Overview

The measuring principle of the OXYMAT 61 gas analyzers is based on the paramagnetic alternating pressure method and is used to measure oxygen in gases in standard applications.

Benefits

- Integrated pump for reference gas (option, e.g. ambient air)
- High linearity
- Compact design
- Physically suppressed zero possible

Application

Application areas

- Environmental protection
- Boiler control in firing systems
- Quality monitoring (e.g. in ultra-pure gases)
- Process exhaust monitoring
- Process optimization

Further applications

- Chemical plants
- Gas manufacturers
- Research and development

Design

- 19" slide-in module with 4 HU for installation
  - In hinged frame
  - In cabinets with or without telescope rails
- Front plate can be swung down for servicing purposes (laptop connection)
- Gas connections for sample gas inlet and outlet; pipe diameter 6 mm or ¼"
- Gas and electrical connections at the rear

Display and control panel

- Large LCD field for simultaneous display of
  - Measured value
  - Status bar
  - Measuring ranges
- Contrast of LCD panel adjustable using menu
- Permanent LED backlighting
- Washable membrane keyboard with five softkeys
- Menu-driven operation for parameterization, test functions, adjustment
- User help in plain text
- Graphic display of concentration trend; programmable time intervals
- Bilingual operating software German/English, English/Spanish, French/English, Spanish/English, Italian/English

Input and outputs

- One analog output per medium (from 0, 2, 4 to 20 mA; NAMUR parameterizable)
- Six digital inputs freely configurable (e.g. for measurement range switchover, processing of external signals from sample preparation)
- Six relay outputs freely configurable (failure, maintenance demanded, maintenance switch, threshold alarm, external magnetic valves)
- Two analog inputs configurable (e.g. correction of cross-interference, external pressure sensor)
- Expansion by eight additional digital inputs and eight additional relay outputs for autocalibration with up to four calibration gases

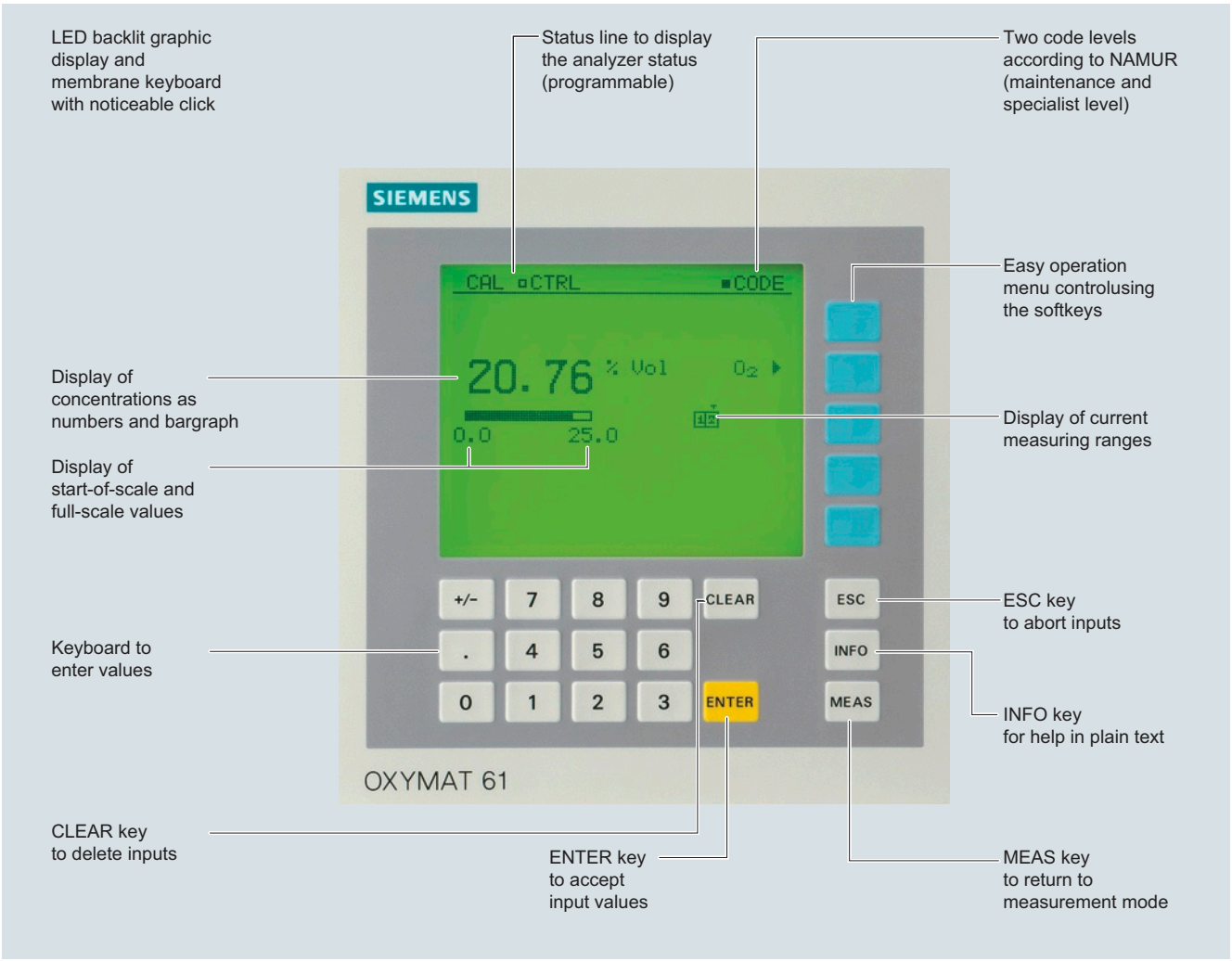
Communication

RS 485 present in basic unit (connection from the rear).

Options

- RS 485/RS 232 converter
- RS 485/Ethernet converter
- RS 485/USB converter
- Connection to networks via PROFIBUS DP/PA interface
- SIPROM GA software as service and maintenance tool

General information



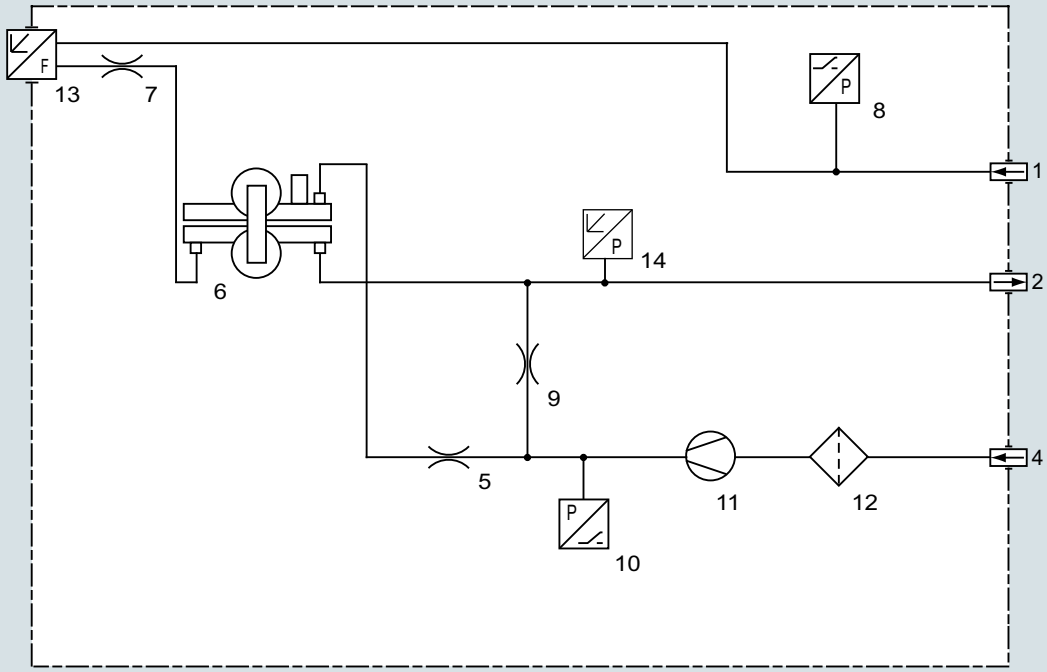
OXYMAT 61, membrane keyboard and graphic display

Designs – Parts wetted by sample gas, standard

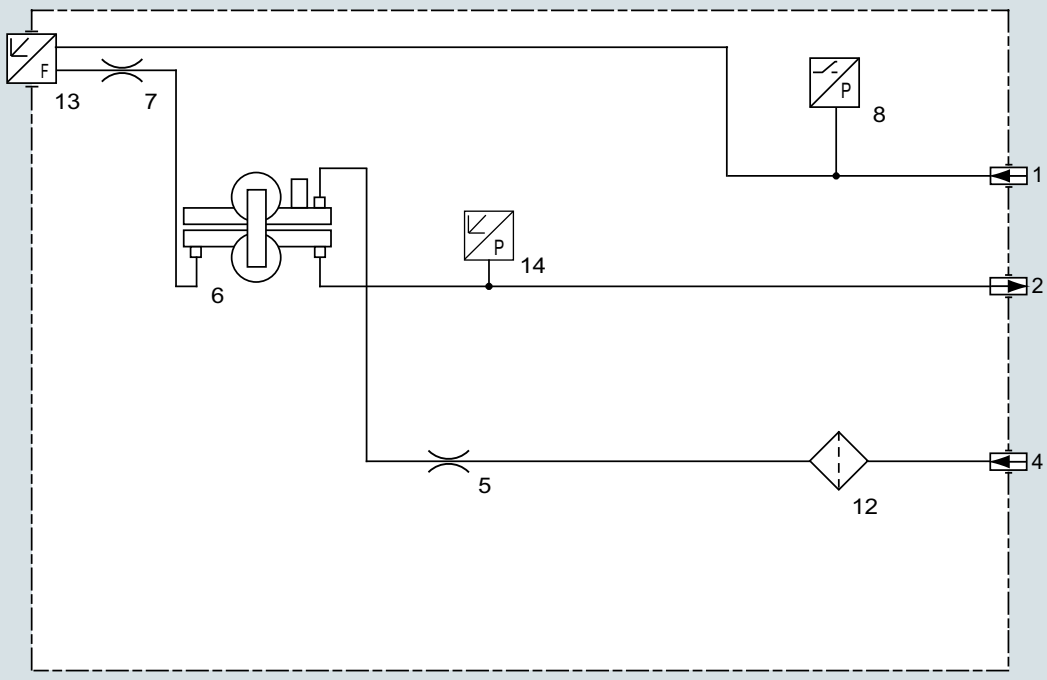
Gas path		19" rack unit
With hoses	Bushing	Stainless steel. Mat. no. 1.4571
	Hose	FKM (Viton)
	Sample chamber	Stainless steel. Mat. no. 1.4571
	Fittings for sample chamber	Stainless steel. Mat. no. 1.4571
	Restrictor	PTFE (Teflon)
	O-rings	FKM (Viton)
	Hose coupling	Polyamide 6
Options		
Flow indicator	Measurement pipe	Duran glass
	Variable area	Duran glass, black
	Suspension boundary	PTFE (Teflon)
	Angle pieces	FKM (Viton)
Pressure switch	Diaphragm	FKM (Viton)
	Enclosure	PA 6.3 T

Gas path

Legend for the gas path figures			
1	Sample gas inlet	8	Pressure switch in sample gas channel (option)
2	Sample gas outlet	9	Restrictor in reference gas path (outlet)
3	Not used	10	Pressure switch for reference gas monitoring
4	Reference gas inlet	11	Pump
5	Restrictor in reference gas path	12	Filter
6	O_2 physical system	13	Flow indicator in sample gas channel (optional)
7	Restrictor in sample gas path	14	Pressure sensor



Gas path OXYMAT 61 with integrated reference gas pump (connection for 1 100 hPa, absolute)



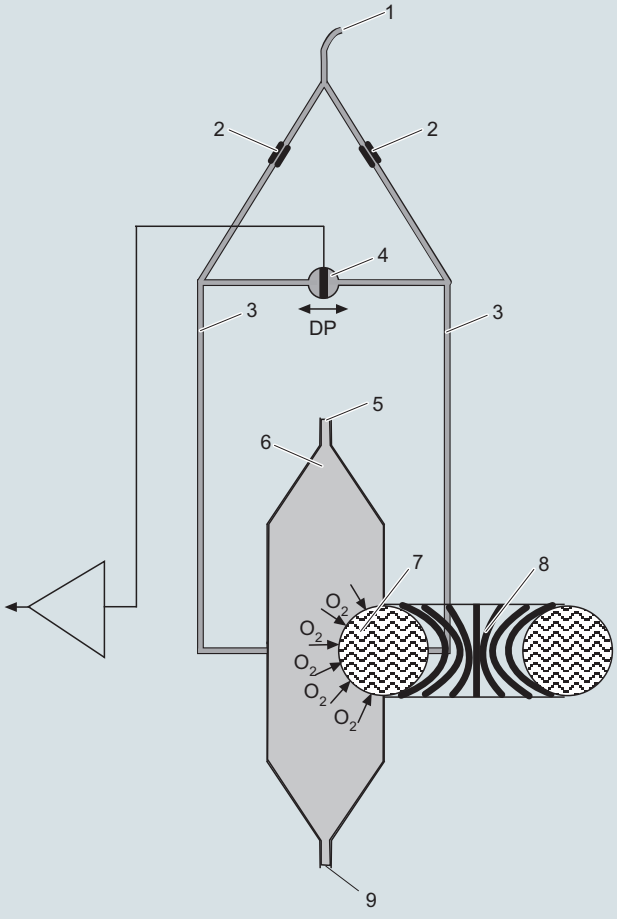
Gas path OXYMAT 61 with reference gas connection 3 000 to 5 000 hPa, absolute

Function

In contrast to almost all other gases, oxygen is paramagnetic. This property is utilized as the measuring principle by the OXYMAT 61 gas analyzers.

Oxygen molecules in an inhomogeneous magnetic field are drawn in the direction of increased field strength due to their paramagnetism. When two gases with different oxygen contents meet in a magnetic field, a pressure difference is produced between them.

In the case of OXYMAT 61, one gas (1) is a reference gas (N_2, O_2 or air), the other is the sample gas (5). The reference gas is introduced into the sample chamber (6) through two channels (3). One of these reference gas streams meets the sample gas within the area of a magnetic field (7). Because the two channels are connected, the pressure, which is proportional to the oxygen content, causes a cross flow. This flow is converted into an electric signal by a microflow sensor (4).



1 Reference gas inlet
2 Restrictors
3 Reference gas channels
4 Microflow sensor for measurement
5 Sample gas inlet
6 Sample cell
7 Paramagnetic effect
8 Electromagnet with alternating field strength
9 Sample gas and reference gas outlet

OXYMAT 61, principle of operation

The microflow sensor consists of two nickel-plated grids heated to approximately 120 °C, which, along with two supplementary resistors, form a Wheatstone bridge. The pulsating flow results in a change in the resistance of the Ni grids. This leads to an offset in the bridge which is dependent on the oxygen concentration of the sample gas.

Because the microflow sensor is located in the reference gas stream, the measurement is not influenced by the thermal conductivity, the specific heat or the internal friction of the sample gas. This also provides a high degree of corrosion resistance because the microflow sensor is not exposed to the direct influence of the sample gas.

By using a magnetic field with alternating strength (8), the effect of the background flow in the microflow sensor is not detected, and the measurement is thus independent of the instrument's operating position.

The sample chamber is directly in the sample path and has a small volume, and the microflow sensor is a low-lag sensor. This results in a very short response time for the OXYMAT 61.

Note

The sample gases must be fed into the analyzers free of dust. Condensation in the sample chambers must be prevented. Therefore, gas modified for the measuring tasks is necessary in most application cases.

Essential characteristics

- Four measuring ranges which can be freely configured, even with suppressed zero point, all measuring ranges are linear
- Galvanically isolated measured-value output 0/2/4 to 20 mA (also inverted)
- Autoranging possible; remote switching is also possible
- Storage of measured values possible during adjustments
- Wide range of selectable time constants (static/dynamic noise suppression); i.e. the response time of the device can be adapted to the respective measuring task
- Easy handling thanks to menu-driven operation
- Low long-term drift
- Two control levels with their own authorization codes for the prevention of accidental and unauthorized operator interventions
- Automatic measuring range calibration can be configured
- Operation based on the NAMUR recommendation
- Monitoring of sample gas (option)
- Customer-specific analyzer options such as:
  - Customer acceptance
  - TAG labels
  - Drift recording
- Simple handling using a numerical membrane keyboard and operator prompting
- Short response time
- Reference gas supply either externally (N_2, O_2 or air, approx. 3 000 hPa) or via built-in reference gas pump (ambient air, approx. 1 100 hPa abs.)
- Monitoring of reference gas with reference gas connection; only on version with built-in reference gas pump
- Different smallest measuring ranges, depending on version 2.0% or 5.0% O_2
- Internal pressure sensor for correction of fluctuations in the sample gas pressure

Correction of zero error / cross-sensitivities

Accompanying gas (concentration 100 vol.%)	Deviation from zero point in vol.% O_2 absolute
Organic gases	
Ethane C_2H_6	-0.49
Ethene (ethylene) C_2H_4	-0.22
Ethine (acetylene) C_2H_2	-0.29
1.2 butadiene C_4H_6	-0.65
1.3 butadiene C_4H_6	-0.49
n-butane C_4H_{10}	-1.26
iso-butane C_4H_{10}	-1.30
1-butene C_4H_8	-0.96
iso-butene C_4H_8	-1.06
Dichlorodifluoromethane (R12) CCl_2F_2	-1.32
Acetic acid CH_3COOH	-0.64
n-heptane C_7H_{16}	-2.40
n-hexane C_6H_{14}	-2.02
Cyclo-hexane C_6H_{12}	-1.84
Methane CH_4	-0.18
Methanol CH_3OH	-0.31
n-octane C_8H_{18}	-2.78
n-pentane C_5H_{12}	-1.68
iso-pentane C_5H_{12}	-1.49
Propane C_3H_8	-0.87
Propylene C_3H_6	-0.64
Trichlorofluoromethane (R11) CCl_3F	-1.63
Vinyl chloride C_2H_3Cl	-0.77
Vinyl fluoride C_2H_3F	-0.55
1.1 vinylidene chloride $C_2H_2Cl_2$	-1.22

Accompanying gas (concentration 100 vol.%)	Deviation from zero point in vol.% O_2 absolute
Inert gases	
Helium He	+0.33
Neon Ne	+0.17
Argon Ar	-0.25
Krypton Kr	-0.55
Xenon Xe	-1.05
Inorganic gases	
Ammonia NH_3	-0.20
Hydrogen bromide HBr	-0.76
Chlorine Cl_2	-0.94
Hydrogen chloride HCl	-0.35
Dinitrogen monoxide N_2O	-0.23
Hydrogen fluoride HF	+0.10
Hydrogen iodide HI	-1.19
Carbon dioxide CO_2	-0.30
Carbon monoxide CO	+0.07
Nitrogen oxide NO	+42.94
Nitrogen N_2	0.00
Nitrogen dioxide NO_2	+20.00
Sulfur dioxide SO_2	-0.20
Sulfur hexafluoride SF_6	-1.05
Hydrogen sulfide H_2S	-0.44
Water H_2O	-0.03
Hydrogen H_2	+0.26

Table 1: Zero error due to diamagnetism or paramagnetism of some accompanying gases with nitrogen as the reference gas at 60 °C and 1 000 hPa absolute (according to IEC 1207/3)

Conversion to other temperatures:

The deviations from the zero point listed in Table 1 must be multiplied by a correction factor (k):

- with diamagnetic gases: $k = 333\ K / (\varphi\ [°C] + 273\ K)$
- with paramagnetic gases: $k = [333\ K / (\varphi\ [°C] + 273\ K)]^2$

All diamagnetic gases have a negative deviation from zero point.

Reference gases

Measuring range	Recommended reference gas	Reference gas connection pressure	Remarks
0 to … vol.% O_2	N_2	2 000 … 4 000 hPa above sample gas pressure (max. 5 000 hPa absolute)	The reference gas flow is set automatically to 5 … 10 ml/min.
… to 100 vol.% O_2 (suppressed zero point with full-scale value 100 vol.% O_2)	O_2		
Around 21 vol.% O_2 (suppressed zero point with 21 vol.% O_2 within the measuring span)	Air	Atm. pressure with internal reference gas pump	

Technical specifications

General information	
Measuring ranges	4, internally and externally switchable; autoranging is also possible
Smallest possible span (relating to sample gas pressure 1 000 hPa absolute, 0.5 l/min sample gas flow and 25 °C ambient temperature)	2 vol.% or 5 vol.% O_2
Largest possible measuring span	100 vol.% O_2
Measuring ranges with suppressed zero point	Any zero point within 0 ... 100 vol.% can be implemented, provided that a suitable reference gas is used
Operating position	Front wall, vertical
Conformity	CE mark in accordance with EN 50081-1 and EN 50082-2
Design, enclosure	
Degree of protection	IP20 according to EN 60529
Weight	Approx. 13 kg
Electrical characteristics	
Auxiliary power	100 … 120 V AC (nominal range of use 90 … 132 V), 48 … 63 Hz or 200 … 240 V AC (nominal range of use 180 … 264 V), 48 … 63 Hz
Power consumption	Approx. 45 VA
EMC (electromagnetic compatibility)	In accordance with standard requirements of NAMUR NE21 (08/98)
Electrical safety	According to EN 61010-1, overvoltage category III
Fuse values	100 ... 120 V: 1.0 T/250 200 ... 240 V: 0.63 T/250
Gas inlet conditions	
Permissible sample gas pressure	
• External reference gas supply	800 … 1 200 hPa absolute
• With integrated pump	Atmospheric pressure ±50 hPa
Sample gas flow	18 … 60 l/h (0.3 … 1 l/min)
Sample gas temperature	Min. 0 to max. 50 °C, but above the dew point
Sample gas humidity	< 90% relative humidity
Reference gas pressure (high-pressure version)	2 000 to 4 000 hPa above sample gas pressure, but max. 5 000 hPa absolute (version without reference gas pump)
Reference gas pressure (low-pressure version) with external pump	Min. 100 hPa above sample gas pressure
Dynamic response	
Warm-up period	At room temperature < 30 min (the technical specification will be met after 2 hours)
Delayed display (T_{90})	3.5 s
Damping (electrical time constant)	0 ... 100 s, configurable
Dead time (purging time of the gas path in the unit at 1 l/min)	Approximately 0.5 ... 2.5 s, depending on version
Time for device-internal signal processing	< 1 s
Pressure correction range	
Pressure sensor internal	500 … 2 000 hPa, absolute (see gas inlet conditions for permissible sample gas pressure)

Measuring response	Based on sample gas pressure 1 013 hPa absolute, 0.5 l/min sample gas flow and 25 °C ambient temperature
Output signal fluctuation	< ± 0.75% of the smallest possible measuring range according to rating plate, with electronic damping constant of 1 s (corresponds to ±0.25% at 2 σ)
Zero point drift	< ± 0.5%/month of the smallest possible span according to rating plate
Measured-value drift	< ±0.5%/month of the current measuring range
Repeatability	< 1% of the current measuring range
Detection limit	1% of the current measuring range
Linearity error	< 1% of the current measuring range
Influencing variables	Based on sample gas pressure 1 013 hPa absolute, 0.5 l/min sample gas flow and 25 °C ambient temperature
Ambient temperature	< 1% of the current measuring range/10 K Zero offset: < 0.1 vol.% O_2 absolute/10 K
Sample gas pressure (with air (100 hPa) as internal reference gas supply, correction of the atmospheric pressure fluctuations is only possible if the sample gas can vent to ambient air.)	• With disabled pressure compensation: < 2% of the current measuring range /1% pressure change • With enabled pressure compensation: < 0.2% of the current measuring range /1% pressure change
Accompanying gases	Deviation from zero point corresponding to paramagnetic or diamagnetic deviation of accompanying gas (see table)
Sample gas flow at zero point	< 1% of the current measuring range according to rating plate with a change in flow of 0.1 l/min within the permissible flow range
Auxiliary power	< 0.1% of the current measuring range with rated voltage ± 10%
Electrical inputs and outputs	
Analog output	0/2/4 … 20 mA, floating; max. load 750 Ω
Relay outputs	6, with changeover contacts, freely configurable, e.g. for measuring range identification; load: 24 V AC/DC/1 A, floating
Analog inputs	2, dimensioned for 0/2/4 … 20 mA for external pressure sensor and accompanying gas influence correction (correction of cross-interference)
Digital inputs	6, designed for 24 V, floating, freely configurable, e.g. for measuring range switchover
Serial interface	RS 485
Options	AUTOCAL function each with 8 additional digital inputs and relay outputs, also with PROFIBUS PA or PROFIBUS DP
Climatic conditions	
Permissible ambient temperature	-30 … +70 °C during storage and transportation 5 … 45 °C during operation
Permissible humidity	< 90% relative humidity as annual average, during storage and transportation (must not fall below dew point)

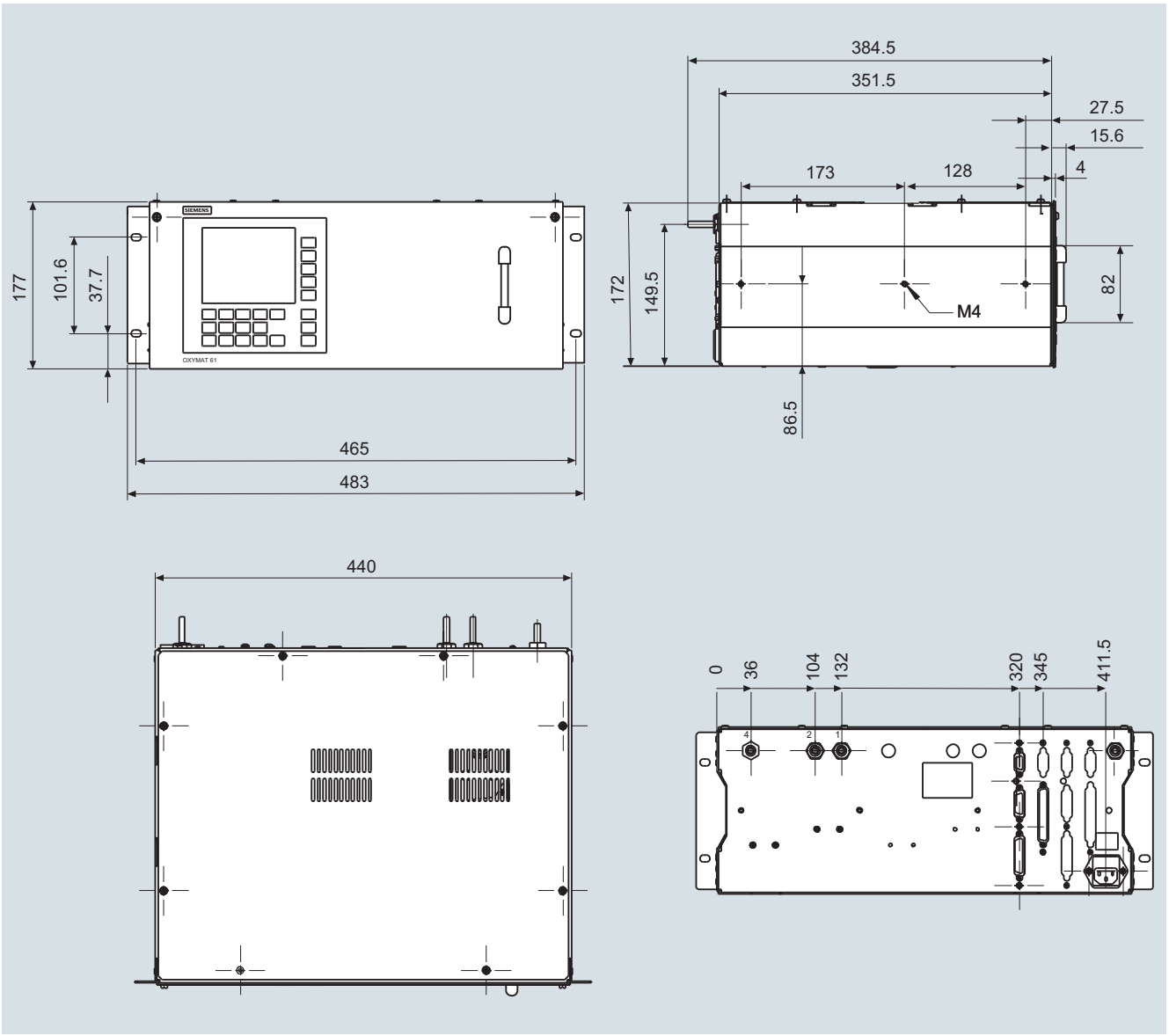
Selection and ordering data	Article No.	
OXYMAT 61 gas analyzer 19" rack unit for installation in cabinets	↗ **7MB2001-** ■■ **A 0 0 -** ■■■■	Cannot be combined
↗ Click on the Article No. for the online configuration in the PIA Life Cycle Portal.		
Gas connections for sample gas and reference gas		
Pipe with 6 mm outer diameter	**0**	
Pipe with ¼" outer diameter	**1**	
Smallest possible measuring span O_2		
2 % Reference gas pressure 3 000 hPa	**C**	
2 % reference gas supply with internal pump	**D**	**D → Y02**
5 % Reference gas pressure 3 000 hPa	**E**	
5 % reference gas supply with internal pump	**F**	**F → Y02**
Power supply		
100 ... 120 V AC, 48 ... 63 Hz	**0**	
200 ... 240 V AC, 48 ... 63 Hz	**1**	
Sample gas monitoring		
Without	**A**	
With (incl. flow indicator and pressure switch)	**D**	
Add-on electronics		
Without	**A**	
AUTOCAL function		
• With 8 additional digital inputs/outputs	**B**	
• With serial interface for the automotive industry (AK)	**D**	
• With 8 additional digital inputs/outputs and PROFIBUS PA interface	**E**	
• With 8 additional digital inputs/outputs and PROFIBUS DP interface	**F**	
Language		
German	**0**	
English	**1**	
French	**2**	
Spanish	**3**	
Italian	**4**	

Additional versions	Order code	
Add "-Z" to Article No. and specify Order code		
Telescopic rails (2 units)	**A31**	
TAG labels (specific lettering based on customer information)	**B03**	
Attenuation element for sample gas	**B04**	**→ Y02**
SIL conformity declaration (SIL 2) Functional Safety according to IEC 61508 and IEC 61511	**C20**	
Clean for O_2 service (specially cleaned gas path)	**Y02**	
Measuring range indication in plain text, if different from the standard setting[1)]	**Y11**	

Accessories	Article No.
RS 485/Ethernet converter	**A5E00852383**
RS 485/RS 232 converter	**C79451-Z1589-U1**
RS 485/USB converter	**A5E00852382**
AUTOCAL function each with 8 digital inputs/outputs	**C79451-A3480-D511**
AUTOCAL function 8 digital inputs/outputs each and PROFIBUS PA	**A5E00057307**
AUTOCAL function 8 digital inputs/outputs each and PROFIBUS DP	**A5E00057312**
Set of Torx screwdrivers	**A5E34821625**

1) Standard setting: Measuring range 1: 0 to smallest measuring span
Measuring range 2: 0 to 10 %
Measuring range 3: 0 to 25 %
Measuring range 4: 0 to 100 %

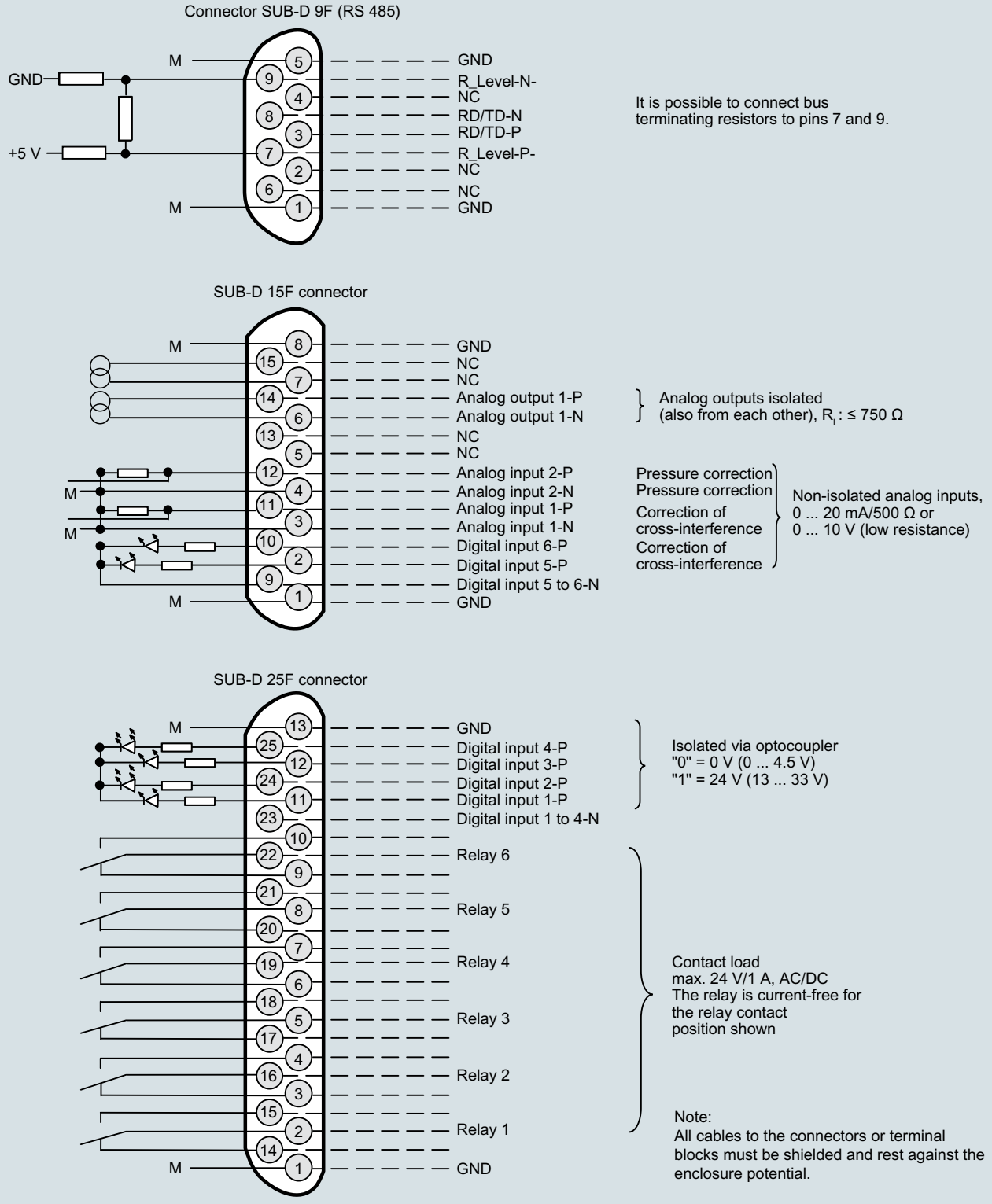
Dimensional drawings



OXYMAT 61, 19" unit, dimensions in mm

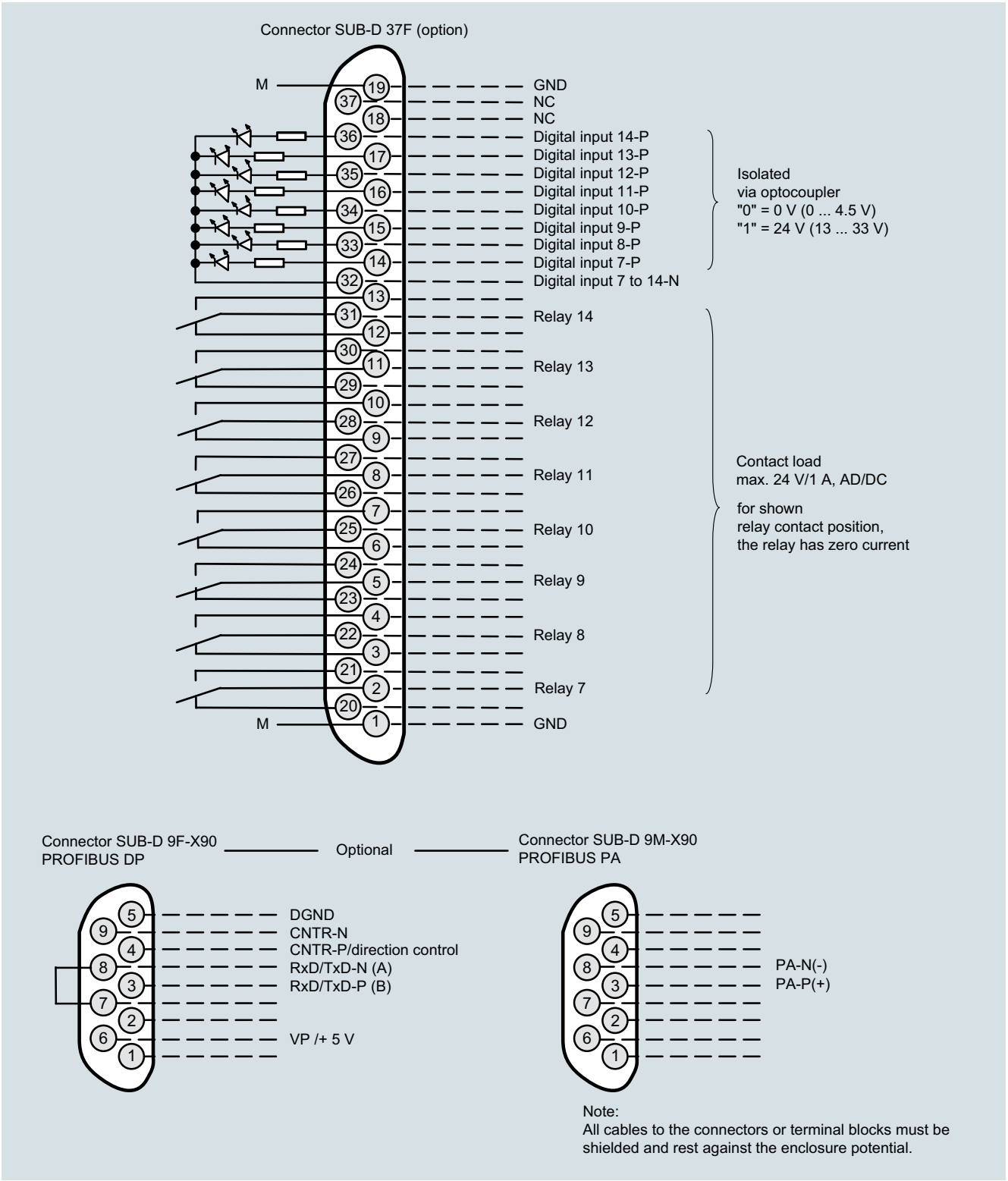
Circuit diagrams

Pin assignment (electrical connections)



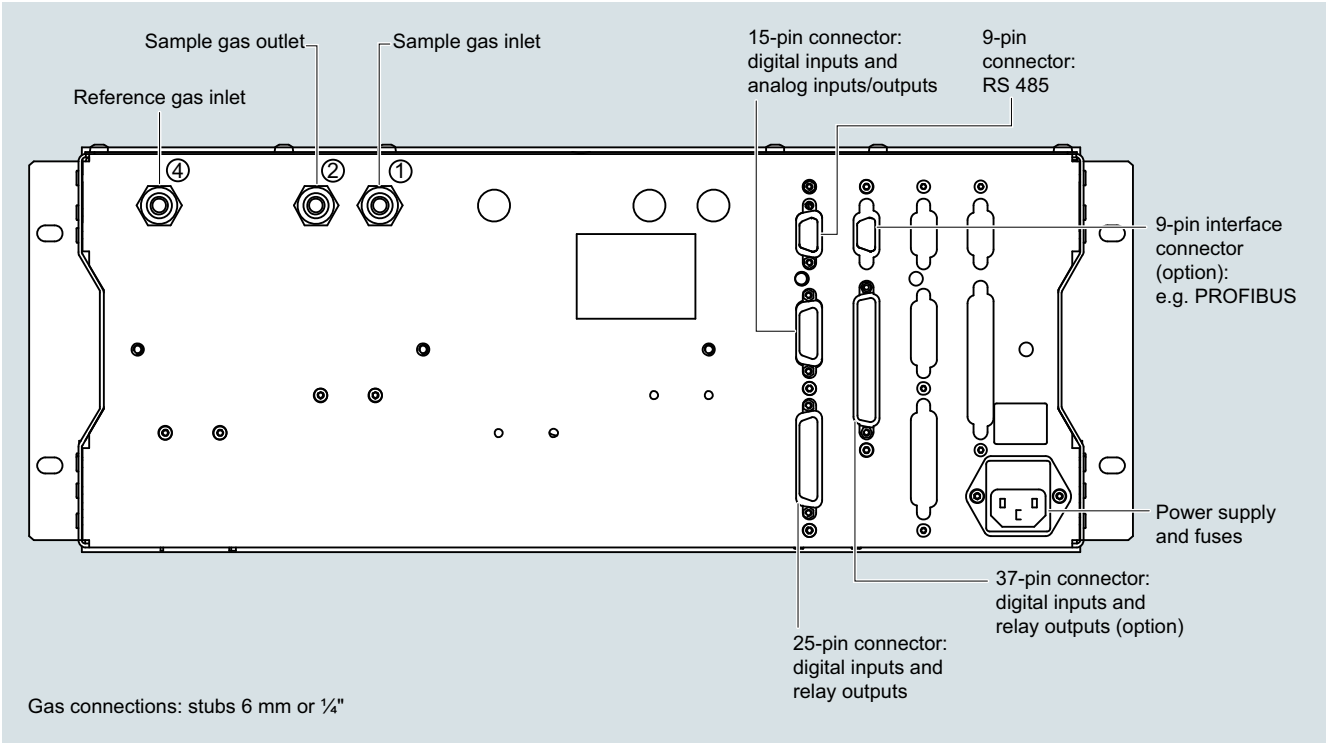
OXYMAT 61, 19" unit, pin assignment

Pin assignment (electrical connections)



OXYMAT 61, 19" unit, pin assignment of the AUTOCAL board and PROFIBUS connectors

Gas and electrical connections



OXYMAT 61, 19" unit, gas and electrical connections