OPERATING INSTRUCTIONS

TOCOR700
TOC Water Analyzer

Installation
Operation
Maintenance

TOCOR700 UV (Ex)

SICK
Sensor Intelligence.

Document Information

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Product name:	TOCOR700
Variants:	TOCOR700 UV
	TOCOR700 TH
	TOCOR700 TH + 2nd reactor
Software:	Version 1.10

In these Operating Instructions, the designation TOCOR700 means that the information is applicable for all variants.

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Guarantee Information

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

Glossary

FIA: Flow Indication Alarm; measured value to monitor the carrier gas volume flow

Firmware: Internal software of the device; mostly stored in erasable storage modules (EEPROMs)

LED: Light emitting diode (small display lights)

NDIR: Non-dispersive infrared; designation for optical gas analysis methods in the infrared spectral range

PC: Personal Computer

TC: Total Organic Carbon (total carbon content)

TIC: Total Inorganic Carbon (carbon content from inorganic substances)

TNB: Total Nitrogen Bound (total nitrogen content)

TOC: Total Organic Carbon (carbon content from organic substances)

VAC: Volt Alternating Current (AC voltage)

VDC: Volt Direct Current (DC voltage)

Warning Symbols


Hazard (general)


Hazard by voltage

Hazard in potentially explosive atmospheres


Hazard by explosive substances/mixtures


Hazard by corrosive substances


Hazard by poisonous substances


Hazard by unhealthy substances


Hazard by high temperature or hot surfaces


Hazard through ultraviolet radiation (UV light)


Hazard for the environment/nature/organic life

Warning levels / Signal words

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

CAUTION
Hazard which could result in less severe or minor injuries *and/or* material damage.

NOTICE
Indicates a hazard or unsafe practice which could result in property damage.

Information Symbols


Information about the use in potentially explosive atmospheres


Important technical information for this device


Important information on electrical or electronic functions


Supplementary information


Link to information at another place


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TOCOR700

1 Important Information

Hazards
Operation
Own responsibility

1.1 Main hazards

► Always observe all warnings (see cross-references).

Health risks

CAUTION: Health risks through chemical substances

The TOCOR700 uses chemical substances during operation that can endanger health.

► Follow safety information on the chemical substances. → page 256, § 18.1
  – Always wear suitable personal protective equipment when handling chemical substances (e.g. protective gloves, protective goggles).
  – Dispose of any substances released carefully and safely.
► Collect or channel off the waste water safely. → page 59, § 4.2

WARNING: Health risk through UV light (only for TOCOR700 UV)

► Do not operate the UV lamp outside the reactor. → p. 204, § 12.3

CAUTION: Possible risk through lightly volatile substances

If the sample water can release substances dangerous to health:

► Channel exhaust gas off safely. → page 59, § 4.3

Operational safety

WARNING: Risk of explosions in potentially explosive atmospheres

► Only use the TOCOR700 in potentially explosive atmospheres when the individual device design allows such use. → page 26, § 2.3.3

CAUTION: Risk of damage through dangerous sample water.

► Do not use the TOCOR700 TH version to measure flammable or explosive liquids. → page 17, § 1.3.4

Electrical safety

WARNING: Hazards through insecure device state

► *If liquid has penetrated electrical components:* Immediately put the device out of operation. → page 230, § 14.1
► *If severe damage is obvious on or in the device:* Immediately put the device out of operation.

► *Before creating signal connections (also when connecting plug-in connectors):* Disconnect the power from the TOCOR700 and all connected devices (switch off). → page 66, § 4.10.2

1.2 Important operating information

Assembly/Start-up

- *Risk of breakage:* Handle ceramic and glass components with care.
- *Leak tightness:* Ensure gas leak tightness of the measuring system.
  - Check the condition of sealing surfaces and sealing rings carefully during component assembly.
  - Close containers properly.
  - Connect hoses properly.
  - Check gas leak tightness (→ page 219, § 13.5).

Prerequisites for operation

- *Reagent:* Fill storage container regularly (→ page 197, § 12.2.1).
- *Pump hoses:* Observe condition and replace regularly (→ page 202, § 12.2.5).
- *Cleanness:* Clean components carrying sample water as necessary.

Operational state

- Pay attention to malfunction indications:
  - LED “Function”: Red = malfunction (→ page 82, § 6.1) / green = normal state
  - LED “Service” (yellow) = need for action (→ page 82, § 6.1)
  - LED “Alarm” (red) = measured value is beyond a limit value (→ page 110, § 8.6.1)
  - Observe status messages in the lower display area (→ page 88, § 7.1)
- Perform calibrations at regular intervals (→ page 147, § 9).

When “Alarm” is indicated

- Check the current measured values. Assess the situation.
- Perform the measures planned for this situation during operation.
- If necessary: Switch the alarm signal off (“acknowledge” → page 97, § 7.4.2).

Putting out of operation procedure

- Do not just switch off but perform the procedure for putting out of operation properly (→ page 230, § 14.1).

1.3 Intended use

1.3.1 Device function

The TOCOR700 is a continuous measuring, extractive water analyzer for cumulative determination of carbon content from carbon compounds or elementary carbon in an aqueous solution.

- *Extractive* means that a certain portion of the water to be analyzed is extracted from the original quantity (“sample water” from the “sample point”) and then fed to the analyzer.
- *Continuous measurement* means that a continuous water volume flow is maintained and that the water analyzer continuously delivers current measured values.

Internal measured value processing is digital; however, measured values are generated in such a fast sequence that a quasi analog display arises. The reaction time mainly depends on the physical characteristics of the measuring system.

1.3.2 Installation location

When not otherwise specified in the individual technical device documentation, type TOCOR700 water analyzers are designed for use in enclosed buildings. These devices must not be exposed to atmospheric conditions (wind, rain, sunshine). Such influences can damage the device and have a negative effect on measuring precision.

1.3.3 Intended users (target group)

- The TOCOR700 is designed for operation by competent commercial and industrial users.
- The work described in this document must be carried out by skilled persons that can perform the tasks described competently and according to the intended application. These skilled persons must be aware of the risks and hazards that can generally arise during such work, even when carried out by competent persons, and must know and apply the required safety measures.
- *When the TOCOR700 is used in a potentially explosive atmosphere (Ex-Zone):* Installation, start-up, maintenance and tests must only be carried out by skilled persons with the respective knowledge on laws, rules and regulations on ignition protection types, range specification and installation procedures.
- Only persons informed on possible risks and necessary protective measures may be allowed to operate and maintain the device.

1.3.4 Application limitations

- *Potentially explosive atmospheres:* Type TOCOR700 water analyzers may only be used in potentially explosive atmospheres when this is specified in the individual technical device documentation (→ page 26, §2.3.3).
- *Particle size:* Maximum allowable particle size in sample water: 0.2 mm. Larger particles can clog internal hose lines.
- *Particle structure:* The sample water must not contain hard particles with sharp edges. Such particles can become stuck and clog pump hoses.
- *Solids:* High solids content in sample water reduces the service life of the reactor. (Remedy: Filtration with “back-flush filter” or MBF 1 tape filter unit option).
- *High TIC content:* High TIC content in sample water can limit measuring precision for sensitive TOC measurements when the TIC content has to be removed from the sample water before measurement. This is because TIC removal efficiency is limited (e.g. approx. 99% when sparging 200 mg/l TIC). Therefore the TOC measured value contains a certain TIC residue. Attention should be paid to this effect when the TIC value is large in relation to the TOC value.
- *Salt content:*
  - TOCOR700 TH: High carbonate or salt content in the sample water shorten the reactor maintenance interval because salt is deposited in the reactor.
  - TOCOR700 UV: High salt content (Cl^-) can have a negative influence on measuring precision because the TOC oxidation rate is reduced. (Conceptional remedy: “Dilution step” option or TOCOR700 TH + 2nd reactor).
- *Dangerous liquids:* Flammable or explosive liquids must not be fed.

WARNING: Risk of explosions on TOCOR700 TH

The operating temperature of the thermal reactor reaches 800 ... 850 °C. There is a risk of explosions inside the device when flammable or explosive sample water leaks out. Therefore:

- ► Never feed flammable or explosive liquids.
- ► Do not feed any liquids where the evaporation and combustion characteristics are not known.
- ► In case of doubt, ask the manufacturer whether the liquid involved may be analyzed with the TOCOR700 TH.

With the “MRF” (back-flush filter) and “MBF” (tape filter unit) options, the sample water is pumped through filters before reaching the TOCOR700. Pore size of the “MRF” filter: 50 or 200 µm.

1.4 Responsibility of user

Intended users

The TOCOR700 gas analyzer 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 device only as described and specified in these Operating Instructions. The manufacturer is not responsible for any other use.
- ► Perform the specified maintenance work.
- ► Do not remove, add, or change any component in the device unless such changes are officially allowed and specified by the manufacturer. Otherwise
  - – the device could become dangerous
  - – the manufacturer's guarantee becomes invalid
  - – the certification for use in potentially explosive atmospheres becomes void (in cases where the certification is available).

Local regulations

These Operating Instructions cannot cover individual local conditions involved in using the device. You have to recognize and consider such conditions yourself.

- ► Check whether any special laws, technical rules or company-internal operating instructions apply at the device installation location.

  This is especially applicable for use in potentially explosive atmospheres (when allowed).

Special responsibility for dangerous media

WARNING: Danger to life/health risks caused by leaks in the gas path

When the sample water can contain toxic substances or substances dangerous to health: A leak in the sample water line can be an acute danger for humans.

- ► Ensure suitable safety measures.
- ► Make sure that these safety precautions are applied.

Examples of safety precautions:

- Appropriate warnings on the device
- Appropriate warnings in the operating area
- Safety instructions for personnel who can be within the location

Safekeeping of device documentation

Keep these Operating Instructions and the individual technical device documentation

- ► for future use
- ► pass on to a new owner

1.5 Additional documents

Each TOCOR700 is adapted to the individual customer requirements during production. This involves, for example,

- Housing design
- Additional equipment fitted (options)
- Liquid feed configuration
- Electrical connections

Therefore these Operating Instructions are supplemented with individual technical documentation that normally includes the following specifications:

- Instrument Card (→ page 20, Figure 1)
- Dimensioned drawing
- Layout drawing
- Substance flow diagram
- Wiring diagram
- Parts list for components

Figure 1 Instrument card (example)

SICK

instrument card

TOCOR 700 UV

Code	5	0	4	3	-	1	1	0	9	0	0	4	5	2	2	1	2	1	0

customer	Company
customer No.	123456
purchase order No.	PO 123456
date of delivery	10. Sep 08

serial No.	08123456
drawing No.	640416
order No	ZTA 1234567
part No.:	1203079

	0
TAG No:	QT 70011

release	10. Sep 08	Kumm
checkout	10. Sep 08	Utermark

application	rain water
component to be measured	TOC (includes TIC stripper)
max. salt conc.	salt conc. < 2 g/l 1,42

power supply	230V / 50Hz
consumption	400 VA
place of installation	indoors
ambient temp.	+5 - 35 °C
classification	No Ex zone
cabinet / dimensions	PS 1200x500x290 mm
reactor	UV-reactor
carrier gas	internal UV-version

basic meas. range mg/l	meas. range 50 mg/lC
2nd output range	without 2nd output range
output signals	4-20 mA
no. of sampling points	1 point

dosing pump M10	12 rpm - 6027110	material of pump hose	Tygon LFL (PVC-transparent)
pump hose 1 V01	ISM-3 bk-bk id=0,76mm	30 ml/h	sample to reactor
pump hose 2 V02	none	0 ml/h	
pump hose 3 V03	none	0 ml/h	reagent to reactor
pump hose 4 V04	ISM-3 or-wh id=0,64mm	20 ml/h	reagent to stripper
pump hose 5 V05	ISM-3 wh-wh id=1,02mm	50 ml/h	sample to stripper
dosing pump M11	SR25 10 rpm - 6032012		
pump hose set SR25	SR25 DI=4,8x1,6 opaque	800 ml/h	sample to drain

reagent for operation	0,2 % H2SO4 (pH1)+ 20 g/l Na2S2O8 17	3 l / week	reagent consumption
receipe	demin. water 5 l		
	H2SO4 (98%) 10 ml / 19 g		
	Na2S2O8 67 ml / 100 g		

gas flow	20 +- 10% l/h

configuration TOC:CO2	X - NN manual
CO2-analyser	S715 UNOR
basic meas. Range (ppm CO2)	100 manual 100
part No. / serial No.	1029673

place for nameplate

comments

0

GerätekarteTOCOR-V8-1-5.xls 18.06.2008 1 / 1

SICK|MAIHAK
Maihak AG
22399 Hamburg

TOCOR700

2 Product Description

Product identification
Intended use
Limits of use
Functionality
Versions
Options

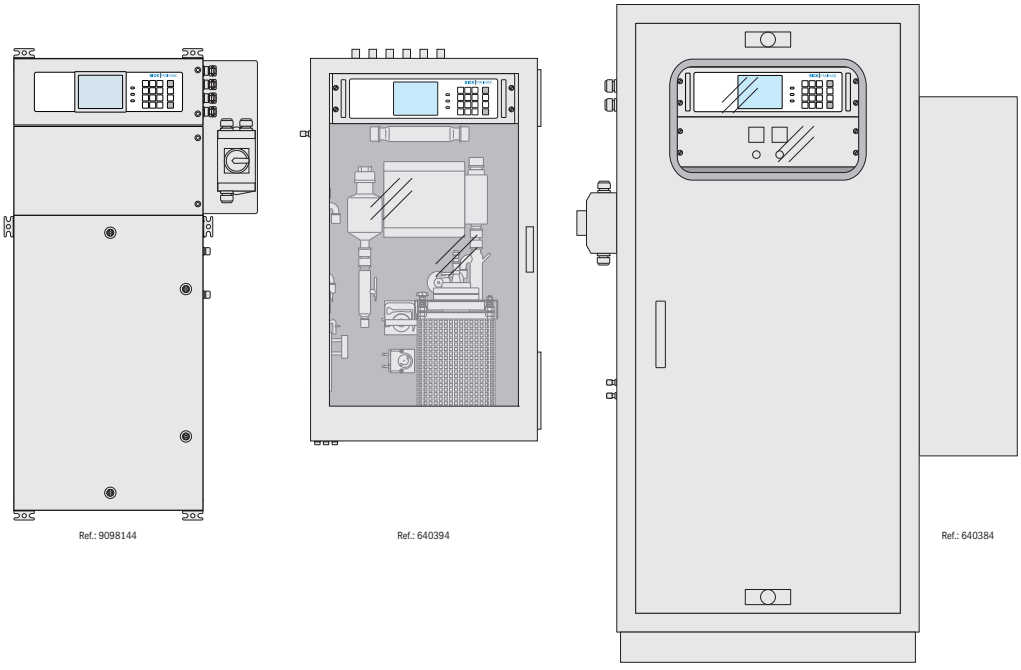
2.1 Product identification

Validity of these Operating Instructions

These Operating Instructions are valid for a device matching the following specifications:

Product name:	TOCOR700
Product variants:	TOCOR700 UV, TOCOR700 TH, TOCOR700 TH + 2nd reactor
Housing design:	See individual technical device documentation
Manufacturer:	SICK AG

Figure 2 Housing types



TOCOR700 UV
Standard housing

TOCOR700 TH
Wall housing

TOCOR700 TH
Standing housing (example)

2.2 Know-how for the TOCOR700

2.2.1 Measuring principle

The TOCOR700 is a continuous measuring water analyzer for cumulative determination of carbon content from carbon compounds or elementary carbon in an aqueous solution.

The carbon content in many chemical compounds must be transformed into a uniform, measurable substance. This is carried out by oxidation of the compounds in a photochemical or thermal reactor. This transforms the carbon content into CO_2. A carrier gas flow then feeds the resulting CO_2 into a gas analyzer. The concentration of CO_2 measured is directly proportional to the carbon content of the water.

Figure 3 Measuring principle

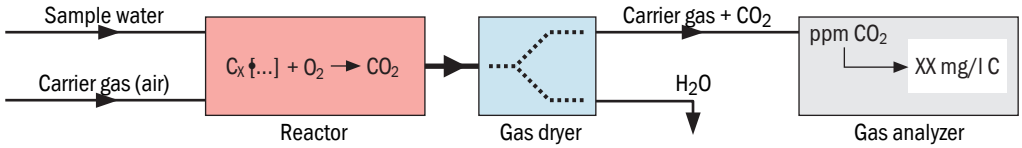
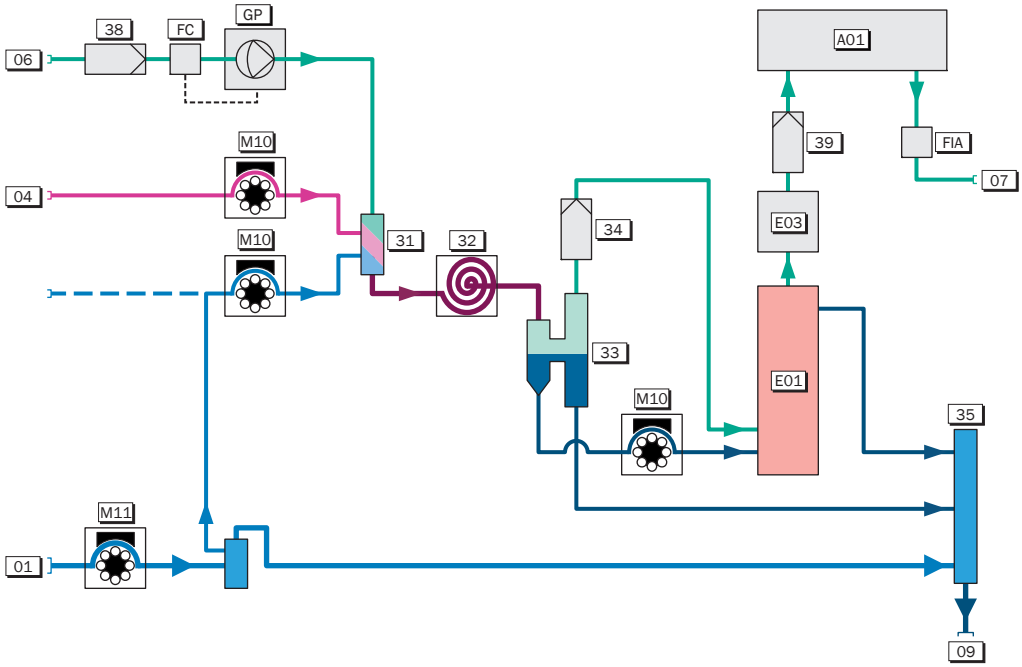


Figure 4 Measuring system (diagram)



01	Sample water inlet
04	Reagent inlet
06	Carrier gas inlet
07	Exhaust gas outlet
09	Waste water outlet
31	Sample inlet module
32	Stripper
33	Phase separator
34	CO_2 absorber
35	Waste water collector

38	Activated charcoal filter
39	Corrosion inhibitor filter
A01	Gas analyzer
E01	Reactor
E03	Gas cooler
FC	Flow sensor (control)
FIA	Flow sensor (monitoring)
GP	Gas pump
M10	Dosing pump
M11	Pre-sampling pump

2.2.2 Measuring system

Schematic diagram → page 23, Figure 4.

Pre-sampling pump

In order to transport the sample water as quickly as possible, a volume flow larger than actually needed is drawn in using pre-sampling pump [M11]. A pump channel of dosing pump [M10] extracts the sample water from this flow.

There are also device versions without pre-sampling pumps.

Dosing pump

All liquid flows after the pre-sampling pump are pumped on by dosing pump [M10] – a hose pump with a maximum of 5 channels. The number and dimensions of the pump hoses depends on the individual device configuration.

Stripper

The inorganic carbon compounds (e.g. carbonates) must be removed from the sample water for TOC measurements. This is done by adding an inorganic acid to the sample water and then removing the generated CO_2/H_2CO_3 through outgassing (“stripping”). The acid is the main component of the reagent liquid.

Sample water, reagent and carrier gas are merged in the sample inlet module [31] and then passed on through the stripper [32]. Sample water and carrier gas are then separated again in the phase separator [33]. The CO_2 generated during stripping is filtered out [34] before the carrier gas enters the reactor. One pump channel of dosing pump [M10] feeds stripped sample water continuously into the reactor.

- Lightly volatile organic substances can vaporize during stripping and therefore disappear from the sample water – partially at least. The lightly volatile substances are not lost for measuring because all the gas used for stripping enters the reactor.
- The reagent liquid can also be used to dilute the sample water. This method allows, for example, realizing large measuring ranges or lengthening the reactor maintenance intervals.

Reactor

The organic carbon compounds are converted into CO_2 in the reactor. The carrier gas provides the oxygen required. An additional oxidant is also mixed with the sample water in the TOCOR700 UV to optimize the reaction; the oxidant is contained in the reagent. The CO_2 created is transported away by the carrier gas flow.

Gas analyzer

The water vapor contained condenses in the gas cooler [E03] and is removed in this manner. The dry gas is pumped to the gas analyzer [A01]. A corrosion inhibitor filter [39] is fitted in the gas line to protect the gas analyzer from corrosive acid vapours. The gas analyzer converts the measured CO_2 concentration automatically into “mg/l C”.

2.2.3 Special advantages

- *Configurable signal connections:* The TOCOR700 has 8 control inputs and 13 switching outputs to which you can assign one of the functions provided as required (→ page 120, §8.10.2 / → page 118, §8.9.4).
- *Configurable measured value outputs:* The TOCOR700 has 4 analog measured value outputs (0/2/4 ... 20 mA), each with 2 output ranges. You can set which measurement components are output via which measured value outputs; you can also output one measured value via several measured value outputs (→ page 112, §8.8.2). The output ranges are adjustable (→ page 113, §8.8.3).
- *Digital data output:* The TOCOR700 can also output the measured values and status messages via a serial RS232 interface (→ page 76, §4.16.1).
- *Chart recorder simulation:* The TOCOR700 can display a continuous image of previous measured values (→ page 90, §7.2.3).
- *Integration of external measured values:* Measurement signals from other devices can be fed in and shown the same as internal measurement components (→ page 71, §4.13).
- *Data backup:* The TOCOR700 can create duplicates of the current settings and all internal data and reactivate these later per menu command (→ page 130, §8.12.1). The original factory settings can also be reactivated. You can also save the data from the TOCOR700 on a connected computer and restore these data from there again (→ page 131, §8.12.2).
- *Remote control:* You can remote control the TOCOR700 completely via a digital interface – with either the PC software MARC2000 (→ page 173, §10) or via the “Modbus” interface (→ page 181, §11).
- *Firmware update:* The internal software of the TOCOR700 can be updated via an interface (→ page 134, §8.13).

2.3 Device variants

2.3.1 Reactor variants

The TOCOR700 is available with a thermal or photochemical reactor:

- TOCOR700 UV: Low-maintenance version with UV reactor (photochemical oxidation of the carbon compounds) – for most standard applications.
- TOCOR700 TH: Version with thermal reactor (thermal oxidation of the carbon compounds) - for higher demands on measuring precision. Also available with a second thermal reactor for alternating reactor use in difficult operating conditions to reduce downtimes during reactor maintenance/cleaning.

In these Operating Instructions, the designation TOCOR700 means that the relevant information is applicable for all reactor variants.

2.3.2 Individual device versions and documentation

Each TOCOR700 is adapted to the individual customer requirements during production. This involves, for example,

- Housing design
- Additional equipment fitted (options)
- Liquid feed configuration
- Electrical connections

Therefore these Operating Instructions are supplemented with individual technical documentation that normally includes the following specifications:

- Dimensioned drawing
- Layout drawing
- Substance flow diagram
- Wiring diagram
- Parts list for components

2.3.3 Versions for potentially explosive atmospheres

Certificates

A TOCOR700 may only be used in a potentially explosive atmosphere when the individual device version is certified for the relevant application area. The relevant specifications are part of the individual technical device documentation.

WARNING: Risk of explosions through improper use

When used in potentially explosive atmospheres:

- ► Observe the specifications in the certification (see individual technical device documentation).
- ► As well as all associated laws, technical standards and regulations applicable for the installation location (for example, IEC/EN 60079-14).
- ► Let the installations be made by specially trained and authorized skilled persons.

These Operating Instructions contain information on usage in potentially explosive atmospheres. The specifications in the certification documents for the individual device version are however applicable for legal and official purposes.

Pressurized enclosure

Device versions for potentially explosive atmospheres are fitted with a pressurized enclosure for the housing. Type of design, function and parameter settings for this fitting depend on the classification of the Ex-Zone and the device type. With the pressurized enclosure, instrument air circulates continuously through the housing during operation. Device versions for potentially explosive atmospheres therefore need a permanent supply of instrument air.

It is possible that the housing has to be purged quite strongly before the device can be put into operation (pre-purging). This process is normally carried out automatically by a control unit. The control unit monitors the purging conditions and triggers an alarm when the purge gas flow is too low.

Refer to the Operating Instructions of the control unit used for detailed information on the pressurized enclosure.

Individual operating information

Additional important operating information and regulations on device versions for potentially explosive atmospheres can be contained in the following documents:

- Individual technical device documentation
- Annex for Certificate of Conformity (94/9/EC Directive)
- EC Type Examination Certificate

For example, these documents can describe how signals from the control unit for the pressurized enclosure are evaluated and to which special operating conditions attention must be paid.

WARNING: Risk of explosions through improper use

► Observe the delivered individual technical documentation in addition to these Operating Instructions.

General operating information for potentially explosive atmospheres

- *Pre-purging:* The housing must be purged with a certain amount of purge gas before start-up. This procedure can possibly be skipped (→ page 28, „Special start-up procedure“).
- *Purge gas flow:* Purge gas must flow through the housing of the TOCOR700 continuously during operation. Volume flow and pressure must remain within a certain value range.
- *Delay time:* If the device is to be opened, a certain delay time may have to be observed after switching off to allow internal components to cool down.
- *Maintenance:* A leak tightness test should be carried out after maintenance when the internal gas line had to be opened (→ page 219, § 13.5).
- *Cleaning:* Only use a damp cloth to clean large plastic surfaces to prevent electrostatic charges.

Special start-up procedure

Pre-purging the housing involves additional work steps during start-up. (Description → page 78, § 5.2).

1 Create purge gas feed to TOCOR700.

2 Switch control unit on. Check pre-purge procedure on control unit.

3 Wait until the pre-purge phase has completed.

Ÿ The TOCOR700 starts operation automatically after the pre-purge phase.

Special maintenance measures

- *Leak tightness test after opening the internal sample gas line (recommendation):* A leak tightness test should be carried out after maintenance when the carrier gas line on the TOCOR700 was opened for maintenance measures.
- *Severe operating conditions:* If you suspect that the leak tightness of the internal carrier gas line could be reduced in the course of operation (for example, due to special characteristics of the sample gas), then you must perform the special leak test periodically, at least once a year.
- Bypass operation: You can switch off the automatic monitoring of the pressurized enclosure, for example when maintenance work is necessary. The protective function of the pressurized enclosure may possibly be inactive in “Bypass mode”. This mode can therefore only be activated with a key switch or by entering a safety code.

WARNING: Risk of explosions

The protective function of the pressurized enclosure may possibly be inactive in bypass operation.

► Observe the relevant local regulations before activating bypass operation.

► Only activate bypass operation when no potentially explosive atmosphere is present at the installation location.

Create an individual code for bypass operation activation.

2.3.4 Additional equipment

Alternative sample feed

Additional connections are available to feed measuring media:

Connection	Function	Activation
Single sample	Sample water feed from sample containers (for single measurements when required)	Manual via menu function (→ page 100, § 7.4.8)
Zero solution	Automatic zero water feed from an external storage container (during calibrations)	Automatic during a calibration (as long as zero water or calibration solution must be fed)
Test solution	Automatic calibration solution feed from a storage container (during calibrations)	

On some device versions, the single sample connection can also serve as test solution connection.

► Observe the individual technical device documentation.

External carrier gas feed

When measuring in sensitive measuring ranges, (e.g. 0 ... 3 mg/l C) and the ambient air contains hydrocarbons or heavily fluctuating CO_2 concentrations, it can be useful to use a different gas free of organic carbon compounds as carrier gas instead of ambient air. The TOCOR700 is then fitted with a suitable gas connection. (→ page 62, § 4.5).

Back-flush filter

Heavily contaminated sample water (sample water containing high quantities of solids) must be filtered before being fed into the TOCOR measuring system.

In the MRF 1 back-flush filter, a large volume of sample water flows through a bypass tube. A slotted hole sieve (slot width 50 or 200 µm) serves as a filter through which a certain quantity of the sample water is drawn into the TOCOR700. Initially, a greater quantity of sample water than is needed in the TOCOR700 is drawn in (pre-sampling); the higher volume flow shortens the system reaction time. Part of the sample water that is drawn in is fed via the same hose pump into the stripper. Excess sample water is pumped out.

The slotted hole sieve is back-flushed automatically in regular intervals (setting → page 137, § 8.15.1). Instrument air fed in from an external source is used for back-flushing. The air is applied through the sieve against the flow direction. Back-flushing must not last longer than 10 s (recommended: 3 s); excess sample water in the stripper can bridge this short interruption without any break in the continuous flow of sample water to the reactor.

Back-flush filter + sample point switching

MFRF systems with several back-flush filters (MRF 2 to MRF 4) are available. Each back-flush filter can be used as single sample point. The TOCOR700 can control up to 4 such sample points when the “Sample point selector” option is fitted (→ page 142, § 8.17).

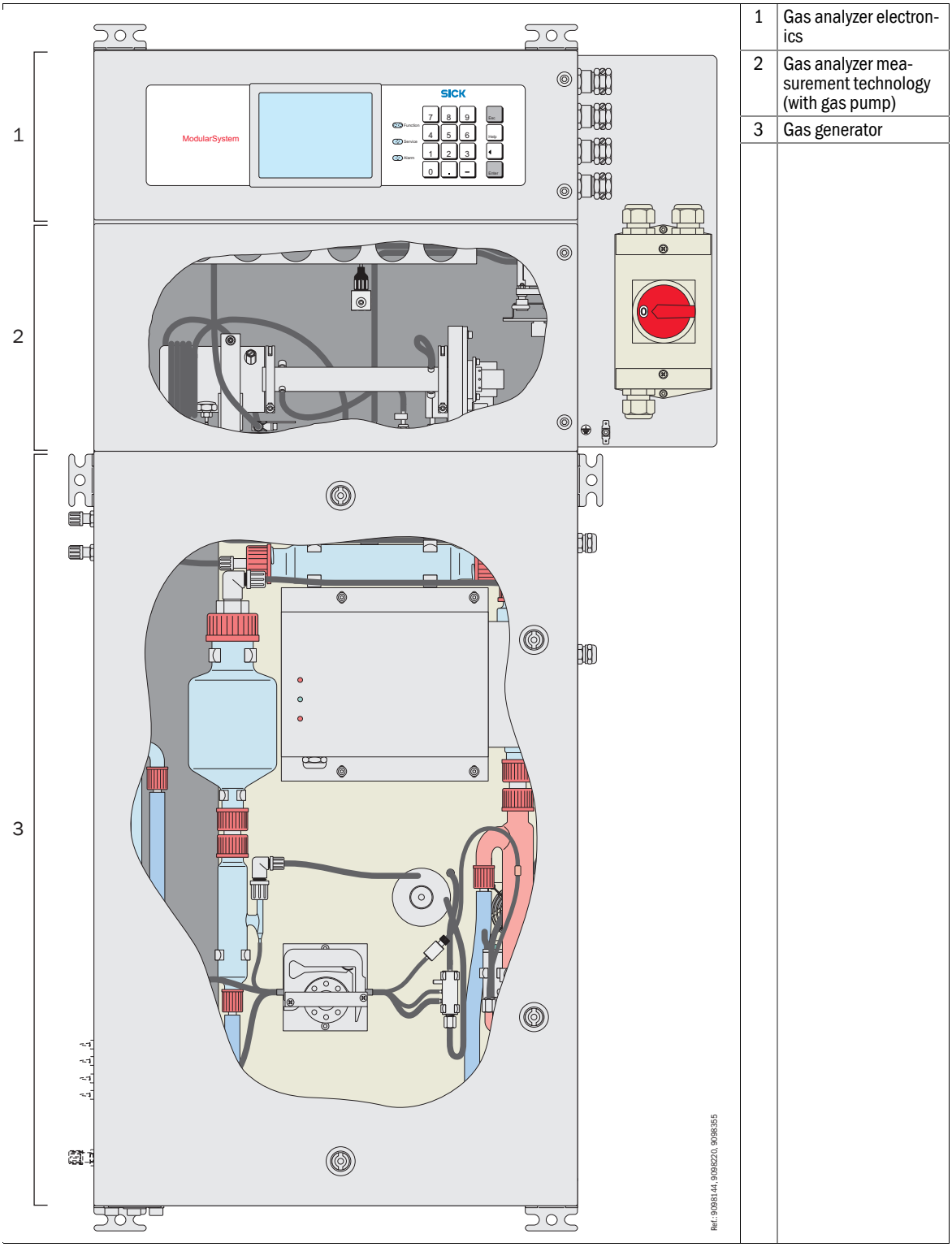
Tape filter

An MBF1 tape filter unit can be switched beforehand when the sample water contains flakes, sediment or slime. The sample water is drawn into the MBF 1 tape filter unit through a filter paper (pore size 5 or 20 µm). The filter paper is in the form of a ribbon which is unrolled from a supply reel and moved on at regular intervals (time interval can be set).

2.4 Device design

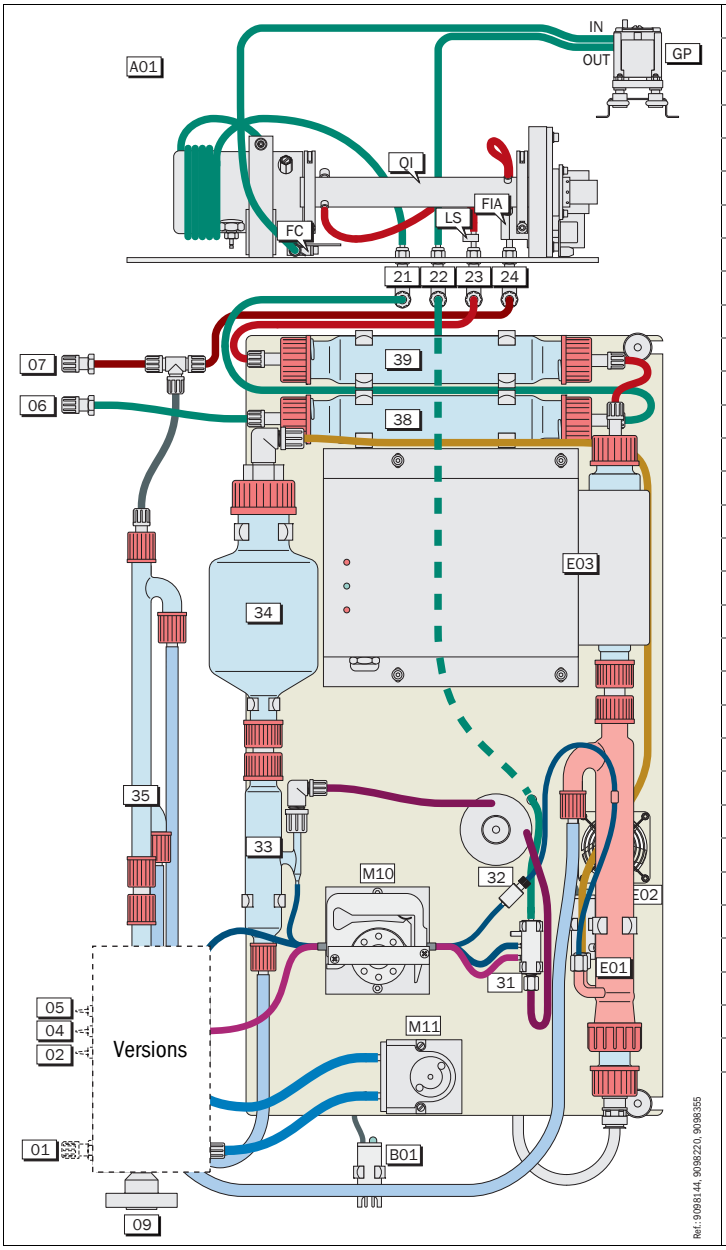
2.4.1 TOCOR700 UV (standard housing)

Figure 5 TOCOR700 UV: Device layout in standard housing



1	Gas analyzer electronics
2	Gas analyzer measurement technology (with gas pump)
3	Gas generator

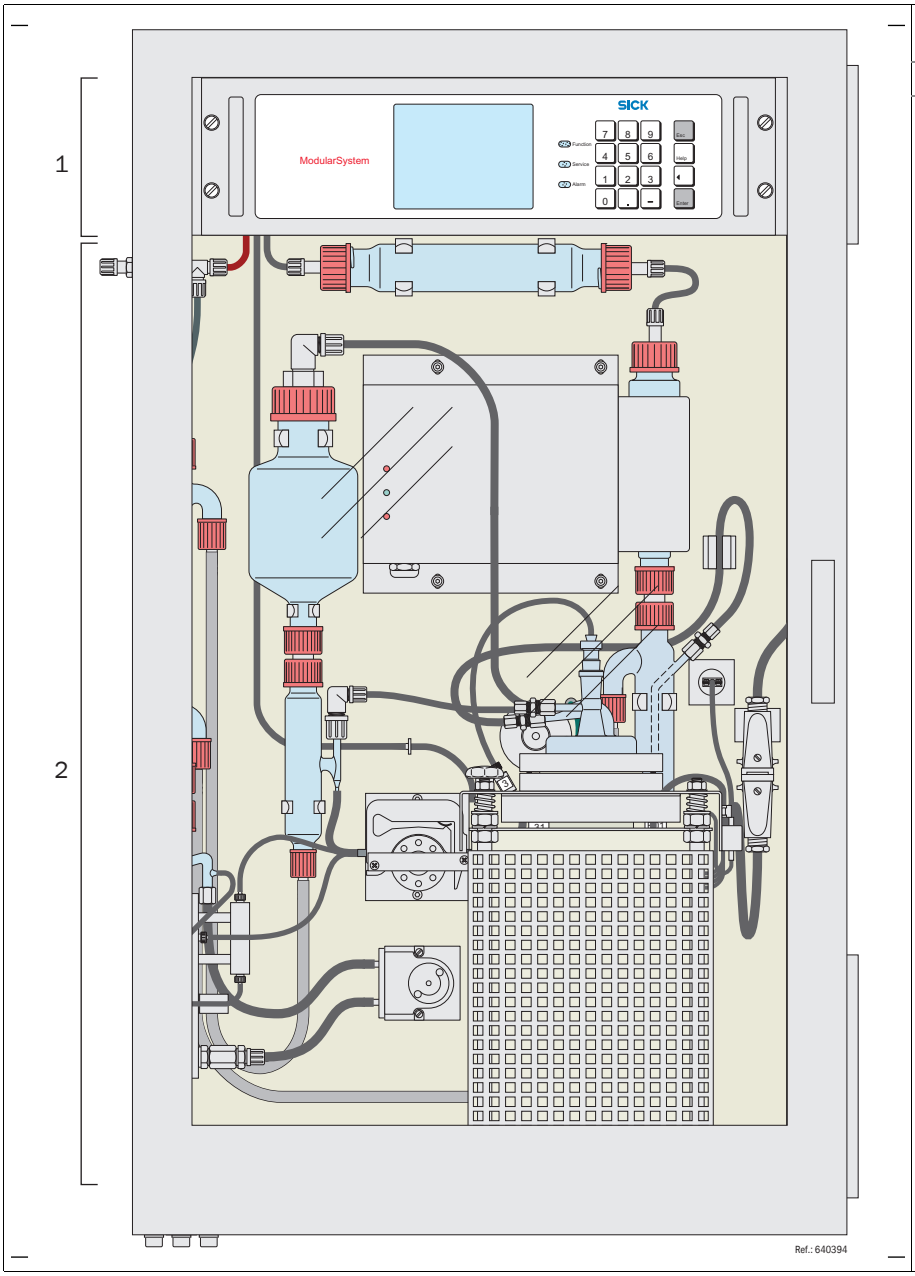
Figure 6 TOCOR700 UV: Measuring system



01	Sample water inlet
02	Single sample inlet
04	Reagent inlet
05	Zero water inlet
06	Carrier gas inlet
07	Exhaust gas outlet
08	Purge air outlet
09	Waste water outlet
10	Purge air inlet
21	Carrier gas inlet (gas analyzer)
22	Carrier gas outlet (gas analyzer)
23	Sample gas inlet (gas analyzer)
24	Sample gas outlet (gas analyzer)
31	Sample inlet module
32	Stripper
33	Phase separator
34	CO_2 absorber
35	Waste water collector
38	Activated charcoal filter
39	Corrosion inhibitor filter
A01	Gas analyzer
B01	Liquid sensor
E01	Reactor
E02	Fan
E03	Gas cooler
FC	Flow sensor (control)
FIA	Flow sensor (monitoring)
GP	Gas pump
LS	Liquid sensor
M10	Dosing pump
M11	Pre-sampling pump
QI	Gas analyzer cuvette

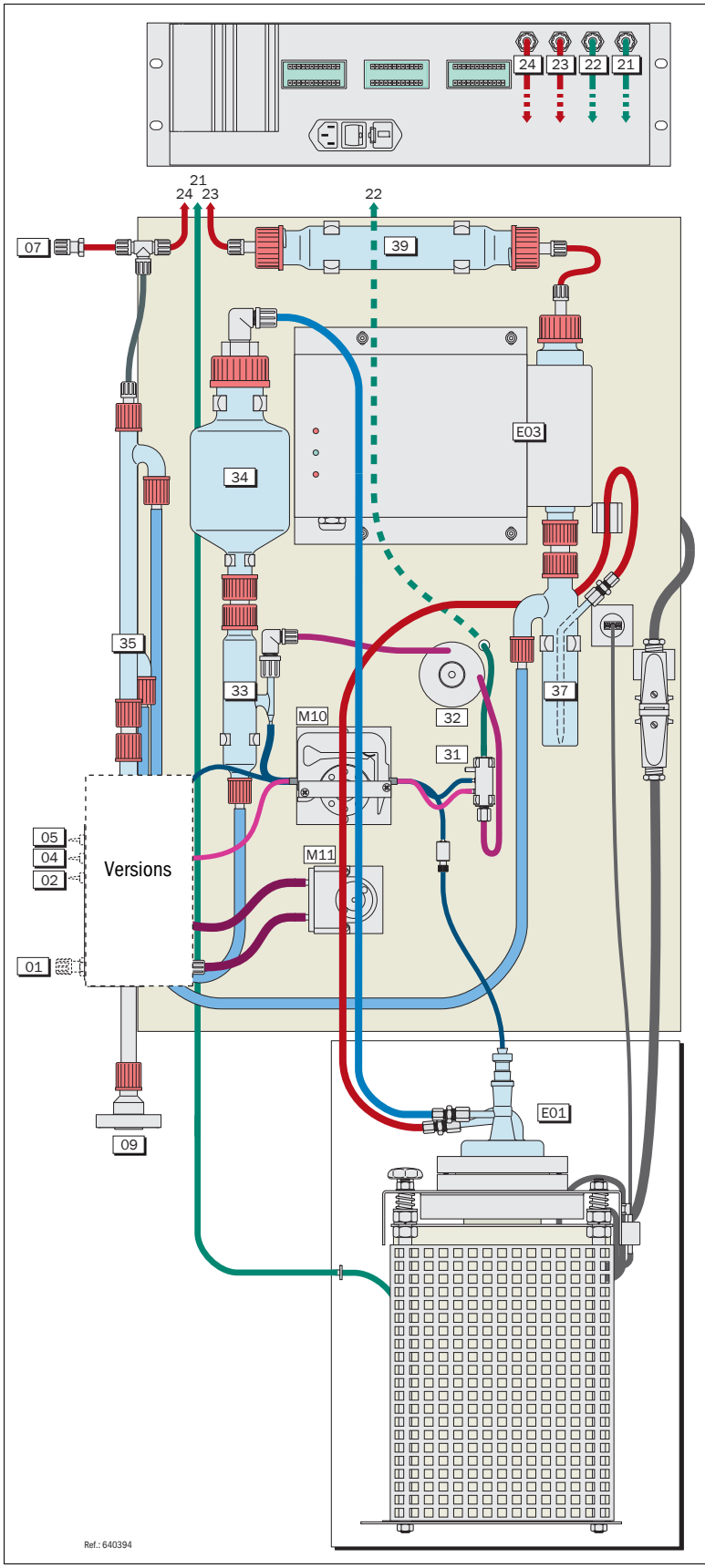
2.4.2 TOCOR700 TH (wall housing)

Figure 7 TOCOR700 TH: Device layout in wall housing



1	Gas analyzer (19" rack)
2	Gas generator

Figure 8 TOCOR700 TH: Measuring system



01	Sample water inlet
03	Single sample inlet
04	Reagent inlet
05	Zero water inlet
07	Exhaust gas outlet
08	Purge air outlet
09	Waste water outlet
10	Purge air inlet
31	Sample inlet module
32	Stripper
33	Phase separator
34	CO_2 absorber
35	Waste water collector
37	Gas washer
39	Corrosion inhibitor filter
A01	Gas analyzer
B01	Liquid sensor
E01	Reactor
E03	Gas cooler
M10	Dosing pump
M11	Pre-sampling pump

2.5 User Guide for the TOCOR700

2.5.1 What must you do?

You must perform the following work to be able to measure with the TOCOR700:

Familiarize yourself with the TOCOR700

It is useful if you spend time learning about the components and functions of the TOCOR700. Read the Data Sheet first if this is your first "contact" with the TOCOR700. It provides a brief introduction to the TOCOR700. More detailed information can be found in the Sections on

– Intended use, application restrictions 16
– Measuring function 23
– Device variants 26
– Measuring system design 30

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Calibrate the TOCOR700

– Prepare calibration liquids....150
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(The TOCOR700 was calibrated at the factory. Nevertheless, you should check the calibration. Correct measured values will only be obtained when the device has been correctly calibrated.)

TOCOR700 maintenance

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2.5.2 What can you do in addition?

The following TOCOR700 functions can be used and adapted as required:

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TOCOR700

3 Mounting and Assembly

Delivery state
Installation location
Assembly

3.1 Delivery state

3.1.1 Unpack and check

1 Remove encasing packing materials carefully.

2 Some components are secured with cable straps (plastic straps). Cut the cable straps with a suitable tool and remove.

3 Check if all required parts have been delivered (→ §3.1.2 to §3.1.3).

► First remove protective caps on gas and water connections when the lines are being connected.

3.1.2 Accessories and spare material included in scope of delivery

For all device versions:

Description	Quantity	Use
Special key	1	Device doors
PVC hose, 10x2 mm	2 m	Siphons (internal waste water lines)
PTFE hose, OD = 3 mm	2 m	Sample water feed
Pump hoses	1 set	Dosing pump
Soda lime	0.75 kg	CO_2 absorber
Brass wool, approx. 12g	3 packets	Absorption metal protective filter
Filter wool[1]	1 packet	Gas filter
Grease pencil	1	Ground glass joints of the glass parts
PHP powder[2] for calibration solution with 1000 mg/l C or 5000 mg/l C	1 packet	Sensitivity calibration
Safeguards 5x20 mm	1 set	Safeguards in gas analyzer
Individual technical documentation	1	

1 Only for temperatures under 200 °C; do not use in the reactor on TOCOR700 TH

2 PHP = potassium hydrogen phtalate ($KHC_8H_4O_4$)

Only for TOCOR700 UV:

Description	Quantity	Use
Sodium peroxy disulphate $Na_2O_8S_2$	1 kg	Oxidant

Only for TOCOR700 TH:

Description	Quantity	Use
Quartz wool	1 packet	Reactor
PTFE sealing tape	1 roll	Crucible lid of reactor
Wooden stand	1	Reactor crucible assembly
Alignment bar	1	Reactor alignment
Socket wrench 13 mm	1	Reactor alignment
Screwdriver, hexagon socket 4 mm	1	Reactor assembly
Screw driver	1	Reactor assembly
Bottle brush ø 30 mm	1	Cleaning the drop tube
Round brush ø 80 mm	1	Cleaning the reactor crucible

Order Numbers → page 243, „Spare Parts“

3.1.3 Components packed separately (TOCOR700 TH)

The reactor is delivered taken apart to avoid transport damage. The following single components are packed separately:

Component[1]	Quantity	Pos.	In Figure
Protective crucible for reactor, small, D=59x1.5, L=70, ceramic	1	1	→ page 50, Figure 16
Granulate VE 88, approx. 70 ml	1 packet	2	
Ceramic disc	1	3	
Drop tube, complete	1	4	
Ceramic crucible, large, D=65x3, L=270	1	5	
Ceramic beads	1 packet	6	
Catalyst beads	1 packet	7	
Crucible furnace	1	5	→ page 52, Figure 17
Flange OD=120 ID=76.5 S=15	2	2	→ page 53, Figure 18
Disc OD=90 ID=77.5 Klingersil (hard paper)	3	3	
O-ring 75.8x3.5, Viton	1	4	
Lid for ceramic crucible, glass	1	6	
Connection tube, complete (capillary drip tube)	1	7	
Joint clip (wire clamp) NS14/23	1	8	

1 Doubled on TOCOR700 TH + 2nd reactor

- Assembly → page 50, § 3.5
- Order Numbers → page 243, „Spare Parts“

3.2 Installation location

Overview of required connections → page 40, §

Required connections

- Mains voltage supply
- Sample water feed via capillary hose (via ¾" fabric hose *with the "Back-flush filter" option*)
- Waste water drain with proper waste water disposal
- Constant pressure conditions for gas outlet
- Compressed air supply for *"Back-flush filter" option*
- *With the "External carrier gas feed" option:* carrier gas feed not containing any organic carbon compounds

Ambient conditions

- ► Select a dry environment free from frost. Avoid condensation.
- ► Avoid exposure to direct sunlight.
- ► Avoid effects of mechanical oscillations, vibrations or impacts. Such effects can make measuring operation impossible.
- ► Maintain the allowable ambient temperature (see Data Sheet) during operation. Otherwise the specified measuring precision will not be achieved.
- ► Do not operate the TOCOR700 in potentially explosive atmospheres – apart from when this is explicitly allowed and specified in the individual technical device documentation.

WARNING: Risk of explosions in potentially explosive atmospheres

- ► Only use the TOCOR700 in a potentially explosive atmosphere when the individual device design is suitable (→ page 26, § 2.3.3).

Placement

- ► Leave space under the device for the waste water connection.
- ► Do not block ventilation openings.
- ► Align the housing vertical (±2°).

Recommendation for the TOCOR700 UV:

- ► Leave space free in front of the device under the housing (approximately 30 cm).

This allows pulling the submersion tube and UV lamp out of the reactor without further disassembly work. This eases cleaning the reactor (→ page 204, § 12.3) and exchanging the UV lamp (→ page 245, § 17.1.3).

Distance to sample point

- ► Keep the distance between sample point and TOCOR700 shorter than 2 m when possible to keep the measuring delay as short as possible.
- ► *When the distance is larger (recommendation):* Direct a larger sample water volume flow to the TOCOR700 via a transport line and use sample water from this line (bypass principle).

The MRF filter container can serve as bypass container when an MRF back-flush filter is fitted as additional unit.

3.3 Final device assembly

3.3.1 Fill drain hoses (siphons) with water

To separate the open waste water drain from the gas-conveying measuring system, the waste water drains off via U-shaped hoses that are filled with water; the water head in the hose serves as gas-tight seal (siphon principle). There are two such drains. The siphons must be filled with water before start-up.

Fill siphon 1

1 Open connection [1] between CO_2 absorber and phase separator (→ Figure 9).

2 Fill water into the phase separator (e.g. with a laboratory spray bottle) until the phase separator is half full.

► Now fill the CO_2 absorber anew as required (→ page 43, § 3.3.2).

3 Reconnect the phase separator and CO_2 absorber. Ensure gas leak tightness.

Fill siphon 2

1 *TOCOR700 UV:* Open connection [2] between gas cooler and UV reactor and push the UV reactor slightly downwards (→ Figure 9).
TOCOR700 TH: Open connection [2] between gas cooler and gas washer (→ Figure 10).

2 Fill water into the UV reactor (TOCOR700 UV) or into the gas washer (TOCOR700 TH) until water escapes into drain tube [C].

3 Reconnect the gas washer. Ensure gas leak tightness.

Figure 9 Siphons on the TOCOR700 UV

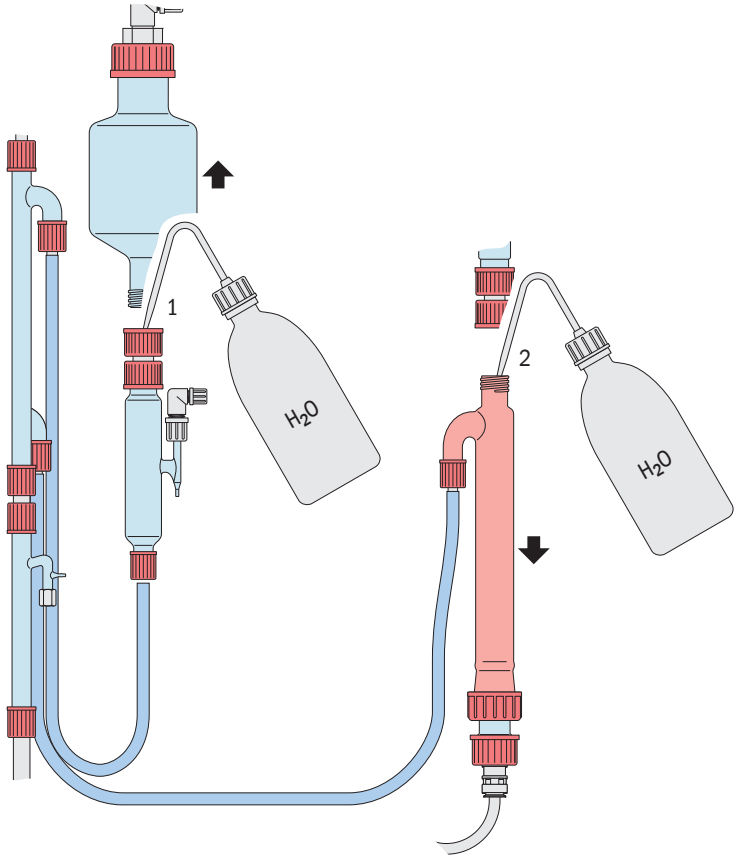
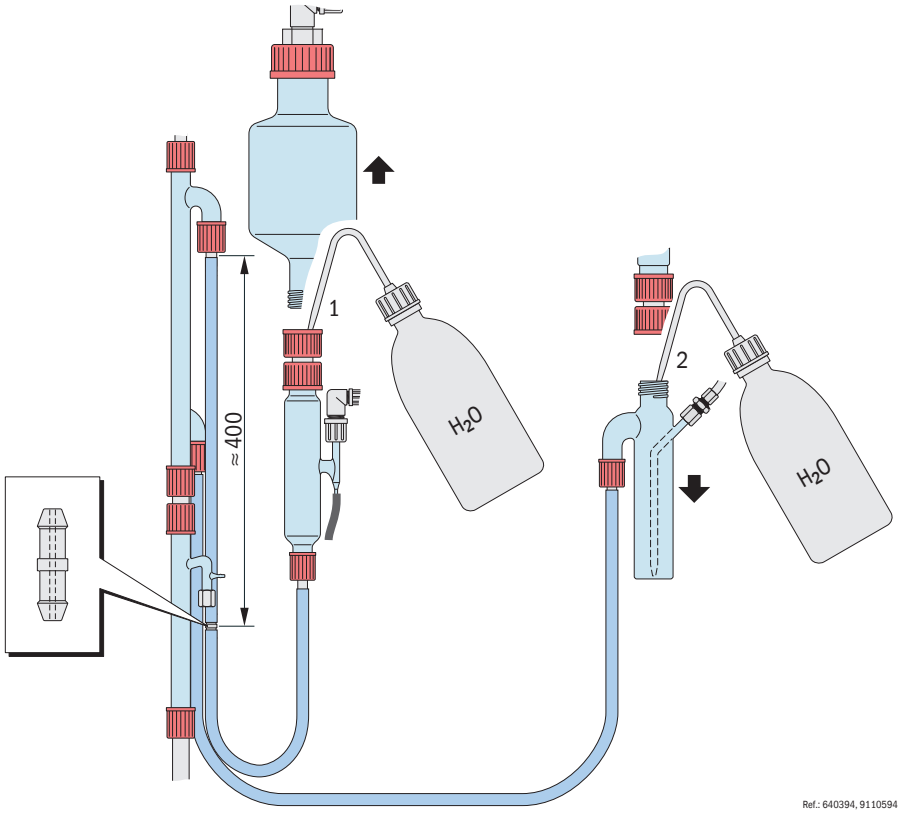


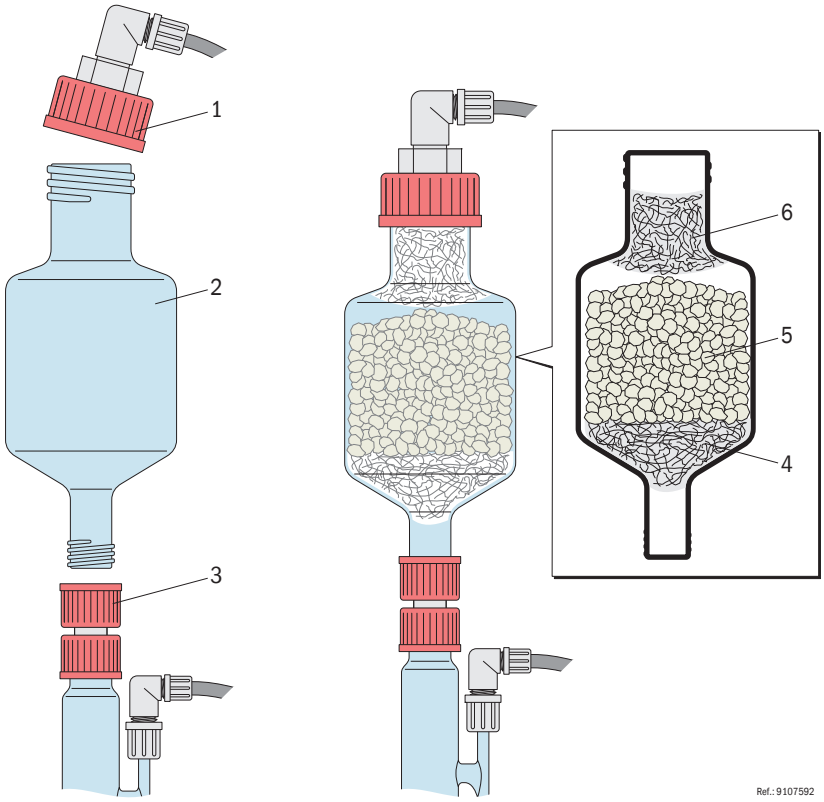
Figure 10 Filling siphons on TOCOR700 TH



The sudden evaporation of sample water drops in the thermal reactor causes pressure surges in the siphon which could cause the water in the siphon to fluctuate and not drain off evenly. Capillaries in the siphon hose suppress this effect and provide steady drainage.

3.3.2 Fill the CO_2 absorber

Figure 11 CO_2 absorber



Procedure

1 Open upper screw cap [1] of absorber container [2].

2 Loosen lower screw cap [3] and push the container (phase separator) positioned underneath down slightly.

3 Take the absorber container out of the retainer clamps.

4 Place about 5 g of filter wool [4] at the bottom of the absorber container. Compress the filter wool slightly to completely block the lower opening.

5 Fill with approx. 500g (375 ml) new soda lime granulate [5].

► Safety information on soda lime → page 257, § 18.1.4

6 Now place about 5 g filter wool over the granulate [6] and compress slightly.

7 Clean sealing surfaces on the absorber unit and screw caps.

8 Refit the absorber container. Fasten both screw caps again.

Notes for operator

► Replace the soda lime filling regularly (→ page 198, § 12.2.2).

► Perform a calibration after each filling.

For sensitive TOC measuring ranges: Wait several operating hours before calibrating.

The zero point value is somewhat higher at first with new soda lime granulate because the granulate still emits traces of CO_2. The soda lime is first "clean" after several operating hours.

► *When the reaction time is much longer than specified:*
- Reduce the amount of soda lime in the absorber container or use a smaller absorber container.
- At the same time, take into account that the maintenance interval for the CO_2 absorber is correspondingly shorter than for the standard version.

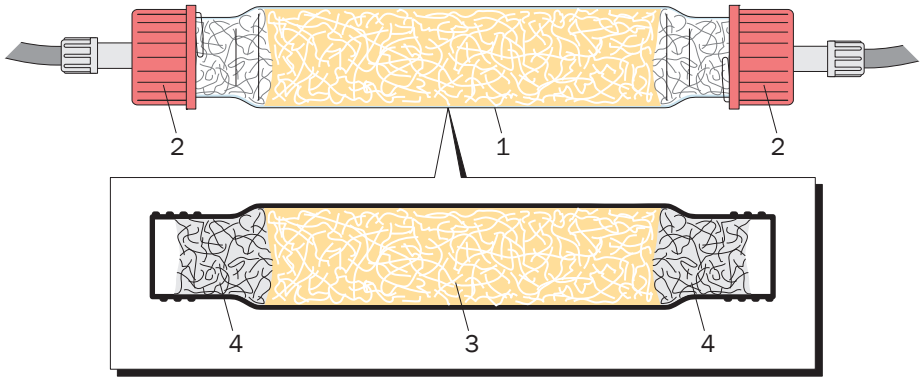
Soda lime also absorbs a certain amount of lightly volatile hydrocarbons and releases these after a time delay. This effect can disturb measurement in some applications. Using less absorber minimizes this effect.

3.3.3 Fill the corrosion inhibitor filter

Function

The corrosion inhibitor filter is filled with brass wool. Brass wool protects the gas analyzer against acid vapours.

Figure 12 Corrosion inhibitor filter



- Position in TOCOR700 UV → page 31, Figure 6
- Position in TOCOR700 TH → page 33, Figure 8

Procedure

1 Take filter tube [1] out of the holder. Take off screw caps [2].
2 Fill approx. 30 g brass wool [3] in the filter tube.
3 Insert a plug made of filter cotton [4] (approx. 5 g) in both ends.
4 Clean sealing surfaces:
- Ends of the filter tube
- Sealing surfaces of the screw caps

5 Fit the filter tube. Close the screw caps properly.

CAUTION: Risk of incorrect measurements
Leaks falsify measured values.
► Ensure gas leak tightness when assembling the components.

- Replace the brass wool when it is strongly discolored.
- Chemical reaction products on used brass wool can be harmful to health.

Detailed information → page 200, § 12.2.3

3.3.4 Fill the activated charcoal filter (only for TOCOR700 UV)

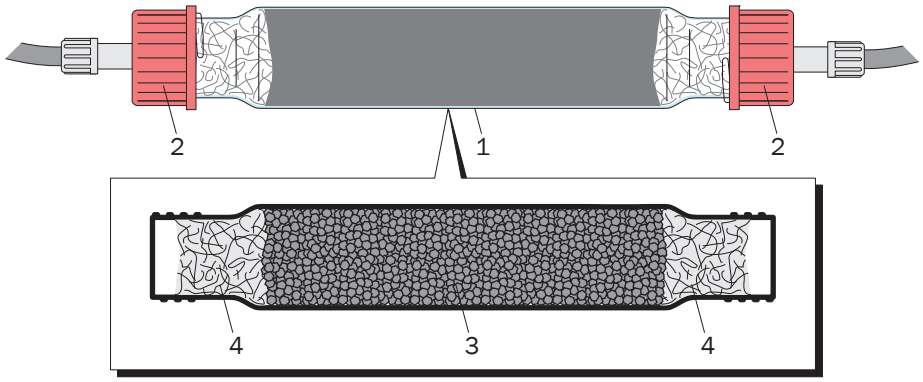
Can possibly be ignored when external carrier gas free of carbon is used.

Function

The activated charcoal filter absorbs hydrocarbons out of the ambient air used as carrier gas. Without this filtering, hydrocarbons out of the ambient air could falsify the measured values.

This filter could possibly be omitted when external carrier gas free of carbon is fed → page 62, § 4.5).

Figure 13 Activated charcoal filter



(Position → page 31, Figure 6)

Procedure

1 Take filter tube [1] out of the holder. Take off screw caps [2].
1 Remove filter cotton [4] from one end of the filter tube.
2 Empty the activated charcoal [3] out of the filter tube.
3 Fill new activated charcoal granulate.
   ► Safety information on activated charcoal → page 256, § 18.1.1
4 Insert filter cotton plug again.
5 Clean sealing surfaces:
   – Ends of the filter tube
   – Sealing surfaces of the screw caps
6 Fit the filter tube. Close the screw caps properly.

CAUTION: Risk of incorrect measurements
Leaks falsify measured values.
► Ensure gas leak tightness when assembling the components.

Replace the activated charcoal regularly (→ page 201, § 12.2.4).

3.3.5 Fit the pump hoses

Notes for operator

The TOCOR700 is fitted with a multi-channel hose pump. The delivery rate of a pump channel depends on the diameter of the respective pump hose. The dimensions of the pump hoses depends on the individual application involved (e.g. measuring range, salt content).

- The required cross-sections of the pump hoses are specified in the Specification Sheet (→ page 20, Figure 1).
- Two color codes on the pump hose identify the hose cross-section (color codes → page 247, § 17.3.1).

> Appropriate hose cross-sections are prerequisites for correct measuring operation.

Procedure

1 Read off the cross-sections of pump hoses in the Specification Sheet (→ page 20, Figure 1; pump channels sequence → Figure 15).

2 Fit appropriate pump hoses:
   a) Take off hose cassette [1].
   b) Thread pump hose [2] into the hose cassette.
   c) Refit the hose cassette with pump hose.

> Chemical operating substances can severely damage the hose cassettes.
> ► Remove liquid immediately from the hose cassettes.

Figure 14 Handling the hose cassettes

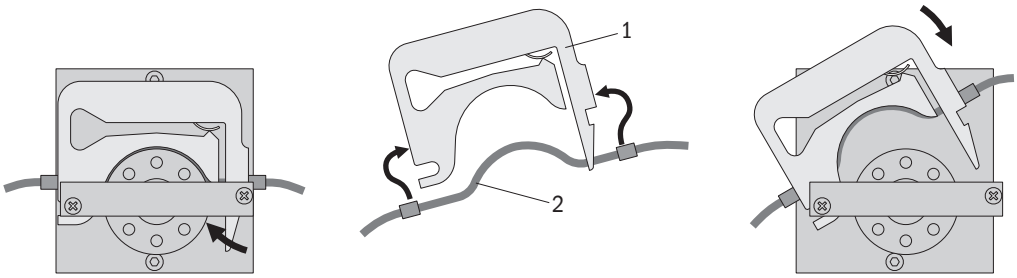
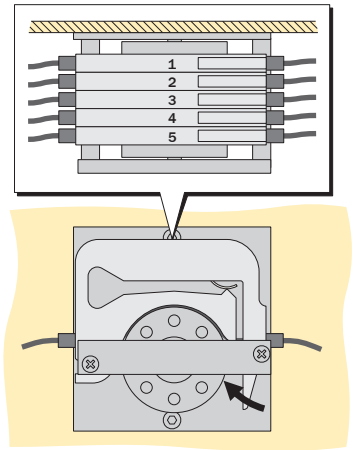


Figure 15 Pump hoses sequence



3.4 Installing the reagent container

3.4.1 Position and connect the reagent container

► Position the delivered reagent container next to (or in) the TOCOR700 so that it is secured against mechanical damage or tipping over.

► Connect the reagent container hose to the “reagent inlet”.

► Fill reagent (composition → § 3.4.2).

Recommendation:

1 Use a reagent container with fill level watchdog.

2 Create a control input with the function “Reserve B11” → page 120, § 8.10).

3 Connect the watchdog signal to this status input.

The TOCOR700 then triggers a malfunction message when the reagent container must be topped up.

3.4.2 Mixing the reagent

Function

The reagent liquid fulfills the following functions:

- Acidification of the sample water to remove the TIC (stripping)
- For large carbon concentrations in the sample water: Dilute the sample water to adapt to the measuring system
- On TOCOR700 UV: Feed oxidant to optimize the reactor effect

Safety Information

CAUTION: Health risk through acid

Acids are dangerous to health

► Observe safety information on chemical substances (→ page 256, § 18.1).

► Always wear suitable personal protective equipment when handling acids (e.g. protective gloves, protective goggles, protective clothes).

WARNING: Risk of accidents when mixing

When water is added to an acid, this can cause sudden, strong heating up and explosive evaporation.

► Always add the acid to the water - never the other way round.

Composition

The reagent comprises:

– Pure water (deionized/demineralizedt/distilled)

– An acid

– For TOCOR700 UV: Oxidant (sodium peroxy disulphate)

The quantitative composition depends on the measuring task and measuring range.

► Refer to the individual technical device documentation for the suitable reagent composition (Specification Sheet → page 20, Figure 1).

CAUTION: Risk of incorrect measurements

Even pure water contains a certain TOC residue. Measured values can possibly be falsified when the TOC concentration varies in the water used.

► Make sure the pureness of the water used remains constant.

Standard substances:

- TOCOR700 UV: Sulphuric acid (H_2SO_4) + sodium peroxy disulphate ($Na_2O_8S_2$)
- TOCOR700 TH: Hydrochloric acid (HCl) or phosphoric acid (H_3PO_4).

- Do not use hydrochloric acid (HCl) on the TOCOR700 UV because chlorine has a negative effect on UV oxidation.
- The oxidant is effective in the UV reactor.

Table 1 Alternative acids for TOCOR700 TH

Acid	Advantages	Disadvantages
Hydrochloric acid (HCl)	Standard substance for all applications.	• Acid vapours from the reactor can damage the gas analyzer when the corrosion inhibitor filter fails. • Acid vapours from the storage container and waste water line can damage device surfaces.
Phosphoric acid (H_3PO_4)	No corrosion risk for the gas analyzer.	Not suitable when sample water constituents can react with phosphoric acid and create substances insoluble in water (salts). Such substances can deposit in the reactor and have a negative effect on the reactor function.

Adapting the acid concentration

The specified acid concentration may have to be adapted to the individual application. Make sure the pH-value of the sample water - acid mix remains in the range 2.0 ... 2.5.

To determine the appropriate acid concentration:

1 Run measuring operation for the planned sample water for some time.

2 Then use the delivered pH test strip to determine the pH-value in the phase separator (→ page 31, Figure 6/→ page 33, Figure 8).

► *When the pH-value is above 2.5:* Increase the acid concentration.

► *When the pH-value is below 1.5:* Reduce the acid concentration.

3 Repeat the pH-value check after a certain operating time until the appropriate acid concentration is found.

When sample water composition varies:

► Repeat the pH-value check during the operating time.

► Use the acid concentration where the pH-value is always below 2.5 during operation.

- pH-values > 3.5 lead to erroneous measured values due to incomplete TIC removal.
- pH-values < 2 shorten the service life of the corrosion inhibitor filling and increase the risk of corrosion in the gas analyzer.

Adapting the oxidant concentration (for TOCOR700 UV)

The oxidant concentration specified at the factory may be adapted for individual use. Observe the following criteria here:

- The oxidant concentration in the UV reactor should be 5 ... 10 g/l.
- Erroneous measured values are created because of incomplete oxidation of the carbon compounds when the oxidant concentration is too low.
- An excessive oxidant concentration
  - is basically not allowed
  - can lead to clogging in the sample water line
  - adds unnecessary costs to measuring operation.

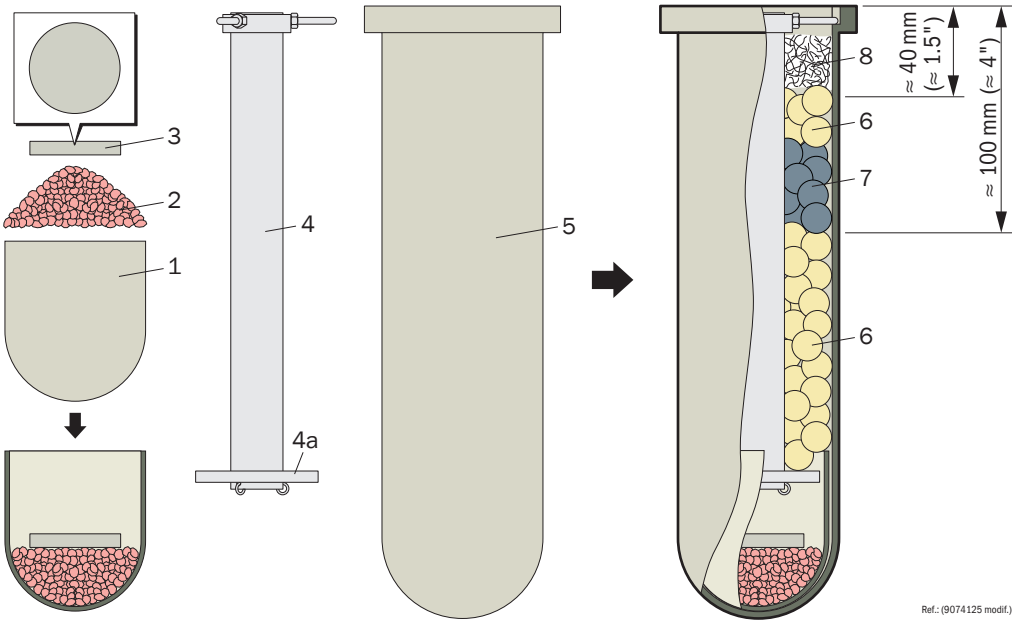
► Installing the storage container → page 61, § 4.4.4
► Reagents (spare material) → page 250, § 17.8.1

3.5 Thermal reactor assembly (only for TOCOR700 TH)

The complete procedure must be carried out for both reactors for a TOCOR700 TH + 2nd reactor.

3.5.1 Fill the reactor crucible

Figure 16 Reactor crucible (TOCOR700 TH)



The scope of delivery includes a wooden stand for the reactor crucible [4].

► First lay the lower flange part with hard paper disc on the wooden stand (→ page 50, Figure 16 [2]+[3]) and then position the reactor crucible in the wooden stand.

This simplifies repositioning in the crucible furnace.

Assemble the reactor crucible

1 Fill and spread one packet of granulate [2] in protective crucible [1].
2 Lay massive ceramic disc [3] on the granulate.
3 Let the filled protective crucible slide carefully into reactor crucible [5].
4 Check whether ceramic disc [3] is more or less horizontal in the vertical reactor crucible. To correct the position, push carefully from above with a rod.
5 Position drop tube [4] in the reactor crucible. The 3 metallic fixing pins for the drop tube belong in the recesses on the reactor crucible rim.

► Take care that perforated disc [4a] of the drop tube does not touch the upper rim of the protective crucible but “floats” inside the protective crucible.
► Make sure there is a gap of at least 0.3 mm between the ends of the fixing pins and the rim of the recess (space for thermal expansion). The fixing pins must not be “trapped” in the recess. Otherwise the ceramic crucible can break when heated up.
► The fixing pins must not protrude into the drop tube.

Fill the reactor crucible

1 Shield the drop tube so that nothing can fall into the drop tube.
   ► E.g. insert a large screwdriver into the drop tube so that the screwdriver grip covers the drop tube.
2 Fill ceramic beads (uncoated beads [6]) into the reactor crucible – up to about 10 cm below the upper rim of the reactor crucible.

> ► Let the ceramic beads roll *carefully and slowly* into the space between drop tube and inner wall of the ceramic crucible.
> Otherwise perforated disc [4a] can break.

3 Put 1 packet of catalyst beads (coated beads [7]) as a layer on top.
4 Top up with ceramic beads – up to about 4 cm below the upper rim of the reactor crucible.
5 Cover the ceramic beads with a layer of quartz wool (about 5 g). This covering layer should be loose but without any gaps.

> ► Make sure the correct reactor beads are used (see the individual technical device documentation).
> ► Only use new catalyst beads with intact coating. Separate questionable catalyst beads out.
> ► Only use quartz wool.[1]

1 Cotton wadding disintegrates, glass fiber wadding melts.

- Reactor beads are made with a diameter of 11 ... 16 mm. Reactor beads in one reactor should have more or less the same diameter.
- The quartz wool covering layer traps salts and other solids. The prevents incrustation in the reactor lid.

- A larger number of catalyst beads can be used for difficult TOC applications. The number of ceramic beads must then be reduced accordingly.
- Catalyst beads with worn coatings can still be used as “normal” ceramic beads.

Spare material → page 246, § 17.2

3.5.2 Align the reactor crucible

Imperative

Align the reactor crucible vertically so that the falling drops do not touch the drop tube wall.

Align the reactor crucible

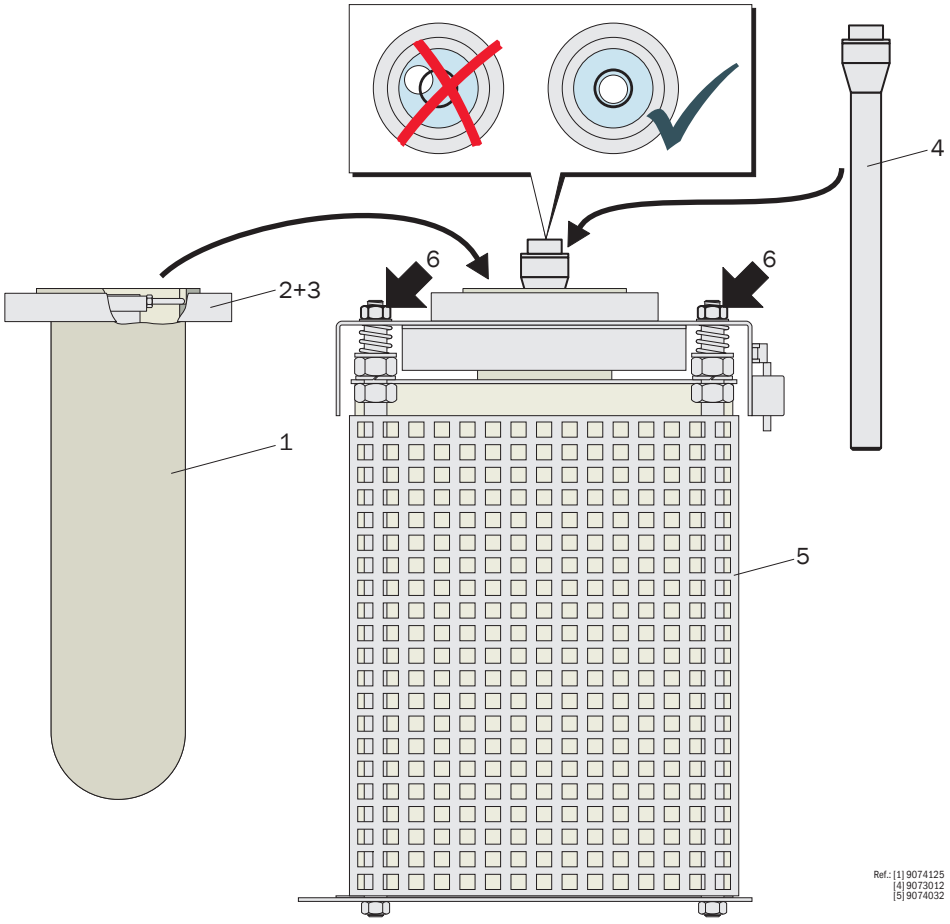
- after the device has been set up for the first time
- after the reactor position has been changed (transport, new location)
- after the crucible furnace has been replaced

Procedure

1 If necessary, pull crucible furnace [5] out of the device (draw mechanism).

2 Insert reactor crucible [1] together with lower flange part [2] (with hard paper disc [3] → page 53, Figure 18) into the crucible furnace.

Figure 17 Align the thermal reactor



3 Push the crucible furnace back into operating position.

4 Align the reactor vertically:

a) Insert alignment bar [4] (in scope of delivery) carefully into the drop tube.

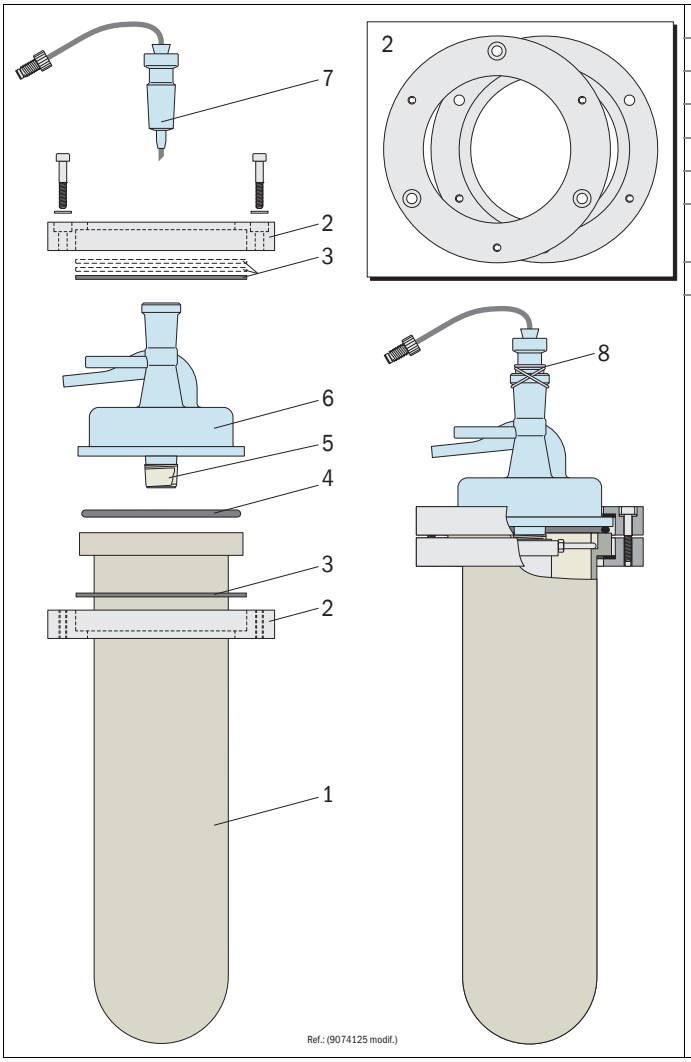
b) Adjust the three nuts [6] so that the air bubble of the alignment bar is in the center of the sight glass.

c) Take the alignment bar out again.

d) Take the reactor crucible out of the crucible furnace for assembly.

3.5.3 Assemble the thermal reactor

Figure 18 Assembling the reactor (TOCOR700 TH)



1	Reactor crucible
2	Flange (half-shell)
3	Hard paper disc
4	O-ring
5	Sealing tape (PTFE)
6	Crucible lid
7	Capillary drip tube (connection tube)
8	Joint clip

1 Adapt peg of the crucible lid [5]:
- Wrap PTFE sealing tape around the peg on the underside of the crucible lid.
- Try out various thicknesses of the PTFE layer until the peg and the drop tube are seated together gas-tight.

2 Position the crucible lid:
a) Check: The sealing surfaces of the reactor crucible are clean and smooth.
b) Lay and center O-ring [4] on the sealing surface of the ceramic crucible. Use a brand new O-ring when possible.
c) Position the lid (guide the peg carefully into the drop tube). The angled connection tube must point towards the gas washer.

3 Fit the upper flange:
a) Lay 2 hard paper discs [3] in the underside of the upper flange part.
b) Fit the upper flange part over the crucible lid.
c) Check visible distance between upper flange part and lower flange part.
► *If the distance is less than 1 mm:* Lay an additional hard paper disc in the upper flange part.

d) Screw the flange together carefully: Tighten the three screws evenly (change screw often) until O-ring [4] is pressed together by about 0.2 mm.

4 *If the capillary drip tube is not fitted with a capillary hose:* Fit a piece of PTFE capillary hose in the capillary drip tube (approx. 1 m long; material → page 248, § 17.4).

To do this:

1	Stretch the capillary hose at one end (pull hard) until the hose is visibly tapered.
2	Cut the hose end off at the thinnest point.
3	Guide the tapered hose end into the angled end of the drip insert and pull the hose through the drip insert in this manner until the full hose diameter juts out of the other end of the drip insert.
4	Cut off the hose piece jutting out with a sharp blade so that 3...6 mm still remain protruding from the glass drip tip.

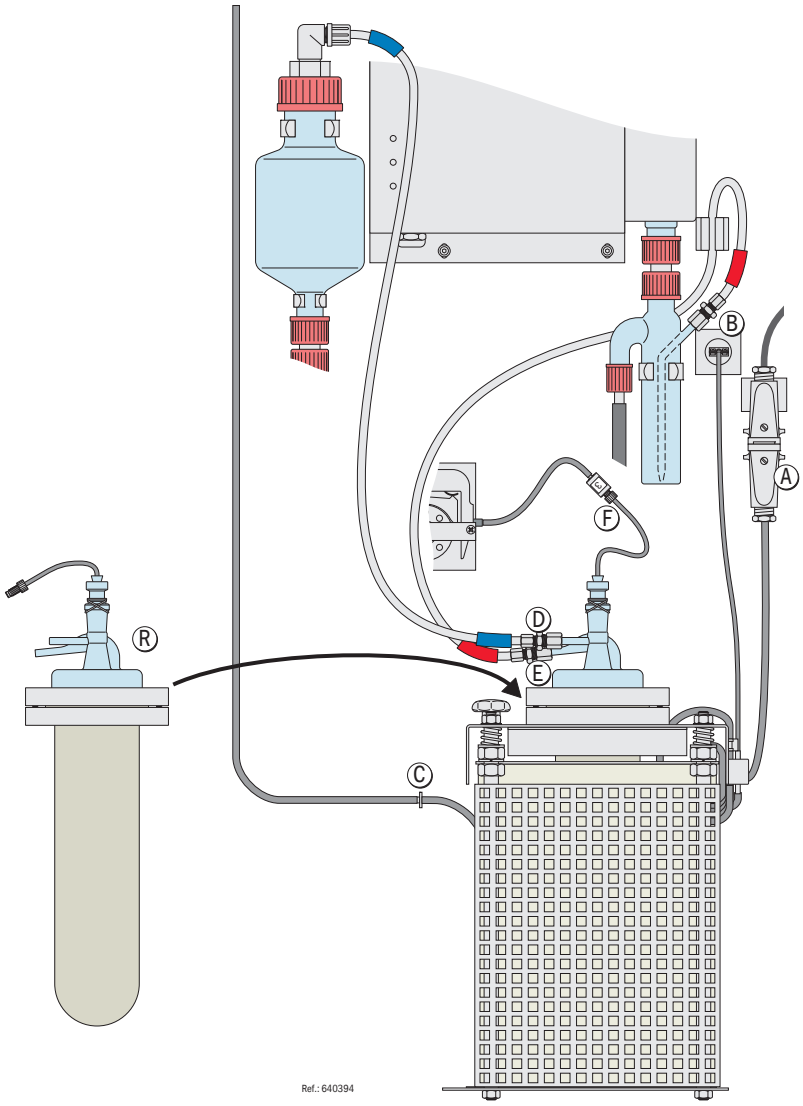
5 Apply a thin film of grease to the ground glass surface of the capillary drip tube (use high-temperature joint grease, e.g. the delivered grease pencil).

6 Position the capillary drip tube on the reactor lid. Press the capillary drip tube on gently and twist it to and fro slightly until the film of grease forms a seal all round the joint.

7 Fasten the capillary drip tube with joint clip [8].

3.5.4 Connect the thermal reactor

Figure 19 Thermal reactor connections



► Position the complete reactor [R] in the crucible furnace opening.

Connect the crucible furnace

1 Connect heating cable [A] to the plug-in connector close to the crucible furnace.
2 Connect temperature sensor cable [B] to the socket near the crucible furnace.
3 Connect the carrier gas suction hose with hose [C].
4 Check the setting of the temperature controller: Standard temperature = 850 °C (optimal oxidation), for special applications 750 ... 850 °C (the number of catalyst beads may have to be increased for lower temperatures).

Connect the reactor

1 Connect the carrier gas feed hose [D] to the hose connections near the capillary drip tube.
2 Connect sample gas hose [E] to the hose connections on the reactor lid.
3 Connect sample water hose [F] of the capillary drip tube to the sample water pump hose.

TOCOR700

4 Installation

Housing installation
Water connections
Back-flush filter (option)
External carrier gas (option)
Signal connections
Mains connection

4.1 Housing installation

Lifting points, transport information → page 235, § 15.2

4.1.1 Dimensions

See individual technical documentation.

4.1.2 Mounting location, ambient conditions

Criterion	Measure	Notes for operator
Temperature	► Maintain the allowable ambient temperature (see Data Sheet) during operation. ► Avoid exposure to direct sunlight.	Otherwise the specified measuring precision will not be achieved.
Humidity	► Avoid condensation - especially inside the device.	Allowable relative humidity inside the device: 0 ... 90 % at 20 °C, non-condensing.
Vibrations	► Select a mounting location free from vibrations and jolts. ► Protect the TOCOR700 from hard impacts.	Jolts (e.g. due to road traffic or heavy machines) can cause measurement errors.
Tilt	► Set up or mount the TOCOR700 so that the base surface of the housing is more or less horizontal during operation.	Otherwise the measuring function could be affected.

4.2 Waste water drain

Function

All liquids fed into the TOCOR700 are drained via the waste water drain. The waste water contains:

- Excessive sample water after passing through the stripper
- Sample water after passing through the reactor
- Chemicals mixed with the sample water in the device.

CAUTION: Risk for the environment and disposal equipment

TOCOR700 TH: The waste water contains acid[1].

TOCOR700 UV: The waste water contains acid [1] and oxidant (sodium peroxy disulphate).

- ► Use non-corrosive drain lines.
- ► Check whether appropriate warning signs need to be installed.
- ► Check whether the sample water contains dangerous substances.
- ► Ensure proper disposal of the waste water.

1 pH > 1.5; see the individual technical device documentation for the type of acid

Installation

Connect the waste water drain of the TOCOR700 with a collection point or a suitable drain.

- ► See the individual technical device documentation for position and design of the waste water drain. Standard: Inner thread G½" on the underside of the housing.
- ► Use a stable hose (or tube) with a minimum inner diameter of 20 mm for the waste water drain.
- ► The drain hose should be no longer than 2 m.
- ► The drain line must always lead downwards; the hose must not sag.
- ► The hose end must be open; no back pressure may build up on the drain.

The internal waste water hoses (siphons) must be filled (→ page 41, §3.3.1).

The waste water drain is connected internally to the gas outlet to compensate the pressure (venting).

4.3 Gas outlet

- ► *If the sample water cannot release substances dangerous to health:* Leave the gas outlet open.
- ► *If the sample water can release substances dangerous to health:* Connect the gas outlet to a suitable collection point (e.g. exhaust duct).

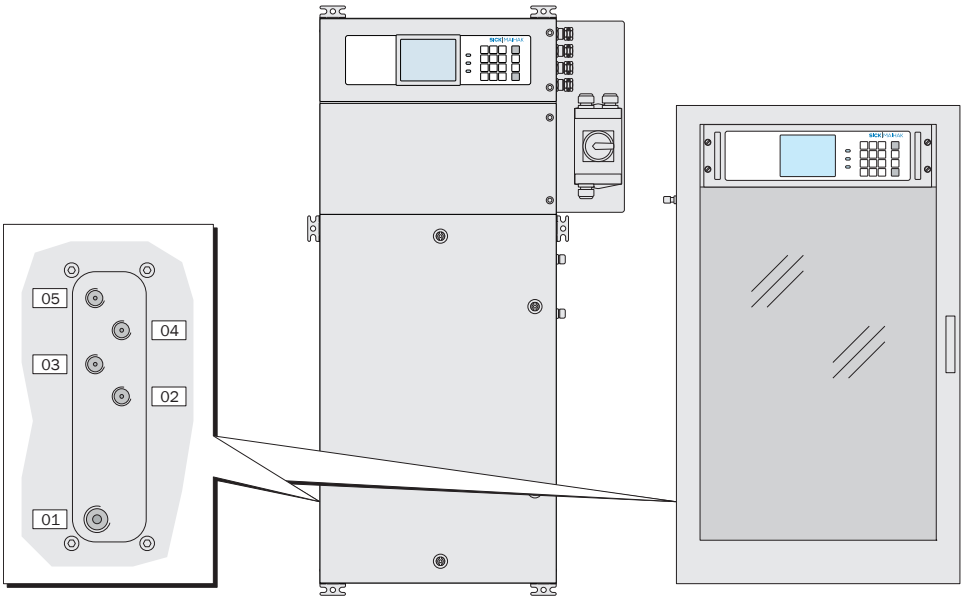
CAUTION: Risk of incorrect measurements

No significant back pressure may arise on the gas outlet and no strong pressure fluctuations may occur. Otherwise erroneous measured values could be produced.

- ► Make sure that the sample gas can “freely” exit the analyzer.

4.4 Liquid feed

Figure 20 Connections for feeding liquid



Pos.	Description	Function
01	Sample	Sample water inlet – with internal pre-sampling pump [1]
02	Sample [2]	Sample water inlet – without internal pre-sampling pump [1]
03	Zero solution	Zero water feed during calibrations
04	Reagent	Reagent feed (→ page 47, §3.4.2)
05	Single sample [3]	Manual sample water feed
	Test solution [3]	Calibration solution feed during calibrations

1 Observe the individual technical device documentation
2 Alternatively; observe the individual technical device documentation
3 Pay attention to information in §4.4.3 (→ page 61)

4.4.1 “Sample” connection

Function

The TOCOR700 draws in the sample water via the sample connection during continuous measuring operation (when the single sample connection is not active → §4.4.2).

WARNING: Risk to health through dangerous sample water

► *If the sample water can be dangerous to health:* Check whether additional safety precautions are necessary (→ page 18, §1.4).

Installation

► Connect a PTFE hose with 3 mm outer diameter (supplied with device: PTFE capillary hose 3x1 m, approx. 1 m long) to the “Sample” inlet.

The hose connection to the sample point should be as short as possible to achieve a short reaction time.

4.4.2 "Single sample" connection

Only valid for devices with the "Single sample" connection (option).

Function

The "Single sample" option serve to switch sample water feed manually to the "Single sample" connection (→ page 100, § 7.4.8). This allows you to take single sample water samples manually as required without having to open the sample water line manually. An internal solenoid valve is available for switching.

- ► *On devices with "Single sample" connection:* The "Single sample" connection also acts as "Zero solution" and "Test solution" connections (→ page 61, § 4.4.3).
- ► *If this is the case:* Make the calibration solution available on the "Single sample" connection for calibrations.

Installation

1 Connect a PTFE hose 3x1 mm to the "Single sample" connection (see left housing side). A suitable hose is included in the scope of delivery (approx. 1 m long).
2 Immerse the open hose end in the respective sample container.

4.4.3 "Zero solution"/"Test solution" connection

Valid only for devices with "Zero solution"/"Test solution" connections (option).

Function

The "Zero solution" and "Test solution" options serves to automate calibration liquid feed:

- The "Zero solution" connection is activated during a zero point calibration.
- The "Test solution" connection is activated during a sensitivity calibration.

An internal solenoid valve is available for switching. This allows calibrations without the sample water line having to be opened.

On these device versions, the "Test solution" connection also acts as "Single sample" connection (→ page 61, § 4.4.2).

Installation

1 Connect a capillary to the relevant connection (see left housing side). A suitable 3x1 mm PTFE hose is included in the scope of delivery (approx. 1 m long).
2 Immerse the open hose end in the storage container with calibration liquid.
3 Seal the storage container (protection against dust and hydrocarbons from ambient air).

4.4.4 "Reagent" connection

1 Connect a PTFE hose 3x1 mm to connection [04]. A suitable hose is included in the scope of delivery (approx. 1 m long).
2 Connect a suitable storage container to the hose.
3 Fill the storage container with reagent (Mixing → page 47, § 3.4.2).

4.5 External carrier gas feed

Only valid for devices with “External carrier gas feed” option.

Function

Standard TOCOR700- versions use ambient air as carrier gas. The “External carrier gas feed” option allows feeding a carrier gas from an external source. This means, a synthetic carrier gas or one prepared accordingly can be used when it is sure that the gas contains absolutely no carbon compounds at all.

Using a carrier gas free from carbon is advantageous,

- when measuring ranges are small (e.g. 0 ... 3 mg/l C) and the ambient air contains hydrocarbons
- when carbon concentrations in the ambient air fluctuate strongly.

Installation

In order to feed an external carrier gas, the TOCOR700 must be able to draw in the gas as for ambient air:

1 Install a T-piece (screw fitting) to the “Carrier gas inlet” connection.

2 Connect the carrier gas feed to this T-piece. Use a suitable gas free of carbon as carrier gas. Leave the gas outlet on the T-piece open.

3 Feed the carrier gas through the T-piece during operation:
   - Without pressure (gas outlet in T-stuck open)
   - In excess (volume flow larger than drawn in by the TOCOR700).

4.6 Compressed air feed for the back-flush filter

Valid only for devices with “Back-flush filter” option.

Function

Back-flush filters of the MRF series flush the filter sieve regularly with compressed air. This means you need a compressed air supply. The TOCOR700 controls the switching valve that triggers back-flushing.

Installation

► Feed compressed air (e.g. instrument air from a compressed air network) from a pressure reducer to the MRF device; feed pressure: 1.0 ... 1.5 bar.

► Connect the compressed air supply to the free compressed air connection of the back-flush filter (screw fitting).

4.7 Purge gas feed for the pressurized enclosure

Only valid for devices with pressurized enclosure (version for potentially explosive atmospheres).

Device versions for potentially explosive atmospheres (→ page 26, §2.3.3) have an attachment to the pressurized enclosure. The pressurized enclosure must have a permanent supply of purge gas. – Installation information see:

- ► Individual technical device documentation
- ► Operating Instructions of the control unit of the pressurized enclosure

The housing must be completely closed when operating with a pressurized enclosure otherwise the pressurized enclosure does not function.

- ► Seal the cable glands spray-water tight and gas-tight when the cable installation has been completed. Seal unused cable glands properly (→ page 63, §).
- ► Seal other housing openings (if present) spray-water tight and gas-tight.
- ► Close the housing doors properly.

4.8 Cable installation in potentially explosive atmospheres

Valid only for potentially explosive atmospheres.

Proper use of cable glands

WARNING: Risk of explosions through improper use of cable glands

If the TOCOR700 is used in a potentially explosive atmosphere:

- ► Only use connection cables with outer diameters that match the cable glands.[1]
- ► Seal all cable glands “vapor-tight” (almost gas-tight) before start-up.
- ► Either seal unused cable glands with sealing plugs[2] or replace the cable glands with closing caps.
- ► Do not replace existing cable glands with other types of cable glands.[3]

1 See individual technical device documentation. Standard: Cable outer diameter = 7 ... 12 mm.

2 Install sealing plugs that must match the allowable cable diameter instead of a cable.

3 The cable glands could possibly be subject of the certification (see the individual technical device documentation).

Proper cable laying

- ► Fit all cables “fixed”, i.e. fasten cables along the whole length.

4.9 Mains connection

4.9.1 Safety information for mains connection

General electrical safety

CAUTION: Health risk

The electrical safety is only guaranteed when a working protective conductor connection has been made.

- ► Only connect the TOCOR700 to a mains supply which has a functioning protective conductor (PE, protective earth).
- ► Only start-up the TOCOR700 when a correct protective conductor connection exists.
- ► Never interrupt the protective conductor connection (yellow-green cable) inside or outside the TOCOR700, such interruptions may make the TOCOR700 dangerous.

CAUTION: Damage or malfunction by wrong power supply

The mains voltage must match the data shown on the TOCOR700 type plate, and the power supply voltage must match the TOCOR700 mains voltage setting.

- – The TOCOR700 can severely be damaged or destroyed when the mains voltage is too high. The TOCOR700 can be dangerous when operated in such a damaged condition.
- – The TOCOR700 will not function correctly when the mains voltage is too low.

Safety in potentially explosive atmospheres

WARNING: Risk of explosions when the potential equalization is missing

- ► Connect the potential equalization connection (on the outside of the housing) to the same electrical potential as the protective conductor connection PE.

WARNING: Risk of explosions when cables are not installed properly

- ► Observe the information on correct cable installation (→ page 63, § 4.8).

4.9.2 Connect the power cable

1 Make sure the TOCOR700 is set to the correct mains voltage (→ page 64, § 4.9.1).

2 Connect the power cable

- ► Lead the power cable into the main switch housing.
- ► Connect the cable to the power connection terminal of the main switch (PE = protective earth, N = neutral, L = live).
- ► Seal the cable ducts spray-water tight.

CAUTION: Safety defects through improper installation

- ► Seal unused cable ducts spray-water tight in a suitable manner, e.g. with sealing plugs.

Otherwise the specified degree of protection of the housing cannot be guaranteed.

3 *In potentially explosive atmospheres:* Connect the potential equalization connection PA (on the outer side of the housing) with the same electrical potential as for the protective conductor connection PE.

See the individual technical device documentation for detailed specifications of the mains connection.

4.10 Signal connections

4.10.1 Position of signal connections

Signal connection terminals in TOCOR700 UV

The signal connections are located inside the gas analyzer and are accessible from the front (→ page 67, Figure 22). To connect signal cables:

1 Open the electronic housing of the gas analyzer (→ page 30, Figure 5).

2 Lead the signal cable over the right housing side of the gas analyzer.

3 Lay the signal cable in the cable duct provided.

Signal connection terminals in TOCOR700 TH

The signal connections are located on the rear side of the gas analyzer → page 67, Figure 23). The gas analyzer is mounted in a swivable holder frame. To connect signal cables:

1 Loosen the locking mechanism of the swivel frame.

2 Swivel the swivel frame out carefully.

Individual signal connection terminals

The signal connections are available on a terminal strip on some device versions.

► Observe the individual technical device documentation (position of the connection terminals, terminal assignment).

4.10.2 Plug-in connectors of gas analyzer connection terminals

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

Each plug connector on the gas analyzer has one blocked recess as a mechanical code for the connection.

► The matching edge on the plug connector counterpart must be removed (→ Figure 21 and → Table 2).

Figure 21 Plug-in connectors of the signal connection terminals of the gas analyzer

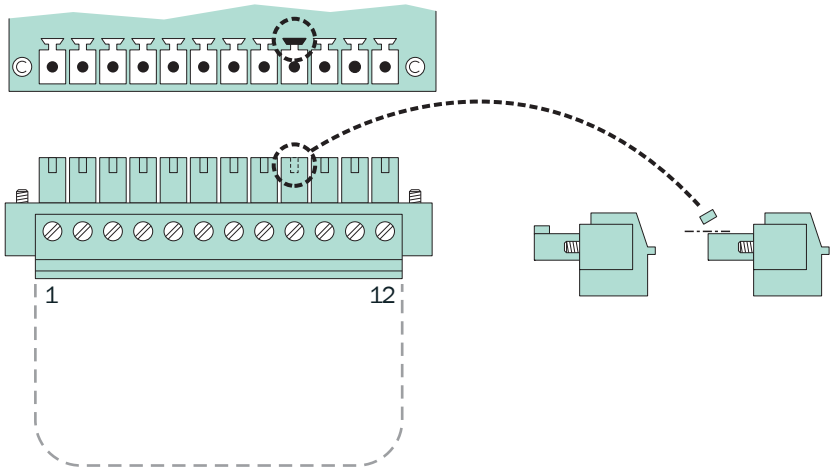


Table 2 Mechanical coding of the plug connectors

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

Figure 22 Connection terminals in the TOCOR700 UV gas analyzer

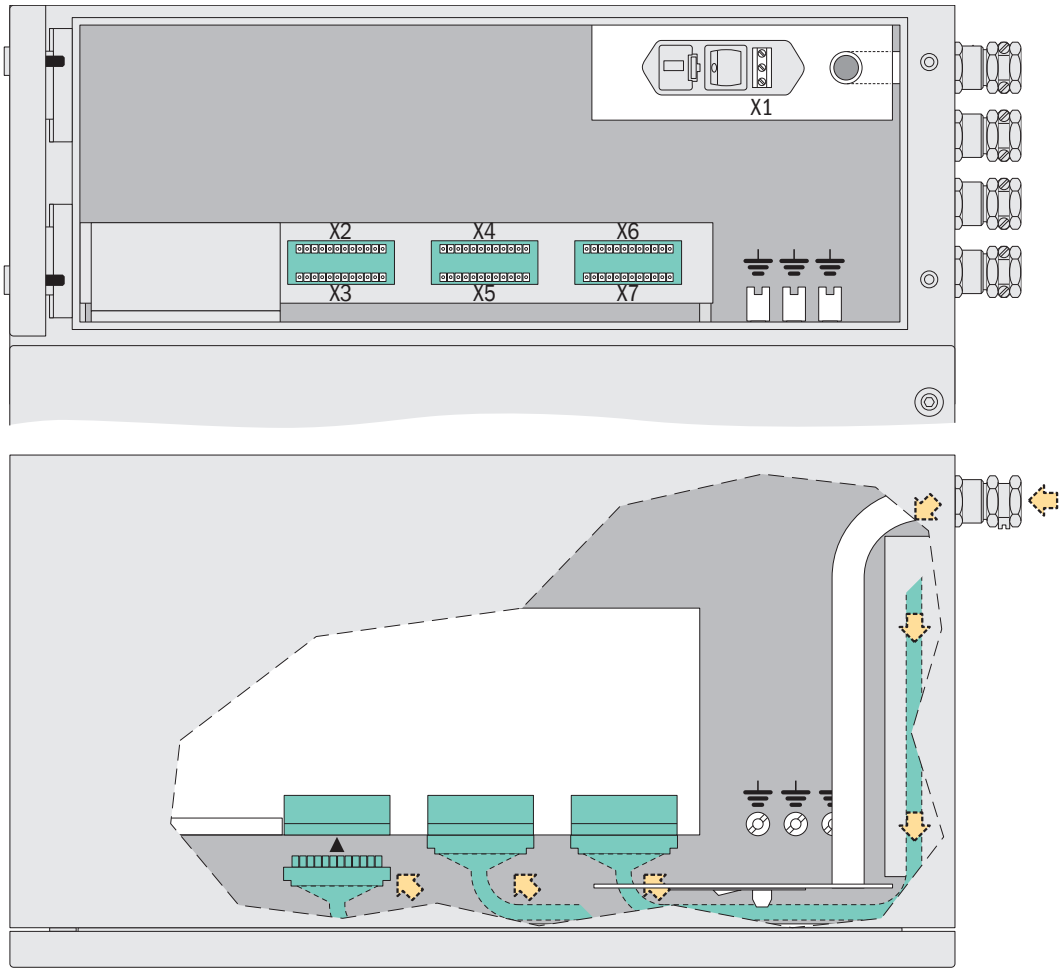
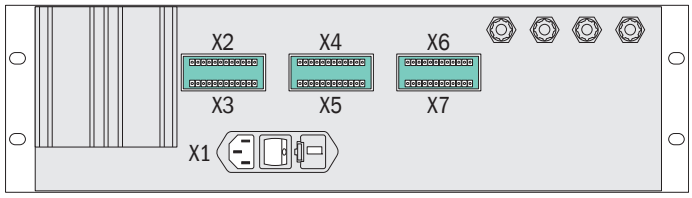


Figure 23 Connections terminals in the TOCOR700 TH gas analyzer



4.10.3 Outputs for signal voltage (auxiliary voltage)

An auxiliary voltage of 24 VDC is available on the “24V1” and “24V2” connections. This can be used as voltage supply for external low-powered devices (for example, relays).

A common internal voltage source supplies both outputs; the allowable amperage is 1 A (24V1 + 24V2). An internal fusible cutout protects against overloads (→ page 251, § 17.10.1).

4.11 Safety information on signal connections

4.11.1 Installation free of voltage

► *Before making signal connections on the TOCOR700: Switch the* TOCOR700 and all connected equipment *free of voltage* (i.e. switch off).

► This also applies when connecting plug connections.

Otherwise incorrect electrical voltages could damage the internal electronics. The mechanical coding on the plug connections can prevent wrong counterparts being fitted, but it does not prevent electrical contact to some connector contacts during an incorrect connection attempt.

Electrostatic voltage can destroy electronic components. Lead off electrostatic charges before these make contact with the internal electronics.

► Earth your body and any tools used before touching electrical connections or internal components.
  - Touch a bare metal surface that is connected to the protective conductor has safe contact to ground (e.g. heating, water pipe).
  - Or when the mains connection is made: Touch a bare metal piece of the housing.

4.11.2 Allowable load

- *Highest allowable peak voltage on digital interfaces:* ±15 V [1]
- *Highest allowable voltage on optical coupler inputs:*
  - Control voltage: ±24 VDC
  - Peak voltage: 48 V
- *Highest allowable peak voltage* on all other signal connections: ±48 V (peak). *Attention:* Higher peak voltages (even short “peaks”) can destroy internal components.
- *Highest allowable load* per relay switch contact:
  - 30 VAC effective AC voltage
  - 48 VDC DC voltage
  - 500 mA effective current
- *Inductive loads* (e.g. relays, solenoid valves) require special protective measures (→ page 69, § 4.11.5).

1 All voltage values referenced to GND/housing

4.11.3 Signal voltages in potentially explosive atmospheres

Valid only for devices in potentially explosive atmospheres.

WARNING: Possible hazard through external voltage sources

► Do not connect external voltages (“separate source voltages”) directly to the signal connections of the TOCOR700.

► Only connect external voltage sources to the TOCOR700 via external separation equipment (relays) that separates external voltages from the TOCOR700 as soon as the housing flushing fails.

Otherwise the TOCOR700 can become dangerous when the housing flushing fails.

4.11.4 Suitable signal cables

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

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

4.11.5 Protection against induced voltages

Internal EMC filters

An EMC filter is fitted between the internal electronics and each TOCOR700 signal connection. These internal EMC filters must be protected against overvoltages.

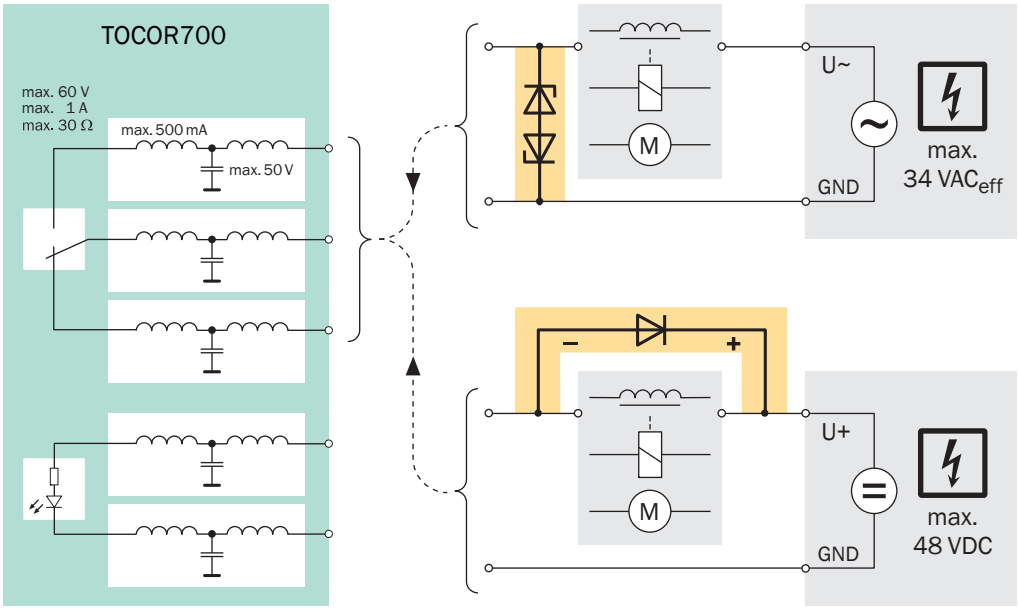
Risks caused by inductive loads

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

Protective measures

► *If the connected devices can create induced voltages and are not fitted with discharging diodes:* Install one or two “discharging diodes” on each inductive load to discharge any induced voltages (→ Figure 24).
Otherwise internal EMC filters can be destroyed, which will make the entire internal electronics board unusable.

Figure 24 Protection against induced voltages



4.12 Measured value outputs

Function

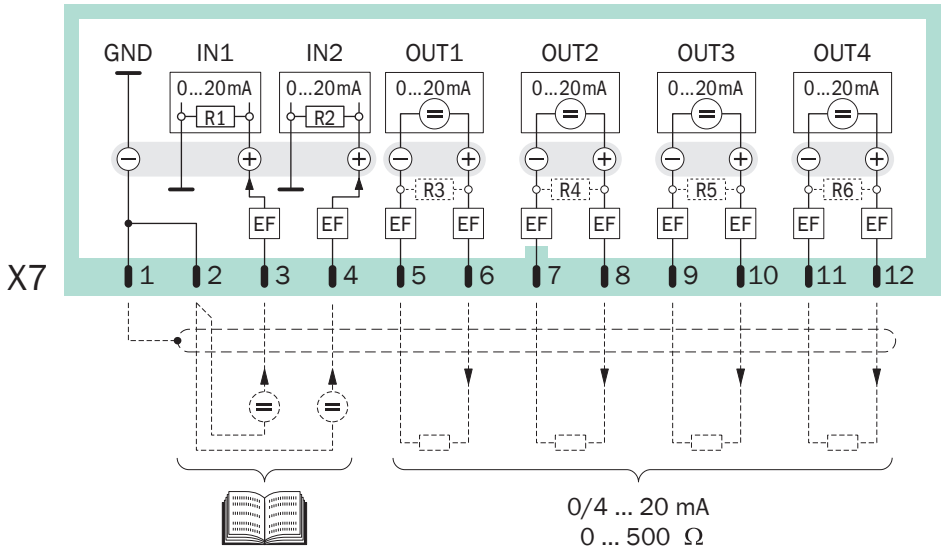
The gas analyzer has four measured value outputs which can be used to output the measured values of the measurement components (OUT1 ... OUT4 → Figure 25).

- *Continuous measurement without sample point switchover (standard):* The measured value is output via the OUT1 measured value output. The last measured value is output constantly during a calibration (sample-and-hold amplifier function).
- *Continuous measurement with sample point switchover (option):* Each sample point is assigned to one measured value output (OUT1 ... OUT4).
  - The associated measured value output shows the current measured value whilst a certain sample point is measured. In the meantime, the remaining measured value outputs retain the last measured value for the associated sample point.
  - During a calibration, all measured value outputs show the last value measured on the associated sample point (sample-and-hold amplifier function).
- *Function during calibration:* Serves to select whether the measured value outputs should show the test values or the last measured value during a calibration (→ page 115, § 8.8.7).
- *Function in "Single sample" mode:* The measured value outputs function the same as during a calibration in "Single sample" mode (option → page 100, § 7.4.8).
- *Output ranges:* Each measured value output can signal a measured value in two different output ranges (setting → page 113, § 8.8.3; selecting the current output range → page 114, § 8.8.5). The active output range can be signaled by a status output (→ page 118, § 8.9.4).
- *Quasi-continuous functionality:* The digital measured value processing updates the measured value in approx. 0.5 second intervals.
- *Damping:* Serves to "smooth out" the measured value trend (→ page 107, § 8.5.1).
- *Behavior at zero point:* Serves to influence how measured value outputs react to the starting value of the measuring range (→ page 109, § 8.5.3). For example, to prevent negative measured values from being displayed.

Electrical signal

- The measured value outputs are galvanically isolated (electrically isolated). Do not connect the minus pole to the ground (⊥) otherwise the electrical isolation is neutralized.
- The electrical measurement span can be set to 0 ... 20 / 2 ... 20 / 4 ... 20 mA (individually for each measured value output → page 115, § 8.8.6). Standard factory setting: 4 ... 20 mA.
- Allowable load resistance: 0 ... 500 Ω .
- Negative output signals are not available.

Figure 25 Plug connector X7 (analog inputs, measured value outputs)



4.13 Analog inputs

Function

The TOCOR700 has two inputs for external analog signals (→ page 71, Figure 25):

- The FIA flow sensor is connected to IN1 (function → page 136, §8.14.3).
- IN2 is only used for special versions (see the individual technical device documentation).

Information on using the analog inputs also contain the internal configuration data (print output → page 125, §8.10.6).

Electrical signal

- *Input signal:* Set at the factory to voltage signal 0 ... 2 V or current signal 0 ... 20 mA (selectable). The internal resistance is 100 Ω (standard value for R1 and R2). R1 and R2 can be removed when the internal resistance is too small for a voltage signal.
- *Highest allowable signal:* 3 V resp. 30 mA. If this value is exceeded, then the message `FAULT: mA/V input` is displayed.
- The analog inputs are *not* galvanically isolated (the minus pole is GND).

4.14 Switching outputs

You can test each signal connection individually without setting or changing any of the gas analyzer functions (→ page 144, §8.18). This allows you, for example, to check the external wiring.

4.14.1 Switching functions

The TOCOR700 has 16 switching outputs for use as follows:

- The switch contacts REL1, REL2 and REL3 are used for basic status messages (details → page 118, §8.9.4). 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 switching functions are available and how the desired assignment are made is described in §8.9 (→ page 117).
  - A list of all the available switching functions is shown in §16.2 (→ page 239). You may want to use this Table to record your assignments.

4.14.2 Electrical function

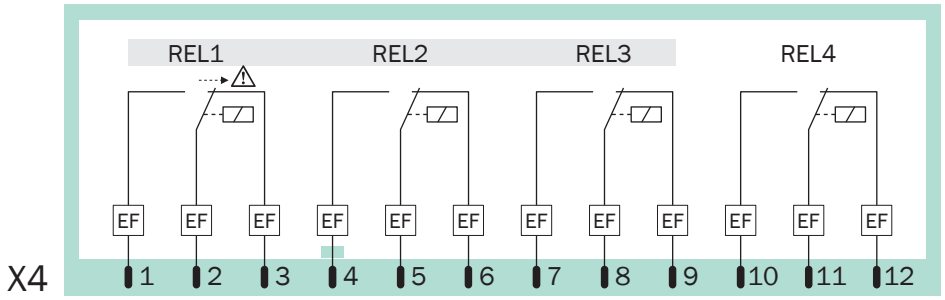
- Switching outputs REL1 ... REL8 are galvanically isolated switch contacts (→ page 73, Figure 26 and → page 73, Figure 27).
- Switching outputs TR1 ... TR8 are transistor outputs (→ page 74, Figure 28) which can be used to switch an external load. For this purpose, the auxiliary voltage output must be used for power supply (→ page 67, §4.10.3).
- The switching outputs can be set to work according to the open-circuit or closed-circuit principle (→ page 117, §8.9.2).

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 electromechanical relays each. Make sure these are then 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.

4.14.3 Connection contacts on the gas analyzer

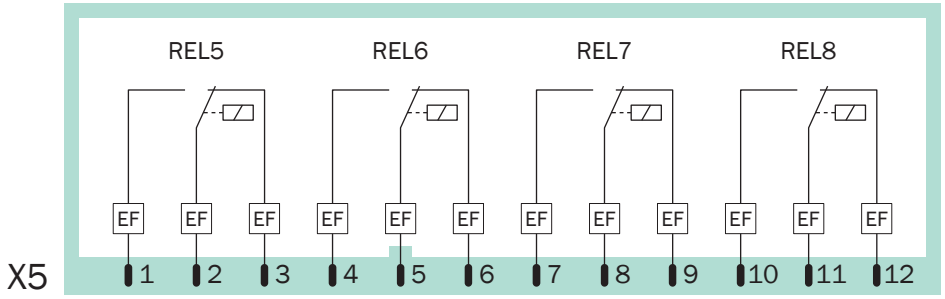
Figure 26 Plug-in connector X4 of the gas analyzer (relay switching outputs)



NOTICE:

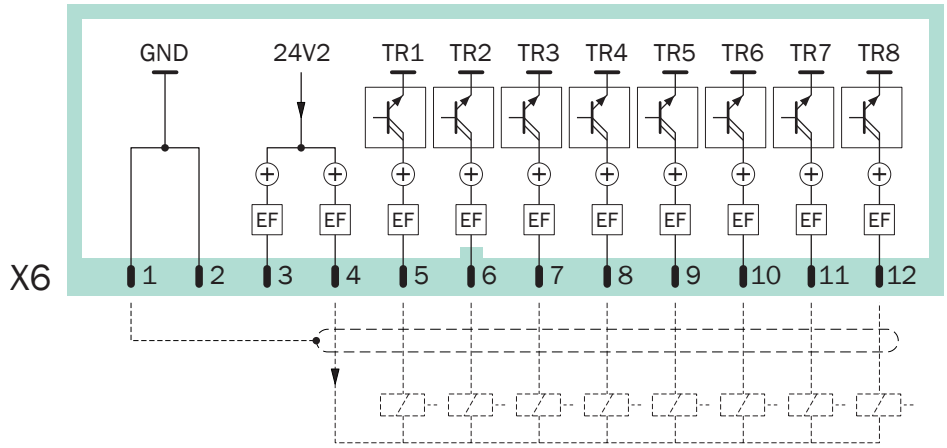
- Observe the maximum contact load (→ page 68, § 4.11.2).
- Keep any voltage greater than 48 V (even fast peaks) away from the signal connections (→ page 68, § 4.11.2).
- When connecting inductive loads (for example, relays or solenoid valves), make sure that discharging diodes are installed (→ page 69, § 4.11.5).

Figure 27 Plug-in connector X5 of the gas analyzer (relay switching outputs)



- Observe the same notes as for plug-in connector X4 (→ Figure 26).

Figure 28 Plug-in connector X6 of the gas analyzer (transistor switching outputs)

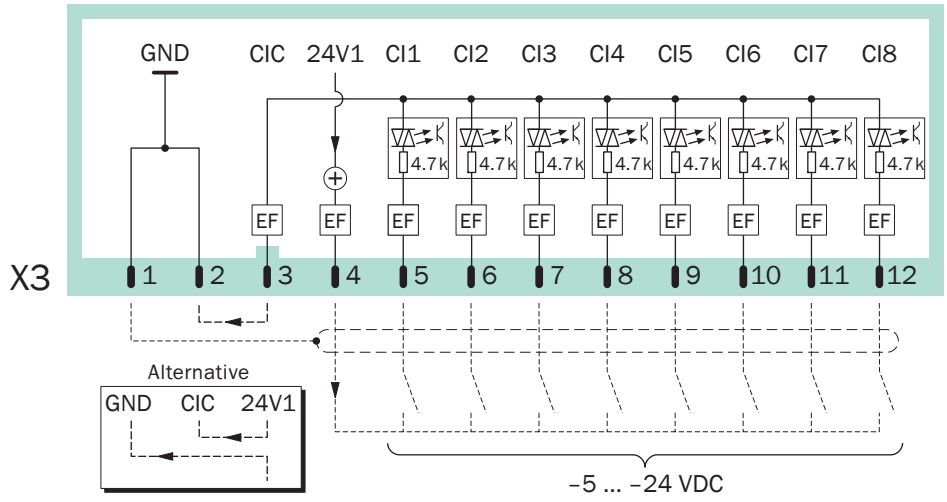


NOTICE:

- To power these switches, use the internal auxiliary voltage source only (24 VDC → page 67, § 4.10.3).
- Observe the highest permitted load (maximum rating):
  - For one single transistor output: ≤ 500 mA (corresponds to ≤ 12 W /external load resistance ≥ 48 Ω)
  - For the total of all 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 69, § 4.11.5).

Figure 29 Plug-in connector X3 of the gas analyzer (control inputs)



NOTICE:

Ä Do not supply more than ±24 VDC for the control voltage.

Ä Do not exceed the maximum peak voltage: 48 V (peak)

Higher voltages could severely damage components. In addition, the safe separation of functional voltages would no longer be guaranteed.

4.15 Control inputs

4.15.1 Available control functions

The TOCOR700 has 8 control inputs. Each of the control inputs can be freely assigned to any of the possible control functions (→ page 120, §8.10).

A list of all the available control functions is shown in §16.4 (→ page 241). You may want to use this Table to record your assignments.

4.15.2 Electrical function

Control inputs CI1 ... CI8 are optical coupler inputs (→ page 74, Figure 29).

- *Activation:* The logical function of a signal input is activated when current flows between the control input connection and the common pole of the control inputs (CIC).
- *Control voltage:* ±5 ... ±24 VDC. Either an external voltage source or the internal auxiliary voltage can be used (24 VDC → page 67, §4.10.3).
- *Polarity:* The optical coupler inputs are bipolar which means they can be activated selectively with either positive or negative voltage. – Figure 29 shows both alternatives when using an internal auxiliary voltage: The common pole (CIC) is connected either to GND (negative) or to 24V1 (positive).
- *Galvanic separation:* The connections of the optical coupler inlets are electrically isolated, i.e. separated galvanically from the remaining TOCOR700 electronics. However, the galvanic isolation is neutralized as soon as one of the connections is connected to another non-isolated contact of the TOCOR700 (e.g. GND or 24V1).
- *Internal resistance:* 4.7 kΩ per control input.
- *External switch:* Mechanical switching contact or open collector output.

NOTICE:

Ä Do not feed voltages greater than 24 V to control inputs.

Otherwise internal components could be damaged and safe separation of functional voltages is no longer guaranteed.

CAUTION: Risk in potentially explosive atmospheres

When used in potentially explosive atmospheres:

► Use the internal voltage outputs (24V1, 24V2) as control voltage for the control inputs.

Ä Do not connect the control inputs with external voltage sources.

Otherwise the explosion protection is no longer ensured.

You can test the current condition of each individual control input (→ page 141, §8.16.7). This allows you, for example, to check the wiring of the connections.

4.16 Digital Interfaces

4.16.1 Function of the interfaces

- The TOCOR700 digital interfaces are serial interfaces (RS232C/V.24).
- Interface #1 can serve to use a remote control: The TOCOR700 receives commands and sends measurement readings and status messages via the interface on command. This feature is available in operation
  - with the MARC2000 software (→ page 173, § 10)
  - with the option “Limited AK protocol” (information → page 180, § 10.4)
  - with the Modbus remote control functions (→ page 181, § 11).
- Interface #2 is used to send measuring and calibration data and status messages.

4.16.2 Connecting the interfaces

To use one of the interfaces:

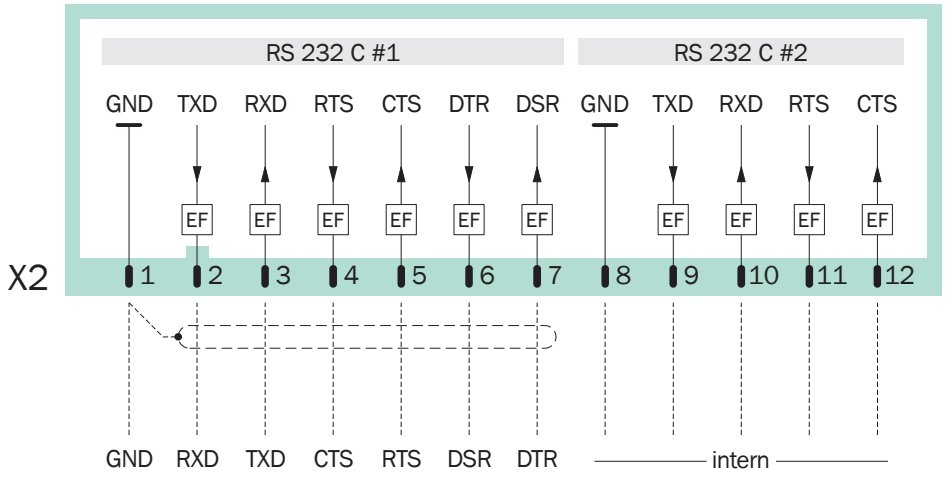
1 Connect the external device to the relevant interface of the TOCOR700 (→ page 76, Figure 30; further information → page 175, § 10.2.1).

2 Set the interface parameters of the TOCOR700 and the external device so that these are identical (→ page 122, § 8.10.4).

3 *For interface #2:* Select whether the TOCOR700 should output certain data automatically (→ page 123, § 8.10.5).

- A serial interface can only work if the interface parameters of all connected devices are identical.
- A function is available to test the data output (→ page 144, § 8.18).

Figure 30 Plug-in connector X2 of the gas analyzer (interfaces)



NOTICE:
Maximum peak voltage on digital interfaces: ±15 V

TOCOR700

5 Start-up

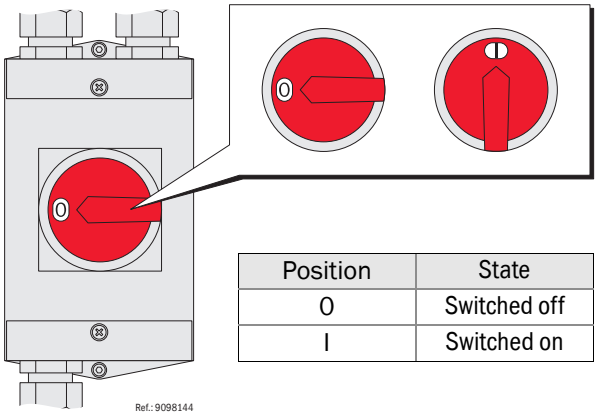
Main switch

Start-up procedure

5.1 Main switch

The main switch is located on the side of the housing.

Figure 31 Main switch



Position	State
0	Switched off
I	Switched on

► Do *not* just switch the main switch off to put out of operation but perform the proper procedure instead (→ page 230, § 14.1).

5.2 Start-up procedure

A) Check/prepare

1 Make sure the TOCOR700 is set to the correct mains voltage (see type plate).
2 Check whether all internal mains switches are switched on (those fitted).
3 Ensure the sample water feed is ready for operation.
4 Check the storage container for reagent, top up as necessary (→ page 47, § 3.4.2).
5 Make the storage container for calibration solution available.
6 Check the connections and operational readiness of additional equipment (e.g. back-flush filter).

B) Put housing flushing into operation/let pre-purging run

– only for devices with pressurized enclosure for potentially explosive atmospheres –

1 Start/check purge gas feed to the TOCOR700.
2 Switch control unit on.
3 Monitor the pre-purging phase progress on the control unit.

C) Switch on

1 Set the TOCOR700 main switch to “I”.

Automatic run-up procedures are executed after switching on. Display lamps and display are active when the device is switched on.

2 *On TOCOR700 TH:* Check the nominal value of the temperature controller for the thermal reactor. The correct nominal value is specified in the individual technical device documentation; standard value: 850 °C. Correct the setting when necessary.

- The switched on state can be seen when the display lamps and display of the gas analyzer are active.
- If the TOCOR700 does not start operation: Switch the main switch off again; information on clearing malfunctions → page 215, § 13.2.1.

Automatically controlled run-up procedure:
The internal subassemblies start operation automatically in sequence after switching on. Here, each subassembly is first activated after the prior subassembly has satisfied the operating conditions. Priority sequence:

1 Gas analyzer, control functions via interface
2 Reactor temperature, reactor function
3 Gas flow
4 Sample water pump

D) Start-up the measuring system

The TOCOR700 reaches constant operating conditions during the start-up time (temperatures, filling levels, pump capacity). During the start-up time:

1 Feed zero water instead of sample water.
Possible methods:
– Immerse the sample feed hose in a container with zero water.
– Activate `single sample` (option → page 100, § 7.4.8) and feed zero water via the single sample connection.
2 Check/monitor function of hose pumps.
3 Wait for the start-up time to end:

Subassembly/subassemblies	Start-up time	Criterion for end of the start-up time
Carrier gas flow	< 1 minute	Constant, steady volume flow
Gas cooler	Approx. 10 minutes	Steady operation display
Gas analyzer	Approx. 1 hour	"Function" goes on, green
Thermal reactor[1]	Approx. 5 hours	
Water analysis system	1 ... 6 hours[2]	Constant, steady measured values when feeding zero water

1 Valid only for TOCOR700 TH
2 For sensitive measuring ranges: Up to 24 hours

► *Recommendation:* Perform a leak tightness test after longer downtimes (→ page 219, § 13.5).

E) Calibrate

► Perform a calibration after the start-up time (→ page 147, § 9).

CAUTION: Risk of incorrect measurements
Perform a new calibration whenever:
► The TOCOR700 was out of operation for a longer period (> 14 days)
► Changes have been made to the TOCOR700 (e.g. components replaced)
► Installations in the sample water line have been modified
► After the TOCOR700 has been transported.
Otherwise the TOCOR700 will not deliver correct measured values.

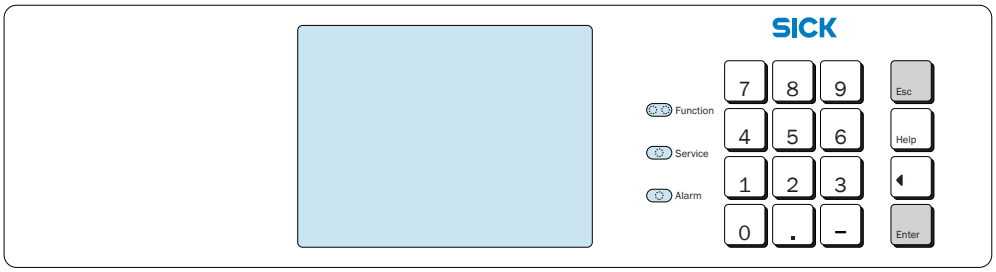
► *Recommendation:* Record measured values with a chart recorder (connect to a measured value output → page 70, § 4.12).
► *When the current measured values are used to detect limit values:* Take the reaction time into account.
► *To avoid erroneous measurements and device failure:* Pay careful attention to the maintenance information (→ page 194, § 12.1).
► Take into account that measuring operation is temporarily suspended during calibrations (approx. 15 ... 30 minutes).

TOCOR700

6 Operation (General)

Main switch
LEDs (signal lamps)
Using the menu system

Figure 32 Operating and display elements on the gas analyzer



6.1 LEDs on the gas analyzer

Function (green/red)

- A *green* light indicates the TOCOR700 is ready for operation and can perform the measuring function.
- A *red* light indicates that the TOCOR700 is not ready for operation. Possible causes:
  - The operating temperature is not reached yet after switching on.
  - The TOCOR700 has detected an internal fault (e.g. defective electronics)
  - The measuring function is interrupted (for example, sample gas volume flow or internal temperature too low).

  Function “red” corresponds to the status output “Failure” (→ page 118, §8.9.4). In most cases, the reason for a malfunction is shown on the display (→ §6.2).

Service (yellow)

If the “Service” LED goes on during normal measuring operation, a problem is developing. The measuring function is not (yet) affected by this problem but a service technician should fix the problem soon. – In these cases, the “Service” LED corresponds to the status output “Malfunction” (→ page 118, §8.9.4).

The “Service” LED is also on

- when a calibration is running (+ a certain time afterwards → page 160, §9.5.7)
- when the menu branch `Service` is in use (→ page 88, §7.1)
- as long as the maintenance signal is activated (→ page 101, §7.6).

Alarm (red)

Goes on when at least one measured value exceeds a set limit value. In addition, the following message appears on the display (example):

`CO2 > 250.00 ppm`

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

- Setting alarm limit values → page 110, §8.6.1
- Setting related switching outputs (→ page 117, §8.9)

6.2 Status messages on the display

The TOCOR700 shows a message on the second to last display line:

- When an internal limit value is exceeded (`SERVICE: ...`)
- When a faulty condition or a malfunction is detected (`FAULT:`
- When an operational state exists which affects the measuring function.

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 using the `Status/Faults` menu (→ page 92, § 7.3.1).

- Example of a status line → page 83, § 6.3
- Explanation on status messages → page 221, § 13.6.

6.3 Principle of operation

6.3.1 Function selection

- For function selection, the display shows various “menus” with several selection options. The starting point is the `main menu` (→ page 88, § 7.1).
- To select a particular function, press the related number key.
- Use the various menu functions to
  - enter parameters (for example, limit values for “Alarm” signals)
  - start routines (for example, calibration)
  - test device functions.
- If a measuring display was activated when the analyzer was switched off (→ page 89, § 7.2), this display will be reactivated automatically after the next switch on. Press the [Esc] key twice to switch to the `main menu`.

Some menu functions of the gas analyzer contain function steps involving selection of measurement components. Only the CO_2 measurement component is measured in the TOCOR700 (standard versions).

6.3.2 Display of menu functions (example)

Display	Operating step / notes
`instrument status 2`	← Selected function and menu number
`1 status/faults`	← These ...
`2 measuring ranges`	←
`3 meas.value outputs`	←
`4 alarm settings`	←
`5 instrument data`	←
`6 absolute drifts`	← are the selection options in this menu
`Enter digit`	← Operating information [1]
`heating up ...`	← Status message (example; → page 83, § 6.2)
`CO2 492.15 ppm`	← Current measured values [2]

1 The operating information shows how to navigate further (here: Press a number key). To cancel a function, use the [Esc] key.

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

6.3.3 Function keys

Apart from the number pad (digits from 0 to 9, decimal point, minus key), the TOCOR700 also has four function keys:

Key	Meaning	Function
	Escape	Ends the displayed function and returns to the preceding menu without changing the displayed instrument status. Pressing [Esc] several times leads back to the main menu.
	Help	Provides information on the menu or function 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 most of the input procedures, the currently stored value is shown after `Status`. Press [Enter] to save a new value after entering.
- The TOCOR700 can give a signal tone for each keypad click. The tone intensity is adjustable (→ page 98, § 7.4.4).
- The TOCOR700 continues determining measured values during menu operation. This is why the TOCOR700 may sometimes react a little slowly to a keypad click.

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

6.3.4 Menu levels

The TOCOR700 menu functions are split into 4 “menu levels”:

- Standard functions
- Expert functions
- Hidden expert functions
- Factory settings

Standard functions

These are categorized as the operating functions necessary for routine operations of the TOCOR700. This group of functions serves to:

– Check the instrument status on the display
– Activate a status output to signal that maintenance work is currently in progress
– Start or run a calibration

Description of these functions → page 87, § 7.

Expert functions

These serve to set device parameters and to test devices. They are only available after pressing a certain key (→ page 104, § 8.1). This group of functions serves to, for example:

– Set limit values for “Alarm” signaling
– Set communication parameters of the digital interface
– Setup the automatic calibration routine
– Enter nominal values for calibration liquids
– Test all inputs and outputs

Some advanced expert functions are located in a “hidden” menu branch which can be accessed via a special key code (→ page 104, § 8.1). This group of functions serves to, for example:

– Assign a switching function to each of the configurable signal connections
– Influence how measured value outputs work
– Save all the settings and restore previous settings

Description of the expert functions → page 103, § 8.

- 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 control input with the function “service lock” has been activated, many of the menu functions cannot be used (→ page 120, § 8.10.2).

Factory settings

In the “factory settings” menu, factory-trained technicians can change basic device settings. Access to this group of functions is not shown in the menus and access is only possible with a special code.

The factory settings are not described in these Operating Instructions.

6.4 Selection switch for thermal reactors

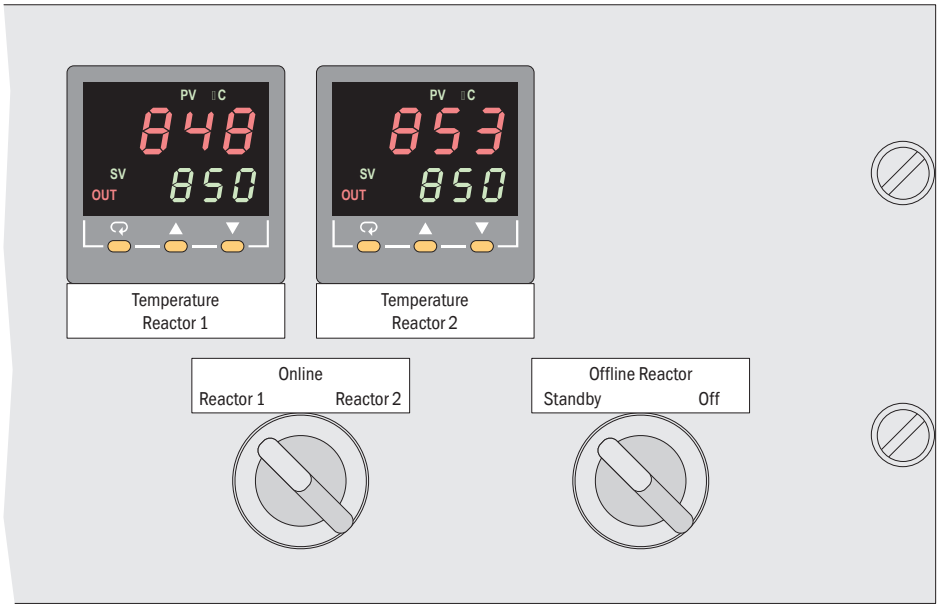
Only valid for the "TOCOR700 TH + 2nd reactor" device version.

- Selection switch "Online": Selects which reactor is used in measuring operation. This reactor is heated with a temperature controller. The other reactor is disconnected from the measuring system (offline).

Manual measures required for switchover → page 208, § 12.4.3

- Selection switch "Offline Reactor":
  - "Standby": Heating of the offline reactor active (temperature controlled).
  - "Off": Heating of the offline reactor switched off

Figure 33 TOCOR700 TH + 2nd reactor: Selection switch for reactors



The menu function "Reactor off/on" serves to switch the heating of both reactors off together (→ page 99, § 7.4.5). The reactor heatings are only in operation when they are switched on in *both* positions.

TOCOR700

7 Standard Menu Functions

Main menu
Measurement displays
Status indicators
Control functions
Maintenance signal

7.1 Main menu

main menu	
1 measuring display	← standard functions
2 instrument status	←
3 control	←
4 calibration	←
5 maintenance signal	←
6 settings	← expert functions (→ page 103, §8)
7 service	←
Enter digit	← operation prompt
no messages	← status messages
C 125 mg/l	← measured value

7.2 Measuring displays

7.2.1 Compact representation of measured values

Function

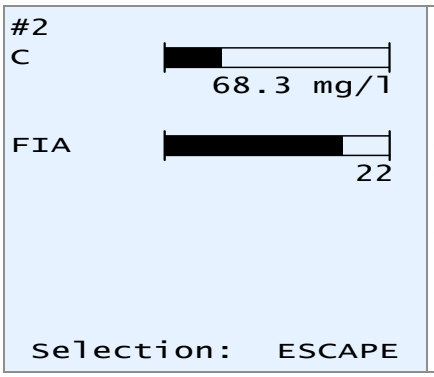
This function serves to display the measured value together with the current carrier gas volume flow (FIA measured value).

The FIA transmitter monitors the carrier gas volume flow on the gas outlet of the measuring system. (Limit value → page 136, § 8.14.3)

Call-up

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

The following appears on the display (example):



← current sample point [1]
← bargraph display [2]
← current measured value [3]

← bargraph and ...
← measured value of carrier gas volume flow [4]

[5]

► *To leave this display:* Press [Esc].

1 Only shown when the sample point selector is activated (option;→ page 142, § 8.17

2 Symbolizes the magnitude of current measured value, either in relation to the measuring range or to the output range (selection → page 106, § 8.4.2).

3 It is possible that measured values are displayed more accurately than the specified measuring precision (→ page 106, § 8.4.1).

4 The measured value originates from the FIA transmitter (flow meter) on the gas outlet of the gas analyzer. The measurement signal is passed through analog input IN1 of the gas analyzer.

5 Further measurement components may be available on special versions. It is then possible that a measurement component represents the measured values of another device or a value calculated from an external measurement signal (→ page 71, § 4.13).

- The display contrast is adjustable (→ page 98, § 7.4.3).
- When a measured value exceeds internal calculation limits, the TOCOR700 will display a malfunction message. – This warning can be disabled (→ page 111, § 8.6.2).

7.2.2 Large measured value display

Function

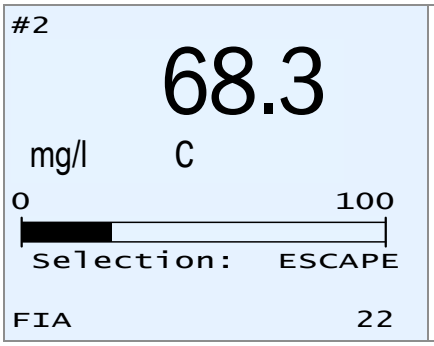
You can activate an especially large measured value display for each measurement component.

Call-up

1 `Select main menu → measuring display`

2 Select the desired measurement component.

ÿ The following should appear on the display (example):



← current sample point [1]

← current measured value [2]

← unit of measurement, measurement component

← physical measuring range end value [3]

← bargraph display [4]

← press [Esc] to leave this display.

← other measured values (shown sequentially)

1 Only shown when the sample point selector is activated (option;→ page 142, §8.17

2 It is possible that measured values are displayed more accurately than the specified measuring precision (→ page 106, §8.4.1).

3 The TOCOR700 delivers, within certain limits, measured values exceeding the maximum values, however, the measuring precision is not known.

4 Symbolizes the magnitude of current measured value, either in relation to the measuring range or to the output range (selection → page 106, §8.4.2).

7.2.3 Chart recorder simulation

Function

The TOCOR700 can graphically show the trend of the measured values, This functions the same way as on paper in a chart recorder: Current sample points appear at the top and “wander” slowly downwards. In this way you can continuously monitor the trend of the measured values. The time scale is adjustable from 1 to 32 hours. The value range corresponds to the current output range.

In addition, the analyzer can display the following values:

– FIA measurement signal (explanation → page 136, §8.14.3)

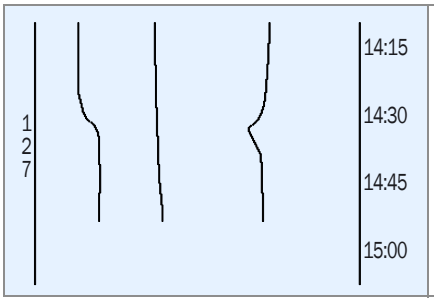
– Temperature inside the TOCOR700 (numerical display → page 139, §8.16.2)

– Sample gas pressure / atmospheric pressure (numerical display → page 139, §8.16.3)

Call-up

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

The display shows:



← Top: Current sample point [1]

← Bottom: Previous sample points

←

←

1 Beginning of the value range = left

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

2 Use the keypad to select which measured values should be displayed:

Key	Toggles the display for the ...
[1]	measured value of the measurement component assigned to measured value output OUT1
[2]	measured value of the measurement component assigned to measured value output OUT2 [1] [2]
[3]	measured value of the measurement component assigned to measured value output OUT3 [1] [2]
[4]	measured value of the measurement component assigned to measured value output OUT4 [1] [2]
[5]	measured value of the fifth meas. component (not assigned to any measured value output) [1]
[6]	internal gas analyzer temperature (0 ... 100 °C)
[7]	measured value of the pressure sensor in the gas analyzer (900 ... 1100 hPa)
[8]	FIA measurement signal (= signal of analog input IN1)
[9]	all values [1] ... [8]
[0]	no values

1 If available

2 If a measurement 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, try switching single values on and off.

4 *To leave this display:* Press [Esc].

7.3 Status displays

7.3.1 Display status/fault messages

Function

`Instrument status – status/fault` displays all current malfunction and status messages of the TOCOR700.

Call-up

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

`status/faults` `heating ...` `FAULT: Condensate` `Back : ESCAPE`	← The ... ← ← ← ← ← current status messages are shown here [1] ► *To leave this display:* Press [Esc].

1 Explanations (in alphabetic order) → page 221, § 13.6

7.3.2 Display measuring ranges

Function

Use the menu `device status – measuring ranges` to view physical measuring ranges. These settings can only be changed at the factory.

Call-up

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

2 Select the desired measurement component.

`measuring ranges` `C 0.0 mg/l` `to 100.0 mg/l` `Reference gas` `100.0 mg/l` `Back : ESCAPE`	← physical measuring range beginning value ← physical measuring range end value ← physical zero point of the related analyzer module ► *To leave this display:* Press [Esc].

- To display the output range of the measured value outputs → page 93, § 7.3.3
- To set output ranges → page 113, § 8.8.3

7.3.3 Display measured value outputs

Function

The `device status – meas. value outputs` display shows which measured values are output via the measured value outputs and which output ranges are set.

Call-up

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

2 Select the desired `meas. value output`.

`meas.value output 1`	← meas. value output number
`C`	← assigned measurement component
`4...20`	← electrical measurement span (output span)
`0.0 - 100.0 mg/l`	← physical meas. range of meas. component
`[1] 0.0 - 20.0`	← beginning and end value for output range 1
`Switch pt.: 20.0`	← switch point for autom. switchover range 1 → 2
`[2] 0.0 - 100.00`	← beginning and end value for output range 2
`Switch pt.: 18.0`	← switch point for autom. switchover range 2 →1
`active 2`	← current output range
`Back : ESCAPE`	► *To leave this display:* Press [Esc].

- Assignment of measurement components → page 112, §8.8.2
- To set output ranges → page 113, §8.8.3

7.3.4 Display alarm limit values

Function

The menu `instrument status – alarm settings` displays the settings of the alarm limit values (→ page 110, §8.6.1).

Call-up

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

`Alarm settings`	
`Meas. comp. ef value`	
`[1] C > 80.0`	← [...] = number of alarm limit value
`[2] C > 84.0`	← > = alarm is given above the limit value
`[3] C < 10.0`	← < = alarm is given below the limit value
`[4] Not in use !`	← this alarm limit value is not defined
`Back : ESCAPE`	► *To leave this display:* Press [Esc].

7.3.5 Display instrument data

Function

The menu `instrument data` provides the following information:

- Individual device identification
- Electronic and software versions of the gas analyzer
- Measuring system type of gas analyzer

Call-up

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

`instrument data`	
`instrument name:`	
`TOCOR`	← stored instrument name
`serial no.:`	
`710123`	← serial number
`hardware version: 1`	← electronic board version fitted
`software version:1.06`	← software version installed
`sensor type 1-3`	
`UNOR`	← gas analyzer measuring system type
`-`	
`-`	
`Back : ESCAPE`	► *To leave this display:* Press [Esc].

7.3.6 Display drift values

Function

The “absolute drifts” do not represent the difference between the last two calibrations but the total drift change over several calibrations. A new summation of “absolute drifts” will be started

- after a drift reset (→ page 166, § 9.7)
- after a basic calibration (→ page 168, § 9.8.2).

- 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 devices where no “absolute drifts” appear before the first calibration has been made.

“Absolute drifts” relate to the displayed measured values (including linearization, drift compensation, etc.). Zero point drifts are related to the physical measurement span of the related analyzer module; sensitivity drifts are related to the nominal value of the test gas used during calibration. Information on calculation → page 164, § 9.6.

Call-up

► main menu → instrument status → absolute drifts.

absolute drifts zero-d. span-d. C 0.2% -2.3%	← “zero point drift” / “sensitivity drift” ← (example values) ← ←
Back : ESCAPE	► *To leave this display:* Press [Esc].

7.4 Control

Main menu → Control:

control 1 gas pump on/off 2 acknowledge 3 display contrast 4 keypad click 5 reactor 6 dosing pump M10 7 dosing pump M11 8 single sample Y03 9 dilution on/off Back : ESCAPE	 ← carrier gas pump on/off ← acknowledgement (switch off) for alarms ← optical display adjustment ← acoustic signal for keypad click ← reactor on/off ← 5-channel dosing pump on/off ← 1-channel pre-sampling pump on/off ← switch to “Single sample” mode ← dilution on/off

Some of the menu items are only available when the relevant device components are fitted in the TOCOR700.

7.4.1 Switching the gas pump on/off

Function

The carrier gas pump (→ page 118, §8.9.4) can be switched on and off per menu function. This function can be useful during maintenance and test work. The carrier gas pump must be switched on during operation.

The carrier gas pump will automatically remain switched off
- as long as the TOCOR700 has not reached its operating temperature
- as long as the fitted condensate sensor triggers.

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:* Enter [0] or [1] and press [Enter]. ► *To exit this function without any (more) changes*: Press [Esc]

This menu is not available when a “service lock” control input is setup and activated (→ page 118, §8.9.4).

7.4.2 Acknowledging alarms

Function

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

- Malfunction message of the condensate sensor
- “Alarm” messages when this characteristic is activated (→ page 110, §8.6.1)

Information on the “condensate” malfunction message

The gas analyzer reports `FAULT: Condensate` when water penetrates the gas line of the gas analyzer and when condensation occurs in the internal sample gas line.

It is possible that condensate is only present for a short time and the condensate sensor is “dry” again after a while. This malfunction should be checked in all cases because the measuring system of the gas analyzer can already have been damaged. This is why the gas analyzer does not switch the `FAULT: condensate` message off automatically even when the condensate sensor no longer signals the malfunction.

When the gas analyzer reports `FAULT: Condensate`*:*

► First locate and clear the cause of the malfunction (→ page 222).

► Then switch the malfunction message off.

Procedure

1 Select `main menu → control → acknowledge`.

Ý 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 3 Code letters for status messages which must 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

Analyzers with the “sample point selector” option (→ page 142, §8.17) will display these codes in a Table which represents the sample points. You can see which sample point has caused the status message.

To acknowledge a status message:

2 Enter the relevant code.

3 Press [Enter].

7.4.3 Setting the display contrast

Function

The contrast setting changes the readability of the LC display. Just try which setting is best for your location.

Setting

► Select `main menu → control → display contrast`.

`display contrast` `unit: value` `min. value: 0` `max. value: 9` `Status: 7` `Input : ■` `Back : ESCAPE`	► *To change the display contrast:* Select a number key. The display contrast will immediately change. ► *To save the new setting:* Press [Enter]. ► *To terminate the function:* Press [Esc].

This menu is not available when a “service lock” control input is setup and activated (→ page 118, §8.9.4).

7.4.4 Setting the keypad click

Function

The gas analyzer can acknowledge each keypad click with a signal tone. The tone duration can be set and influences the tone 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:* Enter the desired value and press [Enter]. ► *To terminate the function:* Press [Esc].

This menu is not available when a “service lock” control input is setup and activated (→ page 118, §8.9.4).

7.4.5 Switching reactor(s) on/off

Function

- On TOCOR700 UV: Switches the UV lamp of the reactor on/off.
- On TOCOR700 TH: Switches the reactor furnace on/off.
- On TOCOR700 TH + 2nd reactor: Switches the heating of both reactors on/off.

Ä Do not use this function on the TOCOR700 TH to cool the reactor down for maintenance purposes

► Change the temperature controller of the reactor to the respective value (“0 °C” resp. operating temperature) instead.

This is because the temperature controller changes the temperature “smoothly” (ramp function). This avoids thermal voltages that could damage the reactor.

- *When a control input is created with the “Reactor on” function:* The reactor is only switched on when this control input is activated (→ page 120, §8.10.2).
- The TOCOR700 TH + 2nd reactor also has a push-button to switch the reactor heating on and off (→ page 85, §6.3.4). The reactor heatings are only in operation when they are switched on in *both* positions.

Setting

► `Select main menu → control → reactor.`

`reactor` `selection: 0=OFF` `1=ON` `Status : ON` `Input : ■ OFF` `Save : ENTER` `Back : ESCAPE`	► *To change the status:* Enter the desired value and press [Enter]. ► *To terminate the function:* Press [Esc].

This menu is not available when a “service lock” control input is setup and activated (→ page 118, §8.9.4).

7.4.6 Switching the dosing pump on/off

Function

Switches the 5 channel dosing pump on/off. This means the dosing pump can be switched off temporarily for maintenance work.

Setting

1 `Select main menu → control → dosing pump M10.`
2 Set the same as for the `reactor` (→ §7.4.5).

7.4.7 Switching the pre-sampling pump on/off (dosing pump M11)

Function

Switches the pre-sampling pump (1 channel hose pump) on/off. This means the pre-sampling pump can be switched off temporarily for maintenance work.

Setting

1 `Select main menu → control → dosing pump M11`.
2 Set the same as for the `reactor` (→ § 7.4.5).

7.4.8 Switching single sample on/off

Function

This function activates measurement mode “Single sample”. In this mode, the TOCOR700 draws the sample water in via the “Single sample” connection instead of the “Sample” connection (→ page 61, § 4.4.2).

Setting

1 `Select main menu → control → single sample Y03`.
2 Set the same as for the `reactor` (→ page 99, § 7.4.5).

Information on measuring in “Single sample” mode

The capillary hose on the “Single sample” connection is made of PTFE (“Teflon”) and can be immersed directly into the sample containers.
For sensitive measurements:
► Flush the hose in a different container with distilled water before switching.
► Make sure grease and dust deposits are avoided.

The sample water must be fed so long until the measured values remain constant.
► First read off the measured value when the measured value display remains constant.

For sensitive measuring ranges and sample water containing particles:
The measured value display may possibly fluctuate around the actual measured value – the measured value therefore never remains constant.
Remedy options:
► Record the measured values with a chart recorder and determine the measured value from the recordings.
► Use damping (→ page 107, § 8.5.1 / page 108, § 8.5.2).

7.4.9 Switching dilution on/off (information)

`Dilution on/off` has no function at this time.

7.5 Calibration (information)

The `calibration` function serves to:

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

All these functions are explained in a separate Section (→ page 147, §9).

7.6 Maintenance signal

Function

The status output “Maintenance” (→ page 118, §8.9.4) can also be activated per menu function. This can be used as a signal message to an external connection to indicate that the TOCOR700 is not working in regular measuring operation because, e.g. maintenance is currently being carried out.

Setting

Display	Operating step / notes
`main menu` `1 measuring display` `2 instrument status` `3 control` `4 calibration` `5 maintenance signal`	**1** *If the* `main menu` *is not displayed:* Press [Esc] repeatedly until the `main menu` appears. **2** Select `maintenance signal`.
`maintenance signal` `Selection: 0=OFF` `1=ON` `Status : OFF` `Input : ■ OFF` `Save : ENTER` `Back : ESCAPE`	► *To change the status:* Enter “0” or “1” and press [Enter]. ► *To exit this function without any (more) changes:* Press [Esc].

- This menu is not available when a “service lock” control input is setup and activated. This menu function can also be interrupted/canceled by switching the “service lock” (→ page 120, §8.10.2).
- Do not forget to switch off the maintenance signal when it is no longer required.

TOCOR700

8 Expert Menu Functions

Adaptations
Analyzer configuration
Settings

8.1 Access to expert functions

Perform the following step to access the expert functions:

Display	Operating step / notes
Any menu	► Press [Esc] as often as required until the `main menu` is displayed.
`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 fade out the expert functions:* Press the decimal point key [.] again.

When you call up `settings` or `service`, a warning message is displayed:

► Read the warning message and react accordingly.

► Press [Enter] to proceed.

If a “service lock” control input is setup and activated, only the menu items `1` and `2` are available in the `main menu` (→ page 120, §8.10.2).

8.2 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 (→ §8.1).

2 Press the [9] key.

3 Enter as `code`: [7] [2] [7] [5] [Enter]

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

8.3 Local adaptation (localization)

8.3.1 Language

Function

The TOCOR700 can display the menus and “Help” information in various 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.

8.3.2 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.

Date

1 Call up menu 612 (`main menu → settings → clock → date`).
2 Enter the current date and press [Enter].

Summer time or standard time

1 Call up menu 613 (`main menu → settings → clock → std./ summer time`).
2 Select `std. time` or `summer time` and press [Enter].

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

Time format

The time can be displayed either in European 24-hour format (`00.00` to `23.59`) or 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 either in European format (day.month.year) or American format (month-day-year).

1 Call up menu 615 (`main menu → settings → clock → date format`).
2 Input the desired setting and press [Enter].

8.4 Measured values display

8.4.1 Number of decimal places

Function

A maximum of five characters can be used to display a measured value. The desired number of decimal places can be selected when measured values include decimal places. The selection range depends on the number format of the physical measuring range end value.

- If the measured value display includes 4 or 5 characters, the measured value display is more accurate than the real measuring precision. Moreover, the last digits of the measured value display might permanently fluctuate even when the measured value should be seen as constant (within the limits of the measuring precision/signal “noise”). This effect can be influenced with `damping` (→ page 107, § 8.5.1).
- Limiting the number of decimal places so that the measured value display only contains 2 or 3 digits may mean that slow measured value changes are not noticed in time.

Setting

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

8.4.2 Bargraph range

Function

Serves to select whether the “bargraph” measurement display (→ page 89, § 7.2) shows the physical measuring range or the current output range of the measured value output (→ page 114, § 8.8.5).

Setting

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

8.5 Influencing measured values

8.5.1 Damping (floating average computation)

Function

The TOCOR700 updates the measured value in about 0.5 second intervals. This intermittent functionality means small “leaps” can occur between single measured values.

If the actual TOC concentration fluctuates continually around an average value, this will produce differing measured values. However, only the average value is perhaps relevant.

You can reduce these effects by setting a “damping” value. When you set this, the TOCOR700 will not display the current measured values but, instead, averages of the current and previous measured values (floating averaging).

- The damping effects both the display and the measured value output signal.
- The damping is also effective during calibration.

- Increasing the damping value will probably increase the reaction time (90% time) of the gas analyzer.
- Reducing the damping can possibly increase the measuring “noise” of the measurement signal (measurement turbulence).
- The reaction time of a water analyzer also depends on physical factors (i.e. length of the sample water line, volume of upstream filter, etc.) and cannot be reduced freely.

“Dynamic damping” serves to compensate measured value fluctuations without increasing the reaction time of the gas analyzer significantly (→ page 108, § 8.5.2).

Setting

CAUTION: Risks for connected devices/systems

The measured values may change erratically when damping is changed during measuring operation.

► Make sure no danger arises in this case.

1 Call up menu 624 (`main menu → settings → measurement → damping`).
2 Select which measurement 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 set damping time constant.

► *When the damping has been set anew or increased:* Check whether the calibration measuring time needs to be adjusted (→ p. 161, § 9.5.8).

8.5.2 Dynamic damping

Function

In contrast to normal damping (→ page 107, §8.5.1), “dynamic damping” is deactivated automatically when the measured value of the gas analyzer changes rapidly and strongly. This allows “smoothing” continuous, *light* measured value fluctuations but *rapid* measured value changes are still displayed immediately.

This dynamic behavior is controlled with the reaction threshold: With dynamic damping, the gas analyzer continuously checks the difference between two consecutive measured values from the internal measured value processing; dynamic damping is then deactivated when the difference is larger than the reaction threshold. The result is:

- If the differences *continue* to be greater than the dynamical threshold (i.e. when measured values still change rapidly), the effect of dynamic damping effect fades out quickly and no longer influences the reaction time.
- As soon as the differences of the measured value remain below the dynamical threshold again (i.e. measured values only change slightly), the effect of dynamic damping will gradually come back into operation.

Functional features

- The dynamic threshold is always related to the measurement span of the current output range of the corresponding measured value output.
- Dynamic damping effects the measured value outputs and the displayed measured values.
- Dynamic damping is also effective during calibration.

Setting the time constant

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

Setting the dynamic threshold

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

CAUTION: Risk of wrong calibration

The calibration measuring time should be at least 150 ... 200 % of the set damping time constant.

► *When the damping has been set anew or increased:* Check whether the calibration measuring time needs to be adjusted (→ p. 161, §9.5.8).

8.5.3 Measured value suppression at the start of the measuring range

Function

In some application cases, it may be useful to display measured values close to the beginning value of the physical measuring range as " 0 " (resp. as measuring range beginning value). This simply "masks" measuring fluctuations at the zero point, e.g. to suppress the display of negative measured values or to "steady" connected controllers for very low measured values. A masked out range can be set above and below the physical beginning value.

Masked ranges are effective for all measured value displays concerned, i.e. for

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

CAUTION: Risk of undesired effects on connected locations

- *With measured value masks:* The measured value displayed does not usually match the actual measured value in masked out display ranges. As soon as the measured value leaves the masked range, the displayed measured values will suddenly change from the "masked" condition to the current measured value. A similar effect will happen in reverse direction. These effects should be considered when an external controller is connected.
- *Without measured value masks:* The measured value display follows the measurement signals consequently even at the start of the physical measuring range. Small *negative* measured values can also be displayed due to the limited measuring precision. (This does not apply to the analog measured value outputs which cannot produce negative signals.)

► Check the effect of measured value masks on connected locations.

Setting

1 Call up menu 692 (`main menu` → `settings` → [9] → [Code] → `meas. sign. window`).
2 Select the `meas. component` for which the 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).

8.6 Monitoring measured values

8.6.1 Alarm limit values

Function

Four limit values can be set to monitor measured values. The associated “Alarm” signal can be triggered when the measured value is above or below the limit value. You can also decide if the “Alarm” signal remains activated, even when the measured value is no longer beyond the limit value, until the “Alarm” signal is manually “acknowledged” (→ page 97, § 7.4.2).

When the measured value exceeds a set limit value

- The “Alarm” LED on the front of the gas analyzer goes on
- A message appears on the display, e.g. `CO2 > 250.00 ppm`
- the related “Alarm” status output is activated (→ page 118, § 8.9.4)

Call up main menu → instrument status → alarm settings for an overview of all alarm limit values set.

Setting

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

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

3 Enter the following settings:

`meas. component`	The measurement component for which the following settings will be valid
`Set point`	Limit value in physical (engineering) units
`effect`	`exceeds set pt.` = “Alarm” triggered when the measured value is above the `set point` `under set pt.` = “Alarm” triggered when the measured value is below the `set point` `off` = the limit value is deactivated (settings are kept but have no effect)
`acknowledge`	`off` = the “Alarm” message is deleted as soon as the measured value is no longer beyond the limit value. `on` = the “Alarm” signal will remain until the signal is manually “acknowledged” (→ page 97, § 7.4.2)

8.6.2 Overflow warnings

Function

The gas analyzer creates a malfunction message,

- when a measured value is larger than 120 % of the end value of the related physical measuring range;
- when an internal measurement signal exceeds the limits of the internal measured value processing.

Connected devices could consider this status message as a device failure In this case, the TOCOR700 would appear as if failed even though it is functioning perfectly and the real reason is the high measured values. Deactivate these automatic malfunction messages to avoid wrong interpretation.

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 malfunction message created when the measured value exceeds 120 % of the physical measuring range (measured value warning)
`no overflow alarm.`	... refers to the malfunction message created when the measured value exceeds the limits of the internal processing range (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

8.7 Configuration of calibrations (information)

Information on menu branch 63 (`main menu → settings → calibration`) can be found under §9.5 (→ page 156).

8.8 Configuration of measured value outputs

A measured value output must be assigned to a particular measurement component before you can make all the other associated settings for the measured value output.

8.8.1 Special function with the “Sample point selector” option

When the TOCOR700 has the “Sample point selector” option (→ page 142, §8.17):

- Each measured value output will automatically represent one of the sample points and constantly displays the last measured value of its assigned sample point as long as other sample points are measured (“sample-and-hold” function)
- Settings for measured value output 1 are automatically valid for the remaining measured value outputs; deviating settings for measured value outputs 2, 3 and 4 are not possible.

8.8.2 Assigning measured value outputs

Function

Measured values can be output on *several* meas. value outputs. This function serves to assign the desired measured value outputs.

Important: To change an existing assignment, first delete the remaining settings of the related measured value output. Otherwise the selection will have no effect.

Setting

1 *To change an existing assignment:* Delete all the settings for the related measured value output (→ page 116, §8.8.8).
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 measurement component from the available list.
The selected component is indicated by `>`.

8.8.3 Configuring output ranges

Function

The output ranges for the measured value outputs have been set as desired at the factory but can be modified.

With the option “second output range”, each measured 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 must be at least 10 % of the physical measuring range end value. This limitation is automatically set in the related setting menus.
- Both output ranges of a measured value output must 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 `Output range 1` or `output range 2` can be selected.

4 Set the following values:

`beginning value`	Physical beginning value for this output range
`end value`	Physical end value for this output range
`switch value`[1]	`switch-up value` = the measured value at which 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 measured value at which the analyzer should switch from output range 2 to output range 1. The `switch-down value` must be *smaller* than the `switch-up value`. Setup this value so that the difference between the `switch-up value` and the `switch-down value` is significantly larger than the specified measuring precision of the TOCOR700.

1 only for analyzers equipped with the option “second output range”

► Do not set identical switch values.
Otherwise the TOCOR700 would continuously switch between the output ranges when the measured value is at the switch value.

- Standard value for the difference in switch points: 2 % of the relevant physical measuring range.
- Set a greater difference between the switch values when fluctuating or “noisy” measured values can be expected.

8.8.4 Displaying of output ranges

To display the output ranges for each measured 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`.

8.8.5 Selecting output ranges

This function is only available with the "Second output range" option

Function

There are three options for output range selection for each measured value output:

- Fixed setting of desired output range
- Automatic range switching (switching points → page 113, §8.8.3)
- External control via a control input (→ page 120, §8.10.2)

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 numeric measured value display will not be effected by the output range selection.
- The bargraph display of the measured values can be set to represent either the physical measuring range or the current output range (→ page 106, §8.4.2).

8.8.6 Setting live zero/deactivating a measured value output

Function

Each measured value output can be set to output measured values within the range 0 ... 20 mA, 2 ... 20 mA or 4 ... 20 mA. When a “live zero” is set (2 mA or 4 mA), the electronic signal “0 mA” can be interpreted as a general device malfunction or electrical connection malfunction.

You can also deactivate each measured value output: The measured value output remains at “0 mA” in this case.

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 Set the desired electrical zero point for this measured value output or select `deac-tivated`.

> The electrical zero point is specified in `mA` here, corresponding to the electronic standard version. Your TOCOR700 can also have measured value outputs with other signal spans (e.g. 0 ... 10 V); related information can be found in the order or delivery documents.

8.8.7 Selecting the output mode during calibration

Function

During a calibration, measured value outputs can function in different ways:

a) Constant output of the measured value that was last measured before the calibration (in the last selected output range).
b) The measured value output outputs the measurement signals generated during calibration liquids feed – *Attention:* The measured value output shows “raw values” without any compensation in this mode. This allows recording calibration values in “raw condition” to determine the “absolute drifts”. The values shown on the display do not correspond with the signals of the measured value outputs in this case.

These settings are also valid in “Single sample” mode (→ page 100, § 7.4.8).

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 current calibration gas values (output range 2)
`hold meas. value`	Constant output of last measured value

8.8.8 Deleting the settings for a measured value output

Function

This menu allows to delete all the settings for a measured value output. After you have deleted the settings, the measured value output will constantly display 0 % (0 mA).

For a short-time shutoff of a measured value output, you can select "`no output`" in the live zero setting (→ page 115, § 8.8.6). In this way, all the other measured 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.`

8.9 Configuration of switching outputs

8.9.1 Functional principle

You can assign each of the configurable switching outputs (REL4 ... REL8 and TR1 ... TR8 → page 72, § 4.14) to one of the available control functions (→ page 118, § 8.9.4).

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

8.9.2 Control logic

Switching logic (make contact/break contact)

The relay switch contacts serve 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)

There are two options once a control function has been assigned to a switching output:

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

b) *Reversed switching logic (closed-circuit principle):* The switching output is activated electronically when the assigned switching function is *not* triggered. And, as long as the switching function is activated, the switching output is in the electronically inactive state (relay passive, transistor output blocks current).

8.9.3 Safety criteria

CAUTION: Risks for connected devices/systems

- ► Before using the switching outputs, clarify the safety-relevant consequences for the following operational malfunctions:
  - Power failure on the TOCOR700 (for example, local power failure or accidental switching-off or defective fuse)
  - Defect in the TOCOR700 (for example, defect of a switching output)
  - Interruption of the electrical connection
- ► Observe the switching method:
  - Switching outputs that operate according to the *open-circuit* principle will show the assigned function as being *non active* when a power failure occurs.
  - Switching outputs that operate according to 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 arise when a failure or defect occurs.

8.9.4 Available switching functions (overview & explanation)

Control signals

Function name	x	Function (when activated)
zero gas x	1 ... 2	Feed the relevant solution (liquid)
test gas x	1 ... 4	
sample gas		
extern pump		Activate external gas pump
switch on pt. x	1 ... 4	Activate sample point x (→ page 142, §8.17)
dosing pump M10		Activate dosing pump (M10)
dosing pump M11		Activate pre-sampling pump (M11)
single sample Y03		Activate single sample/test solution feed (solenoid valve Y03)
zero med. valve Y01		Activate zero solution feed (solenoid valve Y01)
meas. med. valve Y11		Activate measuring solution/sample water feed (solenoid valve Y11)
test med. valve Y03		Activate single sample/test solution feed (solenoid valve Y03)
back-flushing Y21		Activate gas line for back-flushing (solenoid valve Y21)
flush-gas pump		Activate gas pump for back-flushing (M02)
back-flush fil.SPT x	1 ... 4	Activate back-flush filter for SPT x
reactor E01 on		Activate reactor (E01)
dilution Y05		*No function*

Status signals

Function name	x	Meaning (when activated)
failure [1]		Internal fault or defect. "Function" light shines red and a "FAULT" message is displayed simultaneously (→ page 221, §13.6). *Attention:* This switching output is activated when *no* malfunction is present (closed-circuit principle).
service[2]		A calibration is running or the "maintenance signal" has been activated manually (→ page 101, §7.6), or a function in menu level 6 or 7 has been called up.[3] The "Service" LED goes on at the same time. – This function corresponds to the NAMUR status 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 TOCOR700 measuring function, however a technician should correct the problem as soon as possible.
alarm limit x	1 ... 4	Meas. value is smaller/greater than the alarm limit value (→ page 110, §8.6.1).
calibration active		Calibration is running.
auto. calibration		Automatic calibration is running.
range x switching	1 ... 4	Measured value output x works in output range 1.
meas value pt. x	1 ... 4	Current meas. values are related to sample point x (→ page 142, §8.17).[5]
FAILURE sensor 1	1	The gas analyzer is not ready for operation (explanation → page 221).
SERVICE sensor x	1 ... 3	The measured values are possibly erroneous (explanation → page 227).
CALIBR. sensor x	1 ... 3	Calibration is running with analyzer module x.
FAILURE extern x	1 ... 2	The signal on analog input INx (→ page 71, §4.13) is too high (over the tolerance limit) or the signal processing in the TOCOR700 is erroneous because internal processing limits are exceeded.The corresponding displayed measured value is unusable (probably wrong).
SERVICE extern x	1 ... 2	The signal on analog input INx (→ page 71, §4.13) is approaching the upper tolerance limit or the signal processing in the TOCOR700 is approaching an internal processing limit. The corresponding displayed measured value is still correct.
CALIBR. extern x	1 ... 2	A calibration is running with the measurement component which represents the measurement signal from analog input INx (→ page 71, §4.13).
flow sensor		The volume flow in the internal sample gas line is less than 50 % of the set limit value (→ page 135, §8.14.2).
condensate sensor		Condensate is present in the internal sample gas line of the TOCOR700 (corresponds to status message "FAULT Condensate" → page 222)

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

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

[3] Some of these menus will interrupt the TOCOR700 measuring function. That is why the status signal "Maintenance" is automatically activated when this menu level is accessed.

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

[5] After activating the next sample point, a "dead time" will run down before the new status is indicated (→ page 143, §8.17.3).

8.9.5 Assigning switching functions

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

2 Select a category:

Menu branch	Handles	Device / connection
`signal inputs`	Control inputs CI1 ... CI8	Gas analyzer / X3
`relay outputs`	Switching outputs REL4 ... REL8	Gas analyzer / X4, X5
`transistor outputs`	Switching outputs TR1 ... TR8	Gas analyzer / X6
`inputsmodule`	Control inputs I0 ... I7	RS232 module / X3
`sample p. select.`	Switching outputs A0a ... A3a, A0b ... A3b	RS232 module / X5
`transistor out.`	Switching outputs A0 ... A7	RS232 module / X4

3 Select the desired switching output.

4 Enter the code of the desired switching function. The codes can be found in the help information (press [Help]).

5 To reverse the switching function logic: Press [–] [Enter]. (In the display, reverse switching logic is symbolized with " `!` ").

Use the Table in §16.2 (→ page 239) for planning and documentation.

8.10 Configuration of status and control inputs

8.10.1 Functional principle

Each of the control inputs CI1 ... CI8 (→ page 75, §4.15) can be assigned to one of the available software control functions (→ §8.10.2).

8.10.2 Available control functions (overview & explanation)

Inputs for internal control functions

Function name	x	Function (when input 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 gas pump (if fitted and activated via menu function → page 96, § 7.4.1) is switched off.
output x	1 ... 4	Selects output range 1 for measured value output x (input deactivated = output range 2). *Attention:* Only effective as long as “External switching” is selected as measured value output (→ page 114, §8.8.5).
hold sample pt. x	1 ... 8	Sample point x is activated (→ page 142, §8.17). When several control inputs of this type are activated at the same time, the first sample point will be activated.[1] “switch off pt. x” has no influence.
switch off pt. x	1 ... 8	Sample point x skipped when automatic switching is active (→ page 142, §8.17). Can be activated for several sample points at the same time.[1]
no drifts		Drift compensation is deactivated (means that the measured values will be calculated on the basis of the last basic calibration). Applies to all displayed measured values and measured value outputs.
sample value held		“Freezes” all measured value outputs to the value current when this function is activated (“sample hold” function).
auto.cal. x start	1 ... 4	Automatic calibration x (→ page 156, §9.5) is started. This function is triggered when switching from deactivated to activated state; maintaining the activated state does not trigger any further calibrations. – These control functions can be deactivated (→ page 160, §9.5.6).
reactor on		Activate the reactor (purpose: Deactivate reactor automatically when safe operation is not ensured; e.g. when the fan fails, excessive temperature in housing)
validation		*No function* [in preparation: Activate “Single sample” (solenoid valve Y03)]
validation 1		*No function* [in preparation: Start automatic calibration 1 (→ page 156, §9.5)]
validation 2		*No function* [in preparation: Start automatic calibration 2]

[1] This has priority over internal automatic sample point selection (→ page 143, §8.17.3).

Inputs for internal status messages

Function name	x	Function (when input activated)
liquid leak B01		Liquid is leaking inside the device (conductivity sensor).
cooler E03		The gas cooler fitted is in operational state.
reactor E01		The reactor is in operational state (UV emission/operating temperature).
storage B11		Fill level warning for reagent container (option)
sample gas B05		Volume flow warning for internal sample gas flow (signal from a flow sensor with limit value alarm), as alternative for FIA transmitter
sample water B02		Volume flow warning for sample water (signal from a flow sensor with limit value alarm); replaces the “sample water limit value” (→ page 137, §8.15.3)
reactor on		Inner temperature monitoring for TOCOR700 TH Input activated = the inner temperature is below 45 ° C. Control signal “Reactor E01 on” is activated in this state (→ page 118, §8.9.4), i.e. the temperature control of the reactor is active (when not deactivated per menu function → page 99, § 7.4.5). The reactor heating is switched off automatically when the inner temperature is over 45 °C (input deactivated). The input signal originates from temperature sensor B53 (see the individual technical documentation).

- You can reverse the logic of each control function (→ page 121, §8.10.3).
- Use the Table in §16.4 (→ page 241) for planning and documentation.

Inputs for external status messages

Function name	x	Function (when input activated)
zero gas x fault	1 ... 2	If at least one of these inputs is activated, automatic calibrations will not be started, running calibrations will immediately be terminated, the “Service” LED is illuminated, and the switching output “fault” is activated. – For example, you could connect these inputs to devices which 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 messages. When the input is activated, the related status message is shown on the display (→ page 221, § 13.6) and transmitted via interface (→ page 123, § 8.10.5) and the related status output is activated (when setup → page 118, § 8.9.4).
Fault x		
Service x		

8.10.3 Assigning control functions

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

2 Select the desired control input.

3 Enter the code of the desired control function. You can find the codes in the help information menu (press the [Help] key).

4 To reverse the switching function logic: Press [–] [Enter]. (In the display, reverse switching logic is symbolized with “ ! ”).

- The Table in § 16.4 (→ page 241) contains a list of all the control functions. Use this Table to plan and note assignments.
- An overview of the programmed control inputs is displayed when you call up their current status (→ page 141, § 8.16.7).

8.10.4 Digital interface parameters

Function

These functions serve to setup the parameters of the serial interfaces (connection → page 76, § 4.16). Data communication only functions when the interface parameters of the connected devices are identical.

> Interface #2 is used internally to control the analyzer part.
> ► Do not change the settings for `serial interface #2`.

Setting

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

2 Select `serial inter. #1`.

3 Check/make the following settings:

`baud rate`	Data transfer speed of the interface. Select the highest value that the connected devices will allow. Standard setting: `9600`
`parity`	The parity bit (if used) monitors character transfers. 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`	This function determines which characters the TOCOR700 sends at the end of a 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 (TOCOR700) and receiving unit, via the interface connections RTS (Ready To Send) and CTS (Clear To Send). ► Observe the information on the RTS/CTS protocol when operating with BUS converters (→ page 175, § 10.2.1).
`XON/XOFF protocol`	The XON/XOFF protocol is a software handshake procedure where the TOCOR700 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 144, § 8.18).
- 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.

8.10.5 Automatic digital output of measured data

Function

Serves to select the data the TOCOR700 will automatically transmit via interface #1 (hardware information → page 76, § 4.16).

Settings

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

2 Activate or deactivate the desired data output:

`measuring values`	● Set the time interval for automatic periodical output of measured values by the TOCOR700 (`1` ... `600` seconds). ● Select `0` seconds to switch off measured value output.
`status messages`	`ON` = the TOCOR700 sends every status change with a corresponding text message (→ page 124).
`calib. results`	`ON` = after every calibration, the TOCOR700 sends the measured values of the test gases and the calculated calibration values.
`half hour average`	`ON` = on every full and half hour (controlled by the internal clock), the TOCOR700 sends the average of the measured values for all measurement components over the last 30 minutes.

Data output format

● *Measured values* (example)

```
#MS 18.01.00 13:46:06  #2: 68.3 mg/l C
```

```
#MS                          = header for measured value output
18.01.00 13:46:06            = actual date/time
#2                           = number of current sample point (option; → page 142, §8.17)
68.3 mg/l C  etc.            = measured value
```

● *Status messages* (example)

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

```
#AL                          = header for 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 124)
```

● *Calibration results* (example)

```
#Kx 18.01.00 13:43:10  SO2     100.00  101.37
#Ky …
```

```
#KN1 … #KN2                  = calibration data of zero water
#KP3 … #KP6                  = calibration data of calibration solution
18.01.00 13:43:10            = actual date/time
CO2                          = measurement component
200.00  201.37               = nominal value, measured value
```

```
#NE 18.01.00 13:46:00  mg/l C   -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 95, § 7.3.6)
```

● *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            = current date / time
19.51   125.44   203.52      = half hour value for measurement component 1 / 2 / 3
```

Possible status messages via interface #1

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
FAULT: pressure signal
FAULT: condensate
FAULT: fLow signal
SERVICE: flow
FAULT: flow
FAULT: zero gas 1
FAULT: zero gas 2

Message text
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: cal. cuvette
FAULT: internal voltages
FAILURE external message 1
FAILURE external message 2
Interruption ext. message 1
Interruption ext. message 2
Maintenance 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
FAILURE: sensor extern 1
FAILURE: sensor extern 2
CALIBRATION: sensor 1
CALIBRATION: sensor 2
CALIBRATION: sensor 3
CALIBRATION: sensor extern 1
CALIBRATION: sensor extern 2
FAULT: gas pump
SERVICE: gas pump
FAULT: flow
Liquid leak B01
FAULT: cooler E03
Reactor E01 on
FAULT: dosing pump M10
FAULT: dosing pump M11
FAULT: reactor E01 off
Sample water feed B02
sample gas B05
sample water limit value

8.10.6 Printing configuration data (output as text table)

Function

You can output the TOCOR700 configuration (= measuring parameters and settings) as a plain ASCII text Table to a printer via serial interface #1 or #2.

The data is divided into the `config.` and `config. 2` sections (→ Figure 34). The data are output in the selected menu language (exception: Output in English when Polish selected)

Making data backups → page 130, § 8.12

Call-up

1 Menu 71 (`main menu → service → internal signals`).

2 `print config.` or `print config. 2` can be selected (menu 714/ 715).

Figure 34 Data output for “print config.” and “print config. 2” (examples for a gas analyzer)

```
S 700 configuration from 17.12.02 13:16:21
==========================================

Program version     :  V. 1.26 from 17.12.2002
Device No.          :                710790   (79211)
Release date        :                  01.01.00
Instrument name     :                   S 710
Housing type        :                     710
Hardware version    :                       2
Language            :                 English

  options, hardware
Calibration cuvette  :                 OFF   (41117)
Internal pump        :               OFF   (79223)
Pressure sensor      :                ON   (79221)
Condensate sensor    :               ON   (79224)
Flow sensor :              ON   (79222)

  options, software
Remote control, AK :                 OFF   (79235)
Sample point selector  :             OFF   (79236)
Measurement components   :      SO2        CO        CO2        O2    Temp. C
2nd output range :         OFF       OFF       OFF       OFF       OFF
Range ratio > 10:1  :        OFF       OFF       OFF       OFF       OFF
Compensation        :         ON        ON        ON        ON        ON

Flow sensor         :                  20   (79222)
Gas pump on/off  :                   OFF   (31)
Pump capacity       :                  50   (651)
Step motor 0-Pt:                    93   (792481)
Step motor offset:                   144   (792482)
Lamp current    :                   590   (79246)
2 lamp sym.  :                   590   (79247)

Measurement components   :       SO2        CO       CO2        O2    Temp. C
Measurement compensation :         3         3         3         3         3
a                  : +0.000e+00 +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 +0.000e+00
c                  : +0.000e+00 +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 +0.000e+00
e                  : +0.000e+00 +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 +0.000e+00
SO2                :        OFF        No       OFF       OFF       OFF
CO                 :         No       OFF        No       OFF       OFF
CO2                :        OFF       OFF       OFF        No       OFF
O2                 :        OFF       OFF       OFF       OFF       OFF
Temp. C            :        OFF       OFF        No       OFF       OFF

Temp. corr.    :         ON        ON        ON        ON        ON
Physc. unit    :        ppm       Vol%      Vol%      Vol%
Phys. start value :       0.0       0.0000    0.000     0.000     0.00
Phys. end value   :    5000.0       5.0000   25.000    25.000   600.00
Reference gas     :       0.0       0.0000    0.000     0.000     0.00
Phase             :      70.0       70.0     246.0      70.0      70.0
Pressure coefficient :    1.079     0.684     1.477     1.090     0.000

Sensor plug    :      X 18      X 18      X 18      X 19   External 1
Sensor type    :     Multor    Multor    Multor  Oxor (DC)        ---
```

```
S 700 configuration 2 from 17.12.02 13:19:02
============================================

Program version     :  V. 1.26 from 17.12.2002
Device No.          :                710790   (79211)
Instrument name     :                   S 710

  options, software
Calib. results      :                    ON   (6443)
AK-ID active        :                   OFF   (6422)
Sample-and-hold amplifier   :                 0
Semi-continuous mode :                    0
Back-flush filter   :                     0
Dilution step       :                     0
AK-ID               :                    35   (6421)
Pressure gradient   :              0
Flow adjustment low :                 0
Flow adjustment high:                 0
Counter:                              0

Measured values          :                    0   (6441)
Status messages  :                     1   (6442)
El. connection:                    1   (6423)
Autom. answer :                  0   (642411)
Dialing mode                     1   (642412)

Ampl.quotients sig:                   0
Step motor type  :                    5
Modulator frequency:                    7   (79244)
Modulator type   :                      1   (79245)
Press. sensor damping:                  120   (79554)
Quotients value  :                      0

Measurement components   :       SO2        CO       CO2        O2    Temp. C
ADC channel         :         0         0         0         3        13
Component index :        41        30        29        40        67
Delay time          :        21        21        21         0         0

Decimal places   :          1         2         2         2         0
Bargraph disp. range:          1         1         1         1         1
No overrange alarm :           0         0         0         0         0
No overflow alarm.:            0         0         0         0         0
Neg. meas. val. mask:       0.00      0.00      0.00      0.00      0.00
Pos. meas. val. mask:       0.00      0.00      0.00      0.00      0.00

Concen. factor    :    5000.00      5.00     25.00     25.00    600.00
Concen. scaling:    5000.00      5.00     25.00     25.00    600.00
ADC scaling [0]:      44.6311    0.2093    1.0000    1.0000    1.0000
ADC scaling [1]:       0.3052   82.7840    1.0000    1.0000    1.0000
ADC scaling [2]:       1.0000   -0.1781   49.2124    1.0000    0.0843
Calc. ZP drift  :      1.0000    1.0000   -1.1178  482.8556    1.0000
Calc. SP drift [0]:    1.0000    1.0000    1.0000    1.0000  309.9795

Calculate ZP drift  :   -0.6480    0.0821   -0.0749   -2.7270    0.0000
Calc. SP drift [0]:    1.0085    1.0000    1.0000    1.0000    1.0000
Calc. SP drift [1]:    1.0000    0.9828    1.0000    1.0000    1.0000
Calc. SP drift [2]:    1.0000    1.0000    0.9781    1.0000    1.0000
Last ZP drift   :      1.0000    1.0000    1.0000    1.0101    1.0000
```

```
range 1
Start value         :        0.0       0.0000       0.000       0.000
End value           :     5000.0       5.0000      25.000      25.000
Switch. pt. up :       0.0       0.0000       0.000       0.000

Output range 2
Start value         :        0.0       0.0000       0.000       0.000
End value           :        0.0       0.0000       0.000       0.000
Switch. pt. down  :        0.0       0.0000       0.000       0.000

Alarm settings  :           1           2           3           4
Measurement components    :           .           .           .           .
Alarm settings  :           .           .           .           .
Acknowledge     :           0           0           0           0

Signal assignment   :Signal inputs   Relay outputs Transistor outputs
1                   :                     Failure!
2                   :                     Maintenance
3                   :                     Malfunction
4
5
6
7
8
 (! = logic: INVERS)
```

```
  Zero point
Date zero gas meas. 1:  03.08.02         Date zeros gas meas. 1:  02.08.02
time span gas 1:        05:08            Time zero gas meas. 2:     20:08
  ADC results
N1                  :    -820.55     402.35     337.06     -30.45       0.76
N2                  :    -817.87     427.38     292.21      24.02       1.56
Sen. NG unt. Temp :       14731      14731      14731      14731      14731
Sen. NG obe. Temp :           0          0          0          0          0
Temp. corr.  :  -4.31e-03  -4.02e-02  +7.21e-02  -8.76e-02  -1.29e-03

  Sensitivity
Date test gas meas. 1:  03.08.02         Date test gas meas. 2:  02.08.02
Time test gas meas. 1:     05:08         Time test gas meas. 2:     20:08
  ADC results
E1                  :   10823.59    8184.06   19243.82   17818.64       0.00
E2                  :   10477.75    8196.97   19444.44   17761.46       0.00
Sen. PG unt. Temp :       14739      14727      14747      14747          0
Sen. PG obe. Temp :           0          0          0          0          0
Temp. corr.  :  -5.26e-05  -2.44e-06  +1.95e-05  -9.82e-06  +0.00e+00

Number of  SPT       :                    5   (6251)
Man/auto SPT sel.:                    0   (6255)
Sample points       :          1          2          3          4          5
Measuring duration per SPT :      30         30         30         30         30
Dead time per SPT   :           5          5          5          5          5
Activate SPT        :           0          0          0          0          0
```

8.11 Digital remote control (settings)

The TOCOR700 uses interface #1 for digital communication (explanation, connection → page 76, § 4.16; settings → page 122, § 8.10.4).

8.11.1 Setting the ID character

Function

An individual identification character can be assigned to each TOCOR700 for each digital remote control (→ § 10/§ 11). The TOCOR700 will only obey commands which include its own ID character (unless this feature is disabled → page 127, § 8.11.2).

Setting

1 Call up menu 6421 (`main menu → settings → interfaces → communication #1 → AK-ID`).
The identification number set is displayed in two ways: The character on the left and the decimal ASCII code of the character on the right (e.g. `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	

8.11.2 Activating the ID character / activating Modbus

Function

Serves to specify whether the TOCOR700 only accepts remote control commands containing its own ID character (→ page 126, § 8.11.1), or if the TOCOR700 executes all remote control commands, independent of the ID character. – This menu function is also used to activate the Modbus remote control functions (→ page 181, § 11).

If you have a remote control installation for more than one TOCOR700 using the MARC2000 software and BUS converters for the interface connections, then you must set the `AK-ID-active` to `ON`. Otherwise MARC2000 cannot differentiate between signals of 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 TOCOR700 executes all remote control commands it receives. [1]
`With AK-ID`	ID character will be observed – the TOCOR700 only executes remote control commands with matching ID character. [1]
`With AK-ID MODBUS`	As for `With AK-ID` with remote control with Modbus commands also enabled.

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

8.11.3 Setting the installed connection

Function

This function applies to data communication with MARC2000 software (→ page 173, § 10) or with the Modbus protocol (→ page 181, § 11).

There are several options for the electrical connection (→ page 175, § 10.2.1); specify the connection used here.

(Note: Interface #1 is used for the connection on the TOCOR700.)

Setting

1 Call up menu 6423 (`main menu → settings → interfaces → communication #1 → elect. connection`).

2 Set the installed connection:

`serial, simple`	One TOCOR700 is connected directly to the PC via the interface
`serial, bus`	Several TOCOR700s are connected via BUS converters to the PC
`modem, simple`	One TOCOR700 is connected via modems to the PC
`modem, bus`	Several TOCOR700s are connected via modems and BUS converters

8.11.4 Configuring the modem connection

Function

These functions are required when digital electrical connections via modem are installed and to use the connection.

Settings

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

2 Check/make the following settings:

`auto. answer`	• `auto. answer OFF` = the modem does not react when called. You must connect the telephone line via menu command (`receive call` → page 129, § 8.11.5). To do this, you must 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 and then 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) • `impulse dial` = impulse dialing mode (IWF) You can also change the dialing mode when dialing a number (→ page 129, § 8.11.5).
`store settings`	Send a command to the modem: “Store the current settings permanently.” As a result, the modem will keep the current settings even after being switched off or after a power failure.

The modem connected to the TOCOR700 must accept standard AT commands (Hayes-compatible commands) otherwise the TOCOR700 control commands will not work.

8.11.5 Modem control

Function

You can remotely control the basic functions of a modem connected to interface #1 from the TOCOR700.

Actions

1 Call up menu 6424 (`main menu → settings → interfaces → communication #1 → modem`).

2 Possible actions:

`initialisation`	Restarts 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. *Attention:* A remote control command just being received can then be truncated. This can lead to malfunctions in the TOCOR700.
`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. ● – (minus sign) = switch to the alternative dialing mode (→ page 128, §8.11.4). `T` (tone dialing in the following) or `P` (pulse dialing in the following) appears on the TOCOR700 display after input – depending on the dialing mode selected beforehand; you can only switch the dialing mode once when dialing a telephone number.
`receive call`	The modem connects to the incoming call. You must set `manual answer` to use this function (→ page 128, §8.11.4) and be able to notice when a call comes in (e.g. via the modem loudspeaker).
`abort`	The modem will immediately disconnect an existing telephone connection. – This will also terminate the remote control with MARC2000 (if previously activated → page 179, §10.3). *Attention:* A remote control command just being received can then be truncated. This can lead to malfunctions in the TOCOR700.

When the telephone connection originated from the TOCOR700:

► Select the modem function `abort` on the TOCOR700 to end the telephone connection.

8.12 Data backup

8.12.1 Internal backup (saving the settings)

Functions

- Data backup menu functions serve to save a copy of TOCOR700's current working condition. The data backup includes
  - all individual settings
  - all gas analyzer individual settings
  - the calibration at the time of the backup

  The TOCOR700 can store *two* such copies: "Last backup" and "2nd last backup". Both copies can be reactivated. As a result, you can save two versions of the current working state and restore either of these when required.
- In addition, TOCOR700 automatically makes a backup copy after each successful calibration.
- You could also restore the original delivered condition (factory settings). This can be useful when the TOCOR700 is not functioning correctly and you suspect this is due to confusing and unsuitable settings: First save the current operational state and then reactivate the factory settings to temporarily create "reliable conditions" for tests.

- Saving the settings on an external computer → page 131, §8.12.2
- Plain text output of the configuration data → page 125, §8.10.6

Procedure

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

2 Select the desired function:

`store data`	Saves the current working state as the "last back-up" (previous "last back-up" settings will become "2nd last back-up")
`last backup`	Restores the working state of the "last back-up"
`2nd last back-up`	Restores the working state of the "2nd last back-up"
`after calibration`	Restores the working state automatically saved after the latest successful calibration procedure
`factory settings`	Restores the original factory-delivered state

When you restore a "back-up" state, you will loose all recent changes to settings – unless you have saved these settings before, by using `store data` or `send data` (→ page 131, §8.12.2).

3 Press [Enter] to start the procedure.

8.12.2 External backup (data transmission)

Functions

The `data transmission` menu serves to transfer the TOCOR700 configuration (all gas analyzer measurement parameters and settings) to a PC (download) or reload these data to the gas analyzer (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 TOCOR700 if required – for example, after a major breakdown.
- When the TOCOR700 electronic board or memory module need to be replaced, you can reload the individual data into the new electronics.

► Do *not* use the `data transmission` function to copy the data of one gas analyzer into another gas analyzer.

These data include parameters which depend on the individual characteristics of the built-in analyzer modules. Even if gas analyzers are equipped with exactly the same types of modules, their internal data will be different. A gas analyzer will not work correctly with “foreign” data.

- Plain text output of the configuration data → page 125, §8.10.6
- Loading the internal software (firmware) → page 134, §8.13

Requirements

For the data transmission you need:

- A computer with an RS232 serial interface
- A connecting cable to interface #1 of the TOCOR700 (→ page 76, §4.16.2)
- A program which can control data transmission between computer and the connected analyzer (MARC2000 or a terminal program).

One of the programs you could use is “HyperTerminal” which is a standard part of the Windows operating system. You can start “HyperTerminal” without making a connection; this allows you to use HyperTerminal’s Help function to become familiar with the program.

Preparation

NOTICE:

Uploaded data will replace the device’s current settings.

► Prior to the upload, save the analyzer’s current status, if required (external → „Data backup procedure“, internal → page 130, §8.12.1).

1 Connect the TOCOR700 serial interface #1 to the computer (→ page 76, §4.16).

2 Start the terminal program on the computer. Configure it as follows:

► Setup the same interface parameters as for the TOCOR700 (→ page 122, §8.10.4).

► Setup the data transmission mode so that the data are transferred as a text file (ASCII data), not as binary data.

In “HyperTerminal”, the correct transfer mode is “Text file” – not “Data file”.

Data backup procedure

Use this procedure to save the current gas analyzer data:

In the TOCOR700	In the terminal program
	1 Start-up the interface connection to the TOCOR700.
2 Call up menu 695 (`main menu` → settings → `[9]` → `[Code]` → `data transmission)`.	
3 Select `send data`.	
	4 Start data recording for ASCII data.[1]
5 Press [Enter] (this will start the data transmission).	
6 Wait until TOCOR700 indicates that the data transmission 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 TOCOR700's backup data → [Start]

2 In "HyperTerminal": [Transfer] → [Capture text...] → [Close]

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

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

Data restore procedure

Use this procedure to restore data from a backup file to the gas analyzer:

In the TOCOR700	In the terminal program
	1 Start-up the interface connection to the TOCOR700.
2 Call up menu 695 (`main menu` → settings → `[9]` → `[Code]` → `data transmission)`.	
3 Select `receive data`.	
4 Press [Enter] (makes TOCOR700 ready to receive data).	
	5 Send the TOCOR700 data backup file as an ASCII text file.[1]
6 Wait until TOCOR700 indicates that the data transmission is finished (takes 40 seconds at least).[2]	

1 In "HyperTerminal": [Transfer] → [Send Text File...] → select the desired file → [Open]

2 Display messages → page 133

Malfunction messages during the data restore procedure

The gas analyzer monitors the data transmission for `receive data`. If a malfunction occurs, the gas analyzer terminates the data transmission and reports the malfunction on the display:

Display message	Meaning	Remedy
`--OK--`	Data transfer was successful	–
`READ-TIMER`	No characters received	Check the electrical connection (plug connectors, cables).
`READ-BREAK` `READ-ERROR` `READ-CHAR`	Malfunction occurred during character transmission	Set transmission delays in the PC terminal program. Proceed as follows: **1** Set a line delay; set a short delay initially. Then try the data transmission again. **2** If this did not help, increase the line delay step-by-step, up to approx. 10 ms. **3** *If this does not help:* Deactivate the line delay. Instead, set a character delay. Start with the lowest value. **4** If this did not help, increase the character delay step-by-step until the data transmission works.

- Line or character delays increase the time required for the data transmission. Example: A character delay of 10 ms increases the time required for the data transmission to about 3 minutes.
- In some computers, the real delay is much greater then the set value.

8.13 Firmware update

Function

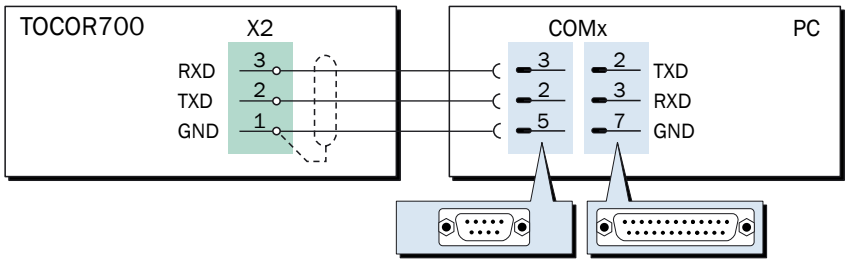
You can load the TOCOR700's internal software (firmware) from a PC into the TOCOR700 – for example, to install a new firmware version. You need:

- A PC with RS232 serial interface and operating system Windows 3.X/95/98/2000/XP
- Connection cable to interface #1 of the TOCOR700 (or the gas analyzer)
- Upload program FLASH.EXE
- Current version of the file 7XX.BIN (contains the TOCOR700 software)

Interface connection

At least three connection lines are required:

Figure 35 Minimum interface connection for the program loader function



- Use a shielded cable.
- Cable length should not exceed approx. 2 meters (7 feet).
- It is not necessary to adjust the interface parameters – this will be done automatically by the upload program.

Procedure

1 Connect the PC and the serial interface of the TOCOR700 (→ page 134, Figure 35).

2 On the PC: Store the FLASH.EXE and 7XX.BIN files in the same folder.

CAUTION: Risks for connected devices/systems

As long as the `program loader` function is activated, the TOCOR700 is not performing any measuring operation.

► Make sure no dangerous situations arise in this case.

3 Call up menu 76 (`main menu → service → program loader`) in the gas analyzer and start the function with [Enter].
   - The gas analyzer then displays a message in English to confirm it is waiting for data communication.

4 On the PC: Start FLASH.EXE.
   - The PC will show the messages of the upload program. The estimated remaining upload time is indicated.
   - The TOCOR700 software is divided into several "blocks". The upload program will check which blocks need to be updated and will only upload the new blocks.
   - The gas analyzer reboots after the load procedure, the same as after switching on.

5 Wait until the `Main menu` appears. The TOCOR700 is then ready for use again.

8.14 Volume flow adjustment and monitoring

8.14.1 Pump capacity (information)

Menu 651 (`main menu → settings → gas flow → pump capacity`) has no function.

The gas pump capacity is controlled automatically in the TOCOR700.

8.14.2 Flow limit value (information)

Menu 652 (`main menu → settings → gas flow → flow limit value`) has no function.

The relevant flow sensor (FC) in theTOCOR700 measures the actual value of the sample gas volume flow in the gas analyzer. This value is monitored automatically.

8.14.3 FIA limit value

Function

The FIA transmitter monitors the carrier gas volume flow on the gas outlet of the measuring system (→ page 31, Figure 6). The TOCOR700 outputs a malfunction message when the volume flow is below the FIA limit value set.

Setting

1 Call up menu 653 (`main menu → settings → gas flow → FIA limit value`).
2 Set the desired limit value. The setting will correspond approximately to the flow in liters per hour (the exact relation depends on the calibration of the FIA sensor).

8.14.4 Carrier gas volume flow

Function

This setting defines the carrier gas volume flow in the measuring system. This synchronizes the CO_2 production of the reactor and the CO_2 sensitivity of the gas analyzer: The higher the carrier gas volume flow, the lower the CO_2 concentration in the gas analyzer. The setting corresponds to a rough setting for measuring sensitivity (further information → page 167, §9.8.1).

The gas pump feeds the carrier gas in the gas analyzer.. A microprocessor regulates the pump capacity so that the nominal volume flow value is held constantly. The FC flow sensor measures the actual value (→ page 31, Figure 6).

Setting

1 Call up menu 654 (`main menu → settings → gas flow → carrier gas`).
2 Set the `status` value so that the desired carrier gas volume flow is achieved.

- The setting value is a dimensionless internal value.
- The regulation state can be displayed per menu function (→ page 139, §8.16.2).

CAUTION: Risk of incorrect measurements

Changing the carrier gas volume flow also changes the calibration.

► Only change the factory setting for important reasons.
► Perform a calibration after changing the `carrier gas` setting.

8.15 TOCOR parameters

8.15.1 Back-flush filter settings (option)

Function

Back-flush filters have a filter sieve that can be flushed with compressed air against the flow direction. Menu functions serve to set the flush interval and interval.

- The flush interval (= interval in which the flush process is started) can be set individually for each back-flush filter.
- The flush interval set is valid for all connected back-flush filters.

Setting

► Call up menu 671 (`main menu → settings → TOCOR parameter → back-flush filter`).

► To set the flush interval:

a) Call up `flush interval X` (X = number of the relevant back-flush filter).

b) Set the desired interval (0 ... 60 minutes).

► To set the flush interval:

a) Call up `flush interval`.

b) Set the desired flush interval (1 ... 10 seconds).

The “Back-flush filter” function can be used to run the dosing pump (M10) in reverse during back-flushing – to prevent clogging in sample water lines.

8.15.2 Dilution factor (information)

Menu 672 (`main menu → settings → TOCOR parameter → dilution factor`) has no function.

8.15.3 Sample water limit value

Function

The TOCOR700 continuously compares the current measured value with the “sample water limit value” set and activates the “Sample water limit value” malfunction message when the measured value is below this limit value. This allows monitoring, for example, the sample water feed: The measured value sinks towards 0 mg/l C when sample water feed is interrupted.

Set a limit value that will not normally be underflowed during operation. Set a negative limit value when you do not wish to use this function.

The “sample water limit value” has no effect when a control input is assigned to the “Sample water B02” function (→ page 120, § 8.10.2).

Setting

► Call up menu 673 (`main menu → settings → TOCOR parameter → water flow limit`).

► Set the desired limit value.

8.15.4 Semi-continuous mode(information)

Menu 674 (`main menu → settings → TOCOR parameter → semi-contin. mode`) has no function.

8.16 Control functions of the gas analyzer

8.16.1 Measurement signals for measurement components

Function

The current measurement signals can be checked for all measurement components for control purposes. The values originate from the measuring system of the gas analyzer or from the analog inputs (→ page 71, §4.13).

“ADC values” are displayed: These are the digitalized values of the analog measurement signals and serve as input signals for digital measured value processing. ADC values include analog amplification of the measurement signals, but no digital computation or correction.

Analog amplification is variable: A basic calibration of the gas analyzer serves to determine the ideal amplification for the measurement signals of the gas analyzer. For measurement signals fed-in via analog inputs, the amplification factor is set manually (factory setting).

Typical values

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

- If ADC values below `10000` are displayed for the measuring range end value, a basic calibration should be made in order to re-optimize measured value processing (→ page 168, §9.8.2).
- If an ADC value remains constant for an extended period of time, 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`).

8.16.2 Status of internal controllers

Function

This control function shows the current condition of the internal gas analyzer controllers:

- Controller 1 serves to regulate the temperature in the gas analyzer.
- Controllers 2 and 3 have no function.
- Controller 4 serves to regulate the carrier gas volume flow (→ page 136, § 8.14.4).

Call-up

1 Call up menu 7112 (`main menu → service → internal signals → analog signals → controller`).

2 Select the desired controller (1 ... 4).

`value`	Actual measured value of the sensor
`set point`	Nominal value (factory setting)
`counter`	Time delay for monitoring (in seconds). When the actual temperature is outside the nominal range, the counter is incremented by 1 each second. `FAULT: Temperature` is displayed when the counter exceeds the value 20. The counter counts backwards as soon as the temperature returns to the nominal range. After power-on, the counter starts with 127.
`cycle`	Current on/off cycle 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 by the software.

8.16.3 Displaying internal analog signals

Function

This function delivers the current signals of the internal auxiliary sensors and the analog inputs of the gas analyzer.

Call-up

► Menu 7113 (`main menu → service → internal signals → analog signals → extra sensors`).

`pressure hPA`	Measured value of the built-in pressure sensor (option)	
`flow %`	Measured value of the FC flow sensor	
`Source V`	Supply voltage of the infrared source in the measuring system of the gas analyzer (standard nominal range: 6.0 ... 7.5 V)	
`external 1 V`	Analog input IN1 signal	(Function → page 71, § 4.13)
`external 2 V`	Analog input IN2 signal	

Analog input IN1 accepts values in the range 0 ... 2 V corresponding to the output signal of the FIA transmitter.

- FIA volume flow = 0 l/h: FIA signal = 4 mA, display value = 0.4 V
- FIA volume flow = 40 l/h: FIA signal = ≈10.4 mA, display value = ≈1.4 V

8.16.4 Internal supply voltages

Function

This control function shows the internal supply voltages of the gas analyzer: Nominal values are shown on the left and current actual values on the right.

`FAULT: Int. voltage` is displayed when an actual value is outside the allowable range. This control function serves to localize the error source in such cases.

Call-up

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

Table 4 Internal supply voltages

Nominal value	Allowable actual 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 Auxiliary voltage outputs (→ page 74, Figure 28 and → page 74, Figure 29)

Internal electronic fuses → page 251, § 17.10.1

8.16.5 Service display of internal analog signals

Function

The analog signal `overview` shows the current internal signals which can be helpful for the manufacturer's technical service to diagnose reasons for malfunctions. Which signals are shown depends on the individual TOCOR700 configuration.

Call-up

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

8.16.6 Linearization values

Function

The linearization values represent the parameters used to compute a linear curve from the gas measurement system curve characteristic.

Call-up

1 Call up menu 713 (`main menu → service → internal signals → linear. values`).
2 Select the measurement component to see the linearization values.
   ► On the TOCOR700: Press [1] (measurement component `C`).
3 The following values will be displayed in tabular form:
   – Title: Date on which values were computed
   – Left column: Physical nominal value
   – Right column: Associated internal measured value

8.16.7 Status of control inputs

Function

Serves to display the current electronic state of all control inputs (→ page 75, § 4.15).

Call-up

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

Setting	Function
`0`	Input is electronically passive (no current)
`1`	Input is electronically activated (current is flowing)
`!`	Input works with reverse logic

8.16.8 Program version

Function

This function shows:

– Gas analyzer instrument name
– Version number and release date of the installed software (firmware)

Call-up

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

8.17 Sample point selector (option)

This information only applies to devices with the “Sample point selector” option.

8.17.1 Function of the sample point selector

Sample points are extraction points for sample water. The “Sample point selector” option of the TOCOR700 serves to control up to four sample points (i.e. issue commands to switch the sample gas line). Sampling times can be set individually for each sample point.

To use this function in practical operation, external switching valves (e.g. on the back-flush filters) and switching outputs to control the switching valves must be available (fitting → page 117, § 8.9).

8.17.2 Sample point selection results

... for the measured value display	● The measured values shown on the display are always the current measured values of the gas analyzer - independent of sample point switching. ● The currently active sample point is indicated with a number in the top line of the measured value display (→ page 89, § 7.2)
... for the measured value outputs	● Each measured value output automatically represents one of the sample points. Each measured value output displays current measured values as long as the associated sample point is activated. When other sample points are active, the measured value output constantly displays the measured value that was last measured with its associated sample point (“sample-and-hold” function). ● All settings for measured value output 1 are automatically valid for all the other measured value outputs.
... for the digital measured value outputs	● Measured value displays for measured values received via the interface (→ page 123, § 8.10.5) are shown with the identification of the originating sample point. ● After switching to another sample point, these measured values outputs are interrupted temporarily until the set “dead time” has elapsed (→ page 143, § 8.17.3).

8.17.3 Configuration of the sample point selector

Function

- Number of sample points used
- Suitable time settings for each sample point
- Activating automatic sample points switching
- Restricting automatic switching to selected sample points

Settings

1 Call up menu 625 (`main menu → settings → measurement → sample point select`).

2 Enter the following settings:

`No. of sam-ple pts.`	► Enter the number of connected sample points (or the number of points to be used). Unused sample points are deactivated when a lower number is set afterwards; the settings are however retained.
`sample time per pt.`	1 Select which sample point this setting should be applied to. 2 Enter how long the measuring solution is to flow from this sample point to the TOCOR700 during automatic sample point selection (`0` ... `9000` s). (This determines how long the related switching output is activated (→ page 117, §8.9.)
`dead time per pt.`	1 Select which sample point this setting should be applied to. 2 Enter how long TOCOR700 should wait after a sample point has been activated before sending measured values via the serial interface again (`0` ... `900` s). The measured value should have reached the final value after this time, i.e. should not change significantly (setting criteria → page 160, „Setting a span delay time“).
`activate pt.`	`yes` = the sample point will be activated during automatic sample point switching. [1] `no` = the sample point will not be activated during automatic switching (however, it can still be activated via menu command or via control output).
`man/auto pt. select`	`0` = automatic sample point selection activated (according to `activate pt.` and `sample time per pt.`). `1` to `4` = the relevant sample point is activated.

[1] Control inputs with the function `hold sample pt.x` and `switch off pt. x` have priority over automatic sample point selection (→ page 120, §8.10).

8.18 Testing electronic outputs (hardware test)

Function

The functions in the `hardware test` menu serve to individually control and test each TOCOR700 electronic output and test the digital interfaces as well. This allows testing the TOCOR700 outputs or the electrical connections and the interaction with connected devices.

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

CAUTION: Risks for connected systems

- When the test function is started in the menu
  - the selected output will be set to the selected electronic state immediately
  - the normal operational function of this output is disabled.
- When the test is running and no key is pressed for some minutes, the selected output will automatically be reset to operational state.

► Make sure that the test of a status or control output cannot cause problems at connected locations.

► Pay attention to the automatic reset during the test. Make sure the automatic reset cannot cause problems.

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 measured value output (OUT1 ... OUT4). 2 Set the value that the measured value output should constantly display (0 `mA` = 0 % / `20 mA` = 100 %).	
`relay group`	Each relay for the control and status outputs can be activated individually (→ page 72, § 4.14): [1] 1 Select the desired switching 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 72, § 4.14) 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`	As long as this function is selected, the TOCOR700 sends lines of characters that are shown on the display. This serves to check whether data transmission to a connected device is working. [3]	
`test interface #2`		
`TOCOR`	`relaismodule 1`	Switching outputs for sample point selection (option → page 142, § 8.17)
	`relaismodule 2`	Switching outputs for back-flush filter (→ page 137, § 8.15.1)
	`transistor group`	Switching outputs to control the analyzer part and for flushing processes

1 Activation will be automatically switched off after 60 seconds – unless this is manually done before.

2 Repeat as often as required (toggle switch).
3 If the connected printer does not print exactly the same characters as shown on the display, the printer is probably not set to the standard ASCII character set (“US character set”).

8.19 Reset

Function

A `Reset` starts the gas analyzer microcomputer again in the same way as when switching the power on. Measured value processing restarts. Stored values remain unchanged.

Procedure

CAUTION: Risks for connected devices/systems
During a reset, all TOCOR700 device functions are temporarily not available. This includes measured value outputs and status messages.
► Make sure that this situation cannot cause problems at connected locations.

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

TOCOR700

9 Calibration

Basics
Calibration solution
Calibration procedure

9.1 Basic calibration information

9.1.1 Why is calibration necessary?

It is unavoidable that certain characteristics of the measuring system will slightly change during the weeks of operation. These changes from the original state have a slight effect on measurement results even when external conditions remain identical.

Analyzers must be calibrated regularly to compensate these unavoidable aging effects (→ Table 5). The first phase of the calibration tests the measuring behavior of the analyzer; then any deviations from the nominal condition are compensated through readjustment.

The two important parameters in the measuring system are:

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

During a routine calibration, the zero point and sensitivity of the gas analyzer are adjusted so that the calibration of the complete measuring system is correct again.

Table 5 Factors influencing calibration on the TOCOR700

Influences on the zero point	Influences on sensitivity
– Zero point drift of the CO_2 gas analyzer – CO_2 content of the carrier gas – Contamination of sample water lines with carbon compounds	– Changes in sample water volume flow[1] – Changes in reagent volume flow[2] – Changes in carrier gas volume flow – Sensitivity drift of the gas analyzer – Changes in oxidation rate in the reactor – *for TOCOR700 UV:* for example, aging of the UV lamp – *for TOCOR700 TH:* for example, gradual soiling of the reactor

1 E.g. through pump hose wear

2 Changes the dilution effect of the reagent

Calibration corrects two metrological parameters:

1 Deviations from the metrological zero point

2 Deviations from the correct measuring sensitivity.

9.1.2 How does a calibration procedure in the TOCOR700 basically work?

During a calibration, the TOCOR700 automatically compensates any drifts according to the following principle:

1 A calibration liquid with an exact, known nominal value is fed into the TOCOR700. The nominal value is the actual carbon concentration in the calibration liquid.

2 The TOCOR700 determines the measured value of the calibration liquid (actual value).

3 The TOCOR700 calculates the deviations between actual and nominal values (drift).

4 The TOCOR700 checks whether drifts can be compensated by mathematical computation. If this is the case, the internal compensation parameters for zero point and sensitivity are automatically corrected. If this is not the case, an error message is displayed and the complete measuring system must be checked and readjusted.

This process must be repeated twice - once for the zero point and once for the sensitivity.

9.1.3 Alternative calibration procedures

You can control the calibration procedure manually using menu functions to run a calibration step-by-step. You can also program the TOCOR700 so that calibrations run fully automatically - after a single Start command or in programmable time intervals. In addition, you can program up to four different calibration procedures to cover different requirements (→ page 156, §9.5).

9.1.4 Alternative methods for zero point calibration

a) When “Zero solution 1” is activated during the calibration procedure, sample water feed is automatically switched to the “Zero solution” connection (solenoid valve). The zero water is drawn out of the storage container by the dosing pump and enters the measuring system in the same way as the sample water – the nominal value of the zero water can be set → page 158, §9.5.4).

b) When “Zero solution 2” is activated during the calibration procedure, the dosing pump is switched off automatically. This means: Neither sample water nor zero water flow into the measuring system during zero point calibration. The effect is that only the zero point of the gas analyzer is calibrated with carrier gas.

9.1.5 When is it necessary to perform a calibration?

The TOCOR700 should be calibrated

- after start-up
- in regular intervals during operation (→ page 194, „Maintenance plan“)
- after changes to the measuring system.

CAUTION: Risk of incorrect measurements

Perform a new calibration whenever:

- ► The TOCOR700 has been switched off for a longer time (e.g. longer than 14 days)
- ► Changes have been made to the TOCOR700 (e.g. after exchanging components)
- ► Installations in the sample water line have been modified
- ► The TOCOR700 has been transported.

Otherwise the TOCOR700 will not deliver correct measured values.

9.1.6 Calibration liquid notation in the menus

Term	Stands for
Zero solution	Zero water
Zero gas	
Test solution	Calibration solution
Test gas	

9.2 Calibration liquids

9.2.1 Zero water

In the ideal case, zero water contains no carbon compounds at all and has no effect on measuring (nominal value: “0”).

Suitable as zero water are:

- Deionized/demineralized/completely desalted water
- Double-distilled water
- Water with equivalent quality.

- Demineralized water contains up to 0.2 mg/l TOC.
- The nominal value for zero solution 1 is set to 0.2 mg/l C at the manufacturer's factory.

For sensitive measurements (measuring range end value ≤ 50 mg/l C):

► Consider the carbon content of the zero water during calibrations (adjust nominal values).

► Make sure the pureness of the water used remains constant.

Recommendation for TOCOR700 UV – when the sample water contains Cl ions (e.g. sea salt NaCl):

► Set the zero water to the same Cl concentration as the sample water – e.g. by adding NaCl.

This keeps the Cl concentration in the measuring system constant during the calibration. This improves calibration precision and speed.

9.2.2 Calibration solution

The calibration solution is used to calibrate the sensitivity. The calibration solution comprises zero water and a known amount of organic carbon compounds.

Calibration substance

According to DIN EN 1484, potassium hydrogen phtalate ($C_8H_5KO_4$, PHP) should be used as calibration substance.

Standards on TOC measurement:

- DIN/EN 1484, “Directive on determination of total organic carbon”, 1997
- Analytical Quality Assurance (AQA), Sheet P-14, “Determination of total organic carbon (TOC) in water”

Nominal value of a calibration solution

- The nominal value of the calibration solution should be 80 ... 100 % of the end value of the basic measuring range.
- The nominal value of the calibration solution is its actual TOC content.

- Nominal values can be set in the range 10 ... 120 % of the end value of the basic measuring range (→ page 158, §9.5.4).
- 4 different nominal values for calibration solutions can be set (→ page 158, §9.5.4) and used optionally for calibrations.

► *When the calibration solution is changed:* Adapt the nominal value (→ page 158, §9.5.4).

Preparing the calibration solution

Prepare the calibration solution as follows:

- ► Measure the suitable amount of an organic substance directly and dissolve it in the zero water – *or*
- ► dilute a stock solution (→ § 9.2.3) with zero water.
- ► Use a pure substance as calibration substance (“pro analysis”).
- ► Ensure cleanness and precision when mixing calibration solutions.

Recommendation: Prepare calibration solutions by diluting a “stock solution”. This is because it is easier and more exact to prepare a stock solution due to the larger substance concentration.

Composition example

Aim: 250 ml calibration solution with 100 mg/l C from 1000 mg/l C-stock solution.

Procedure:

1 *Calculate dilution factor:* 100/1000=0.1=100 ml/1000 ml=25 ml/250 ml.

2 *Preparation:* Pour 25 ml of the PHP stock solution into a 250 ml measuring flask (use a precision burette when necessary) and top up the measuring flask with suitable water. Cap the measuring flask immediately, shake gently and mark with the date of manufacture, etc.

Service life of calibration solutions

Calibration solutions have a limited service life. This is specially true for calibration solutions with a low carbon content where the calibration substance can rapidly decompose so that the carbon concentration deviates considerably from the calculated nominal values after just one day or even after just a few hours.

- ► *To increase the service life:* Store calibration solutions in a capped container in a cool dark place when possible.
- ► Always use freshly prepared calibration solutions for precise calibrations. Only use older calibration solutions for rough calibration tests.

9.2.3 Stock solution

Composition example

How to prepare a stock solution with 1000 mg/l C (= 1000 ppm C):

1 Dry $C_8H_5KO_4$ salt at 105 ... 120 °C.

2 Dissolve 2125 mg in zero water (use a 1000 ml measuring flask).

3 Make sure the substance is completely dissolved.

4 Top up the solution with zero water to exactly 1000 ml.

- PHP is available in single sachets (→ page 250, § 17.8.1).
- Using n-times the PHP amount gives n-times the carbon concentration.

How to calculate the amount required (for PHP powder):

1 The total formula $C_8H_5KO_4$ gives the molecular weight:
$8 \times 12.011 + 5 \times 1.008 + 1 \times 39.10 + 4 \times 15.999 = 204.224$ [g/mol].

2 The carbon portion is $8 \times 12.011 = 96.088$ g/mol.

3 The relative carbon portion in $C_8H_5KO_4$ is 96.088/204.224 = 0.470.

4 Therefore 1000 mg/0.470 = 2125 mg PHP powder is required for 1000 mg C.

Storage

The stock solution can be used for several weeks when stored in a cool, dark place.

9.3 Calibration preparation

Check readiness for operation

Check:	Test criteria	
1 Gas analyzer	"Function" glows green, "Service" not on	→ page 82, § 6.1
2 Measuring system	Start-up procedure completed.	
	Start-up time has elapsed: A constant measured value is displayed when zero water is fed.	
3 Reagent reserves	Storage container is filled sufficiently.	→ page 47, § 3.4.2
4 Carrier gas flow	Volume flow in nominal range and constant.	
5 Dosing pump	Pump hoses OK.	→ page 202, § 12.2.5
6 CO_2 absorber	Absorption material not spent.	→ page 198, § 12.2.2
7 Corrosion inhibitor filter	Brass wool not spent.	→ page 200, § 12.2.3
8 Activated charcoal filter	Activated charcoal not spent.	→ page 201, § 12.2.4
9 Leak tightness	Hoses and containers are leak-tight.	(→ page 219, § 13.5)

Provide calibration solution

Housing version	Work steps
Standard: Both calibration media are drawn in via the "Single probe" connection.	**1** *During zero point calibration:* Immerse the sample hose in the container with the zero solution (zero water). **2** *During sensitivity calibration:* Immerse the sample hose in the container with the test solution (calibration solution).
With "Zero solution" connection (option): Zero water is automatically drawn in via the "Zero solution" connection during calibration.	**1** Provide a container with zero water at the "Zero solution" connection. **2** To calibrate sensitivity: Immerse the sample hose in the container with the test solution (calibration solution).

There is an alternative method for zero point calibration where feeding zero water is not necessary (→ page 148, § 9.1).

9.4 Manual calibration

Manual calibration means that you control the calibration procedure yourself.

► Always perform a zero point calibration when starting a calibration.

9.4.1 Manual calibration procedure

Starting the procedure

► Select main menu → calibration → manual procedure.

manual procedure 1 zero solution 1 2 zero solution 2 3 test solution 3 4 test solution 4 5 test solution 5 6 test solution 6 7 calibr. cuvette	

The calibr. cuvette menu function is not active on TOCOR700.

Procedure for manual zero point calibration

manual procedure 1 zero solution 1 2 zero solution 2 3 test solution 3 4 test solution 4 5 test solution 5 6 test solution 6 7 calibr. cuvette	► *To perform zero point calibration with zero water feed:* *Select* zero solution 1. ► *To perform zero point calibration without zero water feed:* Select zero solution 2.
manual procedure zero solution 1 mg/l 0.00 Start zero calibration with ENTER! Back : ESCAPE	← nominal value set for zero point (→ page 158, §9.5.4) ► Press [Enter] to start the internal procedure.

manual procedure zero solution 1 status: wait.. C 0.27 mg/l Please wait ... Cancel : ESCAPE	The span delay time starts after the start (wait..; → page 160, § 9.5.7). Then the actual values are measured (measuring..); for at least one period of the calibration measuring time set (→ page 161, § 9.5.8). – Information: The actual values displayed are drift-compensated according to the previous calibration (no “raw values”). **1** Wait until End: ENTER appears. **2** Wait until the displayed values remain constant or keep fluctuating slightly at a constant level. **3** Press [Enter].
manual procedure zero solution 1 Status: measuring.. C 0.31 mg/l End : ENTER Break : ESCAPE	► *To accept the value displayed as actual value,* press [Enter]. ► *To terminate the calibration procedure instead:* Press [Esc].
manual procedure zero solution 1 C 1.77 % Save : ENTER	← calculated value for absolute zero point drift[1] (for explanation see → page 95, § 7.3.6) ► *To compensate this drift:* Press [Enter]. ► *To discard the displayed value (previous zero point calibration remains valid):* Press [Esc].

1 = total (accumulated) drift since the last drift reset (→ page 166, § 9.7) or since the last basic calibration (→ page 168, § 9.8.2)

Procedure for manual sensitivity calibration

CAUTION: Risk of incorrect calibration
► Always perform a zero point calibration before a sensitivity calibration. Otherwise the calibration will be incorrect.

`manual procedure` `1 zero solution 1` `2 zero solution 2` `3 test solution 3` `4 test solution 4` `5 test solution 5` `6 test solution 6` `7 calibr. cuvette`	►Select the available `test solution` where the programmed nominal value is suitable for the calibration solution.
`manual procedure`	►Perform the remaining work steps as for a manual zero point calibration with `zero solution 1` (→ page 153). Here, the calibration solution is fed instead of zero water.

End of the calibration procedure

The TOCOR700 is calibrated correctly after successful zero point calibration and sensitivity calibration.

To return to the measuring display:

1 Press [Esc] as often as required until the `main menu` is displayed.

2 Select the desired `measuring display` (→ page 89, § 7.2).

9.5 Automatic calibration

The TOCOR700 controls the calibration procedure flow during an automatic calibration. The calibration procedure runs fully automatically after the start.

9.5.1 Requirements for automatic calibration (overview)

These are the requirements for correct automatic calibrations:

1	The preparatory work for a calibration is completed.	→ page 152, §9.3
2	At least one automatic calibration is programmed.	→ page 156, §9.5.2
3	The planned calibration liquid is selected as suitable.	→ page 157, §9.5.3
4	The calibration liquid nominal value is set correctly.	→ page 158, §9.5.4
5	“Span delay time” and “calibration measuring time” are set to suit the measuring system.	→ page 160, §9.5.7 → page 161, §9.5.8
6	When the TOCOR700 should start automatic calibrations itself: The time interval and timepoint for the first start are set as desired.	→ page 157, §9.5.3
7	When a control input is setup with the “Service lock” function: This control input is not activated.	→ page 120, §8.10.2

Some of these settings can be inquired under `Information` (→ page 162, §9.5.9).

9.5.2 Different automatic calibration routines

Available options

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

- Calibration liquids used
- Start time for automatic calibration
- Time interval between automatic starts

All other settings for automatic calibrations (e.g. drift limit values) are valid for all the programmed calibrations.

► *When your TOCOR700 is set correctly and calibrated:* Use a Backup function to create a safety copy of this condition → page 130, §8.12).

This allows you to restore the functionable condition quickly, for example after an erroneous calibration.

9.5.3 Setting-up an automatic calibration

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

2 Select the automatic calibration (`1` ... `4`) to be configured.

3 Make the following settings:

`auto.cal. mode`	`zero gas 1` ... `2` and `test gas 3` ... `6` are displayed, each with `yes` = will be used for this automatic calibration routine `no` = will not be used To change the status, press the related number key once. ► Select "`yes`" for one `zero gas` and "`no`" for the other one (explanation on alternatives → page 148, §9.1). ► Select "`yes`" for one `test gas` (= calibration solution) and "`no`" for the rest. This selection defines which of the programmed nominal values is used for the sensitivity calibration.
`auto.cal. period`	Time interval (days /hours) in which this automatic calibration is periodically performed. The correct setting depends on how strongly your TOCOR700 drifts (depends on the application, the Analyzer modules and their measuring ranges) and the drift deviation in measuring precision that can be tolerated: ● *For normal applications with usual requirements:* Set 1 ... 7 days (`01-00` ... `07-00`). ● *For difficult applications (high measuring sensitivity) or high requirements (high measuring precision):* Set 12 to 24 hours (`00-12` ... `01-00`). ● *To disable automatic starts for this automatic calibration:* Set `00` days/ `00` hours. The `auto. cal. day` is changed automatically to the next day when the `auto. cal. day` was "today" and the `auto. cal time` has already elapsed. ► Always check the `auto.cal. day` as a precaution.
`auto. cal. time`	Time and date when the next start of this automatic calibration will take place. ● Subsequent start times are determined by the `auto.cal. period` (see above). ● You can always change the next start time by simply setting a new timepoint. The `auto.cal. period` will start anew after that calibration. If the timepoint is in the past, the analyzer will show `incorrect input`. If this happens when you have entered today's date, please change the `auto.cal.time` so that the start time is in the future.
`auto. cal. day`	

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

9.5.4 Setting nominal values for calibration liquids

Function

It is essential for correct automatic calibration that the nominal values set for the calibration liquids correspond to the actual TOC concentrations in the calibration liquids (→ page 150, § 9.2).

Use the `auto. cal. mode` (→ page 157, § 9.5.3) to set which of the calibration liquids set are to be used for an automatic calibration.

Even double-distilled water still has a certain TOC residual content (0.1 ... 0.3 mg/l C). Use such a value as nominal value for the zero solution when using small measuring ranges (<20 mg/l C). This makes calibration more precise.

Do not forget to change the nominal values when a calibration liquid has been changed (e.g. when topping up the storage container).

Nominal value for "zero solution 2"

No zero water flows into the measuring system during zero point calibration when you use the alternative method with "zero solution 2" → page 149, § 9.1.4). A *negative* nominal value may possibly be correct for this condition.

How to determine the suitable nominal value:

1 Calibrate the TOCOR700 with zero water ("zero solution 1") and calibration liquid.
2 Switch dosing pump M10 off per menu function (→ page 99, § 7.4.6).
3 Wait until the measured value remains constant. Note this measured value.
4 Enter this measured value as nominal value for the "zero solution" (see below).

Setting

1 Call up menu 632 (`main menu → settings → calibration → nominal values`).
2 Select a `zero solution` or `test solution`. The current settings will be displayed.
3 Select "`C`" and enter the nominal value in the following menu, i.e. the carbon concentration in this calibration liquid.

   Attention: If you set the nominal value to " – . – " (press Backspace), this calibration liquid is not considered for automatic calibration. Enter "0" as nominal value when the calibration liquid contains 0 mg/l C.

The `gas pump` menu function is not active on TOCOR700.

9.5.5 Setting drift limit values

Function

After each calibration, the TOCOR700 compares the calculated “absolute drift” (→ page 95, § 7.3.6) with the drift limit value set. The violation of a drift limit value is indicated in two steps:

1 When a drift value is 100 ... 120 % of the drift limit value, the TOCOR700 displays the message `SERVICE: zero drift` or `SERVICE: span drift` (+ the relevant measurement component) and activates the “Service” LED and the “Malfunction” status output.

2 When the drift value is more than 120 % of the drift limit value, then `FAULT: zero drift` or `FAULT: span drift` is displayed. The status output “failure” is activated as well and the function LED is red.

Information on the messages displayed → page 221, § 13.6

Possible uses

Drifts are caused, for example, by contamination, mechanical changes or aging effects. It is not useful to perform further compensation for steadily increasing “absolute drifts”. Instead, when an “absolute drift” has become very large, inspect and readjust the measuring system (e.g. clean and perform a basic calibration).

You can setup an automatic monitoring for such cases by setting drift limit values - for example, `20 %` (maximum value: `40 %`).

When the drift compensation of the gas analyzer is used up (information → page 159, § 9.5.5):

1 Check the condition of the measuring system (pump hoses, filters, leaks).

2 Restore the basic settings for measuring sensitivity (→ page 167, § 9.8.1).

Setting

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

2 Enter the following settings:

`meas. component`	Measurement component for the following settings (select “C” for TOC measurements)
`zero drift limit`	desired drift limit value
`sens. drift limit`	

9.5.6 Ignoring an external calibration signal

Function

If control inputs use the “auto.cal. start” function (start automatic calibrations → page 120, §8.10.2), you can decide whether the TOCOR700 should consider or ignore this input 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

9.5.7 Setting a span delay time

Function

The “span delay time” determines how long the TOCOR700 must wait after switching to a calibration liquid before the measured values can be used for calibration.

The delay time should correspond roughly to the TOCOR700 reaction time (dead time + 100% time). To determine the reaction time, check how long it takes until the displayed measured value remains constant after switching to a calibration liquid.

CAUTION: Risk of incorrect calibration
Automatic calibrations are incorrect when the span delay time is set too short. Select a delay time that is too long in preference to too short.

- The “span delay time” should not be longer than necessary in order to minimize the down time of the TOCOR700 during the calibration procedure.
- Another “span delay time” runs at the end of the calibration procedure following the switch back to sample gas. This last delay time is still part of the calibration procedure – with all related consequences for the status messages and measured value outputs.

Setting

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

2 Enter the span delay time (in seconds). – Standard value: 120 s.

9.5.8 Setting the calibration measuring time

Function

During calibrations, the TOCOR700 starts, after the “span delay time” (→ page 160, §9.5.7) has elapsed, the calibration measuring time during which the measured values of the calibration liquid fed are determined. The mean value of all measured values during the calibration interval is then the actual value of the calibration.

The appropriate setting depends on two criteria:

- *Damping:* The calibration measuring time must be at least 150 ... 200 % of the damping time constant set (→ page 107, §8.5.1 + page 108, §8.5.2).
- *Measuring characteristics:* The calibration measuring interval must be long enough to make sure that averaging completely compensates all existing “noise” and measured value fluctuations.

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).

9.5.9 Displaying automatic calibration settings

Menu functions are available to inquire the nominal values set for the calibration liquids (→ page 158, §9.5.4) and the timing of the next automatic calibration starts (→ page 157, §9.5.3):

1 Call up menu 41 (`main menu → calibration → auto. calibration`).
2 Select `auto. calibration` to view the respective settings.
3 Select `information`.

`information` ` auto. calibration x` `1 zero solution 1` `2 zero solution 2` `3 test solution 3` `4 test solution 4` `5 test solution 5` `6 test solution 6` `7 calibr. cuvette` `8 auto. starts` ` Enter digit`	▶Select the desired category.

The `calibr. cuvette` menu function is not active on the TOCOR700.

Information on zero solution/test solution (example)

`information` `test solution 4` ` auto. calibration x` `C 21.00`	← nominal value [1]
`active yes` `gas pump no`	← `no` = not used for this automatic calibration ← condition of the gas pump[2]
`Back : ESCAPE`	▶Press [Esc] to leave this display.

1 "-.--" instead of the nominal value = the measurement component is not considered
2 Of no importance for TOCOR700 (the gas pump is always switched on during calibrations)

Information on automatic starts of the automatic calibrations (example)

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

9.5.10 Starting the automatic calibration procedure manually

CAUTION: Risk of incorrect calibration

Some preparatory work is necessary for automatic calibrations.

► Only start an automatic calibration when all requirements are fulfilled (→ page 156, § 9.5.1).

Some important settings can be inquired under `information` (→ page 162, § 9.5.9).

► `main menu` → `calibration` → `auto. calibration` → `auto. calibration x` → `manual control` must be selected.

`manual control` `auto. calibration x` `Press ENTER to start an automatic calibration now.` `Continue with ENTER` `Break : ESCAPE`	► *To start an automatic calibration procedure:* Press [Enter]. ► *To terminate the function:* 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 terminate the running calibration:* Select `Manual control` again. Press [Enter] to confirm termination.

9.6 Displaying calibration data

Function

Serves to view the data determined and stored during the last calibration – individually for each measurement component.

Procedure

`1 main menu → calibration → show cal. data` must be selected

`show cal. data` `1 C`	►Select "C".
`-Z- -S-` `D: 31.09.05 31.09.05` `T: 11.37.12 11.42.39` `S: 0.00 100.00` `I: 0.23 100.73` `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 actual values at the last calibration ← absolute drifts (explanation → page 95, § 7.3.6) ← difference[1] in drift values to the previous calibration ►Press [Esc] to leave this display.

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

When a calibration has not been performed since a drift reset (→ page 166, § 9.7) or the last basic calibration (→ page 168, § 9.8.2), no calibration data will be shown until a new calibration is performed. (This is also true for brand-new analyzers.)

A calculated drift difference reflects the relation between test value and nominal value. The *sensitivity drift* difference is always calculated in relation to the *larger* of the two values.

- *Example 1:* Nominal value is 100 ppm.
  Test value during calibration was 98 ppm.
  Sensitivity drift = (98-100)/100 = -2.00 %
- *Example 2:* Nominal value is 100 ppm.
  Test value during calibration was 102 ppm.
  Sensitivity drift = (102-100)/102 = +1.96 %

With this method, positive and negative physical drifts are calculated with a different mathematical weighting. *Effect:* When a physical drift occurs and then reverses by the same value, the calculated absolute drift then also returns to the original value. Without the different mathematical weighting, the absolute drift would deviate from the original value and thus no longer represent the actual physical state of the measuring system.

- During each calibration, the TOCOR700 automatically checks whether a drift value is larger than the relevant drift limit value (→ page 159, §9.5.5). A fault message is displayed when this is the case.
- It is not recommended to continue with computed drift compensation when the drift values gradually increase. When an “absolute drift” has become very large, inspect and readjust the relevant Analyzer module (e.g. clean and perform a basic calibration). – Drift values can be monitored automatically (→ page 159, §9.5.5).

9.7 Drift reset

Function

When a drift reset is made, the TOCOR700 cross-calculates the current “absolute drifts” (→ page 95, § 7.3.6) and then starts totaling the “absolute drifts” again at “0.0”. The drift reset allows starting recording “absolute drifts” at any time – for example, to check the drifts over a certain period of time.

NOTICE:

► Only use the “Drift reset” function for drift correction of the gas analyzer after maintenance work on the gas analyzer (e.g. after calibration with a test gas).

Ä Do not use the “Drift reset” function to compensate drift values caused by
- physical or mechanical changes in the gas generator
- erroneous calibrations.

- Physical fault and aging effects in the gas generator can cause large drift values, e.g.
  - Leaks
  - Worn/torn pump hoses
  - Erroneous water feed (e.g. air bubbles)
  - Changes in the carrier gas volume flow.
- Erroneous calibrations are possible due to, e.g.
  - Calibration liquids with wrong characteristics (e.g. test solution mixed incorrectly)
  - Discrepancy between nominal value and the calibration liquid used
- Gas analyzer drift does not normally have such a strong effect as causes in the gas generator.

To compensate large drift effects of the gas generator, change the carrier gas volume flow (→ page 136, § 8.14.4).

NOTICE:

- A drift reset cannot be reversed.
- A drift reset will discard the “history” of “absolute drifts”.

Procedure

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

9.8 Special calibrations

9.8.1 Basic settings for measuring sensitivity

Definition of the basic measuring range

The basic measuring range represents the physical measuring sensitivity. It is determined from:

1 Sample water volume flow

2 Carrier gas volume flow

3 Sensitivity of the CO_2 gas analyzer

On devices with two output ranges (option), the basic measuring range corresponds to the *larger* output range (output range 2). Output range 1 is calculated from the basic measuring range (maximum switching ratio: 1:10).

The pump hoses of dosing pump (M10) determine the sample water volume flow. The correct dimensions and materials of the pump hoses are specified in the Specification Sheet (→ page 20, Figure 1).

Procedure for the basic sensitivity setting

Work step	Measure	
1 Set the gas analyzer in the basic metrological state for measuring[1]	► Perform a basic calibration of the gas analyzer – *or:*	→ page 168, §9.8.2
	► Perform drift reset.	→ page 166, §9.7
2 Create the correct reagent volume flow.	► Fit suitable pump hose.	→ page 202, §12.2.5
3 Create the correct sample water volume flow.	► Fit suitable pump hose.	
4 Calibrate the zero point	► Perform zero point calibration with zero water.	→ page 153, §9.4
5 *On devices with two measuring ranges – when the measured value is read out via an analog measured value output:* Activate output range 2.	► Activate output range 2:	→ page 114, §8.8.5
6 Feed calibration solution.	► Prepare the suitable calibration solution and feed via the sample water line.	→ page 150, §9.2.2
7 Set the carrier gas volume flow so that the measured value approximately matches the nominal value of the calibration solution.[2]	► Set the nominal value of the carrier gas volume flow to a suitable value.	→ page 136, §8.14.4
8 Calibrate the TOCOR700.[3]	► Perform the calibration procedure.	→ page 153, §9.4

1 Only necessary when the procedure is carried out after a certain operational period (months, years)

2 This aligns the sample water volume flow (i.e. the CO_2 production in the reactor) and the CO_2 sensitivity of the gas analyzer roughly to each other (rough calibration).

3 In effect, this adjusts the gas analyzer sensitivity so that the nominal value of the calibration solution is displayed as an exact value (fine calibration).

9.8.2 Basic gas analyzer calibration

NOTICE:

- ► Only use the “Basic calibration” function for maintenance work on the gas analyzer.
- ► Modifications to the gas analyzer should only be made by trained service technicians of the manufacturer or authorized skilled persons. Otherwise the manufacturer’s guarantee will no longer be valid.

Necessity for a basic calibration

In the course of a basic calibration, both the analog and digital measured value processing of the gas analyzer are measured and optimized anew. A basic calibration must be performed in the following situations:

- *After exchanging, readjusting or changing the gas measurement system:* The analog amplification of the relevant measurement signal must be optimized again because these actions normally change the physical characteristics of the gas measurement system.
- *When the digital drift compensation has reached its limit:* The digital part of the measured value processing can be optimized again at any time with a drift reset but → page 166, § 9.7) the causes for analog drift of the gas analyzer remain and must be still be compensated. When the mathematical compensation is very large, it is possible that the specified measuring precision can no longer be maintained. This problem can be solved by performing a basic calibration because this also involves the analog part of the gas analyzer system.

Principle procedure for a basic calibration

During a basic calibration, the following happens in principle:

1 The measurement signals of the gas measurement system are checked and the electronic amplification of the measurement signals is optimized again to match.

2 The basic parameters of the mathematical measured value processing function are recalculated (in the same way as during a drift reset → page 166, § 9.7).

This requires calibration gases suitable for the measuring range of the gas analyzer.

Requirements for a basic calibration

To perform a basic calibration, you need the following:

- *Time:* The procedure usually takes about 20 and 120 minutes. The normal measuring function is not available during this time.
- *Manual gas feed:* You must feed the calibration gases manually into the gas analyzer (e.g. using a hose).
- *Knowledge of the physical zero point:* Check the “reference gas” specification (→ page 92, § 7.3.2) – because either the zero gas or the test gas must correspond to this value during a basic calibration (→ Table 6).
- *Calibration liquids:* A zero gas and an appropriate test gas are required for a basic calibration:

Table 6 Appropriate calibration gases for a basic calibration of the gas analyzer

“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	Physical measuring range end value [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 measurement span (`Min/Max` values are set accordingly).

Starting a basic calibration

CAUTION: Risks for connected devices/systems

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

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

► Make sure no dangerous situations arise in this case.

The measuring function of the gas analyzer is no longer ensured when a basic calibration is not carried out correctly.

► *Recommendation:* Backup the current data of the TOCOR700 before starting a basic calibration (→ page 130, §8.12.1). This allows restoring the functional state should the basic calibration be unsuccessful.

► Keep the TOCOR700 in operation for at least an hour before basic calibration so that all internal temperatures are stable.

► Terminate the procedure should any doubts arise (press [Esc]). This will keep the previous state.

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

Procedure for a single measurement component

1 Call up `meas. component`.
2 Select the measurement component for the following procedure.
3 Call up `zero gas`.
4 Enter the appropriate zero gas nominal value (→ page 168, Table 6).
5 Call up `test gas`.
6 Enter the test gas nominal value (→ page 168, Table 6).
7 When the nominal values have been correctly entered, select `measure`.
8 A display message signals that the following procedure starts with the calibration gas that creates the higher measurement signal (mostly the `test gas`). Press [Enter] to continue.

The following display will be like this (example):

`CO2 30.000 vol.%` `Enter CO2` `test gas` `30.000 vol.-%` `Continue with ENTER` `0 = fixed amplific.`	← measurement component; nominal value of the calibration gas ← only after sufficient waiting time has elapsed ← *only for trained skilled 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.

9 Feed the displayed gas (*Attention:* The procedure starts with the *larger* nominal value.)
10 Wait until the gas has completely filled the internal measuring system, replacing the previous gas (appropriate purge time).
11 Press [Enter].

In the following step, the gas analyzer optimizes the analog amplification of the measurement signal for the selected measurement component. The display shows (example):

CO2 30.000 vol.% CO2 18559 341 18:3 % Please wait ...	← measurement component; nominal value of the calibration gas ← another measurement component ← ADC value[1]; analog amplification stage[2] [3] ← another measurement component ← progress of the internal procedure

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

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

when values are stable,start with Enter.	

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

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

The gas analyzer then carries out a calibration measurement with the test gas (takes 30 times longer than a normal measurement process). Progress is shown in %.

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

The display shows (example):

Enter CO2 zero gas 0.000 vol.-% Continue with ENTER	

15 Feed the calibration gas shown. Press [Enter].

The following display will be like this (example):

CO2 0.000 vol.% CO2 1742 when the values are stable, start with Enter.	← ADC value [1]

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

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

The gas analyzer then carries out a calibration measurement with the zero gas. Progress is shown in %.

17 Wait until `Save: ENTER` is displayed. Press [Enter] to accept the displayed value.
The gas analyzer now calculates the “linearization values” (calibration curve). The function variables of a basic mathematical function are modified until the optimum calibration function is found. Progress (%) and the number of iteration steps are displayed.

18 Wait until a display like this is shown:

`CO2 1.234` `Save: ENTER`	← measurement component; variation coefficient[1]

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

19 Wait until `Save: ENTER` is displayed.

An error message appears instead should the procedure not run successfully: The calibration gas and the measurement component that could not be calculated correctly are shown below the word `FEHLER` (in all languages).

- ► *Clearance:* Terminate the procedure and repeat it carefully (check nominal values, feed calibration liquids correctly, observe purge times).
- ► *If unsuccessful:* Contact the manufacturer's customer service for advice. Or restore the previous TOCOR700 state to use the analyzer in its previous functional state (can only be done when a data backup was made before starting the basic calibration → page 130, § 8.12.1).

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

TOCOR700

10 Remote Control with MARC2000

Connection
Activation

10.1 Introduction to remote control with MARC2000

General function of the remote control with MARC2000

You can remote control all the TOCOR700 functions using a PC with the MARC2000 PC software (separately available from SICK). All TOCOR700 displays appear on the PC screen and the operating keys of the TOCOR700 are simulated on the PC.

You can also use one PC to control several TOCOR700s (BUS mode).

Possible uses

- Gas analyzer control and monitoring via PC
- Remote diagnosis and troubleshooting 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)
- SICK's MARC2000 PC software for analyzer remote control
- Electrical interface connection between gas analyzer and PC – directly or via modems (→ page 175, § 10.2.1)
- Additional for remote control of several gas analyzers: One RS232C/RS422 Bus converter for each PC and each gas analyzer (→ page 175, § 10.2.1)

10.2 Remote control installation

10.2.1 Electrical connection

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

Connecting a single analyzer directly via the interfaces →page 176, Figure 36

At least three lines are required for a connection (TXD → RXD, RXD → TXD, GND → GND). Short out the CTS–RTS and DSR–DTR connections on the PC (install wire bridges in the plug connector of the connecting cable; see Figure). To use the “RTS/CTS protocol” for data transfers (Windows designation: “Protocol: Hardware”), install three further connection lines (see Figure); the shorting jumpers are then not required.

Connecting several analyzers via BUS converters →page 176, Figure 36

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

The BUS converter 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. Setup the BUS converters accordingly or use the appropriate BUS converter versions. – Most BUS converters need an auxiliary voltage (not shown in the Figure).

When using BUS converters, the “RTS/CTS protocol” must be activated in the gas analyzer (→ page 122, §8.10.4).

Connecting a single analyzer via modems →page 177, Figure 37

Modems are used to transmit data via telephone lines. A modem connection requires two modems. The modems must have a Hayes compatible command set; apart from that the modem type and design are optional. – Special menu functions are available in both the TOCOR700 and the MARC2000 software to set the required modem parameters.

Connecting several analyzers via BUS converters and modems →page 177, Figure 37

This version combines modems and BUS converters. Please refer to the information above.

The type of connection to be used must be set in the TOCOR700 (→ page 127, §8.11.3).

Figure 36 Connection of gas analyzer and PC without modems

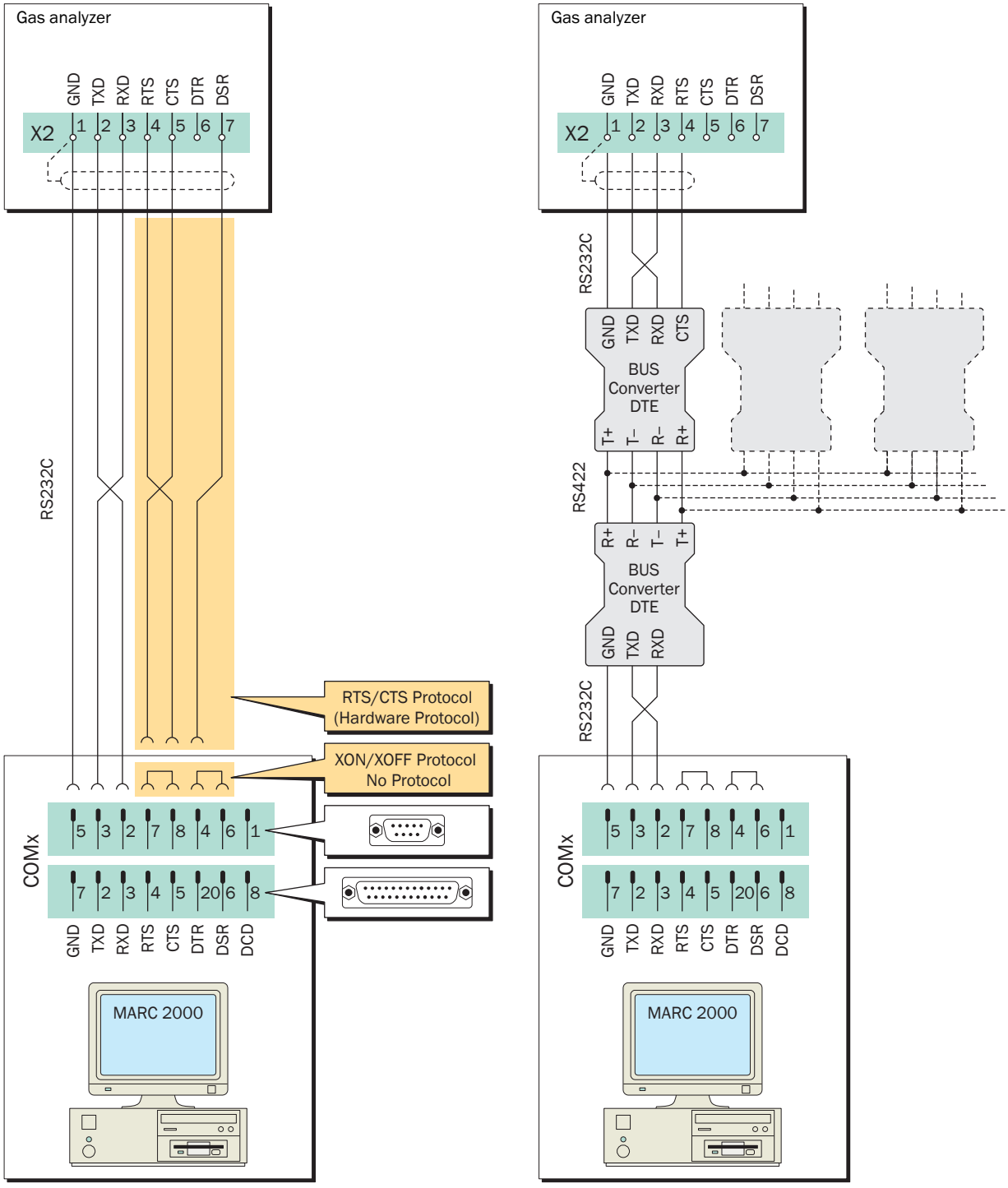
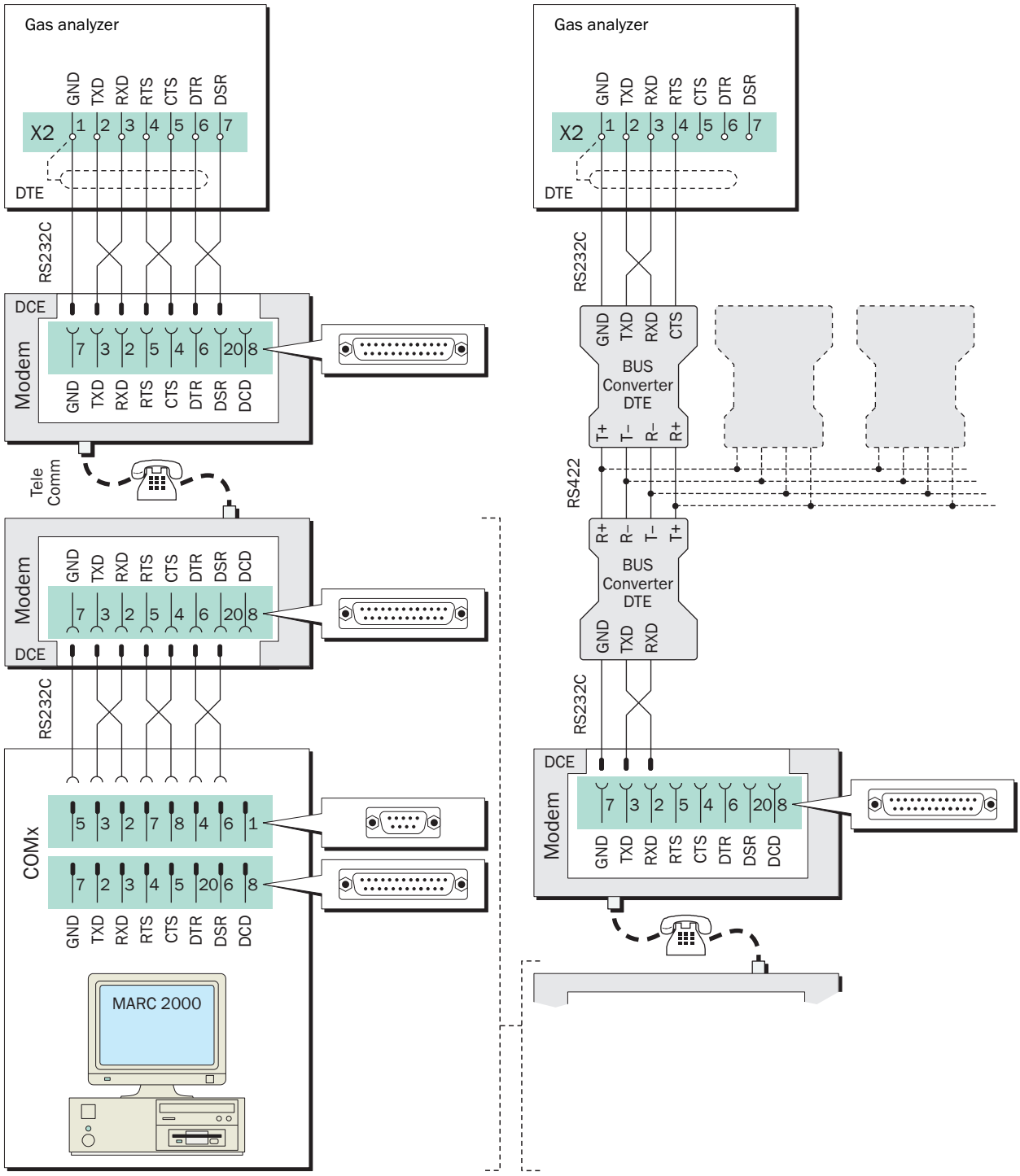


Figure 37 Connection of gas analyzer and PC with modems



10.2.2 Making the necessary settings in the TOCOR700

Basic settings

1 Set interface parameters on interface #1 to match those on the connected PC or modem (→ page 122, § 8.10.4).

2 Set the installed electrical connection (→ page 127, § 8.11.3).

Settings for operation with modems

► Set basic modem functions (→ page 128, § 8.11.4).

Settings for operation with BUS converters

1 Activate the “RTS/CTS protocol” (→ page 175, § 10.2.1).

2 Set an individual identification character for each of the connected gas analyzers (→ page 126, § 8.11.1).

3 Activate `AK-ID-active` (→ page 127, § 8.11.2).

When using BUS converters:

► Make all the remote control settings identical in all the connected gas analyzers –except for the identification character.

10.2.3 Setting the PC for remote control

1 Install the MARC2000 software program on the PC (refer to the MARC2000 operating instructions).

2 Check the Windows system settings for the RS232 serial interface (COMx) that is used for the gas analyzer remote control:

- The settings must match the interface parameters of the connected gas analyzer or modem.
- Observe the information on the RTS/CTS protocol (→ page 175, § 10.2.1).

In the Windows system, the RTS/CTS protocol is called “Protocol: Hardware”.

10.3 Starting and ending remote control operation

10.3.1 Starting remote control

Perform the following steps to activate remote control in MARC2000:

1 Start the MARC2000 program on the PC.

When using modems:

1 Initialize the PC modem. (Not required if the modem has already been initialized and the modem settings have not been changed or erased – refer to operational information for MARC2000.)

2 Initialize the gas analyzer modem. (Not required if the modem has already been initialized and the modem settings have not been changed or erased.)

3 Establish a telephone connection from modem to modem.
   – From the PC: Use the MARC2000 menu function.
   – From the gas analyzer: Use the `dialing` menu function (→ page 129, § 8.11.5).

1 Activate remote control: Perform the corresponding MARC2000 functions on the PC.

The TOCOR700 also transmits all displayed data to the PC as well as long as the remote control is active. This is why the TOCOR700 may react a bit slowly when you press a key.

10.3.2 Status message during remote control with MARC2000

The status message `PC control active !` appears on the TOCOR700 display as long as the remote control with MARC2000 is active. Messages alternate about every second should further status messages (e.g. `CHECK STATUS/FAULTS`) appear.

10.3.3 Ending remote control

Any of the following actions will terminate the remote control with the MARC2000:

- One of the connected devices (PC, gas analyzer, modem, BUS converter) is switched off or its power supply fails.
- The remote control of the TOCOR700 is terminated by a MARC2000 command on the PC.
- MARC2000 is terminated by the command File | Exit on the PC.
- The TOCOR700 has not received any remote control commands for the last 15 minutes.

In addition, when modems are used:

- The modem command `abort` is selected in the TOCOR700. This terminates the telephone connection.
- One of the connected modems is initialized (by doing so, the modem will break off the existing telephone connection).

When data communication is not required, the MARC2000 transmits a "dummy" remote control command approx. every 5 minutes, to prevent the TOCOR700 from automatically terminating the remote control function.

When the PC and TOCOR700 are connected via modems and the telephone connection with the TOCOR700 has been established:

► *When remote control has finished: Select* the modem function `abort` on the TOCOR700.

Otherwise the telephone line connection will be kept on the TOCOR700 modem even though remote control has been terminated.

10.4 Remote control with "AK protocol" (information)

The "AK protocol" is a software specification for digital interfaces which has been defined by the German automobile industry. The device function "limited AK protocol" provides some remote control functions related to this specification.

These functions are not described in these Operating Instructions.

► *For detailed information on the "limited AK protocol":* Request the Operating Instructions for series S700 gas analyzers.

TOCOR700

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 controls to connect a “Master” device with several “Slave” devices. The Modbus protocol only defines the communication commands not their electronic transfer which means it can be used for different digital interfaces (e.g. RS232, RS422, RS485). The Modbus standard was originally developed by the MODICON company for use with their interface controller chips and is now a widely-used industrial application.

Versions

There are two Modbus transmission versions:

- *ASCII transfer mode:* Two ASCII characters (2 characters each with 4 bits) are sent in one byte (8 bits). This mode allows pauses between single characters (up to 1 second).
- *RTU transfer mode:* Two hexadecimal characters are sent as two characters each with 4 bits. The RTU mode can be faster.

Command structure

Device address	Function code	Function data	Checksum

- The device address is set individually for each connected device.
- Function codes are specified by the Modbus standard. For example, they order the slave to output instrument data (Read) or to change internal states (Force).
- The function data contain the additional information required to perform the function. These specifications are device-specific and must therefore be specified by the manufacturer. Function code + function data create the command the slave should perform.
- The checksum is used to validate the transmitted data. The checksum is calculated by both the transmitting and receiving device. Data transmission was correct when the checksums were identical.

Slave response

Normally, the slave will respond to a command by sending an echo with the same function code and the function data containing the requested information. For error messages, the function code is modified and the function data contain an error code.

For more information on the Modbus protocol (in English), go to the Modbus Internet website: http://www.modbus.org

11.2 Modbus specifications for the TOCOR700

Modbus functionality

- The TOCOR700 acts as a slave device.
- The TOCOR700 sends and receives in RTU mode.
- The TOCOR700 processes and replies to an input command immediately without delay after the last command character has been received. 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, maintain the following Modbus parameters:

Slave response time:	≥ 200 ms
Delay between polls:	≥ 200 ms
Scan rate:	≥ 500 ms

► Maintain longer times with lower baud rates.

Data transfer malfunctions can occur with lower values.

The TOCOR700 needs approximately 0.5 seconds to generate a new measured value. New measured values are created about one second apart when the TOCOR700 measures two measurement component. It is probably not necessary to request measured values in shorter intervals.

11.3 Installing a Modbus remote control

11.3.1 Interface

Interface #1 is used for remote control purposes (connection diagram see → page 76, § 30). Permitted interface parameters:

Baud rate:	Maximum 28800
Data bits:	8
Parity:	As required - even/odd/none
Stop bits:	1

Settings → page 122, § 8.10.4

11.3.2 Electrical connection

Connecting one slave device

The Modbus functions can even be used with a simple direct interface connection, as shown on the left part of Figure 36 (→ page 176). In this way, a single TOCOR700 can be connected to a master device – for example, for tests.

Connecting several slave devices (BUS mode)

If several TOCOR700 analyzers are to be controlled by a master device, a BUS system must be installed using RS232C/BUS converters, as shown on the right part of Figure 36 (→ page 176). Other BUS systems can be used instead of RS422; for example, RS485.

11.3.3 Making the necessary settings on the TOCOR700

1 Set interface parameters on interface #1 to match those on the connected BUS converter or master device (→ page 122, § 8.10.4).

2 *For operation with Bus converters:* Activate “RTS/CTS protocol” (→ page 175, § 10.2.1).

3 Set the type of electrical connection installed (→ page 127, § 8.11.3).

4 Provide an individual identification character for each of the connected gas analyzers (→ page 126, § 8.11.1).

5 `Activate AK-ID with MODBUS` (→ page 127, § 8.11.2).

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 TOCOR700

11.4.1 Function codes

The TOCOR700 can process the following function codes:

Code	Description	Function
01	Read Coil Status	Read one or several 1-bit status data (inquiring the TOCOR700 status).
		A maximum of 64 coils can be read with one command. 200 coils available (→ § 11.4.4).
		Address: 0000H to 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 are available, each with 16 bits (→ § 11.4.4).
		Address: 0000H to 00C7H
05	Force Single Coil	Write 1-bit data (to program one TOCOR700 setting).
		Each command changes 1 coil. 32 coils are available (→ § 11.4.3).
		Addresses: 0000H ... 001FH (overlapping with Read Coil Status) and 00A8H ... 00C7H (will be reset after power failure).
16	Preset Multiple Register	Write one or several 16-bit data words (to program one TOCOR700 setting).
		Each command can write a maximum of 32 registers. 32 registers are available (→ § 11.4.3).
		Addresses: 0000H ... 001FH (overlapping with Read Holding Register) and 00A8H ... 00C7H (will be 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 = sign; 0 = + / 1 = –
E = exponent (2 complements biased by 127)
M = mantissa (1st mantissa)
Data transmission sequence:

Byte 1	Byte 0 (LSB)	Byte 3 (MSB)	Byte 2

11.4.3 Modbus control commands

Force Single Coil

The control command Force Single Coil (function code 05) and following function data allow the master device to control the following TOCOR700 functions:

data	control command
1	– not specified –
2	– not specified –
3	– not specified –
4	– not specified –
5	sample hold (20 mA measured 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

data	control command
17	hold sample point 1
18	hold sample point 2
19	hold sample point 3
20	hold sample point 4
21	hold sample point 5
22	hold sample point 6
23	hold sample point 7
24	hold sample point 8
25	skip sample point 1
26	skip sample point 2
27	skip sample point 3
28	skip sample point 4
29	skip sample point 5
30	skip sample point 6
31	skip sample point 7
32	skip sample point 8

Preset Multiple Register

The control command Preset Multiple Register (function code 16) and following register data allow the master device to control the following TOCOR700 functions:

register no.		control command	structure			
X	Y		X-high	X-low	Y-high	Y-low
R1	R2	Set date in the TOCOR700	month	day	– free –	year
R3	R4	set time in the TOCOR700	hours	minutes	– free –	seconds
R5	R6	set 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 127, § 8.11.2)

11.4.4 Modbus read commands

Read Coil Status

The control command Read Coil Status command (function code 01) and following function data allows the master device to read the TOCOR700 instrument status:

data	status
1	maintenance active
2	temp. controller 1 is heating up
3	temp. controller 1 is out of the nominal range
4	temp. controller 2 is heating up
5	temp. controller 2 is out of the nominal range
6	temp. controller 3 is heating up
7	temp. controller 3 is out of the nominal range
8	controller 4 is starting-up
9	controller 4 is out of the nominal range
10	– no function –
11	alarm limit 1 indication is activated
12	alarm limit 2 indication is activated
13	alarm limit 3 indication is activated
14	alarm limit 4 indication is activated
15	signal for compon. 1 too high (ADC overflow)
16	signal for compon. 2 too high (ADC overflow)
17	signal for compon. 3 too high (ADC overflow)
18	signal for compon. 4 too high (ADC overflow)
19	signal for compon. 5 too high (ADC overflow)
20	A/D converter (ADC) not ready
21	meas. value comp. 1 > 120 % of end val.[1]
22	meas. value compon. 2 > 120 % of end val.[1]
23	meas. value compon. 3 > 120 % of end val.[1]
24	meas. value compon. 4 > 120 % of end val.[1]
25	meas. value compon. 5 > 120 % of end val.[1]
26	Calibration running
27	automatic calibration running
28	control output “zero gas 1” is activated
29	control output “sample gas” is activated
30	control output “test gas 3” is activated
31	control output “test gas 4” is activated
32	control output “test gas 5” is activated
33	measuring value output 1: range 2 is active
34	measuring value output 2: range 2 is active
35	measuring value output 3: range 2 is active
36	measuring value output 4: range 2 is active
37	control output “external pump” is activated
38	zero-point drift of compon. 1 > drift limit
39	zero-point drift of compon. 2 > drift limit
40	zero-point drift of compon. 3 > drift limit
41	zero-point drift of compon. 4 > drift limit
42	zero-point drift of compon. 5 > drift limit
43	sensitivity drift of compon. 1 > drift limit
44	sensitivity drift of compon. 2 > drift limit
45	sensitivity drift of compon. 3 > drift limit
46	sensitivity drift of compon. 4 > drift limit
47	sensitivity drift of compon. 5 > drift limit
48	zero pt. drift of compon. 1 120 > drift limit
49	zero pt. drift of compon. 2 > drift limit
50	zero pt. drift of compon. 3 > drift limit
51	zero pt. drift of compon. 4 > drift limit
52	zero pt. drift of compon. 5 > drift limit
53	sens. drift of compon. 1 > 120 % drift limit
54	sens. drift of compon. 2 > 120 % drift limit
55	sens. drift of compon. 3 > 120 % drift limit
56	sens. drift of compon. 4 > 120 % drift limit
57	sens. drift of compon. 5 > 120 % drift limit
58	pressure signal too great (ADC overflow)
59	Condensate in sample gas path (int. sensor)
60	flow signal too great (ADC overflow)
61	flow < flow limit value (failure)
62	flow < flow limit value (failure)

data	status
63	control input “test gas 3 fault” is activated
64	control input “test gas 4 fault” is activated
65	control input “test gas 5 fault” is activated
66	control input “zero gas 1 fault” is activated
67	IR source malfunction
68	chopper wheel malfunction
69	failure during calibration with zero gas 1
70	failure during calibration with test gas 3
71	failure during calibration with test gas 4
72	failure during calibration with test gas 5
73	– no function –
74	internal power supply failure
75	control input “failure 1” is activated
76	control input “failure 2” is activated
77	control input “fault 1” is activated
78	control input “fault 2” is activated
79	control input “service 1” is activated
80	control input “service 2” is activated
81	“FAULT” status is activated
82	“FAULT” status is activated
83	control output “zero gas 2” is active
84	control output “test gas 4” is active
85	control input “zero gas 2 fault” is activated
86	control input “test gas 6 fault” is activated
87	Failure during calibration with zero gas 2
88	Failure during calibration with test gas 6
89	– no function –
90	– no function –
91	– no function –
92	– no function –
93	– no function –
94	– no function –
95	– no function –
96	– no function –
97	– no function –
98	– no function –
99	– no function –
100	– no function –
101	– no function –
102	– no function –
103	– no function –
104	– no function –
105	analyzer module 1 is out of order
106	analyzer module 2 is out of order
107	analyzer module 3 is out of order
108	– no function –
109	– no function –
110	analyzer module 1 malfunction
111	analyzer module 2 malfunction
112	analyzer module 3 malfunction
113	– no function –
114	– no function –
115	calibration running with analyzer module 1
116	calibration running with analyzer module 2
117	calibration running with analyzer module 3
118	– no function –
119	– no function –
120	signal of an. module 1 is too great (ADC overfl.)
121	signal of an. module 2 is too great (ADC overfl.)
122	signal of an. module 3 is too great (ADC overfl.)
123	signal of an. module 4 is too great (ADC overfl.)
124	signal of an. module 5 is too great (ADC overfl.)

[1] Of the physical measuring range

Read Coil Status

The control command Read Coil Status and following data allows the master device to check whether the TOCOR700 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	wwitch-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

data	control command
185	hold sample point 1
186	Hold sample point 2
187	Hold sample point 3
188	hold sample point 4
189	hold sample point 5
190	hold sample point 6
191	hold sample point 7
192	hold sample point 8
193	sSkip sample point 1
194	Skip sample point 2
195	skip sample point 3
196	skip sample point 4
197	skip sample point 5
198	skip sample point 6
199	skip sample point 7
200	skip sample point 8

In the response, status “1” means “function activated” and status “0” means “function not activated”. The status of these messages is “not activated” after a power failure or switching-off the TOCOR700.

Read Holding Register

The control command Read Holding Register command (function code 03) and following register data allows the master device to inquire the following data from the TOCOR700:

register no.		status/value	structure			
X	Y		X-high	X-low	Y-high	Y-low
R1	R2	current date (in the TOCOR700)	month	day	– free –	year
R3	R4	current time (in the TOCOR700)	hours	minutes	– free –	seconds
R5	R6	measuring component 1: current measured value	floating-point value			
R7	R8	measured component 1: end value of physical measuring 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	Measuring component 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	measuring component 1: current sensitivity drift in %	floating-point value			
R21	R22	measuring component 1: previous zero-point drift in %	floating-point value			
R23	R24	measuring component 1: previous sensitivity drift in %	floating-point value			
R25	R26	– not specified –				
R27	R28	– not specified –				
R29	R30	– not specified –				
R31	R32	current date (in the TOCOR700)	month	day	– free –	year
R33	R34	current time (in the TOCOR700)	hours	minutes	– free –	seconds
R35	R36	measuring component 2: current meas. value	floating-point value			
R37	R38	measuring component 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 sensitivity drift in %	floating-point value			
R51	R52	meas. comp. 2: previous zero-point drift in %	floating-point value			
R53	R54	meas. comp. 2: previous sensitivity drift in %	floating-point value			
R55	R56	– not specified –				
R57	R58	– not specified –				
R59	R60	– not specified –				

Continued →

Continued: Register data for the Read Holding Register command

register no.		status/value	structure			
X	Y		X-high	X-low	Y-high	Y-low
R61	R62	current date (in the TOCOR700)	month	day	– free –	year
R63	R64	current time (in the TOCOR700)	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 sensitivity drift in %	floating-point value			
R81	R82	meas. comp. 3: previous zero point drift in %	floating-point value			
R83	R84	meas. comp. 3: previous sensitivity drift in %	floating-point value			
R85	R86	– not specified –				
R87	R48	– not specified –				
R89	R90	– not specified –				
R91	R92	current date (in the TOCOR700)	month	day	– free –	year
R93	R94	current time (in the TOCOR700)	hours	minutes	– free –	seconds
R95	R96	meas. comp. 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 sensitivity drift in %	floating-point value			
R111	R112	meas. comp. 4: previous zero-point drift in %	floating-point value			
R113	R114	meas. comp. 4: previous sensitivity drift in %	floating-point value			
R115	R116	– not specified –				
R117	R118	– not specified –				
R119	R120	– not specified –				
R121	R122	current date (in the TOCOR700)	month	day	– free –	year
R123	R124	current time (in the TOCOR700)	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 sensitivity drift in %	floating-point value			
R141	R142	meas. comp. 5: previous zero-point drift in %	floating-point value			
R143	R144	meas. comp. 5: previous sensitivity 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] (measured 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 127, §8.11.2)

TOCOR700

12 Maintenance

Maintenance plan
Periodical checks
Periodical replacements
Cleaning
Leak tightness test
Maintenance measures

12.1 Scheduled maintenance

12.1.1 Maintenance plan

Table 7 Regular maintenance by the user/owner

Maintenance interval	Maintenance work	
1 ... 2 days	Make a visual inspection	→ page 196, § 12.1.2
1 ... 4 weeks	Top up reagent	→ page 47, § 3.4.2
	Perform calibration	→ page 153, § 9.4 / → page 156, § 9.5
6 ... 8 weeks	Replace CO_2 absorber [1]	→ page 198, § 12.2.2
	Check/replace corrosion inhibitor filter	→ page 200, § 12.2.3
	Replace activated charcoal filter	→ page 201, § 12.2.4
	Replace pump hoses	→ page 202, § 12.2.5
Depending on degree of contamination	Clean phase separator	
	Clean gas washer [2]	
	Clean reactor	→ page 204, § 12.3 / → page 206, § 12.4
1 ... 2 years	Replace UV lamp [3]	→ page 244, § 17.1
According to regulation	Check/service pressurized enclosure[4]	→ page 26, § 2.3.3

1 The maintenance interval is shorter when a smaller absorbent container is fitted (→ page 43, § 3.3.2)
2 Only for TOCOR700 TH
3 Only for TOCOR700 UV – Recommendation: Have work done by Customer Service
4 Only for housings with pressurized enclosure (version for potentially explosive atmospheres)

Additional maintenance regulations could possibly exist:
– For device versions for potentially explosive atmospheres
– For the individual application
► Observe the individual technical device documentation.
► Observe company and official maintenance regulations.

Photocopies of the Maintenance protocol (→ page 196) can be used to document maintenance work.

CAUTION: Risks when the measuring function fails
The measuring function is not in operation during maintenance work.
► *When external locations that process the measured value or status messages of the TOCOR700 TH are connected:* Switch the external locations to a safe state or inform these that the measuring function is not available.

Table 8 Maintenance work by Customer Service

Maintenance interval	Maintenance work	
Approx. 1 year [1]	Check important signal connections	→ page 211, § 12.6.2
	Check flow sensor	[2]
	Check gas pump	[3]
	Check leak tightness	→ page 219, § 13.5
1 ... 2 years	Replace UV lamp	→ page 244, § 17.1

1 *Recommendation:* Have work done by manufacturer's Customer Service
2 Reduce carrier gas volume flow and check error message (→ page 135, § 8.14.2)
3 Check function; disassemble and clean when necessary

12.1.2 Maintenance protocol

Visual inspection				
Object		Check criteria	OK	Remark
1	Pressurized enclosure[1]	*See separate instructions*	❑	
2	Status indicators	LED “Function” is green	❑	❑ Malfunction message:
		LED “Service” not on	❑	
		No error message under `Check status`	❑	❑ Clear malfunction
3	Leak tightness	No liquids escaping	❑	❑ Repair leak
4	UV reactor[2]	Not badly soiled	❑	
	Thermal reactor[3]	Actual temperature = nominal temperature		
5	Gas flow	Actual value in nominal range[4], constant	❑	
6	Dosing pump	Pump hoses OK	❑	❑ Maintenance necessary
7	Pre-sampling pump	Pump hose OK	❑	❑ Maintenance necessary
8	CO_2 absorber	Absorption material not spent	❑	❑ Maintenance necessary
9	Corrosion inhibitor filter	Brass wool not spent.	❑	❑ Maintenance necessary
10	Phase separator	Not dirty/clogged	❑	❑ Maintenance necessary
		Disposal functions OK	❑	
11	Waste water drain	Not clogged	❑	❑ Maintenance necessary
12	Reagent container	Reserve sufficient	❑	❑ Maintenance necessary
13	Calibration solution[5]	Not too old	❑	❑ Maintenance necessary
		Reserve sufficient for calibration	❑	
Date		Signature		

1 Only for housings with pressurized enclosure (version for potentially explosive atmospheres)
2 Only for TOCOR700 UV
3 Only for TOCOR700 TH
4 See Specification Sheet (example → page 20)
5 Check when automatic calibrations are performed

Work done				
Work			OK	Remark
1	Reagent topped up		❑	
2	CO_2 absorption material replaced		❑	
3	Corrosion inhibitor filter replaced		❑	
4	Activated charcoal replaced		❑	
5	Dosing pump hoses replaced[1]		❑	
6	Pre-sampling pump hose replaced[1]		❑	
7	Water lines (containers) cleaned[2]		❑	
8	Dirty water hoses replaced[2]		❑	
9	Reactor cleaned[2]		❑	
10	Calibration	Zero point calibration carried out	❑	
		Sensitivity calibration carried out	❑	
Date		Signature		

1 When necessary
2 Only when necessary

12.2 Replacing expendable materials

12.2.1 Topping up reagent container

Function

The TOCOR700 needs a reagent liquid for operation (→ page 47, § 3.4.2). Top up the reagent container regularly.

The maintenance interval depends on the device configuration and size of the reagent container.

Function

1 Switch gas pump off (per menu function → page 96, § 7.4.1).
2 Switch dosing pump off (per menu function → page 100, § 7.4.7).
3 Fill reagent into the reagent container.
   – Position of the reagent container → page 47, § 3.4.1
   – Preparation, safety information, reagents → page 47, § 3.4.2
4 Switch gas pump and dosing pump on again.

12.2.2 Replacing CO_2 absorption material

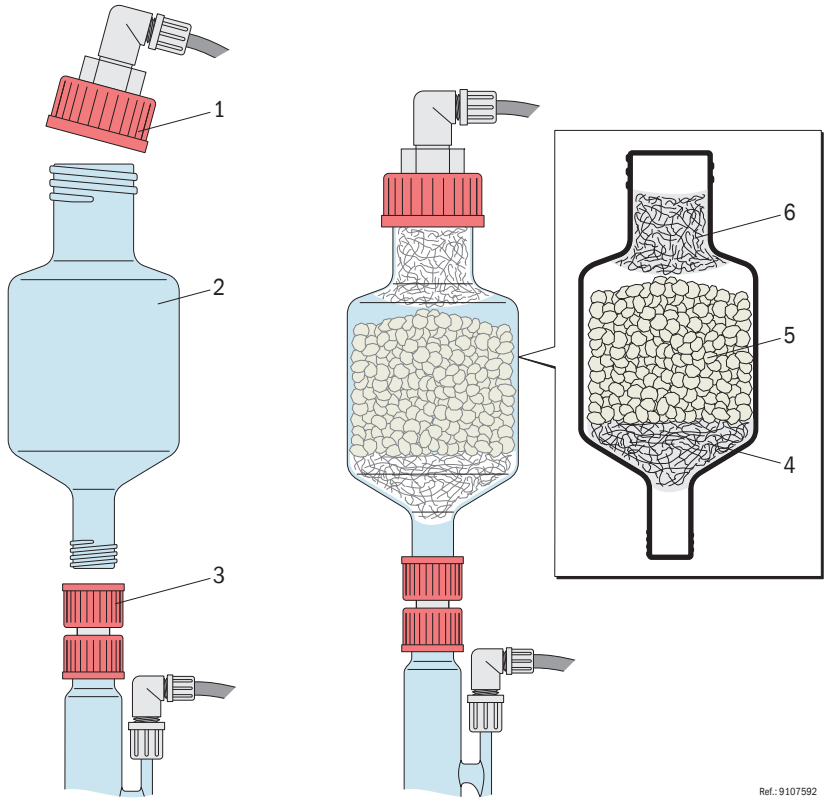
Notes for operator

The CO_2 is removed from the carrier gas in the CO_2 absorber before it reaches the reactor. The correct state of the CO_2 absorber is decisive for measurement. Soda lime granulate is used as absorption material. The soda lime goes bluish when completely spent (color indicator).

The soda lime effect is already unsatisfactory before discoloring is noticeable.

► Replace the soda lime filling regularly – even when no discoloring is noticeable.
  – *For the standard version* (→ Figure 38): Every 6 ... 8 weeks.
  – *When a smaller absorbent container is fitted* (→ page 43, § 3.3.2): In relatively shorter time intervals (2 ... 4 weeks).

Figure 38 CO_2 absorber



Procedure

1 Switch gas pump off (per menu function → page 96, § 7.4.1).
2 Switch dosing pump off (per menu function → page 100, § 7.4.7).
3 Open upper screw cap [1] of absorber container [2].
4 Loosen lower screw cap [3] and push the container (phase separator) positioned underneath down slightly.
5 Take the absorber container out of the retainer clamps and empty it.
  ► Safety information on soda lime → page 257, § 18.1.4
  ► Dispose of used material in an appropriate manner.

6 Place about 5 g of filter wool [4] at the bottom of the absorber container. Compress the filter wool slightly to completely block the lower opening.

- Spare material → page 250, § 17.8.2
- Available filter wool can continue to be used when it is gas-permeable and dry.
- Some moisture can possibly collect at the bottom of the absorber container during operation. This does not influence the CO_2 absorber function.

7 Fill with approx. 500g (375 ml) new soda lime granulate [5].
► Spare material → page 250, § 17.8.1

8 Now place about 5 g filter wool over the granulate [6] and compress slightly.

9 Clean the sealing surfaces on the absorber container and in the screw caps (pay attention to gas leak tightness).

10 Refit the absorber container and screw both screw caps back on.

11 Switch gas pump and dosing pump on again.

12 Perform a calibration.

► *For sensitive TOC measuring ranges:* Wait several operating hours before calibrating.

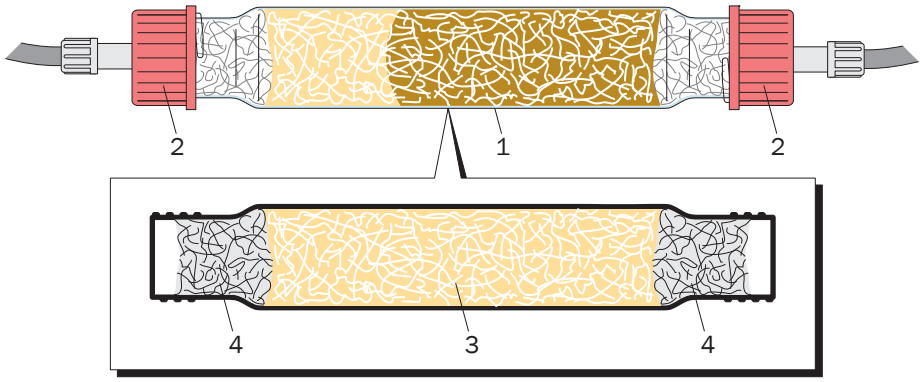
The zero point value is somewhat higher at first with new soda lime granulate because the granulate still emits traces of CO_2. The granulate is first "clean" after several operating hours.

12.2.3 Replacing the corrosion inhibitor filter

Function

The corrosion inhibitor filter is filled with brass wool that protects the gas analyzer against acid vapours. Replace the brass wool at the latest when half of the brass wool is discolored.

Figure 39 Corrosion inhibitor filter



Procedure

1 Switch gas pump off (per menu function → page 96, § 7.4.1).
2 *Recommendation:* Switch dosing pump off (per menu function → page 100, § 7.4.7).
3 Take filter tube [1] out of the holder. Take off screw caps [2].
4 Empty filter tube.

CAUTION: Harmful reaction products
Substances harmful to health and the environment can form on the brass wool during operation (e.g. $CuCl_2$, $CuSO_4$).
► Handle used brass wool securely and safely and dispose of properly.
► Also remove residues from the filter tube with care.

5 Fill approx. 30 g brass wool [3] in the filter tube.

- Spare material → page 250, § 17.8.2
- 1 packet of brass wool contains about 12 g.

6 Insert a plug made of filter cotton [4] (approx. 5 g) in both ends.
7 Clean sealing surfaces:
  – Ends of the filter tube
  – Sealing surfaces of the screw caps
8 Fit the filter tube. Close the screw caps properly.
9 Switch gas pump and dosing pump on again.

CAUTION: Risk of incorrect measurements
Leaks falsify measured values.
► Check condition of sealing surfaces. Replace components with damaged sealing surfaces.
► Check condition and correct position of sealing rings.
► Ensure gas leak tightness when assembling components.

12.2.4

Replacing the activated charcoal filter

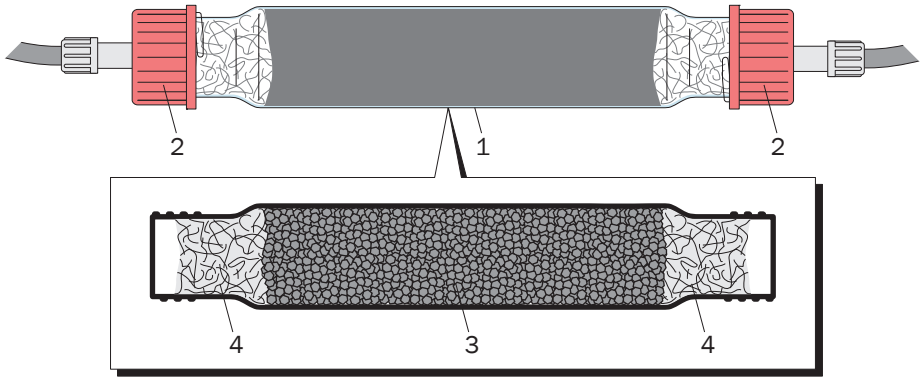
- *Only valid for TOCOR700 UV.*
- *Can possibly be ignored when external carrier gas free of carbon is used.*

Function

The activated charcoal filter absorbs hydrocarbons out of the ambient air used as carrier gas. Without this filtering, hydrocarbons out of the ambient air could falsify the measured values. The maintenance interval depends on how strong the ambient air is charged with hydrocarbons.

This filter is possibly not fitted when external carrier gas free of carbon is installed (→ page 62, § 4.5).

Figure 40 Activated charcoal filter



Spare material → page 250, § 17.8.2

Procedure

1 Switch gas pump off (per menu function → page 96, § 7.4.1).
2 *Recommendation:* Switch dosing pump off (per menu function → page 100, § 7.4.7).
3 Take filter tube [1] out of the holder. Take off screw caps [2].
4 Remove filter cotton [4] from one end of the filter tube.
5 Empty the activated charcoal [3] out of the filter tube.
   ► Safety information on activated charcoal → page 256, § 18.1.1
6 Fill new activated charcoal granulate.
   ► Spare material → page 250, § 17.8.2
7 Insert filter cotton plug again.
8 Clean sealing surfaces:
   – Ends of the filter tube
   – Sealing surfaces of the screw caps
9 Fit the filter tube. Close the screw caps properly.
10 Switch gas pump and dosing pump on again.

CAUTION: Risk of incorrect measurements
Leaks falsify measured values.
► Ensure gas leak tightness when assembling components.

12.2.5 Replacing dosing pump hoses (5 channel hose pump)

NOTICE:

The pump hoses of dosing pump (M10) determine the sample water volume flow. The correct sample water volume flow is prerequisite for correct calibrations and measurements.

► Only use pump hoses with dimensions and materials exactly matching the specifications in the Specification Sheet (→ page 20, Figure 1).

Service life

Under average operating conditions, all the dosing pump hoses must be replaced after 6 ... 12 weeks as a preventive measure.

The service life of the pump hoses is dependent on:

- Pump speed
- Type and concentration of particles in the sample water
- Hose type (inner diameter, wall thickness)
- Chemical aggressiveness of the sample water.

Pump hose types and order numbers → page 247, § 17.3.1

Procedure

1 Switch dosing pump off (per menu function → page 100, § 7.4.7).

2 Replace worn pump hoses.

► Procedure → page 46, § 3.3.5

► Spare parts → page 247, § 17.3.1

3 Switch dosing pump on again.

4 Feed sample water or zero water and wait until the measured value display remains constant (pump hose run-in time).

5 Perform a calibration (→ page 147, § 9).

► Wait a certain run-in time after replacing pump hoses before calibrating.

Pump hoses new from the factory slightly change their delivery rate after fitting and may release organic carbon compounds that can interfere with sensitive measurements.

Estimated run-in time: 45 ... 60 minutes.

12.2.6 Replacing pre-sampling pump hoses (1 channel hose pump)

Only valid for devices with pre-sampling pumps.

Service life

The service life of the pump hose depends on:

- Type and concentration of particles in the sample water
- Chemical aggressiveness of the sample water
- Under average operating conditions, the pump hose must be replaced after 6 ... 12 weeks.
- Replace the removable hose bed every year.

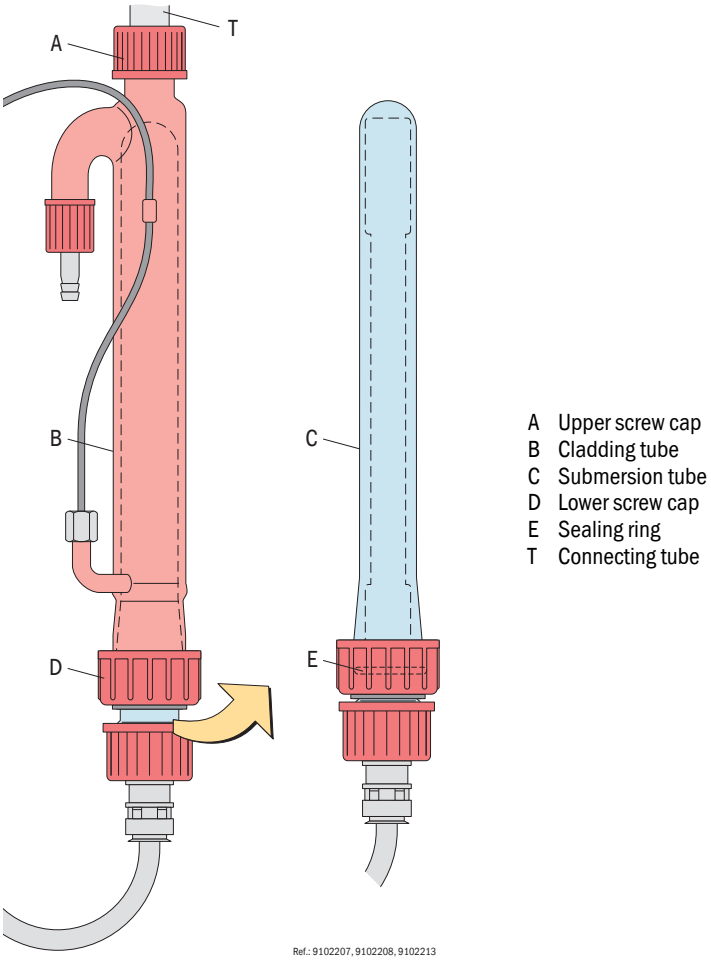
Spare parts → page 247, § 17.3.2

Procedure

1 Switch pre-sampling pump off (per menu function → page 100, § 7.4.7, “Dosing pump M11”).
2 Open bayonet lock.
3 Take hose bed (with pump hose) out of pump.
4 Remove hose adapter from seating.
5 Position hose adapter of new pump hose in seating.
6 Fit hose bed (with new pump hose) in pump.
7 Latch bayonet lock.
8 Switch pre-sampling pump on again.

12.3 Cleaning the UV reactor (TOCOR700 UV)

Figure 41 Reactor tubes (TOCOR700 UV)



A Upper screw cap
B Cladding tube
C Submersion tube
D Lower screw cap
E Sealing ring
T Connecting tube

WARNING: Risk to health through UV radiation

The UV lamp of the reactor emits ultraviolet light when switched on (UV-C).

- UV light can damage unprotected eyes.
- UV light creates ozone (O_3). Ozone is dangerous to health.

The submersion tube is transparent for UV light. The cladding tube protects against UV light.

► Switch the reactor (UV lamp) off before dismantling the reactor.

Ä Do not operate the UV lamp outside the cladding tube.

WARNING: Danger through high voltage

The UV lamp runs with electrical high voltage.

Ä Do not operate the UV lamp outside the cladding tube.

CAUTION: Substances dangerous to health

The reactor contains acid and oxidant (→ page 47, § 3.4.2). The sample water may also possibly contain substances dangerous to health.

► Observe safety information on chemical substances (→ page 256, § 18.1).

► Always wear suitable personal protective equipment when dismantling the reactor (protective gloves, protective goggles, protective clothes).

► Remove and dispose of any liquids released carefully and safely.

Function

Clean the inside of the UV reactor when the reactor is soiled inside.

Cleaning procedure

1 Switch gas pump off (per menu function → page 96, § 7.4.1).
2 Switch dosing pump off (per menu function → page 100, § 7.4.7).
3 Switch reactor off (→ page 99, § 7.4.5).
4 Swivel the internal installation plate out of the housing.
5 Empty the reactor:
   a) Provide a collecting container for the content of the reactor.
   b) Loosen upper screw cap [A].
   c) Push reactor down a few centimeters until the threads of reactor tube [T] are free.
   d) Release reactor from holder.
   e) Pour reactor content out of the upper reactor end (tilt reactor carefully, pour into a container) and dispose of in a safe manner.
   f) Fasten reactor back into holder.
   g) Connect connecting tube [T] again.
6 Loosen lower screw cap [D] of the cladding tube.
7 Pull submersion tube [C] (with UV lamp) carefully out of cladding tube [B].

WARNING: Risk of cuts

Some strength is needed to separate the submersion tube and the cladding tube. Bursting glass pieces can cause serious injuries.

► Wear protective gloves.
► Separate components carefully from each other.

If the submersion tube cannot be separated:

1 Remove the UV lamp (→ page 245, § 17.1.3).
2 Heat the ground glass joint of the submersion tube and cladding tube – e.g. by submerging in warm water.
3 Now try and separate the ground glass joint again.

8 Clean inner cladding tube surfaces and outer submersion tube surfaces and rinse thoroughly with pure water.
9 Clean contact surfaces (ground glass joint) between submersion tube and reactor tube and apply joint grease. Use joint grease free of carbon.
10 Reassemble components.

Put back into operation

1 Switch gas pump, dosing pump and reactor on again.
2 Perform a calibration (→ page 147, § 9).

Recommendation:

► Wait a few hours after replacing the UV lamp (up to 24 hours for sensitive measuring ranges) before final calibration.

A certain run-in time may be necessary for a brand new UV lamp before constant and clean operating conditions are reached in the reactor.

12.4 Maintenance work on the thermal reactor (TOCOR700 TH)

12.4.1 Safety information on the thermal reactor

WARNING: Risk of injuries

The TOCOR700 TH reactor is hot in the operational state (750 ... 850 °C).

- ► Monitor the reactor temperature (on the temperature controller inside the device).
- ► First start work on the reactor when the reactor temperature displayed is below 40° C.

Ceramic reactor components can crack under high temperatures. Therefore:

- ► Do not switch the TOCOR700 TH off to cool the reactor down. Instead, leave the TOCOR700 TH switched on and set the nominal temperature of the temperature controller to room temperature.

The temperature controller lowers the temperature down evenly (ramp function) and the continuing carrier gas flow creates an even temperature spread in the reactor.

It is technically advantageous to slightly raise the glass crucible lid (→ page 53, Figure 18 [4]) before *cooling down* to be able to remove the sealing ring [4] whilst still *warm*. Otherwise it can be difficult to loosen the crucible lid from the crucible because the sealing ring can stick strongly (adhesion effect).

- ► *Caution: Hot surfaces!* Wear protective gloves.

12.4.2 Cleaning the reactor on a TOCOR700 TH (1 reactor)

Not valid for the device version "TOCOR700 TH + 2nd reactor".

Function

Any salts or incombustible solids that may be contained in the sample water gradually deposit in the reactor. Therefore the reactor must be cleaned after a certain operating time otherwise the reactor function is impaired and measurement results are no longer correct.

- The reactor must cool down from the operating temperature (standard: 850 °C) to approx. 40 °C before the reactor crucible can be removed.
- The reactor crucible must be completely dismantled.
- All internal parts of the reactor crucible must be cleaned and dried.

Preparation

1 Switch dosing pump off (per menu function → page 100, § 7.4.7).
2 Note the nominal value set for the temperature controller.
3 Set the reactor temperature controller to room temperature (20 °C) or 0 °C.
4 *When the reactor temperature has reached 40 °C (actual display value of the temperature controller):* Switch the TOCOR700 TH off.

WARNING: Risk of injuries

The reactors are hot during operation (up to 900 °C).

► First start work on the reactor when the actual temperature displayed on the temperature controller is below 40° C.

Cleaning procedure

1 Loosen reactor connections: → page 55, § 3.5.4 („Connect the reactor").
2 Take reactor out of crucible furnace (→ page 55, § 3.5.4).
3 Dismantle reactor (→ page 53, Figure 18).
4 Clean single reactor parts:
   - First brush off the components with a dry brush, apart from the ceramic beads (only rinse or replace the ceramic and catalyst beads). Remove salt deposits on the crucible lid with concentrated hydrochloric acid.
   - *For sensitive measuring ranges:* Immerse all components for about 1 hour in commercial laboratory cleaning solution.
   - First rinse all components with demineralized water and then thoroughly with distilled water. (Even small residues of cleaning solutions can drastically lengthen the start-up time.)
   - Keep all components dry and free from dust.
5 Check the protective crucible granulate (→ page 50, § 3.5.1): It should have no deposits and have sharp edges. In case of doubt, replace with new granulate.
6 Reassemble reactor (→ page 53, § 3.5.3). Replace sealing tape of crucible lid when necessary.

Start-up

1 Start the TOCOR700 again (→ page 78, § 5.2).
2 Set the noted nominal value on the reactor temperature controller.
3 Wait until the nominal temperature is reached (actual value display on temperature controller).
4 Perform a calibration (→ page 147, § 9).

12.4.3 Cleaning the reactor on TOCOR700 TH + 2nd reactor

Only valid for the "TOCOR700 TH + 2nd reactor" device version.

Function

Reasons and procedure for cleaning the reactor are the same as for a TOCOR700 TH with one reactor (→ page 207, § 12.4.2). However, a TOCOR700 TH + 2nd reactor has two reactors in alternate use:

- One of the reactors is used during running measuring operation (online).
- The other reactor is put out of operation (offline) and serves as standby reactor. This reactor can be cleaned and maintained. This reactor is brought back to operating temperature 1 or 2 days before it should take over from the other reactor (standby).

The reactor selection switches (→ page 85, § 6.3.4) serve to trigger electrical switchover.

- An online/offline reactor switch is faster than cleaning a reactor. This means downtimes due to maintenance work are much shorter.
- Additional effect of heating up in offline operation: The reactor content is cleaned thermally before use.

When doing this work for the first time:

► Note the nominal values of the temperature controllers (= operating temperatures of the reactors).

Preparation (1 ... 2 days beforehand)

1 to 2 days before the planned reactor switch:

► Set the nominal value of the temperature controller of the offline reactor to operating temperature.

► Switch the "Offline reactor" selection switch to "Standby" (→ page 85, § 6.3.4).

Reactor switch

1 Switch carrier gas pump off (per menu function → page 96, § 7.4.1).

2 Switch hoses [C], [D], [E] and [F] (→ page 55, Figure 19) from the online to the offline reactor.

WARNING: Risk of skin burns

The reactors are hot during operation (up to 900 °C).

► Wear protective gloves when working on reactors at operating temperature.

3 Switch the "Online" switch on the reactor previously offline.

4 Switch carrier gas pump on again (→ page 96, § 7.4.1).

5 Wait until the system has run for at least 6 hours without malfunctions.

6 Then perform a calibration (→ page 147, § 9).

The zero point calibration can possibly be inaccurate when the calibration is carried out immediately after the reactor switch (especially for sensitive measuring ranges). This is due to traces of contamination that are then oxidized during the first hours of operation.

Cleaning the soiled reactor

1 Set the nominal value on the temperature controller of the offline reactor to room temperature (20 °C).

2 Wait until the actual value of this temperature controller drops below 40 °C.

3 Switch the "Offline reactor" switch to "Off" (heating switched off).

4 Clean the offline reactor (cleaning procedure → page 207, § 12.4.2).

5 Refit the cleaned offline reactor.

12.5 Cleaning the waters lines

Function

It is possible that the water lines of the measuring system gradually become soiled during operation. This is especially the case for the internal waste water hoses (→ page 41, § 3.3.1). Soiling is influenced by the solids content of the sample water and biological activity in the sample water (algae growth).

Visually check hoses and containers of internal sample water lines regularly and clean when necessary. Aims of these checks:

a) Sample water lines do not clog during operation.

b) No large solid particles enter the reactor. Large particles containing carbon can cause sudden increases in measured values (peaks).

It may be sufficient just to flush the water lines thoroughly instead of dismantling them. The following methods could be suitable:

1 Draw in a cleaning liquid for about 5 minutes instead of sample water (e.g. 3 ... 5 % chlorine bleach solution or 0.1 ... 3 % laboratory cleaning solution).

2 Then draw in water for about 15 minutes.

Procedure

1 Put the TOCOR700 out of operation → page 230, § 14.1).

Alternative:

a) Switch gas pump off (per menu function → page 96, § 7.4.1).

b) Switch dosing pump off (per menu function → page 100, § 7.4.7).

CAUTION: Substances dangerous to health

The internal water lines carry, among other matters, acids and possibly oxidant (→ page 47, § 3.4.2). The waste water lines also contain these substances. The sample water may also possibly contain substances dangerous to health.

► Always wear suitable personal protective equipment when dismantling components carrying water (protective gloves, protective goggles, protective clothes).

► Clean up liquids leaked as soon as possible (e.g. soak up with paper tissues) and dispose of safely.

2 Detach hoses from connections.

3 Remove components to be cleaned.

4 Unscrew and dismantle threaded hose connections.

5 Clean all parts inside:

– Use a soft brush or similar to loosen any soiling as necessary.

– Rinse all parts with pure water. Tap water is sufficient for waste water lines.

It may possibly be better to replace soiled hoses completely rather than cleaning them.

6 Reassemble and fit all components again.

On TOCOR700 TH: Pay attention to the position of capillaries in the waste water collector (→ page 42, Figure 10).

7 Check containers and hose connections for leak tightness.

8 *Recommendation:* Check/clean the external waste water drain.

9 Put the TOCOR700 into operation (→ page 77, § 5).

10 Perform a calibration (→ page 147, § 9).

12.6 Preventive maintenance measures

12.6.1 Replacing the filter pads of the housing

Only valid for versions with housing ventilation.

Function

Filter pads are fitted in the ventilation openings of the housing to prevent dust soiling the housing interior. Dirty filter pads impede housing ventilation which causes the temperature in the housing to rise. Possible consequences:

- Condensate in CO_2 absorber
- Reduced measuring precision
- Gas analyzer failure

► Inspect filter pads regularly. Replace soiled filter pads.

Procedure

1 Remove cover/frame of the filter pads.

2 Remove old filter pads. Fit new filter pads.

► See individual technical device documentation for spare parts.

3 Refit cover/frame of the filter pads.

12.6.2 Testing electrical signals

Function

When the TOCOR700 is used to trigger an alarm in case of dangerous operating conditions or to control important processes, check regularly that all electrical functions and connections are working correctly.

Procedure

1 Check whether external processing of the TOCOR700 signals should be deactivated before a test can be done (e.g.: measured value signals, control signals). If so, make the necessary adjustments.

2 Inform the connected locations about the pending test.

3 Use the `hardware test` functions to test all important TOCOR700 electrical signals (→ page 144, §8.18).

12.6.3 Care of the housing

► *To remove dirt from the housing:* Use a soft cloth. If required, 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 penetrate electrical components.

WARNING: Risk of explosions through electrostatic charges
Friction between dry textile fabrics and plastic surfaces can cause high electrostatic charges that can discharge as a spark.
► *In potentially explosive atmosphere:* Clean plastic surfaces with damp cloths.

12.6.4 Annual maintenance work by Customer Service

The following work should be done about once a year by service personnel:

- ► Inspect fan. Clean as required.
- ► Check condition of all gas and water lines.
- ► Check internal and external electrical plug connections (corrosion, mechanical condition).
- ► Inspect the carrier gas pump and replace wearing parts.
- ► Check the gas analyzer function.
- ► Calibrate gas analyzer with test gases.

Then recalibrate the TOCOR700.

TOCOR700

13 Troubleshooting

General malfunctions
Measurement error causes
Leak tightness test
Display messages

13.1 How the TOCOR700 signals a malfunction ...

13.1.1 Signs of a malfunction

The following signals show that the TOCOR700 has recognized a malfunction:

- The “Service” LED goes on (yellow)
- The “Function” LED goes on (red)
- The “Service required” status output is activated
- The “Failure” status output is in the “failure” state (= electrically deactivated)

13.1.2 Malfunction messages

► Watch the TOCOR700 display: Messages are displayed in clear text on the display.

► *If* `CHECK STATUS/FAULT` *appears there: Call up menu* `21` (`main menu → check status → status/fault`). This shows a list of current status messages (these messages are also output via the RS232C interface when this interface is active).

► Follow the relevant information on malfunction clearance (→ page 221, § 13.6).

This Section also contains information on general causes of operational malfunctions and erroneous behavior of the TOCOR700.

13.1.3 Safety information on malfunction clearance

CAUTION: Health risks

There are components inside the device that carry mains voltage when switched on.

► *Before working in the vicinity of electrical contacts:* Put the TOCOR700 out of operation (→ page 230, § 14.1).

CAUTION: Health risks through chemical substances

The TOCOR700 uses chemical substances during operation that can endanger health.

► Dispose of any substances released carefully and safely. Observe and follow safety information on chemical substances. → page 256, § 18.1

CAUTION: Risk of burns on the TOCOR700 TH

The reactor inside the device is hot during operation. There is a risk of burns on the reactor surface.

► *Before working in the vicinity of the reactor:* Put the TOCOR700 TH out of operation and allow to cool down (→ page 230, § 14.1).

13.1.4 Support by Customer Service

Please call our Customer Service should these measures be unsuccessful. Customer Service can help you much faster when you provide the following information:

- Exact device description: Type/variant, order number/serial number (see type plate), additional equipment, special features
- Short precise fault description (just the remark “device defective” is of little or no help)
- Information on devices connected to the TOCOR700
- Description of operating conditions (e.g. sample water composition)
- Details on special installations or operating conditions
- In the case of measurement errors or unexplainable measuring effects: A typical recording of measuring characteristics (recorder strip), if possible with comments.
- Contact person in your own company who can answer any questions that may arise.

13.2 General operational malfunctions

13.2.1 If the TOCOR700 does not function at all ...

Possible causes	Notes for operator
Power cable is not connected.	▶ Check power cable and connections.
Main switch is off.	▶ Switch the TOCOR700 mains switch off.
Power supply has failed.	▶ Check mains supply (e.g. power socket, external fuses).
On housings with pressurized enclosure (version for potentially explosive atmospheres): Control device of the pressurized enclosure does not release the power supply because the operating conditions of housing flushing are not satisfied.	▶ Check purge air delivery (valves, pressure, blockade) ▶ Check leak tightness of housing (doors, condition of seals, cable glands, other housing openings).
Internal fuse defective.	▶ Check fuses (→ page 251, § 17.10).
Internal operating temperatures not correct.	▶ Check whether relevant fault messages are displayed ("FAULT: Temperature..."; Display → page 92, § 7.3.1; Information → page 221, § 13.6).
Internal software not working correctly.	Can only happen after complex internal malfunctions or by strong external interference (for example, strong electromagnetic impulses). Remedy: ▶ Switch the TOCOR700 off and back on again after a few seconds.
Internal overheat fuse triggered.	Measuring system and power transformer of the gas analyzer are fitted with overheat fuses. These fuses are fitted securely and cannot be reversed. Therefore: ▶ Request Customer Service after an overheat fuse triggers and have the relevant component replaced.

13.2.2 When the reactor does not reach the nominal temperature ...

Only valid for TOCOR700 TH.

Possible causes	Notes for operator
Temperature controller setting incorrect.	▶ Check nominal value setting. See individual technical device documentation for correct nominal value. Standard value: 850 °C.
Temperature control interrupted.	▶ Check electrical reactor connections (→ page 55, Figure 19). ▶ Check temperature controller and replace when necessary. ▶ Check temperature sensor (in reactor) and replace when necessary.
Temperature inside housing too high.	▶ Check setting of temperature sensor B53 (safety shutdown when cabinet cooler fails).
Reactor overheat fuse triggered.	▶ Check/repair.

13.3 Malfunctions during measuring operation

13.3.1 When no measured values are displayed ...

Possible causes	Notes for operator	Notes for service
Gas analyzer not switched on.	▶ Check gas analyzer mains switch.	If OK: Internal/external mains fuses? Power cable? Gas analyzer electronic fuses?
Gas analyzer defective.	▶ Check display messages (→ page 221, § 13.6).	See gas analyzer Service Manual for further information.
Carrier gas volume flow interrupted.	▶ Observe display messages. ▶ Check volume flow display. *When correct:* ▶ Check gas lines (filters, hoses).	
Sample water feed interrupted.	▶ Check sample water feed (hoses, pumps, clogging). ▶ Check display messages.	

13.3.2 When the measured value display is very unsteady ...

Possible causes	Notes for operator	Notes for service
Solids in sample water.	Possible clearance: ▶ Filter sample water. ▶ Homogenize sample water. ▶ Active “damping” to create average value → page 107, § 8.5.1).	
Measuring system leaking.	▶ Check measuring system for gas leak tightness. ▶ For TOCOR700 TH: Check reactor (crucible lid sealing ring, capillary drip tube, hairline cracks in reactor crucible)	
Pump hose damaged.	▶ Check pump hoses. ▶ In case of doubt, replace pump hose (→ page 202, § 12.2.5).	
Dosing pump damaged.	▶ Check whether dosing pump runs at constant speed. *If this is not the case:* ▶ Request Customer Service or order a replacement pump.	
Gas analyzer defective.	▶ Check display messages (→ page 221, § 13.6).	See gas analyzer Service Manual for further information.
Gas pressure at gas outlet of gas analyzer fluctuates considerably.	▶ Fit an exhaust gas line that joins at a location with constant pressure conditions.	
Severe mechanical vibrations at installation site.	▶ Check ambient conditions. ▶ Eliminate/damp vibrations.	Vibrations can interrupt the gas analyzer measuring system.
Display damping too low for the application.	Can possibly be increased (→ page 107, § 8.5.1).	

13.3.3 When measured values are obviously incorrect ...

Possible causes	Notes for operator	Notes for service
The TOCOR700 is not ready for operation.	– Start-up→ page 77, § 5 – Status/fault messages → page 92, § 7.3.1	
TOCOR700 TH: Reactor does not have the correct operating temperature.	▶ Check nominal value setting of temperature controller (standard: 850 °C). *When correct:* → page 215, § 13.2.2	
CO_2 absorption material spent.	▶ Replace absorption material (→ page 198, § 12.2.2).	
Reagent does not have correct concentration.	▶ Check/correct (→ page 197, § 12.2.1).	
Sample water feed interrupted or erroneous.	Check sample water line for clogging/leaks/air bubbles: ▶ Hoses ▶ Hose connections ▶ Dosing pumps ▶ Valves ▶ Additional devices (back-flush filter, tape filter unit) ▶ Leak tightness test→ page 219, § 13.5	Make sure that the valves are functioning correctly, disassemble if necessary. Check leak tightness thoroughly.
The TOCOR700 does not measure the sample water (sample water line is not switched correctly).	▶ Check sample water line and valve functions (e.g. sample/spot sample).	Check function and condition of valves.
Carrier gas line leaking	▶ Visually check filter containers and gas line for leak tightness. ▶ Leak tightness test→ page 219, § 13.5	It may be necessary to dismantle the reactor crucible in order to look for leaks (seal on crucible lid, fitting between crucible lid support and drop tube).
The TOCOR700 is not correctly calibrated.	▶ Check calibration liquids used (carbon concentration, manufacturing tolerance, condition) ▶ Check setting of nominal values (→ page 158, § 9.5.4) ▶ Perform calibration	Check calibration substance used. Check calibration solution calculation.
The “damping” value is set too high for your application.	Check setting (→ page 107, § 8.5.1); possibly change as test.	–
Back pressure on gas outlet too high.	▶ Make sure back pressure is not greater than 20 Pa (= 2 mbar) (→ page 59, § 4.3).	The gas pressure can influence gas analyzer measured values.
Severe mechanical vibrations at installation site.	▶ Check ambient conditions. ▶ Eliminate/damp vibrations.	Vibrations can interrupt the gas analyzer measuring system.
If observed on only one measured value output: The load is too large.	▶ Make sure the total internal resistance of the connected devices is not larger than 500 Ω.	Measure, including the connecting line.
Gas analyzer not functioning correctly.	▶ Observe display messages. ▶ Request Customer Service when necessary.	Condensate/water penetration? Soiling?

13.3.4 If the reaction time (90% time) is too long ...

Possible causes	Notes for operator	Notes for service
Measuring system leaking.	▶ Check gas lines. ▶ Check waste water lines.	
Stripper dirty.	Soiling "delays" the sample water. ▶ Check/clean stripper.	
One of the auxiliary devices connected is not in correct state.	*If fitted:* ▶ Check back-flush filter MRF/tape filter unit MBF.	

13.4 Malfunctions during calibrations

13.4.1 When zero point calibration is not possible ...

Possible causes	Notes for operator	Notes for service
CO_2 absorption material spent.	▶ Replace absorption material (→ page 198, § 12.2.2).	
Carrier gas line leaking.	▶ Visually check filter containers and gas line for leak tightness. ▶ Leak tightness test → page 219, § 13.5	It may be necessary to dismantle the reactor crucible in order to look for leaks there (seal on crucible lid, fitting between crucible lid support and drop tube).
Drift limit value too low.	Increase drift limit value (→ page 159, § 9.5.5).	
Gas analyzer not functioning correctly.	▶ Observe display messages. ▶ Request Customer Service when necessary.	Condensate/water penetration? Soiling?

13.4.2 When sensitivity calibration is not possible ...

Possible causes	Notes for operator	Notes for service
Calibration solution does not have correct concentration (prepared incorrectly or too old).	▶ Check whether nominal value matches measuring range (→ page 150, § 9.2.2). ▶ Check calibration solution calculation (→ page 150, § 9.2.2). ▶ Prepare new calibration solution.	Check calibration substance used. Check calibration solution calculation.
Carrier gas line interrupted.	▶ Check filter containers for leak tightness. ▶ Check hose lines for leak tightness and clogging.	It may be necessary to dismantle the reactor crucible in order to look for leaks there (seal on crucible lid, fitting between crucible lid support and drop tube).
Drift limit value too low.	Increase drift limit value (→ page 159, § 9.5.5).	
Gas analyzer not functioning correctly.	▶ Observe display messages. ▶ Request Customer Service when necessary.	Condensate/water penetration? Soiling?

13.5 Leak tightness test

Function

Leak tightness of gas and water lines is an important prerequisite for correct measured values. Small leaks can remain undetected and continually falsify measured values. The leak tightness test is an important measure for unexplainable measurement errors.

Information for devices with pressurized enclosures:
The overpressure inside the housing changes when the housing door is opened or closed. A leak in the gas line can change the measured value with this effect. This effect may possibly increase low measured values close to the zero point because CO_2 from the air penetrates the gas line. One does however normally expect the measured value to be lower when a leak exists because produced CO_2 is lost through the leak.

Safety Information

CAUTION: Risks when the measuring function fails

The measuring function is not in operation during this maintenance work.

- ► Switch external locations that process measured values or status messages from the TOCOR700 TH to a safe state or inform them that the measuring function has failed.

WARNING: Risk of injury by chemicals

An exceptional gas pressure is created in the measuring system during the leak tightness test. Chemicals (acids/oxidants) can escape when a leak exists or when the gas pressure causes a leak.

- ► Wear protective clothes and protective goggles.
- ► Do not open or dismantle any measuring system components when the measuring system is under pressure.
- ► *When danger arises or unusual events occur:* Release gas pressure immediately (open hose clamps).

Procedure

1 Close both siphon hoses (→ page 41, §3.3.1) gas-tight (e.g. cutoff with hose clamps).

2 Call up menu `7112` (→ page 139, §8.16.2).

3 Select `controller 4.`

The nominal and actual values of the flow sensor in the gas line before the sample gas pump are displayed as well as the current pump capacity. The FIA measured value is shown in the bottom line of the display (function → page 136, §8.14.3).

4 Attach a hose clamp over the hose on the gas analyzer gas outlet. Tighten this hose clamp step-by-step until the hose is completely closed – watch the display at the same time: The pump capacity should increase; FIA measured value and actual value of the flow sensor should tend towards “`0`”.

Leak tightness criterion: The pump capacity should increase to 100% whilst the actual value of the flow sensor reaches “0” or close to “0”. This state should be reached after 2 ... 5 minutes. If this is not the case, the measuring system has a gas leak or the sample gas pump valves are not working correctly.

5 *To terminate the procedure:*

► *Slowly* open the hose clamp on the gas analyzer gas outlet.

► Then remove the hose clamps on the siphons.

During the procedure:

► Do not switch the sample gas pump off.

► Do not switch the TOCOR700 off.

Check when searching for leaks:

– Screw fittings, hose connections
– Gas hoses, water hoses
– Reactor (for the TOCOR700 TH as well: Hairline cracks in reactor crucible)

13.6 Status messages (in alphabetical order)

CAUTION: Risk of damage/health risks
"Service information" is aimed at *trained skilled persons*.
► Only work on the TOCOR700 when the possible hazards are known.

Display message	Meaning	Cause/Notes for operator	Notes for service
Calibration active	A calibration procedure is running.	No malfunction message.	
CALIBRATION sensor 1	A gas analyzer calibration is running.		
CHECK STATUS/ FAULT	Several status and/or fault message exist at the present time.	Call up list of status/fault messages (→ page 92, § 7.3.1)	
Communication fault	Measuring system control interrupted or failed.	Electronic communication between gas analyzer and gas generator not functioning. ▶ Check internal fuses. ▶ Check electrical connections. ▶ *If unsuccessful:* Request Customer Service.	▶ Check data transfer parameters. ▶ Check gas generator mains adapter. ▶ Check relay and transistor modules. Active data communication is signaled on LEDs "TxD" and "RxD" on "RS232 Module".
FAILURE extern x (x = 1 … 2)	Control input "Failure x" is activated.	Signals a malfunction message from an external device (→ page 120, § 8.10.2). Not a malfunction in TOCOR700 .	If switching logic is reversed, this message will also occur when the control input is disconnected.
FAILURE extern 1	Control input "Failure 1" is activated.	Indicates a malfunction message from an external device (→ page 120, § 8.10.2). No malfunction in the TOCOR700 .	If switching logic is reversed, this message will also occur when the electrical connection is interrupted. – *Information:* This message is not related in any way to the "FAILURE extern x" status output (→ page 118, § 8.9.4).
FAILURE extern 2	Control input "Failure 2" is activated.		
FAILURE sensor 1	The gas analyzer is not ready for operation.	Possible causes: – Internal temperature is not in the nominal range of the heating control. – Zero point drift or sensitivity drift exceeds 120 % of the drift limit value (→ page 159, § 9.5.5). – Gas analyzer measurement signal not in operating range. – Gas analyzer not working correctly.	Possible defect: Chopper disk not rotating correctly.
FAILURE sensor ext. 1	Measurement signal of FIA flow sensor incorrect (analog input IN1 of gas analyzer).	▶ Check internal electric connections.	▶ Check/replace FIA sensor
FAILURE sensor ext. 2	Measurement signal on analog input IN2 of gas analyzer incorrect.	Function → page 71, § 4.13. ▶ Check electric connections.	

Display message	Meaning	Cause/Notes for operator	Notes for service
FAULT: chopper	Malfunction in gas analyzer measuring system.	Gas analyzer defective. ▶ Request Customer Service.	Rotation signal from chopper disk missing. – Electrical connection? – Chopper disk is loose or stuck? – Defective motor? – Defective light barrier? – Defective chopper motor control?
FAULT: condensate	Condensate in sample gas line of gas analyzer. This message triggers automatic deactivation of the gas pump and switching output "external pump" (when active).	▶ Put the TOCOR700 out of operation. ▶ Request Customer Service or trained skilled persons: The gas analyzer must be serviced. ▶ Check and dry the measuring system. *After servicing:* ▶ Switch fault message off per menu (→ page 97, § 7.4.2).	▶ Check/service external sample gas conditioning. ▶ Service the gas analyzer: – Separate Analyzer module from internal sample gas line to prevent condensate penetrating. – Corrosive condensate, electrically conductive residues → remove condensate sensor, rinse with pure water and dry. – Flush condensate sensor and internal sample gas line (incl. pump) with nitrogen or dry air. – Replace internal safety filter (glass); replace when necessary. ▶ *If condensate could have penetrated the measuring system:* Inspect/service the measuring system.
FAULT: controller 4	Carrier gas volume flow outside nominal range.	▶ Check carrier gas lines (leak tightness, hoses, filters).	
FAULT: cooler E03	Gas cooler has not reached its nominal temperature (temperature too high).	▶ *After start-up:* Wait for start-up time to elapse. ▶ *During operation:* Check ambient temperature. ▶ *If unsuccessful:* Request Customer Service.	▶ Check/replace gas cooler.
FAULT: dosing pump M10	Dosing pump (5 channel hose pump) not running.	Dosing pump switched off manually (→ page 99, § 7.4.6). Automatic switch off. Possible causes: – Automatic start-up procedure still running (information → page 78, § 5.2) – Liquid has escaped – Reactor not in operation. – Carrier gas volume flow incorrect	
FAULT: dosing pump M11	Pre-sampling pump (1 channel hose pump = "dosing pump M11") not running.	Pre-sampling pump switched off manually (→ page 100, § 7.4.7). Automatic switch off. Possible causes: See "FAULT: dosing pump M10".	

Display message	Meaning	Cause/Notes for operator	Notes for service
FAULT: flow signal	Signal from the flow sensor exceeds the working range of the internal analog-to-digital converter.	▶ *If the message remains displayed for a longer time (several seconds):* Switch the gas analyzer off and on again. ▶ *If unsuccessful:* Request manufacturer's Customer Service.	Separate flow sensor cable from electronic board as test. Fault message cleared → check cable and sensor.
FAULT: gas flow	Carrier gas volume flow (in gas analyzer) is much too low (less than 80 % of set limit value).	▶ Check gas lines (leak tightness, hoses, filters).	SERVICE: gas flow appears instead in the range 80 ... 100 % of the limit value. Setting the limit value → page 135, §8.14.2
FAULT: gas pump	Gas pump capacity is not sufficient to reach the required carrier gas volume flow (controller 4 demands 100 % pump capacity).	▶ Check hose connections. ▶ Visually check gas pump function. ▶ *If unsuccessful:* Request Customer Service.	▶ Check gas lines for leaks and clogging. *If unsuccessful:* ▶ Replace gas pump *or* ▶ Service gas pump (see Service Technician Manual for series S700 gas analyzers)
FAULT: int. voltage	At least one internal supply voltage of the gas analyzer is not OK (outside nominal range).	▶ Switch gas analyzer off and then on again. ▶ *If unsuccessful:* Request Customer Service or trained skilled persons.	▶ Check supply voltages (→ page 140, §8.16.4). ▶ Check fuses in gas analyzer (→ page 251, §17.10.1). ▶ *If no fault detectable:* Replace electronic board as test.
FAULT: IR source	Infrared source in gas analyzer measuring system defective or interrupted.	Gas analyzer defective. ▶ Request Customer Service or trained skilled persons.	▶ Check IR voltage (→ page 139, §8.16.3): – Too high → cable defective? Lamp severely damaged or unusable? – Too low → short circuit? Electronics defective? Lamp defective? Fuse defective (→ page 251, §17.10.1)? (Nominal voltage setting is a “factory setting”. Perform a basic gas analyzer calibration after changes.)
FAULT: overrangex (x = 1 ... 5)	Gas analyzer measured value (measurement component x) greater than 120 % of the physical measuring range end value. *Attention:* Displayed measured value does probably not represent the real carbon concentration.	*After a start-up (especially after maintenance work on measuring system and for measuring ranges < 200 mg/l C):* ▶ Wait for start-up time of measuring system to elapse (1 ... 24 hours). *During operation:* ▶ Check whether carbon concentration in sample water could actually be very high now. ▶ *If this is not the case:* Request manufacturer's Customer Service or trained skilled persons.	No assistance is available through changing settings. *When measured value should be within measuring range:* Loosen electrical connection of the Analyzer module. Fault message disappeared → service Analyzer module.

Display message	Meaning	Cause/Notes for operator	Notes for service
FAULT: overrange 1	Measurement signal of CO_2 measurement considerably exceeds internal measuring range.	*After a start-up (especially after maintenance work on measuring system and for measuring ranges < 200 mg/l C):* ▶ Wait for start-up time of measuring system to elapse (1 ... 24 hours). *During operation:* ▶ Check whether carbon concentration in sample water could actually be very high now. ▶ *If this is not the case:* Request manufacturer's Customer Service or trained skilled persons.	A/D transducer value range exceeded (>120 %). ▶ Check gas analyzer calibration. ▶ Check basic measuring sensitivity setting (→ page 167, § 9.8.1)
FAULT: overrange 2	Measurement signal of flow measurement considerably exceeds internal measuring range.	▶ Request Customer Service or trained skilled persons.	A/D transducer value range exceeded (>120 %). ▶ Check flow signal.
FAULT: press-signal	Signal from the pressure sensor exceeds the working range of the internal analog-to-digital converter.	▶ *If the message remains displayed for a longer time (several seconds):* Switch the gas analyzer off and on again. ▶ *If unsuccessful:* Request Customer Service or trained skilled persons.	Separate pressure sensor from electronic board as test (plug-in connector X21). Put gas analyzer back into operation. No fault message → replace sensor.
FAULT: reactor E01 off	Reactor has been switched off automatically (safety shutdown).	Temperature inside housing too high. The reactor on the TOCOR700 TH is then switched off automatically. ▶ Check ventilation openings. ▶ Check filter pads condition (→ page 211, § 12.6.1). ▶ Check fan function.	▶ Check temperature sensor/ limit value switch.
FAULT: reactor E01 on	Reactor not in operation.	▶ Switch reactor on. ▶ Check electrical reactor connections. ▶ *On TOCOR700 TH:*, wait for start-up time to elapse. ▶ *If unsuccessful:* Request Customer Service.	*TOCOR700 UV:* The light sensor on the UV reactor (TOCOR700 UV) shows the status of its switching output per LED: LED red = output “low”, LED green = output “high”. The signal is connected to a control input of the gas analyzer or a switching input of the RS232 module. *TOCOR700 TH:* A switching output of the temperature controller is used as status signal. The output is “high” when the temperature is within the nominal range – i.e. temperature > limit value “AL1” (825°C) and temperature < limit value “AL2” (875°C). The status of the limit values is displayed per LED on the temperature controller.

Display message	Meaning	Cause/Notes for operator	Notes for service
FAULT: S-drift #x (x = 1 … 5)	The sensitivity drift for measurement component x is much higher than the set drift limit value (over 120 % of the drift limit value).	Possible causes: – Calibration solution was not available (check reserve). – Calibration solution feed not functioning correctly (check hose and hose pump) – Set nominal value does not suit calibration solution used (→ page 150, §9.2.2). – Message SERVICE: S-drift was ignored even though the deviation from basic condition is very large. ▶ Clear cause. ▶ Then perform a new calibration or restore the “last backup” (when the previous state had been backed up → page 130, §8.12.1).	▶ Check “span delay time” and “calibration-measuring time” (→ page 160, §9.5.7 / → page 161, §9.5.8). ▶ Check the drift limit value settings (→ page 159, §9.5.5). ▶ *If observed frequently during operation:* Increase relevant drift limit value (particularly applicable for sensitive measuring ranges). ▶ Check calibration solution/test gas and gas line critically. ▶ After above, run a calibration and check the drift values (→ page 95, §7.3.6). ▶ *When drift values still too high:* Clean/adjust measuring system and check basic setting for measuring sensitivity (→ page 167, §9.8.1).
FAULT: signal #1	Measurement signal of CO_2 measurement exceeds internal measuring range.	▶ Check carbon concentration of sample water. ▶ *If unsuccessful:* Request Customer Service or trained skilled persons.	A/D transducer value range exceeded. ▶ Check gas analyzer calibration. ▶ Check basic measuring sensitivity setting (→ page 167, §9.8.1)
FAULT: signal #2	Measurement signal of flow rate measurement exceeds internal measuring range.	▶ Request Customer Service or trained skilled persons.	A/D transducer value range exceeded. ▶ Check flow signal.
FAULT: temperature 1	Gas analyzer temperature not in operating range.	Possible causes: – Ambient temperature is either too high or too low. – The internal heating is not working. – Gas analyzer was previously switched off for a short time. ▶ *If the message appears after a short operating pause:* Wait. The fault message disappears after a few minutes. ▶ *If this is not the case:* Check temperature in TOCOR700 housing. If necessary, take suitable measures to correct the temperature. ▶ *If this does not help:* Request manufacturer's Customer Service or trained skilled persons.	Possible defects: – Electrical fuse (→ page 251, §17.10.1) – Temperature sensor in gas measurement system – Electrical connections in heating circuit – Heating electronics defective – Overheat fuse in gas measurement system (breaks at approx. 80 °C). Chemical fusible cutout; must be replaced after triggering.

Display message	Meaning	Cause/Notes for operator	Notes for service
FAULT: test gas x (x = 3 … 6)	Control input “Test gas x fault” was activated during calibration.	Only applicable when such a control input is installed (→ page 120, § 8.10.2). ▶ Check whether a corresponding external malfunction exists. ▶ *When malfunction cleared:* Repeat calibration.	Further possible causes: – Electrical connection defective – External monitoring device defective
	The actual value deviated strongly from the nominal value (calculated drift exceeded 200% of set drift limit value) when feeding the calibration solution during the last automatic calibration.	Possible causes: – Calibration solution was not available (check reserve). – Calibration solution feed not functioning correctly (check hose and hose pump) – Set nominal value does not match gas used (→ page 158, § 9.5.4). – Set nominal value does not match carbon concentration of calibration solution (→ page 151, § 9.2.3). ▶ Clear drift cause. ▶ Repeat calibration.	▶ Check calibration solution. ▶ Check water lines. ▶ Check “span delay time” and “calibration measuring time” (→ page 160, § 9.5.7 / → page 161, § 9.5.8). ▶ Check the drift limit value settings (→ page 159, § 9.5.5). ▶ Possibly perform a manual calibration procedure to observe the process exactly.
FAULT: Z-drift #1	Zero point drift considerably above set drift limit value (over 120% of the drift 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
Fluid leak B01	Liquid has leaked inside the device (sensor on housing floor). Dosing pump switched off automatically.	▶ Fix fluid leak. *Caution:* Escaped liquids can contain acids and oxidants. ▶ Clear escaped liquids properly. ▶ Clean sensor.	The LED shows the switching state of the sensor: – Green = OK – Red = malfunction
Heating … 1	The gas analyzer has not reached its operating temperature yet after switching on.	No malfunction. These messages disappear within 30 minutes after switching on. ▶ Do not perform any binding measurements or any calibrations as long as this message is displayed.	The message does not disappear when the gas analyzer does not reach the relevant nominal temperature. Possible causes: Ambient temperature too low, internal heating defective.
Maintenance/ Calibr.	Status output “Service” activated manually.	→ page 101, § 7.6	
	A calibration procedure is running.	Remains after the calibration procedure has finished until a further “span delay time” has elapsed.	
	A function of menu branch 7 (Service) has been called.	Some of these menus will interrupt the TOCOR700 measuring function. Therefore the maintenance signal is activated automatically when this menu branch is called.	

Display message	Meaning	Cause/Notes for operator	Notes for service
`No reports!`	There are no status or fault messages at this time.	Only appears in the list of status/ fault messages (→ page 92, § 7.3.1).	
`PC control active!`	External PC controls the TOCOR700	→ page 173, § 10	
`Sample gas B05`	– FIA limit value underflowed (→ page 136, § 8.14.3) *or* – Connected external limit value sensor signaled that the limit value is underflow	▶ Switch gas pump on (→ page 96, § 7.4.1). ▶ Check gas lines (leak tightness, hoses, filters).	The FIA limit value monitors the measurement signal of the FIA transmitter (volume flow monitoring). The individual technical device documentation specifies whether an external limit value sensor is used instead.
`Sample water B02`	External sensor for sample water feed signaled a malfunction.	▶ Restore sample water feed. ▶ Check limit value setting on external sensor/switching device.	▶ Check external sensor.
`Sample water limit`	Sample water flow is too low (lower than the set limit value.)	The malfunction message refers to the status of the control input with the “Sample water B02” function, if installed (→ page 120, § 8.10.2). Otherwise the message refers to the sample water limit value set. ▶ Restore sample water flow. ▶ Possibly adapt the sample water limit value (→ page 137, § 8.15.3).	When the “Sample water B02” control input exists: ▶ Check the connected external flow sensor. ▶ Check electric connection.
`SERVICE extern x (x = 1 … 2)`	Control input “Failure x” is activated.	Signals a malfunction message from an external device (→ page 120, § 8.10.2). Not a malfunction in TOCOR700 .	If switching logic is reversed, this message will also occur when the control input is disconnected.
`SERVICE: gas pump`	The gas pump must run with an unusually high capacity to reach the required carrier gas volume flow (controller 4 demands at least 80 % pump capacity).	→ „FAULT: gas pump“	▶ → „FAULT: gas pump“
`SERVICE: S-drift #1` `SERVICE: S-drift #2`	Drift determined during the last calibration is above the set drift limit value.	Measuring function of the TOCOR700 is not restricted. ▶ Check measuring system ▶ Check calibration solution critically. ▶ Repeat calibration. ▶ Possibly increase drift limit value.	`FAULT: S-drift`... is reported when the drift is higher than 120 % of the set drift limit value (→ page 159, § 9.5.5).
`SERVICE: sensor 1`	Malfunction in gas analyzer. Measured values are possibly erroneous.	▶ Check whether carbon concentration in sample water could actually be very high now. ▶ *If this is not the case:* Request Customer Service.	Criterion for message: Current measurement signal of gas measurements system is larger than 120 % of A/D transducer dynamic range. ▶ Check gas analyzer.

Display message	Meaning	Cause/Notes for operator	Notes for service
SERVICE: sensor ext.1	Measured value of the flow sensor FIA (analog input IN1 of gas analyzer) will be processed with a larger drift compensation.	Zero point drift or sensitivity drift of the measurement signal is greater than 100 120 % of the drift limit value (→ page 159, § 9.5.5).	
	FIA flow sensor defective.	▶ Request Customer Service.	▶ Check/replace FIA.
SERVICE: sensor ext.2	Input signal on analog input 2 of gas analyzer interrupted.	This input is not used on standard versions of the TOCOR700. ▶ Observe the individual technical device documentation.	This malfunction message can only appear when analog input 2 is used.
SERVICE: Z-drift #1 SERVICE: Z-drift #2	Drift determined during the last calibration is above the set drift limit value.	Measuring function of the TOCOR700 is not restricted. ▶ Check measuring system ▶ Check zero water critically. ▶ Repeat calibration. ▶ Possibly increase drift limit value.	FAULT: Z-drift... is reported when the drift is higher than 120 % of the set drift limit value (→ page 159, § 9.5.5).
Spot sample active	Sample water feed is switched to the “Spot sample” connection.	No malfunction. – Connection → page 61, § 4.4.2 – Manual switchover → page 100, § 7.4.8	
Start control x (x = 1 ... 4)	The internal controller (in gas analyzer) attempts to reach the nominal value.	No malfunction. The message disappears within 30 minutes after switching on. ▶ *If the* Start control 4 *message remains:* Check gas lines (leak tightness, hoses, filters).	Controller 1 controls the measuring system temperature in the gas analyzer. Controller 4 controls the gas pump capacity and therefore the carrier gas volume flow.

TOCOR700

14 Putting Out of Operation

Operating pauses
Shutdown
Disposal

14.1 Procedure to put out of operation

Only valid for short operating pauses (→ page 231, § 14.2)

Work step	Single measures
1 Secure connected locations.	► Secure connected devices. ► Inform connected locations.[1] ► Make sure automatic contingency measures are not triggered when putting out of operation.[2]
2 *Recommendation:* Flush sample water lines.[3]	► Feed zero water instead of sample water – through the complete sample water line when possible. ► Keep the TOCOR700 in measuring operation in this state until the sample water in the measuring system is replaced by zero water (10 ... 30 minutes).
3 *Only for TOCOR700 TH:* Let reactor cool down.[4]	► Observe safety information (→ page 206, § 12.4.1). ► Note the temperature controller nominal value. ► Set temperature controller to room temperature (20 °C) or 0 °C. ► Wait until the reactor temperature is below 40 °C (display on temperature controller).
4 Switch off.	► Set the TOCOR700 mains switch to “0” or interrupt mains supply on external locations.
5 *On housings with pressurized enclosures (version for potentially explosive atmospheres):* Stop housing flushing.	► Wait the specified delay time after switching off. ► Put the housing flushing monitoring out of operation (e.g. deactivate relevant alarm signal). ► Put the housing flushing out of operation (see Operating Instructions of the pressurized enclosure control device).
6 Empty waste water collector.	► Empty both siphons (→ page 41, § 3.3.1).
7 Store properly.	► Loosen hose beds of hose pumps.[5] ► Remove or secure reagent storage container. ► Close off water connections and gas outlet. ► Close off waste water connection. ► Follow instructions on storage (→ page 234, § 15.1).

1 It may be necessary to set a planned putting out of operation manually on connected data processing systems so that these systems do not interpret this as an analyzer malfunction.

2 Moreover, you may need to consider which switching logic is used for the switching outputs (→ page 117, § 8.9.2).

3 Minimizes algae growth in sample water lines when using biologically active sample water.

4 Perform for both reactors on the TOCOR700 TH + 2nd reactor.

5 Prevents pump hoses gumming up.

Gas analyzers heat the internal measuring system to create constant internal temperatures (approx. 50 °C in the TOCOR700) and to prevent condensation in the gas measurement system. Liquid in the gas measurement system would make the gas analyzer unusable.

The gas analyzer cools down after being put out of operation – which means moisture contained in the sample gas could condense. To prevent this happening, the gas analyzer gas line must be flushed with a “dry” gas before being put out of operation.

14.2 Short operating pauses

► When possible, do not switch the TOCOR700 off but leave it in operation during short operating pauses.

This protects components when the device remains in operation and the start-up time after the operating pause is not required.

► Do not switch off the dosing pump either when possible – the pump hoses could gum up when the pump is switched off.

- *If sample water feed is interrupted during the operating pause:* Feed zero water instead of sample water.
- *If the dosing pump will remain out of operation for several days:* Loosen the hose cassettes so that the pump hoses are no longer pressed.

14.3 Disposal information

These subassemblies could contain materials which may require special disposal:

- CO_2 absorber (→ page 43, §3.3.2)
- Corrosion inhibitor filter (→ page 44, §3.3.3)
- Hoses (can contain acids, oxidant and sample water)
- Electronics: Electrolyte condensers, tantalum condensers
- Display: Liquid in the Liquid Crystal Display (LCD)
- Reactor on the TOCOR700 UV: Dispose of the UV lamp in the same manner as a commercial mercury low pressure steam lamp (fluorescent lamp).
- Reactor on the TOCOR700 TH: Send the catalyst beads to the manufacturer.

TOCOR700

15 Storage, Transport

Storage
Transport
Shipping
Details on repairs
Protective measures when storing

15.1 Correct storage

Follow this information when the TOCOR700 is to be taken out of operation for longer than 10 days:

Measure	Single measures
1 Put the TOCOR700 out of operation correctly.	→ page 230, § 14.1
2 Protect against frost.[1]	► Make sure the ambient temperature does not sink below freezing point. ► *If frost cannot be excluded at the storage location:* Empty all components filled with water or carrying water.
3 Protect against dust.	► Close housing doors tight. ► Close off all connections (water, gas, open cable glands). ► Close off ventilation slits with moisture-permeable material (paper/gauze + adhesive tape).
4 *On TOCOR700 UV:* Protect the front foil.	► Make sure the device front in the area of the display and keyboard cannot be damaged by objects with sharp edges. ► If necessary, make a protective cover (e.g. cardboard/ styrofoam + adhesive tape).
5 Store dry.	► Whenever possible, select a dry, well-ventilated room for storage. ► *If high humidity can be expected:* Put a drying agent inside the gas analyzer (e.g. silica gel).

[1] The measuring system has glass containers filled with water.

► Check § 15.2 and § 15.3 before transport.

15.2 Transport over short distances

Before transport

- ► *Only for the TOCOR700 TH:* Remove the reactor (→ page 55, § 3.5.4) and transport separately packed.
- ► Close off the sample gas outlet (to prevent moisture and dust from penetrating the internal gas line).
- ► Close the front door tight.
- ► Inform the transport personnel emphatically about the fragility of internal components.

Lifting points

- ► *When the housing has crane brackets:* Lift using the crane brackets.
- ► *When the housing has wall brackets:* Lift using the wall brackets.
- ► *Otherwise:* Position the lifting device under the housing frame.

> ***NOTICE:***
> Ä Do not lift housings made of plastic on the roof or roof frame.

During transport

- ► Use suitable transport means.
- ► Transport the TOCOR700 upright - do not tilt.
- ► Avoid impacts and jolts.
- ► *Recommendation:* Let persons skilled in measurement technology monitor transport.

After transport

- ► *Only for TOCOR700 TH:* Fit the reactor (→ page 55, § 3.5.4) and align (→ page 52, § 3.5.2).

15.3 Correct shipping/transport over long distances

This information is applicable in the case where the TOCOR700 is to be transported over long distances and persons skilled in measurement technology cannot monitor transport:

- ► *Dismantle the measuring system:* Before transport, remove all components sensitive to jolts (→ page 38, § 3.1), dry them (as necessary) and pack them separately and carefully. Follow the information on assembly in the reverse sequence (→ page 37, § 3).
- ► *Protect against moisture and dirt:* Wrap the device and each of the electrical components packed separately completely, with plastic foil at best. Add drying agent to protect against condensation (silica gel).
- ► *Mark lifting points.* (Safe lifting points → § 15.2)
- ► *Shipping for repairs:* Enclose information as detailed as possible on the defect. Describe the operating conditions for unclear malfunctions (→ page 214, § 13.1.4).

TOCOR700

16 Custom Configuration Tables

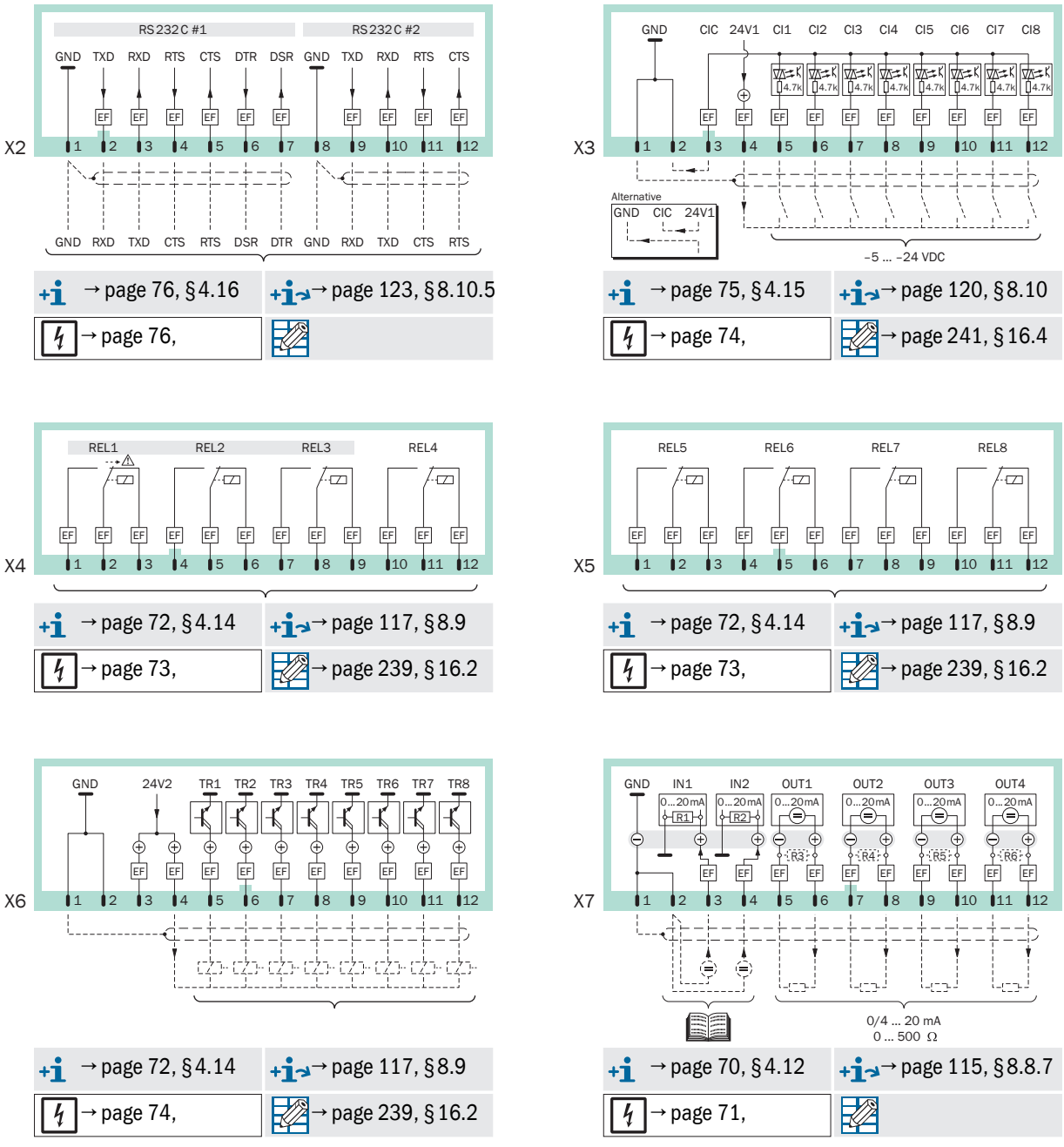
Gas analyzer signal connections
List of signal functions

16.1 Signal connections on gas analyzer (overview)

NOTICE:

► Use this overview only if you are familiar with the related detailed safety information (see references in the Figure).

Figure 42 Signal connection overview



16.2 User Table: Switching outputs – Gas analyzer functions

❑ TOCOR700 UV ❑ TOCOR700 TH ❑ TOCOR700 TH + 2nd reactor	Serial no.:

Function (explanation → page 118, §8.9.4)		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	18	–	–	–	–	–	–																										
range - output 2	19	–	–	–	–	–	–																										
range - output 3	20	–	–	–	–	–	–																										
range - output 4	21	–	–	–	–	–	–																										
switch on pt. 1	22	–	–	–	–	–	–																										
switch on pt. 2	23	–	–	–	–	–	–																										
switch on pt. 3	24	–	–	–	–	–	–																										
switch on pt. 4	25	–	–	–	–	–	–																										
switch on pt. 5	26	–	–	–	–	–	–																										
switch on pt. 6	27	–	–	–	–	–	–																										
switch on pt. 7	28	–	–	–	–	–	–																										
switch on pt. 8	29	–	–	–	–	–	–																										
meas. value pt. 1	30	–	–	–	–	–	–																										
meas. value pt. 2	31	–	–	–	–	–	–																										
meas. value pt. 3	32	–	–	–	–	–	–																										
meas. value pt. 4	33	–	–	–	–	–	–																										
meas. value pt. 5	34	–	–	–	–	–	–																										
meas. value pt. 6	35	–	–	–	–	–	–																										
meas. value pt. 7	36	–	–	–	–	–	–																										
meas. value pt. 8	37	–	–	–	–	–	–																										
FAILURE sensor 1	38	–	–	–	–	–	–																										
FAILURE sensor 2	39	–	–	–	–	–	–																										
FAILURE sensor 3	40	–	–	–	–	–	–																										
FAILURE extern 1	41	–	–	–	–	–	–																										
FAILURE extern 2	42	–	–	–	–	–	–																										
SERVICE sensor 1	43	–	–	–	–	–	–																										
SERVICE sensor 2	44	–	–	–	–	–	–																										
SERVICE sensor 3	45	–	–	–	–	–	–																										
SERVICE extern 1	46	–	–	–	–	–	–																										
SERVICE extern 2	47	–	–	–	–	–	–																										
CALIBR. sensor 1	48	–	–	–	–	–	–																										
CALIBR. sensor 2	49	–	–	–	–	–	–																										
CALIBR. sensor 3	50	–	–	–	–	–	–																										
CALIBR. extern 1	51	–	–	–	–	–	–																										
CALIBR. extern 2	52	–	–	–	–	–	–																										
flow sensor	53	–	–	–	–	–	–																										
condensate sensor	54	–	–	–	–	–	–																										

16.3 User Table: Switching output – TOCOR functions

❑ TOCOR700 UV ❑ TOCOR700 TH ❑ TOCOR700 TH + 2nd reactor	Serial no.:

Function (explanation → page 118, §8.9.4)		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!
dosing pump M10	55	–	–	–	–	–	–																										
dosing pump M11	56	–	–	–	–	–	–																										
single sample Y01	57	–	–	–	–	–	–																										
zero med. valve Y01	58	–	–	–	–	–	–																										
meas. med. valve Y11	59	–	–	–	–	–	–																										
test med. valve Y03	60	–	–	–	–	–	–																										
test med. valve Y04	61	–	–	–	–	–	–																										
back-flushing Y21	62	–	–	–	–	–	–																										
flush-gas pump	63	–	–	–	–	–	–																										
back-flush fil.pt. 1	64	–	–	–	–	–	–																										
back-flush fil.pt. 2	65	–	–	–	–	–	–																										
back-flush fil.pt. 3	66	–	–	–	–	–	–																										
back-flush fil.pt. 4	67	–	–	–	–	–	–																										
reactor E01 on	68	–	–	–	–	–	–																										
dilution Y05	69	–	–	–	–	–	–																										

16.4 User Table: Control inputs

❑ S710 ❑ S711 ❑ S715 ❑ S720Ex ❑ S721Ex	Serial no.:

Control function f (→ page 120, §8.10.2)		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	12																
output 2	13																
output 3	14																
output 4	15																
(no function)	16																
failure 1	17		X[1]														
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	27																
hold sample pt. 2	28																
hold sample pt. 3	29																
hold sample pt. 4	30																
hold sample pt. 5	31																
hold sample pt. 6	32																
hold sample pt. 7	33																
hold sample pt. 8	34																
switch off pt. 1	35																
switch off pt. 2	36																
switch off pt. 3	37																
switch off pt. 4	38																
switch off pt. 5	39																
switch off pt. 6	40																
switch off pt. 7	41																
switch off pt. 8	42																
validation	43																
water leak B01	44																
cooler E03	45																
reactor E01	46																
validation 1	47																
validation 2	48																
storage B11	49																
sample gas B05	50																
sample water B02	51																
reactor on	52																

[1] Normally assigned to the alarm signal of the pressurized enclosure control device for device versions for potentially explosive atmospheres

TOCOR700

17 Spare Parts

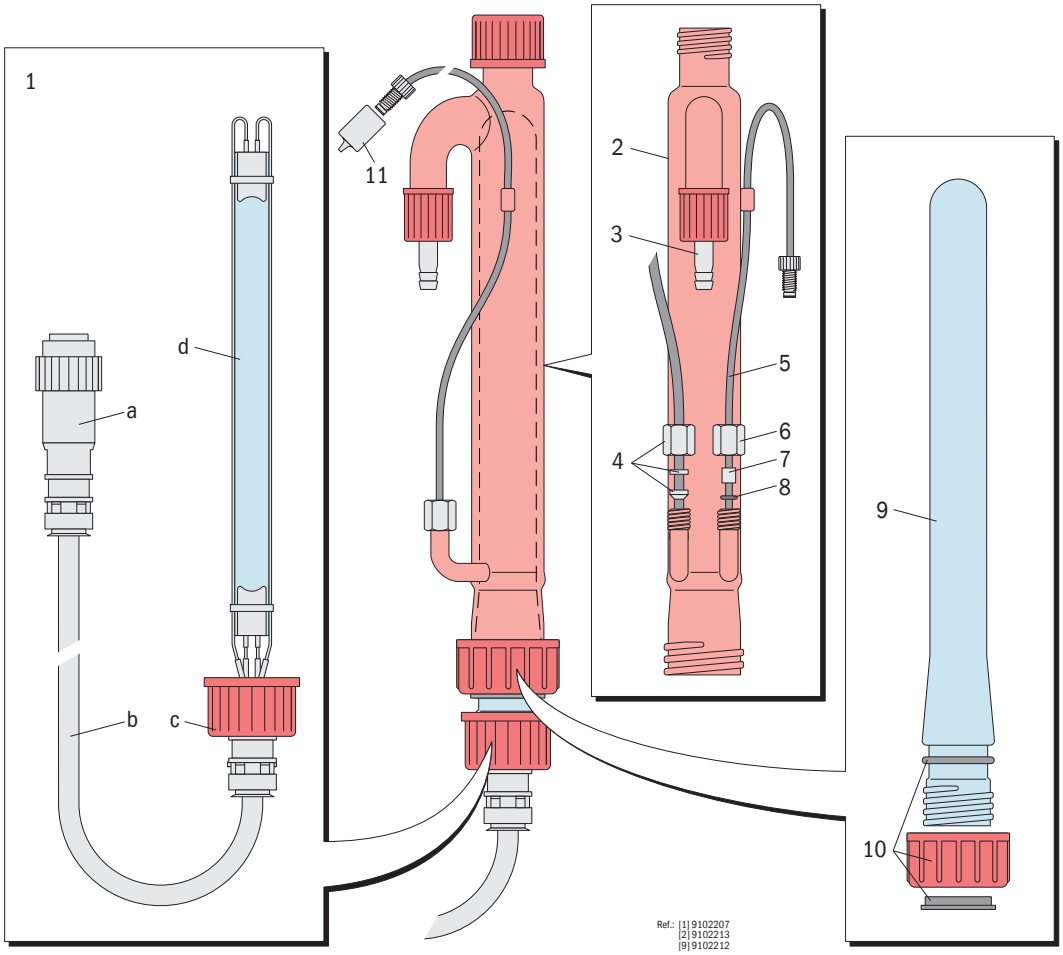
Hoses
Expendable materials
Reactor components
Fuses
Tools

17.1 UV reactor components (TOCOR700 UV)

17.1.1 Spare parts

► Cleaning the reactor → page 204, § 12.3
► Replacing the UV lamp → page 245, § 17.1.3

Figure 43 UV reactor



Pos.	Description	Order No.
1	UV lamp, complete	2038457
2	Cladding tube, Duran glass, brown	4043491
3	Olive, straight, with screw cap GL18 (screw fitting)	5315373
4	Connection set 2N-D4	5317657
5	PTFE hose with screw fitting, 1000 mm long, 1x flared fitting M6	2028289
6	Cap nut M8	5317616
7	Crimp sleeve PVC for O-ring 2.0x1.5	4044595
8	O-ring 2.0x1.5-FPM	5317202
9	Submersion tube, quartz glass	4046460
10	Rodaviss screw fitting	5317880
11	Connecting piece OD 1.3/ID 0.8 – OD 12/ID M6, PVC	4038556
	Connecting piece OD 3/OD 1.3 – OD 12/ID M6, PVC	4041010
	T-connecting piece 2x OD 3/OD 0.8 – ID M6, PVC	2028285
	T-connecting piece OD 3/OD 1.3 – OD 1.6/ID 0.8 – ID M6	2028284

17.1.2 UV lamp service life

The service life of the UV lamp is limited because the UV permeability of its glass gradually decreases during the operating time. This reduces the effective radiancy of the UV lamp. Therefore the UV lamp must be replaced after a certain operating time. The service life for continuous operation is 6000 ... 8000 hours.

The radiant intensity is lower at the end of the service life which means measuring sensitivity declines. This reduced sensitivity can indeed be compensated by calibration but when the mathematical compensation becomes very large it is possible that the specified measuring precision can no longer be maintained. The UV lamp should then be replaced.

Every switching on and off strains the UV lamp and shortens its service life.

► Wait at least 5 minutes after switching off before the UV lamp is switched on again.

► Do not switch the UV lamp off and on unnecessarily.

17.1.3 Replacing the UV lamp

WARNING: Risk to health through UV radiation

The UV lamp of the reactor emits ultraviolet light when switched on (UV-C).

- UV light can damage unprotected eyes.
- UV light creates ozone (O_3). Ozone is dangerous to health.

The submersion tube is transparent for UV light. The cladding tube protects against UV light.

► Switch the reactor (UV lamp) off before dismantling the reactor.

Ä Do not operate the UV lamp outside the cladding tube.

WARNING: Danger through high voltage

The UV lamp runs with electrical high voltage.

Ä Do not operate the UV lamp outside the cladding tube.

Remove UV lamp

1 Switch reactor off (→ page 99, 7.4.5).

2 Swivel the internal installation plate out of the housing.

3 Loosen screw cap [c] (→ page 244, Figure 43) and UV lamp [d] (including cable [b]) and carefully slide out of submersion tube [9].

Fit UV lamp

1 Fit UV lamp: Fit in reversed removing sequence.

1 Switch reactor on.

2 Wait for the start-up time of the new UV lamp to elapse: Feed sample water of zero water and wait until the measured value display remains constant.

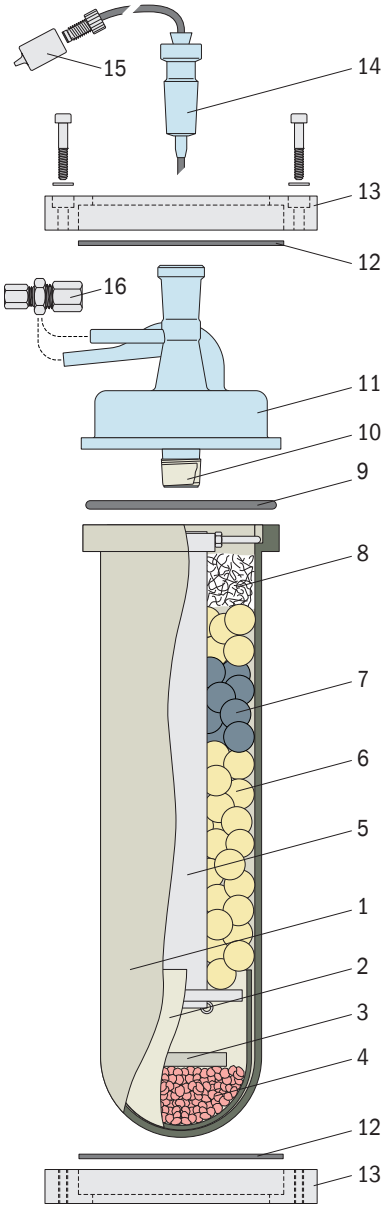
3 Perform a calibration (→ page 147, § 9).

The UV lamp may need a certain “burn-in time” before reaching full effective radiancy. It can therefore be useful for sensitive measuring ranges to wait up to 24 hours before calibrating with the new UV lamp.

17.2 Thermal reactor components (TOCOR700 TH)

Assembly → page 53, § 3.5.3

Figure 44 Thermal reactor – spare parts



Pos.	Description	Order No.
1	Ceramic crucible, large, D=65x3, L=270	4038421
2	Protective crucible, small, D59x1.5 L=70	4038422
3	Ceramic disc, D=35, s=5	4038447
4	Granulate, approx. 70 ml	2028845
5	Drop tube, complete[1]	2028319
	Drop tube, ceramic, OD=23, L=210	4038423
	Platinum eyelet [2]	4044474
	Perforated ceramic disc, D=55, d=4	4038424
	Fixing ring	4045486
	Fixing screw [2]	4038528
	Nut [2]	5311862
6	Ceramic beads D11-16, approx. 1.1 kg	5312618
7	Catalyst beads, approx. 90 ml	4038688
8	Quartz wool, approx. 500 ml	5312174
9	O-ring 75,79x3.53-FPM	5311881
10	PTFE sealing tape (roll)	5311907
11	Lid for ceramic crucible, glass	4038564
12	Hard paper disc	4038567
13	Flange, Al	4038568
14	Connection tubes, complete (capillary drip tube)	2028312
15	Connecting piece OD 1.3/ID 0.8 – OD 12/ ID M6, PVC	4038556
16	Screw fitting, straight, D4–D6, PTFE	5312081
–	Grease pencil, up to 250 °C [3]	5602588

1 Comprising specified single parts
2 3 pieces required
3 Joint grease for Pos. 14

Accessories for the thermal reactor

Description	Quantity	Order No.	Use
Crucible supports, wood	1	2028255	Assembly tool for reactor crucible
Alignment rod	1	2028254	Aligning the reactor (→ page 52, § 3.5.2)

17.3 Pumps

17.3.1 Pump hoses for dosing pump (M10)

Fitting → page 202, § 12.2.5

Designation[1]	Color code[2]	Material: PVC[3] Order No.	Material: Norprene[4] Order No.
Pump hose D0.38/2.18 or/gn	Orange/green	5317691	5312218
Pump hose D0.64/2.44 or/ws	Orange/white	5318221	5312220
Pump hose D0.76/2.44 sw/sw	Black/black	5317692	5312155
Pump hose D0.89/2.57 or/or	Orange/orange	5317694	5312156
Pump hose D1.02/2.70 ws/ws	White/white	5318220	5312221
Pump hose D1.37/3.05 ge/ge	Yellow/yellow	5317695	5312222
Pump hose D1.60/3.28 bl/bl	Blue/blue	5318671	5312223
Pump hose D1.85/3.53 gn/gn	Green/green	5317696	5312224
Pump hose D2.06/3.74 vi/vi	Violet/violet	5317697	5312157
Pump hose D2.62/4.30 vi/or	Violet/orange	5318672	5312225
Pump hose D2.79/4.47 vi/ws	Violet/white	5317698	5312158

1 Numerical values = inner diameter/outer diameter in mm. The specific values are valid for the material PVC; some of the values deviate slightly for the material “Norprene”.
2 That part of the designation wrapped around the pump hose is valid
3 Standard material, transparent
4 Material for higher demands; opaque

17.3.2 Spare parts for the pre-sampling pump (dosing pump M11)

– Only for devices with pre-sampling pump –

Fitting → page 203, § 12.2.6

Description	Order No.
Pump hose set Novoprene ID=1.6x1.6 OD=4.8	5312113
Pump hose set Novoprene ID=3.2x1	5312272
Pump hose set Novoprene ID=4.8x1.6 OD=8.0	5312050
Continuous roll of wrapping tape for hose pump SR25	5312048

17.3.3 Replacement pumps

Description	Order No.	Use
Hose pump CA-4E, 12 rpm [1]	6027110	5 channel dosing pump (M10)
Hose pump CA-4E, 6 rpm [1]	6027111	
Hose pump	6032012	Pre-sampling pump (dosing pump M11)

1 Without pump hoses (→ § 17.3.1); rpm = revolution per minute (speed)

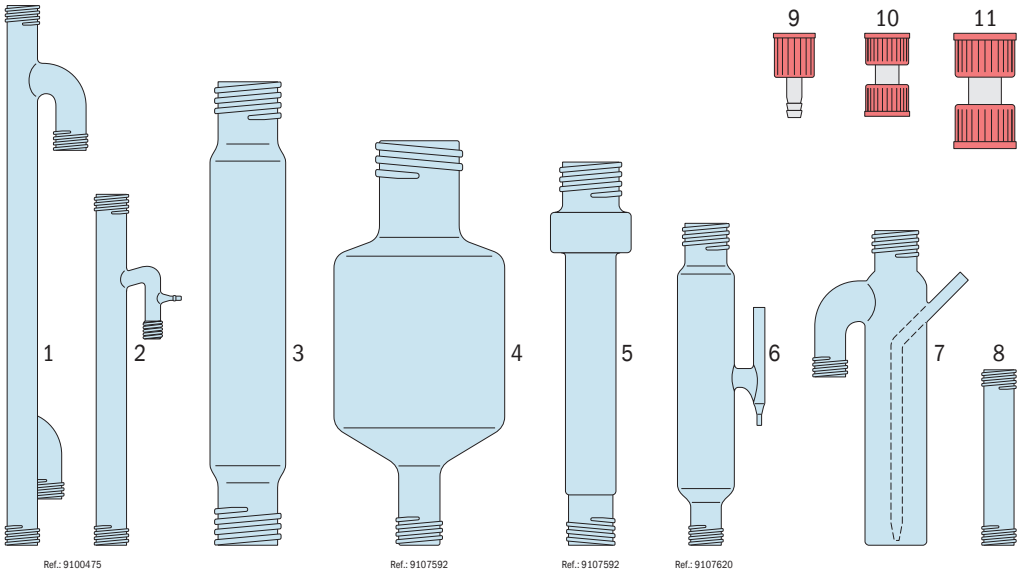
17.4 Hoses

Designation[1]	Order No.	Use
PTFE hose 2x1 mm (ID=2 OD=4)	5312437	Stripper, air line on reactor
PTFE hose with screw fitting, 300 mm long, 1x flared fitting M6	2037568	Internal sample gas line
PTFE hose with screw fitting, 1000 mm long, 1x flared fitting M6	2028289	Internal sample water line
Hose PVC (Guttasyn) ID=10 OD=14	5311979	Internal waste water lines (siphons)
Hose connector OD=12/10 D=I2 PVDF	4049595	= capillaries in siphon (→ page 42, Figure 10)
Hose FPM ID=4 OD=6	5311899	Gas lines
Hose 2x0.5, OD=3, PTFE	5312012	Internal/external sample water lines
Hose 3x1, OD=5, PVC	5311922	Internal sample water line

1 OD = outer diameter / ID = inner diameter in mm

17.5 Glass containers

Figure 45 Glass parts



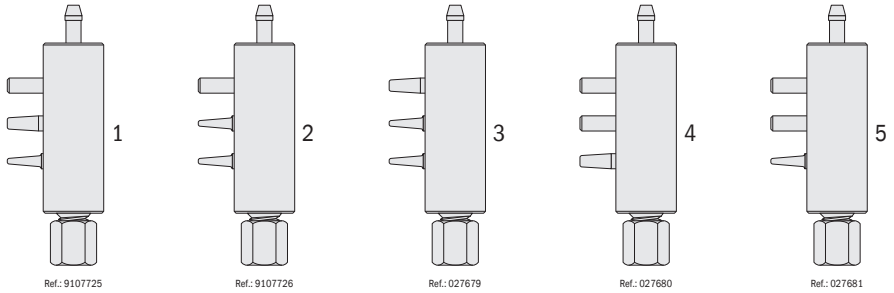
Pos.	Description	Order No.
1	Glass tube, L=270/4xGL18/D16	4044596
2	Glass tube, L=160/2xGL18/M8/D16	5317658
3	Filter tube, OD=40, L=250	4039232
4	Absorber container, OD=90, L=200, GL25, GL45	4043489
5	Cooling tube, L=190, GL25/GL32	4046462
6	Phase separator (water separator GL25/GL18 - D6 - DA2)	4046463
7	Gas washer, glass, 1x GL25, 1x GL18, 1x DA6, D=40 L=180	4044615
8	Glass tube, OD=16, 2x GL18, L=80	4047687
9	Olive, straight, with hose coupling GL18	5315373
10	Coupling GL18-GL18	5317634
11	Coupling GL25-GL25	5317639

- Glass parts of UV reactor (TOCOR700 UV) → page 244, § 17.1
- Glass lid of thermal reactor (TOCOR700 TH) → page 246, § 17.2

17.6 Sample inlet module

Design of the sample inlet module depends on the number and dimensions of the pump hoses used.

Figure 46 Sample inlet module



Pos.	Description	Connections	Order No.
1	Sample inlet module 1	M8 – D1.3 – D2.5 – N – D5	2035405
2	Sample inlet module 2	M8 – D1.3 – D1.3 – N – D5	2035406
3	Sample inlet module 3	M8 – D1.3 – D1.3 – D2.5 – D5	2035407
4	Sample inlet module 4	M8 – D2.5 – N – N – D5	2035408
5	Sample inlet module 5	M8 – D1.3 – N – N – D5	2035409
6	Elbow joint	DN4 – DN6	5317683

Material for all sample inlet modules: PVC

Pos.	Description	Connections	Order No.
6	Elbow joint	DN4 – DN6	5317683

17.7 Components in sample inlet

Description	Order No.
Screw-in fitting DN4/6 – 1/8, PVDF	5312116
Screw-in fitting DN3 – 1/8, PVDF	5312072
Bulkhead union D3, PVDF	5312242
T-fitting D3 – D3 – D3	5319433
Connecting nipple D1.3 – D3, PVC	4044617
Connecting nipple D2.5 – D3, PVC	4044618
Solenoid valve 3/2-way, type 127	6027244

17.8 Expendable material

17.8.1 Chemical operating substances

Description	Order No.	Use	
Sulphuric acid H_2SO_4 98%, 500 ml	5602499	Reagent	→ page 47, § 3.4.2
Hydrochloric acid HCl 32%, 1000 ml	5602856		
Sodium peroxy disulphate $Na_2O_8S_2$, 1 kg [1]	5313301	Reagent (only for TOCOR700 UV)	
Soda lime 0.75 kg	5311941	CO_2 absorber (filter)	→ page 43, § 3.3.2
Potassium hydrogen phtalate for calibration solution with 1000 mg/l C	2028596	Calibration solution	→ page 150, § 9.2.2
Potassium hydrogen phtalate for calibration solution with 5000 mg/l C	2038178		

1 Information on safe storage → page 257, § 18.1.3

WARNING: Health risks through chemical substances

► Observe safety information on chemical substances (→ page 256, § 18.1).

17.8.2 Filter material

Description	Order No.	Use	
Brass wool, approx. 12g	2028844	Corrosion inhibitor filter	→ page 200, § 12.2.3
Activated charcoal, granulate, 2.5 mm, kg[1]	5311976	Activated charcoal filter	→ page 201, § 12.2.4
Quartz wool, approx. 500 ml	5312174	Thermal reactor	→ page 246, § 17.2
Glass filter wool, 500 g [2]	5311940	Filter containers	→ page 198, § 12.2.2 → page 200, § 12.2.3 → page 201, § 12.2.4

1 Specify desired quantity

2 Only for temperatures under 200 °C; do not use in thermal reactor (TOCOR700 TH)

17.8.3 Auxiliary substances

Description	Order No.	Use	
PTFE sealing tape (roll)	5311907	Thermal reactor	→ page 53, § 3.5.3
Grease pencil, up to 250 °C	5602588	Ground glass joints for glass parts	→ page 53, § 3.5.3 + → page 204, § 12.3
Indicator strips pH 0-6	5319080	PH-value check in stripper	→ page 47, § 3.4.2

17.9 Useful accessories

Work equipment

Description	Order No.	Use
Spray bottle 0.5 l	5319089	Filling siphons
Pipette 2.3 ml (to be used once only)	5319086	Dosing acids
Measuring scoop 25 ml	5319087	Dosing oxidant
Measuring cylinder 250 ml	5319085	Preparing calibration liquids
Square bottle 1000 ml	5319083	Calibration liquid
Hose clamp	5319088	Leak tightness check

Tools for TOCOR700 TH

Description	Use	Order No.
Round brush ø 80 mm	Cleaning the reactor crucible	5311904
Bottle brush ø 30 mm	Cleaning the drop tube	5311905
Socket wrench SW 13	Reactor alignment	5313166
Screwdriver, slit 0.5x3.0x100	Reactor assembly	5311983

17.10 Electrical fuses

CAUTION: Health risk

► *Before checking mains fuses:* Separate device from mains supply or switch off mains supply on external locations.

CAUTION: Risk of fire/destruction

If wrong fuses are installed, a fire could possibly be started when an internal component becomes defective.

► Only use fuses as replacements that exactly meet the specified values (type of design, switch-off current, switch-off characteristics).

17.10.1 Electrical fuses in gas analyzer

Table 9 Gas analyzer mains fuses

Mains voltage	Fuse(s)	Order No.
110 V	T 4.0 C 5x20	6004310
115 V		
230 V	T 2.0 C 5x20	6026946

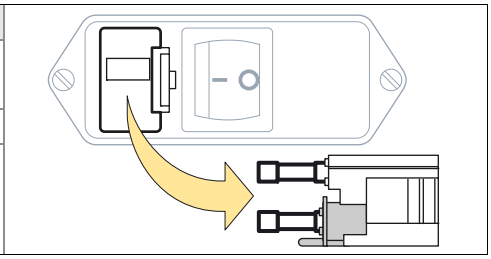


Table 10 Fuses on internal electronics board (revision 4)

Identification	Fuse(s)	Order No.	Protects
F1	F 1.0 A TR5	6030134	+24 VDC output (→ page 67, § 4.10.3)
F2	F 4.0 A TR5	6010712	+24 VDC for relay, internal heating, internal gas pump
F3	F 1.6 A TR5	6026950	+5 VDC for digital electronics, infrared source
F4	F 0.8 A TR5	6032017	+15 VDC for analog electronics, measured value output, motors
F5			–15 VDC for analog electronics, measured value output, motors

Table 11 Fuse pack for gas analyzer

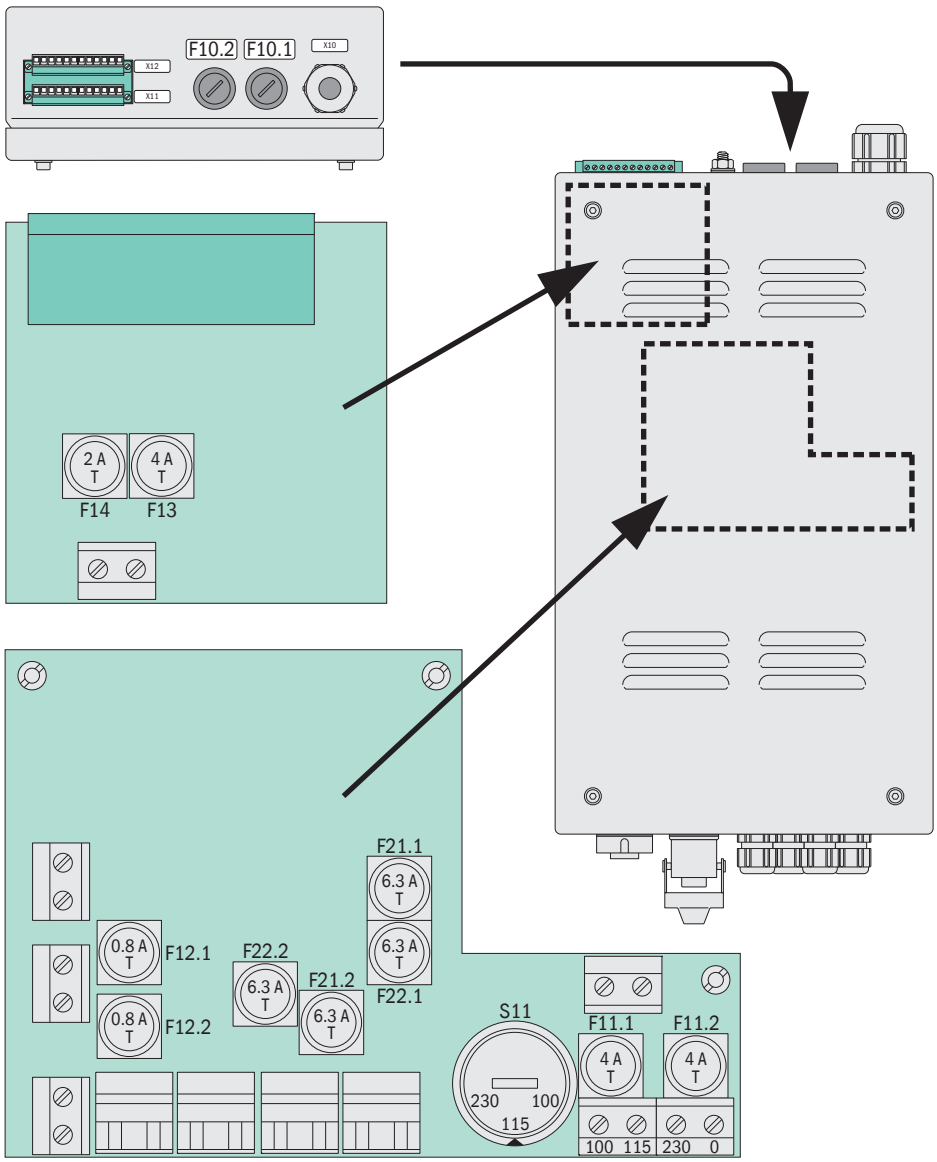
Description	Quantity	Order No.	Note
Spare part set, fuses, S700	1 packet	2028493	Contains one each of fuse types described above

The measuring system of the gas analyzer has an overheat fuse (→ page 225, „FAULT: temperature 1“).

17.10.2 Electrical fuses in power supply unit

The power supply unit (enclosed) supplies the electronic components of the gas analyzer.

Figure 47 Fuses in power supply unit



Fuse	Description	Order No.	Information/function
F10.1, F10.2	Fuse T 16 A	*In preparation*	Main fuse for wet part/gas generator
F11.1, F11.2	Fuse T 4.0 A	6004310	Supply for built-in transformer
F12.1, F12.2	Fuse insert T 0A8 (T 0.8 A)	6004292	Cooler (230 VAC), fan, UV reactor
F13	Fuse insert T 4A0 (T 4.0 A)	6004310	Dosing pump M10, pre-sampling pump M11, back-flush pump M02, rectifier (24 VAC/DC)
F14	Fuse insert T 2A0 (T 2.0 A)	6026946	24 VDC, RS232 module, back-flush filter valve Y21, calibration valve M03, sample points switcher
F21.1, F21.2	Fuse insert T 6A3 (T 6.3 A)	6006661	Thermal reactor 1
F22.1, F22.2	Fuse insert T 6A3 (T 6.3 A)	6006661	Thermal reactor 2

TOCOR700

18 Annex

Safety information on chemical substances
Materials carrying sample water
Flow plan (example)
EU Certificate of Conformity

18.1 Safety information on chemical substances

CAUTION: Health risks through chemical substances

The TOCOR700 uses chemical substances during operation that can endanger health.

- ► Observe the safety information on handling chemical substances in the following Sections.
- ► Always wear suitable personal protective equipment (e.g. protective gloves, protective goggles) when clearing released substances and observe the safety information.

Detailed safety data sheets on chemical substances can be obtained from the manufacturers (e.g. http://www.chemdat.info).

18.1.1 Activated charcoal [C]

Possible risks	*Not a dangerous product in terms of Guideline 67/548/EEC*	
Storage	Closed tight. Storage temperature: Without restrictions.	
Personal protective equipment	Breathing protection:	By dust: Dust mask
	Eye protection:	Necessary
	Hand protection:	Gloves material: Nitrile rubber
First aid measures	After inhaling:	Fresh air.
	After skin contact:	Wash off with plenty of water. Take off contaminated clothing.
	After eye contact:	Rinse eyes with plenty of water and eyelids open. Call eye specialist when necessary.
	After swallowing:	Drink plenty of water immediately. Call a doctor by uneasiness or discomfort.
Measures after unintentional release	Person protection:	Avoid creating dust. Do not inhale dust.
	Clearance:	Collect when dry. Dispose of properly. Clean afterwards.

18.1.2 Potassium hydrogen phtalate (PHP) [$C_8H_5KO_4$]

Possible risks	*Not a dangerous product in terms of Guideline 67/548/EEC*	
Storage	Closed tight. Dry. Storage temperature: +15 ... +25 °C.	
Personal protective equipment	Breathing protection:	Necessary when dust occurs
	Eye protection:	Necessary
	Hand protection:	Gloves material: Nitrile rubber
First aid measures	After inhaling:	Fresh air.
	After skin contact:	Wash off with plenty of water. Take off contaminated clothing.
	After eye contact:	Rinse eyes with plenty of water and eyelids open. Call eye specialist when necessary.
	After swallowing:	Drink lots of water, cause vomiting, call a doctor.
Measures after unintentional release	Person protection:	Avoid creating dust. Do not inhale dust.
	Environment protection:	Do not allow to seep into sewer system.
	Clearance:	Collect when dry. Dispose of properly. Clean afterwards.

18.1.3 Sodium peroxy disulphate [$Na_2O_8S_2$]

Possible risks	Risk of fire in contact with flammable substances. Dangerous to health when swallowed. Irritates eyes, breathing organs and skin. Allergization through inhaling and skin contact possible.	
Storage	Closed tight. Not near flammable substances, well away from ignition or heat sources. Dry. Storage temperature: +15 ... +25 °C.	
Handling	Preferably work under a vent. Do not inhale the substance.	
Personal protective equipment	Breathing protection:	Necessary when dust occurs
	Eye protection:	Necessary
	Hand protection:	Gloves material: Nitrile rubber
First aid measures	After inhaling:	Fresh air.
	After skin contact:	Wash off with plenty of water. Take off contaminated clothing.
	After eye contact:	Rinse eyes with plenty of water and eyelids open. Call eye specialist when necessary.
	After swallowing:	Drink lots of water, cause vomiting, call a doctor.
Measures after unintentional release	Person protection:	Avoid contact with substance. Avoid creating dust. Do not inhale dust.
	Environment protection:	Do not allow to seep into sewer system.
	Clearance:	Collect when dry. Dispose of properly. Clean afterwards.

18.1.4 Soda lime ([NaOH] 2 ... 5 %)

Possible risks	Causes chemical burns.	
Storage	Closed tight. Storage temperature: Without restrictions.	
Personal protective equipment	Breathing protection:	Necessary when dust occurs
	Eye protection:	Necessary
	Hand protection:	Gloves material: Nitrile rubber
First aid measures	After inhaling:	Fresh air. Call a doctor.
	After skin contact:	Wash off with plenty of water. Dab off with polyethylene glycol 400. Take off contaminated clothing immediately.
	After eye contact:	Rinse with plenty of water and eyelid open (at least 10 minutes). Call eye specialist immediately.
	After swallowing:	Drinks lots of water (several liters when possible), avoid vomiting (risk of perforation!). Call doctor immediately. No attempts to neutralize.
Measures after unintentional release	Person protection:	Avoid contact with substance and inhaling dust. Make sure fresh air enters closed rooms.
	Environment protection:	Do not allow to seep into sewer system.
	Clearance:	Collect when dry. Avoid creating dust. Dispose of properly. Clean afterwards.

18.1.5 Hydrochloric acid [HCl]

Possible risks	Causes chemical burns. Irritates breathing organs.	
Storage	Closed tight. No metal containers. Storage temperature: Without restrictions.	
Personal protective equipment	Breathing protection:	Necessary when vapours/aerosols escape
	Eye protection:	Necessary
	Hand protection:	Gloves material for full contact: Nitrile rubber Gloves material for spray contact: Naturlatex
	Further:	Acid resistant protective clothes
First aid measures	After inhaling:	Fresh air. Call a doctor.
	After skin contact:	Wash off with plenty of water. Dab off with polyethylene glycol 400. Take off contaminated clothing immediately.
	After eye contact:	Rinse with plenty of water and eyelid open (at least 10 minutes). Call eye specialist immediately.
	After swallowing:	Drink plenty of water (several liters when possible). Avoid vomiting (risk of perforation). Call doctor immediately. No attempts to neutralize.
Measures after unintentional release	Person protection:	Avoid contact with substance. Do not inhale vapours/ aerosols. Make sure fresh air enters closed rooms.
	Environment protection:	Do not allow to seep into sewer system.
	Clearance:	Collect with water binding and neutralizing material (e.g. Merck Chemizorb H^+). Dispose of properly. Clean afterwards.

18.1.6 Sulphuric acid 98 % [H_2SO_4]

Possible risks	Causes severe chemical burns.	
Storage	Closed tight. Storage temperature: Without restrictions.	
Personal protective equipment	Breathing protection:	Necessary when vapours/aerosols escape
	Eye protection:	Necessary
	Hand protection:	Gloves material for full contact: Viton Gloves material for spray contact: Butyl rubber
	Further:	Acid resistant protective clothes
First aid measures	After inhaling:	Fresh air.
	After skin contact:	Wash off with plenty of water. Dab off with polyethylene glycol 400. Take off contaminated clothing immediately.
	After eye contact:	Rinse with plenty of water and eyelid open (at least 10 minutes). Call eye specialist immediately.
	After swallowing:	Drinks lots of water (several liters when possible), avoid vomiting (risk of perforation!). Call doctor immediately. No attempts to neutralize.
Measures after unintentional release	Person protection:	Avoid contact with substance. Do not inhale vapours/ aerosols. Make sure fresh air enters closed rooms.
	Environment protection:	Do not allow to seep into sewer system.
	Clearance:	Collect with water binding and neutralizing material (e.g. Merck Chemizorb H^+). Dispose of properly. Clean afterwards.

18.2 Materials carrying sample water

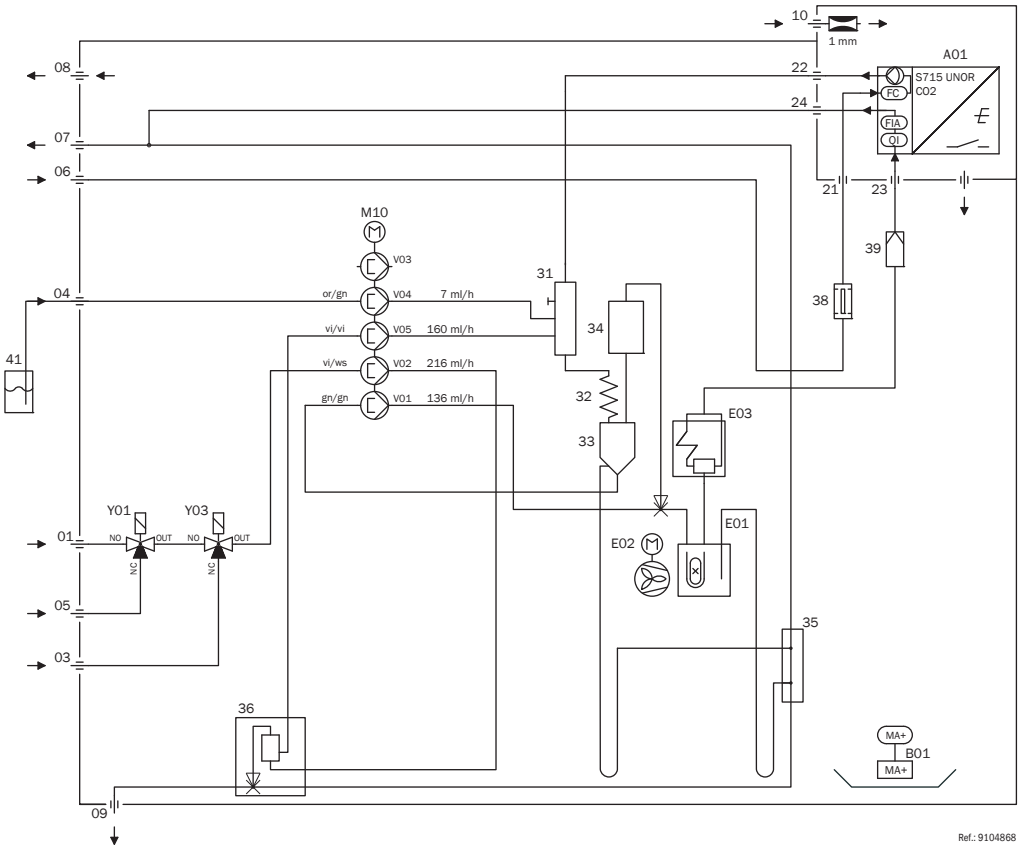
Table 12 Materials in contact with the sample gas

Subassembly	Component	Material
Diverse	Sealing rings	FPM, Viton (fluorocarbon rubber)
Valve block	Basic casing	PP
Connections in water lines	Capillary hoses	PTFE
	Screw fittings	PVDF, PTFE, PVC
Stripper	Hose coil	PTFE
Hose pumps	Pump hoses	PVC, Norprene
Reactor	Casing, inner parts	Glass, ceramic

18.3 Flow plan (example)

The substance flow in the measuring system depends on the individual device design (→ page 26, §2.3). The flow plan for your device can be found in the individual technical device documentation. The following Figure shows an example.

Figure 48 Flow plan (example for TOCOR700 UV)



01	Sample water inlet
03	Single sample inlet
05	Zero water inlet
06	Carrier gas inlet
07	Exhaust gas outlet
08	Purge air outlet
10	Purge air inlet
31	Sample inlet module
21	Carrier gas inlet (gas analyzer)
22	Carrier gas outlet (gas analyzer)
23	Sample gas inlet (gas analyzer)
24	Sample gas outlet (gas analyzer)
32	Stripper
33	Phase separator
34	CO_2 absorber
35	Waste water collector
36	Waste water reservoir
38	Activated charcoal filter

39	Corrosion inhibitor filter
41	Reagent (acid)
A01	Gas analyzer
B01	Liquid sensor
E01	Reactor
E02	Fan
E03	Gas cooler
FC	Sensor for carrier gas flow control
FIA	Sensor for carrier gas flow monitoring
M10	Hose pump
QI	Gas analyzer cuvette
V01	Pump channel sample water > reactor
V02	Pump channel sample water > reservoir
V03	Pump channel reservoir > stripper
V04	Pump channel acid > stripper
V05	–
Y01	Switching valve zero water
Y03	Switching valve single sample

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