Instruction Manual
HASAxE-IM-HS
11/2006

XSTREAM
Gas Analyzer Series

Instruction Manual

ROSEMOUNT Analytical

EMERSON Process Management

www.EmersonProcess.com

ESSENTIAL INSTRUCTIONS

READ THIS PAGE BEFORE PROCEEDING!

Emerson Process Management (Rosemount Analytical) designs, manufactures and tests its products to meet many national and international standards. Because these instruments are sophisticated technical products, you **MUST properly install, use, and maintain them** to ensure they continue to operate within their normal specifications. The following instructions **MUST be adhered to** and integrated into your safety program when installing, using and maintaining Emerson Process Management (Rosemount Analytical) products. Failure to follow the proper instructions may cause any one of the following situations to occur: Loss of life; personal injury; property damage; damage to this instrument; and warranty invalidation.

- **Read all instructions** prior to installing, operating, and servicing the product.
- If you do not understand any of the instructions, **contact your Emerson Process Management (Rosemount Analytical) representative** for clarification.
- **Follow all warnings, cautions, and instructions** marked on and supplied with the product.
- **Inform and educate your personnel in the proper installation, operation, and maintenance of the product**.
- **Install your equipment as specified in the Installation Instructions of the appropriate Instruction Manual and per applicable local and national codes**. Connect all products to the proper electrical and pressure sources.
- To ensure proper performance, **use qualified personnel** to install, operate, update, program, and maintain the product.
- When replacement parts are required, ensure that qualified people use replacement parts specified by Emerson Process Management (Rosemount Analytical). Unauthorized parts and procedures can affect the product's performance, place the safe operation of your process at risk, **and VOID YOUR WARRANTY**. Look-alike substitutions may result in fire, electrical hazards, or improper operation.
- **Ensure that all equipment doors are closed and protective covers are in place, except when maintenance is being performed by qualified persons, to prevent electrical shock and personal injury**.

The information contained in this document is subject to change without notice.

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EMERSON
Process Management

PREAMBLE

This instruction manual provides information about X-STREAM series gas analyzers concerning subassemblies, functions, procedures, installation, operation and maintenance.

This instruction manual covers several X-STREAM series analyzer variations and therefore may describe configurations and/or options not part of your specific analyzer.

Installation and operation of instruments intended to be installed and operated in hazardous areas is not covered by this instruction manual, but part of the specific instruction manual shipped together with such analyzers because of the special requirements for working in hazardous environments!

DEFINITIONS

The following definitions apply to WARNINGS, CAUTIONS and NOTES found throughout this publication.

WARNING

Highlights an operation or maintenance procedure, practice, condition, statement, etc.

If not strictly observed, could result in injury, death, or long-term health hazards of personnel.

CAUTION

Highlights an operation or maintenance procedure, practice, condition, statement, etc.

If not strictly observed, could result in damage to or destruction of equipment, or loss of effectiveness.

NOTE

Highlights an essential operating procedure, condition or statement.

IMPORTANT

Safety Instructions
Wiring and Installation of this Apparatus

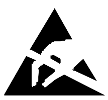
The following safety instructions apply specifically to all EU member states. They should be strictly adhered to in order to assure compliance with the Low Voltage Directive. Non-EU states should also comply with the following unless superseded by local or National Standards.

1. Adequate earth connections should be made to all earthing points, internal and external, where provided.
2. After installation or troubleshooting, all safety covers and safety grounds must be replaced. The integrity of all earth terminals must be maintained at all times.
3. To ensure safe operation of this equipment, connection to the mains supply should only be made through a circuit breaker which will disconnect all circuits carrying conductors during a fault situation. The circuit breaker may also include a mechanically operated isolating switch. Circuit breakers or switches must comply with a recognized standard such as IEC947. All wiring must conform with any local standards.
4. Where equipment or covers are marked with the symbol to the right, hazardous voltages are likely to be present beneath. These covers should only be removed when power is removed from the equipment — and then by trained service personnel only.

5. Where equipment or covers are marked with the symbol to the right, there is a danger from hot surfaces beneath. These covers should only be removed by trained service personnel when power is removed from the equipment. Certain surfaces may remain hot to the touch.

6. Where equipment or covers are marked with the symbol to the right, refer to the Instruction Manual for instructions.

7. Further graphical symbols used in this product:



Electrostatic discharge (ESD)

Explosion Hazard!

Heavy Instrument!

Harmful (to Health)!

Toxic!

Disconnect from Mains!

All graphical symbols used in this product are from one or more of the following standards: EN61010-1, IEC417, and ISO3864.

Operating and Maintaining this Apparatus

This instrument has left the factory in compliance with all applicable safety regulations.
To maintain this operating condition, the user must strictly follow the instructions and consider the warnings in this manual or provided on the instrument.

Before switching on the instrument, verify that the electrical supply voltage matches the instrument´s operating voltage as set in the factory.

Any interruption in the instrument´s ground line, whether inside or outside the instrument, or removal or interruption of its ground line connection, could result in hazardous operating conditions. Intentionally interrupting the instrument´s protective ground is strictly prohibited.

Opening cover panels could expose voltage-carrying components. Connectors may also be under voltage. The instrument must be disconnected from all electrical supplies before attempting any calibrations, maintenance operations, repairs or component replacements requiring opening of the instrument. Any calibrations, maintenance operations, or repairs that need the instrument to be opened while connected to electrical supplies should be subject to qualified technicians familiar with the hazards involved only!

Use only fuses of the correct type and current ratings as replacements. Using repaired fuses and short circuiting of fuse holders is prohibited.

Observe all applicable regulations when operating the instrument from an auto-transformer or variac.

Substances hazardous to health may emerge from the instrument's exhaust.
Please pay attention to the safety of your operation personnel. Protective measures must be taken, if required.

INTENDED USE STATEMENT

X-Stream series gas analyzers are intended to be used as analyzers for industrial purposes. They must not be used in medical, diagnostic or life support applications nor as safety devices, and no independent agency certifications or approvals are to be implied as covering such applications!

SAFETY SUMMARY

If this equipment is used in a manner not specified in these instructions, protective systems may be impaired.

AUTHORIZED PERSONNEL

To avoid loss of life, personal injury and damage to this equipment and on-site property, do not operate or service this instrument before reading and understanding this instruction manual and receiving appropriate training. Save these instructions.

WARNING

ELECTRICAL SHOCK HAZARD

Do not operate without covers secure. Do not open while energized. Installation requires access to live parts which can cause death or serious injury.

For safety and proper performace this instrument must be connected to a properly grounded three-wire source of power.

WARNING

TOXIC GASES

This unit’s exhaust may contain toxic gases such as sulfur dioxide.
These gases can cause serious injuries.
Aviod inhalation of the exhaust gases at the exhaust fitting.

Connect exhaust outlet to a safe vent. Check vent line and connections for leakage.

Keep all fittings tight to avoid leaks. See section 7-2, page 7-2 for leak test instructions.

Safety Instructions

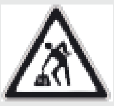
WARNING

EXPLOSION HAZARD

Do not operate nor install these instruments in hazardous areas without additional measures!

CAUTION

HEAVY INSTRUMENTS: X-STREAM F AND X-STREAM FD



The analyzer variation X-STREAM F, intended to be wall mounted and/or outdoor installed, weighs up to approx. 26 kg (57 lbs), depending on included options!

The analyzer variation X-STREAM FD, intended to be wall mounted and/or outdoor installed, weighs up to approx. 63 kg (139 lbs), depending on included options!

Use two people and/or suitable tools for transportation and lifting these instruments!

Take care to use anchors and bolts specified to be used for the weight of the units!

Take care the wall or stand the unit is intended to be installed at is solid and stable to hold the units!

CAUTION

HIGH TEMPERATURES

While working with photometers and/or thermostated components inside the analyzers hot components may be accessible!

GASES AND GAS CONDITIONING

WARNING

INJURY HAZARD


Take care of the safety instructions applicable for the gases (sample gases and test gases) and for the gas bottles containing these gases!

WARNING

EXPLOSION HAZARD

Supplying flammable gases of concentrations above the lower explosion limit (LEL) we recommend to utilize one or more of the following measures:

- **Purging the housing with inert gas**
- **Internal tubing with stainless steel**
- **Flame arrestors at gas input and output fittings**
- **Intrinsically safe paramagnetical or thermal conductivity sensors**

Supplying explosive gases is not permitted ! (Explosive gases are mixtures of flammable gases of concentrations between the explosion limits with air or oxygen).



Before opening gas paths they must be purged with ambient air or neutral gas (N2) to avoid hazards caused by toxic, flammable, explosive or harmful to health sample gas components!

POWER SUPPLY

CAUTION

Verify the mains voltage at site of installation corresponds to the analyzer´s rated voltage as given on the nameplate label!

Verify the safety instruction given by power supply unit manufacturer !

WARNING

CONNECTING INSTRUMENTS FOR FIXED INSTALLATION

Installation and connecting mains and signal cables are subject to qualified personnel only taking into account all applicable standards and legislative requirements!

Failure to follow may cause warranty invalidation, property damage and/or personal injury or death! Connecting mains and signal cables to internal srew terminals requires working at open housing near life parts!

Installation of this instrument is subject to qualified personnel only, familiar with the resulting potential risks!

The gas analyzers do not provide a mains power switch and are operable when connected to power.

The gas analyzers do not provide a mains switch! A mains switch or circuit breaker (to comply with IEC 60947-1 /-3) has to be provided in the building installation. This switch has to be installed near by analyzer, must be easily operator accessible and has to be assigned as disconnector for the analyzer.

CAUTION

Cables for external data processing must be double insulated for mains voltage when used inside the instrument!
If double insulation is not available signal cables inside the analyzer must be installed in a way that a distance of at least 5 mm is ensured permanently (e.g. by utilizing cable ties).

Safety Instructions

WARNING

ELECTRICAL SHOCK HAZARD !

These instruments provide a protective earth terminal. To prevent electrical shock hazards the instrument must be connected to a protective earth. Therefore the instrument has to be connected to mains by using a three wire mains cable with earth conductor!

Any interruption of the earth connector inside or outside the instrument or disconnecting the earth terminal may cause potential electrical shock hazzard! Intended interruption of protective earth connections is not permitted!

General Operating Instructions

WARNING

DANGER TO LIFE ! EXPLOSION HAZARD !

Verify all gas lines are connected as described within this manual and tight!

Improper gas connections may cause explosion, serious injury or death!

Exhaust may contain hydrocarbons and other toxic gases, e.g. carbon monoxide. Carbon monoxide is toxic!

- Indoor installation area has to be clean, free from moisture, excessive vibration and frost-protected.
- Take care to meet the permissible ambient temperatures as given in the technical data section! Instruments must not be exposed to direct sunlight nor sources of heat. Do not cover venting openings and take care to mount the instrument in a distance to walls not affecting venting.
- Do not interchange gas inlet and outlet! All gases must be conditioned before supplying! When supplying corrosive gases ensure that gas path components are not affected!
- Max. permissible gas pressure: 1,500 hPa (7.5 psig), except with paramagnetic Oxygen sensor (atmospheric pressure; ☞ page 3-17)!
- Exhaust lines must be installed in a descending way, need to be pressureless, frost-protected and in compliance with applicable legislative requirements!
- When it is necessary to open gas paths seal the analyzer‘s gas fittings by using PVC caps to avoid pollution of the internal gas path by moisture, dust, etc.
- To stay in compliance with regulations regarding electromagnetic compatibility it is recommended to use only shielded cables, as optionally available from Emerson Process Management or equivalent. Customer has to take care that the shield is connected in proper way (☞ section 4-5, page 4-31). Shield and signal connector enclosure need to be conductively connected, submin-d plugs and sockets must be screwed to the analyzer.
- Using external submin-d-to-terminal adaptor elements (option) affects electromagnetic compatibility. In this case the customer has to take measures to stay in compliance and has to declare conformity, when required by legislation (e.g. European EMC Directive).

Magnetically Operated Front Panel

WARNING

DANGER TO LIFE

Persons with cardiac pacemakers should absolutely avoid magnetic fields !

Negative effects on persons beyond those described above caused by magnetic fields are not known. It is presumed that persons showing allergic reaction on contact with ceramic or metallic material show the same behavior on contact with magnetic material.

CAUTION

Permanent magnets are surrounded by magnetic fields. These magnetic fields can disturb and even destroy sensitive electronic measuring devices, but also mechanical watches, credit cards, etc.

Usually a distance of 20 inch (0.5 m) is enough to avoid damages. All sintered permanent magnets are hard and brittle. Hitting of sintered permanent magnets by the magnetic attraction causes splitting into fragments with many sharp edges. This especially occurs with high energy magnets, and can also cause skin bruises by high attraction.

High energy magnets made of rare-earth materials have to be stored dry, otherwise the surfaces would oxidise. Unprotected operation in a humid environment may cause corrosion. Avoid damaging the protective galvanic coating.

A storage in a hydrogen atmosphere destroys these magnets. A demagnetisation is caused when permanent magnet materials have been exposed in a radioactive radiation for a long time.

For air transportation of magnetic material the IATA instructions have to be observed:

Magnetic fields are not allowed to penetrate the package, if necessary the magnets have to be shorted using a metal plate.

SHORT FORM GUIDE FOR THIS MANUAL

To find information about **see chapter**

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Chapter 1
Technical Description

1-1 Overview

Emerson Process Management´s new X-STREAM gas analyzer series key features:

- compact design with easily accessible internal components
- almost identical internal design supports several housing variations covering a wide range of applications
- highly integrated main board, containing all necessary basic functions and interfaces
- microprocessor based multi-language user interface utilizing an alphanumeric liquid cristal display (LCD) with measuring values and status messages. Outdoor variations provide a magnetically operated impact tested front panel with an optional vacuum fluorescence display (VFD).
- internal wide range power supply for worldwide usage

X-STREAM series analyzers are designed to measure 1 or 2 gas components combining any of the following methods:

IR = non-dispersive infrared measurement
UV = ultraviolet measurement
PO_2 = paramagnetic Oxygen measurement
EO_2 = electrochemical Oxygen measurement
TC = thermal conductivity measurement

For applications with solvent and/or corrosive components in the gas stream special resistant measuring cells are available.
For measuring flammable gases special solutions are available too (e.g. intrinsically safe cells).

Standard General Purpose Applications

Several enclosure variations are available:

- Tabletop and rack mount versions, full 19“ size, IP 20 protected (acc. to EN 60529).
- NEMA 4X / IP 66 protected stainless steel field housing for outdoor installation (ambient temperature range +32 to +122°F; 0 to +50 °C, optional -4 to +122°F; -20 to +50 °C). The analyzer is intended to be wall mounted.
- NEMA 4X / IP 66 protected cast aluminum field housing for outdoor installation (ambient temperature range-4 to +122°F; -20 to +50 °C). The analyzer is intended to be wall mounted in harsh environments.

Installation in Hazardous Areas

For installation in hazardous areas the stainless steel field housing analyzer may be provided with a pressurization system (ATEX type approved for Zone 1 or Zone 2 in Europe).
A z-purge system permits installation in North-American Div 2 environments.

The cast aluminum field housing is designed to provide flameproof explosion protection and is certified to be installed in Zone 1 hazardous areas, too.

CSA-C/US type approvals for installation in North-American hazardous areas are pending!

Consult your local sales office for more information.

Note!
This manual does not deal with special conditions for analyzers in hazardous areas, related to installation, operation, maintenance etc. ***For such applications refer to the separate instruction manuals, delivered together with the analyzers.***

1-1 Overview

The X-STREAM series analyzers offer a wide range of available configurations and options, to be combined according to the selected model:

■ Measuring principles

Up to two out of all offered principles may be combined within one analyzer model to provide best adaption to the application.
For a detailled description of available measuring principles: ☞ chapter 3.

■ Gas path design

Internal tubing with viton or, optional and depending on application, PFA or stainless steel.
In addition one or more of the following options are available:

- Soleniod valve block
  This option uses 4 internal solenoid valves to control sample, zero, span gas 1 and span gas 2. These gases are fed to the analyzers to provide manual or controlled automatic calibration (initialized by keypad, serial interface or digital inputs).
- Sample pump
  Maximum flow rate 2.5 l/min
- Barometric Pressure sensor
  (Measuring range 800 to 1,200 hPa)
  Facilitates compensation of atmospheric pressure variations to improve precision of results (☞ measurement specifi-cations, page 3-17).
  Special sensors for e.g. corrosive gas on request.
- Flow measurement
  A flow sensor (option) can be used to monitor gas flow and set alarms.
- Heated box for physical components
  All the physical components*) can optionally be installed inside thermostatted box to minimize influences from ambient tem-perature fluctuations.

For a detailled description of optional gas path components: ☞ page 1-18

■ Interfaces

All models may be configured to use several interfaces:
Standard:

- analog outputs
- serial interface (RS 485 or RS 232) with Modbus protocol
- status signals (NAMUR; relay outputs)

Optional:

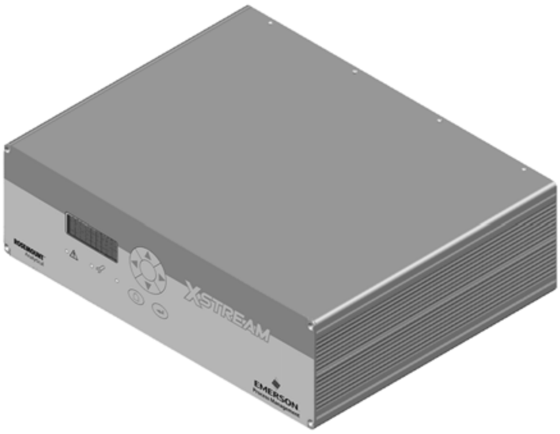
- 8 digital outputs & 7 digital inputs
- Modbus via Ethernet

For a detailled description of optional inter-faces: ☞ page 1-22

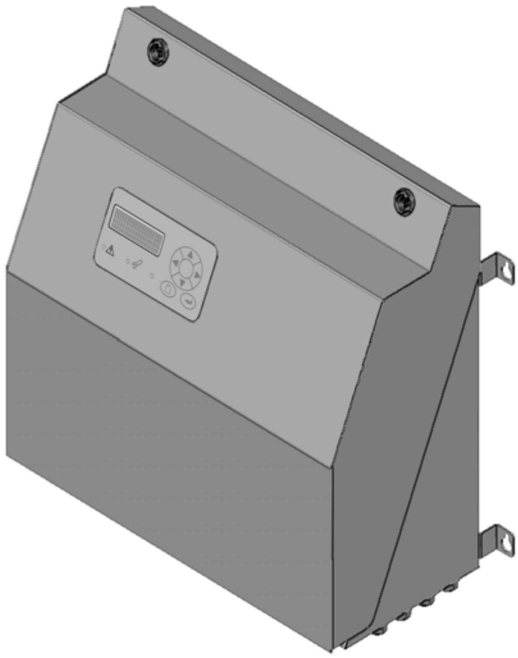
1-1 Overview

The different X-STREAM series models and their appearance.

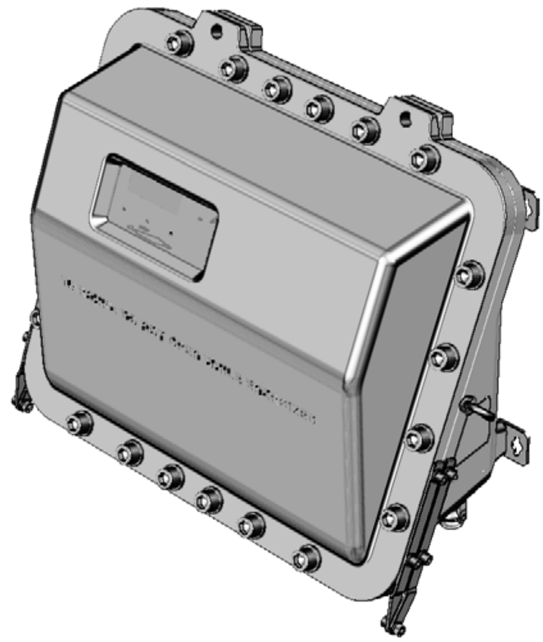
The following sections 1-2 to 1-3 give detailed descriptions for all available configurations.



X-STREAM GP / GPS: Table top and rack mount version (☞ section 1-2, page 1-4)



X-STREAM F: Stainless Steel Field housing
(☞ section 1-3, page 1-6)



X-STREAM FD: Cast Aluminum Field Housing
(☞ section 1-4, page 1-11)

1-2 X-STREAM General Purpose Tabletop or Rack Mount Version

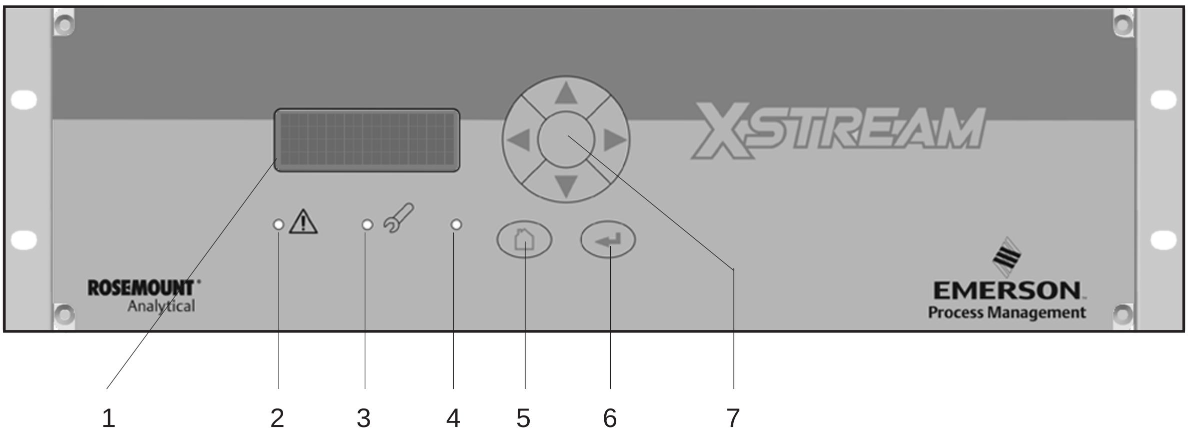
This basic general purpose version contains all components within a full 19 inch housing and is intended to either be used as rack mountable analyzer or as tabletop instrument after removing two mounting brackets and installing 4 feet (part of an accessory kit).
The front panel shows a 4x20 characters alphanumeric display, a membrane keypad and 3 status LEDs (fig. 1-1).
Electrical connections are provided by either screw terminals (version GP, fig. 1-2) or plugs, sockets and mains appliance (version GPS, fig. 1-3) at the instrument's rear side.

Gas fittings are provided at the instrument's rear side, too.

An optional fitting facilitates purging the instrument with inert gas to minimize influences caused by ambient air when measuring low ranges of select gases (e.g. CO, CO_2). The inert gas may exhaust the analyzer through a separate fitting (into an exhaust system) or by leakages in the housing (into ambient).

Purging the physical components with air or inert gas may also be needed when measuring aggressive and/or flammable gases: In addition to the purge fitting an internal box is installed, covering the physical components. This forces the purge medium to flow around all other (electronic) components before it circulates around the physics and exhausts the analyzer through a separate outlet fitting into an exhaust system. In case of internal leakage this ensures that the aggressive/ flammable gas is not flushed towards the electronics causing hazards of corrosion and/ or explosion and provides operator safety.

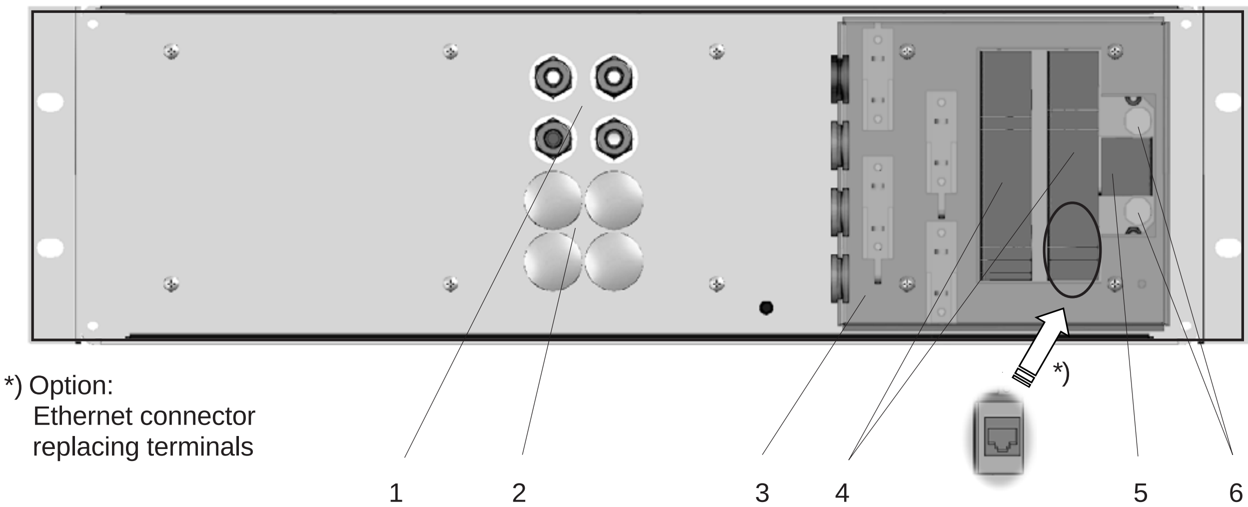
Purge medium specifications: **☞ 2-1, page 2-4.**



1 4x20 characters alphanumeric display
2 LED (red)
3 LED (red)
4 LED (green)
5 "Home" key
6 "Enter" key
7 4 keys for editing and entering menus

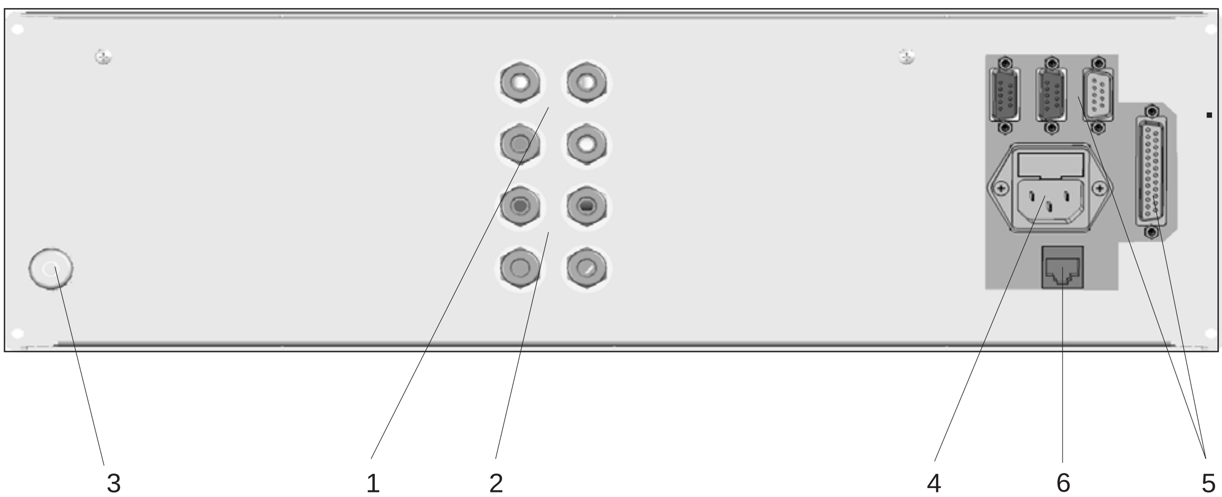
Fig. 1-1: X-STREAM GP, GPS, front side view

1-2 X-STREAM GP, GPS



1	Gas inlet fittings	4	Input / output signal terminals
2	Optional gas inlet fittings	5	Mains terminals
3	Cover for terminals (shown with transparency)	6	Mains fuses

Fig. 1-2: X-STREAM GP, terminals version, rear side view



1	Gas inlet fittings	4	Mains appliance with fuses
2	Optional gas inlet fittings	5	Signals sockets
3	Optional purge gas inlet	6	Ethernet connector (option)

Fig. 1-3: X-STREAM GPS, plugs and sockets version, rear side view

1-3 X-STREAM F Field Housing

This IP66 / NEMA 4X protected housing is intended for outside wall mounting: The housing (fig. 1-4) is made of painted stainless steel. Gaskets protect against water and dust.

The front panel is located behind a safety glass providing protection against mechanical impact and shows a 4x20 characters alphanumeric display and 3 status LEDs. The keypad as it is used to operate the tabletop analyzer is replaced by sensor fields, operated with a magnetic tool (fig. 1-5).

Electrical connections are provided by internal screw terminals, the cables enter the housing via cable glands located at the instruments bottom side (fig. 1-6).

Gas fittings are located at the instrument's bottom side, too.

The front door opens vertically by 180° providing easy access to internal components. Removing the hinge bolts even allows to completely remove the front door.

An optional fitting facilitates purging the instrument with inert gas to minimize influences caused by ambient air when measuring low ranges of select gases (e.g. CO, CO2). The inert gas may exhaust the analyzer through a separate fitting (into an exhaust system) or by leakages in the housing (into ambient).

Purging the physical components with air or inert gas may also be needed when measuring aggressive and/or flammable gases: In addition to the purge fitting an internal box is installed, covering the physical components. This forces the purge medium to flow around all other (electronic) components before it circulates around the physics and exhausts the analyzer through a separate outlet fitting into an exhaust system. In case of internal leakage this ensures that the aggressive/flammable gas is not flushed towards the electronics causing hazards of corrosion and/or explosion and provides operator safety.

Purge medium specifications: see technical data section (2-1).

Provided with an appropriate pressurization system the X-STREAM F is suitable for installation in hazardous areas.

WARNING

EXPLOSION HAZARD

This instruction manual at hand does not deal with X-STREAM analyzers intended to be used in hazardous areas!

Installation, startup and maintenance are described in detail in a separate instruction manual, shipped together with each such analyzer, and are not subject of this current instruction manual!

1-3 X-STREAM F

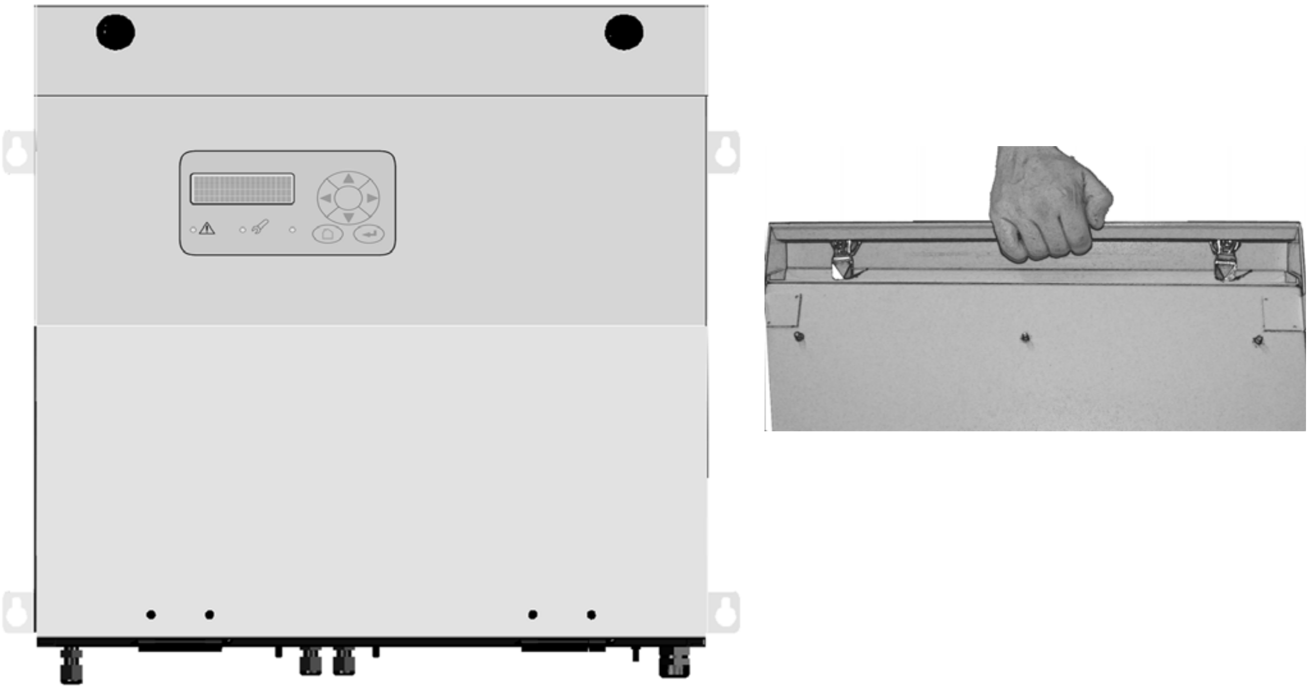
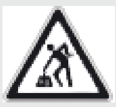


Fig. 1-4: X-STREAM F - Frontal view & rear side view at carrying handle

CAUTION

HEAVY INSTRUMENT

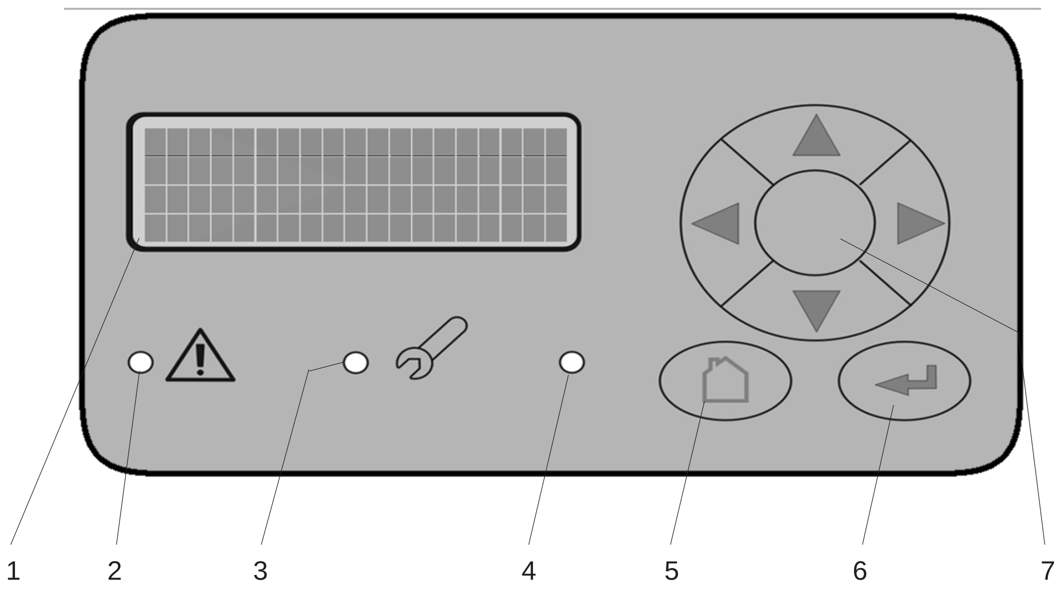


X-STREAM F gas analyzers, designed for wall mounting and/or outdoor installation may weigh up to 26 kg (57 lbs), depending on installed options!

The upper part of the front door is designed to work as a carrying handle, see fig. 1-4.

Use two persons or a suitable lifting device to move or carry the instrument!

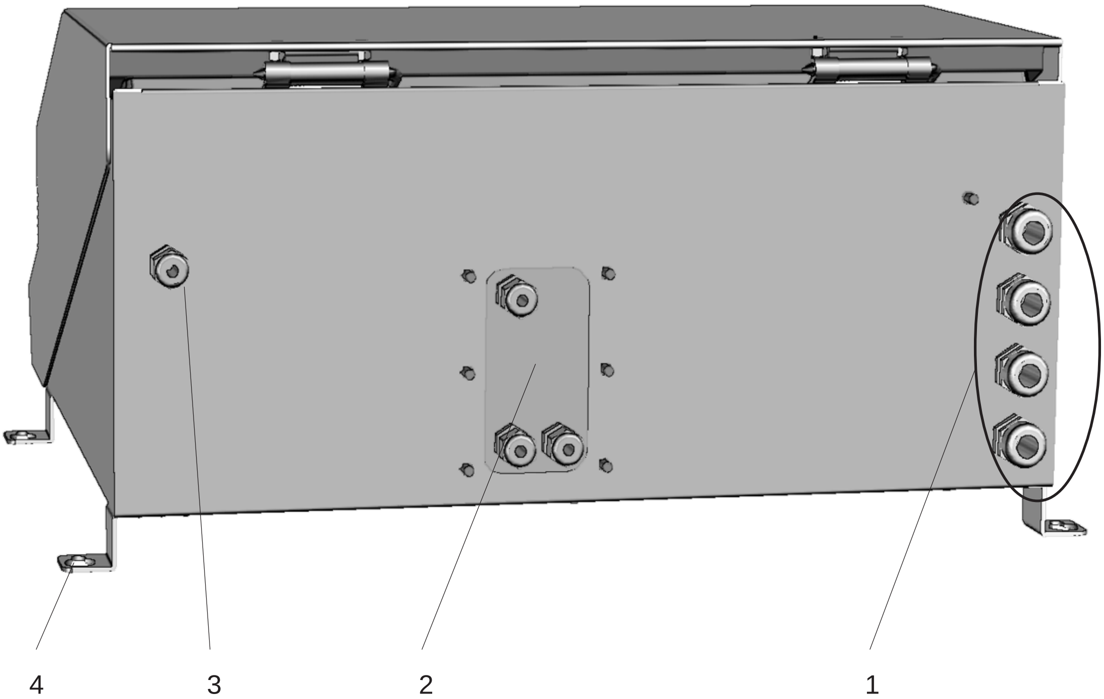
1-3 X-STREAM F



1	4x20 characters alphanumeric display	5	"Home" key
2	LED (red)	6	"Enter" key
3	LED (red)	7	4 keys for editing and entering menus
4	LED (green)		

Fig. 1-5: X-STREAM F - Front panel

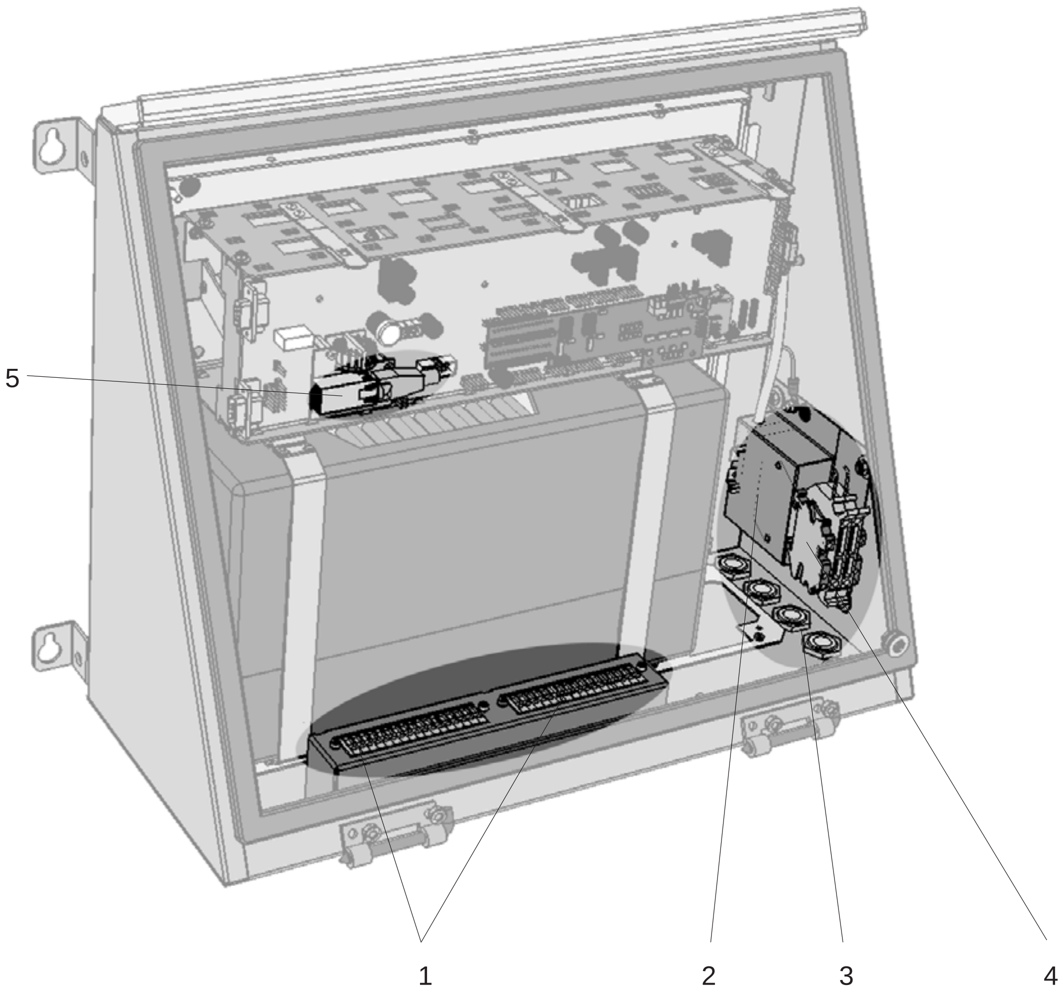
1-3 X-STREAM F



1 Cable glands for mains and signal cables
2 Gas inlet and outlet fittings and purge gas outlet fitting
3 Purge gas inlet fitting
4 4 supports for wall mounting

Fig. 1-6: X-STREAM F - Bottom view

1-3 X-STREAM F



1 Terminals for signal cables
2 Power EMI filter
3 Cable glands for power and signal cables
4 Power terminals with integrated fuses
5 optional Ethernet connector (shown with cable plug)

Fig. 1-7: X-STREAM F - Power and signal terminals (front door removed)

1-4 X-STREAM FD Cast Field Housing

X-STREAM FD analyzers, providing agency certified flame-proof protection are intended to be installed in hazardous areas. The wall mountable cast aluminum enclosure with it´s rugged design and a NEMA 4X / IP66 protection also provides advantages when installed in non-hazardous, but harsh environments.
The front panel is located behind a safety glass providing protection against mechanical impact and shows a 4x20 characters alphanumeric display and 3 status LEDs. The keypad as it is used to operate the tabletop analyzer is replaced by sensor fields, operated with a magnetic tool (Abb. 1-9).
Electrical connections are provided by internal screw terminals, the cables enter the housing via cable glands or conduits located at the instruments bottom side (Abb. 1-11).

Gas fittings are located at the instrument's bottom side, too.

The enclosure consists of two parts, secured together by means of 20 screws, located on a flange at the instrument´s outside. The front cover opens vertically by 180° providing easy access to internal components.

Some gas fittings may optionally be used for purging the instrument with

- Inert gas to minimize influences caused by ambient air when measuring low ranges of select gases (e.g. CO, CO2)

or

- Air or inert gas when measuring aggressive and/or flammable gases: In addition to the purge fitting an internal box is installed, covering the physical components. This forces the purge medium to flow around all other (electronic) components before it circulates around the physics and exhausts the analyzer through a separate outlet fitting into an exhaust system. In case of internal leakage this ensures that the aggressive/flammable gas is not flushed towards the electronics causing hazards of corrosion and/or explosion and provides operator safety.

Purge medium specifications:
☞ 2-1, Seite 2-4.

WARNING

EXPLOSION HAZARD

This instruction manual at hand does not deal with X-STREAM analyzers intended to be used in hazardous areas!

Installation, startup and maintenance are described in detail in a separate instruction manual, shipped together with each such analyzer, and are not subject of this current instruction manual!

1-4 X-STREAM FD

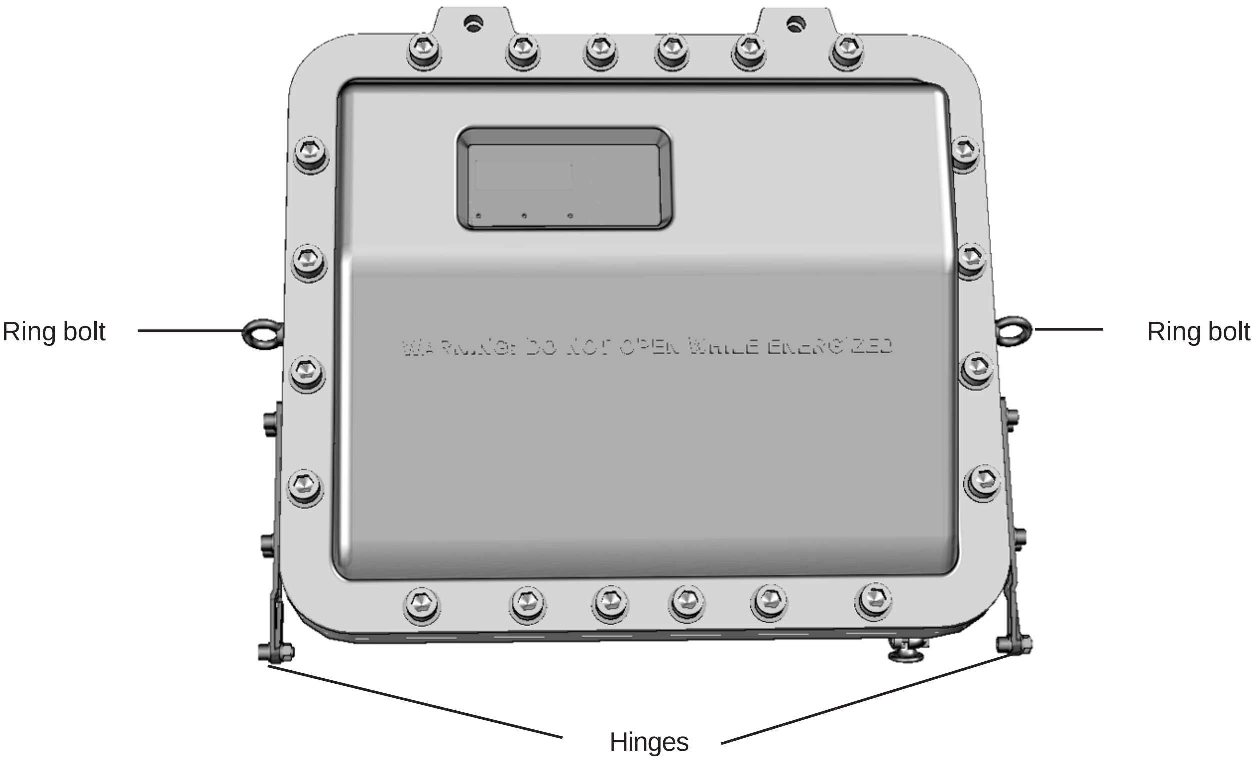
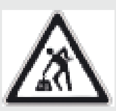


Fig. 1-8: X-STREAM FD - Frontal View

CAUTION

HEAVY INSTRUMENT

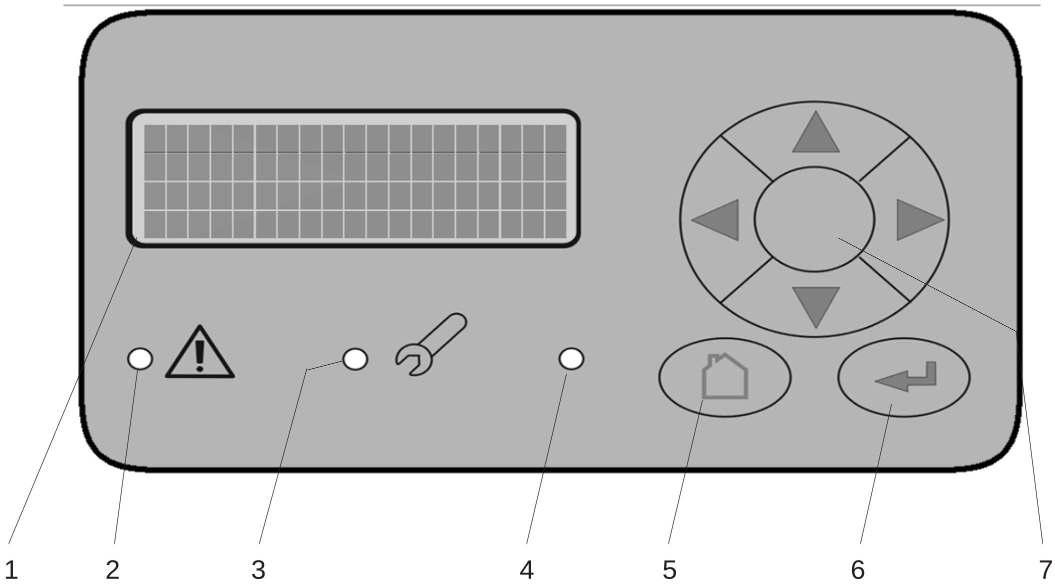


X-STREAM FD gas analyzers, designed for wall mounting and/or outdoor installation may weigh up to 63 kg (139 lbs), depending on installed options!

Use two persons or a suitable lifting device to move or carry the instrument!

Utilize the ring bolts provided at the instrument´s sides (☞ fig. 1-8)!

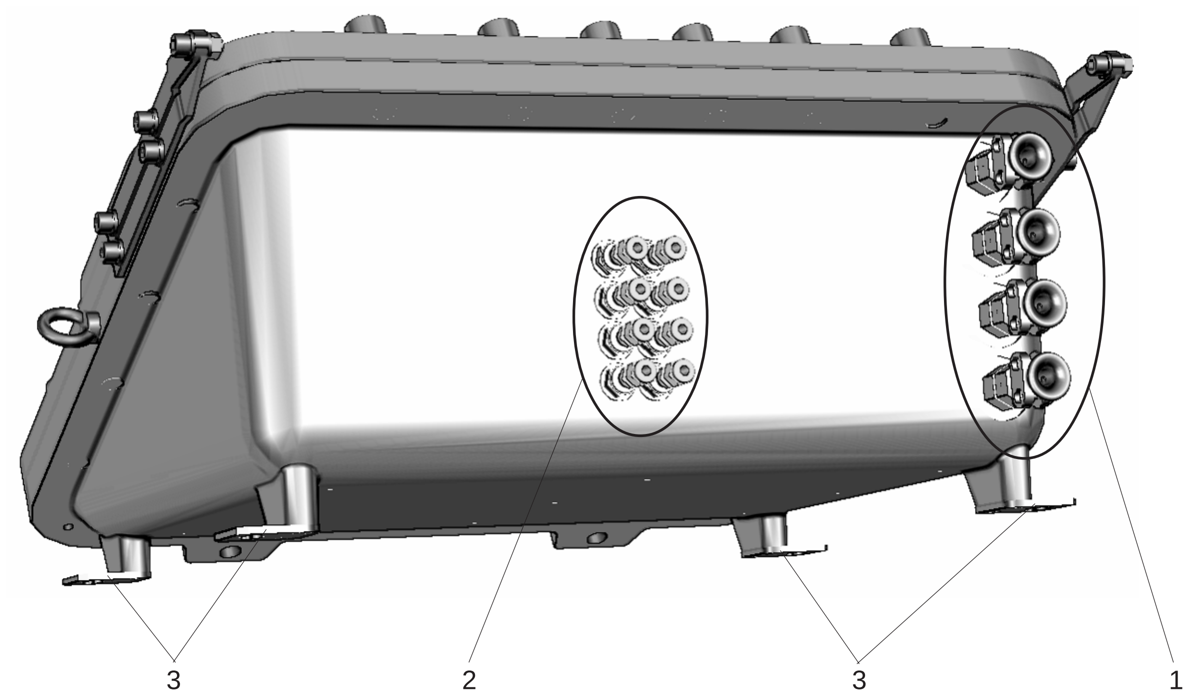
1-4 X-STREAM FD



1 4x20 characters alphanumeric display
2 LED (red)
3 LED (red)
4 LED (green)
5 "Home" key
6 "Enter" key
7 4 keys for editing and entering menus

Fig. 1-9: X-STREAM FD - Front Panel

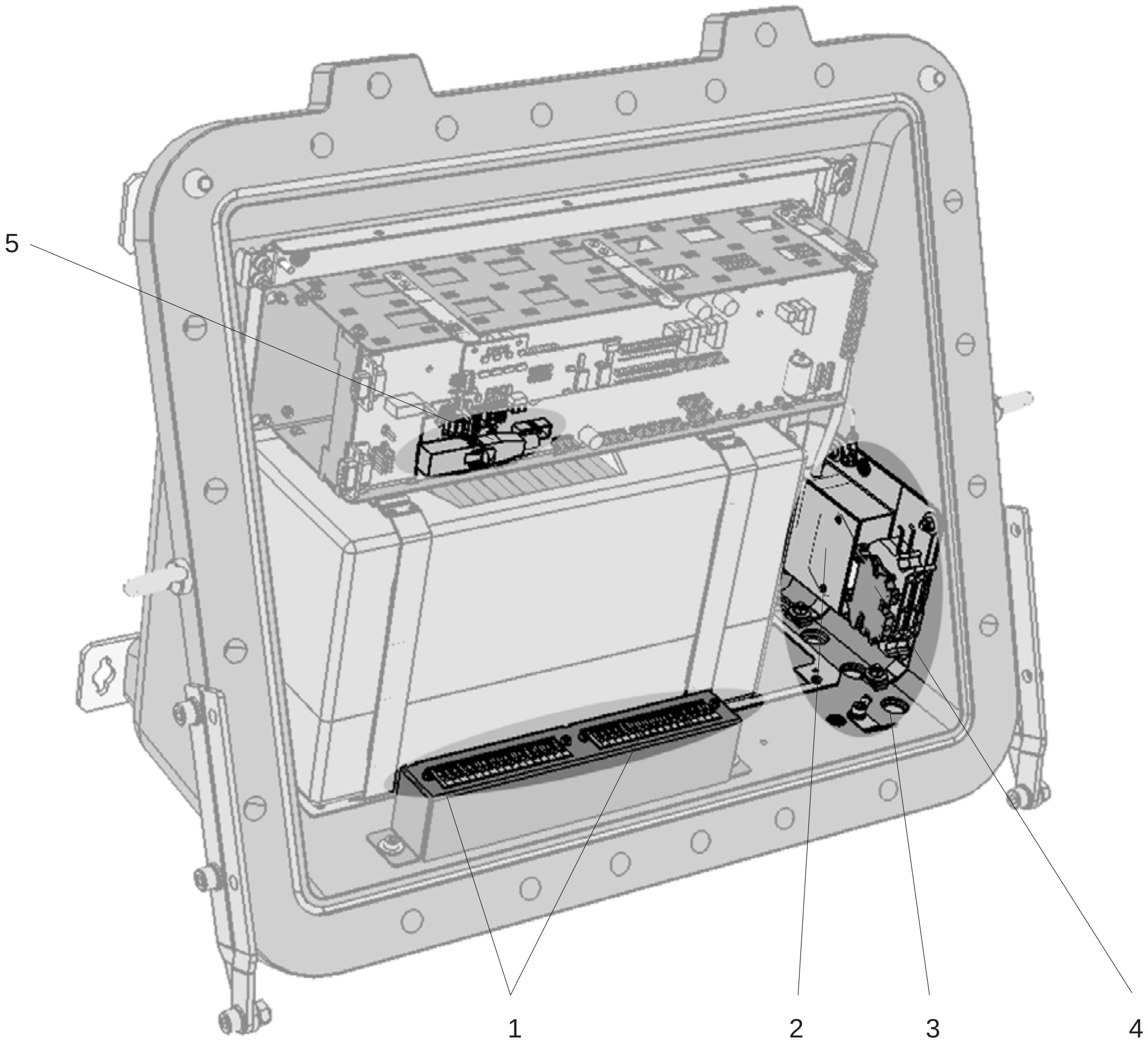
1-4 X-STREAM FD



1 Cable glands for mains and signal cables
2 Gas inlet and outlet fittings and purge gas fittings
3 4 supports for wall mounting

Fig. 1-10: X-STREAM FD - Bottom view

1-4 X-STREAM FD



1 Terminals for signal cables
2 Power EMI filter
3 Cable inlets for power and signal cables
4 Power terminals with integrated fuses
5 optional Ethernet connector (shown with cable plug)

Fig. 1-11: X-STREAM FD - Power and signal terminals (front door removed)

1-5 Gaspath Design

Various materials are available to provide a best possible analyzer adaption to the application. Materials are selected taking into account e.g. diffusion rate, corrosiveness, temperature and pressure of the applied gas.

1-5-1 Gas Paths Materials

Physical and chemical characteristics of applied gases and working conditions (temperature and pressure) affect the available materials.

1-5-2 Safety Filter

All analyzers provide an internal stainless steel safety filter. This filter(s) is (are) not a substitute for a dust filter to be installed in the sample handling system!

1-5-3 Fittings

By default all analyzers are equipped with PVDF fittings (ø 6/4 mm)
Alternatively Swagelok® or stainless steel fittings(ø 6/4 mm or 1/4") or other fitting materials (on request) may be used.

1-5-4 Piping

Analyzers are piped with Viton or PTFE
(ø 6/4 mm).
Other materials (e.g. stainless steel) are used optionally, depending on application.

1-5 Gaspath Design

1-5-5 Gas Path Variations

Depending on the application and the selected options several gas paths configurations are available, as shown in the following figures (examples):

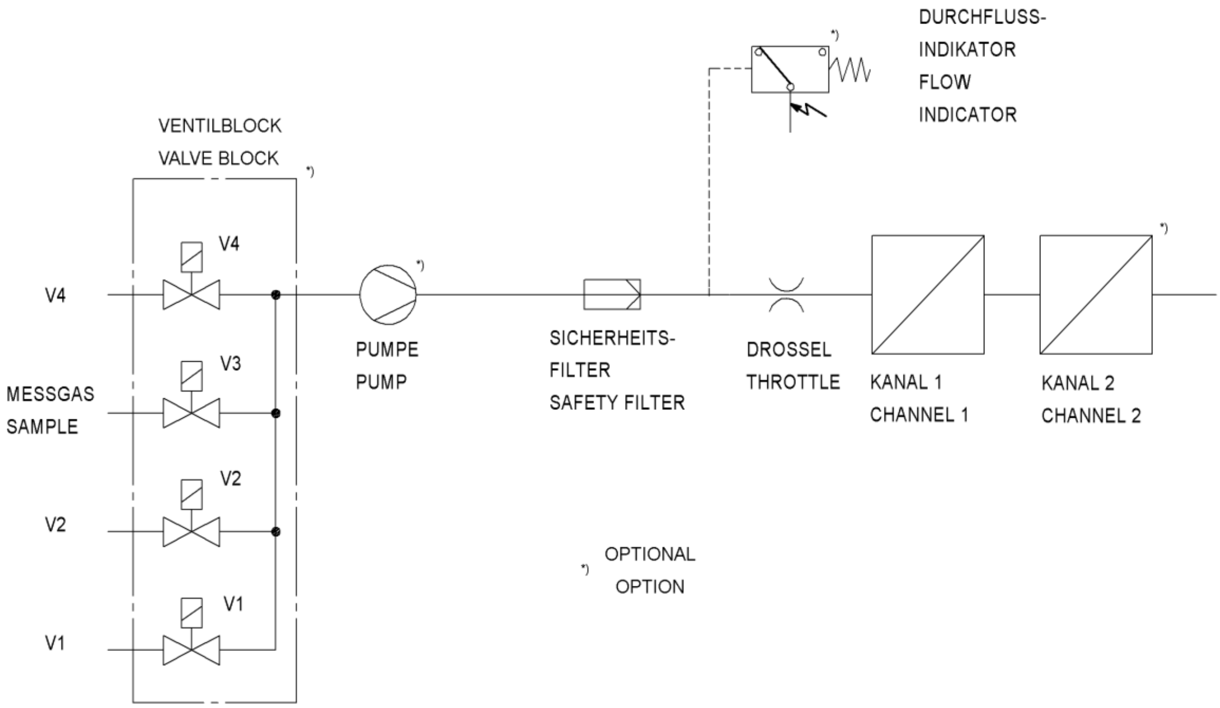


Fig. 1-12: Gas path - single channel or serial tubing

1-5 Gaspath Design

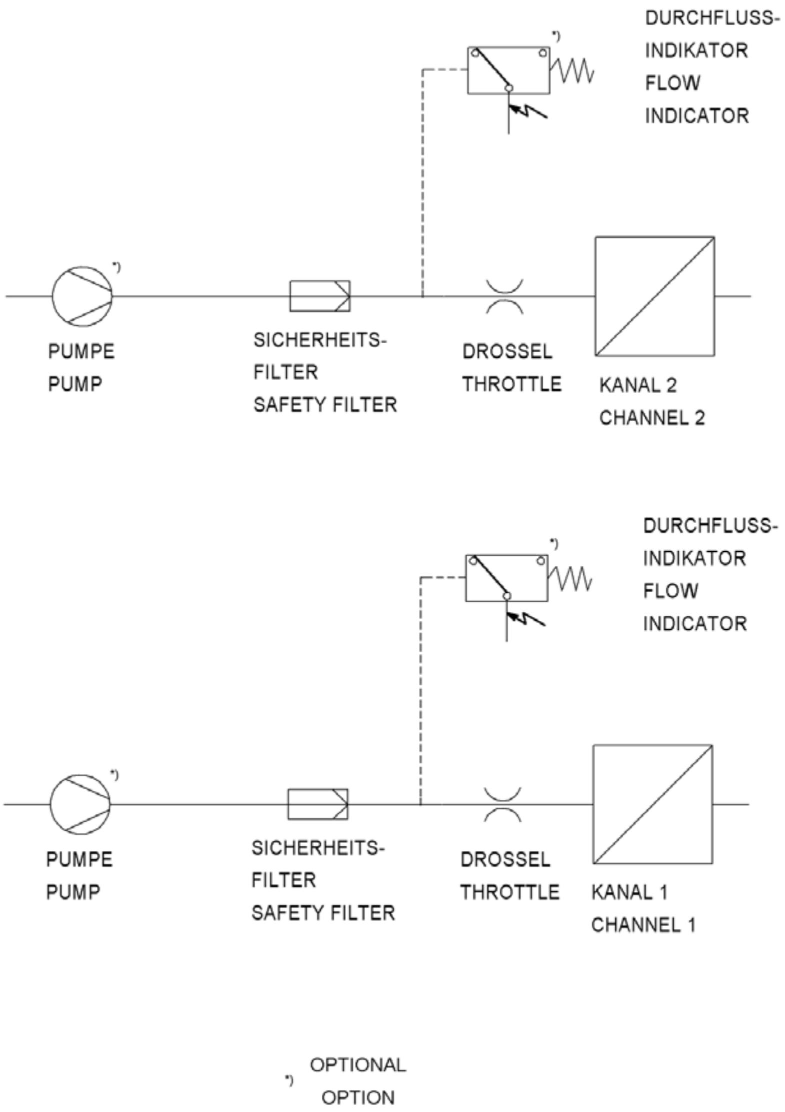


Fig. 1-13: Gas path - Dual channel, parallel tubing

1-6 Optional Gas Path Components

Optionally available for all analyzer variations are:

- internal sample gas pump
- internal valve block
- internal flow monitor
- internal barometric pressure sensor

1-6-1 Internal Sample Gas Pump

An optional sample gas pump may be required if the process gas stream is without exerting pressure. In this case the pump ensures the sample gas stream through the instrument remains constant.
If an internal sample gas pump is installed, the associated software setup menu entry shows **Yes** (☞ 5-4-3-5, page 5-41). The valve may be controlled either manually by a corresponding menu line or remotely by a digital input.

1-6-2 Internal Valve Block

An optional internal valve block allows to directly connect sample gas as well as span and zero calibration gases to the instrument, e.g. enabling automatic calibration.
If an internal valve block is installed, the associated software setup menu entry shows **Internal** or **Int+Ext** (☞ 5-4-3-5, page 5-41). Valve control is supported by a corresponding menu line, by selecting the autocal mode or remotely by digital inputs.

1-6-3 Internal Flow Monitor

An optional internal flow meter allows to monitor the gas flow and set an alarm in case of a fault.
If an internal flow monitor is installed, the associated software setup menu entry shows **Yes** (☞ 5-4-3-5, page 5-41).
There will be a status message in the measuring screen if the gas flow is too low and the related "Check requests" menu entry is **Yes** (☞ chapter 8 "Troubleshooting").

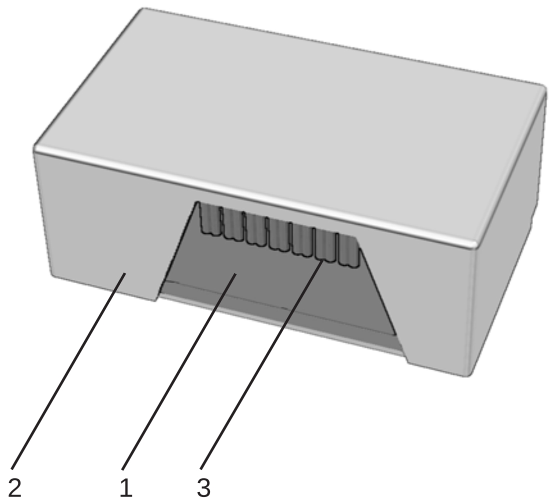
1-6-4 Internal Barometric Pressure Sensor

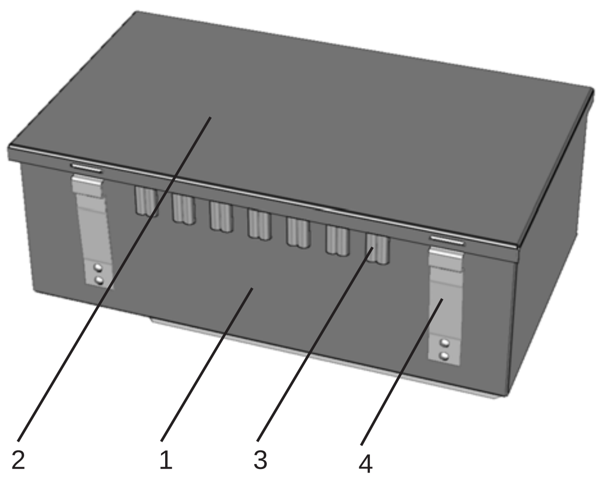
An optional internal barometric pressure sensor allows to compensate the influence of changing ambient pressure on the measuring results.
If an internal pressure sensor is installed, the associated software setup menu entry shows **Internal** or **Use ch2** (☞ 5-4-3-5, page 5-41).

1-6-5 Optional Heated Compartment

Two optional internal heated compartments offer three functionalities:
At first the compartments allow to heat all physical components at 60° C to avoid condensation of gases inside the gas path and/ or reduce influence of ambient temperature fluctuation.
In addition to thermostating the physical components this box can be purged and thus allows to keep out ambient air, interfering measuring gases at low ranges. The purge medium is applied to a separate fitting, passes the electronics, enters the box and exits through leaks into ambient.

An alternative, gastight compartment allows to measure corrosive and toxic gases protecting the electronics and providing operator safety. With this box the purge medium when applied to the separate inlet fitting flows through the electronics, enters the box to flow around the physical components and than exits through a purge gas outlet, recommended to be connected to an exhaust.





1 Fixed part
2 Removeable cover
3 Cable feed throughs
4 Detent springs

Thermostated box, purgeable, for low measuring ranges

Thermostated box, purgeable, for measuring corrosive / toxic gases

Fig. 1-14: Optional Heated Compartment

1-7 Interfaces

All models are configured to provide the following interfaces:

- analog outputs
- Modbus interface (RS 485 / RS 232)
- status signals (NAMUR; relay outputs)

Digital inputs/outputs are optionally available. The interface signals are provided at a submin-d-connectors or screw terminals, depending on analyzer model.

1-7-1 Analog Outputs

The results of each measuring channel are output via a current output.
By means of a software setup menu the outputs can be configured to support a variety of operating modes (e.g. 0-20 mA, 4-20 mA) as well as the NAMUR NE 43 specifications (☞ 5-4-3-4-1, page 5-34).
Factory default settings for analog outputs are 4-20 mA.

1-7-2 Modbus via Serial Interface

The analyzers are equipped with a serial interface supporting Modbus RTU protocol to provide communication with external hosts (e.g. data acquistition systems). The interface supports parameter data transmission, changing of parameters and initializing functions (procedures).
The RS 485 interface is optically isolated from the analyzer electronics and allows to build up a network of several analyzers.

Optionally available is a RS232 interface with or without optical isolation against analyzer electronics or an ethernet connection (☞ 1-8-1, page 1-22).

Read the instructions in the technical data section of your analyzer variation carefully to obtain failure-free data communication (☞ 2-2, page 2-5 et sqq.)!

Refer to chapter 9 for information about available Modbus commands.

1-7-3 Status Signals (NAMUR)

Three relay status outputs are available to digitally monitor the analyzer status according the NAMUR NE107 specification: "Failure", "Maintenance required / Off specification" and "Function check".
The status relays provide dry contacts with a maximum load of 30 V / 1 A / 30 W each!

The operation mode (NO "normally open" / NC "normally closed") is NOT user configurable and by default is factory set to NO. Other settings need to be defined at time of placing the analyzer order.
Refer to the technical data section of your analyzer variation for a more detailled information about relay status signals (☞ 2-2, page 2-5 et sqq.)!

1-8 Optional Interfaces

Optionally available are the following interfaces

- Modbus via Ethernet

and (in combination only):

- 8 digital outputs
- 7 digital inputs

The last listed two interfaces signals are provided at submin-d-connectors or screw terminals, depending on analyzer model.

1-8-1 Modbus via Ethernet

Optional an ethernet connector may be ordered, located either at the instruments rear side (X-STREAM GP / GPS) or on top of the electronics main board BKS (all field mountable versions).
The originally used Modbus connections are either replaced (X-STREAM GP) or internally disconnected (all other analyzer variations).

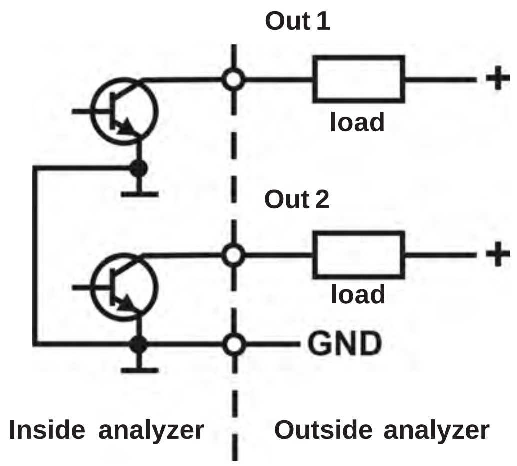
Read the instructions in the technical data section of your analyzer variation carefully to obtain failure-free data communication (☞ 2-2, page 2-5 et sqq.)!

Refer to chapter 9 for information about available Modbus commands.

1-8-2 Digital Outputs

Digital outputs are required for reporting concentration alarms to external systems (e.g. data aquisition systems) and/or for controlling external valves (e.g. for automatic calibration).
Digital outputs are "open collector" outputs, optically isolated against the instrument's electronics. Outputs are not protected against short circuits.

Electrical data
U $\leq$ 30 V dc
I $\leq$ 30 mA dc
Remaining voltage when activated: < 2 V
Common GND (-) for all outputs.



"+" and "GND" from external power supply

Fig. 1-15: Digital Outputs - Schematic

1-8 Optional Interfaces

1-8-3 Digital Inputs

Digital inputs are required for remotely starting calibration proceduresor activating valves or the optional internal pump by simply supplying a voltage.

Electrical data
LOW: $U_{in} \leq 1.5$ V
HIGH: $U_{in} \geq 4.5$ V
Input resistance: 57.5 kΩ
(Voltages to be measured against the reference terminal labeled "IN GND").

Inputs protected against overvoltage up to approx. 40 V. Open inputs are at LOW level.

1-8-3-1 Digital Inputs IN1 to IN3

Digital inputs are used to remotely start calibrations: Input IN1 starts a zero calibration, IN2 starts a span calibration for channel 1 and IN3 starts a span calibration for channel 2.

All these procedures are triggered by a rising edge of a signal with a minimum duration of 2 seconds.

See Chapter 7 Maintenance, section 7-3 Calibration procedures for a detailled description of how to drive the digital inputs In1 to IN3.

1-8-3-2 Digital Inputs IN4 to IN7

IN4 to IN7 are used to control valves. Signal voltages at these inputs are evaluated in decreasing order of priority: IN4 is assigned the highest, IN7 the lowest prioritiy.
IN4 to IN6: A valve is opened by applying a HIGH level signal voltage to the related input while all inputs of higher priority are at LOW level. All other valves are closed at the same moment, regardless of the signal voltages applied to inputs of lower priorities.

Input IN7 has a converted input logic:
The related sample gas valve **opens** by applying a LOW level signal; a HIGH level signal **closes ALL valves**.

Action / Input	*IN4*	*IN5*	*IN6*	*IN7*
Open valve V4	H	X	X	X
Open valve V1	L	H	X	X
Open valve V2	L	L	H	X
Open sample gas valve	L	L	L	L
Close all valves	L	L	L	H
	H: HIGH			
	L: LOW			
	X: don't care			

Table 1-1: Digital inputs IN4-IN7, evaluation array

1-8-3-3 Remote Pump Control

Input IN7 alternatively may be used to control the optional internal sample gas pump: applying a LOW signal switches on the pump, a HIGH level signal switches off.
Pump control depends on the IN7 input only and is independent of inputs IN1 to IN6!

Note!
*Pump control via digital input IN7 requires the parameter "PumpControl" in the IN/OUTPUTS SETUP menu set to **Remote (** ☞ 5-4-3-4, page 5-33)*

Chapter 2
Technical Data

This chapter lists all the analyzers technical data, separated into common and model specific data, therefore the user has to select the appropriate section depending on his analyzer.

2-1 Common Technical Data

Site of installation

Humidity (non condensing)	< 90 % r. h. at 68 F (+20 °C) < 70 % r. h. at 104 F (+40 °C)
Pollution degree	2
Installation category	II
Altitude	0 to 6560 ft (2000 m) above sea level
Sourrounding atmosphere	Analyzers must not be operated in hazardous or flammable atmoshere without additional safety measures. Analyzers must not be operated in corrosive atmoshere.

Compliances

Electrical safety	CAN / USA	CSA-C/US, based on CAN/CSA-C22.2 No. 61010-1-04 / UL 61010-1, 2nd Edition
C US 185562	Europe	CE, based on EN 61010-1
Electromagnetic compatibility		
	Europe	CE, based on EN 61326
	other	NAMUR

Power supply

Rated input voltage	100 - 240 V∿ 50/60 Hz, wide range input **Power supply voltage fluctuations are not to exceed +/- 10 % of the nominal supply voltage!**
Input voltage range	85 - 264 V∿, 47 - 63 Hz
Rated input current	
standard	0.75 - 0.35 A max.
with thermostated physics	2 - 1 A max.

2-1 Common Technical Data

Interfaces, signal inputs / outputs

2 analog outputs channel (optically isolated; start and end concentration user configurable)	4 (0) - 20 mA ($R_B \leq 500\ \Omega$) configurable by keypad
Modbus interface	RS 485 (2- or 4-wire) optional: RS 232 with or without optical isolation Ethernet (RJ45 socket)
3 relay outputs (option "status signals“) according NAMUR NE 107	“Failure” “Maintenance required / Off specification" “Function check” dry contacts, max. 30 V; 1 A; 30 W resistive
Digital Inputs and Outputs (option)	
7 digital inputs (common ground)	zero calibration ch1 & ch2, span calibration ch1, span calibration ch2, open valve V4 open valve V1 open valve V2 open sample gas valve V3 / switch off sample pump max. 30 V, internally limited to 2.3 mA H level: min. 4 V; L level: max. 3 V
8 digital outputs (optically isolated, common ground)	2 thresholds per channel, sample gas valve, zero gas valve V4, span gas valve V1, span gas valve V2 “Open Collector”, max. 30 V⎓ / 30 mA

2-1 Common Technical Data

Gas parameters

☛ Chapter 3 Measuring Principles

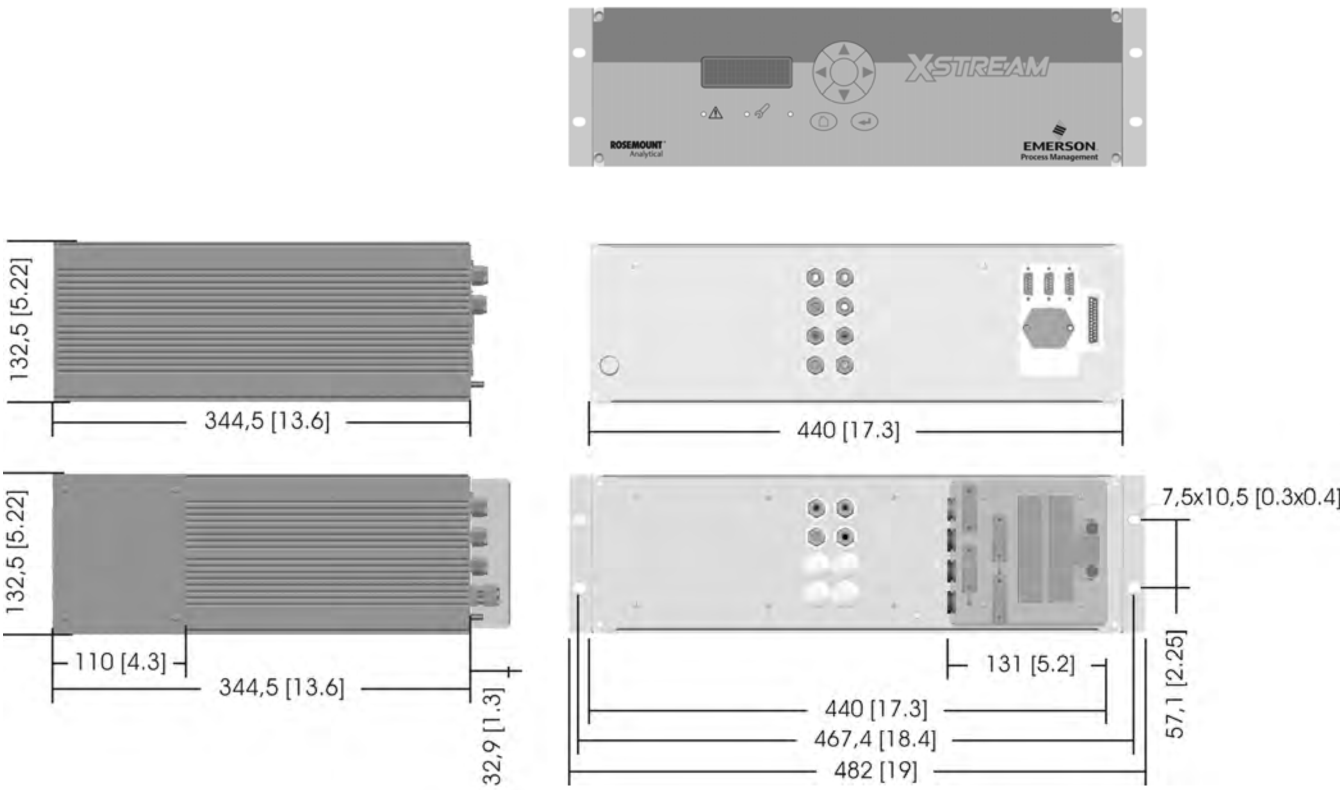
Purge Option

Purge medium (e.g. for minimizing CO_2 interference, safety in events of internal leakage of flammable or/and aggressive gas etc.) **must be dry, clean and free of corrosive and solvent components and on ambient temperature (at least 68...95 F / 20...35 °C) !**

For pressure and flow specification consult factory or your local EMERSON Process Management sales office!

2-2 Model Specific Technical Data

2-2-1 X-STREAM GP, GPS Tabletop or Rack Mount Version



approx. mm [inch]

Fig. 2-1: X-STREAM GP, GPS - Dimensions

2-2-1 X-STREAM GP, X-STREAM GPS

Housing

Permissible ambient temperature range	32 F to 122 F (0 °C to +50 °C)
Weight: (depending on analyzer configuration)	approx. 26.5 to 35.3 lbs (12 - 16 kg)
Protection class to EN 60529:	IP 20 **for indoor installation** Analyzer must not be exposed to dripping or sprayed water. Analyzer must not be operated in corrosive atmosphere.
Gas fittings:	quantity: max. 8 specification: 6/4 mm PVDF optional 6/4 mm or 1/4", stainless steel, other on request

2-2-1-1 Terminals Version

Power connection

Connection via covered screw terminals located at the analyzer's rear panel (fig. 2-2).

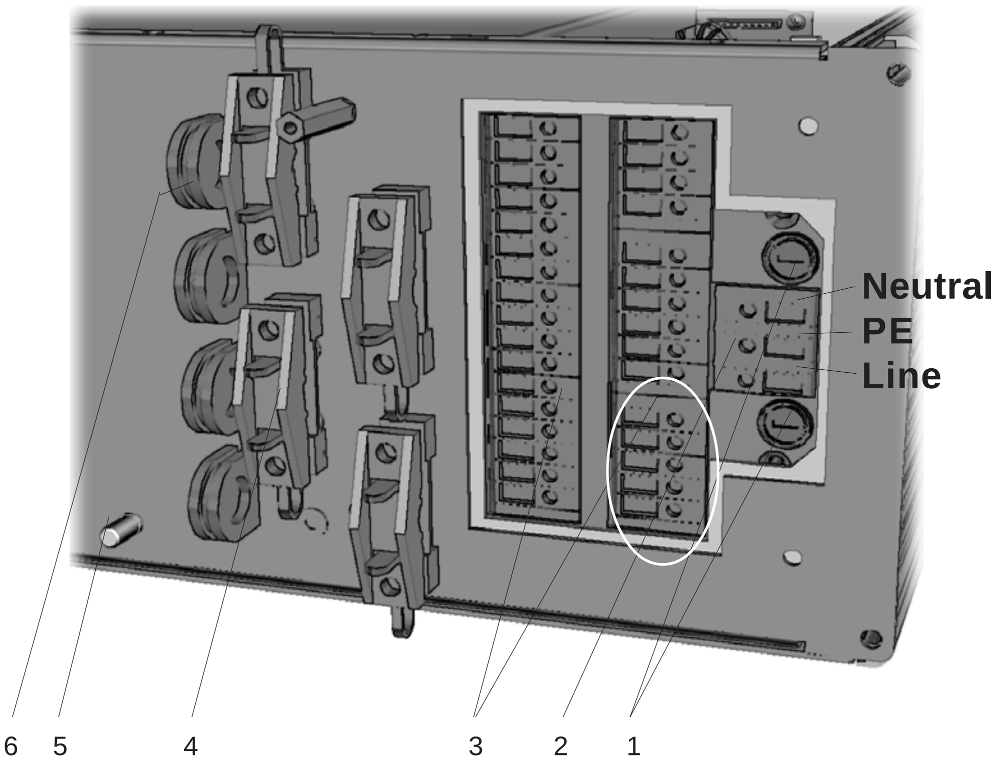
Cross section:	max. 12 AWG (2.5 mm^2), using conductor sleeves is not required
Cable entry through cover via	1 strain relief

Power fuses

Two fuses are located nearby the power terminals.

Fuse ratings:	AC 230 V, 3.15 A, 5x20 mm

2-2-1 X-STREAM GP, X-STREAM GPS



Ethernet connector (option), replacing the lower 5 terminals in middle row.

1	Fuse holders	4	Strain reliefs
2	Power terminals	5	Protective earth terminal (PE)
3	Signal terminals	6	Edge protection (part of removed cover; shown for demonstration only)

Fig. 2-2: X-STREAM GP, (terminals version) - terminals and fuse holders (cover removed)

Signal inputs / outputs

All signal lines need to be connected to screw terminals (exept the optional ethernet connector) located at the analyzer‘s rear panel.

Available signals:	standard:	Analog signal outputs Relay status signals Modbus interface (RS232; RS 485)
	optional:	Digital inputs/outputs Modbus RJ45 ethernet connector

Detailed pin assignment ☞ 4-4 Installation, page 4-6.

2-2-1 X-STREAM GP, X-STREAM GPS

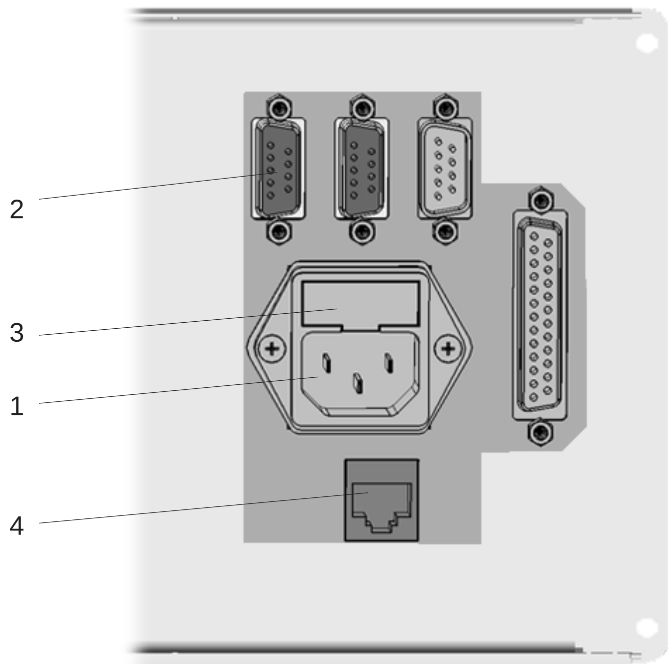
2-2-1-2 Sockets Version

Power Connection

Connection via IEC power appliance, provided at the analyzer's rear panel (fig. 2-3).

Power fuses

Two fuses are located in the power appliance.
Fuse ratings: AC 230 V, 3.15 A, 5x20 mm



1	Power appliance with EMI filter	3	Fuse holder
2	Signal sockets/plugs	4	Ethernet (option)

Fig. 2-3: X-STREAM GPS, (sockets version) - power and signals connectors

2-2-1 X-STREAM GP, X-STREAM GPS

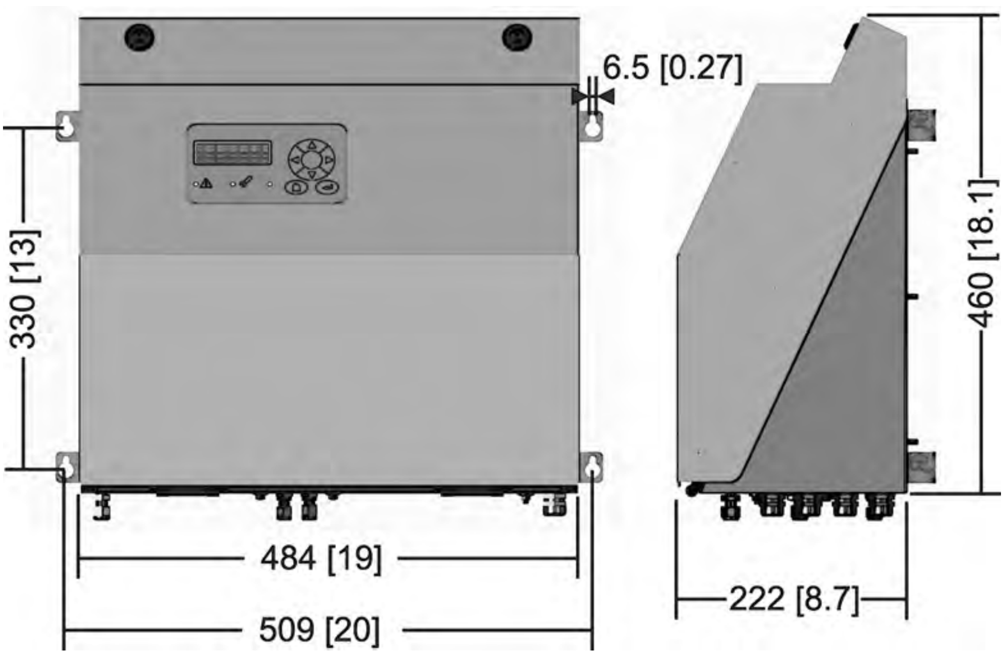
Signal inputs / outputs

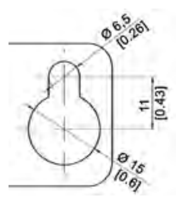
All signal lines need to be connected to 9 pole and 25 pole submin-D-plugs and sockets (exept the optional RJ45 ethernet connector) located at the analyzer‘s rear panel (fig. 2-3).

Available signals:	standard:	Analog signal outputs Relay status signals Modbus interface (RS232; RS 485)
	optional:	Digital inputs/outputs Modbus RJ45 ethernet connector

Detailed pin assignment ☞ 4-4 Installation, page 4-6.

2-2-2 X-STREAM F Field Housing





Eyebolt detail

approx. mm [inch]

Fig. 2-4: X-STREAM F - Dimensions

Housing

Permissible ambient temperature range	-4 F to 122 F (-20 °C to +50 °C)
Weight: (depending on analyzer configuration)	approx. up to 57.3 lbs (26 kg)
Protection class:	IP 66 (EN 60529) / NEMA 4X for outdoor installation Analyzer must not be exposed to direct sun light
Gas fittings:	quantity: max. 8 specification: 6/4 mm PVDF optional 6/4 mm or 1/4", stainless steel, other on request

2-2-2 X-STREAM F

Power Connection

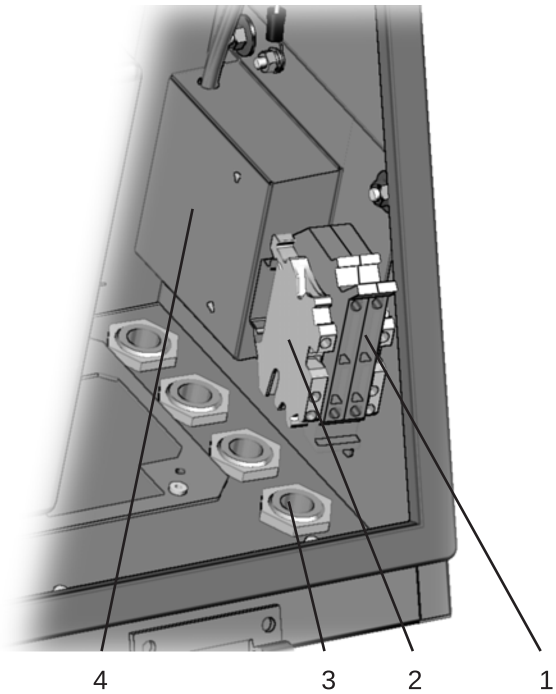
Connection via internal screw terminals near cable glands, (fig. 2-6).

Cross section:	max. 10 AWG (4 mm^2), using conductor sleeves is not required
Cable entry via	1 cable gland, classified IP 68
Permissible outer cable diameter for power cable:	0.28 to 0.5 inch (7 - 12 mm)

Power fuses

The power terminals integrate fuse holders.

Fuse ratings:	AC 230 V, 3.15 A, 5x20 mm



1	Power terminals with integrated fuse holders	3	Power cable gland
2	Protective earth terminal (PE)	4	EMI power filter

Fig. 2-5: X-STREAM F - Power terminals / fuse holders

2-2-2 X-STREAM F

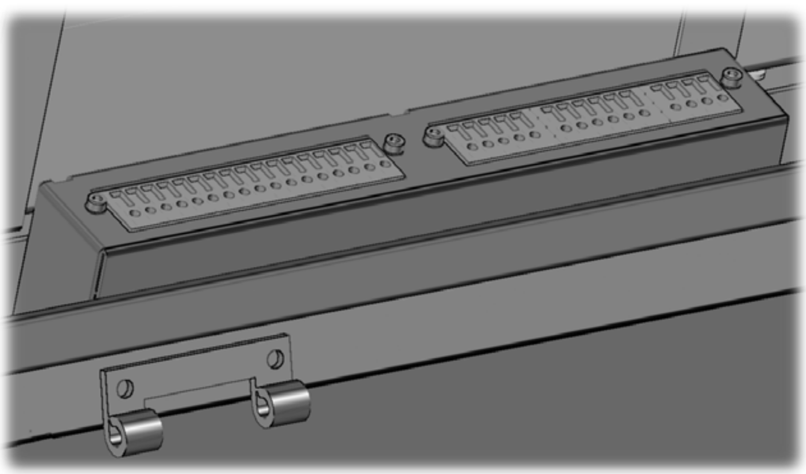
Signal inputs / outputs

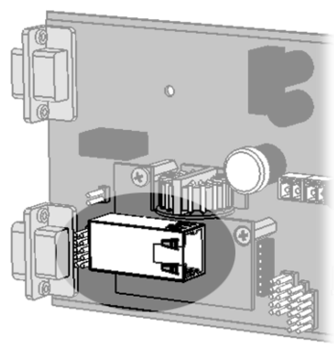
All signal lines need to be connected to internal screw terminals (fig. 2-7), exept the optional RJ45 ethernet connector.

Cross section:	max. 12 AWG (2.5 mm^2), using conductor sleeves is not required
Cable entry via	3 cable glands, classified IP 68
Permissible outer cable diameter for power cable:	0.28 to 0.5 inch (7 - 12 mm)

Available signals:	standard:	Analog signal outputs Relay status signals Modbus interface (RS232; RS 485)
	optional:	Digital inputs/outputs Modbus RJ45 ethernet connector

Detailed pin assignment ☞ 4-4 Installation, page 4-6.





The optional ethernet connector (RJ45), located on the electronics main board BKS

Fig. 2-6: X-STREAM F - Signals terminals

2-2-3 X-STREAM FD Flameproof Field Housing

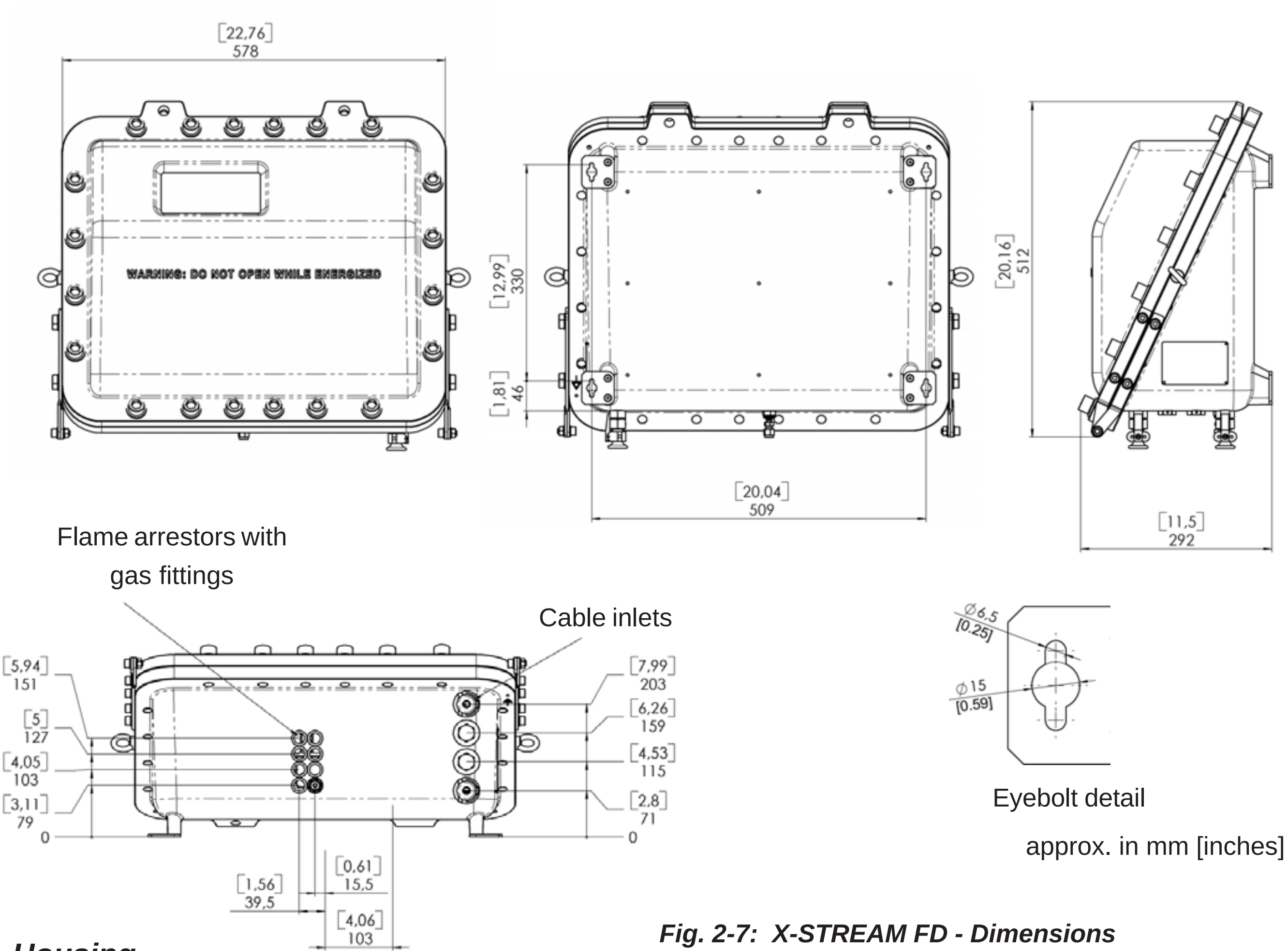


Fig. 2-7: X-STREAM FD - Dimensions

Housing

Permissible ambient temperature range	-22 F to 122 F (-30 °C to +50 °C)
Weight: (depending on analyzer configuration)	approx. up to 139 lbs (63 kg)
Protection class:	IP 66 (EN 60529) / NEMA 4X for outdoor installation Analyzer must not be exposed to direct sun light
Gas fittings:	quantity: max. 8 specification: flame arrestors with fittings 6/4 mm or 1/4", stainless steel

2-2-3 X-STREAM FD

Power Connection

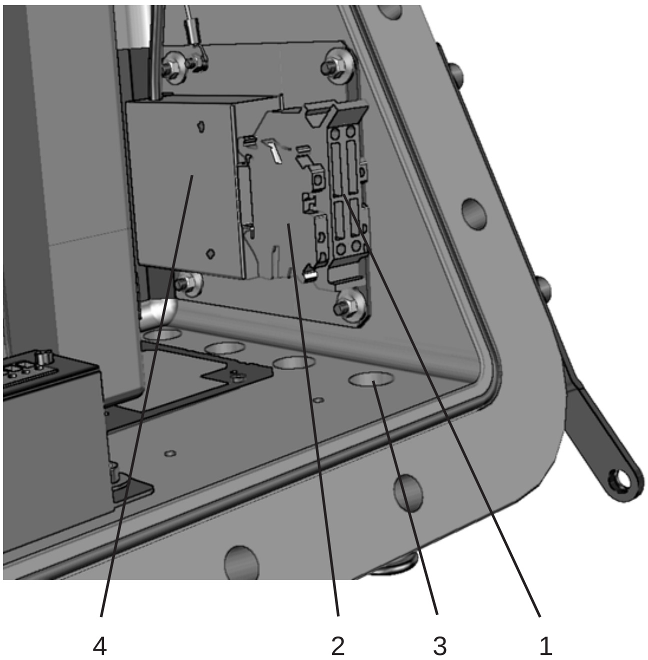
Connection via internal screw terminals near cable entries, (fig. 2-8).

Cross section:	max. 10 AWG (4 mm^2), using conductor sleeves is not required
Cable entry via	1 cable gland, classified IP 68 or suitable conduit with metric-to-NPT adaptor
Permissible outer cable diameter for power cord when provided with cable glands:	0.11 to 0.5 inch (3-13 mm), depending on used cable gland sealing ring

Power fuses

The power terminals integrate fuse holders.

Fuse ratings:	AC 230 V, 3.15 A, 5x20 mm



1	Power terminals with integrated fuse holders	3	Power cable entry
2	Protective earth terminal (PE)	4	EMI power filter

Fig. 2-8: X-STREAM FD - Power terminals / fuse holders

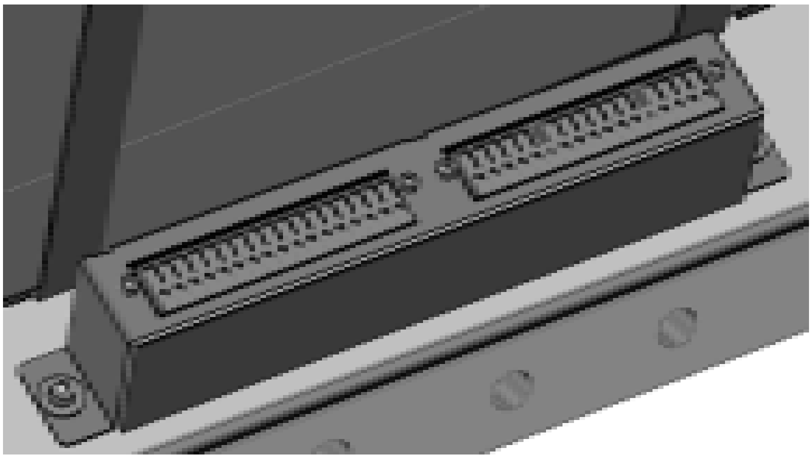
2-2-3 X-STREAM FD

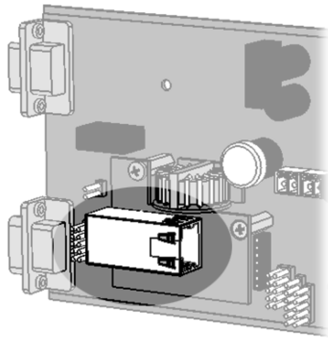
Signal inputs / outputs

All signal lines need to be connected to internal screw terminals (fig. 1-5), , exept the optional RJ45 ethernet connector.

Cross section:		max. 12 AWG (2.5 mm^2), using conductor sleeves is not required
Cable entry via		3 cable glands, classified IP 68 or suitable conduits with metric-to-NPT adaptors
Permissible outer cable diameter for signal cables when provided with cable glands:		0.11 to 0.5 inch (3-13 mm) depending on used cable gland sealing rings
Available signals:	standard:	Analog signal outputs Relay status signals Modbus interface (RS232; RS 485)
	optional:	Digital inputs/outputs Modbus RJ45 ethernet connector

Detailed pin assignment ☞ 4-4 Installation





The optional ethernet connector (RJ45), located on the electronics main board BKS

Fig. 2-9: X-STREAM FD - Signals terminals

2-3 Information on the Nameplate Label

The analyzer nameplate label gives important information about the instrument‘s configuration, installed measuring principle(s), sample gas(es), measuring range(s) and shows the serial number, required when asking for support or spare parts.

The nameplate label is located either on the instruments left or right housing side or at the inner side of the front door (field housing).

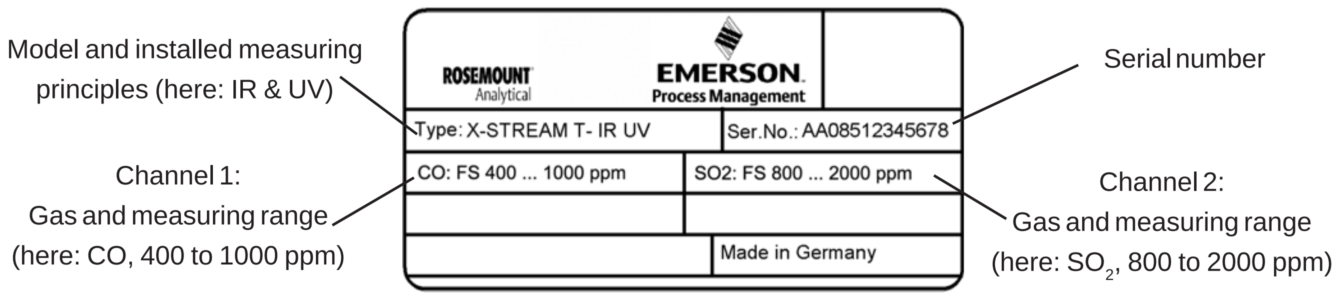


Fig. 2-10: Analyzer Nameplate Label (example)

Note!

As described later in this manual, the operator may change the analog output scaling within the stated measuring ranges without affecting the specifications.

(Here for channel 1 a 20 mA output signal may be assigned to concentration values between 400 and 1000 ppm, ☞ ANALOG OUTPUT SIGNAL SCALING menu, page 5-38).

The measuring ranges are also shown in the INFO - RANGE.. menu, ☞ page 5-56.

Chapter 3
Measuring Principles

X-STREAM series analyzers support several measuring principles or combinations of principles, depending on measured gas components. This provides best possible results as the principle always is adjusted to meet the specific characteristics of the particular gas.
The following sections introduce the available measuring principles and show their specific characteristics.

3-1 Infrared Measurement (IR) Ultraviolet Measurement (UV)

This principles make use of infrared/ultraviolet light absorbed by the sample gas. The wave length of the absorbed portion of IR/UV light characterizes the gas component whereas the intensity of absorption is a measure of concentration.
Two different IR measuring principles are available, both comparing concentration depend and concentration independ signals. The difference of these two signals results in a measure of concentration.
One of these principles (as described in detail in the following sections) is adapted for UV measurements: The absorption measurement in the UV spectral range is based on the same principle as the IR measurement, but a glow-discharge source is used instead of an IR source.

As the glow-discharge source needs a specific and as constant as possible temperature, it is either thermostatted to about 55 °C or built into a thermostatted box, covering all physical components and completely thermostatted. Section 3-1-2 covers both IR and UV measurement.

The decision about which measurement (UV or IR) is selected for a specific application depends on the gas component to be measured. The decision about which IR measurement to be used is based on the required performance.

3-1-1 Interference Filter Correlation (IFC)

This is an IR principle only and suitable for applications not requiring high performance parameters.
An undivided analysis cell is alternately passed by light of two different wave lengths, filtered by interference filter out of the spectrum of an IR source: One wavelength covers the absorption band of the measured gas component, the other is selected to cover a region where no absorption occures.

Fig. 3-1 shows an example of interference filter transmissions and absorption bands of the gas components CO and CO_2. It‘s easy to see that the interference filters‘ transmissible spectral bands overlap the absorption bands of the gases, whereas within the bandwidth of the reference filter no absorptin takes place. Other gases (CH_4) and HC do not affect the measuring result because they do not absorb IR light of these wavelengths.

3-1 Infrared (IR) and Ultraviolet (UV) Measurement

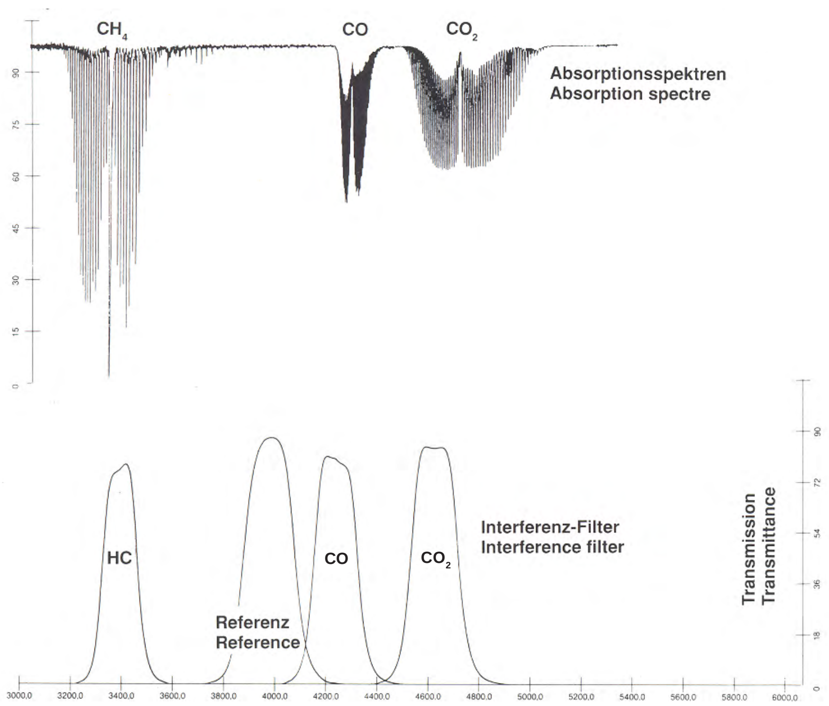


Fig. 3-1: Absorption Bands of Measured Gases and Transmission of Interference Filters

A pyroelectrical detector generates a signal using the effect of charge flow caused by heat flow within a piezo crystal:
The IR radiation passing measuring cell and filters results in a change of temperature when arriving at the detector. The IR absorption is different for measuring wavelength and reference wavelength so the crystal is alternately more or less heated. As result the detector gives an alternating voltage signal which is passed to electronics for further processing.

3-1 Infrared (IR) and Ultraviolet (UV) Measurement

3-1-2 Opto Pneumatic Measuring Principle

This high performance principle is used for IR and UV measurements and utilizes a separated analysis cell whose one side is passed by the sample gas. The other side (reference side) is either filled with an inert gas (e.g. nitrogen) or passed by a reference gas stream, depending on application.
Both sides of the cell are alternately irradiated with IR (UV) light of same intensity, which afterwards passes a filtering cell before it arrives at the detector.

The opto pneumatical detector, which is used instead of the pyroelectrical detector with the IFC principle, converts the radiation from sample side and reference side into a voltage signal proportional to the radiation intensity.
The pneumatical detector consists of a gas filled absorption chamber and a compensation chamber, both connected by a flow channel. A micro flow detector is placed within this channel to measure least flows.

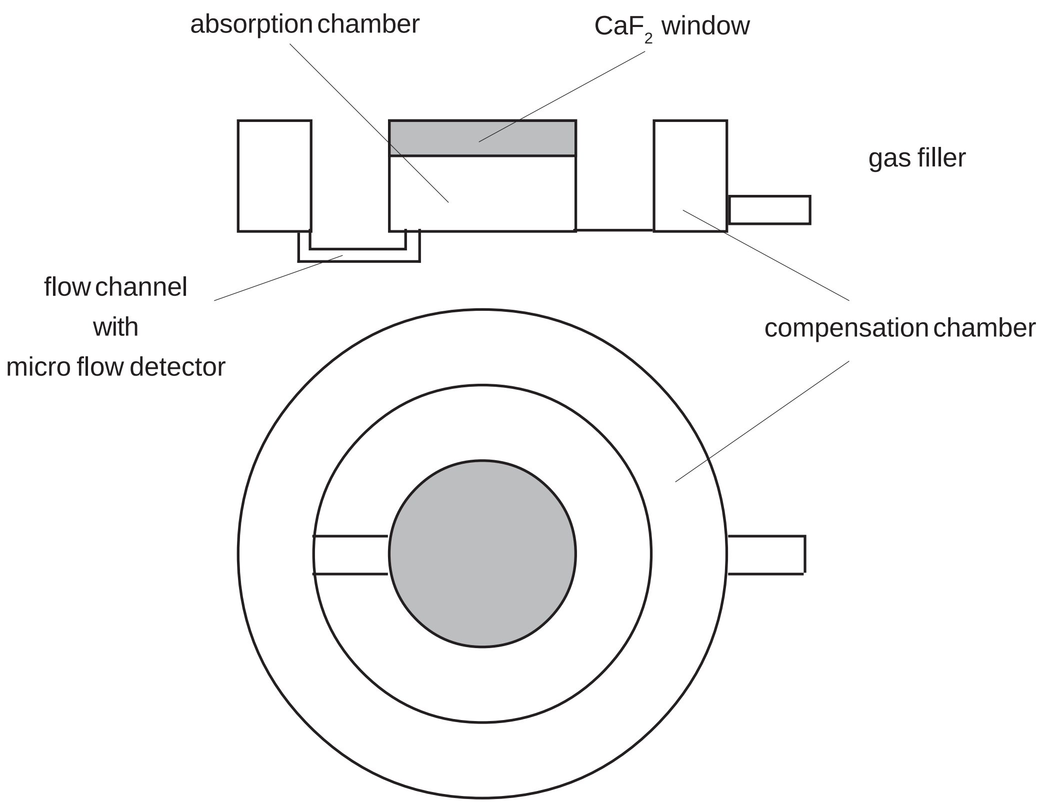


Fig. 3-2: Gas Detector Design Principle

The detector is filled with the gas to be measured and therefore sensitive to the related characteristic wavelength band only.

The absorption chamber is sealed with a window transparent for IR radiation [CaF_2 (Calziumfluorid)] .

There is no absorption when the IR(UV) radiation passes the reference side of the analysis cell , so the intensityis at a maximum when it arrives at the detector. The gas within the detector is heated, therefore expands and flows from absorption chamber through flow channel to the compensation chamber. This flow generates a voltage signal.

When the IR(UV) radiation passes the sample side of the analysis cell, part of it is absorbed by the sample gas decreasing the radiation intensity. As an effect the gas within the detector cools down and flows from the compensatoin chamber back into the absorption chamber. This flow again causes a voltage signal by the micro flow detector which is now reverse to the previous signal.

So the micro flow detector generates alternating signals. The flow channel is designed to not influence the gas flow and therefore the change in signal is proportional to the change in radiation intensity which is proportional to the concentration of gas to be measured.

The flow detector signal is passed to electronics conditioning the signal and converting it into a usefull format.

3-1-3 Technical Implementation

The broadband IR (UV) radiation emitted by a special source passes a chopper wheel (fig. 3-3 showing a dual channel analyzer). In case of IFC principle it passes additional optical filters, before entering the analysis cell. The radiation leaving the cell is focused to the detector by means of a filter cell. The detector output signal is passed to micro processor controlled electronics conditioning and converting it to reasonable units (Vol-%, ppm, mg/m³, etc.) shown on the alphanumeric display.

Depending on gas component and measuring range several photometer designs are used with X-STREAM series analyzers, differing in analysis cell length, kind of detector and used filters. Optionally the assemby may be sealed against ambience: O-rings between the components prevent ambient air to come in the optical path and interfere the measurement.

The photometer assembly is mounted on the BKS main board, which itself is placed in housings rail.

3-1 Infrared (IR) and Ultraviolet (UV) Measurement

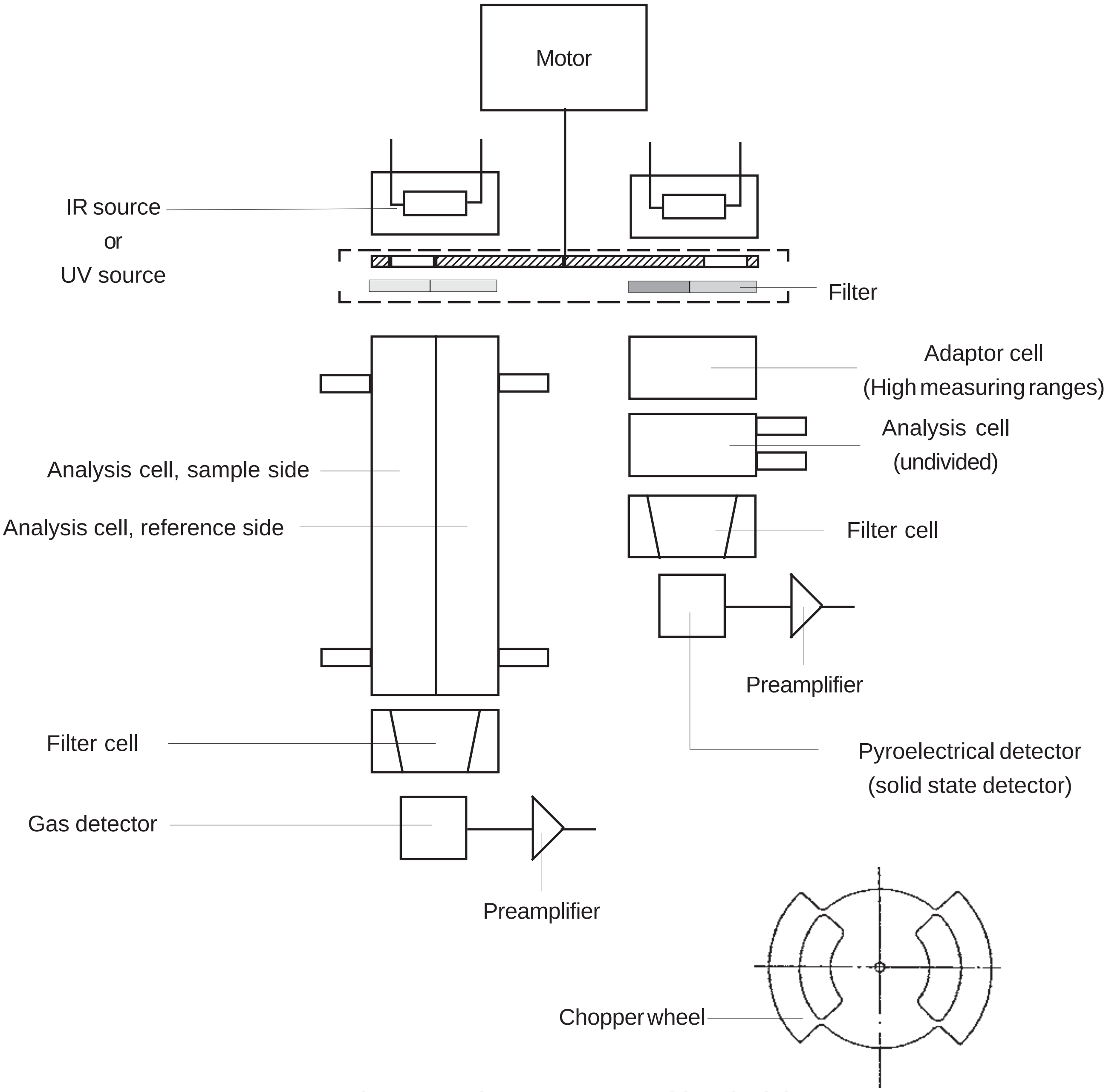


Fig. 3-3: IR Photometer Assembly Principle,
left side: with Gas Detector, right side: with Pyro Electrical Detector

Photometer Assembly with Pyro Detector

Fig. 3-4 shows the mechanical design of an pyro detector assembly:

Attached to the chopper are IR source (07) as well as analysis cell (09) with signal detector unit (filter cell 14 / 15) and pyroelectrical detector with integrated pre amplifier (16).

Furthermore the chopper assembly contains the filter aperture (04 / 05) limiting the IR light to the required bandwidth.

The chopper assembly (03) is made of two parts and contains an inner volume where the stepper motor driven chopper wheel is placed. This inner volume is sealed against ambience by means of an o-ring to prevent ambient CO_2 from entering. This avoids pre absorption and drift. An additional absorber is used to remove CO_2 traces existent by diffusion.

Furthermore the chopper assembly contains a light barrier to detect the chopper wheel phasing. A temperature sensor (28) measures the assemblies‘ temperature. This information is used for the purpose of compensating temperature effects.

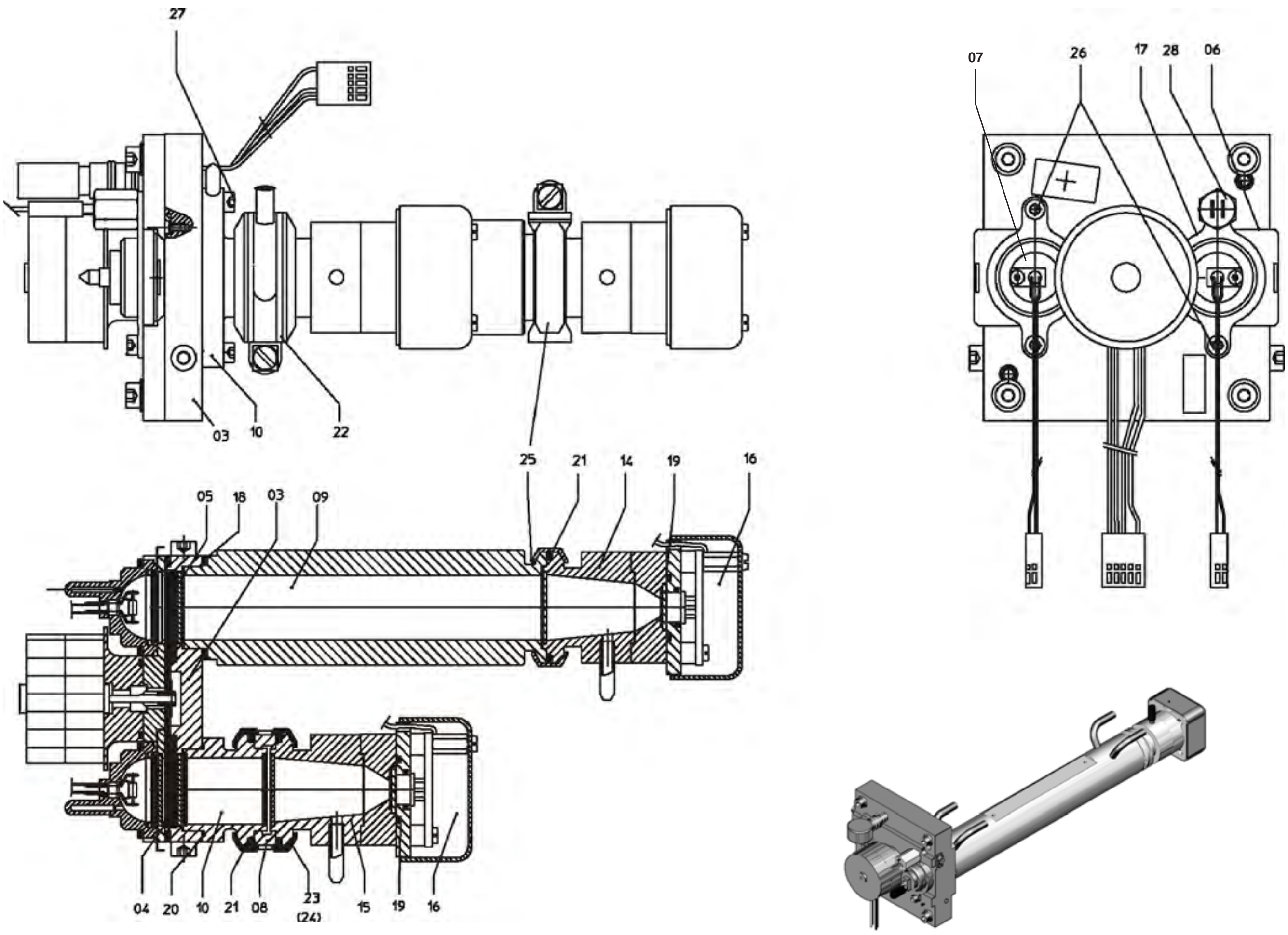
The analysis cell is made of an aluminum tube with two gas fittings. This simple design without windows easily allows cleaning if the cell is polluted.

The chopper windows and those at the filter cell remain as only possibly polluted windows. All of them are accessible once the analysis cell is removed.

The filter cell (14 / 15) is made as two-tiered conus system, which is optimized to focus the beam to the active detector area.

High measuring ranges (up to 100 %) require an adaptor cell (10): The analysis cell is in this case the volume between output window of the adaptor cell and input window of the filter cell , covered by a distance ring (08).

3-1 Infrared (IR) and Ultraviolet (UV) Measurement



03	Chopper	17	Flange (source)
04 / 05	Filter aperture	18-21	O-ring
06	Zero aperture (not with sealed variation)	22	Clamp (for cells 1-7 mm)
07	Source	23 (24)	Clamp (for cells 1-7 mm)
08	Analysis cell 1 - 7 mm (distance ring)	25	Clamp (for cells10-200 mm)
09	Analysis cell 50 - 200 mm	26	Fixing screws (source)
10	Adaptor cell	27	Fixing screws (cells and adaptor cells)
14/15	Filter cell	28	Temperature sensor
16	Detector		

Fig. 3-4: Photometer Assembly with Pyroelectrical Detector

Photometer Assembly with Gas Detector

The design of a gas detector photometer assembly is on principle similiar to the pyro detector design.

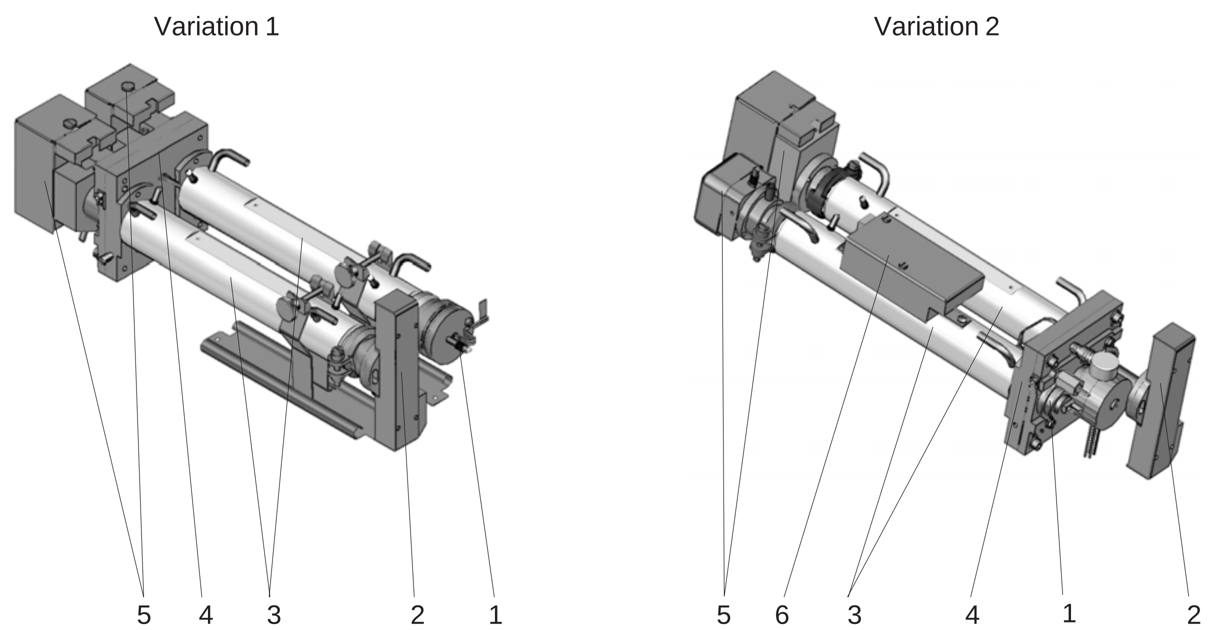
One main difference is the analysis cell, that now is lengthwise divided and both ends sealed with windows. This separates the inner volume into a sample side and a reference side. The sample side is passed by the sample gas, while the reference side is either filled with air, neutral gas or reference gas, depending on the application.

To avoid erroneous measurements absorbers may be installed at the reference side to suppress interfering CO_2 traces (IR only).

The filter cell is made as single-tier conus system.

The gas detector has separated preamplifier electronics, to which it is connected by a shielded cable.

For lower measuring ranges(long analysis cells) the preamplifier is fixed onto the analysis cell, whereas for higher ranges it is mounted on a special cover plate



1	IR source	4	Chopper
2	UV source	5	Detectors
3	Analysis cells	6	Preamplifier

Fig. 3-5: IR & UV Photometer Assemblies with Gas Detectors

3-2 Oxygen Measurement

Two different principles are used for measuring oxygen concentrations. The currently used principle is given by the channel code (sample gas designator) on the nameplate label (☞ fig 2-7, page 2-16):

pO2 = paramagnetical sensor

eO2 = electrochemical sensor

3-2-1 Paramagnetic Measurement

Oxygen measurement is based on the paramagnetical characteristics of oxygen molecules:

Two nitrogen filled quartz spheres (N_2 is not paramagnetic) are arranged in a dumbbell configuration and, hinged to a platinum wire, placed inside a cell. Fixed to the wire a small mirror reflects a light beam to a photo detector (fig. 3-6).

The measuring cell is placed inside an inhomogeneous magnetical field generated by a strong permanent magnet of specific design.

Oxygen molecules within the sample gas now due to their paramagnetical characteristics are deflected into the area of highest field strength. This generates different forces on both spheres and the resulting torque turns dumbbell and mirror out of the rest position. This generates a photodetector signal because the beam is deflected, too.

Initiated by the photodetector signal a preamplifier drives a compensation current through a loop surrounding the dumbbell to turn back the dumbbell into the rest position by effect of a magnetic field

So the current compensating the torque affecting the dumbbell is a direct measure for the oxygen concentration within the sample gas.

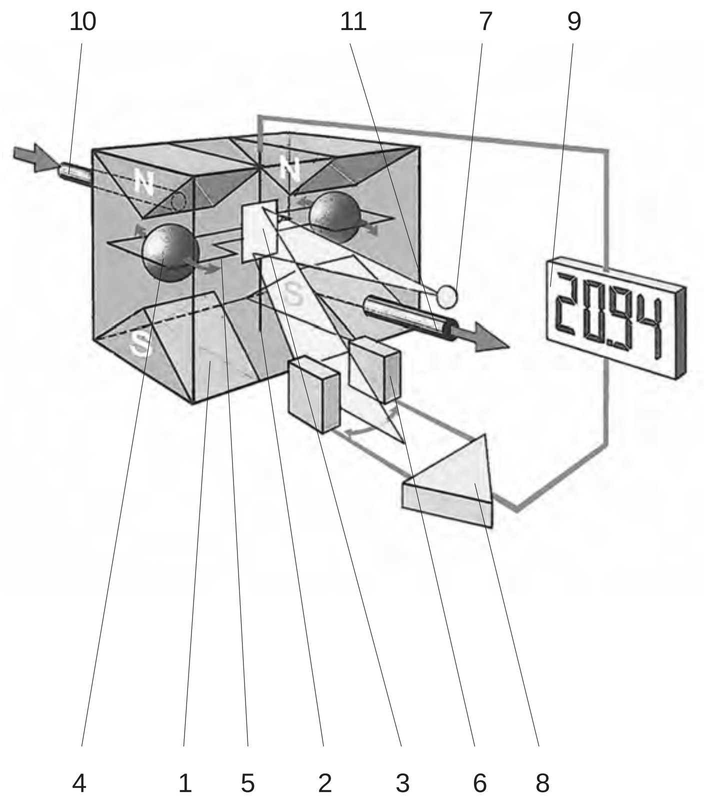
In addition to measuring cell, permanent magnet, electronics and enclosure the paramagnetic oxygen detector contains a temperature sensor and a heating element to hold the detector at approx. 55 °C.

Several variations are available including corrosion resistant, solvent resistant and/or intrinsically safe (for measuring flammable gases) versions.

Solvent Resistant Paramagnetic Oxygen Sensor: approved solvents (inclusive accompanying disturbing components)			
Component	**Concentration**	**Component**	**Concentration**
Acetone	0.1- 20%	i Butyr acid	0.1- 20%
Acrolein	0.1- 20%	i-Butyr aldehyd	0.1- 20%
Argon	0.1- 20%	i-Propylformiat	0.1- 20%
Aromatics	0.1- 20%	Isopropanol	0.1- 20%
Butadiene	0.1- 20%	Carbon dioxide	0.1- 20%
Butadiene-1	0.1- 20%	Methane	0.1- 20%
Butadiene-2	0.1- 20%	Methanol	0.1- 20%
C2H2	0.1- 20%	Methyl ethyl keton	0.1- 20%
C4H8	0.1- 20%	Methyl acetate	0.1- 20%
C5	0.1- 20%	Methyl kaptane	0.1- 20%
C6H12	0.1- 20%	n-Butane	0.1- 20%
CH3COOH	0.1- 20%	Propadiene	0.1- 20%
Cyclohexane	0.1- 20%	Propane	0.1- 20%
Cyclohexanon	0.1- 20%	Propene	0.1- 20%
Dimethyl sulfide	0.1- 20%	Propylene	0.1- 20%
Acetic acid	0.1- 20%	Propylen oxide	0.1- 20%
Ethane	0.1- 20%	Toluene	0.1- 20%
Ethanol	0.1- 20%	Vinyl acetate	0.1- 20%
Ethene	0.1- 20%	Vinyl acetylene	0.1- 20%
Ethylene	0.1- 20%	Hydrogen	0.1- 20%
Ethylene oxid	0.1- 20%	Xylene	0.1- 20%
Heptane	0.1- 20%	Cyclo hexane	0.1- 20%
Hexane	0.1- 20%		
Conditions			
· Single or summarized concentrations do not exceed 20 %			
· Gas passes gas cooler prior to entering the analyzer			
· Gas dew point at max. 5 °C			
Solvent resistant sensors are consumables!			

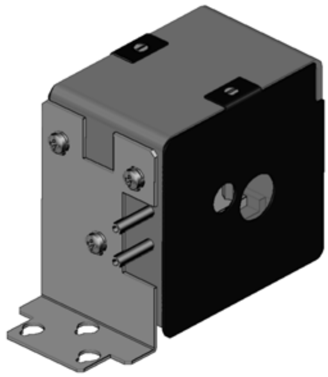
Table 3-1: Solvent Resistant Sensor: Approved Solvents

3-2 Oxygen Measurement



1	Permanentmagnet	6	Photodetector
2	Platinum wire	7	Light source
3	Mirror	8	Preamplifier
4	Glass ball	9	Display
5	Loop	10	Gas inlet
		11	Gas outlet

Fig. 3-6: Paramagnetic Oxygen Detector, Assembly Principle



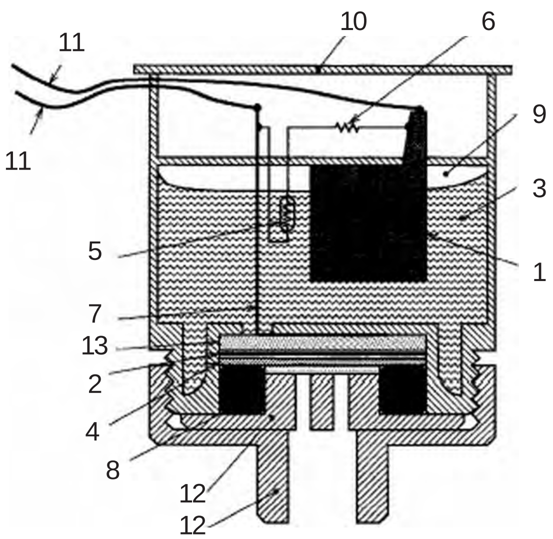
Medium affected Materials within Paramagnetic Oxygen Sensor			
Measuring cell type	**Standard**	**Solvent resistant**	**Corrosion resistant (Chlorine, dry)**
Case	SS 1.4571	SS 1.4572	SS 1.4573
Pole nucleus	Tantalum		
Mirror	Glass		
	Rhodium		
Tension band	Platinum alloy		
Loop wire	Platinum alloy		
Supporting wire	Platinum alloy		
Cylinder	Glass		
Cylinder bushing	Ceramics		
Dumbbell	Glass		
Taring	PP	**Epoxy**	**Epoxy**
Compound material	Plumb bob, Epoxy	Plumb bob, Epoxy	**Epoxy**
Seals	FPM	**Kalrez**	**Kalrez**

Table 3-2: Medium affected Materials within Paramagnetic Oxygen Sensor

3-2 Oxygen Measurement

3-2-2 Electrochemical Measurement

This sensor uses the principle of galvanic cells, fig. 3-7 shows the design.



1 Anode (lead)
2 Kathode (Gold)
3 Electrolyte solution
4 Membrane
5 Thermistor
6 Resistance
7 Titanum wire
8 O-Ring
9 Pressure compensating volumes
10 Lid
11 Electrical connections
12 Lids
13 Current collector

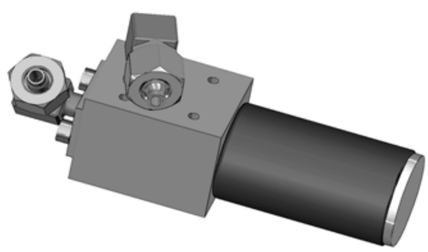
Fig. 3-7: Electrochemical Sensor Assembly Principle

The electrochemical oxygen sensor‘s key components are a lead anode (1) and a gold cathode (2) surrounded by a special acid electrolyte (3).

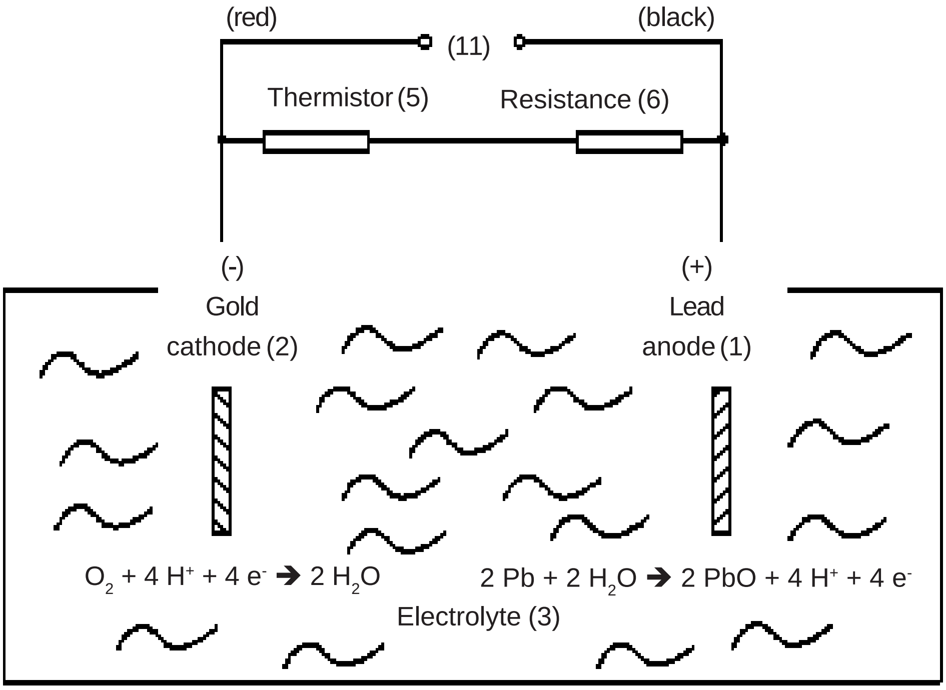
The gold electrode is integrated solid with the membrane,which is a non-porous fluororesin membrane. Oxygen which barely diffuses through the membrane is electrochemically reduced on the gold electrode.

The temperature compensating thermistor and adjusting resistance are connected between the cathode and anode. The current generated by oxygen reduction is converted into a voltage by these resistances.

The value of the current flowing to the thermistor and resistance varies in proportion to the oxygen concentration of the measuring gases which contact the membrane. Therefore, the voltage at the terminal of the resistances is used for the sensor output to measure the oxygen concentration.



3-2 Oxygen Measurement



Electrochemical reaction: $O_2 + 2 Pb \rightarrow 2 PbO$

Fig. 3-8: Electrochemical reaction of Oxygen Sensor

In consequence of it's design the sensor's lifetime is limited and depends on theoretical designed life and oxygen concentration. The sensor output can be taken as a rough criterion for end of lifetime: The sensor is weared when the output in atmosphere is below 70 % of the initial output. The period till this can be calculated by

$$\textit{Lifetime} = \frac{\textit{designed life (hours)}}{O_2 \textit{ concentration (\%)}}$$

The sensor's designed life under constant conditions of 20 °C is approx. **900,000 hrs.** The lifetime at 21 % oxygen is then calculated to approx. **42,857 hrs, corresponding to approx. 5 years.**

Note!
The given values are for reference only! The expected lifetime is greatly affected by the temperature of the environment in which the sensor is used or stored. Increases or decreases in atmospheric pressure have the same effect as that by increases or decreases in oxygen concentration (Operation at 40 °C halves lifetime).

3-2-3 Special Hints on Oxygen Sensors

Paramagnetic Sensor

The table below shows how accompanying gases interfere the paramagnetical oxygen measurement.

If the concentration of such gases is already given at time of enquiry this interference may be taken into account during factory startup and thus minimized (option).

Cross Inferences for Paramagnetic Oxygen Measurement		
100 % Gas		Zero-level effect % O_2
Nitrogen	N_2	+0.00
Carbon Dioxide	CO_2	-0.27
Hydrogen	H_2	+0.24
Argon	Ar	-0.22
Neon	Ne	+0.13
Helium	He	+0.3
Carbon Monoxide	CO	+0.01
Methane	CH_4	-0.2
Ethane	C_2H_6	-0.46
Ethene	C_2H_4	-0.26
Propane	C_3H_8	-0.86
Propene	C_3H_6	-0.55
Nitrogen Oxide	NO	+43.0
Nitrogen Dioxide	NO_2	+28.0
Nitrous Oxide	N_2O	-0.2

Table 3-3: Paramagnetic Oxygen Measurement, cross interference by accompanying gases

Electrochemical Sensor

Due to the measuring principle the electrochemical oxygen cell requires a minimum internal consumption of oxygen (residual humidity avoids drying of the cell). Supplying cells continuously with dry sample gas of low grade oxygen concentration or with sample gas free of oxygen could result in a reversible detuning of O_2 sensitivity. The output signal will become unstable, but response time remains constant.

For correct measurement the cell needs continuously to be supplied with concentrations of at least 0.1 Vol.-% O_2 . We recommend to use the cells if need be in alternating mode, means to purge cells with conditioned (not dried, but dust removed) ambient air when measurement pauses.

If it is necessary to interrupt oxygen supply for several hours or days, the cell has to regenerate (supply cell for about one day with ambient air). Temporary flushing with nitrogen (N_2) for less than 1 h (e.g. for analyzer zeroing purpose) has no influence on measuring characteristics.

This sensor is not suitable for anorganic gases containing chlorene or flourene!

In addition is not suitable for sample gases containing ozone, H_2S (> 100 ppm) or NH_3 (> 20 ppm).

For a number of other interfering gases see table 4-3 below:

Gas	Concentration	Interference Level
Carbon monoxide	0-100%	no effect
Carbon dioxide	0-100%	no effect
Nitric monoxide	0-1%	no effect
Nitrogen dioxide	0-1%	no effect
Sulfur dioxide	0-3%	3%
Hydrogen sulfide	0-3%	no effect
Ammonia	0-3%	1%
Hydrogen	0-100%	no effect
Hydrogen chloride	0-3%	1%
Benzene	0-100ppm	1%
Methane	0-100%	no effect

Table 3-4: Electrochemical Oxygen Measurement, cross interference by accompanying gases

3-3 Thermal Conductivity Measurement

Thermal Conductivity Measurement primarily is used for measuring concentrations of hydrogen (H_2) and helium (He). These gases are characterized by their specific thermal conducitivity, differing clearly from that of other gases (see table 3-5).

Thermal Conductivity of specific gases (100 Vol-%)		
Type of gas		λ in µw / cm grd 50 °C
Helium	He	1580
Neon	Ne	516
Argon	Ar	189
Krypton	Kr	102
Xenon	Xe	60
Radon	Rn	26
Hydrogen	H_2	1910
Oxygen	O_2	283
Chlorine	Cl_2	96,8
Sulfur Dioxide	SO_2	113
Nitrogen	N_2	277
Ammonia	NH_3	270
Carbon Dioxide	CO_2	184
Air	N_2 /O_2	276
Hydrochloric Acid	HCl	151
Carbon Monoxide	CO	267
Methane	CH_4	371
Butane	$C_4 H_{10}$	185

Table 3-5: Examples of Specific Thermal Conductivities

3-3-1 Principle of Operation

A Wheatstone bridge, made of 4 temperature sensitive resistors (PT 100 sensors), is surrounded by gas in a way that each 2 sensors are located in the measuring gas stream (R_M) and in a reference gas stream (R_R), see fig. 2-9. The bridge output signal (U_{br}) is adjusted to zero when in rest position (no gas flow).
By default the reference gas path is closed (not flown through by gas). When sample gas is supplied the sensors in the measuring gas path are cooled due to the thermal conductivity effect: The gas absorbs heat and carries it away from the sensors. This tunes the Wheatstone bridge and generates a signal proportional to the thermal conductivity.
Additional electronics linearizes and conditions this signal to provide usefull measuring values.

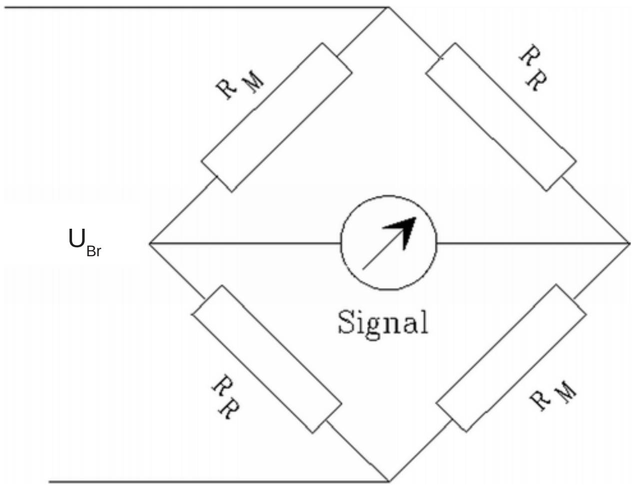


Fig. 3-9: Wheatstone Bridge

Depending on application it is possible to supply a reference gas to the bridge‘s reference side. The output signal in this case is proportional to the difference of the thermal conductivities of sample and reference gas.

3-3-2 Technical Implementation

A block made either of aluminum, stainless steel or hastelloy contains two gas paths. Both, the volume of the block and the mass of the sensors have been minimized in order to obtain short response times. To suppress influences by changing ambient temperature the block is thermostatted and isolated against ambience.
The sensors are fully glass packaged to withstand aggressive gases.

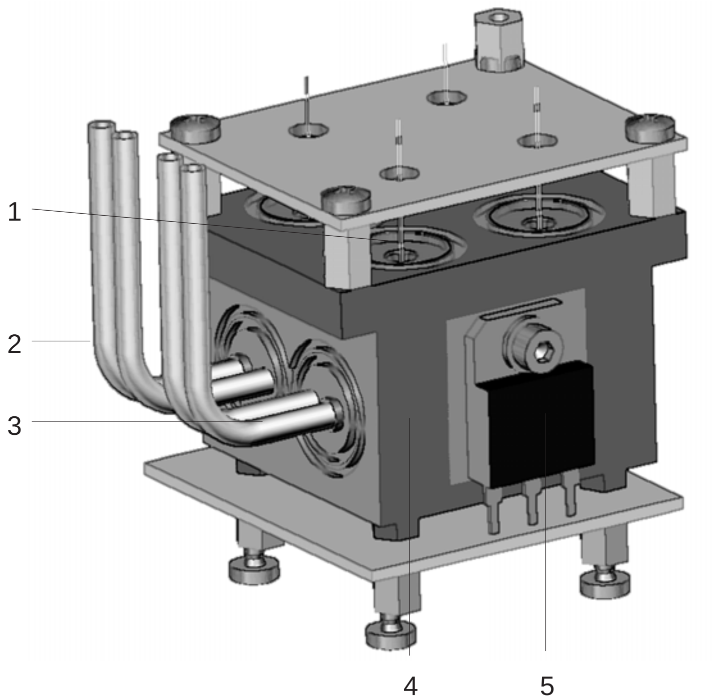


Fig. 3-10a: TC cell, exterior view , thermal isolation removed

1 Sensor
2 Sample gas inlet and output
3 Reference side inlet and output
4 Metal block
5 Heater for thermostatting

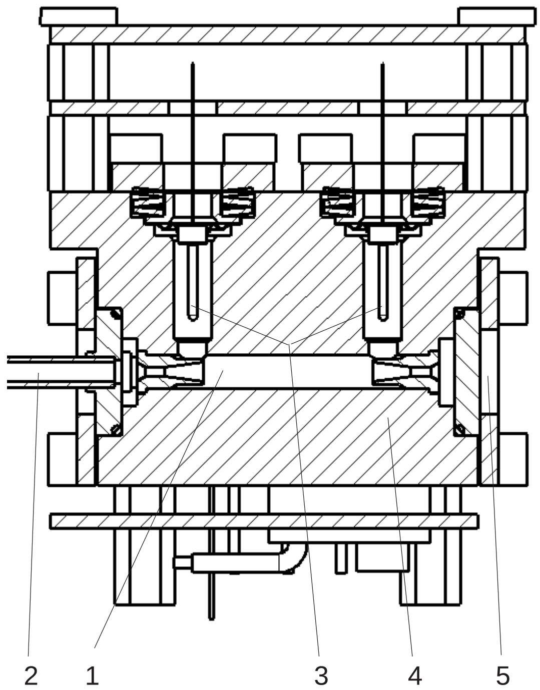


Fig. 3-10b: TC cell, sectional view

1 Internnal gas path
2 Sample gas inlet and output
3 PT 100 sensors
4 Metal block
5 Lid

3-4 Measurement Specification

Sample gas components and measuring ranges (standard configurations)*

Note!
The following table shows generic data. The sample gas(es) and measuring ranges for your specific analyzer are given by the order acknowledgement and on the analyzer's name plate label.

Gas component *		Lowest measuring range	Highest measuring range
Acetone	CH_3COCH_3	0 - 1,000 ppm	0 - 3%
Acetylene	C_2H_2	0 - 3%	0 - 100%
Ammonia	NH_3	0 - 250 ppm	0 - 100%
Argon	Ar	0 - 50%	0 - 100%
Carbon dioxide	CO_2	0 - 100 ppm	0 - 100%
Carbon monoxide	CO	0 - 100 ppm	0 - 100%
Ethylene	C_2H_4	0 - 400 ppm	0 - 100%
Helium	He	0 - 10%	0 - 100%
Hexane	C_6H_{14}	0 - 500 ppm	0 - 9,000 ppm
Hydrogen	H_2	0 - 2% ****	0 - 100%
Methane	CH_4	0 - 1,000 ppm	0 - 100%
n - Butane	C_4H_{10}	0 - 800 ppm	0 - 100%
Nitrogen dioxide	NO_2	0 - 100 ppm	0 - 1,000 ppm
Nitrogen monoxide	NO	0 - 250 ppm	0 - 100%
Nitrous oxide	N_2O	0 - 1%	0 - 100%
Oxygen (electrochemical)	O_2	0 - 5%	0 - 25% ***
Oxygen (paramagnetic)	O_2	0 - 1% *****	0 - 100%
Propane	C_3H_8	0 - 1,000 ppm	0 - 100%
Propylene	C_3H_6	0 - 4,000 ppm	0 - 100%
Sulfur dioxide	SO_2	0 - 100 ppm	0 - 100%
Sulfur hexafluoride	SF_6	0 - 1,000 ppm	0 - 5,000 ppm
Toluene	C_7H_8	0 - 1,000 ppm	0 - 1.2%
Vinyl chloride	C_2H_3Cl	0 - 2%	0 - 2%
Water vapor **	H_2O	0 - 1%	0 - 5%

* Other components and configurations on request
** Dew point below ambient temperature
*** Higher concentrations decrease sensor lifetime
**** Special "refinery" application with 0 - 1% H_2 in N_2 available
***** Specification for lowest range to be verified

Table 3-6: Gas Components and Measuring Ranges, examples

3-4 Measurement Specification

Performance Specifications

	NDIR/UV/VIS	Oxygen Sensor (PO_2 and EO_2)	Thermal Conductivity
Detection limit	≤ 1% [1] [4]	≤ 1% [1] [4]	≤ 2% [1] [4]
Linearity	≤ 1% [1] [4]	≤ 1% [1] [4]	≤ 1% [1] [4]
Zero-point drift	≤ 2% per week [1] [4]	≤ 2% per week [1] [4]	≤ 2% per week [1] [4]
Span (sensitivity) drift	≤ 1% per week [1] [4]	≤ 1% per week [1]	≤ 1% per week [1] [4]
Repeatability	≤ 1% [1] [4]	≤ 1% [1] [4]	≤ 1% [1] [4]
Response time (t_{90})	4 s ≤ t_{90} ≤ 7 s [3] [5]	< 5 s [3] [6] / approx. 12 s [3] [9]	5 s ≤ t_{90} ≤ 20 s [3] [7]
Permissible gas flow	0.2 - 1.5 l/min.	0.2 - 1.0 l/min [6] / 0.2 - 1.5 l/min. [9]	0.2 - 1.5 l/min. [13]
Influence of gas flow	≤ 0.5% [1] [4]	≤ 2% [1] [4]	≤ 1% [1] [4] [13]
Maximum gas pressure	≤ 1,500 hPa abs. (≤ 7 psig)	≤ 1,500 hPa abs. (≤ 7 psig) [16]	≤ 1,500 hPa abs. (≤ 7 psig)
Influence of pressure			
– At constant temperature	≤ 0.10% per hPa [2]	≤ 0.10% per hPa [2]	≤ 0.10% per hPa [2]
– With pressure compensation [8]	≤ 0.01% per hPa [2]	≤ 0.01% per hPa [2]	≤ 0.01% per hPa [2]
Permissible ambient temperature	-20 to +50°C (-4 to +122°F)	-20 to +50°C (-4 to +122°F) [10]	-20 to +50°C (-4 to +122°F)
Influence of temperature			
(at constant pressure)			
– On zero point	≤ 1% per 10 K [1]	≤ 1% per 10 K [1]	≤ 1% per 10 K [1] [15]
– On span (sensitivity)	≤ 5% (0 to +50°C) [1] [11] [15]	≤ 1% per 10 K [1] [15]	≤ 1% per 10 K [1] [15]
Thermostat control [12] [14]	Optionally 60°C (140°F)	55/60°C (131/140°F) [6] / None [9]	75°C (167°F) [12]
Warm-up time [12] [14]	15 to 50 minutes [5]	Approx. 50 minutes [6]	Approx. 15 minutes

[1] Related to full scale
[2] Related to measuring value; 1 psi = 68.95 hPa
[3] From gas analyzer inlet at 1.0 l/min gas flow (electronic damping = 2 s)
[4] Constant pressure and temperature
[5] Dependent on integrated photometer bench
[6] Paramagnetic oxygen measurement (PO_2)
[7] Depending on measuring range
[8] Pressure sensor is required
[9] Electrochemical oxygen measurement (EO_2), not for use with sample gas containing FCHC´s
[10] Electrochemical oxygen measurement (EO_2): +5 to +40°C (41 to 104°F)
[11] Starting from +20°C (68°F) to 0°C (32°F) to +50°C (122°F) to +20°C (68°F)
[12] Sensor / cell only
[13] Flow variation within ± 0.1 l/min
[14] Optional thermostatically controlled box with 60°C (140°F)
[15] Temperature variation: 10 K in 1 h
[16] No sudden pressure surge for PO_2 allowed

Table 3-7: Measurement Performance Specifications

All data provided above is verified during the manufacturing process for each unit by the following tests:

- Linearization and sensitivity test
- Long term drift stability test
- Climate chamber test
- Cross interference test (if applicable)

Chapter 4
Installation

This chapter describes how to install the different analyzer models in a safe manner and gives instructions on what to care about.

4-1 Abstract

Carefully examine the shipping carton and contents for signs of damage. Immediately notify the shipping carrier if the carton or its contents are damaged. Retain the carton and packing material until the instrument is operational.

WARNING

ELECTRICAL SHOCK HAZARD!

Prior to connecting the analyzer to power ensure all safety instructions as given in the appropriate chapter at the beginning of this manual and in the following analyzer refered sections are read and unterstood!

Installation area has to be clean, free from moisture, excessive vibration and frost-protected. Take care to meet the permissible ambient temperatures as given in the technical data section!

Instruments must not be exposed to direct sunlight nor sources of heat.

For outdoor installation it is recommended to mount the instruments into a cabinet. At least sheltering against rain is recommended.

4-1 Installation - Abstract

To stay in compliance with regulations regarding electromagnetic compatibility it is recommended to use only shielded cables, as optionally available from Emerson Process Management or equivalent. Customer has to take care that the shield is connected in proper way. Shield and signal connector enclosure need to be conductively connected, submin-d-plugs and sockets must be screwed on the analyzer.

Using external submin-d-to-terminal adaptor elements (option) affects electromagnetic compatibility. In this case the customer has to take measures to stay in compliance and has to declare conformity, when required by legislation (e.g. European EMC Directive).

4-2 Gas Conditioning

To ensure trouble-free analyzer operation one has to attach great importance to gas conditioning:

All gases must be conditioned before supplying!

When supplying corrosive gases ensure that gas path components are not affected!

Flammable gases must not supplied without additional protective measures!

It is prohibited to supply explosive gases!

Furthermore the gases must be

- dry
- free of dust
- free of aggressive components affecting gas path materials (e.g. by corrosion).

If moisture can not be avoided take care that the gas‘ dew point is at least 18 F (10 °C) below ambient temperature to avoid condensation within the gas path.
The fieldhousing version X-STREAM F offers the option to be ordered with thermostat controlled pipes allowing a maximum dew point of 77 °F (25 °C).
Pressure and flow must be within the limits given by the measurement specifications table 3-7 (☞ 3-4, page 3-17).

WARNING

TOXIC GAS HAZARDS

Take care that all external gas lines are connected as described and are tight to avoid leaks!

Improperly connected gas lines may cause explosion or death!

Exhaust may contain hydrocarbon and other toxic components (e.g. carbon monoxide)! Carbon monoxide is highly toxic and can cause headache, nausea, loss of consciousness, and death. Avoid inhalation of exhaust!

CAUTION

Do not interchange gas inlet and outlet! All gases must be conditioned before supplying! When supplying corrosive gases ensure that gas path components are not affected!

Max. permissible gas pressure: 21.7 psi (1,500 hPa), except instruments with integrated valve blocks (7.25 psi; 500 hPa) and/or paramagnetic oxygen sensor (☞ table 3-7, page 3-17)!

Exhaust lines must be installed in a descending way, need to be pressureless, frost-protected and in compliance with applicable legislative requirements!

The number of gas fittings as well as their assignment vary depending on analyzer model and selected options.
All gas fittings are labeled and are located at

- the analyzer's rear panel (X-STREAM GP, GPS)
- the analyzer's bottom side (X-STREAM F, FD)

When it is necessary to open gas paths seal the analyzer‘s gas fittings using PVC caps to avoid pollution of the internal gas path by moisture, dust, etc.

	IN	OUT
1	SAMPLE	SAMPLE
2		
3		
4		PURGE GAS

Fig. 4-0: Example of gas fittings label

4-2 Installation - Gas Conditioning

The analyzer should be mounted near the sample source to minimize sample transport time. A sample pump may be used to decrease response time, whereat the analyzer is either operated in bypass mode or protected by an overpressure valve against too high flow and pressure (fig. 4-1).

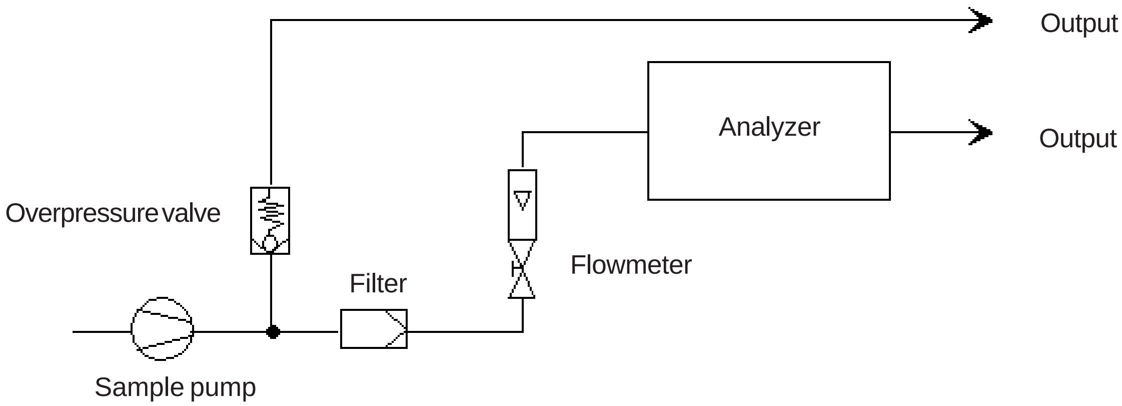


Fig. 4-1: Bypass Mode Installation

Internal Solenoid Valve Block

Supply overpressure for all gases is limited to 0.7 to 7.2 psi (50 to 500 hPa) when the analyzer is equipped with an internal solenoid valve block.

4-3 Electrical Connections

WARNING

ELECTRICAL SHOCK HAZARD!

Installation and connecting power and signal cables are subject to qualified personnel only taking into account all applicable standards and legislative requirements!

Failure to follow may cause warranty invalidation, property damage and/or personal injury or death!

Installation of these instruments is subject to qualified personnel only, familiar with the resulting potential risks! Instruments providing screw terminals for electrical connections may require working near live part!

X-STREAM gas analyzers do not provide a power switch!
For X-STREAM F analyzers a power switch or circuit breaker (complying with IEC 60947-1/-3) has to be provided in the building installation. This switch has to be installed near by analyzer, must be easily operator accessible and has to be assigned as disconnector for the analyzer.

Disconnect instruments with screw terminals from power when working at power terminals (pull power plug or operate power switch/ circuit breaker in building installation)!

The analyzers provide a protective earth terminal. To prevent electrical shock hazards the instruments must be connected to a protective earth. Therefore the instruments must be connected to power by using a three wire power cable with earth conductor!

Any interruption of the earth connector inside or outside the instrument or disconnecting the earth terminal may cause potential electrical shock hazzard!

The analyzers do not provide a power switch and are operable when connected to power.

4-4 Detailled Installation Instructions

Important note regarding X-STREAM FD analyzers!
*Due to the special conditions to be considered when installing and operating equipment in hazardous areas, the installation instruction for the flameproof analyzer variation **X-STREAM FD** is part of the instruction manual **HASADE-IM-....!***
Even if you do not install your X-STREAM FD in a hazardous area, refer to this separate manual for installation instructions.

Installation instructions for X-STREAM GP, X-STREAM GPS ☞ Page 4-7
X-STREAM F ☞ Page 4-21

Hints on wiring signal inputs and outputs ☞ Page 4-31

4-4-1 X-STREAM GP, X-STREAM GPS

The analyzer variations X-STREAM GP and GPS are intended for horizontal orientation during operation.
X-STREAM GP / GPS with mounting frames beside the front panel may be mounted into a rack (rack mount version). Use four screws to fix the analyzer in the rack (fig. 4-2).

Depending on which variation was ordered either screw terminals or plugs and sockets are provided for electrical connections, accessible at the rear panel (fig. 4-3 and 4-10).

The analyzers do not provide a power switch and are operable when connected to power.

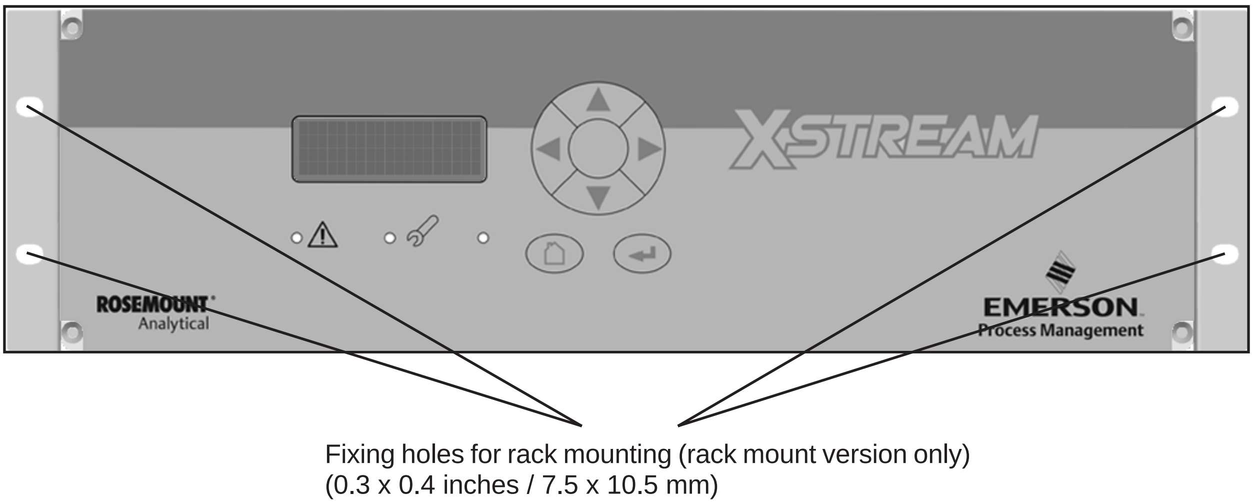


Fig. 4-2:X-STREAM GP/GPS - Frontal view

4-4-1 Installation - X-STREAM GP, X-STREAM GPS

4-4-1-1 X-STREAM GPS: Plugs & Sockets Version

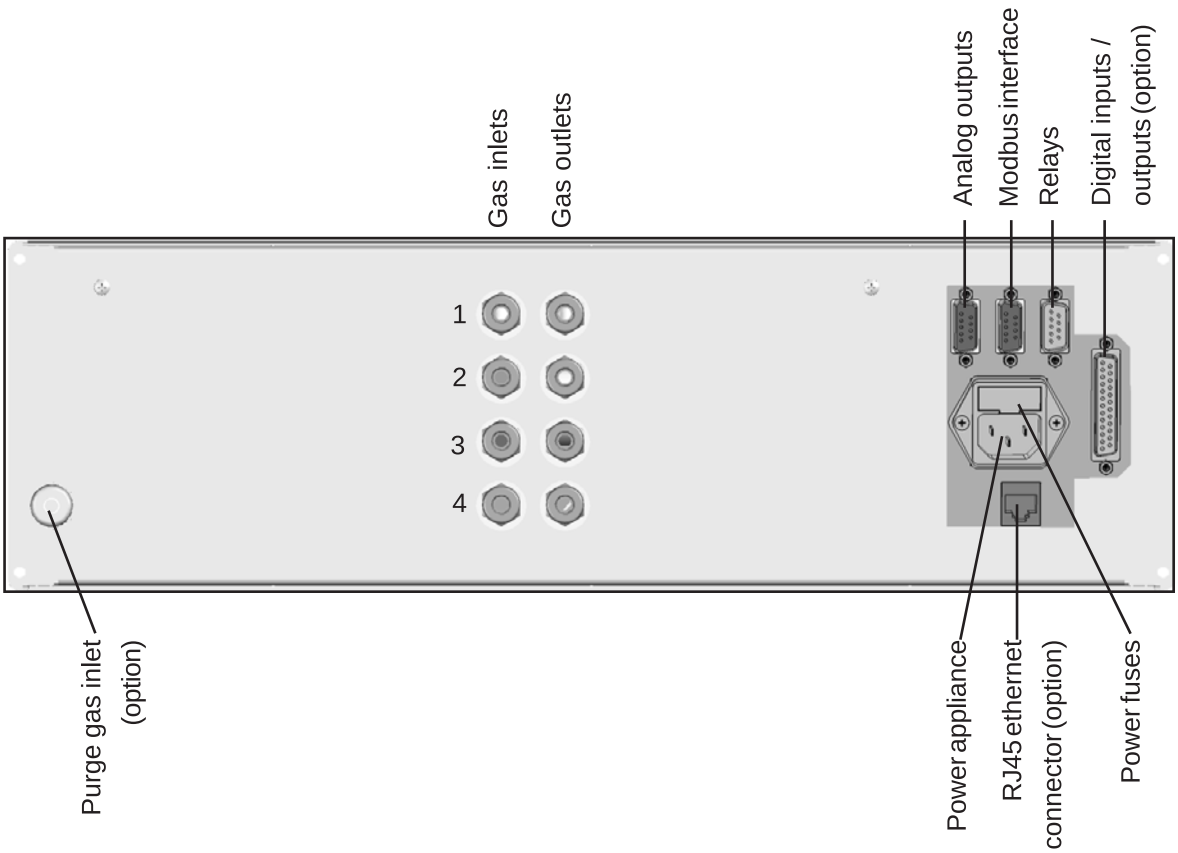


Fig. 4-3: X-STREAM GPS - Rear panel

The number and assignment of gas inlet and outlet fittings depends on the application and is given on a label attached to the analyzer's rear panel adjacent to the fittings.
For simple installation we recommend to mark the gas lines according to fig. 4-3 (In1, Out1, In2, Out2, ...). This avoids confusion during re-installation when the analyzer had to be disconnected for whatever reason.

Gas inlets and outlets

Quantity:		max. 8 (+ 1 optional purge gas fitting)
Specification:		6/4 mm PVDF
	optional	6/4 mm or 1/4", stainles steel, other on request

4-4-1 Installation - X-STREAM GP, X-STREAM GPS

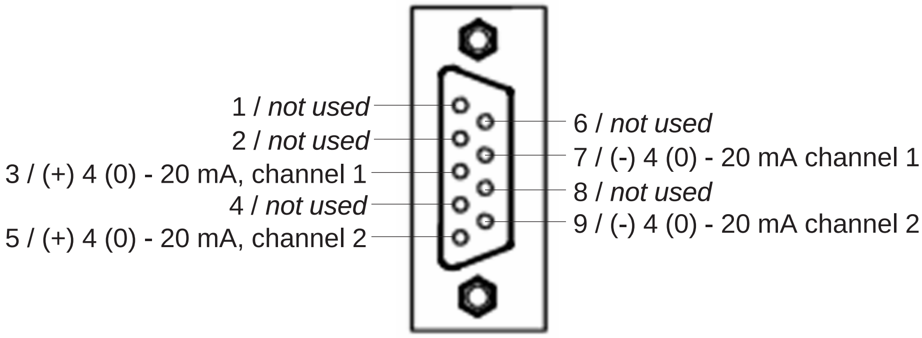
Preparation of signal cables

All signal cables (except the optional RJ45 ethernet connection) are to be connected via submin-d connectors. The connectors at the analyzer's rear panel are assigned as follows:

Signal inputs / outputs

Available signals:	standard:	Analog signal outputs Relay status signals Modbus interface (RS232; RS 485)
	optional:	Digital inputs/outputs Modbus RJ45 ethernet connector

Analog signal outputs



Burden: $R_B \leq 500\ \Omega$

Legend: Pin # / Signal

Fig. 4-4: Socket X1 - pin assignment

Note!
Take care of the special installation instructions in section 4-5!

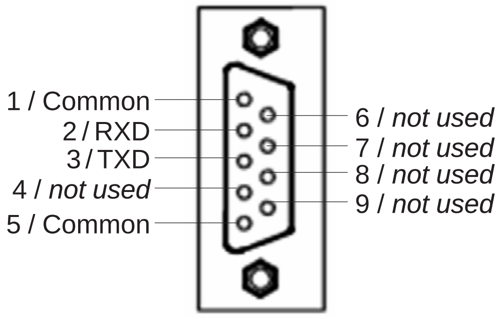
4-4-1 Installation - X-STREAM GP, X-STREAM GPS

Modbus interface

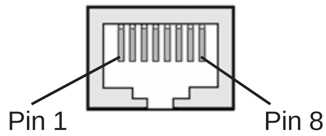
Specification and driving the interface:
☞ Chapter 9

Note1!
Take care of the special installation instructions in section 4-5!

Note2!
X-STREAM analyzers are to be considered a DTE (Data Terminal Equipment).

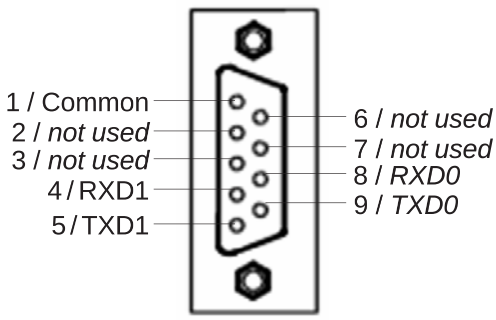


RS 232 interface

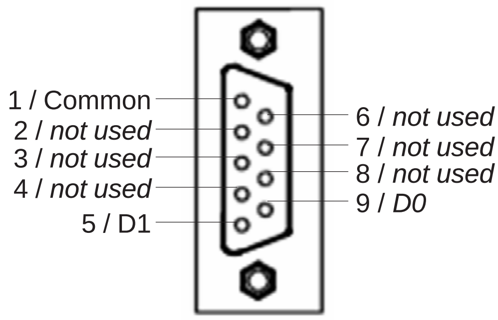


Pin	Signal
1	TX+
2	TX-
3	RX+
6	RX-
other	*not used*

RJ45 connection



4-wire configuration



2-wire configuration

RS 485 interface

Legend: Pin # / Signal

Fig. 4-5: Socket X2 - pin assignment

4-4-1 Installation - X-STREAM GP, X-STREAM GPS

Relay status Signals

Design: dry relay contacts
Electrical specification: max. 30 V⎓, 1 A, 30 W

Note!
Take care of the special installation instructions in section 4-5!

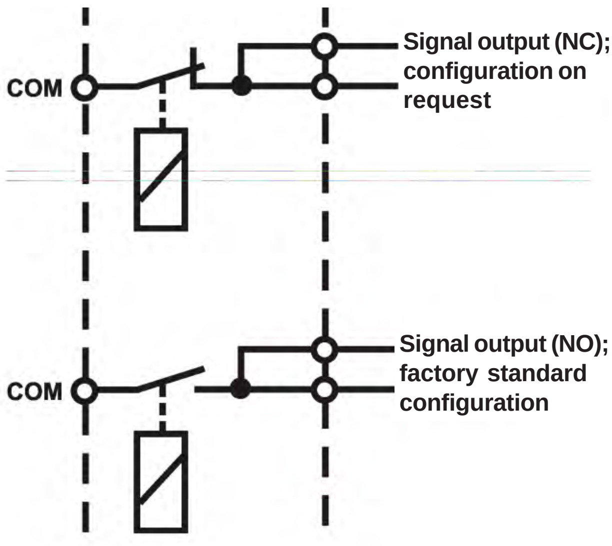
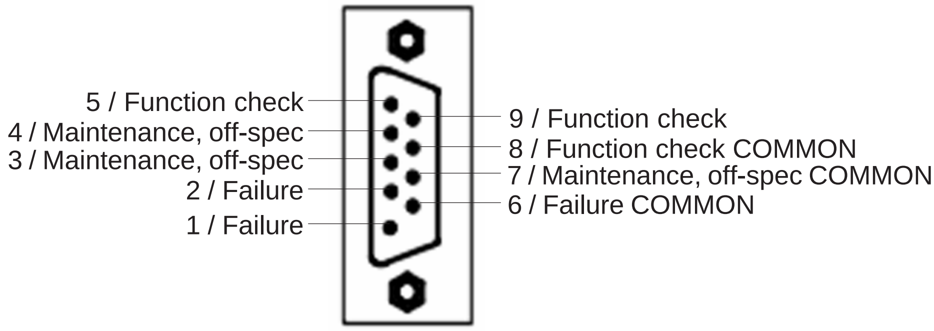


Fig. 4-6: Relay status signals, block diagram



Legend: Pin # / Function

Fig. 4-7: Plug X3 - pin assignment

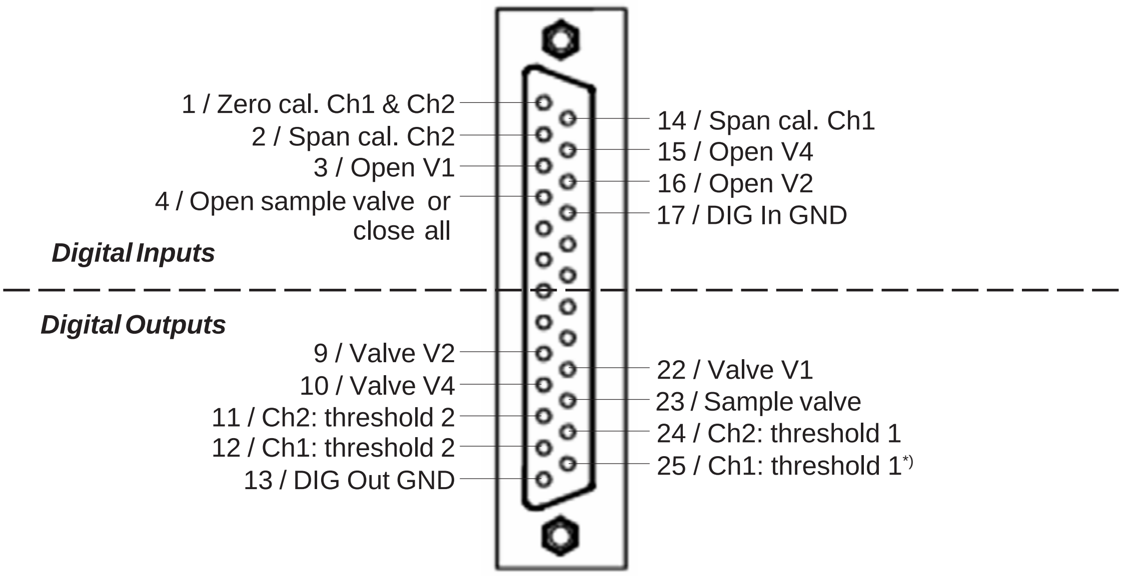
4-4-1 Installation - X-STREAM GP, X-STREAM GPS

Digital Inputs & Outputs

Design: Open collector (outputs)
Electrical specification:

outputs:	max. 30 V⎓, 30 mA
inputs:	max. 30 V⎓, internally limited to 2.3 mA H level: min. 4 V; L level: max. 3 V

Note!
Take care of the special installation instructions in section 4-5!



Legend: Pin # / Function

*) When making use of the range switching option this output is assigned a range indicator (☞ 7-7-5, page 7-56)

Fig. 4-8: Socket X4 - pin assignment

4-4-1 Installation - X-STREAM GP, X-STREAM GPS

Preparation of power cable

The power power inlet appliance is of type IEC. Use a standard power cable with IEC connector complying with your local requirements to supply the instrument with power.

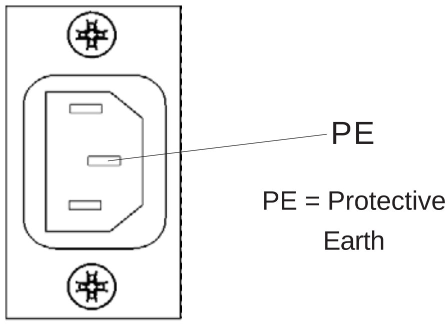


Fig. 4-9: IEC power input plug

4-4-1-2 X-STREAM GP: Terminals Version

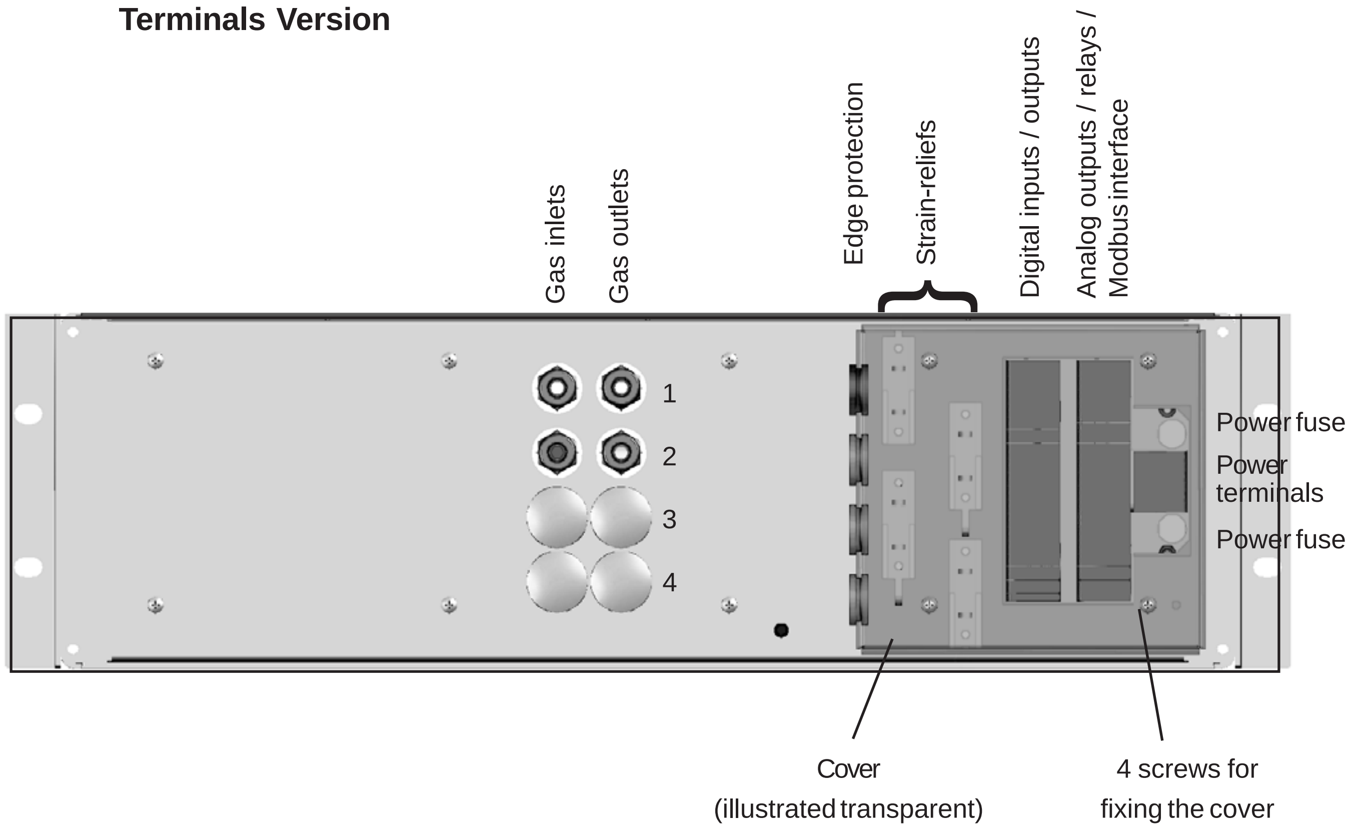


Fig. 4-10: Rear panel - terminals version

The number and assignment of gas inlet and outlet fittings depends on the application and is given on a label attached to the analyzer's rear panel adjacent to the fittings.
For simple installation we recommend to mark the gas lines according to fig. 4-3 (In1, Out1, In2, Out2, ...). This avoids confusion during re-installation when the analyzer had to be disconnected for whatever reason.

A label fixed to the inner side of the terminals cover shows how the terminals are assigned.

Gas inlets and outlets

Quantity:		max. 8 (+ 1 optional purge gas fitting)
Specification:		6/4 mm PVDF
	optional	6/4 mm or 1/4", stainles steel, other on request

4-4-1 Installation - X-STREAM GP, X-STREAM GPS

Preparation of signal cables

All signal cables are to be connected via screw terminals (exept the optional ethernet connector), located at the analyzer's rear panel.

The strain reliefs provide a metal strip to connect to the cable shield after the cable's outer insulation is stripped.

Supported wire cross sections:	24 to 14 AWG (0.2 to 2.5 mm^2), no need to use wire end sleeves
Cable skinning length:	0.354 inch (9 mm)
Hole diameter:	0.05 inch (1.2 mm)
Screw thread:	M 2.5
Tightening torque, min:	3.5 in.lb (0.4 Nm)

Signal inputs / outputs

Available signals:	standard:	Analog signal outputs Relay status signals Modbus interface (RS232; RS 485)
	optional:	Digital inputs/outputs Modbus RJ45 ethernet connector

Analog signal outputs

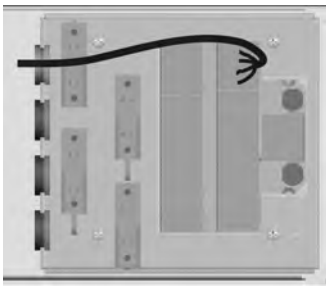
To connect the terminals remove the cover at the analyzer's rear panel (4 screws). Feed the analog signals cable through the uppermost edge protection, and through the upper strain-relief.

The upper 4 terminals (# 1 - 4) of the terminals row next to the power terminals are reserved for analog signal outputs.

Note!

Take care of the special installation instructions in section 4-5!

Interface specification:
☞ 5-4-3-4-1 Analog output setup, page 5-34



(+) 4 (0) - 20 mA, channel 1
(-) 4 (0) - 20 mA, channel 1
(+) 4 (0) - 20 mA, channel 2
(-) 4 (0) - 20 mA, channel 2

Burden: $R_B \leq 500\ \Omega$

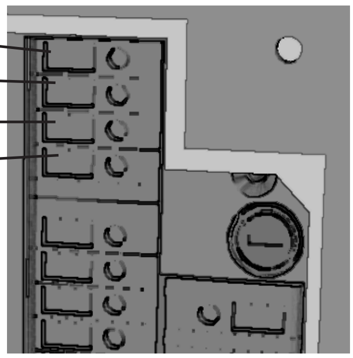


Fig. 4-11: Analog Signal Output Terminals

4-4-1 Installation - X-STREAM GP, X-STREAM GPS

Modbus interface

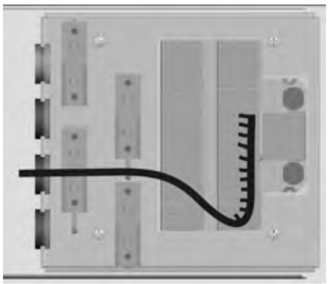
Specification and driving the interface:
☞ Chapter 9

To connect the terminals remove the cover at the analyzer's rear panel (4 screws). Feed the serial signal cable through the 3rd edge protection, and through the 3rd strain-relief.

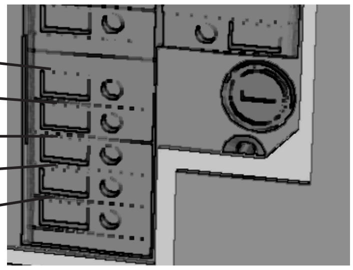
Note 1!
Take care of the special installation instructions in section 4-5!

The lower 5 terminals (# 11 - 15) of the terminals row next to the power terminals are reserved for the Modbus interface (left side of figure shows a combined cable carrying RS and relay contact signals).

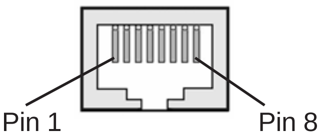
Note 2!
X-STREAM analyzers are to be considered a DTE (Data Terminal Equipment).



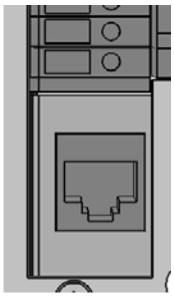
RS 232	RS 485/2w	RS 485/4w
Common	Common	Common
RXD	*not used*	RXD0
TXD	*not used*	RXD1
not used	D1	TXD1
Common	D0	TXD0



Serial interfaces



Pin	Signal
1	TX+
2	TX-
3	RX+
6	RX-
other	*not used*



Screw terminals replaced by RJ45 connector

Optional RJ45 connection

Fig. 4-12: Modbus Interface Terminals

4-4-1 Installation - X-STREAM GP, X-STREAM GPS

Relay Status Signals

Design: dry relay contacts
Electrical specification: max. 30 V⎓, 1 A, 30 W

Note!
Take care of the special installation instructions in section 4-5!

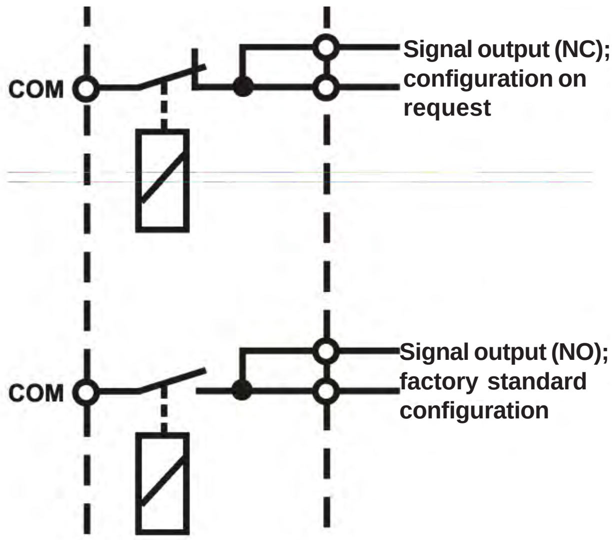


Fig. 4-13: Relay status signals, block diagram

To connect the terminals remove the cover at the analyzer's rear panel (4 screws). Feed the cable through the 3rd edge protection, and through the 3rd strain-relief.

The middle 6 terminals (# 5 - 10) of the terminals row next to the power terminals are reserved for the relay status signals (left side of figure shows a combined cable carrying RS and relay contact signals).

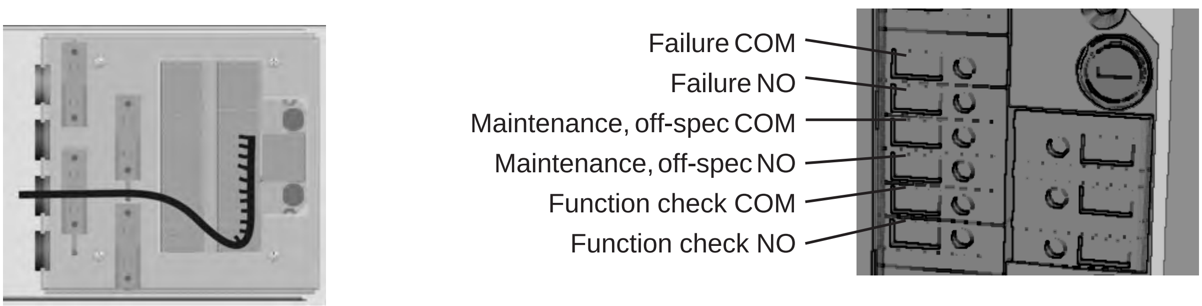


Fig. 4-14: Status Relay Terminals

4-4-1 Installation - X-STREAM GP, X-STREAM GPS

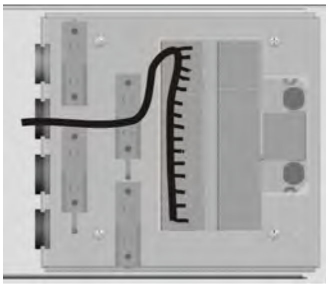
Digital Inputs & Outputs

Design: Open collector (outputs)
Electrical specification:

outputs:	max. 30 V⎓, 30 mA
inputs:	max. 30 V⎓, internally limited to 2.3 mA H level: min. 4 V; L level: max. 3 V

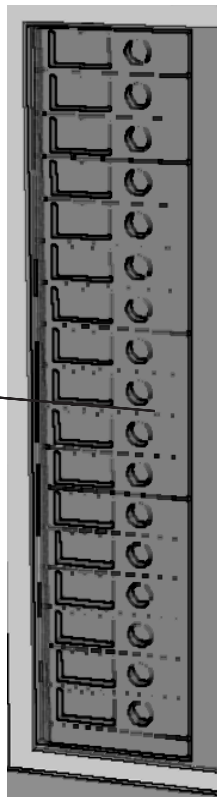
Note!
Take care of the special installation instructions in section 3-5!

To connect the terminals remove the cover at the analyzer's rear panel (4 screws). Feed the digital I/O signal cable through the 2nd edge protection, and through the 2nd strain-relief.



The leftmost terminals row is reserved for the digital inputs and outputs.

	Terminal	Function
Digital Outputs	Terminal 1	Ch1: threshold 1*)
	Terminal 2	Ch1: threshold 2
	Terminal 3	Ch2: threshold 1
	Terminal 4	Ch2: threshold 2
	Terminal 5	Sample valve
	Terminal 6	Valve V4
	Terminal 7	Valve V1
	Terminal 8	Valve V2
	Terminal 9	DIG Out GND
Digital Inputs	Terminal 10	Zero cal. Ch1 & Ch2
	Terminal 11	Span cal. Ch1
	Terminal 12	Span cal. Ch2
	Terminal 13	Open V4
	Terminal 14	Open V1
	Terminal 15	Open V2
	Terminal 16	Open sample valve or close all
	Terminal 17	DIG In GND



*) When making use of the range switching option this output is assigned a range indicator (☞ 7-7-5, page 7-56)

Fig. 4-15: Digital Input & Output Terminals

4-4-1 Installation - X-STREAM GP, X-STREAM GPS

Connecting the power cable

The power cable is connected by screw terminals, located at the analyzer's rear panel.

Use a power cable with plug for wall outlet socket.

WARNING

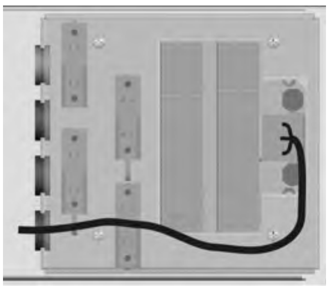
ELECTRICAL SHOCK HAZARD!

Verify cables are disconnected from power prior to working at the power terminals!

Supported wire cross sections:	24 to 14 AWG (0.2 to 2.5 mm^2), no need to use wire end sleeves
Cable skinning length:	0.354 inch (9 mm)
Hole diameter:	0.05 inch (1.2 mm)
Screw thread:	M 2.5
Tightening torque, min:	3.5 in.lb (0.4 Nm)

To connect the terminals remove the cover at the analyzer's rear panel (4 screws). Feed the power cable through the lower edge protection, through the lower strain-relief and around the separation between power terminals and next terminals row.

The 3 rightmost terminals (between the fuse holders) are reserved for power.



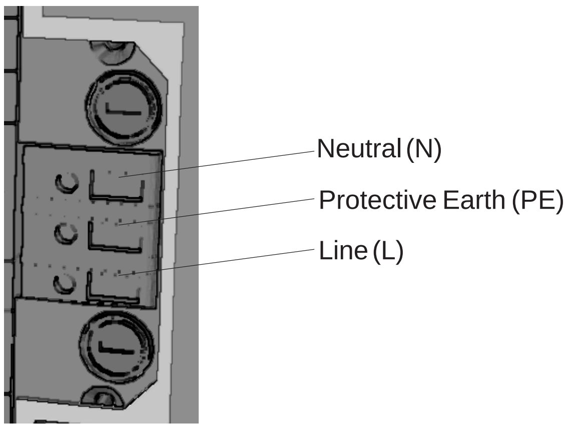


Fig. 4-16: Power terminals

4-4-1 Installation - X-STREAM GP, X-STREAM GPS

WARNING

ELECTRICAL SHOCK HAZARD!

Before completing the electrical connection of the instrumen verify screws are tight and cables are inserted correctly!

Ensure the earthing conductor is connected!

After all connections are established in correct manner and verified,

- place the edge protection rubbers into the associated openings of the cover

and finally

- attach the terminals cover to the instrument's rear panel utilizing all 4 torx screws.

4-4-2 X-STREAM F

The X-STREAM F analyzer variation is intended for outdoor installation and wall mounting, utilizing 4 supports:

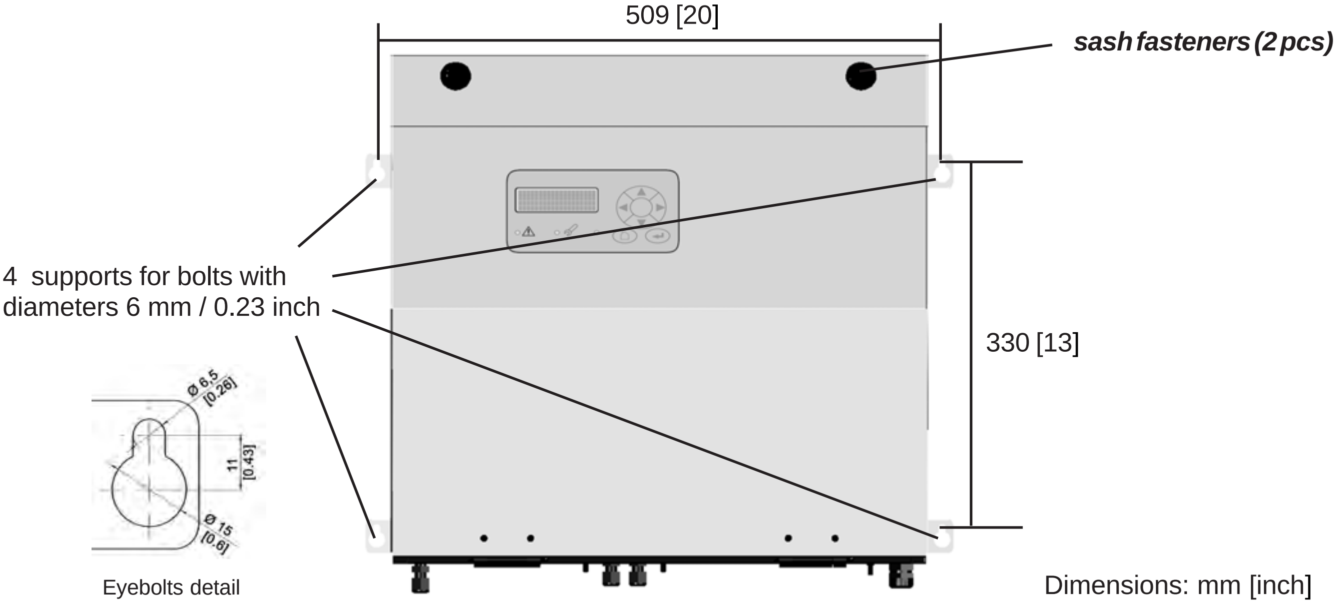
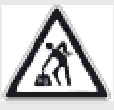


Fig. 4-17: X-STREAM F

CAUTION

HEAVY INSTRUMENTS !



The analyzer variation X-STREAM F , intended to be wall mounted and/or outdoor installed, weighs up to approx. 26 kg / 57 lbs), depending on included options!

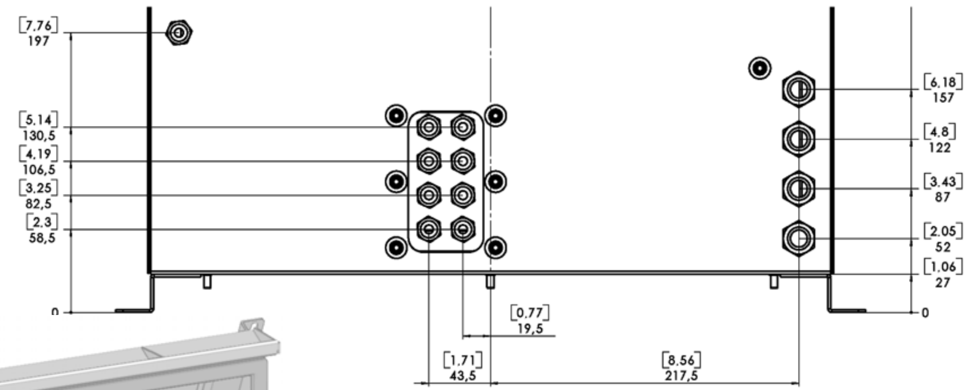
Use two people and/or suitable tools for transportation and lifting these instruments!

Take care to use anchors and bolts specified to be used for the weight of the units!

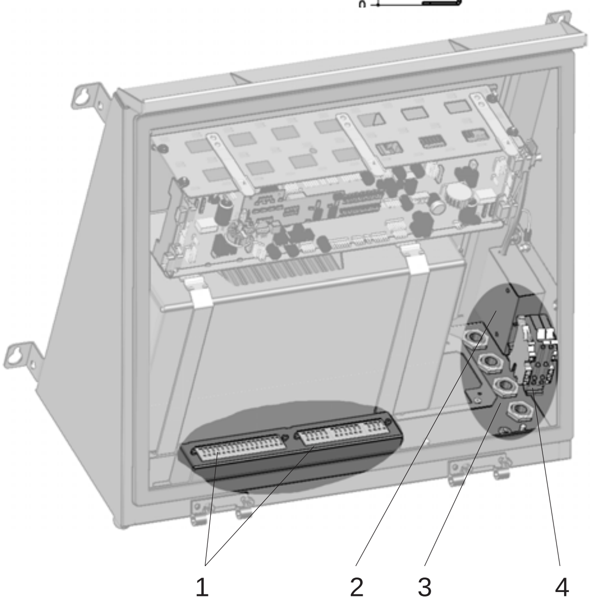
Take care the wall or stand the unit is intended to be installed at is solid and stable to hold the units!

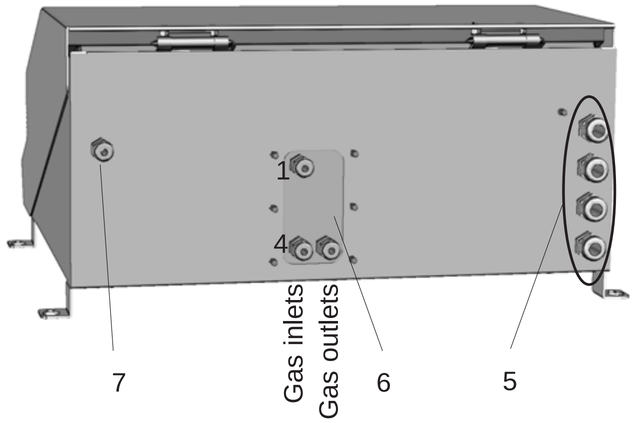
4-4-2 Installation - X-STREAM F

The instrument provides internal screw terminals for connecting power and electrical signal cables. This requires opening the instrument during installation utilizing the sash fasteners.
Gas fittings are accessible at the instrument's outer bottom side.
The number and assignment of gas inlet and outlet fittings depends on the application and is given on a label attached to the analyzer's bottom side adjacent to the fittings.
For simple installation we recommend to mark the gas lines according to the marking. This avoids confusion during re-installation when the analyzer had to be disconnected for whatever reason.



Gas fittings and cable glands





1 Terminals for signal cables
2 Power EMI filter
3 4 cable glands for power and signal cables
4 Power terminals with integrated fuses

5 Cable glands for power and signal cables
6 Gas inlet and outlet fittings
7 Purge gas inlet fitting (option)

Fig. 4-18: X-STREAM F -Allocation of terminals and gas fittings

4-4-2 Installation - X-STREAM F

Gas inlets and outlets

Quantity:		max. 8 (+ 1 optional purge gas fitting)
Specification:		6/4 mm PVDF
	optional	6/4 mm or 1/4", stainles steel, other on request

Preparation of signal cables

All signal cables are to be connected via screw terminals, located inside the analyzer. The instruments inner components are accessible after loosening the two fasteners at it‘s upper end and opening the front door downwards.

Supported wire cross sections:	24 to 14 AWG (0.2 to 2.5 mm^2), no need to use wire end sleeves
Cable skinning length:	0.354 inch (9 mm)
Hole diameter:	0.05 inch (1.2 mm)
Screw thread:	M 2.5
Tightening torque, min:	3.5 in.lb (0.4 Nm)

All cables need to be fed through cable glands when entering the instrument and fixed by the gland nut when connected to the terminals. The cable glands provide strain-relief and protection against EMI (Electro Magnetic Interference) when installed in a proper way:

Cable Gland Assembly Instruction for Shielded Cables

1. Strip the cable insulation
2. Uncover the shielding

3. Feed cable through gland nut and into fixing element
4. Put the shielding net over the element the way that it covers the o-ring 2 mm.

5. Stick the fixing element into the neck and fix the gland.

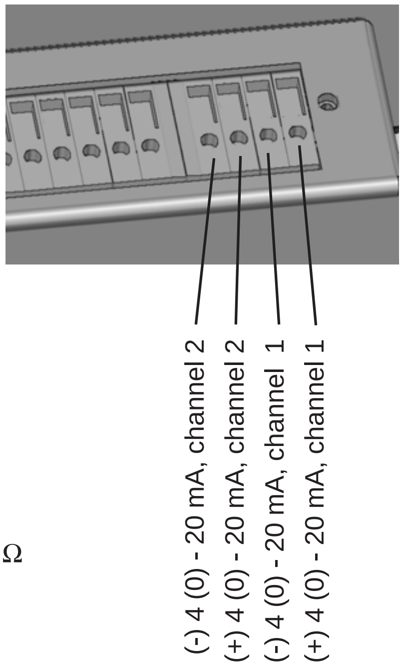
4-4-2 Installation - X-STREAM F

Signal inputs / outputs

Analog signal outputs

For access to the terminals open the instrument's front door.

The rightmost 4 terminals (# 1 - 4) of the terminals row next to the power terminals are reserved for analog signal outputs.



Burden: $R_B \leq 500\ \Omega$

Note!
Take care of the special installation instructions in section 4-5 and of the cable gland assembly instruction on page 4-23!

Fig. 4-19: X-STREAM F - Analog output terminals

WARNING

ELECTRICAL SHOCK HAZARD!

Verify power cables are disconnected and/or instrument is de-energized prior to working at the terminals!

4-4-2 Installation - X-STREAM F

Modbus interface

Specification and driving the interface:
☞ Chapter 9

Note 1!
Take care of the special installation instructions in section 4-5 and of the cable gland assembly instruction on page 4-23!

Note 2!
X-STREAM analyzers are to be considered a DTE (Data Terminal Equipment).

Serial interfaces

For accessing the terminals open the instrument's front door.
The leftmost 5 terminals (# 11 - 15) of the terminals row next to the power terminals are reserved for the Modbus interface, which can be either of type RS 232 or RS 485.

Terminal	RS 232	RS 485/2w	RS 485/4w
11	Common	Common	Common
12	RXD	*not used*	RXD0
13	TXD	*not used*	RXD1
14	*not used*	D1	TXD1
15	Common	D0	TXD0

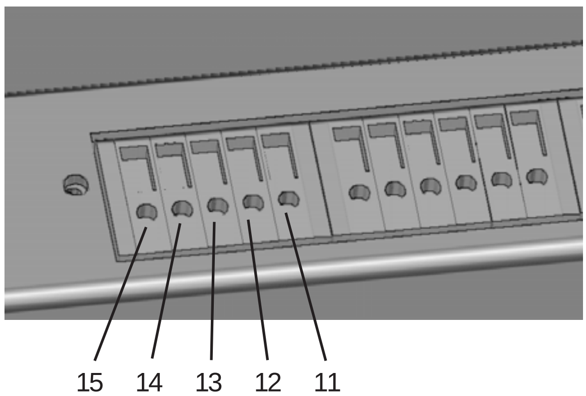


Fig. 4-20: X-STREAM F - Modbus interface terminals

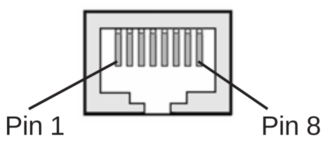
4-4-2 Installation - X-STREAM F

Optional RJ45 connection

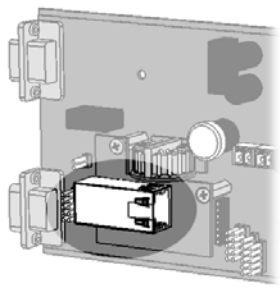
If installed, the optional RJ45 connector is located on the BKS main board, in the upper part of the instrument.
To install this connection one has to insert a cable **without** connetor through the cable inlet.

Once the open end is inside the instrument, the plug connector can be attached:
We recommend using a VARIOSUB RJ45 QUICKON plug connector (PHOENIX CONTACT), as supplied together with the instrument, not requiring special tools. See the separate installation instruction, provided together with the plug connector for information on how to install it.

Note!
Notice, that the modbus screw terminals (☞ page 4-25) are installed, too, but without function!



Pin	Signal
1	TX+
2	TX-
3	RX+
6	RX-
other	*not used*



RJ45 connector on main board BKS

Fig. 4-21: X-STREAM F - Modbus over ethernet connector

4-4-2 Installation - X-STREAM F

Relay Status Signals

Design: dry relay contacts
Electrical specification: max. 30 V⎓, 1 A, 30 W

Note!
Take care of the special installation instructions in section 4-5 and of the cable gland assembly instruction on page 4-23!

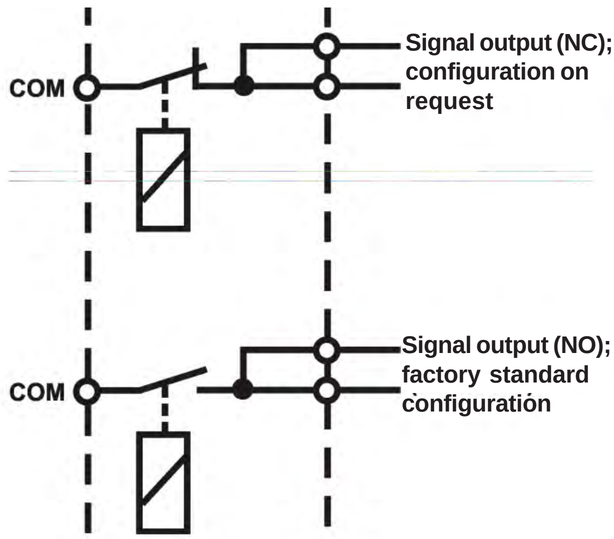


Fig. 4-22: Relay status signals, block diagram

For accessing the terminals open the instrument's front door.
The middle 6 terminals (# 5 - 10) of the terminals row next to the power terminals are reserved for the relay status signals.

Terminal	Signal
5	Failure COM
6	Failure NO
7	Maintenance, off-spec COM
8	Maintenance, off-spec NO
9	Function check COM
10	Function check NO

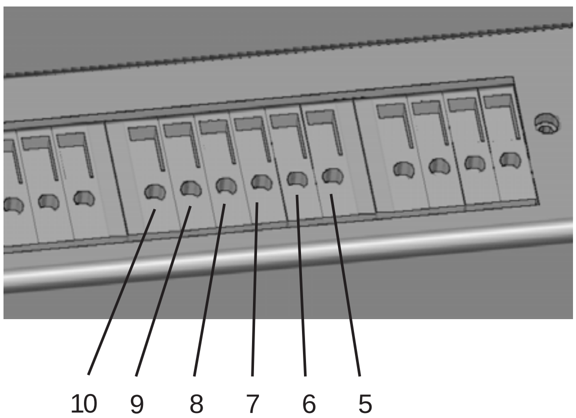


Fig. 4-23: X-STREAM F - Relay Status Terminals

4-4-2 Installation - X-STREAM F

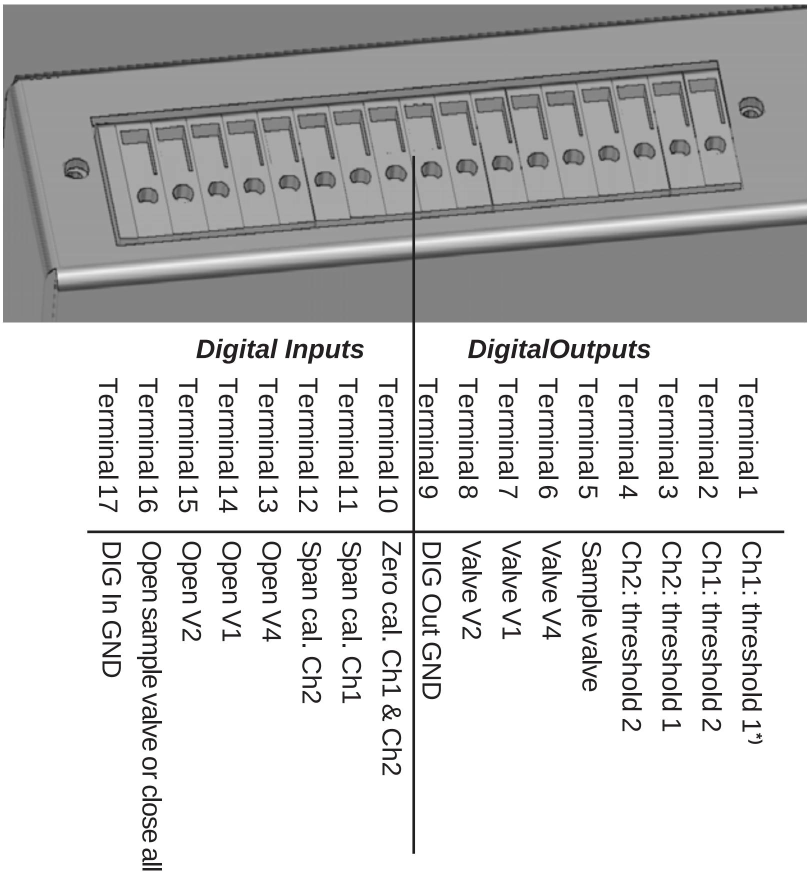
Digital Inputs & Outputs (option)

Design: Open collector (outputs)
Electrical specification:

outputs: max. 30 V⎓, 30 mA
inputs: max. 30 V⎓, internally limited to 2.3 mA
H level: min. 4 V; L level: max. 3 V

For accessing the terminals open the instrument's front door. The leftmost terminal strip is reserved for the digital inputs and outputs.

Note!
Take care of the special installation instructions in section 4-5 and of the cable gland assembly instruction on page 4-23!



*) When making use of the range switching option, this output is assigned a range indicator (☞ 7-7-5, page 7-56)

Fig. 4-24: Digital Input & Output Terminals

4-4-2 Installation - X-STREAM F

Connecting the power cable

The power cable is connected by screw terminals, located inside analyzer.

Supported wire cross sections:	24 to 12 AWG (0.2 to 4 mm^2), no need to use wire end sleeves
Cable skinning length:	0.315 inch (8 mm)
Hole diameter:	0.05 inch (1.2 mm)
Screw thread:	M 3
Tightening torque, min:	4.4 in.lb (0.5 Nm)

WARNING

ELECTRICAL SHOCK HAZARD!

Verify power cables are disconnected and/or instrument is de-energized prior to working at the terminals!

Verify the power cable has a distance of at least 1 cm (0.5“) to any signal cable to ensure proper insulation from signal circuits!

Insert the power cable through the foremost cable gland, strip the outer insulation, skin and connect the conductors to the terminals (a descriptive label is fixed to the filter‘s housing nearby the terminals).
When done, fix the power cable by tightening the outer cable gland nut.

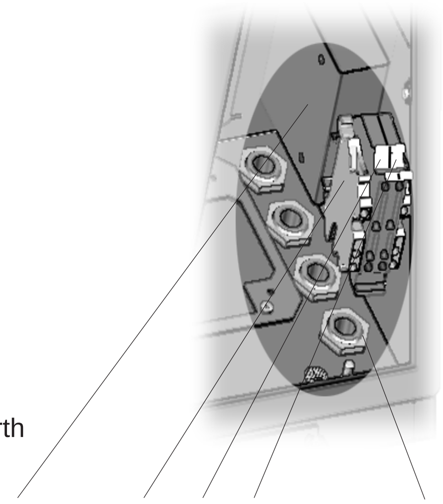


Fig. 4-25: Power terminals

4-4-2 Installation - X-STREAM F

WARNING

ELECTRICAL SHOCK HAZARD!

Before completing the electrical connection of the instrument verify cables are inserted correctly!

Ensure the earthing conductor is connected!

After all connections are established in correct manner and verified,

- close the front door and secure it utilizing the two sash fasteners.

4-5 Hints on Wiring Signal Inputs and Outputs

Emerson Process Managament has taken every effort during the X-STREAM series development process to ensure electromagnetic compatibility (EMC; concerning emission and immunity), stated by EMC measurements according EN 61326.

Nevertheless EMC is not only influenced by the instrument's design, but widely by the installation procedure at site, too. Take care of the following sections and measures described within to ensure safe and trouble-free analyzer operation!

4-5-1 Electrical Connections in General

To minimize electromagnetic interferences by the analyzer's environment it is necessary to carefully execute all electrical connections between the analyzer and other instruments:

- It is recommended to use shielded cables for signal lines, only! Shield has to be connected to the housing at both ends of one connection (fig. 4-26).

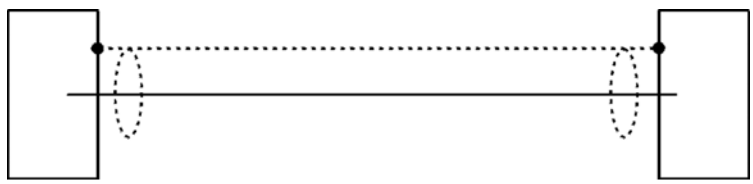


Fig. 4-26: Shielded Signal Cable, shield connected at both ends

4-5 Installation - Hints on Wiring

Local on-site conditions usually differ from test conditions and may require special measures. This is when strong fields are expected, potentially generating high parasitic currents on the cable shield . Such currents result in differences of potential between connected housings.
Two possible measures to avoid parasitic currents are described, whereat installation personnel familiar with EMC problems has to decide about the use of either measure:

- Shield is connected at one side of the cable only (recommended to the analyzer‘s housing): Protection against external distrubances is increased but influence by parasitic currents is prevented due to opening the ground loop.

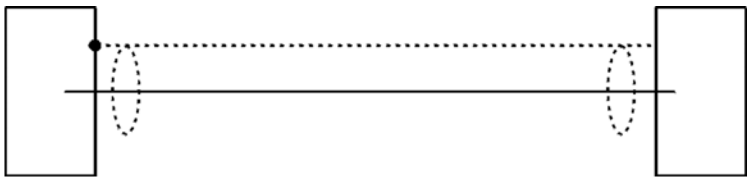


Fig. 4-27: Shielded Signal Cable, shield connected at one end

- Using double-shielded cables:
  In this case one shield is connected to the analyzer‘s housing while the other shield is connected to the external equipment.
  This gives an advantage when both instruments are supplied by different supply networks (e.g. when installed in different buildings).

This measure is more costlybut offers best immunity against distrubances from surrounding fields <u>and</u> from parasitic currents.

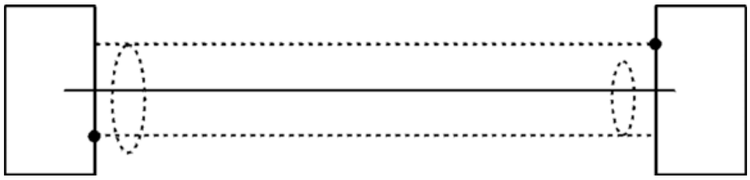


Fig. 4-28: Double-shielded Signal Cable, shields connected at both sides

4-5 Installation - Hints on Wiring

4-5-2 Wiring Inductive Loads

Switching inductive loads is a standard application generating electromagnetic disturbances:
The moment an inductive load (e.g. relay, valve, etc.) is switched off, it‘s magnetic field defies the change of current flow, generating high voltages (up to hundrets of volts) at the coil‘s contacts. This impulse reproduces on connected wires and may influence electrical equipment nearby or destroy signal inputs and/ or outputs on electronic boards.
A simple measure helps to avoid such effects:

- Shunt a silicon diode to the inductive load‘s contacts shorting the voltage impulse just at it‘s source.

  The diode‘s cathode needs to be connected to the positive side of the coil, the anode to the negative side (fig. 4-29).

Suitable filter components are available on request for standard valves.

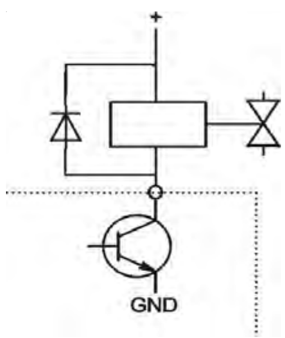


Fig. 4-29: Suppressor Diode for Inductive Loads

4-5-3 Driving Multiple Loads

Another popular application is driving multiple loads within one system by multiple outputs, whereat the supply voltage for the loads is taken from one common source.
To minimize load switching generated disturbances special care is required when wiring the system:

- **AVOID** to "serial" wire the loads‘ power supplies with the power supply line starting at the source and successively connecting all loads (fig. 4-30):

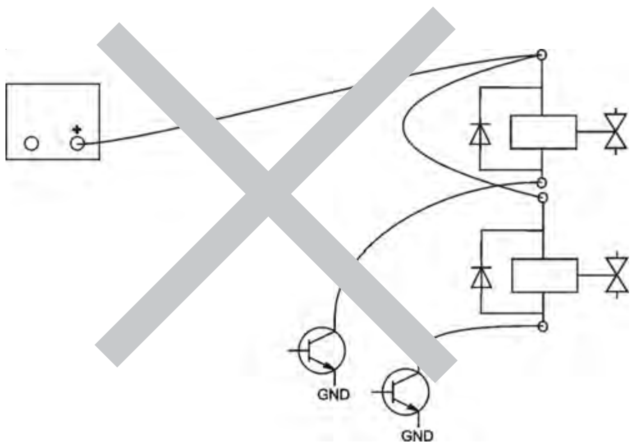


Fig. 4-30: ”Serial” Wiring

- **It's better** to apply "parallel" wiring at which each single load is supplied by a separate connection starting from a distribution point: Both "+" and "-" wire of any load are run together, starting at the point of distribution and ending at the load (fig. 4-31). The effect of minimizing disturbances is intensified when using twisted pair cables.

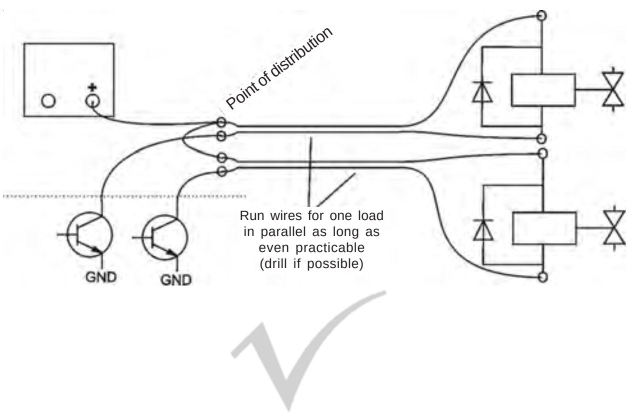


Fig. 4-31: Running Supply Lines "Parallel"

4-5-4 Driving High Current Loads

Loads with currents exceeding the rated currents specified for X-STREAM series analyzers outputs (>30 mA / > 1 A) must not be driven directly by digital or relay outputs.
Driving such loads requires external relays acting as decoupling devices:
The X-STREAM output drives the external relay, which itself drives the load.
It is recommended to use separate supplies for analyzer and high current loads to minimize interferences (fig. 4-32).
As described before using suppressor diodes for inductive loads is strongly recommended!

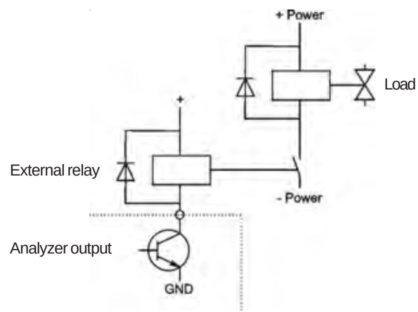


Fig. 4-32: Driving High Current Loads

Chapter 5
User Interface and Software Menus

This chapter describes the elements of the X-STREAM user interface, the structure and the contents of the software menus.

While here the software is described menu by menu, chapters 6 and 7 give examples of how to navigate through the menus to perform basic procedures.

5-1 Abstract

Common to all X-STREAM gas analyzers is an easy to use alphanumeric user interface which provides measuring results as well as status signals, error messages and menus for entering parameters.

For maximum ease of use the operator can choose his preferred language (currently available: English, French, German, Italien and Spanish).

5-2 The User Interface

The X-STREAM gas analyzer‘s user interface consists of a 4x20 character alphanumeric display, providing all the necessary information to operate, calibrate and function check the instrument.

The underlying software is operated by six keys. Additional status information is provided utilizing three LEDs right below the display.
In case of field housings the display, LEDs and keys are located behind a protective glass and the keys (sensors) are operated by a magnetic tool.

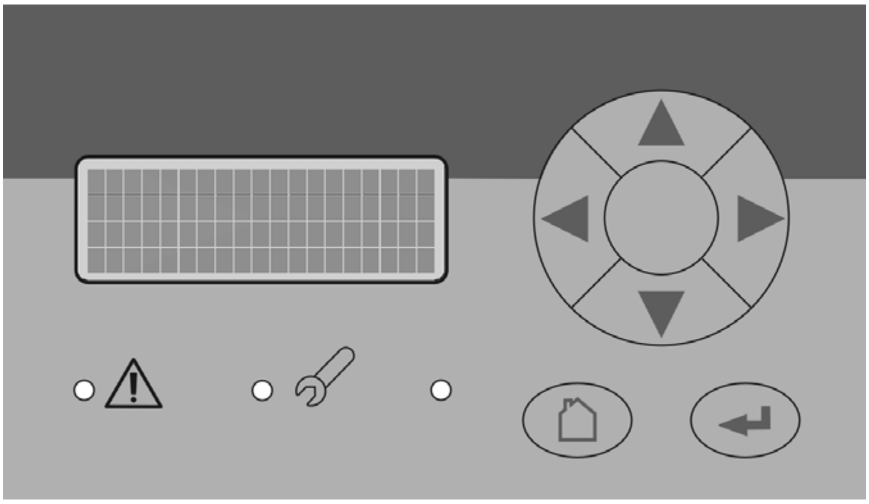
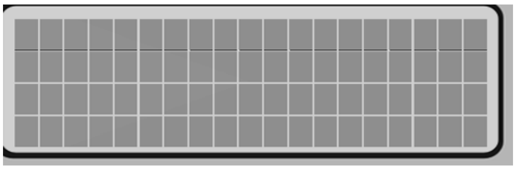


Fig. 5-1: X-STREAM user interface

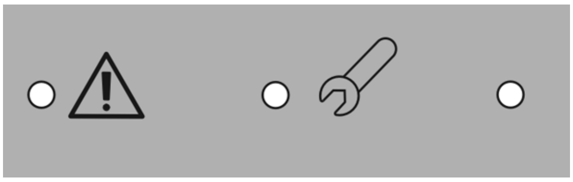
5-2 User Interface

5-2-1 The Display

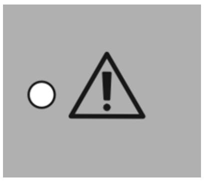


The display is either a alphanumeric 4x20 character liquid cristal or vacuum fluorescence display.
The information shown depends on the currently selected menu.

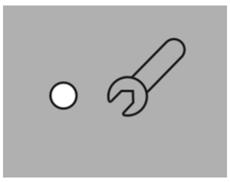
5-2-2 The Status LEDs



These three status LEDs enable the user to see the instrument' s status at a glance, even from larger distances.
The status messages are conform to the German NAMUR NE 44 recommendations.

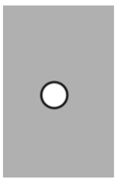


If this red LED is on, the instrument status is "FAILURE".



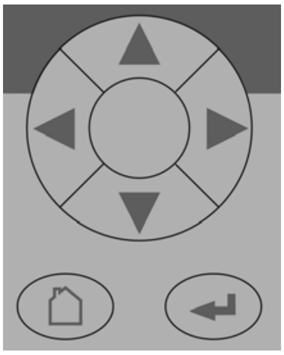
If this red LED is

- Flashing: Maintenance Request, function check or out of specification.
- Off: Measurement OK



The 3rd LED gives power information:
Illuminated (green): Power On
Dark: Power Off

5-2-3 The Keys



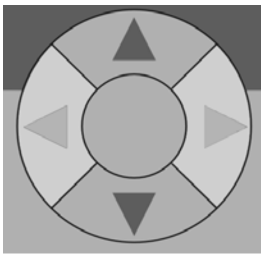
Six keys are provided to operate the menu system. Depending on the three operation modes (measure-browse-edit) they have the following functionality:

ENTER key:

Mode	***Function***
Measure	Exit measuring screen
Browse	Select menu (..) or function (!)
Edit	Submit new input

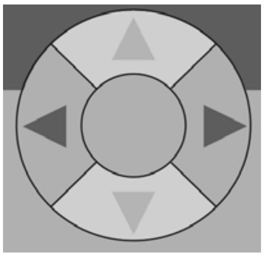
HOME key:

Mode	***Function***
Measure	*(without function)*
Browse	Return to measuring screen
Edit	Abort editing



UP / DOWN keys:

Mode	***Function***
Measure	Exit measuring screen
Browse	- Select a menu line - Open previous/next menu page if placed in a line starting with ▲/▼
Edit	increase /decrease the input value



LEFT key:

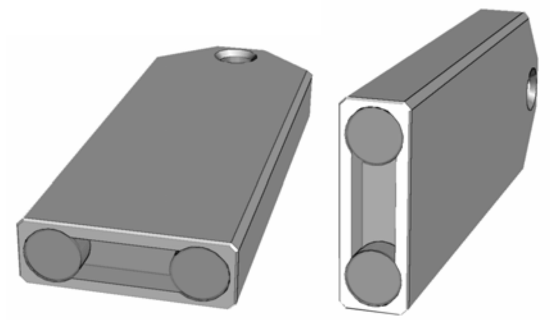
Mode	***Function***
Measure	Exit measuring screen
Browse	One page/level back in menu tree
Edit	- Shift cursor on the input field - Leave Component Selection menu - Abort editing an enumerated variable - show previous menu page for menu pages with ▲ in the 1st line

RIGHT key:

Mode	***Function***
Measure	Exit measuring screen
Browse	- Enter submenu in lines ending .. - show next menu page for menu pages with ▼ in the 4th line
Edit	Shift cursor on the input field

5-2-3-1 Magnetically Operated Front Panel

As mentioned the X-STREAM field housing provides an impact protected front panel, to be operated by a magnetic tool. This tool utilizes two magnets to activate the keys (sensors). To ensure that only the desired key is activated it is required to align the magnets specific for each key:
For activating the LEFT/RIGHT keys hold the tool so that the magnets are horizontally in front of the glass, for the UP/DOWN keys the magnets need to be vertical.
The HOME/ENTER keys require a horizontal orientation (represented by horizontal ellipses surrounding the key symbols).



horizontal versus **vertical** orientation

Fig. 5-2: X-STREAM magnetic tool

5-3 Software

5-3-1 Power-On Sequence

After Power-On a sequence of start-up messages is displayed. During this time all keys are disabled. The sequence takes a few seconds (a counter shows the remaining time) and the measuring screen shows up.

5-3-2 Measuring Screen

The measuring screen shows up

- automatically after the start-up sequence has finished
- when pressing the HOME key
- when a programmable time has elapsed without user interaction (without pressing a key).

The information shown on the upper three lines is (within limits) user configurable: They may be independently configured to show

- the measured gas component, the measuring value and the unit for channel 1
- the measured gas component, the measuring value and the unit for channel 2
- secondary measurementsr, e.g. pressure, flow, temperature
- nothing (left blank)

By default the upper line shows the channel 1 data.
For dual channel instruments the second line gives the data for the second measuring channel.

The 4th line is used for cleartext status information like failures, calibration events etc. Messages are stored in an internal message buffer and then put onto the message line. If there is more than one message in the buffer the content of the message line will change every 1-2 seconds. Any failure, maintenance, function check or out-of-spec message appearing in this line activates the related front panel LED and the NAMUR relay, too.

```
CO2.1        135.1 ppm
O2.2        201952 ppm
Temp-1        58.8 °C
     (Messages)
```

MEASURING SCREEN

5-3-3 Menu Structure

The analyzer software shows measuring results, status messages and enables the user to set and change instrument parameters and to perform maintenance routines, e.g. calibration.

To provide all these funcionality on the 4x20 character display the software has a hierarchical design with the measuring screen at top and menus and submenus beneath.

4 different line types distinguish between different functionalities:

Type	Description
TEXT	Simple text (not selectable by cursor)
VARIABLE	This line has 2-3 fields: 1. a description field, terminated by ':' (colon) 2. The value of the variable 3. Optional, the unit *Example:* Span gas: 2000.4 ppm Live/Non- editable variables have no colon
ACTION	The text of this line is terminated by '!' (Exclamation mark); if the line is selected, pressing ENTER will start an action, e.g. calibration procedure. *Example:* Start zero cal !
MENU	The text of this line is terminated by '..' (2 dots); if the line is selected, pressing ↵ enters a submenu. *Example:* Setup..

5-3-4 Navigating and Editing

Line selection

Lines can be selected by the ↑↓ keys.

A selected line is indicated by a cursor in the first column. Pressing the DOWN key moves the cursor downwards, the UP key moves it upwards.

Pressing the ↑ key while the cursor is in the last line moves the cursor to the first line.

Pressing the ↓ key while the cursor is in the first line moves the cursor to the last line.

Any action on a selected line is initiated by the ↵key, i.e. jumping to a new menu, starting a procedure or starting an editing session.

Editing any parameter sets the analyzer's function check status with the following consequences:

- the related front panel LED is flashing
- the NAMUR relay is activated
- the status menu shows a function check message

The status is cancelled by confirming the message within the acknowledgements menu (☞ 5-4-2-6, page 5-19; standard method for all kinds of status).

In addition a **function check active from editing a parameter** automatically is reset when returning to the measuring screen!

Scrolling

Some menus have more than 4 items, so they cannot be shown on one screen. Such menus show a "scroll indicator" in the last line (▼) or in the first line (▲), depending on the direction the menu is continued.

The menu is scrolled to the following page by moving the cursor to the line with the scroll indicator and pressing the related UP or DOWN key, or by pressing either the LEFT or RIGHT button independently from where the cursor is placed.

```
Line 1
Line 2..
Line 3
▼Line 4
```

Menu continued downwards

```
▲Line 1
Line 2..
Line 3
▼Line 4
```

Menu continued downwards and upwards

```
▲Line 1
Line 2..
Line 3
Line 4
```

Menu continuedupwards

Editing

An editing session allows changing a variable's value. It is initiated by pressing the ↵key.
The cursor is now placed over the last character of the current value. Change the selected character by using the ↑↓ keys; if the variable is an enumerated type, the whole value expression will change.
Select a specific character to be changed by using the ← and → keys.
The available choice of characters/numbers is smart and depends on the cursor position:
It is not possible to select '-' or '.' for the last character. Integer numbers cannot contain a '.'.

The position for '.' within a floating point number is almost free.
An editing session can be terminated by two means:

↵key: The value is checked for consistency (e.g. min/max). If it passes the test it is stored and the line is displayed as selected. If it does not pass the check, the reason will be displayed in a special pop-up menu.

⌂ key: All inputs & changes will be lost. Return to line selection

Component selection menu

A single channel analyzer has only one primary measurement = channel = component, so editing measurement related parameters is always done for this channel.
A dual channel analyzer requires to select the channel the measurement related parameters are to be edited. In this case a selection menu appears automatically when a choice is required; otherwise it remains hidden i.e. a single component instrument will never show such a menu.

```
  Select Component

Component:      CO2.1
(i)Back:  Press ⌂
```

5-3-5 Access Levels

Access levels allow to prevent unauthorized personnel from changing parameters.The menu system supports **four prioritized** access levels, separately to be activated/ deactivated and provided with an individual access code.

Level four has the highest priority and is used for the factory configuration data – only qualified EMERSON service personnel is allowed to access.

Level three gives system integrators or administrators access to parameters important for proper interaction with e.g. data aquisition systems.

Level two covers expert accessible parameters, e.g. basic calibration setup.

Level one is the operator level and covers parameters to be changed by briefed personnel.

All menus not belonging to one of above levels are read-only or of minor relevance.

The menu descriptions later on in this chapter show which menus are related to which access level. This relationship cannot be changed.

The access codes for the levels 1-3 can be defined/enabled/disabled by the customer operator.

Note!

*Setting the status of a lower level to **On** automatically sets all higher level status to **On**!*

*Setting the status of a higher level to **Off** automatically sets all lower level status to **Off**!*

The analyzer is shipped with the following default setup:

Access level	Access Code	Status
1	00000001	Off
2	00000002	Off
3	00000003	Off

It is recommended to change the access codes when using access levels (5-4-3-1-2 Menu Access Setup, page 5-24).

Entering access codes

When an access code is required for entering a specific menu, the following screen shows up:

```
   Access Code 1

Code          00000000
  Back - Press
```

Use

- the UP / DOWN keys for changing the currently selected digit,
- the LEFT / RIGHT keys for selecting another digit,
- the ENTER key for submitting the code

or

- the HOME key for cancelling editing and returning to the previous screen.

5-3-6 Special Screens

Depending on the latest operator action one of the following message screens (may) appear to support or inform the operator (the two confirmation screens automatically disappear after a few seconds):

```
(i) Wrong input (i)
Min:             500
Max:          10.000
     (i) Press ↵
```

Input value overflow information:
The value entered by the operator exceeds the allowed input range. The screen shows the input range.
Return to the previous screen where the wrong value has been entered by pressing ↵ to enter an acceptable value.

```
        (i)

 -COMMAND EXECUTED-
```

Command execution confirmation:
Confirms a procedure (e.g. calibration) has been started.

```
        (i)

    -CANCELLED-
```

Command cancellation confirmation:
Confirms a procedure (e.g. calibration) has been cancelled.

5-4 Menu System

This section describes all menus of the X-STREAM gas analyzer software and how the menus are linked.
Fig. 5-3 on page 5-12 gives a graphical overview of the menu structure.

Note!
Menus or lines shown with grey background are optional or context dependent and therefore do not show always.

Symbols used in the following sections

Symbol	Description
Control.. Setup.. Status.. Info..	Screen dump
	Access level symbols:
1	Access level 1 *(operator)*
2	Access level 2 *(expert)*
3	Access level 3 *(system integrator / administrator)*
4	Access level 4 *(service level)*
XXX	Menu title
XXX.. XXXX	Parent menu title and current menu title
C ?	Optional component selection menu (☞ page 5-7)

Other
(Menu title) 1 ☞ 5-4-2, page 5-12
For a detailed description of the menu "*menu title*" see section 5-4-2 on page 5-12 and following. Menu "*menu title*" may be locked by access level 1 code.

5-4 Menu System - Power-On and Measuring Screen

5-4-1 Power-On and Measuring Screen

```
   Emerson  Process
     Management
       (c)  2005
Revision:     0.06  05
```

After connecting the instrument to power a power-on-self-test (POST) is started showing

- copyright and software revision

followed by

```
       Warm-Up


Time:               10  s
```

- remaining time till operation mode (count down; here: 10 seconds left)

```
CO2.1         135.1 ppm
O2.2         201952 ppm
Temp-1          58.8 °C
     (Messages)
```

MEASURING SCREEN

Finally the **MEASURING SCREEN** shows up. (Here:
CO2.1: CO_2 is channel 1
O2.2: O_2 is channel 2
Temp-1: temperature sensor 1 value
(Messages): Messages, if available)
This screen is operator configurable:
5-4-3-1 Display Setup Menu, page 5-21.

Pressing any key, except the HOME key, while in measuring screen opens the main menu. The entries herein open submenus, described in the following sections:

```
Control…
Setup…
Status…
Info…
```

MAIN MENU

Control Menu 5-4-2, page 5-13
Setup menu 5-4-3, page 5-20
Status menu 5-4-4, page 5-47
Info menu 5-4-5, page 5-55

5-4 Menu System - Control Menu

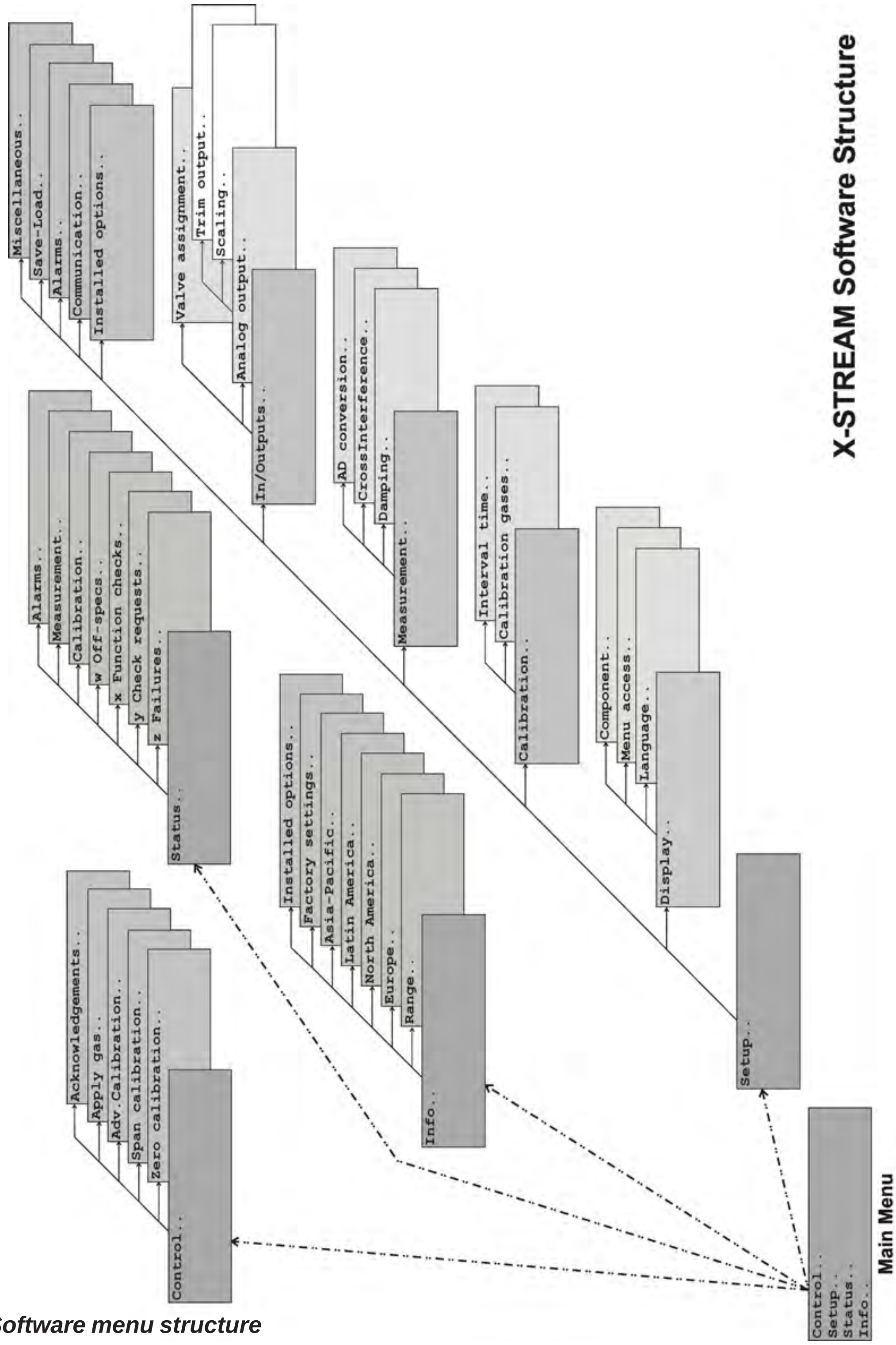


Fig. 5-3: X-STREAM Software menu structure

5-4-2 Control Menu

```
Control..
```

If system is setup accordingly access level 1 code must be entered to access this menu.

```
Zero  calibration..
Span  calibration..
Adv.  calibration..
▼Apply  gas..
```

1st menu page

- Zero calibration..: Zero calibration submenu ☞ 5-4-2-1, page 5-14
- Span calibration..: Span calibration submenu ☞ 5-4-2-2, page 5-15
- Adv. calibration..: Advanced calibration submenu ☞ 5-4-2-3, page 5-16
- Apply gas..: Apply gas submenu ☞ 5-4-2-5, page 5-18

```
▲Lock  menus!
Acknowledgements..
Pump:            Off
Range:             1
```

2nd menu page

- Lock menus!: Pressing the ↵ key while this line is selected immediately locks all menus whose code parameter in the menu access setup is set to **On** or **1 min** (☞ 5-4-3-1-2, page 5-24)
- Acknowledgements..: Acknowledgements submenu ☞ 5-4-2-6, page 5-19
- Pump: Toggle internal pump status: **On** / **Off** (only with optional internal pump) Requires parameter "PumpControl" set to **Menu** (☞ 5-4-3-4, page 5-33)
- Range: When making use of the range switching option (☞ 5-4-3-4-1-1, page 5-35), this line allows to manually set the range. Requires parameter "Ranging" to be set to **Manual** (☞ 5-4-3-4-1, page 5-34).

5-4-2-1 Zero Calibration Menu

```
Control..
Zero calibration..
```

```
C
?
```

Dual channel instrument:
Optional gas component selection menu - Select the component to be calibrated.

```
CANCEL calibration!
START calibration!
ZeroGas         0.0 ppm
▼CO2.1        134.1 ppm
```

1st menu page

- CANCEL calibration!: When this line is selected, pressing the ↵ key cancels the zero calibration procedure without any changes
- START calibration!: When this line is selected, pressing the ↵ key starts the zero calibration procedure
- ZeroGas: Current zero gas concentration setting (Information only; setup zero gas concentration in the "SETUP" menu 5-4-3-2-1, page 5-27)
- CO2.1: Current gas concentration

```
▲RESET calibration..
Status..

CO2.1         134.1 ppm
```

2nd menu page

- RESET calibration..: Enter this line and start the related procedure to reset calibration parameters to the data stored as user configuration. (By default this is the factory data set, if not manually overwritten by the user, 5-4-3-8 "SAVE-LOAD" menu on page 5-44).
- Status..: Select this line and press the ↵ key to view the calibration status screen (page 5-17)
- CO2.1: Current gas concentration

Note!
For detailed descriptions of how to perform calibrations chapter 7 Maintenance.

Dual channel instrument:
Pressing the ← key returns to the optional gas component selection menu to perform the same action for the other measuring channel.

5-4-2-2 Span Calibration Menu

```
Control..
Span calibration..
```

Dual channel instrument:
Optional gas component selection menu - Select the component to be calibrated.

```
CANCEL calibration!
START calibration!
SpanGas    2000.0 ppm
▼CO2.1      134.1 ppm
```

1st menu page

- CANCEL calibration!: When this line is selected, pressing the ↵ key cancels the span calibration procedure without any changes
- START calibration!: When this line is selected, pressing the ↵ key starts the span calibration procedure
- SpanGas: Current span gas concentration setting (Information only; setup span gas concentration in the "SETUP" menu ☞ 5-4-3-2-1, page 5-27)
- CO2.1: Current gas concentration

```
▲RESET calibration..
Status..

CO2.1       134.1 ppm
```

2nd menu page

- RESET calibration..: Enter this line and start the related procedure to reset calibration parameters to the data stored as user configuration. (By default this is the factory data set, if not manually overwritten by the user, ☞ 5-4-3-8 "SAVE-LOAD" menu on page 5-44).
- Status..: Select this line and press the ↵ key to view the calibration status screen (☞ page 5-17)
- CO2.1: Current gas concentration

Note!
For detailed descriptions of how to perform calibrations ☞ chapter 7 Maintenance.

Dual channel instrument:
Pressing the ← key returns to the optional gas component selection menu to perform the same action for the other measuring channel.

5-4-2-3 Advanced Calibration Menu

```
Control..
Adv. calibration..
```

Note!
This menu is available only if the parameter "Valves" in the INSTALLED OPTIONS setup menu is other than ***none***

```
CANCEL calibration!
ZeroAll!
SpanAll!
ZeroSpanAll!
```

CANCEL calibration!: When this line is selected, pressing the ↵ key cancels the ongoing calibration procedure without any changes

ZeroAll!: When this line is selected, pressing the ↵ key starts zero calibrations for all channels.

SpanAll!: When this line is selected, pressing the ↵ key starts span calibrations for all channels.

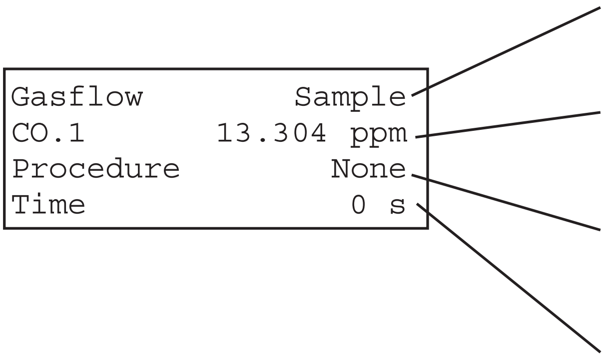
ZeroSpanAll!: When this line is selected, pressing the ↵ key starts zero and span calibrations for all channels.

Note!
This menu appears for dual channel as well as for single channel instruments: In this case the 2nd and 3rd line act like the separate zero / span calibration menus while the 4th line allows to start zero and span calibration by pressing just one key.

Note!
For detailed descriptions of how to perform calibrations ☞ chapter 7 Maintenance.

5-4-2-4 Calibration Status Screen

The calibration status screen is selectable from both ZERO CALIBRATION menu (page 5-14) and SPAN CALIBRATION menu (page 5-15).



The 1st line shows the currently applied gas

This line gives the measured concentration

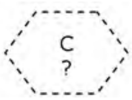
Information about which procedure is active (**none**, **purging**, **zero 1, zero 2, span 1, span 2**)

Remaining time till end of active procedure

5-4-2-5 Apply Gas Menu

```
Control..
Apply gas..
```

Note!
*This menu is available only if the parameter "Valves" in the INSTALLED OPTIONS setup menu is other than **none***



Dual channel instrument:
Optional gas component selection menu - Select the component to be modified.

```
Apply gas:     Sample

CO.1       1.024  ppm
Time              0 s
```

Toggle between **Sample**, **ZeroGas**, **SpanGas** and **None** using the ↑ and ↓ keys.
Entering the selected value using the ↵ key opens the related valve and closes all other valves (except for **None**: all valves are closed).

Dual channel instrument:
Pressing the ← key returns to the optional gas component selection menu to perform the same action for the other measuring channel.

5-4-2-6 Acknowledgements Menu

```
Control..
Acknowledgements..
```

```
   Acknowledgements

Status!
```

This page allows to acknowledge (=reset) all status messages:Just press the ↵ key to perform an acknowledgement.

```
        (i)

 -COMMAND  EXECUTED-
```

When processed the screen changes temporarily to show a command execution confirmation.

5-4-3 Setup Menu

```
Setup..
```

```
Display..
Calibration..
Measurement..
▼In/Outputs..
```

1st menu page

Display setup menu
5-4-3-1, page 5-21

Calibration setup menu
5-4-3-2, page 5-26

Measurement setup menu
5-4-3-3, page 5-29

In/Outputs setup menu
5-4-3-4, page 5-33

```
▲Installed options..
Communication..
Alarms..
▼Save-Load..
```

2nd menu page

Installed options setup menu
5-4-3-5, page 5-41

Communication setup menu
5-4-3-6, page 5-42

Alarms setup menu
5-4-3-7, page 5-43

Save-Load menu
5-4-3-8, page 5-44

```
▲Miscellaneous..
```

3rd menu page

Miscellaneous setup menu
5-4-3-9, page 5-46

5-4-3-1 Display Setup Menu

```
Setup..
Display..
```

If system is setup accordingly access level 1 code must be entered to access this menu.

```
Auto-Home:      Never
Language..
Menu  access..
▼
```

1st menu page

This parameter defines the time to elapse without user interaction before the software automatically returns to the measuring screen. Available options:

Never, 1 min, 10 min

Display language setup menu
5-4-3-1-1, page 5-23

Menu access setup menu
5-4-3-1-2, page 5-24

If system is setup accordingly access level 2 code must be entered to access menu pages 2 to 4

```
▲Line  1:       Comp1
Line  2:        Comp2
Line  3:        Blank
▼Component..
```

2nd menu page

Select the value to be displayed in the related line of the measuring screen:

Comp-1, Temp-1, Pres-1
Comp-2, Temp-2, Pres-2
Blank (none)

Component setup menu
5-4-3-1-3, page 5-25

5-4 Menu System - Display Setup Menu

```
▲     Temperature
Unit:               °C
DecimalPlaces:       1
▼Temp-1      63.7  °C
```

3rd menu page

Set temperature unit:: **°C, F**

Set temperature value's decimal places: **0 to 4**

Current temperature sensor 1 value

```
▲       Pressure
Unit:              hPa
DecimalPlaces:       1
Pressure   998.1  hPa
```

4th menu page

Set pressure unit:: **Pa, hPa, mbar, Bar, psi**

Set pressure value's decimal places: **0 to 4**

Current pressure value

5-4-3-1-1 Display Language Setup Menu

```
Setup..
Display..
Language..
```

If system is setup accordingly access level 3 code must be entered to access this menu.

```
        Language

Language:     English
```

Select your prefferred language for the analyzer software. Number of and languages may change depending on software revision.
Currently available:
English, French, German, Italian, Spanish

5-4-3-1-2 Menu Access Setup Menu

```
Setup..
Display..
Menu access..
```

If system is setup accordingly access level 3 code must be entered to access this menu.

```
Code 1:          Off
Code 2:          Off
Code 3:          Off
▼Activate:       On⌂
```

1st menu page

Use lines 1 to 3 to specify if the related access level is protected by code or not:
Off: Menu access is not protected.
On: Access code must be entered for related menus (code 3 = level 3, ..).

Note!
Setting the status of a lower level to "On" automatically sets all higher level states to "On"!
Setting the status of a higher level to "Off" automatically sets all lower level states to "Off"!

The entry in this line defines how unlocked menus are locked again to reestablish the securitiy level.
Available options:
On ⌂: lock all security enabled levels upon returning to the measuring screen
1 min: lock all security enabled levels 1min after the last user action
Never: no action (menus remain unlocked)

Note!
Selecting the menu function "Lock menus ! " in the CONTROL menus will immediately lock enabled menus.

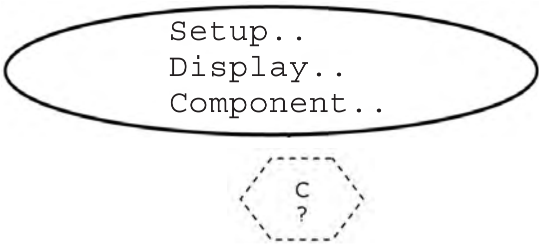
```
▲Code 1:     00000001
Code 2:      00000002
Code 3:      00000003
```

2nd menu page

Specify the access codes to be entered for the related access levels.
Figure shows the factory default settings.

⚠ **We recommend changing the default settings when making use of access codes!**

5-4-3-1-3 Component Setup Menu



Dual channel instrument:
Optional gas component selection menu - Select the component to be setup

```
      Component
Tag:              CO2.1
DecimalPlaces:        1
▼CO2.1:   134.1  ppm
```

1st menu page

Enter the tag to be associated with the gas component: Each digit has to be selected and set independently!

Note!
".1" in this example is used to show that CO_2 is the first measuring channel (maybe helpful for dual channel instruments, but not required).

Set measuring value's decimal places: **0** to **4**

Current sample gas concentration taking into account the settings above. Format is updated the moment setup changes are entered.

```
▲         Unit
Text:               ppm
Factor:          1.0000
Offset:          0.0000
```

2nd menu page

Enter the text string to be associated with the gas component concentration unit: Each digit has to be selected and set independently!

Internally the analyzer handlesconcentrations in ppm. For showing other units enter the factor to convert ppm into the required unit, e.g. 0.0001 for showing %.

If required, set an offset to be added to the measured value.

Note!
Tag and unit text strings as well as factor and offset values are not checked for plausibility! The user may enter whatever data he wants!

Dual channel instrument:
Pressing the ← key while any line is selected returns to the optional gas component selection menu to open the same menu for the other measuring channel.

5-4-3-2 Calibration Setup Menu

```
Setup..
Calibration..
```

If system is setup accordingly access level 1 code must be entered to access this menu.

```
Calibration gases..
Tol.Check:       Off
Purge time:     15 s
Interval time..
```

Calibration gases concentrations setup
☞ 5-4-3-2-1, page 5-27

This parameter defines if the tolerance check during calibration procedures is activated or not.
Available options::

10%: Tolerance check is enabled, limits are 10 % (not changeable). Message has to be acknowledged manually utilizing the related menu (☞ 5-4-2-6, page 5-19)

A-Clr: Auto clear - same as **10 %**, but when a message is set, it is automatically acknowledged (reset) after 2 - 3 min.

Off: Tolerance check is disabled

Note!
*This line is available only if the parameter "Valves" in the INSTALLED OPTIONS setup menu is other than **none** !*

Enter the time required to purge the gas lines with the new gas before starting to measure concentration values during calibration, when switching to zero or span gas.
Input range: **0 .. 600** seconds

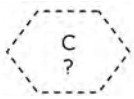
Interval time setup menu
☞ 5-4-3-2-2, page 5-28

Note!
For a detailed description of how to perform calibrations ☞ chapter 7 Maintenance.

5-4 Menu System - Calibration Setup Menu

5-4-3-2-1 Calibration Gases Setup Menu

```
Setup..
Calibration..
Calibration gases..
```



Dual channel instrument:
Optional gas component selection menu - Select the component to be setup

```
 Calibration gases

ZeroGas:      0.0 ppm
SpanGas:    500.0 ppm
```

Enter the concentration value for the zero gas to be used during zero calibration.

Enter the concentration value for the span gas to be used during span calibration.

Note!
The units for the calibration gases are taken from the related entry in the display setup menu.

Dual channel instrument:
Pressing the ← key while any line is selected returns to the optional gas component selection menu to open the same menu for the other measuring channel.

5-4-3-2-2 Interval Time Setup Menu

```
Setup..
Calibration..
Interval time..
```

Note!
*This menu is available only if the parameter "Valves" in the INSTALLED OPTIONS setup menu is other than **none***

If system is setup accordingly access level 3 code must be entered to access this menu.

```
   Interval time

ZeroCal:         2 h
SpanCal:        10 h
```

ZeroCal: Enter the time between two zero calibrations when in autocal mode.

SpanCal: Enter the time between two span calibrations when in autocal mode.

Input range for both values: **0 .. 999** h

Note!
For detailed descriptions of how to perform calibrations ☞ chapter 7 Maintenance.

5-4-3-3 Measurement Setup Menu

```
Setup..
Measurement..
```

If system is setup accordingly access level 2 code must be entered to access this menu.

```
Pressure: 1014.0 hPa
Damping..
CrossInterference..
AD conversion..
```

Pressure: If no pressure sensor is installed (INSTALLED OPTIONS menu - "PressSensor" set to **manual**) enter the current ambient pressure here.
Input range: **500 .. 2000** hPa

Otherwise this field is not editable and shows the pressure sensor value.

Note 1!
The unit for the pressure value is taken from the related entry in the display setup menu.

Note 2!
As the pressure value is used for pressure compensation update it on a regular basis when set to ***manual*** *to achieve best measuring results.*

Damping..: Signal damping setup menu
5-4-3-3-1, page 5-30

CrossInterference..: Cross interference setup menu (access level 3)
5-4-3-3-2, page 5-31

AD conversion..: AD conversion setup
5-4-3-3-3, page 5-32

5-4-3-3-1 Signal Damping Setup Menu

```
Setup..
Measurement..
Damping..
```

```
C
?
```

Dual channel instrument:
Optional gas component selection menu - Select the component to be setup

```
Damping:          5 s
```

Enter the electronic signal damping time. Lower values give faster updated measuring results, higher values may suppress noise from varying gas concentrations.
Input range: **2 .. 60** seconds

Dual channel instrument:
Pressing the ← key while the line is selected returns to the optional gas component selection menu to open the same menu for the other measuring channel.

Note!
The minimum time of 2 seconds is a result of the analyzer's internal signal propagation delay time. Entering higher values forces the software to longer hold up the signal output.
The analyzer's total signal propagation time (commonly t90 time) is the sum of the signal damping time and the physical propagation delay time caused by e.g gas flow and sensor properties.

5-4-3-3-2 Cross Interference Setup Menu

```
Setup..
Measurement..
CrossInterference..
```

Note!
This menu is available only for dual channel instruments.

If system is setup accordingly access level 3 code must be entered to access this menu.

```
  CrossInterference

Status:           Off
@ Span Cal:        No
```

Toggle the status for cross interference compensation:
Available options:
Off: Cross compensation inactive
On: Two-way cross compensation is calculated for both channels.

Toggle the status for cross interference compensation during span calibration:
Available options:
No: disabled
Yes: Enabled - Cross compensation factors are calculated during span calibration. Requires using pure gas for span calibration!

Note!
*Setting this parameter to **Yes** is valid for the next span calibration only and will be reset to **No** automatically after calibration has finished.*

5-4-3-3-3 AD Conversion Setup Menu

```
Setup..
Measurement..
AD conversion..
```

Changing parameters shown in this screen is only required when the analyzer's main board BKS has been replaced: The built-in AD converters have differing unit-to-unit offsets, therefore the data of the cur-rently used units have to be entered.

The offsets are given on a label placed on the main board BKS.

Entering wrong values causes wrong concentration measure-ment results!

Replacing the main board is permitted to trained personnel only!

If system is setup accordingly access level 3 code must be entered to access this menu.

```
   AD conversion
Comp1Offset        20
Comp2Offset        20
MuxOffset          20
```

Select the first line to setup the AD converters offset for the first channel: The offset's unit are counts.

Select the second line to setup the AD converters offset for the second channel: The offset's unit are counts.

Select the last line to setup the AD converters offset for the secondary measurement (This is a multiplexed converter): The offset's unit are counts.

5-4-3-4 In/Outputs Setup Menu

```
Setup..
In/Outputs..
```

If system is setup accordingly access level 2 code must be entered to access this menu.

```
Analog output..
PumpControl:     Menu
Valve assignment..
```

Analog output setup menu
☞ 5-4-3-4-1, page 5-34

Select how the internal pump status is controlled.
Available options:
Menu: This allows to manually switch the pump via the related entry in the "Control.." menu **(**☞ 5-4-2, page 5-13)

External: The pump is controlled by Digital Input 7: A low level signal at Dig IN7 switches the pump on, while a high level signal switches it off. (Detailed description of Digital Inputs: ☞ 1-8-3, page 1-23).
Setting the "PumpControl" to **External** disables the related pump line in the "Control.." menu.

Valve assignment setup menu
☞ 5-4-3-4-2, page 5-40

Note!
*The line "PumpControl" shows up only if the parameter "Pump" in the INSTALLED OPTIONS setup menu is **Yes.***
*The line "Valve assignment" shows up only if the parameter "Valves" in the INSTALLED OPTIONS setup menu other than **None.***

5-4-3-4-1 Analog Output Setup Menu

```
Setup..
In/Outputs..
Analog output..
```

If system is setup accordingly access level 3 code must be entered to access this menu.

```
Signal:          C1-C2
SignalRange:   0-20mA
Scaling..
▼Trim output..
```

1st menu page

Select the signal for the analog output.
Available options:
C1-C2, 20 mA, 0/4 mA, C1-T, T-C2, Rng-C2
☞ 5-4-3-4-1-1, page 5-35

Select the signal range.
Available options:
0-20 mA, 4-20 mA, LL0-20 mA, LL4-20mA, HL0-20 mA, HL4-20 mA
☞ 5-4-3-4-1-2, page 5-36

Setup the output scaling (relationship between concentration and lowest/highest output)
☞ 5-4-3-4-1-3, page 5-38

Trim output menu
☞ 5-4-3-4-1-4, page 5-39

```
▲Ranging:      Manual
```

2nd menu page

If parameter „Signal“ (see above) is set to **RNG-C2** (range switching), enter this lines to specify manual or automatic range switching
Available options:
Manual, **Auto**

5-4-3-4-1-1 Analog Output Signal Setup

```
Setup..
In/Outputs..
Analog output..
Signal:
```

Enter this line to select which values to output via the analog outputs.
Available options are:

Option	Output 1	Output 2	
C1-C2	Channel 1 gas concentration	Channel 2 gas concentration	Operational Modes
C1-T	Channel 1 gas concentration	Temperature sensor "Temp-1" value	
T-C2	Temperature sensor "Temp-1" value	Channel 2 gas concentration	
Rng-C2[*)]	Gas concentration of higher or lower range	Gas concentration of higher range	
20 mA	A signal is applied to both analog outputs creating a 20 mA output signal		Modes for checking the output signal adjustments only [**)]
0 / 4 mA	A signal is applied to both analog outputs creating an output signal of 0 mA (when in Dead-Zero mode) or 4 mA when in Life-Zero mode. Dead-Zero or Live-Zero mode is selected by the "Signal range" parameter (☞ 5-4-3-4-1-2, page 5-36)		

[*)] Aktivates the range switching option ((☞ Chapter 7).
[**)] Select one of these modes only to do a quick check if the analog output level settings are still correct.

Table 5-1: Analog Output Signal Selection

5-4-3-4-1-2 Analog Output Range Setup

```
Setup..
In/Outputs..
Analog output..
SignalRange:
```

Enter this line to select the analog outputs ranges. In addition this entry allows to setup the analog outputs to follow the NAMUR NE43 recommendations.

Choose **0-20 mA** to get a 20 mA signal when the measuresd concentration meets the upper range limit. A signal of 0 mA is generated for a gas concentration of "0" (Dead-zero).
A signal cable break results in a "0" signal, too. Therefore an external data acquisition is not capable of detecting such a failure and accepts a gas concentration signal of "0".

The commonly used methode to detect cable breaks is driving the analog outputs in live-zero mode: A concentration corresponding to the lower measuring range limit (e.g. "0") is assigned to an analog signal of 4 mA. Thus a failure like cable break is clearly detectable by a signal of 0 mA.
This live-zero mode is selected when setting parameter "SignalRange" to **4-20 mA.**

Operation Modes corresponding to NAMUR Recommendation 43 (NE 43)

Both modes described above do not provide a signal to be used to detect a failure within the measuring system. In such case the output signal behaviour is undefined: either it keeps the last value or is set to an arbitrary value: Measuring system failures are not detectable by an external data acquisition system.

NE43 gives recommendations how to setup analog outputs to avoid above situation and the X-STREAM series analyzers consider NE 43:

Setting "SignalRange" to values other than **0-20 mA** or **4-20 mA** defines specific signal levels for analog outputs in case of detecting system failures. During normal operation these values are not output, so an data acquisition system is capable of distinguishing between

- cable break ("0" signal),
- failure (signal outside accepted range, but differing from "0")
- valid measuring value(signal within accepted range)
- measuring range overrun or underrun (the output signal increases / decreases to the limit given in table 5-1 and then keeps this value until the measured concentration is back within the measuring range).

Special feature for single channel instruments!

In case the instrument does not provide a second measuring channel, the NE 43 compatible operating modes adjust the channel 2 analog output to the value normally output during measuring range underrun. This ensures that a data acqusition system recognizes the signal as a non valid measuring signal and does not activate an alarm due to a missing measuring channel.

5-4 Menu System - Analog Output Setup Menu

			Output signal, when					
Signal range setting	**Operation mode**	**Failure signal level acc. NE 43**	**Measured value is valid**	**Measured value is below lower range limit**	**Measured value is above upper range limit**	**An internal failure occured**	**Cable is broken**	**Channel 2 is not equipped**
0-20mA	Dead-Zero	-	0 … 20 mA	< -19 mA	> 21 mA	undefined	0 mA	0 mA
4-20mA	Live-Zero	-	4 … 20 mA	< -19 mA	> 21 mA	undefined	0 mA	4 mA
LL0-20mA	similiar Dead-Zero	below	0 … 20 mA	-0,2 mA	20,5 mA	-2 mA	0 mA	-0.2 mA
LL4-20mA	similiar Live-Zero	below	4 … 20 mA	3,8 mA	20,5 mA	2 mA	0 mA	3.8 mA
HL0-20mA	similiar Dead-Zero	above	0 … 20 mA	-0,2 mA	20,5 mA	>21 mA	0 mA	-0.2 mA
HL4-20mA	similiar Live-Zero	above	4 … 20 mA	3,8 mA	20,5 mA	>21 mA	0 mA	3.8 mA

Table 5-2: Analog Output Signal Setting & Operation Modes

5-4-3-4-1-3 Analog Output Signal Scaling Setup

```
Setup..
In/Outputs..
Analog  output..
Scaling..
```

```
C
?
```

Dual channel instrument:
Optional gas component selection menu - Select the component to be setup

```
       Scaling

0/4mA:     0.0000  ppm
20mA:      1000.0  ppm
```

Use this menu to setup the analog out scaling :
In the upper line enter the gas concentration to create a 0 mA or 4 mA output.
In the lower line enter the gas concentration to create a 20 mA output.

This allows to limit the upper output signal range to a concentration level less than full scale.
Selecting values within the range limits given by the RANGE INFO menu (☞ page 5-56) and the nameplate label (☞ 2-3, page 2-16) ensures that the analog output is always within the measurement specifications (e.g. linearity < 1% of full scale; ☞ 3-4, page 3-17), **as long as** the lower output (0/4 mA) is assigned to zero (0).
Assigning other concentrations than zero (0) to the lower output (0/4 mA) always affects the measurement accuracy!

Example:
Range specification:
CO: FS 400 ... 1000 ppm
When assigning the "0/4 mA" signal to 0 ppm and the "20 mA" output signal to values between 400 and 1000 ppm, the analog output accuracy is always within the measurement specifications .

Factory setting is always
- *0/4 mA correspond to 0 ppm*
- *20 mA correspond to the highest range (here: 1000 ppm)*

Dual channel instrument:
Pressing the ← key while any line is selected returns to the optional gas component selection menu to open the same menu for the other measuring channel.

5-4-3-4-1-4 Analog Output Signal Trimming

```
Setup..
In/Outputs..
Analog output..
Trim output..
```

```
C
?
```

Dual channel instrument:
Optional gas component selection menu - Select the component to be setup

This menu allows to finetune the analog signal output:
First choose the **signal** to be generated by the output electronics:

```
   Trim output
Signal:      0/4mA
0/4mA:        2048
20mA:         3456
```

Option	Output 1	Output 2
20 mA	A signal is applied to both analog outputs creating a 20 mA output signal	
0/4 mA	A signal is applied to both analog outputs creating an output signal of 0 mA or 4 mA. These Dead-Zero or Life-Zero modes are selected by the "Signal range" parameter (☞ 5-4-3-4-1-2, page 5-36)	
The following options only set the output signal, but do not allow output trimming!		
C1-C2	*Channel 1 gas concentration*	*Channel 2 gas concentration*
C1-T	*Channel 1 gas concentration*	*Temperature sensor "Temp-1" value*
T-C2	*Temperature sensor "Temp-1" value*	*Channel 2 gas concentration*
Rng-C2		*Channel 2 gas concentration*

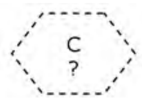
Select one of these lines (depending on the signal selected above), change the related parameter and confirm by pressing the ↵key. The analog output signal changes accordingly. Repeat editing the parameter until the analog output creates the expected signal.

Dual channel instrument:
Pressing the ← key while any line is selected returns to the optional gas component selection menu to open the same menu for the other measuring channel.

5-4-3-4-2 Valve Assignment

```
Setup..
In/Outputs..
Valve assignment..
```

If system is setup accordingly access level 3 code must be entered to access this menu.



Dual channel instrument:
Optional gas component selection menu - Select the component to be setup

```
 Valve assignment

Zero/Span:      V1/V4
```

This menu allows to assign internal and/or external valves V1, V2 and V4 to zero gas and span gas.

Available options are:
V1/V2, **V1/V4**, **V2/V4**, **V2/V1**, **V4/V1**, **V4/V2**
(the first value names the zero gas valve. the second the span gas valve).

Dual channel instrument:
Pressing the ← key returns to the optional gas component selection menu to open the same menu for the other measuring channel.

Note for dual channel instruments:
The combinations may be assigned for channel 1 and 2 independently. This includes:

- *selecting the same combination for both channels*
- *selecting combinations where one valve has the same function for both channels*
- *selecting combinations where one valve has different functions for both channels, e.g. the channel 1 zero valve is the channel 2 span valve.*

Depending on the gases used such combinations may result in calibration procedures optimized for time or gas consumption (☞ 7-3 Calibration procedures, page 7-3).

5-4-3-5 Installed Options Setup Menu

```
Setup..
Installed options..
```

If system is setup accordingly access level 3 code must be entered to access this menu.

```
 Installed options
Valves:     Internal
COM-Interf:      Yes
▼Pump:           Yes
```

1st menu page

Select if and in which way valves are installed. Available options:
Internal, **External**, **Int**(ernal)**+Ext**(ernal), **None**

Select whether a serial interface is installed (**Yes**) or not (**No**)

Select whether an internal pump is installed (**Yes**) or not (**No**).

```
▲DigitalInp:     Yes
PressSensor:Internal
Flow monitor:    Yes
```

2nd menu page

Select whether digital inputs are installed (**Yes**) or not (**No**)

Select if and in which way a barometric pressure sensor is installed.
Available options:
Manual: No sensor available, ambient pressure has to be entered manually for compensation (☞ 5-4-3-3 Measurement Setup Menu, page 5-29)
Internal: Internal digital pressure sensor installed
External: Pressure input via network (e.g. DeltaV)
Use CH2: If the digital sensor's accuracy is not sufficient for specific applications, within a single channel istrument an analog sensor may be connected to the second measuring channel electronics and used for compensation purpose.

Select whether a flow monitor is installed (**Yes**) or not (**No**).

5-4-3-6 Communication Setup Menu

```
Setup..
Communication..
```

If system is setup accordingly access level 3 code must be entered to access this menu.

```
Protocol:    MODB RTU
MODB mode:      32Bit
ID number:          2
▼Interface: RS485/2w
```

1st menu page

Select the Modbus protocol to be used by the serial interface.
Available options:
MODB RTU, Status, Test
Note!
*The options **Status** and **Test** are for service needs only!*

Select the Modbus operation mode.
Available options:
32Bit (=Daniel mode),
16BitLow (=Modicon mode, LOW word first),
16BitHi(g)**h** (=Modicon mode, HIGH word first)

Enter the ID the instrument uses for network identification.
Input range: 1 .. 254

Select the installed RS interface variation.
Available options:
RS232, **RS485/2w**(ire), **RS485/4w**(ire)

Note1!
☞ Chapter 9 for a detailed description of Modbus parameters, and appendix for a general description of Modbus.

Note2!
*For using the optional ethernet interface select **MODB RTU** and **RS232**!*

```
▲Baud rate:     19200
Parity:          None
```

2nd menu page

Select the serial interface baud rate.
Available options:
2400, **4800**, **9600**, **19200**

Select if a parity bit is used or not.
Available options:
None, **Even**, **Odd**

5-4-3-7 Alarms Setup Menu

```
Setup..
Alarms..
```

If system is setup accordingly access level 3 code must be entered to access this menu.

Dual channel instrument:
Optional gas component selection menu - Select the component to be setup

```
Level1:        100  ppm
  Function:         Low
Level2:        500  ppm
  Function:        High
```

Enter a first concentration (threshold) level to activate an alarm.

Select the alarm output operation mode for level 1.
Available options:
Off, **Low, High**, **Off FS**, **Low FS**, **High FS**
(☞ next page for a detailed description of these options and on alarm settings)

Enter a second concentration (threshold) level to activate an alarm.

Select the alarm output operation mode for level 2.
Available options:
Off, **Low, High**, **Off FS**, **Low FS**, **High FS**
(☞ Chapter 6 for a detailed description of these options and of alarm settings)

Note!
The units for the level values are taken from the related entry in the display setup menu (☞ 5-4-3-1-3, page 5-25).

Dual channel instrument:
Pressing the ← key while any line is selected returns to the optional gas component selection menu to open the same menu for the other measuring channel.

5-4-3-8 Save-Load Menu

```
Setup..
Save-Load..
```

If system is setup accordingly access level 3 code must be entered to access this menu.

Note 1!
All the following procedures require an appropriate terminal software to be installed on an external hardware (e.g. PC, connected to the serial interface) to receive and save the data.

Note 2!
A notification screen appears while ongoing procedures, showing how to cancel.

```
      Save-Load
CfgData>COMport!
COMport>CfgData..
▼Verify!
```

1st menu page

Pressing the ↵key while this line is selected starts a configuration backup procedure. The data is sent to the serial interface.

Pressing the ↵key while this line is selected starts a configuration restore procedure: The instrument now waits for data to be received via the serial interface.
CAUTION!
This overwrites all ConfigData. Changes made since last backup are lost!
Note!
A query screen appears to confirm starting the procedure.

Use this line to start a "COMport>CfgData" procedure for a online comparison of the current ConfigData set with data received via the serial interface.
The current configuration data is not over-written! Incoming data is erased after being compared to the RAM data.

5-4 Menu System - Safe-Load Menu

```
▲
FactData>CfgData..
CfgData>UserData..
UserData>CfgData..
```

2nd menu page

Select this line to overwrite current CfgData by FactData.

Select this line to save current CfgData as UserData.

Select this line to overwrite current CfgData by UserData.

CAUTION!
All these 3 procedures overwrite internal data. Changes made since last backup are lost!

Note!
A query screen appears to confirm starting the procedures.

Explanation of terms:

FactData This is the factory setup analyzer configuration. The data is stored in FLASH. The user may only restore this data into RAM, but not save changed parameters as FactData.

UserData The user may save/restore his individual analyzer configuration and settings into/from FLASH.

CfgData This current analyzer configuration is stored in the RAM.
During startup the configuration checksum is calculated. If there is a failure, the UserData settings are restored into RAM overwriting the ConfigData. This ensures the instrument remains operable.

Chapter 7 for a detailled description of these functions.

5-4-3-9 Miscellaneous Screen

```
Setup..
Miscellaneous..
```

If system is setup accordingly access level 3 code must be entered to access this menu.

```
Hold on cal:          No
```

This entry specifies if the analog outputs and the concentration alarms status are updated during calibrations or not:

Selecting **Yes** means during calibration

- the analog outputs hold the last value measured before calibration was started
- concentration alarms possibly caused by calibration gas concentrations are suppressed

The alternative option (**No**) results in an analog output following the measured value during calibration. Alarms will be activated when the currently measured values exceed the given limits during calibration.

Note!

This behaviour may cause trouble when the instrument is connected to e.g. a data aquisition system.

5-4-4 Status Menu

```
Status..
```

Note!
All menu lines within this status menu and its submenus are read-only lines! They are for information only.

```
1  Failures..
0  Check requests..
1  Function checks..
▼0  Off spec..
```

1st menu page

Failures status screen
☛ 5-4-4-1, page 5-48

Check requests status screen
☛ 5-4-4-2, page 5-49

Function checks status screen
☛ 5-4-4-3, page 5-50

Off spec status screen
☛ 5-4-4-4, page 5-51

Note!
The 1st page menu lines include a number in the first row, showing the number of currently set messages of the given type.

```
▲
Calibration..
Measurement..
▼Alarms..
```

2nd menu page

Calibration status menu
☛ 5-4-4-5, page 5-52

Measurement status menu
☛ 5-4-4-6, page 5-53

Alarms status menu
☛ 5-4-4-7, page 5-54

```
▲Range                1
```

3rd menu page

If range switching is activated, this line shows the currently selected range (**1**, **2**)
☛ 5-4-3-4-1, page 5-34

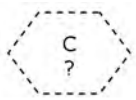
5-4-4-1 Failure Status Screen

```
Status..
1  Failures..
```

The number starting the "Failures.." line in the previous menu shows how much failures currently are active (here: 1). So in the following screens there will be only a related number of entries showing **Yes**.
For a detailed description of failure messages ☞ Chapter 8 "Troubleshooting".

Note!
If at least 1 failure shows up, the leftmost front panel LED is illuminated (permanent red) and relay 1 is activated.

```
RAMmemory          Yes
ROMmemory           No

▼
```



Dual channel instrument:
Optional gas component selection menu - Select the component of interest.

```
▲ADC-Error          No
```

Dual channel instrument:
Pressing the ← key returns to the optional gas component selection menu to open the same menu for the other measuring channel.

5-4-4-2 Check Requests Status Screen

```
Status..
0 Check requests..
```

The number starting the "Check requests.." line in the previous menu shows how much such messages currently are upcoming (here: 0). So in the following screens there will be only a related number of entries showing "Yes".
For a detailed description of check request messages ☞ Chapter 8 "Troubleshooting".

Note!
If at least 1 check request shows up, the middle front panel LED is illuminated (flashing red) and relay 2 is activated..

```
Flow too low        No
CheckBattery        No

▼
```

```
C
?
```

Dual channel instrument:
Optional gas component selection menu - Select the component of interest.

```
▲ZeroCalTolC        No
SpanCalTolCh        No
```

Dual channel instrument:
Pressing the ← key returns to the optional gas component selection menu to open the same menu for the other measuring channel.

5-4-4-3 Function Check Status Screen

```
Status..
1 Function checks..
```

The number starting the "Function checks.." line in the previous menu shows how much such messages currently are upcoming (here: 1). So in the following screens there will be only a related number of entries showing "Yes".
For a detailed description of function check messages ☞ Chapter 8 "Troubleshooting".

Note!
If at least 1 function check shows up, the middle front panel LED is illuminated (flashing red) and relay 3 is activated.

```
Calibration        None
Simulation           No
NotSampleGas         No
▼Warm-up             No
```

C
?

Dual channel instrument:
Optional gas component selection menu - Select the component of interest.

```
▲LocalAccess         No
```

Dual channel instrument:
Pressing the ← key returns to the optional gas component selection menu to open the same menu for the other measuring channel.

5-4-4-4 Off Spec Status Screen

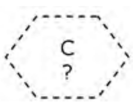
```
Status..
0 Off specs..
```

The number starting the "Off spec.." line in the previous menu shows how much such messages currently are upcoming (here: 0). So in the following screens there will be only a related number of entries showing "Yes".
For more detailed information about off spec messages Chapter 8 "Troubleshooting".

Note!
If at least 1 off spec message shows up, the middle front panel LED is illuminated (flashing red).

```
Pressure            No
SecMeasurem         No

▼
```

Note!
*The Pressure line shows up only if the parameter "PressSensor" in the INSTALLED OPTIONS setup menu is other than **manual**..*



Dual channel instrument:
Optional gas component selection menu - Select the component of interest.

```
▲Lineariser     Normal
Temperature         No
SignalRange         No
```

Dual channel instrument:
Pressing the ← key returns to the optional gas component selection menu to open the same menu for the other measuring channel.

5-4-4-5 Calibration Status Screen

```
Status..
Calibration..
```

If a calibration is ongoing, this screens gives some information about the status. But, differing from the "Control.. - Zero/Span Calibration.." screen, where the operator has to select the channel (dual channel instruments only), the data shown here are channel independent, means they give a general calibration status.

```
Gasflow          Sample

Procedure          None
Time                0 s
```

Gasflow:
Possible values are **Sample**, **V1**, **V2** and **V4**. These values represent the external or internal valves used for autocalibration. Except for the sample valve they are all operator configurable: The operator can allocate each valve to zero and span gas. Therefore this line shows the activated valve (for V1, V2 and V4) only (and not the related gas).

Procedure:
This line shows the current calibration status :
None: no calibration ongoing
Zero 1: channel 1 is zero calibrating
Span 1: channel 1 is span calibrating
Zero 2: channel 2 is zero calibrating
Span 2: channel 2 is span calibrating
Purging: the instrument is purging the gas path

The last line shows the remaining time for the given procedure.

Note!
For a detailed description of calibration status and how to perform calibrations chapter 7 Maintenance.

5-4-4-6 Measurement Status Screen

```
Status..
Measurement..
```

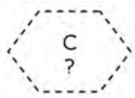
```
Temp-1          54  °C
Temp-2          44  °C
Pressure   1014   hPa
▼
```

1st menu page

Shows the current temperature measured by sensor Temp-1.

Shows the current temperature measured by sensor Temp-2.

Shows the current pressure value, either measured by internal / external sensor or manually entered.
☞ 5-4-3-5, page 5-41 for information about how pressure is measured.



Dual channel instrument:
Optional gas component selection menu - Select the component of interest.

Shows the detectors raw signal value. This is the signal without being linearized, compensated or converted to the expected unit.

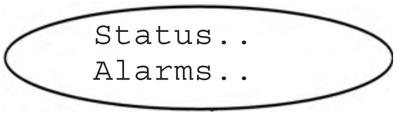
Shows IR source current.

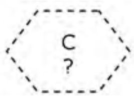
```
▲Rawsignal    1962.1
ScrCurrent    704  mA
```

2nd menu page

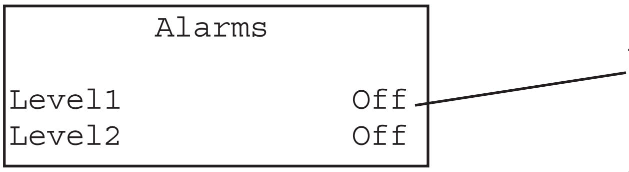
Dual channel instrument:
Pressing the ← key returns to the optional gas component selection menu to open the same menu for the other measuring channel.

5-4-4-7 Alarms Status Screen





Dual channel instrument:
Optional gas component selection menu - Select the component of interest.



Shows the current concentration alarm status for the selected channel. If a concentration alarm is active the related status shows **On,** otherwise it is **Off**.
An active concentration alarm gives a corresponding message in the measuring screen, too (e.g. CO.1 Alarm Level1).

Dual channel instrument:
Pressing the ← key returns to the optional gas component selection menu to open the same menu for the other measuring channel.

5-4-5 Info Menu

```
Info..
```

```
Serial 1        Ax123
Serial 2      4567890
Revision      0.16 05
▼Range..
```

1st menu page

- Serial 1: Instrument's serial number, 1st part
- Serial 2: Instrument's serial number, 2nd part
- Revision: Installed software revision
- ▼Range..: Measuring range information menu ☞ 5-4-5-1, page 5-56

```
▲Europe..
North America..
Latin America..
▼Asia Pacific..
```

2nd menu page

Service addresses: Enter one of these lines to see the service contact address for the related world region.

```
▲Factory settings..
Installed options..

UseDOutAlrm1  Alarms
```

3rd menu page

- ▲Factory settings..: Factory settings information menu ☞ 5-4-5-2, page 5-57 (access level 4)
- Installed options..: Installed options info menu ☞ 5-4-5-3, page 5-58
- UseDOutAlrm1: This line shows how the digital output, normally assigned to channel 1 threshold 1 is used: **Alarms** means it is used as intended (channel 1 threshold 1 alarm) **Range** means it is used as a range indicator for range switching (☞ Chapter 7)

5-4-5-1 Measuring Range Info Screen

```
Info..
Range..
```

```
C
?
```

Dual channel instrument:
Optional gas component selection menu - Select the component of interest.

This info screen showsrange information for the selected channel.

```
MinRange   400.000 ppm
MaxRange  1000.000 ppm
SpanRange      110  %
```

These two lines show the permissible minimum and maximum ranges for the analog output signal scaling to stay within the specifications (☞ 5-4-3-4-1-3, page 5-38).

Gives the maximum factor of span gas to be used in relation to the maximum measuring range (☞ chapter 7 calibration procedures).

Dual channel instrument:
Pressing the ← key returns to the optional gas component selection menu to open the same screen for the other measuring channel.

5-4-5-2 Factory Settings Screen

```
Info..
Factory settings..
```

This is not an information menu, but here are entries to basically setup the instrument.

Changing parameters within this menu may cause the instrument to show faulty values and in worst case set the instrument to a non-operable status!

For this reasons access is protected by access level code 4 and permitted to specially trained personnel only!

Access level 4 code must be entered to access this menu.

5-4-5-3 Installed Options Info Screen

```
Info..
Installed options..
```

```
 Installed options
Valves        Int+Ext
COM-Interf        Yes
▼Pump             Yes
```

1st menu page

```
▲DigitalInp       Yes
Pressure     Internal
Flow monitor       No
```

2nd menu page

These pages provide information about installed options.
To change any of these status enter the INSTALLED OPTIONS SETUP menu
(☞ 5-4-3-5, page 5-41).

Chapter 6
Initial Startup

6-1 Abstract

After unpacking and installing the instrument it's always a good choice to check the instrument's setup and configure it to the operator's needs before performing any other actions, e.g.:

- What hardware is installed?
- Is it setup to meet your needs (alarms setup, in/outputs, etc.)

This chapter describes how to navigate through the menus and on what to pay attention to perform a good initial startup.
The structure of the following sections is such that an operator can perform the procedures one-by-one after first time installation and at the end the instrument is working properly with basic settings.
It is assumed that the operator is familiar how to navigate through menus and how to activate procedures, as described in chapter 5.

Furthermore the instrument should be installed according the instructions given in chapter 4.

6-2 Checking the Instrument's Setup

After applying power the instrument starts into the MEASURING screen, showing a set of measuring values.
(If another screen is shown, press the home key to enter the MEASURING screen).
While in this screen press any key, except the home key, to open the main menu and select the following sequence of menus:

Setup..

Display..

Note!
If you are not used to the currently setup language: next page for a key symbols sequence to be entered to change a language.

If system is setup accordingly access level 1 code must be entered to access this menu. Factory default setting is "no code required".

Language..

If system is setup accordingly access level 3 code must be entered to access this menu. Factory default setting is "no code required".

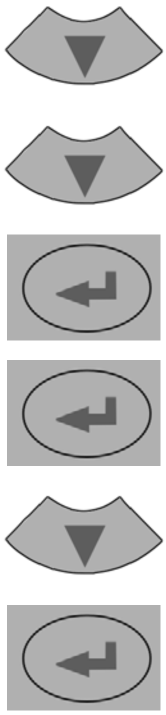
```
        Language

Language:     English
```

Select your prefferred language for the analyzer software. Number of and languages may vary depending on software revision.
Currently available (to be extended) :
English, German, French, Spanish, Italien

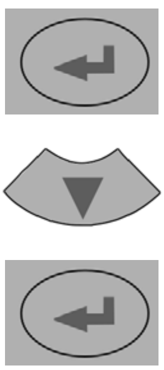
6-2 Checking the Instrument's Setup

6-2-1 Instrument's Language Setup

Sequence of keys to be entered for changing the language of an analyzer, if the operator is not competent in the currently setup language
(Sequence starting from the measuring screen)



Note!
After pressing the ENTER key the 4th time within this sequence you entered the LANGUAGE parameter line.



The DOWN key changes the language. After pressing the ENTER key this language is set and the menu's language is updated immediately.
If the selected language is not the one desired, repeat the sequence of last three keys multiple times until the desired language is set.

6-2 Checking the Instrument's Setup

6-2-2 Display Information Setup

Press the LEFT key to return to the DISPLAY SETUP screen.

Next check the display settings for the measurement screen, temperature & pressure units and menu access using the DOWN and ENTER keys to access the related menu pages.

If system is setup accordingly access level 2 code must be entered to access these menus. Factory default setting is "no code required".

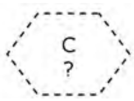
If any of the settings do not meet your requirements just enter the related menu and change the parameter.
For easier handling it is recommended to not change the menu access codes settings during the first instrument setup check.

6-2-3 Calibration Data Setup

```
Calibration..
Calibration gases..
```

After the display settings are checked press the LEFT key to return to the SETUP menu to enter the CALIBRATION setup menu for specifying the calibration gas concentrations and more.

If system is setup accordingly access level 2 code must be entered to access these menus. Factory default setting is "no code required".



Dual channel instrument:
Optional gas component selection menu - Select the component to be setup

```
 Calibration gases

ZeroGas:      0.0 ppm
SpanGas:    500.0 ppm
```

Within this screen enter the values for the listed gases: Take the correct values from your gas supplier's certificate. Proper values only assure faultless measuring results.
For multichannel instruments enter the values for each channel separately.

6-2 Checking the Instrument's Setup

```
Calibration gases..
Tol.Check:       Off
Purge time:     15 s
Interval time..
```

Press the LEFT key to return to the CALIBRATION setup menu and concentrate on the "Tol. Check" entry.

By default the option "Tol. Check" (tolerance check) is disabled (**OFF**).
With tolerance check enabled (**ON**) during calibration the analyzer checks that the entered (setpoint) values for zero gas and span gas are reasonable compared to the currently connected gas. If the currently connected gas concentration differs more than 10 % of measuring range from zero (during zero calibration) or span (during span calibration), calibration is aborted.
This helps avoiding calibrating with a wrong gas applied (e.g. starting a span calibration while zero gas is flowing) resulting in an instrument out of tune.

Note!
The next two lines (purge time & interval time) show up only if the valve option is other than ***None*** *(see installed options menu).*
"Purge time": Before starting a calibration it must be verified that the gas path has been sufficiently flown through by the calibration gas and does not contain other components.
In case the gas flow is controlled by internal or external valves, these valves immediatley apply the required gas when a calibration starts. Due to the limited flow and the distance between valves and measuring cell it takes some time to fill the cell with the calibration gas. This time is the purge time, giving a delay in time for starting the calibration calculations.
Enter a purge time that assures the measuring cell is sufficiently filled after switching from one to the other gas.

6-2 Checking the Instrument's Setup

```
Interval time..
```

If available now enter the interval time screen.

```
   Interval time

ZeroCal:         5 h
SpanCal:         5 h
```

Specifying an interval time is required for unattended autocalibration: This means that the analyzer can initiate calibrations based on a given time interval. This interval (time between two calibrations) is entered separately for zero calibrations and span calibrations (7-3-5, page 7-26 for more detailed information).
Setup the time intervals depending on your applicational needs, but consider that always a span calibration automatically is preceded by a zero calibration!

Press the LEFT key to return to the SETUP screen and enter the MEASUREMENT menu.

```
Measurement..
```

```
Pressure: 1014.0 hPa
SignalDamp..
CrossInterference..
```

The first entry allows to set the atmospheric pressure when no pressure sensor is installed or to view the currently measured atmospheric pressure when a sensor is used (see installed options menu). The unit of measure is the one set in the display setup menus.
For best accuracy of measuring results set the pressure value to the current atmospheric pressure and update it at relevant changes.

The signal damping time ("SignalDamp") enables smoothing the measuring signal but also affects the reaction rate of outputs and display:Higher values cause slower behavior. Factory setting is 2 seconds, values from 2 to 60 seconds are accepted, for multichannel instruments independently for each channel.

"Cross interference" settings are available for multichannel instruments only. Single channel instruments don't show this line, opening a next screen:

```
  CrossInterference

Status:          Off
@ Span Cal:       No
```

The first line allows to enable (**On**) or disable (**Off**) two-way cross interference compensation of two channels. Enabled compensation minimizes the interacting influences of the measuring gases in both channels.
The second line specifies if the cross compensation factors are automatically calculated during a next span calibration or not. "**Yes**" enables automatic calculation but requires using pure gases for one single span calibration procedure.
For a detailed description of how to setup cross compensation ☞ 7-3-9, page 7-31.

6-2-4 Analog Output Setup

Press the LEFT key to return to the SETUP screen and enter the IN/OUTPUTS menu.

Note!
If an internal pump is installed, the menu shows two lines, without pump the lower line does not show.

```
Analog output..
PumpControl:    Menu
```

The line "PumpControl" allows to specify how the optional internal pump is controlled (switched ON/OFF): Either by a software **Menu** or by an **external** signal, applied via Digital Input 7, if such is installed (☞ INSTALLED OPTIONS menu, page 5-41).

6-2 Checking the Instrument's Setup

```
Signal:          C1-C2
SignalRange:  4-20mA
Scaling..
Trim output..
```

Select the "Analog output" line to open a submenu to specify the analog outputs: The two analog outputs may be configured to output several signals via the "Signal" entry:

Option	Output 1 source	Output 2 source	
C1-C2	Channel 1 gas concentration	Channel 2 gas concentration	Operational Modes
C1-T	Channel 1 gas concentration	Temperature sensor "Temp-1" value	
T-C2	Temperature sensor "Temp-1" value	Channel 2 gas concentration	
20 mA	A signal is applied to both analog outputs creating a 20 mA output signal		Modes for checking the output signal adjustments only *)
0 / 4 mA	A signal is applied to both analog outputs creating an output signal of 0 mA (when in Dead-Zero mode) or 4 mA when in Live-Zero mode. Dead-Zero or Live-Zero mode is selected by the "Signal range" parameter (☞ page 6-9)		

*) Select one of these modes only to perform a quick check if the analog output level settings are still correct.

The next line "Signal Range" allows to configure the analog outputs ranges / the analog outputs to comply with the NAMUR NE43 recommendations as described on the next page.

6-2 Checking the Instrument's Setup

Enter this line to select the analog outputs ranges. In addition this entry allows to setup the analog outputs to follow the NAMUR NE43 recommendations.

Choose **0-20 mA** to get a 20 mA signal when the measuresd concentration meets the upper range limit. A signal of 0 mA is generated for a gas concentration of "0" (Dead-zero).
A signal cable break results in a "0" signal, too. Therefore an external data acquisition is not capable of detecting such a failure and accepts a gas concentration signal of "0".

The commonly used methode to detect cable breaks is driving the analog outputs in live-zero mode: A concentration corresponding to the lower measuring range limit (e.g. "0") is assigned to an analog signal of 4 mA. Thus a failure like cable break is clearly detectable by a signal of 0 mA.
This live-zero mode is selected when setting parameter "SignalRange" to **4-20 mA.**

Operation Modes corresponding to NAMUR Recommendation 43 (NE 43)

Both modes described above do not provide a signal to be used to detect a failure within the measuring system. In such case the output signal behaviour is undefined: either it keeps the last value or is set to an arbitrary value: Measuring system failures are not detectable by an external data acquisition system.

NE43 gives recommendations how to setup analog outputs to avoid above situation and the X-STREAM series analyzers consider NE 43:

Setting "SignalRange" to values other than **0-20 mA** or **4-20 mA** defines specific signal levels for analog outputs in case of detecting system failures. During normal operation these values are not output, so an data acquisition system is capable of distinguishing between

- cable break ("0" signal),
- failure (signal outside accepted range, but differing from "0")
- valid measuring value(signal within accepted range)
- measuring range overrun or underrun (the output signal increases / decreases to the limit given in table 5-1 and then keeps this value until the measured concentration is back within the measuring range).

Special feature for single channel instruments!

In case the instrument does not provide a second measuring channel, the NE 43 compatible operating modes adjust the channel 2 analog output to the value normally output during measuring range underrun. This ensures that a data acqusition system recognizes the signal as a non valid measuring signal and does not activate an alarm due to a missing measuring channel.

6-2 Checking the Instrument's Setup

			Output signal, when					
Signal range setting	**Operation mode**	**Failure signal level acc. NE 43**	**Measured value is valid**	**Measured value is below lower range limit**	**Measured value is above upper range limit**	**An internal failure occured**	**Cable is broken**	**Channel 2 is not equipped**
0-20mA	Dead-Zero	-	0 … 20 mA	< -19 mA	> 21 mA	undefined	0 mA	0 mA
4-20mA	Live-Zero	-	4 … 20 mA	< -19 mA	> 21 mA	undefined	0 mA	4 mA
LL0-20mA	similiar Dead-Zero	below	0 … 20 mA	-0,2 mA	20,5 mA	-2 mA	0 mA	-0.2 mA
LL4-20mA	similiar Live-Zero	below	4 … 20 mA	3,8 mA	20,5 mA	2 mA	0 mA	3.8 mA
HL0-20mA	similiar Dead-Zero	above	0 … 20 mA	-0,2 mA	20,5 mA	>21 mA	0 mA	-0.2 mA
HL4-20mA	similiar Live-Zero	above	4 … 20 mA	3,8 mA	20,5 mA	>21 mA	0 mA	3.8 mA

Table 6-1: Analog Output Signals Settings & Operation Modes

```
      Scaling

0/4mA:    0.0000  ppm
20mA:     2000.0  ppm
```

Press the LEFT key to return to the ANALOG SIGNAL SETUP screen, enter the "Scaling.." line and select the channel to setup (multi-channel instruments only).

Enter the gas concentrations generating analog output signals according the lower respectively upper range (4(0) or 20 mA). By default the gas concentrations comply with the measuring ranges. Setting other concentrations allows to limit the output signal range to a concentration level range smaller than full scale.

Dual channel instrument:
Pressing the ← key while any line is selected returns to the optional gas component selection menu to open the same menu for the other measuring channel.

6-2 Checking the Instrument's Setup

Press the LEFT key several times to return to the SETUP MENU.

```
▲Installed options..
Communication..
Alarms..
▼Save-Load-Update..
```

The cursor is now placed in the IN/OUTPUTS.. line, overwriting a small triangle. Press the DOWN key to enter the next SETUP MENU page and enter the "Installed options.." menu to view the installed options.

If system is setup accordingly access level 3 code must be entered to access this menu. Factory default setting is "no code required".

```
 Installed options
Valves:    Internal
COM-Interf:     Yes
▼Pump:          Yes
```

```
▲DigitalInp:    Yes
PressSensor:Internal
Flow monitor:   Yes
```

This menu consists of two pages, showing the status of available options. The entries of your specific instrument may differ from those shown at the left, depending on its configuration!

Do not change entries on these pages without detailed knowledge!

Wrong entries may cause faulty measuring results or strange analyzer behaviour!

When entering this menu for the first time just use it to get informed about the instrument's configuration.

6-2 Checking the Instrument's Setup

Press the LEFT key several times to return to the SETUP MENU, select the "Communication.." line and enter the menu.

```
Protocol:   MODB  RTU
MODB  mode:     32Bit
ID  number:         2
▼Interface: RS485/2w
```

```
▲Baud  rate:    19200
Parity:          None
```

6-2-5 Concentration Alarms Setup

Note!
If you do not want to make use of concentration alarms, skip the next pages and continue with page 6-18.

Press the LEFT key several times to return to the SETUP MENU, select the "Alarms.." line, enter the menu and select the channel to be setup (multi-channel instruments only).

```
Level1:       100  ppm
 Function:         Low
Level2:       500  ppm
 Function:        High
```

Two different concentration thresholds can be set for each channel, freely configurable within the limits given by the "SpanRange" parameter. The moment the measured concentration exceeds one of the thresholds, a status message appears in the measuring screen's 4th line and the related digital output (option) is set.

6-2 Checking the Instrument's Setup

The "SpanRange" parameter is shown in the MEASURING RANGE INFO Screen (☞ 5-4-5-1, page 5-56) and always gives a value in relation to the upper measuring range limit of the selected channel.
The "SpanRange" parameter is factory set and not operator changeable. It is used for different functionalities:

At first the "SpanRange" parameter defines the maximum value a span gas may have:
For a given "SpanRange" value of 110 % this means, the maximum span gas concentration to be used for the selected channel is 110 % of the maximum measuring range.

Example:
Oxygen measuring range is 10 %. If the "SpanRange" value is 220 %, then the permissible maximum span gas concentration is 22 %, which allows to use ambient air (21 % O_2) for calibration.

The second functionality of the "SpanRange" parameter is to specify the range for setting concentration thresholds:
After substracting 100 % from SpanRange, the result gives the value to expand the measuring range in both ("+" and "-") directions for setting thresholds.

Example 1:
Maximum measuring range is 1000 ppm, SpanRange is set to 100 %.
This means the SpanRange covers exactly the measuring range and thresholds may not exceed this range: Thresholds to be set between 0 ppm and 1000 ppm.

Example 2:
Maximum measuring range is 1000 ppm, SpanRange is set to 110 %.
This means the SpanRange exceeds the upper measuring range by 10 %. In consequence this means for the lower threshold limit, it may exceed the lower range limit by 10 %, too:
For the values given above the threshold limits may be set between -100 ppm and + 1100 ppm.

Example 3:
Maximum measuring range is 1000 ppm, SpanRange is set to 220 %.
This means the SpanRange exceeds the measuring range by 120 % in both directions (220 % - 100 % = 120 %):
The threshold limits may be set between -1200 ppm (-120 % of 1000 ppm) and +2200 ppm (+120 % of 1000 ppm).

	Measuring range: 0 … 1000 ppm				
	SpanRange value	SpanRange value exceeding measuring range		Expanded range for thresholds	
	relative to measuring range	relative value	absolute value	lower limit	upper limit
Example 1	100%	0%	0 ppm	0 ppm	1000 ppm
Example 2	110%	10%	100 ppm	-100 ppm	+1100 ppm
Example 3	220%	120%	1200 ppm	-1200 ppm	+2200 ppm

Table 6-2: Thresholds influenced by SpanRange parameter

Each threshold may be configured to be OFF, a LOW or a HIGH alarm, utilizing the "Function" parameter:

Off: Alarm function deactivated, digital output signal is digital "LOW" all the time.

Low: The moment, the currently measured concentration goes below the specified level, an alarm signal is activated.
Alarm signal level is digital "HIGH".

High: The moment, the currently measured concentration goes above the specified level, an alarm signal is activated.
Alarm signal level is digital "HIGH".

In addition the "Function" parameter supports the fail-safe operation mode:
Fail-**S**afe means an activated alarm gives a digital "LOW" level signal instead of a "HIGH" level signal:

Off FS: Alarm function deactivated, output level is digital "HIGH" all the time.

Low FS: The moment, the currently measured concentration goes below the specified level, an alarm signal is activated.
Alarm signal level is digital "LOW".

High FS: The moment, the currently measured concentration goes above the specified level, an alarm signal is activated.
Alarm signal level is digital "LOW".

Note!
"Function" parameter factory setting is Off FS (fail-safe) unless otherwise specified at time of order.

Combining the different modes with setting the threshold levels in a proper way gives the operator the choice of programming different behaviours:

- Window mode: If the concentration exceeds the limits defining a concentration window, an alarm is activated.
- High and high-high alarms: This mode allows to set a prealarm level and a main alarm level for increasing concentrations
- Low and low-low alarms: This mode allows to set a prealarm and a main alarm for decreasing concentrations.

Refer to the following paragraphs and figures for detailed information on alarm settings!

6-2 Checking the Instrument's Setup

- **Defining a window**

Defining a window between the high and the low threshold level (fig. 6-1) gives an alarm when the current concentration either exceeds the upper limit (area "D") or falls below the lower limit (area "B").
Maximum one alarm is activated at a time for each channel!

Standard mode:
If an alarm is activated, the corresponding alarm outputs a "High" level signal.
Settings:
- Level 1 > level 2
- Level 1 function: High
- Level 2 function: Low

Fail-safe mode:
If an alarm is activated, the corresponding alarm outputs a "Low" level signal.
Settings:
- Level 1 > level 2
- Level 1 function: High FS
- Level 2 function: Low FS

As long as any alarm is activated a status message appears in the measuring screen's 4th line.

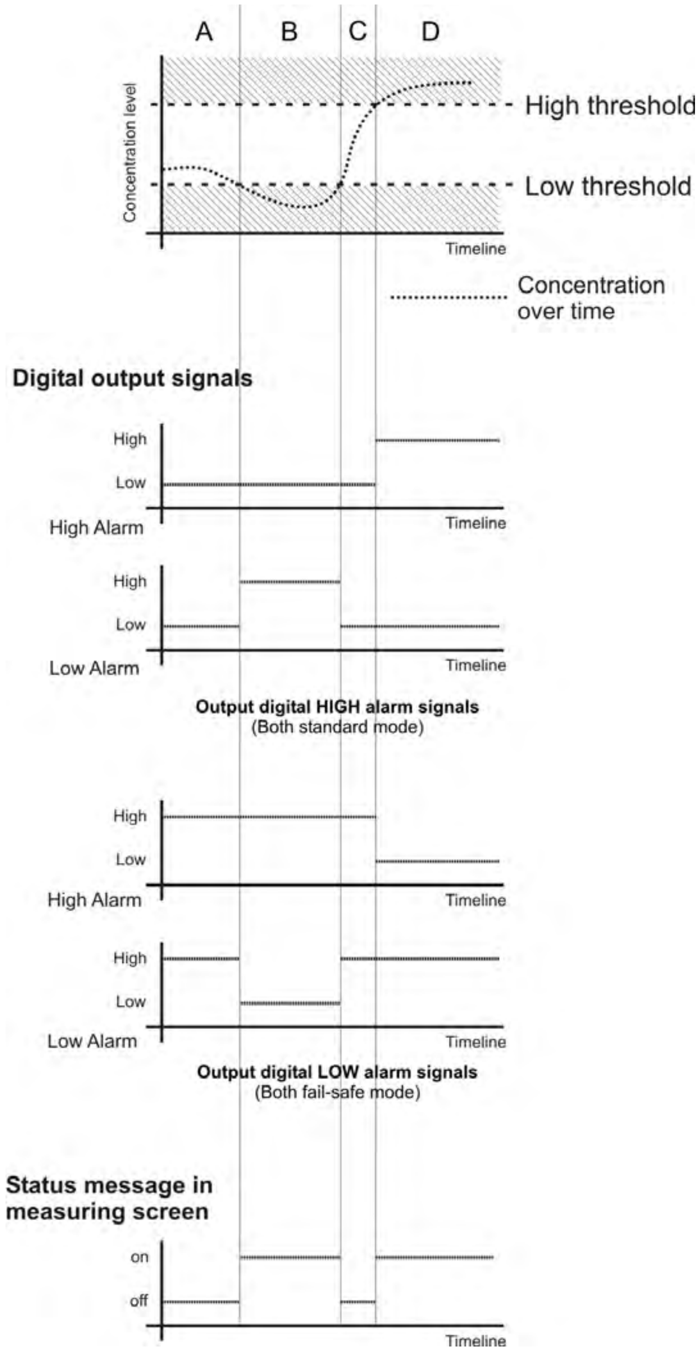


Fig. 6-1: Thresholds defining a window

6-2 Checking the Instrument's Setup

- **Setting "HIGH" and "HIGH-HIGH" alarms**

Setting one threshold above the allowed level and the second threshold above the first threshold (fig. 6-2) results in an operation mode which gives a prealarm ("HIGH alarm") when the current concentration exceeds the "high" threshold (area "B"). Also, a main alarm ("HIGH-HIGH alarm") is activated if no corrective action was performed and the current concentration exceeds the "high-high" threshold (area "C").
Up to two alarms can be activated at a time for each channel!

Standard mode:
If an alarm is activated, the corresponding alarm outputs a "High" level signal.
Settings:
- Level 1 > level 2
- Level 1 function: High
- Level 2 function: High

Fail-safe mode:
If an alarm is activated, the corresponding alarm outputs a "Low" level signal.
Settings:
- Level 1 > level 2
- Level 1 function: High FS
- Level 2 function: High FS

As long as any alarm is activated a status message appears in the measuring screen's 4th line.

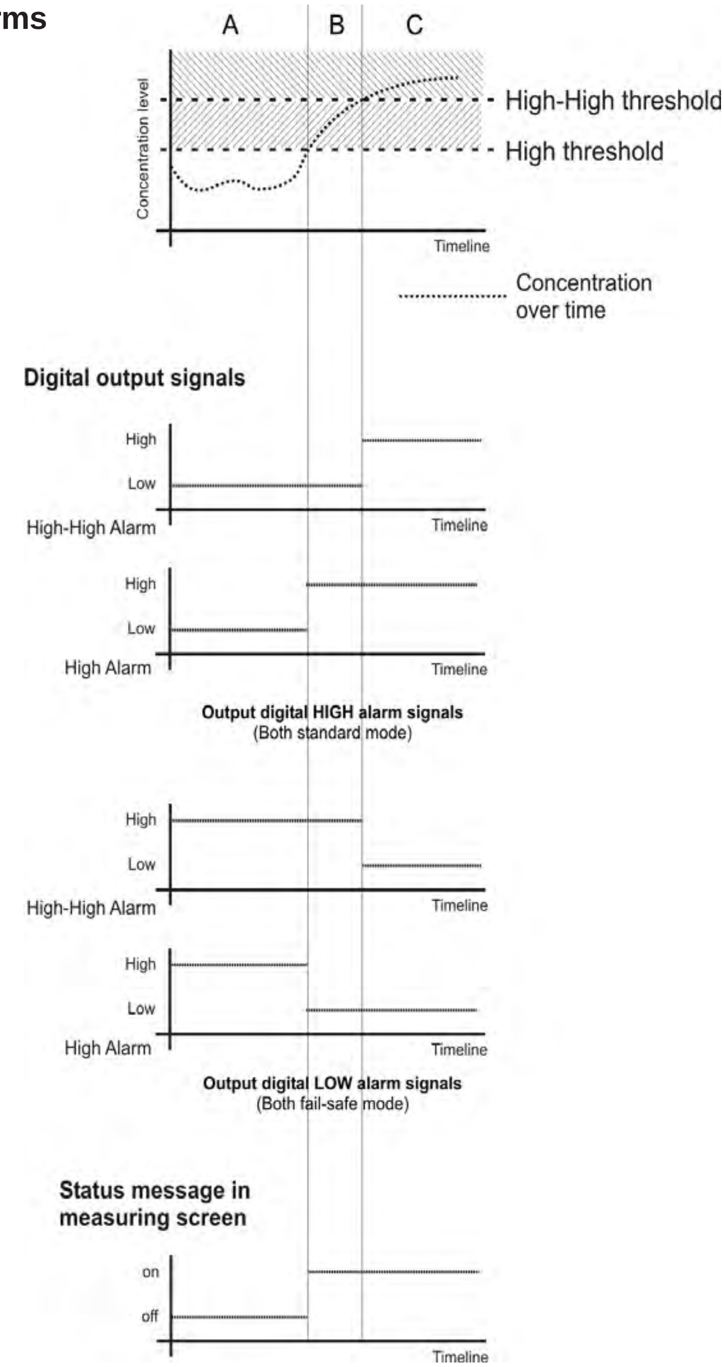


Fig. 6-2: HIGH and HIGH-HIGH alarm mode

6-2 Checking the Instrument's Setup

- **Setting "LOW" and "LOW-LOW" alarms**

Setting the one threshold below the allowed level and the second threshold below the first threshold (fig. 6-3) results in an operation mode which gives a prealarm ("LOW alarm") when the current concentration falls below the "low" threshold level (area "B"). Also, a main alarm ("LOW-LOW alarm") is activated if no corrective action was performed and the current concentration falls below the "low-low" threshold level (area "C").
Up to two alarms can be activated at a time for each channel!

Standard mode:
If an alarm is activated, the corresponding alarm outputs a "High" level signal.
Settings:
- Level 1 > level 2
- Level 1 function: Low
- Level 2 function: Low

Fail-safe mode:
If an alarm is activated, the corresponding alarm outputs a "Low" level signal.
Settings:
- Level 1 > level 2
- Level 1 function: Low FS
- Level 2 function: Low FS

As long as any alarm is activated a status message appears in the measuring screen's 4th line.

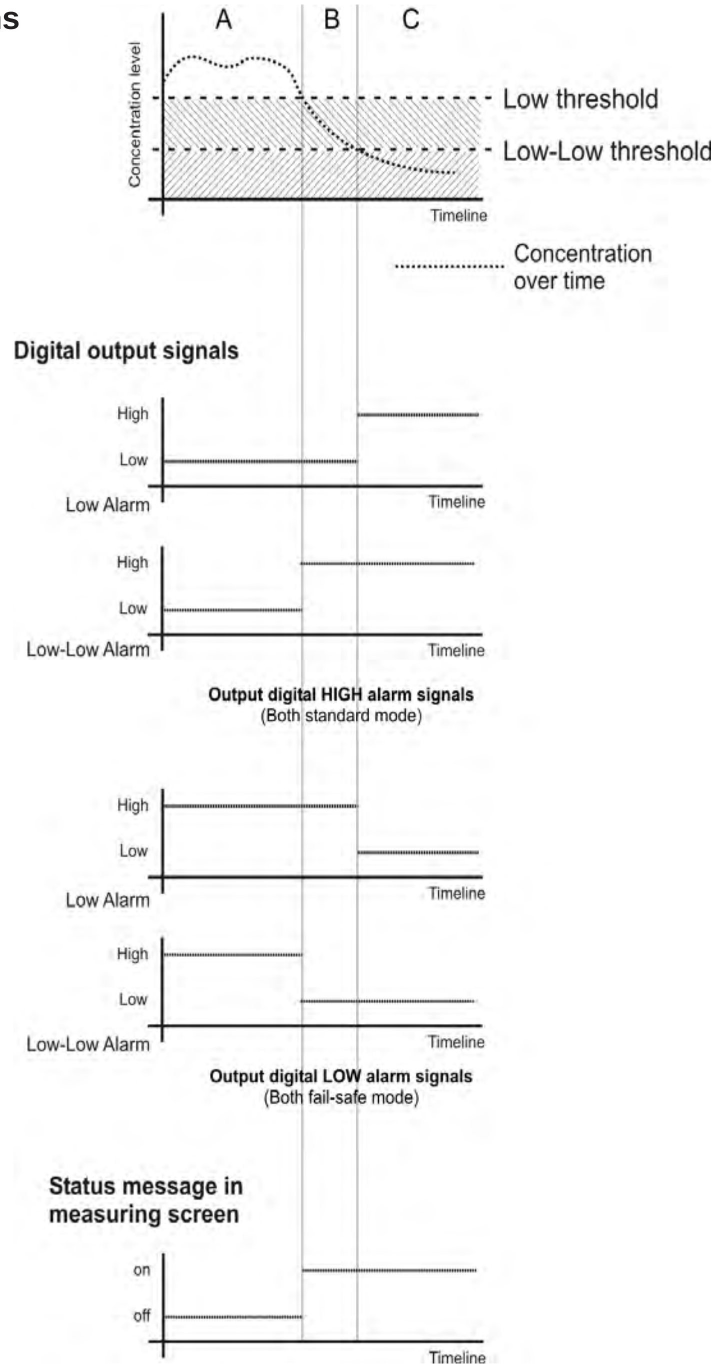


Fig. 6-3: LOW and LOW-LOW alarm mode

6-2 Checking the Instrument's Setup

Press the LEFT key several times to return to the SETUP MENU.

```
▲Installed options..
Communication..
Alarms..
▼Save-Load-Update..
```

The line "Save-Load-Update.." is used for saving/reloading a configuration and for resetting the instrument to the factory settings.

```
▲Miscellaneous..
```

For now skip this line pressing the DOWN key and enter the "Miscellaneous.." line on the 3rd menu page.

```
Hold on cal:       No
```

This entry specifies if the analog outputs and the concentration alarms status are updated during calibrations or not:

Selecting **Yes** means during calibration

- the analog outputs keep the last value measured before calibration was started
- concentration alarms are suppressed

The other option (**No**) results in an analog output following the measured value during calibration and alarms activated when the currently measured values exceed the given limits during calibration.
This behaviour may cause trouble when the instrument is connected to e.g. a data aquisition system.

6-2 Checking the Instrument's Setup

Now the most important parameter settings are checked and the instrument is setup to operate to your needs.
This is the moment where you could save for backup reasons the changed data into a special memory.

Press the LEFT key several times to return to the SETUP MENU and enter the SAVE-LOAD menu.

```
▲Installed options..
Communication..
Alarms..
▼Save-Load..
```

If system is setup accordingly access level 3 code must be entered to access this menu.

```
     Save-Load
CfgData>COMport!
COMport>CfgData..
▼Verify!
```

1st menu page

Press the DOWN key to open the second menu page.

```
▲
FactData>CfgData..
CfgData>UserData..
UserData>CfgData..
```

2nd menu page

Now select the "CfgData>UserData.." line and press the ENTER key.

6-2 Checking the Instrument's Setup

```
  CfgData>UserData
    Are you sure?
No!
Yes!
```

A screen appears to confirm the operation: Select **Yes!** and after pressing the ENTER key a new screen shows up showing the current status.

```
     Copying data
   - PLEASE WAIT -

Procedure   X:078000
```

The instrument now stores the currently used (and changed by operator) analyzer setup into a special memory area. This data is then called UserData and used for backup only, while the data used for operation is called CfgData.
Any further changes affecting the instrument's setup update the CfgData only, as long as not again stored into the UserData set.
Other options in the SAVE-LOAD-UPDATE menu allow to restore the UserData into the CfgData, in case the analyzer setup has been changed into a undesired status.
When the procedure has finished, the COMMAND EXECUTED screen shows up.

```
         (i)

 -COMMAND  EXECUTED-
```

Note!
For a detailed description of all SAVE-LOAD options *☞ 7-6, page 7-44.*

Press the HOME key to return to the MEASURING SCREEN, because the setup checking procedure is finished.

Chapter 7
Maintenance

7-1 Abstract

Maintenance carried out on a regular basis ensures long-term efficiency of your EMERSON Process Management gas analyzer!

For a description of how to

perform a leak test ☞ 7-2, page 7-2
perform a calibration ☞ 7-3, page 7-3
replace an electrochemical oxygen sensor ☞ 7-4, page 7-33
clean the instrument's outside ☞ 7-5, page 7-43
backup / restore configuration data sets ☞ 7-6, page 7-44
range switching ☞ 7-7, page 7-52

7-2 Performing a Leak Test

To achieve best and proper measuring results you must ensure the gas path system does not have leaks.
The following procedure describes how to perform a leak test with focus on the instrument.
The gas path system should be leak tested at least on a bimonthly basis and after maintenance, replacement or repair of gas path parts.
Note!
It is recommended to include external equipment (e.g. cooler, dust filters, etc.) into a leak test!

WARNING

HAZARD FROM GASES !

Before opening gas paths they must be purged with ambient air or neutral gas (N_2) to avoid hazards caused by toxic, flammable, explosive or harmful to health sample gas components!

Required tools

- U-turn manometer for max. 1.45 psi (100 mbar)
- Stop valve

Procedure

- Connect the water filled u-turn manometer to the analyzer‘s sample gas output (disconnect external gas lines).
- Install the stop valve between gas input fitting and a Nitrogen (N_2) supply.
- Open the stop valve until the internal gas path is under pressure of approx. 0.725 psi/50 mbar (corresponding to 19.7 inch/ 500 mm water column)
- Close the stop valve. After a short time for the water to balance the water level must not change over a time period of approx. 5 minutes!

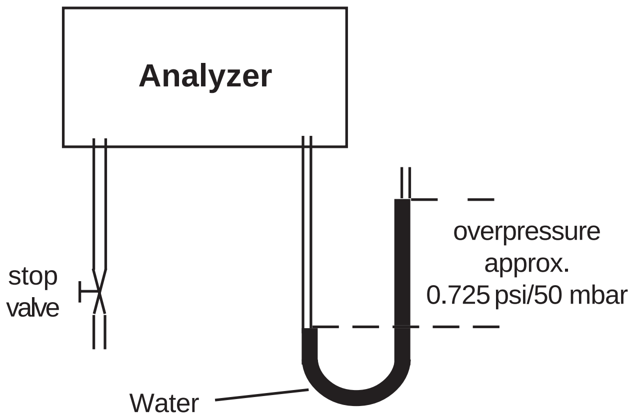


Fig. 7-1: Leak Testing with U-turn Manometer

Max. pressure 7.25 psig (500 mbar)!

Dual channel instruments: Analyzers with parallel tubing require separate leak tests for each gas path !

7-3 Calibration Procedures

Note!
To achieve best and proper measuring results it is recommended to perform zero and span calibrations on a regular weekly basis.
Also a zero calibration must always precede a span calibration!

Zero calibration
To perform a zero calibration supply either Nitrogen (N2) or another suitable zero gas [conditioned ambient air or industrial air (NOT for Oxygen measurement!)] to the gas path.

Span calibration
Supply span gases with concentrations of 80 % to 110 % of the upper measuring range limit to the gas path. Using lower concentrations may decrease accuracy when measuring above the span gas concentration!
If the Oxygen concentration is known ambient air may be used for an Oxygen channel span calibration.

X-STREAM gas analyzers support several calibration procdures:

Manual calibration
Typically a calibration procedure is carried out manually by supplying the gases sequentially by hand and activating the procedures via front panel keys.The operator has to take care to consider purge times and supply the proper gases in correct order.
It is the operators responsibility to not perform a span calibration without a preceding zero calibration!

Advanced (manual) calibration
Advanced calibration is a more comfortable variation of manual calibration, providing ONE KEY calibrations supported by internal and/or external valves. The analyzer automatically supplies the right gas and considers purge times.

Remote calibration
Remote calibrations may be activated by means of digital inputs or Modbus commands. Calibrations activated via digital inputs require either internal or external valves to be installed. Modbus supports both calibrations with or without valves as well as calibration sequences.

Unattended automatic calibration
Unattended automatic calibrations are activated utilizing the analyzer software time interval setting:
After a specified time interval has elapsed, the analyzer automatically carries out valve supported zero or span calibrations.
The main advantage is that no user interaction is required to start a calibration nor during calibrations: The analyzer automatically supplies the right gas, considers purge times and, that a span calibration has to be preceded by a zero calibration.

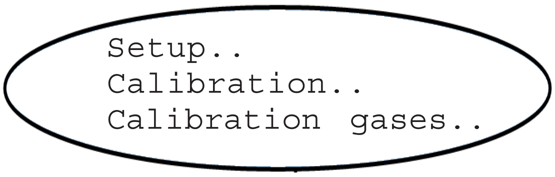
Before starting calibrations take care of section 7-3-1. pg. 7-4, describing general preparations for all kinds of calibration procedures!

The following sections describe in detail how to carry out manual calibrations (☞ 7-3-2, pg. 7-10), advanced calibrations (☞ 7-3-3, pg. 7-13), remote calibrations (☞ 7-3-4, pg. 7-21) and unattended automatic calibrations (☞ 7-3-5, pg. 7-26).

7-3 Calibration Procedures

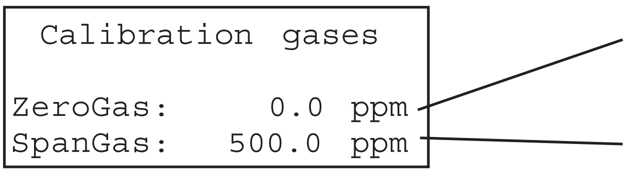
7-3-1 Preparing a Calibration

Before starting calibrations it is required to tell the instrument the calibration gas concentrations.



Starting from the measurement screen press the DOWN key to open the MAIN MENU, enter the SETUP-CALIBRATION.. menu and directly enter the CALIBRATION GASES.. menu.

Dual channel instrument:
Optional gas component selection menu - Select the component to be setup



Enter the concentration value for the zero gas to be used during zero calibration.

Enter the concentration value for the span gas to be used during span calibration.

Note!
The units for the calibration gases are taken from the related entry in the display setup menu.

Dual channel instrument:
Pressing the ← key while any line is selected returns to the optional gas component selection menu to open the same menu for the other measuring channel.

When done, press the LEFT key to return to the CALIBRATION menu.

7-3 Calibration Procedures


```
Calibration gases...
Tol.Check:       Off
Purge time:     15 s
Interval time...
```

Example:
Measuring range: 0 ... 50 %
Zero gas: 0 %
Span gas: 50 %
Situation:
Due to a fault zero gas is supplied to carry out a span calibration, instead of span gas.
Tolerance check disabled (Off):
The analyzer calibrates the span with the wrong gas resulting in an analyzer out of tune.
Tolerance check enabled(10%; AutoOff):
Starting a span calibration with zero gas connected instead of span gas, the analyzer gives an error message and stops calibrating because the measured (expected span gas) value differs more than 10 % from the upper measuring range limit.

By default the option TOL. CHECK (tolerance check) is disabled (**OFF**).
So tolerance check helps avoiding calibrating with a wrong gas applied (e.g. starting a span calibration while zero gas is flowing) resulting in an instrument out of tune.

With tolerance check enabled ("10%") during calibration the analyzer checks that the entered (setpoint) values for zero gas and span gas are reasonable compared to the currently flowing calibration gas. If this gas concentration differs more than 10 % of measuring range from zero (during zero calibration) or span gas setup (during span calibration), calibration is aborted and a maintenance request alarm is set (LED and relay output). Resetting the alarm requires to perform a valid calibration or to confirm it within the CONTROL -> ACKNOWLEDGEMENTS.. screen.
The 3rd option (**AutoOff**) has the same functionality as **10%** except that the maintenance request is reset after 2-3 minutes.

There are still situations when tolerance check must be disabled, e.g. when calibrating after changing the span gas concentration.

Note!
Unacknowledged maintenance requests are stored even if the instrument is switched off and on again!
In addition: If, for example, a calibration was aborted because of a tolerance check, the maintenance request is active. If the operator does not acknowledge the request and performs a new calibration, now with disabled tolerance check, the earlier maintenance request is stored and re-activated again, when the tolerance check is enabled somewhere in the future!

7-3 Calibration Procedures

```
Calibration gases...
Tol.Check:       Off
Purge time:     15 s
Interval time...
```

Note!
*The next two lines (purge time & interval time) show up only if the valve option is other than "**none**" (see INSTALLED OPTIONS menu) and are used for remote calibrations and unattended calibrations only (see related sections for a description).*

7-3-1 Preparing Calibrations

7-3-1-1 Additional Preparations for Valve Supported Calibrations

As described earlier, several calibration procedures require installed internal and/or external valves.
In addition this requires all requested calibration gases to be connected to the valves and the valves to be software assigned to the gases.

Why is assigning valves required?
For such calibrations the analyzer controls the gas flow and therefore needs to "know" about the different valve functions - this is done by valve assignment.
In addition variable valve assignment allows to use one valve for different functions.

Example:

- *Dual channel analyzer for measuring CO and CO_2.*
- *Spangases are CO and CO_2, zero gas for both channels is N_2.*

***Without** variable assignment one would need to zero span channel 1 separately from channel 2. Taking into account the purges times before a calibration calculation starts, to ensure the measuring cells are filled with calibration gas, the whole procedure would take a quite long time.*

***With** variable valve assignment the operator can specify e.g. the valve V1 to be the zero gas valve for channel 1 AND channel 2. Now, when starting a zero calibration, the analyzer calculates the zero values for both channels at a time!*

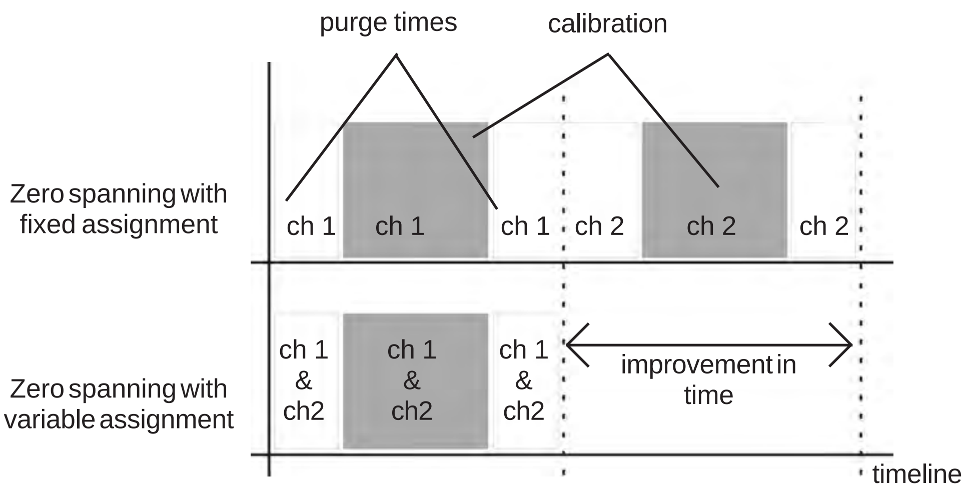
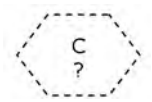


Fig. 7-2: Calibration improvement by variable valve assignments

7-3-1 Preparing Calibrations

```
Setup..
In/Outputs..
Valve  assignment..
```

If system is setup accordingly access level 3 code must be entered to access this menu.



Dual channel instrument:
Optional gas component selection menu - Select the component to be setup

Examples for assignments:

- *Dual channel analyzer, zero gas is the same for both channels:*

  Possible assignments

Span 1	*V1*	*V1*	*V2*	*V2*	*V4*	*V4*
Span 2	*V2*	*V4*	*V1*	*V4*	*V1*	*V2*
Zero	*V4*	*V2*	*V4*	*V1*	*V2*	*V1*

- *Dual channel analyzer, span gas is the same for both channels, zero gas is different:*

  Possible assignments

Span 1	*V1*	*V1*	*V2*	*V2*	*V4*	*V4*
Zero 1	*V2*	*V4*	*V1*	*V4*	*V1*	*V2*
Zero 2	*V4*	*V2*	*V4*	*V1*	*V2*	*V1*

- *Dual channel analyzer, both channels require the same zero AND span gas concentrations:*

  Possible assignments

Span	*V1*	*V2*	*V1*	*V4*	*V2*	*V4*
Zero	*V2*	*V1*	*V4*	*V1*	*V4*	*V2*

Internal valves by default are assigned as follows:
V1: Spangas 1 (span gas for channel 1)
V2: Spangas 2 (span gas for channel 2 , dual channel instrument only)
V3: Sample gas (not changeable)
V4: Zero gas

If you're using **external valves**:
Assign your valves individually to the applied gasesusing the labels V1, V2 and V4; only valve V3 cannot be changed and is fixed to the sample gas:
Label them V1, V2 , V3, V4 and write down the relations.

7-3-1 Preparing Calibrations

```
 Valve  assignment

Zero/Span:      V1/V4
```

As the next step open the valve assignment menu. This menu allows to assign internal and external valves V1, V2 and V4 to zero gas and span gas.

Now select the proper assignment for every channel according your written relations.

Available options are:
V1/V2, **V1/V4**, **V2/V4**, **V2/V1**, **V4/V1**, **V4/V2**

Example for an assignment:

Dual channel analyzer, zero gas is the same for both channels:

Relation taken from the gas system:
Span 1: V2
Span 2: V4
Zero: V1

Within the menu select ***V1/V2*** *for the first channel and* ***V1/V4*** *for the second channel.*

Note for dual channel instruments:
The combinations may be assigned for channel 1 and 2 independently. This includes:

- *selecting different combinations for both channels*
- *selecting the same combination for both channels*
- *selecting combinations where one valve has the same function for both channels*
- *selecting combinations where one valve has different functions for both channels, e.g. the channel 1 zero valve is the channel 2 span valve.*

Depending on the gases used this may allow higher calibration performance .

7-3-2 Manual Calibration

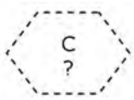
```
Control..
```

Starting from the measurement screen press the DOWN key to open the MAIN MENU, enter the CONTROL.. menu.

```
Zero  calibration..
Span  calibration..

▼
```

7-3-2-1 Manual Zero Calibration

To start a calibration select one of the two upper lines to perform the related calibration, e.g. ZERO CALIBRATION:



Dual channel instrument:
Optional gas component selection menu - Select the component to be calibrated.

Before selecting any further line make sure the required calibration gas is applied and flowing!

Supply all calibration gases with the same flow as the sample gas (recommeded approx. 1 l/min), pressureless and utilizing the right gas fitting (see sect. 3-4).

Ensure the warm-up time after switching on has elapsed! Warm-up time is 15 to 50 minutes depending on installed measuring system and configuration!

```
CANCEL  calibration!
START  calibration!
ZeroGas      0.000  ppm
▼CO2.1       0.200  ppm
```

The first line gives you the choice to cancel the procedure now.
Select the second line to **start the calibration**.
Line 3 shows the calibration gas setup (here: required zero gas concentration is 0.000 ppm), while line 4 shows the currently measured gas concentration.

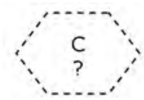
7-3-2 Manual Calibration


```
CO2.1        0.000 ppm
Procedure       Zero 1
Time              10 s
```

After having started a calibration watch the screen for information about the status:
The first lines shows the gas (channel) to be calibrated and the currently measured concentration (at the end of zero calibration this value should be set to about "0").
The line PROCEDURE shows what's currently happening (**Zero 1** = calibration for channel 1 ongoing; **None**= calibration finished), while the last line shows the remaining time till end of calibration (countdown starting from 2 times "t_{90} for calibration", which is 15 seconds).

When finished press the LEFT key two times to return to **either**
the component selection menu (dual channel analyzer only), if required select the second channel and perform the steps above to zero calibrate this channel, too,
or
to return to the CONTROL.. menu, which allows you to start a span calibration. The procedure and screens look similiar to those of a zero calibration: Select SPAN CALIBRATION...

7-3-2-2 Manual Span Calibration



Dual channel instrument:
Optional gas component selection menu - Select the component to be calibrated.

Before selecting any further line make sure the required calibration gas is applied and flowing!

```
CANCEL  calibration!
START  calibration!
SpanGas    20.000 ppm
▼CO2.1     16.200 ppm
```

The first line gives you the choice to cancel the procedure now.
Select the second line to **start the calibration**.
Line 3 shows the calibration gas setup (here: required span gas concentration is 20 ppm), while line 4 shows the currently measured gas concentration.

7-3-2 Manual Calibration

```
CO2.1      20.000 ppm
Procedure      Span 1
Time             10 s
```

After having started a calibration watch the screen for status information:
The first lines shows the gas (channel) to be calibrated and the currently measured concentration (at the end of span calibration it should be set to about the expected value).
The line PROCEDURE shows what's currently happening (Span 1 = calibration for channel 1 ongoing; None= calibration finished), while the last line shows the remaining time till end of calibration (countdown starting from 2 times "t_{90} for calibration", which is 15 seconds).

When finished either
press the LEFT key two times to return to the component selection menu (dual channel analyzer only), if required select the second channel and perform the steps above to span calibrate this channel, too,
or
press the HOME key to return to the measurement screen to close the manual calibration procedures.

7-3-3 Advanced Calibration

Standard manual calibration procedures offer limited funtionality:
To zero and span calibrate a dual channel instrument the operator has to manually start 4 procedures in proper sequence. In addition he has to stay at the instrument to see when the one sequence has finished and to start the following.
The same is applicable for a single channel instrument, when the operator wants to perform both zero and span calibrations.

To improve even manual calibration procedures, X-STREAM analyzers offer a new ADVANCED CALIBRATION menu: It allows single key activation for

- zero calibration of both channels of an analyzer
- span calibration of both channels of an analyzer
- zero and span calibration of both channels of an analyzer

Although advanced calibration offers most advantage for dual channel instruments, is may be used for single channel analyzers as well: Activate zero and span calibration for the one channel by a single key.

The only precondition for making use of this new feature is to have installed internal and/or external valves and proper assigned (☞7-3-1-1, page 7-7).

For a description of how to

perform advanced zero calibrations	☞ 7-3-3-1, page 7-14
perform advanced span calibrations	☞ 7-3-3-2, page 7-16
perform advanced zero & span calibrations	☞ 7-3-3-3, page 7-18

7-3-3 Advanced Calibration

7-3-3-1 Zero All Calibration

Before selecting any further line make sure the required calibration gas is applied!

Supply all calibration gases with the same flow as the sample gas (recommeded approx. 1 l/min), pressureless and utilizing the right gas fitting ((sect. 3-4).

Make sure the calibration purge time is set to a value ensuring the measuring cell is filled pro-perly with the related calibration gas after the valve has opened!

Ensure the warm-up time after switching on has elapsed! Warm-up time is 15 to 50 minutes depending on installed measuring system and configuration!

```
Control..
Adv.Calibration..
```

Starting from the measurement screen press the DOWN key to open the MAIN MENU and enter the CONTROL - ADV.CALIBRATION menu.

```
Cancel  calibration!
ZeroAll!
SpanAll!
ZeroSpanAll!
```

To start a ZERO calibration for ALL channels select the second line.

Note!
Single channel analyzers show the same menu, with the restriction, that the term "ALL" relates to the single channel only!

The analyzer immediately begins zero calibration(s). Watch the screen for status information (explained by means of exemplary pictures on the next page).

7-3-3 Advanced Calibration

```
Gasflow               V4

Procedure        Purging
Time                10 s
```

The first screen appearing shows that valve V4 is open. Currently the system is purged (prepurge) to ensure it is properly filled with zero gas when zero calculation is started. The remaining purge time is 10 seconds (decreasing from the value entered in the calibration setup screen, page 7-6).

```
Gasflow               V4

Procedure         Zero 1
Time                29 s
```

When the prepurge time has elapsed, the instrument starts to calculate the zero point (here indicated by the procedure term **Zero 1**): Zero gas is still applied, the time count down starts at a value corresponding to 2 times "t_{90}-for- calibration" (2 x 15 s).

Note!

Dual channel instruments zeroing both channels at a time, show "Zero 1" in the procedure line while calibration is ongoing. When calibration has finished, for a short periode (about 1 to 2 seconds) the line shows "Zero 2" to indicate the second channel has been calibrated, too.

```
Gasflow           Sample
CO2.1          0.000 ppm
Procedure        Purging
Time                10 s
```

After zero calibration has finished, the instrument closes the zero gas valve and opens the sample gas valve. Now a postpurge procedure starts to indicate that proper sample gas measurement values require the system to be filled with the related gas only. Postpurge time again is the purge time entered in the calibration setup screen (see page 7-6).

The zero calibration procedure has finished when the last time interval shows remaining *0 seconds* and the gas flow is *sample*.

Now press
either the LEFT key to return to the advanced calibration menu to select another calibration procedure
or the HOME key to return to the measuring screen.

7-3-3 Advanced Calibration

7-3-3-2 Span All Calibration

Before selecting any further line make sure the required calibration gas is applied!

Supply all calibration gases with the same flow as the sample gas (recommeded approx. 1 l/min), pressureless and utilizing the right gas fitting ((☞ sect. 3-4).

Make sure the calibration purge time is set to a value ensuring the measuring cell is filled pro-perly with the related calibration gas after the valve has opened!

Ensure the warm-up time after switching on has elapsed! Warm-up time is 15 to 50 minutes depending on installed measuring system and configuration!

```
Control..
Adv.Calibration..
```

Starting from the measurement screen press the DOWN key to open the MAIN MENU and enter the CONTROL - ADV.CALIBRATION menu.

```
Cancel  calibration!
ZeroAll!
SpanAll!
ZeroSpanAll!
```

To start a SPAN calibration for ALL channels select the third line.

Note!
Single channel analyzers show the same menu, with the restriction, that the term "ALL" relates to the single channel only!

The analyzer immediately begins span calibration(s). Watch the screen for status information (explained by means of exemplary pictures on the next page).

7-3-3 Advanced Calibration

```
Gasflow              V1

Procedure       Purging
Time               10 s
```

The first screen appearing shows that a valve (here: **V1**) is open. Currently the system is purged (prepurge) to ensure it is properly filled with zero gas when zero calculation is started. The remaining purge time is **10** seconds (decreasing from the value entered in the calibration setup screen, (☞ page 7-6).

```
Gasflow              V1

Procedure        Span 1
Time               29 s
```

When the prepurge time has elapsed, the instrument starts to calculate the span value (here indicated by the procedure term **Span 1**): Span gas is still applied, the time count down starts at a value corresponding to 2 times "t_{90}-for- calibration" (2 x 15 s).

```
Gasflow              V2

Procedure       Purging
Time               10 s
```

```
Gasflow              V2

Procedure        Span 2
Time               29 s
```

When channel 1 has finished spanning, the same procedure is automatically started for the second channel (if installed!): The next valve (here: **V2**) opens to prepare spanning for channel 2. Again the instrument shows **Purging**, followed by **Span 2**.

After span calibration has finished, the instrument closes the last open valve and opens the sample gas valve. Now a postpurge procedure starts to indicate that proper sample gas measurement values require the system to be filled with the related gas only. Postpurge time again is the purge time entered in the CALIBRATION SETUP screen ((☞ page 7-6).

```
Gasflow          Sample
CO2.1         0.000 ppm
Procedure       Purging
Time               10 s
```

The SpanAll calibration procedure has finished when the last time interval shows remaining **0** seconds and the gas flow is **Sample**.
Now press
either the LEFT key to return to the advanced calibration menu to select another calibration procedure
or the HOME key to return to the measuring screen.

7-3-3-3 Zero & Span All Calibration

Before selecting any further line make sure the required calibration gas is applied!

Supply all calibration gases with the same flow as the sample gas (recommeded approx. 1 l/min), pressureless and utilizing the right gas fitting (see sect. 3-4).

Make sure the calibration purge time is set to a value ensuring the measuring cell is filled pro-perly with the related calibration gas after the valve has opened!

Ensure the warm-up time after switching on has elapsed! Warm-up time is 15 to 50 minutes depending on installed measuring system and configuration!

```
Control..
Adv.Calibration..
```

Starting from the measurement screen press the DOWN key to open the MAIN MENU and enter the CONTROL - ADV.CALIBRATION menu.

```
Cancel  calibration!
ZeroAll!
SpanAll!
ZeroSpanAll!
```

To start a ZERO & SPAN calibration for ALL channels select the last line.

Note!
Single channel analyzers show the same menu, with the restriction, that the term "ALL" relates to the single channel only!

The analyzer immediately begins zero calibration(s for all channels), followed by span calibration(s). Watch the screen for status information (explained by means of exemplary pictures on the next page).

7-3-3 Advanced Calibration

```
Gasflow                V4

Procedure         Purging
Time                 10 s
```

The first screen appearing shows that valve V4 is open. Currently the system is purged (prepurge) to ensure it is properly filled with span gas when span calculation is started. The remaining purge time is **10** seconds (decreasing from the value entered in the calibration setup screen, ☞ page 7-6).

```
Gasflow                V4

Procedure          Zero 1
Time                 29 s
```

When the prepurge time has elapsed, the instrument starts to calculate the zero point (here indicated by the procedure term **Zero 1**): Zero gas is still applied, the time count down starts at a value corresponding to 2 times "t_{90}-for- calibration" (2 x 15 s).

Note!
*At dual channel instruments zero spanning both channels at a time, the procedure line shows **Zero 1** while calibration is ongoing. When calibration has finished, for a short periode (about 1 to 2 seconds) the line shows **Zero 2** to indicate the second channel has been calibrated, too.*

```
Gasflow                V1

Procedure         Purging
Time                 10 s
```

After zero calibration has finished, the instrument closes the zero gas valve and opens the sample gas valve. Now a postpurge procedure starts to indicate that proper sample gas measurement values require the system to be filled with the related gas only. Postpurge time again is the purge time entered in the calibration setup screen (☞ page 7-6).

7-3-3 Advanced Calibration

```
Gasflow                V1

Procedure          Span 1
Time                 29 s
```

When the prepurge time has elapsed, the instrument starts to calculate the span value (here indicated by the procedure term **Span 1**): Span gas is still applied, the time count down starts at a value corresponding to 2 times "t_{90}-for-calibration" (2 x 15 s).

```
Gasflow                V2

Procedure         Purging
Time                 10 s
```

```
Gasflow                V2

Procedure          Span 2
Time                 29 s
```

When channel 1 has finished spanning, the same procedure is automatically started for the second channel (if installed!): The next valve (here: **V2**) opens to prepare spanning for channel 2. Again the instrument shows **Purging**, followed by **Span 2**.

```
Gasflow            Sample
CO2.1           0.000 ppm
Procedure         Purging
Time                 10 s
```

After span calibration has finished, the instrument closes the last open valve and opens the sample gas valve. Now a postpurge procedure starts to indicate that proper sample gas measurement values require the system to be filled with the related gas only. Postpurge time again is the purge time entered in the calibration setup screen (page 7-6).

The SpanAll calibration procedure has finished when the last time interval shows remaining **0** seconds and the gas flow is **Sample**.
Press the HOME key to return to the measuring screen.

7-3-4 Remote Calibrations

Remote calibrations may be initialized by digital inputs or Modbus commands, whereat both offer different functionalities::

Remote control via **digital inputs** (option) is feasible only in combination with internal or external valves and is limited to 3 procedures, each linked to one separate input:Zero calibrate all channels, span calibrate channel 1 and span calibrate channel 2. It is the operators responsibility to not perform a span calibration without a preceding zero calibration!

The **Modbus interface** offers more variability in performing calibrations:

- Calibration without valves:
  The Modbus command initializes the procedure within the analyzer, but the operator has to take care that the gases are supplied in proper order, has to consider purge times as well as the condition to not perform a span calibration without a preceding zero calibration. So, in this configuration Modbus may be used e.g. together with an external sample handling system that controls the gas flow.
- Calibration with valves:
  Installed and assigned valves (☞ 7-3-1-1, page 7-7) support two different variations of how to perform calibrations:
  1. Perform single calibrations
     The Modbus command initializes single procedures (zero or span calibrations). The analyzers controls gas supply and purge times while it is the operators responsibility to not activate a span calibration without a preceding zero calibration!
  2. Special calibration procedures:
     - Zero calibrate both channels
     - Span calibrate both channels
     - Zero and span calibrate both channels (or the only channel in case of single channel instruments).

     Initialized by the Modbus command the analyzer performs above mentioned procedures and controls gas supply, purge times and (for the last given procedure only) considers to not activate a span calibration without a preceding zero calibration.

For detailled descriptions on how to perform

calibrations initialized via digital inputs ☞ 7-3-4-1, page 7-22
calibrations initialized via Modbus, without valves ☞ 7-3-4-2, page 7-24
calibrations initialized via Modbus, with valves ☞ 7-3-4-3, page 7-25

7-3-4 Remote Calibrations

7-3-4-1 Calibrations Initialized via Digital Inputs

As already mentioned, the analyzer must either provide internal valves or external valves (connected to its digital outputs), to make use of this feature.
It has also to be considered, that digital inputs and outputs have fixed functions which are not to be changed:

Digital inputs:
- Input 1: Start zero calibration
- Input 2: Start channel 1 span calibration
- Input 3: Start channel 2 span calibration
- Input 4: Valve V4
- Input 5: Valve V1
- Input 6: Valve V2
- Input 7: Sample gas valve

Digital outputs:
- Output 5: Sample gas valve
- Output 6: Valve V4
- Output 7: Valve V1
- Output 8: Valve V2

☞ Chapter 4 for information about electrical data and installation of digital inputs and outputs.

Use digital inputs IN1 to IN3 to start calibration procedures as listed above. Take care that IN1 starts a zero calibration for **all** channels (if the instrument is a dual channel analyzer), while span calibrations need to be initialized for each channel separately.
These digital inputs are edged triggered and require a subsequent signal with a duration of at minimum 2 seconds, to be activated **(**☞ page 7-23 for a detailled description).

Applying signals to the voltage level triggered inputs N4 to IN7 activate valves. The signal voltages are evaluated in decreasing order of priority: IN4 is assigned the highest, IN7 the lowest prioritiy.

IN4 to IN6: A valve is opened by applying a HIGH level signal voltage to the related input while all inputs of higher priority are at LOW level. All other valves are closed at the same moment, regardless of the signal voltages applied to inputs of lower priorities.

Input IN7 has a converted input logic:
The related sample gas valve **opens** by applying a LOW level signal; a HIGH level signal **closes ALL valves (**☞ table 7-1).

Action / Input	***IN4***	***IN5***	***IN6***	***IN7***
Open valve V4	H	X	X	X
Open valve V1	L	H	X	X
Open valve V2	L	L	H	X
Open sample gas valve	L	L	L	L
Close all valves	L	L	L	H
	H: HIGH			
	L: LOW			
	X: don't care			

Table 7-1: Digital inputs IN4-IN7, evaluation array

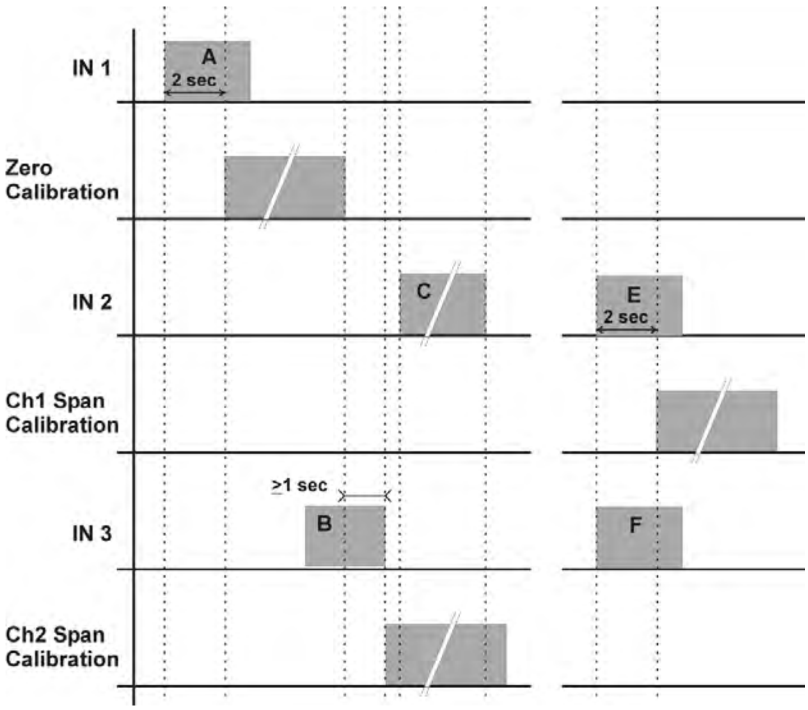
7-3-4 Remote Calibrations

As mentioned, input IN1 starts a zero calibration, IN2 a span calibration for channel 1 and IN3 a span calibration for channel 2.

The related procedure is initialized by a rising edge, subsequently follwoed by a signal with a duration of at minimum 2 seconds. Once started, such a procedure cannot be cancelled.

Additional triggers applied to any inputs during an ongoing calibration are considered only, if the subsequent signal is lasting at minimum 1 second, after the ongoing procedure has finished.

Multiple triggers applied to different inputs at the same time are evaluated in the order IN 1 - IN 2 - IN 3, means, first of all IN1 is considered, next IN2 and finally IN3 (So, if multiple triggers are applied, IN3 will never be activated because of the higher priorities of the other inputs!).



Example 1:
Signal A starts a zero calibration
Signal B is applied during the ongoing zero calibration. It ends more than 1 sec after the calibration is finished, so the related channel 2 span calibration is initialized.
Signal C is not considered, because it ends during the ongoing (channel 2 span) calibration.

Example 2:
Signals E and F are applied at the same time: Signal F is not considered because of its lower priority.

Fig. 7-3: Digital Inputs - Initializing Calibrations

7-3-4 Remote Calibrations

7-3-4-2 Modbus Activated Calibrations Without Valves

Several Modbus commands allow to start calibrations (☞ Chapter 9, List of Modbus Commands).

If the analyzer does neither provide internal valves nor digital inputs and outputs (for controlling external valves), then the procedure corresponds to the manual calibration, with the Modbus commands replacing the manual front panel button keypresses.

This means, the Modbus command immediately starts the calculation. The operator has to ensure in this moment, the proper gas is applied and the measuring system is filled with calibration gas. If applicable, he also has to take care to not activate a span calibration without a preceding zero calibration.

For detailled instructions about manual calibration ☞ 7-3-2, page 7-10.

7-3-4-3 Modbus Activated Calibrations With Valves

Several Modbus commands allow to start calibrations (☞ Chapter 9, List of Modbus Commands).

If the analyzer provides either internal valves or digital inputs and outputs (for controlling external valves), then Modbus commands allow to make use of all the options described in section 7-3-3 "Advanced Calibration" (page 7-13), with the Modbus commands replacing the manual front panel button keypresses.

This means, Modbus commands can initialize

- Zero calibrate both channels
- Span calibrate both channels
- Zero and span calibrate both channels (or the only channel in case of single channel instruments).

The analyzer controls the gas flow, if applicable optimizes the sequence of multiple calibrations and takes care to not activate a span calibration without a preceding zero calibration.

7-3-5 Unattended Automatic Calibration

The unattended automatic calibration feature allows to program the analyzer to automatically perform valve supported calibration procedures.

Compared to the procedures described in the section before (advanced calibration) there are only very limited options, comparable to the manual calibration procedures: The operator has the simple choice of programming zero, or zero and span calibration intervals.

The main features compared to single auto calibrations as described in sections 7-3-3-2 and 7-3-3-3 are:

1) the time, a calibration starts is defined by an interval time,

2) starting and processing calibrations does not need operator interaction

3) for span calibrations the analyzer considers the requirement that always a zero calibration has to be carried out first,

4) (dual channel instruments only) there is no selection for channel one or two. Every time an unattended calibration is started, this is done for both channels!

Before selecting any further line make sure the required calibration gases are applied, and valves are assigned properly!

Supply all calibration gases with the same flow as the sample gas (recommeded approx. 1 l/min), pressureless and utilizing the right gas fittings (see sect. 3-4).

Make sure the calibration purge time is set to a value ensuring the measuring cell is filled properly with the related calibration gas after the valve has opened!

Ensure the warm-up time after switching on has elapsed!
Warm-up time is 15 to 50 minutes depending on installed measuring system and configuration!

7-3-5 Unattended Automatic Calibration

```
Setup..
Calibration..
Interval time..
```

```
   Interval time

ZeroCal:          5 h
SpanCal:          5 h
```

Within the SETUP CALIBRATION menu the INTERVAL TIME.. line opens the following screen:

Two time intervals may be entered:

ZeroCal: This entry specifies intervals for zero calibrations only! If there is an entry for the SpanCal too, the instrument will carry out additional zero calibrations based on the ZeroCal interval.

SpanCal: This is the interval to elapse before the analyzer automatically starts a **complete calibration procedure** consisting of a zero calibration followed by a span calibration.

Setup the time intervals depending on your applicational needs.
Time intervall starts when the value is entered.
Entering **0** disables the related autocalibration.

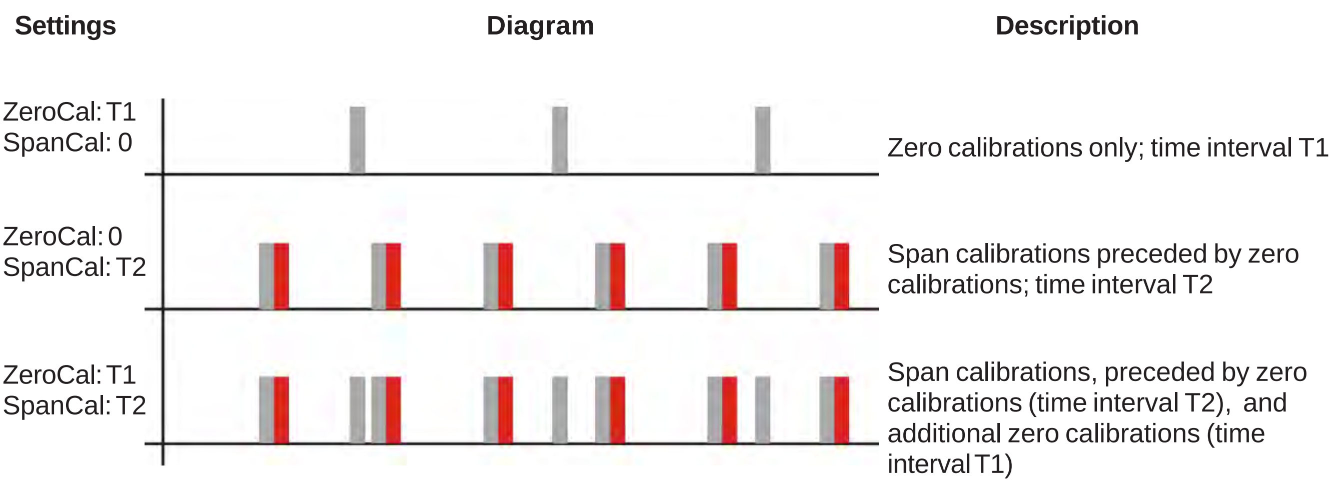


Fig. 7-4: Graphical Explanation of Interval Time Settings

7-3-6 Resetting a Calibration

```
CANCEL  calibration!
START  calibration!
ZeroGas      0.000  ppm
▼CO2.1       0.200  ppm
```

```
▲RESET  calibration..


CO2.1        0.200  ppm
```

```
  RESET  calibration
    Are  you  sure?
No!
Yes!
```

In case a wrong configuration was detected after calibration was performed (e.g. wrong gas connected) there is an option to restore the last user saved calibration data:
Within the screen where to start the calibration (either for span or zero) enter line 4:

A new screen appears with the option RESET CALIBRATION.. Pressing the ENTER key in this line results in a prompt for confirmation. Choosing YES replaces the current calibration data with the last calibration data (from UserData; 5-4-3-8 "SAVE-LOAD", page 5-44).

7-3-7 Verifying a Calibration

For instruments **without** internal and/or external valves simply apply either span or zero calibration gas to the sample gas inlet. If the calibration still is proper, the reading on the measurement screen should show the related value.

For instruments **with** internal and/or external valves follow the procedure below:

```
Control..
```

```
Zero  calibration..
Span  calibration..

▼Apply  gas..
```

Starting from the measurement screen press the DOWN key to open the MAIN MENU, enter the CONTROL.. menu.
Enter the last line (APPLY GAS..)

Dual channel instrument:
Optional gas component selection menu - Select the component to be setup

```
Apply gas:    ZeroGas
CO2.1       4.000 ppm

Time               2s
```

Changing the APPLY GAS parameter opens the related valve. Available options are *SpanGas, ZeroGas, Sample, None*.

The TIME line starts counting down the pre-purge time. When set properly and arrived at "0" the measuring cell is filled with the selected gas and the measuring value (here: CO_2; first channel) should show the expected concentration.

7-3-8 Cancelling an Ongoing Calibration

```
CANCEL calibration!
START calibration!
ZeroGas     0.000 ppm
▼CO2.1      0.200 ppm
```

To cancel an ongoing calibration procedure press the LEFT key to bring up the screen where the calibration was started and enter the CANCEL CALIBRATION! line.

Cancelling an ongoing calibration is feasible at any time with the following consequences:

During manual calibration:
Because there are no pre- and postpurge times, cancelling is feasible only during the calibration calculation process. Doing so will reset the calibration data to the data valid before the currently cancelled calibration was started.

During autocalibration**:**
Cancelling while prepurging or during calibration itself: The status changes showing sample gas to flow and the countdown starts with the postpurge time. Calibration data is reset to the data valid before the currently cancelled calibration was started.

Cancelling during postpurge does not influence the procedure because the new data has already been calculated and stored, and the (post-)purge time cannot be shortened (except by changing the related setup menu parameter).

```
CO2.1          0.000 ppm
Procedure         Zero 1
Time                 0 s
```

```
Gasflow           Sample
CO2.1          0.000 ppm
Procedure        Purging
Time                10 s
```

A confirmation popup appears, replaced by the calibration procedure screen, whose content depends on which calibration was cancelled (manual or auto).
Refer to the figures to the left :
The upper screen comes up when a manual calibration was cancelled.
The lower screen shows up when an autocalibration was cancelled: As the sample valve was opened again, a postpurge procedure was started.

Press the LEFT key to exit these screens.

7-3-9 Cross Interference Compensation

Note!
The following section refers to dual channel instruments only!

Several gases interfere the measuring results when appearing in the gas stream at the same time. The effect is that the concentration shown for component A is differing from the effectively present concentration due to influence of the component B, which in- or decreases the concentration shown for component A.

X-Stream gas analyzers allow to calculate and consider this effect of cross interference by means of a special calibration procedure: Calibrating the instrument once using **pure** span gases (instead of the standard span gases to be used for all following calibrations) allows the analyzer to calculate the effect of cross interference and to consider it during all following measurements and standard calibration procedures.
To do so, follow the instructions below:

```
Setup..
Measurement..
CrossInterference..
```

Enter the Cross Interference screen

If system is setup accordingly access level 3 code must be entered to access this menu.

```
 CrossInterference

Status:           Off
@ Span Cal:        No
```

⇩

```
 CrossInterference

Status:            On
@ Span Cal:       Yes
```

Setting the STATUS to **On** activates the cross interference compensation. To calculate the effect of interference during the **next following calibration** set the @SPAN CAL parameter to **YES**. (This parameter is automatically reset to **NO** after the this calibration was performed).

In a next step ensure the span gases for both channels are applied and are of **pure quality!** (Pure span gases are only required for this special calibration procedure. Further calibrations can be performed with standard span gases).

Now perform a calibration considering the following procedure (only possible by manual calibration!):

1. Zero cal both channels
2. Span cal channel 1 with pure span gas
3. Span cal channel 2 with pure span gas
4. Span cal channel 1 once more with pure span gas.

What happens?
After having zero calibrated both channels, the analyzer span cals the first channel and calculates the interference of span gas 1 into channel 2.
The next step span calibrates channel 2, already considering the influence of span gas 1. At the same time the analyzer calculates the interference of span gas 2 on channel 1.
Performing step 4 recalibrates channel 1 taking into account the inference of span gas 2 on channel 1 (that was not considered in step 1).

When step 4 has finished, the @ SPAN CAL parameter is automatically reset to **No**.
For considering the calculated effects of cross interference during all future measurements and calibrations ensure the STATUS parameter is **On**.

Pure span gases are not longer required and for cost saving reasons may now be replaced by standard span gases.

7-4 Replacing the ElectrochemicalSensor

In consequence of it‘s design the sensor‘s lifetime is limited and depends on theoretical designed life and Oxygen concentration. The sensor output can be taken as a rough criterion for end of lifetime: The sensor is worn-out when the output in atmosphere is below 70 % of the initial output. The period till then can be calculated by

$$\text{Lifetime} = \frac{\text{designed life (hours)}}{O_2 \text{ concentration (\%)}}$$

The sensor‘s designed life under constant conditions of 20 °C is approx. **900,000 hrs.**

The lifetime at 21 % Oxygen is therefore calculated to approx. **42,857 hrs, corresponding to approx. 5 years.**

Irrespective of all calculations above:
A sensor is worn-out when, connected to ambient air, the output voltage is less than 2.8 V: Replace the sensor!

For replacing the electrochemical sensor the following tools are required:

- 1 Philips screw driver # 1 for 19" instruments or the square key for the field housing's squash fasteners to remove/ open the cover/front door.
- 1 Torx screw driver # 10 for disassembling the sensor unit.
- 1 digital volt meter (measuring range 0 ... 2 V dc minimum) with suitable cables and probes.

Note 1!
The given values are for reference only! The expected lifetime is greatly affected by the temperature of the environment in which the sensor is used or stored. Increases or decreases in atmospheric pressure have the same effect as that by increases or decreases in Oxygen concentration. (Operation at 40 °C halves lifetime).

Note 2!
Due to the measuring principle the electrochemical Oxygen cell requires a minimum internal consumption of Oxygen (residual humidity avoids drying up the cell). Supplying cells continuously with dry sample gas of low grade Oxygen concentration or with sample gas free of Oxygen could result in a reversible detuning of O_2 sensitivity. The output signal will become unstable, but response time remains constant.
For proper measurement results the cell needs to be supplied continuously with concentrations of at least 0.1 Vol.-% O_2.
We recommend using the cell if need be in alternating mode, means to purge the cell with conditioned ambient air (not dried, but dust removed) when measurement pauses.
If it is necessary to interrupt Oxygen supply for several hours or days, the cell has to regenerate (supply cell for about one day with ambient air). Temporary flushing with Nitrogen (N_2) for less than 1 h (e.g. for analyzer zeroing purpose) has no influence on measuring characteristics.

7-4 Replacing the Electrochemical Sensor

WARNING

ELECTRICAL SHOCK HAZARD !

Working at opened and powered instruments means working near live parts and is subject to instructed and trained personnel only!

WARNING

EXPLOSIVE, FLAMMABLE AND HARMFUL GASES HAZARD !

Before opening gas paths they must be purged with ambient air or neutral gas (N_2) to avoid hazards caused by toxic, flammable, explosive or harmful to health sample gas components!

CAUTION

ELECTROSTATIC DISCHARGE HAZARD !

Working at internal components of electronical and electrical instruments may cause electrostatic discharge (ESD), destroying components!

Working at open instruments is recommended at special workplaces only! If no such workplace is available, at minimum perform the following procedures to not destroy electronic components:

Discharge the electric charge from your body. Do this by touching a device that is grounded electrically (e.g. instruments with earth connectors, heating installations). This should be done periodically when working at open instruments (especially after leaving the service site, because e.g. walking on low conducting floors might cause additional ESD).

7-4 Replacing the Electrochemical Sensor

7-4-1 Precautions for Sensor Handling

CAUTION

GENERAL HINTS ON HANDLING THE SENSOR

Do not expose the sensor to a temperature other than the temperature range of -20 to +60'C (-4 to +140 F). Exposing to a temperature outside the temperature range may cause abnormal output or leak of the electrolyte due to parts degradation or damage.

Make sure to prevent condensation of the oxygen concentration detecting part. If condensed, the output will lower and response speed will slow down, disabling accurate concentration measurement. The sensor characteristics will return to the original characteristics if condensation moisture evaporates after putting the sensor in dry air several hours to several days.

Do not drop or apply a violent shock or vibration to the sensor. If shocked or vibrated, the sensor output may temporarily vary or become unstable. The original sensor condition will usually reset by putting the sensor in a stationary condition in the atmosphere at a ordinary temperature several hours to several days. Depending on the degree of a shock or vibration, the internal sensor structure may break and the sensor may not return to original condition.

Do not disassemble or repair the sensor. Removing a sensor part or remodeling the sensor will damage the sensor or leak the electrolyte and restoration to the original condition may not be possible.

7-4 Replacing the Electrochemical Sensor

WARNING

HAZARD FROM WEAK ACID AQUEOUS SOLUTION

If the electrolyte leaks due to sensor damage, put the sensor in a plastic bag so that the solution will not be smeared on other places and return the sensor to Emerson Process Management or an industrial waste management contractor.

The electrolyte is a weak acid aqueous solution of 5 to 6 in pH with an irritating odor. It will not ignite spontaneously even if it is left. Nevertheless, lead acetate, which is a component of the solution, is harmful to human bodies and should be handled with care as follows:

- **If the electrolyte leaked due to sensor damage is smeared on the skin or clothing, immediately wash the contacted part with soapy water and wash off the solution with a large amount of tap water.**
- **If the electrolyte leaked due to sensor damage gets into an eye, immediately wash the eye with a large amount of tap water for 15 minutes and consult a doctor promptly.**
- **If the electrolytic solution or atomized electrolytic solution leaked due to sensor damage is inhaled, immediately wash the nostrils and gargle with tap water and consult a doctor promptly.**
- **If the electrolyte leaked due to sensor damage is swallowed, immediately wash the mouth with tap water. Swallow a large amount of tap water or 600 cc of milk and vomit it. Consult a doctor promptly.**

Discarded sensors may cause environmental pollution. Return a worn-out sensor to Emerson Process Management or an industrial waste management contractor when discarding a worn-out sensor.

7-4 Replacing the Electrochemical Sensor

7-4-2 Opening the Analyzer

WARNING

ELECTRICAL SHOCK HAZARD

Live parts are accessible when working at open instruments!
Take care to observe all applicable safety instructions!

7-4-2-1 Opening X-STREAM GP / GPS

Locate the 12 screws at the top of the instrument and after loosening them remove the cover.

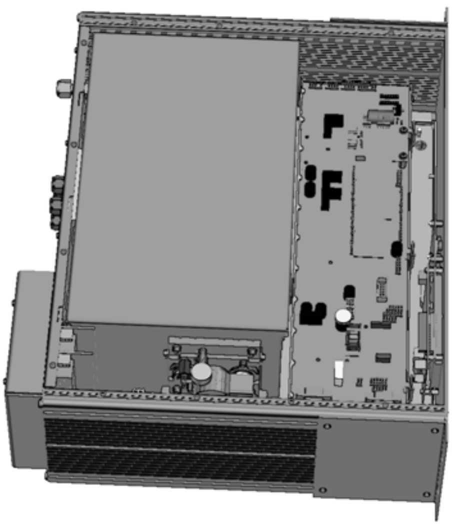


Fig. 7-5: X-STREAM GP/GPS - Interior view

7-4 Replacing the Electrochemical Sensor

7-4-2-2 Opening X-STREAM F

Open the front door utilizing the two sash fasteners. Flip down the front door carefully to not damage the instrument, hinges or equipment installed below the analyzer.

7-4-2-3 Opening X-STREAM FD

To open a X-STREAM FD loosen the 20 screws located at the instrument´s flange. Then carfeully flip down the front door to not damage the instrument, hinges or equipment installed below the analyzer.

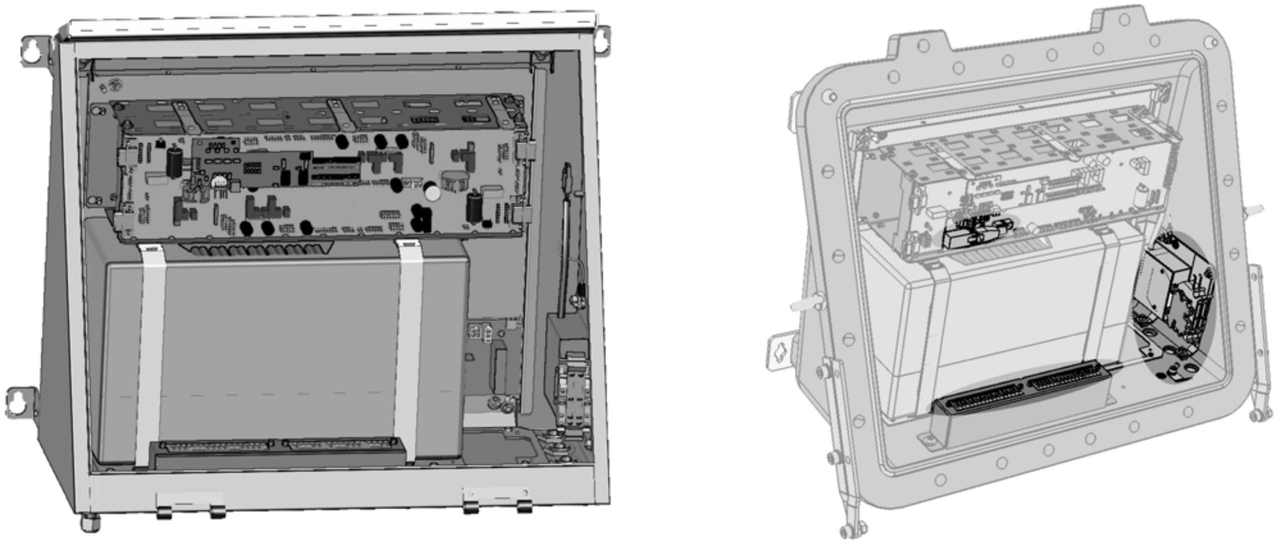


Fig. 7-6: X-STREAM F AND FD - Interior views (shown without front doors)

WARNING

POSSIBLE EXPLOSION HAZARD

The analyzer variations X-STREAM F (provided with an external pressurization system) and FD may be installed in a hazardous area.

Maintaining such instruments is permitted only considering special conditions, givenin the related separate manuals.

Do not open nor maintain instruments in hazardous areas without having read and understood all related instruction manuals!

7-4 Replacing the Electrochemical Sensor

7-4-3 Locating the Sensor

There are two options for the sensor to be placed (fig. 7-7):

- for instruments with internal thermostatic control the sensor unit is placed within the electronics card cage beneath the main board BKS.
- for instruments without internal thermostatic control the sensor unit is placed inside the physical components box.

The main board is fixed in the cardcage by means of 3 detent springs (fig. 7-8): Pushing the upper end from the cardcage loosens the main board allowing to take it out.
The eO_2 sensor unit is now accessible (fig. 7-9).

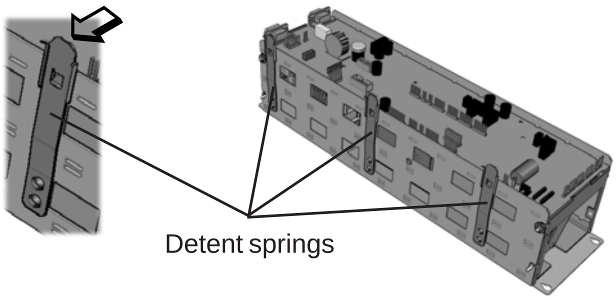


Fig. 7-8: Cardcage Detail

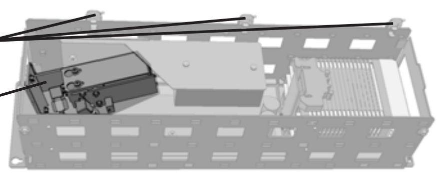


Fig. 7-9: Allocation of eO_2 Sensor Unit (BKS removed)

Note!
Cardcage and components box are shown on the basis of a X-STREAM GP instrument, but look alike in all other variations.

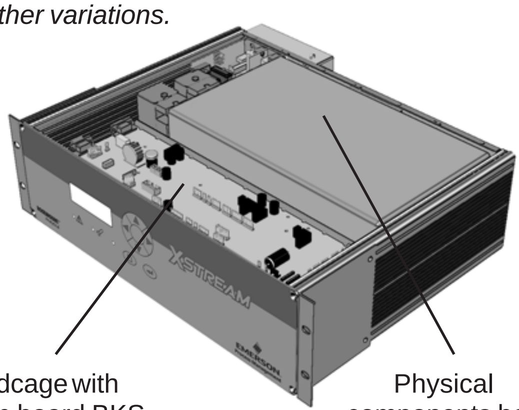


Fig. 7-7: X-STREAM GP Interior View

In case the sensor unit is installed inside the physical components box, remove the box cover to get access to the internal components: Depending on design the cover is secured with up to 2 detent springs (fig. 7-10):Press the springs to release the cover.

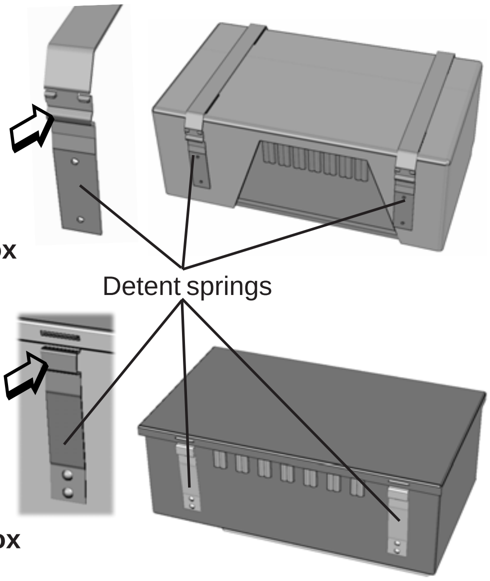
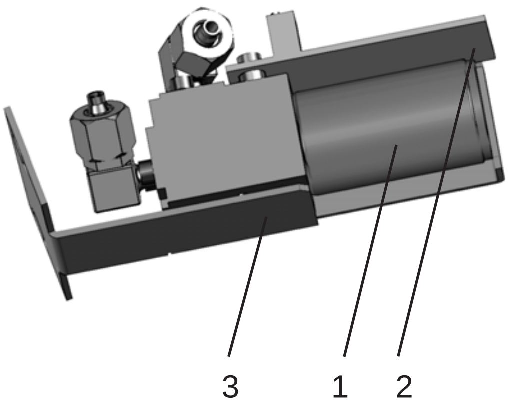


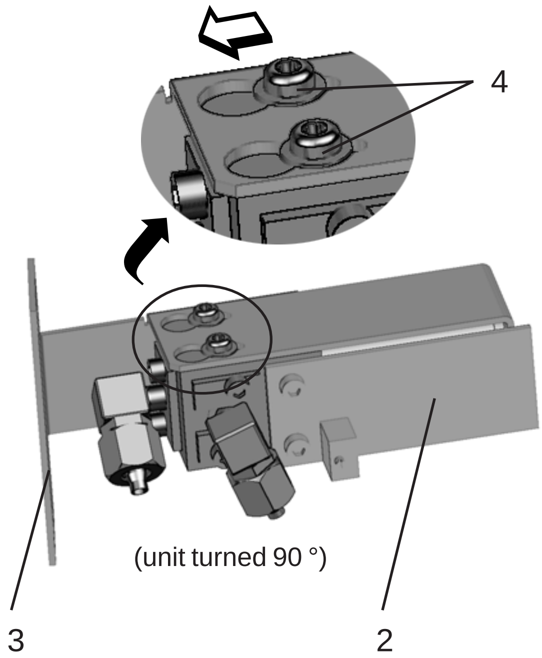
Fig. 7-10: Physical Components Box

7-4-4 Sensor Unit Disassembly

The sensor unit consists of a mounting support, an electronics board and the sensor itself (fig. 7-11).

The right side picture shows two screws fixing the sensor block to the mounting support: Loosen the screws and push the block with attached electronics and sensor towards the wider end of the slot to separate them from the mounting support.





1	Sensor	3	Mounting support
2	Electronics board	4	Fixing screws

Fig. 7-11: Sensor Unit Assembly

Now unplug the connector from the electronics board and remove the sensor from the block. Take the new sensor, remove it's plug, place it into the sensor block and attach the connector to the related strip P2 on the electronics board.

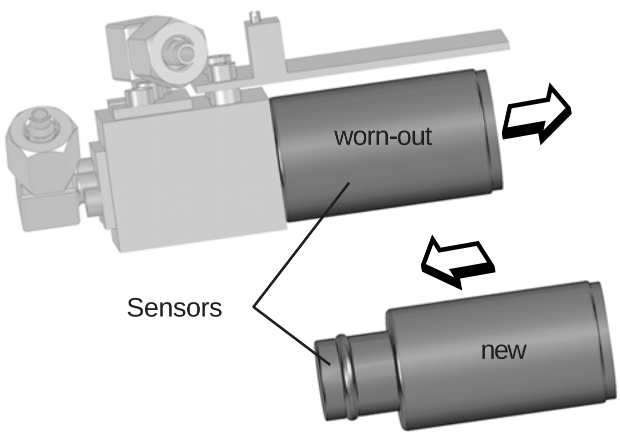


Fig. 7-12: Sensor Block Assembly

7-4 Replacing the Electrochemical Sensor

7-4-5 Sensor Amplifier Adjustment

After having replaced an electrochemical sensor the related amplifier requires adjustment to achieve proper measurement results.

WARNING

ELECTRICAL SHOCK HAZARD

Working at open and powered instruments means working near live parts and is subject to instructed and trained personnel only!

To do so,

- power on the opened instrument.
- Supply ambient air (approx. 21 % O_2)
- Connect a digital voltmeter (DVM) to Tp 1 (signal) and Tp 2 (GND) on the electronics board OXS (fig. 7-13).
- Adjust the measured signal to 3360 mV DC (± 5 mV) utilizing the potentiometer R4 on OXS board.

Note!
Once the output signal has been adjusted for a specific sensor changing the potentiometer settings will cause incorrect measuring results!

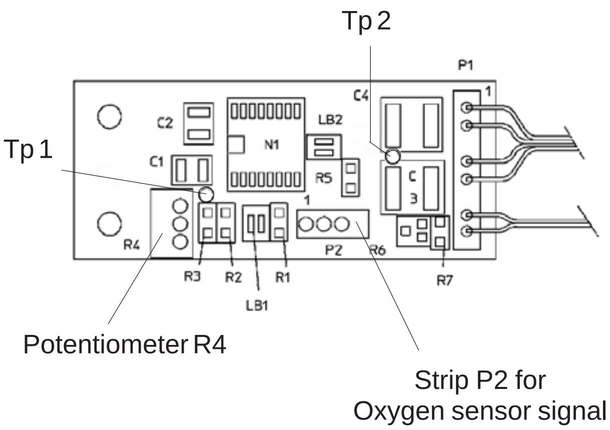


Fig. 7-13: OXS Board, top view

7-4-6 Finalizing the Sensor Replacement

- Power off the analyzer and close the housing.

In a next step now perform a zero and span calibration at least for the channel the replaced sensor is related to.

Close the worn-out sensor´s opening with the sealing plug taken from the new sensor. Send it back to the EMERSON Process Management factory (or to your local sales office) or to an industrial waste management contractor for waste disposal.

7-5 Cleaning the Instrument's Outside

Use a liquid general purpose detergent and a lint-free cloth for cleaning the analyzer´s outside.

Procedure

- Disconnect instrument from mains!

WARNING

EXPLOSIVE, FLAMMABLE AND HARMFUL GASES HAZARD !

Before opening gas paths they must be purged with ambient air or neutral gas (N_2) to avoid hazards caused by toxic, flammable, explosive or harmful to health sample gas components!

If opening the gas paths is required, seal the open analyzer´s gas fittings utilizing PVC caps to avoid pollution of inner gas path.

- Moisten the lint-free cloth with a mixture of 3 parts of water and 1 part of the general purpose detergent.

Do NOT drench the cloth, just moisten it to prevent liquid entering the housing!

- Clean the analyzer housing outside with the moistened cloth.
- If required dry the housing after cleaning.

7-6 Save / Restore Configuration Data Sets

After a couple of days operating the instrument one can assume the operator has setup the instrument to his needs. This is the moment to backup this configuration utilizing the SAVE-LOAD.. menu.

Before starting, read some more information about the internal data, of which X-STREAM analyzers provide three different sets:

FactData

This is the factory setup analyzer configuration. The data is stored in FLASH. The user may only restore this write-protected data into RAM, but not save changed parameters as **FactData**.

UserData

The user may save/restore his individual analyzer configuration and settings into/ from FLASH.
The analyzer is shipped with a **UserData** set being a copy of the **FactData**.

CfgData

This current analyzer configuration is stored in a RAM with battery backup.
During startup the configuration checksum is calculated. If there is a failure, the **UserData** settings are restored into RAM overwriting the **CfgData**. This ensures the instrument remains operable.

So, as **CfgData** is overwritten by **UserData** in case of a checksum failure, it is recommended to store the **CfgData** once the instrument is setup to the operator's needs, to ensure, the analyzer setup can easily be restored.

In addition to saving the **CfgData** in internal memory, the SAVE-LOAD menu allows to save / restore such data to / from an external device, connected to the serial interface (**COMPort**).

Note!
If system is setup accordingly access level 3 code must be entered to access the SAVE-LOAD menu!

For information about how to:

save CfgData to UserData ☞ 7-6-1, page 7-45

restore UserData to CfgData ☞ 7-6-2, page 7-46

restore FactData to CfgData ☞ 7-6-3, page 7-47

save / restore CfgData to/from COMPort ☞ 7-6-4, page 7-48

7-6 Save / Restore Configuration Data Sets

7-6-1 Save CfgData to UserData

```
Setup..
Save-Load..
```

Starting from the measurement screen press the DOWN key to open the MAIN MENU, enter the SETUP and next the SAVE-LOAD.. menu.

If system is setup accordingly access level 3 code must be entered to access this menu.

```
     Save-Load
CfgData>COMport!
COMport>CfgData..
▼Verify!
```

1st menu page

Press the DOWN key to open the second menu page.

```
▲
FactData>CfgData..
CfgData>UserData..
UserData>CfgData..
```

2nd menu page

Now select the "CfgData>UserData.." line and press the ENTER key.

```
  CfgData>UserData
    Are you sure?
No!
Yes!
```

A screen appears to confirm the operation: Select **Yes!** and after pressing the ENTER key a new screen comes up showing the current status.

```
    Copying data
  - PLEASE WAIT -

Procedure   X:078000
```

The instrument now stores the currently used (and changed by operator) analyzer setup into a special memory area. This data is then called **UserData** and used for backup only, while the data used for operation is called **CfgData**. Any further changes affecting the instrument's setup update the **CfgData** only, as long as not again stored into the **UserData** set.

```
        (i)

 -COMMAND  EXECUTED-
```

When the procedure has finished, the COMMAND EXECUTED screen shows up.

7-6 Save / Restore Configuration Data Sets

7-6-2 Restore UserData to CfgData

```
Setup..
Save-Load..
```

Starting from the measurement screen press the DOWN key to open the MAIN MENU, enter the SETUP and next the SAVE-LOAD.. menu.

If system is setup accordingly access level 3 code must be entered to access this menu.

```
     Save-Load
CfgData>COMport!
COMport>CfgData..
▼Verify!
```

1st menu page

Press the DOWN key to open the second menu page.

```
▲
FactData>CfgData..
CfgData>UserData..
UserData>CfgData..
```

2nd menu page

Now select the "UserData>CfgData.." line and press the ENTER key.

```
  UserData>CfgData
   Are you sure?
No!
Yes!
```

A screen appears to confirm the operation: Select **Yes!** and after pressing the ENTER key a new screen shows up showing the current status.

```
   Copying data
 - PLEASE WAIT -

Procedure   X:078000
```

The instruction now overwrites the currently used (and possibly changed by operator) analyzer setup by the **UserData** saved earlier into a separate memory area. The restored data is then called **CfgData** and used for operating the analyzer.

```
        (i)

 -COMMAND EXECUTED-
```

When the procedure has finished, the COMMAND EXECUTED screen shows up.

7-6-3 Restore FactData to CfgData

```
Setup..
Save-Load..
```

Starting from the measurement screen press the DOWN key to open the MAIN MENU, enter the SETUP and next the SAVE-LOAD.. menu.

If system is setup accordingly access level 3 code must be entered to access this menu.

```
     Save-load
CfgData>COMport!
COMport>CfgData..
▼Verify!
```

1st menu page

Press the DOWN key to open the second menu page.

```
▲
FactData>CfgData..
CfgData>UserData..
UserData>CfgData..
```

2nd menu page

Now select the "FactData>CfgData.." line and press the ENTER key.

```
  FactData>CfgData
   Are you sure?
No!
Yes!
```

A screen appears to confirm the operation: Select **Yes!** and after pressing the ENTER key a new screen shows up showing the current status.

```
   Copying data
 - PLEASE WAIT -

Procedure   X:078000
```

The instrument now overwrites the currently used (and possibly changed by operator) analyzer setup by the **FactData** stored in a separate memory area. The restored data is then called **CfgData** and used for operating the analyzer.

```
        (i)

 -COMMAND EXECUTED-
```

When the procedure has finished, the COMMAND EXECUTED screen shows up.

7-6-4 Save / Restore to an External Device

Before starting any of these procedures an external device (e.g. computer) has to be connected to the analyzer via the serial interface.

Make sure both devices (computer and analyzer) provide the same type of interface: RS 232, RS 485/2wire or RS 485/4wire. If need be use a converter.
For the analyzer's interface open the SETUP - COMMUNICATION screen:

```
Setup..
Communication..
```

If system is setup accordingly access level 3 code must be entered to access this menu.

```
Protocol:   MODB  RTU
MODB  mode:     32Bit
ID  number:         2
▼Interface: RS485/2w
```

1st menu page

Modbus protocol is disabled when transfering data over the serial interface.

The ID the instrument uses for network identification.
Input range: 1 ... 254

Installed RS interface variation.
Available options:
RS232, **RS485/2w**(ire), **RS485/4w**(ire)
Note!
Changing this parameter causes trouble if not supported by the hardware!

```
▲Baud  rate:     19200
Parity:           None
```

2nd menu page

Serial interface baud rate.
Available options:
2400, **4800**, **9600**, **19200**

Supported parity bit.
Available options:
None, **Even**, **Odd**

7-6-4-1 Save CfgData to COMPort

Open a standard terminal software on the computer.

Note!

The analyzer's Modbus protocol will be disabled during COMPort data transfer.

```
Setup..
Save-Load..
```

Starting from the measurement screen press the DOWN key to open the MAIN MENU, enter the SETUP and next the SAVE-LOAD.. menu.

If system is setup accordingly access level 3 code must be entered to access this menu.

```
      Save-Load
CfgData>COMport!
COMport>CfgData..
▼Verify!
```

Now select the "COMPort>CfgData.." line and press the ENTER key.

```
   CfgData>COMPort
    Are you sure?
No!
Yes!
```

A screen appears to confirm the operation: Select **Yes!** and after pressing the ENTER key a new screen shows up showing the current status.

```
    Copying data
 - PLEASE WAIT -

Procedure   X:078000
```

The instrument now saves the currently used (and possibly changed by operator) analyzer setup on an external device for future use.

```
         (i)

 -COMMAND  EXECUTED-
```

When the procedure has finished, the COMMAND EXECUTED screen shows up.

To verify, the saved data on the external device is not corrupted during transmission, you can now select **Verify!** from the SAVE-LOAD.. menu.

```
     Save-Load
CfgData>COMport!
COMport>CfgData..
▼Verify!
```

With the external device still connected select the "Verify!" line and press the ENTER key. The analyzer now loads the data from the external device and compares it to the **CfgData**. A status screen comes up followed by a COMMAND EXECUTED screen or an error message, if the data does not match.

7-6-4-2 Restore COMPort to CfgData

Before starting this procedure connect an external device (e.g. computer) via the serial interface to the analyzer.

Open a standard terminal software on the computer with it's serial interface setup the same way as the analyzer's.

Note!
The analyzer's Modbus protocol will be disabled during COMPort data transfer.

```
Setup..
Save-Load..
```

Starting from the measurement screen press the DOWN key to open the MAIN MENU, enter the SETUP and next the SAVE-LOAD.. menu.

If system is setup accordingly access level 3 code must be entered to access this menu.

```
     Save-Load
CfgData>COMport!
COMport>CfgData..
▼Verify!
```

Now select the "COMPort>CfgData.." line and press the ENTER key.

```
   COMPort>CfgData
    Are you sure?
No!
Yes!
```

A screen appears to confirm the operation: Select **Yes!** and after pressing the ENTER key a new screen shows up showing the current status.

```
    Copying data
  - PLEASE WAIT -

Procedure   X:078000
```

The instruction now overwrites the currently used (and possibly changed by operator) analyzer setup by the data stored in an external device. The restored data is then called **CfgData** and used for operating the analyzer.

```
         (i)

 -COMMAND  EXECUTED-
```

When the procedure has finished, the COMMAND EXECUTED screen shows up.

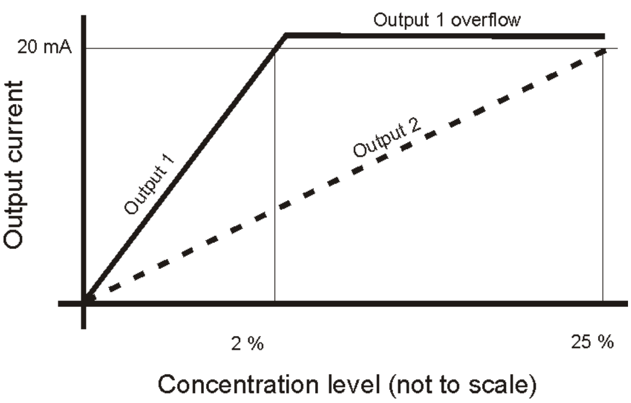
7-7 Range Switching

The softwareoption "Range switching" allows for **single channel** instruments to analog output the measured value as if the instrument had two different measuring ranges:
For example the analog output range 4(0) ... 20 mA may be assigned to concentration ranges of 0 ... 2 % and 0 ... 25 % at a time. The decision, which range is currently selected for output may either be made manually by the operator or automatically by the analyzer.
So, range switching allows to spread a part of the measuring range to the full analog output signal range (see example below).

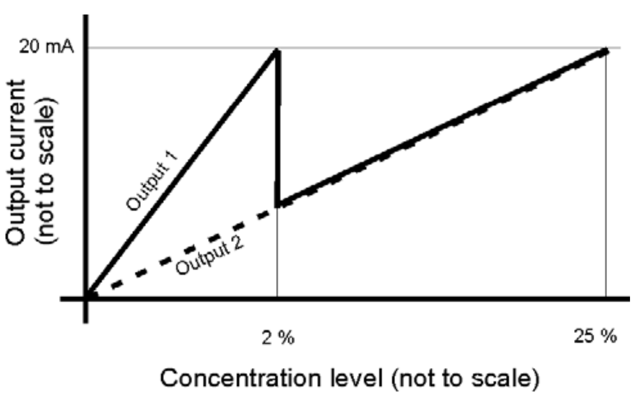
Implementation:
The output signal of the single channel detector is simultaneously supplied to the two available signal processing circuitries on the BKS board, adjusted to different concentration ranges, whose the output signals therefore are different for same concentrations:
By default the lower measuring range is assigned to analog output 1, while the higher is assigned to output 2.
By activating the option "range switching" output 1 now outputs both measuring ranges signals, while output 2 still outputs the higher range only.

Example:
Measuring range 1: 0 ... 2%
Measuring range 2: 0 ... 25 %
Analog output ranges set to 0 ... 20 mA

Situation 1:
Each measuring range is assigned a separate analog output.



Situation 2:
Both measuring ranges are output via analog output 1 utilizing range switching (while analog output 2 is still assigned to measuring range 2 only).



7-7 Range Switching

If range switching is set to automatically select the range, the output current is the criteria switching is based on:
Situation 1 of the example on page 7-52 shows range switching from the lower to the higher range is acitvated, the moment the output current becomes **20 mA**. Range switching in the opposite direction is activated in a similiar way the moment, the measured gas concentration drives an output current of 18 mA (dead zero) or 18.4 mA (life zero), relating to 90 % of the maximum range.

Alternatively the operator may manually select the range. In this case an overflow analog signal is output and a warning comes up (front panel LED and status message),if the measured concentration is above the upper range limit.

The active range can be inspected by an entry in the STATUS menu and a re-assigned digital output (☞ 7-7-5, page 7-57) and scanned by a Modbus command.

7-7 Range Switching

7-7-1 Activating Range Switching

```
Setup..
In/Outputs..
Analog output..
```

If system is setup accordingly access level 3 code must be entered to access this menu.

```
Signal:          RNG-C2
SignalRange:     0-20mA
Scaling..
▼Trim output..
```

1st menu page

Enter this line to select **RNG-C2**

Select the signal range.
Available options:
0-20 mA, 4-20 mA, LL0-20 mA, LL4-20mA, HL0-20 mA, HL4-20 mA
☞ Table 7-2 or for more detailled information
☞ 5-4-3-4-1-2, page 5-36

Enter this submenu to setup the ranges (☞ page 7-55)

```
▲Ranging:          Auto
```

2nd menu page

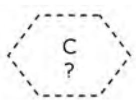
If parameter „Signal“ (see above) is set to **RNG-C2** (range switching), enter this line to specify manual or automatic range switching
Available options:
Manual, **Auto**

7-7 Range Switching

				Output signal, when				
Signal range setting	**Operation mode**	**Failure signal level acc. NE 43**	**Measured value is valid**	**Measured value is below lower range limit**	**Measured value is above upper range limit**	**An internal failure occured**	**Cable is broken**	**Channel 2 is not equipped**
0-20mA	Dead-Zero	-	0 ... 20 mA	< -19 mA	> 21 mA	undefined	0 mA	0 mA
4-20mA	Live-Zero	-	4 ... 20 mA	< -19 mA	> 21 mA	undefined	0 mA	4 mA
LL0-20mA	similiar Dead-Zero	below	0 ... 20 mA	-0,2 mA	20,5 mA	-2 mA	0 mA	-0.2 mA
LL4-20mA	similiar Live-Zero	below	4 ... 20 mA	3,8 mA	20,5 mA	2 mA	0 mA	3.8 mA
HL0-20mA	similiar Dead-Zero	above	0 ... 20 mA	-0,2 mA	20,5 mA	>21 mA	0 mA	-0.2 mA
HL4-20mA	similiar Live-Zero	above	4 ... 20 mA	3,8 mA	20,5 mA	>21 mA	0 mA	3.8 mA

Table 7-2: Analog Output Signal Setting & Operation Modes

```
Setup..
In/Outputs..
Analog output..
Scaling..
```



Select the first channel (".1" tag factory setting) to setup the lower measuring range.

```
        Scaling

0/4mA:     0.0000  ppm
20mA:      1000.0  ppm
```

Now enter the last line to setup the upper range limit for the lower range: This is the concentration value to be measured to activate the range switching.
In addition the limits for the higher range may be setup in a similar way by pressing the LEFT key to return to the component selection menu and then choosing the second channel (tag ".2")

Note!
Assigning other concentrations than zero (0) to the lower output (0/4 mA) always affects the measurement accuracy!

7-7-2 Manual Range Switching

Once the measuring ranges are setup as described in section 7-7-1, the user may select the range to be output during operation:

```
Control..
```

If system is setup accordingly access level 1 code must be entered to access this menu.

```
▲Lock  menus!
Acknowledgements..
Pump:              Off
Range:               1
```

2nd menu page

Enter the last line of the second CONTROL menu page to select the range for analog output 1:
Available options: **1**, **2**

Note!
This line shows up only if manual range switching is selected 7-7-1, page 7-54).

7-7-3 Automatic Range Switching

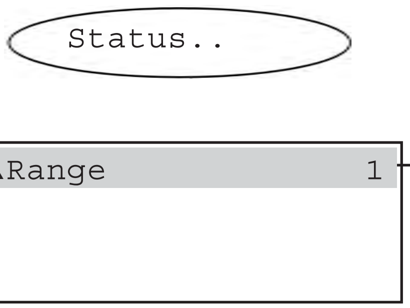
If automatic range switching is selected (7-7-1, page 7-54) the analyzer automatically selects the range depending on the measured concen-tration.

7-7-4 Range Switching via Modbus

All steps described in sections 7-7-1 to 7-7-3 can be executed by Modbus commands instead of pressing front panel keys.
Refer to Chapter 9 for a list of available Modbus commands.

7-7-5 Range Indicator

To see which range currently is set, open the 3rd menu page in the STATUS menu:



3rd menu page

If range switching is activated, this line shows the curently selected range (**1** or **2**).

Note!
This line is hidden if range switching is de-activated.

In addition the digital output, which normally is assigned to be the concentration alarm 1 for channel 1 is re-assigned to be used as range indicator:
Range 1: Digital output is **activated**
Range 2: Digital output is **NOT activated.**

Chapter 8
Troubleshooting

8-1 Abstract

This chapter covers troubleshooting the analyzer: Section 8-2 describes messages possibly appearing in the measuring screen‘s status line (4th line), gives hints on the potential causes and on how to solve the problem(s).
Two tables differentiate between analyzer related messages and channel related messages.

As the analyzer software is not capable to detect all problems and faults, section 8-3 describes such faults, their consequences, gives hints on potential causes and on how to solve the problem(s).
Section 8-4 gives detailled instructions on how to replace or adjust components, addressed to personnel familiar with the aspects of working on such components.

8-2 Solving Problems Indicated by Status Messages

As mentioned status messages are displayed inthe measuring screen‘s 4 th line. Multiple status messages active at a time show up sequentially in the status line. To see all status messages at a glance enter the STATUS menu:

```
Status..
```

```
1  Failures..
0  Check  requests..
1  Function  checks..
▼0  Off  spec..
```

The first page shows 4 lines each beginning with a number (indicating how many messages of the related kind are active). Enter a line with a number different than "0" to see the related messages.

In the following all possible status messages are listed in an alphabetical order together with hints on the possible causes and tips on how to solve the problems.

The list also shows a level indicator: In general one can assign four different levels to causes generating status messages. Depending on the level assigned the instrument activates different relay status signals, according the NAMUR NE 1067 specifications.

Supported status levels:

Failures: Requires immediate actions. The Instrument is not any longer working properly and the output signal is invalid due to malfunction.

Off spec: The instrument is working out of its specification (e.g. measuring range), or internal diagnoses indicate deviations due to internal problems. To achieve proper outputs corrective action is required.

Check requests (also: Maintenance requests**)**: Instrument is still working properly, within its specifications and the output signal is valid, but maintenance is required in forseeable future because a function will soon be restricted or a wear reserve is nearly exhausted.

Function Checks: The instrument is still working properly but currently is in a status where the output signal is temporarily invalid (e.g. frozen) due to the ongoing work on the instrument (e.g. during calibration).

If solving a reported problem requires working inside an open instrument take care of the safety instructions given at the beginning of this manual!

8-2 Solving Problems Indicated by Status Messages

Analyzer related messages		
Message / *Level*	**Potential Cause**	**How to Solve**
ADC-Error *Out of spec* Explanation: The 3rd A/D converter‘s "A/D conversion finished“ signal is missing	1. A/D conversion of multiplexed converter failed 2. Supply voltage missing (internal 6 V DC)	1. Switch analyzer OFF and ON again 2. Check voltage
CheckBattery *Check request* Explanation: There is a problem with the internal battery on electronics board BKS	1. Battery buffer faulty 2. UserData values loaded	1. Check if jumper J7 is set correctly (☞ 8-4-4, page 8-21). 2. Replace battery, if battery voltage is below 3.5 V (BKS jumper J7 set) 3. Reset the message by means of the ACKNOWLEDGE menu or by sending the related Modbus software command
Flow too low *Check request* Explanation: The internal flow control detected a flow problem	The detected flow is too low or missing due to a leak not limited to the instrument‘s internal gas path	Check the external and internal gas path for leakage and plugging If applicable check internal pump function
LocalAccess *Out of spec* Explanation: This status message is activated when a parameter is changed using the front panel keys	Someone has changed a parameter by using the front panel keys	1. Press the HOME key: The status message is reset when returning to the measurement screen 2. Acknowledge the message via menu CONTROL.. - ACKNOWLEDGEMENTS.. ***Note!*** *This resets ALL status messages!*

8-2 Solving Problems Indicated by Status Messages

Analyzer related messages		
Message / *Level*	**Potential Cause**	**How to Solve**
NotSampleGas *Check function* Explanation: The gas currently flowing is not the expected sample gas	1. Other than sample valve is opened within installed valve block 2. Installed pump is switched off 3. Instrument is currently in calibration mode 4. After calibration the sample gas valve has opened, but the time interval of purge time and 2 times t_{90} has not yet elapsed	1. Switch on sample valve 2. Switch on the pump 3. Wait for calibration to end 4. Wait for time interval of purge time and 2 times t_{90} to elapse. If appropriate reduce purge time.
PressSensor *Out of spec* Explanation: The internal pressure control detected a pressure problem	The detected pressure is too low or missing due to a leak inside or outside the instrument	Check the external and internal gas path for leakage and plugging If applicable check internal pump function
RAMmemory *Failure* Explanation: SRAM test failed	Installed SRAM and/or electronics board BKS defective	Replace BKS
ROMmemory *Failure* Explanation: Wrong EPROM checksum	1. Installed EPROM defective 2. BKS defective	1. Replace EPROM (see service manual) 2. Replace BKS

8-2 Solving Problems Indicated by Status Messages

Analyzer related messages		
Message / *Level*	**Potential Cause**	**How to Solve**
Simulation *Check function* Explanation: This message does not appear during operation modes!	The instrument is set into a debugging mode by service personnel	Switch analyzer off and on again to exit the debugging mode Switch off the related simulation parameters (in service level or by Modbus command)
Warm-up *Check function* Explanation: This message requires tempe-rature monitoring enabled within the service level	1. The warm-up time has not yet elapsed after last analyzer restart 2. Temperature of analyzer components or physical thermostatted compartment is not within the configured range	1. Wait for warm-up time to elapse 2. Wait for instrument to heat up or check internal heater for proper function

8-2 Solving Problems Indicated by Status Messages

Channel related messages (preceded by a channel tag, e.g. CO2.1)

Message / *Level*	**Potential Cause**	**How to Solve**
ADC-Error *Failure* <u>Explanation:</u> "A/D conversion finished“ signal is missing	1. The A/D converter of the related channel is defective 2. Positive or negative reference voltage is missing 3. Light barrier signal is missing 4. IR channel: Chopper motor not turning 5. Internal 6 V supply voltage is missing	1. Switch analyzer OFF and ON again 2. Check reference voltages 3. Check light barrier connection to electronics board BKS Check (☞ 8-4-3-1-5) 4. Check chopper connection to electronics board BKS Check (☞ 8-4-3-1-5) 5. Check (☞ 8-4-3-1-1)
Alarm Level1 - - <u>Explanation:</u> Concentration alarm level 1 is activated (exceeded)	Alarm level 1 was exceeded	Adjust the gas concentration to be within the set limits
Alarm Level2 - - <u>Explanation:</u> Concentration alarm level 2 is activated (exceeded)	Alarm level 2 was exceeded	Adjust the gas concentration to be within the set limits

8-2 Solving Problems Indicated by Status Messages

Channel related messages (preceded by a channel tag, e.g. CO2.1)

Message / *Level*	Potential Cause	How to Solve
Lineariser *Out of spec* Explanation: Gas concentration is out of range	Gas concentration is out of measurement range and therefore linearization curve does not apply	Adjust gas concentration to be within range
Overrange *Out of spec* Explanation: Gas concentration is out of range	Gas concentration is out of measurement range and therefore linearization curve does not apply	Adjust gas concentration to be within range
Simulation *Check function* Explanation: This message does not appear during operation modes!	The instrument is set into a debugging mode by service personnel	Switch analyzer off and on again to exit the debugging mode Switch off the related simulation parameters (in service level menu)
SpanCalTolChk *Check request* Explanation: Enabled tolerance check detected while spanning (measured value differing more than 10 % from setpoint)	1. Wrong setpoint value 2. Wrong span gas applied 3. IR/UV channel: Photometric components polluted 4. Instrument not yet calibrated (first calibration after installation)	1. Check span gas setpoint 2. Check span gas 3. Check and if need be clean photometric components 4. Disable tolerance check before restarting the calibration
Spanning *Check function* Explanation: Ongoing span calibration	Span calibration ongoing for the channel identified by the tag	Wait until calibration has finished Cancel calibration

8-2 Solving Problems Indicated by Status Messages

Channel related messages (preceded by a channel tag, e.g. CO2.1)		
Message / *Level*	**Potential Cause**	**How to Solve**
Temperature *Out of spec* Explanation: Temperature out of specified range	Warm-up not yet finished Temperature controler defective	Wait until warm-up has finished (10 - 50 min, depending on system) Call service center
ZeroCalTolChk *Check request* Explanation: Enabled tolerance check detected while zeroing (measured value differing more than 10 % from setpoint)	1. Wrong setpoint value 2. Wrong zero gas applied 3. IR/UV channel: Photometric components polluted 4. Instrument not yet calibrated (first calibration after installation)	1. Check zero gas setpoint 2. Check zero gas 3. Check and if need be clean photometric components 4. Disable tolerance check before restarting the calibration
Zeroing *Check function* Explanation: Ongoing zero calibration	Zero calibration ongoing for the channel identified by the tag	Wait until calibration has finished Cancel calibration

8-3 Solving Problems Not Indicated by Status Messages

The following table lists possible faults not detectable by the instrument's software, gives hints on the potential causes and tips on how to solve the problems.
If solving a problem requires working inside the instrument take care of the safety instructions given at the beginning of this manual!

Note on X-STREAM F and FD!
To see the current status even when the front door is open, just flap the front panel as shown in figure 8-0.
To do so loosen the four nuts fixing the front panel to the door and flap the front panel using the lower srews as hinges.

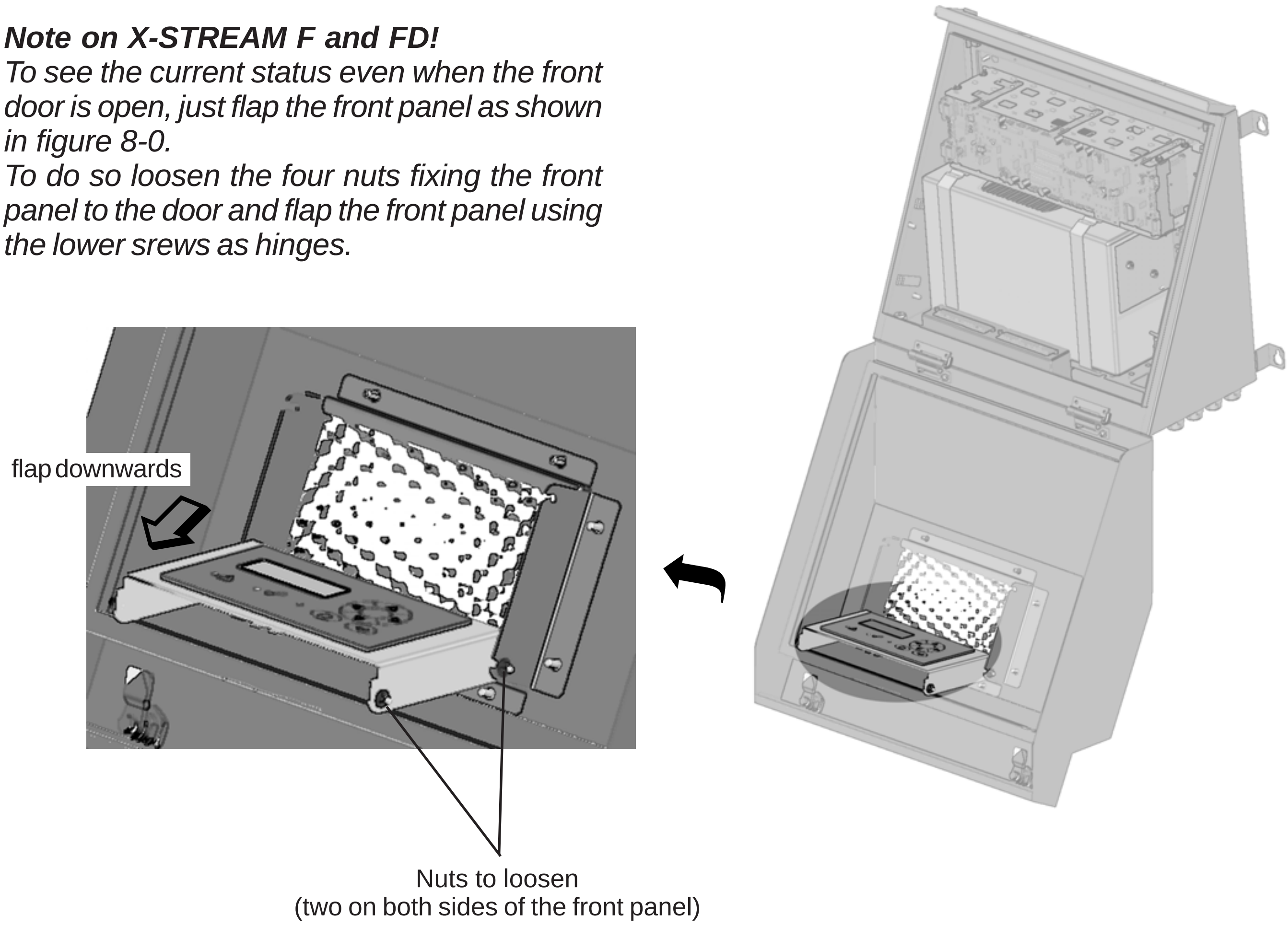


Fig. 8-0: X-STREAM F interior view with flapped front panel

8-3 Solving Problems Not Indicated by Status Messages

Effect	Potential Cause	How to Solve
Display dark	1. Power supply missing 2. Front panel connection faulty	1. Check mains connection Check mains supply Check instrument‘s mains fuses Check fuse on electronics board BKS (☞8-4-5, page 8-22) 2. Check front panel connections
No analog output signal	1. Connection failure 2. Main board BKS defective	1. Check signal connections 2. Replace main board BKS
Fluctuating or invalid readout	1. Leak in gas path 2. Ambient air contains high concentration of measured gas component 3. Fluctuating gas pressure 4. Sensor or detector not connected 5. Electrochemical Oxygen sensor worn-out	1. Perform a leak test 2. Check absorber (at chopper/ measuring cell) and replace if need be. Replace photometer with sealed version (option) Purge instrument with neutral gas 3. Check gas path before and behind cell and sensor Remove restriction behind gas outlet Reduce gas flow or pump rate 4. Check detectors connections 5. Check sensor and replace if need be

8-3 Solving Problems Not Indicated by Status Messages

Effect	Potential Cause	How to Solve
Fluctuating or invalid readout (continued)	6. IR channel: Source not connected or defective 7. Analog preamplifier of affected channel defective 8. Gas path(s) polluted	6. Check connections: X3 (1/2) / source channel 1 X3 (4/5) / source channel 2 If source housing is cold: Exchange both source in case of dual channel analyzer / replace source if need be (see service manual) 7. Check measuring point (☞ 8-4-2-1-6, page 8-19) 8. Check analysis cells and windows for pollution Clean polluted parts (see service manual) Check gas paths for pollution and clean gas paths if need be 9. Set ambient pressure to proper value (☞ 5-4-3-3, page 5-29) Sensor failure (☞ status message "PressSensor", page 8-4) 10. Check temperature of gas path(s) Remove all sources of condensation Keep all temperatures at least 10 °C above sample gas temperature 11. Replace BKS

8-3 Solving Problems Not Indicated by Status Messages

Effect	Potential Cause	How to Solve
Readout damping time too long	1. Wrong signal damping settings	1. Check signal damping (☞ 5-4-3-3-1, page 5-30)
	2. Pump rate too low	2. Distance between sampling point and analyzer too long Replace pump by external model with higher pump rate (operate in bypass mode, ☞ 4-2, page 4-4)
	3. Gas path(s) polluted	3. Check gas path and sample handling system for pollution Clean gas path
No gas flow	1. Sample gas pump (option) switched off	1. Switch on sample gas pump (☞ 5-4-3-4, page 5-33)
	2. Membrane of sample gas pump defective	2. Replace sample pump membrane
	3. Sample gas pump defective	3. Replace sample gas pump
	4. Solenoid valves (option) not opened / defective	4. External valves: Check connection between valves and digital outputs Check valve seat and replace if need be Replace solenoid valves For valve control via serial interface or digital inputs: Any valve activated?
	5. Gas path(s) polluted	5. Check gas path and sample handling system for pollution Clean gas path

8-4 Troubleshooting on Components

This section give information on how to check and replace internal components.

Some work described on the next pages need to be carried out by qualified personnel only, and may require special tools, to ensure the instrument or component is not damaged or disadjusted!

WARNING

ELECTRICAL SHOCK HAZARD

Live parts are accessible when working at open instruments!
Take care to observe all applicable safety instructions!

8-4 Troubleshooting on Components

8-4-1 Opening X-STREAM Analyzers

8-4-1-1 Opening X-STREAM GP / GPS

Locate the 12 screws at the top of the instrument and after loosening them, remove the cover.

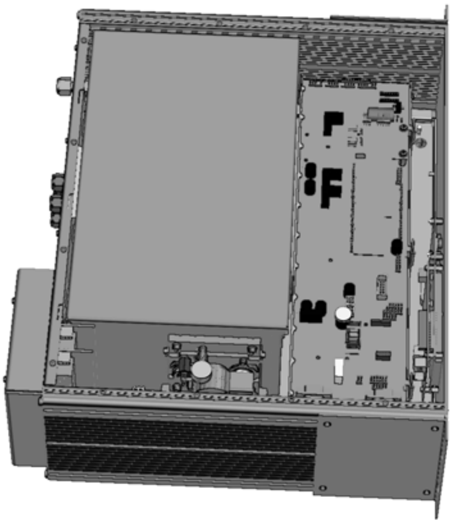


Fig. 8-1: X-STREAMGP / GPS - interior view

8-4 Troubleshooting on Components

8-4-1-2 Opening X-STREAM F

Open the front door utilizing the two sash fasteners. Flip down the front door carefully to not damage the instrument, hinges or equipment installed below the analyzer.

8-4-1-3 Opening X-STREAM FD

To open a X-STREAM FD loosen the 20 screws located at the instrument´s flange. Then carfeully flip down the front door to not damage the instrument, hinges or equipment installed below the analyzer.

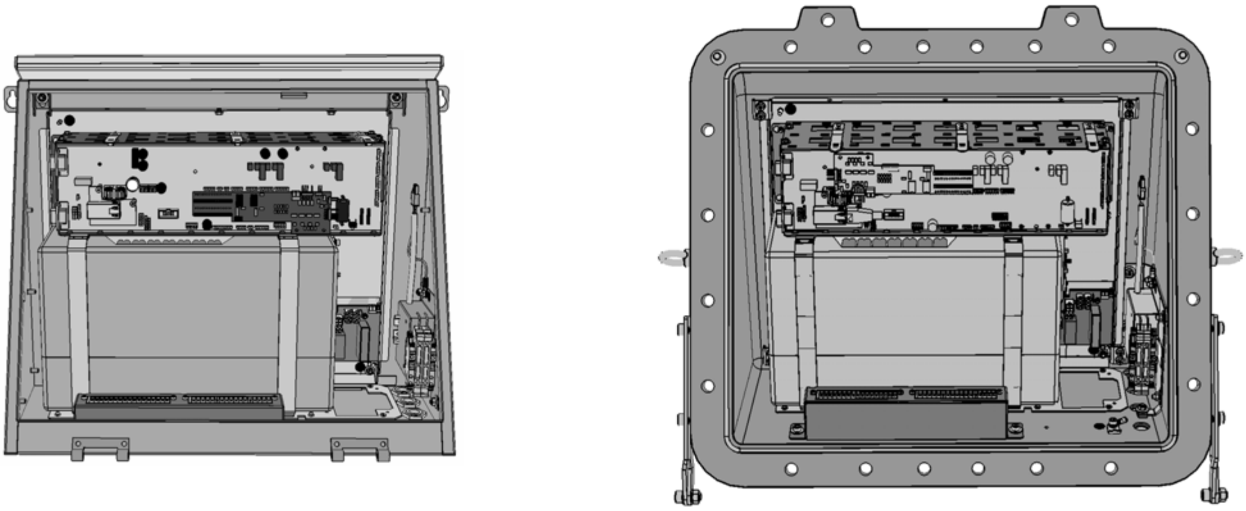


Fig. 8-2: X-STREAM F AND FD - Interior views (shown without front doors)

WARNING

POSSIBLE EXPLOSION HAZARD

The analyzer variations X-STREAM F (provided with an external pressurization system) and FD may be installed in a hazardous area.

Maintaining such instruments is permitted only considering special conditions, givenin the related separate manuals.

Do not open nor maintain instruments in hazardous areas without having read and understood all related instruction manuals!

8-4-2 Measuring Points at BKS Board

8-4-2-1 Location of Measuring Points

(Pin 1 of all connectors are marked within the silk screen or by use of square pads)

Measure all voltages against GND, available at X11 and X28 !

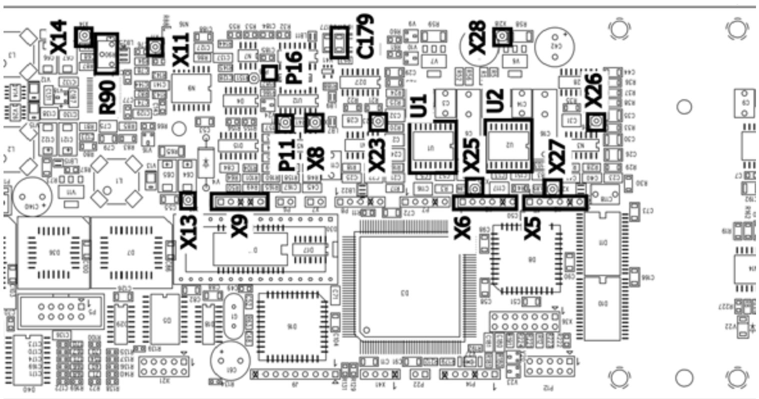


Fig. 8-3: BKS Board (section), measuring points

8-4-2-1-1 Supply voltage +6 V

Measuring Point: X14
Measuring instrument: DVM
Signal: + 6 V DC (+10 mV / -200 mV)
Failure: No or wrong signal

Potential cause:

a) Supply voltage missing
b) Supply voltage connected wrong way round or is < 9 V
c) Fuse F2 broken (☞ 8-4-5, pg. 8-22)
d) BKS board defective

How to solve:

a) Connect supply voltage
b) Check polarity or replace power supply unit
c) Replace F2 (by same type !)
d) Replace BKS board

8-4-2-1-2 Positive reference voltage

Measuring Point: X5, pin 6
Measuring instrument: DVM
Signal: + 5.535 V DC (± 60 mV)
Failure: No or wrong signal

Potential cause:

a) +6V voltage faulty
b) +3 V Reference voltage faulty (measure at C179, pin 1 (lower pin in fig. 8-3))

How to solve:

a) Check supply voltage
b) Replace BKS board

8-4 Troubleshooting on Components

8-4-2-1-3 Negative reference voltage

Measuring Point: X5, pin 4
Measuring instrument: DVM
Signal: inverse positive reference voltage
Failure: Both reference voltages differ by more than 10 mV ($U_{ref.\ pos.} + U_{ref.\ neg.} \leq 10$ mV) !

How to solve:
Replace BKS board

8-4-2-1-4 Temperature sensor

Measuring Point: X8
Measuring instrument: DVM
Signal: approx. 0 ± 500 mV DC (at ambient temperature)
Failure: Signal not within stated range

Potential cause:

- *IR measurement or paramagnetic Oxygen measurement*

Potential cause	How to solve:
a) sensor not connected	a) connect temperature sensor
b) sensor defective	b) replace temperature sensor
c) sensor cable broken	c) replace temperature sensor
d) BKS board defective	d) replace BKS board

- *electrochemical Oxygen measurement:*

Potential cause	How to solve
a) sensor not connected	a) connect temperature sensor
b) OXS board defective	b) replace OXS board
c) BKS board defective	c) replace BKS board

8-4 Troubleshooting on Components

8-4-2-1-5 Light barrier signal

Measuring Point: X9, pin 2
Measuring instrument: Oscilloscope
Signal: rectangle (level see below)
frequency = 24 Hz (± 0.1 Hz)
Failure: No or faulty signal

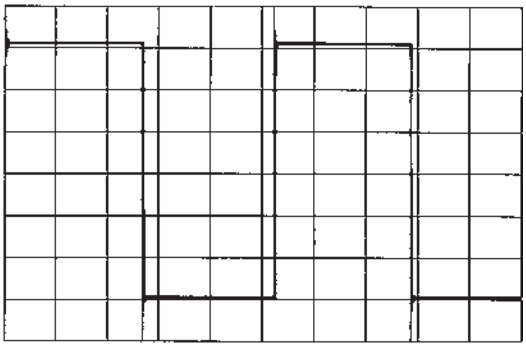


Fig. 8-4:Light barrier signal

Potential cause:

- *IR measurement:*
  Signal level set point: U = 6 V_{SS} (± 0.3 V)

Potential cause	How to solve:
a) Chopper not connected	a) Connect chopper
b) Chopper not turning	b) Switch off analyzer and on again
c) Light barrier not connected	c) Connect light barrier
d) Light barrier defective	d) Replace chopper
e) Cable broken	e) Replace chopper
f) BKS board defective	f) Replace BKS board

- *Oxygen measurement w/o IR channel:*
  Signal level set point:
  LOW ≤ 0.45 V; HIGH ≥ 2.4 V (TTL logic)

Potential cause	How to solve:
a) µP not working	a) Switch off analyzer and on again
b) BKS board defective	b) Replace BKS board

8-4-2-1-6 Analog Preamplifier

a) Paramagnetic Oxygen Measurement

Measuring Point: X 25 (channel 1)
Measuring instrument: DVM
Signal when connected to
zero gas: 0 V dc (± 50 mV)
ambient air (approx. 21 Vol. - % O_2):
100 % O2 sensor: approx. 840 mV
25 % O2 sensor: approx. 3.36 V
(Type of sensor: see separate nameplate label)

Failure: No signal or wrong measuring values

Potential cause:	How to solve:
a) Oxygen sensor not connected	a) Connect Oxygen sensor
b) Oxygen sensor defective	b) Replace Oxygen sensor
c) BKS board defective	c) Replace BKS board

b) IR Measurement

Measuring Point:
X 25 (channel 1; not for instruments with Oxygen measurement)
X 27 (channel 2)
Measuring instrument: DVM
Signal when connected to
zero gas: 0 V dc (± 100 mV)

Zero point voltage and span voltage must differ at least by 600 mV (at ranges < 1000 ppm difference should be 500 mV min.)

Failure: No signal or wrong measuring values

Potential cause:	How to solve:
a) Detector not connected	a) Connect detector
b) Detector defective	b) Replace detector
c) BKS board defective	c) Replace BKS board

8-4-3 Measuring Points at OXS Board (Electrochemical Oxygen Measurement)

8-4-3-1 Sensor Signal

Measuring Points: Tp 1 (Signal)
Tp 2

Measuring instrument: DVM

Signal when connected to ambient air (approx. 21 Vol. - % O_2): approx. 3.36 V with new cell

Failure: No signal or wrong measuring values

Potential cause:	How to solve:
a) Sensor not connected to OXS board	a) Connect sensor to OXS board
b) OXS board defective	b) Replace OXS board
c) Sensor defective or worn-out	c) Replace sensor
d) BKS board defective	d) Replace BKS board

Note!
Sensor is worn-out when, connected to ambient air, the output voltage is less than 2.8 V: Replace sensor!

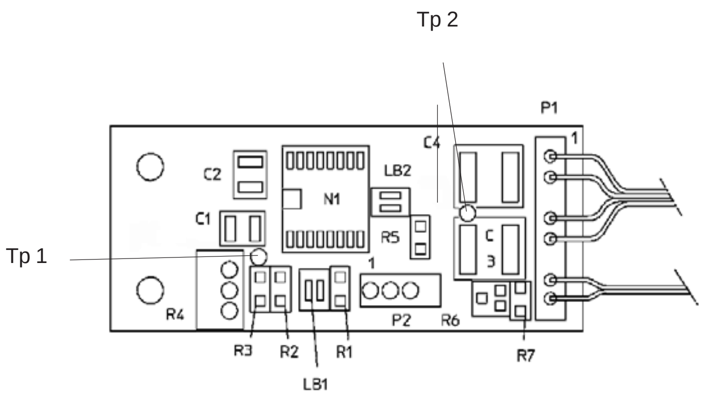


Fig. 8-5: OXS board, assembled, top view

8-4-4 BKS 20 Board Jumper Configuration

There is only one single jumper on the BKS board: J7 is for enabling SRAM battery buffering. With buffering enabled (jumper set) all operator configured data is stored within the SRAM memory and protected against power supply failure.
If J7 is not set properly all data gets lost and the analyzer is reset to factory default settings the moment the analyzer is disconnected from power supply!

J7
Battery buffer jumper

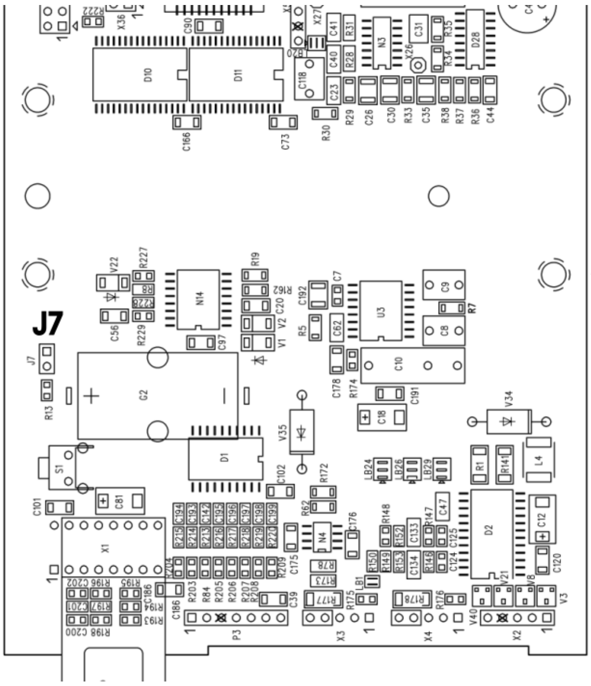


Fig. 8-6: BKS board (section)

8-4 Troubleshooting on Components

8-4-5 Fuse on BKS 20 Board

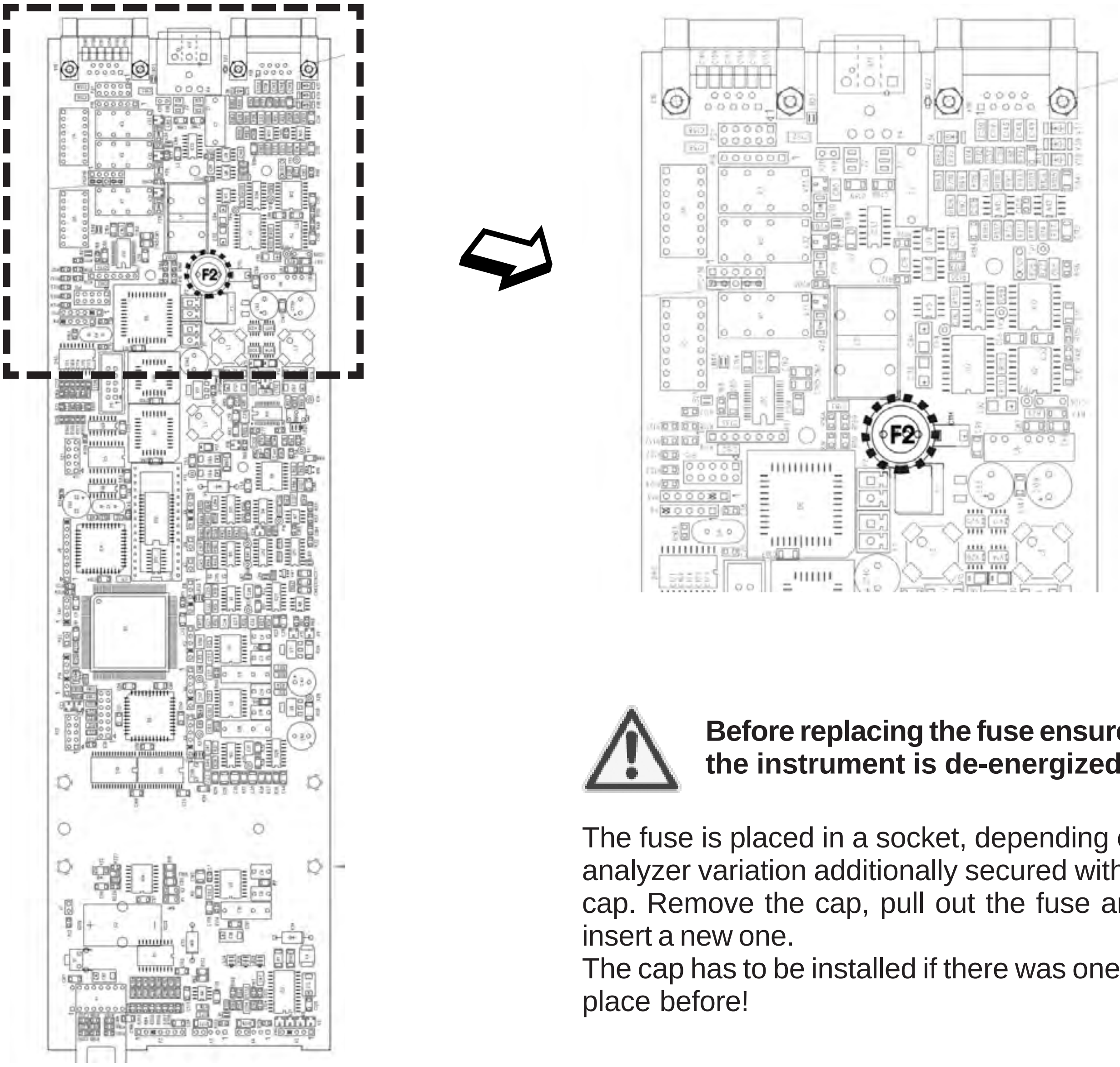


Fig. 8-7: Allocation of fuse on BKS board

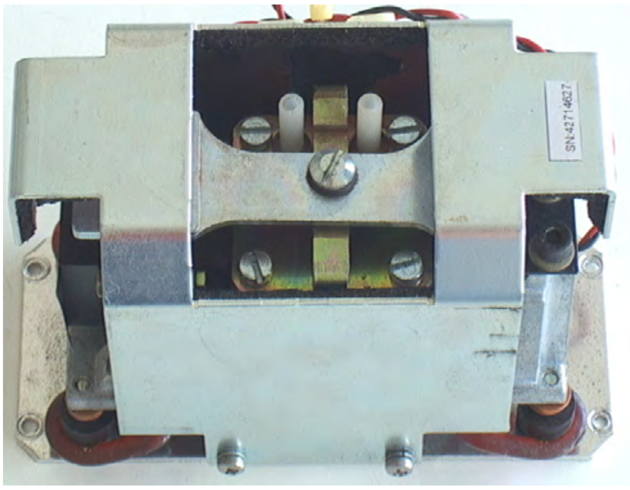
Before replacing the fuse ensure the instrument is de-energized!

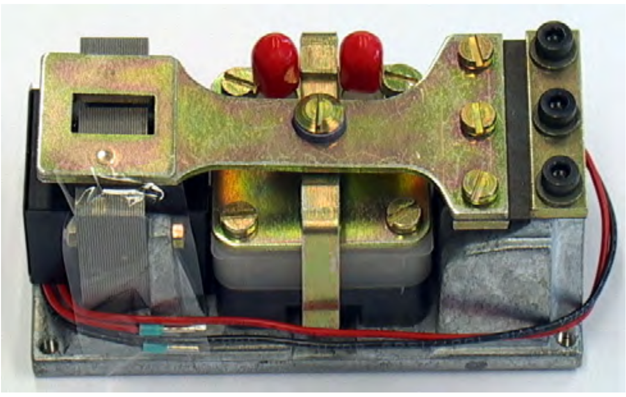
The fuse is placed in a socket, depending on analyzer variation additionally secured with a cap. Remove the cap, pull out the fuse and insert a new one.
The cap has to be installed if there was one in place before!

Use only the same type and ratings of fuse!

Fuse data: Type Wickmann 372
T 4 A / 250 V

8-4-6 Sample Pump: Replacement of Diaphragm

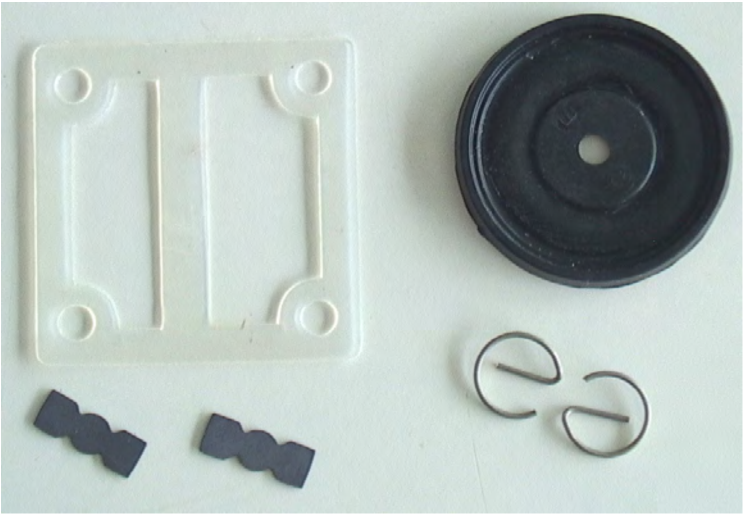




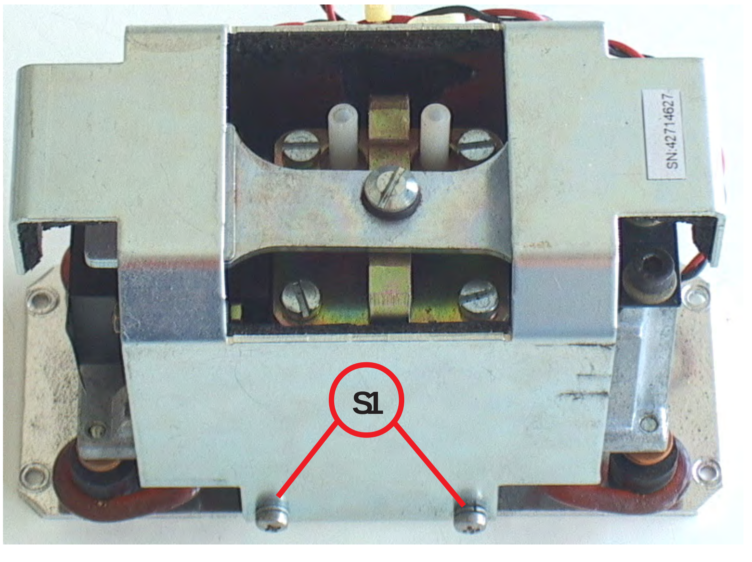
This instruction explains the procedure to replace the diaphragms of sample gas pumps (PN 42716569) used in the X-STREAM series gas analyzers.

To do so you need to dismantle the pump from your analyzer.

8-4 Troubleshooting on Components



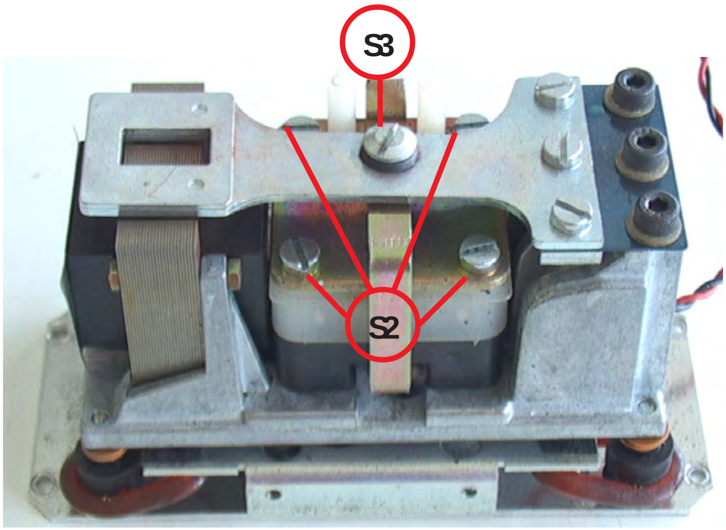
Required parts for the spare parts kit for the pump (PN 0375946).



Step 1:

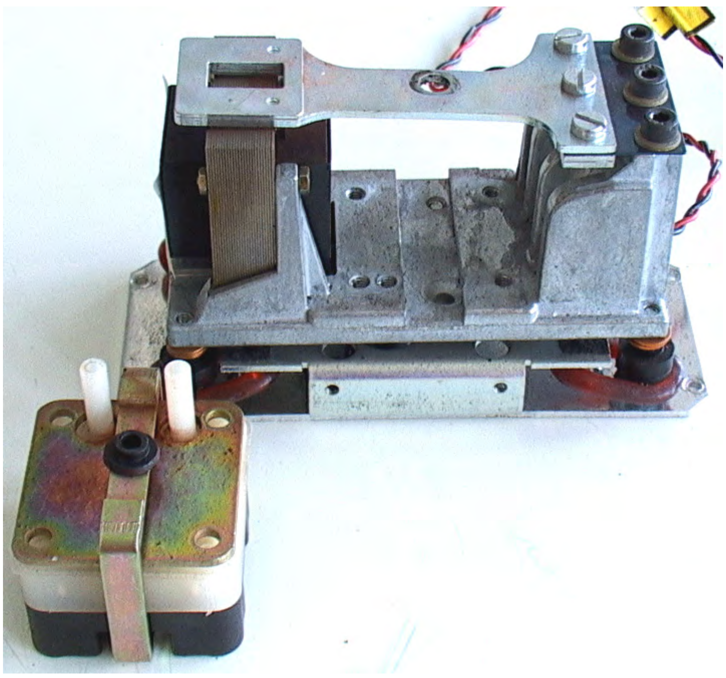
If applicable:
Remove the screws **S1** on both sides of the pump. Take off the cover.

8-4 Troubleshooting on Components



Step 2:

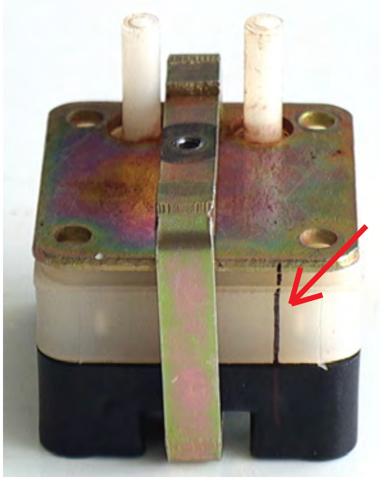
Remove the screws **S2** and screw **S3**.



Step 3:

Take out the pump assy.

8-4 Troubleshooting on Components



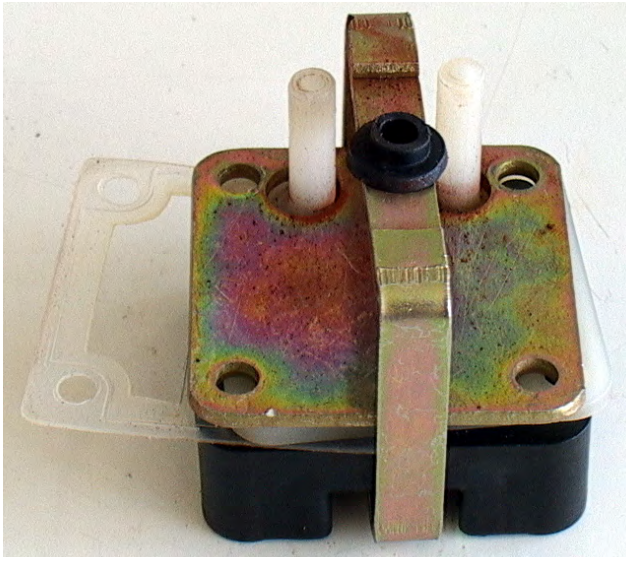
Step 4:

Mark the pump assy. before disassembly.

Step 5:

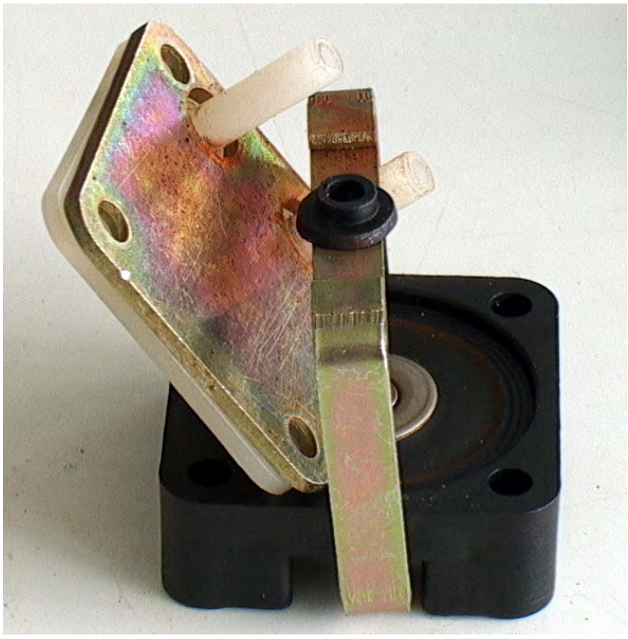
Remove the white block.

8-4 Troubleshooting on Components



Step 6:

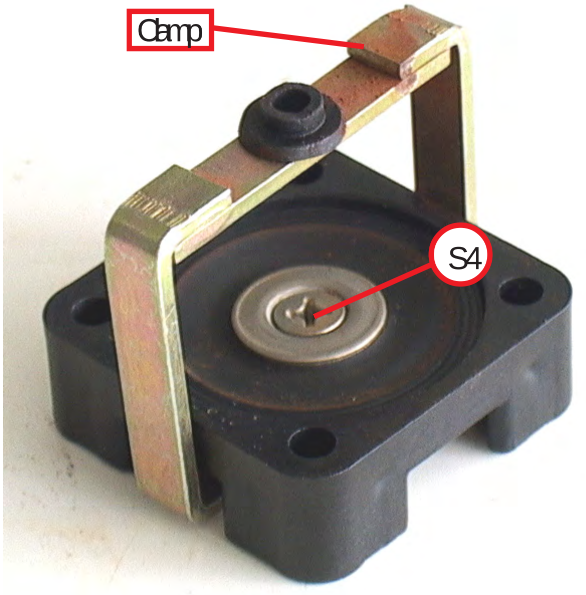
Remove the teflon gasket.



Step 7:

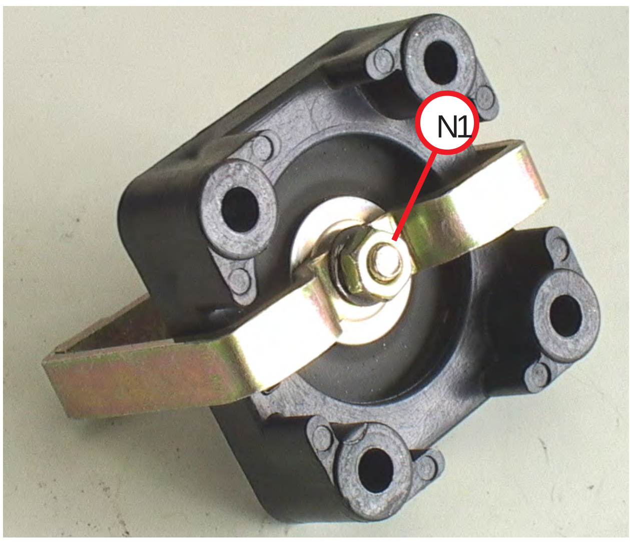
Remove the remaining two pump parts.
Clean the white plate for the gas in- and outlet.

8-4 Troubleshooting on Components



Step 8:

Disassemble the lower block and the clamp.
Loosen the screw **S4** and the nut **N1**.



8-4 Troubleshooting on Components

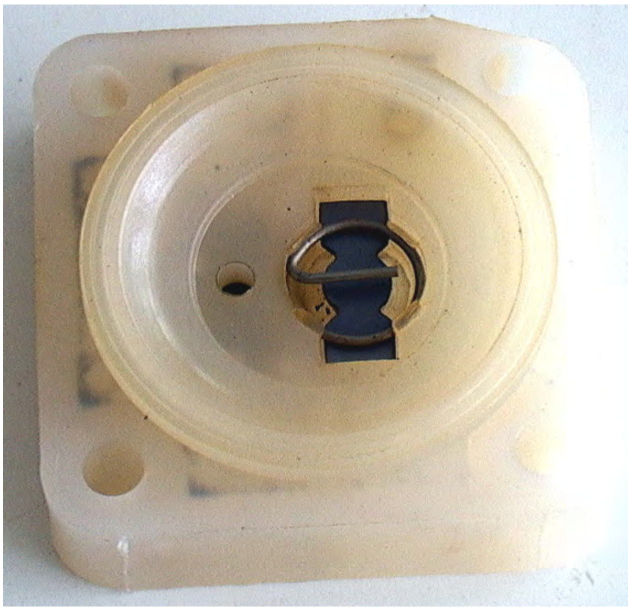
Step 9:

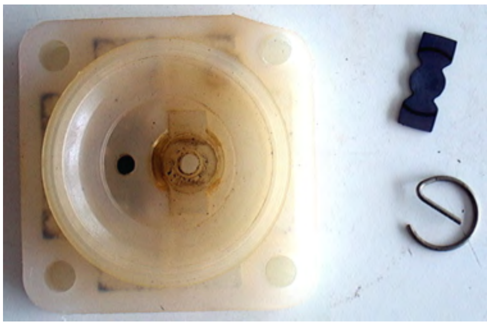
Remove the two washers on the diaphragm.

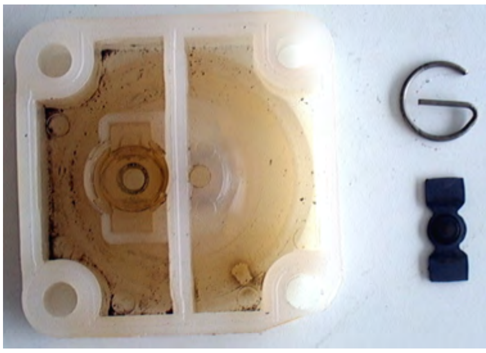
Step 10:

Replace the old with the new diaphragm and assemble the washers and the clamp in reverse order (step 9 and 8).

8-4 Troubleshooting on Components



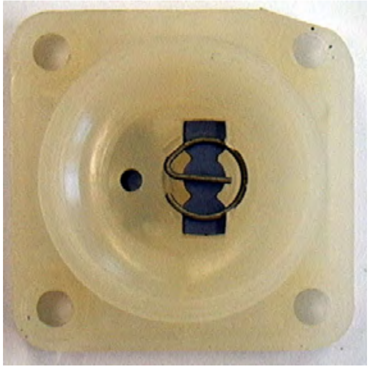


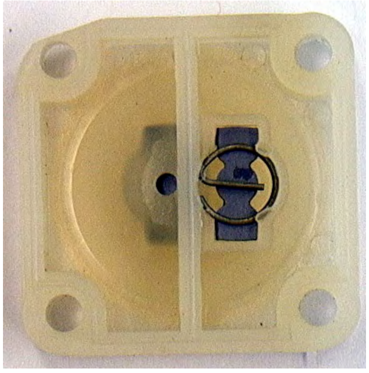


Step 11:

Remove the locking springs on both sides of the white block and take out the old diaphragms on both sides.

8-4 Troubleshooting on Components

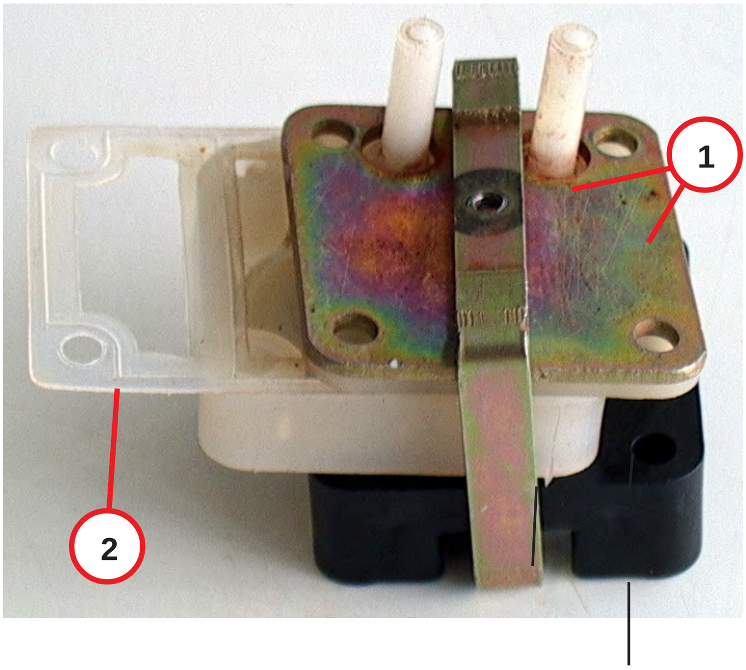




Step 12:

Clean the white block.

Afterwards put in the new diaphragms and fix them with the new locking springs.



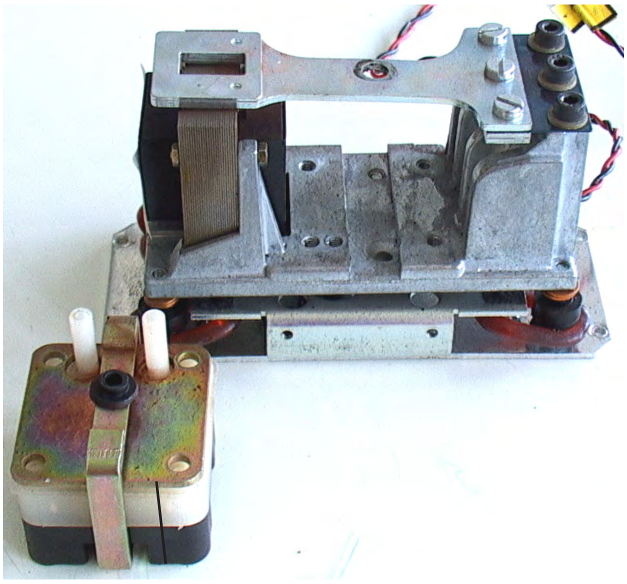
Step 13:

Assemble the pump assy. Take care of your marker (☞ step 4)

1. Put the two upper plates under the clamp (☞ steps 6 & 7 for reference).

2. Put the white block and the **new** teflon gasket between the lower block and the in-outlet plate.

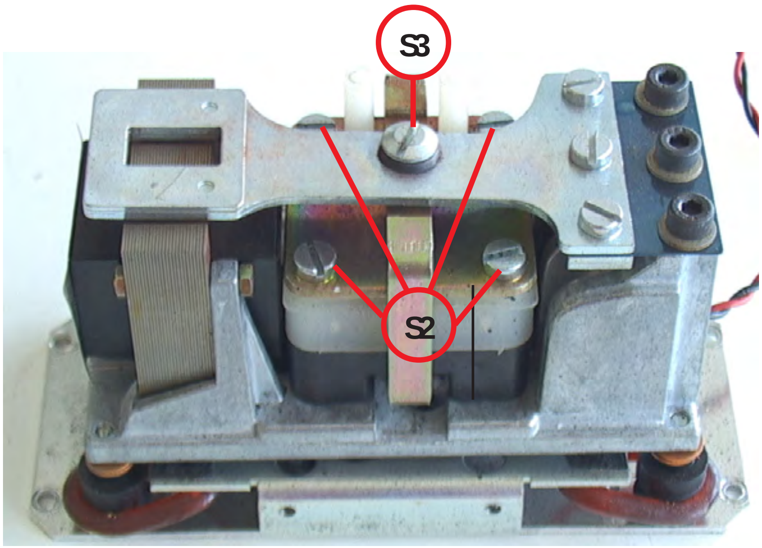
8-4 Troubleshooting on Components



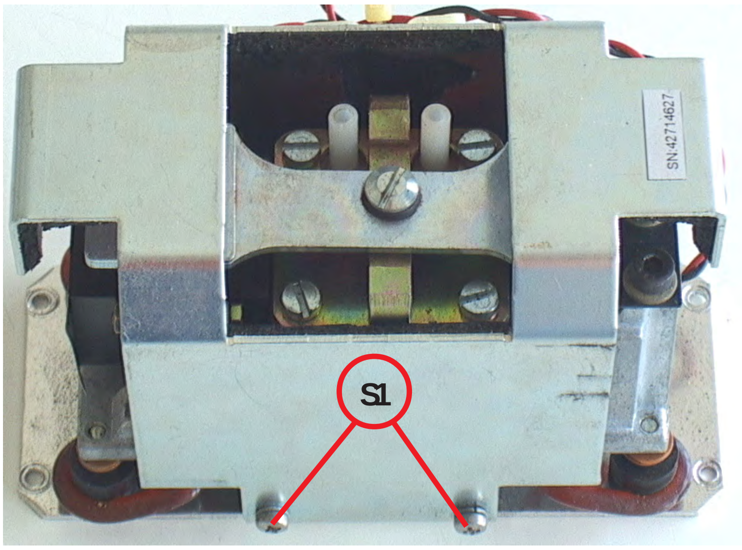
Step 14:

Assemble the pump assy in reverse order.

Put it in the pump housing and fix it with the screws **S2**.
Fix the clamp with screw **S3** and the black buffer.



8-4 Troubleshooting on Components



Step 15:

If applicable:
Install the cover and fix it with screws **S1** at both sides.

Finally re-install the pump into your analyzer, to complete the replace-ment of pump diaphragm.

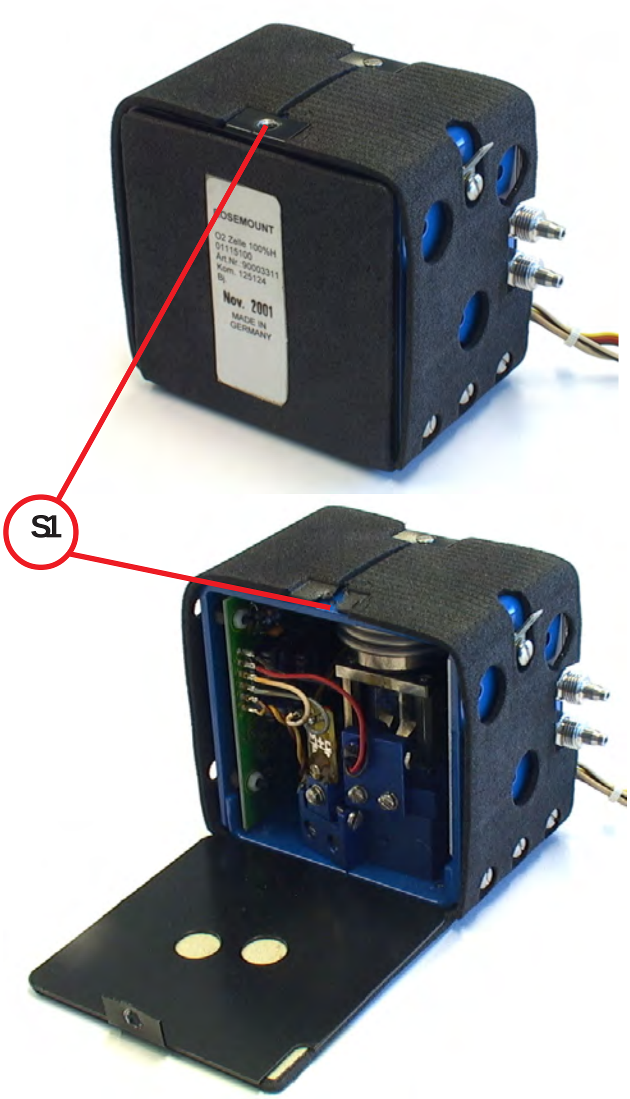
8-4-7 Paramagnetic Oxygen Cell: Adjustment of Physical Zero

To adjust the physical zero you need to measure some voltages on the BKS board: Depending on which channel the cell is assigned to, the measuring signal (+) can be measured at either measuring point X25 (ch 1) or X27 (ch 2), while GND (-) is always at X11 (fig. 8-3, page 8-16) .

The measured voltage should be **0 V ± 50 mV**.

The cell contains strong magnets!

Use only non-magnetic tools to adjust the zero point!



Step 1:

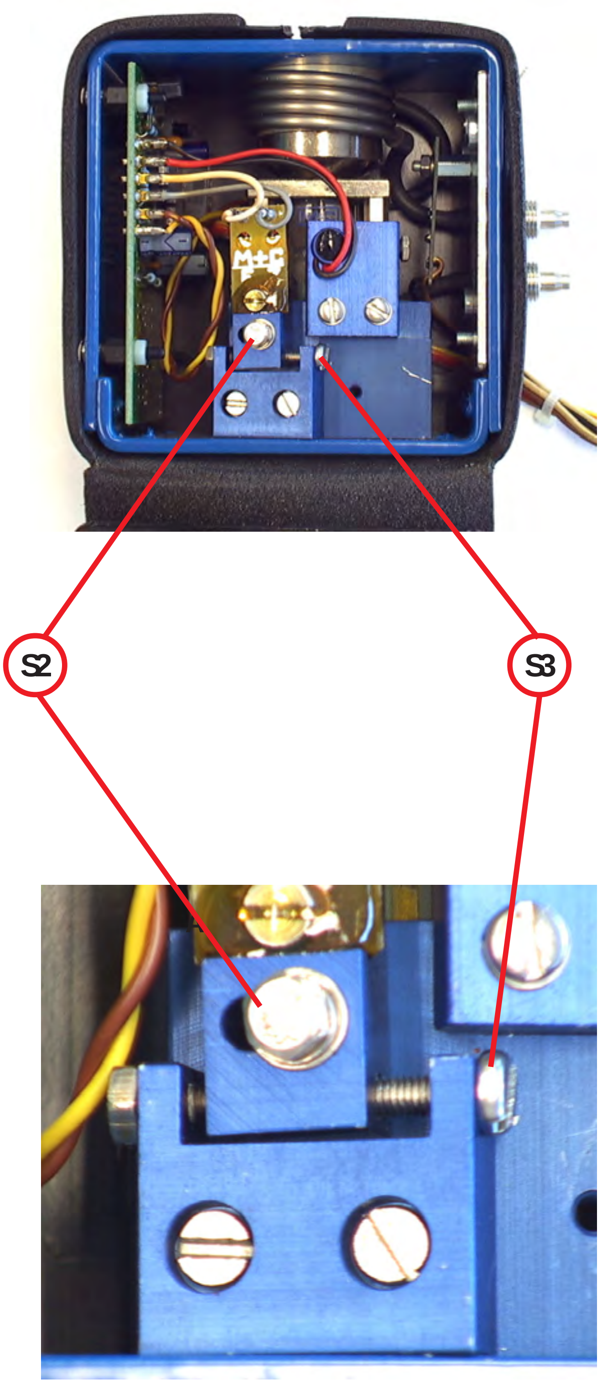
The adjoining figure shows a heated paramagnetic oxygen cell.

Depending on your specific instrument alternatively an unheated cell may be installed. In this case skip step 2 and continue with step 3.

Step 2:

Open the cell cover by loosening the screw **S1** at the top.

8-4 Troubleshooting on Components



Step 3:

Apply N2 to the analyzer.

Step 4:

Carefully loosen the screw **S2**.
Now you can adjust the physical zero point with screw **S3**.
Turn the screw carefully.

The cell´s electronic is light sensitive: When exposed to light while adjusting the zero point utilizing screw S3, a zero point shift may arise after the cover is closed.

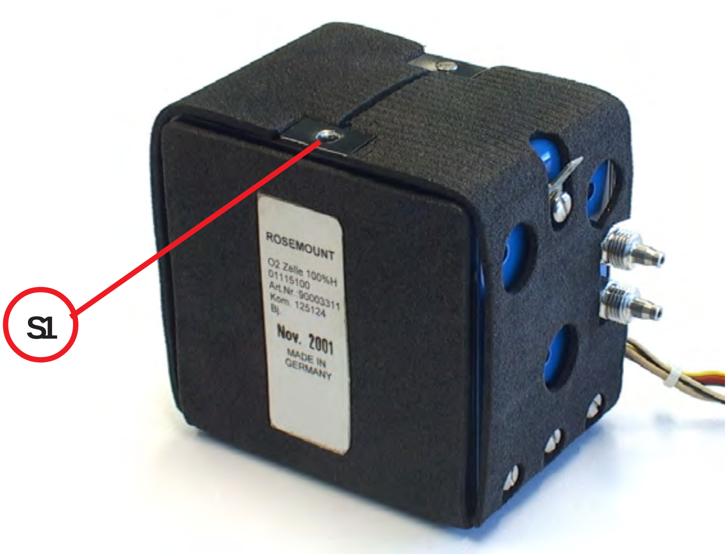
Tip:
Shade the cell with a cloth when adjusting screw S3.

Step 5:

Tighten the screw **S2** with care, close the cover and check the zero point again.

You might have to re-adjust the zero point several times until it remains at the expected value.

8-4 Troubleshooting on Components



Step 6:

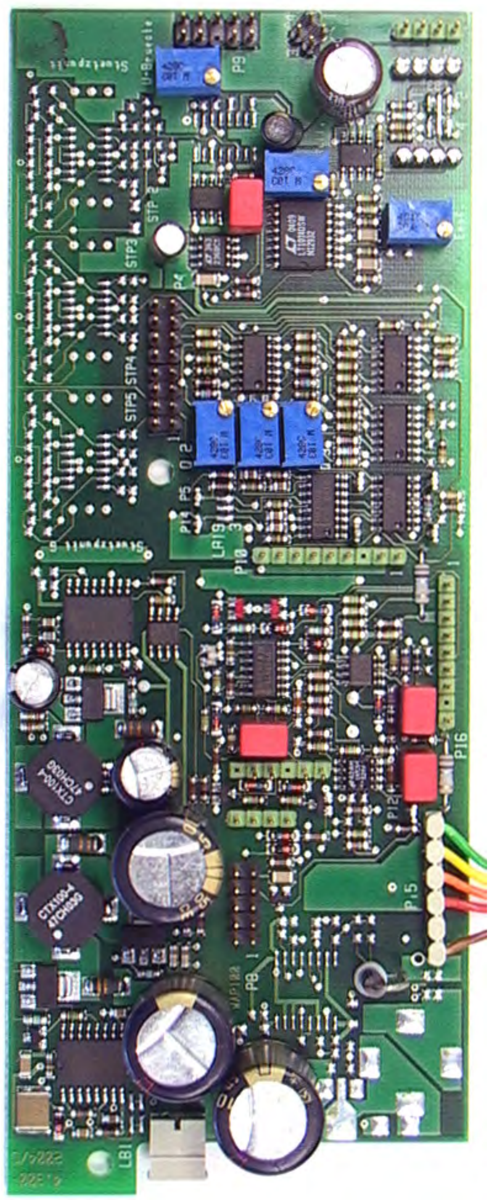
Fix the closed cell´s cover with screw **S1**.

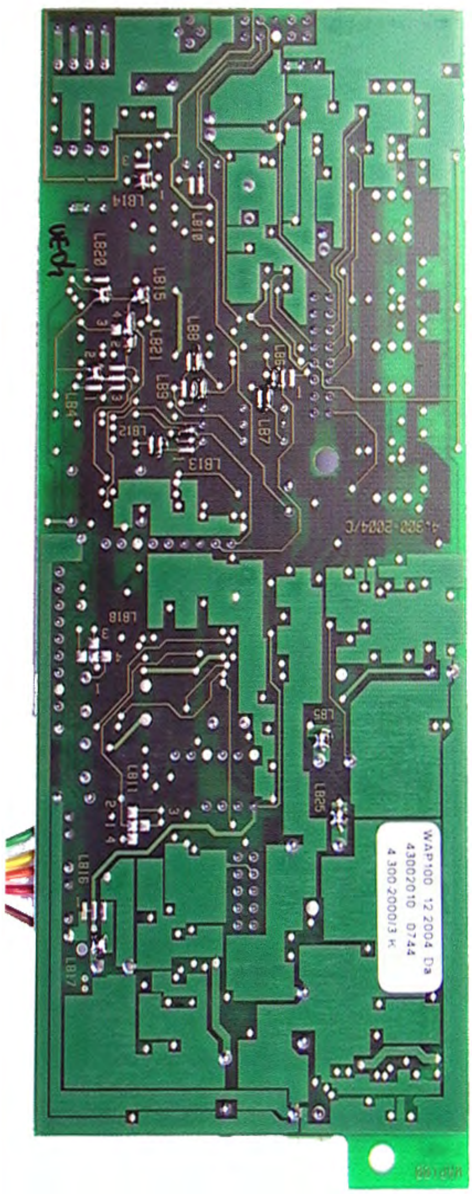
This completes the zero point adjustment procedure.

8-4-8 Thermal Conductivity Cell: Adjustment of Output Signal

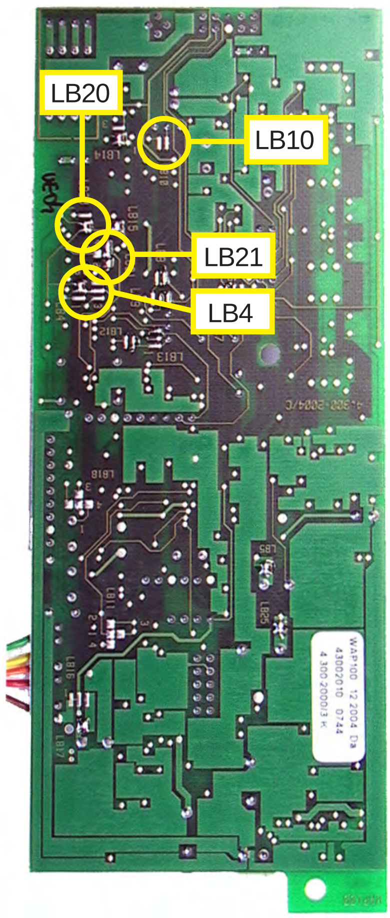
To adjust the zero signal of this measuring cell you need to have access to both sides of the related electronics board WAP 100.

A digital voltmeter (DVM) is required to measure and adjust several voltages!





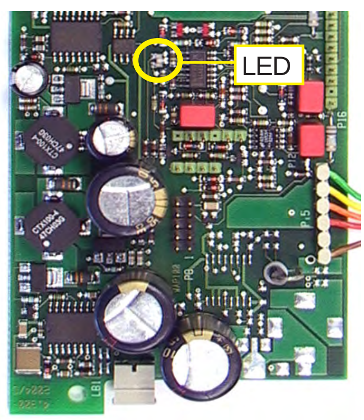
8-4 Troubleshooting on Components



Step 1:

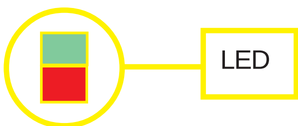
Check the solder bridges, located at the solder side of the board, for proper configuration:

LB10	open
LB4 2-5	closed
LB21 1-4	closed
LB20	open

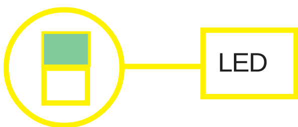


Step 2:

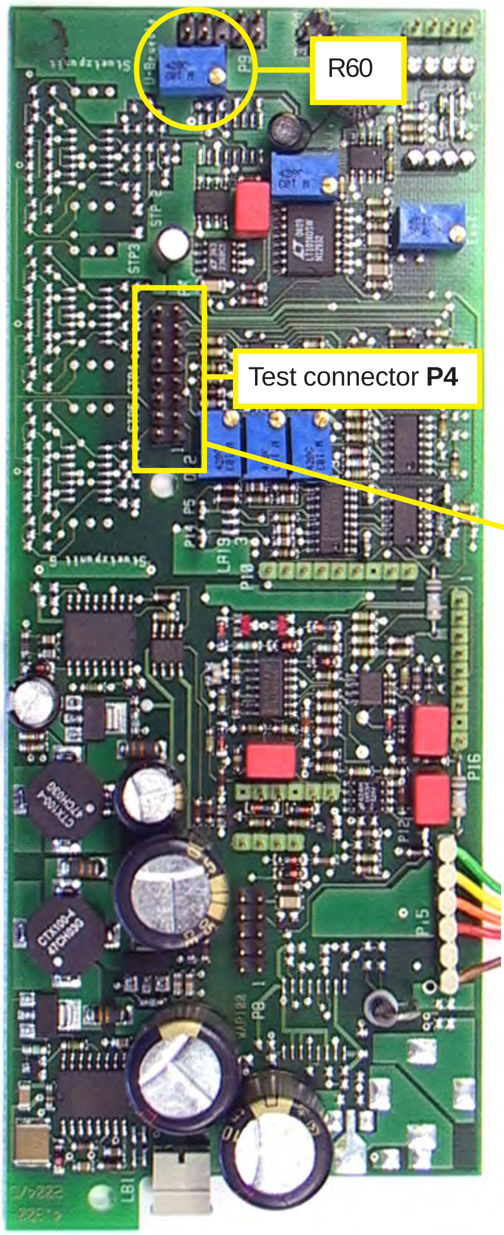
Switch on the analyzer.
The onboard LED will light up red and green.



When the warmup time has elapsed, the LED flashes green.



8-4 Troubleshooting on Components

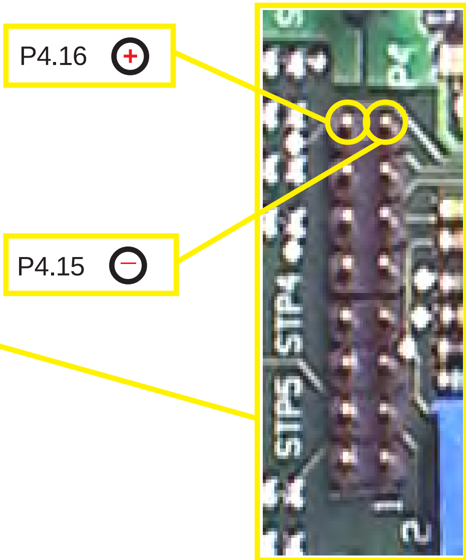


Step 3:

Locate test connector P4 to **measure the bridge voltage**:

P4.16 Bridge voltage (+)
P4.15 Bridge voltage (-); GND

CAUTION!
Do not short-circuit pins!

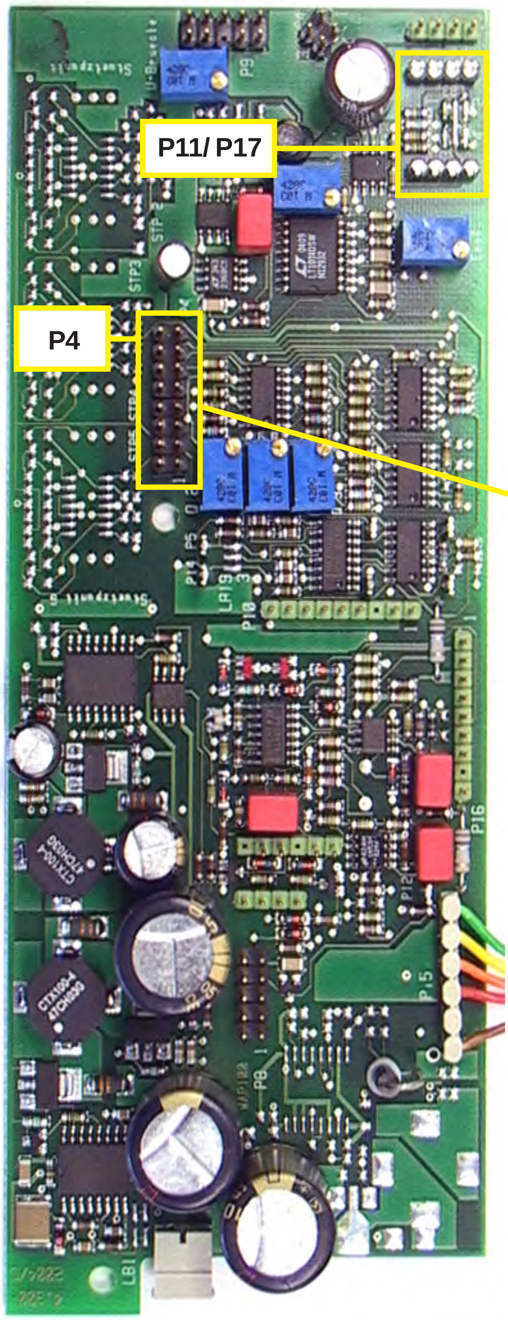


Alternatively the GND signal (-) is accessible on the main board BKS, too: Locate X11 (☞ fig. 8-3, page 8-16) .

The bridge voltage depends on range and sample gas and should be between 3V and 5V.

Only if the WAP 100 board has been replaced, it is necessary to adjust the voltage with potentiometer R60.

8-4 Troubleshooting on Components



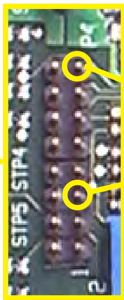
Step 4:

To **adjust the physical zero point**:

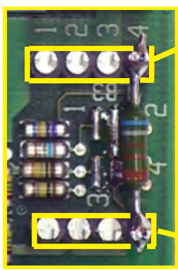
Apply zero gas to the analyzer.

Connect the DVM to the following pins:
P4.5 Raw signal (+)
P4.15 Bridge voltage (-); GND

CAUTION!
Do not short-circuit pins!

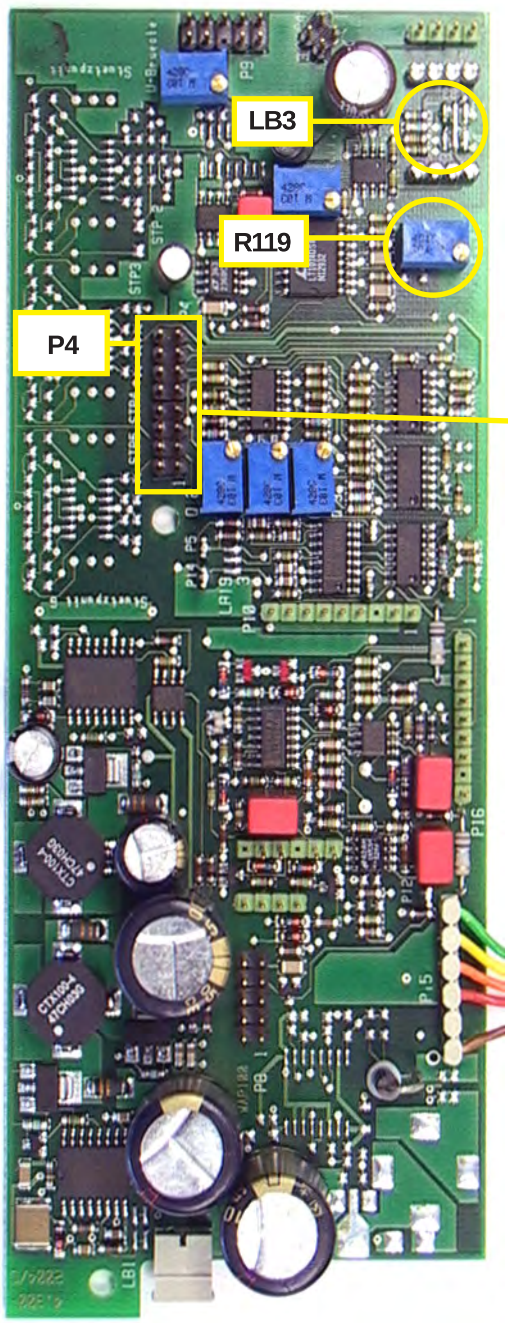


To adjust the physical zero point, it is necessary to install a resistor between **P11/ P17** at position 1, 2, 3 or 4 (the following figure shows it at position 4).
The position and value depends on the individual cell parameters. Proper configuration is a result of "try and error"!
Change resistor and/or position until the voltage is **0 V ± 500 mV**.



Finally solder in the resistor between P11/ P17.

8-4 Troubleshooting on Components

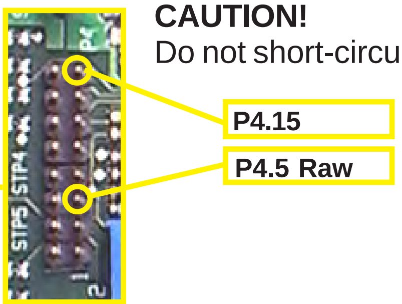


Step 5:

To **adjust the physical span**:
Apply span gas to the analyzer.

Do not disconnect the DVM:
P4.5 Raw signal (+)
P4.15 Bridge voltage (-); GND

CAUTION!
Do not short-circuit pins!



Adjust the voltage to **10V** utilizing **R119**.

If 10V is not within the adjustable range, it is necessary to change the signal amplification with **solder bridge LB3**:

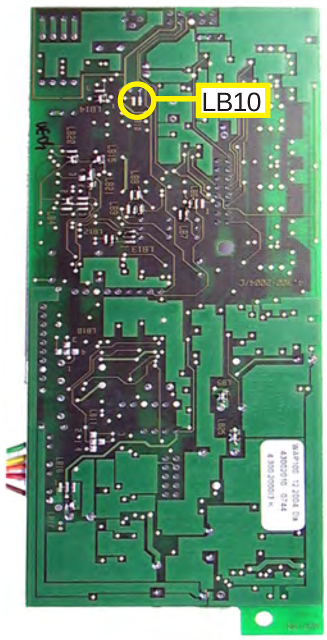
For an amplification factor of	close
20	1-5
150	3-5
300	4-5
500	2-3-4-5

Step 6:

Now once more check the zero point:
Apply zero gas to the analyzer.
Do not disconnect the DVM:

The voltage should be **0 V ± 500 mV.**
If it does not, repeat from step 3!

8-4 Troubleshooting on Components



Step 7:

To **finetune the physical zero point**:

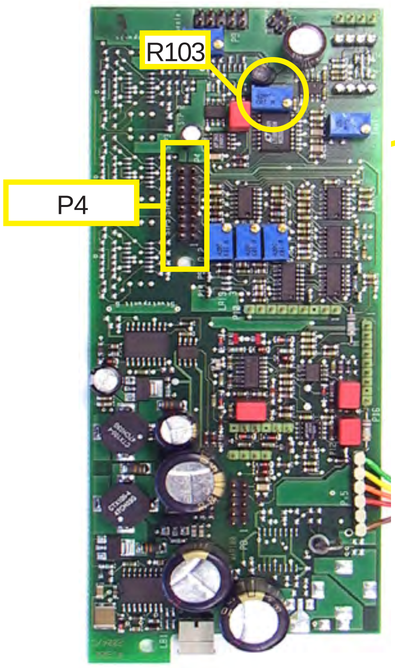
Close solder bridge LB10.

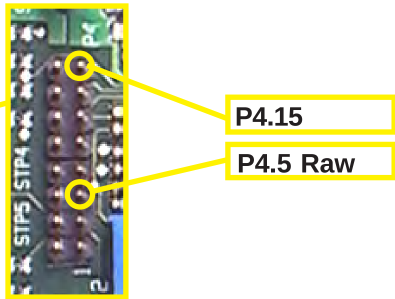
Apply zero gas to the analyzer.

Do not disconnect the DVM:
P4.5 Raw signal (+)
P4.15 Bridge voltage (-); GND

CAUTION!
Do not short-circuit pins!

Now you can finetune the zero point to a minimum value, using R103.





Check the zero point with **zero gas** again and perform a **zero calibration**.

Check the full scale signal (10V at P4.5) with **span gas** and perform a **span calibration**.

This step completes the adjustment of output procedure.

Chapter 9
Modbus Functions

9-1 Abstract

This chapter lists all Modbus functions and registers supported by X-STREAM gas analyzers.
Refer to the *www.Modbus-IDA.org* website for detailled documentation about programming the interface. At date of creation of this instruction manual the following documents were used:

- MODBUS Protocol Specification: Modbus_Application_Protocol_V1_1a.pdf
- MODBUS Serial Line Implementation Guide: Modbus_over_serial_line_V1.pdf.

For a list of

supported functions ☞ 9-2, page 9-2

supported parameters and registers,
ordered by parameter name ☞ 9-3, page 9-3
ordered by register number ☞ 9-4, page 9-16

9-1-1 Modbus TCP/IP

Before using Modbus TCP/IP take care to configure the communication properly:
☞ 5-4-3-6, page 5-42.

For Modbus TCP/IP the analyzer is factory configured to support DHCP servers: The moment, the powered instrument is connected to a DHCP server via ethernet, it will receive a valid IP address and become visible in the network.
If a DHCP server is not available, special software is downloadable to configure the ethernet port.

Download the configuration utility software for the installed XPort AR from:
http://www.lantronix.com/support/downloads.html

9-2 Supported Functions

Modbus Description	Function Code decimal	(hex)	Remark [1]
ReadCoils	01	(0x01)	for registers of 2000
ReadDiscreteInputs	02	(0x02)	for registers of 1000
ReadHoldingRegisters	03	(0x03)	for registers of 3000, 8000, 9000
ReadInputRegisters	04	(0x04)	for registers of 4000, 8000, 9000
WriteSingleCoil	05	(0x05)	for registers of 2000
WriteSingleRegister	06	(0x06)	for registers of 3000
Diagnostic	08	(0x08)	sub function "00 = Return Query Data" only
WriteMultipleCoils	15	(0x0F)	for registers of 2000
WriteMultipleRegisters	16	(0x10)	for registers of 3000, 8000, 9000
EncapsulatedInterfaceTransport	43	(0x28)	sub function "0x60" and "0x81" only (to be used for configuration file transfer)

1) Registers ranges 8000 and 9000 are **Daniel** long word or floating point registers.
To calculate the related **Modicon** registers use the following table:

Daniel		**Modicon**	**Data type**
8001 - 8499	equals	5001 - 5999	long word
9001 - 9999	equals	6001 - 7999	floating point

or ☞ the following pages for comparisons of all Daniel and Modicon registers.

9-3 List of Parameters and Registers

This list is ordered alphabetically by the parameter name („Mnemonic") column.
Any "#" is a wildcard, to be replaced by "1" or "2" for the desired measuring channel. In this case the upper register line is assigned to channel 1, the lower line to channel 2.

Modbus-Register Daniel	Modbus-Register Modicon	Mnemonic / Description	Range / Enum values / Coefficients	Attribute[1] / Type
3066 3067	3066 3067	ActivateSimulValue#DB activates simulation of concentration measurement values	bit0: RawValueConcentration#DB bit1: ZeroOffset#DB bit2: TemperatureOffset#DB bit3: CrossInterferenceOffset#DB bit4: TemperatureFactor#DB bit5: PressureFactor#DB bit6: MEASx bit7: Concentration#DB	Par, Fac Byte-Bitfield
3131..3138	3131..3138	ActivSimulMuxValuesDB activates simulation of the multiplexed values of the 3rd AD-converter	bit0: ADC-value bit1: averaged ADC-value bit2: reserved bit3: reserved bit4: reserved bit5: reserved bit6: reserved bit7: finale value	Par, Fac Byte-Bitfield-Arr8
9081..9082 9083..9084	6161..6164 6165..6168	ADC_Isrc#CoeffsDB polynom coefficients that convert ADC-value into current of light source1 in mA	A0, A1	Cfg, Fac Float-Arr2
9041..9043	6081..6086	ADC_Temp1CoeffsDB polynom coefficients that convert ADC-value into Temperature1 in °C	A0, A1, A2	Cfg, Fac Float-Arr3
9044..9046	6087..6092	ADC_Temp2CoeffsDB polynom coefficients that convert ADC-value into Temperature2 in °C	A0, A1, A2	Cfg, Fac Float-Arr3
1001 1002	1001 1002	AdConversionError#DB raw measurement of concentration is not running		Dyn Boolean
1003	1003	AdConversionTemperatureDB raw measurement of 3rd AD-converter is not running		Dyn Boolean
3103 3104	3103 3104	ADconvOffset#DB defines the AD-converter# correction offset		Cfg, Fac Byte
3102	3102	ADconvOffsetMuxDB defines the AD-converter3(Mux) correction offset		Cfg, Fac Byte
9025	6049..6050	AirPressureDB current air pressure (in hPa): if internal pressure measurement is enabled (PressureSensorInstalledDB) this is a dynamic variable; if no pressure sensor is installed we have to input the current value	500 .. 2000	Dyn, Cfg Float

9 Modbus

9-3 Modbus - List of Parameters and Registers

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Modbus-Register Daniel	Modbus-Register Modicon	Mnemonic Description	Range / Enum values / Coefficients	Attribute[1] Type
3016	3016	AnalogAmplifierSettingDB high/low analog amplifying is used	bit0 = high amplification Ch1 bit1 = high amplification Ch2	Cfg, Fac Byte-Bitfield
3042 3044	3042 3044	AOutAdjustEnd#DB Adjustment value for end of analog output range	3300 .. 4050	Cfg, Fac Int
3041 3043	3041 3043	AOutAdjustStart#DB Adjustment value for begin of analog output range	1500 .. 2500	Cfg, Fac Int
9096 9098	6191..6192 6195..6196	AOutEndRange#DB concentration level where the range of analog output ends	min/max depend on EndOfRange#DB, DifferentialMeasurementDB	Cfg Float
3046	3046	AOutSignalAssignDB Assignment of signals to the analog outputs	0 = AOut1-Comp1 AOut2-Comp2 1 = AOut1-Temp1 AOut2-Comp2 2 = AOut1-Comp1 AOut2-Temp1 3 = StartRange_ADJUST Aout# 4 = EndRange_ADJUST Aout#	Cfg, Fac enum
9095 9097	6189..6190 6193..6194	AOutStartRange#DB concentration level where the range of analog output starts	min/max depend on EndOfRange#DB, DifferentialMeasurementDB	Cfg Float
3045	3045	AOutTypeDB behavior type of the analog outputs	0 = 0 .. 20 mA (no Limits) 1 = 4 .. 20 mA (no Limits) 2 = 0 .. 20 mA (NE43; failure below) 3 = 4 .. 20 mA (NE43; failure below) 4 = 0 .. 20 mA (NE43; failure above) 5 = 4 .. 20 mA (NE43; failure above)	Cfg enum
3100	3100	AutoCodeModeDB defines how codes are automatically locked again	0 = never 1 = on home key 2 = 1 minute after last key press	Cfg enum
3006	3006	AutoZeroSpanTimeIntervalDB time interval (in hours) for automatic zero&span calibrations of both channels	0..999	Cfg Integer
3005	3005	AutoZeroTimeIntervalDB time interval (in hours) for automatic zero calibrations of both channels	0..999	Cfg Integer
3111..3114	3111..3114	BasicAccessCodeDB user code for getting access to basic areas	2 characters per register: 1st character at HIGH byte, 2nd character at LOW byte.	Cfg String-8
3115	3115	BasicAccModeDB mode for getting access to basic areas	0 = access is allowed 1 = access requires user code 2 = access is prohibited	Cfg enum
3101	3101	BoardSerialNrDB computer board serial number		Cfg, Fac Word

9-3 Modbus - List of Parameters and Registers

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Modbus-Register Daniel	Modbus-Register Modicon	Mnemonic Description	Range / Enum values / Coefficients	Attribute[1] Type
4002	4002	CalibrationCountDB second decrementer for calibration and/or purging procedures		Dyn Word
4001	4001	CalibrationStateDB current calibration status	0=no calibration active 1=zero cal Ch1 11=purge zero Ch1 2=zero cal Ch2 12=purge zero Ch2 3=zero cal Ch1&Ch2 13=purge zero Ch1+Ch2 4=span cal Ch1 14=purge span Ch1 5=span cal Ch2 15=purge span Ch2 6= zero & span cal Ch1&Ch2 16=purge zero & span Ch1&Ch2 7=span cal Ch1&Ch2 17=purge span Ch1&Ch2 8=zero cal Ch2 & span cal Ch1&Ch2 18=purge zero Ch2 & span Ch1&Ch2 9=cancel 10=wait for purge sample gas (purge + 2*t90)	Dyn Enum
4003	4003	CalValveStateDB current state of the valves	bit0 = sample gas opened bit1 = zero gas opened bit2 = span gas Ch1 opened bit3 = span gas Ch2 opened	Dyn Byte-Bitfield
3021..3030 3031..3040	3021..3030 3031..3040	ChannelId#DB Channel Identification String	2 characters per register: 1st character at HIGH byte, 2nd character at LOW byte.	Cfg String-20
9001 9002	6001..6002 6003..6004	Concentration#DB calculated concentration value		Dyn, Sim Float
9017 9018	6033..6034 6035..6036	CorrRawValueConc#DB offset corrected raw value of A/D-conversion		Dyn Float
2023	2023	CrossCompensationCalibrationDB calibrate cross interference calculations during span calibrations		Cfg Boolean
2022	2022	CrossCompensationDB cross interference failure are compensated		Cfg Boolean
9089 9090	6177..6178 6179..6180	CrossInterferenceFact#DB factor that determines the cross interference influence between 2 measurement channels		Cfg, Self Float
9009 9010	6017..6018 6019..6020	CrossInterferenceOffset#DB zero correction of cross interference compensation		Dyn, Sim Float

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Modbus-Register Daniel	Modbus-Register Modicon	Mnemonic / Description	Range / Enum values / Coefficients	Attribute[1] / Type
2029	2029	dbAcknowledgeStates() acknowledge all status messages		Fct
2007 = 1	2007 = 1	dbCalibCommand (CAL_ZERO_SPAN_1_2,…) start zero&span calibration of all channels		Fct
2001 = 0 2007 = 0	2001 = 0 2007 = 0	dbCalibCommand (CALCMD_CANCEL, ..) cancel a running calibration		Fct
2003 = 1 2004 = 1	2003 = 1 2004 = 1	dbCalibCommand (CALCMD_SPAN_#,…) start span calibration of a channel		Fct
2006 = 1	2006 = 1	dbCalibCommand (CALCMD_SPAN_1_2,…) start span calibration of all channels		Fct
2001 = 1 2002 = 1	2001 = 1 2002 = 1	dbCalibCommand (CALCMD_ZERO_#,…) start zero calibration of a channel		Fct
2005 = 1	2005 = 1	dbCalibCommand (CALCMD_ZERO_1_2,…) start zero calibration of all channels		Fct
2028	2028	dbResetDevice() reset the device (warm start)		Fct Boolean
2033 = 1 2034 = 1	2033 = 1 2034 = 1	dbRestoreCalib (CALCMD_SPAN_#,…) restore span calibration data of a channel from user data memory		Fct
2031 = 1 2032 = 1	2031 = 1 2032 = 1	dbRestoreCalib (CALCMD_ZERO_#,…) restore zero calibration data of a channel from user data memory		Fct
3109 = 2	3109 = 2	dbStoreData2FLASH (.., FL_PARA_USER) save configuration data to user memory		Fct
3109 = 3	3109 = 3	dbStoreData2FLASH(..,FL_PARA_FACT) save configuration data to factory memory		Fct
2011 = 1/0 2012 = 1/0	2011 = 1/0 2012 = 1/0	dbSwitchValves (VALVE_SAMPLEGAS) switch on/off sample gas valve		Fct
2015 = 1/0 2016 = 1/0	2015 = 1/0 2016 = 1/0	dbSwitchValves (VALVE_SPANGAS#) switch on/off span gas valve of channel		Fct
2013 = 1/0 2014 = 1/0	2013 = 1/0 2014 = 1/0	dbSwitchValves (VALVE_ZEROGAS) switch on/off zero gas valve		Fct

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Modbus-Register Daniel	Modbus-Register Modicon	Mnemonic / Description	Range / Enum values / Coefficients	Attribute[1] / Type
3078 3088	3078 3088	DecimalPoint#DB decimal point for concentration display	0 = no digits after DP 1 = 1digit after DP 2 = 2digits after DP 3 = 3digits after DP 4 = 4digits after DP	Cfg Enum
1016	1016	DeviceStateDB measurement is running without errors		Dyn Boolean
3056	3056	DifferentialMeasurementDB min/max values for differential measurement is used	bit0 = differential measurement Ch1 bit1 = differential measurement Ch2	Cfg, Fac Byte-Bitfield
3059	3059	DigInputsInstalledDB The optional digital inputs are installed	0 = not installed 1 = installed	Cfg, Fac Boolean
4009	4009	DOLimitAlarmUseDB function of digital output normally assigned to Limit1Alert1DB: LimitAlert or RangeID	0 = LimAlert 1 = RangeID	Dyn Enum
3068 3069	3068 3069	DynamicNoiseReduction#DB value for dynamic noise reduction (0 = Off)	0 .. 9999	Cfg, Fac Integer
3126..3129	3126..3129	EmersonAccessCodeDB user code for getting access to Emerson areas	2 characters per register: 1st character at HIGH byte, 2nd character at LOW byte.	Cfg, Fac String-8
3130	3130	EmersonAccModeDB mode for getting access to Emerson areas	0 = access is allowed 1 = access requires user code 2 = access is prohibited	Cfg, Fac enum
9033 9034	6065..6066 6067..6068	EndOfRange#DB end of measurement range in ppm	1 .. 1000000	Cfg, Fac Float
1013	1013	EpromErrorDB checksum of EPROM is erroneous		Dyn Boolean
3116..3119	3116..3119	ExpertAccessCodeDB user code for getting access to expert areas	2 characters per register: 1st character at HIGH byte, 2nd character at LOW byte.	Cfg String-8
3120	3120	ExpertAccModeDB mode for getting access to expert areas	0 = access is allowed 1 = access requires user code 2 = access is prohibited	Cfg enum
3055	3055	FlowAlarmInstalledDB flow alarm hardware installed	0 = not installed 1 = installed	Cfg, Fac Boolean
1018	1018	FlowTooLowDB too low flow is indicated		Dyn Boolean
3001	3001	FlushingPeriodDB purge delay time (in secs) for gas supply	0..600	Cfg Integer

9-3 Modbus - List of Parameters and Registers

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Modbus-Register Daniel	Modbus-Register Modicon	Mnemonic / Description	Range / Enum values / Coefficients	Attribute[1] / Type
3060	3060	HideOptionLinesDB defines if menu lines are hidden when depending on installed options	0..1	Cfg Boolean
2021	2021	HoldStatusDB hold analog outputs and alarm contacts during no sample gas flowing		Cfg Boolean
1019	1019	InvalidProcessGasDB concentration values not coming from valid process gas		Dyn Boolean
3107	3107	KeyDebounceCountDB defines debouncing of key presses; value is the number of key scans before a key is seen as valid; a convenient value might depend on key technology (pressure, magnetic, optic)	0..40	Cfg uchar
3091	3091	LanguageDB The language in which the menus appear.	0 = English 1 = German 2 = French 3 = Spanish 4 = Italian	Cfg Enum
3047 3049	3047 3049	Limit1AlarmTyp#DB Type of a alarming with limit1	0 = alarm off 1 = low alarm 2 = high alarm 3 = alarm off (failsafe) 4 = low alarm (failsafe) 5 = high alarm (failsafe)	Cfg Enum
1021 1023	1021 1023	Limit1Alert#DB concentration hurts configured alarm level Limit1Level#DB		Dyn Boolean
9101 9103	6201..6202 6205..6206	Limit1Level#DB concentration is compared with this level; according Limit1AlarmTyp#DB an alarm contact gets activated	unit is ppm; min/max depend on EndOfRange#DB, MaxConcePercent#DB, DifferentialMeasurementDB	Cfg Float
3048 3050	3048 3050	Limit2AlarmTyp#DB Type of a alarming with limit2	0 = alarm off 1 = low alarm 2 = high alarm 3 = alarm off (failsafe) 4 = low alarm (failsafe) 5 = high alarm (failsafe)	Cfg Enum
1022 1024	1022 1024	Limit2Alert#DB concentration hurts configured alarm level Limit2Level#DB		Dyn Boolean

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Modbus-Register Daniel	Modbus-Register Modicon	Mnemonic / Description	Range / Enum values / Coefficients	Attribute[1] / Type
9102 9104	6203..6204 6207..6208	Limit2Level#DB concentration is compared with this level; according Limit2AlarmTyp#DB an alarm contact gets activated	unit is ppm; min/max depend on EndOfRange#DB, MaxConcePercent#DB, DifferentialMeasurementDB	Cfg Float
9071..9075 9076..9080	6141..6150 6151..6160	LinearCoeffs#DB polynom coefficients that determines the linearization correction curve	A0, A1, A2, A3, A4	Cfg, Fac Float-Arr5
3015	3015	LinearizationDB activates linearization procedure for concentration measurement	0 = no linearization 1 = linearization Comp1 on; Comp2 off 2 = linearization Comp1 off; Comp2 on 3 = linearization Comp1 on; Comp2 on	Cfg, Fac Enum
4004 4005	4004 4005	LinearizerError#DB concentration calculation is outside defined linearizer limits; there is linear extrapolated	0 = no error 1 = value below lower limit 2 = value above upper limit	Dyn Enum
9039 9040	6077..6078 6079..6080	LinearMaxInFac#DB in conjunction with MaxConcePercent#DB this value defines the min/max values of the linearization curve, below/above there is linear extrapolated	1 .. 10	Cfg, Fac Float
9021 9022	6041..6042 6043..6044	LinearNormVal#DB linearized measurement value which is still normalized		Dyn Float
3099	3099	LOIAutoHomeDB defines if/when menu system is returning automatically to main measurement display	0 = Never 1 = 1 minute after last keypress 2 = 10 minutes after last keypress	Cfg Enum
1028	1028	LOISetupStateDB Operator currently changing instrument setup via local interface		Dyn Boolean
9107 9108	6213..6214 6215..6216	LowestEndRng#DB lowest usable range complying to device's specifications (in ppm)		Cfg, Fac Float
3019 3020	3019 3020	MaxConcePercent#DB defines max. allowed values in percent from measurement range for calibration gases and concentration alarms	0 .. 250 %	Cfg, Fac Integer
9019 9020	6037-6038 6039..6040	MaxValue#DB maximum offset corrected raw value at end of range		Cfg, Self Float

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Modbus-Register Daniel	Modbus-Register Modicon	Mnemonic / Description	Range / Enum values / Coefficients	Attribute[1] / Type
9099 9100	6197..6198 6199..6200	MeasBufAvg#DB average value of used ring buffer values		Dyn, Sim Float
8001..8012 8021..8032	5001..5024 5041..5064	MeasBufValues#DB ring buffer which contains single raw measurement values		Dyn Lword-Arr12
3092	3092	MeasLine1DB Signal assigned to Line1 of measurement display	0 = NoSignal 1 = Comp1 2 = Temp1 3 = Press1 4 = Comp2 5 = Temp2 6 = Press2	Cfg Enum
3093	3093	MeasLine2DB Signal assigned to Line2 of measurement display	0 = NoSignal 1 = Comp1 2 = Temp1 3 = Press1 4 = Comp2 5 = Temp2 6 = Press2	Cfg Enum
3094	3094	MeasLine3DB Signal assigned to Line3 of measurement display	0 = NoSignal 1 = Comp1 2 = Temp1 3 = Press1 4 = Comp2 5 = Temp2 6 = Press2	Cfg Enum
3106	3106	MotorTimerDB defines the turning frequency of the chopper motor		Cfg, Fac Word
9023 9024	6045..6046 6047..6048	NormConcentration#DB normalized concentration value		Dyn Float
3070	3070	NumberChannelsDB how many channels are built-in	1..2	Cfg, Fac uchar
4006	4006	ParamAccessModeDB parameter write access mode the analyzer is currently in	0=normal 1=local access 2 = exclusive remote access 4=service access	Dyn Enum
9063..9066 9067..9070	6125..6132 6133..6140	PfactCorrCoeffs#DB polynom coefficients that compute span factor correction (PressureFactor#DB) using the assigned pressure (PressureSensorInstalledDB)	A0, A1, A2, A3	Cfg, Fac Float-Arr4
3090	3090	PresDecimalPointDB decimal point position for pressure displays	0..4	Cfg uchar

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Modbus-Register		Mnemonic / Description	Range / Enum values / Coefficients	Attribute[1] / Type
Daniel	Modicon			
9087..9088	6173..6176	PressSensorCoeffsDB polynom coefficients that converts the digital pressure sensor output into hPa	A0, A1	Cfg, Fac Float
3053	3053	PressSensorMaxValDB max valid value if using digital pressure sensor		Cfg, Fac Ushort
3052	3052	PressSensorMinValDB min valid value if using digital pressure sensor		Cfg, Fac Ushort
3089	3089	PressUnitDB specify pressure unit to show on front panel display	0 = Pa 1 = hPa 2 = mbar 3 = Bar 4 = Psig	Cfg Enum
9015 9016	6029..6030 6031..6032	PressureFactor#DB span correction of pressure compensation	0.05-1.8, depending on pressure	Dyn, Sim Float
1004	1004	PressureMeasurementErrorDB if internal pressure measurement is enabled (PressureSensorInstalledDB) sensor delivers erroneous measurement; if cyclic remote pressure input is enabled the values are not written in time		Dyn Boolean
3051	3051	PressureSensorInstalledDB defines what instance determines pressure	0 = user parameter input 1 = installed sensor value input 2 = cyclic remote pressure input (via AirPressureDB) 3 = use channel 2 for single channel devices	Cfg, Fac Enum
3071..3074 3081..3084	3071..3074 3081..3084	PrimVariableName#DB Tag that is displayed for marking the component channel	2 characters per register: 1st character at HIGH byte, 2nd character at LOW byte.	Cfg String-7
3075..3077 3085..3087	3075..3077 3085..3087	PrimVariableUnit#DB string that is displayed as unit of primary variable	2 characters per register: 1st character at HIGH byte, 2nd character at LOW byte.	Cfg String-5
4011..4026	4011..4026	ProgramVersionDB program version string	2 characters per register: 1st character at HIGH byte, 2nd character at LOW byte.	Read String-32
3018	3018	PumpControlDB internal pump is controlled by explained instance	0 = pump is controlled by parameter PumpStateDB 1 = digital input controls pump	Cfg Enum
3017	3017	PumpInstalledDB device has a pump installed and controls it	0 = not installed 1 = installed	Cfg, Fac Boolean

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Modbus-Register Daniel	Modbus-Register Modicon	Mnemonic / Description	Range / Enum values / Coefficients	Attribute[1] / Type
2017	2017	PumpStateDB runs/stops a pump; to write this para-meter is determined by PumpControlDB	0 = Off 1 = On	Cfg Boolean
9091 9093	6181..6182 6185..6186	PVAunitFactor#DB factor to convert into a value according configured PVA unit (linear equation)		Cfg Float
9092 9094	6183..6184 6187..6188	PVAunitOffset#DB offset to convert into a value according configured PVA unit		Cfg Float
1014	1014	RamErrorDB erroneous RAM-test		Dyn Boolean
3007	3007	RangeDB selected range is range switching mode is active	1 or 2	Cfg Byte
3009	3009	RangeModeDB activated instance that switches ranges if range switching mode is activated (AOutSignalAssignDB)	0 = manual 1 = auto	Cfg Enum
1009 1010	1009 1010	RangeOverflow#DB measured gas concentration overflows range of analyzer		Dyn Boolean
9003 9004	6005..6006 6007..6008	RawValueConcentration#DB raw value of A/D-Conversion of measurement channel		Dyn, Sim Float
9109 9110	6217..6218 6219..6220	RawValueTemperature#DB raw value of A/D-Conversion of temperature measurements		Dyn, Sim Float
9105 9106	6209..6210 6211..6212	RawValueTfact#DB factor that corrects raw value depending on assigned temperature (TempCompSpan#DB); see also TcntCorrCoeff#DB		Dyn Float
3109 = 1	3109 = 1	ReinitParas (.., FL_PARA_FACT) load configuration data from factory memory		Fct
3109 = 0	3109 = 0	ReinitParas (..,FL_PARA_USER) load configuration data from user memory		Fct
2030	2030	RemoteExclusiveDB sets ParamAccessModeDB to 'exclusive remote access'		Par Boolean

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Modbus-Register Daniel	Modbus-Register Modicon	Mnemonic / Description	Range / Enum values / Coefficients	Attribute[1] / Type
3008	3008	RemoteSecurityDB sets ParamAccessModeDB to 'service access' if input value equals service code		Par Word
3002 3003	3002 3003	ResponseTime#DB signal damping (in secs) for gas change	2..60	Cfg Integer
3061..3065	3061..3065	SerialNumberDB serial number	2 characters per register: 1st character at HIGH byte, 2nd character at LOW byte.	Cfg, Fac String-10
1020	1020	SimulationDB any kind of value simulation is running (ActivateSimulValue#DB, ActivSimulMuxValuesDB)		Dyn Boolean
3057	3057	SIntInstalledDB Defines whether serial interface hardware is installed	0 = not installed 1 = installed	Cfg, Fac Boolean
3058	3058	SIntModbusFt32DB In Modbus-Protocol: transmission format of 32-bit registers	0 = 32bit (Daniel / Enron) 1 = 16bit low word first (default Modicon) 2 = 16bit high word first (swapped Modicon)	Cfg Enum
9029 9030	6057..6058 6059..6060	SourceCurrent#DB calculated current of light source in mA		Dyn Float
9011 9012	6021..6022 6023..6024	SpanFactor#DB span correction factor (calculated by span calibration)		Cfg, Self Float
9037 9038	6073..6074 6075..6076	SpanGasValue#DB value which a span calibration adjusts to	unit is ppm; min/max depend on EndOfRange#DB, MaxConcePercent#DB, DifferentialMeasurementDB	Cfg Float
1011 1012	1011 1012	SpanGasValueIncorrect#DB spangas = zerogas value not allowed		Dyn Boolean
1007 1008	1007 1008	SpanTolerance#DB tolerance check did not allow span calibration		Dyn Boolean
3121..3124	3121..3124	SpecialAccessCodeDB user code for getting access to specialist areas	2 characters per register: 1st character at HIGH byte, 2nd character at LOW byte.	Cfg String-8
3125	3125	SpecialAccModeDB mode for getting access to specialist areas	0 = access is allowed 1 = access requires user code 2 = access is prohibited	Cfg Enum
9031 9032	6061..6062 6063..6064	StartOfRange#DB beginning of measurement range in ppm	0	Rd Float

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Modbus-Register Daniel	Modbus-Register Modicon	Mnemonic / Description	Range / Enum values / Coefficients	Attribute[1] / Type
9085 9086	6169..6170 6171..6172	TcntCorrCoeff#DB gradient m of equation 'RawValueTfact#DB = m*Temperature + 1'; see RawValueTfact#DB		Cfg, Fac Float
3139 3140	3139 3140	TempCheckEnable#DB defines if a channel is checked for correct temperature range	0 = Off 1 = use Temperature 1 2 = use Temperature 2	Cfg, Fac Enum
3012 3014	3012 3014	TempCompSpan#DB activates temperature span compensation procedure for concentration measurement	0 = Off 1 = use Temperature 1 2 = use Temperature 2	Cfg, Fac Enum
3011 3013	3011 3013	TempCompZero#DB activates temperature offset compensation procedure for concentration measurement	0 = Off 1 = use Temperature 1 2 = use Temperature 2	Cfg, Fac Enum
3080	3080	TempDecimalPointDB decimal point position for temperature displays	0..4	Cfg uchar
9027 9028	6053..6054 6055..6056	Temperature#DB calculated temperature value in °C		Dyn, Sim Float
9013 9014	6025..6026 6027..6028	TemperatureFactor#DB span correction of temperature compensation	0.05-1.8, depending on temperature	Dyn, Sim Float
9007 9008	6013..6014 6015..6016	TemperatureOffset#DB zero correction of temperature compensation		Dyn, Sim Float
3143 3144	3143 3144	TempHighLimit#DB high limit level of the correct temperature range	value to be °C; 0..250	Cfg, Fac Byte
3141 3142	3141 3142	TempLowLimit#DB low limit level of the correct temperature range	value to be °C; 0..250	Cfg, Fac Byte
1025 1026	1025 1026	TempRangeError#DB temperature is outside the configured allowed range		Dyn Boolean
3079	3079	TempUnitDB specify the temperature unit to show on front panel display	0 = °C 1 = °F	Cfg Enum
9055..9058 9059..9062	6109..6116 6117..6124	TfactCorrCoeffs#DB polynom coefficients that compute span factor correction (TemperatureFactor#DB) using the assigned temperature (TempCompSpan#DB)	A0, A1, A2, A3	Cfg, Fac Float-Arr4

9-3 Modbus - List of Parameters and Registers

This list is ordered alphabetically by the parameter name („Mnemonic“) column.
Any "#" is a wildcard, to be replaced by "1" or "2" for the desired measuring channel. In this case the upper register line is assigned to channel 1, the lower line to channel 2.

Modbus-Register Daniel	Modbus-Register Modicon	Mnemonic / Description	Range / Enum values / Coefficients	Attribute[1] / Type
9047..9050 9051..9054	6093..6100 6101..6108	ToffCorrCoeffs#DB polynom coefficients that compute zero offset correction (TemperatureOffset#DB) using the assigned temperature (TempCompZero#DB)	A0, A1, A2, A3	Cfg, Fac Float-Arr4
3004	3004	ToleranceCheckDB check deviation tolerance (10 %) for calibrations	0 = Off 1 = Check; clear automatically after approx. 1 minute 2 = Check; no auto clear	Cfg Enum
1017	1017	UserFLASHConfigDB user's FLASH configuration is loaded		Dyn Boolean
3145 3146	3145 3146	ValveAssign#DB defines the assignment of zero/span calibration gas to the valves	0 = V4/V1 1 = V4/V2 2 = V1/V4 3 = V1/V2 4 = V2/V4 5 = V2/V1	Cfg, Fac Enum
3054	3054	ValvesInstalledDB defines what kind of valve unit is installed	bit0 = internal valves installed bit1 = external valves installed	Cfg, Fac Byte-Bitfield
1027	1027	WarmingUpStateDB device is in the warming up phase		Dyn Boolean
3105	3105	WarmupTimeDB Time that is used for warmup phase		Cfg, Fac Byte
9035 9036	6069..6070 6071..6072	ZeroGasValue#DB value which a zero calibration adjusts to	unit is ppm; min/max depend on EndOfRange#DB, MaxConcePercent#DB, DifferentialMeasurementDB	Cfg Float
9005 9006	6009..6010 6011..6012	ZeroOffset#DB zero correction offset (calculated by zero calibration)		Cfg, Self, Sim Float
1005 1006	1005 1006	ZeroTolerance#DB tolerance check did not allow zero calibration		Dyn Boolean

Note 1:
Dyn: Variable, changing dynamically
Cfg: Parameter, needs to be saved nonvolatile as configuration
Par: volatile Parameter, which is not changed dynamically and has a defined state after restart
Fac: parameter, only setable by service/factory people
Self: parameter, determined by device's algorithms itself
Sim: can be simulated, then writable
Fct: function to be called
Ver: parameter, set by version control
Rd: only readable
Wr: only writable

9-4 Comparison of Registers and Parameters

This list is ordered by the Daniel Modbus register column.
Any "#" is a wildcard, to be replaced by "1" or "2" for the desired measuring channel. In this case the upper register line is assigned to channel 1, the lower line to channel 2.

Modbus-Register		Mnemonic
Daniel	Modicon	
1001 1002	1001 1002	AdConversionError#DB
1003	1003	AdConversionTemperatureDB
1004	1004	PressureMeasurementErrorDB
1005 1006	1005 1006	ZeroTolerance#DB
1007 1008	1007 1008	SpanTolerance#DB
1009 1010	1009 1010	RangeOverflow#DB
1011 1012	1011 1012	SpanGasValueIncorrect#DB
1013	1013	EpromErrorDB
1014	1014	RamErrorDB
1016	1016	DeviceStateDB
1017	1017	UserFLASHConfigDB
1018	1018	FlowTooLowDB
1019	1019	InvalidProcessGasDB
1020	1020	SimulationDB
1021 1023	1021 1023	Limit1Alert#DB
1022 1024	1022 1024	Limit2Alert#DB
1025 1026	1025 1026	TempRangeError#DB
1027	1027	WarmingUpStateDB
1028	1028	LOISetupStateDB
2001 = 1 2002 = 1	2001 = 1 2002 = 1	dbCalibCommand (CALCMD_ZERO_#,…)
2001 = 0 2007 = 0	2001 = 0 2007 = 0	dbCalibCommand (CALCMD_CANCEL, ..)
2003 = 1 2004 = 1	2003 = 1 2004 = 1	dbCalibCommand (CALCMD_SPAN_#,…)
2005 = 1	2005 = 1	dbCalibCommand (CALCMD_ZERO_1_2,…)
2006 = 1	2006 = 1	dbCalibCommand (CALCMD_SPAN_1_2,…)
2007 = 1	2007 = 1	dbCalibCommand (CAL_ZERO_SPAN_1_2,…)
2011 = 1/0 2012 = 1/0	2011 = 1/0 2012 = 1/0	dbSwitchValves (VALVE_SAMPLEGAS)
2013 = 1/0 2014 = 1/0	2013 = 1/0 2014 = 1/0	dbSwitchValves (VALVE_ZEROGAS)

9-4 Modbus - Comparison of Parameters and Registers

This list is ordered by the Daniel Modbus register column.
Any "#" is a wildcard, to be replaced by "1" or "2" for the desired measuring channel. In this case the upper register line is assigned to channel 1, the lower line to channel 2.

Modbus-Register		Mnemonic
Daniel	Modicon	
2015 = 1/0 2016 = 1/0	2015 = 1/0 2016 = 1/0	dbSwitchValves (VALVE_SPANGAS#)
2017	2017	PumpStateDB
2021	2021	HoldStatusDB
2022	2022	CrossCompensationDB
2023	2023	CrossCompensationCalibrationDB
2028	2028	dbResetDevice()
2029	2029	dbAcknowledgeStates()
2030	2030	RemoteExclusiveDB
2031 = 1 2032 = 1	2031 = 1 2032 = 1	dbRestoreCalib (CALCMD_ZERO_#,…)
2033 = 1 2034 = 1	2033 = 1 2034 = 1	dbRestoreCalib (CALCMD_SPAN_#,…)
3001	3001	FlushingPeriodDB
3002 3003	3002 3003	ResponseTime#DB
3004	3004	ToleranceCheckDB
3005	3005	AutoZeroTimeIntervalDB
3006	3006	AutoZeroSpanTimeIntervalDB
3007	3.007	RangeDB
3008	3008	RemoteSecurityDB
3009	3.009	RangeModeDB
3011 3013	3011 3013	TempCompZero#DB
3012 3014	3012 3014	TempCompSpan#DB
3015	3015	LinearizationDB
3016	3016	AnalogAmplifierSettingDB
3017	3017	PumpInstalledDB
3018	3018	PumpControlDB
3019 3020	3019 3020	MaxConcePercent#DB
3021..3030 3031..3040	3021..3030 3031..3040	ChannelId#DB
3041 3043	3041 3043	AOutAdjustStart#DB

9-4 Modbus - Comparison of Parameters and Registers

This list is ordered by the Daniel Modbus register column.
Any "#" is a wildcard, to be replaced by "1" or "2" for the desired measuring channel. In this case the upper register line is assigned to channel 1, the lower line to channel 2.

Modbus-Register		Mnemonic
Daniel	Modicon	
3042 3044	3042 3044	AOutAdjustEnd#DB
3045	3045	AOutTypeDB
3046	3046	AOutSignalAssignDB
3047 3049	3047 3049	Limit1AlarmTyp#DB
3048 3050	3048 3050	Limit2AlarmTyp#DB
3051	3051	PressureSensorInstalledDB
3052	3052	PressSensorMinValDB
3053	3053	PressSensorMaxValDB
3054	3054	ValvesInstalledDB
3055	3055	FlowAlarmInstalledDB
3056	3056	DifferentialMeasurementDB
3057	3057	SIntInstalledDB
3058	3058	SIntModbusFt32DB
3059	3059	DigInputsInstalledDB
3060	3060	HideOptionLinesDB
3061..3065	3061..3065	SerialNumberDB
3066 3067	3066 3067	ActivateSimulValue#DB
3068 3069	3068 3069	DynamicNoiseReduction#DB
3070	3070	NumberChannelsDB
3071..3074 3081..3084	3071..3074 3081..3084	PrimVariableName#DB
3075..3077 3085..3087	3075..3077 3085..3087	PrimVariableUnit#DB
3078 3088	3078 3088	DecimalPoint#DB
3079	3079	TempUnitDB
3080	3080	TempDecimalPointDB
3089	3089	PressUnitDB
3090	3090	PresDecimalPointDB
3091	3091	LanguageDB

9-4 Modbus - Comparison of Parameters and Registers

This list is ordered by the Daniel Modbus register column.
Any "#" is a wildcard, to be replaced by "1" or "2" for the desired measuring channel. In this case the upper register line is assigned to channel 1, the lower line to channel 2.

Modbus-Register		Mnemonic
Daniel	Modicon	
3092	3092	MeasLine1DB
3093	3093	MeasLine2DB
3094	3094	MeasLine3DB
3099	3099	LOIAutoHomeDB
3100	3100	AutoCodeModeDB
3101	3101	BoardSerialNrDB
3102	3102	ADconvOffsetMuxDB
3103 3104	3103 3104	ADconvOffset#DB
3105	3105	WarmupTimeDB
3106	3106	MotorTimerDB
3107	3107	KeyDebounceCountDB
3109 = 0	3109 = 0	ReinitParas (..,FL_PARA_USER)
3109 = 1	3109 = 1	ReinitParas (.., FL_PARA_FACT)
3109 = 2	3109 = 2	dbStoreData2FLASH (.., FL_PARA_USER)
3109 = 3	3109 = 3	dbStoreData2FLASH(..,FL_PARA_FACT)
3111..3114	3111..3114	BasicAccessCodeDB
3115	3115	BasicAccModeDB
3116..3119	3116..3119	ExpertAccessCodeDB
3120	3120	ExpertAccModeDB
3121..3124	3121..3124	SpecialAccessCodeDB
3125	3125	SpecialAccModeDB
3126..3129	3126..3129	EmersonAccessCodeDB
3130	3130	EmersonAccModeDB
3131..3138	3131..3138	ActivSimulMuxValuesDB
3139 3140	3139 3140	TempCheckEnable#DB
3141 3142	3141 3142	TempLowLimit#DB
3143 3144	3143 3144	TempHighLimit#DB

9-4 Modbus - Comparison of Parameters and Registers

This list is ordered by the Daniel Modbus register column.
Any "#" is a wildcard, to be replaced by "1" or "2" for the desired measuring channel. In this case the upper register line is assigned to channel 1, the lower line to channel 2.

Modbus-Register		Mnemonic
Daniel	Modicon	
3145 3146	3145 3146	ValveAssign#DB
4001	4001	CalibrationStateDB
4002	4002	CalibrationCountDB
4003	4003	CalValveStateDB
4004 4005	4004 4005	LinearizerError#DB
4006	4006	ParamAccessModeDB
4009	4009	DOLimitAlarmUseDB
4011..4026	4011..4026	ProgramVersionDB
8001..8012 8021..8032	5001..5024 5041..5064	MeasBufValues#DB
9001 9002	6001..6002 6003..6004	Concentration#DB
9003 9004	6005..6006 6007..6008	RawValueConcentration#DB
9005 9006	6009..6010 6011..6012	ZeroOffset#DB
9007 9008	6013..6014 6015..6016	TemperatureOffset#DB
9009 9010	6017..6018 6019..6020	CrossInterferenceOffset#DB
9011 9012	6021..6022 6023..6024	SpanFactor#DB
9013 9014	6025..6026 6027..6028	TemperatureFactor#DB
9015 9016	6029..6030 6031..6032	PressureFactor#DB
9017 9018	6033..6034 6035..6036	CorrRawValueConc#DB
9019 9020	6037-6038 6039..6040	MaxValue#DB
9021 9022	6041..6042 6043..6044	LinearNormVal#DB
9023 9024	6045..6046 6047..6048	NormConcentration#DB
9025	6049..6050	AirPressureDB
9027 9028	6053..6054 6055..6056	Temperature#DB
9029 9030	6057..6058 6059..6060	SourceCurrent#DB
9031 9032	6061..6062 6063..6064	StartOfRange#DB
9033 9034	6065..6066 6067..6068	EndOfRange#DB
9035 9036	6069..6070 6071..6072	ZeroGasValue#DB

9-4 Modbus - Comparison of Parameters and Registers

This list is ordered by the Daniel Modbus register column.
Any "#" is a wildcard, to be replaced by "1" or "2" for the desired measuring channel. In this case the upper register line is assigned to channel 1, the lower line to channel 2.

Modbus-Register		Mnemonic
Daniel	Modicon	
9037 9038	6073..6074 6075..6076	SpanGasValue#DB
9039 9040	6077..6078 6079..6080	LinearMaxInFac#DB
9041..9043	6081..6086	ADC_Temp1CoeffsDB *(A0, A1, A2)*
9044..9046	6087..6092	ADC_Temp2CoeffsDB *(A0, A1, A2)*
9047..9050 9051..9054	6093..6100 6101..6108	ToffCorrCoeffs#DB *(A0, A1, A2, A3)*
9055..9058 9059..9062	6109..6116 6117..6124	TfactCorrCoeffs#DB *(A0, A1, A2, A3)*
9063..9066 9067..9070	6125..6132 6133..6140	PfactCorrCoeffs#DB *(A0, A1, A2, A3)*
9071..9075 9076..9080	6141..6150 6151..6160	LinearCoeffs#DB *(A0, A1, A2, A3, A4)*
9081..9082 9083..9084	6161..6164 6165..6168	ADC_Isrc#CoeffsDB *(A0, A1)*
9085 9086	6169..6170 6171..6172	TcntCorrCoeff#DB
9087..9088	6173..6176	PressSensorCoeffsDB *(A0, A1)*
9089 9090	6177..6178 6179..6180	CrossInterferenceFact#DB
9091 9093	6181..6182 6185..6186	PVAunitFactor#DB
9092 9094	6183..6184 6187..6188	PVAunitOffset#DB
9095 9097	6189..6190 6193..6194	AOutStartRange#DB
9096 9098	6191..6192 6195..6196	AOutEndRange#DB
9099 9100	6197..6198 6199..6200	MeasBufAvg#DB
9101 9103	6201..6202 6205..6206	Limit1Level#DB
9102 9104	6203..6204 6207..6208	Limit2Level#DB
9105 9106	6209..6210 6211..6212	RawValueTfact#DB
9107 9108	6213..6214 6215..6216	LowestEndRng#DB
9109 9110	6217..6218 6219..6220	RawValueTemperature#DB

9-4 Modbus - Comparison of Parameters and Registers

Chapter 10
Service Information

10-1 Return of Material

If factory repair of defective equipment is required, proceed as follows:

1. Secure a return authorization from a Rosemount Analytical Sales Office or Representative before returning the equipment. Equipment must be returned with complete identification in accordance with Rosemount instructions or it will not be accepted.
2. In no event will Rosemount be responsible for equipment without proper authorization and identification.
3. Carefully pack defective unit in a sturdy box with sufficient shock absorbing material to ensure no additional damage will occur during shipping.

State which gases have been supplied to the gas analyzer. This information is required to prevent service personnel from being impacted by harmful gases.

4. In a cover letter, describe completely:

a. The symptoms that determined the equipment is faulty.
b. The environment in which the equipment was operating (housing, weather, vibration, dust, etc.).
c. Site from which equipment was removed.
d. Whether warranty service or non-warranty service is requested.
e. Complete shipping instructions for the return of the equipment.

5. Enclose a cover letter and purchase order and ship the defective equipment according to instructions provided in a Rosemount Return Authorization, prepaid, to:

In Europe:

Emerson Process Management
GmbH & Co. OHG
Service Department
Deutschland
+49 6055 884-470/-472

In US:

Emerson Process Management
Rosemount Analytical Inc.
Customer Service Center
1-800-433-6076
1-440-914-1261

In Asia Pacific:

Emerson Process Management
Asia Pacific Pte Limited
Singapore
+65-6-777-8211

If warranty service is expected, the defective unit will be carefully inspected and tested at the factory. If failure was due to conditions listed in the standard Rosemount warranty, the defective unit will be repaired or replaced at Rosemount's option, and an operating unit will be returned to the customer in accordance with shipping instructions furnished in the cover letter.

For equipment no longer under warranty, the equipment will be repaired at the factory and returned as directed by the purchase order and shipping instructions.

10 Service Information

10-2 Customer Service

For order administration, replacement parts, applicaton assistance, on-site or factory repair, service or maintenance contract information, contact:

In Europe:

Emerson Process Management
GmbH & Co. OHG
Service Department
Germany
+49 6055 884-470/-472

In US:

Emerson Process Management
Rosemount Analytical Inc.
Customer Service Center
1-800-433-6076
1-440-914-1261

In Asia Pacific:

Emerson Process Management
Asia Pacific Pte Limited
1 Pandan Crescent
Singapore 128461
+65-6-777-8211

10-3 Training

A comprehensive Factory Training Program of operator and service classes is available. For a copy of the training schedule contact:

In Europe:

Emerson Process Management
GmbH & Co. OHG
Service Department
Germany
+49 6055 884-470/-472

In US:

Emerson Process Management
Rosemount Analytical Inc.
Customer Service Center
1-800-433-6076
1-440-914-1261

In Asia Pacific:

Emerson Process Management
Asia Pacific Pte Limited
1 Pandan Crescent
Singapore 128461
+65-6-777-8211

Appendix

This chapter contains

A-1 Modbus Implementation

MODBUS over Serial Line

Specification & Implementation guide

V1.0

A-1 Modbus Implementation

3 Physical Layer

3.1 Preamble

A new MODBUS solution over serial line should implement an electrical interface in accordance with EIA/TIA-485 standard (also known as RS485 standard). This standard allows point to point and multipoint systems, in a "two-wire configuration". In addition, some devices may implement a "Four-Wire" RS485-Interface.

A device may also implement an RS232-Interface.

In such a MODBUS system, a Master Device and one or several Slave Devices communicate on a passive serial line.

On standard MODBUS system, all the devices are connected (in parallel) on a trunk cable constituted by 3 conductors. Two of those conductors (the "Two-Wire" configuration) form a balanced twisted pair, on which bi-directional data are transmitted, typically at the bit rate of 9600 bits per second.

Each device may be connected (see figure 19):

- either directly on the trunk cable, forming a daisy-chain,
- either on a passive Tap with a derivation cable,
- either on an active Tap with a specific cable.

Screw Terminals, RJ45, or D-shell 9 connectors may be used on devices to connect cables (see the chapter "Mechanical Interfaces").

3.2 Data Signaling Rates

9600 bps and 19.2 Kbps are required and 19.2 is the required default

Other baud rates may optionally be implemented : 1200, 2400, 4800, … 38400 bps, 56 Kbps, 115 Kbps, …

Every implemented baud rate must be respected better than 1% in transmission situation, and must accept an error of 2% in reception situation.

A-1 Modbus Implementation

3.3 Electrical Interfaces

3.3.1 Multipoint Serial Bus Infrastructure

Figure 19 gives a general overview of the serial bus infrastructure in a MODBUS multipoint Serial Line system.

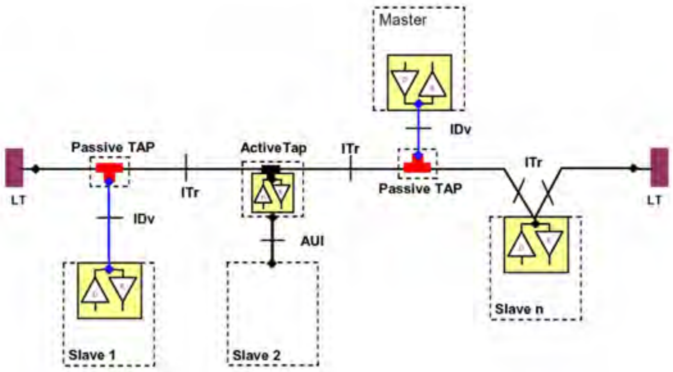


Figure 19 : Serial bus infrastructure

A multipoint MODBUS Serial Line bus is made of a principal cable (**the Trunk**), and possibly some **derivation** cables.
Line terminations are necessary at each extremity of the trunk cable for impedance adaptation (see § "Two-Wire MODBUS Definition" & "Optional Four-Wire MODBUS Definition" for details).

As shown in figure 19, different implementations may operate in the same MODBUS Serial Line system :

- the device integrates the communication transceiver and is connected to the trunk using a **Passive Tap** and a derivation cable (case of Slave 1 and Master) ;
- the device doesn't integrate the communication transceiver and is connected to the trunk using an **Active Tap** and a derivation cable (the active TAP integrates the transceiver) (case of Slave 2) ;
- the device is connected directly to the trunk cable, in a **Daisy-Chain** (case of Slave n)

The following conventions are adopted :

- The interface with the **trunk** is named **ITr** (Trunk Interface)
- The interface between the device and the **Passive Tap** is named **IDv** (Derivation Interface)
- The interface between the device and the **Active Tap** is named **AUI** (Attachment Unit Interface)

Remarks :

1. In some cases, the Tap may be connected directly to the IDv-socket or the AUI-socket of the device, without using a derivation cable.
2. A Tap may have several IDv sockets to connect several devices. Such a Tap is named **Distributor** when it is a passive one.
3. When using an active Tap, power supply of the Tap may be provided either via its AUI or ITr interface.

ITr and **IDv** interfaces are described in the following chapters (see § "Two-Wire MODBUS DEFINITION" & "Four-Wire MODBUS DEFINITION").

A-1 Modbus Implementation

3.3.2 Two-Wire MODBUS Definition

A MODBUS solution over serial line should implement a "Two-Wire" electrical interface in accordance with EIA/TIA-485 standard.

On such a 2W-bus, at any time one driver only has the right for transmitting.

In fact a third conductor must also interconnect all the devices of the bus : the common.

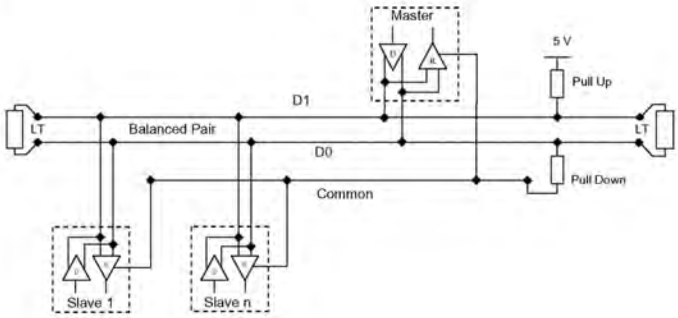


Figure 20: General 2-Wire Topology

2W-MODBUS Circuits Definition

Required Circuits		For device	Required on device	EIA/TIA-485 name	Description
on ITr	**on IDv**				
D1	D1	I/O	**X**	B/B'	**Transceiver terminal 1, V1 Voltage** (V1 > V0 for binary 1 [OFF] state)
D0	D0	I/O	**X**	A/A'	**Transceiver terminal 0, V0 Voltage** (V0 > V1 for binary 0 [ON] state)
Common	Common	--	**X**	C/C'	Signal and optional Power Supply Common

Notes :

- For Line Termination (LT), Pull Up and Pull Down resistors, please refer to section "Multipoint System requirements".
- D0, D1, and Common circuit names must be used in the documentation related to the device and the Tap (User Guide, Cabling Guide, …) to facilitate interoperability.
- Optional electrical interfaces may be added, for example :
  - **Power Supply :** 5..24 V D.C.
  - **Port mode control :** PMC circuit (TTL compatible). When needed, port mode may be controlled either by this external circuit and/or by another way (a switch on the device for example). In the first case while an open circuit PMC will ask for the 2W-MODBUS mode, a Low level on PMC will switch the port into 4W-MODBUS or RS232-MODBUS Mode, depending on the implementation.

A-1 Modbus Implementation

3.3.3 Optional Four-Wire MODBUS Definition

Optionally, such MODBUS devices also permit to implement a **2-pair** bus (4 wires) of mono directional data. The data on the **master pair** (RXD1-RXD0) are only received by the slaves ; the data on the **slave pair** (TXD1-TXD0) are only received by the only master.

In fact a fifth conductor must also interconnect all the devices of the 4W-bus : the common.

In the same way as on a 2W-MODBUS, at any time one driver only has the right for emitting.

Such a device must implement, for each balanced pair, a driver and a transceiver **in accordance with EIA/ TIA-485**. (Sometimes this solution has been named "RS422", which is not correct : the RS422 standard does not support several drivers on one balanced pair.)

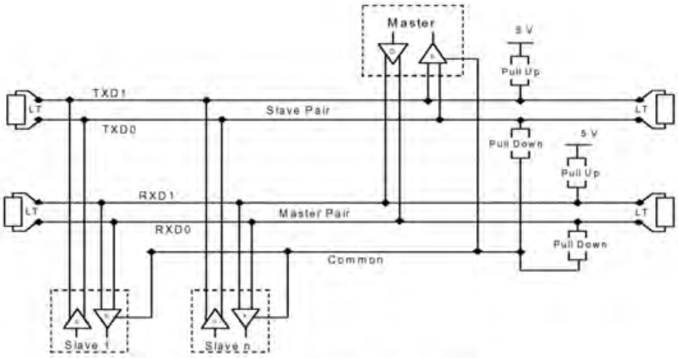


Figure 21: General 4-wire topology

Optional 4W-MODBUS Circuits Definition

Required Circuits		For device	Required on device	EIA/TIA-485 name	Description for IDv
on ITr	**on IDv**				
TXD1	TXD1	Out	**X**	B	**Generator terminal 1**, Vb Voltage (Vb > Va for binary 1 [OFF] state)
TXD0	TXD0	Out	**X**	A	**Generator terminal 0**, Va Voltage (Va > Vb for binary 0 [ON] state)
RXD1	RXD1	In	**(1)**	B'	**Receiver terminal 1**, Vb' Voltage (Vb' > Va' for binary 1 [OFF] state)
RXD0	RXD0	In	**(1)**	A'	**Receiver terminal 0**, Va' Voltage (Va' > Vb' for binary 0 [ON] state)
Common	Common	--	**X**	C/C'	Signal and optional Power Supply **Common**

Notes :

- For Line Termination (LT), Pull Up and Pull Down resistors, please refer to section "Multipoint System requirements".
- Those circuits **(1)** are required only if an 4W-MODBUS option is implemented.
- The name of the 5 required circuits must be used in the documentation related to the device and the Tap (User Guide, Cabling Guide, ...) to facilitate interoperability.
- Optional electrical interfaces may be added, for example :
  - **Power Supply :** 5..24 V D.C.
  - **PMC circuit :** See above (In 2W-MODBUS Circuits Definition) the note about this optional circuit.

A-1 Modbus Implementation

3.3.3.1 4W-Cabling System Important Topic

In such a 4W-MODBUS, Master Device and Slave Devices have IDv interfaces with the same 5 required circuits.
As the master has to :

- receive from the slave the data on the slave pair (TXD1-TXD0),
- and transmit on the master pair (RXD1-RXD0 , received by the slaves) ,

the 4W-cabling system must cross the two pairs of the bus between ITr and the IDv of the master :

	Signal on Master IDv		EIA/TIA-485 Name	Circuit on ITr
	Name	Type		
Slave Pair	RXD1	In	B'	TXD1
	RXD0	In	A'	TXD0
Master Pair	TXD1	Out	B	RXD1
	TXD0	Out	A	RXD0
	Common	--	C/C'	Common

This crossing may be implemented by crossed cables, but the connection of such crossed cables in a 2-wire system may cause damages. To connect a 4W master device (which have a MODBUS connector) a better solution is to use a Tap which includes the crossing function.

3.3.3.2 Compatibility between 4-Wire and 2-Wire cabling

In order to connect devices implementing a 2-Wire physical interface to an already existing 4-Wire system, the 4-Wire cabling system can be modified as described below :

- TxD0 signal shall be wired with the RxD0 signal, turning them to the D0 signal
- TxD1 signal shall be wired with the RxD1 signal, turning them to the D1 signal.
- Pull-up, Pull-down and line terminations resistors shall be re-arranged to correctly adapt the D0, D1 signals.

A-1 Modbus Implementation

The figure hereafter gives an example where slaves 2 and 3 which use a 2-Wire interface can operate with the Master and the slave 1 which use a 4-Wire interface.

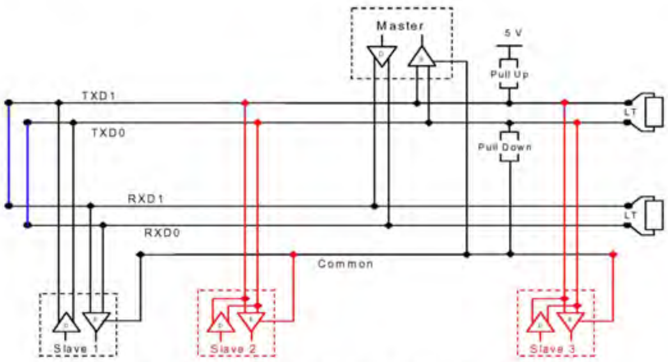


Figure 22 : Changing a 4-Wire cabling system into a 2-Wire cabling system

In order to connect devices implementing a 4-Wire physical interface to an already existing 2-Wire system, the 4-Wire interface of the new coming devices can be arranged as describe below :

On each 4-Wire device interface :

- TxD0 signal shall be wired with the RxD0 signal and then connected to the D0 signal of the trunk ;
- TxD1 signal shall be wired with the RxD1 signal and then connected to the D1 signal of the trunk.

The figure hereafter gives an example where slaves 2 and 3 which use a 4-Wire interface can operate with the Master and the slave 1 which use a 2-Wire interface.

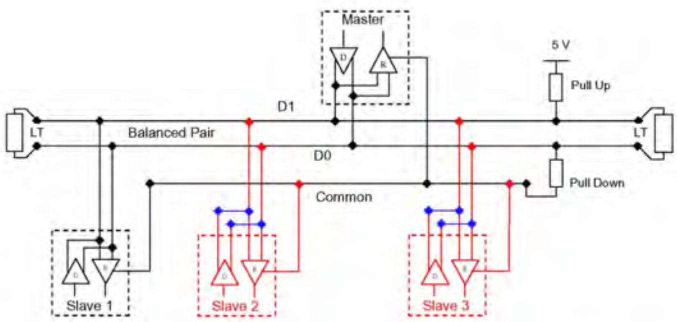


Figure 23 : Connecting devices with 4-Wire interface to a 2-Wire cabling system

A-1 Modbus Implementation

3.3.4 RS232-MODBUS Definition

Some devices may implement an RS232-Interface between a DCE and a DTE.

Optional RS232-MODBUS Circuits Definition

Signal	For DCE	Required on DCE (1)	Required on DTE (1)	Description
Common	–	X	X	**Signal Common**
CTS	In			Clear to Send
DCD	–			Data Carrier Detected (from DCE to DTE)
DSR	In			Data Set Ready
DTR	Out			Data Terminal Ready
RTS	Out			Request to Send
RXD	In	X	X	**Received Data**
TXD	Out	X	X	**Transmitted Data**

Notes :

- "X" marked signals are required only if an RS232-MODBUS option is implemented.
- Signals are in accordance with EIA/ TIA-232.
- Each TXD must be wired with RXD of the other device ;
- RTS may be wired with CTS of the other device,
- DTR may be wired with DSR of the other device.
- Optional electrical interfaces may be added, for example :
  - **Power Supply :** 5..24 V D.C.
  - **PMC circuit :** See above (In 2W-MODBUS Circuits Definition) the note about this optional circuit.

3.3.5 RS232-MODBUS requirements

This optional MODBUS on Serial Line system should only be used for short length (typically less than 20m) point to point inter-connection.

Then, the EIA/TIA-232 standard must be respected :

⇒ circuits definition,

⇒ maximum wire capacitance to ground (2500 pF, then 25 m for a 100 pF/m cable).

Please refer to chapter "Cables" for the shield, and for the possibility to use Category 5 Cables.

Documentation of the device must indicate :

⇒ if the device must be considered as a DCE either as a DTE,

⇒ how optional circuits must work if such is the case.

A-1 Modbus Implementation

3.4 Multipoint System requirements

For any EIA/ TIA-485 multipoint system, in either 2-wire or 4-wire configuration, the following requirements all apply.

3.4.1 Maximum number of devices without repeater

A figure of **32 devices** is always authorized on any RS485-MODBUS system without repeater.

Depending of :
- all the possible addresses,
- the figure of RS485 Unit Load used by the devices,
- and the line polarization in need be,

A RS485 system may implement a larger number of devices. Some devices allow the implementation of a RS485-MODBUS serial line with more than 32 devices, without repeater.

In this case these MODBUS devices must be documented to say how many of such devices are authorized without repeater.

The use of a **repeater** between two heavy loaded RS485-MODBUS is also possible.

3.4.2 Topology

An RS485-MODBUS configuration without repeater has one trunk cable, along which devices are connected, directly (daisy chaining) or by short derivation cables.

The trunk cable, also named "Bus", can be long (see hereafter). Its two ends must be connected on Line Terminations.

The use of repeaters between several RS485-MODBUS is also possible.

3.4.3 Length

The end to end length of the **trunk cable** must be limited. The maximum length depends on the baud rate, the cable (Gauge Capacitance or Characteristic Impedance), the number of loads on the daisy chain, and the network configuration *(2-wire or 4-wire)*.

For a maximum 9600 Baud Rate and AWG26 (or wider) gauge, the maximum length is 1000m. In the specific case shown in the figure 22 (4 Wire cabling used as a 2 Wire cabling system) the maximum length must be divided by two.

The **derivations** must be short, never more than 20m. If a multi-port tap is used with n derivations, each one must respect a maximum length of 40m divided by n.

3.4.4 Grounding Arrangements

The « Common » circuit (Signal and optional Power Supply Common) must be connected directly to protective ground, preferably at **one point only** for the entire bus. Generally this point is to choose on the master device or on its Tap.

3.4.5 Line Termination

A reflection in a transmission line is the result of an impedance discontinuity that a travelling wave sees as it propagates down the line. To minimize the reflections from the end of the RS485-cable it is required to place a Line Termination **near each of the 2 Ends** of the Bus.

It is important that the line be terminated at **both** ends since the propagation is bi-directional, but it is not allowed to place more than 2 LT on one passive D0-D1 balanced pair . Never place any LT on a derivation cable.

A-1 Modbus Implementation

Each line termination must be connected between the two conductors of the balanced line : D0 and D1.

Line termination may be a 150 ohms value (0.5 W) resistor.

A serial capacitor (1 nF, 10 V minimum) with a 120 Ohms (0.25 W) resistor is a better choice when a polarization of the pair must be implemented (see here after).

In a 4W-system, each pair must be terminated at each end of the bus.

In an RS232 interconnections, no termination should be wired.

3.4.6 Line Polarization

When there is no data activity on an RS-485 balanced pair, the lines are not driven and, thus susceptible to external noise or interference. To insure that its receiver stays in a constant state, when no data signal is present, some devices need to bias the network.

Each MODBUS device must be documented to say :

- if the device needs a line polarization,
- if the device implements, or can implement, such a line polarization.

If one or several devices need polarization, **one** pair of resistors must be connected on the RS-485 balanced pair :

- a Pull-Up Resistor to a 5V Voltage on D1 circuit,
- a Pull-Down Resistor to the common circuit on D0 circuit.

The value of those resistors must be between 450 Ohms and 650 Ohms. 650 Ohms resistors value may allow a higher number of devices on the serial line bus.

In this case, a polarization of the pair must be implemented **at one location for the whole Serial Bus**. Generally this point is to choose on the master device or on its Tap. Other devices must not implement any polarization.

The maximum number of devices authorized on such a MODBUS Serial Line is reduced by 4 from a MODBUS without polarization.

A-2 EC Declaration of Conformity

EC DECLARATION OF CONFORMITY

Document number: RAE/X-STREAM-E7
Date: November 2005

We,

Emerson Process Management GmbH & Co. OHG

located at

Industriestrasse 1, D-63594 Hasselroth, Germany

declare under our sole responsibility that our gas analyzer, type

X-STREAM

to which this declaration relates is in conformity with the provisions of:

89/336/EEC **EMC Directive** **(changed by directive 91/263/EEC 92/31/EEC and 93/68/EEC)**
with the application of the harmonized standards:

EN 61326-1:1997 + A1:1998 + A2:2001 + A3:2003	Electrical equipment for measurement, control and laboratory use - EMC requirements

---

73/23/EEC **Low Voltage Directive** **(changed by directive 93/68/EEC)**
with the application of the harmonized standards:

EN 61010-1:2001	Safety requirements for electrical equipment for measurement, control and laboratory use Part 1: General requirements

---

97/23/EC **Pressure Equipment Directive**
This analyzer has been designed and manufactured considering article 3, paragraph 3 of the above mentioned directive and therefore CE marking does not refer to this directive.

This document covers all 19" and fieldhousing X-STREAM gas analyzer variations.

Hasselroth, 11/23/2005

....
(Signature)

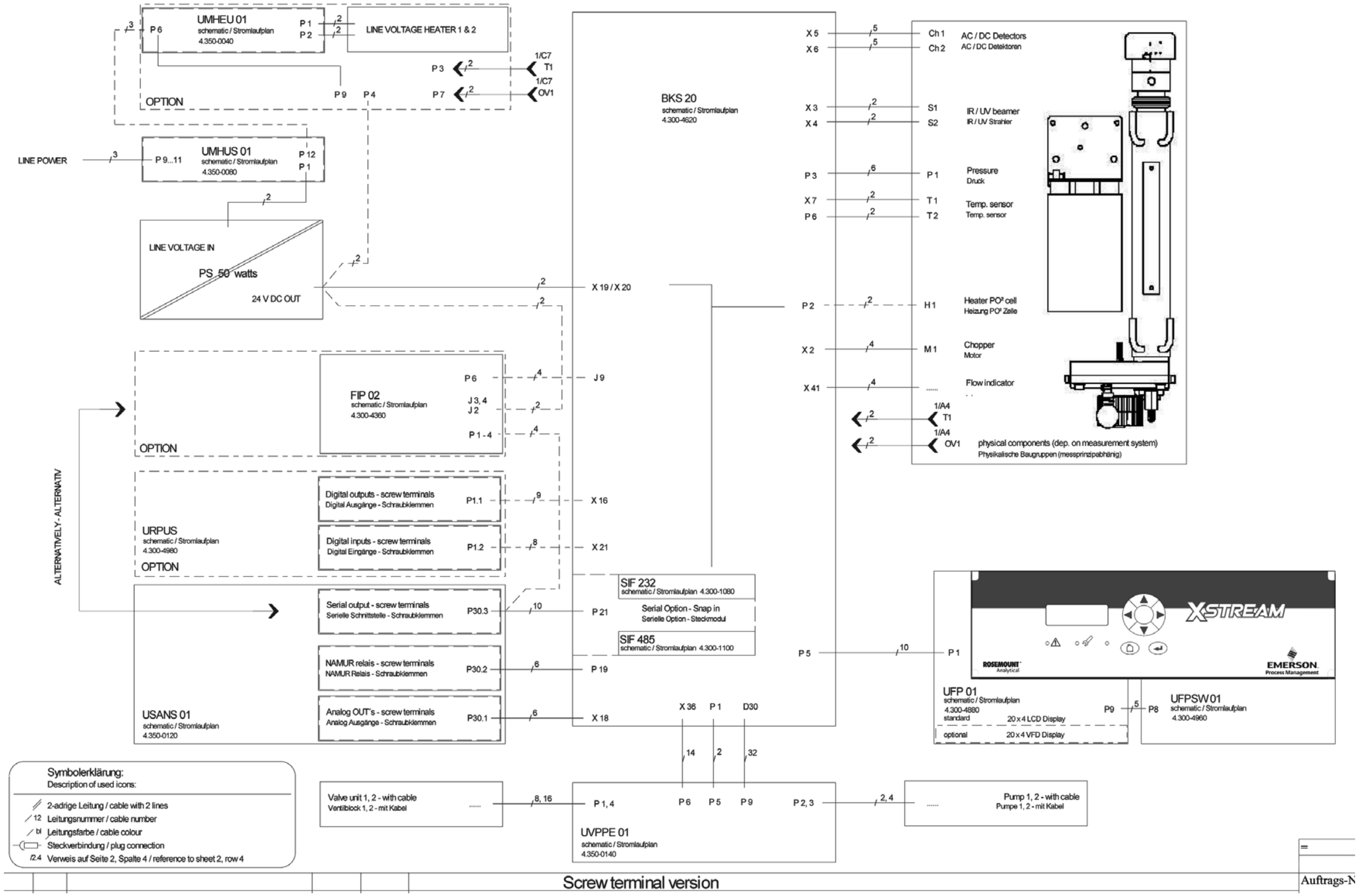
Ian Macleod
(Name)

VP Sales & Marketing EMA
(Function name)

This declaration confirms the compliance with announced directives but does not include the assurance of properties.
The safety and installation instructions of the documentation have to be followed.

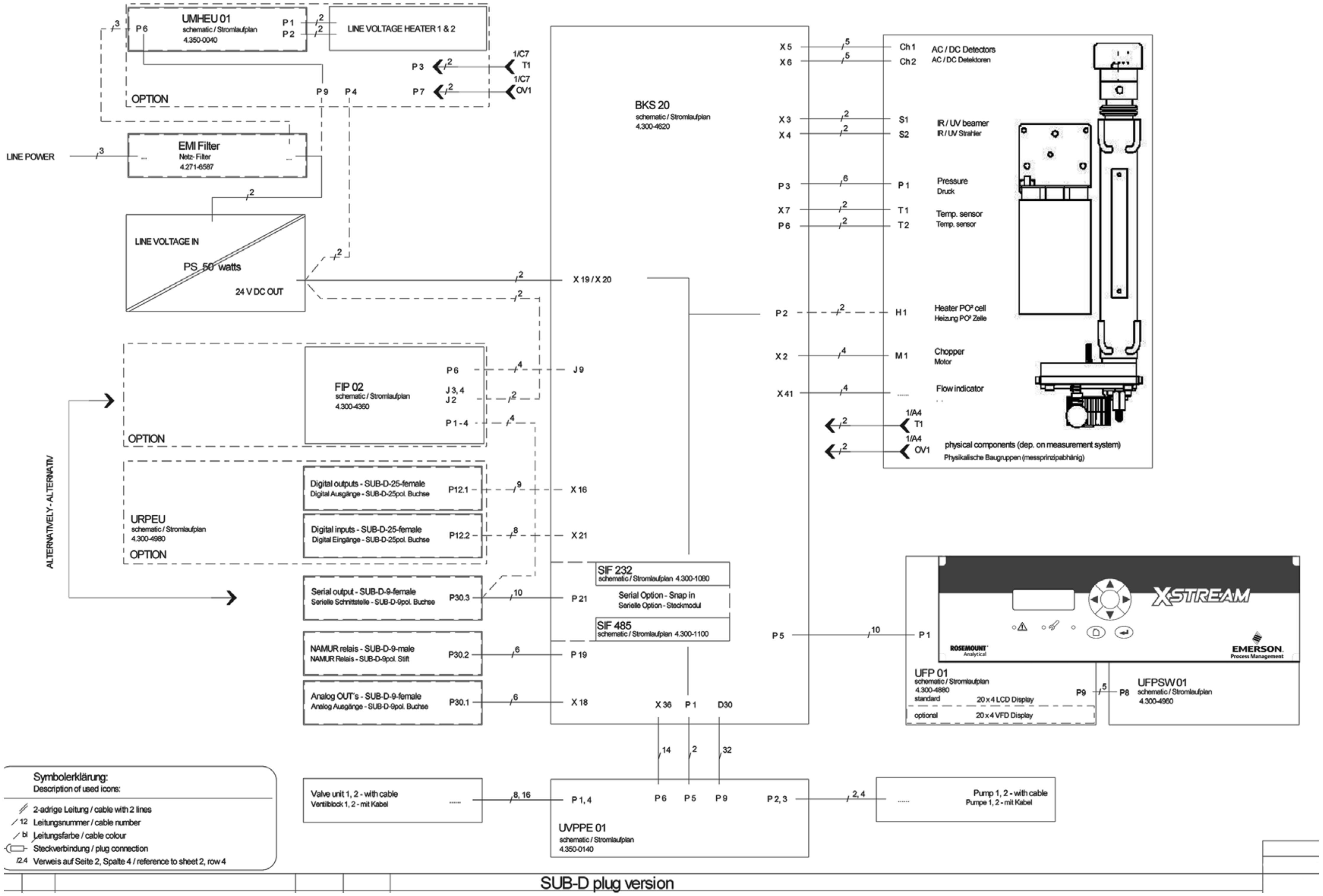
A-3 Block Diagrams

X-STREAM GP



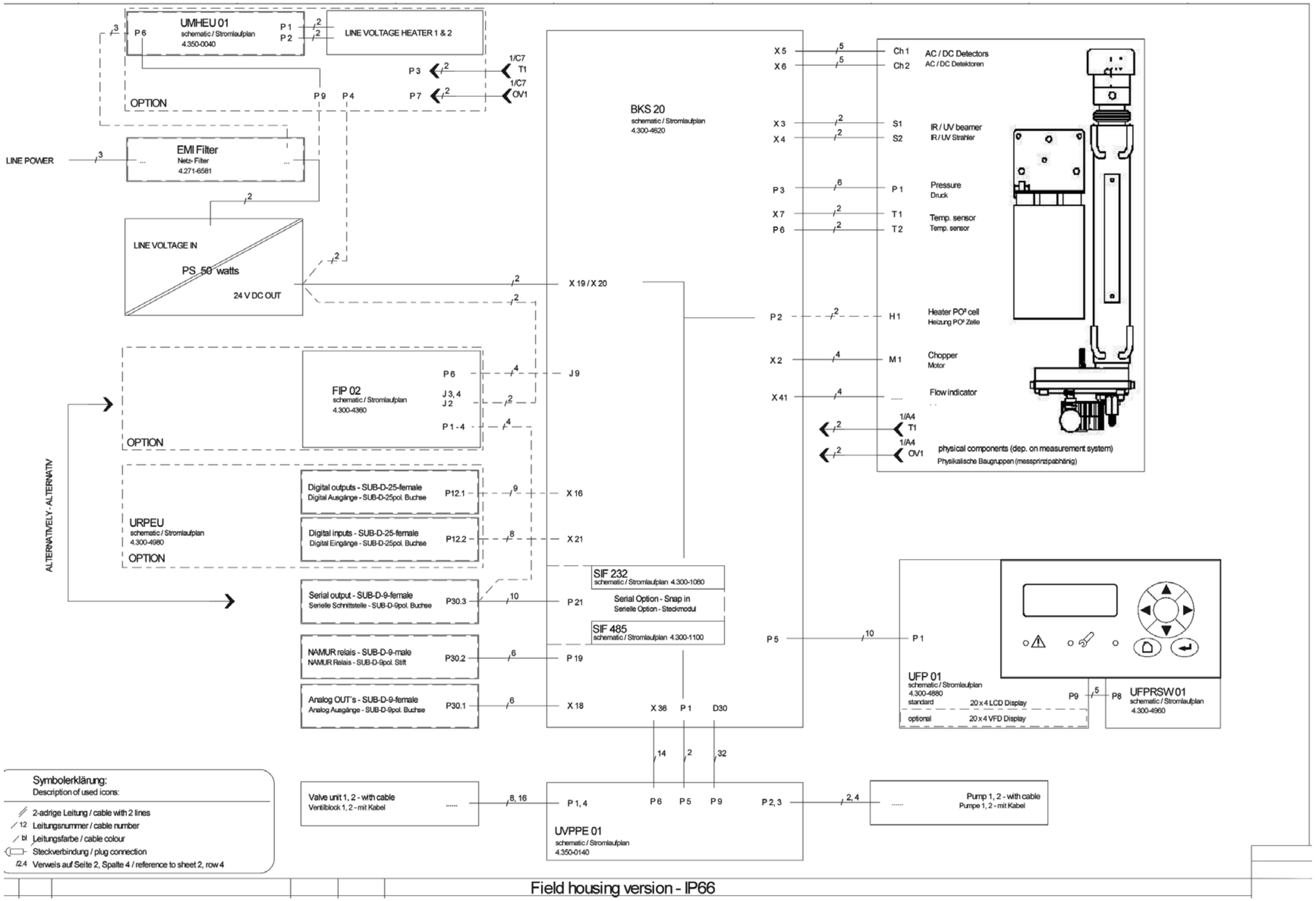
A-3 Block Diagrams

X-STREAM GPS



A-3 Block Diagrams

X-STREAM F, FD



A-4 Assignment of Plugs, Sockets and Terminals

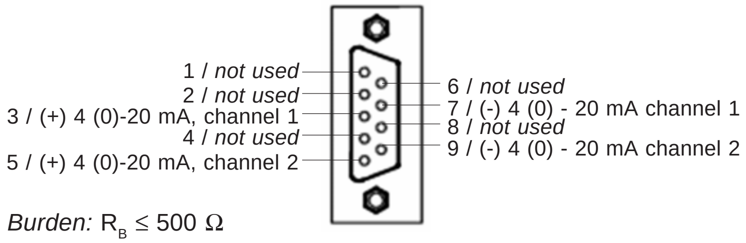
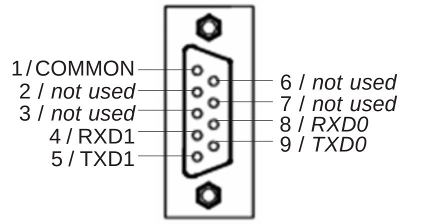
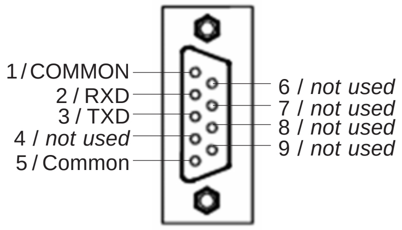
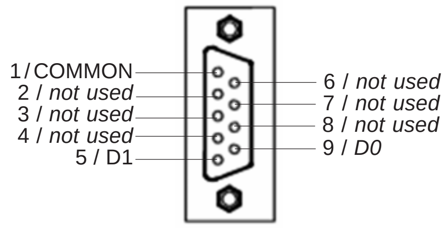


Fig. A-1: X-STREAM GPS - Analog output socket X1



4 wire configuration





2 wire configuration

RS 232 Interface ***RS 485 Interface***

Fig. A-2: X-STREAM GPS - Modbus interface socket X2

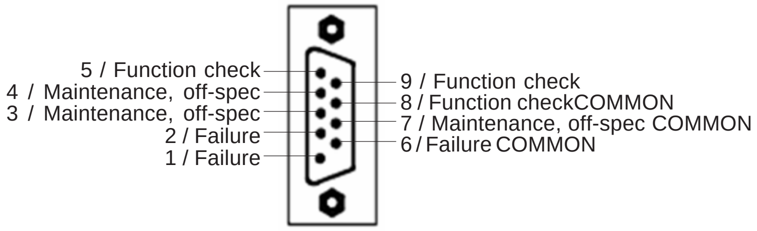


Fig. A-3: X-STREAM GPS - Relay outputs plug X3

*) With optional range switching this output is used as range indicator (☞ 7-7-5, page 7-58)

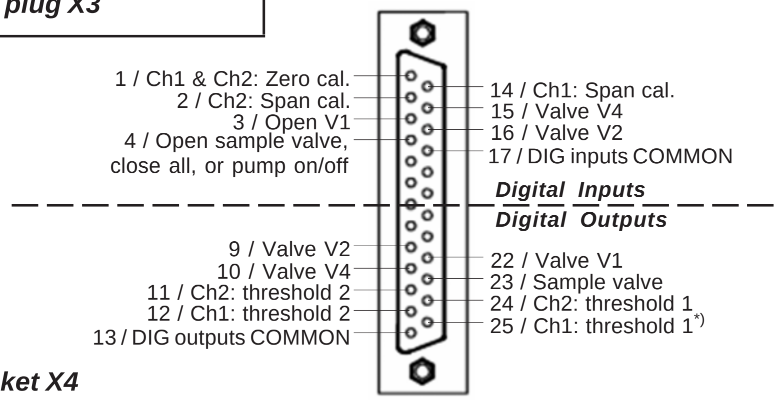


Fig. A-4: X-STREAM GPS - Digital I/O socket X4

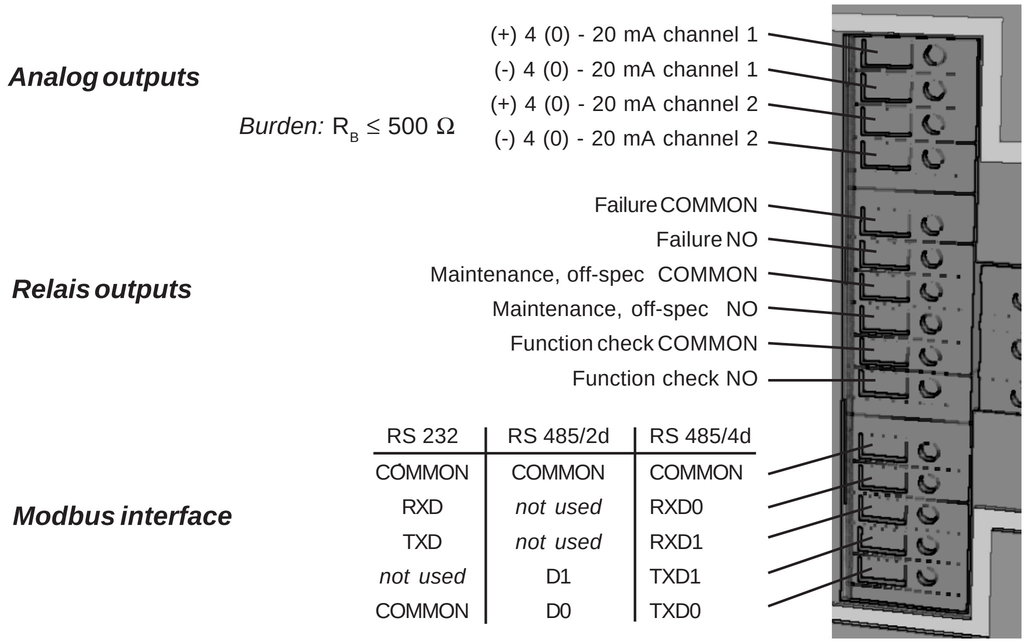


Fig. A-5: X-STREAM GP - Terminals strip 1

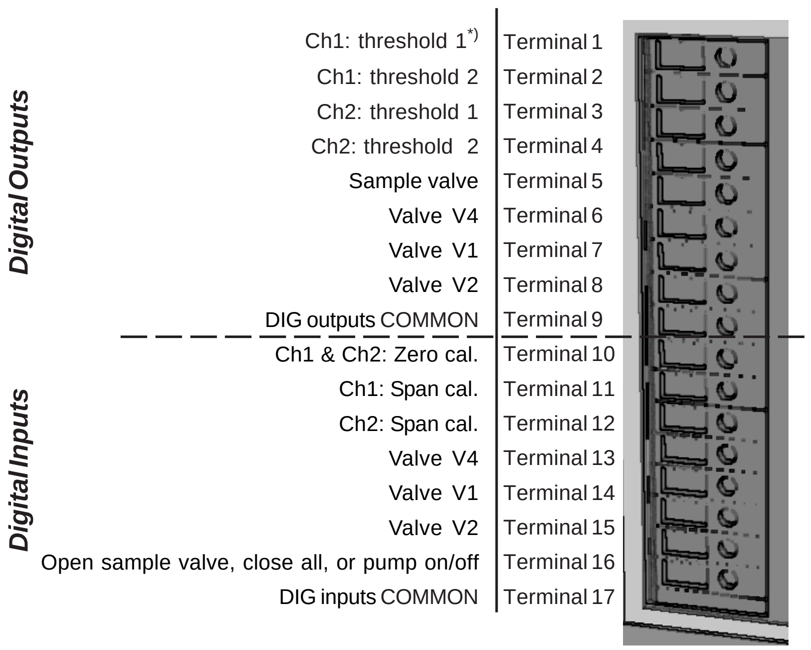


Fig. A-6: X-STREAM GP - Terminals strip 2

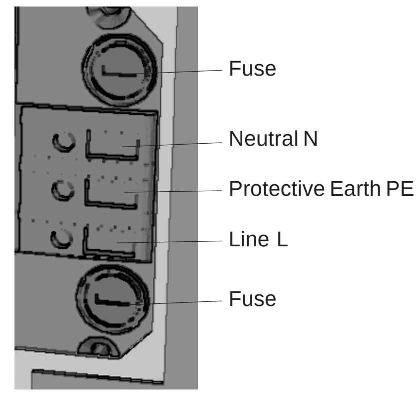
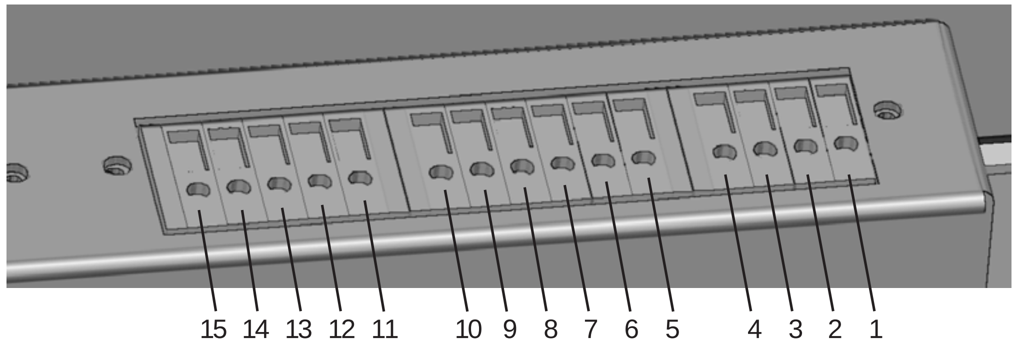


Fig. A-7: X-STREAM GP - Power terminals

*) With optional range switching this output is used as range indicator (☞ 7-7-5, page 7-58)

A-4 Assignment of Plugs, Sockets and Terminals



Terminal	RS 232	RS 485/2d	RS 485/4d
11	Common	Common	Common
12	RXD	*not used*	RXD0
13	TXD	*not used*	RXD1
14	*not used*	D1	TXD1
15	Common	D0	TXD0

Modbus interface

Terminal	Signal
1	(+) 4 (0) - 20 mA, ch 1
2	(-) 4 (0) - 20 mA, ch 1
3	(+) 4 (0) - 20 mA, ch 2
4	(-) 4 (0) - 20 mA, ch 2

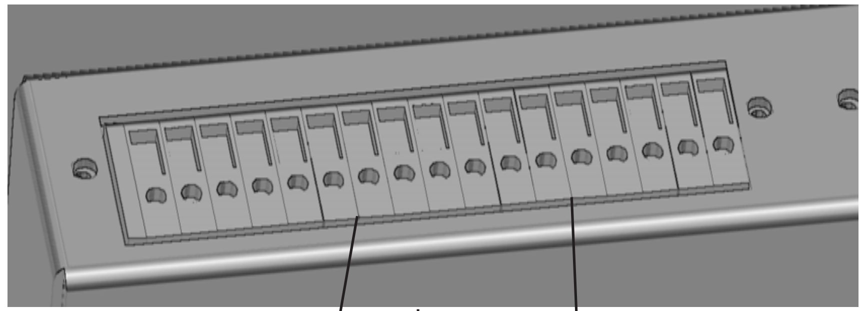
Burden: $R_B \leq 500\ \Omega$

Analog outputs

Terminal	Signal
5	Failure COM
6	Failure NO
7	Maintenance, off-spec COMMON
8	Maintenance, off-spec NO
9	Function check COMMON
10	Function check NO

Relay outputs

Fig. A-8: X-STREAM F, FD - Terminals strip 1

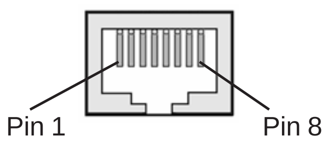


Terminal	Signal
Terminal 1	Ch1: threshold 1*)
Terminal 2	Ch1: threshold 2
Terminal 3	Ch2: threshold 1
Terminal 4	Ch2: threshold 2
Terminal 5	Sample valve
Terminal 6	Valve V4
Terminal 7	Valve V1
Terminal 8	Valve V2
Terminal 9	DIG outputs COMMON
Terminal 10	Ch1 & Ch2: Zero cal.
Terminal 11	Ch1: Span cal.
Terminal 12	Ch2: Span cal.
Terminal 13	Valve V4
Terminal 14	Valve V1
Terminal 15	Valve V2
Terminal 16	Open sample valve, close all, or pump on/off
Terminal 17	DIG inputs COMMON

Digital Inputs | ***Digital Outputs***

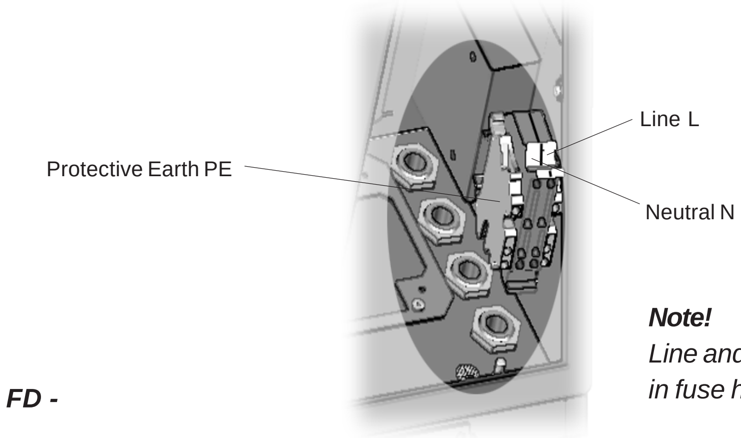
*) With optional range switching this output is used as range indicator (☞ 7-7-5, page 7-58)

Fig. A-9: X-STREAM F, FD - Terminals strip 2



Pin	Signal
1	TX+
2	TX-
3	RX+
6	RX-
andere	*nicht verwendet*

Fig. A-11: All versions - Ethernet connector for Modbus



Note!
Line and neutral terminals with built-in fuse holders

Fig. A-10: X-STREAM F, FD - Power terminals

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