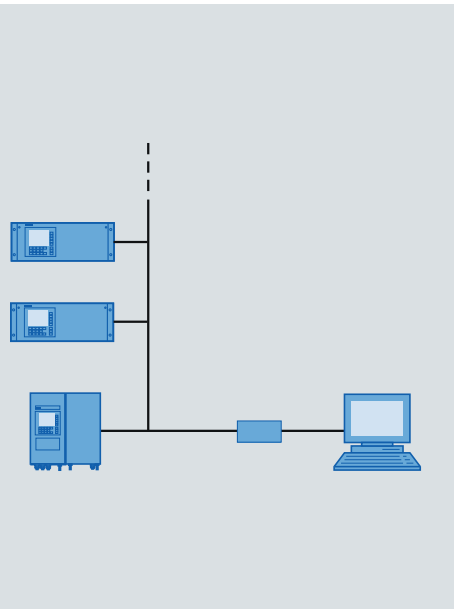
General information

5



Overview

Reliable functioning of analyzers is of decisive importance for process control. It is necessary to record, correct and transmit measured values, to set and modify parameters, to check functions, to update calibrations, and to scan status signals e.g. for preventive maintenance. Communication between the operator and device is therefore an important part of process analysis, and the offered facilities have become a decisive performance feature of analyzers.

Extractive

The gas analyzers of Series 6 (ULTRAMAT 6, ULTRAMAT/OXYMAT 6, OXYMAT 6, OXYMAT 61, FIDAMAT 6 and CALOMAT 6) as well as the ULTRAMAT 23 offer the following communications facilities in addition to data transmission over analog and binary outputs:

- RS 485 interface
- SIPROM GA
- PROFIBUS DP/PA
- Generic communications interface (only OXYMAT 6, ULTRAMAT 6 and ULTRAMAT/OXYMAT 6).

RS 485 interface

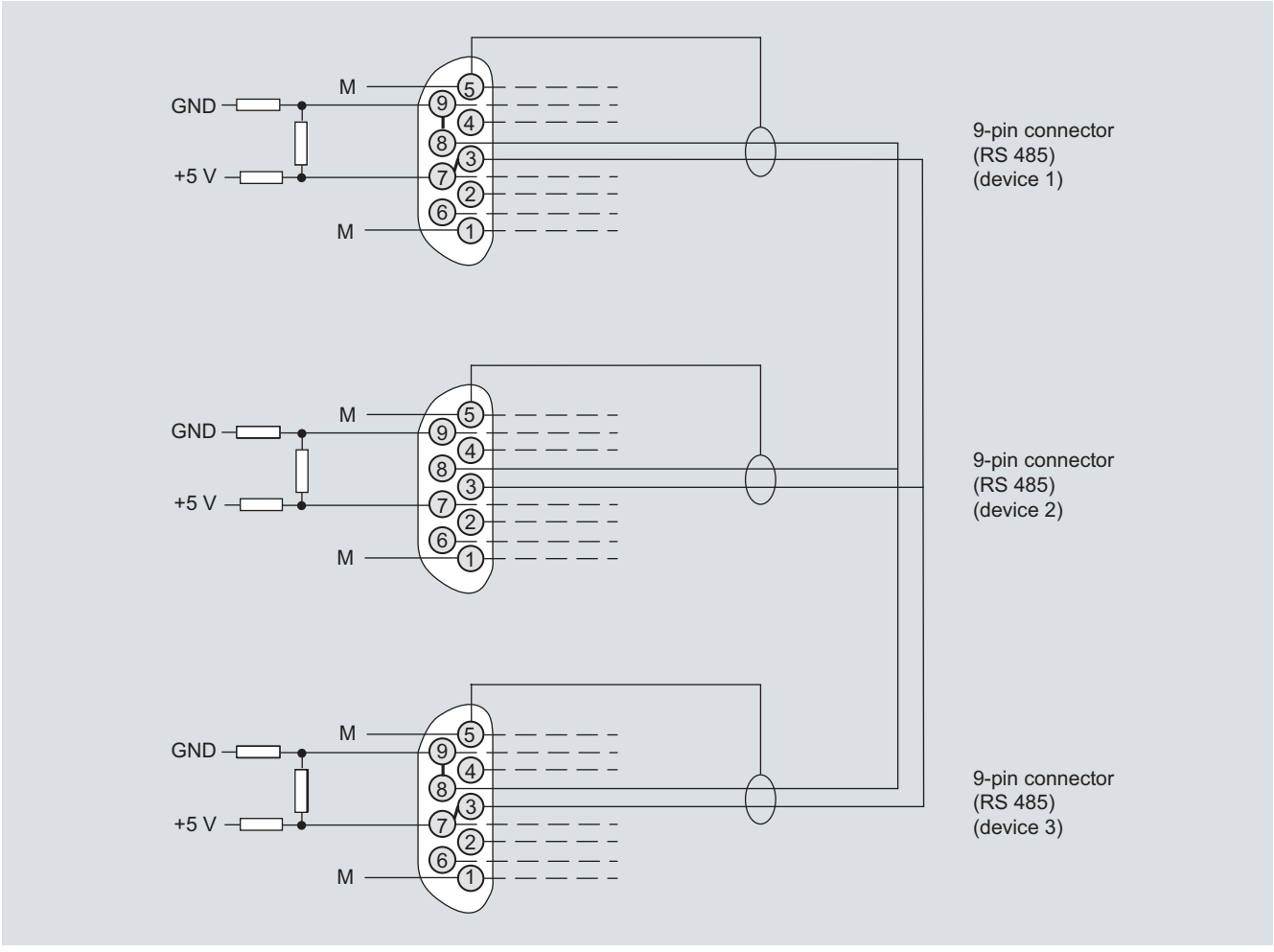
The serial interface integrated as standard permits communication between several analyzers over the internal bus (ELAN). Parameterization is carried out using the analyzer's menu.

Networking over ELAN

ELAN communication is used e.g. for the correction of cross-interference. Direct connection is only possible between Siemens gas analyzers.

Specification for the interface cable

Surge impedance	100 ... 300 Ω, with a measuring frequency of > 100 kHz
Cable capacitance	Typ. < 60 pF/m
Core cross-section	> 0.22 mm^2, corresponds to AWG 23
Cable type	Twisted pair, 1 x 2 conductors of cable section
Signal attenuation	Max. 9 dB over the whole length
Shielding	Copper braided shield or braided shield and foil shield
Connection	Pin 3 and pin 8



Bus cable with plug connections, ELAN networking

Bus terminating resistors

Pins 3-7 and 8-9 of the first connector of a bus cable must be bridged (ELAN networking).

Note

It is advisable to install a repeater on the device side in the case of a cable length of more than 500 m or with high interferences.

Networking with SIPROM GA

When used externally, the RS 485 interface requires software matched to the analyzers, e.g. SIPROM GA.

SIPROM GA is a software program for communication between PC/laptop and analyzers. A maximum of 12 devices (electronics modules) with up to four channels/measured components of the following type can be connected, displayed and remote-controlled per COM interface:

- OXYMAT 6/61
- OXYMAT 64
- ULTRAMAT 6
- CALOMAT 6
- CALOMAT 62
- FIDAMAT 6
- ULTRAMAT 23

SIPROM GA allows access to device parameters, right up to the configuration of devices. All analyzer functions (except factory default functions) can be remote-controlled and monitored in this manner. SIPROM GA is therefore an ideal servicing and maintenance tool for Siemens gas analyzers.

In addition to remote control of all operator functions, SIPROM GA offers complete access to all diagnostics data. SIPROM GA therefore permits preventive maintenance as well as fast responses when maintenance becomes necessary or when the production sequence is changed.

SIPROM GA ensures:

- High operational reliability
- High availability
- Central, comprehensive information
- Fast response time
- Flexibility
- Economical system integration

In addition to output of TAG No., components, current measured values, comprehensive diagnostics information (status) and parameter settings on the analyzer display, SIPROM GA also offers the following features:

- Bargraph display
- Recorder display of one or more measured values with printer output
- Calibration functions (adjustment of all setpoints for calibration, remote calibration)
- Saving of all device data
- Remote control of all device functions
- Remote calibration
- Online help
- Downloading of new device firmware
- Cyclic saving of measured values on hard disk
- Writing user data to the device's EEPROM, or downloading data from it.

Access to the analyzers using SIPROM GA is carried out either:

- Directly from the PC over an RS 485 interface or
- Over an Ethernet gateway

Hardware requirements

The following hardware and system requirements must be provided for the PC/laptop configuration in order to use SIPROM GA:

- Windows computer with Pentium 133 MHz and 32 MB RAM: Recommendation: Pentium II 266 MHz and 64 MB RAM
- CD-ROM drive (for installation)
- Vacant hard disk capacity of at least 10 MB
- VGA graphics card (Windows-supported); resolution: 1024 x 768
- Printer (Windows-supported)
- MS-Windows 95, ME; NT 4, Windows 98, Windows 2000 or Windows XP operating system
- Vacant COM port (COM 1, 2 ...)
  - The RS 485 / RS 232 interface converter is required for coupling to the RS 485 ELAN network
  - A standard 10-Mbit or 100-Mbit network (RJ45 connection) with TCP/ IP is required for connecting the Ethernet / RS 485 interface converter

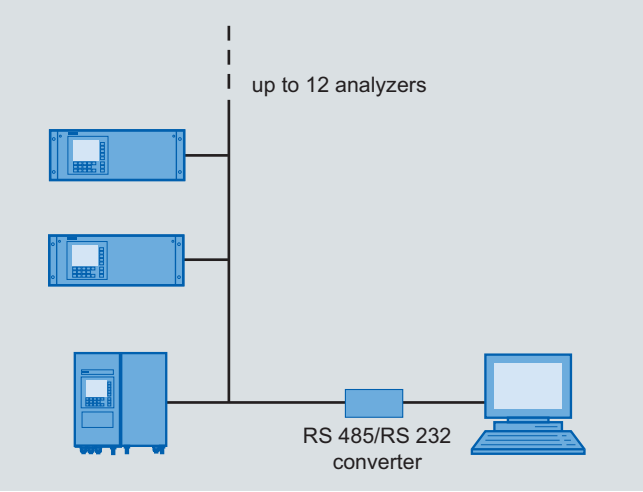
Accessories for the network

For cables, connectors, repeaters etc., see Catalog IK PI or CA 01 on the Mall under SIMATIC NET communications systems/PROFIBUS/network components.

Networking with SIPROM GA via converter

Up to 12 analyzers with max. four components each can be networked.

The functional principle is shown in the following illustration.



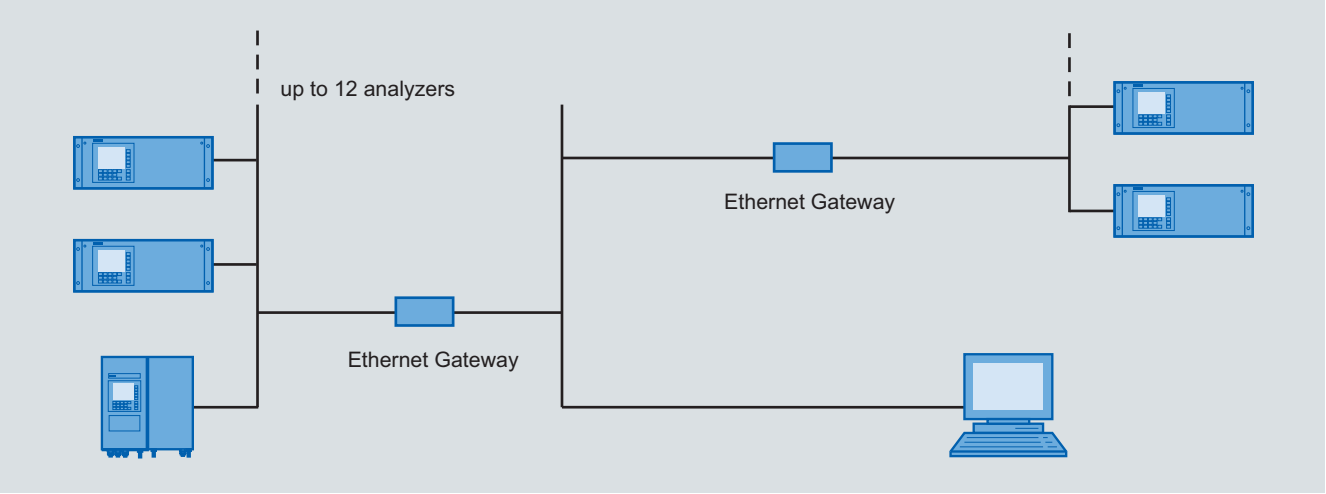
Typical design of an RS 485 network with SIPROM GA

The gas analyzers can be installed at distances up to 500 m. One network can be connected to each COM port.

Continuous gas analysis

Networking with SIPROM GA via Ethernet

When networking with Ethernet, there are no limitations for the distance between PC and gateway. In addition, communication over Ethernet permits connection of several gateways to one COM port, and thus the possibility for monitoring and operating several widely distributed or separately installed analyzers/systems from one station.



Typical design of an RS 485 Ethernet network with SIPROM GA

PROFIBUS

The usual transmission of measured values and fault messages via analog and binary outputs requires complex cabling. On the other hand, when using PROFIBUS DP and PROFIBUS PA, one single two-wire conductor is sufficient for digital transmission e.g. of all measured values (also from several channels), status information or diagnostics functions for preventive maintenance.

The PROFIBUS DP version with its high transmission rate for relatively small data quantities per device is widely used in production automation, whereas PROFIBUS PA takes into account the features important for process engineering, e.g. large data quantities and use in hazardous areas.

The limited dynamic performance of 4 to 20 mA mA signals can be replaced, the laborious configuring of measuring ranges can be omitted. By using simulated measured values without media, increased safety can be provided for the plant configuration, and configuration errors can be avoided. Parameter sets can be generated offline (from your desk) and subsequently downloaded and saved in the device. Local operations can thus be reduced to a minimum.

The Siemens gas analyzers

- OXYMAT 6/61
- OXYMAT 64
- ULTRAMAT 23
- ULTRAMAT 6
- CALOMAT 6
- CALOMAT 62
- FIDAMAT 6

are PROFIBUS-compatible when using an optional plug-in card (retrofitting also possible) and therefore comply with the "Device profile for analyzers" defined as binding by PI (PROFIBUS International).

Customer benefits include an enormous savings potential in all plant areas, covering configuration and commissioning, operation and maintenance, up to subsequent plant expansions.

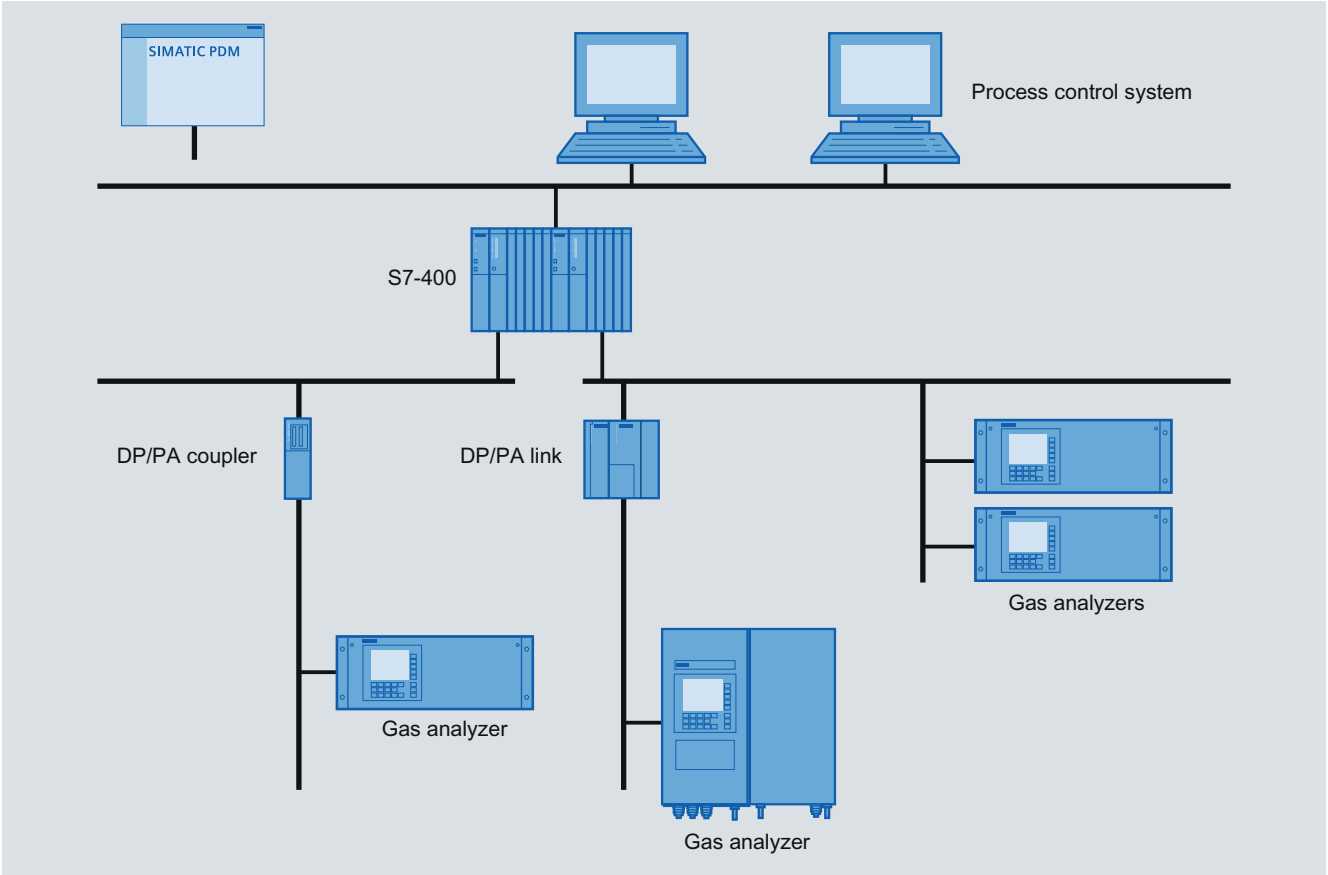
Operation of the gas analyzers from a control system or a separate PC is possible using the SIMATIC PDM (Process Device Manager); this is software which executes under Windows and which can also be integrated into the SIMATIC PCS 7 process control system. This permits a clear presentation for integration of the analyzers in the system as well as for the complex parameter structure of the analyzers.

Direct connection of the analyzers to a control system is also possible without PDM, e.g. using STEP7, but this necessitates additional programming and offers less user friendliness. In most cases, this direct connection is therefore only applicable if acyclic (device operation) data are not used.

A differentiation is made between cyclic and acyclic services. Cyclic services are used to transmit time-critical data such as measured values and statuses. Acyclic services permit scanning or modification of device parameters during operation.

Both graphic displays and values can be output on a PC. Signaling of maintenance, fault and diagnostics information is also cyclic. These data are displayed in plain text when using SIMATIC PDM.

The binary outputs can also be switched using cyclic services, thus also permitting triggering of relays over PROFIBUS (e.g. for measuring point switchover, calibration etc.).



Schematic structure of a PROFIBUS system

Continuous gas analysis

The following acyclic device parameters and configurations can be used in PROFIBUS DP and PROFIBUS PA by means of SIMATIC PDM:

- Factory data
- Diagnostics values
- Logbook
- Display measuring ranges
- Zero calibration
- Sensitivity calibration
- Setpoints for zero/sensitivity
- Total/single calibration and AUTOCAL
- Select measuring ranges
- Define measuring ranges
- Electric time constants
- On/off functions
- Chopper frequency
- Magnetic field frequency
- Date/time
- Measuring point switchover
- Logbook settings
- Relay assignment
- Binary inputs
- Reset
- Save/load data
- Suppression of short noise signals
- Calibration tolerances
- Switch valves
- PROFIBUS configuration

Use of PROFIBUS offers the following customer benefits:

- Cost reductions for planning, installation and operation
- Use of (distributed) device intelligence
- Replaceability of devices
- Only one cable for everything, no complex cabling
- No limited 4 to 20 mA resolution
- No laborious parameterization of measuring ranges
- Simulation of measured values
- Simplification of commissioning
- Testing of network/AS
- Avoidance of errors during startup
- Online diagnostics
- Offline parameterization

Generic communications interface
(only OXYMAT 6, ULTRAMAT 6 and ULTRAMAT/OXYMAT 6)

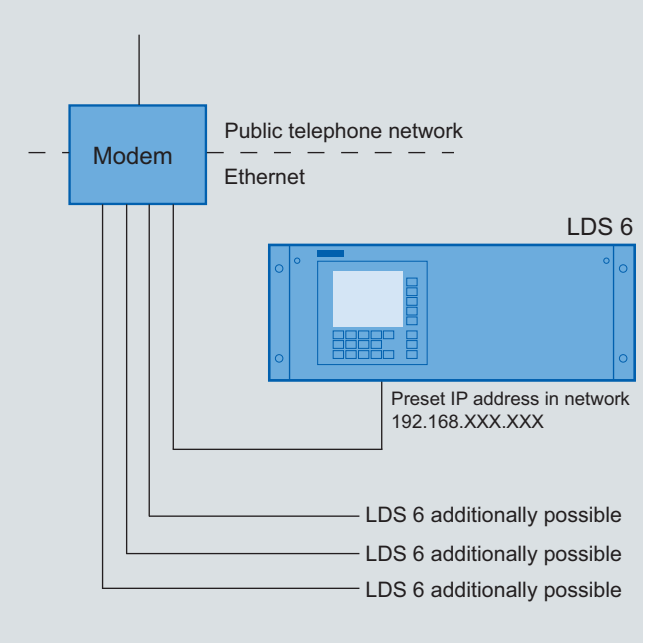
User benefits are offered thanks to numerous functions which are mainly required in the automotive industry, for example to carry out repeated linearization. In contrast to PROFIBUS and ELAN, communication is only possible between one device and one PC, and takes place according to the master/slave principle. The device only transmits data when requested by a command telegram, where only one command can be processed and replied to at a time.

The generic communications menu can be called using *Function88*, and the parameters adjusted.

Continuous gas analysis/in-situ

LDS 6 can send and receive data over an Ethernet connection together with the LDScom software. This installation and service tool is able to check and adapt device status and calibration parameters from a remote location. If necessary, even a complete system check can be carried out over the remote connection. If servicing is necessary, the required information can be sent to the Siemens service engineer by modem, and he can then carry out the appropriate measures from the remote location.

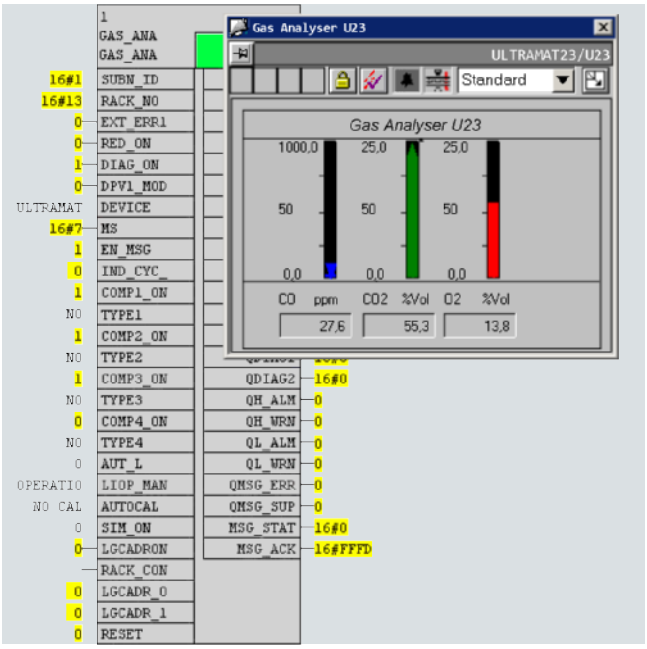
This facility for remote maintenance and diagnostics is implemented using a standard LAN modem.



External connection of LDS 6 via a modem for implementing remote maintenance measures

Overview

PCS 7 Add-on fit for SIMATIC PCS 7 V7



The driver blocks from the gas analysis library permit integration of the following gas analyzers into the SIMATIC PCS 7 process control system over PROFIBUS DP:

- ULTRAMAT 6 and ULTRAMAT 23
- CALOMAT
- OXYMAT

The driver blocks permit access to the measured values and to the calibration functions of these devices. They can also be used to evaluate and display diagnostics information, and to trigger alarms if necessary.

Note:

The gas analysis library can be used together with SIMATIC PCS 7 V6 and V7.

Function

Driver blocks

The gas analyzers are integrated into the hardware configuration of the SIMATIC PCS 7 process control system using their GSD files. Parameterization of the driver blocks is subsequently carried out corresponding to the device configuration. The driver blocks provide the following functions:

- Reading of analyzer values
- Starting of autocalibration
- Evaluation of device-specific diagnostics
- Standard diagnostics
- Alarms for analyzer values (alarm limits adjustable on the block)
- Simulation

Symbols and faceplates

The symbols are automatically created and connected using the wizard "Create block symbols". The faceplates can be displayed in various views:

- Standard
- Maintenance
- Configuration
- Limits
- Trend
- Alarm

More information

Please contact your Siemens sales partner for further information and for ordering.

Process gas chromatography

Overview

The MAXUM edition II and MicroSAM gas chromatographs can transfer measured results and status information to process control systems, operator panels or printers during operation.

Interfaces

Chromatograph, operator panel, printer and control system use special electronic interfaces:

- Electrical connection
  The device interfaces are connected by electric cables.
  The electrical properties of the interfaces are standardized.
- Control of communication and language
  Rules must be observed to control the communication. It must be clearly defined in networks who is the "sender" and who is the "receiver" of the data. Both communication partners must use the same protocol.

MODBUS

MODBUS is a rule for controlling data transfer between two computer systems - a transmission protocol. MODBUS is the "de facto" industry standard for connecting measuring and control devices to process control systems (PCS). Most process control systems can be equipped with serial interfaces and MODBUS.

Using the MODBUS coupling, information can be sent interference-proof via just one data line. Information can be read from process gas chromatographs (PGC), and certain functions of the PGC can also be parameterized.

Advantages:

- Information on the PGC status during operation
- Supply of protected data in numerical form without falsification by interfering pulses
- Reduced cabling overhead

The MODBUS coupling can:

- Transmit measured values
- Transmit status information
- Output information on the current analysis
- Trigger control functions

The MODBUS uses a master/slave transmission procedure. The control system is always the master, the process gas chromatograph is the slave.

The representation of data in the message frames is based on the compact RTU format.

Memory division

To ensure that the meaning of the registers is known to each network station, this must be defined in the configuration. The results of each component in each sample must be written into defined positions in the PCS memory. These address declarations depend on the number of chromatographs, samples and components. The same applies to status, sample sequence and sample release. Standard addresses are also defined in these cases.

OPC server (OLE for Process Control)

OPC is a vendor-independent software interface. It allows standardized access from Windows applications to chromatograph data. OPC corresponds to a typical client/server architecture.

OPC allows a universal connection between any Windows application which supports an OPC client interface and the MAXUM edition II / MicroSam.

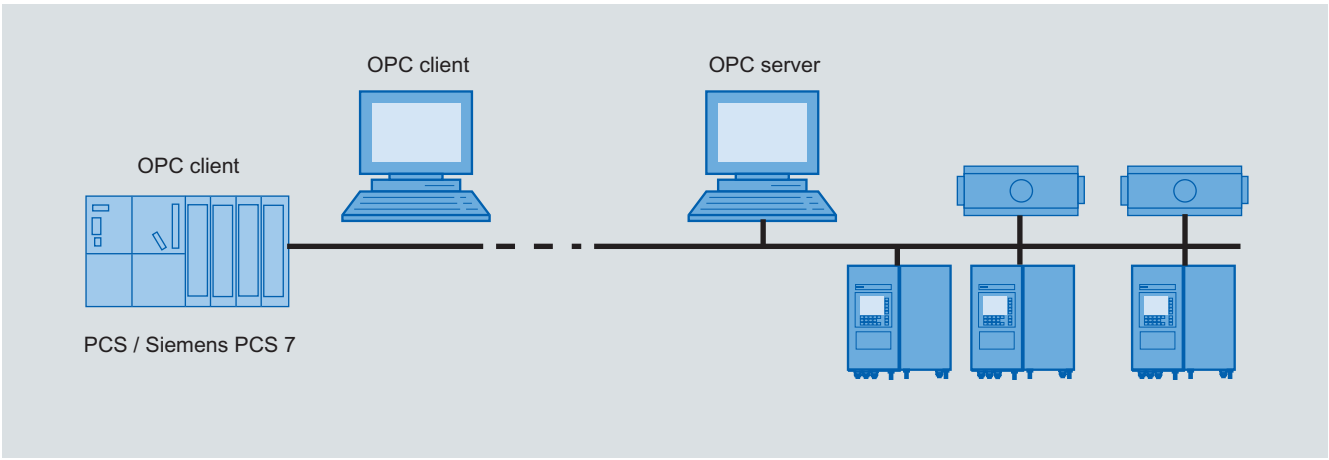
The OPC server is usually installed on a separate PC.

OPC is a modern alternative to MODBUS. MAXUM edition II and MicroSAM do not require an additional interface, they use the existing Ethernet connection (TCP/IP).

OPC standardizes the access to measured values, status functions, control functions and analytical data in a manner similar to MODBUS.

Advantages with OPC applications:

- Reduced maintenance costs
- Simple GUI for configuration
- Reduced system integration costs
- Reduced test costs
- Reduced maintenance costs



OPC server

Hardware components

NAU - Network Access Unit

An NAU expands and supplements a GC network, and has three fundamental functions:

- Enclosure for 7 additional I/O plug-in cards
- Connection of serial ASCII printers and external host PCs (control system)
- Central operation of a GC network from one point

The Network Access Unit (NAU) is an input/output station for the Siemens process chromatographs. It can be used to centrally call, process and pass on data. It is used if it is not possible to connect the electronics close to the analyzer, if the number of MicroSam inputs/outputs is insufficient, or if installation in a central control room is required. This significantly reduces the required wiring to the control room.

The NAU can also be used as a central control unit for function testing, data output and parameterization of the MicroSam. It permits access to the MicroSam to which it is connected, as well as to all other Siemens gas chromatographs and further NAUs of the system which are networked over the system bus.

The NAU is connected to the Ethernet or DataNet and has a total of 7 slots to accommodate a wide range of electronics cards. These comprise cards for analog and digital signal processing as well as interfaces for host computers and process control systems. An NAU can be expanded by a further 10 slots using a CAN Extension Unit.

A total of 7 different electronics cards are available:

• Input/output module	8 analog outputs
• Input/output module	4 digital outputs, 4 digital inputs
• Input/output module	2 digital outputs, 2 digital inputs, 2 analog outputs, 2 analog inputs
• Communication module	10 Base FO Ethernet (fiber-optic coupling)
• Communication module	DataNET Copper (redundant system bus)
• Communication module	DataNET Fiber Optic
• Communication module	Advanced Data Highway (OptiCHROMe Advance coupling)

CEU - CAN Extension Unit (only MAXUM edition II)

- Increases the I/O capacity of the GC or NAU
- 10 additional I/O plug-in cards
- Has its own power supply
- Also for zone 1

ANG - Advance Network Gateway

Connects OptiCHROMs to the Ethernet network.

DNH - DataNET Hub

Communications router completely redundant in the network: has 2 own TCP/IP addresses, dual electronics and power supply.

ANCB - Advance Network Communication Board

Converts the communications protocols in the device

Two versions:

- MAXUM directly to DataNET
- MAXUM directly to OptiCHROM data highway

Software

Modern chromatographs are controlled by microprocessors. We differentiate between software in the device and software on a PC operator panel.

Software in the chromatograph

The chromatograph can carry out analyses independently, without an operator panel being connected. It then requires its own control software and local operating software (HMI).

Software in the operator panel (PC)

Siemens gas chromatographs can be operated over Ethernet and a PC, by using the built-in control panel (HMI), or with a Network Extension Unit (NAU).

Workstation software

The most important programs this contains are the MAXUM System Manager, the MAXUM EZChrom and the HMI-Emulation. In addition, it contains useful MAXUM utilities and loadable extensions such as:

MaxBasic

For modification of MaxBasic programs in the gas chromatographs or the NAU.

MAXUM OPC Server

For coupling of the MAXUM e.g. to control systems.

Simulated Distillation

For import/export of methods for simulated distillation.

MAXUM System Tools

For data logging, for firmware updating, or for operation of discontinued OptiCHROMs (APC 8.0).

Different levels of operation

Operation of the PC is in three levels:

- System Manager - network monitoring and configuration of the chromatograph
- EZChrom - method development and control of analysis
- MMI emulation - operator control and monitoring

System Manager:
Configuration of database and applications

The System Manager provides the connection to the chromatograph as well as an overview of the network.

It is additionally used for configuration and high-level monitoring of the chromatograph, and additionally branches to the MMI emulation, EZ Chrom and Basic editor.

The System Manager almost exclusively outputs static displays, i.e. it fetches a table from the chromatograph's database, and saves it again there later. Only results and alarms are displayed dynamically.

The System Manager presents the hardware in tables, e.g. the system table contains all hardware components of the chromatograph: detectors, valves, ovens, digital outputs, etc.

In addition, the System Manager can:

- Save databases of a chromatograph as a file on the PC, or load them from the PC into the chromatograph.
- Upgrade the chromatograph software.
- Call EZChrom, MMI emulation, Datalogger or the MaxBasic editor.

Process gas chromatography

EZChrom:
Generate methods and sample sequences

The EZChrom software is installed on the PC and is also included in the operator software in the chromatograph, e.g. it integrates the detector signals there, calculates the results, or switches time-controlled events.

EZChrom on the PC is responsible for the following tasks:

- Generate or modify methods
- Carry out re-integration
- Calibrate a method
- Display and print saved and real-time chromatograms
- Archive chromatograms
- Generate and modify sample flow sequences
- View analysis clock
- Switch the chromatograph to Run or Hold.

MMI emulation: Operator control and monitoring

This is identical to operation on the built-in control panel of a MAXUM or an NAU. It is used for operator control and monitoring. For example, it is possible to display results, switch valves or modify temperatures. However, there are only minimum possibilities for editing the configuration and tables. The MMI is always a dynamic display.

APC 8.0

This is an interface to the OptiCHROM Advance gas chromatographs. It is started from the MAXUM System Manager. It permits operation of older types of chromatograph via a PCI card.

The following can be executed with APC 8.0:

- Service panel emulation on the PC
- Data logging
- Viewing of chromatograms
- Editing of tables in OptiCHROM.

GC-Tools operating software

GC-Tools is the Windows-based operating software for discontinued Siemens gas chromatographs of Series 202 and 302. This software expands the BEDI operating software, which is based on MS-DOS.

The Network Explorer shows all information at the device level, e.g.:

- Chromatogram display
- Manual control of all parameters
- Drivers for the four serial interfaces of the chromatograph

Main menu	No.	Function designation	Manual	SIPROM GA	PA/DP V1.6.0	PA/DP V2.0.0
Diagnostics	1	Factory data	X	X	X	X
	2	Diagnostic values	X	X	—	X
	3	Log book	X	X	—	X
	4	Display measuring ranges	X	X	—	X
Calibration	20	Zero calibration	X	X	—	X
	21	Sensitivity calibration	X	X	—	X
	22	Zero point/sensitivity setpoints	X	X	—	X
	23	Total/individual calibration	X	X	—	X
	24	AUTOCAL	X	X	X	X
	25	Drift values	X	X	—	—
	26	Calibration with air (**OXYMAT 64** only)	X	—	—	—
Measuring ranges (Code 1)	40	Select measuring ranges	X	X	—	X
	41	Define measuring ranges	X	X	—	X
Parameter (Code 1)	50	Electrical time constants	X	X	—	X
	51	Limit values	X	X	—	—
	52	On/off functions	X	—	—	X
	53	Status messages	X	X	—	—
	54	Graphical measured value representation	X	X	—	—
	55	Measured-value display	X	X	—	—
	56	LCD contrast	X	—	—	—
	57	Chopper frequency (**ULTRAMAT 6** only) Magnetic field frequency (**OXYMAT 6** only) Flame ignition (**FIDAMAT 6** only)	X	X	—	X
	58	Date/time	X	X	—	X
	59	Measuring point switchover	X	X	—	—
	60	Log book settings	X	—	—	X
	61	Vibration compensation (**OXYMAT 6** only) Switch internal valves (**FIDAMAT 6** only)	X	X	—	X
	62	Switch external pressures (**FIDAMAT 6 "without pump"** only)	X	X	—	X
Configuration (Code 2)	70	Analog output	X	X	—	—
	71	Relay assignment	X	X	—	X
	72	Binary inputs	X	X	—	X
	73	ELAN configuration	X	X	—	—
	74	Reset	X	X	—	X
	75	Save, load data	X	X	—	X
	76	Suppression of short noise signals	X	X	—	X
	77	Measured value memory (analog output)	X	X	—	—
	78	Calibration tolerances	X	X	—	X
	79	Change codes	X	X	—	—
	80	Unit test	X	X	—	—
	81	Language selection	X	X	—	—
	82	Pressure correction (**ULTRAMAT 6, OXYMAT 6, OXYMAT 64 and CALOMAT 62** only)	X	X	—	—
	83	Correction of cross-interference	X	X	—	—
	84	Phase calibration (**ULTRAMAT 6** and **OXYMAT 6** only)	X	—	—	—
	85	Switch valves	X	—	—	—
	86	Linear temperature compensation	X	X	—	—
	87	Fault on/off	X	—	—	—
	88	AK configuration (**ULTRAMAT 6 and OXYMAT 6** only)	X	—	—	—
	89	Sample chamber heating (**ULTRAMAT 6, OXYMAT 6 and CALOMAT 62** only)	X	X	—	—
	90	PROFIBUS configuration	X	X	X	X
	91	Startup state (**FIDAMAT 6** only)	X	X	—	—
	92	Pressure values (**FIDAMAT 6** only)	X	X	—	—
	93	Units (**FIDAMAT 6** only)	X	—	—	—
	—	Control of external valves	—	—	—	X
	—	Software download	—	X	—	—

FAT & factory certificates

Selection and ordering data	Order No.	
FAT & factory certificates for extractive gas analyzers of Series 6 and ULTRAMAT 23	**7MB8100-** ■■■■■ - ■■■■	not applicable for
Factory acceptance (FAT) with customer		
Visual inspection and basic settings		
None	**0**	
Visual acceptance, 1 to 8 devices, incl. function test and calibration	**1**	
Visual acceptance, 9 devices and more, incl. function test and calibration	**2**	
Measured signal response		
None	**A**	
Noise, drift	**B**	
Noise, drift, linearity, T_{90} time	**C**	
Compensation, cross-interference		
None	**A**	
Pressure compensation	**B**	FIDAMAT
1 interfering gas	**C**	
2 ... 3 interfering gases	**D**	
Pressure compensation and 1 interfering gas	**E**	FIDAMAT
Pressure compensation and 2 or 3 interfering gases	**F**	FIDAMAT
Factory acceptance, explosion protection		
None	**0**	
Pressurized enclosure for explosion-proof units (functionality)	**1**	19" rack units
Relay test	**2**	
Pressurized enclosure for explosion-proof units and relay test	**3**	19" rack units
Number of test channels		
None	**0**	
1 ... 3	**2**	
4 ... 6	**3**	
7+	**4**	
Certificates		
General certificates		
Factory certificate DIN EN 10204 2.1 (quality test certificate)[1]	**0**	
Adjustment certificate DIN EN 10204 3.1 (with calibration gas)	**1**	
Certificate of origin[1]	**2**	
Certificate of origin and adjustment certificate	**3**	
Certificate of origin and factory certificate DIN EN 10204 2.1[1]	**4**	
Certificate of origin, adjustment certificate and factory certificate DIN EN 10204 2.1	**5**	
Adjustment certificate and factory certificate EN 10204 2.1	**6**	
Factory certificate EN 10207 2.1 following repair	**7**	
Parameter sheets (only with suffix Y22)	**8**	
Factory certificate DIN EN 10204 2.2		
None	**A**	
Noise, drift, linearity	**B**	
Noise, drift, linearity, pressure compensation	**C**	FIDAMAT
Noise, drift, linearity, pressure and temperature compensation	**D**	FIDAMAT
Factory certificate DIN EN 10204 2.2, extended		
none	**A**	
Cross-interference of residual gases (H_2O and 2 other gases)	**B**	
T_{90} time	**C**	
Influence of atmosphere containing CO_2	**D**	
Cross-interference of residual gases[2] and T_{90} time	**E**	
Cross-interference of residual gases[2] and influence of atmosphere containing CO_2	**F**	
T_{90} time and influence of atmosphere containing CO_2	**G**	
Cross-interference of residual gases[2], T_{90} time and influence of atmosphere containing CO_2	**H**	
Factory certificate DIN EN 10204 2.2, language		
German	**0**	
English	**1**	
French	**2**	
Required analyzer information	**Order code**	
Add "-Z" to Order No. and specify order codes.		
Information on product/order with order item and contact partner (Sales Region, region or distributor)	**Y22**	

[1] Can also be ordered following delivery

[2] H_2O and 2 other gases

Overview

Use of Series 6 in hazardous areas

Dependent on the application, the measuring equipment can include the following parts:

- Analyzer
- EEx p safety equipment (purging unit)
- Flame arrestors
- Ex i isolation amplifier
- Isolating relay

Gas analyzers

Suitability-tested field analyzers of Series 6 must be used to measure gases in hazardous areas.

The Series 6 analyzers are approved in accordance with Ex type of protection "Pressurized enclosure EEx p" for Zone 1 and Zone 2. In addition, these analyzers must be connected to monitoring equipment which must also be suitability-tested.

Exception: a pressurized enclosure is not required in zone 2 for the measurement of gases whose composition always remains below the lower explosive limit (LEL); in this case, it is sufficient for the field housing to be gas fume-proof (type of protection EEx n R).

Following pre-purging of 5 minutes, the monitoring equipment ensures that no gas fumes can enter the enclosure, and accumulation of the sample gas in the enclosure is prevented. The volume flow during the pre-purging phase is > 50 l/min. The protective gas is usually fed into the analyzer enclosure from a supply network via the monitoring equipment.

Category ATEX II 2G (Ex zone 1)

Two versions of pressurized enclosure EEx p complying with the directive 94/9/EC are available for use in zone 1:

- *Pressurized enclosure with compensation of losses resulting from leaks*
  The principle of this type of protection is based on prevention of ingress of the surrounding atmosphere or of the sample gas into the enclosure of the electrical equipment.
  Only that volume of protective gas is fed into the enclosure that is required to maintain an overpressure of at least 50 Pa compared to the sample gas pressure and atmospheric pressure. The maximum purging gas pressure is 165 hPa; this results in a maximum permissible sample gas pressure of 160 hPa;
  If the sample gas is combustible or occasionally flammable, the analyzer enclosure must be additionally purged with inert gas (e.g. nitrogen). In these cases, you must additionally ensure that the internal enclosure pressure is at least 5 mbar higher than the fail-safe-regulated sample gas pressure.
  If the pressure control of the sample gas is not fail-safe (= "double fault safety"), but only operationally safe (="single fault safety"), a differential pressure switch of the EEx p safety equipment must be used to signal if the sample gas pressure exceeds the purging gas pressure. This measure trips a safety shutdown.
  With occasionally flammable sample gas mixtures, flame arrestors must be additionally mounted externally at the sample gas inlet and outlet.
  Both the differential pressure switch and the flame arrestors come into contact with the sample gas and must therefore be made of corrosion-proof material, if applicable.
  Test certification: PTB 00 ATEX 2022 X
  Device identification: II 2 G Eex p [ia] ia IIC T4
- *Pressurized enclosure with continuous purging*
  The principle of this type of protection is based on having continuous purging of the Eex p enclosure after the pre-purge. It prevents ingress of the surrounding atmosphere and ensures that, for example, sample gas released through leaks is thinned to the extent that a combustible mixture cannot be created. The volume flow of the protective gas is fixed at 1 l/min and exceeds the maximum release volume by a factor of more than 100.
  Protective gas flows continuously through the enclosure with a volume flow of at least 1 l/min; in addition, the flow ensures that the enclosure pressure is increased to at least 50 Pa higher than the surrounding pressure.
  The max. permissible purging gas pressure is 25 hPa.
  The max. permissible sample gas pressure is equivalent to the permissible analyzer sample gas pressure.
  Test certification TÜV 01 ATEX 1708 X
  Device identification: II 2 G EEx p [ia] ia IIC T4.

The fundamental safety requirements of both versions are satisfied by compliance with the European standards EN 50014:1997, EN 50016:1995, EN 50020:1994 and EN 954:1996.

The purging gas is monitored using EEx p monitoring equipment: This is a stand-alone unit which is connected electrically and pneumatically to the analyzer. Explosion protection is only provided when both devices are combined (analyzer and purging unit, and possibly further measures) (see below).

Category ATEX II 3G (Ex zone 2)

The principle of the type of protection "Pressurized enclosure for devices of Category 3" is based on preventing the ingress of any hazardous atmosphere into the gas analyzer.

Two versions complying with Directive 94/9/EC are available for use in Zone 2. In both cases, the standard devices of Series 6 (field version, not Ex) can be used.

- *Explosion protection due to gas-fumes-proof enclosure*
  The enclosure of the Series 6 gas analyzers (standard, field version) is sealed sufficiently to prevent gas fumes from penetrating. With this type of protection, only sample gases may be fed in which are below the LEL.
  Test certificate: TÜV 01 ATEX 1686 X
  Device identification: II 3 G EEx n R II T6
  It is not necessary to install a purging unit here.
- *Pressurized enclosure with continuous purging*
  Protective gas continuously flows through the enclosure with a volume flow of at least 1 l/min; furthermore, the flow results in an overpressure in the enclosure of at least 50 Pa compared to atmospheric pressure.
  The max. permissible purging gas pressure is 25 hPa. The max. permissible sample gas pressure is equivalent to the permissible analyzer sample gas pressure.
  Test certification TÜV 01 ATEX 1697 X
  Device identification: II 2/3 G EEx n P II T4
  The purging gas is monitored using E Ex p monitoring equipment. This is a stand-alone unit which is connected electrically and pneumatically to the analyzer. Explosion protection is only provided when these two units (analyzer and purging unit) are combined. (see below, purging unit)

The fundamental safety requirements of both versions are satisfied by compliance with the European standards EN 50014:1997, EN 50016:1995, EN 50020:1994 and EN 954:1996.

The EEx p monitoring equipment is a stand-alone unit which is connected electrically and pneumatically to the analyzer. Explosion protection is only provided when these two units are combined.

Continuous gas analysis, extractive

Category ATEX II 3D (Ex zone 22)

Ex zone 22 concerns the so-called dust protection. This is the European successor to the previous German zone 11. Zone 22 concerns the area in which during normal operation it is *not* expected that potentially explosive atmospheres occur in the form of a cloud of flammable dust in the air. Should such a cloud occur, however, *then only briefly.*

Considering the more stringent conditions for zone assignment, it can be expected that there will be increased demand for dust-protected analyzers.

The field versions of CALOMAT 6, OXYMAT 6 and ULTRAMAT 6 can be used in this zone according to the conformity statement TÜV 03 ATEX 2278 X.

They are assigned the Ex identification II 3 D IP65 T60 °C or T65 °C or T85 °C or T135 °C.

However, this only concerns the so-called external explosion protection. With respect to the measurement of flammable gases, the additional measures applicable to gas explosion protection apply in addition, such as flame inhibitors. These separate certificates apply here.

FM/CSA Class I Div 2

The field versions of the standard analysis units can be used. Explosion protection is only provided when combined with the suitable equipment.

Definitions

Non-flammable gas	Gas or gas compositions with concentrations below the lower explosion limit (LEL). Non-explosive, even in contact with air. Example: CH_4 < 4.4 %; H_2 < 4 %; C_2H_2 < 2.3 %
Flammable gas	Gas or gas composition with concentrations above the LEL. Explosive, but additionally requires air and ignition energy. Example: CH_4 > 4.4 %; H_2 > 4 %; C_2H_2 > 2.3 %
Explosive gas	Mixture of flammable gas and a gas matrix containing oxygen; between the LEL and the UEL (upper explosion limit). Already contains O_2 and is explosive without additional air. Example: 4,4 % ... 16.5 % CH_4 in air Note: Very little data is available on the existing LEL and UEL for oxygen concentrations other than ambient air (20.95 % O_2) or for sample pressures other than atmospheric pressure.

Although the IEC and EN directives IEC 60079-10, EN 60079-10 (gas) and IEC 61241-10, EN 50281 (dust) do not specifically define the terms seldom, occasional, frequent, and permanent, the following interpretation is customary:

- Frequent or permanent: > 1 000 hours per year
  → a frequent explosive atmosphere corresponds to Zone 0 or Class I, Div. 1
- Occasional: 10 to 1 000 hours per year
  → an occasional explosive atmosphere corresponds to Zone 1 or Class I, Div. 1
- Seldom: < 10 hours per year
  → a seldom explosive atmosphere corresponds to Zone 2 or Class I, Div. 2

The following additional safety mechanisms are recommended for continuous gas analyzers for measuring explosive gases (internal explosion protection). These requirements are based on the European ATEX approvals for analyzers, but can also be used as directives in the USA since no other specific definition exists there.

Purging requirements

The continuous analyzers from Siemens with approvals for Class I, Div. 2 never require purging in a hazardous area in accordance with Class I, Div. 2 / Zone 2 under the aspect of area classification. All electronic and mechanical components are classified as “non-explosive” and can be used in environments in accordance with Class I, Div. 2 / Zone 2. However, purging may be necessary for a specific application, depending on the type of sample gas and the respective analyzer model in order to comply with the NEC and NFPA standards and to guarantee maximum possible safety as well as protection of the system.

NFPA 496 requirements for continuous gas analyzers and systems from Siemens

The NFPA 496 "Standard for Purged and Pressurized Enclosures for Electrical Equipment" describes in great detail and clarity the requirements for purging and for the pressurized enclosure for electric systems depending on 1) the external hazardous area classification, 2) the classification/grading of the system, 3) the type of gas in the gas path, and 4) the expected discharge of gas (none/limited/unlimited).

It is assumed for the internal gas path of a continuous gas analyzer that it exhibits only low losses under normal conditions and uncontrolled losses in the case of a mechanical failure (abnormal conditions).

When connecting gases with flammable components (> LEL) to the gas path of an analyzer with a hermetically sealed enclosure, the flammable component can become enriched in the inside of the analyzer enclosure – even under normal conditions – beyond a limit for continuous explosiveness and change the area classification (inside the analyzer enclosure) from "General Purpose" (Universal) or Class I, Div. 2 / Zone 2 to Class I, Div. 1 / Zone 0. This can also occur under abnormal conditions in any type of analyzer enclosure (including NEMA 1).

Analyzers for installation in the field – O6F, U6F and C6F – have a gas-tight enclosure (IP65 / NEMA 4 equivalent in accordance with IEC/EN 60529 and NEMA Standards Publication 250). Only a small natural exchange of air takes place with the environment. In accordance with NFPA 496, a limited discharge of gas is to be expected under normal conditions, and an unlimited discharge under abnormal conditions.

Analyzers for 19" rack mounting – O6E, U6E, U/O6, C6E, U23, O61, FID5 and FID6 – have an "open" enclosure (IP20 in accordance with IEC/EN 60529, no exact NEMA equivalent to IP20 available). A high natural exchange of air takes place with the environment unless the exchange is restricted. In accordance with NFPA 496, no discharge of gas is to be expected under normal conditions, but an unlimited discharge under abnormal conditions.

In the case of analyzers designed for general applications, it is assumed that they can ignite an explosive gas mixture at any time, and therefore no type of explosive atmosphere whatsoever may be present in the vicinity of these analyzers or within the enclosure at any time.

In the case of analyzers designed for Class I, Div. 2 / Zone 2 it is assumed that they cannot ignite an explosive gas mixture under normal conditions (single fault safety), and these analyzers can therefore be used in an occasionally explosive atmosphere in the environment or within the enclosure in accordance with the definition of Class I, Div. 2 / Zone 2. However, a frequent or permanent explosive atmosphere must be avoided since a simultaneous fault occurring on the electrical components of the analyzer could constitute an ignition source.

When purging a continuous gas analyzer or when purging/venting a continuous gas analyzer system suitable for Class I, Div. 2 / Zone 2 with instrument air or ambient air, and if failure of the safety vessel is not obvious, a leak detector (measurement in % of LEL) or similar equipment should be used in order to detect the unlimited discharge under abnormal conditions and to avoid a frequent or permanent explosive atmosphere inside the analyzer or in its environment. The leak detector must be fitted at a location where the escaping sample gas can be measured before becoming too greatly diluted. The alarm limit of the leak detector must be set to a level which enables detection of a dangerous state with consideration of the fact that the discharged sample gas has most probably already been diluted before it reaches the sensor.

Further important information

Gas paths material

It is strongly recommended that you use gas paths made of metal for applications with flammable gases since such gas paths offer the greatest safety. This particularly applies to analyzers or systems which are purged with instrument air or ambient air since an explosive atmosphere can be produced under abnormal conditions. This immediate danger does not exist in the case of analyzers or systems purged with inert gas.

It should be mentioned that, with an integrated system, all parts containing flammable gas (pumps, gas coolers, filters etc.) must be assessed in the same manner.

Purging of left-hand analyzer side (electronics side) of continuous gas analyzers for field installation

Since the left electronics side and the right measurement side of continuous gas analyzers are separated gas-tight from each other, it is unnecessary to purge the electronics side in most cases – purging of the (right-hand) measurement side is sufficient.

However, if doubt exists that flammable gas could penetrate the left-hand electronics side and become enriched there, it is advisable to purge both sides.

Further reasons for purging analyzers

- Corrosive sample gases: Purging with air or inert gas is necessary to prevent the enrichment of corrosive gas inside the analyzer, whereby operators or servicing personnel could be injured or the analyzer unit could be damaged. The discharged purging gas should be released at a non-critical point (collective vent etc.)
- Toxic gases: Purging with air or inert gas is necessary to prevent the enrichment of toxic gas inside the analyzer, whereby operators or servicing personnel could be injured. The discharged purging gas should be released at a non-critical point (collective vent etc.). Further information can be found in the OSHA directives for handling toxic materials.

Purging rate / applied pressure

Purging with air: The air throughput for purging an analyzer for field installation must be sufficient such that the concentration of flammable gases is less than 25 % of the LEL (see NFPA 496, Section 8.3). An air throughput of 1 l/min is recommended.

Purging with inert gas: The inert gas throughput for purging an analyzer for field installation must be sufficient such that the oxygen level is less than 5 % of the volume or, at a maximum, less than 50 % of the oxygen required to form an explosive mixture (see NFPA 496, Section 8.3). An inert gas throughput of 1 l/min is recommended.

Applied pressure with inert gas: The purging and holding pressure applied to an analyzer for field installation must be sufficient such that the oxygen level is less than 5 % of the volume or, at a maximum, less than 50 % of the oxygen required to form an explosive mixture (see NFPA 496, Section 8.3). A pressure of 25 Pa (0.1 inch water column) in accordance with NFPA 496 is recommended. It should be taken into consideration when applying a pressure to an analyzer, that instead of continuous purging, flammable gas can collect within the analyzer if the sample gas pressure is higher than the purging pressure. It is recommendable to appropriately adapt the purging pressure within the permissible pressure range of the field device enclosure.

Exceptions: Inert gas should not be used as the purging gas for certain applications. This particularly applies to safety-related measurements of oxygen (LEL proof) where the sample gas has a slight overpressure and the inert gas used for purging could dilute the sample under abnormal conditions. Such applications require individual assessment of the purging equipment required and the mode of operation.

Integrated systems and analyzer containers: Purging or the application of pressure to continuous gas analyzer systems must be designed such that the requirements of NFPA 496 are complied with.

Leak detector

When purging a continuous gas analyzer or when purging/venting a continuous gas analyzer system suitable for Class I, Div. 2 / Zone 2 with instrument air or ambient air, and if failure of the safety vessel is not obvious, a leak detector (measurement in % of LEL) or similar equipment should be used in order to detect unlimited discharges under abnormal conditions and to avoid a frequent or permanent explosive atmosphere inside the analyzer or in its environment. The leak detector must be fitted at a location where the escaping sample gas can be measured before becoming too greatly diluted. The alarm limit of the leak detector must be set to a level which enables detection of a dangerous state with consideration of the fact that the discharged sample gas has most probably already been diluted before it reaches the sensor.

Application

Differentiation of cases: Ex zones/danger through flammable sample gas

Zone	Gas type	Sample gas non-flammable below the lower explosive limit (LEL)	Sample gas is flammable and/or is rarely, and then only briefly, above the LEL	Sample gas is flammable and/or is occasionally above the LEL
Category ATEX II 1G (zone 0)		Individual acceptance test (on request)	Individual acceptance test (on request)	Individual acceptance test (on request)
Category ATEX II 2G (zone 1) **Operating mode "Leakage compensation"**	Analyzer	Ex analyzer EEx p (certificate ATEX 2022X)	Ex analyzer EEx p (certificate ATEX 2022X)	Ex analyzer EEx p (certificate ATEX 2022X)
	Gas path	Pipe gas path	Pipe gas path	Pipe gas path
	Flame arrester	—	—	Flame arrester in sample gas inlet and outlet
	Monitoring	EEx p control device (certificate ATEX E 082)	EEx p control device sample gas pressure < 165 hPa, fail-safe (certificate ATEX E 082)	EEx p control device sample gas pressure < 165 hPa, fail-safe (certificate ATEX E 082)
	Pressure switch	—	Differential pressure switch (when sample gas pressure is not controlled fail-safely)	Differential pressure switch (when sample gas pressure is not controlled fail-safely)
Category ATEX II 2G (zone 1) **Operating mode "Continuous purging"**	Analyzer	Ex analyzer EEx p (certificate ATEX 1708X)	Ex analyzer EEx p (certificate ATEX 1708X)	Ex analyzer EEx p (certificate ATEX 1708X)
	Gas path	Pipe gas path	Pipe gas path	Pipe gas path
	Flame arrester	—	—	Flame arrester in sample gas inlet and outlet
	Monitoring	EEx p control device (certificate DMT 99 ATEX E 082)	EEx p control device (certificate DMT 99 ATEX E 082)	EEx p control device (certificate DMT 99 ATEX E 082)
	Pressure switch	—	—	—
Category ATEX II 3G (zone 2)	Analyzer	Standard analyzer in field housing (addition E11: certificate ATEX 1686X)	Standard analyzer in field housing (addition E12: certificate ATEX 1697X)	Standard analyzer in field housing (addition E12: certificate ATEX 1697X)
	Gas path	Pipe or hose gas path	Pipe gas path	Pipe gas path
	Flame arrester	—	—	Flame arrester in sample gas inlet and outlet
	Monitoring	—	EEx p control device (certificate DMT 99 ATEX E 082)	EEx p control device (certificate DMT 99 ATEX E 082)
Non-hazardous zone	Analyzer	Analyzer as rack unit or in field housing	Analyzer as rack unit or in field housing	Analyzer as rack unit or in field housing
	Gas path	Pipe or hose gas path	Pipe gas path, recommended Enclosure purging with inert gas (N_2) recommended	Pipe gas path, recommended Enclosure purging with inert gas (N_2) recommended
	Flame arrester	—	—	Flame arrester in sample gas inlet and outlet
	Monitoring	—	—	Simplified monitoring of purging recommended

Ex configurations – principle selection criteria

	Signal line routing		
	Within zone 1	**From zone 1 to zone 2**	**From zone 1 to non-hazardous zone**
Ex i isolation amplifier	Required	Conditional use (when energy feedback cannot be excluded)	Conditional use (when energy feedback cannot be excluded)
Isolating relay	Required	Conditional use (when energy feedback cannot be excluded)	Conditional use (when energy feedback cannot be excluded)

Additional units, selection criteria (ATEX 2G)

Use of OXYMAT 6 in hazardous area and/or for measurement of flammable gases

		Order No.	Certification (short codes)				Additional unit				
			Gas	Dust	Gas warning unit		Purging unit	Flame arrestor	Pressure switch	Ex i isolation amplifier	Ex i isolating relay
Category	**Operating mode**		**Ex zone**	**Ex zone**	**Non-heated**	**Heated**	**7MB8000-**	**7MB8000-**	**7MB8000-**	**7MB8000-**	**7MB8000-**
ATEX II 2G (zone 1)	Leakage compensation	7MB2011-***0*-2***	X	—	E31	E31 + E38	2BB	6BA/6BB[1)]	5AA[1)]	3AB[1)]	4AB[1)]
		7MB2011-***0*-3***	X	—	E31	E31 + E39	2BA	6BA/6BB[1)]	5AA[1)]	3AB[1)]	4AA[1)]
	Continuous purging	7MB2011-***0*-6***	X	—	E32	E32 + E38	2CB	6BA/6BB[1)]	o	3AB[1)]	4AB[1)]
		7MB2011-***0*-7***	X	—	E32	E32 + E39	2CA	6BA/6BB[1)]	o	3AB[1)]	4AA[1)]
ATEX II 3G (zone 2)	Flammable gases	7MB2011-***0*-0***	E12	—	E33	E33 + E38	2CB	6BA/6BB[1)]	o	o	o
		7MB2011-***0*-1***	E12	—	E33	E33 + E39	2CA	6BA/6BB[1)]	o	o	o
		7MB2011-***0*-0***	E42		—	—	2CB	6BA/6BB[1)]	o	o	o
		7MB2011-***0*-1***	E42		—	—	2CA	6BA/6BB[1)]	o	o	o
	Non-flammable gases	7MB2011-***0*-0***	E11	—	E33	E33 + E38	o	o	o	o	o
		7MB2011-***0*-1***	E11	—	E33	E33 + E39	o	o	o	o	o
		7MB2011-***0*-0***	E41		—	—	o	o	o	o	o
		7MB2011-***0*-1***	E41		—	—	o	o	o	o	o
Non-hazardous zone	Non-hazardous gas zone	7MB2011-***0*-0***	E40		—	—	o	o	o	o	o
		7MB2011-***0*-1***	E40		—	—	o	o	o	o	o
		7MB2011-***0*-0***	—	—	E30	E30 + E38	o	o	o	o	o
		7MB2011-***0*-1***	—	—	E30	E30 + E39	o	o	o	o	o
		7MB2021-****0-****	X	—	E30	—	o	o	o	o	o
CLASS 1 Div 2	Flammable and non-flammable gases	7MB2011-***0*-0***	E20	—	—	—	1AA	6BA/6BB	o	o	o
		7MB2021-*****-****[2)]									

— Combination not allowed

X Possible combination, no additional data required

o Not required

Ex configurations, possible combinations

[1)] Conditionally required: see table of Ex configurations, selection criteria

[2)] Installation in additional enclosure required

Ex versions

Continuous gas analysis, extractive

Use of ULTRAMAT 6 in hazardous area and/or for measurement of flammable gases

		Order No.	Certification and short codes		Additional unit				
			Gas	Dust	Purging unit	Flame arrestor	Pressure switch	Ex i isolation amplifier	Ex i isolating relay
Category	**Operating mode**	**7MB2111- 7MB2112-**	**Ex zone**	**Ex zone**	**7MB8000-**	**7MB8000-**	**7MB8000-**	**7MB8000-**	**7MB8000-**
ATEX II 2G (zone 1)	Leakage compensation	*****-2*A*	X	—	2BB	6BA/6BB[1)]	5AA[1)]	3AB[1)]	4AB[1)]
		*****-3*A*	X	—	2BA	6BA/6BB[1)]	5AA[1)]	3AB[1)]	4AA[1)]
	Continuous purging	*****-6*A*	X	—	2CB	6BA/6BB[1)]	o	3AB[1)]	4AB[1)]
		*****-7*A*	X	—	2CA	6BA/6BB[1)]	o	3AB[1)]	4AA[1)]
ATEX II 3G (zone 2)	Flammable gases	*****-0*A*	E42		2CB	6BA/6BB[1)]	o	o	o
		*****-1*A*	E42		2CA	6BA/6BB[1)]	o	o	o
		*****-0*A*	E12	—	2CB	o	o	o	o
		*****-1*A*	E12	—	2CA	o	o	o	o
	Non-flammable gases	*****-0*A*	E41		o	o	o	o	o
		*****-1*A*	E41		o	o	o	o	o
		*****-0*A*	E11	—	o	o	o	o	o
		*****-1*A*	E11	—	o	o	o	o	o
Non-hazard-ous zone	Non-hazardous gas zone	*****-0*A*	X	E40	o	o	o	o	o
		*****-1*A*	X	E40	o	o	o	o	o
CLASS 1 Div 2	Flammable and non-flammable gases	7MB2111- *****-0*A*,	E20	—	1AA	6BA/6BB	o	o	o
		7MB2111- *****-1*A*							
		7MB212*- *****_****[2)]							

— Combination not allowed

X Possible combination, no additional data required

o Not required

[1)] Conditionally required; see table of Ex configurations, selection criteria.

[2)] Installation in additional enclosure required

Use of CALOMAT 6 in hazardous area and/or for measurement of flammable gases

		Order No.	Certification		Additional unit				
			Gas	Dust	Purging unit	Flame arrester	Pressure switch	Ex i isolation amplifier	Ex i isolating relay
Category	**Operating mode**				**7MB8000-**	**7MB8000-**	**7MB8000-**	**7MB8000-**	**7MB8000-**
ATEX II 2G (zone 1)	Leakage compensation	7MB2511-***0*-0AE*	X	—	2BB	6BA/6BB[1)]	5AA[1)]	3AB[1)]	4AB[1)]
		7MB2511-***0*-1AE*	X	—	2BA	6BA/6BB[1)]	5AA[1)]	3AB[1)]	4AA[1)]
	Continuous purging	7MB2511-***0*-0AF*	X	—	2CB	6BA/6BB[1)]	o	3AB[1)]	4AB[1)]
		7MB2511-***0*-1AF*	X	—	2CA	6BA/6BB[1)]	o	3AB[1)]	4AA[1)]
ATEX II 3G (Zone 2)	Flammable gases	7MB2511-***0*-*AJ*	X	X	2CA/2CB	6BA/6BB[1)]	o	o	o
		7MB2511-***0*-*AC*	X	—	2CA/2CB	6BA/6BB[1)]	o	o	o
		7MB2521-***0*-*AB*	X	—	acc. to Certificate	6BA/6BB[1)]	o	o	o
	Non-flammable gases	7MB2511-***0*-*AH*	X	X	o	o	o	o	o
		7MB2511-***0*-*AB*	X	—	o	o	o	o	o
		7MB2521-***0*-*AB*	X	—	o	o	o	o	o
Non-hazardous zone	Non-hazardous gas zone	7MB2511-***0*-*AG*	—	X	o	o	o	o	o
CLASS 1 Div 2	Flammable and non-flammable gases	7MB2511-***0*-0AD*,	X	—	7MB8000-1AA	6BA/6BB	o	o	o
		7MB2511-***0*-1AD*							
		7MB2521-***D*-**D*							
		7MB2521-***D*-**B*							

X Possible combination, no additional data required

— Combination not allowed

o Not required

Ex configurations, possible combinations

[1)] Conditionally required; see table of Ex configurations; selection criteria

Use of ULTRAMAT 23 in hazardous area and/or for measurement of flammable gases

		Order No.	Certification and short codes		Additional unit					
			Gas	Dust	Purging unit	Gas path	Flame arrestor	Pressure switch	Ex i isolation amplifier	Ex i isolating relay
Category	**Operating mode**	**7MB233*-**	**Ex zone**	**Ex zone**	**7MB8000-**		**7MB8000-**	**7MB8000-**	**7MB8000-**	**7MB8000-**
ATEX II 3G (zone 2)	Only for non-flammable gases[1)]	*****-****	X	—	o	Metal[2)]	o	o	o	o
		*****-****	X	—	o	Metal[2)]	o	o	o	
Class 1 Div 2	Flammable and non-flammable gases	*****-****	X	—	1AA	o	o	o	o	o
		*****-****	X	—	o	o	o	o	o	

— Combination not allowed

X Possible combination, no additional data required

o Not required/not defined

[1)] Depends on the gas side, installation in IP54 enclosure necessary, see "FM Approval report" or ATEX approval.

[2)] Required

Ex versions

Continuous gas analysis, extractive

		Ex approval							
		ATEX				CLASS I Div 2			ATEX
		2G - CP	2G-LC	3G burn.	3G nbrn.	FM	CSA		3D (dust)
Field device									
	U6F	ATEX 2022 X	ATEX 1708 X	ATEX 1697 X	ATEX 1686 X	3016050	1526657		ATEX 2278 X
	U6F-S	ATEX 2022 X	ATEX 1708 X	ATEX 1697 X	ATEX 1686 X	3016050	—		—
	O6F	ATEX 2022 X	ATEX 1708 X	ATEX 1697 X	ATEX 1686 X	3016050	1526657		ATEX 2278 X
	O6F-S	ATEX 2022 X	ATEX 1708 X	ATEX 1697 X	ATEX 1686 X	3016050	—		—
	C6F	ATEX 2022 X	ATEX 1708 X	ATEX 1697 X	(ATEX 1697 X)	3018862	1526660		ATEX 2278 X
	C6F-S	ATEX 2022 X	ATEX 1708 X	ATEX 1697 X	(ATEX 1697 X)	3018862	o		—
	C62F	ATEX 2022 X	ATEX 1708 X	—	—	—	—		—
	C62F-S	ATEX 2022 X	ATEX 1708 X	—	—	—	—		—
Rack version									
	U6E	—	—	—	3016050	1526657		—	U6E
	U6E-S	—	—	—	3016050	—		—	U6E-S
	O6E	—	—	—	3016050	1526657		—	O6E
	O6E-S	—	—	—	3016050	-		—	O6E-S
	OU6E	—	—	—	3016050	1526657		—	OU6E
	OU6E-S	—	—	—	3016050	-		—	OU6E-S
	C6E	—	—	ATEX 1873 X	3018862	1526660		—	C6E
	C6E-S	—	—	ATEX 1873 X	3018862	—		—	C6E-S
	C62E	—	—	—	—	—		—	C62E
	C62E-S	—	—	—	—	—		—	C62E-S
	O61	—	—	—	—	—		—	O61
	O64	—	—	—	—	—		—	O64
	F6	—	—	—	(SET)	—	—		—
	U23	—	—	ATEX 0027 x	3035269	2133209		—	U23
	U23 O2p	—	—	ATEX 0027 x	3035269	2133209		—	U23 O2p
	U23 H2S	—	—	ATEX 0027 x	3035269	2133209		—	U23 H2S

CP = Continuous Purging
LC = Leakage Compensation
… -S = Special Application
burn. = Flammable gases
nbrn. = Non-flammable gases
o = In progress

Overview

EEx p safety equipment (purging unit)

The EEx p safety equipment to be connected to the analyzer must have at least the following features:

- Adjustable pre-purging phase; purging gas flow must be approximately 50 l/min
- Limitation of purging gas pressure during the pre-purging phase: < 165 hPa
- "Leakage compensation" or "Continuous purging"
- Connection for purging gas lines with Ø 10 mm or Ø 3/8" from and to the analyzer
- Pressure after pressure reducer
  - 0.2 to 0.4 MPa (leakage compensation)
  - 0.2 to 0.3 MPa (continuous purging)
- Max. permissible input pressure 0.6 MPa
- Relay contacts for all-pole isolation of the analyzer supply voltage
- Connection option for a key-operated switch and a pressure switch (intrinsically-safe circuits)
- Device version "Leakage compensation": Connection option for a pressure switch with intrinsically-safe scan

The Bartec control unit APEX 2003.SI/B meets the requirements for "Pressured enclosure with leakage compensation or continuous purging" in accordance with EN 50016 or ATEX guidelines, and can be used as explosion-proof equipment in Zones 1 and 2.

The purging unit ensures that in a closed enclosure, any explosive gases will be purged and then a pressure higher than the surrounding atmosphere will be generated and maintained.

A non-hazardous area is thus created in the enclosure in which electrical devices can be installed that are not themselves explosion-proof. After commissioning, a distinction is made between the pre-purging phase and the operating phase:

The pre-purging phase is necessary to ensure that any explosive atmposphere entering during the standstill time does not become a hazard; the enclosure must therefore be purged with protective gas (air from a non-hazardous area or inert gas) before commissioning.

Additional function

By connecting additional pressure sensors, the internal pressure of the enclosure is maintained at a pressure higher than that of the sample gas by means of a proportional valve. During the pre-purging phase the purging gas flow is max. 4 100 Nl/h with an internal enclosure pressure of 50 hPa.

4 programmable relay inputs (8 relay contacts) are available to separate the data lines.

During the operating phase, the pressure inside the enclosure must be maintained at a level at least 50 Pa higher than that of the surrounding atmosphere. If the internal pressure drops below the defined minimum value, safety equipment must shut down the entire electical supply to the EEx-p enclosure autonomously (including the possible data lines) .

Enclosures frequently contain accessories to which flammable gases or sometimes also flammable gas mixtures are fed via a separate gas path. This is the case with gas analyzers, for example. In this case, it must be ensured that the pressure of the protective gas is always more than 50 Pa higher than the pressure of the sample gas.

After mounting the control device APEX 2003.SI/B on the EEx-p enclosure, and after connecting the mains power and the protective gas, the control module regulates and monitors the flow of purging gas automatically during the pre-purging phase, and the internal enclosure pressure during the operating phase.

If the minimum operating pressure of the enclosure is exceeded and if flow through the pressure monitoring module is sufficient, the pressure sensors forward the sensor module signals to the control module.

Ex versions

Continuous gas analysis, extractive
ATEX II 2G control unit, leakage compensation

Overview

BARTEC EEx p control unit "Leakage compensation"

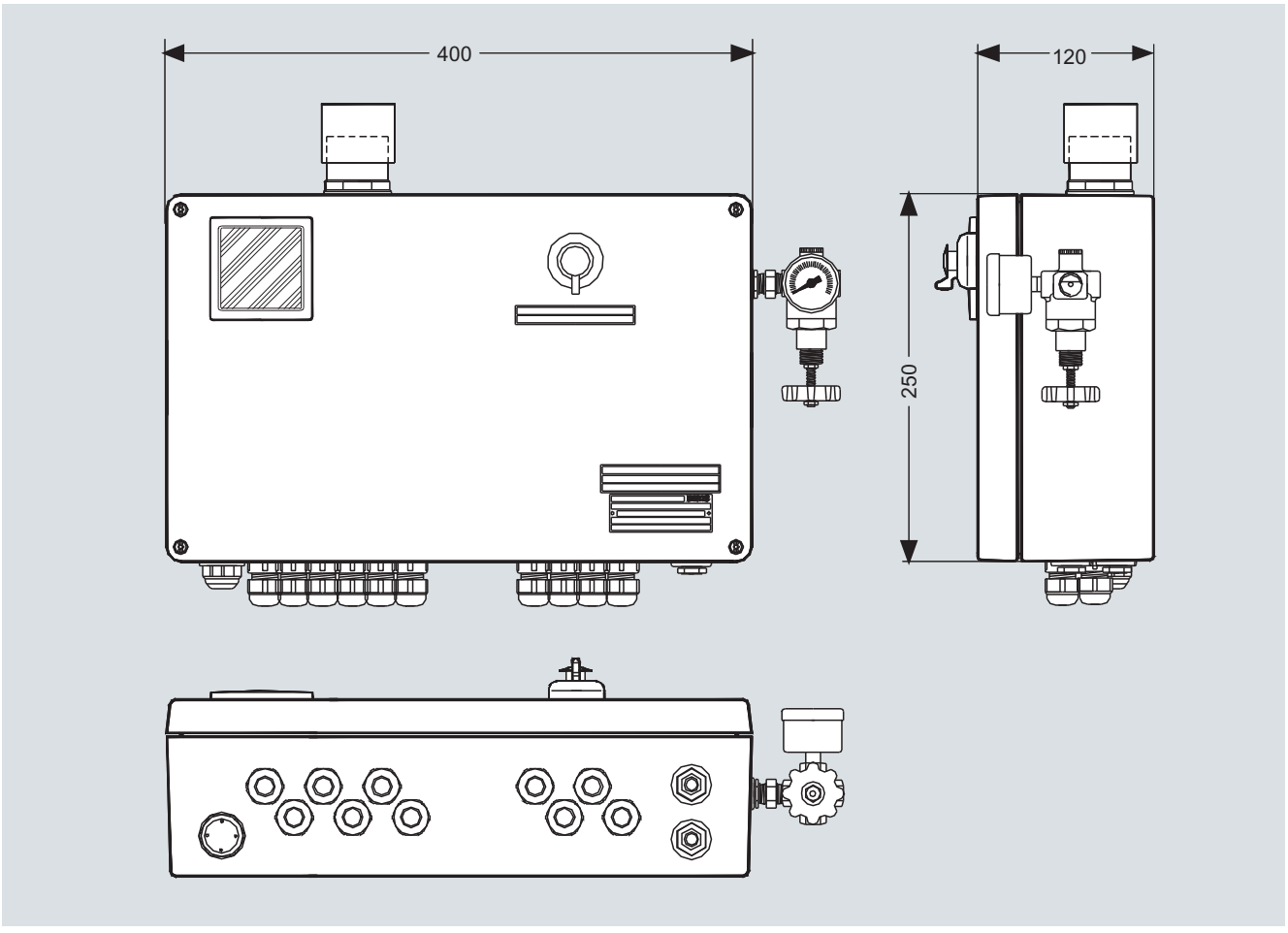
The APEX 2003.SI/A2 control unit controls and monitors the pre-purging and operating phases of gas analyzers with containment systems in hazardous zone 1.

The control unit redundantly monitors the set overpressure of the purging gas. When the overpressure decreases, it is corrected to the adjustable setpoint (max. purging gas pressure 165 hPa).

Technical specifications

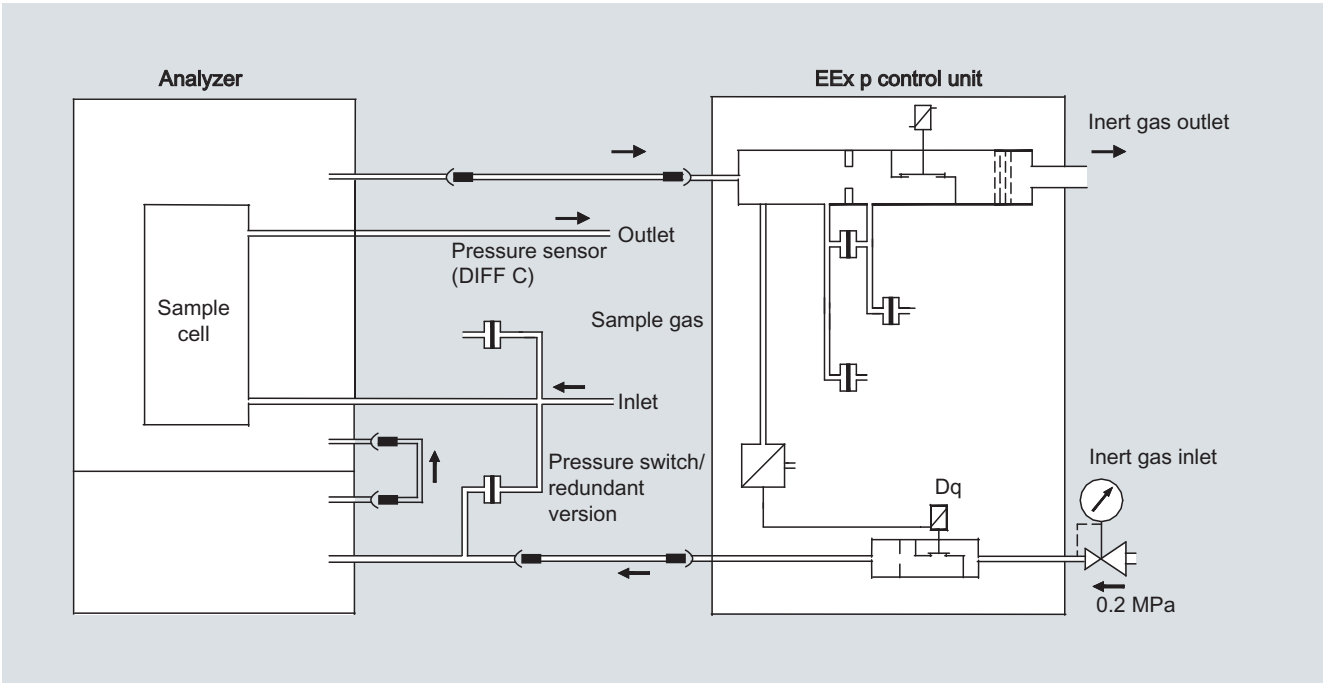
Control unit ATEX IIG, compensation of losses through leaks	
Guidelines	EC EMC directive 89/336/EEC, EC low voltage, RL 73/23/EEC, Ex directive 94/9/EC
Design	Explosion-protected enclosure (EEx e) with viewing window in the cover
Enclosure material	Glass fiber-reinforced polyester
Degree of protection	IP65
Terminals	2.5 mm, finely stranded
Pressure sensors	MIN A = 0 … 300 hPa, MIN B = 0 … 300 hPa, MAX = 0 … 300 hPa, MAX 1 = 0 … 300 hPa, DIFF A = 0 … 25 hPa, DIFF B = 0 … 25 hPa
Prepurging time	0 … 99 min; 5 sec dropout delayed
Weight	11 kg
Electrical data	
Supply voltage	230 V AC (115 V AC) ± 10 %, 48 … 62 Hz
Power consumption	21 W /230 V
NO contacts	K2/3; max. 250 V, 5 A with cos φ = 1, K4/K5; supply voltage or floating, max. 250 V, 5 A with cos φ = 1
Communication	RS 485 interface
Temperature switching value (option)	0 … +40 °C
Explosion protection	
Marking	EEx e d ib [ia p] IIC T4/T6
Test certification	DMT 99 ATEX E 082
Ambient temperature	-20 … +40 °C

Dimensional drawings

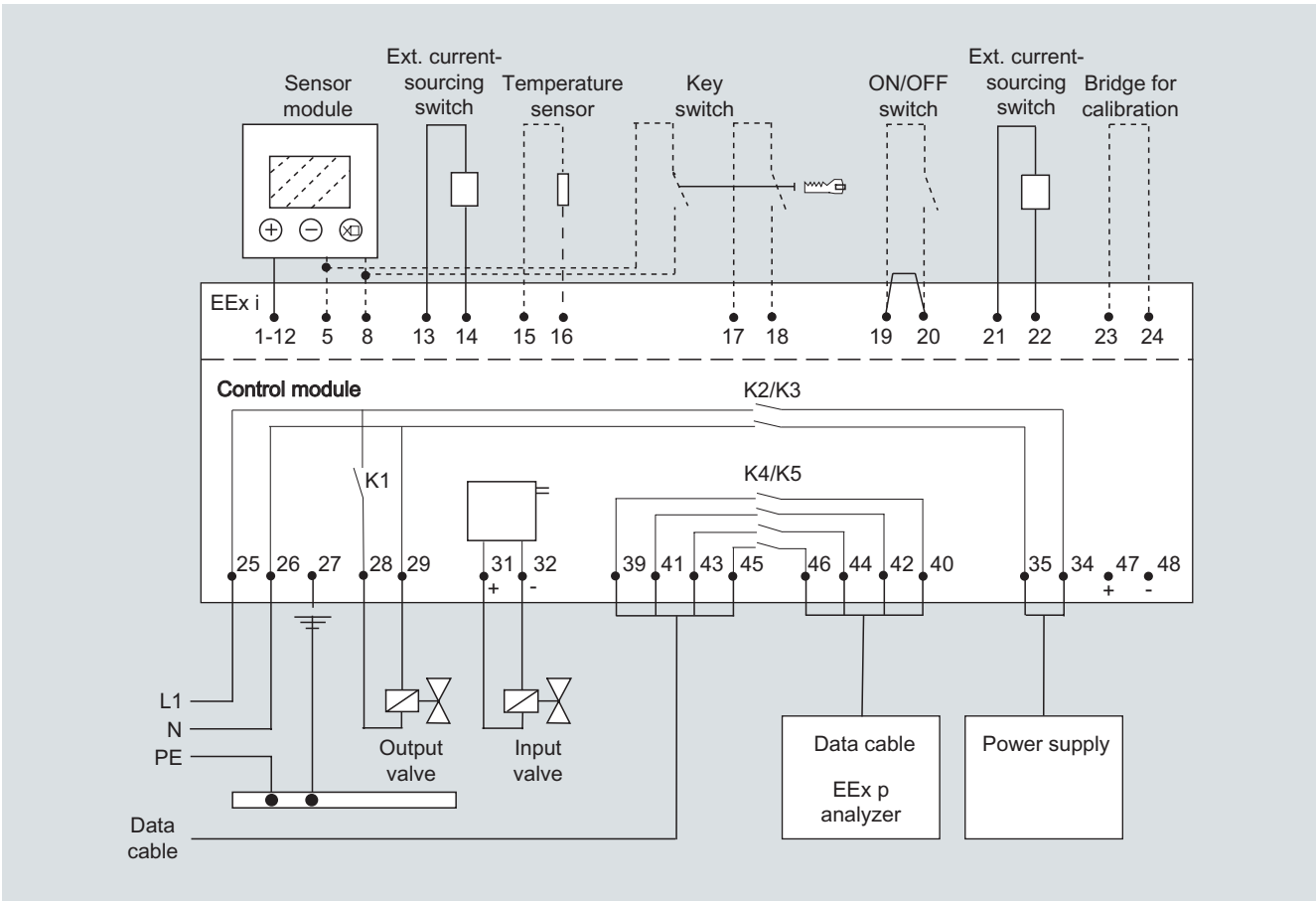


BARTEC control unit, dimensions in mm

Schematics



BARTEC control unit, leakage compensation, gas connection diagram



BARTEC control unit, leakage compensation, electric connection diagram

Ex versions

Continuous gas analysis, extractive
ATEX II 2G/3G control unit, continuous purging

Overview

BARTEC EEx p control unit "Continuous purging"

The APEX 2003.SI/A4 control unit controls and monitors the pre-purging and operating phases of gas analyzers with containment systems in Ex zone 1 and Ex zone 2.

The control unit redundantly monitors the continuous flow of protective gas through the connected analyzer and thereby dilutes any escaping sample gas to below the lower explosive limit (max. purging gas pressure 25 hPa).

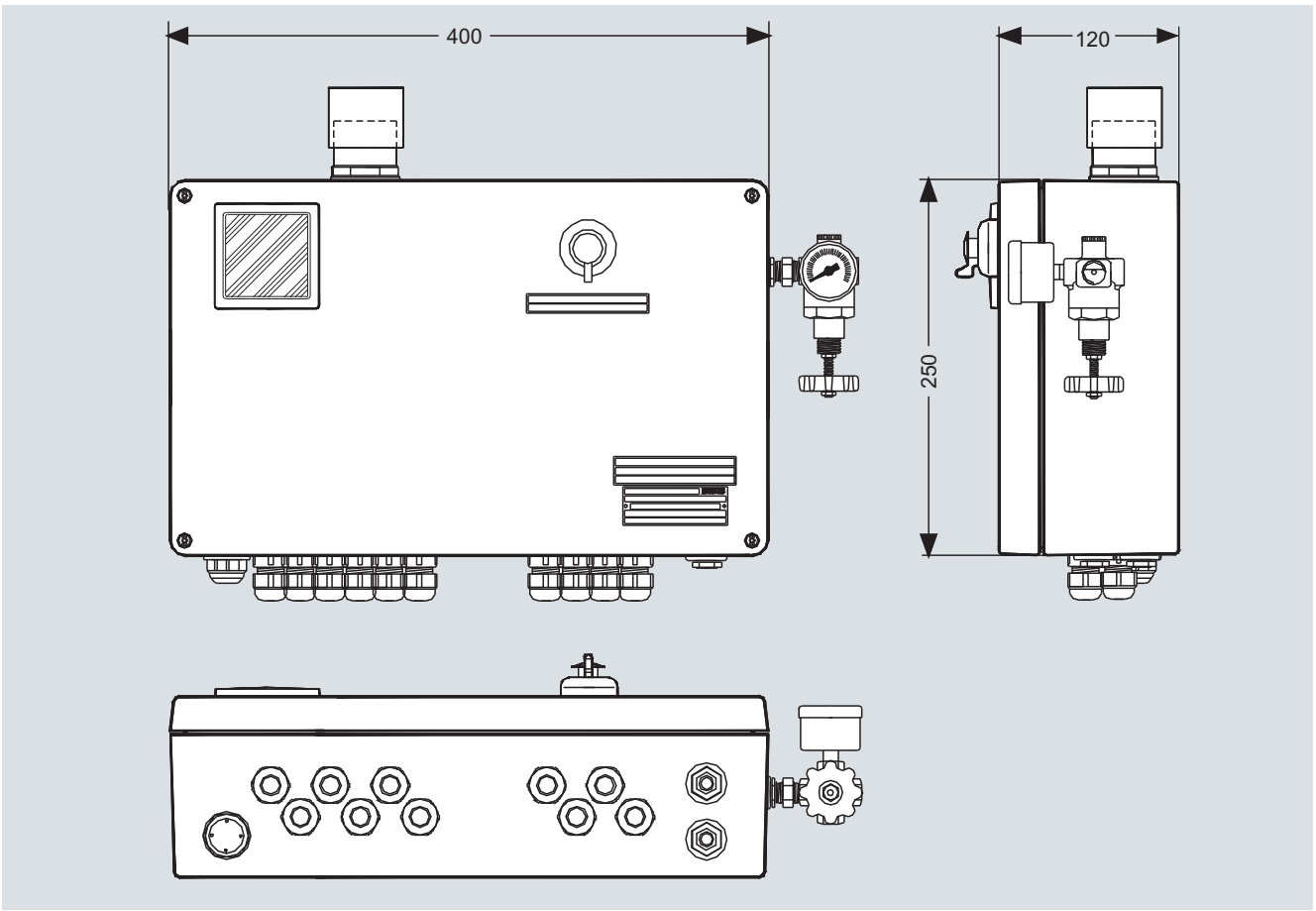
At the same time, a higher pressure is maintained inside the EEx-p enclosure than in the surrounding atmosphere. If the flow of purging gas or the internal pressure falls below a determined minimum value, the supply voltage to the equipment in the pressurized enclosure is shut down.

4 programmable relay inputs (8 relay contacts) are available to separate the data lines.

Technical specifications

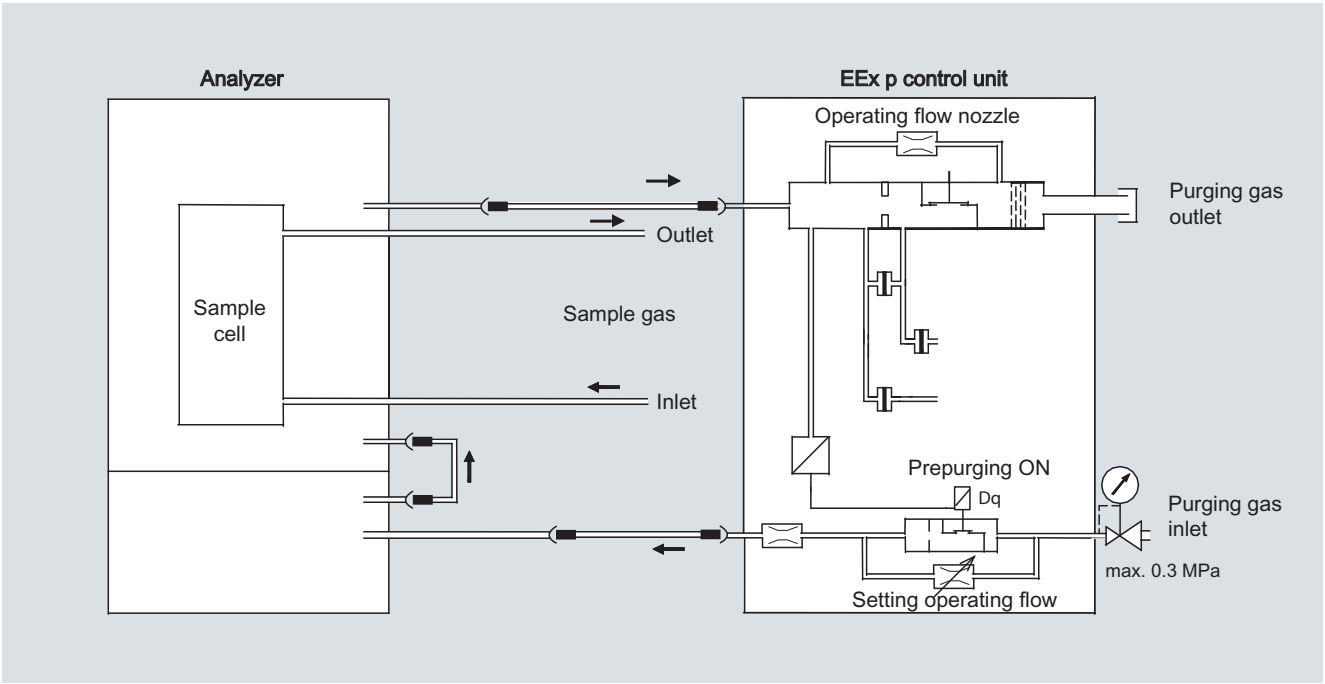
Control unit ATEX II 2G, continuous purging	
Guidelines	EC EMC directive 89/336/EEC, EC low voltage, RL 73/23/EEC, Ex directive 94/9/EC
Design	Explosion-protected enclosure (EEx e) with viewing window in the cover
Degree of protection	IP65
Terminals	2.5 mm, finely stranded
Pressure sensors	MIN A = 0 … 25 hPa, MIN B = 0 … 25 hPa, MAX = 0 … 25 hPa, MAX 1 = 0 … 25 hPa, DIFF A = 0 … 25 hPa, DIFF B = 0 … 25 hPa
Prepurging time	0 … 99 min; 5 sec dropout delayed
Weight	10 kg
Electrical data	
Supply voltage	230 V AC (115 V AC) ± 10 %, 48 … 62 Hz
Power consumption	21 W /230 V
NO contacts	K2/3; max. 250 V, 5 A with cos φ = 1, K4/K5; supply voltage or floating, max. 250 V, 5 A with cos φ = 1
Communication	RS 485 interface
Temperature switching value (option)	0 … +40 °C
Explosion protection	
Marking	EEx e d ib [ia p] IIC T4/T6
Test certification	DMT 99 ATEX E 082
Ambient temperature	-20 … +40 °C

Dimensional drawings

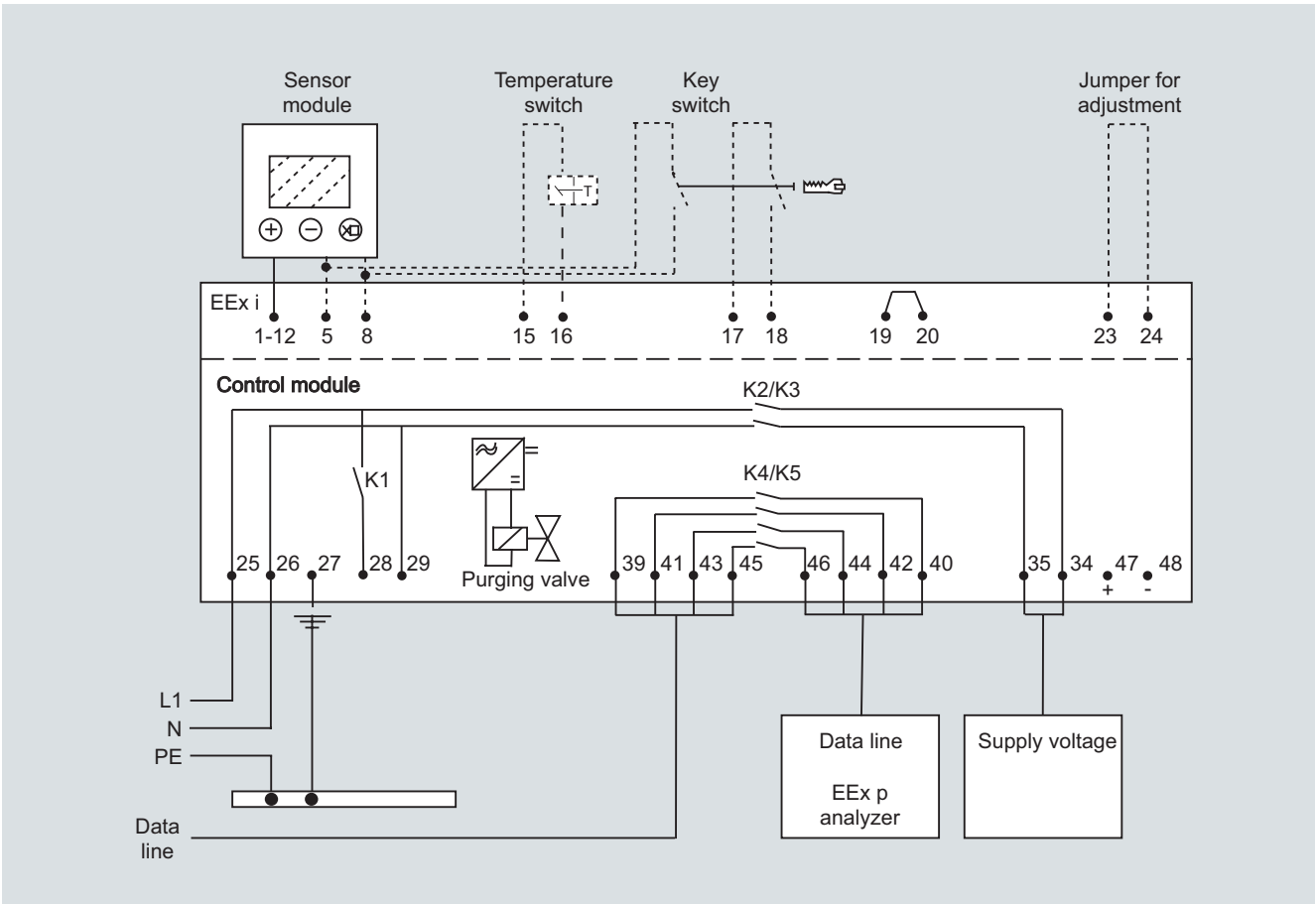


BARTEC control unit, dimensions in mm

Schematics



BARTEC control unit, continuous purging, gas connection diagram



BARTEC control unit, continuous purging, electric connection diagram

Ex versions

Continuous gas analysis, extractive
Purging unit FM (Class I Div 2)

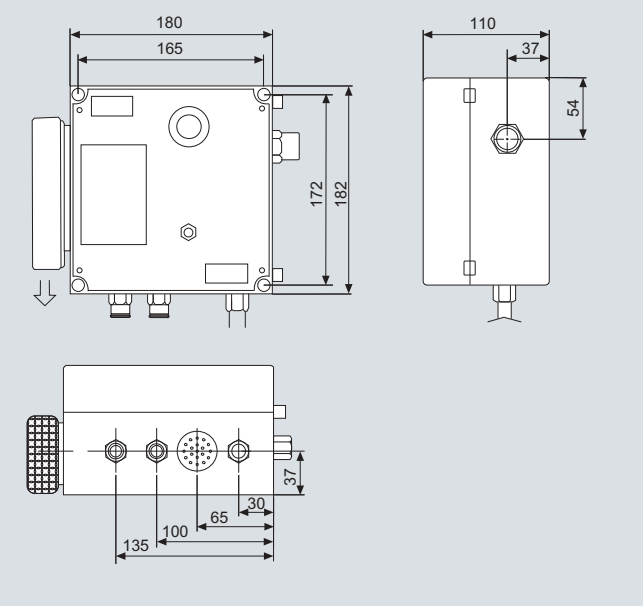
Application

The Ex purging unit MiniPurge FM is used to monitor the pressure during continuous purging of an analyzer with purging or inert gas. If the pressure falls below the set value, an optical display is triggered and the relay is activated. This monitoring unit is driven by the purging gas pressure and therefore does not require an additional power supply.

Technical specifications

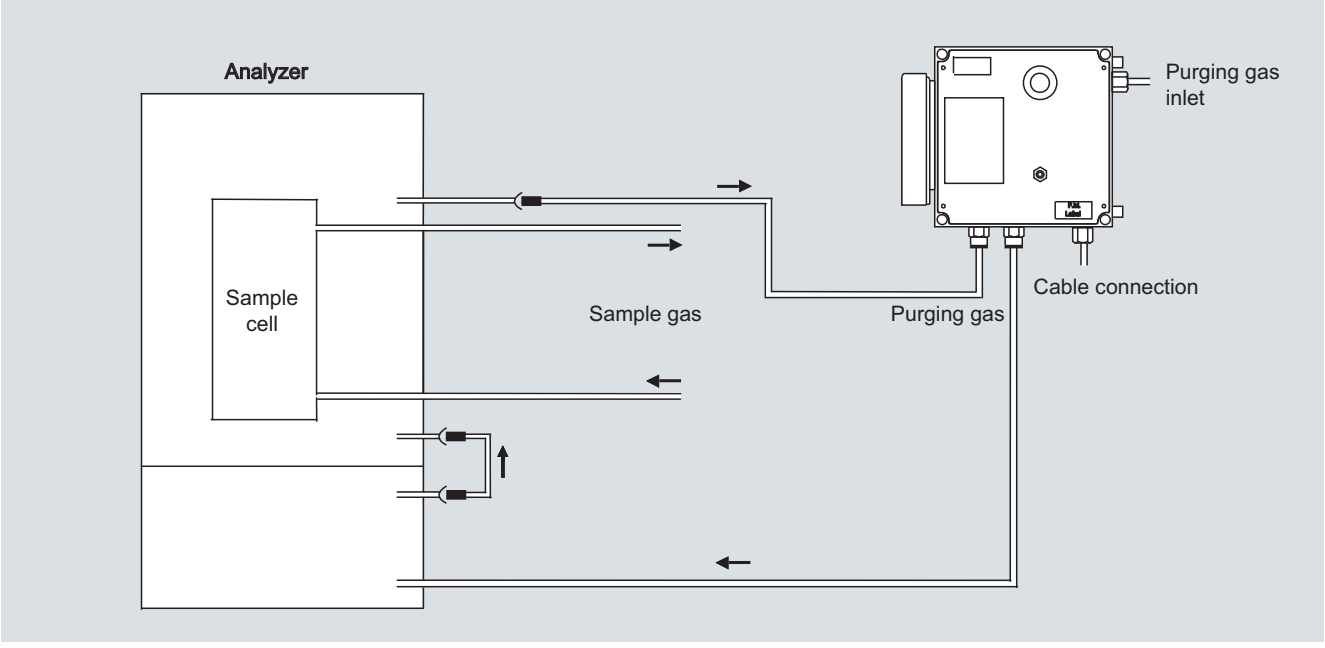
Classification	Class I Division 2
Enclosure dimensions (in mm)	444 x 438 x 275
Enclosure volume (l)	Approx. 50 l
Enclosure pressure (normal)	1 hPa
FM certificate	Certificate of compliance 1X8A4.AE / 0B3A3.AE
Reaction upon failure of pressure	Opening of switching contact, and alarm via signal indicator (red display)
System type	MiniPurge complete system
Operating mode	Continuous purging
Type of enclosure	Reinforced polycarbonate
Enclosure surface	RAL 7035 gray with transparent cover
Pressure supply	Dry, oil-free air or inert gas with regulated pressure of approx. 2000 hPa (30 psi) at inlet of MiniPurge
Supply connections	Pressure via ¼ BSPP connection, pressure hose at least ½" or 12 mm
Display (signal indicator)	Pneumatically driven color signal: green/red
Switching contact	Via SPCO switch approved for Class 1 Division 2
Settings	Lower response limit 0.5 hPa set relative to purging gas flow of 1 … 2 l/min
Prepurging time	Is defined by operator, and controlled manually
Enclosure pressure limitation	By means of stainless steel with integrated flame arrestor; opens at 10 hPa ± 10 %

Dimensional drawings



MiniPurge, dimensions in mm

Schematics



MiniPurge, purging unit, Class I, Div 2, gas connection diagram

Overview

Installation of Ex isolation modules / Ex i isolation amplifiers

The mounting rail in the analyzer has a length of approximately 250 mm, with the number of installable components being limited.

The maximum installation height is approximately 95 mm; however, it is less in the area of the display (88 mm). The width must not exceed 80 mm.

The add-on devices must be approved for an ambient temperature of up to 60 °C; this temperature can be reached under extreme marginal conditions.

The label of the analyzer shows all types of explosion protection that the device itself and the components can have.

Installation must always be discussed with the competent experts.

Slots in the analyzer and the purging unit.

	Ex i isolation amplifier	Ex isolating relay 8S	Comment
Analyzers	2	2	Max. 2
Bartec purging unit	0	1	Max. 1

Ex i isolation amplifier, 7MB8000-3AB

The analog inputs and outputs of the analyzers are **not intrinsically safe** in the basic version.

The analog output can be supplemented later with an intrinsically-safe analog output (explosion protection type EEx ib II C or EEx ia II C). For this purpose, a suitable commercially available isolating transformer can be mounted on a rail in the device.

Technical data:

- Intrinsically-safe analog output
- mA isolating transformer without power supply
- For installing in the analyzer

Isolation amplifier, rail mounting

- Intrinsically-safe output EEx ia IIC
- Galvanic isolation

Technical data

Input voltage	8.4 V + 0.02 x load x (V/Ω)
Linearity	< 0.1 V
Temperature impact	< 0.1 %/10 K
Power supply	8.4 ... -30 V DC from the current loop
Weight	160 g
Ambient temperature	-20 °C … +60 °C
Relative humidity	< 95 %, no condensation

Explosion protection

Type of protection	II (1) G D [Eex ia] IIC
EC type-examination certificate	TÜV 98 ATEX 1338
Safety limits	$U_0 \leq 12.6$ V $I_0 \leq 95$ mA

Isolating relay (signal outputs with external voltage supply) 7MB8000-4AA/-4AB

If the device has to be opened, it must be isolated at all poles from the mains cable, the binary inputs, relay outputs, analog inputs/ outputs, RS485 interface cable, and the PROFIBUS PA cables (not Ex i). For this purpose, isolating relays must be inserted. Intrinsically-safe circuits are excepted from this.

An isolating relay must be explosion-proof if it is to be set up in an area subject to explosion hazard.

Protective gas

- The fed-in gases are not flammable. Air from an area not subject to explosion hazard can be used as the protective gas (purging gas).
- Flammable gases or gas mixtures that are rarely or only briefly ignitable are fed in. The enclosure must be flooded with inert gas.
- Gas mixtures that are occasionally ignitable are introduced. As with b), the enclosure must be flooded with inert gas; in addition, the sample gas inlet and outlet must be equipped with flame arrestors.
- Explosive gas mixtures that are present in the long term or permanently must not be connected!

Flame arrestors

If the gas mixture to be measured sometimes has an explosive composition, flame arrestors must be installed in the sample gas inlet and, in certain circumstances, also in the sample gas outlet, in addition to the application already described with flammable sample gases.

The material of the flame arrestors must be resistant to the flow-type sample gas mixture. For this reason, they are available in two different versions:

- The detonation protection (Ex designation Ex IIG IIC) is used to prevent flashover in the case of unstable detonations and deflagrations of explosive gas or vapor/air mixtures of explosion group IIC.
- The flame arrestor consists essentially of a detonation-proof enclosure with gas connections and a ceramic sinter cartridge built into the housing (max. pore width: 80 µm) to prevent flashover.

It may be heated up to 150 °C and subjected to a pressure up to 3 bar (abs.).

Technical data

Length	83.5 mm
Diameter	32 mm
External thread	M 30 x 1.5; 30 mm long
Gas connections	G 1/4"
Material	Stainless steel or Hastelloy C
Max. gas operating pressure	3 bar (abs.)
Max. operating temperature	150 °C (200 °C on request)
Explosion group	IIC

Continuous gas analysis, extractive
Additional units

Differential pressure switch: 7MB8000-5AA

There must be a fail-safe guarantee that the sample gas pressure will never exceed 5 hPa under the purging gas pressure.

If this cannot be guaranteed on the plant side, a differential pressure switch must be mounted between the sample gas line and the purging gas line and connected electrically with the purging unit.

The differential pressure switch always has contact with the sample gas.

Technical data

- Differential pressure switch with magnetic spring contact
- Type 821.1
- Materials coming into contact with the sample gas:
  Stainless steel, mat. no. 1.4571
- Measuring range: -20 ... +20 hPa
- Trigger point: adjustable

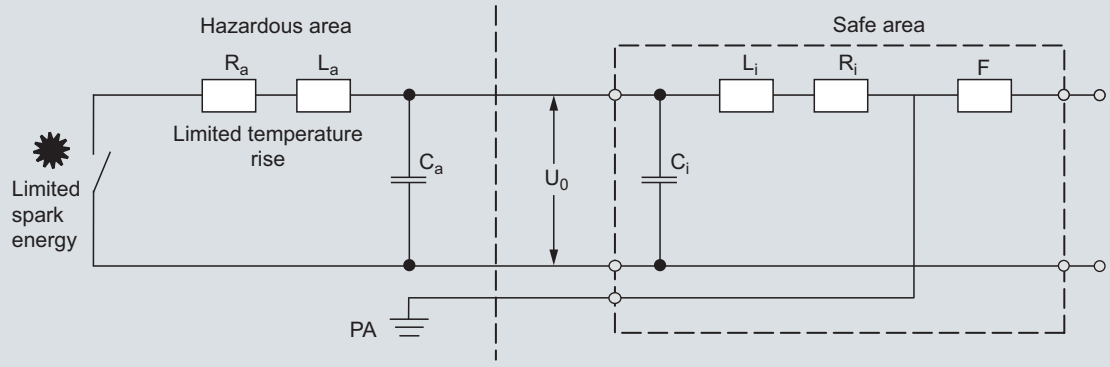
Overview

Sensors and cables for applications of the LDS 6 in hazardous areas

Intrinsic safety and intrinsically-safe circuit

Principles

The physical principle for the degree of protection "Intrinsic safety" is that a certain minimum ignition energy is required to ignite an explosive atmosphere. In an intrinsically-safe circuit, this minimum ignition energy is not present in the hazardous area, neither during normal operation nor in the event of an incident. The intrinsic safety of a circuit is achieved by limiting the current, voltage, power and temperature. Therefore the type of protection "Intrinsic safety" is limited to circuits with relatively small capacity. To prevent sparks during closing or opening, the capacitance and inductance of an intrinsically-safe circuit are also limited depending on the maximum current and voltage values. No sparks or thermal effects which could lead to ignition of an explosive atmosphere occur either in normal operation or in the process upset. Therefore intrinsically-safe circuits may also be connected or disconnected during operation when live, since the safety is also guaranteed in the event of a short-circuit or interruption. The following figure shows the block diagram for the type of protection "Intrinsic safety".



Block diagram for voltage/current limiting with type of protection "Intrinsic safety"

Intrinsically-safe electrical equipment and intrinsically-safe components of associated equipment are divided into two categories ("Protection levels"). A differentiation is made between the protection levels "ia" and "ib". Protection level "ib" also provides protection should one protective measure fail (fault redundancy 1). Protection level "ia" provides protection even if two protective measures should fail (fault redundancy 2). The standard refers to so-called "countable faults" instead of protective measures. These refer to protective measures, such as current limiting resistors, Zener diodes for voltage limiting, fuses, safe distances etc., i.e. all components or measures which implement an exactly defined safety function for the associated equipment.

Protection level	Description according to EN 50020	Installation
ia	The intrinsically-safe electrical equipment must not cause an ignition: • During normal operation or with the existence of non-countable safety-related faults which result in the most unfavorable condition. • During normal operation or with the existence of countable faults plus non-countable faults which result in the most unfavorable condition. • During normal operation or with the existence of two countable faults plus non-countable faults which result in the most unfavorable condition.	Up to zone 0
ib	The intrinsically-safe electrical equipment must not cause an ignition: • During normal operation or with the existence of non-countable faults which result in the most unfavorable condition. • During normal operation or with the existence of countable faults plus non-countable faults which result in the most unfavorable condition.	Zone 2 Zone 1

Protection levels of electrical equipment and intrinsically-safe components

Continuous gas analysis, in-situ
LDS 6

Minimum ignition curves

The "minimum ignition curves" are used to evaluate an intrinsically- safe circuit and to determine the maximum capacitance and inductance values. They are included in the valid intrinsically-safe standards (EN 50020 or DIN EN 50020 and IEC 60079-11 or EN 60079-11). Minimum ignition curves exist for resistive, capacitive and inductive circuits. Different minimum ignition curves are applied depending on the gas group for which an intrinsically-safe circuit is to be designed, and take into account the minimum ignition energies of the gas groups.

Associated electrical equipment

Associated electrical equipment is a reference to equipment which contains one or more intrinsically-safe circuits, but in which not all circuits are intrinsically-safe. Associated electrical equipment usually has an isolating function, i.e. separating intrinsically-safe equipment from non-intrinsically-safe equipment within a signal circuit. Such devices include, for example: safety barriers, switch amplifiers, power supply units etc.

Associated electrical equipment is not explosion-proof and must therefore not be installed in hazardous areas. It only contains intrinsically-safe circuits which may be routed into the hazardous area. Associated electrical equipment is identified by a square bracket enclosing "EEx" and the symbol for the type of protection, as well as absence of the temperature class (e.g. [EEx ia] IIC).

Cables

DIN/EN 60079-14 (VDE 165, Part 1) must be observed when selecting and routing the cables. Particular attention must be paid to the characteristic values, such as electric strength and minimum cross-section. In the case of intrinsically-safe circuits, the cable capacitance and inductance must be observed in addition, and must not exceed the values specified for the intrinsically-safe or associated equipment used (Co, Lo). The connection points and cables of intrinsically-safe circuits must be identified, e.g. in light blue, and be separated from the other connection points and cables of non-intrinsically-safe circuits.

Typical setup of an LDS 6 system in a hazardous area

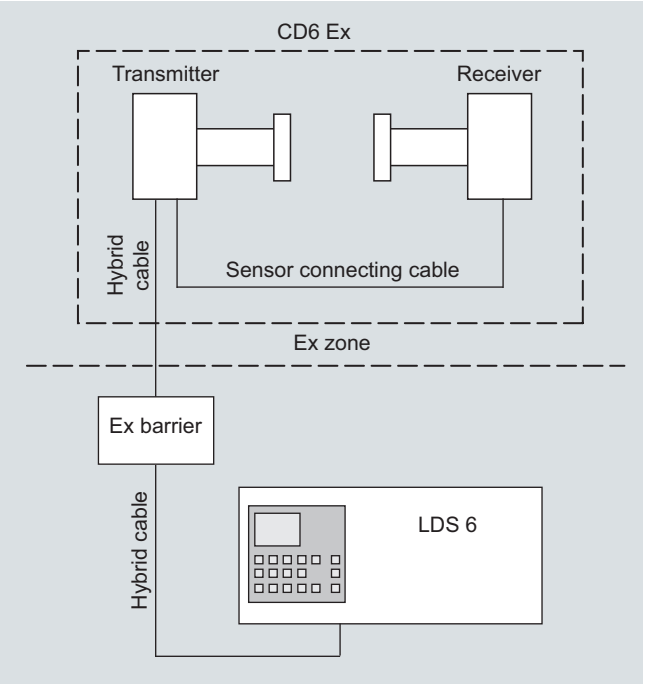
LDS 6 is capable of measuring gases in EEx environments, provided all safety-relevant points are particularly observed. The central unit of LDS 6 must always be located outside of hazardous areas.

Special EEx-type sensors (see explosion protection tag), certified according to

- ATEX II 1G Ex ia IIC T4 and
- ATEX II 1 D Ex iaD 20 IP65 T135 °C

allow operation inside almost any EEx-classified area.

For the intrinsically-safe version, an EEx barrier must be provided between the sensors and central unit. A typical version is shown in the following figure for intrinsically safe EEx ia sensors.



Typical setup of LDS 6 in a hazardous area

Overview

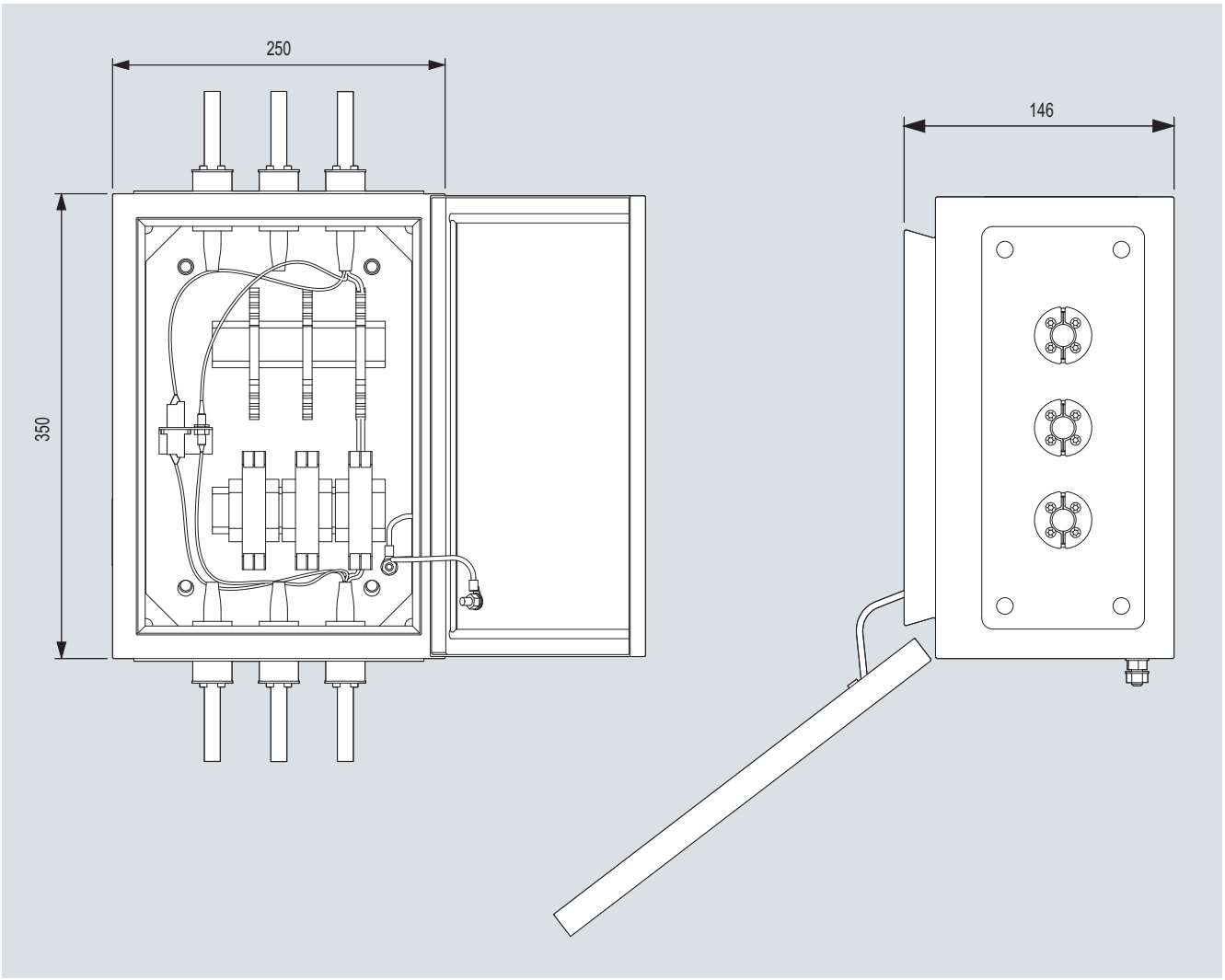
The EEx barrier is included in the scope of delivery of the CD 6 sensors in EEx ia version. It is meant for wall mounting close to the location of the LDS 6 central unit within an EEx-safe environment.

The EEx barrier defines the interface between the analyzer central unit and the intrinsically-safe sensor heads and ensures under all circumstances that the total electrical energy transferred via the hybrid cable to the sensors is always less that than needed to ignite combustible gas mixtures.

Technical specifications

EEx barrier	
Hazardous area output	
• Minimum output voltage	12.5 V at 45 mA
• Maximum output voltage	24 V at 170 Ω
• Current limitation	45 mA
Max. power consumption (45 mA output)	90 mA at 24 V, 110 mA at 20 ... 35 V DC
Safety description	25 V, 170 Ω, 147 mA, U_m = 250 V_{rms} or DC

Dimensional drawings

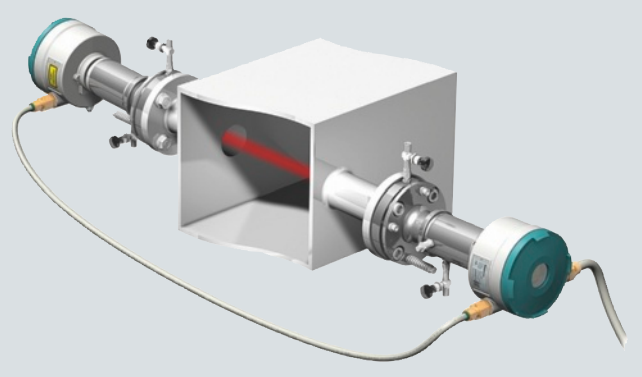


EEx barrier, dimensions in mm

Ex versions

Continuous gas analysis, in-situ
SITRANS SL

Overview



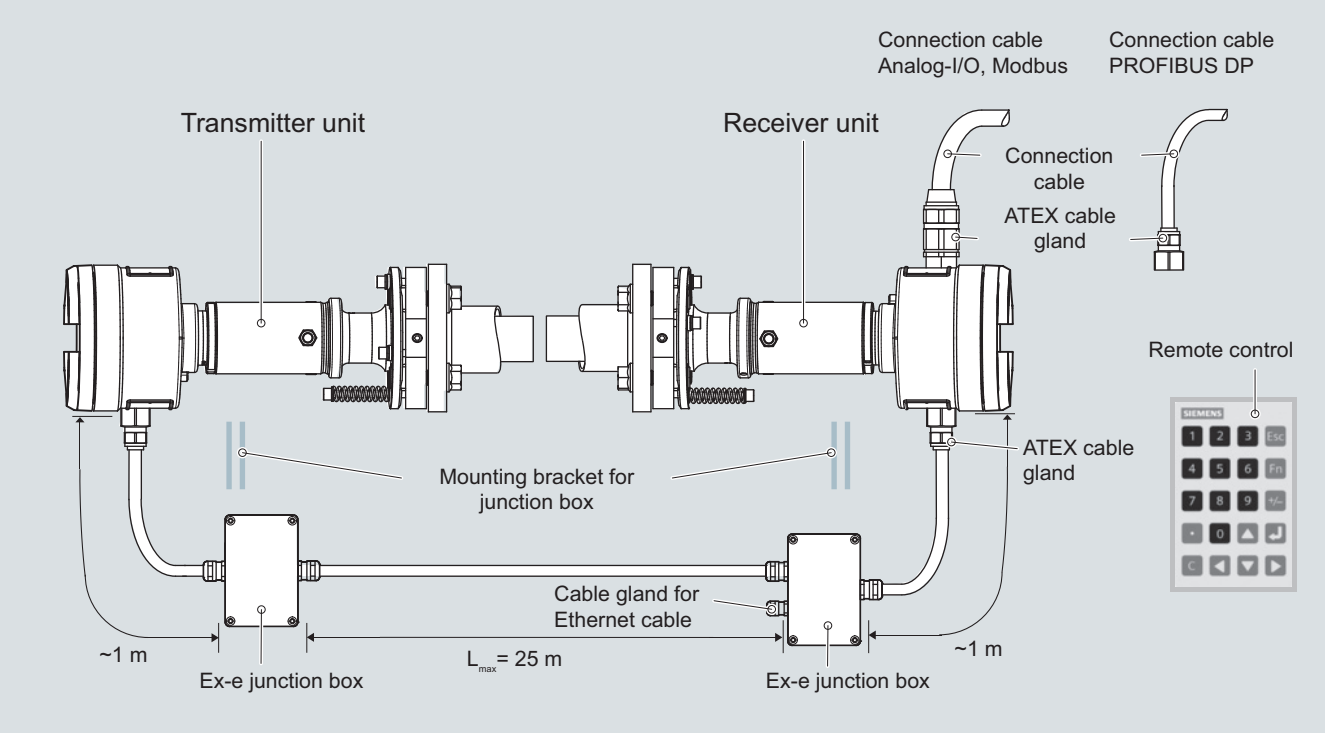
An Ex concept with type of explosion protection "Pressurized enclosure d" is used for the SITRANS SL. The enclosure used resists an explosion caused by an explosive gas mixture in the analyzer. Ignition of an explosive atmosphere produced outside the enclosure is therefore reliably prevented.

The SITRANS SL consists of a flameproof transmitter, a flameproof receiver, and optionally a specially certified junction box of increased safety. The complete analytical system is accommodated in the two flameproof enclosures which are connected together by a cable. A further cable is connected to the receiver, and serves as the power supply and customer interface. Both cables have a fixed connection to the flameproof enclosure. They must be connected in a suitable junction box if applicable. The receiver also has a local display.

SITRANS SL can be operated by Ex-certified infrared remote control.

The laser has a radiated power of 0.8 mW. The irradiance is approx. 10.9 10 - 3 mW/mm^2. This is below the values permitted in EN 60079-28.

The SITRANS SL is available with ATEX or FM certificates.



Special conditions

Repairing of the flameproof gaps must only be carried out in accordance with the manufacturer's design directives.

Connection conditions

- Unused openings must be closed in accordance with EN 60079-1 Section 11.9.
- A fixed cable must be used for the SITRANS SL gas analyzer, and routed such that it is sufficiently protected against damage.
- If the temperature on the entry components is higher than 70 °C, appropriate temperature-resistant cables must be used.
- The SITRANS SL gas analyzer must be included in the local equipotential bonding.
- The end of the SITRANS SL gas analyzer cable must be connected in an enclosure which complies with the requirements of a recognized type of explosion protection in accordance with EN 60079-0, Section 1, if the connection is made in the hazardous area.

Overview

Safety is extremely important during the storage, manufacture, processing and transportation of flammable materials, especially in the chemical and petrochemical industries, and in oil and gas production.

Gas chromatographs and the sample preparation carried out in these plants must be designed such that no explosive mixtures can be ignited when applied. National directives and guidelines as well as international standards regulate the equipment prerequisites.

The MAXUM edition II and MicroSAM chromatographs can be used in hazardous areas according to ATEX II 2G (zone 1) and ATEX II 3G (zone 2).

The following individual protective measures apply:

Type of protection: pressurized enclosure "p"

The ignition source is enclosed by a protective gas with overpressure (at least 0.5 hPa). Air is used in most cases. The surrounding explosive atmosphere cannot penetrate.

No flammable sample or flammable carrier gas may be passed into this pressurized area. Switching valves for the carrier gas H_2 must therefore be mounted outside this area.

The strength of the enclosure is at least 1.5 times the resistance to operating pressure.

An alarm is generated in the event of failure of the purging gas or the overpressure.

The electronics area must be purged prior to starting up the equipment.

This purging also provides additional protection in corrosive environments.

Type of protection: flameproof enclosure "d"

This type of protection is used for most of our detectors. The detector is fitted in an enclosure which is resistant to the explosion of an explosive atmosphere within it. This means that the mechanical stability of the enclosure must withstand this internal explosion pressure.

Joints must also be so tight that hot gas escaping between two parts of the enclosure is not explosive.

Ignition of an explosive atmosphere produced outside the enclosure is therefore reliably prevented. This is known as resistance to transmission of internal ignition.

The FID, TCD and FPD detectors are available with this degree of protection.

The maximum demands with regard to the joint parameters (width/length) are placed on enclosures of explosion group II C. MicroSAM is an example of this.

Basic design with MAXUM edition II

The electronic components are accommodated in a pressurized area. If the overpressure falls below a certain value, a control device switches off the power supply when a defined threshold is reached.

The MAXUM edition II is available with certificates according to CSA/US, or ATEX certificates according to Cenelec for the EU market.

MAXUM edition II

Basic design with MicroSAM

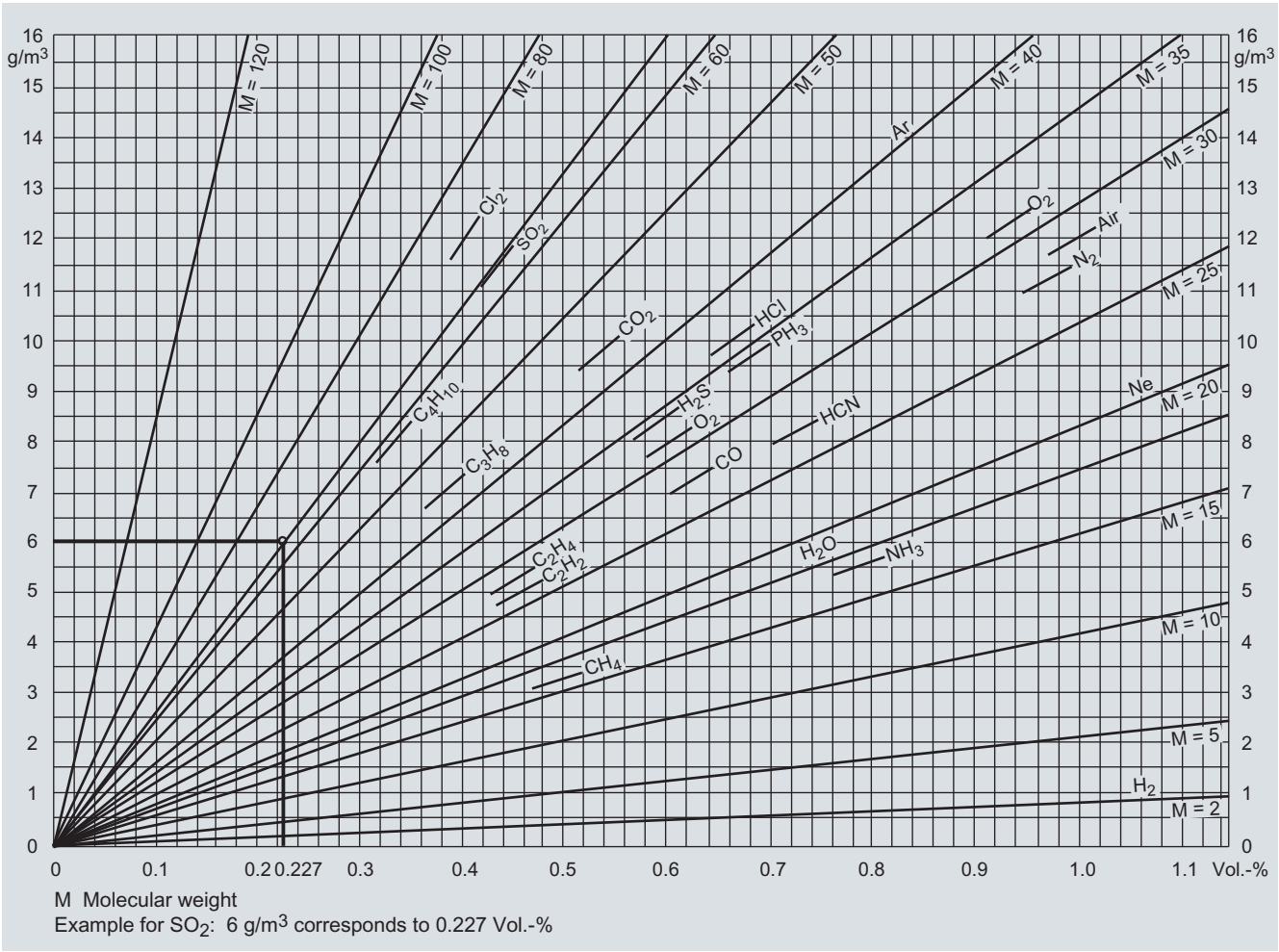
The MicroSAM is designed such that all components (electronic and analytical) are accommodated in a flameproof enclosure. The advantage of this version is that no additional purging gases or safety monitoring systems are required.

The MicroSAM is available with ATEX or FM/CSA certificates for the US market.

MicroSAM

Conversion tables

Overview



M Molecular weight
Example for SO_2: 6 g/m³ corresponds to 0.227 Vol.-%

Conversion from g/m³ to vol. % (at 293 K and 1013 hPa)

Conversion tables

Component	Molecular mass	1 ppm in mg/m³	1 mg/m³ in ppm
CO	28	1.250	0.800
NO	30	1.339	0.747
SO_2	64	2.857	0.350
CO_2	44	1.964	0.509
CH_4	16	0.714	1.400
C_2H_4	28	1.250	0.800
C_2H_6	30	1.339	0.747
C_4H_{10}	58	2.589	0.386
C_3H_8	44	1.964	0.509
C_3H_6	42	1.875	0.533

Conversion ppm ↔ mg/m³ (1 atm; 0 °C), examples

	atm	bar	hPa	psia
atm		1.01325	1013.25	14.69595
bar	0.9869		1000	14.50377
hPa	0.0009869	0.001		0.0145038
psia	0.0680	0.06894	68.94	

Conversion of pressure units

hPa	psia
420	6.091
500	7.251
600	8.202
800	11.603
1 000	14.503
1 160	16.824
1 200	17.404
1 300	18.854
1 485	21.538
1 500	21.755
2 000	29.007
3 000	43.511
3 500	50.763
4 000	58.015

Conversion hPa ↔ psia

Dew point/saturation table

Dew point		Water content	
°C	°F	ppm (vol.)	g/m^3 1)
-100	-148.0	0.014	0.0000103
-90	-130.0	0.008	0.000119
-80	-112.0	0.54	0.000565
-70	-94.0	2.57	0.00269
-60	-78.0	10.7	0.011
-55	-67.0	20.8	0.021
-50	-58.0	38.4	0.038
-48	-54.4	49.6	0.049
-46	-50.8	63.0	0.061
-45	-49.0	68.5	0.067
-44	-47.2	80.1	0.076
-42	-43.6	101.5	0.097
-40	-40.0	126.9	0.11
-39	-38.2	137.0	0.12
-38	-36.4	158.0	0.14
-37	-34.6	174.1	0.16
-36	-32.8	197.8	0.17
-35	-31.0	224.0	0.19
-34	-29.2	245.0	0.22
-33	-27.4	274.0	0.24
-32	-25.6	303.4	0.26
-31	-23.8	336.0	0.30
-30	-22.0	374	0.33
-29	-20.2	411	0.37
-28	-18.4	461	0.40
-27	-16.8	511	0.45
-26	-14.3	563	0.49
-25	-13.0	623	0.55
-24	-11.2	689	0.59
-23	-9.4	759	0.66
-22	-7.3	840	0.72
-21	-5.8	922	0.80
-20	-4.0	1 015	0.88
-19	-2.2	1 118	0.96
-18	-0.4	1 231	1.05
-17	+1.4	1 358	1.15
-16	+3.2	1 480	1.26
-15	+5.0	1 630	1.38
-14	+6.8	1 779	1.51
-13	+8.8	1 953	1.65
-12	+10.4	2 140	1.79
-11	+12.2	2 338	1.96
-10	+14.0	2 562	2.14
-9	+15.8	2 798	2.33
-8	+17.6	3 047	2.54
-7	+19.4	3 333	2.76
-6	+21.2	3 632	2.99
-5	+23.0	3 955	3.20
-4	+24.8	4 303	3.51
-3	+26.6	4 690	3.81
-2	+28.4	5 100	4.13
-1	+30.2	5 547	4.47
0	+32.0	6 020	4.84
+1	+33.8	6 480	5.2
+2	+36.8	6 850	5.6
+3	+37.4	7 487	6.0
+4	+39.2	8 022	6.4
+5	+41	8 595	6.8
+6	+42.8	9 216	7.3
+7	+44.6	9 875	7.8
+8	+46.4	10 584	8.3
+9	+48.2	11 318	8.8
+10	+50	12 114	9.4
+11	+51.8	12 935	10.0
+12	+53.6	13 806	10.7
+13	+55.4	14 800	11.4
+14	+57.2	15 796	12.1
+15	+59	16 791	12.8
+16	+60.8	17 885	13.6
+17	+62.6	19 030	14.5
+18	+64.4	20 396	15.4
+19	+66.2	21 641	16.3
+20	+68	23 020	17.3
+21	+69.8	24 502	18.3
+22	+71.6	26 120	19.4
+23	+73.4	27 736	20.6
+24	+75.2	29 477	21.8
+25	+77	31 219	23.0
+26	+78.8	33 209	24.4
+27	+80.6	35 200	25.8
+28	+82.4	37 312	27.2
+29	+84.2	39 551	28.7
+30	+86	41 791	30.3
+31	+87.8	44 322	32.0
+32	+89.6	46 936	33.5
+33	+91.4	49 675	35.6
+34	+93.2	52 539	37.2
+35	+95	55 472	39.6
+36	+96.8	58 639	41.3
+37	+98.6	62 001	43.8
+38	+100.4	65 487	45.8
+39	+102.2	68 973	48.4
+40	+104	71 761	50.7
+42	+107.6	81 049	56.5
+44	+111.2	89 889	62.3
+45	+113	94 527	65.3
+46	+114.8	99 600	68.7
+48	+118.4	110 681	75.5
+50	+122	120 398	82.3
+55	+131	155 472	104.0
+60	+140	196 517	129.5
+70	+158	307 212	196.5
+80	+176	467 662	290.5
+90	+194	691 542	418.0
+100	+212	1 000 980	558.0

1) Reference temperature = dew point temperature.

Tables

Dew point/saturation table

Guide values for dead time (sec) per meter of sample gas line

d / Q	4 mm	6 mm	8 mm	10 mm	12 mm	14 mm	16 mm	18 mm	20 mm
30 l/h	1.5	3.4	6	9.4	13.5	18.4	24	30.5	37.6
60 l/h	0.8	1.7	3	4.7	6.8	9.2	12	15.3	18.8
90 l/h	0.5	1.1	2	3.1	4.5	6.1	8	10.2	12.5
120 l/h	0.4	0.9	1.5	2.4	3.4	4.6	6	7.6	9.4
150 l/h	0.3	0.7	1.2	1.9	2.7	3.7	4.8	6.1	7.5
180 l/h	0.3	0.6	1	1.6	2.3	3.1	4	5.1	6.3
210 l/h	0.2	0.5	0.9	1.3	1.9	2.6	3.4	4.3	5.4
240 l/h	0.2	0.5	0.8	1.2	1.7	2.3	3	3.8	4.7
270 l/h	0.2	0.4	0.7	1	1.5	2	2.7	3.4	4.2
300 l/h	0.15	0.34	0.6	0.9	1.4	1.8	2.4	3.1	3.8

d = Inner diameter of sample gas lines
Q = Flow rate

International standards

National standards also exist in most EU member states, and may be used in these countries in addition to the valid EN standards. In the Federal Republic of Germany, these are the DIN standards and the VDE regulations.

However, extensive harmonization has already been carried out in the explosion protection sector, and most standards now also exist as "DIN EN ...." versions, which have also been incorporated into the VDE regulations. DIN EN standards are identical to the corresponding EN standards, were special national features, e.g. concerning areas of validity etc., are formulated in a national foreword.

Topic	International		Europe/Germany		USA		Canada	
			FM	UL	ANSI/ISA	Ex zone model	Ex Class Div. model	Miscella-neous
Ex: General regulations	IEC 60079-0	EN 50014/ VDE 0170/0171 Part 1	FM 3600		ANSI/ISA-S12.0.01	CSA 79-0-95		
Oil immersion "o"	IEC 60079-6	EN 50015/ DIN EN 50015, VDE 0170/0171 Part 2		UL2279, Pt.6	ANSI/ISA-S12.26. 01	CSA-E79-6		
Pressurized enclosure "p"	IEC 60079-2	EN 50016/ DIN EN 50016, VDE 0170/0171 Part 3	FM 3620	(NFPA4 96)		CSA-E79-2	CSA TIL. E 13 A	
Powder filling "q"	IEC 60079-5	EN 50017/ DIN EN 50017, VDE 0170/0171 Part 4		UL2279, Pt.5	ANSI/ISA-S12.25. 01	CSA-E79-5		
Flameproof enclosure "d"	IEC 60079-1	EN 50018/ DIN EN 50018, VDE 0170/0171 Part 5	FM 3615	UL2279, Pt.1 UL1203	ANSI/ISA-S12.22. 01	CSA-E79-1	CSA C22.2 No. 30	
Increased safety "e"	IEC 60079-7	EN 50019/ DIN EN 50019, VDE 0170/0171 Part 6		UL2279, Pt.7	ANSI/ISA-S12.16. 01	CSA-E79-7		
Intrinsic safety "i"	IEC 60079-11	EN 50020/ DIN EN 50020, VDE 0170/0171 Part 7	FM 3610	UL2279, Pt.11 UL 913	pr ANSI/ISA-S12.02. 01	CSA-E79-11	CSA C22.2 No. 157	
Degree of protection "n"	IEC 60079-15	EN 50021/ DIN EN 50021, VDE 0170/0171 Part 8	FM 3611	UL2279, Pt.15	pr ANSI/ISA S12.12. 01	CSA-E79-15	CSA C22.2 No. 213	
Encapsulation "m"	IEC 60079-18	EN 50028/ DIN EN 50028, VDE 0170/0171 Part 9		UL2279, Pt.18	ANSI/ISA-S12.23. 01	CSA-E79-18		
Zone 0	IEC 60079-26	EN 50284/ DIN EN 50284, VDE 0170/0171 Part 12						
Electrical safety	IEC 61010	EN 61010-1/ DIN EN 61010-1, VDE 0411 Part 1			ANSI/ISA-82. 02.01			CAN/CSA-C22.2 No. 1010.1

Comparison of international and European standards

International standards

European standard	German standard	German title
EN 1127	DIN EN 1127-1	Explosive atmospheres - Explosion protection - Part 1: Fundamentals and method
EN 50039	DIN EN 50039, VDE 0170/0171 Part 10	Electrical equipment for hazardous areas; intrinsically-safe electrical systems "i"
EN 13463-1	DIN EN 13 463-1	Non-electrical equipment for use in hazardous areas, Part 1: Fundamental method and requirements
EN 50281-1-1	DIN EN 50281-1-1, VDE 0170/0171 Part 15-1-1	Electrical equipment for use in areas with combustible dust, Part 1-1: Electrical equipment with protection by enclosure
EN 60079-10	DIN EN 60079-10, VDE 165 Part 101	Electrical equipment for potentially explosive gas atmospheres, Part 10: Division of potentially explosive areas
EN 60079-14	DIN EN 60079-14, VDE 165 Part 1	Electrical equipment for hazardous areas, Part 14: Electrical installations in potentially explosive areas (except underground excavation)
EN 60079-17	DIN EN 60079-17, VDE 0165 Part 10	Electrical equipment for potentially explosive gas atmospheres, Part 17: Testing and maintenance of electrical installations in hazardous areas (except underground excavation)
EN 60950	DIN EN 60950, VDE 0805	Safety of information technology equipment, including electrical office machines

Harmonized European standards for explosion protection

	T 1 > 450 °C	T 2 > 300 °C	T 3 > 200 °C	T 4 > 135 °C	T 5 > 100 °C	T 6 > 85 °C
I	Methane					
II A	Acetone Ethane Ethyl acetate Ammonia Benzene (pure) Acetic acid Carbon monoxide Methane Methanol Propane Toluene	Ethyl alcohol i-amyl acetate n-butane n-butyl alcohol	Petrol Diesel fuel Aviation gasoline Fuel oil n-hexane	Acetyl aldehyde Ethyl ether		
II B	Town gas (Illuminating gas)	Ethylene				
II C	Hydrogen	Acetylene				Carbon disulfide

Classification of gases and vapors into explosion groups and temperature classes

Overview

Definitions

Calibration gas

Gas used for adjusting the sensitivity (deflection) of the detected gas. It is a gas mixture of known composition (measured component and suitable residual gas).

Sensitivity

Ratio between a change in output variable observed on the measuring instrument and the change in input variable required for this.

Linearity error of devices with linear characteristics

Deviation of measured characteristic from a linear reference characteristic.

The linearity is an important variable particularly for instruments which use a measuring effect with nonlinear characteristic and where the measured characteristic is linearized electronically.

Cross-sensitivity

Measure for the selectivity of a gas analyzer with regard to interfering components.

It is the ratio between the displayed value of the interfering component and the displayed value of the measured component; both have the same concentration.

In the case of analyzers where the total concentration of different materials is measured (e.g. total hydrocarbon concentration) and where the individual components are weighted differently in the measuring result, these factors are specified in equivalents of a master component (e.g. CH_4 equivalents for the total hydrocarbon measurement) and not as cross-sensitivity.

Dynamic response

The dynamic response of an analyzer is characterized by its response time and dead time. The response time is the time which passes until the output variable remains constantly within defined limits following an abrupt change in the input variable. The response time is usually understood as the time required to reach 90 (T_{90}) or 95 % of the expected display.

Units of measurement

Vol%

Volume proportion in % of measured component, based on the sample gas.

ppm (vpm)

Parts per million, i.e. one proportion of the measured component per 10^6 proportions of the sample gas (corresponds to 10^{-4} %).

In gas analysis technology, ppm is usually understood as volume concentrations. The dimension unit vpm is frequently used for unequivocal identification:

1 vpm = 1 cm^3 / m^3

Example: 1 000 vpm = 0.1 vol.% = 1 dm^3 / m^3

mg/m^3

Mass of measured component in mg referred to 1 m^3 of sample gas at 1 013 hPa and 20 °C.

Example: 1 vpm = 1 cm^3 / m^3 corresponds to:

(molecular weight of component / molecular volume of component) · (mg / m^3)

Weight concentration

Specification of measured values in weight concentrations is not common with gas analysis. Weight concentrations can only be determined in exceptional cases. The dimension unit mg/m^3 does not mean weight concentration.

Notes