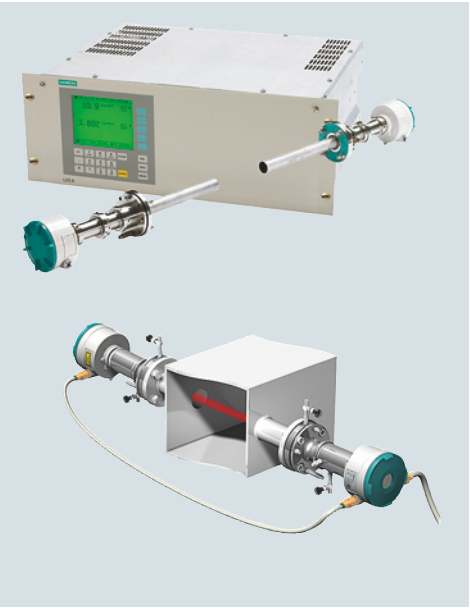
In situ continuous process gas analysis



Overview

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 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, 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 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.

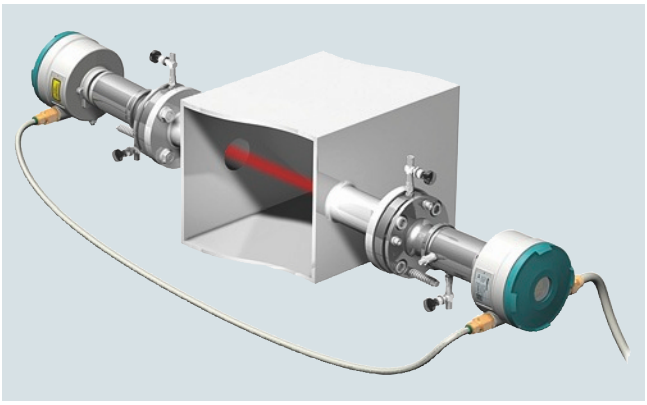
The list of gas components measurable using NIR diode laser technology already comprises:

- For the LDS 6 analyzer:
  - NH_3, HCl, HF, H_2O, CO, CO_2
  - More gas components on request
- For the SITRANS SL analyzer:
  - O_2

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



SITRANS SL

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.

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

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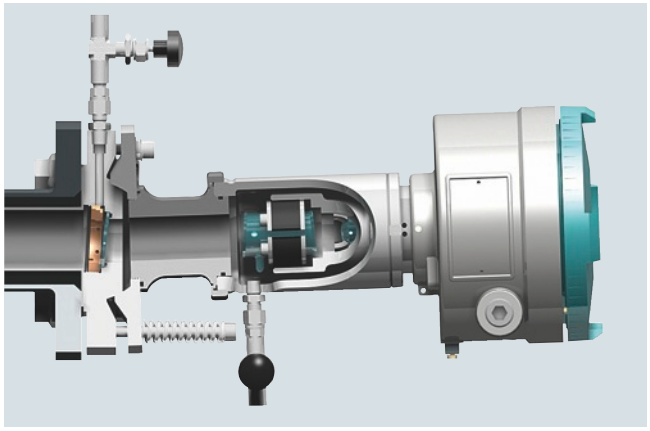
Design

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
  - Ex II 2G Ex de op is IIC T6
    Ex II 2D Ex tD A21 IP65 T85°C



SITRANS SL, detector unit

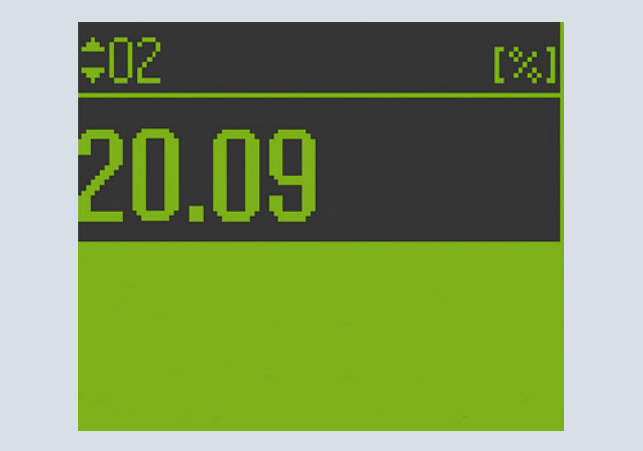
Parts in contact with the process gas

Only the stainless steel flange of the sensor with borosilicate window and FFKM seal comes in contact with the process gas. This has optional connections for purging the process gas side with an appropriate gaseous medium.

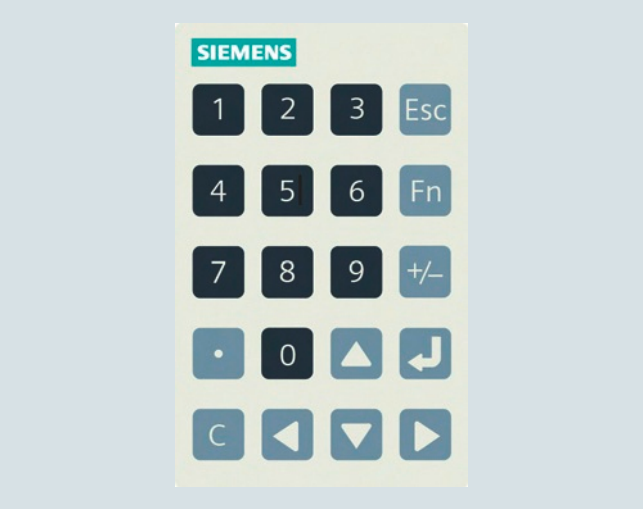
Display and control panel

Special features of the detector unit:

- Display for simultaneous output of result and device status
- LED backlighting of display
- Remote control with infrared interface for simplified configuration and operation for safe implementation in hazardous areas
- Menu-driven operation for parameterization and diagnostics



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 standard ATEX version is supplied with pre-installed 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 digital input
- 2 configurable digital outputs (display of faults, maintenance requirement, function monitoring, alarms for limit violations of measured value or transmission)
- 1 Ethernet 10Base-TX port, only for servicing and maintenance

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 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.

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 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 cable can also only be used for temporary service and maintenance purposes.

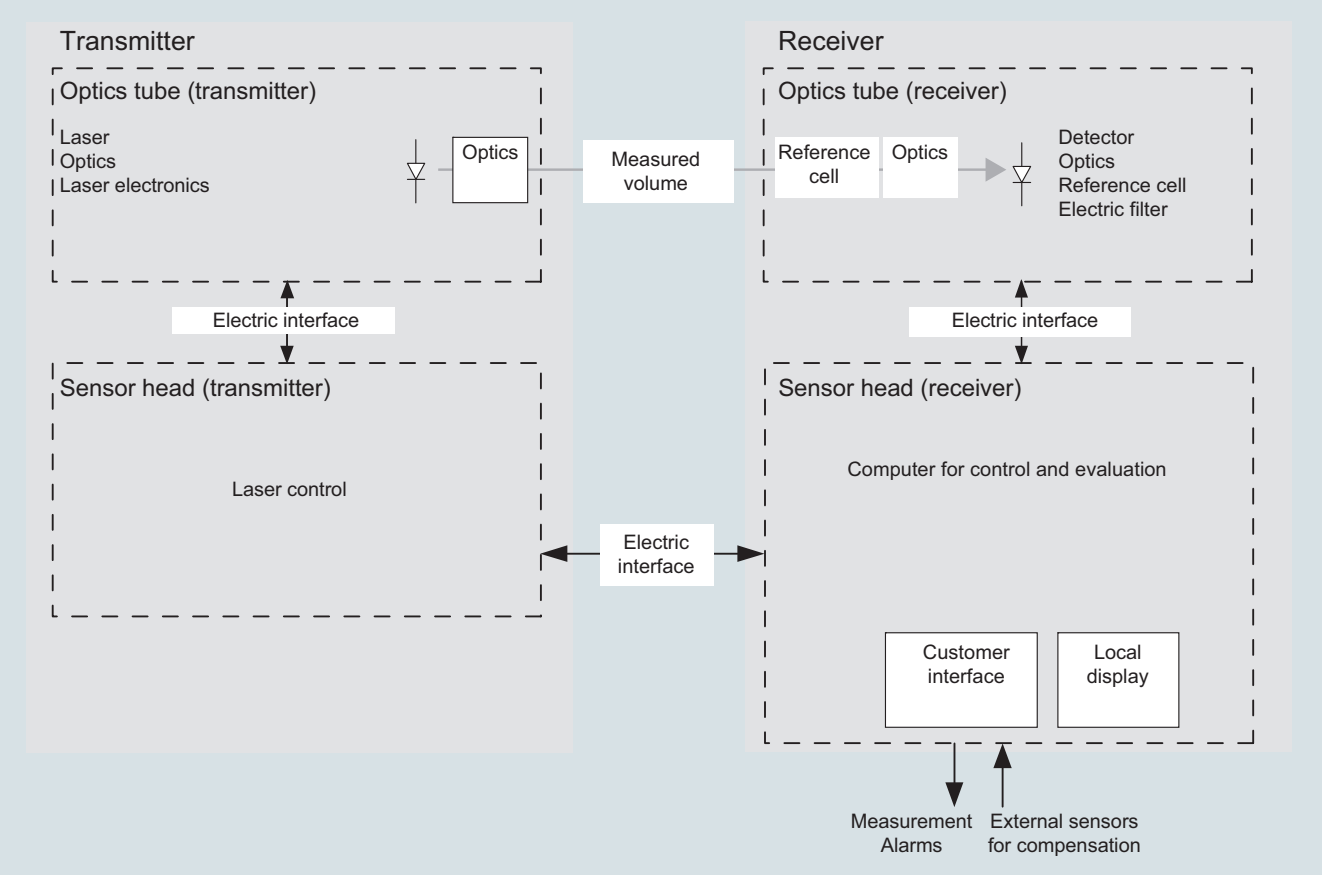
NOTICE:

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.

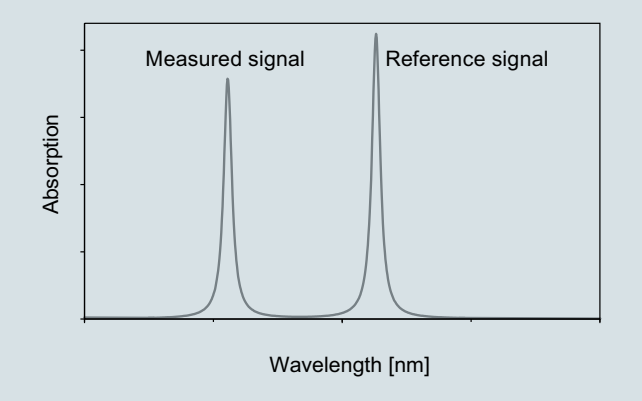


Basic design of the SITRANS L

In situ O2 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) with high sensitivity.

Typical application specifications:

Oxygen concentration	0 ... 100 vol %
Process pressure/temperature conditions (with O_2 application)	700 ... 5 000 hPa (absolute)/ 0 ... 200 °C
	900 ... 1 100 hPa (absolute)/ 0 ... 600 °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.

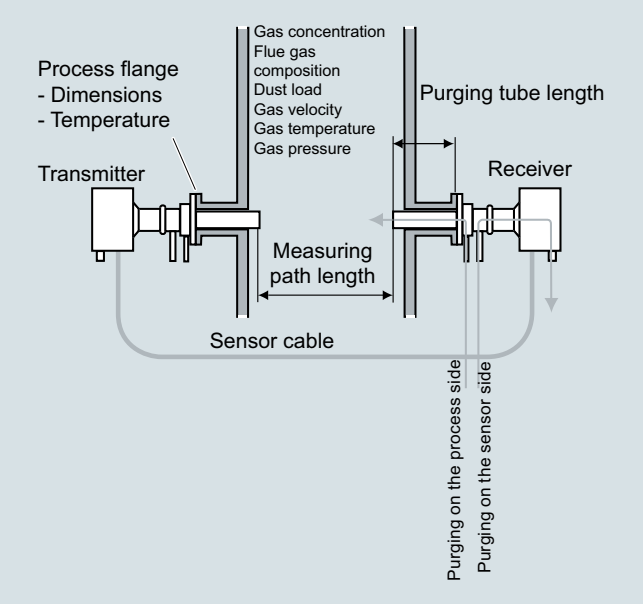
An internal reference cell is used to constantly check the stability of the spectrometer.

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

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 website for the SITRANS SL:
http://www.siemens.com/insituquestionnaire



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/Nm³ 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 attenuation increases exponentially at longer path lengths. Smaller particles also have a very large influence on the optical attenuation. 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 concentration 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

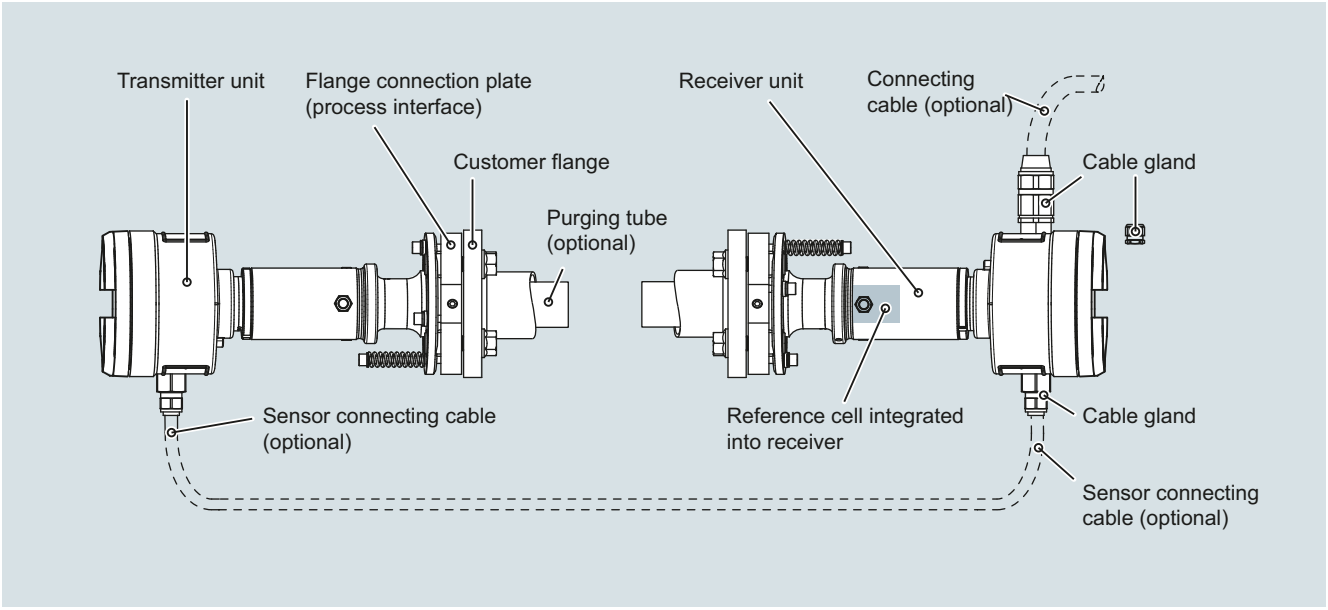
In addition to the temperature signal, an external pressure signal can be fed to the instrument to provide complete mathematical compensation for the pressure influence including the density effect. Without compensation, the relative error caused by changes in the process gas pressure is approx. 0.1 %/hPa. An external pressure signal is therefore recommended in most cases.

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.

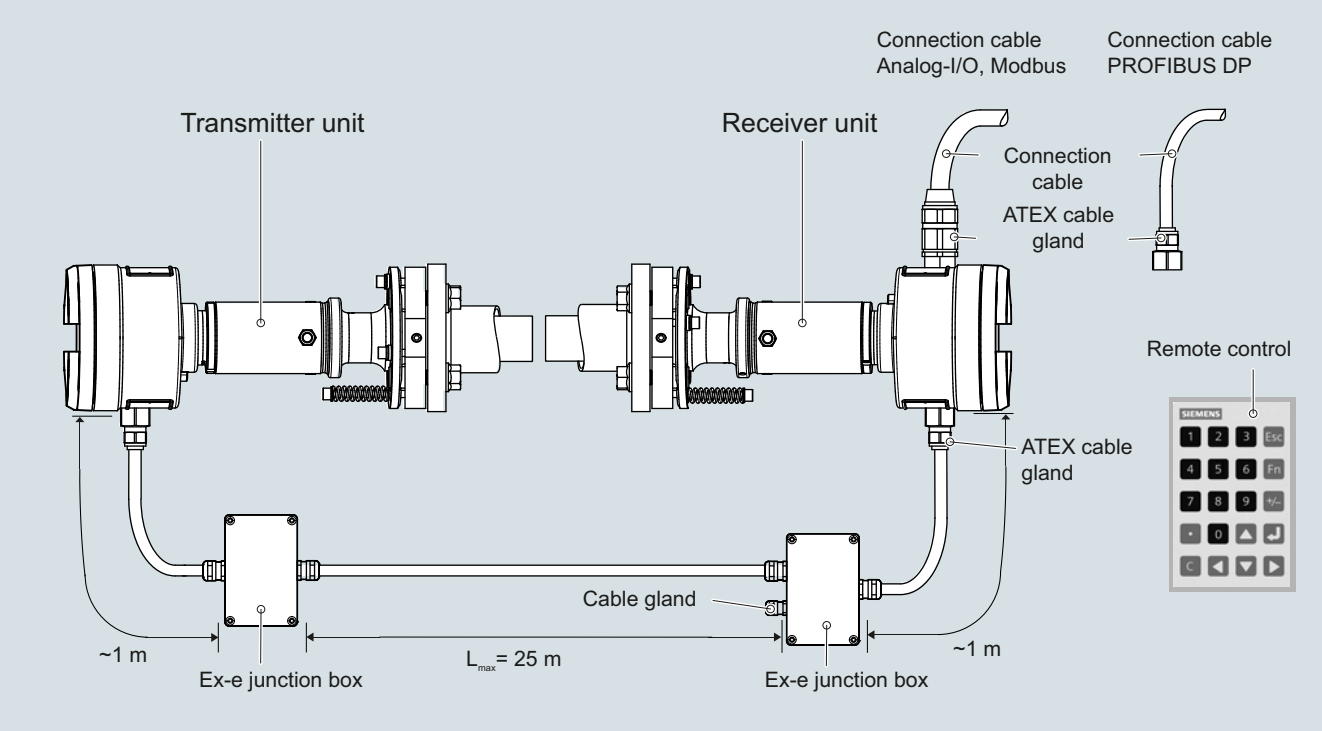
Since the sensor optics on the process side usually has to be purged to keep it clean for a longer period, the extent of the mixed zone between the purging medium and the process gas as well as the latter's concentration distribution must be considered. In a typical in-situ installation with an optical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

The maximum possible path length and dust load mutually affect each other: the higher the dust load in the process, the shorter the max. possible path length.

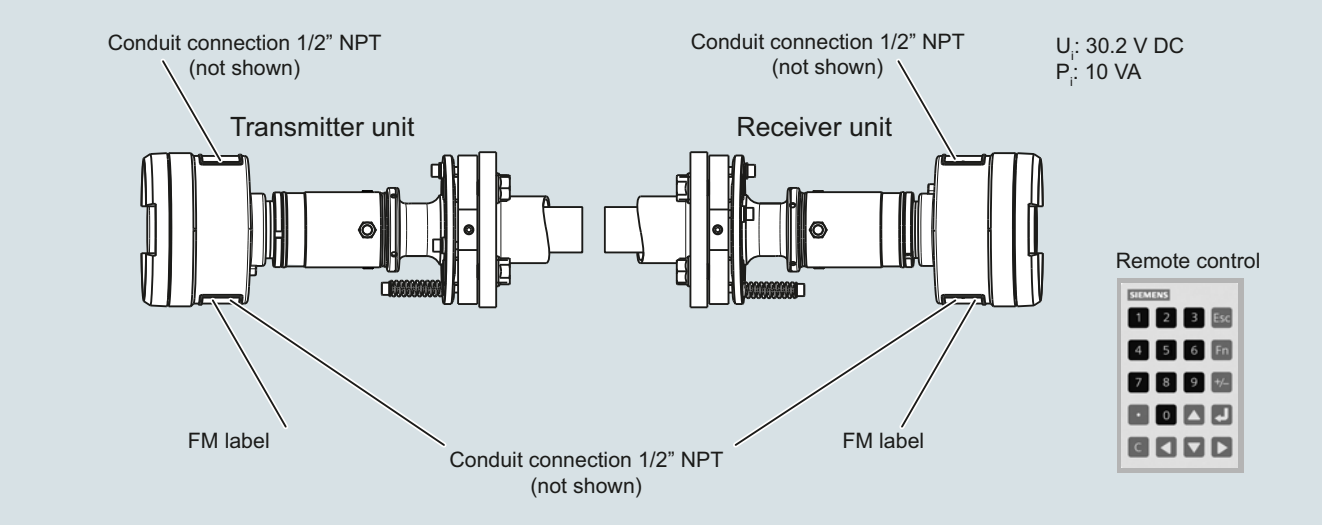


Design of the SITRANS SL system in non-Ex version

In situ O2 gas analyzer



Design of the SITRANS SL system in ATEX version

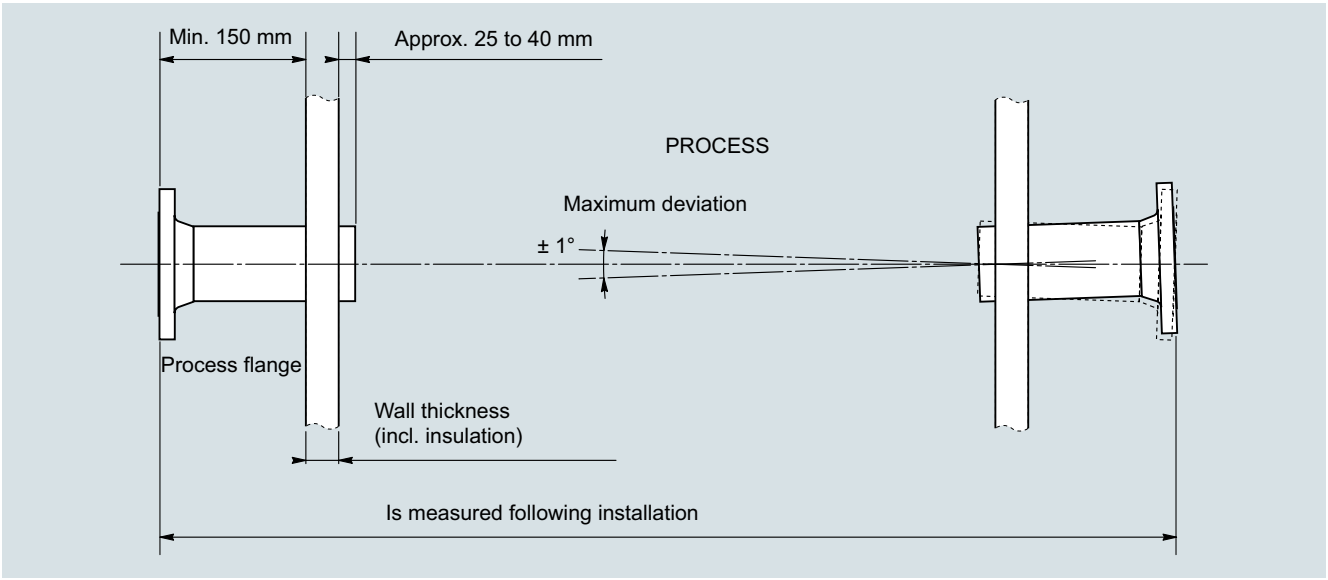


Design of the SITRANS SL system in FM version

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.



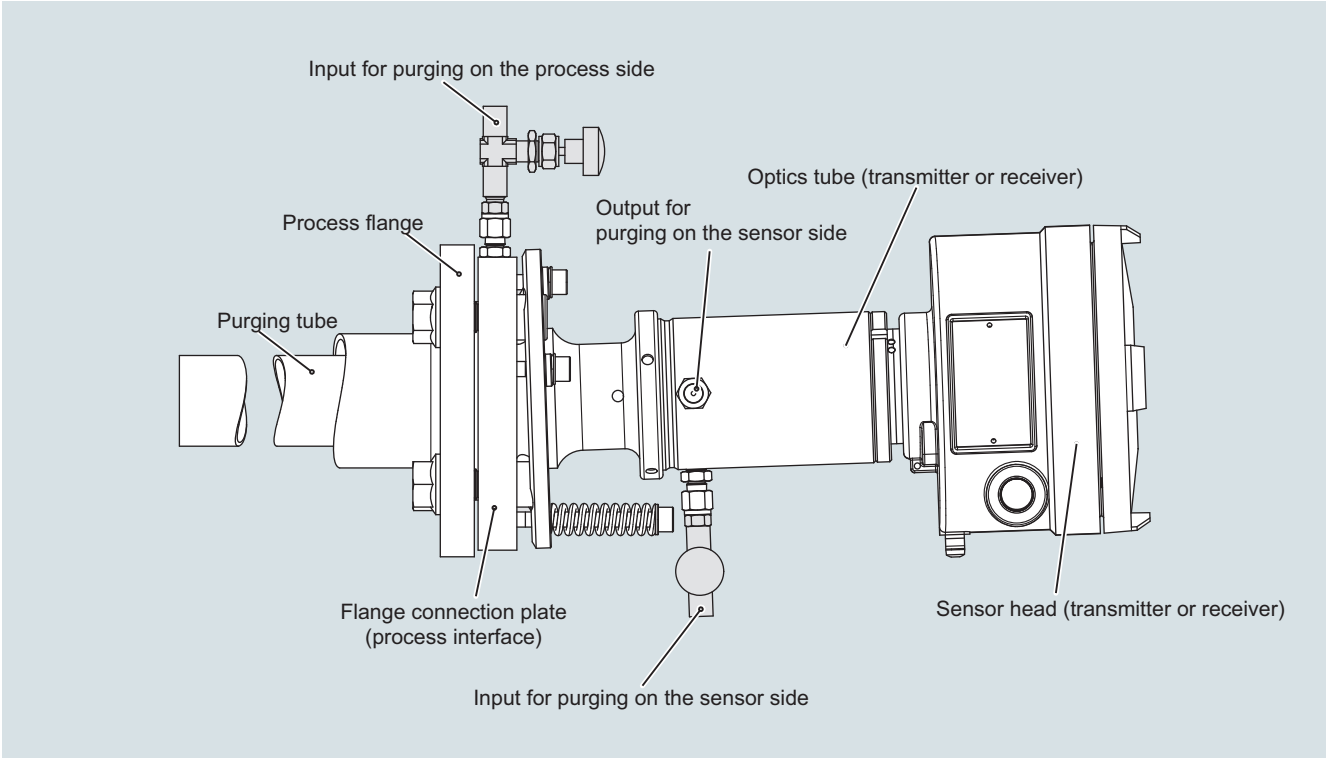
Installation/adjustment requirements for the pair of cross-duct sensors

In situ O2 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).

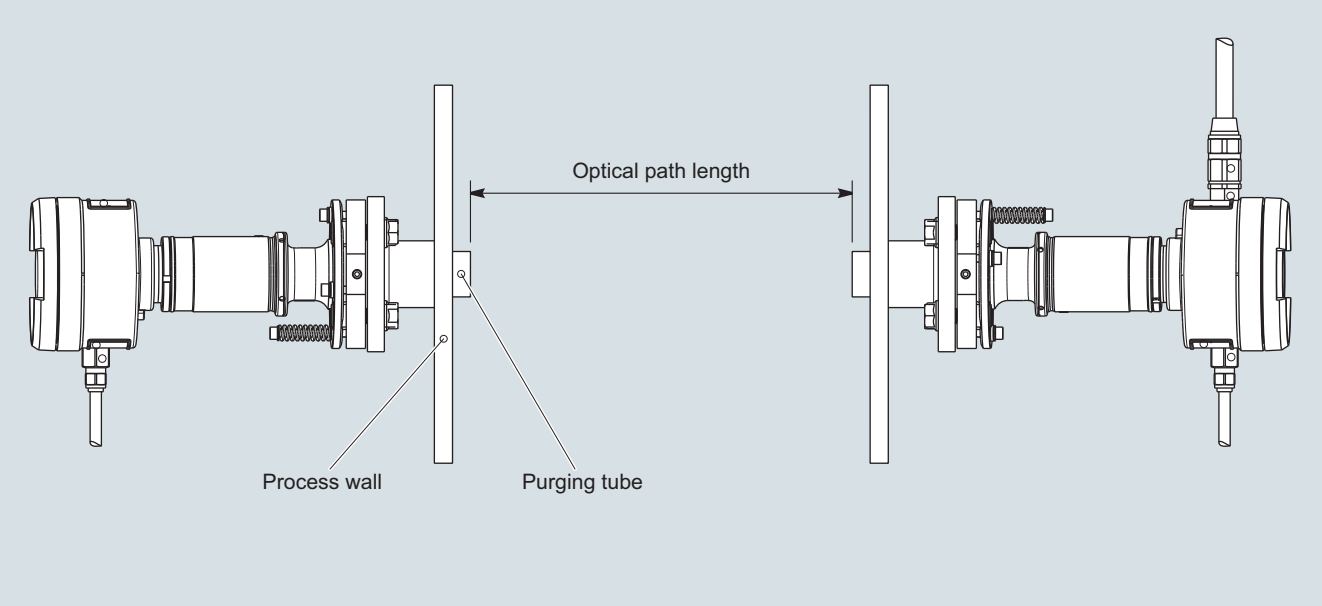
Purging on sensor side

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 removed. 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 achieve sufficient calibration of the transmitter and receiver, 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 stabilization by using an internal reference cell; for calibration interval of 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 gas analyzer

Standard applications

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. Note that the values for the detection limit and the maximum measuring range are based on a path length of 1 m. Longer path lengths will improve the detection limit, but not linearly. This is 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

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

DL = detection limit

1) The specification applies at 20 °C and 1013 hPa in a nitrogen atmosphere. In rare cases, a deviating process gas matrix or process conditions can have a negative effect on performance. Contact Siemens to determine the exact performance under your process conditions.

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 attenuation increases exponentially at longer path lengths. Smaller particles also have a very large influence on the optical attenuation. With high dust load, long path length and small particle size, the technical support at Siemens should be consulted.

3) Based on 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. If the process conditions deviate from the specifications of the standard applications, special applications are also possible on request.

- Complete the application questionnaire which can be found on the Internet at http://www.siemens.com/insituquestionnaire:


SIEMENS

Fragebogen für in-situ Prozessanalyse

Technical specifications

Analytical performance	
Measuring range	Internally adjustable
Detection limit at standardized conditions: 25 °C gas temperature, 1 000 hPa, 1 m effective optical path length, 3 s integration time and constant ambient conditions.	O_2: 200 ppmv
Linearity (under standard conditions)	Better than 1%
Repeatability (under standard conditions)	O_2: 1% of the measuring range
General information	
Design	Transmitter and detector units, connected by a sensor cable
Materials	• Sensor enclosure: Treated aluminum/stainless steel (1.4305/303) • Process interface: Acid-resistant stainless steel (1.4404/316L) • Window: hardened borosilicate glass • Compressible gaskets: FKM, FF, EPDM (holder for reference cell) • Flat gaskets: Graphite
Parts wetted by the process gases	• Purging tubes, flanges, window ring, process purging: acid-resistant stainless steel • Window: Borosilicate • Gasket in window: FFKM • Flat gasket between customer flange and process flange: Graphite
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 • ATEX II 2G Ex de op is IIC T6 ATEX II 2D Ex tD A21 IP65 T85 °C • FM Class I, II, III Div 1 Groups A, B, C, D, E, F, G T6 FM Class I, Zn 1, AEx d IIC T6 FM Class II, Zn 21, AEx td T85 °C • XP Class I, II, III Div 1 Groups C, D T6 Ta = 55 °C; DIP Class II,III Div 1 Groups E, F, G T6 Ta = 55 °C; Class I, Zn 1, Ex d IIC T6 Ta = 55 °C; Zn 21, Ex tD T85 °C Ta = 55 °C
Design, enclosure	
Degree of protection	IP65 according to EN 60529
Purging tube	• Length: 340 mm • Outer diameter: 48 mm • Inside diameter: 44 mm
Purging tube	Length, outer diameter, inner diameter: 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, DN 50/PN 40 or ANSI 4"/150 lbs

Electrical characteristics	
Auxiliary power	24 V DC nominal (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 atmospheric pressure	Negligible
Process gas pressure	O_2: With compensation: < 1%/ 4 000 hPa of the measuring range
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. External isolating power supplies may have to be provided by the customer.
Analog inputs	2 inputs, designed for 4 ... 20 mA, 120 Ω
Digital outputs	2 outputs, with switchover contacts, configurable, 24 V/0.5 A, floating, single pole double throw (SPDT)
Digital 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 Mbps, -7 … 12 V
RS 485 Modbus version	Two-wire interface, up to 115 200 bit/s, -7 … 12 V
Connection cable to customer interface	Not included in standard delivery, permanently installed for ATEX or optional for standard
Analog connection cable (only supplied cables may be used for ATEX configuration!)	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

In situ O2 gas analyzer

Sensor cable	Not included in standard delivery, permanently installed for ATEX or optional for standard
Sensor cable type configuration	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 • Length: up to 25 m
Minimum bending radius	ATEX: 85 mm
Climatic conditions	
Ambient temperature range	**Note** The display on the receiver side must not be exposed to direct solar radiation. • -20 ... +55 °C during operation (additional solar radiation not permissible!) • -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 • O_2: 700 … 5 000 hPa, 0 … 200 °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	Nitrogen (for O_2 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 the 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

Accessories

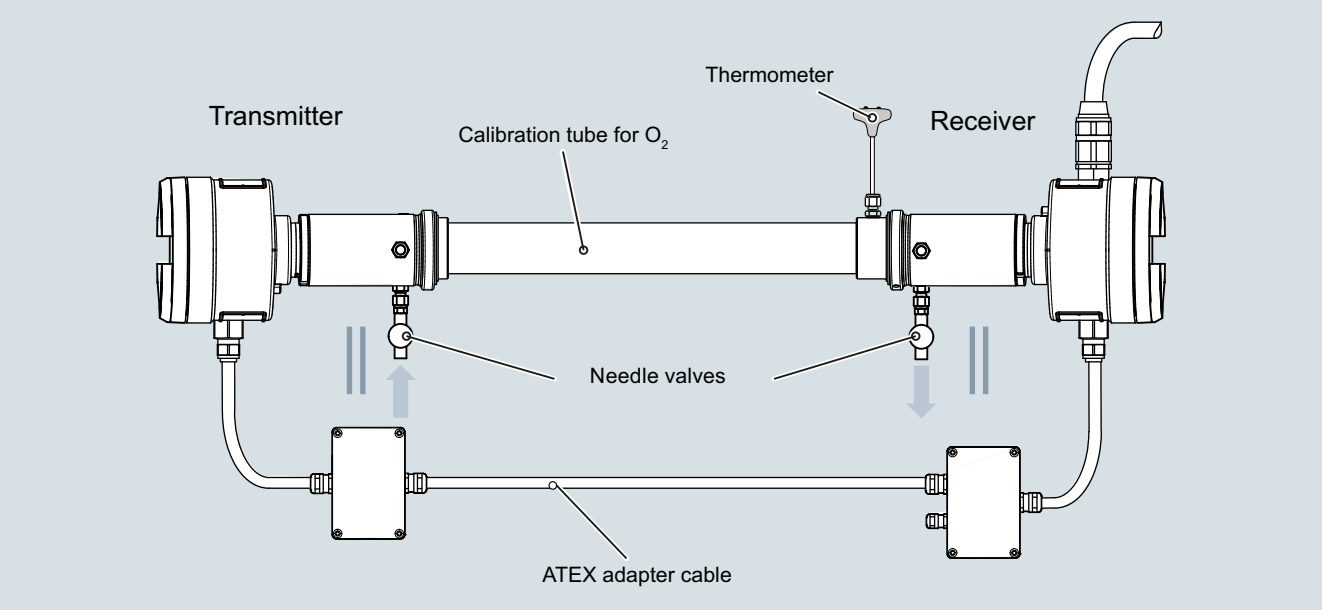
SITRANS SL sensor alignment kit

The SITRANS SL sensor alignment kit includes a battery-operated lamp, a centering aid with cross-hairs 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 validation setup of SITRANS SL O_2

Additional accessories

You can find more accessories and spare parts in our PIA Life Cycle Portal product selector:
http://www.pia-portal.automation.siemens.com

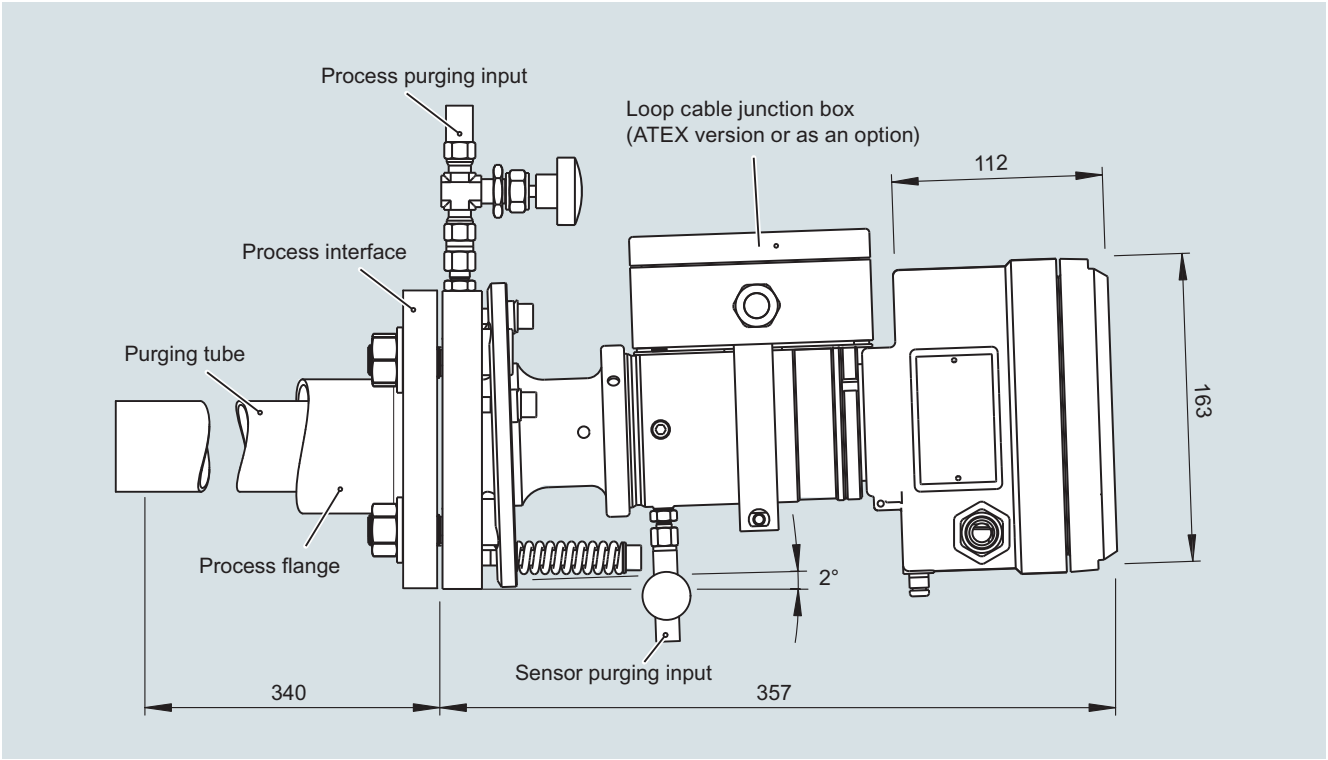
2

Dimensional drawings

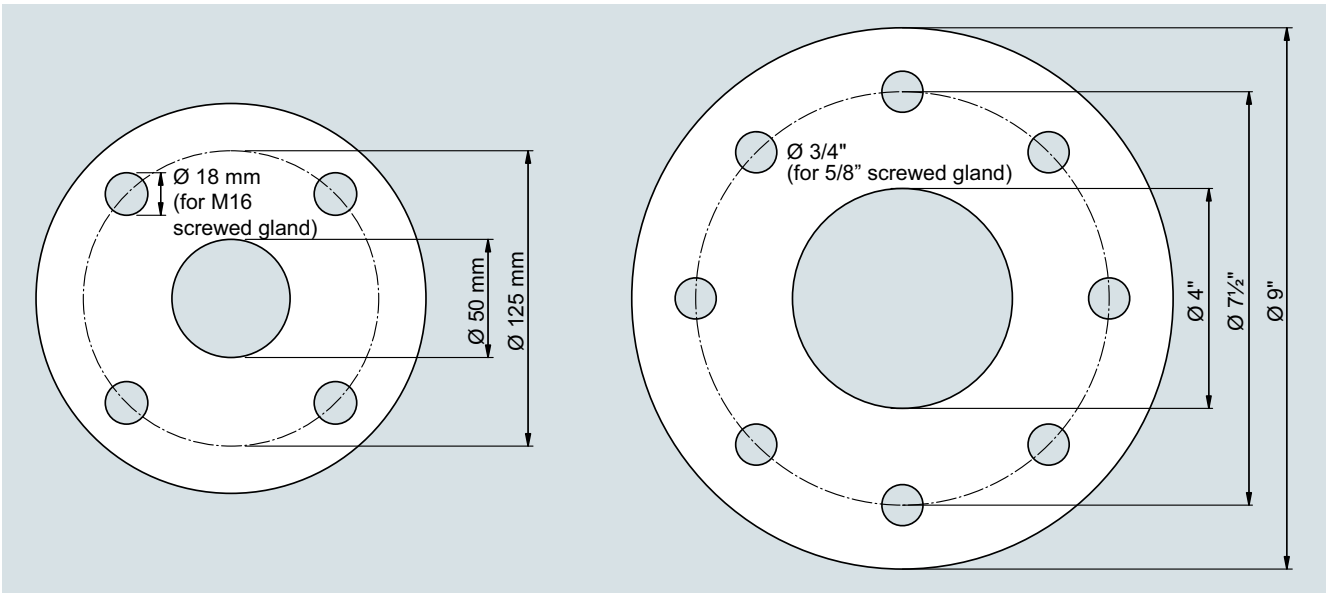
Note

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 clearance of at least 10 cm must be provided around the SITRANS SL to maintain 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

Circuit diagrams

Electrical connections

Non-hazardous area version connection cable - customer interface

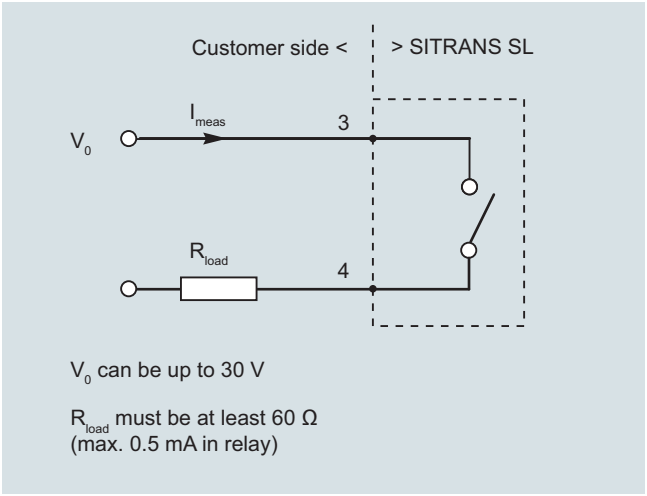
Terminal block in the receiver enclosure			Function/voltage	Ethernet cable
1	+		Power supply 19 … 30.2 V, 10 VA[1)]	
2	-			
3	Normally closed under power[4)]		Digital output 0 (relay) 30 V, 0.5 A[3)]	
4				
5	Normally closed under power[4)]		Digital output 1 (relay) 30 V, 0.5 A[3)]	
6				
7	+		Digital input 0 0 … 30 V[2)]	
8	-			
9	+		Analog output 0 (measurement) 30 V, 24 mA[3)]	
10	-			
11	+		Analog output 1 (measurement) 30 V, 24 mA[3)]	
12	-			
13	PROFIBUS A line (RxD/TxD_N - data inverted)	Modbus D1 (RxD/TxD_N - data inverted)	RS 485 (PROFIBUS/Modbus)	
14	PROFIBUS B line (RxD/TxD_P - data not inverted)	Modbus D0 (RxD/TxD_P - data not inverted)	-7 ... +12 V DC	
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) 0 … 30 mA[2)], 120 Ω	
21	-			
22	+		Analog input 1 (pressure) 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.

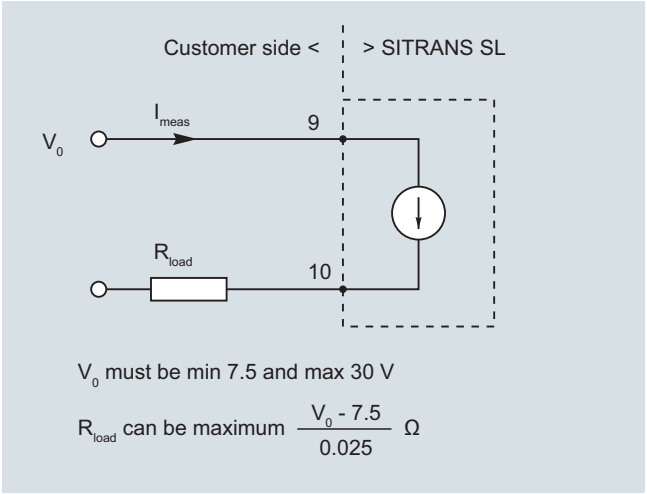
2

Examples of digital output and analog output

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



Example of digital output 0



Example of an analog output 0

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

Selection and ordering data		Article No.
SITRANS SL in-situ gas analyzer	↗	**7MB6221-** ■■■■■ - ■■■■ Cannot be combined
↗ Click on the Article No. for the online configuration in the PIA Life Cycle Portal.		
Explosion protection[1]		
Without		0
Ex II 2 G Ex de op is IIC T6 Ex II 2 D Ex tD A21 IP65 T85°C		1
FM USA: XP Class I, II, III Div 1 Groups A, B, C, D T6 Ta = 55°C DIP Class II,III DIV 1 Group EFG Ta = 55°C Class I, Zn 1, AEx d IIC T6 Ta = 55°C Zn 21, AEx tD T85°C Ta = 55°C		2
FM Canada: XP Class I, II, III Div 1 Groups C, D T6 Ta = 55°C DIP Class II,III DIV 1 Group EFG Class I, Zn 1, Ex d IIC T6 Ta =55°C Class II, III Zn 21, Ex t IIIC T85°C Ta = 55°C		
Measured component		
O_2		A
Application examples[2]		
Control of combustion processes		B
Process control, safety monitoring in appropriate plant concepts		C
Communication interface		
2x analog I/O, 1x DI, 2x DO		0
PROFIBUS DP		1
Modbus		2
Purging tubes, material	**Length**	
No purging tubes		0
Stainless steel	340 mm	1
Purging: Process side	**Purging: Sensor side**	
No purging	No purging	0
No purging	3 ... 5 l/min	1
0 ... 50 l/min	No purging	2
0 ... 50 l/min	3 ... 5 l/min	3
Process connection[3]		
Stainless steel flange (1.4404/316L), connection dimensions ANSI 4"/150 lbs, MAWP (PS) at 20 °C: 232 psi		B
Stainless steel flange (1.4404/316L), connection dimensions DN50/PN25, MAWP (PS) at 20 °C: 2.5 MPa		C
Stainless steel flange (1.4404/316L), connection dimensions DN50/PN40, MAWP (PS) at 20 °C: 4.0 MPa		E
Without process connection		X
Sensor cable		
With brass bushing		
• 5 m		A
• 10 m		B
• 25 m		C
With stainless steel gland		
• 5 m		D
• 10 m		E
• 25 m		F
Without cable		X
Documentation language		
German		0
English		1
French		2
Spanish		3
Italian		4

[1] Complete and consistent implementation of the safety concept by the plant operator must be ensured during the commissioning and operation of the in-situ laser spectrometer SITRANS SL in hazardous atmospheres.

[2] 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.).

[3] MAWP: Maximum Allowable Working Pressure.

In situ O2 gas analyzer

Selection and ordering data

Additional versions	Order code	
Add "-Z" to Article No. and specify Order code		
Acceptance test certificate 3.1 (leak test) in accordance with EN 10204	**C12** [1]	
Acceptance test certificate 3.1 (material certificate) in accordance with EN 10204	**C13** [1]	
SIL 1 conformity declaration in accordance with standards IEC 61508/IEC 61511 (for the measured component oxygen in combination with analog interfaces)	**C20** [1]	
TAG label, customized inscription	**Y30**	

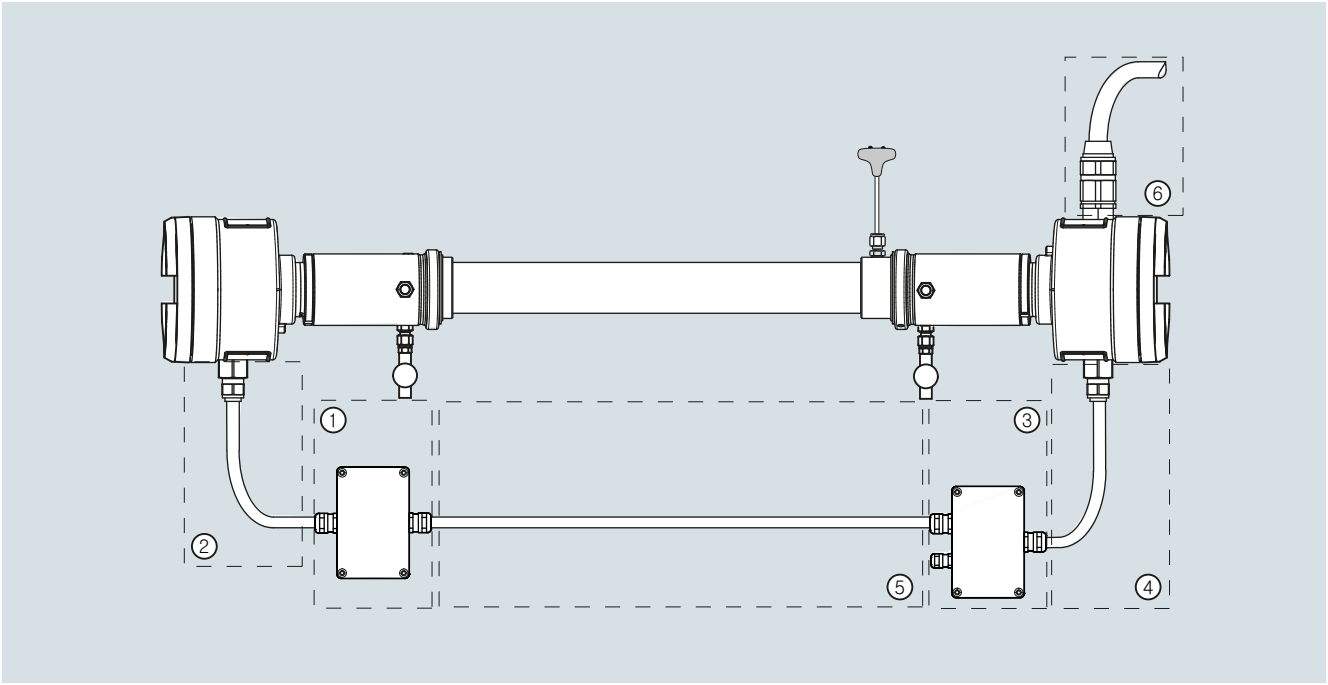
[1] Together with explosion protection as per FM, on request

Selection and ordering data

Additional units and spare parts	Article No.	Item no. (see graphic on page 2/21)
Additional units		
SITRANS SL, calibration test kit O_2,	**A5E01000694**	
SITRANS SL, sensor alignment kit	**A5E01000740**	
SITRANS SL, connection box Ex-e for 25-pin connecting cable	**A5E01267567**	
SITRANS SL, connecting cable set analog (for non-Ex)	**A5E03328474**	
SITRANS SL, connecting cable set PROFIBUS DP (for non-Ex)	**A5E03328473**	
SITRANS SL, UV protective hose for outdoor use, ND = 48 mm per 30 m length	**A5E01714061**	
SITRANS SL, sensor cable set (non-Ex) with cable glands of nickel-plated brass, length: 5 m	**A5E02509347**	**3+4+5**
SITRANS SL, sensor cable set (non-Ex) with cable glands of nickel-plated brass, length: 10 m	**A5E02528048**	**3+4+5**
SITRANS SL, sensor cable set (non-Ex) with cable glands of nickel-plated brass, length: 25 m	**A5E02528052**	**3+4+5**
Spare parts		
SITRANS SL, process connection plate (1 unit) for customer flange size: DN 50/PN 10 ... 40 including seal	**A5E01009881**	
SITRANS SL, gasket for DN 50/PN 10 ... 40	**A5E02522036**	
SITRANS SL, process connection plate (1 unit) for customer flange size: ANSI 4"/150 lbs including seal	**A5E01009883**	
SITRANS SL, gasket for ANSI 4''/150 lbs	**A5E02789535**	
SITRANS SL, purging tube 340 mm incl. seal for DN 50/PN 10 ... 40	**A5E01009892**	
SITRANS SL, window cover for detector unit	**A5E01009897**	
SITRANS SL, cover for transmitter unit	**A5E02568437**	
SITRANS SL, connecting cable for analog and Modbus (ATEX), cable gland of nickel-plated brass, for devices delivered after October 2009 (Version 1.1)	**A5E02608597**	**6**
SITRANS SL, connecting cable for analog and Modbus (ATEX), cable gland of stainless steel	**A5E34834297**	**6**
SITRANS SL, connecting cable for PROFIBUS DP (ATEX), cable gland of nickel-plated brass	**A5E02608594**	**6**
SITRANS SL, cable for transmitter (ATEX), cable gland of nickel-plated brass	**A5E44678580**	**2**
SITRANS SL, cable for detector (ATEX), cable gland of nickel-plated brass	**A5E44678567**	**4**
SITRANS SL, connecting cable for PROFIBUS DP (ATEX), cable gland of stainless steel	**A5E34834296**	**6**
SITRANS SL, connecting cable for transmitter (ATEX), cable gland of stainless steel	**A5E34830928**	**2**
SITRANS SL, connecting cable for detector (ATEX), cable gland of stainless steel	**A5E34831050**	**4**
SITRANS SL, terminal box and connecting cable for transmitter (ATEX), cable gland of stainless steel	**A5E34831075**	**1**
SITRANS SL, terminal box (ATEX), cable gland brass, nickel-plated	**A5E02091532**	**1**
SITRANS SL, terminal box and connecting cable for transmitter (ATEX), cable gland of nickel-plated brass	**A5E02568463**	**1+2**
SITRANS SL, sensor cable 5 m	**A5E02571180**	**5**
SITRANS SL, sensor cable 10 m	**A5E02571184**	**5**
SITRANS SL, sensor cable 25 m	**A5E02571186**	**5**
SITRANS SL, terminal box and connecting cable for detector (ATEX), cable gland of stainless steel	**A5E34831078**	**3**
SITRANS SL, terminal box and connecting cable for detector (ATEX), cable gland of nickel-plated brass	**A5E02568465**	**3+4**
SITRANS SL, cable gland for non-ex cables	**A5E02568457**	
SITRANS SL, screw cap	**A5E01010033**	
SITRANS SL, printed-circuit board for detector with LUI (Version 1.1)	**A5E31503119**	
SITRANS SL, remote control IS, CSA, FM, ATEX certifications	**A5E02091214**	
SITRANS SL, assembly kit for needle valve	**A5E02569944**	
SITRANS SL, assembly kit restrictor for sensor purging	**A5E02183375**	

Additional accessories

You can find more accessories and spare parts in our PIA Life Cycle Portal product selector:
http://www.pia-portal.automation.siemens.com

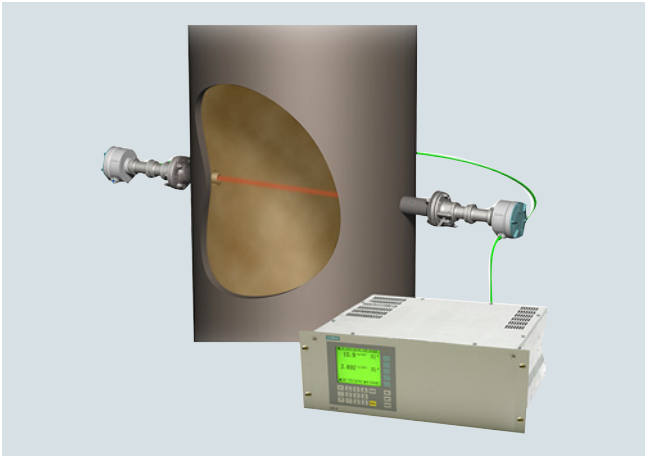


SITRANS SL spare parts, item numbers

More information

The complete documentation is available in various languages for downloading free of charge:
http://www.siemens.com/processanalytics/documentation

Overview



LDS 6, typical installation with transmitted-light sensors

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 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.

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
- Semiconductor and computer chip production

Special applications

In addition to the standard applications, special applications are available upon request. These contain both an expansion of the temperature and pressure range, as well as an expansion of the concentration measuring range. Furthermore, other gas species can be measured using special application.

2

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 housing with 4 fixing points for mounting

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

Display and operator panel

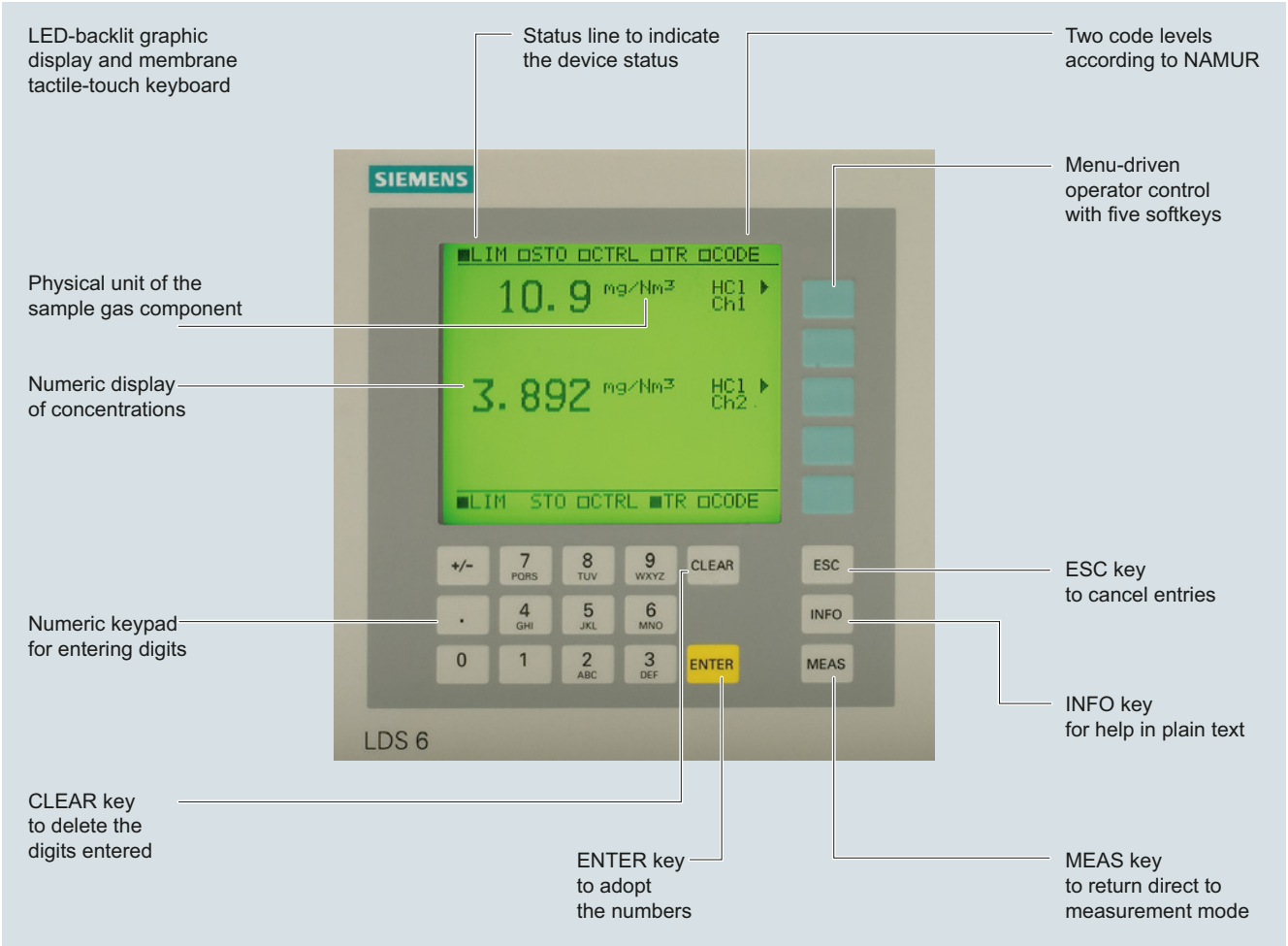
- Large LCD field for simultaneous display of measurement result and device status
- Contrast of the LCD field is adjustable via the menu
- LED background illumination of the display with energy-saving function
- Easy-to-clean membrane touch pad with softkeys
- Menu-driven operation for parameterization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

Inputs 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). For selected versions, the transmission can be read out as an alternative.
- 6 freely configurable digital inputs per channel for signaling faults or maintenance requests from external temperature or pressure transducers or sensor purging failure.
- 6 freely configurable digital outputs per channel (signaling of fault, maintenance requirements, function control, transmission limit alarm, concentration limit alarm, store analog output)

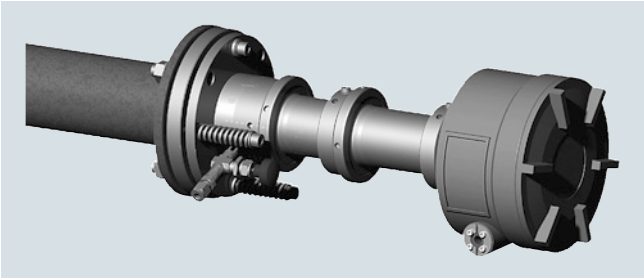
Communication

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



LDS 6 central unit, membrane keyboard and graphic display

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 via a so-called hybrid cable of max. 700 m length (total hybrid and sensor connecting cable length: max. 250 m in Ex Zone 0 and Ex Zone 1)
- 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 can be performed at the process end with instrument air or nitrogen
- Quick release fasteners 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 are immersed slightly into the process gas and thus limit the purging volume. Special materials such as Hastelloy and plastics (PP) are available on request.

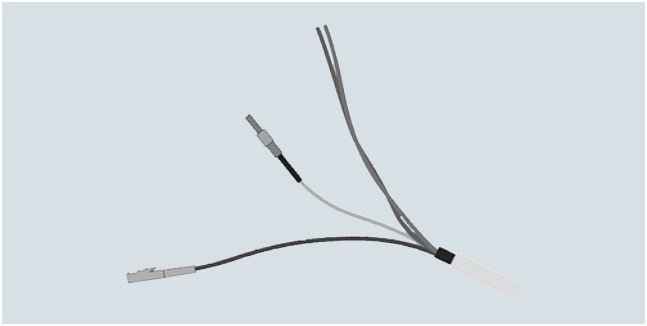
Hybrid and sensor cables

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 (total hybrid and sensor connecting cable length)
  - 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

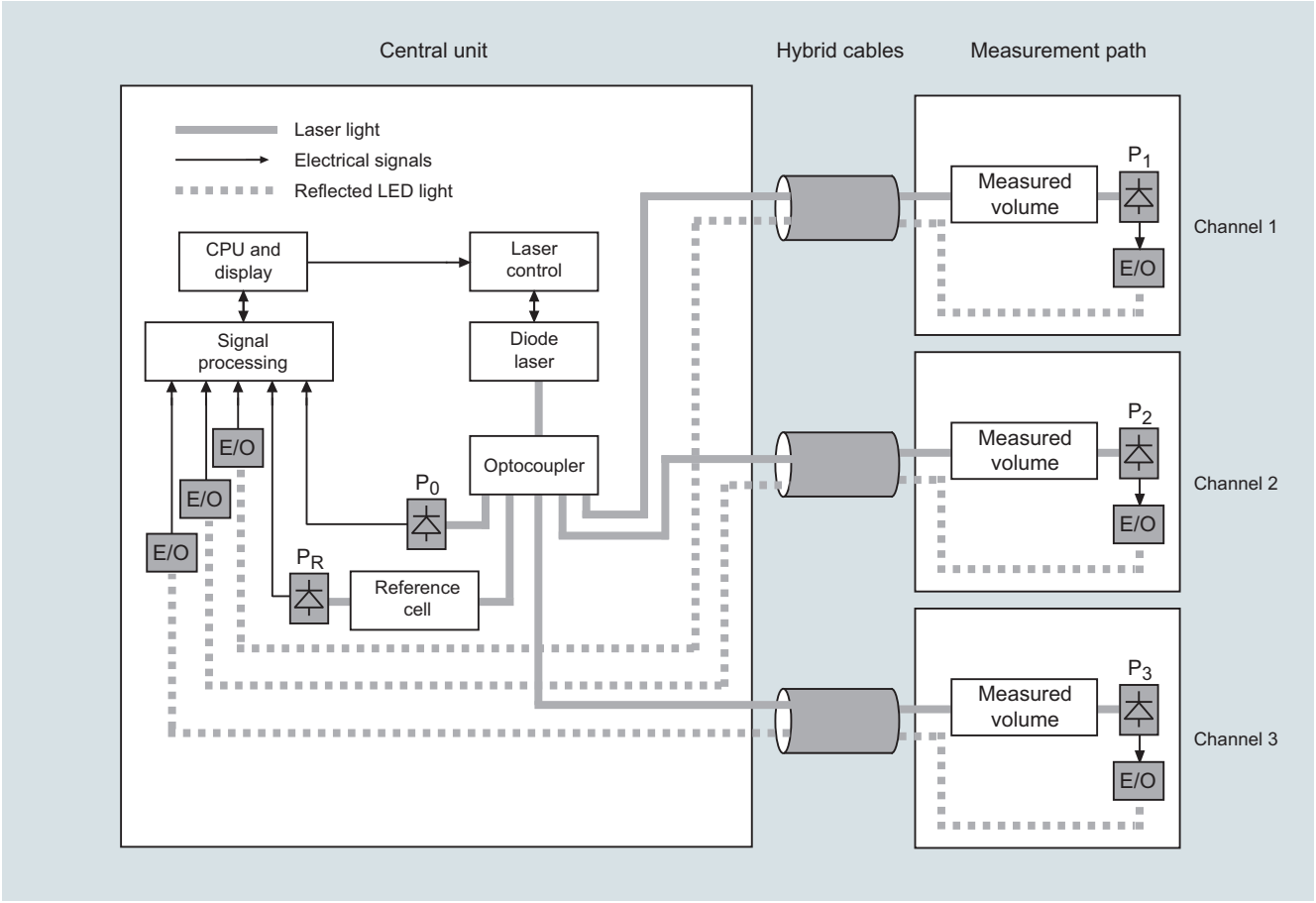
2

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.

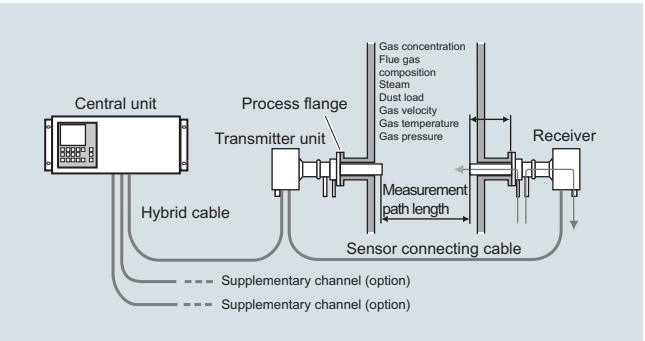


Basic design of the LDS 6

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.

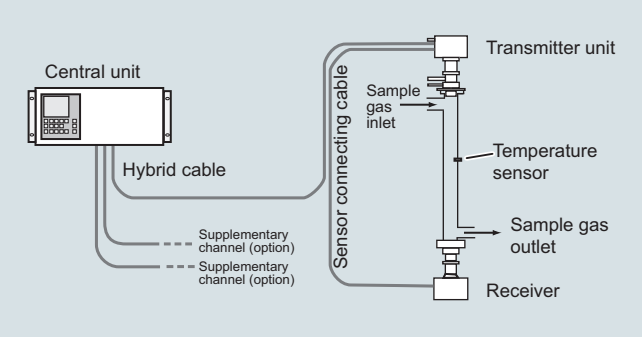
A feature of the standard applications defined in the ordering data of the LDS 6 is that the typical process conditions are well-known, documented, and the guaranteed measuring properties can be proven by reference installations. If you cannot find your application among the standard applications, please 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 6 product pages on the Internet: www.siemens.com/insituquestionnaire



Typical transmitted light setup of LDS 6, in-situ

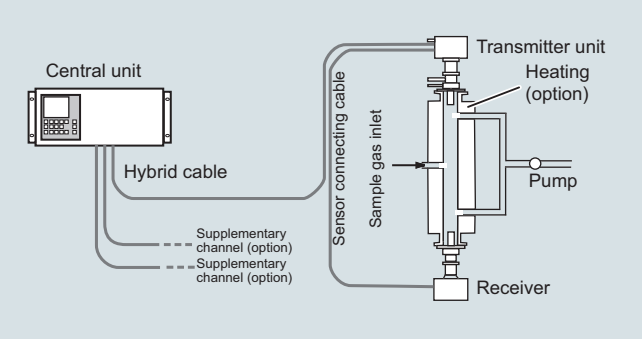
To avoid contamination of sensor optics on the process side, clean gaseous purging media such as instrument air, N_2 or steam are used. Purging air tubes on the sensor heads, which slightly penetrate into the process gas stream, define the effective measuring path length.

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.



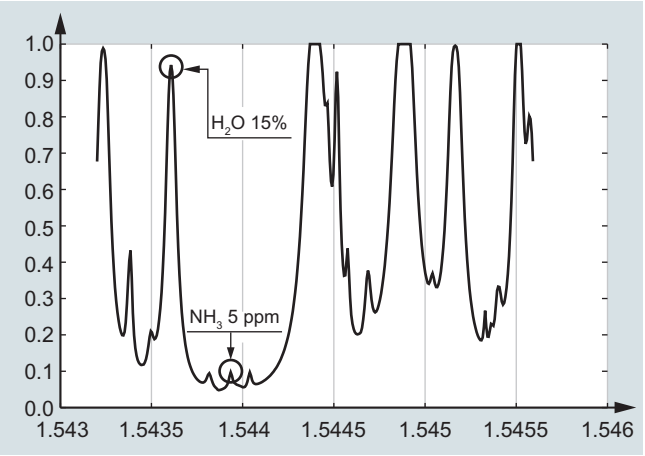
Measuring configuration of LDS 6 with heated flow cell

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 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)).



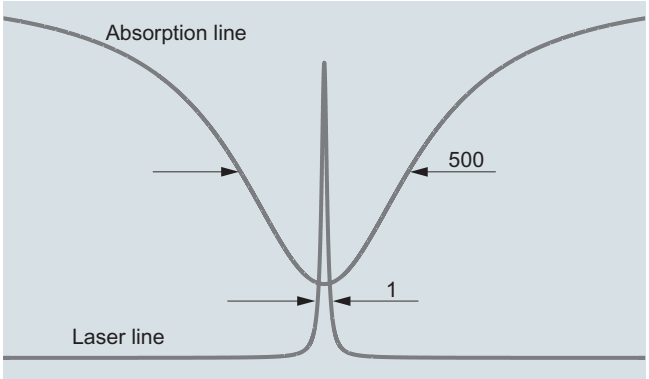
Absorption spectra of water and ammonia

Typical measurable gases for LDS 6 are:

- Oxygen (O_2) for low pressure range
- 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 (distance 1 m) 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.
The effect 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 very large influence on the optical attenuation. With a combination of high dust load, long path length and small particle size, the technical support at Siemens should be consulted.

Temperature

The effect of temperature on the absorption strength of the molecule line is compensated by a correction factor. A temperature signal can be fed into an analog 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 for an LDS 6 measuring O_2 can be set upstream of the detector to protect it and prevent saturation by the strong background radiation.

Pressure

The effect of pressure on the absorption line, and consequently on the measured concentration, is compensated with a correction factor. The gas pressure can affect the line shape of the molecular absorption line. An analog pressure signal can be sent to the device from an external pressure sensor to fully compensate for the effect of the pressure including the density effect.

Optical path length

The absorption values analyzed by the LDS 6 are typically small. According to the Lambert-Beer law, the absorption of laser light depends on the optical path length within the gas, among other factors. Therefore, the precision in determining the effective optical path length in the process might limit the overall precision of the measurement.
As the sensor optics on the process side 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. For short path lengths in the range ≤ 0.3 m, contact Siemens Technical Support.

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

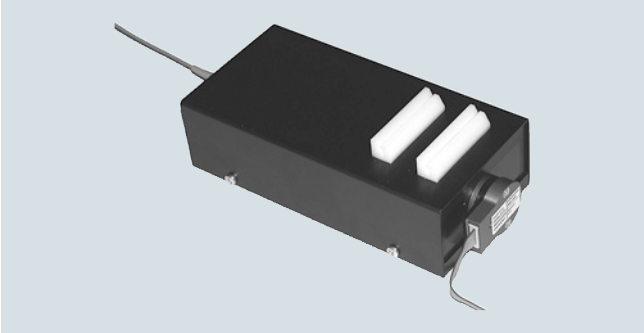
Certified versions for emission monitoring

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. Test kits for ammonia, water and HCl should be used to conduct regular calibration and linearity checks on site. 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 analyzers already installed, contact Siemens Technical Support. 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. These are used to rapidly verify the factory calibration in the field without compressed gas bottles or flow cell.

Calibration test kits are available for the following sample gases: O_2, NH_3, CO, CO_2, CO/CO_2. A "Zero gas test kit" is also available for individual applications (see Additional units).



Example of an assembly for verification of calibration

2

Technical specifications

Analytical performance	
Measuring range	Depending on sample gas component: See table for standard applications.
Detection limit (DL): 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. For application letter ET and FT: in accordance with the requirements of 17th and 27th BImSchV
Smallest recommended measuring range (with 1 m path length) 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.	Depending on sample gas component: see table for standard applications.
Accuracy[1)]	2% / 5%, depending on sample gas component and application letter. At best: detection limit. See table for standard applications. For application letter ET and FT: in accordance with the requirements of 17th and 27th BImSchV
Linearity	Better than 1%
Repeatability	2% of the measured value or same amount as the detection limit (whichever is larger) For application letter 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
Time response	
Warm-up time at 20 °C ambient temperature	Approx. 15 min
Response time	Min. of 1 s, depending on application
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 temperature 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
Digital outputs	6 per channel, with changeover contacts, configurable, 24 V AC/DC/1 A, floating
Digital 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)

1) The accuracy corresponds to intrinsic uncertainty according to IEC 61207 for 7MB6121-xKD00-0xxx.

Selection and ordering data		Article No.
LDS 6 in-situ gas analyzer 19" rack unit for installation in cabinets		↗ **7MB6121-** ■■■ **0** ■ **-** **0** ■■■ Cannot be combined
↗ Click on the Article No. for the online configuration in the PIA Life Cycle Portal.		
Explosion protection[1]		
Without, not suitable for connection to Ex sensors		**0**
Without, suitable for connection to Ex sensors in accordance with II 1 G Ex ia op is IIC T4 Ga, II 1 D Ex ia op is IIIC T135 °C Da		**1** **1 1 1**
Measured component	**Possible with application code of the respective channel**	
O_2	B, C	**A**
NH_3	A, E, F, L, T	**C**
NH_3/H_2O	A, E, F, L, T	**D**
HCl	A, H, T	**E**
HCl/H_2O	A, H, T	**F**
HF	A, H	**G**
HF/H_2O	A, H	**H**
CO	C	**J**
CO/CO_2	D	**K**
CO_2	A	**L**
H_2O	A, T	**M**
Application code of measured component channel 1	**Application examples channel 1**[1]	
A	Emission monitoring, non-certified	**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**
L	Automotive, for use according EU regulation No. 595/2009/EC from June 18, 2009 (EURO VI)	**L**
T	Emission measurement, device design in accordance with QAL1 certification acc. to EN 14181 and EN 15267. Notice: Only in combination with measuring component version C, D, M, E and F (NH3, NH_3/H_2O, H_2O, HCl, HCl/H_2O).	**T** **T**
CD 6, sensor alignment kit		
With		**0**
Without		**1**
Application code of measured component channel 2	**Application examples channel 2**[1]	
X	Channel 2 not used	**X**
A	Emission monitoring, non-certified	**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**
L	Automotive, for use according EU regulation No. 595/2009/EC from June 18, 2009 (EURO VI)	**L**
T	Emission measurement, device design in accordance with QAL1 certification acc. to EN 14181 and EN 15267. Notice: Only in combination with measuring component version C, D, M, E and F (NH3, NH_3/H_2O, H_2O, HCl, HCl/H_2O).	**T** **T**

[1] Complete and consistent implementation of the safety concept by the plant operator must be ensured during the commissioning and operation of the in-situ laser spectrometer LDS6 or the sensor CD 6 in hazardous atmospheres.

[2] 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.). It is only possible to configure the same applications for multiple channels. If required, please contact Siemens for a special application (refer to page 2/41)

19" central unit

2

Selection and ordering data		Article No.	Cannot be combined
LDS 6 in-situ gas analyzer 19" rack unit for installation in cabinets		**7MB6121-** ■■■ **0** ■ **- 0** ■■■	
Application code of measured component channel 3	**Application examples channel 3**[1)] External 24 V DC power supply included in scope of delivery		
X	Channel 3 not used	**X**	
A	Emission monitoring, non-certified	**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**	
L	Automotive, for use according EU regulation No. 595/2009/EC from June 18, 2009 (EURO VI)	**L**	
T	Emission measurement, device design in accordance with QAL1 certification acc. to EN 14181 and EN 15267. Notice: Only in combination with measuring component version C, D, M, E and F (NH3, NH_3/H_2O, H_2O, HCI, HCI/ H_2O).	**T**	**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 Article No. and specify order codes.	
Telescopic rails (2 units)	**A31**
Set of Torx tools	**A32**
TAG label, customized inscription	**Y30**
Additional units	**Article No.**
LDS 6, optical bandpass filter for reducing infrarot background radiation (flame filter)	**A5E00534668**
LDS 6, external power supply unit for 3 channels	**A5E00854188**
LDS 6, linearity verification kit NH_3, Version 2	**A5E01075594**
LDS 6, TÜV/MCERT linearity verification kit NH_3, Version 2; 2 cells	**A5E00823339013**
LDS 6, TÜV/MCERT linearity verification kit NH_3/H_2O, Version 2; 3 cells	**A5E00823339014**
LDS 6, TÜV/MCERT linearity verification kit H_2O (for H_2O single component analyzer), Version 2; 2 cells	**A5E00823339015**
LDS 6, TÜV/MCERT linearity verification kit NH_3 (version 1); 2 cells	**A5E00534675**
LDS 6, TÜV/MCERT linearity verification kit NH_3/H_2O, Version 1; 3 cells	**A5E00823339003**
LDS 6, TÜV/MCERT linearity verification kit H_2O, Version 1; 2 cells	**A5E00823339004**
LDS 6, TÜV/MCERT linearity verification kit HCl; 2 cells	**A5E00823339005**
LDS 6, TÜV/MCERT linearity verification kit H_2O; 3 cells	**A5E00823339008**
LDS 6, TÜV/MCERT linearity verification kit H_2O, Version 1; 2 cells	**A5E00823339009**
LDS 6, TÜV/MCERT linearity verification kit HCl; 2 cells	**A5E00823339007**
LDS 6, TÜV/MCERT linearity verification kit H_2O; 3 cells	**A5E00823339002**
LDS 6, TÜV/MCERT linearity verification kit H_2O (only for HCl/H_2O analyzers); 5 cells	**A5E00823339012**
LDS 6, TÜV/MCERT linearity verification kit H_2O (only for NH_3/H_2O analyzers), Version 2; 5 cells	**A5E00823339006**
LDS 6, TÜV/MCERT linearity verification kit HCl; 5 cells	**A5E00823339001**
LDS 6, TÜV/MCERT linearity verification kit NH_3, Version 1; 5 cells	**A5E00823339011**
LDS 6, linearity verification kit NH_3, Version 2; 10 cells[2)]	**A5E03693426**
LDS 6, calibration test kit O_2, Version 1	**A5E01143755001**
LDS 6, calibration test kit CO Version 2	**A5E01143755003**
LDS 6, calibration test kit CO_2, Version 2	**A5E01143755004**
LDS 6, calibration test kit CO/CO_2, Version 2	**A5E01143755006**

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 design, possibly redundant, application of appropriate components required in addition, compliance with possible directives, etc.). It is only possible to configure the same applications for multiple channels. If needed, contact Siemens for a special application (refer to page 2/41).

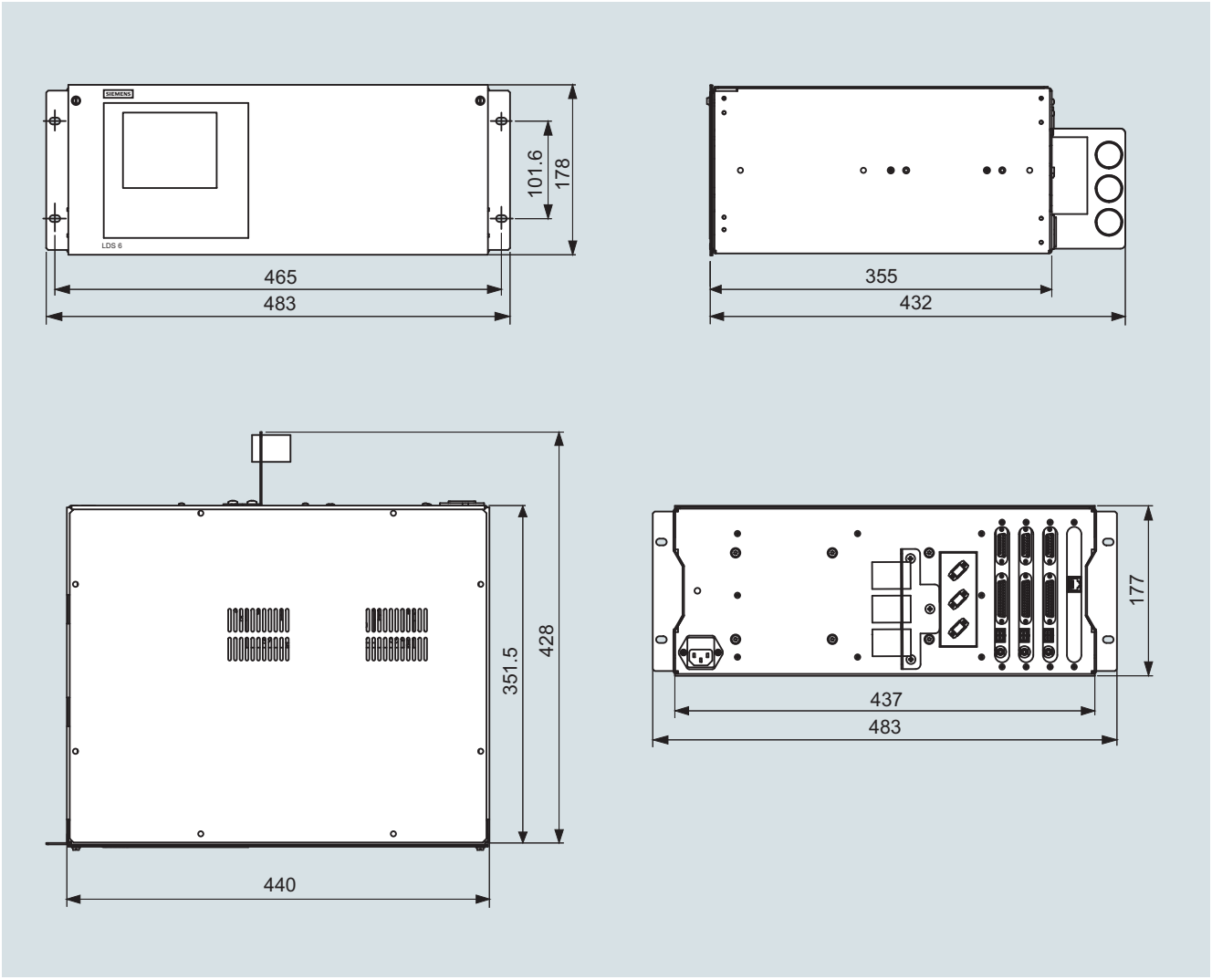
2) In combination with the CL/DL LDS 6 application, suitable for use to measure NH_3 according to the requirements of regulation 595/2009/EC "Implementing regulations on type-approval of motor vehicles and engines with respect to emissions from heavy duty vehicles (EURO VI)" from June 18, 2009 and its regulation for implementation of number 582/2011/EC from May 25, 2011 of the Commission of the European Union.

Additional accessories

You can find more accessories and spare parts in our PIA Life Cycle Portal product selector:
http://www.pia-portal.automation.siemens.com

2

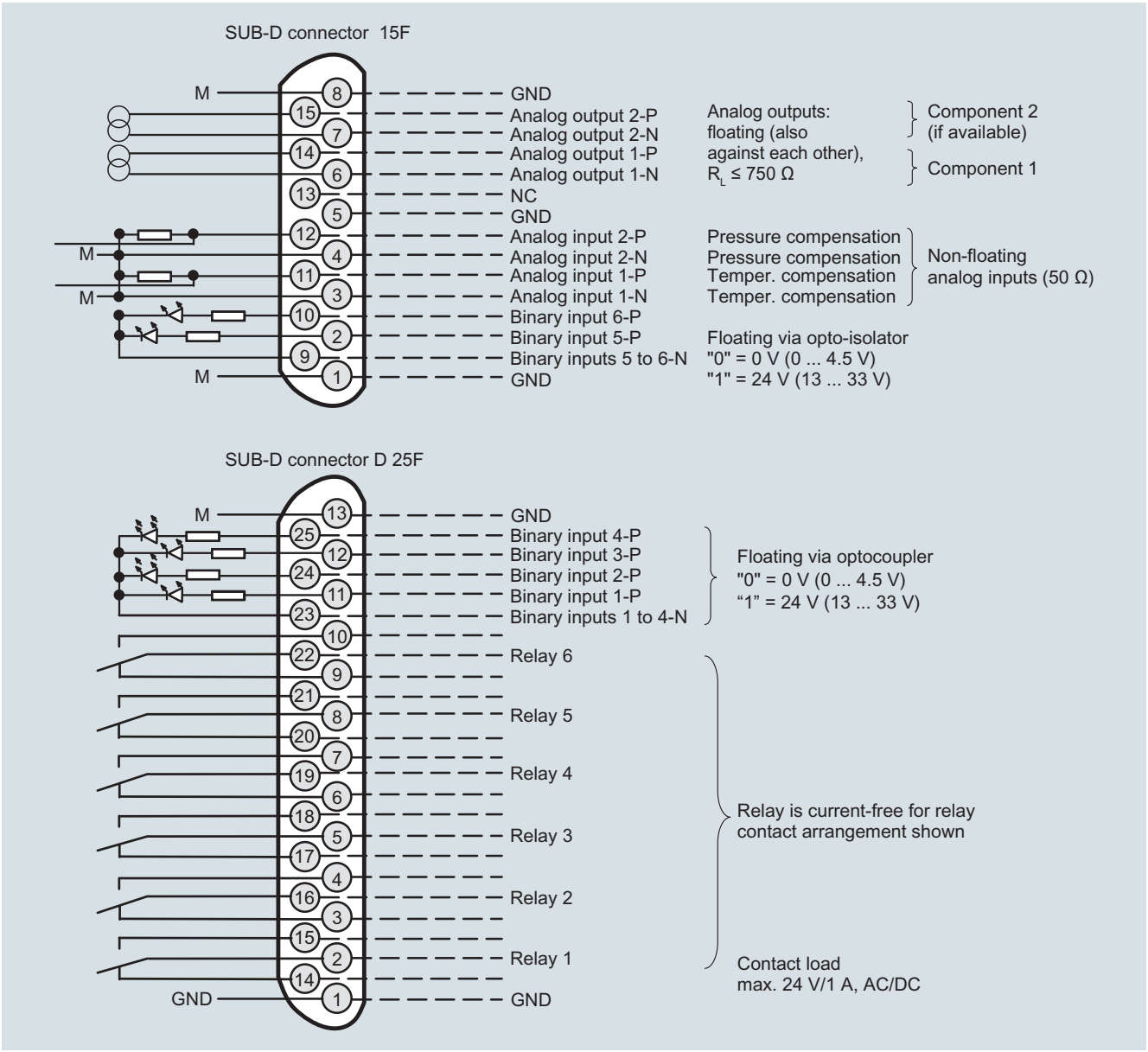
Dimensional drawings



LDS 6, 19" central unit, dimensions in mm

Circuit diagrams

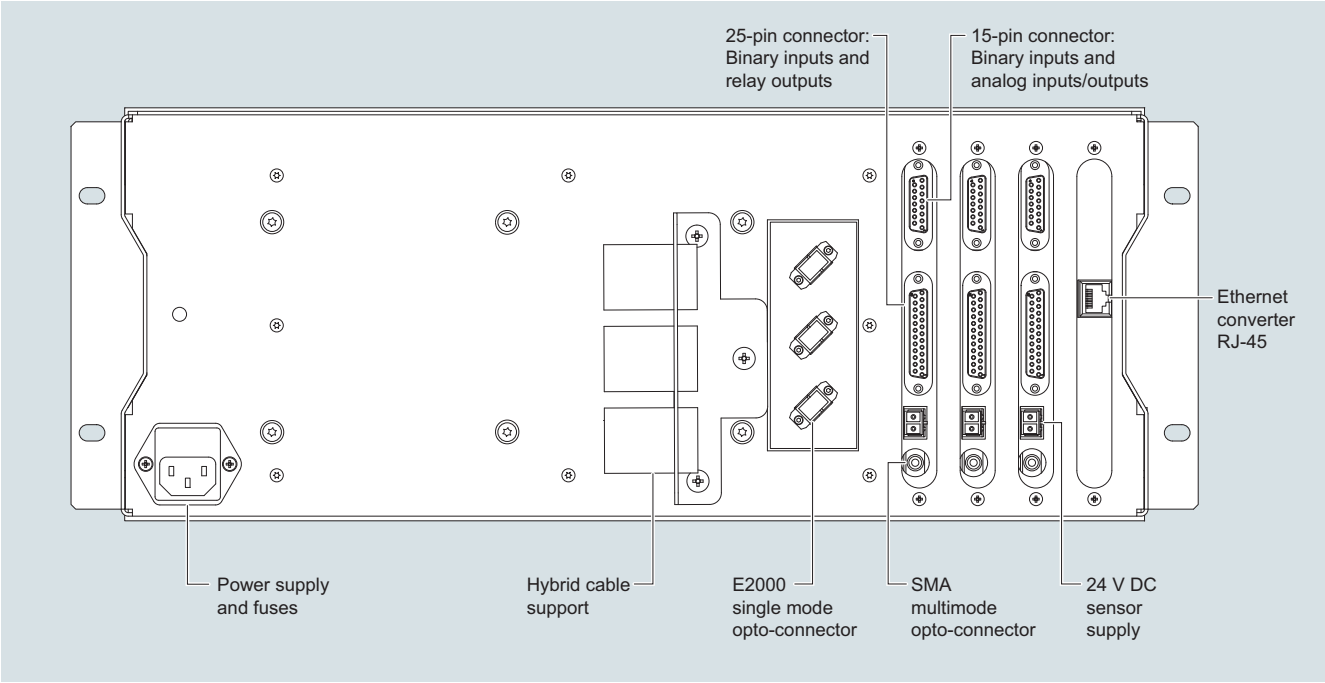
Pin assignments



LDS 6, 19" central unit, pin assignments

19" central unit

Optical and electrical connections



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

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. Note that the values for the detection limit and the maximum measuring range are based on a path length of 1 m. Longer path lengths will improve the detection limit, but not linearly. This is due to restrictive effects such as dust load. The maximum applicable measuring ranges can only be used if permitted by the process conditions such as dust load.

19" central unit

Standard application Effective optical path length: 0.3 … 12 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 next column)	Max. measuring range x path length	DL x path length (under standard conditions[1] without cross-interference from other gases)	DL x path length (at 1 013 hPa with cross-interference from gas 2)	Accuracy[3]
Gas 1	**Gas 2**	**Gas code**	**Appl. code**			**Gas 1**	**Gas 1**	**Gas 1**	**Gas 1**	**Gas 1**	**Gas 1**
O_2		A	C	0 … 600 °C	950 …1 050 hPa	0 … 5 vol%	0 … 100 vol%	75 vol%*m	0.1 vol%*m		2%[4]
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%
			L[6]	0 … 400 °C[7]	920 … 1 120 hPa	0 … 15 ppmv	0 … 500 ppmv	2 500 ppmv*m	0.5 ppmv*m	1.4 ppmv*m at 15 vol% H_2O, 250 °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%
			L[6]	0 … 400 °C[7]	920 … 1 120 hPa	0 … 15 ppmv	0 … 100 ppmv	1 200 ppmv*m	0.5 ppmv*m	1.4 ppmv*m at 15 vol% H_2O, 250 °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%

1) All technical specifications apply to an optical path distance of 1 m in a nitrogen atmosphere under standard conditions 25 °C (or T_{min}) and 1 013 hPa. The effective detection limit, the measuring range and the accuracy can be influenced by process parameters such as pressure, temperature and gas composition. Not all combinations of maximum pressure and temperature can be realized with the minimum measuring ranges. If the process conditions deviate from the specifications of the standard applications, special applications are also possible on request.
Complete the application questionnaire which can be found on the Internet at http://www.siemens.com/insituquestionnaire .

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

3) At least: Detection limit

4) Up to 200 °C, 5% above this

5) Accuracy corresponds to intrinsic uncertainty acc. to IEC 61207: 2 % of MV (0 ... 200 °C); 2.5% of MV (0 ... 400 °C); at best 0.25 vol%*m.

6) Suitable for use to measure NH_3 according to requirements of Directive 595/2009/EC "Implementing regulations on type-approval of motor vehicles and engines with respect to emissions from heavy duty vehicles (EURO VI)" from 18 June 2009 and its regulation for implementation of number 582/2011/EC from 25 May 2011 of the Commission of the European Union.

7) Device also able to operate above 400 °C to 1 000 °C. Due to decomposition of NH_3 at higher temperatures, no specification can be given in these ranges.

Standard application **Effective optical path length: 0.3 … 12 m** **Dust load[3]: < 50 g/Nm³**				**Min. measuring range** (with 1 m eff. opt. path length)	**Max. measuring range** (usually also dependent on eff. opt. path length: see next column)	**Max. measuring range x path length**	**DL x path length** (under standard conditions[1] [2])	**DL x path length** (at 1 013 hPa with cross-interference from 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	C							D	B	N_2
NH_3		C	A							C	G	Air
			T							C	G	Air
			E							E	G	Air
			F							E	G	Air
			L							C	D	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
			L	0 … 5 vol%	0 … 30 vol%	250 vol%*m	0.1 vol%*m at 250 °C	0.1 vol%*m at 250 °C	5%	C	D	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

[1] At 20 °C, 1 013 hPa

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

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

[4] At least: Detection limit

[5] Accuracy corresponds to intrinsic uncertainty acc. to IEC 61207: 5% of MV; at best 0.5 vol%*m.

19" central unit

Standard application **Effective optical path length: 0.3 … 12 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 next column)	**Max. measuring range x path length**	**DL x path length** (under standard conditions[1] without cross-interference from other gases)	**DL x path length** (at 1 013 hPa with cross-interference from gas 2)	**Accuracy[3]**
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 at 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	1 000 ppmv*m at 50 vol% CO_2, 20 °C	2%
CO	**CO_2**	K	D	0 … 400 °C	800 …1 400 hPa	0 … 5 vol%	0 … 100 vol%	0 ... 200 vol%*m	0.1 vol%*m	0.5 vol% at 50 vol% CO_2, 20 °C	2%[5]
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) All technical specifications apply to an optical path distance of 1 m in a nitrogen atmosphere under standard conditions 25 °C (or T_{min}) and 1 013 hPa. The effective detection limit, the measuring range and the accuracy can be influenced by process parameters such as pressure, temperature and gas composition. Not all combinations of maximum pressure and temperature can be realized with the minimum measuring ranges. If the process conditions deviate from the specifications of the standard applications, special applications are also possible on request.
Complete the application questionnaire which can be found on the Internet at http://www.siemens.com/insituquestionnaire .

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

3) At least: Detection limit

4) Up to 200 °C, 5% above this

5) Accuracy corresponds to intrinsic uncertainty acc. to IEC 61207: 2 % of MV (0 ... 200 °C); 2.5% of MV (0 ... 400 °C); at best 0.25 vol%*m.

6) Suitable for use to measure NH_3 according to requirements of Directive 595/2009/EC "Implementing regulations on type-approval of motor vehicles and engines with respect to emissions from heavy duty vehicles (EURO VI)" from 18 June 2009 and its regulation for implementation of number 582/2011/EC from 25 May 2011 of the Commission of the European Union.

7) Device also able to operate above 400 °C to 1 000 °C. Due to decomposition of NH_3 at higher temperatures, no specification can be given in these ranges.

Standard application **Effective optical path length: 0.3 … 12 m** **Dust load[3]:** **< 50 g/Nm³**				**Min. measuring range** (with 1 m eff. opt. path length)	**Max. measuring range** (usually also dependent on eff. opt. path length: see next column)	**Max. measuring range x path length**	**DL x path length** (under standard conditions[1] [2])	**DL x path length** (at 1 013 hPa with cross-interference from 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 … 10 vol%	0 … 100 vol%	0 ... 200 vol%*m	0.2 vol%*m	1 vol% at 50 vol% CO, 20 °C	5%[5]	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 application is T_{min} > 20 °C, the DL refers to T_{min} and standard pressure (1 013 hPa)

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

[4] At least: Detection limit

[5] Accuracy corresponds to intrinsic uncertainty acc. to IEC 61207: 5% of MV; at best 0.5 vol%*m.

Special applications

If the process conditions deviate from the specifications of the standard applications, special applications are also possible on request.

- Complete the application questionnaire which can be found on the Internet at http://www.siemens.com/insituquestionnaire:


SIEMENS

Fragebogen für in-situ Prozessanalyse

2

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 use a purging gas, 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.

Applications with oxygen (high-pressure)

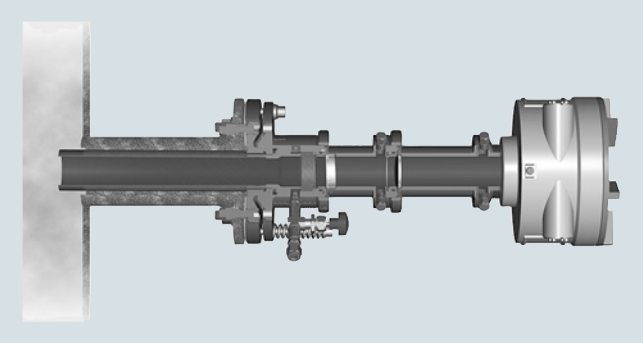
For oxygen measurements with a higher process gas pressure (1 to 5 bar), the sensor CD 6 can be used together with a high-pressure window flange as the process connection. This window flange is also available in the standard sizes DN 65/PN 6, DN 80/PN 16 or ANSI 4"/150 lbs. The optical surface to the process is made of borosilicate glass. High-pressure window 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 letter "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

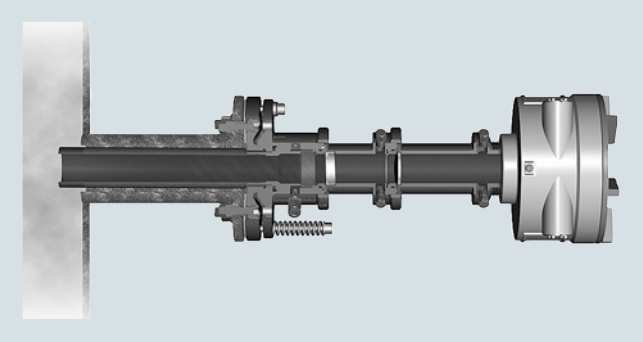
Selected for pure gas applications, emission monitoring, inertia monitoring, for example. The purging gas flow can be adjusted between 0 and approx. 120 l/min at each sensor head using a needle valve (included in delivery).



Moderate purging on the process side

Purging on the process side with increased flow

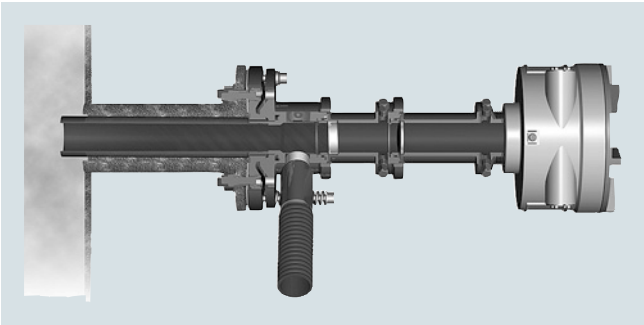
Through omission of needle valve. This type of purging is selected in crude gas applications with higher concentrations of particles and/or condensation as well as in non-purified flue gases in combustion plants. The purging gas flow is typically set between 200 and 500 l/min on each sensor head depending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



Increased purging on the 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 (Tmax. 240 °C). 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.



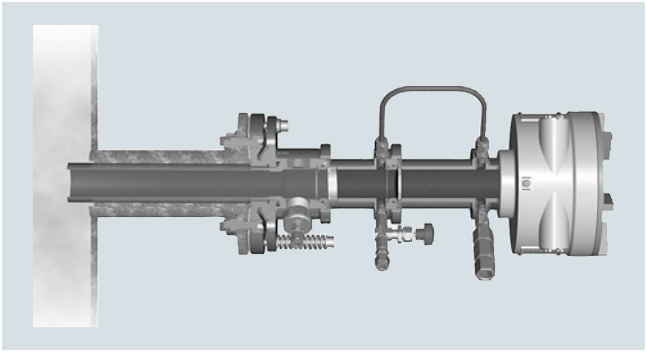
Increased purging on the process side, with hose connection adapter

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 (with H_2O-free gas in the case of moisture measurement).

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

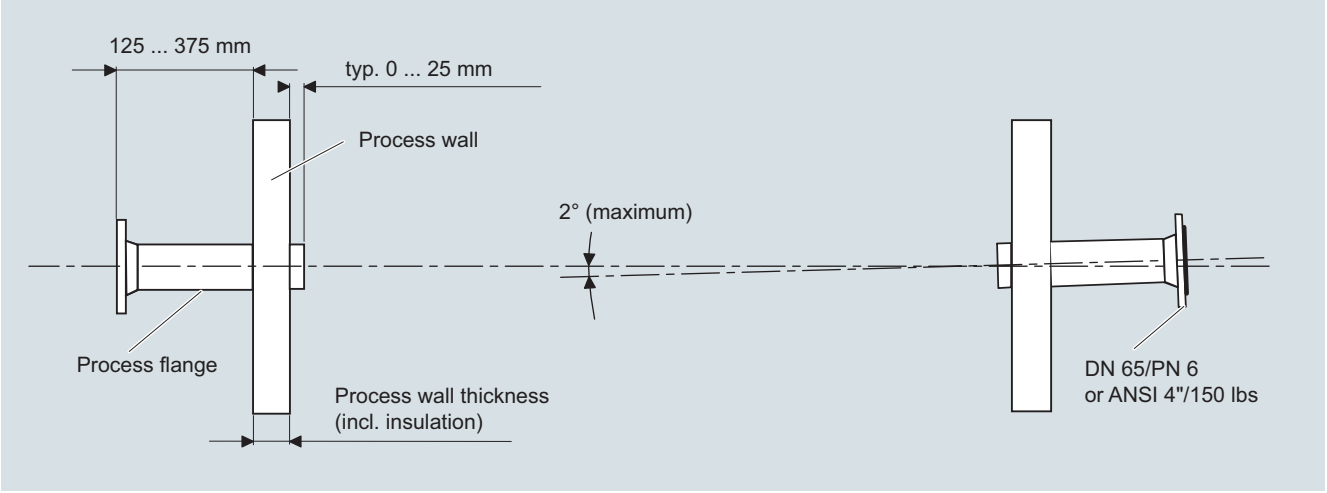
The purging media used on the process side flow through purging gas tubes into the process gas flow. The tubes extend a few centimeters into the process area, and usually receive a flow of process gas from the side. This results in a wedge being generated in the inlet zone of the purging gas. The effective 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.

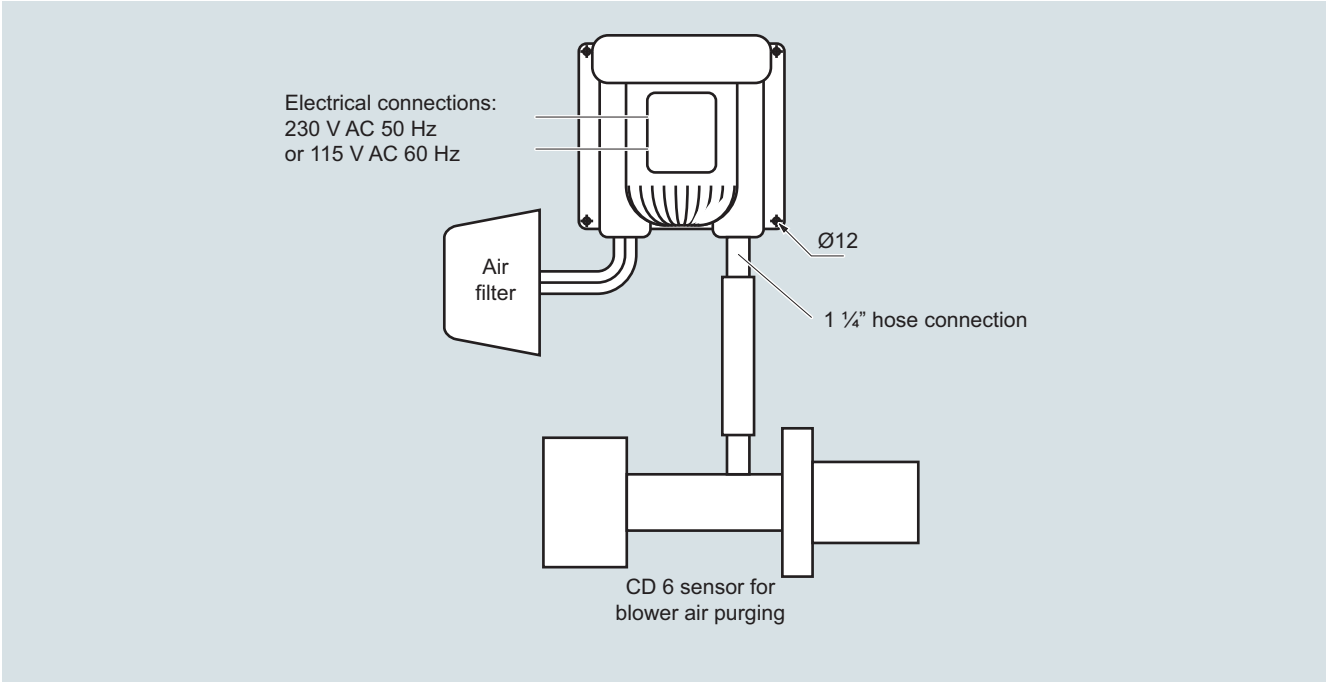


Installation requirements for the cross-duct sensors CD 6, dimensions in mm

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 with electropolished internal surfaces 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 (only for O_2-CD 6)

Serves to protect the light-sensitive detector in the receiver unit of the sensor from saturation by IR background radiation. 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 (1.4305/303), aluminum
Installation	Vertical or parallel to the gas flow
Laser protection class	Class 1, safe to the eye
Explosion protection	II 1 G Ex ia op to IIC T4 Ga II 1 D Ex ia op to IIIC T135 °C Da
	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; IECEx UL 13.0029X
Design, enclosure	
Degree of protection	IP65
Dimensions	Diameter: 163, L: 450 mm
Purging gas tube in mm	400 (370 net) x 44 x 40 800 (770 net) x 54 x 40 1 200 (1 170 net) x 54 x 40
Weight	2 x approx. 11 kg
Mounting	DN 65/PN 6, DN 80/PN 16 or ANSI 4"/150 lbs

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 between the process and environment depending on the type of assembly.

Electrical characteristics	
Power supply	24 V DC, supply from central unit via hybrid cable
Power consumption	< 2 W with non-Ex configuration, max. 0.6 W with Ex configuration
Climatic conditions	
Sensor temperature	
Non-Ex	-20 ... +70 °C in operation
	-30 ... +70 °C during transport and storage
Ex	-20 ... +60 °C in operation
	-30 ... +70 °C during transport and storage
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 (other path lengths on request)
Dust load	The influence of dust is very complex and depends on the path length and particle size. The optical attenuation increases exponentially at longer path lengths. Smaller particles also have a very large influence on the optical attenuation. 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	
• Max. overpressure in the sensor	< 500 hPa
• Quality	
- Instrument air	According to ISO 8573-1:2010 [2:3:3]
	Note: It is sufficient if the pressure condensation point is min. 10 K below the minimum ambient temperature.
- Nitrogen	Purity better than 99.7 %. For oxygen measurements, 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 (process purging)	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

Cross-duct sensor CD 6

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 fabricated at both ends with E2000 angle connectors. Multimode optical fiber configured at both ends with SMA connectors. Cable is flame-retardant, very good resistance to oil, gasoline, acids and alkalis, outer sheath UV-resistant
Cable sheath	Oil-resistant polyurethane
Dimensions	• An external power supply must be additionally ordered for > 500 m • For installation in hazardous zones, non-intrinsically-safe cables have to be spatially separated from intrinsically-safe lines
• Diameter	< 8.5 mm
• Length	• Use in non-hazardous and Ex Zone 2: Up to 700 m • Use in Ex Zone 0 and Zone 1: Up to 250 m
Weight	75 kg/km
Maximum tensile force	200 N
Maximum lateral pressure	1 000 N/cm
Impact resistance	200 N/cm
Maximum tensile strength	500 N
Minimum bending radius	12 cm
Climatic conditions	
Ambient temperature	-40 ... +70 °C during transport, storage and operation -5 ... +50 °C during cable installation
Humidity	< 95% rel. humidity, above dew point (in operation and storage)

Selection and ordering data		Article No.														
LDS 6 in-situ gas analyzer	↗	**7MB6122-**	■	■	■	■	■	-	■	■	■	■				Cannot be combined
Pair of sensors (cross-duct sensor)																
↗ Click on the Article No. for the online configuration in the PIA Life Cycle Portal.																
Explosion protection[1]																
Without			0													
II 1 G Ex ia op is IIC T4 Ga, II 1 D Ex ia op is IIIC T135 °C Da			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 to 2 l/min; incl. needle valve, 6 mm Swagelok				B											
Instrument air or N_2 Reduced flow: 0 ... 120 l/min incl. needle valve, 6 mm Swagelok	Without purging				C											
	Air or N_2, 1 to 2 l/min; incl. needle valve, 6 mm Swagelok				D											
Air or N_2 Increased flow: 200 ... 500 l/min incl. 6 mm Swagelok	Without purging				E											
	Air or N_2, 1 to 2 l/min; incl. needle valve, 6 mm Swagelok				F											
Air, fan or steam; high flow: > 500 l/min incl. 1¼" hose adapter	Without purging				G								G			
	Air or N_2, 1 to 2 l/min; incl. needle valve, 6 mm Swagelok				H									H		
Purging tubes, material																
No purging tubes						0										
Stainless steel, EN 1.4432/316L						1									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 (1.4404/316L), connection dimension DN 65/PN 6, MAWP (PS) at 20 °C: 0.05 MPa								0								0 → C12, C13
Stainless steel flange (1.4404/316L), connection dimension ANSI 4"/150 lbs, MAWP (PS) at 20 °C: 7.25 psi								1								1 → C12, C13
Stainless steel flange (1.4404/316L), connection dimension DN 65/PN 6, MAWP (PS) at 20 °C: 0.05 MPa, incl. enclosed welding flanges, e.g. for engine test rigs								2								2 → C12, C13
Pressure-resistant window flange (1.4404/316L, borosilicate glass), connection dimension DN 65/PN 6, MAWP (PS) at 20 °C: 0.6 MPa								3					3	3	3	
Pressure-resistant window flange (1.4404/316L, borosilicate glass), connection dimension DN 80/PN 16, MAWP (PS) at 20 °C: 1.6 MPa								4					4	4	4	
Pressure-resistant window flange (1.4404/316L, borosilicate glass), connection dimension ANSI 4"/150 lbs, MAWP (PS) at 20 °C: 232 psi								5					5	5	5	
Hybrid cable																
No hybrid cable									X							
Standard length																
• 5 m									A							
• 10 m									B							
• 25 m									E							
• 40 m									G							
• 50 m									H							
Customized length (specified in complete meters)									Z							

[1] Complete and consistent implementation of the safety concept by the plant operator must be ensured during the commissioning and operation of the in-situ laser spectrometer LDS6 or the sensor CD 6 in hazardous atmospheres.

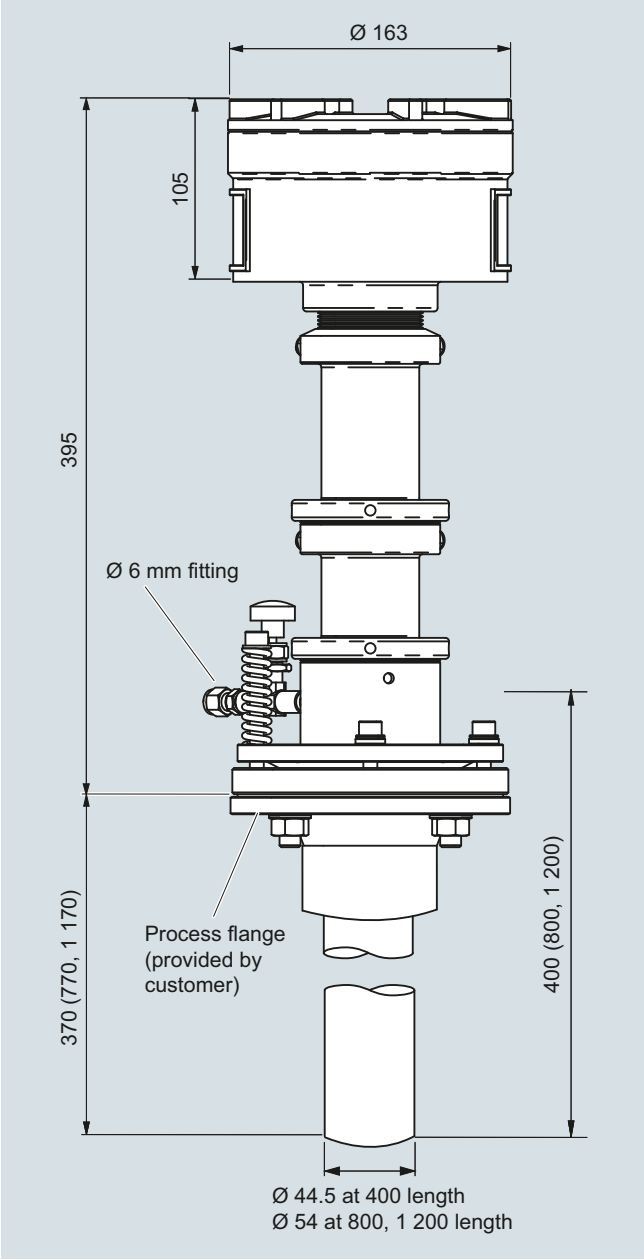
Cross-duct sensor CD 6

Selection and ordering data	Article No.	
LDS 6 in-situ gas analyzer Pair of sensors (cross-duct sensor)	**7MB6122-** ■■■■■ - ■■■■	Cannot be combined
Sensor connecting cable		
No sensor connecting cable	**X**	
Standard length		
• 5 m	**A**	
• 10 m	**B**	
• 25 m	**E**	
Customer-specific length (specified in complete meters)	**Z**	
Language (supplied documentation)		
German	**0**	
English	**1**	
French	**2**	
Spanish	**3**	
Italian	**4**	

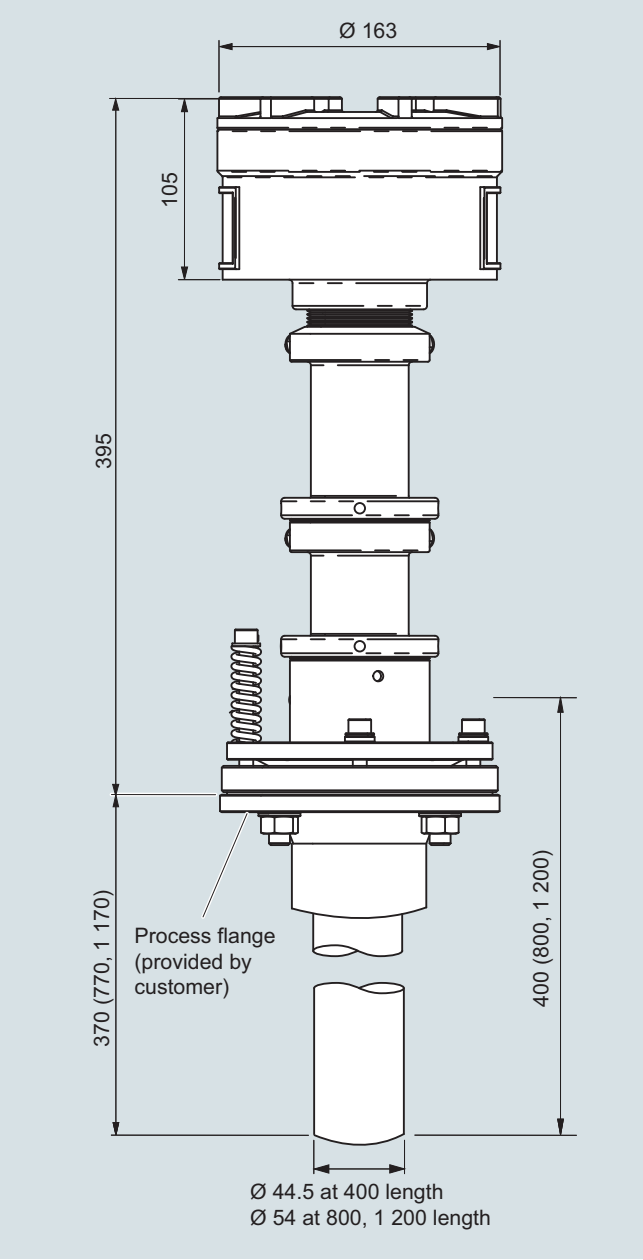
Additional versions	Order code
Add "-**Z**" to Article No. and specify order codes.	
6 mm Swagelok adapter for purging with steam, purging modes G and H	**A27**
Acceptance test certificate 3.1 (leak test) in accordance with EN 10204 (only in combination with flameproof window flanges)	**C12**
Acceptance test certificate 3.1 (material certificate) in accordance with EN 10204 (only in combination with flameproof window flanges)	**C13**
Hybrid cable, customized length	**P1Y**
Sensor cable, customized length	**Q1Y**
TAG label, customized inscription	**Y30**

Additional units	Article No.
CD 6, purging air blower 230 V / 50 Hz	**A5E00829151**
CD 6, purging air blower 115 V / 60 Hz	**A5E00829150**
CD 6, sensor alignment kit	**A5E00253142**
LDS 6, optical bandpass filter for reducing infrarot background radiation (flame filter), only for O_2	**A5E00534668**

Dimensional drawings

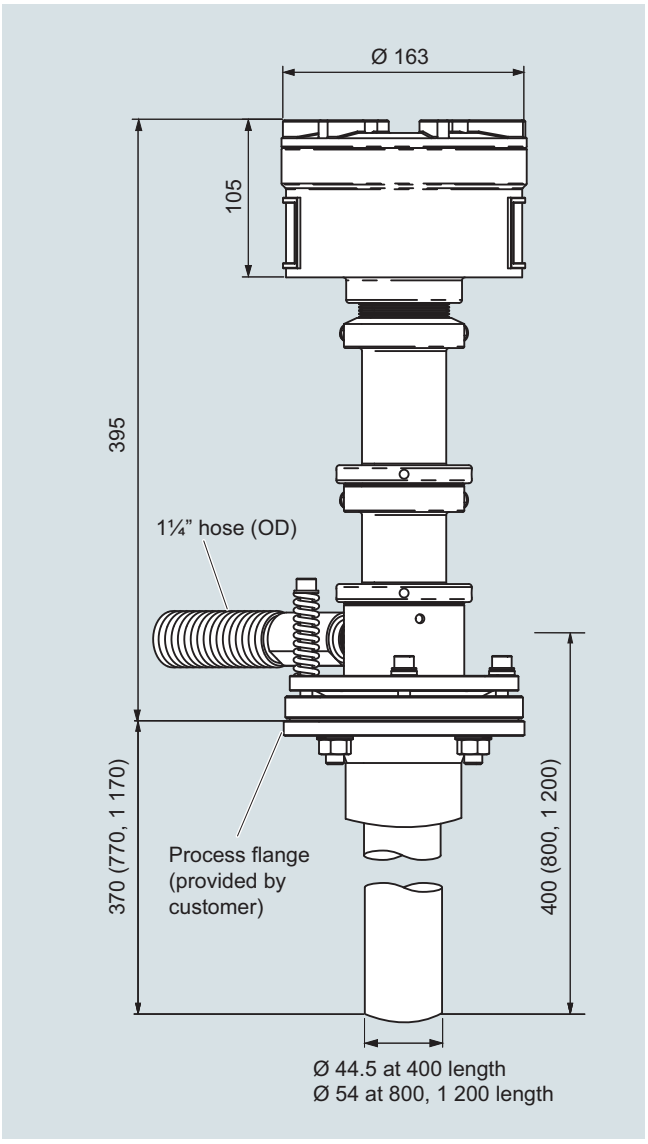


Cross-duct sensor CD 6, moderate purging (instrument air), version according to Order No. 7MB6122-**C1*-0***, dimensions in mm

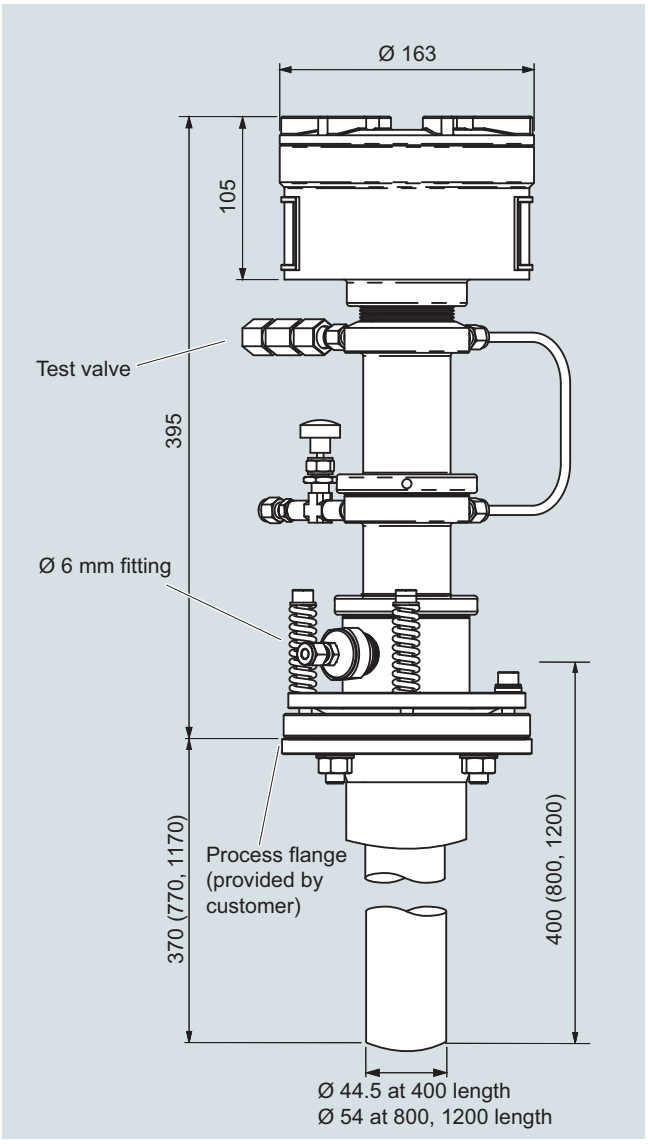


Cross-duct sensor CD 6, increased purging (instrument air), version according to Order No. 7MB6122-**E1*-0***, dimensions in mm

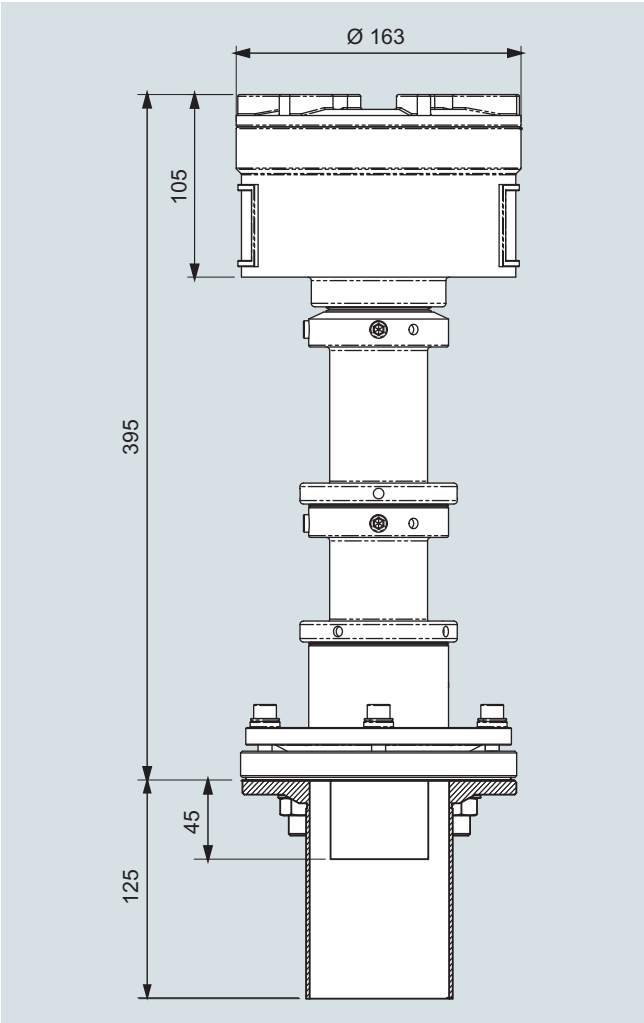
Cross-duct sensor CD 6



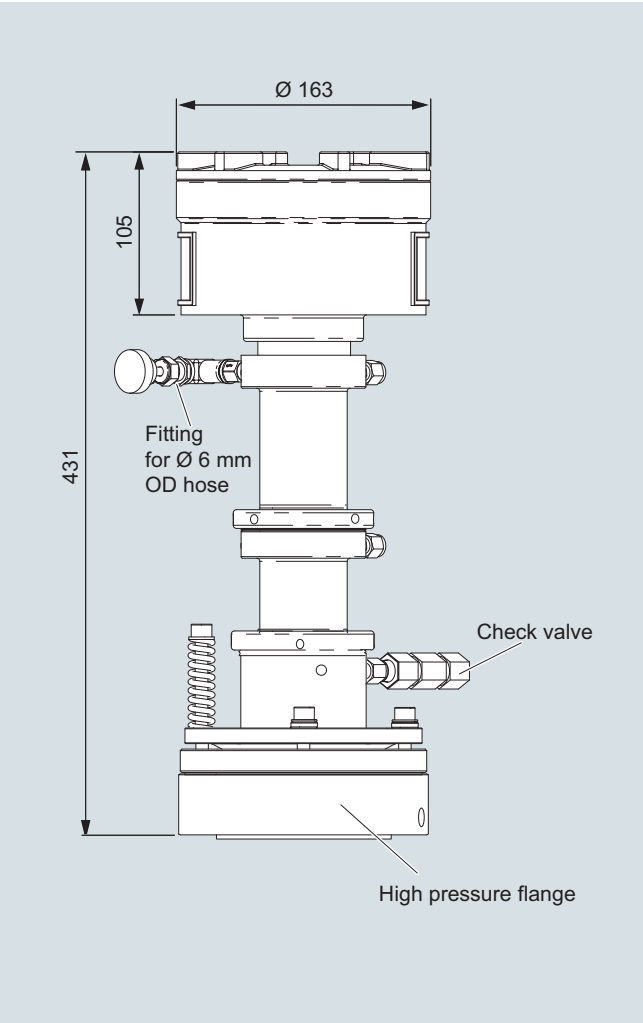
Cross-duct sensor CD 6, blower purging, version according to Order No. 7MB6122-**G1*-0***, dimensions in mm



Cross-duct sensor CD 6, sensor and process side purging, version according to Order No. 7MB6122-**H1*-0***-Z A27, dimensions in mm



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

Selection and ordering data

Manual	Article No.
LDS 6 manual	
• German	**A5E00295893**
• English	**A5E00295894**
• French	**A5E00295895**
• Italian	**A5E00295896**
• Spanish	**A5E00362720**

More information

The complete documentation is available in various languages for downloading free of charge:
http://www.siemens.com/processanalytics/documentation

Selection and ordering data

Description	Quantity for 2 years	Quantity for 5 years	Article 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 (1.4404/316L), DN 65/PN 6	1	2	**A5E00534662**
CD 6, high-pressure window flange (1.4404/316L), DN 80/PN 16	1	2	**A5E00534663**
CD 6, high-pressure window flange (1.4404/316L), ANSI 4"/150 lbs	1	2	**A5E00534664**
Gasket for CD 6 hybrid cable	1	2	**A5E00853911**
CD 6, sensor electronics FO InGaAs (version 2)	1	1	**A5E01090409**
CD 6, sensor electronics FO Ge, only HCl (version 2)	1	1	**A5E01090413**
CD 6, sensor electronics SW, only O_2	1	1	**A5E00338533**
CD 6, sensor electronics ATEX SW, only O_2	1	1	**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	**A5E00338572**
CD 6, purging tube 400 mm 1.4432/316L	1	2	**A5E00253111**
CD 6, purging tube 800 mm 1.4432/316L	1	2	**A5E00253112**
CD 6, purging tube 1200 mm 1.4432/316L	1	2	**A5E00253113**

More information

For demanding applications it is recommended to keep purging tubes, window modules and detector electronics in stock (quantities stated per measuring point, i.e. per pair of sensors).

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.