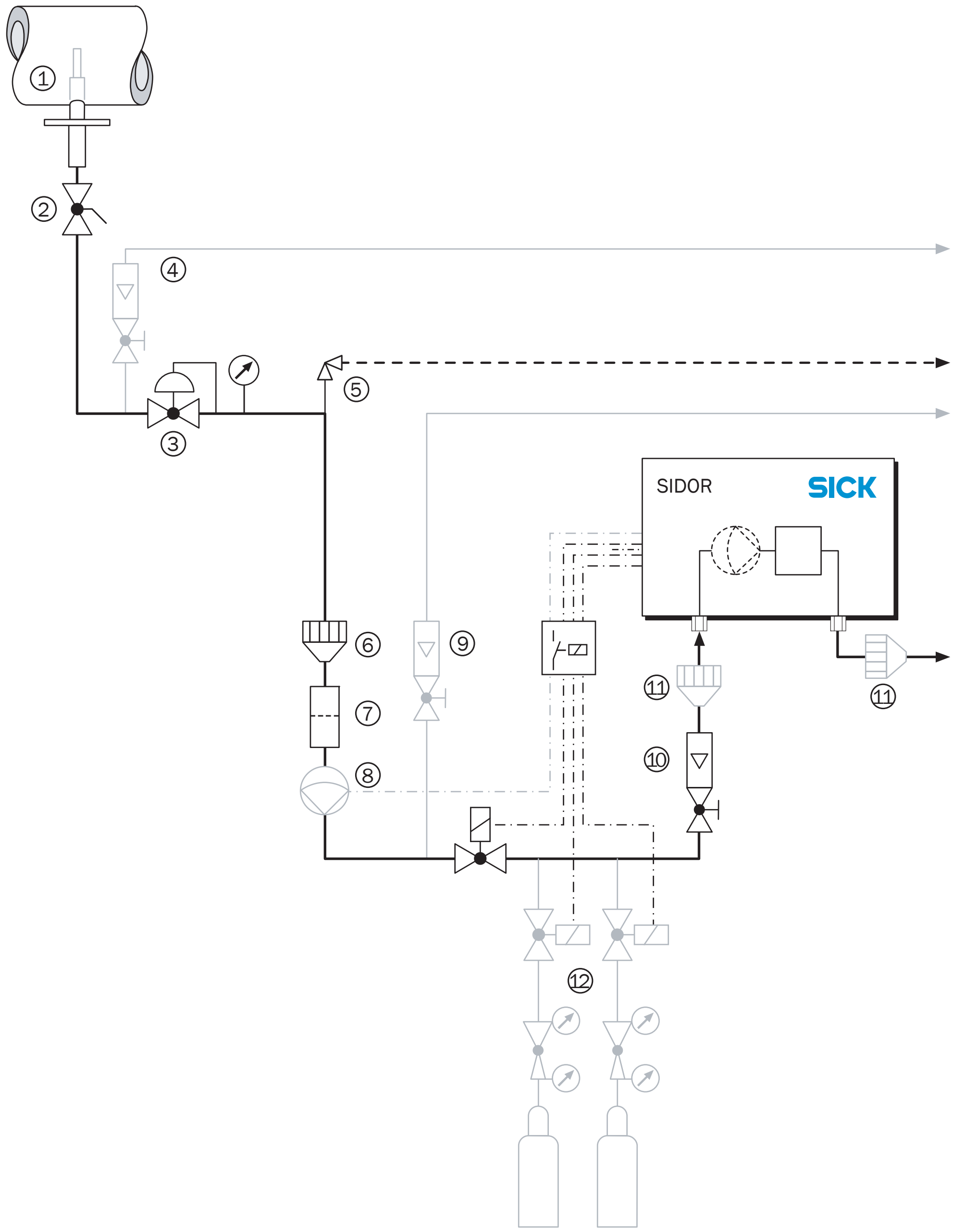
6 *Fine dust filter:* You should always install a fine dust filter in front of the SIDOR sample gas inlet – even if another dust filter is provided in the sample gas path. This will protect the optical system of the gas analyzer against immediate contamination in case of system troubles (for example, when the other dust filter fails to work) and against slow “hidden” contaminations (for example, caused by pump wear).

7 *Zero gas:* During a calibration, it is required to feed zero gas into the analyzer. In most cases, ambient air can be used as the zero gas. The zero gas feed can be automatically controlled if you set-up the required switch output (→ page 81, § 7.9.4). This is the basis for fully-automatic calibrations (→ page 115, § 8.5.1) and it makes manual calibrations easier (→ page 115, § 8.5).

8 *Test gas:* A complete calibration requires to feed a test gas into the analyzer. It is useful to have a corresponding gas connection point in the sample gas path.

- Calibration gases should flow into the analyzer under the same conditions as the sample gas – which means, they should flow through the sample gas conditioning system before they are fed into the analyzer. However, for some applications special criteria shall be observed (→ page 185, § 16).
- If you intend to use an NO_X converter, in order to measure the $NO+NO_2$ concentration with an NO gas analyzer, please observe the special information in §16.4 (→ page 192).

Figure 4 Sample gas delivery from a production process (example)



Legend for Figure 4:

1 *Sampling point:* When removing sample gas from large vessels or duct cross sections, the mixture of the sample gas should be homogeneous at the sampling point. If stratification in the gas flow is expected, you should check the entire cross-section of the gas stream to find the best location of the sampling probe. Please observe the operating instructions of the sampling system.

2 *Shutoff valve:* Can be useful to isolate the analysis system from the industrial process.

3 *Pressure reducing device:* Brings the sample gas pressure down to the allowable pressure for the gas analyzer.

4 *Slipstream bypass* (if required): Increases the flow from the sampling point to the pressure regulator and therefore reduces the analyzer response time.

5 *Relief valve* or *bursting disk*: Protects the analyzer when the initial pressure reduction fails.

6 *Flame arresters* in the sample gas flow: Prevents inflamed gas from entering the gas analyzer, or that ignited gas from the analyzer can break into the process.

7 *Dust filter:* You should always install an external dust filter (fine dust filter) in front of the system to protect the gas analyzer against contamination. Even if the sample gas can be expected to be free of particles, it is a good idea to have a dust filter, so that the system is protected in case of external troubles.

8 *Sample gas pump:* If the sample gas pressure is not sufficient, a gas pump is required. Please pay attention to the following notes:
   - If dust or particles can pass through the pump (e.g. through valve abrasion), then you should install an additional particle filter after the pump.
   - The power supply to this pump can be controlled via a SIDOR switch output (→ page 81, § 7.9.4). As a result, the pump would automatically be switched off as long as the gas analyzer is not ready for measuring operation.
   - If the SIDOR is equipped with a built-in pump (→ page 21, § 2.2.5), you should use the pump capacity menu to set-up the desired gas flow (→ page 97, § 7.15.1).

9 *Analyzer bypass* (if required): Increases the sample gas flow to the analyzer. Install an analyzer bypass if a quick response time is required.

10 *Regulating valve:* Sets the correct sample gas flow through the analyzer. (Might not be required if the SIDOR has a built-in gas pump → page 97, § 7.15.1).

11 *Flame arresters* near the gas analyzer: Prevent flames from escaping from the internal gas lines.

12 *Calibration gases* → page 29.

3.4.2 Connecting the sample gas inlet

► For permissible temperature/pressure/flow of the sample gas see §18.4 (→ page 202).
► Connect the sample gas to the SAMPLE fitting.

WARNING: Health risk by poisonous sample gas
► *If the sample gas is poisonous:* check if additional safety precautions are required (→ page 15, § 1.5).

NOTICE:
► *Before feeding-in the sample gas:* check if the sample gas contains chemical substances which could damage the internal gas path (→ page 203, § 18.7).
► Prevent that any liquids can enter the analyzer.
► Prevent condensation in the gas lines of the analyzer. If the sample gas contains condensable components, then you should only operate the analyzer in conjunction with an appropriate gas conditioning system (→ page 28, § 3.4.1).
► Always install an external fine dust filter to protect the gas analyzer against contamination.[1]

[1] Even if the sample gas is expected to be free of particles, you should install a dust filter as a safety filter to protect the gas analyzer in case of external troubles.

For instruments with built-in sample pump:
- The maximum pump capacity is approximately 60 l/h at 10 kPa (0.1 mbar / 1.4 psig) vacuum.
- Pump capacity setting → page 97, § 7.15.1. Factory setting: approx. 40 l/h.

3.4.3 Connecting the sample gas outlet

► Connect the OUTLET fitting to a suitable collection point (e. g. exhaust gas channel).

CAUTION: Risk of incorrect measurements

The sample gas should not enter the enclosure.
► Make sure that the sample gas outlet is surely led away.

At the sample gas outlet, no significant counter-pressure may built-up, and no strong pressure fluctuations may occur. Otherwise wrong measuring values might be produced.
► Make sure that the sample gas can “freely” exit the analyzer.

The pressure at the sample gas outlet should not be increased significantly. Installing a throttle valve at the sample gas outlet is not permissible.
► Install a regulating valve (if required) only in front of the sample gas inlet.

Otherwise significant measuring errors might occur.

3.5 Power connection

3.5.1 Safety information for power connection

CAUTION: Health risk
The electrical safety is only guaranteed when a working Protective Earth connection has been made.
- ► Only connect the SIDOR to a mains supply which has a Protective Earth line (PE).
- ► Only start-up the SIDOR if a correct Protective Earth connection exists.
- ► Never interrupt the Protective Earth connections (yellow-green cable) inside or outside the SIDOR in any way. Such interruption may lead to the SIDOR becoming dangerous.

CAUTION: Damage or malfunction by wrong power supply
The mains frequency must meet the data given on the SIDOR nameplate, and the power supply voltage must meet the SIDOR mains voltage setting.
- If the mains voltage is too high, then the SIDOR can severely be damaged. The SIDOR can be dangerous when operated in such a damaged condition.
- If the mains voltage is too low, the SIDOR will not work correctly.
- ► Check the power supply voltage setting (→ page 34, Figure 5).
- ► Adapt the setting if required (→ page 34, §3.5.4).

3.5.2 External mains switch

If the SIDOR power switch is not visible and accessible during operation:
- ► Install an external power switch which can switch on and off the mains power supply to the SIDOR. Install this switch near the SIDOR.
- ► Indicate this switch clearly and unmistakably.
- ► Provide an external mains fuse for the SIDOR.

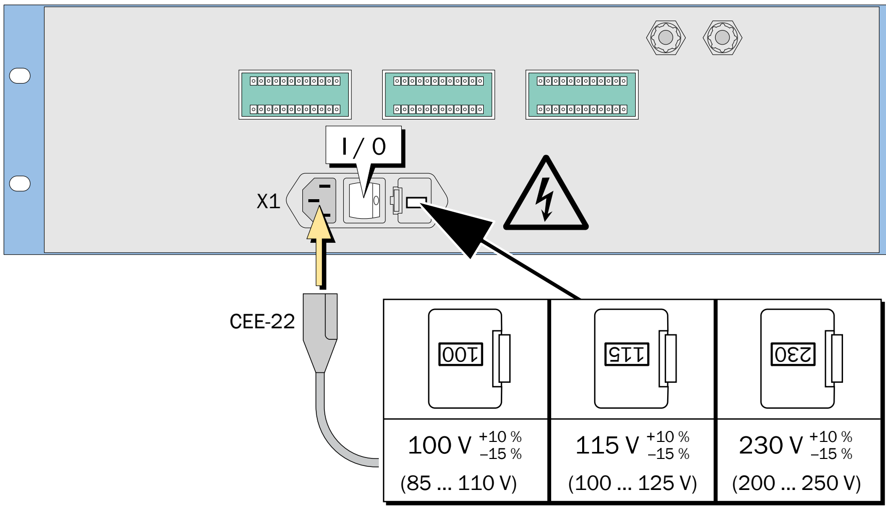
If the SIDOR is installed in a 19" rack or housing, then its power switch will no longer be visible or accessible. The European standard EN 61010 specifies that any fix-mounted device which does not have an individual power switch shall be equipped with an external power switch.

After power-on, for a very short time, the SIDOR draws a much higher current than specified for operation (approx. 40 A for approx. 5 ms). Therefore, external fuses for the SIDOR power supply should have a slow-blow or delay-action characteristic.

3.5.3 **Connecting the power cable**

1 Check the SIDOR mains voltage setting (100/115/230 V → Figure 5). If required, adapt the setting to your mains power voltage (→ §3.5.4).
2 Connect the power cable to the built-in plug on the rear panel (standard CEE-22 plug → Figure 5).
3 Connect the power cable to an appropriate mains supply (safety information → page 33, §3.5.1).

Figure 5 Power connection, power switch, location of signal connections

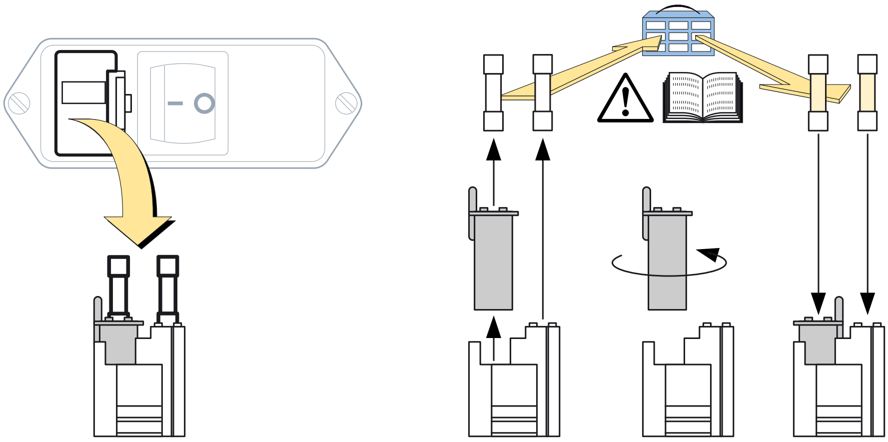


3.5.4 **Changing the mains voltage input (if required)**

The SIDOR can be set to 100 V or 115 V or 230 V mains voltage. To change the setting:

1 Disconnect the SIDOR from the power supply.
2 Pull out the fuse box (→ page 35, Figure 6).
3 Remove the existing fuses.
4 One of the fuse holders can be removed from the fuse box. Pull out this fuse holder, turn it 90° or 180° (as required) and put it back into the fuse box. The desired line voltage window should now be indicated on the front of the fuse box.
5 Insert fuses with matching specification (→ page 35, §3.5.5) into the fuse holders.
6 Re-install the fuse box.

Figure 6 Power fuses / Changing the required mains voltage



3.5.5
Internal fuses

> **CAUTION: Health risk**
> As long as the fuse box is removed, there are free electrical contacts which output the mains power voltage.
> ► *Before checking the fuses:* Disconnect the SIDOR from mains supply, or switch off the mains supply at an external point.

> **CAUTION: Risk of fire or damage by wrong fuses**
> If wrong fuses are installed, a fire could possibly be started when an internal component becomes defective.
> ► Use only those fuses as replacement which exactly meet the specified values (type of design, switch-off current, switch-off features).

Table 2 Power fuses

Line voltage	Fuse(s)	part no.
110 V	T4A0 D5x20	6027999
115 V		
230 V	T2A0 D5x20	6026946

Table 3 Fuses on the internal electronics board

Identification	Fuse(s)	Part no.	Protects
F1	TR5-F F1A0	6021782	+24 V DC output (→ page 37, §3.6.4)
F2	TR5-F F4A0	6010712	+24 V DC for relays, internal heating, internal gas pump (option)
F3	TR5-F F1A6	6026950	+5 V DC for digital electronics, IR source
F4	TR5-F F0A8	6032017	+15 V DC for analog electronics, measuring value output, motors
F5			−15 V DC for analog electronics, measuring value output, motors

> Each analyzer module has its own overheat fuse (→ page 175, "`FAULT: temperature` x (x = `1` ... 3)").

3.6 **Signal connections**

3.6.1 **Terminal connections**

12-pole plug connectors are use for the signal connections. The supplied counterparts are equipped with screw terminals and lock-in housings.

Each SIDOR connector has one blocked recess as a mechanical code for the connection. On the counterpart, the matching edge needs to be removed (→ Figure 7 and → Table 4).

Figure 7 SIDOR plug connector

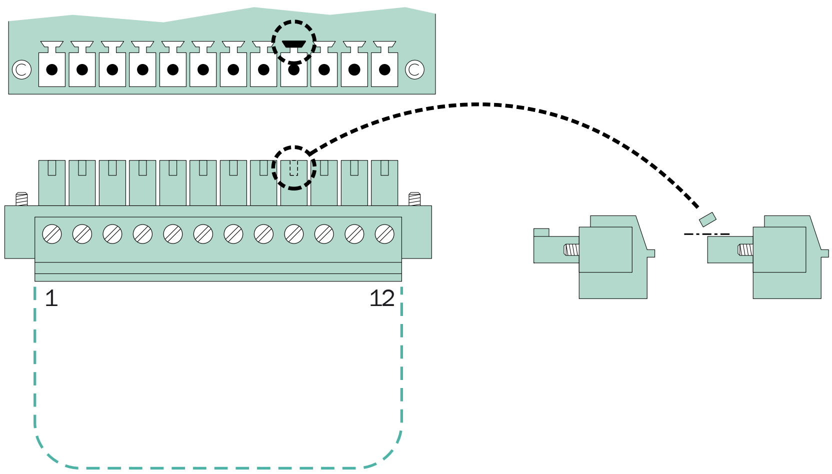


Table 4 Mechanical coding of the SIDOR plug connectors

Plug connector	X2	X3	X4	X5	X6	X7
Coding on pin no.	2	3	4	5	6	7

NOTICE:
Before making signal connections (also when connecting plug connectors):
► Disconnect power from all devices which are to be connected to the SIDOR.
Otherwise the internal electronics could be damaged.

3.6.2 **Signal cable specifications**

► Use *shielded* cable for all of the signal connections, with a low high-frequency impedance of the shield.
► Connect *one* side of the cable shield to GND/enclosure. Please make a short connection with a broad contact.
► Observe the shielding concept of the host system (if existing).

► Use appropriate cables only. Install all the cables properly.
Otherwise the specified EMI protection is not guaranteed, and sporadic and obscure functional problems might occur.

3.6.3 Maximum load

Maximum relay contact load

Table 5 Maximum permitted load for each opf the relay switch contacts [1]

product version		AC voltage (RMS)	DC voltage	current (RMS)
standard		max. 30 V AC	max. 48 V DC	max. 500 mA
CSA	either[2]	max. 30 V AC	max. 48 V DC	max. 50 mA
	or[2]	max. 15 V AC	max. 24 V DC	max. 200 mA
	or[2]	max. 12 V AC	max. 18 V DC	max. 500 mA

[1] All voltage values referenced to GND/enclosure.
[2] At user's choice.

NOTICE:
Inductive loads (for example, relays or solenoid valves) may only be connected if discharging diodes are provided.
- ► *When connecting inductive loads:* Check if discharging diodes are built-in.
- ► *If this is not true:* Install external discharging diodes (→ page 38, §3.6.5).

Maximum input voltage

- Peak voltage on the digital interfaces: ±15 V
- Highest permitted voltage at the opto-coupler inputs:
  - Control voltage: ±24 V DC
  - Peak voltage: 48 V
- Highest permitted peak voltage at the other signal connections: maximum ±48 V.

NOTICE:
Any voltage greater than 48 V (even fast peaks) could damage internal components.
- ► Keep voltage peaks and wrong external voltages away from the signal connections.

3.6.4 Outputs for signal voltage (auxiliary voltage)

An auxiliary voltage of 24 V DC is available at the connector pins "24V1" and "24V2". This can be used as voltage supply for external low-powered devices (for example, relays).

Both output pins are powered by the same internal voltage source; the permitted total amperage is 1 A (24V1 + 24V2), protected by an internal fuse (→ page 35, §3.5.5).

3.6.5 Anti-inductive protection for the signal connections

Internal EMI filters

There is an EMI filter between the internal electronics and each SIDOR signal connection. This also applies to analog measuring value outputs and digital interfaces; only the ground connections (GND) are not equipped with EMI filters. These internal EMI filters must be protected against high voltages.

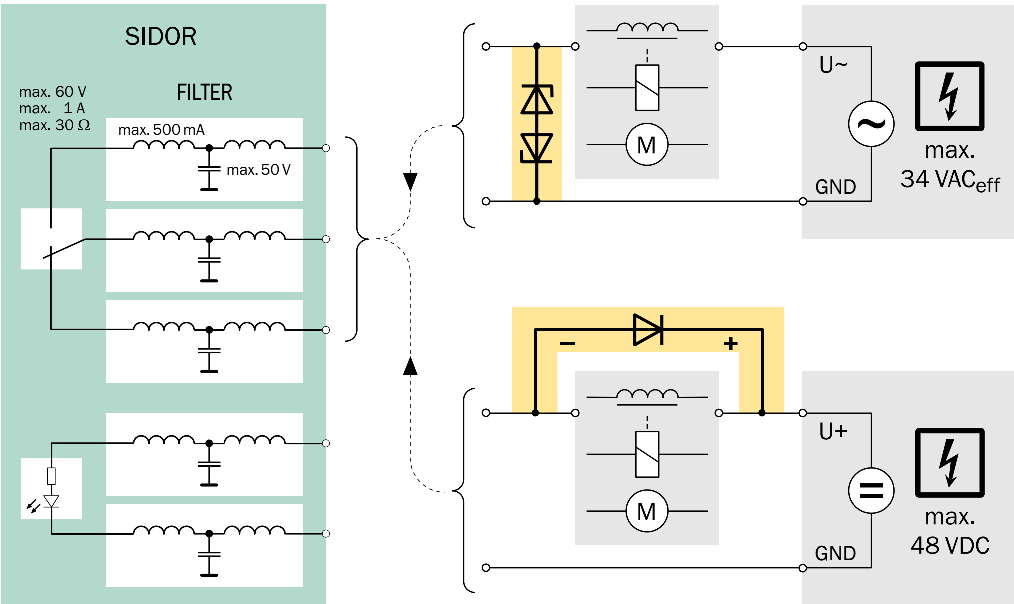
Risks caused by inductive loads

Devices, whose internal electric circuits are equipped with coils or windings with iron core, can produce a countervoltage which can be very much larger than the operating voltage. Such devices are, for example, solenoid valves, pumps, electrical bells, relays, and electrical motors. The countervoltage can immediately destroy an internal EMI filter. A defective EMI filter can short-circuit the signal connection to ground (GND).

Protective measures

> ***NOTICE:***
>
> ► *If an device is connected which can produce a countervoltage, and this device is not equipped with built-in discharging diodes:* install one or two "discharging diodes" to discharge inductive countervoltage (→ Figure 8).
>
> Otherwise internal EMI filters can be destroyed, which will make the entire internal electronics board useless.

Figure 8 Discharging diodes as a protection against inductive loads



3.7 Measuring value outputs

Function

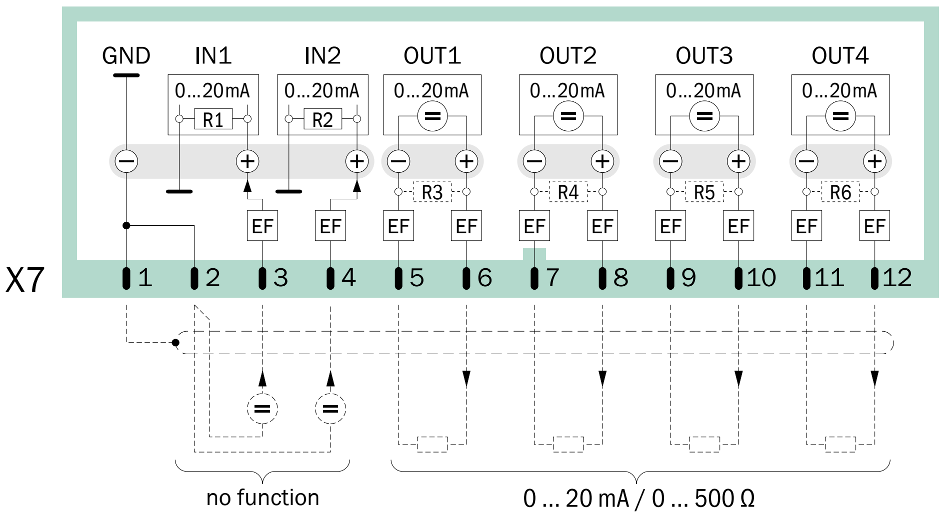
The SIDOR has four measuring value outputs which can be used for the different measuring components (OUT1 ... OUT4 → Figure 9).

- *Operation:* The SIDOR measures in a quasi-continuous mode. New measuring values are generated approximately every 0.5 seconds.
- *Measuring component:* You can select which measuring value output is used for a certain measuring component (→ page 76, § 7.8.1). The default assignment corresponds to the displayed order of the measuring components (→ page 56, § 6.2).
- *Output ranges:* Each measuring value output has two different output ranges (settings → page 77, § 7.8.2; range selection → page 78, § 7.8.4). The working output range can be indicated by a status output (→ page 81, § 7.9.4).
- *Function during calibration:* During calibrations, the measuring value outputs can either display the current test gas values or the last measuring value (→ page 79, § 7.8.6).
- *Zero-point setting:* You can influence how the measuring value output work at the beginning value of the measuring range (→ page 73, § 7.5.3). For example, this allows you to prevent negative measuring values from being displayed.
- The measuring value outputs are galvanically isolated from the other internal electronics. Negative electronic output signals will not occur.

Electrical signal – standard version/CSA version

- The standard signal is 4 ... 20 mA; permitted load: 0 ... 500 Ω.
- As an option, voltage signals can be set-up in the factory, for example 0 ... 10 V.
- The electrical display range can be set-up for 0 ... 100 %, 10 ... 100 % or 20 ... 100 % (corresponds to 0 ... 20, 2 ... 20 or 4 ... 20 mA; → page 78, § 7.8.5).

Figure 9 Plug connector X7 (measuring value outputs)



► Do not connect the minus pole of a measuring value output to Ground/GND. Otherwise the galvanical isolation is no longer kept.

3.8 Switch outputs

> You can individually make a test for each signal connection without setting or changing any of the SIDOR functions (→ page 103, § 7.18). This allows you, for example, to check the external wiring.

3.8.1 Switch functions

The SIDOR has 16 switch outputs which you can use in the following way:

- The switch contacts REL1, REL2 and REL3 are used for basic status messages (details → page 81, § 7.9.4). This assignment cannot be changed.
- The switch contacts REL4 ... REL8 and the transistor outputs TR1 ... TR8 can freely be assigned to any of the supplied status or control functions.
  - Which switch functions are available and how the desired assignment are made is described in §7.9 (→ page 80).
  - A list of all the available switch functions is shown in §17.3 (→ page 196). You may want to use this table to record your assignments.

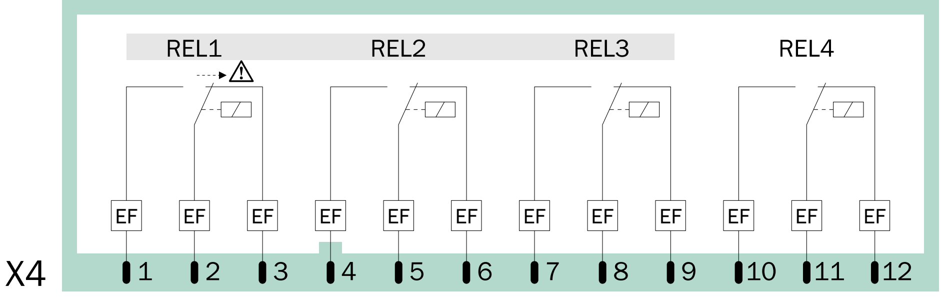
3.8.2 Electrical function

- The switch outputs REL1 ... REL8 are potential-free make & break contacts (→ page 41, Figure 10 and → page 41, Figure 11).
- The switch outputs TR1 ... TR8 are transistor outputs (→ page 42, Figure 12) which can be used to switch an external load. For this purpose, the SIDOR auxiliary voltage output should be used (→ page 37, § 3.6.4).
- The switch outputs can be programmed to work under the open-circuit or the closed-circuit principle (→ page 80, § 7.9.2).

> Transistor outputs can be used to switch a higher load than specified if an external relay is installed between the transistor output and the load:
> - Electronic shops offer various relay modules, for example with 8 electro-mechanical relays each. Please make sure that these are equipped with discharging diodes.
> - Consider if solid-state relays could be better. Solid-state relays do not require discharging diodes and can directly be connected to the transistor outputs.

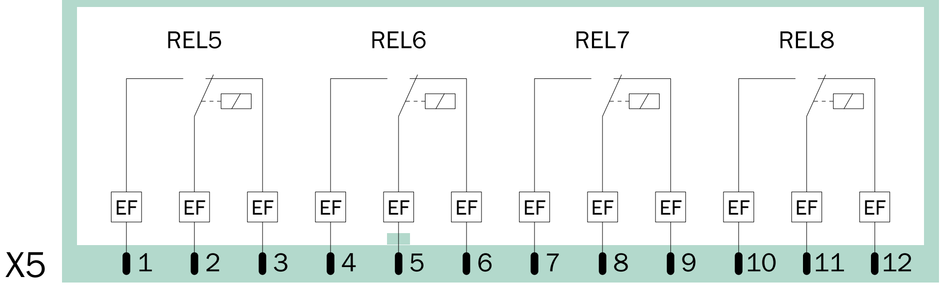
3.8.3 Contact connections (pin assignment)

Figure 10 Plug connector X4 (relay switch outputs)



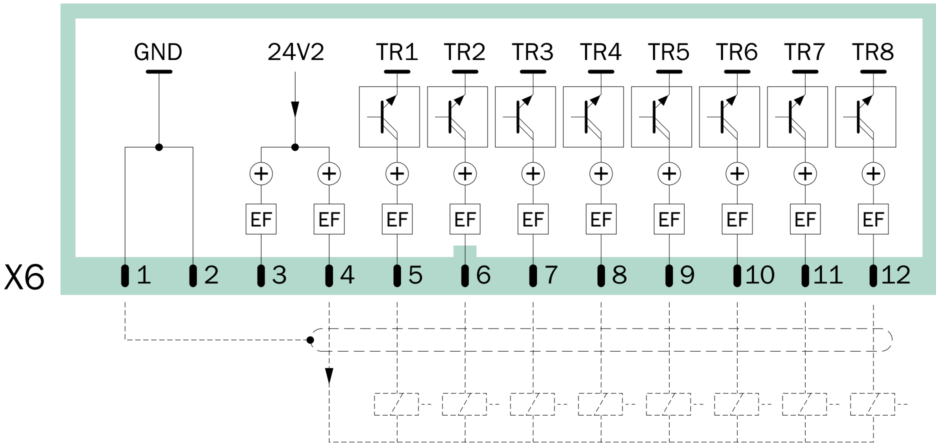
NOTICE:
- Observe the maximum contact load (→ page 37, §3.6.3).
- Keep any voltage greater than 48 V (even fast peaks) away from the signal connections (→ page 37, §3.6.3).
- *When connecting inductive loads (for example, relays or solenoid valves):* make sure that discharging diodes are provided (→ page 38, §3.6.5).

Figure 11 Plug connector X5 (Relay switch outputs)



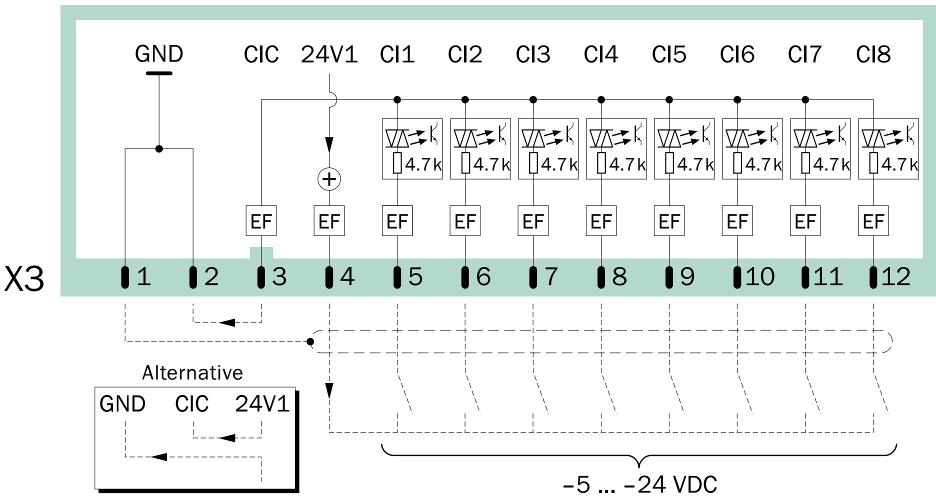
NOTICE:
- Observe the same safety notes as for plug connector X4 (→ Figure 10).

Figure 12 Plug connector X6 (transistor switch outputs)



> **NOTICE:**
> - To power these switches, use the internal auxiliary voltage source only (24 V DC → page 37, §3.6.4).
> - Observe the highest permitted load (maximum rating):
>   - for each individual transistor output: ≤ 500 mA (equals ≤ 12 W /external load ≥ 48 Ω)
>   - for the sum of all of the transistor outputs: ≤ 1000 mA (24 W)
>
>   Higher loads (even short-term or peak) will immediately destroy internal components.
> - When connecting inductive loads (for example, relays or solenoid valves), make sure that discharging diodes are installed (→ page 38, §3.6.5).

Figure 13 Plug connector X3 (control inputs)



> **NOTICE:**
> - Do not supply more than ±24 V DC for the control voltage.
> - Do not exceed the maximum peak voltage: 48 V
>
> Higher voltages could damage internal components. In addition, the safety separation of functional voltages would no longer be guaranteed.

3.9 Control inputs

3.9.1 Control functions

The SIDOR has 8 control inputs. Each of the control inputs can be freely assigned to any of the possible control functions (→ page 83, § 7.10).

A list of all the available control functions is shown in §17.4 (→ page 197). You may want to use this table to record your assignments.

3.9.2 Electrical function

The control inputs CI1 ... CI8 are opto-coupler inputs (→ page 42, Figure 13).

- *Activating:* The logical function of a signal input is activated when current is flowing between the control input connection and the common pole of the control input (CIC).
- *Control voltage:* ±5 ... ±24 V DC. You can use an external voltage source or the internal auxiliary voltage (24 V DC → page 37, § 3.6.4).
- *Polarity:* The opto-coupler inputs are bipolar, which means that they can be controlled either with positive or negative voltage; Figure 13 shows both alternatives when using the internal auxiliary voltage: The common pole (CIC) is either connected to ground GND (negative) or to 24V1 (positive).
- *Galvanic isolation:* The connections of the opto-coupler input are potential-free, i.e. they are galvanically separated from the rest of the SIDOR electronics. However, the galvanic isolation is no longer kept if one of the connections is connected to another non-isolated SIDOR contact (for example, GND or 24V1).
- *Internal resistance:* 4.7 kΩ for each control input.
- *External switch:* Mechanical switch contact or open-collector output.

NOTICE:
► Do not connect the control inputs to voltages greater than 24 V.
Otherwise internal components could be damaged, and the safe separation of functional voltages is no longer guaranteed.

You can test the current condition of each individual control input (→ p. 102, § 7.17.9). This allows you, for example, to check the external wiring.

3.10 Digital Interfaces

3.10.1 Function of the interfaces

- The SIDOR digital interfaces are serial interfaces (RS232C / V.24).
- Interface #1 can be used for remote control functions: SIDOR receives operating commands and sends data and status messages on command via the interface. This feature is available
  - with the MARC2000 software (→ page 137, §9)
  - with the "limited AK protocol" option (→ page 145, §10)
  - with the Modbus remote control functions (→ page 153, §11).
- Interface #2 is used to send measuring and calibration data and status messages.

3.10.2 Connecting the interfaces

If you wish to use one of the interfaces:

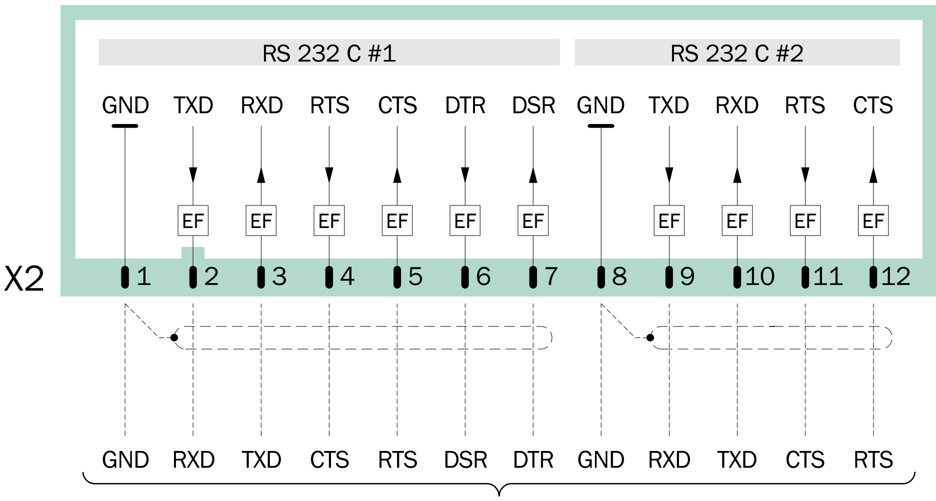
1 Connect the external instrument to the related SIDOR interface (→ page 44, Figure 14; more information → page 139, §9.2.1).

2 Set the interface parameters of the SIDOR and of the external instrument so that they are identical (→ page 84, §7.11.1).

3 For interface #2: Select if the SIDOR should automatically give certain data outputs (→ page 85, §7.11.2).

> - A serial interface can only work if the interface parameters of all connected instruments are identical.
> - The SIDOR offers a function that allows you to test the data output (→ page 103, §7.18).

Figure 14 Plug connector X2 (Interfaces)



NOTICE:
Maximum peak voltage for the digital interface connections = ±15 V

SIDOR

4 Start-up

Power-on procedure
Measurement preparations

4.1 Power-on procedure

A) Check/prepare

► Make sure that the SIDOR is set-up for your mains voltage (→ page 34, §3.5.4).
► Make sure that the sample gas supply system is working (→ page 28, §3.4.1).

B) Switch-on power

► Switch on the power switch, located on the rear side of the enclosure (0 / 1 → page 34, Figure 5), or switch on the external mains switch (→ page 33, §3.5.2).

Automatic procedures after power-on:

a) LED activities during power-on procedure (trouble-free condition):

LED	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
"Function"	red/green	red	red	red	green[1]
"Service"	on	on	off	on	off
"Alarm"	on	on	off	off	off

[1] When the operating temperature is reached and sample gas flow is established (gas pump on).

b) The microprocessor system is testing the SIDOR hardware. The display will show:

```
128 KB Ram & 1 MB Flash Memory ......
Real-Time Clock ....................
System Timers ......................
CPU Clock = 20.000 MHz .............
Processor: AM188ES Rev.:   B
Mainboard Version:    ..............
Startup-Code Version: xxxxxxx.......
8 KB non-volatile Parameters RAM.....
Power-Supply Voltages & ADC ........
      --- Tests finished ---
```

If no fault is detected, then `OK` will appear at the end of the line.

c) The microprocessor system is testing the data memory integrity.

››› *If the test was error-free:* the measuring display is shown (→ page 56, §6.2).
  ► Continue with → "C) Wait for the warm-up time to pass"

››› *If an error was detected:* the microprocessor will automatically recover the status which was saved after the last calibration (→ page 92, §7.13.1), which makes the SIDOR operative again. Then the measuring display is shown and the warm-up time begins.
  ► Continue with → "C) Wait for the warm-up time to pass"

C) Wait for the warm-up time to pass

As long as the internal operating temperature is not reached, the LED "Function "will be *red* (at least for 2 minutes after power-on; status message: `heating`).

► Wait until the LED "Function" is *green*.
► Then wait another 2 hours for the internal temperature to stabilize.

D) Prepare for measuring

► → §4.2

4.2 Preparation for measuring

- *Before making important measurements:* Check the SIDOR calibration – because only a correctly calibrated analyzer will produce correct measuring values. Check the calibration even if you have a brand-new analyzer (→ p. 105, §8).

> **CAUTION: Risk of wrong analysis**
> Without correct calibration, the measuring results might be wrong.
> - Make a new calibration whenever
>   - the SIDOR has been switched off for a longer time (for example, for more than 14 days)
>   - changes have been made to the SIDOR (for example, when sub-assemblies have been changed)
>   - something has been changed to the external installation (for example, the sample gas cooler)
>   - the SIDOR has been transported.

- *If the SIDOR has a built-in sample gas pump or if the SIDOR controls an external pump or a sample gas valve (→ page 80, § 7.9):* switched on the `Gas pump` function (→ page 62, §6.4.1).

SIDOR

5 Operation (general)

LEDs
Keypad
Display
Menu levels

Figure 15 Operating and display elements

5.1 LEDs

After power-on, all these LEDs are temporarily illuminated (→ page 46, § 4.1).

Function (green/red)

- A *green* light indicates that the SIDOR is operationally ready and the measuring operation can be started.
- A *red* light indicates that the SIDOR is not operationally ready. Possible reasons are:
  - After power-on, the operational temperature is not reached yet (→ page 46, § 4.1).
  - The SIDOR has detected an internal fault (for example, defective electronics)
  - The measuring function is disturbed (for example, the sample gas flow or the internal temperature is too low).

  Function “red” condition corresponds to the status output signal “Fault” (→ page 81, § 7.9.4). In most cases, the reason for trouble is indicated on the display (→ § 5.2).

Service (yellow)

If the “Service” LED is illuminated during normal measuring operation, a problem is coming up. The measuring function is not (yet) affected by this trouble, but a service technician should fix the problem soon. – In these cases, the “Service” LED corresponds to the status output signal “Service” (→ page 81, § 7.9.4).

The “Service” LED is also illuminated

- when a calibration is running (+ a certain time afterwards → page 119, § 8.5.7)
- when the menu branch `Service` is used (→ page 56, § 6.1)
- as long as the maintenance signal is activated (→ page 65, § 6.6).

Alarm (red)

Is illuminated when at least one measuring value is beyond a programmed alarm limit value. In addition, the following message appears on the display (example):

```
CO2    >    250.00 ppm
```

(= “the current CO_2 value is greater than the alarm limit value of 250.00 ppm”).

- Setting alarm limit values → page 74, § 7.6.1
- Programming the related switch outputs (→ page 80, § 7.9)

5.2 Status messages on the display

On the second to last display line, the SIDOR shows a message
- when an internal limit value has been exceeded (SERVICE: ...)
- when a faulty condition or a fault is detected (FAULT: ...)
- when an operating condition exists which affects the analysis.

If several status messages exist at the same time, then CHECK STATUS/FAULTS is displayed instead. The list of the all current status messages can be found under the Status/Faults menu (→ page 59, § 6.3.1).

- Example of a status line → page 51, § 5.3
- Clarification of status messages → page 172, § 13.2.

5.3 Principle of operation

5.3.1 Function selection

- For function selection, the SIDOR displays various “menus” with several selection options. The starting point is the main menu (→ page 56, § 6.1).
- To select a particular function, press the related number key.
- Using the various menu functions, you can
  - enter parameters (for example, limit values for “Alarm” signals)
  - start routines (for example, calibration)
  - test instrument functions.
- If a measuring display was activated when the analyzer was shutoff (→ page 56, § 6.2), then this display will be re-activated when the SIDOR is switched on again. To call-up the main menu, press the [Esc] key twice.

Display of menu functions (example)

Display	*Operating step / notes*
instrument status 2	← menu number and selected function
1 status/faults	← These ...
2 measuring ranges	←
3 signal outputs	←
4 alarm limits	←
5 instrument data	←
6 absolute drift	← ... are the possible selections in this menu
Enter digit	← operation note [1]
heating up ...	← status message (example; → page 51, § 5.2)
CO2 492.15 ppm	← current measuring values [2]

[1] The operating notes tell you how you could proceed with the menu operation (here: select a number). To cancel a function, use the [Esc] key.

[2] Even during menu operations, the current status message (if there is one) and the current measuring values are shown at the bottom line of the display.

5.3.2 Keypad

Next to the numerical keys (numbers 0 to 9, decimal point, minus key), there are four function keys for the SIDOR. They work in the same way as on a PC:

- [Esc] (Escape): Ends the displayed function and moves you back into the preceding menu, without changing the instrument status. Pressing the [Esc] key several times will bring you back to the main menu.
- [Help]: Gives you information on the menu or function which is currently displayed.
- [<] (Backspace): Deletes the last digit of the current entry.
- [Enter]: Enters the input or displayed value and stores it as the new value.

- In many of the input procedures, the currently stored value is shown after `Status`. When you have entered a new value, you need to push [Enter] to store this new value.
- The SIDOR can give a signal tone for each keypad entry. The tone intensity is adjustable (→ page 64, §6.4.4).
- Even during menu operation, the SIDOR is permanently analysing. This is why the SIDOR may sometimes react a little slow to a keypad entry.

If you wish to learn about the operating functions, you can call-up menus and [Help] texts as you like. As long as you don't press the [Enter] key in an input menu, you will not change any of the settings.

5.3.3 Menu levels

The SIDOR menu functions are sub-divided into "menu levels":

- standard functions
- expert functions
- hidden expert functions
- factory settings

Standard functions

are categorised as the operating functions, necessary for routine operations of the SIDOR. With this group of functions you can:

- check the instrument status on the display
- switch the sample pump on and off
- activate a status output to signal that maintenance work is currently in progress
- start or run a calibration

Description of these functions → page 55, § 6.

Expert functions

are used for setting instrument parameters and for instrument testing. They are only available after pushing the hidden key (→ page 68, § 7.1). With this group of functions you can for example:

- set the limit values for "Alarm" signalling
- set the power of the built-in gas pump (option)
- set the communication parameters of the digital interfaces
- set-up the automatic calibration routine
- enter the nominal values of the calibration gases
- test all of the inputs and outputs

Some advanced expert functions are located in a "hidden" menu branch which can be accessed via a special key code (→ page 68, § 7.1). With this group of functions you can, for example:

- assign a switching function to each of the configurable signal connections
- influence how the measuring value output works
- save all of the settings and restore previous settings

Description of the expert functions → page 67, § 7.

- You should only use the expert functions when you are completely familiar with the effects of the function settings and you understand the procedures.
- If a "service block" control input is set-up and activated (→ page 83, § 7.10.2), then many of the menu functions cannot be used.

Factory settings

In the "factory settings" menu, factory-trained technicians can change basic instrument settings. Access to this group of functions is not shown in the menus and they are only accessible with a pass code.

The factory settings are not described in this instruction manual.

SIDOR

6 Standard functions

Main menu
Measuring displays
Status messages
Pump control
Maintenance signal

6.1
Main menu

`main menu`	
`1 measuring display`	← standard functions
`2 instrument status`	←
`3 control`	←
`4 calibration`	←
`5 maintenance signal`	←
`6 settings`	← expert functions
`7 service`	←
`Enter digit`	← operation note
`no messages`	← status messages [1]
`CO 12 mg/m3`	← measuring values (alternating)

[1] Clarification (in alphabetical order) → page 172, § 13.2.

At first, the expert functions are hidden; access → page 68, § 7.1.

6.2
Measuring displays

6.2.1
Combined display for all components

Function

This type of display allows you to see all current measuring values at the same time. The display is updated every 2 seconds (approximately).

Activation

Select `main menu → measuring display → all components`.

The following should appear on the display (example):

`CO` [bar graph]	← bar graph display [1]
`120 mg/m3`	← current measuring value [2]
`SO2` [bar graph]	
`97 mg/m3`	
`O2` [bar graph]	
`10.6 vol.%`	
`Operation: ESCAPE`	← Press [Esc] to leave this display.

[1] Symbolises the magnitude of current measuring value, either in relation to the measuring range or to the output range (selection → page 70, § 7.4.2).

[2] Possibly the measuring values are displayed more accurate than the specified measuring accuracy would allow (→ page 70, § 7.4.1).

- The display contrast is adjustable (→ page 64, § 6.4.3).
- When a measuring value exceeds the internal calculation limits, then the SIDOR will display a fault message. – This feature can be disabled (→ page 75, § 7.6.2).

6.2.2 Large display for one selected component

Function

You can select a large version of the measuring display for only one measuring component – for example, if you would like to watch this measuring value more closely. The measuring values for the other components are displayed in the bottom text line.

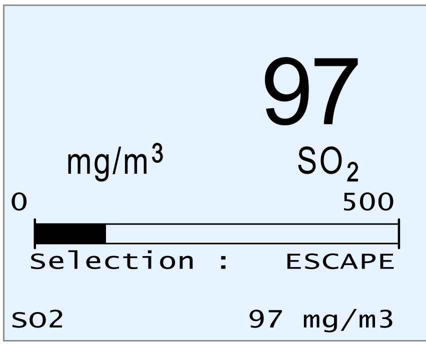
The display is updated every 2 seconds (approximately).

Activation

1 Select `main menu → measuring display`.

2 Select the desired measuring component.

The following should appear on the display (example):



← current measuring value [1]

← units of measurement, measuring component

← physical measuring range end value [2]

← bar graph display [3]

← press [Esc] to leave this display

← other measuring values (shown sequentially)

[1] Possibly the measuring value is displayed more accurate than the specified measuring accuracy would allow (→ page 70, § 7.4.1).

[2] The SIDOR displays measuring values which exceed the maximum values within limits, however, the accuracy of these measuring values is not known.

[3] Symbolises the magnitude of current measuring value, either in relation to the measuring range or to the output range (selection → page 70, § 7.4.2).

6.2.3 Chart recorder simulation

Function

The SIDOR can graphically show the trend of the measuring values, like the paper on a chart recorder: Current measuring values are displayed at the top and “wander” slowly towards the bottom of the display. In this way you can continuously monitor the trend of the measuring values. The time scale is adjustable from 1 to 32 hours. The value range corresponds to the current output range.

In addition, you can have the analyzer display the following values:

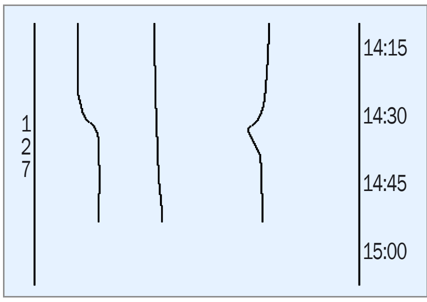
– temperature inside the SIDOR enclosure (numerical display → page 100, § 7.17.2)

– sample gas pressure / atmospheric pressure (numerical display → page 100, § 7.17.3)

Activation

1 Select `main menu` → `measuring display` → `chart recorder`.

Then a display like this is shown:



← on top: the current measuring values [1]

← below: previously measured values

←

←

[1] Beginning of the range = left.

- If you do not see any measuring line, there are possibly no previous measuring values available to display. Try selecting the smallest time interval (see below) and wait for a few minutes.
- Moreover, you might not see “lively” chart lines when the measuring values are constant (for example, when they are “0”), or when they are identical, or if there are no measuring values activated to display.

2 Using the keypad, select which measuring values should be displayed:

Key	toggles the display for the ...
[1]	measuring value of the measuring component assigned to output OUT1
[2]	measuring value of the measuring component assigned to output OUT2 [1] [2]
[3]	measuring value of the measuring component assigned to output OUT3 [1] [2]
[4]	measuring value of the measuring component assigned to output OUT4 [1] [2]
[5]	measuring value of the fifth meas. component (not assigned to any output) [1]
[6]	internal temperature (0 ... 100 °C)
[7]	measuring value for the built-in pressure sensor (900 ... 1100 hPa)
[8]	*no function*
[9]	all values [1] ... [8]
[0]	no values

[1] If available.

[2] If a measuring component is assigned more than once, only *one* line will be displayed.

3 Select the desired time interval to be displayed:

Key	Effect
[Enter]	toggles the time interval in steps: 1/32/16/8/4/2/1/32/... hours
[.]	shifts the time interval 25 % towards the past
[-]	shifts the interval 25 % towards the present [1]
[<]	resets to default setting (starting time = present, interval = 1 hour)

[1] If the interval was previously shifted towards the past.

- These functions are also explained when you select the on-line [Help].
- If you want to determine which lines represent which values then try switching single values on and off.

4 To exit this display, press [Esc].

6.3 Status displays

6.3.1 Display of status/fault messages

Function

When you call-up `instrument status - status/faults`, a list of all current fault and status messages is displayed.

Activation

Select `main menu → instrument status → status/faults`.

status/faults	
heating ...	← The current status messages ...
FAULT: condensate	←
	←
	←
	←
	← ... are shown here [1]
Back : ESCAPE	To exit this display, press [Esc].

[1] Clarification (in alphabetical order) → page 172, § 13.2.

6.3.2 Display of measuring ranges

Function

Using the menu `instrument status - measuring ranges`, you can see the physical measuring ranges. These settings can only be changed in the factory.

Activation

1 Select `main menu → instrument status → measuring ranges`.

2 Select the desired measuring component.

measuring ranges	
O2 0.00 vol.%	← physical measuring range beginning value
to 20.00 vol.%	← physical measuring range end
Reference gas	
20.00 vol.%	← physical zero-point of the related analyzer module
Back : ESCAPE	To exit this display, press [Esc].

- To display the output range of the meas. value outputs → page 60, § 6.3.3
- To set the output ranges → page 77, § 7.8.2

6.3.3 Display of measuring value outputs

Function

The `instrument status - meas. value outputs` display shows which measuring values are given via the analog outputs and which output ranges are set-up.

Activation

1 Select `main menu` → `instrument status` → `meas. value outputs`.

2 Select the desired `meas. value output`.

meas. value output 2	← meas. value output number
O2	← assigned measuring component
4...20 mA	← electrical measuring span (output span)
0.00 - 25.00 vol.%	← physical meas. range of the meas. component
[1] 0.00 - 10.00	← beginning and end value for output range 1
switch pt.: 10.00	← switching pt. for auto. range switching 1 → 2
[2] 0.00 - 25.00	← beginning and end value for output range 2
Switch pt.: 9.50	← switching pt. for auto. range switching 2 → 1
active 2	← current output range
Back : ESCAPE	To exit this display, press [Esc].

- Assignment of the measuring components → page 76, §7.8.1
- Output range settings → page 77, §7.8.2

6.3.4 Display of alarm limit values

Function

The menu `instrument status – alarm settings` displays the settings of the alarm limit values (→ page 74, §7.6.1).

Activation

Select `main menu` → `instrument status` → `alarm settings`.

alarm settings	
component ef value	
[1] CO2 > 360.00	← [...] = alarm number
[2] O2 < 12.75	← < = alarm is given below the limit value
[3] CO2 > 250.00	← > = alarm is given above the limit value
[4] Not in use !	← this alarm limit value is not defined
Back : ESCAPE	To exit this display, press [Esc].

6.3.5 Display of instrument data

Function

The menu `instrument data` offers the following information:

- individual instrument identification
- version of internal hardware and software
- built-in analyzer modules

Activation

Select `main menu` → `instrument status` → `instrument data`.

instrument data	
instrument name:	
SIDOR	← stored instrument name
instrument no.:	
123456	← serial number
hardware version: 1	← electronic card version in your analyzer
software version:1.28	← version of the software in your analyzer
sensor type 1-3	
SIDOR	← built-in analyzer module (example)
OXOR	← built-in analyzer module (example)
Back: ESCAPE	To exit this menu, press [Esc].

6.3.6 Display of drift values

Function

The “absolute drifts” represent the total drift over a number of calibrations (thus they do not represent the difference between the last two calibrations).

A new summation of “absolute drifts” will be started

- after a drift reset (→ page 124, §8.7)
- after a basic calibration (→ page 126, §8.8.2).

> - After a drift reset or a basic calibration, there are no absolute drifts until a new calibration has been made.
> - This also applies to brand-new analyzers where absolute drifts will not appear before a calibration has been made.

“Absolute drifts” are referred to the displayed measuring values (including linearisation, drift compensation, etc.). Zero-point drifts are related to the physical measuring span of the related analyzer module; sensitivity drifts are related to the nominal value of the test gas used during calibration.

Activation

Select `main menu` → `instrument status` → `absolute drifts`.

absolute drifts			
	zero-d	span-d	← “zero-point drift” / “sensitivity drift”
CO	0.2%	-2.3%	← (example values)
SO2	-1.0%	-1.6%	←
O2	-0.7%	0.3%	←
Back : ESCAPE			To exit this menu, press [Esc].

6.4 Control

6.4.1 Switching the gas pump on/off

Function

This function allows to switch the built-in gas pump (option) and the switch output "external pump" (→ page 81, § 7.9.4) on and off.

> The gas pump will automatically remain switched off
> – as long as the SIDOR has not reached its operating temperature
> – when the built-in condensate sensor (option) indicates "fault" condition
> – when calibration gas is fed into the SIDOR (if this feature is activated → page 117, § 8.5.4)
> – if the control input "gas pump off" is set-up and activated (→ page 83, § 7.10.2).

Setting

Select `main menu` → `control` → `gas pump on/off`.

`gas pump on/off`
 	
`Selection: 0=OFF`
`           1=ON`
 	
`Status    :   OFF`
 	
`Input     : ■ OFF`
 	
`Save      : ENTER`
`Back      : ESCAPE`
	To change the status:
	1 Enter either [0] or [1].
	2 Press [Enter].
	3 Press [Esc] to exit this function without any (more) changes.

> If a "service block" control input is set-up and activated (→ page 83, § 7.10.2), then this menu is not available.

6.4.2 Acknowledging alarms

Function

For safety purposes, some SIDOR status messages will remain activated even when the initial reason for the message does not exist any more. This applies to:

– the fault message from the condensate sensor (option)
– “Alarm” messages, if this characteristic is activated (→ page 74, § 7.6.1)

Notes on the “condensate” fault message

If the SIDOR is equipped with a built-in condensate sensor (option), the message `FAULT: condensate` is given when condensation occurs in the internal sample gas path and/or when a conductive liquid has entered the SIDOR sample gas path.

It might happen that the condensate is only present for a short time, and after a while the condensate sensor is “dry” again. However, some components of the SIDOR measuring system might have been damaged by the condensate. This trouble should always be checked. This is why the `FAULT: condensate` message is not automatically cancelled when the condensate sensor no longer detects a fault condition.

> **!** ***NOTICE:***
> *When* `FAULT: condensate` *is indicated:*
> ► First locate and repair the source of the problem (→ page 173).
> ► Then go ahead and switch off the fault signal.

Procedure

1 Select `main menu → control → acknowledge`.

2 The status messages which need to be acknowledged will be displayed. There is a code above each status message. A code letter identifies the current status:

Table 6 Code letters for status messages which need to be acknowledged

Code	The cause for the status message is ...	The status message is currently ...
–	currently not present	not activated
A	actively present	activated (not acknowledged)
N	currently not present	
Q	actively present	acknowledged and deactivated

3 To acknowledge the status message: Enter the desired code and press [Enter].

6.4.3 Setting the display contrast

Function

LC displays don't have a wide viewing angle. However, the `display` setting allows you to adjust the visual impression. Just try which setting is best for your location.

Setting

Select `main menu → control → display`.

`Display`
 	
`Unit:          value`
`Min. value:        0`
`Max. value:        9`
 	
`Status :    7`
 	
`Input:     ■`
` Back: ESCAPE`
	To change the status:
	1 Enter a new value. The display contrast will immediately change.
	2 To save the value, press [Enter].
	
	To exit this function, press [Esc].

If a "service block" control input is set-up and activated (→ page 83, § 7.10.2), then this menu is not available.

6.4.4 Setting the keypad click

Function

The SIDOR can give an acoustic signal on each keypad entry. The length of the tone is adjustable, which allows you to adjust the intensity. – To disable the key click, set the status value to "0".

Setting

Select `main menu → control → keypad click`.

`keypad click`
 	
`unit:          value`
`min. value:        0`
`max. value:       20`
 	
`Status :    7`
 	
`Input:     ■`
` Back: ESCAPE`
	To change the status:
	1 Enter the desired value.
	2 Press [Enter].
	
	To exit this function, press [Esc].

If a "service block" control input is set-up and activated (→ page 81, § 7.9.4), then this menu is not available.

6.5 Calibration (note)

The `calibration` function allows you to

- start or perform calibration procedures
- check the stored calibration parameters
- check the starting time of the next automatic calibration (if set).

All these functions are explained in a separate chapter (→ page 105, §8).

6.6 Maintenance signal

Function

The status output "service" (→ page 81, §7.9.4) can also be activated from the keypad. This can be used as a signal message to an external place to indicate that the SIDOR is not working in measuring mode; for example, because maintenance is currently made.

Setting

main menu 1 measuring display 2 instrument status 3 control 4 calibration 5 maintenance signal	Select `maintenance signal`.
maintenance signal Selection: 0=OFF 1=ON Status : OFF Input : ■ OFF Save : ENTER Back : ESCAPE	To change the status: **1** Enter either "0" or "1". **2** Press [Enter]. ● Press [Esc] to exit this function without making any (additional) changes.

- If a "service block" control input is set-up and activated, then this menu is not available.
- This menu function can also be interrupted/cancelled by switching the "service block" (→ page 83, §7.10.2).

Don't forget to switch off the maintenance signal when it is no longer required.

SIDOR

7 Expert functions

Adaptations
Analyzer configuration
Function settings

7.1 Access to the expert functions

- General explanation of the expert functions → page 53, §5.3.3
- Hidden expert functions → §7.2

To access the expert functions, make the following steps:

Display	*Operation step / notes*
any menu	► Press [Esc] until the `main menu` appears.

`main menu`
 	
`1 measuring display`
`2 instrument status`
`3 control`
`4 calibration`
`5 maintenance signal`
	► Press the decimal point key [.]
	After that ...

`main menu`
 	
`1 measuring display`
`2 instrument status`
`3 control`
`4 calibration`
`5 maintenance signal`
`6 settings`
`7 service`
	... the menu items `6` and `7` are available.
	
	► *To hide the expert functions:* press the decimal point key [.] again.

If a “service block” control input is set-up and activated, then only the menu items `1` and `2` are available in the `main menu` (→ page 83, §7.10.2).

7.2 Hidden expert functions

Some of the expert functions are located in menu branch `69`. However, menu item `9` is not shown in the `settings` menu. To access the expert functions in menu branch `69`:

1. Call up the `settings` menu (→ §7.1).
2. Press the [9] key.
3. Enter this `Code:` [7] [2] [7] [5] [Enter]

After that, menu `69` is displayed, with all its functions available.

7.3 Local adaptation (localization)

7.3.1 Language

Function

Each SIDOR can display the menu texts and the “Help” information in different languages. You can change the language at any time. Call-up the selection menu to see the available languages.

Setting

1 Call-up menu 66 (`main menu → settings → language`).

2 Select the desired language from the displayed list.

7.3.2 Clock settings

Time

1 Call-up menu 611 (`main menu → settings → clock → time`).

2 Enter the current time and press [Enter]. When you press the key, the internal clock starts with the entered time and `:00` seconds.

> Check also the summer time/standard time setting.

Date

1 Call-up menu 612 (`main menu → settings → clock → date`).

2 Enter the current date and press [Enter].

Summer time or standard time

With summer time, the clock is set one hour forwards. – Example: standard time 18:00 = summer time 19:00.

1 Call-up menu 613 (`main menu → settings → clock → std./summer time`).

2 Select `standard time` or `summer time` and press [Enter].

Time format

The internal clock can be set to display either in European 24-hour format (`00.00` to `23.59`) or in American `am/pm` format.

1 Call-up menu 614 (`main menu → settings → clock → time format`).

2 Input the desired setting and press [Enter].

Date format

The date can be displayed in European format (day.month.year) or in American format (month-day-year).

1 Call-up menu 615 (`main menu → settings → clock → date format`).

2 Input the desired setting and press [Enter].

7.4 Display of measuring values

7.4.1 Number of decimal places

Function

A maximum of five characters can be used to display a measuring value. And if the measuring value includes decimal places, you can select the desired number of decimals. The selection range depends on the number format of the physical measuring range end value.

- If the measuring value display includes 4 or 5 characters, then the measuring value display is more accurate than the real measuring accuracy. Moreover, the last digits might permanently fluctuate even when the measuring value should be seen as constant (within the limits of the measuring accuracy/signal “noise”). This effect can be influenced by the `damping` (→ page 71, § 7.5.1).
- If you limit the number of decimal places so that the measuring value display only contains 2 or 3 numbers, then you might possibly not be able to notice slow measuring value shifts in time.

Setting

1 Call-up menu 623 (`main menu → settings → measurement → meas. value display`).
2 Select the desired measuring component for the following setting.
3 Select `decimal places`.
4 Set the desired number of decimal places (select anywhere between `min.value / max.value)`.

7.4.2 Bar graph range

Function

You can select if the “bargraph” display (→ page 56, § 6.2) represents the physical measuring range of the related measuring component or if it represents the current output range of the associated measuring value output (→ page 78, § 7.8.4).

Setting

1 Call-up menu 623 (`main menu → settings → measurement → meas. value display`).
2 Select which measuring component the setting should be made for.
3 Select `bargraph range`.
4 Select `phys. meas. range` or `output range`.

7.5 Measuring value computation

7.5.1 Damping (average value computation)

Function

The signals of the measuring value outputs are updated approximately every 0.5 seconds. In some applications, this may cause some problems:

- Rapid changes in the gas concentration will cause “leaps” between the generated measuring values.
- If the current gas concentration fluctuates around an average value, this will produce many different measuring values. However, you may want to see the average value.

You can reduce these effects by setting a “damping” value. When you set-up this, the SIDOR will not display the current measuring values, but averages of the current and the previous values (floating averaging).

- You can set the damping for each measuring component individually, e.g in order to optimise the setting for each analyzer module.
- The damping effects both the display and the measuring value output signal.
- The damping is also effective during calibration.

> - Increasing the SIDOR damping value will increase the total response time (90% time) of the gas analysis system.
> - Reducing the damping can possibly increase the measuring “noise”.
> - The response time of the gas analyzer also depends on the gas delivery (for example, filter volumes and length of the sample gas line).

> If you need to compensate for measuring value fluctuations without increasing the response time significantly, try the “dynamic damping” (→ page 72, § 7.5.2).

Setting

> **CAUTION: Risks to connected devices**
> If the damping is changed during measuring operation, it might happen that the measuring values make a rapid change once.
> ► Make sure that this situation cannot cause problems at connected devices.

1 Call-up menu 624 (`main menu → settings → measurement → damping (el. T90)`).
2 Select which measuring component the setting should be made for.
3 Set the desired time constant.

> **CAUTION: Risk of wrong calibration**
> The calibration measuring time should be at least 150 ... 200 % of the programmed damping time constant.
> ► *If the damping is increased or set-up for the first time:* Check if the calibration measuring time needs to be re-adjusted (→ page 120, § 8.5.8).

7.5.2 Dynamical damping

Function

Dynamical damping is automatically de-activated when the measuring value is changing rapidly and strongly. This allows you to “smooth out” continuous minor fluctuations of the measuring value, while having an instant response when the measuring value is changing rapidly.

The dynamical reaction is controlled by an adjustable threshold: When dynamical damping is selected, the SIDOR is permanently comparing the difference of successive measuring values, as generated from the internal process. If this difference is greater than the threshold value, the dynamical damping is de-activated:

- If the differences continue to be greater the threshold value (which means that the measuring values are still changing rapidly), the damping effect will fade out – after the selected damping time constant has run down, the damping effect is completely off and does not slow down the response time any longer.
- As soon as the differences of the measuring value come down and remain below the threshold value (which means that the measuring values changes are small and slow), the damping effect will gradually come back into operation.

Functional features

- The time constant of the damping and the threshold value are individually adjustable for each measuring component.
- The dynamical threshold is always related to the measuring span of the current output range of the corresponding measuring value output.
- The dynamical damping effects the measuring value output signal and the displayed measuring values.
- Dynamical damping is also effective during calibration.

Setting the time constant

1. Call-up menu 6971 (`main menu` → `settings` → [9] → [Code] → `dyn. damping` → `integration time`).
2. Select which measuring component the setting should be made for.
3. Set the desired time constant. (1 ... 120 s).

Setting the dynamical threshold

1. Call-up menu 6972 (`main menu` → `settings` → [9] → [Code] → `dyn. damping` → `threshold value`).
2. Select which measuring component the setting should be made for.
3. Set the desired threshold value. – Setting range: 0.0 ... 10.0 % of the measuring value output range (span). 0.0 = dynamical damping off (de-selected).

> **CAUTION: Risk of wrong calibration**
> The calibration measuring time should be at least 150 ... 200 % of the programmed damping time constant.
> ► *If the damping is increased or set-up for the first time:* Check if the calibration measuring time needs to be re-adjusted (→ page 120, §8.5.8).

7.5.3 Suppression at the begin of the measuring range (meas. signal window)

Function

In some applications it may be desired that all measuring values which are close to the beginning value of the physical measuring range, are displayed as “ 0 ” (or as the respective beginning value). This would “mask” measuring fluctuations at the zero-point. For example, this could be used to suppress the display of negative measuring values, or if the measuring values are delivered to an external control unit, to “turn down” the control to zero in case of very small measuring values. You can set-up masked ranges

- separately for a range above and below the physical beginning value of the range
- individually for each measuring component

Masked ranges are effective for all measuring value indications concerned, i.e. for

- measuring values shown on the SIDOR display
- measuring value output signals
- digital measuring value outputs via interface

> **CAUTION: Possible effects on connected devices**
>
> - *When operating* with *a measuring signal mask:* Within masked ranges, the displayed measuring value usually does not correspond to the true current measuring value. As soon as the true measuring value leaves the masked range, the displayed measuring values will suddenly change from the “masked” condition the current measuring value. A similar effect will happen in reverse direction. If an external controller is connected, these effects should be considered.
> - *When operating* without *a measuring signal mask:* The measuring value displays will exactly follow the current measuring signals, even at the beginning of the measuring range. Due to the limited measuring accuracy, also small *negative* measuring values could be displayed. (This does not apply to the analog measuring value outputs which cannot produce negative signals.)
>
> ► Consider the effect of measuring signal masks on connected devices.

Setting

1. Call-up menu 692 (`main menu` → `settings` → [9] → [Code] → `meas. sig. window`).
2. Select the `meas. component` for which this following settings should apply.
3. Select `neg. window` or `pos. window`.
4. Set the end value of the masked range. (The beginning value of the masked range is identical to the beginning value of the physical measuring range).

7.6 Monitoring of measuring values

7.6.1 Alarm limit values

Function

You can set four limit values to monitor the measuring values. The associated “Alarm” signal can be given when the measuring value is above the limit value or when it is below the limit value. You can also decide if the “Alarm” signal remains activated even when the measuring value is no longer beyond the limit value, until the “Alarm” signal is manually “acknowledged” (→ page 63, § 6.4.2).

When the measuring value exceeds a programmed limit value

- the LED “Alarm” on the SIDOR front panel is illuminated
- the SIDOR displays a message like `CO2 > 250.00 ppm`
- the related “Alarm” status output is activated (→ page 81, § 7.9.4)

For an overview of all alarm limit settings, call-up `main menu` → `instrument status` → `alarm settings`.

Setting

1 Call-up menu 622 (`main menu` → `settings` → `measurement` → `alarm settings`).

2 Select the desired `alarm limit value` (1 ... 4).

3 Make the following settings:

`meas. component`	the measuring component for which the following settings will be valid
`set point`	limit value in physical (engineering) units

`effect`	`exceeds set pt.` = “Alarm” will be given when the measuring value is larger than the `set point`
	`under set pt.` = “Alarm” will be given when the measuring value is smaller than the `set point`
	`off` = the limit value is deactivated (settings are kept, but have no effect)

`acknowledge`	`off` = the “Alarm” signal is shutoff as soon as the measuring value is no longer beyond the `set point` `on` = the “Alarm” signal will remain until the signal is manually “acknowledged” (→ page 63, § 6.4.2)

7.6.2 Overflow warnings

Function

The SIDOR monitors its own limits of measuring signal processing:

- When a measuring value is larger than 120 % of the end value of the related physical measuring range, the following fault indications are activated:
  - The LED "Service" is illuminated.
  - The display message `FAULT: overrange x` is shown.
  - The status output "service" is activated (function → page 81, § 7.9.4)
- When an internal measuring signal exceeds the limits of the internal measuring value processing, the following fault indications are activated:
  - The LED "Function" shines red.
  - The display message is shown `FAULT: signal #x` is shown.
  - The status output "fault" is activated (function → page 81, § 7.9.4)

You can disable these indications. You may want to do this if connected devices would consider these indications as a malfunction of the analyzer, although it is fully working and the real reason are very high measuring values.

Procedure

1 Call-up menu 693 (`main menu` → `settings` → [9] → [Code] → `meas. signal effect`).

2 Select the desired function:

`no over range al.`	refers to the fault message which is given when a measuring value exceeds 120 % of the physical measuring range (measuring value warning)
`no overflow alarm`	refers to the fault message which is given when a measuring signal exceeds the limits of the internal signal processing (overflow warning)

3 Now select the desired mode for this function:

`OFF` = automatic fault message is enabled (= standard setting)

`ON` = automatic fault message is disabled

7.7 Configuration of calibrations (note)

For information on menu branch 63 (`main menu` → `settings` → `calibration`), please refer to §8.5 (→ page 115).

7.8 Configuration of measuring value outputs

> A measuring value output needs to be assigned to a particular measuring component before you can make all the other associated settings.

7.8.1 Assigning a measuring component

Function

Each measuring value output can be assigned to one of the measuring components. You can also assign one certain measuring component to several measuring value outputs.

Note: If you want to change an existing assignment, you must first delete the settings of the related measuring value output. Otherwise your selection would be without effect.

Setting

1 *If an existing assignment is to be changed:* delete the settings of the related measuring value output (→ page 79, § 7.8.7).
2 Call-up menu 621 (`main menu → settings → measurement → meas. value outputs`).
3 Select the desired `meas. value output`.
4 Call-up `meas. component`.
5 Select the desired measuring component from the available list.
The selected component is indicated by `>`.

7.8.2 Setting-up the output ranges

Function

The output ranges for the measuring value outputs have been set-up in the factory, but they can be modified.

With the option "second output range", each measuring value output can have two output ranges which can be independently set. Please note:

- The difference between the beginning and end value of an output range shall be at least 10 % of the physical measuring range end value. This limitation is automatically set in the related setting menus.
- The output ranges should logically overlap. A "gap" between the output ranges is not allowed.
- These settings can not change the physical measuring range.
- Output range 2 should correspond to the physical measuring range.

Setting

1 Call-up menu 621 (`main menu → settings → measurement → meas. value outputs`).
2 Select the desired `meas. value output`.
3 Select `output range 1` or `output range 2`.
4 Set the following values:

`begin value`	physical beginning value for this output range
`end value`	physical end value for this output range
`switch value`[1]	`switch-up value` = the measuring value where the analyzer should switch from output range 1 to output range 2. Usually this is the same value as the end value of this output range. But you can also select any value within the displayed `Min./Max.` range.
	`switch-down value` = the measuring value where the analyzer should switch from output range 2 to output range 1. The `switch-down value` must be *smaller* than the `switch-up value`. Set-up this value in such a way that the difference between the `switch-up value` and the `switch-down value` is significantly larger than the specified measuring accuracy of the SIDOR.

[1] Only for analyzers equipped with the option "second output range".

► Do not set-up identical switch values.
Otherwise the SIDOR would permanently be switching between the output ranges when the measuring value is at the switch point.

- Standard difference between the switch values:
  2 % of the related physical measuring range.
- Set-up a greater difference between the switch values if the measuring values can be expected to be fluctuating or "noisy".

7.8.3 Display of output ranges

To display the output ranges for each measuring value output:

1 Call-up menu 621 (`main menu → settings → measurement → meas. value outputs`).
2 Select the desired `meas. value output`.
3 Call-up `output range list`.

7.8.4 Selecting the output ranges

Only applies to analyzers with the option "second output range".

Function

There are three modes of output range selection for each measuring value output:

- Fixed setting of the desired output range
- Internal automatic range switching (switching points → page 77, § 7.8.2)
- External range control via control input (→ page 83, § 7.10.2)

Setting

1 Call-up menu 621 (`main menu → settings → measurement → meas. value outputs`).
2 Select the desired `meas. value output`.
3 Call-up `range selection`.
4 Select the desired mode:

`output range 1`	output range is fixed
`output range 2`	
`auto. switching`	internal automatic range switching
`ext. switching`	external range selection via control input

- The numerical measuring value display on the SIDOR will not be effected by the output range selection.
- The bar graph display can be set-up to represent either the physical measuring range or the current output range (→ page 70, § 7.4.2).

7.8.5 Setting the "live zero" /deactivating a measuring value output

Function

Each measuring value output can be programmed to represent the measuring values within the electronic span of 0 ... 20 mA, 2 ... 20 mA, or 4 ... 20 mA. When a "live zero" is selected (2 mA or 4 mA), the electronic signal "0 mA" can be interpreted as an general fault condition or electrical disconnection.

You can deactivate each measuring value output. In this case, the measuring value output permanently shows "0".

Setting

1 Call-up menu 621 (`main menu → settings → measurement → meas. value outputs`).
2 Select the desired `meas. value output`.
3 Call-up `live zero (mA)`.
4 Select the desired electrical zero-point for this measuring value output or select `no output`.

7.8.6 Selecting the output mode during calibration

Function

During a calibration, the measuring value outputs can function in two different modes:

a) constant output of the measuring value that was last measured before the calibration started (in the last selected output range); or

b) output of the measuring signals which are generated during the measurement of the calibration gases. In this mode, the measuring value outputs show “raw values” without any compensation; this allows to record the calibration gas values in a “raw condition” in order to determine the “absolute drift”. The measuring values shown on the SIDOR display do not exactly correspond to these output signals.

Setting

1 Call-up menu 621 (`main menu → settings → measurement → meas. value outputs`).
2 Select the desired `meas. value output`.
3 Call-up `output assignment`.
4 Select the desired mode during calibration:

`calibr. value`	output of the current cal. gas values (output range 2)
`hold meas. value`	constant output of the last measured value

7.8.7 Deleting the setting for a measuring value output

Function

This menu allows to delete all of the settings for a measuring value output. After you have deleted the settings, the measuring value output will constantly display 0 mA.

> For a short-time shutoff of a measuring value output, you could select “`no output`” in the live zero setting (→ page 78, § 7.8.5). In this way, all the other measuring value output settings would be kept.

Setting

1 Call-up menu 621 (`main menu → settings → measurement → meas. value outputs`).
2 Select the desired `meas. value output`.
3 Call-up `delete config.`

7.9 Configuration of the switch outputs

7.9.1 Functional principle

You can assign each of the configurable switch outputs (REL4 … REL8 and TR1 … TR8 → page 40, §3.8) to any of the available control functions (→ page 81, §7.9.4).

> You can assign the same control function to multiple switch outputs – for example, if you need two separate switch contacts for the same operation.

7.9.2 Control logic

Switch logic (make contact / break contact)

The relay switch contacts allow you to connect the external switching function to a make contact or a break contact. Use this feature in combination with the activation logic to find the appropriate control logic for your system.

Activation logic (open-circuit/closed-circuit principle)

Once you have assigned a control function to a switch output, you have two possibilities:

a) *Normal switching logic (open-circuit principle):* In this case, the switch output is electronically activated (relay is activated, transistor output conducts current) when the assigned function is logically in the activated condition.

b) *Reverse switching logic (closed-circuit principle):* The switch output is electronically activated as long as the related function is *not* in the activated condition. When the function is logically activated, then the switch output is in the electronically inactive condition (relay is passive, transistor output blocks current).

7.9.3 Safety criteria

CAUTION: Risks to connected devices

- ► Before using the switching outputs, clarify the safety-relevant consequences for the case of the following operational troubles:
  - Power failure to the SIDOR (for example, local power failure, or accidental switching-off, or defective fuses)
  - Fault or defect in the SIDOR (for example, defect of a switch output)
  - Interruption of the electrical connection
- ► Observe the switching method:
  - Switch outputs which operate by the *open-circuit* principle will show the assigned function as being *non active*, when a power failure occurs.
  - Switch outputs which operate by the *closed-circuit* principle will immediately signal the assigned function as being *active*, when a power failure occurs.
- ► Carefully review the consequences. Make sure that no dangerous situation can be created when a failure or a defect occurs.

7.9.4 Available switch functions (overview & explanation)

Control signals

Function name	x	Function (when activated)
zero gas x	1 ... 2	The matching gas should be fed-in.
test gas x	1 ... 4	
sample gas		
extern pump		Switch on the external sample gas pump.

After power-on, these control outputs remain deactivated until SIDOR has reached its operating temperature.

Status signals

Function name	x	Meaning (when activated)
failure [1]		Internal fault or defect. Simultaneously, the “Function” light shines red and a “FAULT” or “FAILURE” message is displayed (→ page 172, § 13.2). Note: This output is activated when no failure exists (closed-circuit principle).
service [2]		A calibration is running, or the “maintenance signal” has been activated manually (→ page 65, § 6.6), or a function in menu level 6 or 7 has been called up.[3] – This function corresponds to the NAMUR signal “function monitoring”.
fault [4]		Certain internal limit values are slightly exceeded. The “Service” LED and a “SERVICE” message are activated. This function corresponds to the status signal “service required” as defined by the German NAMUR requirements. – The cause for this signal does not yet reduce the SIDOR measuring ability, however a technician should correct the problem soon.
alarm limit x	1 ... 4	Meas. value is smaller/greater than the alarm limit (→ page 74, § 7.6.1).
calibration active		Calibration is running.
auto. calibration		Automatic calibration is running.
range x switching	1 ... 4	Measuring value output x works in output range 1.
FAILURE sensor x	1 ... 3	Analyzer module x is not operational (explanation → page 173).[5]
FAILURE sens.ext. x	1 ... 2	External sensor (analyzer) x is not operational. [6]
SERVICE sensor x	1 ... 3	Current measuring values from analyzer module x might be wrong (explanation → page 177). [5]
SERVICE sens.ext. x	1 ... 2	Current measuring values from external sensor (analyzer) x might be wrong. [6]
CALIBR. sensor x	1 ... 3	Calibration is running with analyzer module x. [5]
CALIBR. sens.ext. x	1 ... 2	Calibration is running with external sensor (analyzer) x. [6]
flow sensor		The gas flow in the internal sample gas path is smaller than 50 % of the programmed limit value (→ page 97, § 7.15.2).
condensate sensor		Condensate is present in the internal sample gas path (same meaning as display message “FAULT: condensate” → page 173).

[1] This function is permanently assigned to switch output REL1. If required, this function can also be assigned to other switch outputs.

[2] Is permanently assigned to switch output REL2. If required, this function can also be assigned to other switch outputs.

[3] Some of these menus will interrupt the SIDOR measuring function. That is why the status signal “service” is automatically activated when this menu level is accessed.

[4] Is permanently assigned to the switch output REL3. If required, this function can also be assigned to other switch outputs.

[5] Display of built-in analyzer modules → page 61, § 6.3.5.

[6] It is possible to handle a built-in analyzer module like an external sensor. Such a configuration can be set-up in the factory. The status of such an analyzer module is separately considered, and such an analyzer module requires separate calibration. For more information see the delivered documents.

Use the table in §17.3 (→ page 196) to plan and record your assignments.

7.9.5 Assigning the switch functions

1 Call-up menu 691 (`main menu` → `settings` → [9] → [Code] → `signal assignment`).

2 Select a category:

`relay outputs`	= switch outputs REL4 ... REL8
`transistor outputs`	= switch outputs TR1 ... TR8

3 Select the desired switch output.

4 Enter the code of the desired switch function. You can find the codes in the help information menu (press the [Help] key) and in the table in §17.3 (→ page 196).

5 If you want to reverse the activation logic: Press [–] [Enter]. (In the display, reverse logic is symbolized with “ ! ”.)

Use the table in §17.3 (→ page 196) to plan and record your assignments.

7.10 Configuration of the control inputs

7.10.1 Functional principle

Each of the control inputs CI1 ... CI8 can be assigned to any of the pre-defined software control functions.

- Electrical function of the control inputs → page 43, §3.9.2
- Pin assignment (plug connector X3) → page 42, Figure 13

7.10.2 Available control functions (overview & explanation)

Internal controls

Function name	x	Function (when input is activated)
service block		The main menu is reduced to the functions "measuring display" and "instrument status". Settings and calibrations cannot be made. A running calibration is terminated. – Corresponds to the NAMUR control input function "communication".
pump on/off		The built-in pump (if existing and if the pump has been activated via menu → page 62, §6.4.1) is switched off.
output x	1 ... 4	Output range 1 is selected for measuring value output x (deactivated status means output range 2). Caution: This works only if "external switching" is selected for the measuring value output (→ page 78, §7.8.4).
no drifts		Drift compensation is deactivated (means that the measuring values will be calculated on the basis of the last basic calibration). Applies to all displayed measuring values and measuring value outputs.
sample value held		"Freezes" all measuring value outputs, to hold the value that is present when this function is activated ("sample hold" function).
auto.cal. x start	1 ... 4	Automatic calibration x (→ page 115, §8.5) is started. – These control functions can be deactivated (→ page 119, §8.5.6). *Please note:* If such an input is activated when the calibration is finished, another automatic calibration will start.
cal. stop		Interrupts a running automatic calibration.

External status signals

Function name	x	Function
zero gas x fault	1 ... 2	If at least one of these inputs is activated, then automatic calibrations will not be started, running calibrations will immediately be terminated, the "Service" LED is illuminated, and the switch output "fault" is activated. – For example, you could use these inputs to monitor the pressure of calibration gas cylinders.
test gas x fault	1 ... 4	
failure x	1 ... 2	These inputs can be used to connect external status signals. When the input is activated, the related status message is shown on the display (→ page 172, §13.2) and transmitted via interface (→ page 85, §7.11.2) and the related status output is activated, if existing (→ page 81, §7.9.4).
fault x		
service x		

- You can reverse the logic of each control function (→ page 83, §7.10.3).
- Use the table in §17.4 (→ page 197) to plan and record your assignments.

7.10.3 Assigning the control functions

1 Call-up menu 6911 (`main menu` → `settings` → [9] → [Code] → `Signal assignment` → `signal inputs`).

2 Select the desired control input.

3 Enter the code of the desired control function. You will find this number listed in the help information (Press the [Help] key).

4 If you want to reverse the control logic: Press [–] [Enter]. (In the display, reverse logic is symbolized with " ! ".)

To get an overview on the programmed control inputs, call-up the their current status (→ page 102, §7.17.9).

7.11 Digital data transmission

7.11.1 Digital interface parameters

Function

These functions are used to set-up the parameters of the digital interfaces (connection → page 44, §3.10). Data communication will only work if the interface parameters of all connected instruments are identical.

Setting

1 Call-up menu 64 (`main menu → settings → interfaces`).

2 Select `serial inter. #1` or `serial inter. #2`.

3 Check/make the following settings:

`baud rate`	Data transfer speed of the interface. Select the highest value that the connected instruments will allow. Standard: `9600`
`parity`	The parity bit (if used) monitors the character transfer. Standard for communication with PCs: `no parity`
`data bits`	SIDOR only uses characters from the 7-bit range (ASCII code range 0 ... 127), but can also communicate in the 8-bit format. Standard for communication with PCs: `8 bit format`
`CR signal`	Determines which characters the SIDOR sends at the end of the data line (`CR` = carriage return; `LF` = line feed). Standard for output on PC printers: `CR LF`
`RTS/CTS protocol`	The RTS/CTS protocol is a hardware handshake procedure between sending (SIDOR) and receiving unit, via the interface connections RTS (Ready To Send) and CTS (Clear To Send). ● Please observe the notes on RTS/CTS protocol when operating with BUS converters (→ page 139, §9.2.1).
`XON/XOFF protocol`	The XON/XOFF protocol is a software handshake procedure where the SIDOR reacts to the XOFF and XON codes (received via the RXD connection). After switching the analyzer on or after a power failure, the `XON/XOFF protocol` is activated.

- You can test the data output (→ page 103, §7.18).
- If the data transfer does not work even when all the interface parameters are identical, try a lower baud rate (on all connected devices).
- If the interface still does not work even at the lowest baud rate, check the electrical connections.

7.11.2 Automatic digital output of analysis data

Function

You can select what data the SIDOR will automatically transmit via interface #2 (hardware information → page 44, §3.10).

Settings

1 Call-up menu 644 (`main menu → settings → interfaces → auto. reports #2`).

2 Activate or deactivate the desired data output:

`measuring values`	• Select the time interval for periodical measuring value outputs (1 ... 600 seconds). • To switch off the measuring value output, select 0 seconds.
`status messages`	`ON` = the SIDOR sends every status change with a describing text message (→ page 86).
`calib. results`	`ON` = after every calibration, the SIDOR sends the measuring values of the calibration gases and the calculated calibration values.
`half hour average`	`ON` = on every full and half hour (controlled by the internal clock), the SIDOR will send the average of the measuring values for all measuring components, taken over the last 30 minutes.

Data output format

- *Measuring values* (example)

```
#MS 18.01.00 13:46:06  18.98 vol.% O2    883.6 ppm CO2   162.96 mg/m3 NO
```

`#MS` = header for the measuring value output
`18.01.00 13:46:06` = actual date/time
`18.98 vol.% O2` etc. = measuring value for measuring component 1, 2, 3, ...

- *Status messages* (example)

```
#AL 18.01.00 13:43:11  01 ON  calibration/maintenance
```

`#AL` = header for the status messages
`18.01.00 13:43:11` = actual date/time
`01` = message number
`ON` = status has been activated (`OFF` = deactivated)
`calibration/maintenance`= status message in text format (→ page 86)

- *Calibration results* (example)

```
#Kx 18.01.00 13:43:10  SO2     200.00  201.37
#Ky …
```

`#KN1 … #KN2` = calibration data for the zero gases
`#KP3 … #KP6` = calibration data for the test gases
`18.01.00 13:43:10` = actual date/time
`SO2` = respective measuring component
`200.00  201.37` = nominal value, measured value

```
#NE 18.01.00 13:46:00  SO2        -0.81%   -0.17%
```

`#NE` = header for zero-point and sensitivity drift
`18.01.00 13:46:00` = actual date/time
`-0.81%   -2.17%` = zero-point drift, sensitivity drift (→ page 61, §6.3.6)

- *Half hour averages* (example)

```
#HM 18.01.00 14:30:00   19.51   125.44   203.52
```

`#HM` = header for half hour averages
`18.01.00 14:30:00` = actual date/time
`19.51    125.44    203.52`= half hour value for measuring component 1 / 2 / 3

Possible status messages via interface #2

message text
calibration/maintenance
heating 1 ....
heating 2 ....
heating 3 ....
FAULT: temperature 1
FAULT: temperature 2
FAULT: temperature 3
start control 4
FAULT: controller 4
FAULT: signal #1
FAULT: signal #2
FAULT: signal #3
FAULT: signal #4
FAULT: signal #5
FAULT: electronic
FAULT: overrange #1
FAULT: overrange #2
FAULT: overrange #3
FAULT: overrange #4
FAULT: overrange #5
calibration active
auto. calibration active
sample gas
zero gas 1
zero gas 2
test gas 3
test gas 4
test gas 5
test gas 6
analog output 1: range 1
analog output 2: range 1
analog output 3: range 1
analog output 4: range 1
external pump
SERVICE: zero drift #1
SERVICE: zero drift #2
SERVICE: zero drift #3
SERVICE: zero drift #4
SERVICE: zero drift #5
SERVICE: sensitivity drift #1
SERVICE: sensitivity drift #2
SERVICE: sensitivity drift #3
SERVICE: sensitivity drift #4
SERVICE: sensitivity drift #5
FAULT: zero drift #1
FAULT: zero drift #2
FAULT: zero drift #3
FAULT: zero drift #4
FAULT: zero drift #5
FAULT: sensitivity drift #1
FAULT: sensitivity drift #2
FAULT: sensitivity drift #3
FAULT: sensitivity drift #4
FAULT: sensitivity drift #5

message text
FAULT: pressure-signal
FAULT: condensate
FAULT: flow-Signal
SERVICE: flow
FAULT: flow
FAULT: zero gas 1
FAULT: zero gas 2
FAULT: test gas 3
FAULT: test gas 4
FAULT: test gas 5
FAULT: test gas 6
FAULT: IR source
FAULT: chopper
FAULT: filter wheel
FAULT: internal voltages
FAILURE external message 1
FAILURE external message 2
Interruption ext. message 1
Interruption ext. message 2
Service external message 1
Service external message 2
Common alarm failure
Common alarm interruption
SOV sample pt. 1
SOV sample pt. 2
SOV sample pt. 3
SOV sample pt. 4
SOV sample pt. 5
SOV sample pt. 6
SOV sample pt. 7
SOV sample pt. 8
pt. 1 value available
pt. 2 value available
pt. 3 value available
pt. 4 value available
pt. 5 value available
pt. 6 value available
pt. 7 value available
pt. 8 value available
FAILURE: sensor 1
FAILURE: sensor 2
FAILURE: sensor 3
FAILURE: sensor extern 1
FAILURE: sensor extern 2
SERVICE: sensor 1
SERVICE: sensor 2
SERVICE: sensor 3
SERVICE: sensor extern 1
SERVICE: sensor extern 2
CALIBRATION: sensor 1
CALIBRATION: sensor 2
CALIBRATION: sensor 3
CALIBRATION: sensor extern 1
CALIBRATION: sensor extern 2

7.11.3 Printing the configuration data (text table output)

Function

You can output the SIDOR configuration (= measuring parameters and settings) as a plain ASCII text table, using SIDOR's serial interface #1 or #2 – for example, in order to print it.

The data is divided into the `config.` and `config. 2` sections (→ Figure 16). The data are provided in the selected menu language (exception: for Polish menu language in English).

Making data backups → page 92, §7.13

Call-up

1 Call-up menu 71 (`main menu → service → internal signals`).
2 Call-up `print config.` (menu 714) or `print config. 2` (menu 715).
3 To start the output, select `serial inter. #1` or `serial inter. #2`.

Figure 16 Data output "print config." and "print config. 2" (examples)

```
SIDOR configuration from 30.01.00 21:05:50
==========================================
program version   : #V. 0.28 from 30.08.2004
serial number     :             123456   (79211)
release date      :           01.01.00
instrument name   :              SIDOR
enclosure type    :                710
hardware version  :                  4
language          :            english
  options, hardware
built-in pump     :                 ON   (79223)
pressure sensor   :                 ON   (79221)
condensate sensor :                OFF   (79224)
flow sensor       :                OFF   (79222)
  options, software
remote control, AK:                OFF   (79235)
sample pt. select :                 ON   (79236)
meas. component   :       CO       SO2
2nd output range  :      OFF       OFF
range ratio > 5:1 :      OFF       OFF
compensation      :      ON        ON
calib. results    :                 ON   (6443)
AK-ID-active      :                 ON   (6422)
sample-hold amp.  :                  0
semi-contin. mode :                  0
back-flush filter :                  0
dilution step     :                  0
AK-ID             :                 35   (6421)
pressure gradient :       0.0647
flow adjust. low  :                  0
flow adjust. high :                  0
Counter:          :                  0
flow sensor       :                  0   (79222)
gas pump on/off   :                 ON   (31)
pump capacity     :                 25   (651)
                  :               1200  (79246)
meas. component   :       CO       SO2

meas. compensation:        0         0
a                 : +0.000e+00 +0.000e+00
b                 : +0.000e+00 +0.000e+00
c                 : +0.000e+00 +0.000e+00
d                 : +0.000e+00 +0.000e+00
e                 : +0.000e+00 +0.000e+00
f                 : +0.000e+00 +0.000e+00
temp. correction  :       ON        ON
3 plug X 20       :      ppm       ppm
Lin-3 plug X 20   :
```

```
zero point        :     0.00      0.00
sensitivity       :     0.00      0.00
meas.value outputs:        1           2           3           4
calibration       :  150.000     150.000     150.000     150.000
meas. component   :       CO         SO2           .           .
live zero (mA)    : 4...20 mA   4...20 mA           .           .
output assignment :        0           0           0           0
range selection   :        .           .           .           .
output range 1
beginning value   :     0.00        0.00           .           .
end value         :   100.00      100.00           .           .
switch-up value   :     0.00        0.00           .           .
output range 2
beginning value   :     0.00        0.00           .           .
end value         :     0.00        0.00           .           .
switch-down value :     0.00        0.00           .           .
alarm settings    :        1           2           3           4
meas. component   :        .           .           .           .
alarm settings    :        .           .           .           .
acknowledge       :        0           0           0           0
signal assignment :   signal inputs   relay outputs transistor outputs
1                :                          failure!
2                :                          service
3                :                            fault
4                :                     switch on pt. 1
5                :
6                :
7                :
8                :
 (! = Logic: INVERS)
```

```
SIDOR configuration 2 from 30.01.00 21:06:20
============================================
 program version   : #V. 0.28 from 30.08.2004
serial number     :             123456   (79211)
instrument name   :              SIDOR
 measuring values  :                  0   (6441)
status messages   :                  0   (6442)
elect. connection :                  1   (6423)
auto. answer      :                  0   (642411)
dialing mode      :                  1   (642412)
 ampl.quotients sig:                  0
type step motor   :                  5
modulator freq.   :                  7   (79244)
modulator type    :                  1   (79245)
                  :                120  (79554)
quotients value   :                  0
 meas. component   :       CO       SO2
adc channel       :        0         1
component index   :       30        41
---               :       21        21
 decimal places    :        2         2
bargraph range    :        1         1
no over range al. :        0         0
no overflow alarm :        0         0
neg. window       :     0.00      0.00
pos. window       :     0.00      0.00
 concentr. factor  :   100.00    100.00
concentr. scaling :   100.00    100.00
adc scaling [0]   :   1.0000    1.0000
adc scaling [1]   :   1.0000    1.0000
 calculate zp-drift:   0.0000    0.0000
calc. sp-drift [0]:   1.0000    1.0000
calc. sp-drift [1]:   1.0000    1.0000
 An. EmD, sDriftE 0:   0.0000    0.0000
An. EmD, sDriftE 1:   0.0000    0.0000
 Let. EmD, lDriftE :   1.0000    1.0000
 last zp-drift     :   0.0000    0.0000
last sp-drift     :   1.0000    1.0000
last zp cal. gas  :        8         8
last sp cal. gas  :        8         8
 span delay time   :                 60   (635)
cal. meas. time   :                180   (636)
cal. w/correction :                  0   (696)
last zp cal. gas  :                  0
last sp cal. gas  :                  0
 auto. calibration :        1         2         3         4
auto. cal.  period:        0         0         0         0
auto. cal.   time :    23:24     23:24     23:24     23:24
```

```
meas. time        :                 60   (79562)
meas. component   :       CO       SO2
temp. correction  :      ON        ON
   zero point
date zero gas1 cal:  21.01.00          date zero gas2 cal:  21.01.00
time zero gas1 cal:     02:29          time zero gas2 cal:     05:27
  ADC results
N1                :  -4.89e-02  -2.79e-01
N1                :  -2.89e-01  -2.77e-01
N1                :   15097.02   15097.02
N2                :  -4.42e-02  -2.76e-01
N2                :  -2.90e-01  -2.89e-01
sen. zg low temp. :      15097      15097
sen. zg high temp.:      14606      14606
temp. correction  :  -9.44e-06  -5.77e-06
temp. correction  :  +2.74e-06  +2.45e-05
   sensitivity
date span gas1 cal:  21.01.00          date span gas2 cal:  21.01.00
time span gas1 cal:     02:29          time span gas2 cal:     05:27
  ADC results
E1                :  +1.03e+00  +1.00e+00
E2                :  +1.00e+00  +1.02e+00
sen. sg low temp. :      15098      15098
sen. sg high temp.:      14601      14601
temp. correction  :  +8.73e-05  -2.42e-05
 No. of sample pts.:                 2   (6251)
man/auto pt.select:                  2   (6255)
sample point      :        1         2
Sample time per pt.:     3000       600
Dead time per pt. :        5         5
Activate pt.      :        1         1
```

7.12 Digital remote control settings

> For digital communication, the SIDOR interface #1 is used (explanation, connection → page 44, §3.10; settings → page 84, §7.11.1).

7.12.1 Setting the ID character

Function

For use with digital remote control (→ §9 / §10 / §11), you can set-up an individual ID character for each SIDOR. The SIDOR will only obey commands which include its own ID character (unless this feature is disabled → p. 89, §7.12.2).

Setting

1 Call-up menu 6421 (`main menu → settings → interfaces → communication #1 → AK-ID`).
The current ID character is displayed in two different notations: On the left – the ID character; on the right – its decimal ASCII code; like `M 77`.

2 Enter the decimal ASCII code of the desired ID character (`0` ... `127`).

3 Press [Enter].

! = 33	- = 45	9 = 57	E = 69	Q = 81	] = 93	i =105	u =117
" = 34	. = 46	: = 58	F = 70	R = 82	^ = 94	j =106	v =118
# = 35	/ = 47	; = 59	G = 71	S = 83	_ = 95	k =107	w =119
$ = 36	0 = 48	< = 60	H = 72	T = 84	’ = 96	l =108	x =120
% = 37	1 = 49	= = 61	I = 73	U = 85	a = 97	m =109	y =121
& = 38	2 = 50	> = 62	J = 74	V = 86	b = 98	n =110	z =122
’ = 39	3 = 51	? = 63	K = 75	W = 87	c = 99	o =111	{ =123
(= 40	4 = 52	@ = 64	L = 76	X = 88	d =100	p =112	| =124
) = 41	5 = 53	A = 65	M = 77	Y = 89	e =101	q =113	} =125
* = 42	6 = 54	B = 66	N = 78	Z = 90	f =102	r =114	~ =126
+ = 43	7 = 55	C = 67	O = 79	[= 91	g =103	s =115	
, = 44	8 = 56	D = 68	P = 80	\ = 92	h =104	t =116	

7.12.2 Activating the ID character / Activating Modbus

Function

You can determine if the SIDOR only reacts on remote control commands which contain its own ID character (→ page 88, § 7.12.1), or if the SIDOR reacts on all remote control commands, independent of the ID character. – This menu function is also used to activate the Modbus remote control functions (→ page 153, § 11).

> If you have a remote control installation for more than one SIDOR, using the MARC2000 software and BUS converters for the interface connections, then set the `AK-ID-active` to `ON`. Otherwise MARC2000 cannot differentiate between the individual analyzers.

Setting

1 Call-up menu 6422 (`main menu → settings → interfaces → communication #1 → AK-ID-active`).
2 Select the desired mode:

`Without AK-ID`	The ID character will be ignored – the SIDOR will obey all of the remote control commands it receives. [1]
`With AK-ID`	ID character will be observed – the SIDOR will only obey remote control commands with matching ID character. [1]
`With AK-ID MODBUS`	Like `With AK-ID`, but in addition the remote control with Modbus commands is enabled. Note: In this mode, MARC2000 remote control functions are not available (disabled).

[1] Modbus functions (option) disabled, i.e. Modbus commands will be ignored.

7.12.3 Setting the installed connection

Function

This function is applies to data communication with MARC2000 software (→ page 137, § 9) or with the Modbus protocol (→ page 153, § 11).

Several electrical connection configurations can be used (→ page 139, § 9.2.1); set-up the connection which is actually installed.

(Note: On the SIDOR, interface #1 is used for the connection.)

Setting

1 Call-up menu 6423 (`main menu → settings → interfaces → communication #1 → elect. connection`).
2 Set the installed connection:

`serial, single`	one SIDOR is connected directly to the PC via the interface
`serial, bus`	several SIDORs are connected via BUS converters to the PC
`modem, single`	one SIDOR is connected via modems to the PC
`modem, bus`	several SIDORs are connected via modems and BUS converters

7.12.4 Setting-up the modem connection

Function

These functions are required if you have a digital electrical connection via modem (and you intend to use it).

Settings

1 Call-up menu 64241 (`main menu` → `settings` → `interfaces` → `communication #1` → `modem` → `modem settings`).

2 Check/change the following settings:

`auto. answer`	● `auto. answer off` = the modem will not respond to incoming calls. You will need to connect the telephone line via menu command (`receive call` → page 91, § 7.12.5). To do this, you should be able to notice when a call is coming (for example, by listening to the modem loudspeaker). ● `after x rings` = the modem will wait for the number of rings to pass and then will automatically connect to the incoming call.
`dialing mode`	Adjust the dialing mode to the telephone system where the modem is installed: ● `tone dial` = multiple frequency dialing mode (MFV) ● `impuls` = impulse dialing mode (IWF) You can also change the dialing mode when dialing a number (→ page 91, § 7.12.5).
`store setting`	Sends this command to the modem: “Store the current settings permanently!” As a result, the modem will keep the current settings even after being shutoff or after a power failure.

+i The modem connected to the SIDOR must accept standard AT commands (Hayes-compatible commands). Otherwise the SIDOR remote control commands will not work.

7.12.5 Modem control

Function

If you have a modem connected to interface #1, then you can remotely control its basic functions from the SIDOR.

Actions

1 Call-up menu 6424 (`main menu → settings → interfaces → communication #1 → modem`).
2 Possible actions:

`initialisation`	Re-starts the modem and sends the settings for answering and dialing mode from the gas analyzer to the modem. An existing telephone connection will be disconnected, and the modem will delete all existing internal error messages. *Caution:* The abrupt disconnection could cut remote control commands in the course of transmission, and make them garbled. This can produce errors in the SIDOR.
`dialing`	Calls up a menu where you can enter a telephone number that the modem should call. – You can integrate the following special characters into the telephone number: ● `.` (decimal point) = dial pause of 3 seconds (for example, to wait for an “external line” when dialing from an internal telephone system). On the display you will see a “ `,` ” (= related Hayes command). You can enter multiple dial pauses in succession, if required. ● – (minus sign) = switch to the alternative dialing mode (→ page 90, § 7.12.4). The SIDOR will display `T` (tone dialing will follow) or `P` (impulse dialing will follow) – depending on which dialing mode was previously selected. You can switch the dial mode only once in a telephone number.
`receive call`	The modem connects to the incoming call. To use this function, you need to select `manual answer` (→ page 90, § 7.12.4), and you should be able to notice when a call is coming in (for example, via the modem’s loudspeaker).
`abort`	The modem will immediately disconnect an existing telephone connection. – This will also terminate the remote control with MARC2000 (if previously activated → page 143, § 9.3). *Caution:* The abrupt disconnection could cut remote control commands in the course of transmission, and make them garbled. This can produce errors in the SIDOR.

+i If a telephone connection was established from the SIDOR, then you need to use the `abort` function in the SIDOR to terminate the connection.

7.13 Data backup

7.13.1 Internal backup

Functions

- The `data backup` menu functions allow you to save a copy of SIDOR's current working condition. The data backup includes
  - all individual settings
  - all the individual SIDOR parameters
  - the calibration at the time of the backup

  SIDOR can save *two* backup copies: "last back-up" and "the second-to-last back-up". Both copies can be re-activated. As a result, you can save two versions of SIDOR's current working condition and restore either of these when required.
- In addition, SIDOR automatically makes a backup copy after each successful calibration.
- You could also restore the original delivered condition (factory settings). This can be helpful if the SIDOR is not operating correctly and you think that this could be caused by unqualified or obscure settings: Just save the current condition and then re-activate the factory settings to have "reliable conditions" for tests.

> - Saving the settings on an external computer → page 93, § 7.13.2
> - Text output of the configuration data → page 87, § 7.11.3

Procedure

1 Call-up menu 694 (`main menu` → `settings` → [9] → [Code] → `data storage`).

2 Select the desired function:

`store data`	saves the current working condition as the "last back-up" (previous "last back-up" settings will become "2nd last back-up")
`last back-up`	restores the working condition of the "last back-up"
`2nd last back-up`	restores the working condition of the "2nd last back-up"
`after calibration`	restores the working condition which was automatically saved after the latest successful calibration procedure
`factory settings`	restores the original factory-delivered condition

> When you restore a "back-up" condition, you will loose all recent changes of SIDOR's settings – unless you have saved these settings before, by using `store data` or `send data` (→ page 93, § 7.13.2).

3 Press [Enter] to start the procedure.

7.13.2 External backup (data transfer)

Functions

The `data transfer` menu allows you to transmit the SIDOR configuration (= measuring parameters and settings) to a PC (download) and reload the data into the SIDOR (upload). The data is stored in a hex-coded file with a size of some kilobytes. Possible uses include:

- You can generate a back-up copy of all data and reload the data into the SIDOR if required – for example, after a major breakdown.
- When the SIDOR electronic card or the memory module needed to be replaced, you can reload the individual data into the new electronics.

> ► Do not use the `data transfer` function to copy the data of one SIDOR into another SIDOR.
>
> These data include parameters which depend on the individual characteristics of the built-in analyzer modules. Even if analyzers are equipped with exactly the same types of modules, their internal data sets will be different. A SIDOR will not work correctly with “foreign” data loaded.

- Plain text output of the configuration data → page 87, § 7.11.3
- Loading the internal software (firmware) → page 96, § 7.14

Requirements

For the data transfer you need:

- a computer with a RS232 serial interface
- a connecting cable to interface #1 of the SIDOR (→ page 44, § 3.10.2)
- a program which can operate the data transfer between computer and the connected analyzer (MARC2000 or a terminal program).

> One of the programs you could use is “HyperTerminal” which is provided with the Windows operating system. HyperTerminal can be started without making a connection. This allows you to call-up HyperTerminal’s Help function, in order to become familiar with the program.

Preparations

- If you intend to upload data into the SIDOR, you may want to save its current status first – because the upload data will replace your current settings.

  > Internal backup function: `data backup` (→ page 92, § 7.13.1)
  > External backup function: `send data` (→ page 94).

- Connect the SIDOR serial interface #1 to the computer (→ page 44, § 3.10).
- In the computer: Start the terminal program and adjust it as follows:
  - *Interface parameters:* same as for the SIDOR (→ page 84, § 7.11.1)
  - *Data transfer format:* data should be transferred as ASCII data (*not* as binary data)

  > In HyperTerminal, there is no optional preset for the data transfer format.

Data backup procedure

Use this procedure to save SIDOR's current data:

In the SIDOR	In the terminal program
	1 Start-up the interface connection to the SIDOR.
2 Call-up menu 695 (`main menu` → `settings` → [9] → [Code] → `data transfer`).	
3 Select `send data`.	
	4 Start data recording for ASCII data.[1]
5 Press [Enter] (this will start the data transfer).	
6 Wait until SIDOR indicates that the data transfer is finished (takes 40 seconds at least).	
	7 Stop data recording.[2]

[1] In HyperTerminal: Transfer → Capture text... → select desired file location (folder) and enter the desired file name for SIDOR's backup data → [Start].
[2] In HyperTerminal: Transfer → Capture text... → Stop.

!
- ► To finish with data recording, always use the corresponding menu command of the terminal program.

If the terminal program is just being closed instead, the recorded file may become useless (file not correctly closed).

Data restore procedure

Use this procedure to restore SIDOR's data from a backup file:

In the SIDOR	In the terminal program
	1 Start-up the interface connection to the SIDOR.
2 Call-up menu 695 (`main menu` → `settings` → [9] → [Code] → `data transfer`).	
3 Select `receive data`.	
4 Press [Enter] (makes SIDOR ready to receive data).	
	5 Send the SIDOR data backup file as an ASCII text file.[1]
6 Wait until SIDOR indicates that the data transfer is finished (takes 40 seconds at least).[2]	

[1] In HyperTerminal: Transfer → Send Text File... → select the desired file → [Open].
[2] Display messages → page 95.

Error messages of the data restore procedure

SIDOR's `receive data` function will automatically check the data transfer. If an error occurs, the data transfer is terminated and the trouble is indicated on the display:

Display message	Meaning	Remedy
`--OK--`	the data transfer was successful	–
`READ-TIMER`	no characters received	Check the electrical connection (plug connectors, cables).

`READ-BREAK`
`READ-ERROR`
`READ-CHAR`
	error occurred during character transmission	Make transmission delay settings in the terminal program. Proceed as follows:
		1 First set a line delay; use the least available value. Then try the data transfer again.
		2 If this did not help, increase the line delay step-by-step, up to approx. 10 ms.
		3 If this did not help: Reset the line delay. Instead, set a character delay. Start with the least available value.
		4 If this did not help, increase the character delay step-by-step until the data transfer works.

+i

- Transmission delays will increase the time required for the data transfer. Example: With a character delay of 10 ms, the data transfer will take approx. 3 minutes.
- In some computers, the real delay is much greater then the set value.

7.14 Firmware update

Function

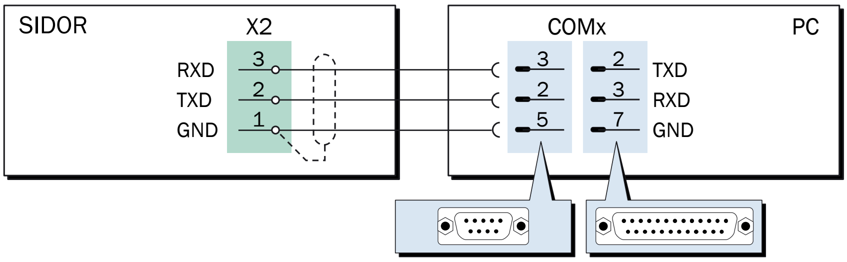
You can load the SIDOR's internal software (firmware) from a PC into the SIDOR – for example, to install an new firmware version. You will need:

- a PC with a RS232 serial interface and the operating system Windows 3.X/95/98/2000/XP
- a connecting cable to the SIDOR interface #1
- the upload program FLASHSID.EXE
- a current version of the file SID.BIN (contains the SIDOR firmware)

Interface connection

Three interface lines are required:

Figure 17 Minimum interface connection for the program loader function



- Please use a shielded cable.
- Cable length should not exceed approx. 2 meters (7 feet).
- You do not need to adjust the interface parameters – this will automatically be done by the upload program.

Procedure

1 Connect the PC to the SIDOR serial interface #1 (→ page 44, §3.10.2).
2 In the PC: Place the files FLASHSID.EXE and SID.BIN in the same folder/directory.

> **CAUTION: Risks to connected devices**
> As long as the `program loader` function is activated, the SIDOR is not performing any measuring operation.
> ► Make sure that this situation cannot cause problems at connected devices.

3 In the SIDOR: Call-up menu 76 (`main menu → service → program loader`) and start the function with [Enter].
   – The SIDOR will show a message: waiting for data communication.
4 In the PC: Start FLASHSID.EXE.
   – The PC will show the messages of the upload program. The estimated remaining upload time is indicated.
   – The SIDOR software is divided into several "blocks". The upload program will check which blocks need to be updated and will only upload the new blocks.
   – When the upload procedure has been completed, the SIDOR will re-boot.
5 Wait until the `main menu` is shown on the SIDOR display. Then the SIDOR is ready for use again.
6 Press [Enter] to start the procedure.

7.15 Flow adjustment and monitoring

7.15.1 Setting the capacity of the gas pump

Applies only to analyzers which include the option “built-in gas pump”.

Function

Using this menu function, you can change the internal power supply to the built-in sample gas pump. This allows you to set the delivery capacity of the pump.

> If the SIDOR has a built-in gas pump, it is recommended to use this function to set the desired gas flow rate. It is more useful than operating the pump at full power and then reducing the flow with a regulating valve. When the load on the pump is reduced, it will have a longer life.

Setting

1 Call-up menu 651 (`main menu → settings → gas flow → pump capacity`).
2 Set the `status` value which gives the desired flow.

7.15.2 Setting the flow monitor set point

Applies only to analyzers which include the option “flow sensor”.

Function

The flow sensor generates a fault signal when the sample gas flow in the SIDOR is below the selected flow limit. This allows you to monitor the sample gas flow.

The fault indication works in two levels:

1 When the flow is only *slightly* below the flow limit, the SIDOR will give the status message `SERVICE: gas flow` (the LED “Service” and the status output “service required” will be activated simultaneously).
2 When the flow is *significantly* below the flow limit (less than 50 % of the set limit value), then `FAULT: gas flow` will be displayed (the “Function” LED is red and the status outputs “failure” and “service” will be activated).

Setting

1 Call-up menu 652 (`main menu → settings → gas flow → flow limit value`).
2 Set the desired limit value. The setting will approximately correspond to the flow in liters per hour (the exact relation depends on each individual flow sensor).

> If you need an accurate setting:
> 1 Connect an external flowmeter to the sample gas outlet.
> 2 Adjust the actual gas flow to the desired flow limit.
> 3 Use the menu 652 settings by trial and error to determine the limit value where the SIDOR just activates the `SERVICE: gas flow` message.

7.15.3 Calibrating the flow sensor

Function

If advanced flow monitor precision is desired, the flow sensor can be calibrated. An external flowmeter is required for the procedure.

Procedure

1 Connect a flowmeter to SIDOR's sample gas path, in order to measure the sample gas flow (for example, at the sample gas outlet).
2 Call-up menu 698 (`main menu` → `settings` → [9] → [Code] → `flow sensor`).
3 Follow the displayed instructions:
   a) Set the flow to 0.0 l/h (in other words: stop it completely).
   b) Wait until the displayed ADC value is constant (takes approx. 5 minutes).
   c) Press [Enter].
   d) Set the flow to 30.0 l/h (500 cm^3/min).
   e) Wait again until the displayed ADC value is constant.
   f) Press [Enter].

7.16 Pressure sensor adjustment

Function

The internal pressure sensor can be adjusted to a certain pressure. As a result, the precision of the pressure measurement is optimized around this pressure.

The procedure requires to enter the actual gas pressure which exists in SIDOR's sample gas path. An easy way is to use the actual atmospheric pressure, while having SIDOR's sample gas outlet open to the ambient air.

Procedure

! ► Keep the gas pressure in SIDOR's sample gas path constant during this procedure.

1 Call-up menu 699 (`main menu` → `settings` → [9] → [Code] → `pressure sensor`).
2 Enter the pressure which currently exists in the SIDOR sample gas path.

Menu 7113 allows you to check the pressure measurement (→ page 100, §7.17.3).

7.17 Checking internal values and conditions

7.17.1 Measuring signals for the measuring components

Function

For service purposes, you can check the current measuring signals for all measuring components. The display will show “ADC values”: These are the digitized internal measuring signals from the analyzer modules, thus the input signals of the digital processing. ADC values include analog amplification of the measuring signals, but no digital computation or correction.

> +i The analog amplifications are variable. The optimum amplification for the measuring signals in the analyzer module is determined during a basic calibration.

Typical values

- The ADC values will permanently fluctuate somewhat, even if the measuring values are is constant.
- When the measuring range end value is measured (which means, when the matching test gas flows through the analyzer module), “optimum” ADC values are in the range of `18000` ... `24000`. This is should be true directly after a basic calibration.

> +i
> - If ADC values below `10000` are displayed for the measuring range end value, then a basic calibration should be made, in order to re-optimise the measuring value processing (→ page 126, §8.8.2).
> - If the ADC value remains constant for an extended period of time, then the analyzer module is possibly defective, or the electrical connection is interrupted.

Call-up

Call-up menu 7111 (`main menu → service → internal signals → analog signals → meas. signals`).

7.17.2 Status of the internal controller

Function

This control function shows the actual condition of the internal controllers:

- Controllers 1, 2, and 3 are used for temperature control of the analyzer modules.
- Controller 4 does not have a function at this time (reserved for future applications).

Call-up

1. Call-up menu 7112 (`main menu → service → internal signals → analog signals → controller`).
2. Select the desired controller (`1` ... `4`).

`value`	actual measuring value of the sensor
`set point`	set point (factory setting)
`counter`	time delay of the temperature monitor (in seconds). When the actual temperature is outside of the nominal range, the counter will advance `1` each second. If the counter exceeds `12`, then the message `FAULT: temperature` will appear. As soon as the temperature returns to nominal range, the counter begins counting backwards. After power-on, the counter starts with `128`.
`cycle`	current on/off ratio for the controller, in % (minimum value = `0.0`, maximum value = `99.9`)
`not available`	= the controller electronics are physically not present, or the controller is not activated in the software.

7.17.3 Display of the internal analog signals

Function

This function displays the actual signals of the internal sensors.

Call-up

Call-up menu 7113 (`main menu → service → internal signals → analog signals → extra sensors`).

`pressure hPA`	measuring value of the built-in pressure sensor (option)
`flow %`	measuring value of the flow sensor (option → page 97, § 7.15.2)
`source V`	supply voltage of the infrared source in the analyzer module SIDOR (standard range: 6.0 ... 7.5 V)
`external 1 V`	*no function*
`external 2 V`	

7.17.4 Internal supply voltages

Function

This control function displays a list of the internal supply voltages. The left column shows the nominal values, the right column shows the current real values.

If a real value is out of the allowable range, `FAULT: int.voltage` is displayed. In such cases you may want to use this control function to locate the source of trouble.

Call-up

Call-up menu 7114 (`main menu` → `service` → `internal signals` → `analog signals` → `supply voltages`).

Table 7 Internal supply voltages

nominal value	allowable real value
+24 V	18.0 … 30.0 V
+24 V ext[1]	18.0 … 30.0 V
+15 V	14.0 … 16.0 V
−15 V	−14.0 … −16.0 V
+12 V	9.5 … 16.5 V
+5 V	4.5 … 5.5 V
−5 V	−4.5 … −5.5 V
0 V	−0.2 … 0.2 V

[1] Applies to auxiliary voltage outputs (→ page 42, Figure 12 and → page 42, Figure 13).

Internal fuses → page 35, §3.5.5

7.17.5 Service display of the internal analog signals

Function

The `overview` function displays the actual internal analog signals. These values can help a manufacturer's service technician to diagnose the reason for an instrument malfunction. Which signals are shown depends on the individual SIDOR configuration.

Call-up

Call-up menu 7115 (`main menu` → `service` → `internal signals` → `analog signals` → `overview`).

7.17.6 Service display of detector signals (scope)

Function

The `scope` function provides a graphic display of actual measuring signals from the SIDOR analyzer module. These displays may help a service technician to check the measuring system.

Call-up

1 Call-up menu 7116 (`main menu` → `service` → `internal signals` → `analog signals` → `scope`).
2 To switch over to the next signal, press [Enter].

7.17.7 Bridge adjustment

Function

At present without function.

Call-up

Call-up menu 712 (`main menu → service → internal signals → bridge setting`).

7.17.8 Linearisation values

Function

The linearisation values represent the parameters which are used to compute a linear curve from the analyzer module's curve characteristic. Moreover, the linearisation values include the parameters for the mathematical compensation of cross-sensitivity effects.

Call-up

1. Call-up menu 713 (`main menu → service → internal signals → linear. values`).
2. If the SIDOR measures more than one component: Select the measuring component for which you want to see these linearisation values.
3. The following values will be displayed in table form:
   - Heading: date on which the values were computed
   - Left column: physical nominal value
   - Right column: related internal measuring value

   When you press [Enter] or [<], related measuring values for the other components will be displayed (used for internal cross-sensitivity compensation).

7.17.9 Status of the control inputs

Function

You can display the current electronic condition of all control inputs (→ page 43, §3.9).

Call-up

Call-up menu 716 (`main menu → service → internal signals → control inputs`).

`0` = the input is electronically passive (no current)

`1` = the input is electronically activated (current is flowing)

`!` = the input works with reverse logic

7.17.10 Program version

Function

This function shows you:

- Model name of your analyzer (factory setting)
- Version number and release date of the built-in software (firmware)

Call-up

Call-up menu 717 (`main menu → service → internal signals → program version`).

7.18 Testing of electronic outputs (hardware test)

Functions

Using the functions in the `hardware test` menu, you can individually control and test each SIDOR signal output, and you can check the digital interfaces. This allows you to test the electrical connections and interaction with external devices, or to test the SIDOR output hardware.

The hardware test function is applied to one selected output. All the other outputs will remain in operating condition.

> **CAUTION: Risks to connected devices**
> - When the test function is started in the menu
>   - the selected output will be set to the selected electronic status
>   - the operational function of this output is disabled.
> - When the test is running and no key is being pressed for some minutes, the selected output will automatically be reset to operational condition.
>
> ► Make sure that the test situation cannot cause problems at connected devices.
> ► During the test, take care of the automatic reset. Make sure that the automatic reset cannot cause problems at connected devices.

Call-up

1 Call-up menu 72 (`main menu → service → hardware test`).
2 Select the desired test function:

`meas. value outputs`	1 Select the desired measuring value output (OUT1 ... OUT4). 2 Set the value that the output should permanently display (0 mA = 0 % / 20 mA = 100 %).
`relay group`	Each relay for the control and status outputs can be activated individually (→ page 40, §3.8): [1] 1 Select the desired switch output (REL1 ... REL8). 2 Press [Enter] to change the status of the relay.[2] – ON= relay is activated (working state) – OFF= relay is deactivated (resting state)
`transistor group`	Each transistor output (→ page 40, §3.8) can be activated individually: [1] 1 Select the desired transistor output (TR1 ... TR8). 2 Press [Enter] to change the status of the output circuit.[2] – ON= output is activated (transistor is conducting) – OFF= output is deactivated (transistor is blocked).
`test interface #1` `test interface #2`	As long as this function is selected, the SIDOR sends certain lines of characters (shown on the display). This allows you to check if data transmission to a connected device is working. [3]

[1] The activation will be automatically switched off after 60 seconds – unless this is manually done before.
[2] Repeat as often as you like (toggle switch).
[3] If the connected printer does not print exactly the same characters as shown on the display, then the printer is probably not set on the standard ASCII character set (“US character set”).

7.19 Reset

Function

A `reset` re-starts the SIDOR microcomputer in the same way as switching the power off and on would do. The signal processing will re-start. Stored values will remain unchanged.

Procedure

> **CAUTION: Risks to connected devices**
> During a reset, all SIDOR functions are shutdown. This includes measuring value outputs and status signals.
> ► Make sure that this situation cannot cause problems at connected devices.

1 Call-up menu 75 (`main menu → service → reset`).
2 Press [Enter] to activate a reset.

SIDOR

8 Calibration

General explanations
Requirements
Settings
Procedures

8.1 Introduction to the calibration of the SIDOR

Why is calibration necessary?

It is unavoidable that the characteristics of optical and electrical components will slightly change during the weeks of operation. These changes affect a high-precision measuring system and result in small changes of the measuring results. This effect is known as drift.

To compensate for the drift, a gas analyzer should regularly be calibrated. A calibration means that first the measuring result of the analyzer is checked, then the offset from the nominal value is adjusted to bring the analyzer back to the true reading.

The two important parameters in the measuring system are:

- The *zero-point (*defined as the measuring result when the cause for a particular measuring effect is not present or should not be present).
- The *sensitivity (*defined as the relationship between the value of the measuring effect and the displayed measuring value).

There is a zero-point drift and a sensitivity drift for each measuring component. Each needs to be determined and corrected independently.

How does a calibration procedure in the SIDOR work?

During a calibration, the SIDOR automatically compensates for drifts in the following way:

1 A test gas is fed into the SIDOR; the true concentrations of the measuring components in test gases are known. The nominal values are the true concentrations of the measuring components in the test gas.

2 The SIDOR measures the concentrations of the measuring components in the test gas (measured values).

3 The SIDOR calculates the drifts, i.e. the differences between the measured values and the nominal values.

4 The SIDOR checks if drift compensation can still be done by mathematical computation. If it is possible, the internal values for zero-point and sensitivity drift compensation are automatically adjusted. If this is no longer possible, a fault message is displayed – which means that the measuring system should be inspected and re-adjusted by the manufacturer or a trained skilled person.

Theoretically, a complete calibration requires that this procedure is performed twice for each measuring component – once for the zero-point and once for the sensitivity. Practically, in most applications, some parts of the procedure can be combined into one step – for example, a zero-point calibration for all measuring components.

Running a calibration

You can manually control the calibration procedure using the menu functions so that you can run a calibration step-by-step. Alternatively you can program the SIDOR so that it will run itself through an automatic calibration – initiated by a start command or in regular time intervals. In addition, you can program up to four different calibration procedures to cover various different requirements (→ page 116, §8.5.3).

When is it necessary to perform a calibration?

► after a new start-up

► regularly during analyzer operation (→ §8.2)

General variations of the calibration procedure

A calibration can either run automatically or be manually controlled:

a) *Automatic calibration*

For an automatic calibration, the calibration procedure is completely controlled by the SIDOR, including the calibration gas supply. This requires an external gas supply (for example, from gas cylinders) and automated switching devices (for example, solenoid valves), to deliver the calibration gas to the analyzer. Before an automatic calibration is started, the associated settings should have been made: the nominal values for the calibration gases (→ page 117, §8.5.4), the test gas waiting time (→ page 119, §8.5.7), the calibration measuring interval (→ page 120, §8.5.8). When all this has been done, you only need to push one button in a menu or give the start signal via a control input to run an automatic calibration.

In addition, periodical automatic starts can be programmed (→ page 116, §8.5.3).

b) *Manual calibration with automatic feed of test gases*

This type of calibration requires the same external installation for calibration gas supply as an automatic calibration. However, you control the calibration procedure. This allows you to supervise each calibration step and repeat single steps if required.

c) *Manual calibration with manual feed of test gases*

In this version, you control each calibration step as in B above. However, the calibration gas feed is not controlled by the SIDOR, instead you are responsible for feeding in these gases “manually”. External automatic devices for calibration gas feed are not required.

8.2 Guideline for calibrations

► *For applications in compliance with the German regulation "13.BImSchV":* observe the corresponding information on calibrations (→ page 134, §8.8.5).

8.2.1 Single-point adjustments: weekly

During measuring operation, make a single-point calibration approximately every week. The required procedure depends on the analyzer modules and the measuring ranges:

SIDOR without O_2 analysis

► Make a zero-point calibration.

► Use ambient air or nitrogen as the zero gas (notes → page 110, §8.3.2).

► Set the nominal value(s) to 0 vol.%.

SIDOR with O_2 analysis, measuring range end value ≥ 21 vol.% O_2

– with analyzer module OXOR-P:
  - ► Make a zero-point calibration.
  - ► Use ambient air as the zero gas (notes → page 110, §8.3.2).
  - ► For the NDIR measuring component(s): Set the nominal value(s) to 0 vol.%.
  - ► For the measuring component O_2: Set the nominal value to 21 vol.%.

– with analyzer module OXOR-E:

For the NDIR measuring component(s):	► Make a zero-point calibration. ► Use ambient air or nitrogen as the zero gas (notes → page 110, §8.3.2). ► Set the nominal value(s) to 0 vol.%.
For the measuring component O_2:	► Make a sensitivity calibration. ► Use ambient air or nitrogen as the test gas (notes → page 110, §8.3.2). ► Set the nominal value to 21 vol.%.

SIDOR with O_2 analysis, measuring range end value < 21 vol.% O_2

– with analyzer module OXOR-P:

For all the measuring components:	► Make a zero-point calibration. ► Use an inert gas as the zero gas, for example nitrogen (→ page 110, §8.3.2). ► Set the nominal value(s) to 0 vol.%.

– with analyzer module OXOR-E:

For the NDIR measuring component(s):	► Make a zero-point calibration. ► Use ambient air as the zero gas (notes → page 110, §8.3.2) or nitrogen or the test gas for O_2. ► Set the nominal value(s) to 0 vol.%.
For the measuring component O_2:	► Make a sensitivity calibration. ► Use a test gas with a matching O_2 concentration (→ page 111, §8.3.3). ► Set the nominal value to the O_2 concentration of the test gas.

► Please check if your SIDOR was delivered with technical information where a special zero gas is specified.

- If a sample gas cooler is used in the sample gas conditioning system, feed the calibration gases in front of the sample gas cooler inlet. Thus the physical influence of the cooler is identical during measurement and calibration and will be compensated for.
- Special systems (for example, process applications with a complex gas conditioning system) may need an individual concept for calibrations.

8.2.2 Complete calibrations: every 3 months (or according to certification)

At intervals of approximately 3 months, make a complete calibration where zero-point and sensitivity are adjusted for all the measuring components (complete adjustment).

You might do this at longer intervals (for example, 6 months or 1 year) if this is officially allowed for your application (for example, due to a TÜV certificate).

8.2.3 Full calibrations: exceptionally

If the SIDOR is running with an internal cross-sensitivity compensation, a “full calibration” should be performed at long time intervals (→ page 125, §8.8.1).

8.3 Calibration gases

8.3.1 Programmable calibration gases

You can enter the nominal values for 6 different calibration gases:

- 2 “zero gases” for zero-point calibration of all measuring components (→ page 110, §8.3.2)
- 4 “test gases” for sensitivity calibration (→ page 111, §8.3.3).

It is required to set the nominal values prior to starting a calibration.

- This manual provides a table where you can record the nominal values of the calibration gases (→ page 194, §17.1).
- You can program 4 different automatic calibration routines where you can use the 6 calibration gases as you wish (→ page 115, §8.5.2).

8.3.2 Zero gas (calibration gas for the zero-point)

General requirements

As a rule, zero gas should not produce a measuring effect for the measuring components which are zero-calibrated with this gas (nominal values: “0”). Which means that the zero gas should not contain any of the measuring components, with the exception of the analyzer module OXOR-P where the zero calibration can be made with a gas which includes O_2. For some applications, ambient air (fresh atmospheric air) can be used as the zero gas (→ page 108, §8.2).

► Check if your SIDOR was delivered with technical information where a special zero gas is specified.

Ambient air

- Ambient air should not contain any of the SIDOR measuring components (or only in non-significant concentrations). Exception: O_2.
- Atmospheric fresh air contains an O_2 concentration of 20.96 vol.%; in this manual, the corresponding nominal value is rated to be “21 vol.%”. However, if the O_2 concentration in your ambient air is much different, you should adapt the O_2 nominal value accordingly.

Nitrogen

► *If “nitrogen” is specified to be the zero gas:* Use nitrogen of either “technical” or “top grade” quality, depending on your application.

- You may set particular nominal values for the zero gases. This may be useful in special applications when you want to use a zero gas which causes the analyzer to give a response signal. You need to know the quantitative effect and should take it into account when setting up the nominal values.
- In applications where large cross-sensitivities are present, you may want to use the “interfering gas” as the zero gas, or a gas mixture which represents the average sample gas composition. In this way, the calibrations would physically compensate for the cross-sensitivities. (Usefulness for OXOR-P → page 135, §8.8.6).

8.3.3 Test gases for sensitivity calibration

The “test gases” are used to calibrate the sensitivity. A test gas is a mixture of zero gas and a measuring component. In most cases, you can also use test gas mixtures with more than one measuring component, if required.

Appropriate nominal values

The nominal values of a test gas are the true concentrations of the measuring components in the test gas. The nominal values can be within 10 ... 120 % of the physical measuring range end value of the related measuring component – see `min./max.` values in the settings menu (→ page 117, §8.5.4). For an accurate calibration, the nominal values should be within 60 ... 100 % of the physical range end value.

- ► Please check if there was separate information delivered with the SIDOR including notes on the test gases required for correct calibration.
- ► Do not forget to change the nominal value settings when a test gas has been changed (for example, after replacing a test gas cylinder).

Test gas mixtures

A test gas mixture is a mixture of zero gas and more than one measuring component. Test gas mixtures can be used for simultaneous calibration of several measuring components. You could also use a test gas mixture for the calibration of several gas analyzers with different measuring components.

Test gas mixtures can be used in most applications. However, please note that test gas mixtures should *not* be used in the following cases:

- if the co-existence of the gas components could physically interfere with the analysis
- if the gas components could chemically react with each other
- if the mixture components would produce cross-sensitivity effects in the SIDOR for those measuring components which are to be calibrated, and these cross-sensitivity effects are not automatically compensated for
- if separate information was delivered with the analyzer which rules out the use of test gas mixtures.

Test gas criteria versus cross-sensitivities

- If the SIDOR is working with a cross-sensitivity compensation, please observe the notes in §16.1.2 (→ page 187).
- If your SIDOR has measuring components with an relevant H_2O cross-sensitivity, please observe the notes in §8.8.4 (→ page 133).

8.3.4 Correct feeding of the calibration gases

Inlet pressure

- *Without* a built-in sample gas pump: Feed the calibration gases into the analyzer at the same inlet pressure as the sample gas.
- *With* a built-in sample gas pump:
  - When calibration gases are fed into the analyzer, the pump should be switched off. You can do this manually (→ page 62, § 6.4.1), or you can set-up the automatic switch-off (→ page 117, § 8.5.4).
  - Then feed the calibration gases at a slight positive pressure (50 ... 100 mbar). *Caution:* A higher pressure could damage the internal pump.

Gas flow

The volumetric flow should be identical (approximately) for the sample gas and the calibration gases.

Physical influences

The standard rule is: The calibration gases should be fed into the gas analyzer under the same conditions as the sample gas.

This means: The calibration gases should be fed-in under the same physical conditions as the sample gas. For example, if there are sample conditioning devices in front of the gas analyzer (filter, etc.), then the calibration gases should flow through these conditioning components before entering the gas analyzer.

Calibrations with sample gas cooler

If a sample gas cooler is used, then all of the calibration gases should flow through the sample gas cooler before they are fed into the analyzer (exemplary flow schedule → page 28, Figure 3).

Please note the information on disturbing physical effects (→ page 190, § 16.3.2) and on calibrations with a sample gas cooler (→ page 191, § 16.3.3).

8.4 Manual calibration

8.4.1 Methods for calibration gas delivery

Manual calibration means that you control the calibration procedure. There are two methods to deliver the calibration gases to the analyzer:

a) *Manual delivery:* You deliver the calibration gases manually (for example, you switch or open the valves).

b) *Automatic delivery:* This requires the same external devices for calibration gas supply as for automatic calibrations (gas cylinders and solenoid valves connected to the SIDOR switch outputs). When a certain calibration gas is selected in the course of the calibration procedure, it will automatically be delivered to the analyzer.

Correct delivery of calibration gases → page 112, § 8.3.4

8.4.2 Manual calibration procedure

Starting the procedure

Select `main menu → calibration → manual procedure.`

manual procedure 1 zero gas 1 2 zero gas 2 3 test gas 3 4 test gas 4 5 test gas 5 6 test gas 6	● When making a calibration, always start with a zero-point calibration (`zero gas`).

Procedure for manual zero-point calibration

manual procedure 1 zero gas 1 2 zero gas 2 3 test gas 3 4 test gas 4 5 test gas 5 6 test gas 6	Select the `zero gas` which has the correct nominal value programmed in the analyzer. If you are using an automatic calibration gas delivery, then this gas must be available.
manual procedure zero gas 2 CO 0.00 SO2 0.00 O2 0.00 Start zero calibration with ENTER! Back : ESCAPE	← pre-set nominal values for the zero-point ← (→ page 117, §8.5.4) ← 1 If the zero gas delivery is not automatically controlled, feed the zero gas manually into the SIDOR now. 2 Press [Enter] to start the internal procedure.
manual procedure zero gas 2 status: wait.. CO 0.27 vol.% SO2 -0.46 ppm O2 0.18 mg/m3 Please wait ... Break : ESCAPE	● After the start, a span delay time (→ page 119, §8.5.7) runs down, indicated by `wait..` ● Then the real values are measured (`measuring..`); at least for one period of the calibration measuring time which has been set (→ page 120, §8.5.8). – Note: the displayed real values are drift-compensated according to the last calibration (no “raw values”). 1 Wait until `End: ENTER` is displayed. 2 Observe the displayed values. Wait until all values are constant or keep slightly fluctuating on a constant level. 3 Then press [Enter].

manual procedure zero gas 2 Status: measuring.. CO 0.31 vol.% SO2 -0.44 ppm O2 0.11 mg/m3 End : ENTER Break : ESCAPE	When you press [Enter], the SIDOR accepts the displayed values as the true real values and calculates the differences from the nominal values (= drifts). You can abort the calibration by pressing [Esc].
manual procedure zero gas 2 CO 1.77 % SO2 -3.05 % O2 0.91 % Save: ENTER	← calculated values for absolute zero-point drift[1] ← (for clarification see → page 61, §6.3.6) ← ● Press [Enter] to have the SIDOR compensate these drifts. ● Press [Esc] if you do not want to accept these values (the previous zero-point calibration will be kept).

[1] = Total (accumulated) drift since the last drift reset (→ page 124, §8.7) or the last basic calibration (→ page 126, §8.8.2) has been done.

Procedure for manual sensitivity calibration

> ⚠ **CAUTION: Risk of wrong calibration**
> ► Before making a sensitivity calibration, always make the corresponding zero-point calibration.
> Otherwise the calibration will become wrong.

manual procedure 1 zero gas 1 2 zero gas 2 3 test gas 3 4 test gas 4 5 test gas 5 6 test gas 6 7 - 8 auto. starts	Select the `test gas` which matches the nominal value set in the analyzer. If you are using an automatic calibration gas delivery, this gas must be available.
manual procedure	The remaining steps are the same as with a manual zero-point calibration (→ page 113). Deliver test gas instead of zero gas for this procedure.

End of the calibration

When you have correctly calibrated the zero-point and the sensitivity for all measuring components, the SIDOR is correctly calibrated.

To return to the measuring display:

1 Press [Esc] until the `main menu` appears.

2 Select the desired `measuring display` (→ page 56, §6.2).

8.5 Automatic calibration

8.5.1 Requirements for an automatic calibration (overview)

These are the requirements for correct automatic calibrations:

1	An external valve system is installed to switch from sample gas to the calibration gases.	→ page 28, §3.4.1
	This system is electrically connected to the related SIDOR switch outputs.	→ page 80, §7.9
2	The required gases are available (gas cylinders connected and sufficiently filled) and will correctly be delivered.	→ page 112, §8.3.4
3	At least one automatic calibration is programmed.	→ page 115, §8.5.2
4	The required calibration gases are correctly selected.	→ page 116, §8.5.3
5	The nominal values for the calibration gases are correctly set.	→ page 117, §8.5.4
6	Span delay time and calibration measuring time are set with respect to the measuring system design.	→ page 119, §8.5.7 → page 120, §8.5.8
7	If the SIDOR should automatically start automatic calibrations: the calibration interval and the time of the first calibration period are set as desired.	→ page 116, §8.5.3
8	If a “service block” control input exists: it is not activated.	→ page 83, §7.10.2

Some of these settings can be checked in the `information` menu (→ page 121, §8.5.9).

8.5.2 Different automatic calibration routines

Potential features

You can program four different automatic calibration routines where the following parameters can be set individually:

- calibration gases used
- start time for the automatic calibration
- time interval between automatic starts

All the other settings for automatic calibrations (for example, span delay time and drift limit values) are valid for all the programmed routines.

Potential use

- If you use an individual test gas for each automatic calibration (→ page 117, §8.5.4), you can set-up four independent automatic calibration routines.
- A particular measuring component can be calibrated more frequently than the others – for example, if the related analyzer module is working in a very sensitive measuring range. To do this, set-up a test gas with nominal values only for the selected measuring component (nominal values for all other measuring components = “ – ”) and configure a more frequent automatic calibration with this test gas.

8.5.3
Setting-up an automatic calibration

1 Call-up menu 631 (`main menu` → `settings` → `calibration` → `auto. calibration`).

2 Select which calibration routine (1 ... 4) you want to configure.

3 Make the following settings:

<table>
<tr><td><code>auto.cal. mode</code></td><td><code>zero gas 1</code> ... <code>2</code> and <code>test gas 3</code> ... <code>6</code> will be shown, each with the option
<code>yes</code> = will be used for this automatic calibration routine
<code>no</code> = will not be used
● To change the status, press the related number key once.
● If “<code>no</code>” is set for all of the calibration gases, then this calibration routine is practically disabled and cannot be started.
During the calibration procedure, the calibration gases will be activated one after another in the displayed order.</td></tr>
<tr><td><code>auto.cal. period</code></td><td>Time interval (days /hours) in which this automatic calibration is periodically performed. The correct setting depends on the how much your SIDOR is drifting (depending on the application, the analyzer modules and the measuring ranges) and how much drift-related change of measuring accuracy you may tolerate.
● Standard setting: 1 ... 7 days (<code>01-00</code> ... <code>07-00</code>)
● Recommended setting for difficult analysis (high sensitivity) or high-accuracy requirements: 12 to 24 hours (<code>00-12</code> ... <code>01-00</code>).
● To disable automatic starts for this automatic calibration, set <code>00</code> days/ <code>00</code> hours.
If the <code>auto.cal. day</code> was “today” and the <code>auto. cal. time</code> has already passed, then the start time will automatically be shifted to the future by one <code>auto.cal. period.</code></td></tr>
<tr><td><code>auto cal. time</code></td><td rowspan="2">Time and day when the next start of this automatic calibration will take place.
● Subsequent start times are determined by the <code>auto.cal. period</code> (see above).
● You can always change the next start time by re-selecting the <code>auto. cal. time</code>. The <code>auto.cal. period</code> will start anew after that calibration.
If the time input is in the past, the analyzer will show <code>incorrect input</code>. If this happens when you have entered today’s date, please change the <code>auto.cal.time</code> so that the start time is in the future.</td></tr>
<tr><td><code>auto.cal. day</code></td></tr>
</table>

If the start time for an automatic calibration occurs while another calibration procedure is running, then this second calibration will be started when the running procedure is finished.

8.5.4 Setting the nominal values for the calibration gases

Function

It is essential for a correct automatic calibration that the programmed nominal values correspond to the actual concentrations of the measuring components in the calibration gases (→ page 110, §8.3).

In the same menu, you can select to have the built-in gas pump (option) and the switch output "external pump" (if set-up) deactivated during the calibration gas feed.

> You need to determine which of the test gases will be used during an automatic calibration (`auto.cal.mode` → page 116, §8.5.3).

Setting

1 Call-up menu 632 (`main menu → settings → calibration → nominal values`).
2 Select a `zero gas` or `test gas`. The current settings will be displayed.
3 Call-up `gas pump` and select if you want to have the built in pump (option) and the switch output "external pump" `on` or `off` when the calibration gases are fed into the analyzer.
4 Select one of the measuring components from the displayed list. In the following menu, enter its nominal value, i.e. the concentration of this measuring component in the selected test gas. *If this measuring component is not included in the test gas:* set the nominal value to "`-.-`" (by pressing the backspace key).

> **CAUTION: Risk of wrong calibration**
> - Do not set the nominal value to "0" for a measuring component which is not included in the test gas. Set it to "`-.-`".
> - Do not forget to change the nominal values if a test gas has been changed (for example, when the gas cylinder has been replaced).
>
> Otherwise the calibration will become wrong.

> When you set the nominal value to "`-.-`", then the related measuring component will not be calibrated with this particular calibration gas.
> This setting can even be used when this measuring component is included in the calibration gas mixture.

> You could set-up several nominal values for each measuring component, by programming a different nominal value for each test gas.
> However, the calibration quality will not be improved by making several correct calibration procedures in succession – with the same test gas or with different test gases – because the analyzer's current calibration only results on the *last* calibration procedure which was made.
> Repeating a calibration procedure is only useful when you think that the last calibration procedure was not correct.
> - *To prevent from errors:* Program only *one* nominal value for each measuring component.

8.5.5 Setting the drift limit values

Function

After each calibration, the SIDOR compares the current drift values for each measuring component to the drift limit values (→ page 61, §6.3.6).

The reaction on the violation of a drift limit works in three stages:

absolute drift	reaction
100 ... 120 % of drift limit value	→ status output "fault" is activated → `SERVICE: zero drift` or `SERVICE: span drift` is diplayed (+ the related measuring component) → LED "Service" is illuminated
> 120 % of drift limit value	→ status output "failure" is activated (in addition) → `FAULT: zero drift` or `FAULT: span drift` is displayed (+ the related measuring component) → LED "Function" shines red
> 150 % of drift limit value	After an *automatic* calibration additionally: → The results of this calibration are rejected. → The previous calibration is kept.

Detailed information on displayed messages → page 172, §13.2.

User possibilities

Drifts are caused, for example, by contamination, mechanical changes, or ageing effects. It is not useful to perform more and more mathematical compensation for permanently increasing drift values. Instead, when an absolute drift has become very large, the related analyzer module should be inspected and re-adjusted (for example, a cleaning procedure and a basic calibration should be performed).

You can set-up an automatic monitoring for this matter by setting drift limit values for the measuring components – for example, `20 %` (maximum value: `50 %`).

If your SIDOR is equipped with the analyzer module OXOR-E, you could use drift limit values to monitor the end of life of this module (→ page 168, §12.5).

Setting

1 Call-up menu 633 (`main menu → settings → calibration → drift limits`).

2 Make the following settings:

`meas. component`	measuring component selected for the following settings
`zero drift limit`	desired drift limit value
`span drift limit`	

8.5.6 Ignoring an external calibration signal

Function

If an “auto.cal. start” control input is used (start of an automatic calibration → page 83, § 7.10.2), you can decide whether the SIDOR should obey or ignore this control signal.

Setting

1 Call-up menu 634 (`main menu → settings → calibration → ext. cal. signals`).

2 Select the desired mode:

OFF	Input signal will be ignored
ON	Input signal can start an automatic calibration

8.5.7 Setting a span delay time

Function

The span delay time determines how long the SIDOR will wait after switching to a calibration gas before the measuring values are taken for calibration.

The span delay time should correspond to the SIDOR response time (dead time + 100% time). To determine the response time, check for each measuring component how long it takes after switching to a calibration gas until the displayed measuring value remains constant. The longest time should be used.

CAUTION: Risk of wrong calibration

If the span delay time is too short, then the calibration will be wrong.

► Better select a span delay time which might be longer than required than one that is too short.

- On the other hand, the span delay time should not be longer than necessary, in order to limit the time that the SIDOR is out of its measuring mode.
- At the end of the calibration procedure, after the analyzer has switched over to measure the sample gas again, the span delay time will run once again. This last waiting time is still a part of the calibration procedure – with all related consequences for the status messages and measuring value outputs.

Setting

1 Call-up menu 635 (`main menu → settings → calibration → span delay time`).

2 Enter the span delay time (in seconds). – standard setting: 30 s.

8.5.8 Setting the calibration measuring time

Function

During a calibration, first the “span delay time” (→ page 119, § 8.5.7) runs down, then SIDOR starts the “calibration measuring time” where the measuring values of the calibration gas are permanently determined. For each measuring component, the average measuring value within the calibration measuring time is calculated. These average values are used as the real values.

The appropriate setting depends on two criteria:

- *Damping:* The calibration measuring time must be at least 150 ... 200 % of the programmed damping time constant (→ page 71, § 7.5.1 + page 72, § 7.5.2).
- *Measuring characteristics:* The calibration measuring time should be long enough to make sure that the averaging covers all existing measuring “noise” and fluctuations. Check the analyzer modules to find the “worst” characteristic.

> The longer the calibration measuring time is, the more accurate the automatic calibrations will be.

Setting

1 Call-up menu 636 (`main menu → settings → calibration → cal. meas. time`).

2 Enter the calibration measuring time (in seconds).

8.5.9 Display of the automatic calibration settings

You can check the nominal values for the calibration gases and the timing for automatic calibrations via menu:

1. Call-up menu 41 (`main menu` → `calibration` → `auto. calibration`).
2. Select `auto. calibration` which you want to check.
3. Select `information`.

information auto. calibration x 1 zero gas 1 2 zero gas 2 3 test gas 3 4 test gas 4 5 test gas 5 6 test gas 6 7 auto. starts Enter digit	Select which parameter you want to check.

Information on zero gas or test gas (example).

information test gas 2 auto. calibration x	
CO 21.00	← nominal value for the 1st meas. component
SO2 450.00	← nominal value for the 2nd meas. component
O2 -.--	← means: will not be taken into account
active yes	← `no` = will not be used for auto. calibrations
gas pump no	← status of the gas pump (→ page 62, §6.4.1)
Back : ESCAPE	To leave this display, press [Esc].

Settings → page 117, §8.5.4

Information on automatic starts of the automatic calibrations (example)

Information auto. starts auto. calibration x next start:	
Date : 16.09.04	← date and time when the next automatic
Time : 11:30	← calibration will start
Period : 02-00 DD-HH	← interval between automatic starts [1] (days-hours)
Back : ESCAPE	To leave this display, press [Esc].

[1] 00-00 = no automatic starts (Date/Time of next start is insignificant).

Settings → page 116, §8.5.3

8.5.10 Manual start of an automatic calibration

CAUTION: Risk of wrong calibration
For automatic calibrations, some preparations are required.
► Only start an automatic calibration when all requirements are fulfilled (→ page 115, §8.5.1).

Some important settings can be checked in the `information` menu (→ page 121, §8.5.9).

Select `main menu` → `calibration` → `auto. calibration` → `auto. calibration x` → `manual control`.

`manual control`
` auto. calibration x`
`Press ENTER to start`
`an automatic`
`calibration now.`
 	
` Continue with ENTER`
` Break   : ESCAPE`
	If all requirements for an automatic calibration are fulfilled (see above), press [Enter] now.
	
	To abort the procedure, press [Esc].

`auto. calibration`
 	
`1 information`
`2 manual control`
	As long as the calibration procedure is running, `calibration running` is displayed on the status line.
	
	To abort a running calibration, select `manual control` again and confirm the abort with [Enter].

8.6 Display of calibration data

Function

You can look at the data which were taken and stored during the last calibration – individually for each measuring component.

Procedure

Select `main menu` → `calibration` → `show cal. data`.

`show cal data`
 	
`1 CO`
`2 SO2`
`3 O2`
	Select the desired measuring component.

`       -Z-       -S-`
`D: 31.08.04 31.08.04`
`T: 11.30.00 11.31.30`
`C:     0.00   300.00`
`V:     0.68   300.09`
 	
`     Drift in %`
`abs.:   0.23    -0.20`
`dif.:   0.02    -0.03`
 	
` Back: ESCAPE`
	← zero-point / sensitivity (table heading)
	← date at the end of the last calibration
	← time at the end of the last calibration
	← nominal values at the last calibration
	← measured real values at the last calibration
	
	← absolute drift (explanation → page 61, §6.3.6)
	← difference[1] in drift values to the previous cal.
	
	To exit this display, press [Esc].

[1] = "percentage points" ($Dif_X = abs_X - abs_{X-1}$).

+i When a drift reset (→ page 124, §8.7) or basic calibration (→ page 126, §8.8.2) was performed, no calibration data will be shown until a new calibration was made. (This is also true for brand-new analyzers.)

+i Drift differences represent the ratio of test value versus nominal value. For the *sensitivity drift,* the drift difference is always computed with reference to the *smaller* value of the two values.

- *Example 1:* The nominal test gas value is 100 ppm.
  The test value during calibration was 102 ppm.
  Computed sensitivity drift = (102-100)/100 = +2.00 %
- *Example 2:* The nominal test gas value is 100 ppm.
  The test value during calibration was 98 ppm.
  Computed sensitivity drift = (98-100)/98 = –2.04 %

With this method, positive and negative physical drifts are calculated with a different mathematical loading. *The fruit is:* If a physical drift had occurred and then had gone back for the same value, then the calculated absolute drift will also be back to its previous value. Without the different mathematical loading, the absolute drift would differ from its previous value and thus no longer represent the actual physical state of the measuring system.

- It is not recommended to continue with computed drift compensation when the drift values are more and more increasing. If an absolute drift becomes very large, the related analyzer module should be inspected and re-adjusted (for example, a cleaning procedure and a basic calibration should be performed).
- You can program limit values for automatic drift monitoring (→ page 118, §8.5.5). This feature will automatically provide you with a fault message when a drift exceeds your drift limit value.

8.7 Drift reset

Function

When a drift reset is made, the SIDOR cross-calculates the current "absolute drifts" (→ page 61, §6.3.6) with the measuring parameters, and then the summation of the "absolute drifts" is restarted at "0.0" values. The drift-reset allows you to begin the determination of "absolute drifts" at any time of your choice – for example, to check the analyzer's drift over a certain period of time.

CAUTION: Risk of wrong calibration

If very high drift values are displayed after a manual calibration, then probably the test gases did not correspond to the programmed nominal values, or the test gas feed was faulty. And – although great discrepancies had been displayed – the calibration had been accepted by keypad entry.

► Never try to correct such a faulty situation by making a drift reset. Instead, try to calibrate the analyzer again carefully.

- The drift reset cannot replace a mechanical or optical adjustment, which is necessary when the physical condition of the analyzer module has changed greatly in comparison with its delivered condition.[1]
- You cannot undo a drift reset. Making a drift reset means that you loose the recent "history" of the "absolute drifts".
- It is highly recommended to make a drift reset after an analyzer module has been cleaned or replaced.

[1] Such work should be made by a trained service technician.

Procedure

1 Call-up menu 73 (`main menu → service → drift reset`).
2 Enter the `Code`: [7] [2] [7] [5] [Enter]
3 Wait until `End: Enter` is displayed.
4 Press [Enter] to finish the procedure.

8.8 Special calibrations

8.8.1 Full calibration

Applies only to analyzers with the optional "internal cross-sensitivity compensation".

When to make a full calibration

- ► Make a "full calibration" *periodically* at the following recommended intervals:
  - for analyzers measuring SO_2 and NO: every year
  - for analyzers measuring all other components: every two years
- ► Make a "full calibration" whenever one of the following modifications has been made:
  - adjustment, modification, or replacement of an analyzer module
  - firmware update to software version 1.26 or 1.27

How to make a full calibration

- ► Make two sets of calibrations in succession ...
  1. a basic calibration (→ §8.8.2) for each of the SIDOR measuring components
  2. a calibration of cross-sensitivity compensations (→ page 132, §8.8.3)
- ► ... following these rules during the calibration procedures:
  - *Pure calibration gases:* Use an individual "pure" test gas (consisting of zero gas and the measuring component) for each measuring component. Do not use test gas mixtures.
  - *Dry calibration gases:* Feed the calibration gases directly into the analyzer, not through the sample gas cooler (if existing).

8.8.2 Basic calibration

When is a basic calibration required?

► Make a basic calibration
  – when an analyzer module has been newly adjusted, replaced, or modified
  – when the absolute sensitivity drift exceeds 40 % (→ page 61, §6.3.6)
  – when the digital drift compensation has reached its limit.

What does a basic calibration do?

In the course of a basic calibration, both the analog and digital signal processing are measured and optimised anew. This may be useful in the following situations:

– When an analyzer module has been modified in any way – because this will have changed the physical characteristic of this analyzer module. Thus the analog amplification of the its measuring signal should be re-optimised.
– When the digital drift compensation has reached its limit – the drift reset function (→ page 124, §8.7) could be used to re-optimise the digital part of the signal processing, but the causes for analog drift would remain and still needs to be compensated for. If the mathematical compensation is very large, then it might happen that the specified measuring accuracy is no longer kept. A basic calibration can solve this problem because it includes a re-optimisation of the analog sections.

The internal procedure of a basic calibration includes the following:

1 The measuring signals of the analyzer module are checked, and the electronic amplification of the measuring signals is re-optimised to match.
2 The basic parameters of the mathematical measuring value processing are recalculated (in the same way as during a drift reset → page 124, §8.7).

This needs to be done individually for each measuring component and requires matching calibration gases.

How is a basic calibration made?

► For a *complete* basic calibration, you need to perform the procedure once for each individual measuring component.
► However, you can run the procedure for *selected* measuring components only – for example, if the basic calibration is only required for a particular analyzer module.

What is required to make a basic calibration?

- *Time:* Depending on the number, type, and measuring range of the measuring components, the procedure can take from 20 to 120 minutes. During this time, the SIDOR is not available for measuring operation.
- *Manual gas delivery:* You need to feed the calibration gases manually into the SIDOR (for example, via a hose connection or a manual valve).
- *Knowledge of the physical zero-points:* Check the “Reference gas” value (→ page 59, §6.3.2) for all measuring components which are intended for the basic calibration – because in a basic calibration, either the zero gas or the test gas is related to this value (→ Table 8).
- *Calibration gases:* For a basic calibration of each measuring component, both an appropriate zero gas and span gas is required:

Table 8 Appropriate calibration gases for a basic calibration

“Reference gas” value is ...	`Zero gas` nominal value	`Test gas` nominal value
... close or identical to the begin value of the physical measuring range (standard).	identical to the “Reference gas” value	end value of the physical measuring range [1]
... close or identical to the end value of the physical measuring range (special).	begin value of the physical measuring range [1]	identical to the “Reference gas” value

[1] ± 20 % of the full scale range (`Min`/`Max` values are set accordingly).

- If you would like to have the internal analysis system calibrated “from the ground up”, it may be useful to clean and/or re-adjust the analyzer module before the basic calibration is performed.
- Modifications to the analyzer modules should only be made by trained service technicians or trained and authorised skilled persons. Otherwise the manufacturer’s product guarantee will no longer be valid.

Starting a basic calibration

CAUTION: Risk to connected devices

During a basic calibration, the measuring value outputs will work in the following way:

- Measuring value output OUT1 transmits the internal measuring signals which are measured during the procedure (“ADC values”).
- Measuring value outputs OUT2, OUT3 and OUT4 constantly show the last measuring value which was measured before the basic calibration procedure began.

► Make sure that this situation cannot cause problems at connected devices.

NOTICE:

If a basic calibration could not be completed successfully, then the SIDOR measuring function will be out of order.

► If you have any doubts during the basic calibration process, cancel the procedure by pressing [Esc]. This will keep the previous condition.

► *Recommendation:* Before you start a basic calibration, save the current SIDOR data (→ page 92, § 7.13.1). This will allow you to repair the SIDOR if the basic calibration fails.

When a basic calibration is started, the SIDOR should already be in operation at least one hour, to insure that all internal temperatures are stable.

► Call-up menu 74 (`main menu → service → basic calibration`).

Procedure for a single measuring component

1 Call-up `meas. component`.

2 Select the measuring component for which the basic calibration will be made. Then leave the menu (press [Esc]).

3 Call-up `zero gas`.

4 Enter the nominal value of the zero gas (→ page 127, Table 8). Then leave the menu (press [Esc]).

5 Call-up `test gas`.

6 Enter the test gas nominal value (→ page 127, Table 8). Then leave the menu (press [Esc]).

7 Select `measure`.

This section does not apply to `meas. component O2`.

The display will show:

```
zero gas
admit !

 Continue with ENTER
```

8 Deliver zero gas. Then press [Enter].

The display will show (for example):

```
measure

          SO2
SO2      23715
CO2       4871
O2        3266


when stable,
SAVE:    ENTER
```

9 Wait until the displayed values are “stable”, i.e. until they fluctuate around a relatively constant average value (± 50). Then press [Enter].

10 The display will show:

```
test gas
admit !

 Continue with ENTER
```

11 Deliver the test gas. Then press [Enter].

12 The display will show (for example):

```
measure

          SO2
SO2      23715    191
CO2       4871
O2        3266


When stable,
SAVE:    ENTER
```

13 Wait until the displayed values are “stable”, i.e. until they fluctuate around a relatively constant average value (± 50). Then press [Enter].

14 The following display message tells you that the procedure is continued with the calibration gas which effects a higher measuring signal. Press [Enter] to continue.

The following display will be like this (example):

SO2 30.000 vol.%	← measuring component; nominal value of the calibration gas
Enter SO2 test gas 30.000 vol.%	
Continue with ENTER	← only after sufficient waiting time as elapsed
0 = fixed amplific.	← *only for trained personnel* [1]

[1] Press [0] = current analog amplification will be fixed (will not be corrected). This can save time if the procedure had already been completely run and is now repeated after a short time. Not recommended for a completely new basic calibration.

15 Deliver the gas which is shown (*caution:* The procedure starts with the *larger* nominal value, i.e. with the higher concentration test gas.)

16 Wait until the gas has completely filled the internal gas path, replacing the previous gas (appropriate purge time).

17 Press [Enter].

Next, the SIDOR optimises the analog amplification of the measuring signal for the selected measuring component. The display will show (for example):

SO2 30.000 vol.%	← measuring component and nominal value of the calibration gas
CH4	← another measuring component
CO2 18559 341	← ADC value[1]; analog amplification step[2] [3]
CO	← another measuring component
18,3 %	← progress of the internal procedure
Please wait ...	

[1] Current digitized measuring signal (–32768 ... 32768).
[2] Will automatically change and be adjusted during the procedure (0 ... 4095).
[3] Values will only be shown for the selected measuring component.

18 Wait until the display changes from `please wait ...` to the following:

```
When stable,
start with ENTER.
```

19 Wait until the ADC value is “stable”, i.e. until it fluctuates around a relatively constant average value (± 50). Then press [Enter].

> +i The ADC values displayed in this step (automatic amplification optimization) and in the next step (calibration measurement) may be different.

After this step, the SIDOR runs a calibration measurement with test gas (procedure takes 30 times longer than a normal measurement does). The completion of the procedure will be shown in %.

20 Wait until `Save: ENTER` is displayed. Press [Enter] to accept the displayed value.

The following can be seen on the display (for example):

```
     Enter SO2
     zero gas

     0.000 vol.%


Continue with ENTER
```

21 Deliver the gas which is shown. Press [Enter].

The following display will be like this (example):

SO2 0.000 vol.% CO SO2 1742 O2 When stable, start with ENTER.	← ADC value [1]

[1] May rapidly change until the new gas has completely purged out the old gas.

22 Wait until the ADC value is “stable”, i.e. until it fluctuates around a relatively constant average value (± 50). Then press [Enter].

Next, the SIDOR runs a calibration measurement with zero gas. The progress of the procedure will be shown in %.

23 Wait until `Save: ENTER` is displayed. Press [Enter] to accept the displayed value.

Now the SIDOR calculates the “linearisation values” (calibration curve): The variables of a basic mathematical function are modified until the optimum calibration function is found. The progress (%) and the number of iteration steps are displayed.

24 Wait until a display like this is shown:

SO2 1.234 Save: ENTER	← measuring component; variation coefficient[1] ← ←

[1] Represents the offset of the measured calibration values from the new calibration function. Values under `5.000` are typical; for difficult applications, the values can be larger.

25 Wait until `save: ENTER` is displayed.

> If the procedure was not successful, a fault message is displayed: under the word `FEHLER` (for all menu languages), the calibration gas and the measuring component are indicated which could not be processed.
> - ► *Remedy:* Stop the procedure now and carefully repeat it (check the nominal values, make sure that the calibration gases are correctly delivered, wait long enough for an appropriate purge time).
> - ► *If this doesn't help:* Contact the manufacturer's customer service for advice. Or restore the previous SIDOR values, to use the analyzer in its previous condition (can only be done if a data back-up was made before starting the basic calibration → page 92, § 7.13.1).

26 Press [Enter] to accept the displayed values for the basic calibration of the selected measuring component.

Repeat for the other measuring components

> This will be necessary, if the SIDOR measures *several* measuring components and a *complete* basic calibration should be made.

27 In the `basic calibration` menu, select another `measuring component` and repeat the procedure for this new component, as described in "Procedure for a single measuring component".

28 Repeat this until the "Procedure for a single measuring component" has been made for all desired measuring components.

> - When you leave the `basic calibration` function, a test gas waiting time (→ page 119, § 8.5.7) will run down before the measuring value outputs display the current measuring values of the sample gas.
> - If you have *terminated* a running basic calibration at any step of the procedure (using the [Esc] key), then the previous condition of the basic calibration is kept.

Calibration with new cross-sensitivity correction

29 *If* SIDOR *is running with an internal cross-sensitivity compensation:* Perform a complete "calibration with correction" (→ page 132, § 8.8.3).

Checking the measuring characteristics

After the basic calibration, check the measuring characteristics:

1 Deliver zero gas.

2 For at least 5 minutes, observe or record the measuring values (for example, on a chart recorder) to check the measuring fluctuations (noise ratio).
   - *If the measuring values are fluctuating in the range or below the specified detection limit (→ page 202, § 18.5):* The gas analyzer is ready for operation.
   - *If the measuring value fluctuations are greater than the detection limit:* Contact the manufacturer's customer service to get the analyzer repaired.

> If you notice after the basic calibration that the sensitivity drift is greater (over a certain period) than it had been before the basic calibration: Contact the manufacturer's customer service for advice.

8.8.3 Calibration of cross-sensitivity compensations (option)

Applies only an internal cross-sensitivity compensation is running (→ page 21, §2.2.4).

Function

While usual calibrations will calibrate the zero-point and sensitivity of a measuring component, it is possible to make special calibrations which include the re-calibration of the internal cross-sensitivity compensations. During such calibrations, the SIDOR will additionally check for cross-effects which occur in the analysis of all those measuring components which are associated for cross-sensitivity compensation, and then will re-adjust the compensations accordingly. The corresponding menu function is called “calibration with correction”.

Calibrations “with correction” may be more demanding than normal calibrations (because of more exacting requirements for the calibration gases), but they only need to be done at long time intervals.

When is a calibration of cross-sensitivity compensations required?

► Make a calibration of the cross-sensitivity compensations periodically at the following intervals (recommendation):
  - For the measuring components SO_2 and NO: once a year
  - For other measuring components: every 2 years

Which calibration gases are required?

► For a calibration of the cross-sensitivity compensations, you need to use “pure” test gases, which means that each test gas consists of the zero gas and only one measuring component.

► You may also use test gas mixtures which include more than one measuring component if it is sure that the mixed components do not produce any cross-effects.

Procedure

1 Call-up menu 696 (`main menu` → `settings` → [9] → [Code] → `cal. w/correction`).

> In analyzers equipped with software version 1.26 (or previous), this function is located in menu 637 (`main menu` → `settings` → `calibration` → `cal. w/correction`).

2 Set the function status to `ON`.

3 Perform a calibration procedure as usual – however use “pure” test gases or “cross-effect free” test gas mixtures.

4 When the calibration procedure has been finished, set the “calibration with correction” function status to `OFF`.

> ► Make sure that during measuring operation and routine calibrations, the `cal. w/correction` function is set to `OFF`.

8.8.4 Calibrations of “H_2O cross-sensitive” measuring components

Criteria for a “H_2O-sensitive” calibration procedure

► Check if one of the following criteria applies to your SIDOR:
  - At least one measuring component is affected by a cross-sensitivity against H_2O (for example SO_2, NO), and the H_2O concentration in the sample gas is great enough that, as a result, the specified measuring accuracy could be reduced.
  - The SIDOR is used for emission monitoring in compliance with the German regulations “13. BImSchV”, “27. BImSchV”, or “TA Luft”.

If one of these criteria is true:

► When making calibrations for “cross-sensitive” measuring components, make sure that calibration gases include the same H_2O concentration as the sample gas when they are fed into the analyzer.

> Calibrations in compliance with “13. BImSchV” → page 134, §8.8.5

H_2O-sensitive calibration procedure with sample gas cooler

If a sample gas cooler is installed in the sample gas supply system (as usual for emission monitoring systems), comply with the following instructions during calibrations:

1. Before starting the calibration, let the sample gas cooler run with sample gas flowing through for at least 5 minutes. The sample gas should contain an adequate H_2O concentration (for example, 10 vol.%).
2. Feed-in zero gas for approximately 10 minutes. Let the zero gas low through the sample gas cooler (in the same way as the sample gas).
3. Make the zero point calibration.
4. Repeat step 1.
5. Feed-in the test gas for sensitivity calibration for approximately 10 minutes. Let the test gas low through the sample gas cooler (in the same way as the sample gas).
6. Make the sensitivity calibration.

> - Step1 makes sure that the sample gas cooler has a sufficient reservoir of condensed H_2O. Under usual conditions, this reservoir is enough for 15 minutes of calibration gas feed.
> - Steps2 and5 are used to establish constant conditions in the sample gas cooler. This is essential for “H_2O-sensitive” measuring components.
> - Step2 will purge out remaining quantities of measuring components (for example, SO_2) from the sample gas cooler.

H_2O-sensitive calibration procedure without sample gas cooler

If a sample gas cooler is not provided, supply the calibration gases as follows:

1. First, produce a high H_2O gas concentration in the calibration gases. To do this, install a suitable vessel in the gas path, filled with water, and make the calibration gases bubble through the water. – *Exception:* Ignore this step for SO_2 test gases.
2. Feed the calibration gases from the water vessel through the sample gas cooler into the gas analyzer.

8.8.5 Calibrations in compliance with “13. BImSchV”

Applies only for use in compliance with the German regulation “13. BImSchV”.

Calibration procedure for automatic readjustments

For automatic readjustments, make the following calibrations:

► Zero point calibration for measuring components CO, NO, SO_2 – every 7 days

► Sensitivity calibration for measuring component O_2 – every 3 days

Simplification by using ambient air

For the above calibrations, ambient air can be used as the calibration gas – which means that no specific calibration gas is required. Ambient air should meet the following criteria:

- O_2 concentration = 20.94 vol.% ± 0.05 Vol.%
- CO, NO, or SO_2 are not included.
- Humidification must be made before usage (see below).

Calculating the nominal values for NO/SO_2 zero gas

As a preparation, the measuring values of NO and SO_2 need to be measured once:

1 Perform a complete calibration, using N_2 as zero gas (nominal values: 0 mg/m^3).

2 Back in measuring mode, feed-in the ambient air as the sample gas.

3 Note down the measured values for NO and SO_2.

4 Program these measured values as the nominal values for zero gas.

When feeding-in ambient air, the measuring values for NO and SO_2 might slightly differ from 0 mg/m3. This is due to the H_2O cross-sensitivity of the NO and SO_2 analysis which varies according to the O_2 concentration.

Humidification of ambient air

► Let the ambient air flow through a water vessel, with a volume of approximately 0.5 l.

► Feed the humidified ambient air through the sample gas cooler, then into the gas analyzer.

Every 3 months:

► Check/fill-up the water reserve in the vessel.

► Clean the water vessel, if required.

Settings for automatic calibrations with ambient air

► For automatic readjustments with ambient air, use the following set-up:

Table 9 Settings for automatic readjustments in compliance with “13. BImSchV”

period of automatic calibrations	for measuring component CO, NO, SO_2	7 days	→ page 116, §8.5.3
	for measuring component O_2	3 days	
nominal values	zero gas for measuring component CO	0 mg/m^3	→ page 117, §8.5.4
	zero gas for measuring component NO	measured value	
	zero gas for measuring component SO_2	measured value	
	test gas for measuring component O_2	20.94 vol.%	
span delay time		140 s	→ page 119, §8.5.7
calibration measuring time		950 s	→ page 120, §8.5.8

8.8.6 Cross-sensitivity compensation with OXOR-P

Physical interference effect

If the zero-point of the OXOR-P module (→ page 20, §2.2.3) is calibrated with nitrogen and the sample gas consists mainly of other gases with considerable paramagnetic or diamagnetic susceptibility, then major measurement errors might occur. In this case, the SIDOR will display a measured value for O_2 even when the sample gas does not contain any oxygen.

Compensation methods

There are three methods to compensate for this interference effect:

- *Special zero gas:* For zero gas calibrations, you could use the “interfering gas” or an O_2-free gas mixture which represents the average composition of the sample gas. Because the zero-point is calibrated “under sample gas conditions”, the cross-sensitivity is considered in the calibration.
- *Manual compensation:* When you calibrate the zero-point with a standard zero gas, you could set the nominal value for zero gas not to “0”, but to the value which exactly counters the cross-sensitivity effect. In this way, the zero-point is constantly shifted, which compensates for the cross-sensitivity effect.
- *Automatic compensation:* The SIDOR measures the interfering component(s) simultaneously with a different analyzer module and, using these measuring values, automatically compensates for the cross-sensitivity effect (“internal cross-sensitivity compensation” → p. 21, §2.2.4).

SIDOR

9 Remote control with MARC2000

Connection
Start-up

9.1 Introduction to the remote control with MARC2000

General function of the remote control with MARC2000

You can control all of the SIDOR functions by means of a PC, using the MARC2000 PC software (separately available). All SIDOR displays are shown on the PC screen, and the analyzer keyboard is simulated on the PC.

Moreover, you could use one PC to control several SIDOR analyzers (BUS mode).

Possible uses

- Gas analyzer control and monitoring via PC
- Remote diagnosis and trouble shooting via telephone

Components required

- A PC, equipped with Microsoft Windows NT, Microsoft Windows 95/98, or Microsoft Windows-for-Workgroups 3.11 software and at least one free RS232 serial interface (COMx)
- MARC2000 PC software for analyzer remote control
- Electrical interface connection between gas analyzer and PC – directly or via modems (→ page 139, §9.2.1)
- Additional requirement for remote control of multiple gas analyzers: One RS232C/ RS422 BUS converter for the PC and each connected gas analyzer (→ page 139, §9.2.1)

9.2 Remote control installation

9.2.1 Electrical connection

To establish the PC remote control with MARC2000, you need to connect the gas analyzer to the PC via an RS232 serial interface. There are several ways to do this:

Connecting a single analyzer directly via the interface → **page 140, Figure 18**

This connection requires three electrical lines (TXD → RXD, RXD → TXD, GND → GND). On the PC serial interface, short-cutting bridges should be installed between the CTS–RTS and DSR–DTR connections (install wire bridges in the plug connector of the connecting cable; see figure). However, if you want to use the “RTS/CTS protocol” for data transmission (Windows name: “Protocol: Hardware”), then you need to install three more connection lines and no bridges (see figure).

Connecting several analyzers via BUS converters → **page 140, Figure 18**

In order to control several gas analyzers from one PC, you will need a RS422 BUS connection. Each connected instrument will need one RS232C/RS422 BUS converter. These are available from various manufacturers.

The BUS converter which is connected to the PC must work as “data circuit-terminating equipment” (DCE). The BUS converters connected to the gas analyzers must work as “data terminal equipment” (DTE). Many BUS converters allow you to select between these modes. Set-up the BUS converters accordingly or use the appropriate BUS converter versions. – Most BUS converters need an external power supply (not shown in the figure).

When using BUS converters, you need to activate the “RTS/CTS protocol” feature of the gas analyzer (→ page 84, § 7.11.1).

Connecting a single analyzer via modems → **page 141, Figure 19**

Modems are used to transmit data via telephone lines. A modem connection requires two modems. You can use any type of modem which has a Hayes-compatible command set. – For setting the required modem parameters, a special menu function (“initialise”) is available both in the SIDOR and the MARC2000 software.

Connecting several analyzers via BUS converters and modems → **page 141, Figure 19**

This version combines modems and BUS converters. Please refer to the notes above.

You need to set-up which type of connection is used (→ page 89, § 7.12.3).

Figure 18 Connection of gas analyzer and PC, without modems

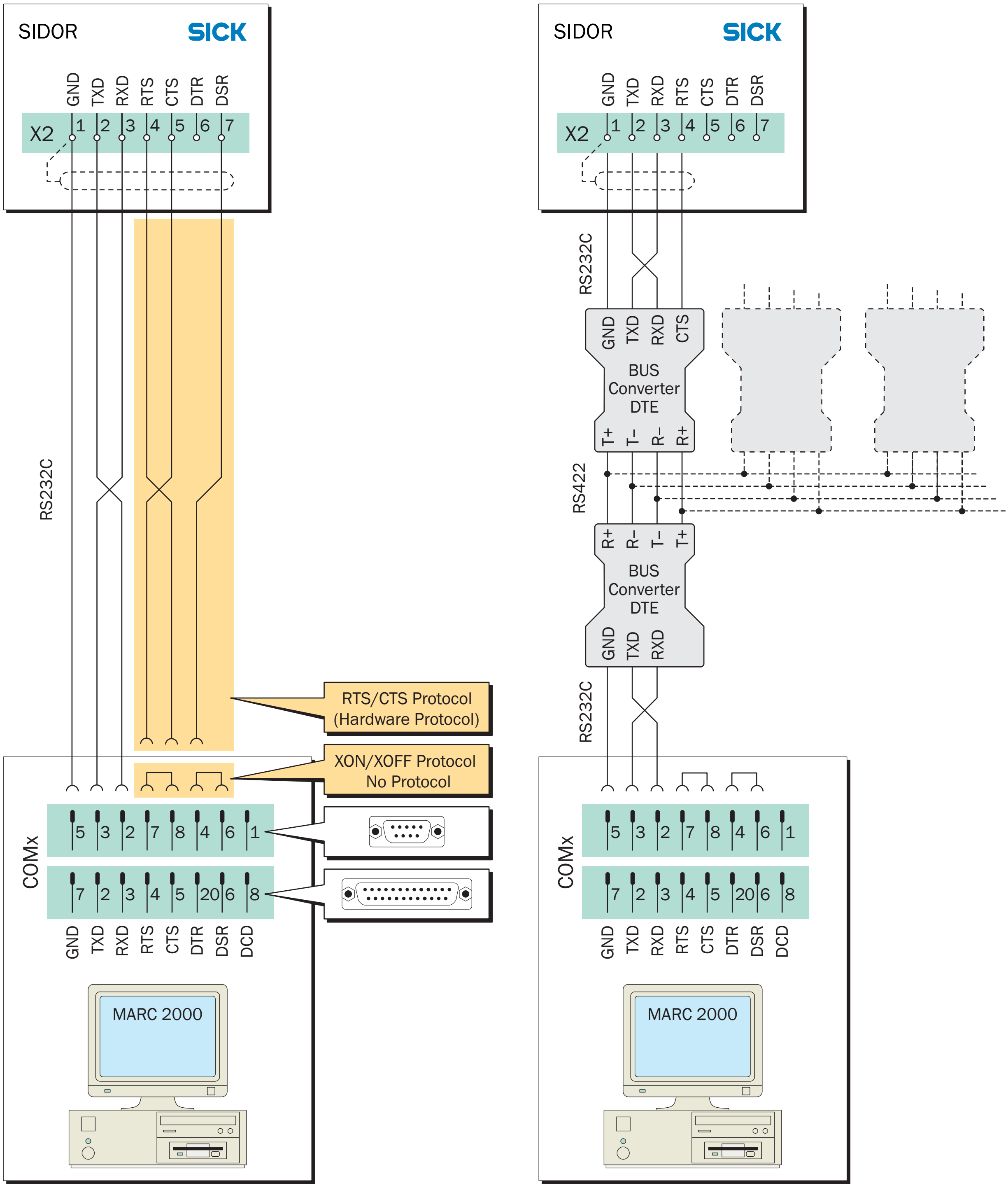
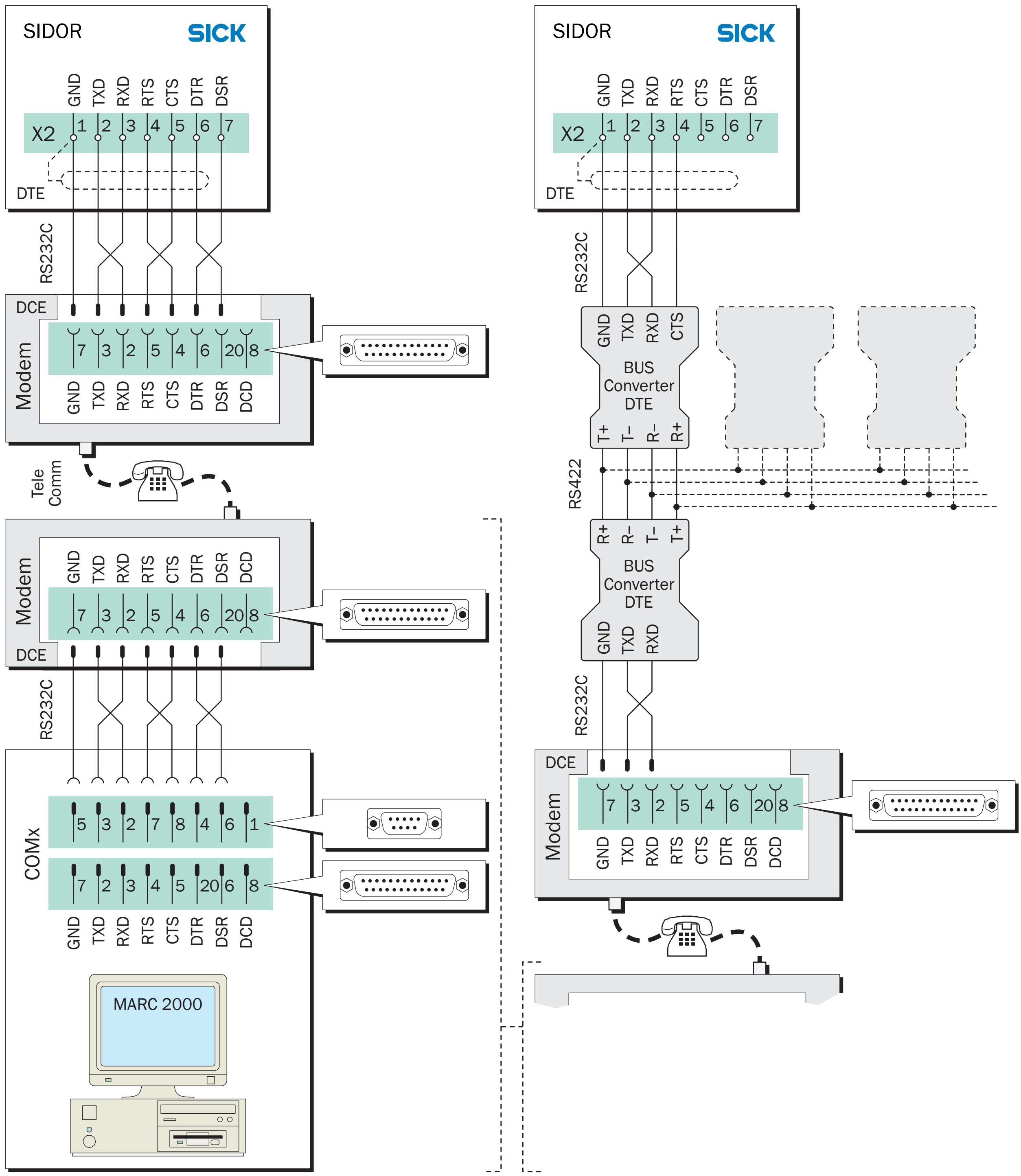


Figure 19 Connection of gas analyzer and PC via modems



9.2.2 Programming the SIDOR remote control settings

Basic settings

1 Set-up the interface parameters on interface #1 to match those on the connected PC or modem (→ page 84, § 7.11.1).

2 Set-up the desired electrical connection (→ page 89, § 7.12.3).

Settings for operation with modems

► Set-up the basic modem functions (→ page 90, § 7.12.4).

Settings for operation with BUS converters

1 Activate the “RTS/CTS protocol” (→ page 84, § 7.11.1).

2 Set-up an individual identification character for each of the connected gas analyzers (→ page 88, § 7.12.1).

3 Activate `AK-ID-active` (→ page 89, § 7.12.2).

> **!** *When using BUS converters:*
> ► Make all the remote control settings *identical* in all the connected gas analyzers – except for the identification character.

9.2.3 Set-up the PC for remote control

1 The MARC2000 software must be installed on the PC. For installation, please refer to the information delivered with the MARC2000 software.

2 Check the Windows system settings for the RS232 serial interface (COMx) that is used for the gas analyzer remote control:

- The settings must be identical to the interface parameters of the connected gas analyzer or modem.
- Please refer to the notes on the RTS/CTS protocol (→ page 139, § 9.2.1). In the Windows system, the RTS/CTS protocol is called “Protocol: Hardware”.

9.3 Starting and ending the remote control operation

9.3.1 Starting the remote control

To activate the remote control in MARC2000, the following steps are required:

1 Start the MARC2000 program in the PC.

When using modems:

1 Initialise the PC modem. (Not required if the modem has already been initialised and the modem settings have not been changed or erased – refer to operational notes for the MARC2000.)
2 Initialise the gas analyzer modem. (Not required if the modem has already been initialised and the modem settings have not been changed or erased.)
3 Establish a telephone connection from modem to modem.
   – Calling from the PC: Use the menu functions in the MARC2000 program.
   – Calling from the gas analyzer: Use the menu function `dialing` (→ page 91, §7.12.5).

2 Activate remote control: Use the related functions in the MARC2000 software.

+i As long as the remote control is active, the SIDOR transmits all displayed data to the PC. That's why the SIDOR may react a bit slowly when you push a key.

9.3.2 Status message during remote control with MARC2000

As long as the remote control with MARC2000 is activated, the SIDOR will display the status message `PC control active !`. If additional status messages are also present (for example, `CHECK STATUS/FAULTS`), then this message switches on the display approximately every second.

9.3.3 Ending the remote control

Any to the following actions will terminate the remote control with the MARC2000:

- One of the connected instruments (PC, gas analyzer, modem, BUS converter) is switched off or its power supply fails.
- The remote control of the SIDOR is terminated by a command in the MARC2000 software, on the PC.
- The MARC2000 is terminated by the command File | Exit on the PC.
- The SIDOR has not received any remote control commands for the last 15 minutes.

In addition, when modems are used:

- In the SIDOR, the modem command `abort` is selected. This terminates the telephone connection.
- One of the connected modems is initialised (by doing so, the modem will break off the existing telephone connection).

> +i If there is no need for data communication, the MARC2000 will transmit a "dummy" remote control command approx. every 5 minutes, to prevent the SIDOR from automatically terminating the remote control mode.

> ! *If the PC and the SIDOR are connected via modems and the telephone line connection was made from the SIDOR:*
>
> ► *When the remote control via PC is finished:* select the SIDOR modem command `abort`.
>
> Otherwise, the telephone line connection will be kept from the SIDOR modem, even though the remote control is off.

SIDOR

10 Remote control with “AK protocol”

Basics
Control commands

10.1 Introduction to the remote control with “AK protocol”

The “AK protocol” is a software specification for digital interfaces which has been defined by the German automobile industry. The SIDOR option “limited AK protocol” provides some remote control functions which are related to this specification.

Using the “limited AK protocol” remote control commands, you can

- activate and deactivate the “limited AK protocol” remote control mode
- call-up the current instrument status of the SIDOR
- remotely control and set some of the calibration functions

10.2 Technical basics

10.2.1 Interface

For remote control purposes, interface #1 is used (interconnecting diagram see → page 44, § 14). The standard interface parameters are:

Baud rate	9600
Data bits	8
Parity	no parity
Stop bits	1

Settings → page 84, § 7.11.1

10.2.2 Complete command sequence (command syntax)

A complete remote control command consists of the following characters:

- First character = character STX (02hex).
- Second character = ID character [AK-ID] of the SIDOR (→ page 88, § 7.12.1).
- The [AK-ID] is followed by the 4-character command plus additional parameters (if required). There must be a space character (20hex) between the command and each parameter.
- Last character = character ETX (03hex).

Byte	Contents
1	character STX (02hex)
2	[AK-ID]
3 ... 6	four command characters
7 ... (n-1)	space character + parameter, if required
n	character ETX

10.3 Command types

There are 3 types of remote control commands:

First command character	General function	available
A	Read data from the SIDOR	always (no preparation required)
E	Change settings in the SIDOR	when remote control is activated (→ page 149, § 10.5.1)
S	Start SIDOR procedure	

10.4 Reply to a received command

The SIDOR checks every command it receives and sends a “reply”.

10.4.1 Status character

Part of the reply is a status character which gives information about the internal status of the SIDOR:

- Normally the status is 0.
- The status will increase by 1 for any of the internal faults:

```
FAULT: gas flow
FAULT: chopper
FAULT: step motor
FAULT: temperature
```

Other status or fault messages do not influence the status character. To obtain complete status information, you can use the remote control command AFLT (→ page 149, § 10.5.2).

10.4.2 Normal reply

Command status	Reply	
The received command will be executed.	Byte 1	STX
	Byte 2	[AK-ID]
	Byte 3 ... 6	[received command]
	Byte 7	[space character]
	Byte 8	[status character] [1]
	Byte 9 ... n	[space]+[parameter]
	Byte n+1	ETX

[1] → page 147, § 10.4.1.

10.4.3 Reply to an erroneous command

Command status	Reply	
The [AK-ID] character in the received command does not match the ID character of this SIDOR (→ page 88, § 7.12.1).	Byte 1	STX
	Byte 2	[AK-ID]
	Byte 3 ... 6	????
	Byte 7	[space character]
	Byte 8	[status character] [1]
	Byte 9 ... n	[space]+[parameter]
	Byte n+1	ETX
The received command began with E or S, but the remote control is not activated (→ page 149, § 10.5.1).	Byte 1	STX
	Byte 2	[AK-ID]
	Byte 3 ... 6	[received command]
	Byte 7	[space character]
	Byte 8	[status character]
	Byte 9	[space character]
	Byte 10 ... 13	SMAN
	Byte 14	ETX
The received command cannot be executed at this time. (Example: While an automatic calibration is running, the test gas switch outputs cannot be activated via remote control.)	Byte 1	STX
	Byte 2	[AK-ID]
	Byte 3 ... 6	[received command]
	Byte 7	[space character]
	Byte 8	[status character]
	Byte 9	[space character]
	Byte 10 ... 11	BS
	Byte 12	ETX
The received command does not meet the command syntax.	Byte 1	STX
	Byte 2	[AK-ID]
	Byte 3 ... 6	[received command]
	Byte 7	[space character]
	Byte 8	[status character]
	Byte 9	[space character]
	Byte 10 ... 11	SE
	Byte 12	ETX
The received command is not defined.	Byte 1	STX
	Byte 2	[AK-ID]
	Byte 3 ... 6	????
	Byte 7	[space character]
	Byte 8	[status character]
	Byte 9	ETX

[1] → page 147, § 10.4.1.

10.5 Remote control commands

10.5.1 General commands

Command	Activating the remote control
Function	After this command, the SIDOR will execute all remote control commands which begin with S and E. (“A” commands can be executed without this activation.)
Command syntax	SREM
Transmitted reply	SREM [status character] (= command was executed)

Command	De-activating the remote control
Function	After this command the SIDOR will only execute control commands beginning with A or the command SREM. The SIDOR will reject other commands which begin with S or E.
Command syntax	SMAN
Transmitted reply	SMAN [status character] (= command was executed)
	SMAN [status character] SMAN (= SREM is not activated)

Command	Abort procedure
Function	The SIDOR terminates the procedure which is currently running (for example, calibration) and controls the switch outputs in such a way that sample gas is delivered to the analyzer.
Command syntax	SBRK
Transmitted reply	SBRK [status character] (= command was executed)
	SBRK [status character] SMAN (= SREM is not activated)

Command	Read command status
Function	The SIDOR sends information about the S-command which has just been executed.
Command syntax	ASTA
Transmitted reply	ASTA [status character] [actual command]
Reply examples	AKOW 0 SMGA (= measuring)
	AKOW 0 SSG3 (= last command was SSG3)
	AKOW 0 SATK SNGA (= automatic calibration is running, zero gas is switched on)

10.5.2 Status reading commands

Command	Read measuring components and measuring ranges
Function	The SIDOR sends the internal name of a measuring component and the related physical measuring range, user-selectable for a single component or for all components.
Command syntax	AKMP Kx x = 1 ... 5: number of the desired measuring component x = 0: all measuring components
	AKMP = same function as AKMP K0
Transmitted reply	AKMP [status character] [x] [y] [x] = identification of the measuring component [y] = end value of the related physical measuring range

Command	Read measuring values
Function	The SIDOR sends the current measuring value for a single component or for all measuring components.
Command syntax	AKONx x = number of the desired measuring component x = 0 or no x: all measuring components
Transmitted reply	AKON [status character] [x] [mv] ([x2] [mv2] [x3] [mv3] ...)
	AKON [status character] # (= currently no measuring value)

Command	Read instrument status
Function	The SIDOR sends a coded status message.
Command syntax	AFLT
Transmitted reply	AFLT [status character] 00100001 00001000 00000000 ... (8 blocks of 8 Bits, each block separated by a space character)

Command	Read serial number
Function	The SIDOR sends its own serial number (→ page 61, §6.3.5).
Command syntax	AGNR
Transmitted reply	AGNR [status character] [x] [x] = serial number

Command	Read menu language
Function	The SIDOR sends a character as identification for the selected menu language (example: E = english).
Command syntax	ASPR
Transmitted reply	ASPR [status character] [character]

10.5.3 Calibration commands

Command	Read time interval
Function	The SIDOR sends the time interval which has been set for a particular function. (Currently this is only available for “calibration” = start command SATK.)
Command syntax	AFDA [function start command]
Transmitted reply	AFDA [function start command] [Value1] [Value2] ...
	AFDA [function start command] SE (= there is no time interval for this function or the command was partially incorrect.)

Command	Set time interval
Function	Set span delay time (→ page 119, §8.5.7) or calibration measuring time (→ page 120, §8.5.8).
Command syntax	EFDA SATK [x] [y] [x] = span delay time = 10 ... 180 (seconds) [y] = calibration measuring time = 2 ... 600 (seconds)
Transmitted reply	EFDA [status character] (= command has been executed)
	EFDA [status character] SMAN (= SREM is not activated)
	EFDA [status character] SE (= command was partially incorrect)

Command	Read the settings for the calibration gases
Function	The SIDOR sends the nominal values and the pump status which are set for a particular calibration gas.
Command syntax	AKNx x = 1 ... 2 = selected zero gas
	AKPy y = 3 ... 6 = selected test gas
Transmitted reply	AK... [status character] [pump status] [SW1] [SW2] [SW3] ... [SW...] = nominal value of the measuring component in % full scale of the physical measuring range (NO = “ -.- ” is set)

Command	Set values for calibration gases
Function	Sets the nominal values and the pump status for the calibration gases. l The nominal values are only valid for the first automatic calibration (→ page 115, §8.5.2). l The nominal values need to be set for each calibration gas and for each measuring component which will be used during the first automatic calibration. l A nominal value is either a value in % of the physical measuring range or NO. NO means that this calibration gas will not be used for sensitivity calibration for a particular measuring component (equals the menu setting “ -.- ”). l If all of the nominal values are set to NO, then this calibration gas will not be used for an automatic calibration. l The [pump status] determines if the gas pump (built-in or controlled by the SIDOR) will remain switched on during delivery of the calibration gas to the analyzer.
Command syntax	EKNx [pump status] [SN1] [SN2] ... [SNn] x = 1 or 2 (for zero gas x) [SN...] = –20.0 ... 80.0 or NO
	EKPx [pump status] [SP1] [SP2] ... [SPn] x = 3, 4, 5 or 6 (for test gas x) [SP...] = 10.0 ... 120.0 or NO
	[pump status] = ON or OFF n = total number of measuring components
Transmitted reply	EK... [status character] (= command was executed)
	EK... [status character] SMAN (= SREM is not activated)
	EK... [status character] SE (= command was partially incorrect)

Command	Start an automatic calibration
Function	The SIDOR runs an automatic calibration according to the settings for the first automatic calibration.
Command syntax	SATK
Transmitted reply	SATK [status character] (= command was executed)
	SATK [status character] SMAN (= SREM is not activated)
	SATK [status character] BS (= command cannot be executed because another procedure is running)

Command	Read calibration results
Function	The SIDOR sends the “absolute drifts” (→ page 61, §6.3.6) for a particular measuring component. The values have been calculated during the last calibration.
Command syntax	AKOW Kx x = 1 ... 5 = number of the selected component
Transmitted reply	AKOW [pump status] [x] [y] [x] = zero-point drift (%) [y] = sensitivity drift (%)

Command	Measure a calibration gas
Function	The SIDOR controls the switch outputs for gases in such a way that the desired calibration gas will be entered into the analyzer and measured in the normal measuring mode.
Command syntax	SNGx x = 1 ... 2 = desired zero gas
	SPGx x = 3 ... 6 = desired test gas
Transmitted reply	S...G... [status character] (= command was executed)
	S...G... [status character] SMAN (= SREM is not activated)
	S...G... [status character] BS (= command cannot be executed because another procedure is currently running)

10.5.4 Measuring mode commands

Command	Deliver sample gas
Function	The SIDOR controls the switch outputs in such a way that the sample gas will be delivered to the analyzer and the analyzer is in its normal measuring mode.
Command syntax	SMGA
Transmitted reply	SMGA [status character] (= command was executed)
	SMGA [status character] SMAN (= SREM is not activated)
	SMGA [status character] BS (= command cannot be executed because another procedure is currently running)

10.5.5 Instrument identification commands

Command	Read instrument identification
Function	The SIDOR sends the programmed instrument identification.
Command syntax	AKEN
Transmitted reply	AKEN [status character] [Instrument identification]

Command	Set the instrument identification
Function	The SIDOR saves the entered instrument identification. This [Instrument ID] can consist of a maximum of 40 ASCII characters.
Command syntax	EKEN [Instrument identification]
Transmitted reply	EKEN [status character] (= Instrument ID has been saved)
	EKEN [status character] SMAN (= SREM is not activated)
	EKEN [status character] SE (= Command was partially incorrect)

10.5.6 Temperature compensation commands

Command	Read the temperature compensation status
Function	The SIDOR reports if the temperature compensation has been activated for a particular measuring component.
Command syntax	ATMP Kx x = 1 ... 5 = number of the selected measuring component
Transmitted reply	ATMP [status character] x ON (= temp. compensation is active)
	ATMP [status character] x OFF (= temp. compens. is not active)
	ATMP [status character] SE (= command was partially incorrect)

Command	Switch on/off the temperature compensation
Function	Activate or deactivate the temperature compensation for a particular component.
Command syntax	ETMP Kx [a] x = 1 ... 5 = number of the selected measuring component [a] = ON (activate) or OFF (deactivate)
Transmitted reply	ETMP [status character] (= Command was executed)
	ETMP [status character] SMAN (= SREM is not activated)
	ETMP [status character] SE (= command was partially incorrect)

SIDOR

11 Remote control with Modbus

Modbus specifications
Installation
Control commands

11.1 Introduction to the Modbus protocol

Function

Modbus® is a communication standard for digital control systems, used to establish a connection between a “master” device and a number of “slave” devices. The Modbus protocol specifies only the communication commands, but not the electronic transmission; therefore it can be used with various digital interfaces, like RS232, RS422, or RS485. The Modbus standard was originally developed by the MODICON company for use with their interface controller chips; now it is a widely-used industrial application.

Versions

There are two Modbus transmission versions:

- *ASCII transmission mode:* Each byte (8 bits) is sent as two 4-bit ASCII characters. It allows pauses between message characters (up to 1 second) without causing an error.
- *RTU transmission mode:* Each byte in a message is sent as two 4-bit hexadecimal characters. The RTU mode can be faster.

Command structure

Address	Function	Data	Check sum

- The Address is individually set for each connected device.
- Function codes are specified by the Modbus standard. For example, there are functions used to trigger data output from the slave device (Read) and to change status or settings in the slave (Force).
- The Data contain the additional information required to perform the Function. These information are device-specific, which means that possible Data should be specified by the manufacturer. The set of Function+Data is the command that the addressed slave should perform.
- The check sum is used to validate the transmitted data. The check sum is calculated both by the transmitting and the receiving device. If the results are identical, the data transmission was correct.

Slave’s Respond

Normally, the slave will respond to a command by sending an echo, with the same Function code, and with the Data containing the requested information. For error messages, the Function code is modified, and the Data contain an error code.

+i For more information on the Modbus protocol, you may want to get in touch with the Modbus Internet website: http://www.modbus.org

11.2 Modbus specifications for the SIDOR

Modbus functionality

- The SIDOR works as a slave device.
- The SIDOR uses the RTU mode for input and output transmission.
- The SIDOR responds to an input command immediately after the last command character has been received, without any delay. This is an exception from the “Modicon Modbus Reference Guide” which specifies a “silent interval” of 3.5 character times after each message.

Allowable Modbus parameters

► With a Baud rate of 9600 Baud, keep the following Modbus parameters:

slave response time:	≥ 200 ms
delay between polls:	≥ 200 ms
scan rate:	≥ 500 ms

► With smaller Baud rates, keep greater times respectively.

With a closer timing, data transfer errors might occur.

The SIDOR needs approximately 0.5 seconds to generate a new measuring value. With two measuring components, new measuring values are available at intervals of approximately 1 second. It is not necessary, probably, to request SIDOR measuring values at shorter intervals.

11.3 Installation of a Modbus remote control

11.3.1 Interface

Interface #1 is used for the remote control (pin schedule → page 44, § 14). Permitted interface parameters:

Baud rate	maximum 28800
Data bits	8
Parity	even/odd/none (as required)
Stop bits	1

Setting → page 84, § 7.11.1

11.3.2 Electrical connection

Connecting a single slave device

The Modbus functions can even be used with a simple direct interface connection, as shown on the left part of Figure 18 (→ page 140). In this way, a single SIDOR can be connected to a master device – for example, for a test.

Connecting several slave devices (BUS mode)

If several SIDOR analyzers are to be controlled by a master device, a BUS system with RS232C/BUS converters needs to be used, as shown on the right part of Figure 18 (→ page 140). Other BUS systems can be used instead of RS422; for example, RS485.

11.3.3 Programming the SIDOR remote control settings

1 Set-up the interface parameters on interface #1 to match those on the connected BUS converter or master device (→ page 84, § 7.11.1).

2 *When using BUS converters:* Activate the “RTS/CTS protocol” (→ page 84, § 7.11.1).

3 Set-up the installed electrical connection (→ page 89, § 7.12.3).

4 Set-up an individual identification character for each of the connected gas analyzers (→ page 88, § 7.12.1).

5 Activate `AK-ID with MODBUS` (→ page 89, § 7.12.2).

> **!** *When using BUS converters:*
> ► Make all the remote control settings *identical* in all the connected gas analyzers –except for the identification character.

11.4 Modbus function commands for the SIDOR

11.4.1 Function codes

The SIDOR can process the following function codes:

Code	Description	Function
01	Read Coil Status	Read one or several 1-bit status information (in order to request the SIDOR status).
		A maximum of 64 coils can be read with one command. 200 coils available(→ §11.4.4).
		Address range: 0000H ... 00C7H
03	Read Holding Register	Read one or several 16-bit data words.
		A maximum of 32 registers can be read with one command. 200 registers available of 16 bits each (→ §11.4.4).
		Address range: 0000H ... 00C7H
05	Force Single Coil	Write a 1-bit information (in order to program one SIDOR setting).
		Each command allows to change 1 coil. 32 coils available (→ §11.4.3).
		Address ranges: 0000H ... 001FH (overlapping the Read Coil Status range) and 00A8H ... 00C7H (is being reset after power failure).
16	Preset Multiple Register	Write one or several 16-bit data words (in order to program SIDOR settings).
		Each command allows to write a maximum of 32 registers. 32 Register available (→ §11.4.3).
		Address ranges: 0000H ... 001FH (overlapping the Read Coil Status range) and 00A8H ... 00C7H (is being reset after power failure).

Modbus commands with other function codes will be ignored.

11.4.2 Data formats

Data format for function values (status information)

A digital value is a 1 Bit information:

Logical 0 = function OFF

Logical 1 = function ON

A data byte consists of 8 Bits with 8 digital values:

Bit 0 = least significant bit (lowest digital value)

Bit 7 = most significant bit (highest digital value)

Data format for floating-point values

A floating-point value consists of two 16-bit data words (2x 16 Bit = 4 Byte):

Byte 3 (MSB)	Byte 2	Byte 1	Byte 0 (LSB)
SEEE EEEE	EMMM MMMM	MMMM MMMM	MMMM MMMM

S = mathematical sign; 0 = + / 1 = –

E = exponent (2 complements biased by 127)

M = mantissa (1st mantissa)

Order of data transmission:

Byte 1	Byte 0 (LSB)	Byte 3 (MSB)	Byte 2

11.4.3 Modbus control commands

Force Single Coil

Using the control command “Force Single Coil” (function code 05) and its subsequent function data, the master device can control the following SIDOR functions:

data	control command
1	– not specified –
2	– not specified –
3	– not specified –
4	– not specified –
5	sample hold (20 mA measuring value outputs)
6	switch-off pump
7	activate service lock
8	stop/disable automatic calibrations
9	start automatic calibration 1
10	start automatic calibration 2
11	start automatic calibration 3
12	start automatic calibration 4
13	measuring value output 1: activate range 2
14	measuring value output 2: activate range 2
15	measuring value output 3: activate range 2
16	measuring value output 4: activate range 2

Preset Multiple Register

Using the control command “Preset Multiple Register” (function code 16) and its subsequent register data, the master device can control the following SIDOR functions:

Register Nr.		control command	structure			
X	Y		X-high	X-low	Y-high	Y-low
R1	R2	set date in the SIDOR	month	day	– free –	year
R3	R4	set time in the SIDOR	hours	minutes	– free –	seconds
R5	R6	sett AK-ID/Modbus mode	mode code [1]		– free –	– free –
R7	R8	– not specified –				
R9	R10	– not specified –				
R11	R12	– not specified –				
R13	R14	– not specified –				
R15	R16	– not specified –				
R17	R18	– not specified –				
R19	R20	– not specified –				
R21	R22	– not specified –				
R23	R24	– not specified –				
R25	R26	– not specified –				
R27	R28	– not specified –				
R29	R30	– not specified –				
R31	R32	– not specified –				

[1] 0 = “without AK-ID” / 1 = “with AK-ID” / 2 = “with AK-ID MODBUS” (→ page 89, § 7.12.2)

11.4.4 Modbus read commands

Read Coil Status

Using the “Read Coil Status” command (function code 01) and its subsequent function data, the master device can read the SIDOR instrument status:

data	status	data	status
1	maintenance active	63	control input “test gas 3 fault” is activated
2	temp. controller 1 is heating up	64	control input “test gas 4 fault” is activated
3	temp. controller 1 is out of the nominal range	65	control input “test gas 5 fault” is activated
4	temp. controller 2 is heating up	66	control input “zero gas 1 fault” is activated
5	temp. controller 2 is out of the nominal range	67	IR source malfunction
6	temp. controller 3 is heating up	68	chopper wheel malfunction
7	temp. controller 3 is out of the nominal range	69	failure during calibration with zero gas 1
8	controller 4 is starting-up	70	failure during calibration with test gas 3
9	controller 4 is out of the nominal range	71	failure during calibration with test gas 4
10	– no function –	72	failure during calibration with test gas 5
11	alarm limit 1 indication is activated	73	– no function –
12	alarm limit 2 indication is activated	74	internal power supply failure
13	alarm limit 3 indication is activated	75	control input “failure 1” is activated
14	alarm limit 4 indication is activated	76	control input “failure 2” is activated
15	signal for compon. 1 too high (ADC overflow)	77	control input “fault 1” is activated
16	signal for compon. 2 too high (ADC overflow)	78	control input “fault 2” is activated
17	signal for compon. 3 too high (ADC overflow)	79	control input “service 1” is activated
18	signal for compon. 4 too high (ADC overflow)	80	control input “service 2” is activated
19	signal for compon. 5 too high (ADC overflow)	81	“FAULT” status is activated
20	A/D converter (ADC) is not ready	82	“SERVICE” status is activated
21	meas. value compon. 1 > 120 % of end val.[1]	83	control output “zero gas 2” is activated
22	meas. value compon. 2 > 120 % of end val.[1]	84	control output “test gas 4” is activated
23	meas. value compon. 3 > 120 % of end val.[1]	85	control input “zero gas 2 fault” is activated
24	meas. value compon. 4 > 120 % of end val.[1]	86	control input “test gas 6 fault” is activated
25	meas. value compon. 5 > 120 % of end val.[1]	87	failure during calibration with zero gas 2
26	calibration running	88	failure during calibration with test gas 6
27	automatic calibration running	89	sample point 1 is activated
28	control output “zero gas 1” is activated	90	– no function –
29	control output “sample gas” is activated	91	– no function –
30	control output “test gas 3” is activated	92	– no function –
31	control output “test gas 4” is activated	93	– no function –
32	control output “test gas 5” is activated	94	– no function –
33	measuring value output 1: range 2 is active	95	– no function –
34	measuring value output 2: range 2 is active	96	– no function –
35	measuring value output 3: range 2 is active	97	– no function –
36	measuring value output 4: range 2 is active	98	– no function –
37	control output “external pump” is activated	99	– no function –
38	zero-point drift of compon. 1 > drift limit	100	– no function –
39	zero-point drift of compon. 2 > drift limit	101	– no function –
40	zero-point drift of compon. 3 > drift limit	102	– no function –
41	zero-point drift of compon. 4 > drift limit	103	– no function –
42	zero-point drift of compon. 5 > drift limit	104	– no function –
43	sensitivity drift of compon. 1 > drift limit	105	analyzer module 1 is out of order
44	sensitivity drift of compon. 2 > drift limit	106	analyzer module 2 is out of order
45	sensitivity drift of compon. 3 > drift limit	107	analyzer module 3 is out of order
46	sensitivity drift of compon. 4 > drift limit	108	– no function –
47	sensitivity drift of compon. 5 > drift limit	109	– no function –
48	zero pt. drift of compon. 1 > 120 % drift limit	110	analyzer module 1 malfunction
49	zero pt. drift of compon. 2 > 120 % drift limit	111	analyzer module 2 malfunction
50	zero pt. drift of compon. 3 > 120 % drift limit	112	analyzer module 3 malfunction
51	zero pt. drift of compon. 4 > 120 % drift limit	113	– no function –
52	zero pt. drift of compon. 5 > 120 % drift limit	114	– no function –
53	sens. drift of compon. 1 > 120 % drift limit	115	calibration running with analyzer module 1
54	sens. drift of compon. 2 > 120 % drift limit	116	calibration running with analyzer module 2
55	sens. drift of compon. 3 > 120 % drift limit	117	calibration running with analyzer module 3
56	sens. drift of compon. 4 > 120 % drift limit	118	– no function –
57	sens. drift of compon. 5 > 120 % drift limit	119	– no function –
58	pressure signal too great (ADC overflow)	120	signal of an. module 1 is to great (ADC overflow)
59	condensate in sample gas path (int. sensor)	121	signal of an. module 2 is to great (ADC overflow)
60	flow signal too great (ADC overflow)	122	signal of an. module 3 is to great (ADC overflow)
61	flow < flow limit value (failure)	123	signal of an. module 4 is to great (ADC overflow)
62	flow < flow limit value (fault)	124	signal of an. module 5 is to great (ADC overflow)

[1] Of the physical measuring range.

Read Coil Status

With a “Read Coil Status” command and its subsequent function data, the master device can check whether the SIDOR has received and processed the related “Force Single Coil” control command:

data	control command
169	– not specified –
170	– not specified –
171	– not specified –
172	– not specified –
173	sample hold (20 mA measuring value outputs)
174	switch-off pump
175	activate service lock
176	stop/disable automatic calibrations
177	start automatic calibration 1
178	start automatic calibration 2
179	start automatic calibration 3
180	start automatic calibration 4
181	measuring value output 1: activate range 2
182	measuring value output 2: activate range 2
183	measuring value output 3: activate range 2
184	measuring value output 4: activate range 2

In the response, status “1” means “function is activated” and status “0” means “function is not activated”. After power failure or switching-off the SIDOR, the status of these messages is “not activated”.

Read Holding Register

With a “Read Holding Register” command (function code 03) and subsequent function data, the master device can read the following values from the SIDOR:

register no.		status/value	structure			
X	Y		X-high	X-low	Y-high	Y-low
R1	R2	current date (in the SIDOR)	month	day	– free –	year
R3	R4	current time (in the SIDOR)	hours	minutes	– free –	seconds
R5	R6	measuring component 1: current meas. value	floating-point value			
R7	R8	meas. comp. 1: end value of physical range	floating-point value			
R9	R10	date of the last zero-point calibration	month	day	– free –	year
R11	R12	time of the last zero-point calibration	month	day	– free –	year
R13	R14	meas. comp. 1: current zero-point drift in %	floating-point value			
R15	R16	date of the last sensitivity calibration	month	day	– free –	year
R17	R18	time of the last sensitivity calibration	month	day	– free –	year
R19	R20	meas. comp. 1: current sens. drift in %	floating-point value			
R21	R22	meas. comp. 1: previous zero-point drift in %	floating-point value			
R23	R24	meas. comp. 1: previous sens. drift in %	floating-point value			
R25	R26	– not specified –				
R27	R28	– not specified –				
R29	R30	– not specified –				
R31	R32	current date (in the SIDOR)	month	day	– free –	year
R33	R34	current time (in the SIDOR)	hours	minutes	– free –	seconds
R35	R36	measuring component 2: current meas. value	floating-point value			
R37	R38	meas. comp. 2: end value of physical range	floating-point value			
R39	R40	date of the last zero-point calibration	month	day	– free –	year
R41	R42	time of the last zero-point calibration	month	day	– free –	year
R43	R44	meas. comp. 2: current zero-point drift in %	floating-point value			
R45	R46	date of the last sensitivity calibration	month	day	– free –	year
R47	R48	time of the last sensitivity calibration	month	day	– free –	year
R49	R50	meas. comp. 2: current sens. drift in %	floating-point value			
R51	R52	meas. comp. 2: previous zero-point drift in %	floating-point value			
R53	R54	meas. comp. 2: previous sens. drift in %	floating-point value			
R55	R56	– not specified –				
R57	R58	– not specified –				
R59	R60	– not specified –				

continued →

Register data for the “Read Holding Register” command (continued)

register no.		status/value	structure			
X	Y		X-high	X-low	Y-high	Y-low
R61	R62	current date (in the SIDOR)	month	day	– free –	year
R63	R64	current time (in the SIDOR)	hours	minutes	– free –	seconds
R65	R66	measuring component 3: current meas. value	floating-point value			
R67	R68	meas. comp. 3: end value of physical range	floating-point value			
R69	R70	date of the last zero-point calibration	month	day	– free –	year
R71	R72	time of the last zero-point calibration	month	day	– free –	year
R73	R74	meas. comp. 3: current zero-point drift in %	floating-point value			
R75	R76	date of the last sensitivity calibration	month	day	– free –	year
R77	R78	time of the last sensitivity calibration	month	day	– free –	year
R79	R80	meas. comp. 3: current sens. drift in %	floating-point value			
R81	R82	meas. comp. 3: previous zero-point drift in %	floating-point value			
R83	R84	meas. comp. 3: previous sens. drift in %	floating-point value			
R85	R86	– not specified –				
R87	R48	– not specified –				
R89	R90	– not specified –				
R91	R92	current date (in the SIDOR)	month	day	– free –	year
R93	R94	current time (in the SIDOR)	hours	minutes	– free –	seconds
R95	R96	measuring component 4: current meas. value	floating-point value			
R97	R98	meas. comp. 4: end value of physical range	floating-point value			
R99	R100	date of the last zero-point calibration	month	day	– free –	year
R101	R102	time of the last zero-point calibration	month	day	– free –	year
R103	R104	meas. comp. 4: current zero-point drift in %	floating-point value			
R105	R106	date of the last sensitivity calibration	month	day	– free –	year
R107	R108	time of the last sensitivity calibration	month	day	– free –	year
R109	R110	meas. comp. 4: current sens. drift in %	floating-point value			
R111	R112	meas. comp. 4: previous zero-point drift in %	floating-point value			
R113	R114	meas. comp. 4: previous sens. drift in %	floating-point value			
R115	R116	– not specified –				
R117	R118	– not specified –				
R119	R120	– not specified –				
R121	R122	current date (in the SIDOR)	month	day	– free –	year
R123	R124	current time (in the SIDOR)	hours	minutes	– free –	seconds
R125	R126	measuring component 5: current meas. value	floating-point value			
R127	R128	meas. comp. 5: end value of physical range	floating-point value			
R129	R130	date of the last zero-point calibration	month	day	– free –	year
R131	R132	time of the last zero-point calibration	month	day	– free –	year
R133	R134	meas. comp. 5: current zero-point drift in %	floating-point value			
R135	R136	date of the last sensitivity calibration	month	day	– free –	year
R137	R138	time of the last sensitivity calibration	month	day	– free –	year
R139	R140	meas. comp. 5: current sens. drift in %	floating-point value			
R141	R142	meas. comp. 5: previous zero-point drift in %	floating-point value			
R143	R144	meas. comp. 5: previous sens. drift in %	floating-point value			
R145	R146	– not specified –				
R147	R148	– not specified –				
R149	R150	– not specified –				
R151	R152	pressure [hPa] (meas. value of int. sensor)	floating-point value			
R153	R154	flow [l/h] (measuring value of internal sensor)	floating-point value			
R155	R156	temperature [°C] for int. temp. compensation	floating-point value			
R157	R158	IR source supply voltage [V]	floating-point value			
R159	R160	signal input 1 [V]	floating-point value			
R161	R162	signal input 2 [V]	floating-point value			
R163	R164	– not specified –				
R165	R166	– not specified –				
R167	R168	– not specified –				
R169	R170	“set current date” command received	month	day	– free –	year
R171	R172	“set current time” command received	hours	minutes	– free –	seconds
R173	R174	“set AK-ID/Modbus mode” command received	mode code [1]		– free –	– free –
R175	R176	– not specified –				
R175	R176	– not specified –				
to						
R199	R200					

[1] 0 = “without AK-ID” / 1 = “with AK-ID” / 2 = “with AK-ID MODBUS” (→ page 89, § 7.12.2).

SIDOR

12 Maintenance

Periodical checks
Periodical replacements

12.1 Maintenance plan

Table 10 Maintenance plan

Wartungsintervall	Wartungsarbeit	
1 ... 2 days	make a visual inspection	→ page 165, § 12.2
1 week	make a single-point calibration	→ page 108, § 8.2
3 months	make a complete calibration	→ page 108, § 8.2
	check important signal connections	→ page 165, § 12.3
	check the flow monitor [1]	[2]
6 months	check the gas lines for leaks	→ page 166, § 12.4
	check/change the internal safety filter	[3]
	check the built-in gas pump [1]	[3]
1 ... 2 years	make a full calibration [4]	→ page 125, § 8.8.1
1 ... 5 years	replace the OXOR-E module [5]	→ page 168, § 12.5
10 years	replace the internal battery[6]	[3]

[1] Only for analyzers which are equipped with this feature.
[2] Reduce sample gas flow to the SIDOR and check for fault indication (→ page 97, § 7.15.2).
[3] Should be performed by a service technician or a trained skilled person.
[4] Only for analyzers working with internal cross-sensitivity compensation.
[5] Only for analyzers which are equipped with the analyzer module OXOR-E.
[6] Buffers the digital memory.

► In addition, observe all official and internal company regulations which are valid for your application.

WARNING: General risks during maintenance work
► Observe the general safety information (→ page 26, § 3.1).

12.2 Visual inspection

Purpose

A visual inspection is made to check the operating condition of the analyzer.

Maintenance interval

Recommendation: at least every 2 days

Procedure

1 SIDOR:
   - LED “Function”: Should be *green*. (If it is *red*: Check the status messages shown on the analyzer’s front display. Notes see → page 172, § 13.2).
   - LED “Service”: Should *not* be illuminated. (If the LED “Service” is on: Check the status messages shown on the display. See → page 172, § 13.2).

2 Peripherals:
   - Check all system devices (for example: gas filter, sample gas cooler, converter).
   - Check the gas lines (condition, connections).
   - *If calibration gases are automatically fed to the SIDOR:* Check the condition and availability of the calibration gases (for example: gas delivery pressure from a central gas supply, remaining quantity in the gas cylinder, expiration date).

12.3 Testing the electrical signals

Purpose

If you are using the SIDOR to give an alarm in case of a dangerous operating condition or to control important processes, then you should regularly check that all electrical functions and interconnections are working correctly.

Maintenance interval

Recommendation: at least every 3 months

Procedure

1 Check if the external processing of the SIDOR signals should be deactivated before a test can be done (for example: measuring value signals, control signals). If so, make the necessary adjustments.

2 Inform the connected stations that you intend to make a test.

3 Use the `hardware test` functions to test all important SIDOR electrical signals (→ page 103, § 7.18).

> Testing the LED indications → page 170, § 12.7

12.4 Leak test

12.4.1 Safety notes on leak tightness

WARNING: Hazards caused by leaky gas lines

- If the sample gas is poisonous or harmful, a danger to health exists if the gas path is leaky.
- If the sample gas is corrosive or can produce corrosive liquids with water (for example, with air humidity), then escaping sample gas might cause damage to the gas analyzer and proximate devices.
- If the escaping gas is explosive or can produce an explosive gas mixture with the ambient air, an explosion risk occurs if the safety precautions against explosion hazards have not been kept.
- If the gas path is leaky, then the measuring values are possibly wrong.

If the gas path is noticed to be leaky:

► Stop the gas feed.
► Take the gas analyzer out of operation.
► *If the escaping gas is harmful, corrosive, or explosive:* Thoroughly remove all the escaped gas (purge, exhaust, ventilate), keeping all the necessary safety precautions – for example:
  – explosion prevention (for example, purge the enclosure with neutral gas)
  – health protection (for example, wear respiratory equipment)
  – pollution control

12.4.2 Test criteria for gas tightness

- When applying an overpressure of 100 kPa (1 bar / 14.5 psig) against ambient air pressure, then the leak rate of gas escaping from the internal gas path of the gas analyzer (between gas inlet and outlet) should not exceed 10 ml/min (0.6 l/h). If the leak rate is higher, the gas analyzers must be considered to be leaky.
- Recommended test interval: max. 6 months.

12.4.3 A simple leak test method

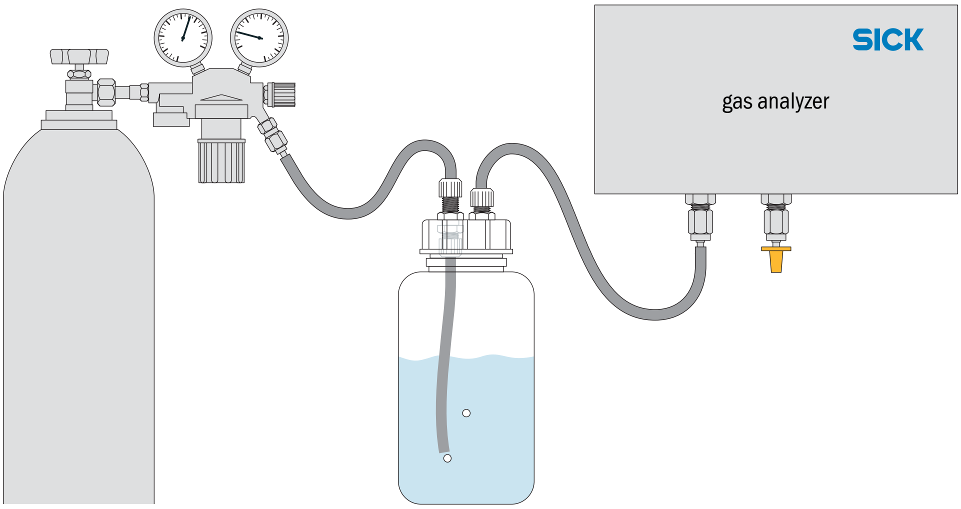
There are many other test methods – for example, using a digitally-controlled mass flow controller.

Test equipment

For a simple test, you will need

- a gas cylinder with adjustable pressure reducer (recommended: nitrogen)
- a “washing flask” or similar with two hose connectors (→ page 167, Figure 20).
  – Make sure that the washing flask can withstand the test pressure (1 bar) and can be closed gas-tight.
  – The outlet diameter of the hose (or tube) which extends into the water should be 5 mm (0.2 inch).
  – Ordinary water can be used for the filling. Set-up a filling level where no water can escape through the gas connections.

Figure 20 A simple leak test method (example)



Test procedure

► *If the gas analyzer is equipped with several separate internal gas paths:* Make this procedure once for each individual gas path.

1 Take the gas analyzer out of operation. Disconnect the gas inlet and outlet of the analyzer from the connected installations (if existing).
2 Connect the gas inlet of the analyzer to the gas outlet of the washing flask.
3 Seal the gas outlet of the analyzer gas-tight, for example with a suitable plug.
4 Seal all the other gas connections of the internal gas path (if existing) in the same way.
5 Check: The outlet valve of the pressure reducer should be shut. Then open the main valve of the gas cylinder.
6 Adjust the pressure reducer to an outlet pressure of 100 kPa (1.0 bar / 14.5 psig).
7 Connect the gas outlet of the pressure reducer to the gas inlet of the washing flask.
8 *Slowly* open the outlet valve of the pressure reducer (avoid pressure shock).
9 Wait until the pressure in the test system is constant (may take some seconds).
10 Observe the washing flask: count how many the air bubbles come out in one minute.
If you count 60 air bubbles or less, then the gas path can be considered to be tight.
11 To finish with the test:
- Shut the outlet valve of the pressure reducer.
- To release the gas pressure: slowly and carefully release the hose connected to the *gas outlet of the washing flask*.
- Re-install all the regular gas connections of the analyzer – with high attention to gas tightness.

12.5 Replacing the OXOR-E sensor

Maintenance interval

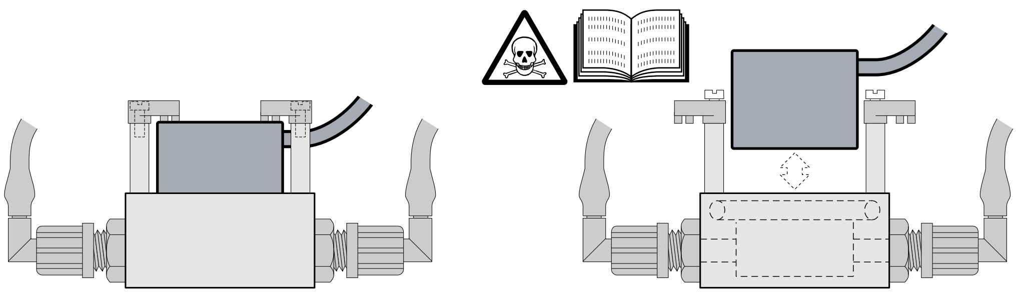
The analyzer module OXOR-E consists of an electrochemical O_2 sensor and a socket with hose connections. Due to the measuring principle (→ page 20, §2.2.3), the expected life of the O_2 sensor is limited.

You can tell when the O_2 sensor is no longer operational, based on the following criteria:

- The response time of the O_2 measurement is permanently increasing.
- The O_2 sensitivity is rapidly decreasing, which means that the O_2 sensitivity drift is suddenly increasing (display → page 61, §6.3.6).

- *Recommendation:* For preventative service, replace the O_2 sensor after an active operational life of approx. 2 years.
- You can automatically monitor the O_2 sensitivity drift by setting a suitable drift limit value for the O_2 measurement (→ p. 118, §8.5.5).

Figure 21 Analyzer module OXOR-E



Procedure

WARNING: **Risk for your health**

If the SIDOR was used to measure poisonous or dangerous gases:

► Before disassembling any gas path components, carefully purge all sample gas lines with a neutral gas (for example, nitrogen).

1 Stop the sample gas flow to the SIDOR (close valve / switch off the pump) and take the SIDOR out of operation.

2 Open the SIDOR: Remove the top cover.

3 Disconnect the sensor cable of the OXOR-E module (plug connection).

4 Release the module clamps (2 screws).

5 Pull the OXOR-E module (cylindrical body) out of the socket.

6 Check the sealing ring in the socket:

CAUTION: **Risks by incorrect assembly**

► Make sure that the connection between the OXOR-E module and the threaded “T” fitting is gas-tight:

- The O-ring (sealing ring) should be absolutely intact.
- The sealing surfaces should be clean and dust-free.
- For easy insertion of the module, you can apply a thin film of high-quality vacuum grease. – *Caution:* Do not use any other type of material.

Otherwise gas could be released during operation, and the measurement could be faulty.

7 Insert a new OXOR-E module into the socket (as far as it goes).

8 Fix the module clamps.

9 Connect the OXOR-E cable to the electronics board (connector X20).

10 Close the enclosure and restart the SIDOR. Wait for the proper warm-up time. Then re-start the sample gas flow.

11 Run a basic calibration for O_2 (→ page 126, §8.8.2).

Disposal

The OXOR-E module contains an acid. Dispose it like a battery.

Spare parts

Part #	Description	Remark
024893	Oxygen sensor	for analyzer module OXOR-E

> ***NOTICE:***
> - ► Store the OXOR-E module hermetically sealed.
> - ► Store the OXOR-E module in a cool place.
> - ► Allowable storage temperature: –20 ... +60 °C (–4 ... 140 °F).
> - ► Long storage will decrease the life of the OXOR-E module.

12.6 Cleaning the enclosure

- To remove dirt from the enclosure, use a soft cloth. If required, you can wet the cloth with water and a mild cleaning solution.
- Do not use any mechanically or chemically aggressive cleaning agents.
- Do not allow any liquids to enter into the enclosure.

> **CAUTION: Hazardous situation if liquids enter the enclosure**
> *If liquids happened to get into the instrument:*
> - ► Do not touch the instrument any more.
> - ► Take the instrument out of operation by disconnecting the power at an *external* point (for example, pull out the power plug at the socket or switch off the external mains fuse).
> - ► Contact the manufacturer’s customer service or a trained skilled person from your company who is able to repair the instrument.

12.7 Testing the LEDs

Purpose

If you use SIDOR's LEDs to watch for dangerous or unsafe operation conditions, then you should regularly check that the LEDs are operative.

Maintenance interval

Recommendation: at least every 3 months

Test preparation

> **CAUTION: Risks to connected devices**
> During the test procedure, some switch outputs will follow the LED status.
> ► Check if it is necessary to deactivate SIDOR's fault and alarm indication at external devices. Make the corresponding measures, if required.
> ► Inform the operators of connected equipment about the test situation.

Testing the LEDs "Function" and "Service"

In operational, trouble-free condition, the LED "Function" shines green and the LED "Service" is off. This is how you can produce LED fault indications:

1 Call-up 652 (`main menu → settings → gas flow → flow limit value`)(→ page 97, § 7.15.2).
2 Note down the current setting of the limit value.
3 Set-up the maximum value (120 l/h) for the limit value.
 ››› The LED "Service" is illuminated (provided that the sample gas flow is not greater than the maximum permissive flow).
 ››› If the sample gas flow is smaller than 50 % of the limit value, the LED "Function" shines red. Temporarily throttle or stop the sample gas flow to achieve this fault condition, if required.
4 Re-establish the operational flow limit value.

> - If you need to throttle the gas flow, it might be easier to perform this test with a calibration gas (for example, when feeding-in zero gas).
> - The "Service" LED indication can also be produced by activating the maintenance signal (→ page 65, § 6.6).

Testing the LED "Alarm"

To produce the "Alarm" LED signal, you just need to program an extreme alarm limit value:

1 Call-up 622 (`main menu → settings → measurement → alarm settings`)(→ page 74, § 7.6.1).
2 Select an `alarm limit value` (1 ... 4).
 ► If available, select an alarm limit value which is not used during operation. *If this is not possible:* Select an alarm limit value and note down the current settings of `set point`, `effect`, and `acknowledge`.
3 Set `acknowledge` to `off`.
4 Set-up an extreme `alarm limit value`:
 ► *If "exceeds set pt." is programmed:* Enter the minimum value.
 ► *If "under set pt." is programmed:* Enter the maximum value.
››› The LED "Alarm" is illuminated.
5 Re-establish the operational settings.

SIDOR

13 Trouble-shooting

General troubles
Display messages
Measuring troubles

CAUTION: **Health risks**
► *Before any works are made inside the SIDOR:* Observe the general safety notes (→ page 26, §3.1).

13.1 If the SIDOR does not work at all ...

Possible causes	Notes
Power cable is not connected.	Check the power cable and its connections.
Main switch is off.	Check SIDOR’s power switch (on the rear panel).
Power supply is shutoff.	Check the power supply (for example: power socket, external fuses).
Internal power fuse is defective.	Check the SIDOR power fuses (→ p. 34, §3.5.4).
Internal operating temperatures are not correct.	Check if a related fault message exists (“`FAULT: temperature`...”; display → page 59, §6.3.1; notes → page 172, §13.2).
The sample gas delivery is not working correctly.	→ page 28, §3.4
The internal software is not working correctly.	Can only happen after a complex internal failure or by strong external interferences (for example, strong electromagnetic impulses). Remedy: Switch off the SIDOR , wait for a few seconds, then switch on again.
An internal overheat protection was released.	There are overheat circuit breakers in heated analyzer modules and in the internal power transformer. These breakers are integrated in the units and irreversible: After being released, the unit is defective and needs to be replaced.

If the SIDOR still does not start-up after you have followed these notes, please contact the manufacturer’s customer service.

13.2 Status messages (in alphabetical order)

CAUTION: Health risks / damage risks
“Notes for service” are given *for trained service technicians* only.
► Do make any work inside the SIDOR unless you are familiar with the possible hazards.

WARNING: Risk for your health
If the SIDOR is used to measure poisonous or dangerous gases:
► Before disassembling any gas path components, thoroughly purge all sample gas lines with a neutral gas (for example, with nitrogen).

Display message	Meaning	Cause/Notes for operator	Notes for service
`Calibration active`	A calibration is running.	This is not a fault message.	
`CALIBRATION Sensor` x (x = 1 ... 3)	A calibration is running with analyzer module x.	Coding of x → page 61, §6.3.5	
`CHECK STATUS/ FAULTS`	There are several status or fault messages present.	Call-up the list of status / fault messages (→ page 59, §6.3.1)	
`FAILURE extern x` (x = 1 ... 2)	Control input “failure x” is activated.	Indicates a failure signal from an external device (→ page 83, §7.10.2). Not a trouble in the SIDOR.	If control logic is reversed, this message will also occur when the control input is disconnected. *Note:* This message is not related, in any way, to the status output “FAILURE sens.ext. x” (→ page 81, §7.9.4).

Display message	Meaning	Cause/Notes for operator	Notes for service
FAILURE Sensor x (x = 1 ... 3)	Analyzer module x is not fully operational. (Coding of x → page 61, §6.3.5).	Possible causes: – The internal temperature is not in the nominal range of the heating control. – The zero-point drift or span drift exceeds 120 % of the drift limit value (→ page 118, §8.5.5). – The measuring signal of the analyzer module is not in the operational range. – The SIDOR analyzer module is defective.	SIDOR module: check modulation wheel (chopper).
FAULT: chopper	Internal rotation signal from the chopper in the SIDOR module is missing.	The SIDOR is out of order. Contact the manufacturer's customer service.	– Electrical connection? – Chopper is loose or stuck? – Defective motor? – Defective photoelectric barrier? – Defective chopper motor control?
FAULT: condensate	Condensate is present in the internal sample gas path. Note: When this message appears, the internal gas pump and the control output "external pump" (if existing) are automatically deactivated.	Take the SIDOR out of operation. Then call the manufacturer's customer service: The SIDOR will need to be repaired. After repair: Manually switch off the fault message by menu (→ page 63, §6.4.2).	1. Check / repair the external gas conditioning system. 2. Repair the SIDOR: – Separate the analyzer module from the internal sample gas path to prevent condensate from entering. – If the condensate is corrosive or can leave an electrically conductive film Æ remove the condensate sensor, rinse with demin. water and then dry. – Purge the condensate sensor and the internal sample gas lines (incl. pump) with nitrogen or dry air. – Check internal glass safety filter; replace if necessary. If condensate could have entered one of the analyzer modules → repair or replace the module.
FAULT: controller 4	Control value of the internal controller 4 is outside of the nominal range.	Controller 4 is not currently in use.	Reserved for future applications.
FAULT: flow signal	The signal from the flow sensor has exceeded the operating range of the internal analog/digital converter.	If this message appears for a long time (several seconds), then switch off the SIDOR and on again. If this does not help, contact manufacturer's customer service.	Try disconnecting the sensor cable from the electronic printboard. If fault message disappears → check cable and sensor.

Display message	Meaning	Cause/Notes for operator	Notes for service
`FAULT: gas flow`	The gas flow in the SIDOR sample gas path is less than 50 % of the programmed flow limit value (→ p. 97, §7.15.2).	– During measuring operation: Check the sample delivery (filters, valves, gas lines etc.) – During a calibration: Check the calibration gas supply (gas cylinders, pressure reducer setting, valves etc.)	This message will only appear in analyzers equipped with the “flow monitor” option. When the gas flow is between 50 % and 100 % of the limit value, the `SERVICE: gas flow` message will appear instead.
`FAULT: int.voltage`	At least one of the internal supply voltages is out of order (outside of its nominal range).	Switch off the SIDOR and then switch on again. If this does not help: the SIDOR is out of order; contact manufacturer’s customer service or a trained skilled person.	Check internal supply voltages (→ page 101, §7.17.4) and internal fuses (→ page 35, §3.5.5). If you cannot find a fault → try exchanging the electronic printboard.
`FAULT: IR source`	The infrared source for the SIDOR analyzer module is out of order or disturbed in some way.	The SIDOR is out of order; contact manufacturer’s customer service or a trained skilled person.	Check IR voltage (→ page 100, §7.17.3): – too high → cable broken? source damaged or unusable? – too low → short circuit? defective electronics? defective source? defective fuse (→ page 35, §3.5.5)? (Setting a new voltage is located in the “factory settings”. Afterwards a basic calibration must be made.)
`FAULT: overrange x` (x = 1 ... 5)	The measuring value for measuring component x is larger than 120 % of the physical measuring range end value. *Caution:* The displayed value does probably not match the real concentration of this measuring component.	Check if the current concentration of this measuring component could be that high at this moment. If this is not the case: Call the manufacturer’s customer service or a trained skilled person. – See also page 75, §7.6.2.	– This problem cannot be solved by changing any settings. – If you know that the measuring value is within the measuring range: disconnect the internal electrical connection to the analyzer module. If the fault message disappears → repair or replace the module.
`FAULT: press-signal`	The signal from the pressure sensor has exceeded the operating range of the internal Analog-Digital converter.	If this message appears for a long time (several seconds), then switch off the SIDOR and on again. If this does not help, contact the manufacturer’s customer service.	Try disconnecting the pressure sensor (located on the inside of the enclosure wall; plug connector X21). Re-start the SIDOR. If no fault message → replace the pressure sensor.

Display message	Meaning	Cause/Notes for operator	Notes for service

`FAULT:`
`S-drift #x`
(x = 1 ... 5)
	The span drift is significantly greater than the set drift limit value for measuring component x (over 120 % of the limit value).	Possible causes:
		– Test gas was not available (check gas cylinders).
		– Gas delivery does not work correctly (check gas lines, valve function, gas flow).
		– The set nominal value does not match the real test gas concentration (→ page 111, §8.3.3).
		– The status message `SERVICE: S-Drift` was ignored; the deviation from the basic setting is now too large.
		– For `O2` see the special notes (→ page 168, §12.5).
		Remedy the cause and then run a new calibration.
			– Check the settings for span delay time and calibration measuring time (→ p. 119, §8.5.7 / → p. 120, §8.5.8).
			– Check the drift limit value settings (→ p. 118, §8.5.5).
			– If this fault appears often during operation for SIDOR components, increase the respective drift limit values (especially applies to low measuring ranges).
			– Thoroughly check test gases and gas lines.
			After above, run a calibration and check the drift values (→ page 61, §6.3.6). If they are still too high → clean / adjust the analyzer module, then perform a basic calibr.

`FAULT:`
`signal #x`
(x = 1 ... 5)
	The measuring signal for measuring component x cannot be internally processed.	Switch off the SIDOR and then switch on again. If this does not help: contact the manufacturer's customer service or a trained skilled person. – See also page 75, §7.6.2.	(The signal has exceeded the input range of the A/D converter.) Try separating the electrical connection from the related analyzer module.

`FAULT:`
`temperature x`
(x = 1 ... 3)
	The temperature of the analyzer module x is not in the proper operating range.	Possible causes:
		– Ambient temperature is either too high or too low.
		– The internal heating is not working.
		– The SIDOR has been previously shutoff for a short time.
		If the message appears after a short operational shutdown, it will disappear after a few minutes.
		Otherwise: Check the ambient temperature. If the SIDOR is mounted in a housing (for example, in a cabinet), check the temperature inside the housing. If necessary, take suitable measures to correct the surrounding temperature. If this does not help, inform the service personnel.
			Possible defects:
			– Electrical fuses (→ page 35, §3.5.5)
			– Temperature sensor in the analyzer module
			– Electrical connections in the internal heating circuit
			– Heating electronics are defective
			– Overheat fuse in the analyzer module (breaks the heating circuit at approx. 80 °C). This is a chemical disposable fuse; needs to be replaced after it has blown.

Display message	Meaning	Cause/Notes for operator	Notes for service
FAULT: test gas x (x = 3 ... 6)	The control input "fault test gas x" was activated during calibration.	Is only valid if such a control input is set-up (→ page 83, §7.10.2). Check if there is a related external fault (for example, gas bottle is empty). When the problem has been solved, run a calibration again.	Other possible causes: – Defective electrical connection – Defective external monitoring device
	During the last automatic calibration, during the delivery of the gas, at least one measured value was significantly different from the its nominal value (calculated drift has exceeded 150 % of the set drift limit value).	Possible causes: – The calibration gas was not available (check gas cylinders). – Gas delivery did not work correctly (check gas lines, valves, gas flow). – The programmed nominal value does not match the real concentration in the gas (→ page 117, §8.5.4). – The programmed nominal value does not meet the criteria (→ p. 110, §8.3.2). Have a look at the drift values (→ page 61, §6.3.6) to check which component has caused the problem. Solve the problem; then run another calibration again (automatic or manual).	– Check calibration gases. – Check the gas lines. – Check the settings for span delay time and calibration measuring time (→ p. 119, §8.5.7 / → p. 120, §8.5.8). – Check the drift limit values (→ page 118, §8.5.5). If you need to get an idea of where the problem occurs, run a manual calibration and watch each step.
FAULT: Z-drift #x (x = 1 ... 5)	The zero drift is significantly greater than the set drift limit value for measuring component x (over 120 % of the limit value).	→ Fault S-drift #x.	→ Fault S-drift #x.
FAULT: zero gas x (x = 1 ... 2)	→ Fault test gas x	→ Fault test gas x	→ Fault test gas x
Heating ... x (x = 1 ... 3)	The SIDOR has not yet reached its operating temperature. (x = internal heating circuit).	Not a fault. This message will disappear within 30 minutes after power-on. Do not make any important measurements and do not run a calibration as long as this message is displayed.	Will not disappear if the SIDOR does not reach its nominal temperature. Possible causes: Ambient temperature too low, internal heating is defective.
INTERRUPT ext. x (x = 1 ... 2)	The control input "fault x" is activated (→ page 83, §7.10.2).	Indicates a fault message from an external device (→ page 83, §7.10.2). Not a fault in the SIDOR.	If control logic is reversed, then this message would also be given when the electrical connection is broken.

Display message	Meaning	Cause/Notes for operator	Notes for service
maintenance/ calibr.	The status output “service” has been manually activated.	→ page 65, §6.6	
	A calibration procedure is running.	At the end of the calibration gas feed, another span delay time will run down before this message is cancelled.	
	A function in menu level 7 (service) has been called up.	The maintenance signal is activated because the SIDOR measuring operation stops when one of these functions is called up.	
No reports !	There are currently no status or fault messages.	Only shown in the list of the status / fault messages (→ page 59, §6.3.1).	
PC control active !	An external PC is controlling the SIDOR.	→ page 137, §9 / → page 145, §10	
SERVICE extern. x (x = 1 ... 2)	Control input “service x” is activated.	Indicates a trouble signal from an external device (→ page 83, §7.10.2). Not a trouble in the SIDOR.	If control logic is reversed, this message will also occur when the control input is disconnected.
SERVICE: gas flow	The gas flow in the SIDOR sample gas path is somewhat less than the programmed flow limit value (→ p. 97, §7.15.2).	– During measuring operation: Check the sample delivery (filters, valves, gas lines etc.) – During a calibration: Check the calibration gas supply (gas cylinders, pressure reducer setting, valves etc.)	This message will only appear in analyzers equipped with the “flow monitor” option. If the gas flow is less than 50 % of the limit value, the FAULT: gas flow message will appear.
SERVICE sensor x (x = 1 ... 3)	The current measuring values from analyzer module x might be wrong.	First check if the real concentration could currently be very high. If this is not the case: Call the manufacturer’s customer service or a trained skilled person.	Criterion for this message: The current measuring signal from the analyzer module x is greater than 120 % of the programmed operation range of the A/D converter.
SERVICE: S-drift #x (x = 1 ... 5)	The drift of meas. component x, as determined during the last calibration, has exceeded the set drift limit value.	The SIDOR measuring function is not yet affected.	If the drift is greater than 120 % of the drift limit value (→ page 118, §8.5.5), then the message FAULT: ...-drift #x will appear.
SERVICE: Z-drift #x (x = 1 ... 5)			
Start control 4	Internal controller is trying to establish its nominal value.	Not a fault. This message will disappear within 30 minutes after power-on.	Controller 4 is currently not in use (reserved for future applications).

13.3 If the measuring value is obviously incorrect ...

Possible causes	Notes for operator	Notes for service
The SIDOR is not ready for operation.	Start-up procedure → page 45, § 4. Check status / fault messages → page 59, § 6.3.1	–
The SIDOR is not measuring the sample gas.	Check the sample path and all of the valves (for example, switching from test gas to sample gas).	Make sure that the valves are functioning correctly, disassemble if necessary.
The sample gas supply is not activated.		
The SIDOR is not correctly calibrated.	Run a calibration. Before starting, check the following: – Were correct test gases used? (→ page 110, § 8.3) – Nominal values correctly set? (→ page 117, § 8.5.4).	Carefully check the test gases you are using (nominal values, manufacturing tolerances, condition, age).
The “damping” value is set too high for your application.	Check the setting (→ page 71, § 7.5.1); try a different setting.	
The sample gas pressure inside the SIDOR is too high.	Make sure that the internal sample gas pressure is not greater than 20 kPa (= 200 mbar = 2.9 psig).	The gas pressure can influence the measuring values in most of the measuring principles used.
The sample gas path is not gas-tight.	Visually inspect the installation. If you suspect a gas leak, contact the manufacturer’s customer service or a trained skilled person.	Perform a leak test → page 166, § 12.4.
If only observed on one of the measuring value outputs: the load is too high.	Make sure that the total internal resistance of the connected devices is not larger than 500 Ω.	Measure including the connecting line.
The analyzer module is dirty.	Contact manufacturer’s customer service or a trained skilled person.	Inspect the measuring cell or cuvette. Clean or replace if necessary.

13.4 If the measuring values are unstable and you don’t know why ...

Possible causes	Notes for the operator	Notes for service
Great pressure fluctuations at the sample gas outlet.	Install a separate vent line for the SIDOR.	
Strong mechanical vibrations.	Check the conditions where the SIDOR is installed.	

SIDOR

14 Taking out of operation

Shutdown procedure
Safety precautions
Disposal information

14.1 Shutdown procedure

A) Safety measure: Taking care of connected devices/systems

1. The shutdown of the analyzer could affect external systems. You may need to inform the operators of connected equipment that you are planning a shutdown.
2. Check if an automatic emergency signal could be generated when you shutdown the analyzer. You may need to consider which switching logic has been set-up for the SIDOR switch outputs (→ page 80, § 7.9.2).
3. If a data processing system is connected, it may be required to manually indicate a planned shutdown, so that the system will not interpret the shutdown as an analyzer malfunction.

B) Safety measure: Complete removal of the sample gas

1. Stop the gas delivery to the SIDOR.
2. Disconnect the sample gas supply line from the SIDOR, so that the sample gas is no longer fed into the analyzer.
3. Purge all gas paths in the SIDOR for several minutes with a “dry” neutral gas – for example, with technical grade nitrogen or with a zero gas. It is a good idea to include the peripheral gas lines in this purging operation.
4. Then close-off all SIDOR gas connections, or close the related valves in the purged gas line.

WARNING: Risk for your health

If the SIDOR is used to measure poisonous or dangerous gases:

► Before disassembling any gas path components, thoroughly purge all sample gas lines with a neutral gas (for example, with nitrogen).

C) Switch off power

► Switch off the power switch on the rear side of the enclosure (→ page 34, Figure 5), or disconnect the power supply at an external place (i.e. external switch, fuse).

D) Provide correct storage conditions

► → page 184, § 15.1

The internal measuring system of a gas analyzer is heated to have a constant internal temperature (SIDOR: approx. 50 °C). A side-effect is that condensation would not occur in the internal measuring system.

However, when the gas analyzer is taken out of operation, the internal temperature falls, and now condensation could occur inside the analyzer. This should never happen because liquids can damage the measuring system or make it unusable.

That’s why it is so important to thoroughly purge all the internal gas lines with a neutral gas (for example, nitrogen) prior to shutdown.

14.2 Disposal information

These sub-assemblies could contain materials which may require special disposal:

- *Electronics:* electrolyte capacitors, tantalum capacitors
- *Display:* liquid in the Liquid Crystal Display (LCD)
- *Sample gas lines:* Poisonous materials in the sample gas could have been absorbed or trapped in the “soft” sample line material (for example: hoses, sealing rings). Check if special procedures are required for the disposal of such components.
- *Analyzer module* SIDOR: In some cases, the measuring chamber (IR sensor) is filled with a gas or gas mixture which is similar to the sample gas. Check if this could be a poisonous or dangerous gas; if you are in doubt, contact the manufacturer’s customer service before you open or destroy these components.

WARNING: Risk for your health

If the SIDOR is used to measure poisonous or dangerous gases:

► Before disassembling any gas path components, thoroughly purge all sample gas lines with a neutral gas (for example, with nitrogen).

SIDOR

15 Storage, transport

Protective measures
Shipping for repair

15.1 Correct storage

► Protect the internal gas lines.	*When the SIDOR is separated from the gas lines:* close-off all gas connections on the SIDOR (with plugs, or if necessary with adhesive tape) to insure that moisture, dust or particles do not enter the internal sample gas paths.[1]
► Protect the plug connectors.	Cover the electrical connectors (dust-tight), for example with adhesive tape.
► Protect the front panel.	Protect the keypad and display against sharp-edged objects. If necessary, cover the instrument with a protective material (for example: cardboard or styrofoam, fixed with adhesive tape).
► Protect the instrument from liquids and dirt.	Cover the instrument to protect it from liquids and dirt (for example, put it into a plastic bag), and select a dry and well-ventilated room for storage.
► Protect the instrument from moisture.	*If the relative air humidity is expected to be high:* include a desiccant in the packing (for example, Silica-gel).

[1] If the SIDOR is equipped with the analyzer module OXOR-E, the SIDOR gas connections should always be sealed gas-tight – because the life of the OXOR-E module will be reduced by contact to the oxygen of the air, even when the analyzer is switched-off.

15.2 Correct transport

► Make protective measures.	As described in § 15.1.
► Use appropriate packing for shipping.	– Use a strong container which is completely padded on the inside. – Carefully fix the analyzer in the container. – Make sure that there is sufficient space between the analyzer and the walls of the container.
► Add useful information.	Please observe § 15.3.

15.3 Shipping for repair

If the instrument is shipped for repair to the factory or to a service workshop:

► Please include the following information:

- A detailed, clear description of the problem (single words are fine, but merely stating that “the instrument does not work” is of little help).
- The name of the our representative who is informed about the problem or with whom you have arranged transport to the workshop.
- The contact person in your company who can answer any questions that may arise.

Please add the information even if your matter has already been discussed with our customer service or a representative.

SIDOR

16 Special notes

Automatic compensations
Peculiar measuring components
Sample gas cooler
NO_X converter

16.1 Automatic compensations

> **CAUTION:** Risk of wrong measurements
> ► *If the* SIDOR *is working with a cross-sensitivity compensation:*
> Observe the information in this section.
> Otherwise wrong measuring values could be produced.

16.1.1 How you can notice if your SIDOR is working with compensations

Information delivered with the analyzer

Check the delivered information for notes on compensations for certain measuring components. The compensation mode should be specified there.

Information in the software configuration

You can get all the information on working compensations when you manage to print (or transmit) the internal data of the `print config.` output (→ page 87, § 7.11.3). These are the required data lines (example):

```
meas. component  :     SO2       CO2       O2    Temp. C
meas. compensation:      3         3         3        3
a              : +0.000e+00 +0.000e+00 +0.000e+00 +0.000e+00
b              : +0.000e+00 +0.000e+00 +0.000e+00 +0.000e+00
c              : +0.000e+00 +0.000e+00 +0.000e+00 +0.000e+00
d              : +0.000e+00 +0.000e+00 +0.000e+00 +0.000e+00
e              : +0.000e+00 +0.000e+00 +0.000e+00 +0.000e+00
f              : +0.000e+00 +0.000e+00 +0.000e+00 +0.000e+00
SO2            :     OFF       OFF       OFF       OFF
CO2            :     OFF       OFF       no        OFF
O2             :     OFF       OFF       OFF       OFF
Temp. C        :     OFF       no        OFF       OFF
```

- The `measuring component` lines shows all SIDOR measuring components and in addition the temperature which can also be compensated for.
- The code in the `meas. compensation` line specifies the automatic compensation or mathematical calculation which is active for the measuring component (explanation and consequences → page 187, Table 11).
- The lines `a` ... `f` are displaying the factory-set mathematical parameters used for the measuring value processing.
- The `yes`/`no`/`OFF` information specifies whether a cross-sensitivity effect was found for the respective measuring component during the manufacturing process:

`OFF`	A cross-sensitivity effect was not found – which means that at a cross-sensitivity compensation is not required for this pair of gas components
`yes`	A cross-sensitivity effect was found and an automatic cross-sensitivity compensation was activated.
`no`	A cross-sensitivity effect was found, but an automatic cross-sensitivity compensation was not activated.

16.1.2 Consequences of automatic compensations

The following table shows the available compensations and their consequences:

Table 11 Consequences of automatic compensations

Code	Auto. compensation or calculation	Consequences ...	
		... for measurement	... for calibration
0	None	None	None
1	– no function –		
2			
3	Cross-sensitivity compensation for measuring component A with internal meas. component X	If X is an internal measuring value: None If X represents a connected external measuring value: See information on code 1 and 2.	Zero gases: The zero gas which is used for measuring component A shall not contain measuring component X.
4	Mathematical cross-calculation if the internal measuring values A and X	This option creates a “virtual” measuring component V which is displayed like a real measuring component.	You cannot make calibrations for the measuring component V. The measuring values of V are correctly calibrated when the measuring components A and X are correctly calibrated.

16.2 Notes on particular measuring components

16.2.1 Measuring component CO

Disturbing effects: If an unsuitable NO_X converter is installed in the sample gas path, then CO_2 could partly or totally be converted to CO. Thus wrong measuring values would be produced for CO, although the gas analyzer is working correctly.

Remedy: Use a suitable NO_X converter (→ page 192, § 16.4.2).

16.2.2 Measuring component CO_2

NO_X converter

Disturbing effect: If an NO_X converter is installed in the sample gas path, then under certain circumstances CO_2 could partly or totally be converted to CO. Thus wrong measuring values would be produced for CO, although the gas analyzer is working correctly.

Remedy: Use a suitable NO_X converter (→ page 192, § 16.4.2).

Sample gas cooler

Disturbing effect: If a sample gas cooler is used, CO_2 could partly be solved in the condensate and thus be removed from the sample gas. This would effect wrong CO_2 measuring values, although the gas analyzer is working correctly.

Remedy: → page 190, § 16.3.2

16.2.3 Measuring component O_2

Disturbing effect: If the O_2 concentration is measured with the analyzer module OXOR-P, wrong O_2 measuring values can be produced if the sample gas contains other gas components which have a high paramagnetic or diamagnetic susceptibility.

Remedy: Observe the information in §8.8.6 (→ page 135).

16.2.4 Measuring component SO_2

H_2O cross-sensitivity

In the NDIR analysis of SO_2, an H_2O cross-sensitivity cannot be avoided due to strong overlapping of the absorption ranges. Thus the SO_2 analysis is generally “sensitive” against the H_2O concentration. In many cases this effect is so small that it does not reduce the specified measuring accuracy.

Sample gas cooler

Disturbing effect: If a sample gas cooler is used, SO_2 could partly be solved in the condensate and thus be removed from the sample gas. This would cause wrong SO_2 measuring values, although the gas analyzer is working correctly.

Remedy: → page 190, § 16.3.2

16.2.5 Disturbing effects with the measuring component NO or NO_X

H_2O cross-sensitivity

As for SO_2, the NDIR gas analysis of NO cannot avoid a certain H_2O cross-sensitivity, due to strong overlapping of the absorption ranges. So the NO analysis is generally “sensitive” against the H_2O concentration. Please observe the following notes:

Sample gas cooler

Disturbing effect: If a sample gas cooler is used, NO_2 could partly be solved in the condensate and thus be removed from the sample gas. This would cause wrong NO_2 measuring values, although the gas analyzer is working correctly. This effect can also interfere with the NO concentration analysis: If the NO/NO_2 balance in the sample gas is shifting, the NO measuring value becomes too small.

NO_X converter

→ page 192, § 16.4.2

16.3 Notes on the use of a sample gas cooler

16.3.1 Purpose of a sample gas cooler

Condensation is a fatal effect when it happens in the internal gas paths of a gas analyzer. Condensation can occur when the sample gas temperature at the sampling point is higher than in the gas analyzer and the sample gas contains condensable gas components – for example, H_2O in the exhaust gas of a combustion plant.

In such cases, the temperature of the sample gas needs to be lowered once, prior to feeding into the analyzer, in order to lower the dew point (= the temperature where condensation occurs). Usually a sample gas cooler is used for this purpose. In a sample gas cooler the temperature of the flowing sample gas is strongly reduced; in this way, most of the condensable components are separated from the gas.

However, the condensable components will not be removed completely. You might need to consider this fact in some applications in order to produce correct measuring values (→ page 190, § 16.3.2). For H_2O, the remaining concentration is approximately 7000 ... 11000 ppm, depending on the cooler temperature.

16.3.2 Disturbing effects with a sample gas cooler

Disturbing effect with an “H_2O-sensitive” analysis

If the SIDOR measures at least one measuring component which has a cross-sensitivity against H_2O, then the measuring values can be affected by physical changes in the sample gas cooler.

Remedy: Provide a constant condition of the sample gas cooler.

Disturbing effect with water-soluble gases (for example, CO_2, SO_2)

Inside the sample gas cooler, there is a relatively large surface of condensed water. That has a consequence for gases which have a physical or chemical high solubility in water (for example, CO_2, SO_2): A portion of such a gas component would be solved in the condensate and thus be removed from the sample gas. This means that the measuring value would be smaller – although the gas analyzer is working correctly. The smaller the real gas concentration is, the greater is the relative measuring error. This effect does also apply to the calibration of such gas components, if the calibration gases are flowing through the sample gas cooler (→ page 191, § 16.3.3).

Remedy A: All the calibration gases go through the sample gas cooler, which means that you introduce the calibration gases in front of the sample gas cooler inlet. In this way, the calibration gases are processed in the same way as the sample gas, which will produce a calibration with “built-in” compensation of possible interfering effects. If the test gas value of a measuring component strongly differs from its average concentration in the sample gas, set-up a long span delay time, to allow the sample gas cooler to get into a constant physical condition with the new concentration before the gas analyzer starts the calibration (→ page 119, § 8.5.7; recommendation: some minutes). In addition, observe the information in §16.3.3 (→ page 191).

Remedy B: If the solution of the respective gas in water produces an acid, you can minimize the disturbing effect by acidifying the condensate in the sample gas cooler with this acid and keeping the pH level in the sample gas cooler permanently below pH 2. In this way, the condensate will be “saturated” and thus will not absorb the respective component. To do this, you need to feed the respective acid (for example, H_2CO_3, H_2SO_3) into the gas path of the sample gas cooler. Please note that the sample gas cooler needs to be corrosion-resistant.

Disturbing effect due to drying-out in the course of long calibration procedures

Calibration gases from gas cylinders are usually “dry”, which means they practically do not contain H_2O. When such calibration gases are flowing through the sample gas cooler for a certain time, the cooler could dry out. This extreme change of condition can effect a wrong calibration – especially for “H_2O-sensitive” measuring components.

Remedy: Produce “wet” calibration gases. To do this, install a suitable vessel in the gas path, filled with water, and make the calibration gases bubble through the vessel before they are fed into the sample gas cooler.

16.3.3 Calibrations with a sample gas cooler

Consequences of “wet” calibration gases

If the calibration gases are flowing through the sample gas cooler before they are fed into the gas analyzer, they are conditioned in the same way as the sample gas. Advantage: The actual physical condition of the sample gas cooler is physically considered in the calibration gas test values; even its influence on H_2O cross-sensitivity effects (if existing) will physically be considered in this way.

However, there are some disadvantages with this method:

– Because the physical conditions in the sample gas cooler are not exactly constant, the results of several calibrations might not be exactly identical. This means that you could not calculate the analyzer drift by direct comparison of subsequent calibrations.
– Because calibration gases from gas cylinders practically do not contain any H_2O, the sample gas cooler could dry out in the course of a long calibration procedure. This would kill the advantage of this method (remedy → page 190, § 16.3.2).

Consequences of “dry” calibration gases

If the calibration gases are fed directly into the gas analyzer without being led through the sample gas cooler, the calibration results can be reproduced. This allows, for example, an analyzer drift monitoring.

However, the calibrations would not consider the influence and the current physical condition of the sample gas cooler. It might be required to determine the influence of the sample gas cooler by making test measurements where calibration gases are fed once directly into the analyzer (“dry” gases) and then through the sample gas cooler first (“wet” gases). The difference should be considered, and it might be advisable to repeat this test periodically.

16.4 Notes on the use of NO_X converters

16.4.1 Purpose of NO_X converters

If the NO concentration is measured, but the sample gas also contains NO_2, some applications may require the measurement of the NO_2 portion in combination with the NO portion. This can be done by installing a “NO_X converter” in the sample gas line. A NO_X converter provides a thermal-catalytic process which converts NO_2 to NO. Thus an NO gas analyzer will actually determine the “NO_X” concentration ($NO_X = NO + NO_2$).

16.4.2 Disturbing effects with NO_X converters

Thermal re-conversion

The thermal NO_2 conversion is reversible. This means that the conversion effect can be reduced if the sample gas is allowed to cool down before it reaches the gas analyzer.

Remedy: Keep the gas line distance between NO_X converter and SIDOR as short as possible.

Conversion of other gases

There are some other gases which could possibly be converted in the same way. This applies to CO/CO_2, for example. An unwanted conversion would distort the analysis of such measuring components.

Remedy: Use a low-temperature NO_X converter (approx. 400 °C/750 °F) equipped with a molybdenum catalyst. If you would use a high-temperature converter or a converter with a graphite catalyst, the measuring values of the CO and CO_2 analysis would be not be correct.

SIDOR

17 Customizing assistance

Analyzer modules and measuring ranges (form)
All pin/terminal connectors (figure)
All switch and control functions (listing/form)

17.1 User table: Measuring components and calibration gases

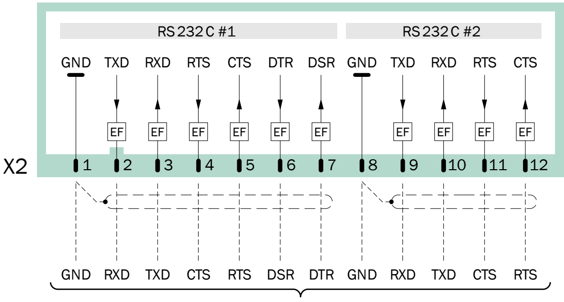
SIDOR	Serial number:

		Measuring component			Remarks
		1	2	3	
Name/Formula:					
Is measured with the analyzer module:		☐ SIDOR ☐ SIDOR section 2 ☐ OXOR-P ☐ OXOR-E	☐ SIDOR ☐ SIDOR section 2 ☐ OXOR-P ☐ OXOR-E	☐ SIDOR ☐ SIDOR section 2 ☐ OXOR-P ☐ OXOR-E	
Physical unit for the measuring value:		☐ ppm ☐ vol.% ☐ mg/m^3 ☐ g/m^3 ☐	☐ ppm ☐ vol.% ☐ mg/m^3 ☐ g/m^3 ☐	☐ ppm ☐ vol.% ☐ mg/m^3 ☐ g/m^3 ☐	
Nominal values for calibration gases	`zero gas 1`				
	`zero gas 2`				
	`test gas 3`				
	`test gas 4`				
	`test gas 5`				
	`test gas 6`				

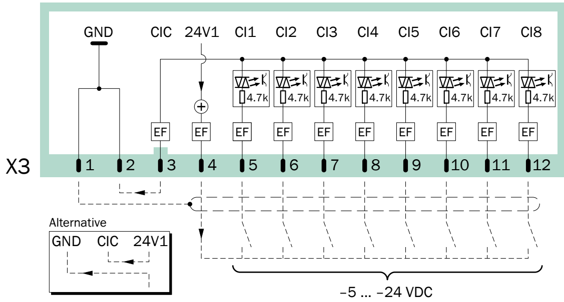
17.2 Signal connection overview

> **NOTICE:**
> ► Use this overview only if you are familiar with the related safety notes (see references in the illustration).

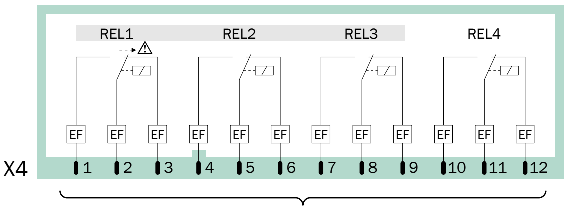
Figure 22 Signal connection overview



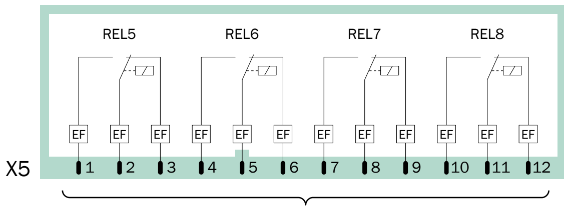
→ p. 44, §3.10
→ p. 85, §7.11.2
→ p. 44, §14



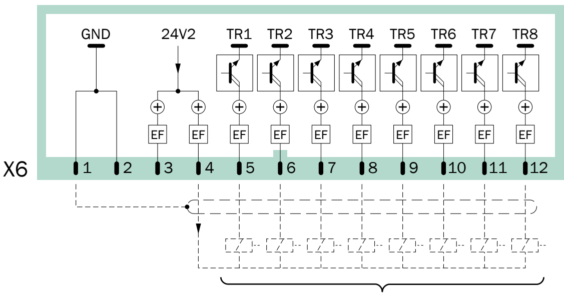
→ p. 43, §3.9
→ p. 83, §7.10
→ p. 42, §13
→ p. 197, §17.4



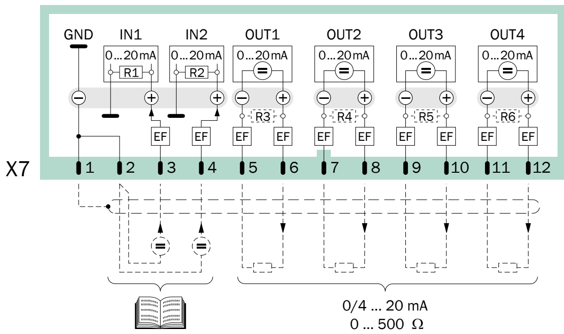
→ p. 40, §3.8
→ p. 80, §7.9
→ p. 41, §10
→ p. 196, §17.3



→ p. 40, §3.8
→ p. 80, §7.9
→ p. 41, §11
→ p. 196, §17.3



→ p. 40, §3.8
→ p. 80, §7.9
→ p. 42, §12
→ p. 196, §17.3



→ p. 39, §3.7
→ p. 79, §7.8.6
→ p. 39, §9

17.3 User table: Switch outputs

SIDOR	Serial no.:

Function (→ page 81, § 7.9.4) [1] requires 2nd output range [2] no function in SIDOR		REL1		REL2		REL3		REL4		REL5		REL6		REL7		REL8		TR1		TR2		TR3		TR4		TR5		TR6		TR7		TR8	
Name	Code	f	f-1!	f	f-1!	f	f-1!	f	f-1!	f	f-1!	f	f-1!	f	f-1!	f	f-1!	f	f-1!	f	f-1!	f	f-1!	f	f-1!	f	f-1!	f	f-1!	f	f-1!	f	f-1!
failure	1	–	X	–	–	–	–																										
service	2	–	–	X	–	–	–																										
fault	3	–	–	–	–	X	–																										
alarm limit 1	4	–	–	–	–	–	–																										
alarm limit 2	5	–	–	–	–	–	–																										
alarm limit 3	6	–	–	–	–	–	–																										
alarm limit 4	7	–	–	–	–	–	–																										
external pump	8	–	–	–	–	–	–																										
calibration active	9	–	–	–	–	–	–																										
auto. calibration	10	–	–	–	–	–	–																										
zero gas 1	11	–	–	–	–	–	–																										
zero gas 2	12	–	–	–	–	–	–																										
test gas 3	13	–	–	–	–	–	–																										
test gas 4	14	–	–	–	–	–	–																										
test gas 5	15	–	–	–	–	–	–																										
test gas 6	16	–	–	–	–	–	–																										
sample gas	17	–	–	–	–	–	–																										
range – output 1 [1]	18	–	–	–	–	–	–																										
range – output 2 [1]	19	–	–	–	–	–	–																										
range – output 3 [1]	20	–	–	–	–	–	–																										
range – output 4 [1]	21	–	–	–	–	–	–																										
switch on pt. 1 [2]	22	–	–	–	–	–	–																										
switch on pt. 2 [2]	23	–	–	–	–	–	–																										
switch on pt. 3 [2]	24	–	–	–	–	–	–																										
switch on pt. 4 [2]	25	–	–	–	–	–	–																										
switch on pt. 5 [2]	26	–	–	–	–	–	–																										
switch on pt. 6 [2]	27	–	–	–	–	–	–																										
switch on pt. 7 [2]	28	–	–	–	–	–	–																										
switch on pt. 8 [2]	29	–	–	–	–	–	–																										
meas. value pt. 1 [2]	30	–	–	–	–	–	–																										
meas. value pt. 2 [2]	31	–	–	–	–	–	–																										
meas. value pt. 3 [2]	32	–	–	–	–	–	–																										
meas. value pt. 4 [2]	33	–	–	–	–	–	–																										
meas. value pt. 5 [2]	34	–	–	–	–	–	–																										
meas. value pt. 6 [2]	35	–	–	–	–	–	–																										
meas. value pt. 7 [2]	36	–	–	–	–	–	–																										
meas. value pt. 8 [2]	37	–	–	–	–	–	–																										
FAILURE sensor 1	38	–	–	–	–	–	–																										
FAILURE sensor 2	39	–	–	–	–	–	–																										
FAILURE sensor 3	40	–	–	–	–	–	–																										
FAILURE sens.ext. 1	41	–	–	–	–	–	–																										
FAILURE sens.ext. 2	42	–	–	–	–	–	–																										
SERVICE sensor 1	43	–	–	–	–	–	–																										
SERVICE sensor 2	44	–	–	–	–	–	–																										
SERVICE sensor 3	45	–	–	–	–	–	–																										
SERVICE sens.ext. 1	46	–	–	–	–	–	–																										
SERVICE sens.ext. 2	47	–	–	–	–	–	–																										
CALIBR. sensor 1 [2]	48	–	–	–	–	–	–																										
CALIBR. sensor 2 [2]	49	–	–	–	–	–	–																										
CALIBR. sensor 3 [2]	50	–	–	–	–	–	–																										
CALIBR. sens.ext. 1	51	–	–	–	–	–	–																										
CALIBR. sens.ext. 2	52	–	–	–	–	–	–																										
flow sensor	53																																
condensate sensor	54																																
meas.value output1	55																																
meas.value output2	56																																
meas.value output3	57																																

17.4 User table: Control inputs

SIDOR	Serial no.:

Control function f (→ page 83, § 7.10.2) [1] requires 2nd output range [2] no function in SIDOR		CI1		CI2		CI3		CI4		CI5		CI6		CI7		CI8	
Name	Code	f	f^{-1}!	f	f^{-1}!	f	f^{-1}!	f	f^{-1}!	f	f^{-1}!	f	f^{-1}!	f	f^{-1}!	f	f^{-1}!
service block	1																
auto.cal. 1 start	2																
auto.cal. 2 start	3																
auto.cal. 3 start	4																
auto.cal. 4 start	5																
cal. stop	6																
pump on/off	7																
zero gas 1 fault	8																
test gas 3 fault	9																
test gas 4 fault	10																
test gas 5 fault	11																
output 1 [1]	12																
output 2 [1]	13																
output 3 [1]	14																
output 4 [1]	15																
(no function)	16																
failure 1	17																
failure 2	18																
service 1	19																
service 2	20																
fault 1	21																
fault 2	22																
no drifts	23																
sample value hold	24																
zero gas 2 fault	25																
test gas 6 fault	26																
hold sample pt. 1 [2]	27																
hold sample pt. 2 [2]	28																
hold sample pt. 3 [2]	29																
hold sample pt. 4 [2]	30																
hold sample pt. 5 [2]	31																
hold sample pt. 6 [2]	32																
hold sample pt. 7 [2]	33																
hold sample pt. 8 [2]	34																
switch off pt. 1 [2]	35																
switch off pt. 2 [2]	36																
switch off pt. 3 [2]	37																
switch off pt. 4 [2]	38																
switch off pt. 5 [2]	39																
switch off pt. 6 [2]	40																
switch off pt. 7 [2]	41																
switch off pt. 8 [2]	42																

SIDOR

18 Technical Data

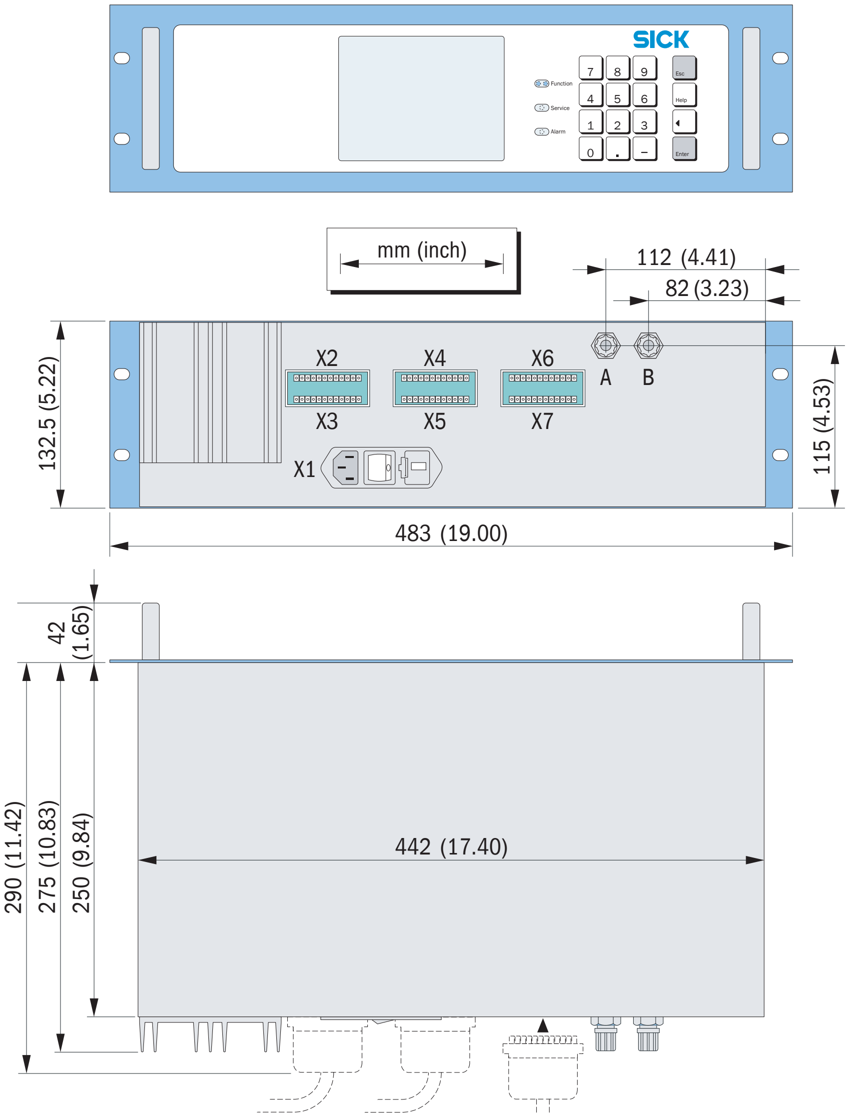
Dimensions
Ambient conditions
Electrical specifications
Measuring specifications

18.1 Enclosure

Design	
Type of construction:	19" slide-in enclosure
Vertical rack space required:	3 height units [1]
Protection class:	IP 20 [2]
Ground:	9 ... 20 kg (depending on equipment)

[1] + 1 height unit above recommended for ventilation (→ page 27, §3.3).
[2] EN 60529.

Dimensions



A gas inlet (SAMPLE)
B gas outlet (OUTLET)

18.2 Ambient conditions

Installation site · Assembly	
Atmospheric influences:	The equipment is intended only for indoor use
Vibrations/impacts:	The installation site should be free from vibrations and impacts
Position of use (allowed inclination of housing during operation):	Max. ± 15° inclination [1] to each spatial axis

[1] Keep constant during operation. When the inclination has changed, make a new calibration.

Pressure · Temperature	
Geographic altitude of installation site:	Max. 2500 m above sea level (approx. 750 hPa)
Ambient air pressure:	700 ... 1200 hPa
Operating temperature:	+5 ... +45 °C (41 ... 113 °F)
Storage temperature:	–20 ... +70 °C (–4 ... +158 °F)

Humidity · Dirt	
Relative humidity:	0 ... 90% over complete temperature range, non condensing
Permissible contamination:	Degree of contamination 1 [1]

[1] No contamination or only dry, nonconductive contamination.

18.3 Electrical Data

Power supply	
Mains voltages	Optionally 100/115/230 V AC [1]
Mains frequency:	48 ... 62 Hz
Allowed mains voltage variations/mains voltage tolerance:	–15% ... +10%
Permissible overvoltages:	Transient overvoltages in the supply network should not exceed overvoltage category II according to IEC 60364-4-443
Power input: – maximum (in the warm-up period): – in the normal operational state:	 150 VA approx. 50 VA

[1] Can be selected mechanically (→ page 34, §3.5.4); adaptation of mains fuses required (→ page 35, §3.5.5).

Electrical safety	
Class of protection:	Class of protection I [1]
Electrical safety:	Checked according to EN 61010 (VDE 411) Low Voltage Directive 72/73/EEC
Transformer:	Safety transformer according to EN 61558 (VDE 0570)
Electromagnetic compatibility:	According to EN 61326 and EN 61000 EMC Directive 89/336/EEC

[1] VDE 0411 Part 1 / IEC 348.

Battery (memory buffer)	
Expected life:	10 years

18.4 Gas technical requirements

Sample gas properties	
Permissible sample gas temperature: [1]	0 ... 45 °C (32 ... 113 °F)
Permissible sample gas dew point:	Below ambient temperature
Particles in the sample gas:	Sample gas should be free from dust and aerosols [2]
Permissible sample gas pressure [3]	
– internal gas paths hose-connected:	–200 ... +300 hPa (–0.2 ... +0.3 bar/–2.9 ... 4.3 psig)
– internal gas paths tube-connected:	–200 ... +1000 hPa (0.2 ... 1.0 bar/–2.9 ... 14.5 psig)
Sample gas flow [1]	
minimum:	5 l/h (85 cm^3/min)
maximum:	100 l/h (1660 cm^3/min)
recommended:	30 ... 60 l/h (500 ... 1000 cm^3/min)
standard:	60 l/h (1000 cm^3/min)

[1] Should be constant during operation.
[2] When entering the gas analyzer.
[3] Relative to the ambient/atmospheric air pressure.

Built-in gas pump (option)	
Type of construction:	Oscillating diaphragm pump
Flow rate:	max. 60 l/h (with 100 hPa pressure difference)

Gas connections on housing	
Standard:	PVDF bulkhead fitting for 6x1 mm hose
Option:	Screw fittings type SWAGELOK, 6 mm or ¼"

18.5 Measuring characteristics

Detection limits	
– for measuring spans ≥ 200 % of minimum measuring span:	≤ 1 % of measuring span
– for measuring spans < 200 % of minimum measuring span:	≤ 2 % of measuring span

Response behaviour	
Warm-up time:	120 minutes
Response time t_{90}:	< 45 s [1]
Response time t_{20}:	< 10 s [1]
Decay time t_{90}:	< 45 s [1]

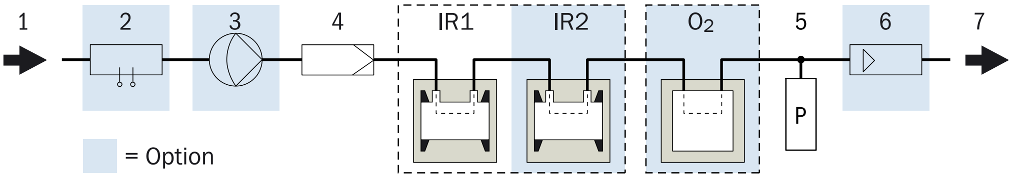
[1] When sample gas flow = 60 l/h and damping time constant ($t_{90\ electr.}$) = 15 s.

Influencing variables	
Influence of atmospheric air pressure:	≤ 1 % [1]

[1] With option “barometric pressure compensation”.

18.6 Flow schematic

Figure 23 Internal gas flow



1	Sample gas inlet
2	Condensate sensor (option)
3	Gas pump (option)
4	Safety filter
IR1	NDIR analyzer module SIDOR, section 1 (basic equipment)
IR2	NDIR analyzer module SIDOR, section 2 (option)
O_2	O_2 analyzer module OXOR-E or OXOR-P (option)
5	Pressure sensor
6	Flow sensor (option)
7	Gas outlet

18.7 Materials in contact with the sample gas

Table 12 Materials in contact with the sample gas

Sub-assembly	Component	Material
Gas lines	Fittings	Standard: PVDF; option: stainless steel
	Hoses	Fluorocarbon rubber “Viton”
	Safety filter	Glass
SIDOR cuvette	Cuvette tube	Aluminium
	Optical window	CaF_2 or special version
	Glue	2-component special epoxy
	Tube supports	Aluminium
OXOR-P	Housing / Interior	Stainless steel 1.3952, SiO_2, Platinum-Iridium; magnet poles gold plated
	Glue	2-component epoxy glue
	Tube supports	Stainless steel 1.4301 (clamp: 1.4571)
OXOR-E	Body	ABS
	Membrane	PTFE
	Internal seal	Fluorene rubber (acc. JIS B2401-4D)
	External seal	Fluorocarbon rubber “Viton”
	External T-piece	PP
Flow monitor / Condensate monitor	Body	Stainless steel 1.4571
	Sensors	Glass (coating of the PT100 resistors)
	Glue	2-component special epoxy
Pressure sensor	T-piece	Stainless steel 1.4571
	Membrane	Bronze (CuZn) 2.1050
Gas pump	Pump body	PVDF
	Membrane, valves, seals	Fluorocarbon rubber “Viton”

D

E

L

M

S

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