# Continuous Gas Analyzers, in-situ

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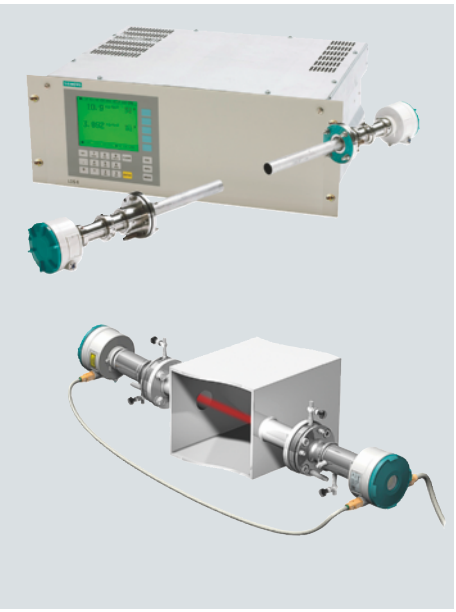


## Introduction to LDS 6 and SITRANS SL

### Overview

***In-situ process gas analysis***

Process gas analyzers are used for continuous determination of the concentrations of one or more gases in a gas mixture. Determination of the concentration of gases in a process is used to control and monitor process flows, and is therefore decisive for the automation and optimization of processes and ensuring product quality. In addition, process gas analyzers are used to check emissions, thus making an important contribution to environmental protection, as well as for ensuring compliance with statutory directives.

In-situ analytical procedures feature physical measurements in the flow of process gas directly in the actual process gas line. In contrast to extractive gas analysis, a sample is not taken and routed on to the analyzer via a sample line and sample preparation. Only in exceptional cases, the process conditions make it necessary to condition the sample gas stream in a bypass line with respect to process temperature, pressure and/or optical path length. Further conditioning of the process gas, such as drying or dust precipitation, is unnecessary. The analyzer carrying out in-situ measurements must always take into account changing process conditions (if these occur) and be able to automatically process them in the calibration model. Computed temperature and pressure compensation is frequently required for this. In addition, the analyzer must be extremely rugged since its sensors have direct contact with the process gas. The fast and non-contact measurement of gas concentrations and temperatures directly in the process is the domain of in-situ diode laser gas analyzers.

The gas analyzer LDS 6 combines the compact and service-friendly design and the simple operation and network capability of the Series 6 analyzers with the well-known exceptional performance data of in-situ gas analysis - namely high ruggedness and availability as well as low maintenance - by using diode laser technology and fiber-optics. Up to three CD 6 in-situ cross-duct sensors (which are also optionally available in an intrinsically-safe version for operation in hazardous areas) can be combined with an LDS 6 analyzer in the compact 19" rack unit enclosure. The distance between the analyzer's control unit - typically in an existing instrument room or the process plant's control room - and the max. three measuring points can be up to 700 m in each case.

The SITRANS SL gas analyzer for highly sensitive measurement of oxygen and carbon monoxide has a more integrated design without fiber-optic cables and with only one pair of cross-ducts sensors - a transmitter unit and a detector unit. In this case the receiver has a local user interface (LUI) which is controlled using IR remote control.

A maintenance-free reference gas cell integrated in both analyzers drastically reduces the need for recalibration (SITRANS SL) or even makes its superfluous (LDS 6). Remote scanning and diagnostics of the analyzers is possible using the Ethernet interface present as standard.

The list of gas components measurable using NIR diode laser technology already comprises:

- For the LDS 6 analyzer:
  $O_2$, $NH_3$, HCl, HF, $H_2O$, CO, $CO_2$, ...
- For the SITRANS SL analyzer: $O_2$, CO

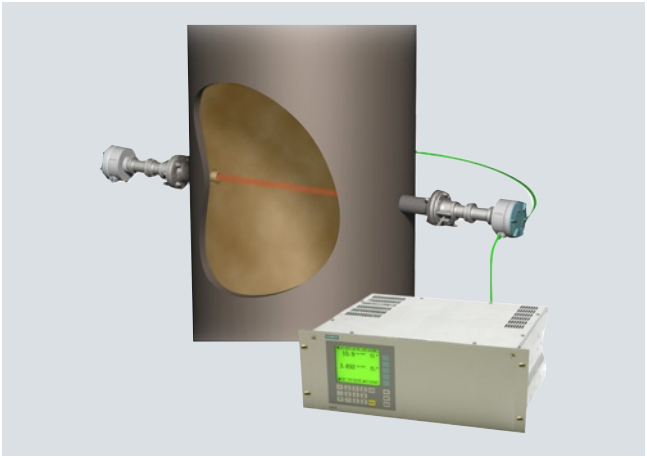
The list is being permanently extended as laser technology is developed further. The LDS 6 $O_2$ analyzers additionally allow simultaneous non-contact determination of high process gas temperatures.

Gas measurements with diode lasers feature exceptional selectivity and flexibility. Neither high process temperatures nor high and varying concentrations of particles in the gas have an influence on the quality of the result within wide ranges. For example, it is possible with the LDS 6 to determine trace concentrations of $NH_3$, HCl or HF directly in moist process gases even before any gas purification stage.

These features together with fast measurements free of dead times mean that diode laser gas analysis with the LDS 6 or the SITRANS SL is an extremely interesting alternative to established extractive analyses.

## Overview

LDS 6 is a diode laser gas analyzer with a measuring principle based on the specific light absorption of different gas components. LDS 6 is suitable for fast and non-contact measurement of gas concentrations or temperatures in process or flue gases. One or two signals from up to three measuring points are processed simultaneously by the central analyzer unit. The in-situ cross-duct sensors at each measuring point can be separated up to 700 m from the central unit by using fiber-optic cables. The sensors are designed for operation under harsh environmental conditions and contain a minimum of electrical components.



LDS 6, typical installation with transmitted-light sensors

## Benefits

The in-situ gas analyzer LDS 6 is characterized by a high availability and unique analytical selectivity, and is optimally suitable for numerous applications. LDS 6 enables the measurement of one or two gas components or - if desired - the gas temperature directly in the process:

- With high dust load
- In hot, humid, corrosive, explosive, or toxic gases
- In applications showing strong varying gas compositions
- Under harsh environmental conditions at the measuring point
- Highly selective, i.e. mostly without cross-sensitivities

LDS 6 properties:

- Little installation effort
- Minimum maintenance requirements
- Extremely rugged design
- High long-term stability through built-in, maintenance-free reference gas cell, field calibration is unnecessary
- Real-time measurements

Moreover, the instrument provides warning and failure messages upon:

- Need for maintenance
  - Erroneous reference function
  - Bad signal quality
- Violation of a lower or upper alarm level for the measured variable
- Transmitted amount of light violating an upper or lower limit

## Application

***Applications***

- Process optimization
- Continuous emission monitoring for all kinds of fuels (oil, gas, coal, and others)
- Process measurements in power utilities and any kind of incinerator
- Process control
- Explosion protection
- Measurements in corrosive and toxic gases
- Quality control
- Environmental protection
- Plant and operator safety

***Sectors***

- Power plants
- Steel works
- Cement industry
- Chemical and petrochemical plants
- Automotive industry
- Waste incinerators
- Glass and ceramics production
- Research and development

***Special applications***

In addition to the standard applications, special applications are available upon request.

## General information

### Design

The gas analyzer LDS 6 consists of a central unit and up to three in-situ sensors. The connection between the central unit and the sensors is established by a so-called hybrid cable, which contains optical fibers and copper wires. An additional cable connects the transmitter and receiver parts of the cross-duct sensor.

***Central unit***

The central unit is housed in a 19" rack unit enclosure with 4 holders for mounting

- in a hinged frame
- in racks with or without telescopic rails

Display and control panel

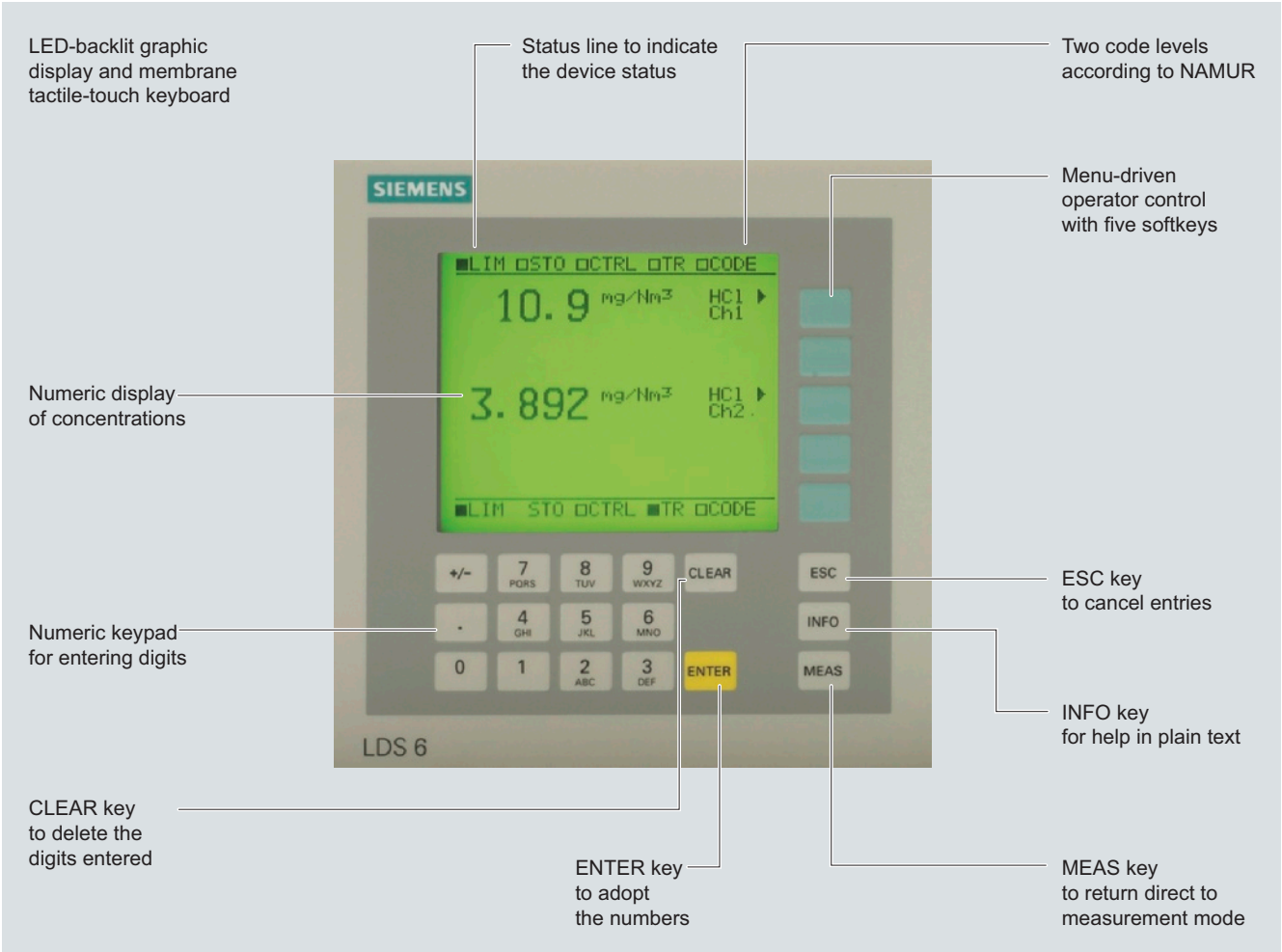
- Large LCD field for simultaneous display of measurement result and device status
- Contrast of the LCD field is adjustable via the menu
- LED background illumination of the display with energy-saving function
- Easy-to-clean membrane touch pad with softkeys
- Menu-driven operation for parameterization and diagnostics
- Operation support in plain text

Input and outputs

- One to three measurement channels with hybrid connections for the sensors at the measuring points
- 2 analog inputs per channel for process gas temperature and pressure
- 2 analog outputs per channel for gas concentration(s) or for gas temperature and concentration For selected versions, the transmission can be read out as an alternative.
- 6 freely configurable binary inputs per channel for signaling faults or maintenance requests from external temperature or pressure transducers or sensor purging failure.
- 6 freely configurable binary outputs per channel (signaling of fault, maintenance requirements, function control, transmission limit alarm, concentration limit alarm, store analog output)

Communication

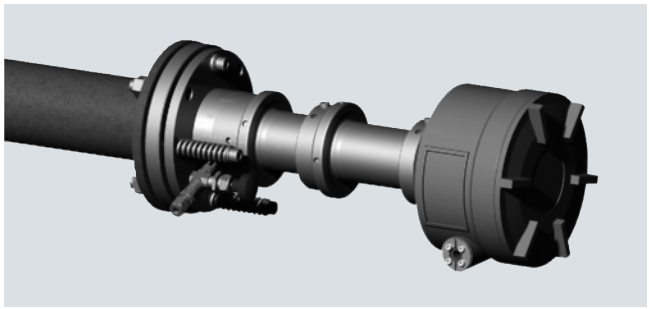
Network connection: Ethernet (T-Base-10) for remote diagnostics and maintenance.




LDS 6 central unit, membrane keyboard and graphic display

## General information

***Cross-duct sensors***



Sensor CD 6, transmitter or detector unit

- In-situ cross-duct sensors, configured as transmitter and detector unit, connected via sensor cable
- Connection to the LDS 6 central unit by a so-called hybrid cable, max. length 700 m
- Stainless steel, some painted aluminum
- IP65 degree of protection for sensor
- Adjustable flanges with flange connection
- DN 65/PN 6, ANSI 4"/150 lbs
- Optional flameproof window flanges with dimensions: DN 65/PN 6, DN 80/PN 16, ANSI 4"/150 lbs, other process interfaces available on request
- Purging facilities on the process and the sensor sides, configurable application with purging gas connections for:
  - Instrument air
  - Purging air blower
  - Steam
  - Nitrogen
  - Process gases to which the pressure equipment directive cat. 2 does not apply
- In combination with high-pressure window flanges, purging with instrument air or nitrogen is possible
- Fast connectors for cleaning the measurement openings and the sensor window
- Optional: Version with explosion protection in accordance with ATEX / IEC Ex ia
- Sensor type CD 6 is compliant with the pressure equipment directive

Parts in contact with the process gas

The sensors normally do not come into contact with the process gas, since purging with a gaseous media is applied at the process side. Stainless steel purging gas tubes in front of the sensor windows immerse slightly into the process gas and thus limit the purging volume. Special materials such as Hastelloy, plastics (PP) and ceramics are available on request.

Hybrid and sensor cables

A combination of fiber-optic cables and twisted copper wires connects the sensors to the central unit. The hybrid cable connects the central unit with the detector unit of the sensor, the sensor cable connects the transmitter and receiver units of the sensor.

For installation in Ex-protected environments, the legislative regulations have to be complied with, such as the spatial separation of intrinsically-safe from non-intrinsically-safe cables.

In compliance with standard EN IEC 60079-14, systems with intrinsically-safe circuits must be installed such that their intrinsic safety is not impaired by electric or magnetic fields. Therefore the hybrid and sensor cables of the LDS 6 in an Ex application must be routed in such a way that they cannot generate electric or magnetic fields, e.g. by coiling them in more than one cable loop. To guarantee a good signal quality and to avoid impermissible inductance loops, the hybrid and sensor cables should be kept as short as possible.

- The distance between central unit and measuring point can be
  - up to 250 m for Ex units when used in Zone 0 and Zone 1
  - up to 700 m for Ex units used in Zone 2 and for non-Ex units
- Hybrid and sensor cables
  - Multimode fiber-optic cable, provided with SMA connections for transmission of the measured signal
  - Two-wire copper cable, in twisted pair version, for +24 V supply of the detector electronics (+12 V in the case of Ex-suitable instruments)
- Additionally for the hybrid cable:
  - Single-mode fiber-optic cable, configured double-sided with E2000 connectors for transmission of laser light
- Rugged cable sheath for laying in open cable ducts or ductworks
- Sheath material: oil-resistant polyurethane

Connections of the hybrid cable

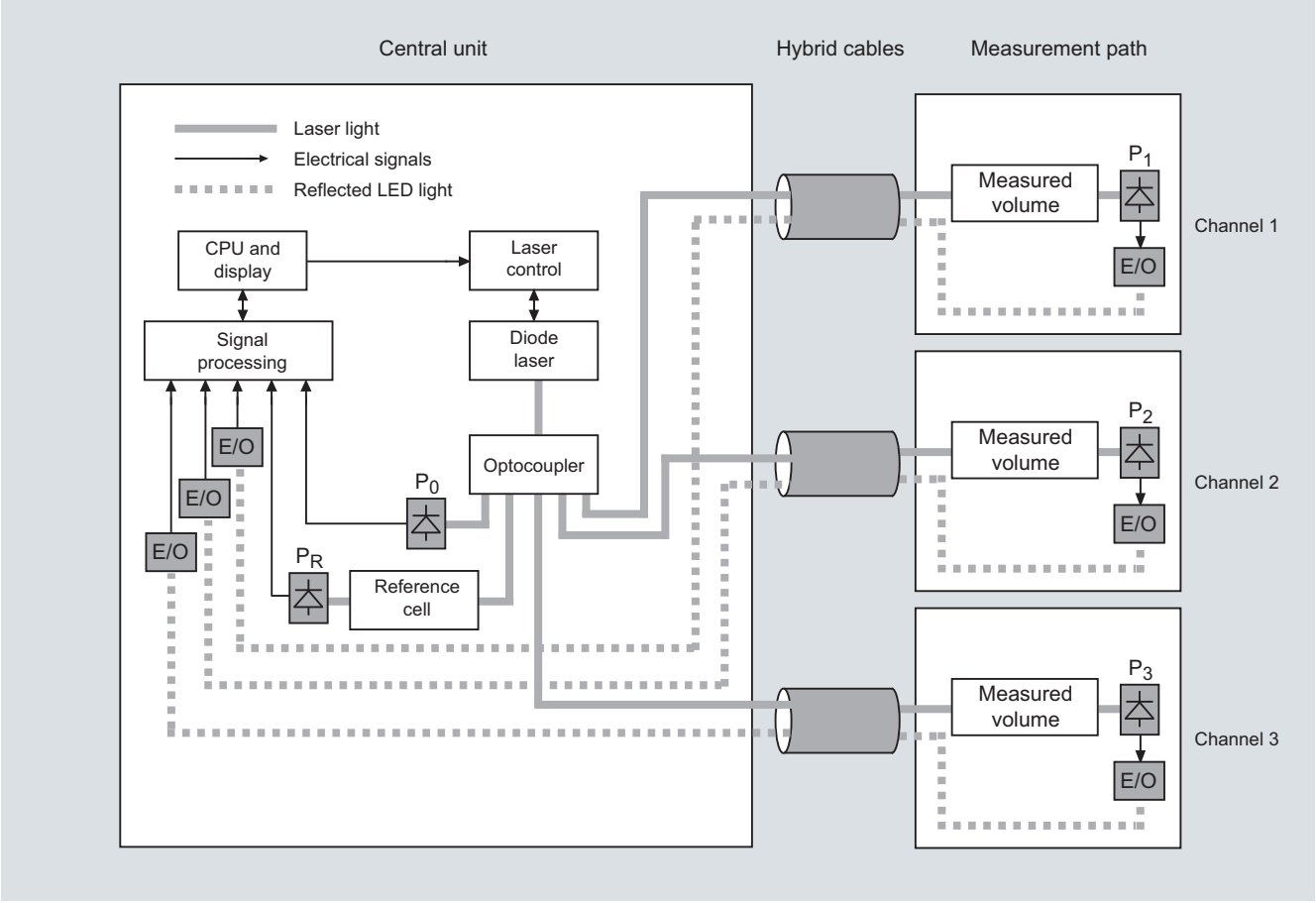
## General information

### Function

***Operating principle***

LDS 6 is a gas analyzer employing single-line molecular absorption spectroscopy. A diode laser emits a beam of near-infrared light, which passes through the process gas and is detected by a receiver unit. The wavelength of the laser diode output is tuned to a gas-specific absorption line. The laser continuously scans this single absorption line with a very high spectral resolution.

The result is a fully resolved single molecular line which is analyzed in terms of absorption strength and line shape. The influence of cross-sensitivities on the measurement is negligible, since the quasi-monochromatic laser light is absorbed very selectively by only one specific molecular line in the scanned spectral range.

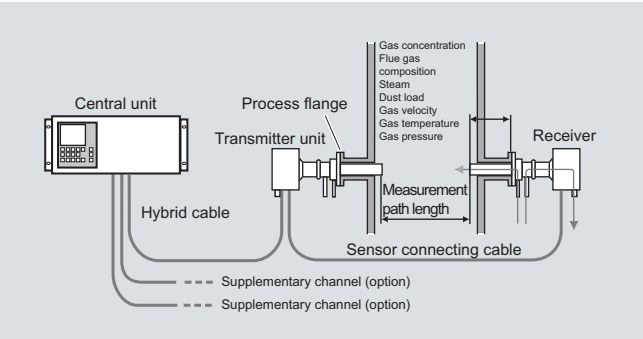



Basic design of the LDS 6

Configuration examples:

A feature of the in-situ analytical procedure is that the physical measurement takes place directly in the stream of process gas, and usually also directly in the actual process gas line. All process parameters such as gas matrix, pressure, temperature, moisture, dust load, flow velocity and mounting orientation can influence the measuring properties of the LDS 6 and must therefore be systematically investigated for each new application.

A feature of the standard applications defined in the ordering data of the LDS 6 is that the typical process conditions are well-known and documented, and that the guaranteed measuring properties can be proven by reference installations. If you cannot find your application among the standard applications, please contact Siemens. We will be pleased to check your possible individual application of the LDS 6. You can find an application questionnaire on the LDS product sites on the Internet.

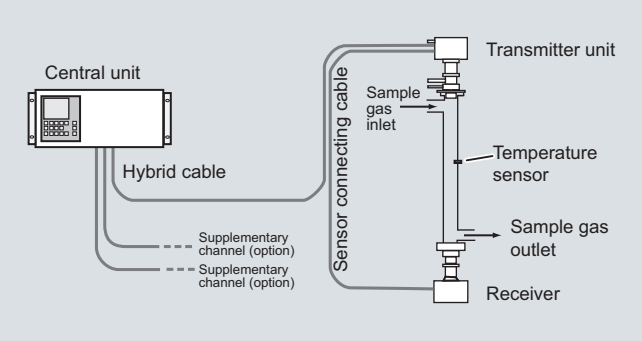



Typical transmitted light setup of LDS 6, in-situ

To avoid contamination of sensor openings on the process side, clean gaseous purging media are used such as instrument air, $N_2$ or steam. Purging air tubes on the sensor heads, which slightly penetrate into the process gas stream, define the effective measuring path length.

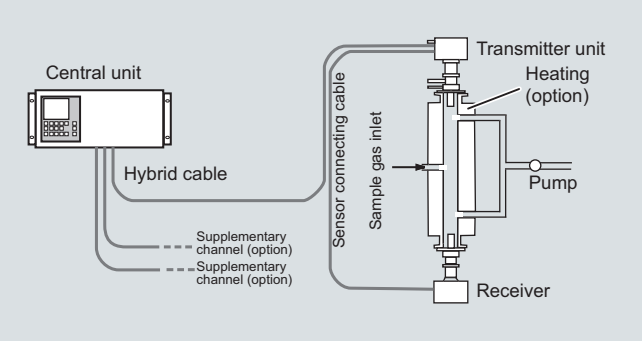
## General information

The LDS 6 can measure in both the transverse and longitudinal directions of the process gas flow. In certain cases, the process conditions make it necessary to condition the sample gas stream in a bypass line with respect to process temperature, pressure and/or optical path length. Further treatment of the process gas, such as drying or dust precipitation, is usually unnecessary.




Typical transmitted light setup of LDS 6, in bypass

A flow cell is available by special application for the LDS 6 which has been specially optimized for use with the LDS 6 and its transmitted-light sensors with respect to handling and measuring performance. It is designed to reduce surface effects, and is therefore also highly suitable for polar gases like ammonia. This flow cell is available in heated and non-heated versions. Wheel mounted and wall mounted versions are available.



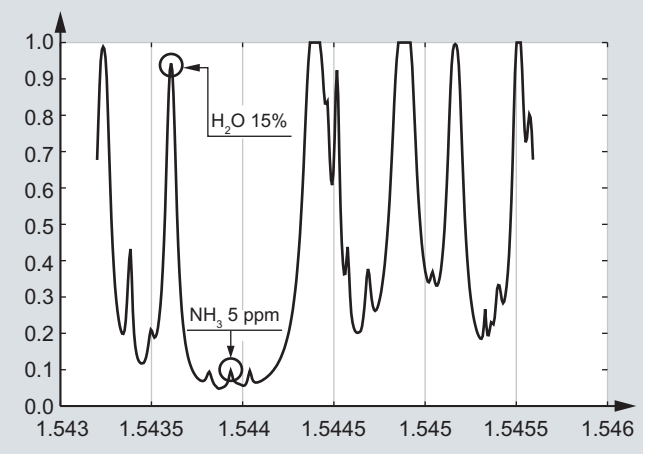

Measuring configuration of LDS 6 with heated flow cell

### *General information*

LDS 6 is connected to the measuring points by fiber optics. The laser light is guided by a single-mode fiber from the central unit to the transmitter unit of the in-situ sensor. The sensor consists of a transmitter and a receiver; the distance between them defines the measurement path. In the receiver box, the light is focused onto a suitable detector. The detector signal is then converted into an optical signal and transmitted via a second optical fiber to the central unit, where the concentration of the gas component is determined from the detected absorption signal.

LDS 6 usually measures a single gas component by means of the absorption capacity of a single fully resolved molecular absorption line. The absorption results from conversion of the radiation energy of the laser light into the internal energy of the molecule. In the working range of the LDS 6, both rotation-vibration transitions and electronic transitions - such as with $O_2$ - can be triggered.

In some specific cases, two components can be measured simultaneously if their absorption lines are so close to each other that they can be detected within the laser spectrum by one single scan (for example water ($H_2O$) and ammonia ($NH_3$)).




Absorption spectra of water and ammonia

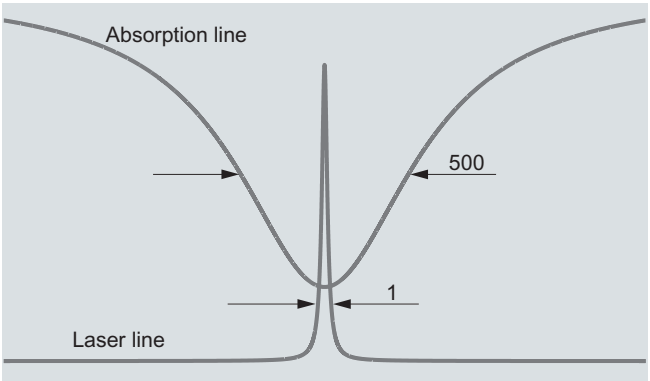
Moreover, in some applications it is possible to determine the gas temperature as a measured value. In this case, the ratio of the absorbance of two characteristic lines of the same molecule measured at the same time in the same volume gives the actual temperature in the process gas.

Typical measurable gases for LDS 6 are:

- Oxygen ($O_2$) for low and high pressure
- Oxygen + temperature
- Hydrogen fluoride (HF) + water
- Hydrogen chloride (HCl) + water
- Ammonia ($NH_3$) + water
- Water vapor ($H_2O$)
- Carbon monoxide (CO)
- Carbon dioxide ($CO_2$)
- CO + $CO_2$

By using an internal reference cell normally filled with the gas measured, the stability of the spectrometer is permanently checked in a reference channel.

By doing so, the continuous validity of the calibration is ensured without the need to carry out external recalibration using bottled calibration gases or reference gas cells.




Typical spectral bandwidth of an absorption line compared to the bandwidth of the laser light.

## General information

***Influences on the measurement***

Dust load

As long as the laser beam is able to generate a suitable detector signal, the dust load of the process gases does not influence the analytical result. By applying a dynamic background correction, measurements can be carried out without any negative impact. Under good conditions, particle densities up to 100 g/Nm$^3$ can be handled by the LDS 6. Varying dust loads are compensated by scanning the laser over the gas absorption line and the current background. At a scan position next to the absorption line, the instrument can "see" only absorption caused by the dust load where at the line center the signal is composed of the molecular absorption and the continuous, unspecific background absorption. With the wavelength modulation technique, the actual measured transmission is always compared with the baseline. After signal processing, phase-sensitive application delivers a signal only from the molecular line free of background.
The influence of a high dust load is complex and depends on the path length and particle size. The optical damping increases at longer path lengths. Smaller particles also have a large influence on the optical damping. With a combination of high dust load, long path length and small particle size, the technical support at Siemens should be consulted.

Temperature

The temperature influence on the absorption line strength is compensated by a correction factor determined during calibration. A temperature signal can be fed into the instrument from an external temperature sensor. This signal is then used to correct the influence of the temperature on the observed line strength. If the temperature of the sample gas remains constant, it is alternatively possible to carry out a static correction using a preset value.
At high process gas temperatures, generally from approximately 1 000 °C, there may be noticeable broadband IR radiation of gas and dust, or flames may occasionally occur in the measurement path. An additional optical bandpass filter can be set upstream of the detector to protect it and prevent saturation by the strong background radiation.

Pressure

The gas pressure can affect the line shape of the molecular absorption line. LDS 6 uses a special algorithm to adapt the line shape. Additionally, an external pressure signal can be fed to the instrument to provide complete compensation for the pressure influence including the density effect.

Cross-interferences

Since LDS 6 derives its signal from a single fully resolved molecular absorption line, cross-interferences with other gases are quite unlikely. LDS 6 is therefore able to measure the desired gas components very selectively. In special cases, the composition of the process gas might have an influence on the shape of the absorption line features. This influence is compensated by analyzing the full shape of the detected signal curve applying specific algorithms.

Optical path length

The absorption values analyzed by the LDS 6 are typically small. As a result of Beer-Lambert's law, the absorption of laser light depends on the optical path length within the gas. Therefore, the precision in determining the effective optical path length in the process might limit the overall precision of the measurement.
As the sensor openings toward the process normally need to be purged to keep them clean over a long period of time, the thickness of the mixing zone between the purging medium and the process gas and its concentration distribution need to be considered. In a typical in-situ installation directly in the line and with some meters of path, the influence of the purging gas on the effective path length can be neglected.
Path length and dust load are mutually influencing: the higher the dust load in the process, the shorter the max. possible path length.

***Maintenance and fault messages***

LDS 6 outputs different warnings via relays:

- Need for maintenance (measured value is not influenced)
- Operating error (measured value might be influenced)

Note

Individual requirements for the measuring point can make the utilization of special sensor equipment necessary. The possibilities for adapting the sensors are:

- Different purging media, such as instrument air, ambient air, nitrogen or steam
- Different purging modes on process and sensor sides
- Special materials of purging tubes and/or sensor flanges
- Cooling or heating of the sensors
- Explosion-protected sensor configurations

***Essential characteristics***

- Integrated calibration adjustment with an internal reference cell
- Negligible long-term drifts of zero and span
- Dynamic background correction for varying dust loads
- Isolated signal outputs, 4 to 20 mA
- User-friendly, menu-driven operation
- Selectable time constants (response time)
- Two user levels with individual access codes for prevention of unwanted and unauthorized operations
- Operation according to NAMUR recommendations
- Monitoring of overall optical transmission
- Remote preventive maintenance and servicing via Ethernet/modem
- Straightforward replacement of the central unit, since connections can easily be removed
- Sensor and central unit housing free of wear and corrosion
- Easy operation with a numerical keypad and menu prompting

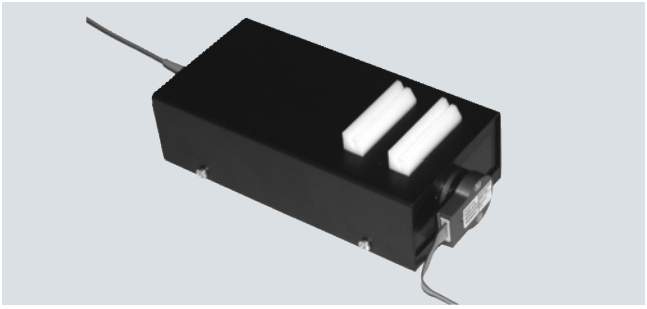
***Certified versions for emission monitoring***

The LDS 6 is available as certified instrument for emission monitoring of $NH_3$, $NH_3/H_2O$, $H_2O$, HCl, $HCl/H_2O$. The certificates are issued by TÜV for Germany and MCERTS for the United Kingdom. For conducting regular calibration and linearity checks, test kits for ammonia, water and HCl should be used. These kits can be ordered separately as instrument accessories. For new analyzer orders, the $NH_3$, $NH_3/H_2O$ and $H_2O$ kits named "Version 2" must be ordered. For already installed analyzers, please contact Siemens for spotting the correct kit version, or consult the instrument manual.

***Verification of calibration***

Assembly with certified, maintenance-free calibration gas cell with connections for laser fiber-optic conductors and detector module of cross-duct sensor. Serves to rapidly verify the factory calibration in the field without compressed gas bottles and flow cell.

Calibration verification kits are available for the following sample gases: $O_2$ (application codes AA, AC, AD), $NH_3$, CO, $CO_2$, $CO/CO_2$. A "Zero gas test kit" is also available (see "Additional units")



Example of an assembly for verification of calibration

## 19" central unit

### Technical specifications

| | |
|---|---|
| **Analytical performance** | |
| Measuring range | Adjustable |
| Detection limit (DL):<br>Calculated in accordance with VDI 2449, measured on every supplied analyzer during the temperature test (between 5 ... 45 °C) in accordance with VDI 4203. | Depending on sample gas component: see table for standard applications.<br>For Code ET and FT: in accordance with the requirements of 17th and 27th BImSchV |
| Smallest recommended measuring range (with 1 m path length) | Depending on sample gas component: see table for standard applications. |

The maximum applicable measuring ranges can be found in the table of standard combinations. These can only be applied if the individual process conditions allow it. Please contact the Technical Support from Siemens for checking the applicability.

| | |
|---|---|
| Accuracy | 2 % / 5 %, depending on sample gas component and application letter. At best: detection limit. See table for standard applications.<br>For Code ET and FT: in accordance with the requirements of 17th and 27th BImSchV |
| Linearity | Better than 1 % |
| Repeatability | 2 % of the measured value or minimum detection limit (whichever is largest)<br>For Code ET and FT: in accordance with the requirements of 17th and 27th BImSchV |
| Calibration interval | No recalibration required thanks to internal reference cell |
| **General information** | |
| Concentration units | ppmv, Vol%, mg/Nm$^3$ |
| Display | Digital concentration display (5 digits with floating decimal point) |
| Laser protection class | Class 1, safe to the eye |
| Certificates | CE marking, TÜV, MCERTS |
| **Design, enclosure** | |
| Degree of protection | IP20 according to EN 60529 |
| Dimensions | 177 x 440 x 380 mm |
| Weight | Approx. 13 kg |
| Mounting | Horizontal |

| | |
|---|---|
| **Electrical characteristics** | |
| Power supply | 100 ... 240 V, AC 50 ... 60 Hz, automatically adapted by the system; with a 3-channel central unit, an additional external power supply +24 V DC, 50 VA is included in the scope of delivery |
| Power consumption | 50 W |
| EMC | According to EN 61326 and standard classification of NAMUR NE21 |
| Electrical safety | According to EN 61010-1, overvoltage classification II |
| Fuse specifications | 100 ... 240 V: T2.5L250V |
| **Dynamic response** | |
| Warm-up time at 20 °C ambient temperature | Approx. 15 min |
| Response time | Less than 3 s, application-dependent |
| Integration time | 1 … 100 s, adjustable |
| **Influencing variables** | |
| Ambient temperature | < 0.5 %/10 K of the measured value |
| Atmospheric pressure | Negligible |
| Process gas pressure compensation | Recommended |
| Process gas pressure range | See table for standard applications |
| Power supply changes | < 1 %/30 V |
| **Electrical inputs and outputs** | |
| Number of measurement channels | 1 … 3, optional |
| Analog output | 2 per channel, 4 ... 20 mA, floating, ohmic resistance max. 750 Ω |
| Analog inputs | 2 per channel, designed for 4 ... 20 mA, 50 Ω |
| Binary outputs | 6 per channel, with changeover contacts, configurable, 24 V AC/DC/1 A, floating |
| Binary inputs | 6 per channel, designed for 24 V, floating, configurable |
| Communication interface | Ethernet 10BaseT (RJ-45) |
| **Climatic conditions** | |
| Temperature range | 5 … 45 °C during operation, -40 … +70 °C during storage and transportation |
| Atmospheric pressure | 800 … 1 200 hPa |
| Humidity | < 85 % relative humidity, above dew point (in operation and storage) |

| Selection and ordering data | | | Order No. |
|---|---|---|---|
| **LDS 6 in-situ gas analyzer**<br>19" rack unit for installation in cabinets | | C) | **7MB6121-** ■■■ **0 0 - 0** ■■■ |
| Explosion protection | | | |
| Without, not suitable for connection to Ex sensors | | | **0** |
| Without, suitable for connection to Ex sensors in accordance with ATEX II 1 G Ex ia IIC T4, ATEX II 1D Ex iaD 20 IP65 T135 °C | | | **1** |
| Measured component | Possible with application letter of the respective channel | | |
| $O_2$ | B, C, P | | **A** |
| $O_2$/temp | B | | **B** |
| $NH_3$ | A, E, F, T | | **C** |
| $NH_3/H_2O$ | A, E, F, T | | **D** |
| HCl | A, H, T | | **E** |
| $HCl/H_2O$ | A, H, T | | **F** |
| HF | A, H | A) | **G** |
| $HF/H_2O$ | A, H | A) | **H** |
| CO | C | | **J** |
| $CO/CO_2$ | D | | **K** |
| $CO_2$ | A | | **L** |
| $H_2O$ | A, T | | **M** |
| Application letter of measured component channel 1 | Application examples channel 1[1] | | |
| A | Emission monitoring, non-certified | | **A** |
| B | Emission monitoring, combustion optimization | | **B** |
| C | Safety monitoring with appropriate plant concept | | **C** |
| D | Process control | | **D** |
| E | SNCR-DeNOx | | **E** |
| F | SCR-DeNOx | | **F** |
| H | Filter optimization | | **H** |
| P | Process control (high pressure) | | **P** |
| T | Emission monitoring, certified according to 17th BImSchV and MCerts, in combination with measured component variants C, D, E, F, M | | **T** |
| Application letter of measured component channel 2 | Application examples channel 2[1] | | |
| X | Channel 2 not used | | **X** |
| A | Emission monitoring | | **A** |
| B | Combustion optimization | | **B** |
| C | Safety monitoring with appropriate plant concept | | **C** |
| D | Process control | | **D** |
| E | SNCR-DeNOx | | **E** |
| F | SCR-DeNOx | | **F** |
| H | Filter optimization | | **H** |
| P | Process control (high pressure) | | **P** |
| T | Emission monitoring, certified according to 17th BImSchV and MCerts, in combination with measured component variants C, D, E, F, M | | **T** |

A) Subject to export regulations AL: 2B351A, ECCN: EAR99

C) Subject to export regulations AL: N, ECCN: EAR99

[1] The examples shown represent possible applications where appropriately configured LDS 6 solutions can be used. The user is responsible for the prevailing conditions (plant concept (possibly redundant), application of appropriate components required in addition, compliance with possible directives, etc.).

## 19" central unit

| Selection and ordering data | | | Order No. |
|---|---|---|---|
| **LDS 6 in-situ gas analyzer**<br>19" rack unit for installation in cabinets | | C) | **7MB6121-** ■■■ **0 0 - 0** ■■■ |
| Application letter of measured component channel 3 | Application examples channel 3[1]<br>External 24 V DC power supply included in scope of delivery | | |
| X | Channel 3 not used | | **X** |
| A | Emission monitoring | | **A** |
| B | Combustion optimization | | **B** |
| C | Safety monitoring with appropriate plant concept | | **C** |
| D | Process control | | **D** |
| E | SNCR-DeNOx | | **E** |
| F | SCR-DeNOx | | **F** |
| H | Filter optimization | | **H** |
| P | Process control (high pressure) | | **P** |
| T | Emission monitoring, certified according to 17th BImSchV and MCerts, in combination with measured component variants C, D, E, F, M | | **T** |
| Language (supplied documentation, software) | | | |
| German | | | **0** |
| English | | | **1** |
| French | | | **2** |
| Spanish | | | **3** |
| Italian | | | **4** |

| Selection and ordering data | | |
|---|---|---|
| ***Additional versions*** | | **Order code** |
| Add "-Z" to Order No. and specify order code | | |
| Telescopic rails (2 units) | | **A31** |
| Set of Torx tools | | **A32** |
| TAG labels (customized inscription) | | **Y30** |
| ***Additional units*** | | **Order No.** |
| External power supply for hybrid cable length > 500 m | | **A5E00854188** |
| Calibration verification kit for $NH_3$ (version 2) | E) | **A5E01075594** |
| TÜV/MCERT calibration verification kit $NH_3$ (version 2), 2 cells | B) | **A5E00823339013** |
| TÜV/MCERT calibration verification kit $NH_3/H_2O$ (version 2), 3 cells | B) | **A5E00823339014** |
| TÜV/MCERT calibration verification kit $H_2O$ (version 2), 2 cells | B) | **A5E00823339015** |
| Calibration verification kit for $NH_3$ (version 1) | B) | **A5E00534675** |
| TÜV/MCERT calibration verification kit $NH_3$ (version 1), 2 cells | E) | **A5E00823339003** |
| TÜV/MCERT calibration verification kit $NH_3/H_2O$ (version 1), 3 cells | D) | **A5E00823339004** |
| TÜV/MCERT calibration verification kit $H_2O$ (version 1), 2 cells | D) | **A5E00823339005** |
| TÜV/MCERT calibration verification kit HCl, 2 cells | B) | **A5E00823339008** |
| TÜV/MCERT calibration verification kit $HCl/H_2O$, 3 cells | B) | **A5E00823339009** |
| Calibration verification kit for $O_2$ (version 2) | B) | **A5E01143755001** |
| Calibration verification kit for CO (version 2) | B) | **A5E01143755003** |
| Calibration verification kit for $CO_2$ (version 2) | B) | **A5E01143755004** |
| Calibration verification kit for $CO/CO_2$ (version 2) | | **A5E01143755006** |
| Zero gas verification kit for all gases except $O_2$ | | **A5E00823386009** |

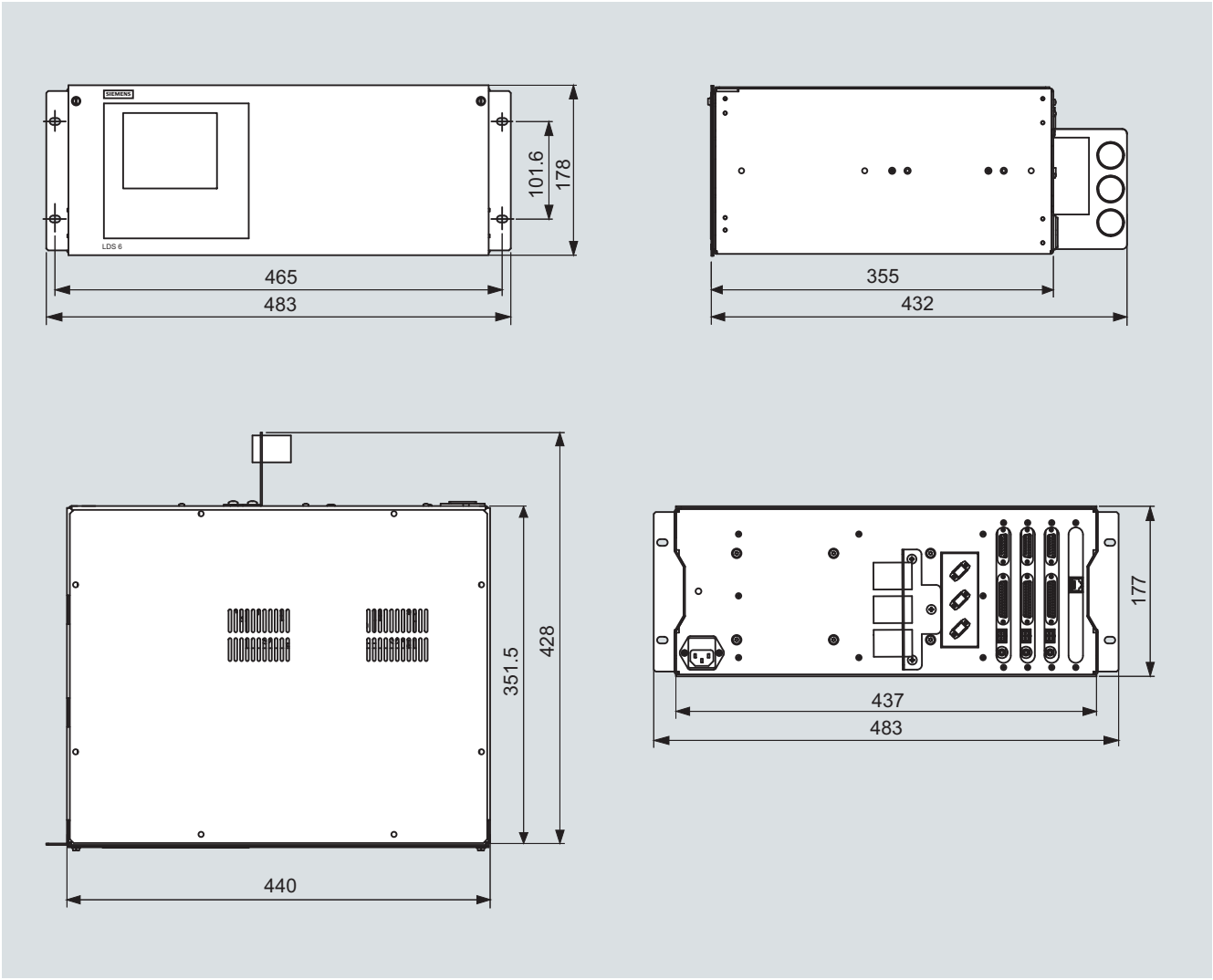
B) Subject to export regulations AL: N, ECCN: 3A991X

D) Subject to export regulations AL: 9I999, ECCN: N

E) Subject to export regulations AL: 9I999, ECCN: 3A991X

The examples shown represent possible applications where appropriately configured LDS 6 solutions can be used. The user is responsible for the prevailing conditions (plant concept (possibly redundant), application of appropriate components required in addition, compliance with possible directives, etc.).

## Dimensional drawings

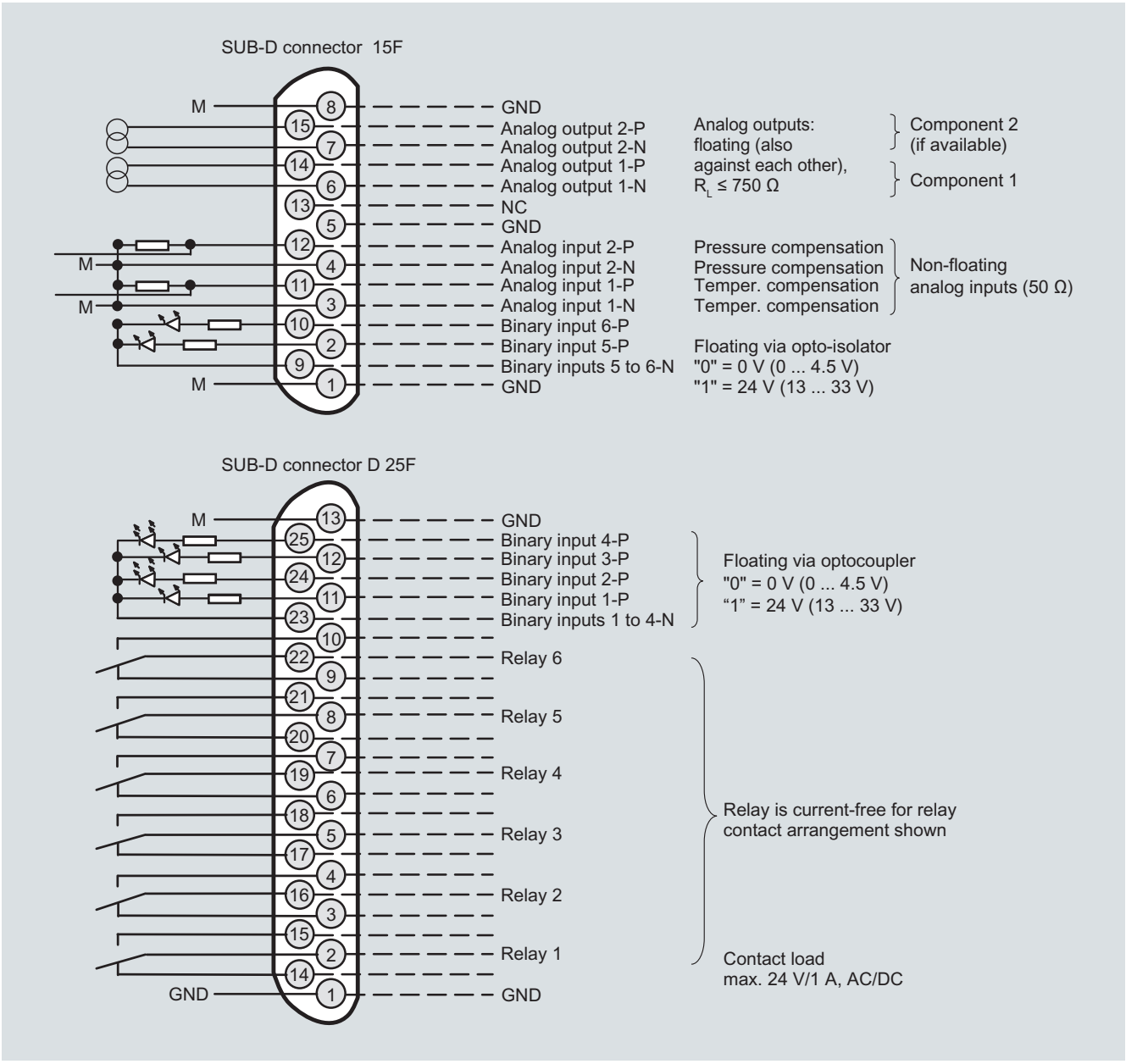



LDS 6, 19" central unit, dimensions in mm

## 19" central unit

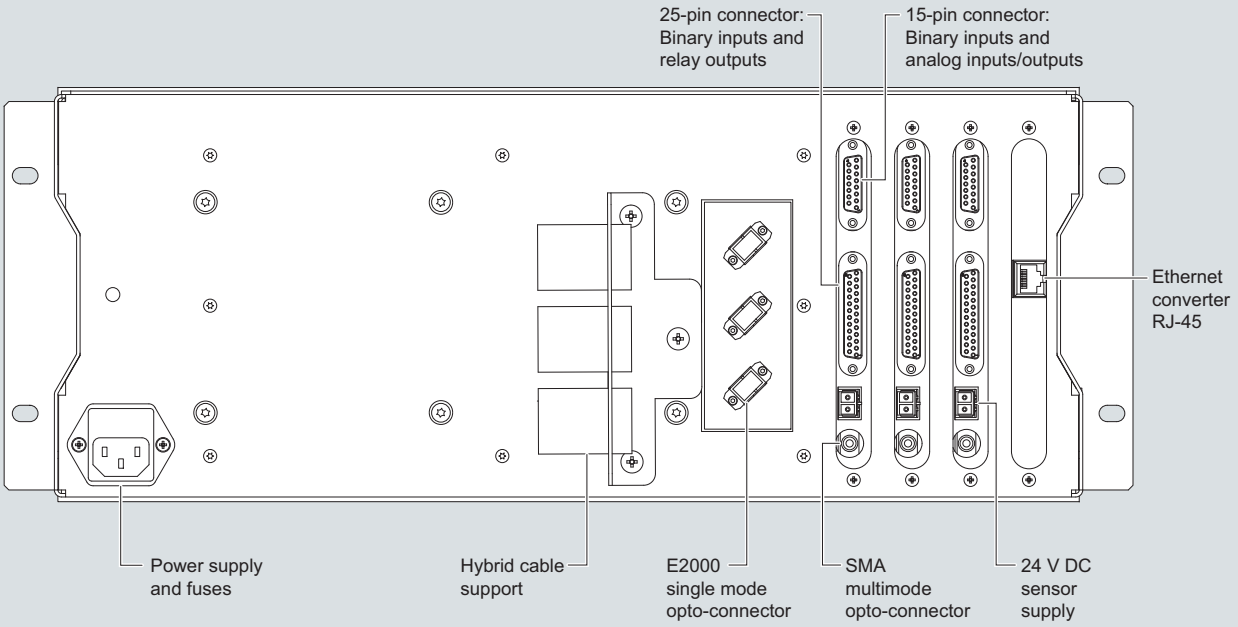
### Schematics

***Pin assignments***




LDS 6, 19" central unit, pin assignments

***Optical and electrical connections***




LDS 6, three-channel 19" central unit, optical and electrical connections

## 19" central unit

### More information

The following table lists the measuring conditions for standard applications. The listed values for the measuring range and detection limit (DL) are only approximate values. The exact values at the respective measuring point depend on the totality of all influencing variables and can be determined by Siemens for the specific case.

Please note that the values for the detection limit and the maximum measuring range refer to an optical path of 1 m. Longer path lengths will improve the detection limit, but not linearly. Due to limiting effects such as dust load. The maximum applicable measuring ranges can only be used if permitted by the process conditions such as dust load.

| **Standard application**<br>**Effective optical path length: 0.3 … 12 m**<br>**Dust load[3]: < 50 g/Nm³** | | | | **Process gas temperature**<br>$T_{min}$ … $T_{max}$ | **Process gas pressure**<br>$p_{min}$ … $p_{max}$ | **Min. measuring range**<br>(with 1 m eff. opt. path length) | **Max. measuring range**<br>(also dependent on eff. opt. path length: see following column) | **(Max. measuring range x path length)** | **(DL x path length)**<br>under standard conditions[1) 2)] without cross-interference of other gases | **(DL x path length)**<br>at 1 013 hPa with cross-interference of gas 2 | **Accuracy**[4)] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gas 1** | **Gas 2** | **Gas code** | **Appl. code** | | | **Gas 1** | **Gas 1** | **Gas 1** | **Gas 1** | **Gas 1** | **Gas 1** |
| **$O_2$** | | A | B | 600 … 1 200 °C | 950 …1 050 hPa | 0 … 15 vol% | 0 … 100 vol% | 240 vol%*m | 0.3 vol%*m at 600 °C | | 5 % |
| | | | C | 0 … 600 °C | 950 …1 050 hPa | 0 … 5 vol% | 0 … 100 vol% | 75 vol%*m | 0.1 vol%*m | | 2 %[5)] |
| | | | P | 0 … 200 °C | 950 …5 000 hPa | 0 … 5 vol% | 0 … 100 vol% | 75 vol%*m | 0.1 vol%*m | | 2 % |
| **$O_2$** | **Temp** | B | B | 600 … 1 200 °C | 950 …1 050 hPa | 0 … 35 vol% | 0 … 100 vol% | 240 vol%*m | 0.7 vol%*m at 600 °C | | 5 % |
| **$NH_3$** | | C | A | 0 … 150 °C | 950 …1 050 hPa | 0 … 25 ppmv | 0 … 500 ppmv | 2 500 ppmv*m | 0.5 ppmv*m | 0.9 ppmv*m at 15 vol% $H_2O$, 55 °C | 2 % |
| | | | T | 0 … 150 °C | 950 …1 050 hPa | 0 … 25 ppmv | 0 … 500 ppmv | 2 500 ppmv*m | 0.5 ppmv*m | 0.9 ppmv*m at 15 vol% $H_2O$, 55 °C | 2 % |
| | | | E | 250 … 350 °C | 950 …1 050 hPa | 0 … 45 ppmv | 0 … 500 ppmv | 2 500 ppmv*m | 0.9 ppmv*m at 250 °C | 1.4 ppmv*m at 15 Vol% $H_2O$, 250 °C | 2 % |
| | | | F | 300 … 400 °C | 950 …1 050 hPa | 0 … 50 ppmv | 0 … 500 ppmv | 2 500 ppmv*m | 1 ppmv*m at 300 °C | 1.5 ppmv*m at 15 Vol% $H_2O$, 300 °C | 2 % |
| **$NH_3$** | **$H_2O$** | D | A | 0 … 150 °C | 950 …1 050 hPa | 0 … 25 ppmv | 0 … 100 ppmv | 1 200 ppmv*m | 0.5 ppmv*m | 0.9 ppmv*m at 15 vol% $H_2O$, 55 °C | 2 % |
| | | | T | 0 … 150 °C | 950 …1 050 hPa | 0 … 25 ppmv | 0 … 100 ppmv | 1 200 ppmv*m | 0.5 ppmv*m | 0.9 ppmv*m at 15 vol% $H_2O$, 55 °C | 2 % |
| | | | E | 250 … 350 °C | 950 …1 050 hPa | 0 … 45 ppmv | 0 … 100 ppmv | 1 200 ppmv*m | 0.9 ppmv*m at 250 °C | 1.4 ppmv*m at 15 vol% $H_2O$, 250 °C | 2 % |
| | | | F | 300 … 400 °C | 950 …1 050 hPa | 0 … 50 ppmv | 0 … 100 ppmv | 1 200 ppmv*m | 1 ppmv*m at 300 °C | 1.5 ppmv*m at 15 vol% $H_2O$, 300 °C | 2 % |
| **HCl** | | E | A | 0 … 150 °C | 950 …1 050 hPa | 0 … 30 ppmv | 0 … 6 000 ppmv | 1 200 ppmv*m | 0.6 ppmv*m | 2.2 ppmv*m at 15 % $H_2O$, 55 °C | 5 % |
| | | | T | 120 … 210 °C | 950 …1 050 hPa | 0 … 10 ppmv | 0 … 60 ppmv | 720 ppmv*m | | | |
| | | | H | 150 … 250 °C | 950 … 1 050 hPa | 0 … 50 ppmv | 0 … 6 000 ppmv | 1 200 ppmv*m | 1.0 ppmv*m at 150 °C | 3.1 ppmv*m at 15 Vol% $H_2O$, 150 °C | 5 % |
| **HCl** | **$H_2O$** | F | A | 0 … 150 °C | 950 …1 050 hPa | 0 … 30 ppmv | 0 … 100 ppmv | 1 200 ppmv*m | 0.6 ppmv*m | 2.2 ppmv*m at 15 % $H_2O$, 55 °C | 5 % |
| | | | T | 120 … 210 °C | 950 …1 050 hPa | 0 … 10 ppmv | 0 … 60 ppmv | 720 ppmv*m | | | |
| | | | H | 150 … 250 °C | 950 … 1 050 hPa | 0 … 50 ppmv | 0 … 100 ppmv | 1 200 ppmv*m | 1.0 ppmv*m at 150 °C | 3.1 ppmv*m at 15 vol% $H_2O$, 150 °C | 5 % |

| **Standard application**<br>**Effective optical path length: 0.3 … 12 m**<br>**Dust load[3]: < 50 g/Nm³** | | | | **Min. measuring range**<br>(with 1 m eff. opt. path length) | **Max. measuring range**<br>(usually also dependent on eff. opt. path length: see following column) | **(Max. measuring range x path length)** | **(DL x path length)**<br>under standard conditions[1) 2)] | **(DL x path length)**<br>at 1 013 hPa with cross-interference of gas 1 | **Accuracy[4)]** | **Purging gas mode** | | **Purging gas medium** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gas 1** | **Gas 2** | **Gas code** | **Appl. code** | **Gas 2** | **Gas 2** | **Gas 2** | **Gas 2** | **Gas 2** | **Gas 2** | **Standard** | **Optional** | |
| **$O_2$** | | A | B | | | | | | | E, F | G, H | Steam + air, $N_2$ |
| | | | C | | | | | | | D | B | $N_2$ |
| | | | P | | | | | | | D | B | $N_2$ |
| **$O_2$** | **Temp** | B | B | | 600 … 1 200 °C | | | | [5)] | F | H | Steam, $N_2$ |
| **$NH_3$** | | C | A | | | | | | | C | G | Air |
| | | | T | | | | | | | C | G | Air |
| | | | E | | | | | | | E | G | Air |
| | | | F | | | | | | | E | G | Air |
| **$NH_3$** | **$H_2O$** | D | A | 0 … 5 vol% | 0 … 30 vol% | 240 vol%*m | 0.1 vol%*m | 0.1 vol%*m | 5 % | C | G | Air |
| | | | T | 0 … 5 vol% | 0 … 30 vol% | 240 vol%*m | 0.1 vol%*m | 0.1 vol%*m | 5 % | C | G | Air |
| | | | E | 0 … 5 vol% | 0 … 30 vol% | 240 vol%*m | 0.1 vol%*m at 250 °C | 0.1 vol%*m at 250 °C | 5 % | E | G | Air |
| | | | F | 0 … 5 vol% | 0 … 30 vol% | 240 vol%*m | 0.1 vol%*m at 300 °C" | 0.1 vol%*m at 300 °C | 5 % | E | G | Air |
| **HCl** | | E | A | | | | | | | C | G | Air |
| | | | T | | | | | | | C | G | Air |
| | | | H | | | | | | | E | G | Air |
| **HCl** | **$H_2O$** | F | A | 0 … 5 vol% | 0 … 30 vol% | 360 vol%*m | 0.1 vol%*m | 0.1 vol%*m | 5 % | C | G | Air |
| | | | T | 0 … 5 vol% | 0 … 30 vol% | 360 vol%*m | | | | C | G | Air |
| | | | H | 0 … 5 vol% | 0 … 30 vol% | 360 vol%*m | 0.1 vol%*m at 150 °C | 0.1 vol%*m at 150 °C | 5 % | E | G | Air |

## 19" central unit

| Standard application<br>Effective optical path length: 0.3 … 12 m<br>Dust load[3]: < 50 g/Nm³ | | | | Process gas temperature<br>$T_{min}$ … $T_{max}$ | Process gas pressure<br>$p_{min}$ … $p_{max}$ | Min. measuring range<br>(with 1 m eff. opt. path length) | Max. measuring range<br>(also dependent on eff. opt. path length: see following column) | (Max. measuring range x path length) | (DL x path length)<br>under standard conditions[1) 2)] without cross-interference of other gases | (DL x path length)<br>at 1 013 hPa with cross-interference of gas 2 | Accuracy[4)] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gas 1** | **Gas 2** | **Gas code** | **Appl. code** | | | **Gas 1** | **Gas 1** | **Gas 1** | **Gas 1** | **Gas 1** | **Gas 1** |
| **HF** | | G | A | 0 … 150 °C | 950 …1 050 hPa | 0 … 5 ppmv | 0 … 1 500 ppmv | 200 ppmv*m | 0.1 ppmv*m | 0.6 ppmv*m at 15 vol% $H_2O$, 55 °C | 5 % |
| | | | H | 150 … 250 °C | 950 … 1 050 hPa | 0 … 5 ppmv | 0 … 1 500 ppmv | 200 ppmv*m | 0.11 ppmv*m at 150 °C | 0.6 ppmv*m at 15 vol% $H_2O$, 150 °C | 5 % |
| **HF** | **$H_2O$** | H | A | 0 … 150 °C | 950 …1 050 hPa | 0 … 5 ppmv | 0 … 200 ppmv | 200 ppmv*m | 0.1 ppmv*m | 0.6 ppmv*m Aat 15 vol% $H_2O$, 55 °C | 5 % |
| | | | H | 150 … 250 °C | 950 … 1 050 hPa | 0 … 5 ppmv | 0 … 200 ppmv | 200 ppmv*m | 0.11 ppmv*m at 150 °C | 0.6 ppmv*m at 15 vol% $H_2O$, 150 °C | 5 % |
| **CO** | | J | C | 0 … 600 °C | 950 …1 050 hPa | 0 … 1.5 vol% | 0 … 100 vol% | 40 vol%*m | 300 ppmv*m | 1 500 ppmv*m at 50 vol% $CO_2$, 20 °C | 2 % |
| **CO** | **$CO_2$** | K | D | 0 … 400 °C | 800 …1 400 hPa | 0 … 3.0 vol% | 0 … 100 vol% | 35 vol%*m | 0.5 vol%*m | 0.7 vol%*m at 50 vol% $CO_2$, 20 °C | 2 %[6)] |
| **$CO_2$** | | L | A | 0 … 150 °C | 950 …1 050 hPa | 0 … 7.5 vol% | 0 … 100 vol% | 40 vol%*m | 300 ppmv*m | | 2 % |
| **$H_2O$** | | M | A | 0 … 150 °C | 950 …1 050 hPa | 0 … 5 vol% | 0 … 30 vol% | 240 vol%*m | 0.1 vol%*m | | 5 % |
| | | | T | 0 … 150 °C | 950 …1 050 hPa | 0 … 5 vol% | 0 … 30 vol% | 240 vol%*m | 0.1 vol%*m | 5 % | |

1) At 20 °C, 1 013 hPa

2) If the smallest permissible process gas temperature of the application is $T_{min}$ > 20 °C, the detection limit refers to $T_{min}$ and standard pressure (1 013 hPa)

3) At 0.3 m effective optical path length, average diameter of the dust particles: 15 µm, specific weight of the dust particles: 650 kg/m³

4) At least: Detection limit

5) Up to 200 °C, 5 % above this

6) Up to 60 vol% CO or up to 60 vol% $CO_2$. Higher CO or $CO_2$ concentrations on request.

| **Standard application**<br>**Effective optical path length: 0.3 … 12 m**<br>**Dust load[3]: < 50 g/Nm³** | | | | **Min. measuring range**<br>(with 1 m eff. opt. path length) | **Max. measuring range**<br>(usually also dependent on eff. opt. path length: see following column) | **(Max. measuring range x path length)** | **(DL x path length)**<br>under standard conditions[1] [2] | **(DL x path length)**<br>at 1 013 hPa with cross-interference of gas 1 | **Accuracy**[4] | **Purging gas mode** | | **Purging gas medium** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gas 1** | **Gas 2** | **Gas code** | **Appl. code** | **Gas 2** | **Gas 2** | **Gas 2** | **Gas 2** | **Gas 2** | **Gas 2** | **Standard** | **Optional** | |
| **HF** | | G | A | | | | | | | C | G | Air |
| | | | H | | | | | | | E | G | Air |
| **HF** | **$H_2O$** | H | A | 0 … 5 vol% | 0 … 30 vol% | 360 vol%*m | 0.1 vol%*m | 0.1 vol%*m | 5 % | C | G | Air |
| | | | H | 0 … 5 vol% | 0 … 30 vol% | 360 vol%*m | 300 ppmv*m at 200 °C | 300 ppmv*m at 200 °C | 5 % | E | G | Air |
| **CO** | | J | C | | | | | | | E | G | Air, $N_2$ |
| **CO** | **$CO_2$** | K | D | 0 … 7.5 vol% | 0 … 100 vol% | 75 vol%*m | 0.5 vol%*m | 1 500 ppmv*m at 50 vol% CO, 20 °C | 2 … 5 %[6] | C | G | Air |
| **$CO_2$** | | L | A | | | | | | | C | G | Air |
| **$H_2O$** | | M | A | | | | | | | C | G | Air |
| | | | T | | | | | | | C | G | Air |

[1] At 20 °C, 1 013 hPa

[2] If the smallest permissible process gas temperature of the application is $T_{min}$ > 20 °C, the detection limit refers to $T_{min}$ and standard pressure (1 013 hPa)

[3] At 0.3 m optical path length, average diameter of the dust particles: 15 µm, specific weight of the dust particles: 650 kg/m³

[4] At least: Detection limit

[5] At 600 °C and at least 5 vol%*m $O_2$ concentration: Resolution = 15 °C, at 1 000 °C and at least 5 vol%*m $O_2$ concentration: Resolution = 25 °C

[6] Depends on temperature (higher values at higher temperatures)

## Cross-duct sensor CD 6

### Overview

***Cross-duct sensors CD 6 and cables for non-Ex applications***

The standard cross-duct sensor consists of a transmitter unit and a detector unit with the same dimensions. The transmitter unit provides a connector for the fiber-optic cable. The laser light is transmitted through this cable. The receiver unit contains a photodetector and an electronics PCB, and is connected to the detector unit by a sensor cable.

The sensors are mounted onto flanges. The easiest way to avoid condensation and dust deposits on the sensor windows is to purge them, e.g. with instrument air. Purging must be selected depending on the application. The cross-duct sensors can therefore be configured for the respective situation. The application reference table provides recommendations for suitable purging with standard applications.

If a component is to be measured which is also present in measurable quantities in the purging medium - such as oxygen or moisture - it is necessary to use purging gases such as nitrogen, superheated process steam or similar. In such cases it is usually also necessary to purge the sensor heads, since the ambient air must also be displaced here out of the laser beam path. A differentiation is therefore made between purging on the process side and purging on the sensor side.

Note

For measurement of $O_2$ at gas temperatures above 600 °C, it may also be possible to tolerate air as the purging medium since its influence on the measurement can be compensated. In contrast, the combination $O_2$/temperature always requires $O_2$-free purging.

Applications with oxygen (high-pressure)

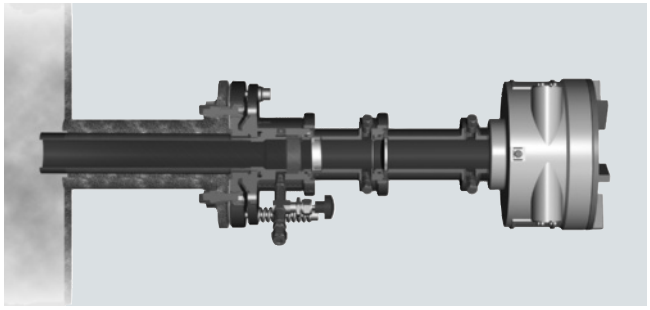
For oxygen measurements with a higher process gas pressure (1 to 5 bar), the sensor CD 6 can be used together with a suitable window flange as the process connection. This window flange is also available in the standard sizes DN 65/PN 6, DN 80/PN 16 or ANSI 4"/150 lbs. The optical surface to the process is made of borosilicate glass. Flanges can be equipped with window purging, but without purging tubes. Possible purge modes for the window flanges are "A-C" (no purging or moderate purging on the process side). Window flanges are tested for leakage before delivery using overpressure, and show leakage rates of less than $10^{-5}$ mbar·l/s.

For ordering this application, the MLFB code of the central unit with the application code "P" must be selected. The process interface suitable for the sensors can be chosen by selection of the corresponding code in the 6th configurable position of the MLFB number.

The most important sensor purging configurations are presented below:

Purging on the process side with moderate flow

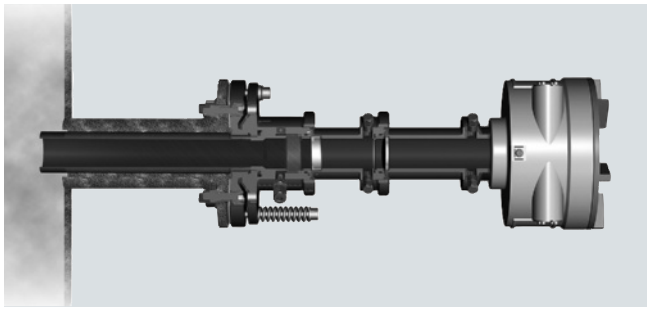
Is selected e.g. for pure gas applications, emission monitoring, inerting monitoring. The purging gas flow can be adjusted between 0 and approx. 120 l/min at each sensor head using a needle valve (included in delivery).



Moderate purging on process side

Purging on the process side with increased flow

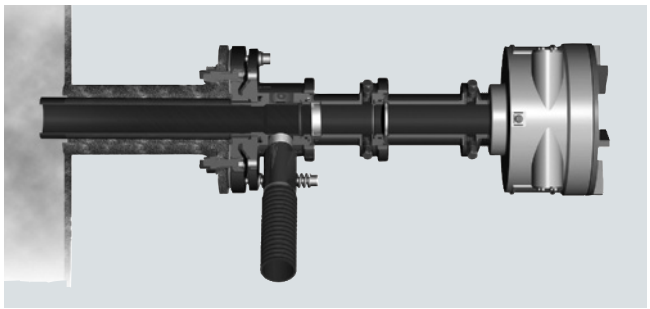
Through omission of needle valve. This type of purging is selected in crude gas applications with higher concentrations of particles and/or condensation as well as in non-purified flue gases in combustion plants. The purging gas flow is typically set between 200 and 500 l/min on each sensor head depending on the input pressure of the purging medium.



Increased purging on process side

Purging on the process side with high flow

Through use of air blower or dry process steam. Connectors with hose adapters are included in the delivery. An additional Swagelok adapter must be ordered if a high flow of steam or instrument air purging is required (option A27). This type of purging is selected in crude gas applications with very high concentrations of particles and/or condensation such as in the furnaces of combustion plants. If instrument air is not available, an air blower is also an alternative for purging in applications with lower demands. On the process side, dry steam can be used as the inert purging gas instead of nitrogen. The purging gas flow is automatically set between 500 and <1 000 l/min on each sensor head depending on the purging air blower or the steam pressure.



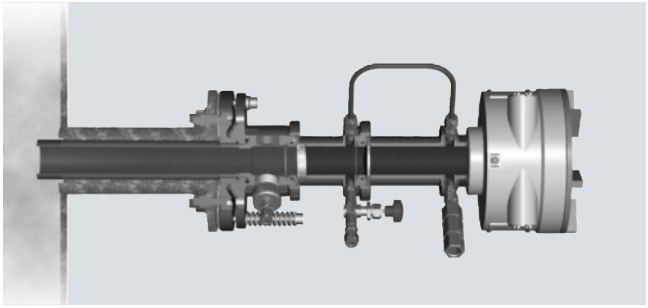
Increased purging on process side, with hose connection adapter

Purging on sensor side

Can be combined with any purging mode on the process side, and is always selected if the ambient air must never have an influence on the measurement. The volumes within the sensor head are then continuously purged with an $O_2$-free gas. Allowed purging gases are nitrogen or carbon dioxide. The flow of purging gas required in this case is approx. 1 to 6 l/min and is set using a needle valve (included in delivery). The combination shown here of purging with superheated process steam on the process side and with nitrogen from a compressed gas bottle on the sensor side may satisfy the necessity for $O_2$-free purging e.g. also in combustion plants with boilers without own nitrogen network.

Note

With purging on the process side, it may be necessary to use non-return valves to ensure no process gas can enter the purging gas line in the event of failure of the purging gas supply. This applies especially in the case of cascaded process and sensor purging where there is otherwise the danger that, for example, corrosive process gases could enter the sensor enclosure.



Sensor configuration with high purging on process side, with 6 mm joint for use with steam, and with $N_2$ purging on the sensor side

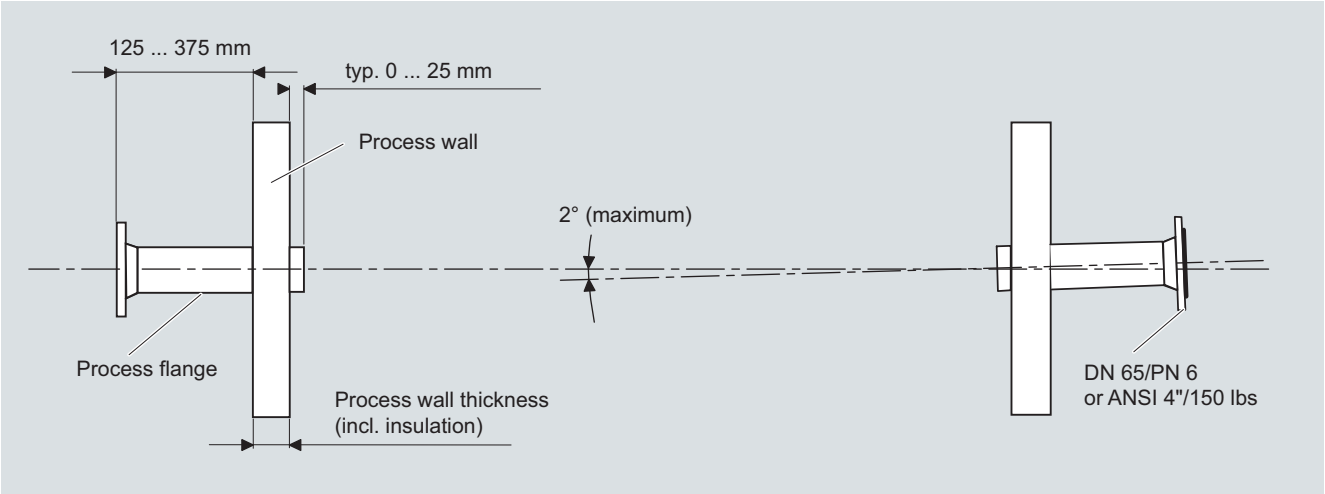
The purging media used on the process side flow through purging gas tubes into the process gas stream. The tubes extend a few centimeters into the process area, and usually provide a flow from the side. This results in a wedge being generated in the inlet zone of the purging gas. The effective measuring path in the process gas is therefore well-defined as the distance between the ends of the two purging gas inlet tubes.

***Cross-duct sensor CD 6: Options and accessories***

Sensor alignment kit

Includes a battery-operated visible light source, a centering aid with crosshair, and two hook spanners for opening the optics tube of the sensors.

Please note: the sensor alignment kit is not explosion protected.

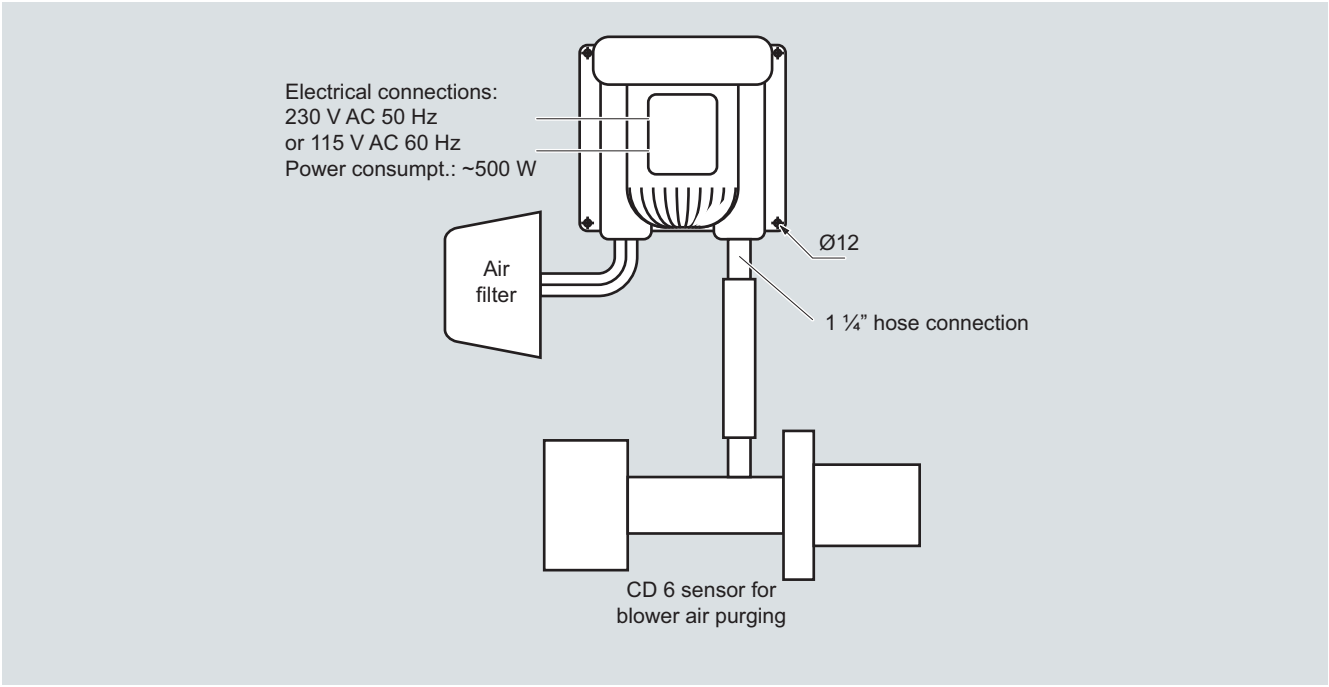



Installation requirements for the cross-duct sensors CD 6, dimensions in mm

## Cross-duct sensor CD 6

Purging air blower

Two purging air blowers are required to purge the sensor heads. Both 230 V AC and 115 V AC versions can be ordered.




Sensor configuration with purging air blower

Flow cell (available on special application)

For implementation of measuring configurations with bypass mode. The cell consists of a stainless steel tube whose internal surfaces are coated with PTFE to minimize surface effects. With an effective measuring path of 1 m, the inner volume is only 1.2 l, and fast gas displacement times can therefore be achieved. The flow of sample gas can be from the ends or from the center of the tube, since appropriate 6 mm joints are present here. The flow cell can be ordered in four configurations:

- Unheated, including assembly for wall mounting
- Unheated, including assembly for wall mounting and a 19" housing with an air jet pump with a delivery rate of max. 30 l/min
- As above, but can be heated up to approx. 200 °C
- As above, but can be heated up to approx 200 °C and mounted on a rack with wheels and integrated 19" frame

Optical bandpass filter

Serves to protect the light-sensitive detector in the receiver unit of the sensor from saturation by IR background radiation. Is used with measurements in very hot process gases (T > 1 000 °C) or with unavoidable appearances of flames in the measurement path.

## Technical specifications

### *Cross-duct sensor CD 6*

| | |
|---|---|
| **General information** | |
| Design | Transmitter and detector units, connected by a sensor cable |
| Materials | Stainless steel |
| Installation | Horizontally to the optical axis, perpendicular or parallel to the gas flow |
| Laser protection class | Class 1, safe to the eye |
| Explosion protection | Optional, acc. to ATEX II 1 G Ex ia IIC T4, ATEX II 1 D Ex iaD 20 IP65 T135 °C<br>A defined leak rate can only be guaranteed when using high-pressure window flanges. Otherwise it may be necessary for the owner to carry out an evaluation in accordance with ATEX (DEMKO 06 ATEX 139648X [17]). |
| **Design, enclosure** | |
| Degree of protection | IP65 |
| Dimensions | Diameter: 163, L: 395 mm |
| Purging gas tube in mm | 400 (370 net) x 44 x 40<br>800 (770 net) x 44 x 40<br>1 200 (1 170 net) x 44 x 40 |
| Weight | 2 x approx. 11 kg |
| Mounting | DN 65/PN 6 or ANSI 4"/150 |

Please note:
- For purging tubes with a length of 800 and 1 200 mm, the wall thickness must not exceed 200 mm with DN 65/PN 6 connections. To carry out measurements with thicker walls, please contact Siemens.
- The optimum adjustment of the flanges can change with high differences in temperature depending on the type of assembly.

| | |
|---|---|
| **Electrical characteristics** | |
| Power supply | 24 V DC, supply from central unit via hybrid cable |
| Power consumption | < 2 W during operation |
| **Climatic conditions** | |
| Ambient temperature | -30 ... +70 °C during operation, -40 ... +70 °C during storage and transportation |
| Humidity | < 95 % RH, above dew point |
| Pressure | 800 ... 1 100 hPa |
| Temperature range on the sensor side of the process interface (connection plate) | -20 … +70 °C |
| **Measuring conditions** | |
| Measurement path | 0.3 ... 12 m<br>(other lengths on request) |
| Gas temperatures | 0 ... 1 200 °C,<br>application-dependent |
| Gas pressure | General: 1 013 ± 50 hPa<br>With high-pressure window flanges:<br>$CO/CO_2$ application KD:<br>800 ... 1 400 hPa<br>High-pressure $O_2$ application AP:<br>950 ... 5 000 hPa |
| Dust load | The influence of dust is very complex and depends on the path length and particle size. The optical damping increases exponentially at longer path lengths. Smaller particles also have a large influence on the optical damping. With high dust load, long path length and small particle size, the technical support at Siemens should be consulted. |

### *Accessories*

**Purging**

Nitrogen is permissible as the purging gas for the sensor side. Nitrogen, steam, air and gases which are not subject to the pressure equipment directive Cat. 2 are permissible as purging gases for the process side.

| | |
|---|---|
| Purging with instrument air, $N_2$ | |
| • Pressure at purging inlet | 2 000 ... 8 000 hPa |
| • Max. overpressure in the sensor | < 500 hPa |
| • Quality | |
| - Instrument air | Free of oil and water |
| - Nitrogen | Purity better than 99.7 %. For oxygen measurements, and an $O_2$ content < 0.01 % in the purging gas (optical path length ≥ 1 m, min. 5 % oxygen in the process gas) |
| • Maximum flow rate | 500 l/min |
| • Dew point | Benchmark: < -10 °C, condensation on the optics must be avoided |
| Blower purging | |
| • Maximum counter pressure | 40 hPa |
| • Maximum flow rate | 850 l/min |
| • Power consumption | 370 W |
| • Degree of protection (fan) | IP54, cover required to protect against rain |
| Steam purging | |
| • Steam conditioning | Overheated |
| • Maximum temperature | 240 °C |
| • Minimum pressure | > 4 000 hPa |
| • Maximum pressure | 16 000 hPa, refers to a volume flow of approx. 1 100 l/min |

### *Hybrid and sensor cables*

| | |
|---|---|
| **General information** | |
| Configuration hybrid cable | Two optical fibers and two twisted copper wires in one cable for 24 V DC. Single-mode optical fiber configured at both ends with E2000 angle connectors. Multimode optical fiber configured at both ends with SMA connectors. |
| Cable sheath | Oil-resistant polyurethane |
| Dimensions | • For > 500 m, an external power supply must be additionally ordered<br>• For installation in hazardous zones, non-intrinsically-safe cables have to be spatially separated from intrinsically-safe lines |
| • Diameter | < 8 mm |
| • Length | • Use in non-hazardous and Ex Zone 2: Up to 700 m<br>• Use in Ex Zone 0 and Zone 1: Up to 250 m |
| Impact resistance | 200 N/cm |
| Maximum tensile strength | 500 N |
| Minimum bending radius | 10 cm |
| **Climatic conditions** | |
| Ambient temperature | -40 ... +80 °C during operation |
| Humidity | < 95 % rel. humidity, above dew point (in operation and storage) |

# LDS 6

## Cross-duct sensor CD 6

| Selection and ordering data | | Order No. |
|---|---|---|
| **LDS 6 in-situ gas analyzer**<br>Pair of sensors (cross-duct sensor) | | **7MB6122-** ■■■■■ - ■■■■ |
| **Explosion protection** | | |
| Without | | 0 |
| According to ATEX II 1 G Ex ia IIC T4, ATEX II 1 D Ex iaD 20 IP65 T135 °C | | 1 |
| **Sensor type** | **Measured component** | |
| Standard cross-duct sensor | $O_2$ | A |
| | All gases except $O_2$ | W |
| **Purging, process side** | **Sensor side** | |
| Without purging | Without purging | A |
| | Air or $N_2$, 1 ... 2 l/min;<br>incl. needle valve, 6 mm Swagelok | B |
| Instrument air or $N_2$<br>Reduced flow: 0 ... 120 l/min<br>incl. needle valve, 6 mm Swagelok | Without purging | C |
| | Air or $N_2$, 1 ... 2 l/min;<br>incl. needle valve, 6 mm Swagelok | D |
| Air or $N_2$<br>Increased flow: 200 ... 500 l/min<br>incl. 6 mm Swagelok | Without purging | E |
| | Air or $N_2$, 1 ... 2 l/min;<br>incl. needle valve, 6 mm Swagelok | F |
| Air, fan or steam;<br>high flow: > 500 l/min<br>incl. 1¼" hose adapter | Without purging | G |
| | Air or $N_2$, 1 ... 2 l/min;<br>incl. needle valve, 6 mm Swagelok | H |
| **Purging tubes, material** | | |
| No purging tubes | | 0 |
| Stainless steel, EN 1.4432/316L | | 1 |
| **Purging tubes, length** | | |
| No purging tubes | | 0 |
| 400 mm | | 1 |
| 800 mm | | 2 |
| 1 200 mm | | 3 |
| 75 mm, e.g. for engine test rigs | | 4 |
| **Process connection** | | |
| Stainless steel flange (EN 1.4404/316L), dimensions acc. to DN 65/PN 6 | | 0 |
| Stainless steel flange (EN 1.4404/316L), dimensions acc. to ANSI 4"/150 lbs | | 1 |
| Stainless steel flange (EN 1.4404/316L), dimensions acc. to DN 65/PN 6, including enclosed welding flanges, e.g. for engine test rigs | | 2 |
| Pressure-resistant window flange (EN 1.4404/316L, borosilicate glass), DN 65/PN 6 | | 3 |
| Pressure-resistant window flange (EN 1.4404/316L, borosilicate glass), DN 80/PN 16 | | 4 |
| Pressure-resistant window flange (EN 1.4404/316L, borosilicate glass), ANSI 4"/150 lbs | | 5 |
| **Hybrid cable** | **Length [m]** | |
| No hybrid cable | | X |
| Standard length | 5 | A |
| | 10 | B |
| | 25 | E |
| | 40 | G |
| | 50 | H |
| Customized length | (specified in complete meters) | Z |

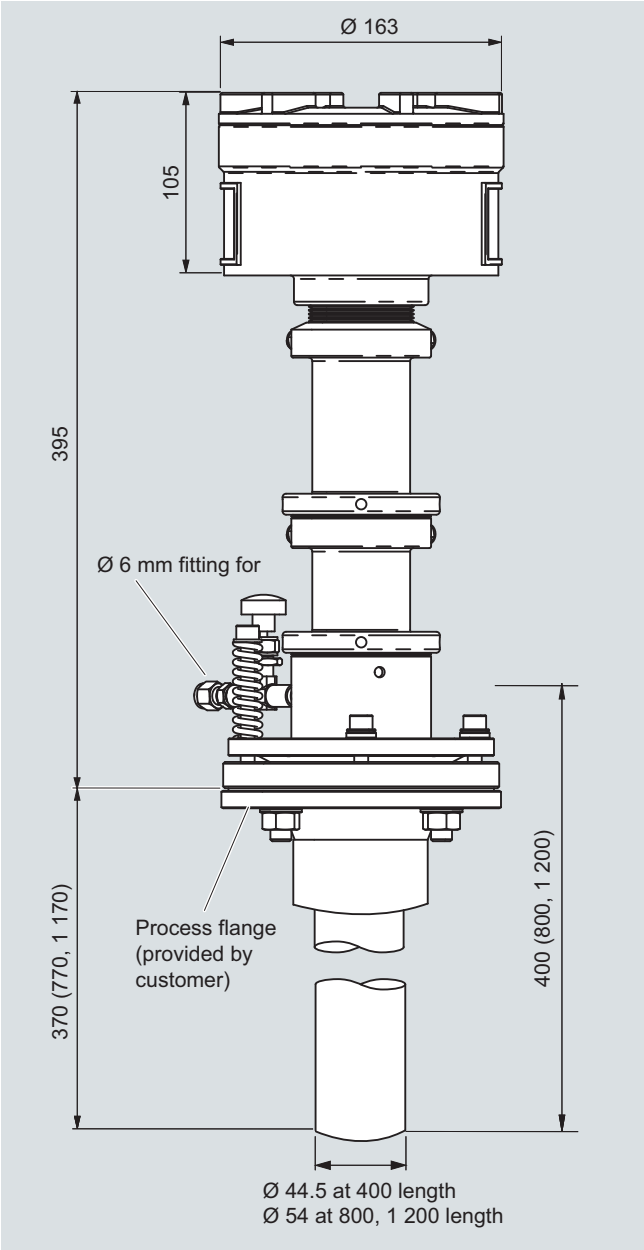
| Selection and ordering data | | Order No. |
|---|---|---|
| **LDS 6 in-situ gas analyzer**<br>Pair of sensors (cross-duct sensor) | | **7MB6122-** ■■■■■ - ■■■■ |
| **Sensor connecting cable** | **Length [m]** | |
| No sensor connecting cable | | **X** |
| Standard length | 5 | **A** |
| | 10 | **B** |
| | 25 | **E** |
| Customer-specific length | (specified in complete meters) | **Z** |
| **Language (supplied documentation)** | | |
| German | | **0** |
| English | | **1** |
| French | | **2** |
| Spanish | | **3** |
| Italian | | **4** |

| Selection and ordering data | | |
|---|---|---|
| ***Additional versions*** | | **Order code** |
| Add "-Z" to Order No. and specify order code | | |
| 6 mm Swagelok adapter for purging with steam, purging modes G and H | | **A27** |
| Acceptance test certificate 3.1 (leak test) in accordance with EN10204 | | **C12** |
| Purging tube, special length | | **M1Y** |
| Hybrid cable, customized length | | **P1Y** |
| Sensor cable, customized length | | **Q1Y** |
| TAG label, customized inscription | | **Y30** |
| ***Additional units*** | | **Order No.** |
| Purging air blower 230 V | D) | **A5E00829151** |
| Purging air blower 115 V | | **A5E00829150** |
| CD 6, sensor alignment kit | | **A5E00253142** |
| Optical filter for reducing IR background radiation (flame filter) | | **A5E00534668** |

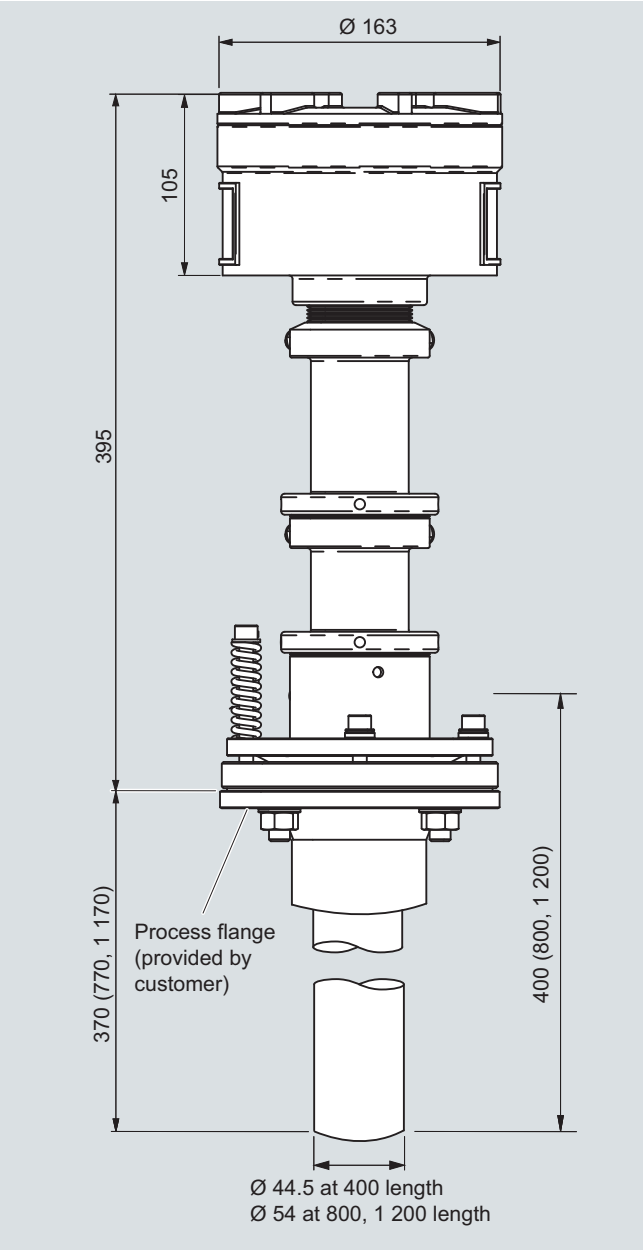
D) Subject to export regulations AL: 9I999, ECCN: N

## Cross-duct sensor CD 6

### Dimensional drawings

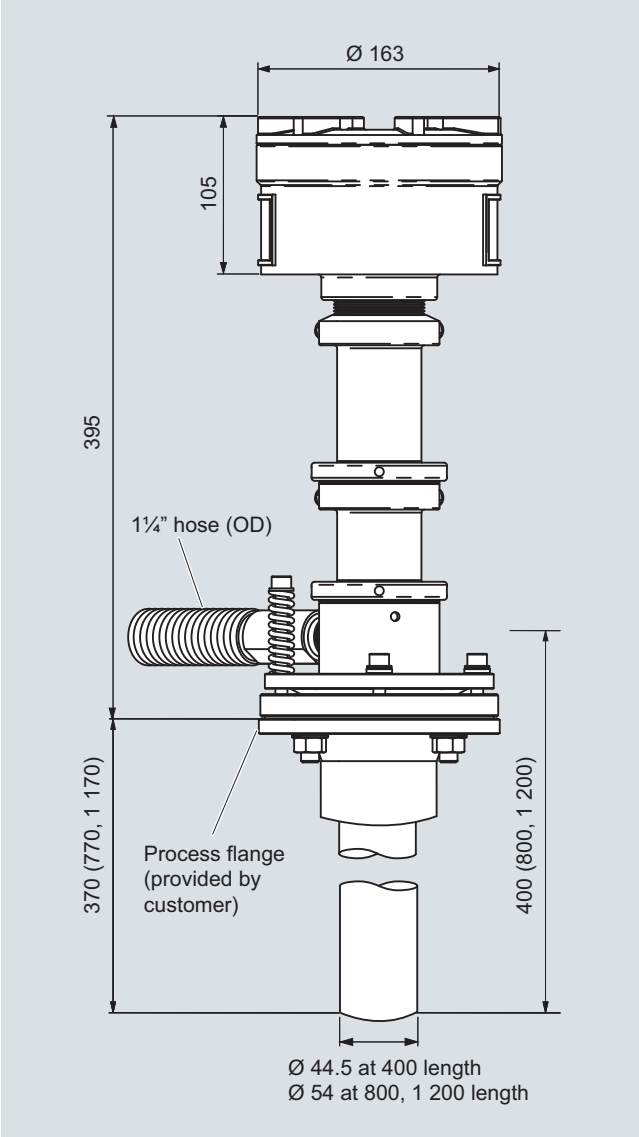



Cross-duct sensor CD 6, moderate purging (instrument air), version according to Order No. 7MB6122-**C1*-0***, dimensions in mm

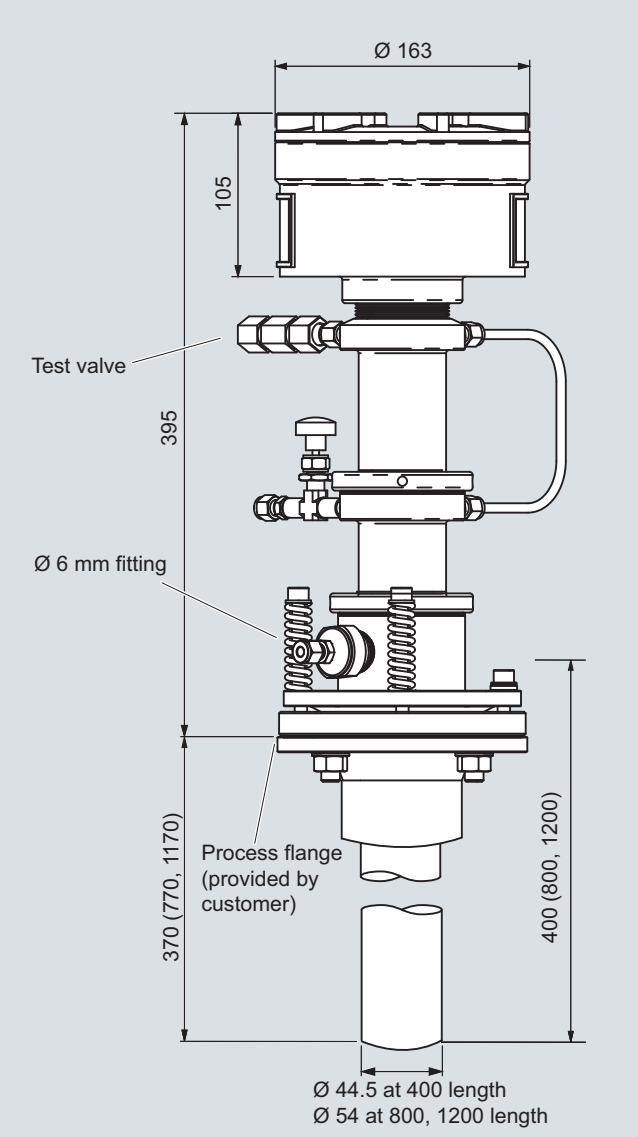



Cross-duct sensor CD 6, increased purging (instrument air), version according to Order No. 7MB6122-**E1*-0***, dimensions in mm

## Cross-duct sensor CD 6



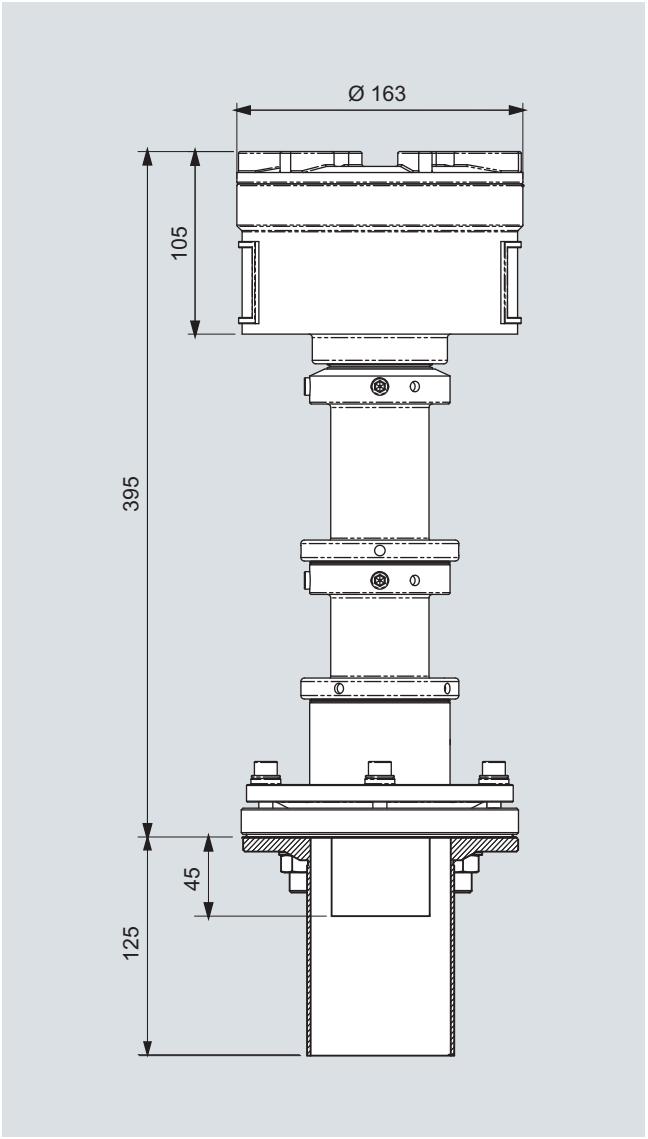

Cross-duct sensor CD 6, blower purging, version according to Order No. 7MB6122-**G1*-0***, dimensions in mm



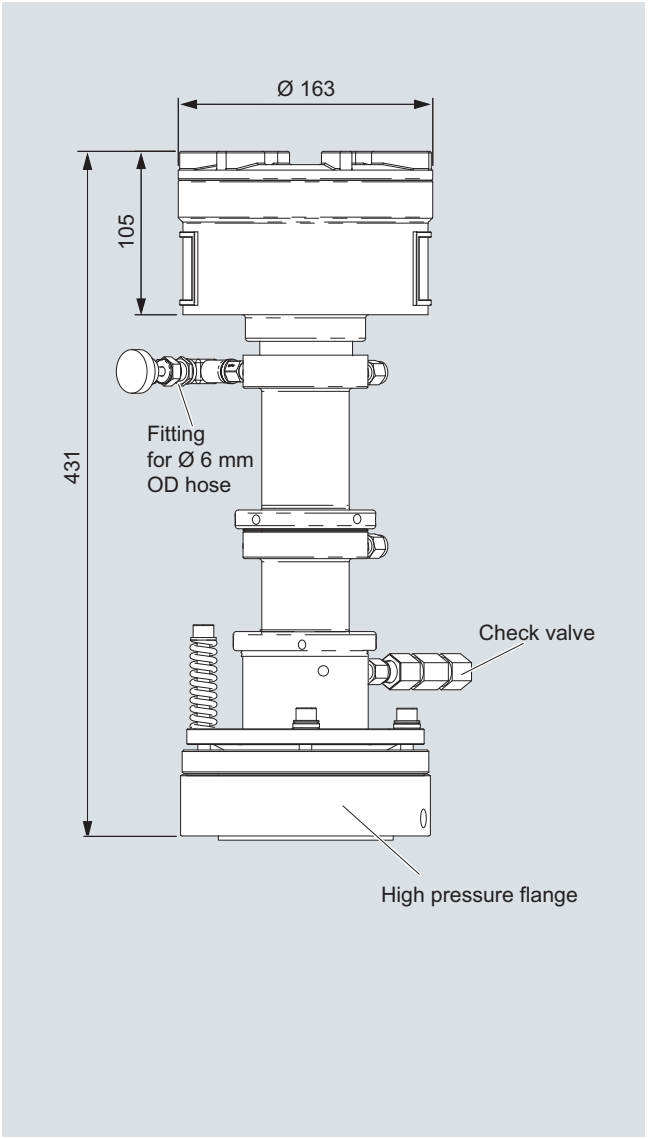

Cross-duct sensor CD 6, sensor and process side purging, version according to Order No. 7MB6122-**H1*-0***, dimensions in mm

## Cross-duct sensor CD 6






Cross-duct sensor CD 6, purged version according to Order No. 7MB6122-*WC14-2***, dimensions in mm




CD 6 high-pressure sensor for oxygen, dimensions in mm

## Documentation

### Selection and ordering data

| Manual | Order No. |
|---|---|
| LDS 6 operating instructions | |
| • German | **A5E00295893** |
| • English | **A5E00295894** |
| • French | **A5E00295895** |
| • Italian | **A5E00295896** |
| • Spanish | **A5E00362720** |

## Suggestions for spare parts



### Selection and ordering data

| Description | Quantity for 2 years | Quantity for 5 years | | Order No. |
|---|---|---|---|---|
| CD 6, window module, quartz | 1 | 2 | | **A5E00338487** |
| CD 6, window module, engine test rig, no purging | 1 | 2 | | **A5E00338490** |
| CD 6, high-pressure window flange (EN 1.4404/316L), DN 65/PN 6 | 1 | 2 | | **A5E00534662** |
| CD 6, high-pressure window flange (EN 1.4404/316L), DN 80/PN 16 | 1 | 2 | | **A5E00534663** |
| CD 6, high-pressure window flange (EN 1.4404/316L), ANSI 4"/150 lbs | 1 | 2 | | **A5E00534664** |
| Gasket for CD 6 hybrid cable | 1 | 2 | D) | **A5E00853911** |
| CD 6, sensor electronics FO InGaAs (version 2) | 1 | 1 | B) | **A5E01090409** |
| CD 6, sensor electronics FO Ge, only HCl (version 2) | 1 | 1 | B) | **A5E01090413** |
| CD 6, sensor electronics SW, only $O_2$ | 1 | 1 | B) | **A5E00338533** |
| CD 6, sensor electronics ATEX SW, only $O_2$ | 1 | 1 | B) | **A5E00338563** |
| CD 6, sensor electronics ATEX HCl | 1 | 1 | | **A5E00853896** |
| CD 6, sensor electronics ATEX $NH_3$, CO, $CO_2$, HF, $H_2O$, low gain | 1 | 1 | B) | **A5E00338572** |

B) Subject to export regulations AL: N, ECCN: 3A991X

D) Subject to export regulations AL: 9I999, ECCN: N

### More information

LDS 6 does not contain parts subject to wear, but some parts within the sensors might be stressed. For this reason it is recommended for demanding applications to keep window modules and detector electronics on stock (quantities stated per measuring point, i.e. per sensor pair).

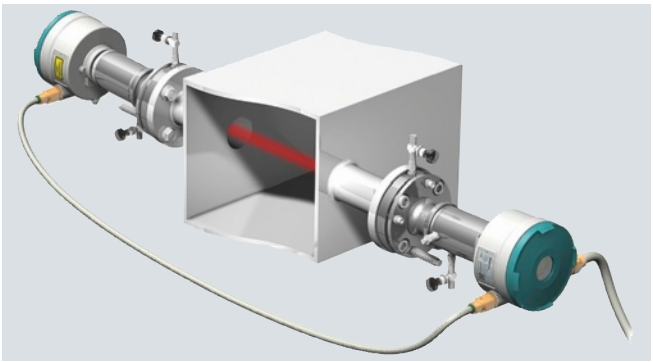
For the suitability of different parts (version 1 or version 2) please consult the instrument manual or contact Siemens directly. In general, all new analyzers are compatible with spare parts of version 2.

# SITRANS SL

## In-situ O2 an CO gas analyzer

### Overview

SITRANS SL is a diode laser gas analyzer with a measuring principle based on the specific light absorption of different gas components. SITRANS SL is suitable for fast, non-contact measurement of gas concentrations in process or flue gases. An analyzer consisting of transmitter and receiver units (sensors) is used for each measuring point. The hardware for further processing of the measured signal into a concentration value, as well as the monitoring, control and communication functions, are integrated in these two main modules. The sensors are designed for operation under harsh environmental conditions.



SITRANS SL

### Benefits

The in-situ SITRANS SL gas analyzer features high operational availability, unique analytical selectivity, and a wide range of possible applications. SITRANS SL permits measurement of a gas component directly in the process:

- With high dust load
- In hot, humid, corrosive, explosive, or toxic gases
- In applications showing strong varying gas compositions
- Under harsh environmental conditions at the measuring point
- Highly selective, i.e. mostly without cross-sensitivities

Special features of the SITRANS SL:

- Little installation effort
- Minimum maintenance requirements
- Extremely rugged design
- High long-term stability through built-in, maintenance-free reference gas cell
- Real-time measurements

Moreover, the analyzer provides warning and error messages:

- When maintenance is required
  - With large variations in the reference signal
  - With poor signal quality
- If the transmission violates an upper or lower limit

## Application

### *Applications*

- Control of combustion processes
- Process optimization
- Plant and operator safety
- Process measurements in all types of power and combustion plants
- Process control
- Explosion protection
- Measurements in corrosive and toxic gases
- Quality control

### *Sectors*

- Chemical and petrochemical plants
- Power plants
- Waste incinerators
- Iron and steel industry

The following table lists the measuring conditions for standard applications. The listed values for the measuring range and detection limit are only approximate values. The exact values at the respective measuring point depend on the totality of all influencing variables and can be determined by Siemens for the specific case. Please note that the values for the detection limit and the maximum measuring range refer to an optical path of 1 m. Longer path lengths will improve the detection limit, but not linearly. due to limiting effects such as dust load. The maximum applicable measuring ranges can only be used if permitted by the process conditions such as dust load.

| **Standard application Effective optical path length: 0.3 … 8 m Dust load[2]: < 50 g/Nm³** | | | **Process gas temperature $T_{min}$ … $T_{max}$** | **Process gas pressure $p_{min}$ …$p_{max}$** | **Min. measuring range (with 1 m eff. opt. path length)** | **Max. measuring range (also dependent on eff. opt. path length: see following column)** | **Max. measuring range x path length** | **DL x path length (under standard conditions[1] without cross-interference of other gases)** | **Repeatability[3]** | **Purging gas medium** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Sample gas component** | **Gas code** | **Appl. code** | | | | | | | | |
| $O_2$ | A | B | 0 … 600 °C | 900 … 1 100 hPa | 0 … 1 vol% | 0 … 100 vol% | 75 vol%*m | 200 ppmv*m | 2 % | $N_2$ |
| $O_2$ | A | C | 0 … 200 °C | 700 … 5 000 hPa | 0 … 1 vol% | 0 … 100 vol% | 75 vol%*m | 200 ppmv*m | 2 % | $N_2$ |
| CO | J | C | -20 … 700 °C | 700 ... 2 000 hPa, max. 300 °C<br>800 ... 1 200 hPa, above 300 °C | 0 … 100 ppmv | 0 … 6 000 ppmv | 2 000 ppmv*m | 0.6 ppmv*m | 2 % | Air, $N_2$ |

Reference table: Standard applications. The specified pressures are absolute.

DL = detection limit

1) At 20 °C, 1 013 hPa, without dust

2) With 0.3 m effective optical path length
Average diameter of the dust particles: 15 µm
Specific weight of the dust particles: 650 kg/m³
The influence of dust load is extremely complex, and depends on the path length and particle size. The optical damping increases exponentially at longer path lengths. Smaller particles also have a very large influence on the optical damping. With high dust load, long path length and small particle size, the technical support at Siemens should be consulted.

3) Referred to measuring range.
With stable or externally measured and software-compensated process gas temperature and pressure conditions.

### *Special applications*

In addition to the standard applications, special applications are available upon request.

## In-situ O2 an CO gas analyzer

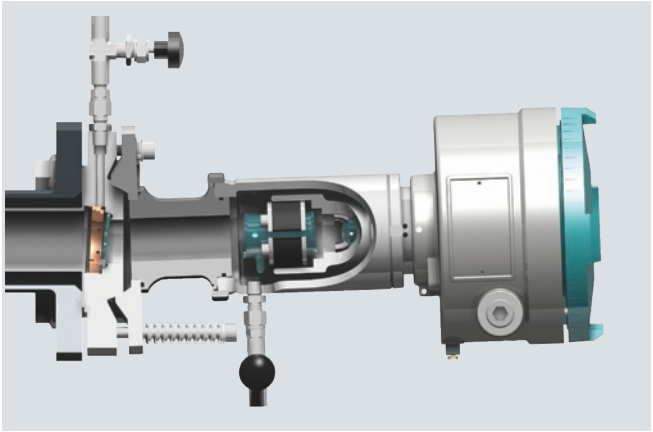
### Design

The SITRANS SL gas analyzer consists of a pair of cross-duct sensors, a transmitter unit and a detector unit, both with the same dimensions. The complete analyzer is integrated in these two enclosures. The transmitter unit contains the laser source whose light is transmitted to the receiver through the measurement path. The detector unit contains a photodetector including electronics as well as a reference cell. The detector unit is connected to the transmitter unit by means of a sensor cable. A further cable on the receiver is used to connect the power supply and the communication interfaces. The receiver enclosure contains a local user interface (LUI) with an LC display which can be read through a window in the cover. The LUI is operated by remote-control.

***Transmitter and detector units***

Special features of the transmitter and detector units:

- In-situ cross-duct sensors, designed as transmitter and detector units, connected via sensor cable
- Powder-coated aluminium; stainless steel
- Degree of protection IP65
- Adjustable process connection plates
- Flange sizes (provided by customer): DN50/PN25, ANSI 4"/150 lbs
- Purging gas connections (see "Purging")
- Optional: Explosion-protected version in accordance with
  - ATEX II 2G Ex de op is IIC T6
    ATEX II 2D Ex tD A21 IP65 T85°C



SITRANS SL, detector unit

Parts in contact with the process gas

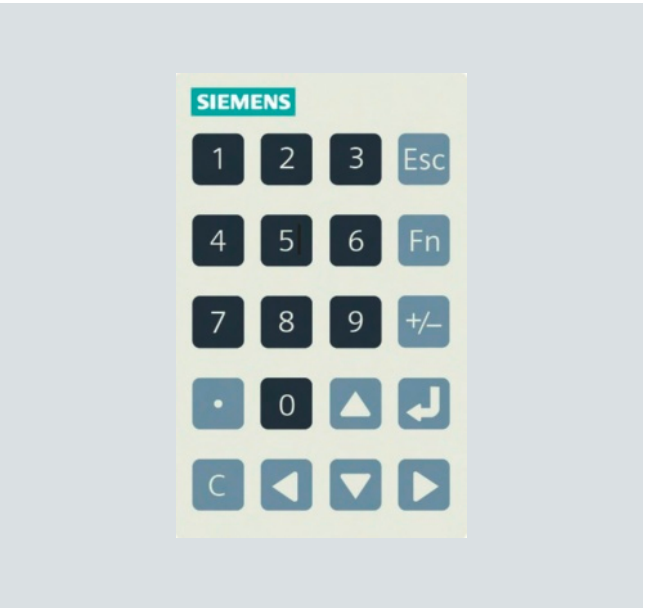
Only the stainless steel and borosilicate window flange of the sensor is wetted by the process gas. This has optional connections for purging the process gas side with an appropriate gaseous medium.

***Display and control panel***

Special features of the detector unit:

- Display for simultaneous output of result and device status
- LED backlighting of display
- Remote operation using membrane keypad and softkeys which are easy to clean
- Menu-driven operation for parameterization and diagnostics
- Remote operation via infrared interface for safe use in hazardous zones


Local user interface (LUI) of SITRANS SL in the detector unit (display of measured value)




Remote control keypad for SITRANS SL

***Connection cables***

SITRANS SL is supplied as standard without connecting cables. These must be provided by the customer or are available as accessories. Exception: the ATEX version is supplied as standard with cabling.

The sensor cable connects together the transmitter and detector units of the analyzer.

The sensor connecting cable available as a cable set for the ATEX version as standard, and for non-Ex applications optionally, is offered in lengths of 5, 10 or 25 m. This (optional) cable set also enables permanent installation of an Ethernet cable used for service and maintenance purposes.

A rugged cable sleeve should be used as UV protection for installations in open cable ducts or channel systems.

The statutory directives must be observed in the event of installation in hazardous areas.

For the ATEX version of SITRANS SL, the sensor connecting cable must be connected between the two Ex-e terminal boxes secured on the transmitter and receiver units.

***Inputs/outputs***

- 2 analog inputs (4 to 20 mA) for process gas temperature and pressure
- 2 analog outputs (4 to 20 mA) for gas concentration or for concentration and transmission
- 1 configurable binary input
- 2 configurable binary outputs (display of faults, maintenance requirement, function monitoring, alarms for limit violations of measured value or transmission)
- Optional: 1 PROFIBUS DP interface with:
  - Output of concentration as cyclic data
  - Alarm output, alarm classification
  - Input for temperature and/or pressure data for compensation

The PROFIBUS DP protocol provides DPV0, cyclic data. Measured values are provided with additional quality data.

Optional

- 1 MODBUS interface with
  - Output of concentration as cyclic data
  - Alarm output, alarm classification
  - Input for temperature and/or pressure data for compensation
- 1 Ethernet 10Base-TX port, only for servicing and maintenance

Note

In contrast to the other interfaces, the Ethernet plug-in connector on standard non-Ex devices is only accessible following removal of the detector unit cover. With the help of the sensor connection cable set (optional with non-Ex devices), an Ethernet cable can be permanently installed via the terminal box of the sensor connecting cable. The Ethernet connection via the sensor connecting cable can also only be used for temporary service and maintenance purposes.

NOTICE

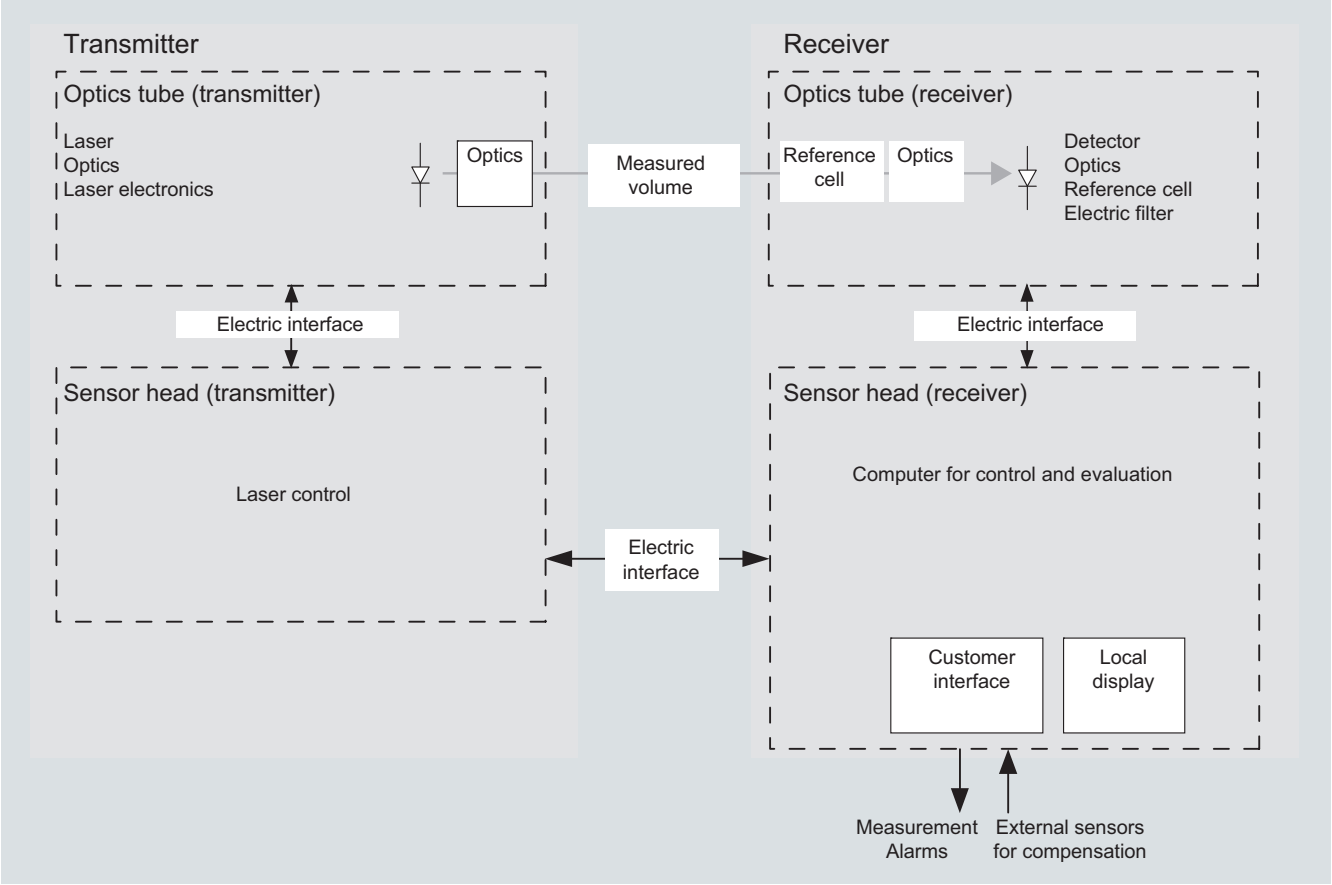
In an Ex environment, Ethernet connections may only be made or removed with the permission of the plant operator!



## Function

***Operating principle***

SITRANS SL is a gas analyzer employing single-line molecular absorption spectroscopy. A diode laser emits a beam of infrared light which passes through the process gas and is received by a detector unit. The wavelength of the laser diode output is tuned to a gas-specific absorption line. The laser continuously scans this single absorption line with a very high spectral resolution. The degree of absorption and the line shape are used for the evaluation. The measurement is free of cross-interferences, since the quasi-monochromatic laser light is absorbed very selectively by only one specific line in the scanned spectral range.

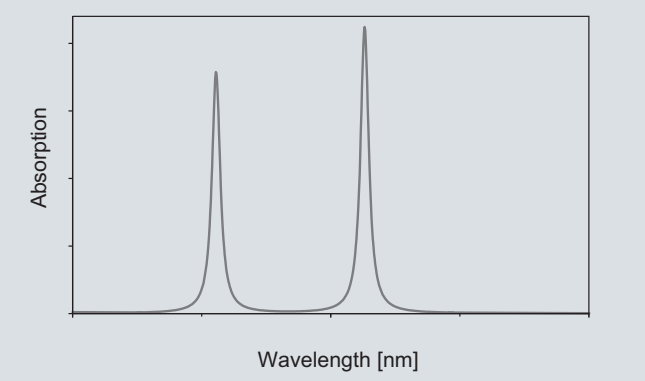



Basic design of the SITRANS SL

## In-situ O2 an CO gas analyzer

The field design of the SITRANS SL in-situ gas analyzer consists of a transmitter unit and a detector unit. The light which is not absorbed by the sample is detected in the receiver. The concentration of the gas component is determined from the absorption.

The SITRANS SL analyzer measures a single gas component by means of the absorption capacity of a single fully resolved molecular absorption line.




Absorption spectrum of measured signal and reference signal with SITRANS SL

SITRANS SL is designed for measuring oxygen ($O_2$) and carbon monoxide (CO) at high sensitivity.

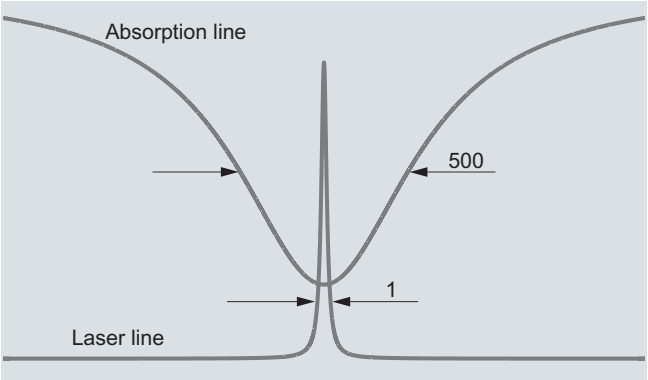
Typical application specifications:

| | |
|---|---|
| Oxygen concentration | 0 ... 21 vol % |
| Process pressure/temperature conditions (with $O_2$ application) | 700 ... 5 000 hPa (absolute)/0 ... 200 °C<br>900 ... 1 100 hPa (absolute)/0 ... 600 °C |
| Carbon monoxide concentration | Smallest measuring range: 0 … 100 ppm @ 1 m<br>Largest measuring range: 0 … 6 000 ppm @ 30 cm |
| Process gas pressure/temperature conditions with CO application | 700 … 2 000 hPa (absolute) / -20 … 300 °C<br>800 … 1 200 hPa (absolute) / -20 … 700 °C |

The measuring performance of the SITRANS SL depends, among others, on the actual, individual process conditions with regard to concentration ranges, pressure and temperature.

An internal reference cell is used to constantly check the stability of the spectrometer.

The self-calibration of the analyzer is therefore valid for at least one year without the necessity for external recalibration using calibration gases.

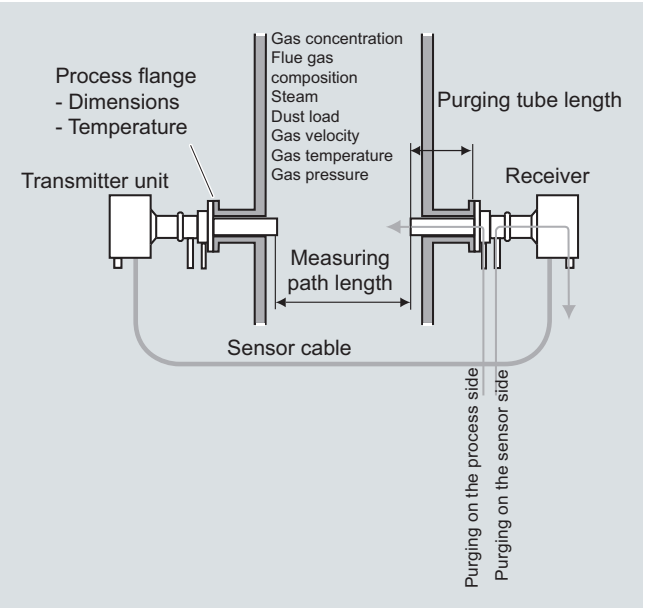



Typical spectral bandwidth of an absorption line compared to the bandwidth of the laser light.

Configuration

A feature of the in-situ analytical procedure is that the physical measurement takes place directly in the stream of process gas and directly in the actual process gas line. All process parameters such as gas matrix, pressure, temperature, moisture, dust load, flow velocity and mounting orientation can influence the measuring properties of the SITRANS SL and must therefore be investigated for each new application.

The standard applications listed in the ordering data for the SITRANS SL are distinguished in that the typical process conditions are adequately well-known and documented. If you cannot find your application among the standard applications, please contact Siemens. We will be pleased to check your possible individual application of the SITRANS SL. You can find an application questionnaire on the SITRANS SL product site on the Internet.




Typical cross-duct arrangement of the SITRANS SL

The SITRANS SL can be optionally purged on the process side using appropriate purging gases to prevent contamination of the sensor optics on the process side. Purging tubes on the sensor heads, which slightly extend into the process gas stream, define the effective measuring path length.

***Influences on the measurement***

Dust load

As long as the laser beam is able to generate a suitable detector signal, the dust load in the process gas does not influence the analytical result. By applying a dynamic background correction, measurements can be carried out without any negative impact. Under optimal conditions, the SITRANS SL can cope with dust loads up to 20 g/Nm$^3$ and up to a measured path length of 8 m. The influence of a high dust load is extremely complex, and depends on the optical path length and particle size. The optical damping increases exponentially at longer path lengths. Smaller particles also have a very large influence on the optical damping. With high dust load, long path length and small particle size, the technical support at Siemens should be consulted.

Temperature

The influence of temperature on the absorption line is compensated by a correction file. A temperature signal can be fed into the instrument from an external temperature sensor. The signal is then used for mathematical correction of the influence of the temperature on the observed line strength. If the process gas temperature remains constant, a static correction can be carried out as an alternative. Without temperature compensation, the relative error caused by changes in the gas temperature has an extensive effect on the measurement (e.g. up to 0.24 %/K with the $O_2$ application). An external temperature signal is therefore recommended in most cases.

Pressure

The process gas pressure can affect the line shape of the molecular absorption line. For known pressure values, the SITRANS SL uses a special algorithm to adapt the line shape. Additionally, an external pressure signal can be fed to the instrument to provide complete mathematical compensation for the pressure influence including the density effect. Without compensation, the relative error caused by changes in the process gas pressure is approx. 0.1 %/hPa. An external pressure signal is therefore recommended in most cases.

Interferences

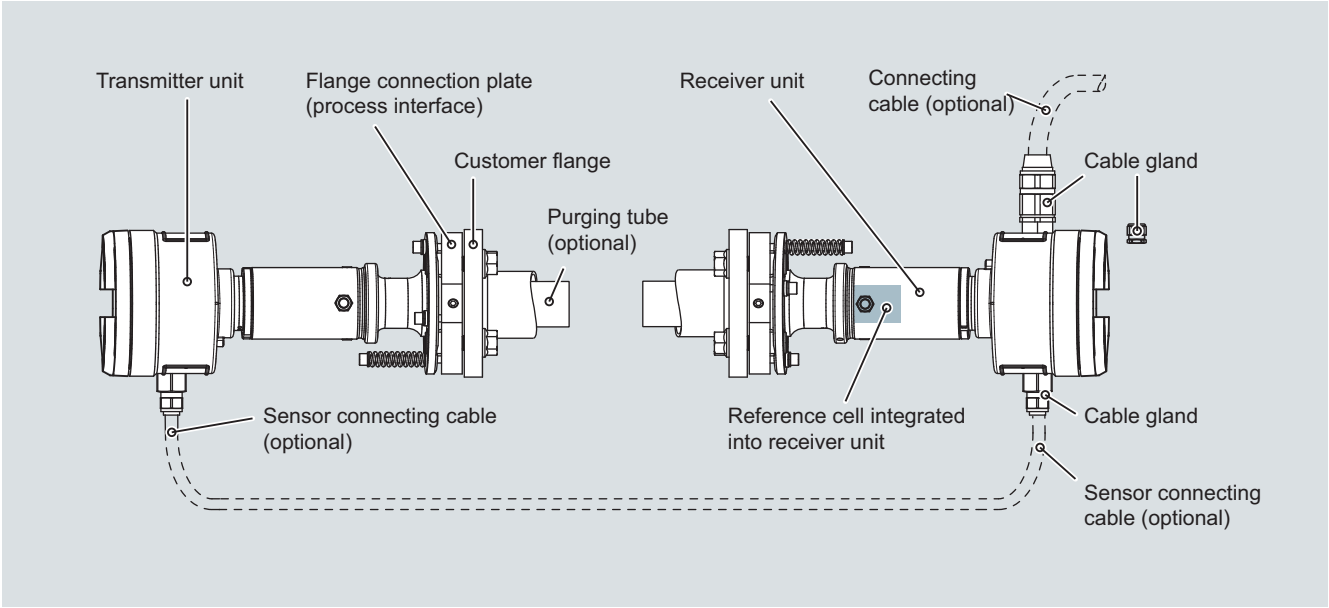
Since the SITRANS SL derives its signal from a single fully resolved molecular absorption line, interferences from other gases are quite unlikely. The SITRANS SL is therefore able to measure the desired gas components very selectively. In special cases, the composition of the process gas might have an influence on the shape of the absorption lines. This influence is compensated by analyzing the full shape of the detected signal curve applying specific algorithms.

Effective optical path length

As a result of Beer-Lambert's law, the absorption of laser light depends on the optical path length within the sample gas. Therefore the precision of the effective optical path length measurement can have an effect on the precision of the total measurement.

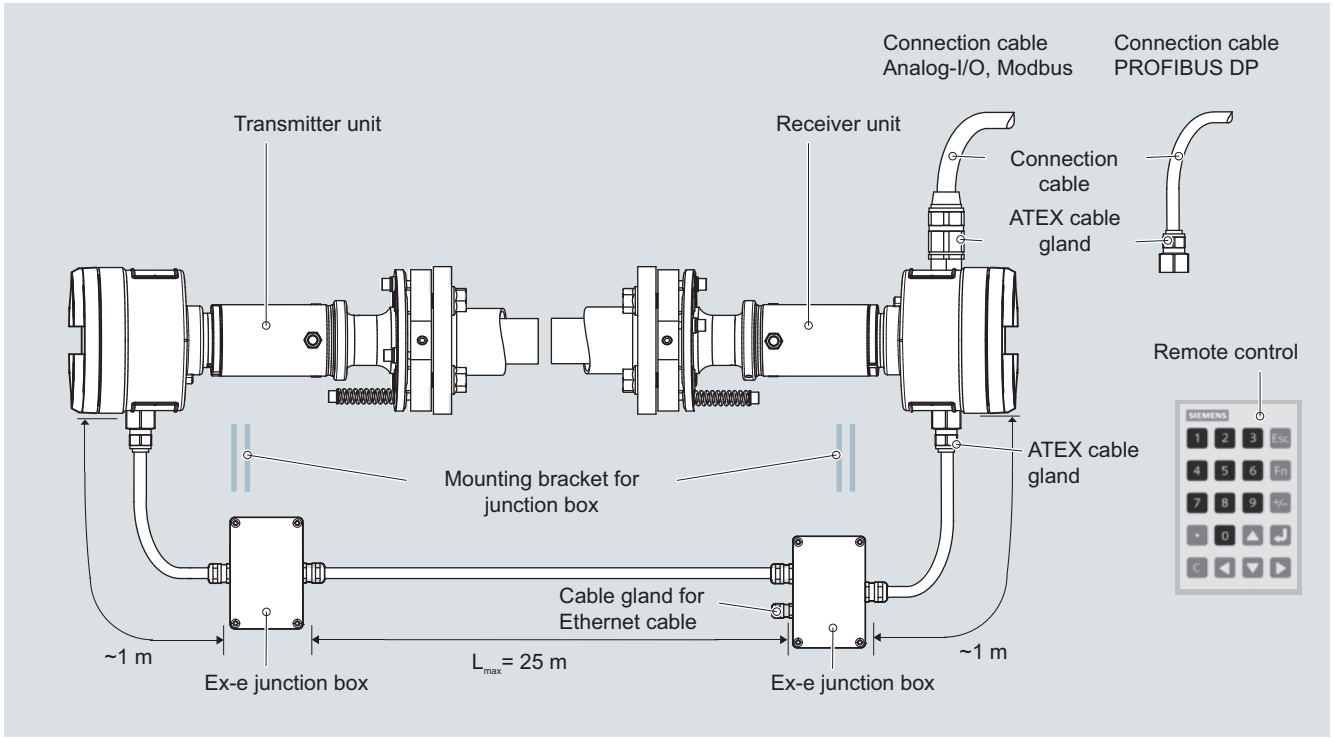
Since the sensor optics on the process side usually has to be purged to keep it clean for a longer period, the extent of the mixed zone between the purging medium and the process gas as well as the latter's concentration distribution must be considered. In a typical in-situ installation with an optical path length of several meters, the influence of the purging gas on the effective path length can be ignored.

The path length and dust load are mutually influencing: the higher the dust load in the process, the shorter the max. possible path length.

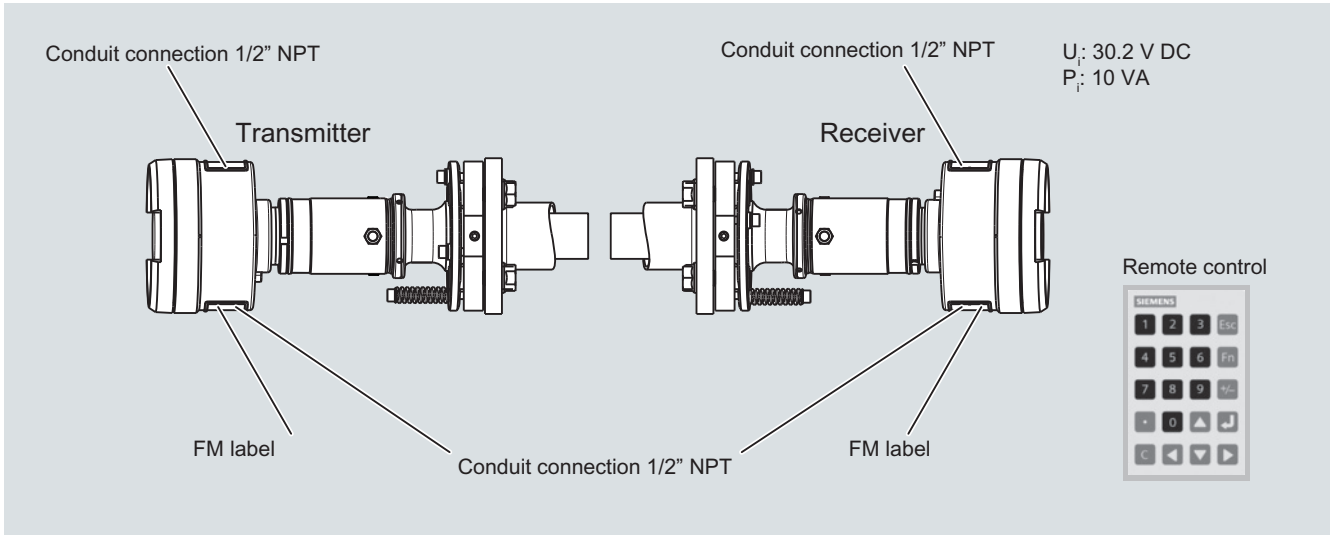



Design of the non-Ex version of the SITRANS SL system

## In-situ O2 an CO gas analyzer




Design of the ATEX version of the SITRANS SL system

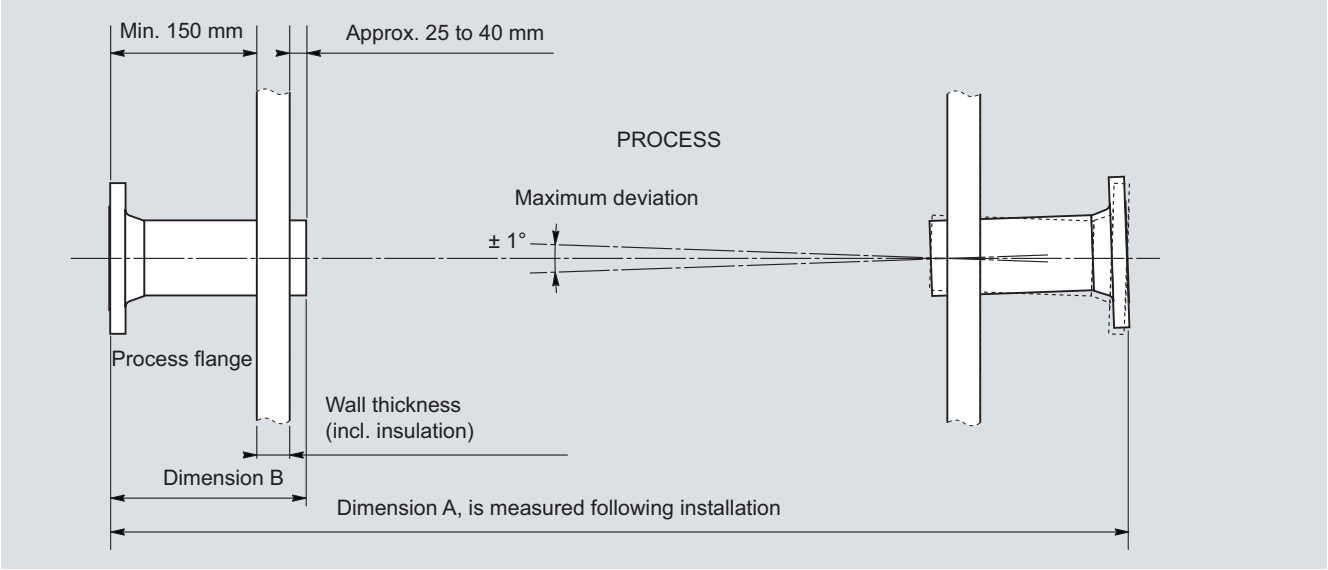



Design of the FM version of the SITRANS SL system

The transmitter and detector units are mounted on process flanges provided by the customer. Correct alignment of these flanges must be guaranteed, e.g. by using the optional sensor alignment kit.

Adjustment of the pair of sensors

The flange connection plates (process interface) of the SITRANS SL to the process flanges on the customer side must be correctly aligned so that the laser beam generated by the transmitter hits the photodetector in the detector unit This is guaranteed in that the transmitter and detector units have a curved surface integrated in the connection plates. The adjustment is carried out by shifting the flanges on these surfaces, through which the symmetry axis is aligned. The axis can be offset by ± 1 degree, which means that the process flanges must be welded onto the process wall with at least this accuracy - see following figure.




Installation/adjustment requirements for the pair of cross-duct sensors

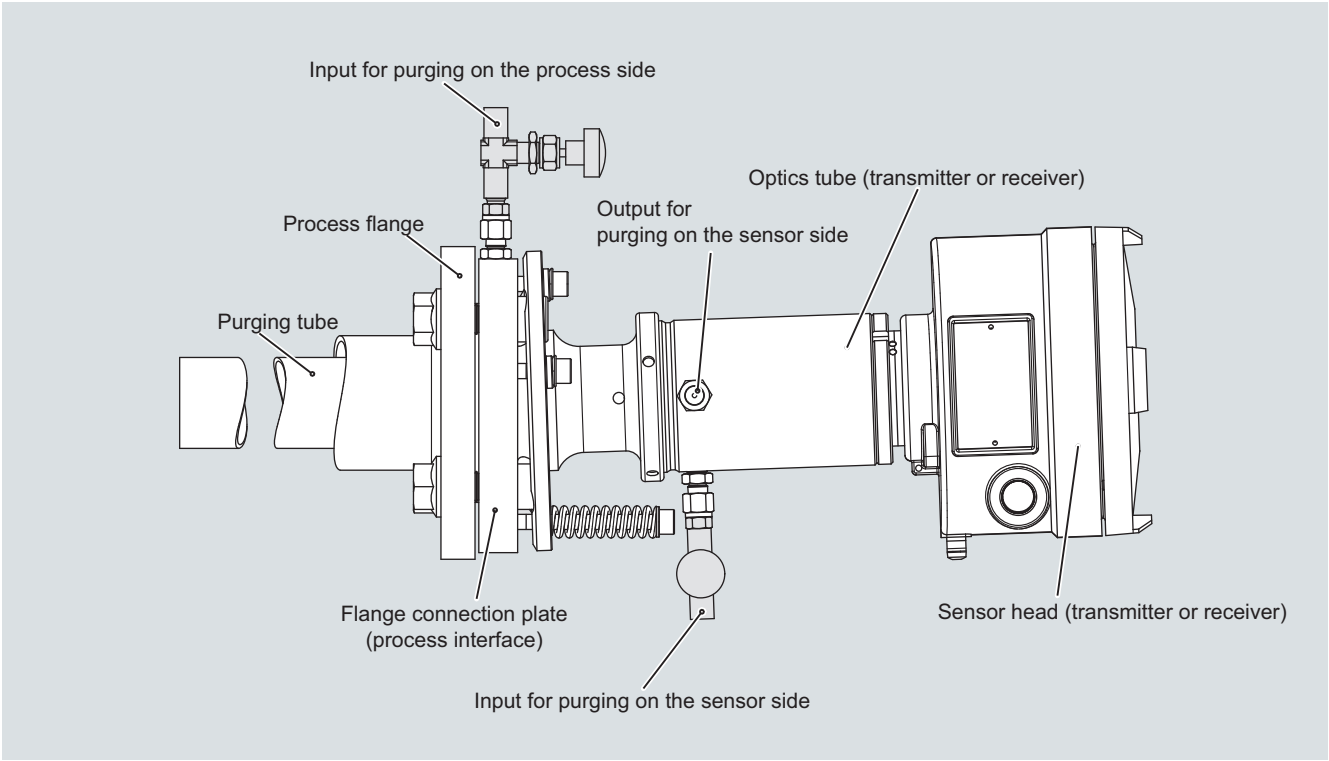
## In-situ O2 an CO gas analyzer



Purging

The easiest way to avoid condensation and dust deposits on the sensor windows or excessively high thermal load of the windows and the sealing material as well as the sensor electronics is to purge them (with $O_2$ application: nitrogen). Purging must be selected depending on the application. The transmitted-light sensors can therefore be configured for the respective situation. The application reference table provides recommendations for suitable purging for the standard applications.

If oxygen is to be measured with the SITRANS SL - which is also present in measurable quantities in the ambient air - oxygen-free purging gases must be used, such as nitrogen. It is equally necessary to purge the inside of the sensor heads, since the ambient air must also be displaced here out of the laser beam path. A differentiation is therefore made between purging on the process side and purging on the sensor side.




Arrangement for purging on the sensor side of the SITRANS SL

Purging on process side

For purging on the process side, the flow of purging gas can be adjusted between 0 and approx. 50 l/min at each sensor head using a needle valve (included in delivery).

Purging on sensor side

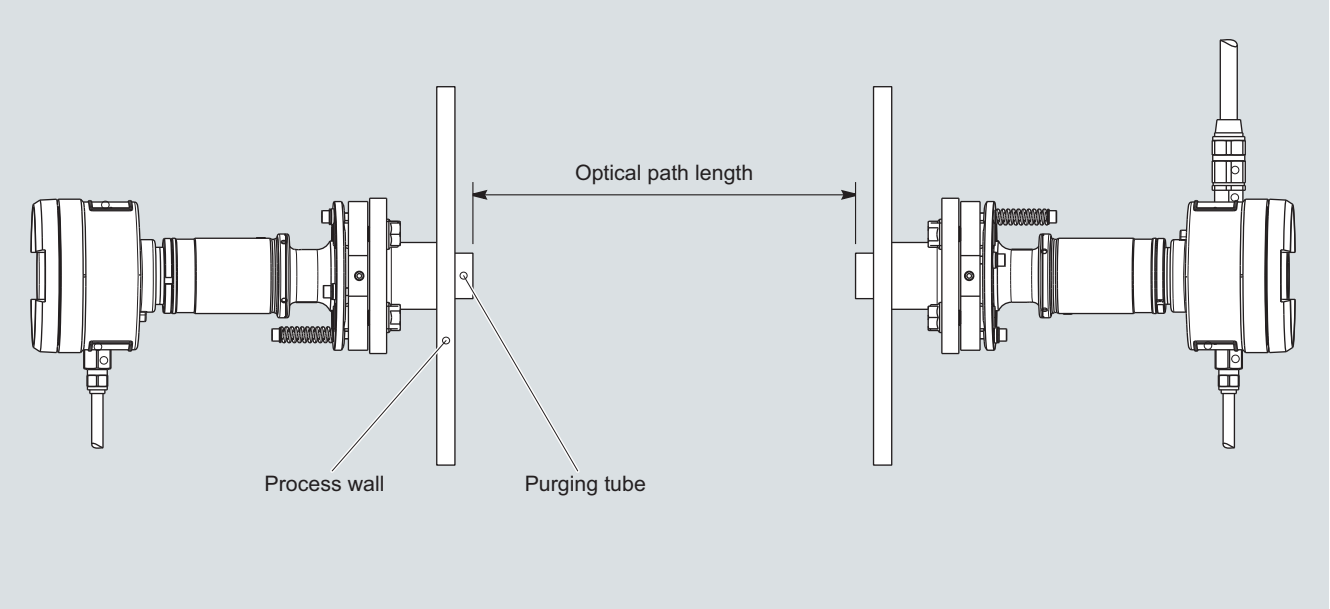
This can be combined with the purging on the process side, if required. Purging with nitrogen on the sensor side is almost always necessary for $O_2$ applications to avoid an offset caused by the oxygen of the air present in the unit. The cells in the sensor head are then continuously purged with nitrogen. Particularly when (re)starting the SITRANS SL $O_2$, a sufficiently high flow of purging gas of approx. 3 to 5 l/min must be provided for several minutes to ensure that all residues of oxygen are displaced. The flow of sensor purging gas can subsequently be set to a lower value using the needle valve (included in delivery).

Note

With purging on the process side, it may be necessary to use non-return valves to ensure no process gas can enter the purging gas line in the event of failure of the purging gas supply. This applies especially in the case of cascaded process and sensor purging where there is otherwise the danger that, for example, corrosive process gases could enter the sensor enclosure.

Purging tubes

The purging media used on the process side flow through purging tubes into the process gas stream. The tubes extend into the process area by a few centimeters, usually perpendicular to the process gas stream. This means that an exactly defined optical path length is defined through the sample gas. The effective measuring path in the process gas is therefore defined as the distance between the ends of the two purging tubes. The standard length of the purging tubes is 340 mm. To enable sufficient pivoting, the process wall should be max. 150 mm thick.




Measurement of the optical path length between the ends of the purging gas tubes

***Maintenance and fault messages***

The SITRANS SL carries out continuous self-monitoring, and outputs alarms and warnings to indicate maintenance requirements or a system fault. The information is output as plain text on the LUI display, where symbols identify the category and the severity of the fault.

Alarm categories:

- Maintenance (system must be cleaned or repaired)
- Process value (problem with external sensor, or process conditions outside the permissible range for SITRANS SL)
- Configuration (SITRANS SL is not correctly configured)

Severity:

- Fault (measurements could not be carried out)
- Warning (measurements may be inaccurate, or the system will soon shut down measuring mode if an intervention is not made)
- Advanced warning/information (measurements are carried out)

The two binary (relay) outputs can be configured freely for the alarm output.

The response of the analog outputs in the event of an alarm is configurable; possible actions are:

- Off (current measured value is displayed)
- Last measured value (freezing of last value displayed)
- Standard level (setting to predefined value)
- 3 mA (NAMUR NE43 fault status)

In addition, the transmission is available as an output variable.

Note

Specific requirements for the measuring point can make the utilization of special sensor equipment necessary. The possibilities for adapting the sensors are:

- Special materials for purging tubes (on request)
- Various types/sizes of sensor flanges
- Explosion-protected sensor configurations

***Essential characteristics***

- Long-term stability through use of an internal reference cell; calibration interval at least one year
- Dynamic background correction for varying dust loads
- Isolated signal outputs of 4 to 20 mA
- User-friendly, menu-driven operation
- Selectable time constants (response time)
- Password-protected user interface
- I/O operation in accordance with NAMUR recommendations
- Monitoring of overall optical transmission
- Sensor enclosure resistant to wear and corrosion
- Simple local operation using remote-control unit with numeric keypad and menu prompting

## In-situ O2 an CO gas analyzer

### Technical specifications

| | |
|---|---|
| **Analytical performance** | |
| Measuring range | Internally adjustable |
| Detection limit at standardized conditions:<br>25 °C gas temperature, 1 000 hPa, 1 m effective optical path length, 3 s integration time and constant ambient conditions. | $O_2$: 200 ppm<br>CO: 0.6 ppm |
| Linearity<br>(under standard conditions) | Better than 1 % |
| Repeatability<br>(under standard conditions) | $O_2$: 1 % of the measuring range<br>CO: 0.5 % of the measuring range |
| **General information** | |
| Design | Transmitter and detector units, connected by a sensor cable |
| Materials | • Sensor enclosure: treated aluminium/stainless steel<br>• Process interface: acid-resistant stainless steel<br>• Window: hardened borosilicate glass |
| Installation | In-situ or bypass |
| Concentration units | ppm, vol. %, mg/Nm$^3$ |
| Display | Digital concentration display (4 digits with floating decimal point) |
| Laser protection class | Class 1, safe to the eye |
| Explosion protection | Optionally, according to<br>• ATEX II 2G Ex de op is IIC T6<br>ATEX II 2D Ex tD A21 IP65 T85°C<br>• FM Class I, II, III Div 1 Groups A, B, C, D, E, F, G T6<br>FM Class I, Zn 1, AEx d IIC T6<br>FM Class II, Zn 21, AEx td T85°C |
| **Design, enclosure** | |
| Degree of protection | IP65 according to EN 60529 |
| Dimensions | For each unit (transmitter, detector)<br>• Diameter: 165 mm<br>• Length: 357 mm |
| Purging tube | Length, outer diameter, inner diameter:<br>340, 48, 44 mm |
| Weights | |
| • Detector unit | 6.0 kg |
| • Transmitter unit | 5.2 kg |
| • Process interface | |
| - for DN50/PN25 | 5.3 kg |
| - for ANSI4"/150 lbs | Approx. 12 kg |
| Connection dimension customer flange | DN 50/PN 25 or ANSI 4"/150 lbs |
| **Electrical characteristics** | |
| Power supply | 24 V DC nominal<br>(18 ... 30.2 V DC) |
| Power consumption, maximum | 10 VA |
| EMC | In accordance with EN 61326-1 |
| Electrical safety | In accordance with EN 61010-1 |
| Fuse specifications | T1.6L250V |

| | |
|---|---|
| **Dynamic performance** | |
| Warm-up time at 20 °C ambient temperature | Approx. 15 min |
| Response time (T90) | Approx. 2 s, depends on application |
| Integration time | 0 ... 100 s, selectable |
| **Influencing variables** | |
| Variations in ambient temperature | < 0.5 %/10 K of the measuring range |
| Process gas temperature | With compensation: < 1 %/100 K of the measuring range |
| Variations in ambient pressure | Negligible |
| Process gas pressure | $O_2$: With compensation:<br>< 1 %/4 000 hPa of the measuring range<br>CO: Negligible |
| Variations in supply voltage | Negligible |
| **Electrical inputs and outputs** | |
| Number of measurement channels | 1 |
| Analog outputs | 2 outputs, 4 ... 20 mA, floating, ohmic resistance max. 660 Ω<br>External isolating power supplies may have to be provided by the customer. |
| Analog inputs | 2 inputs, designed for 4 ... 20 mA, 120 Ω |
| Binary outputs | 2 outputs, with switchover contacts, configurable, 24 V/0.5 A, floating, single pole double throw (SPDT) |
| Binary input | 1 input, designed for 24 V, floating, configurable |
| Service port | Ethernet 10BaseT (RJ-45) |
| RS 485 PROFIBUS DPV0 version | Two-wire interface, up to 3 Mbit/s, -7 … 12 V |
| RS 485 MODBUS version | Two-wire interface, up to 115 200 bit/s, -7 … 12 V |
| **Cable to customer interface (not included in standard delivery, ATEX or optional)** | |
| Analog connection cable (with ATEX configuration: only supplied cables may be used!) | 10 x 2, with shielding in twisted-pair configuration (depending on type and number of I/Os used) |
| PROFIBUS DP connection cable (with ATEX configuration: only supplied cables may be used!) | 1 x 2 + 4 (PROFIBUS DP hybrid cable) |
| MODBUS connection cable (with ATEX configuration: only supplied cables may be used!) | 1 x 2 + 3, with shielding in twisted-pair configuration |
| Cable length for ATEX configuration | 3 m |
| Conductor cross-section | Min. 0.34 mm$^2$ |
| Cable diameter | 8 ... 12 mm or 13 ... 18 mm |
| Minimum bending radius ATEX-PROFIBUS | 110 mm |
| **Sensor cable (not included in standard delivery, ATEX or optional)** | |
| Sensor cable type | 4 x 2, with shielding, in twisted-pair configuration |
| Conductor cross-section | Min. 0.34 mm$^2$ |
| Cable sheath | PUR (polyurethane) |
| Dimensions | • Diameter: 11 mm<br>• Length: up to 25 m |
| Minimum bending radius | ATEX: 85 mm |

| | |
|---|---|
| **Climatic conditions** | |
| Ambient temperature range | • -20 ... +55 °C during operation (additional solar radiation not permissible!)<br>• -40 ... +70 °C during transport and storage |
| Temperature range on the sensor side of the process interface (connection plate) | -20 ... +70 °C |
| Atmospheric pressure | 800 ... 1100 hPa (for ATEX and FM version) |
| Humidity | < 100 % rel. humidity |
| **Measuring conditions** | |
| Measurement path | 0.3 ... 8 m (other lengths: please contact Siemens) |
| Process gas pressure, temperature | • $O_2$: 900 ... 1 100 hPa, 0 … 600 °C<br>• $O_2$: 700 … 5 000 hPa, 0 … 200 °C<br>• CO: 700 … 2 000 hPa, -20 … 300 °C<br>• CO: 800 … 1 200 hPa, -20 … 700 °C |
| Dust load | The influence of a high dust load is complex, and depends on the optical path length and particle size distribution. |
| **Purging** | |
| Purging gas | • Oxygen (for $O_2$ and CO applications)<br>• Instrument air (for CO applications) |
| • Quality | $O_2$ application: Purity better than 99.7 % in order to achieve full performance. For oxygen measurements, an $O_2$ content < 0.01 vol. % in the purging gas is recommended. |
| • Dew point | < -10 °C, condensation on the optics must be avoided |
| Sensor purging | |
| • Max. overpressure in the sensor | 500 hPa |
| • Purging gas temperature on sensor side | 0 ... +55 °C |
| • Flow | $O_2$ application: When commissioning a sensor enclosure previously filled with air: 3 ... 5 l/min (for at least 15 min), subsequently: at least 0.25 l/min |
| Purging on process side (optional) | |
| • Pressure at purging gas inlet | 2 000 ... 8 000 hPa |
| • Flow | Dependent on process gas pressure, process gas velocity, dust load, moisture, etc. up to max. 50 l/min |

## In-situ O2 an CO gas analyzer

### Accessories

***SITRANS SL sensor alignment kit***

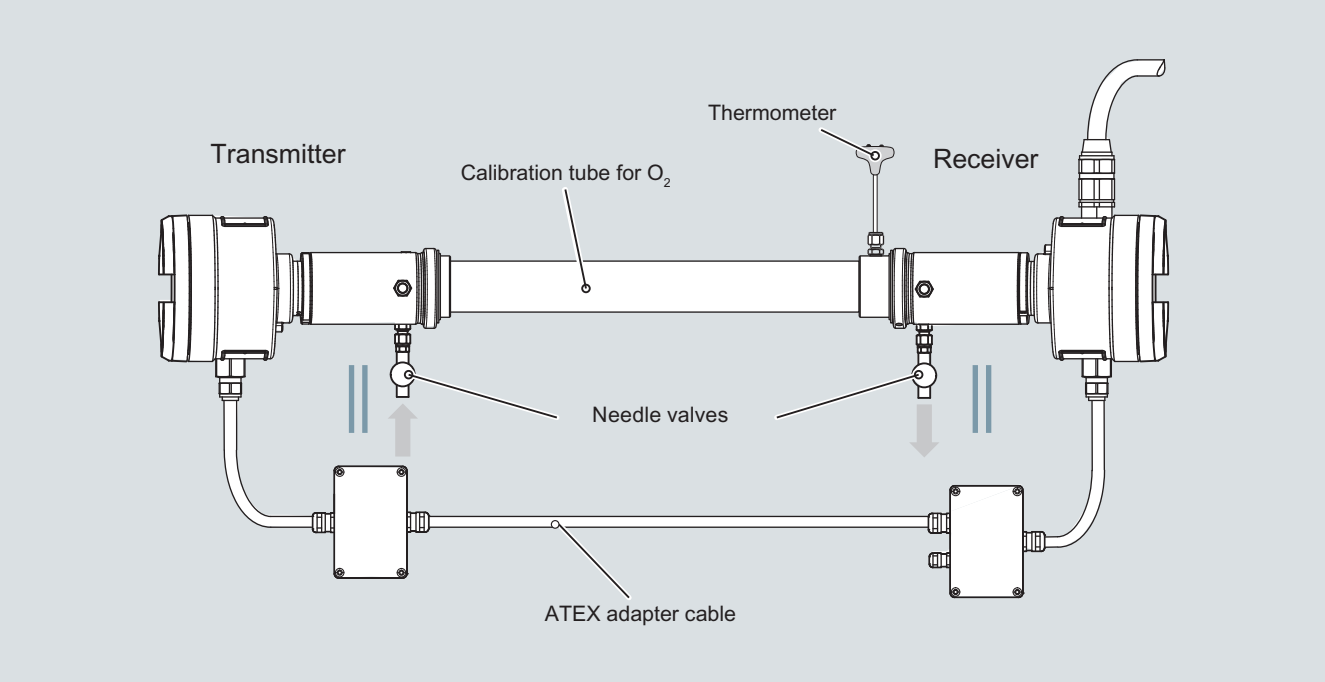
The SITRANS SL sensor alignment kit includes a battery-operated lamp, a centering aid with crosshair, and two hook spanners for loosening the sensors from the flange connection plates.

Please note

The SITRANS SL sensor alignment kit is not explosion-protected! Therefore it must never be used in a hazardous area without approval by the plant operator!

***Calibration test kit***

The SITRANS SL has already been factory-calibrated. If it is desirable or necessary to check the calibration, this can be performed using an external calibration test kit following removal of the transmitter and detector units. This procedure has no influence on the optical adjustment of the unit since the flange connection plates remain mounted on the customer flange. The calibration test kit for $O_2$ consists of a stainless steel calibration tube and a thermometer. To carry out the calibration, it is mounted between the transmitter and receiver. The calibration tube for $O_2$ can then be filled with air or a calibration gas.



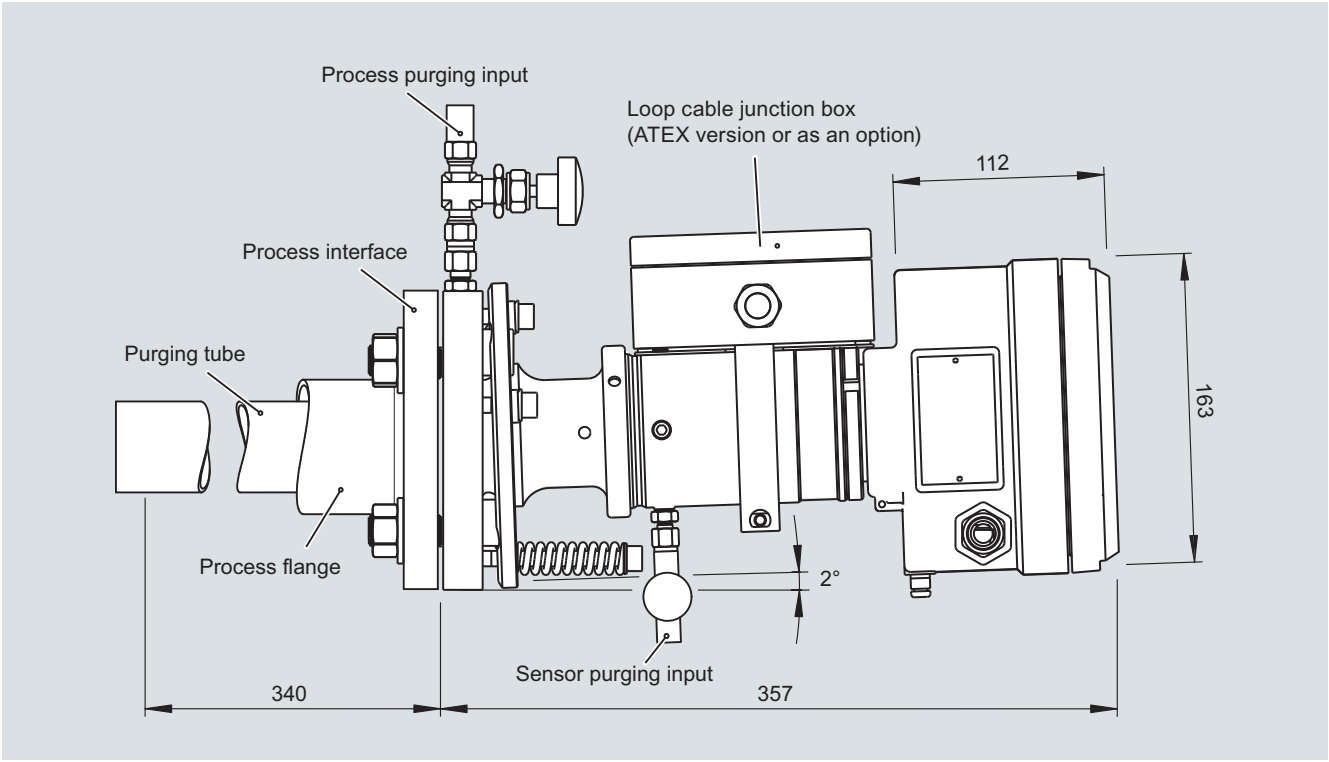

Calibration setup of SITRANS SL $O_2$

## Dimensional drawings

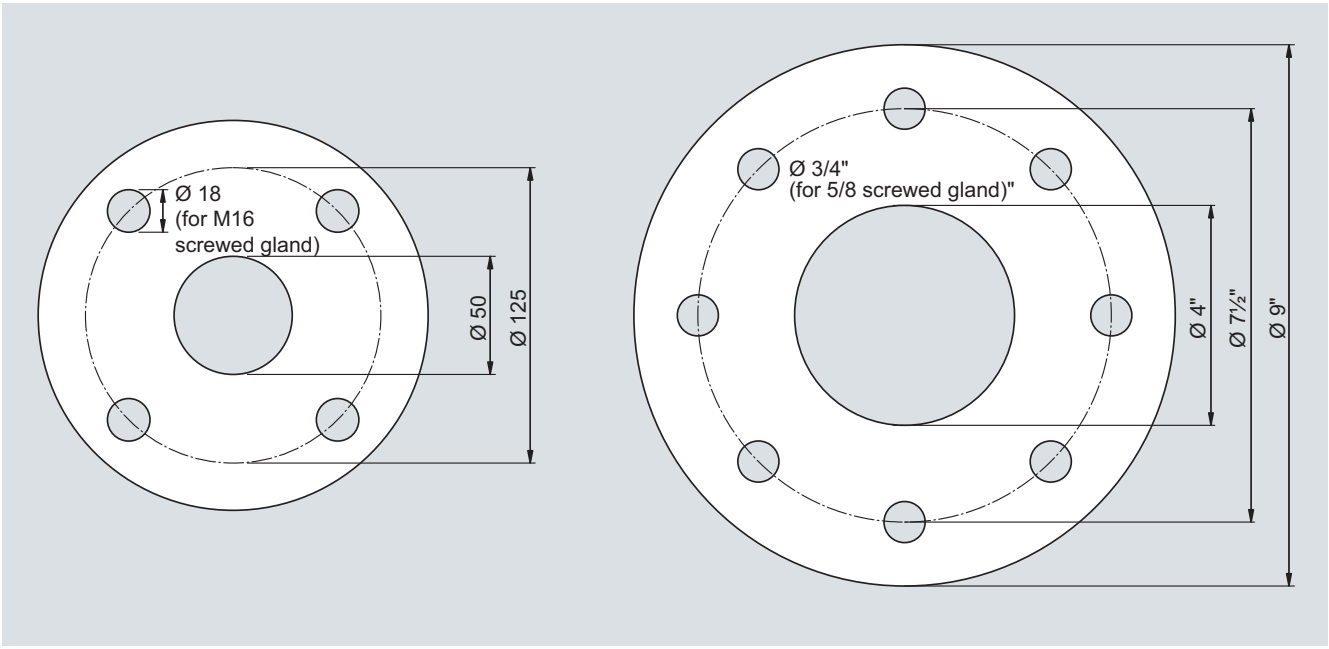
***Note***

The SITRANS SL sensors must be accessible from the side. A space of at least 60 cm must be provided next to the SITRANS SL transmitter and detector units in order to facilitate maintenance and servicing.

To fulfill the safety requirements, a space of at least 10 cm must be provided around the SITRANS SL to facilitate cooling.




SITRANS SL, transmitter/detector unit (same housing for DN50/PN25 process interface version), dimensions in mm




Connection dimensions of process flanges provided by customer DN50/PN25 and ANSI 4"/150 lbs

## In-situ O2 an CO gas analyzer

### Schematics

***Electrical connections***

Non-EEx version: connection cable - customer interface

| Terminal block in the receiver enclosure | | | Function/voltage | Ethernet cable |
|---|---|---|---|---|
| 1 | + | | Power supply<br>19 … 30.2 V, 10 VA[1] | |
| 2 | - | | | |
| 3 | Normally closed under power[4] | | Binary output 0 (relay)<br>30 V, 0.5 A[3] | |
| 4 | | | | |
| 5 | Normally closed under power[4] | | Binary output 1 (relay)<br>30 V, 0.5 A[3] | |
| 6 | | | | |
| 7 | + | | Binary input 0<br>0 … 30 V[2] | |
| 8 | - | | | |
| 9 | + | | Analog output 0 (measurement)<br>30 V, 24 mA[3] | |
| 10 | - | | | |
| 11 | + | | Analog output 1 (measurement)<br>30 V, 24 mA[3] | |
| 12 | - | | | |
| 13 | PROFIBUS A line (RxD/TxD_N - data inverted) | MODBUS D1 (RxD/TxD_N - data inverted) | RS 485<br>(PROFIBUS/MODBUS)<br>-7 ... +12 V DC | |
| 14 | PROFIBUS B line (RxD/TxD_P - data not inverted) | MODBUS D0 (RxD/TxD_P - data not inverted) | | |
| 15 | PROFIBUS/MODBUS shield | | | |
| 16 | $T_x$+ | | Ethernet[5] | White/orange |
| 17 | $T_x$- | | | Orange |
| 18 | $R_x$+ | | | White/green |
| 19 | $R_x$- | | | Green |
| 20 | + | | Analog input 0 (temperature)<br>0 … 30 mA[2], 120 Ω | |
| 21 | - | | | |
| 22 | + | | Analog input 1 (pressure)<br>0 … 30 mA[2], 120 Ω | |
| 23 | - | | | |
| 24 | | | Grounding | |
| 25 | | | Grounding | |
| Ground | | | Grounding | |
| Ground | | | Grounding | Shielding |

1) This is the maximum power consumption of the SITRANS SL

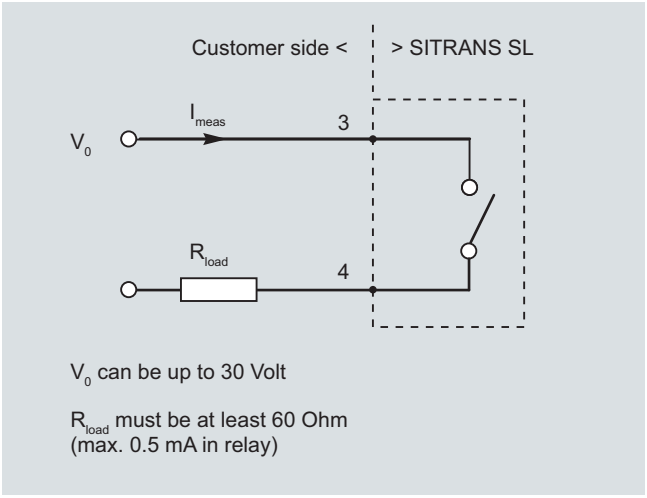
2) These are the maximum input values

3) These are the maximum output values

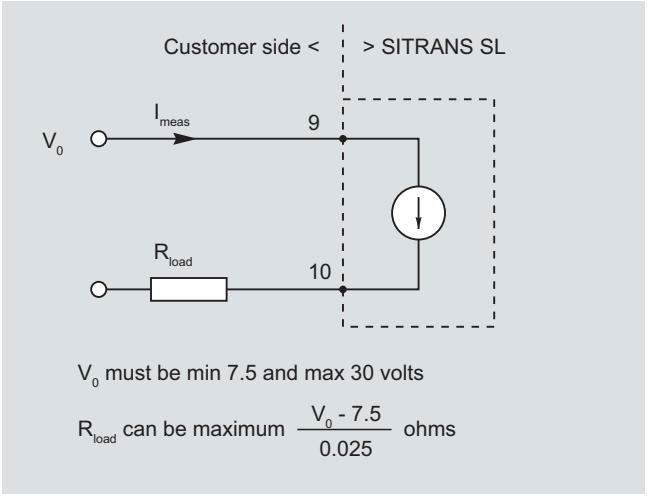
4) Note:
"Normal operation" stands for normal operation of the analyzer. The system is connected to the voltage source and is running without problems; no error message generated or displayed.
"Normal under power" refers to the status of the relay under the above-named normal operation. The relay contact of the alarm signal is closed.

5) We recommend that the Ethernet connection is not made via the cable to the Ethernet terminals in the detector unit. Instead, the Ethernet connection should be made via the sensor cable connection set which is optionally available for the detector unit.

Examples of digital output and analog output




Example of digital output 0




Example of analog output 0

Caution:

Please note that an external isolating power supply may be required!

Sensor cable terminal box on the receiver side (ATEX version)

| Terminal strip in terminal box | | Function | Color code |
|---|---|---|---|
| 1 | + | 24 V DC voltage supply for transmitter unit | Red |
| 2 | - | | Blue |
| 3 | Com + | Communication with transmitter | Pink |
| 4 | Com - | | Gray |
| 5 | Sync + | Synchronization with transmitter | White |
| 6 | Sync - | | Brown |
| 7 | NC | Not used | - |
| 8 | Tx+ | Ethernet | Gray/pink |
| 9 | Tx- | | Red/blue |
| 10 | Rx+ | | Black |
| 11 | Rx- | | Violet |
| PE terminal | - | Grounding | Green |
| PE terminal | | Grounding | Yellow |
| Gland | | Grounding | Shielding |

# SITRANS SL

## In-situ O2 an CO gas analyzer



| Selection and ordering data | | Order No. | |
|---|---|---|---|
| **SITRANS SL in-situ gas analyzer** | C) | **7MB6221-** ■■■■■ - ■■■■ | Cannot be combined |
| **Explosion protection** | | | |
| Without | | 0 | 0 |
| ATEX II 2G Ex de op is IIC T6<br>ATEX II 2D Ex tD A21 IP65 T85°C | | 1 | 1 |
| FM Class I, II, III Div 1 Groups A, B, C, D, E, F, G T6<br>FM Class I, Zn 1, AEx d IIC T6<br>FM Class II, Zn 21, AEx td T85°C | | 2 | 2 |
| **Measured component** | | | |
| $O_2$ | | A | A |
| CO | | J | J |
| **Application examples**[1] | | | |
| Control of combustion processes | | B | B B |
| Process control, safety monitoring in appropriate plant concepts | | C | |
| **Communication interface** | | | |
| Analog | | 0 | |
| PROFIBUS DP | | 1 | |
| MODBUS | | 2 | |
| **Purging tubes, material** | **Length** | | |
| No purging tubes | | 0 | |
| Stainless steel | 340 mm | 1 | |
| **Purging mode, process side** | **Sensor side** | | |
| No purging | No purging | 0 | |
| No purging | 3 ... 5 l/min | 1 | 1 |
| 0 ... 50 l/min | No purging | 2 | 2 |
| 0 ... 50 l/min | 3 ... 5 l/min | 3 | |
| **Process interface** | | | |
| Interface ANSI 4" 150 lbs (EN 1.4404/316L) | | B | |
| Interface DN50/PN25 (EN 1.4404/316L) | | C | |
| **Sensor cable** | **Length** | | |
| Standard length | 5 m | A | A A |
| | 10 m | B | B B |
| | 25 m | C | C C |
| Without cable | | X | X |
| **Documentation language** | | | |
| German | | 0 | |
| English | | 1 | |
| French | | 2 | |
| Spanish | | 3 | |
| Italian | | 4 | |

| Selection and ordering data | Order code |
|---|---|
| ***Additional versions*** | |
| Add "-Z" to Order No. and specify order code | |
| Acceptance test certificate 3.1 (leak test) in accordance with EN10204 | **C12** |
| TAG label, customized inscription | **Y30** |

C) Subject to export regulations AL: N, ECCN: EAR99

[1] The examples shown represent possible applications where appropriately configured SITRANS SL solutions can be used. The user is responsible for the prevailing conditions (plant concept (possibly redundant), application of appropriate components required in addition, compliance with possible directives, etc.).

## In-situ O2 an CO gas analyzer

### Selection and ordering data

| *Additional units* | | Order No. |
|---|---|---|
| Calibration verification kit $O_2$, SITRANS SL | | **A5E01000694** |
| Calibration verification kit CO, SITRANS SL | | **A5E03090938002** |
| SITRANS SL sensor alignment kit | | **A5E01000740** |
| EEx junction box for 25-wire cable | | **A5E01267567** |
| Cable set analog (for non-Ex SITRANS SL) | C) | **A5E03328474** |
| Cable set PROFIBUS DP (for non-Ex SITRANS SL) | C) | **A5E03328473** |
| UV protective hose for outdoor use, ND = 48 mm, per 30 m | | **A5E01714061** |
| Sensor connecting cable set | | |
| • 25 m | F) | **A5E02528052** |
| • 10 m | F) | **A5E02528048** |
| • 5 m | | **A5E02509347** |
| *Spare parts* | | |
| Process interface for DN50/PN25 including gaskets | | **A5E01009881** |
| Process interface for ANSI 4"/150 lbs including gaskets | | **A5E01009883** |
| Purging tube 340 mm including gasket for DN50/PN25 | | **A5E01009892** |
| Cover for SITRANS SL transmitter housing | | **A5E02568437** |
| Window cover of receiver housing | | **A5E01009897** |
| Union nut SITRANS SL | | **A5E01010033** |
| Gasket for DN50 PN25 | | **A5E02522036** |
| Gasket for ANSI 4'' 150 lbs | | **A5E02789535** |
| Analog cable | | **A5E02608597** |
| PROFIBUS cable | | **A5E02608594** |
| Sensor cable connection set for transmitter side | | **A5E02568463** |
| Sensor cable connection set for receiver side | | **A5E02568465** |
| Non-Ex cable gland for SITRANS SL | | **A5E02568457** |
| Sensor cable for SITRANS SL, R1.1 and higher, 5 m long | C) | **A5E02571180** |
| Sensor cable for SITRANS SL, R1.1 and higher, 10 m long | C) | **A5E02571184** |
| Sensor cable for SITRANS SL, R1.1 and higher, 25 m long | C) | **A5E02571186** |
| Needle valves for SITRANS SL | | **A5E02569944** |
| Spare capillary tubes for SITRANS SL | | **A5E02183375** |
| Ex-e connection box for 7-pole SITRANS SL cable | | **A5E02091532** |
| Remote control for SITRANS SL, IS, CSA, FM, ATEX certified | | **A5E02091214** |

C) Subject to export regulations AL: N, ECCN: EAR99

F) Subject to export regulations AL: N, ECCN: EAR99H

## Documentation

### Selection and ordering data

| Manual | Order No. |
|---|---|
| SITRANS SL manual | |
| • German | **A5E01132949** |
| • English | **A5E01132948** |
| • French | **A5E01132951** |
| • Italian | **A5E01132952** |
| • Spanish | **A5E01132953** |

## Notes