User Manual

SSM 6000 Classic

PRONOVA
ANALYSENTECHNIK GmbH & Co.KG

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Software Version 2.60

This manual contains information concerning installation, operation and maintenance/service of the analyzer system.

! Certain activities – such as replacing hardware components or changing internal settings – may only be carried out by qualified personnel.

The manufacturer reserves the right to implement modifications at any time in order to adapt the user manual to the latest state of the art. Any reproduction or distribution of the user manual or any parts thereof, including translated versions, are subject to written approval.

The manufacturer does not assume any liability for errors or omissions, if any, in this documentation. Any liability for direct or indirect losses or damage arising in conjunction with the delivery or use of this documentation is excluded to the extent permitted by law.

This device left the factory in an impeccable, safe condition. In order to maintain this condition and in order to ensure safe operation, users must proceed in accordance with the information and warnings in this manual.

! Please read this manual carefully before setting the device into operation!

All brands and their respective owners referred to in this manual are recognized and accepted. The manufacturer does not claim any rights with regard to such brands.

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Within the scope of ongoing technical improvement of our products, a new hardware with upgraded functionality was developed for the SSM6000 biogas analyzer. Analyzer versions "A" and "B" are currently available. Analyzers with the new hardware are marked "SSM 6000 (B)" on the rating plate and on the calibration certificate. The "B" version differs from its predecessor version in terms of connector layout and with regard to the type of inputs and outputs, for example.

This is why this documentation explicitly mentions the analyzer version if there are any differences regarding design, installation and operation of the unit.

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The description of the PROFIBUS interface can be found at the end of this documentation.

General safety information

The following safety information must always be observed during operation as well as during any maintenance and repair work on this device. Non-compliance with safety measures or any other information or warnings contained in this user manual constitutes a violation of safety standards underlying the design, manufacture and proper use of the device.

Non-compliance with such information can cause hazards for users and/or damage to the device! The manufacturer does not accept any liability for losses or damage caused by non-compliance with such safety measures on the part of the customer.

In order to avoid any additional hazards, unauthorized modification of the device is not permitted. In the event that repair work is necessary, the device should be returned to our technical office after prior notification.

Users are not permitted to open the device. Certain activities – such as replacing hardware components or internal settings – may only be carried out by qualified personnel.

Devices which are suspected to be at fault or defective must be switched off and protected against unauthorized access until the necessary repair/service work has been performed by expert personnel.

EX When working in explosive or flammable environments, do not operate the device without additional protection measures!

! Proceed in accordance with the safety instructions applicable to the respective gases and calibration gas bottles or cylinders!
Prior to performing any work on gas ducts or pipes, flush these with ambient air or nitrogen (N_2) in order to avoid any hazard due to toxic, explosive, flammable or harmful components of the measuring gas.

When connecting the device, make sure that the correct mains voltage is available, and proceed in accordance with the information in the section titled "Requirements for the place of installation, power supply".

The analyzer is a safety-class 1 device, i.e. it is fitted with an earthing connection. Any interruption of the PE conductor inside or outside the device, or opening of the PE connection can make the device a hazard. Deliberate interruption of the PE conductor is not permitted.

The device comes with a power cable with earthed-contact plug and may only be connected to an earthed-contact receptacle. The protective effect may not be rendered ineffective by using an extension cable without PE conductor.

Before performing any fault-finding or repair work, or before replacing any parts, disconnect the device from any voltage sources! In the event that work must be performed on the live, opened device, this may only be carried out by an informed expert who must be familiar with the related risks and hazards!

1 Introduction

1.1 Description and use of the device

The SSM 6000 was specifically developed for analyzing biogenous process gases, such as biogas, sewage purification gas or landfill gas. It is designed for the requirements of regular process control directly at plants and equipment and to this effect combines quality sensor equipment for continuous gas analysis with multi-stage gas processing technology.
The full version is capable of analyzing the main gas types, i.e. methane, hydrogen sulphide, oxygen and carbon dioxide, of hydrogen rather than carbon dioxide, respectively. The analyzer features ease of operation and a clear-cut display structure.

In terms of time and frequency of use, the SSM 6000 family can draw on the largest experience of all biogas analyzers available on the market. The first analyzer developed in Europe specifically for continuous operation in biogas plants belongs to the SSM family and has been in use since 1998. Several hundred SSM gas analyzers have been delivered up to now.
The demanding, strongly varying measuring conditions in biogas plants mean exacting requirements for gas analyzers for continuous operation. Like in so many applications in biogas process technology, optimum adaptation to the difficult medium is the decisive test. In order to increase service life, measuring precision and, above all, operational safety, Pronova has integrated a host of additional functions into its SSM 6000 Classic which, in their totality, are quite unusual on the market:

- Limitation of the maximum hydrogen sulphide concentration at the H_2S sensor
- Multi-stage measuring-gas processing, including measuring-gas cooling to 5°C for dehumidification
- Pressure and temperature compensation of measured values
- Detonation protection EN 12874, housing rinsing

Hydrogen sulphide is measured by means of electrochemical sensors. Already at typical gas concentrations in biogas plants, sensors of this kind can be subject to saturation with a reduction of signals and increased sensor wear or even sensor failure. The SSM 6000 prevents this by microprocessor-controlled, concentration-dependent dilution of measuring gases which keeps the H_2S gas concentration at the sensor at a level of below 25 ppm – even at levels of several 1000 ppm in the biogas. The sensor hence always works in its optimum load range.

Advantages: Wide measuring range of 0 – 5000 ppm without exposing the sensor to excessive load or strain
Increased measuring precision
Lower operating costs thanks to extended service life
Increased reliability of the measurement

Biogas contains components which are harmful for the sensors, in particular, hydrogen sulphide which has an aggressive action in conjunction with humidity. The SSM 6000 hence comes with a measuring-gas cooler in order to reduce high humidity levels and protect the sensors.

Advantage: Reduced susceptibility to failure
Lower operating costs thanks to extended service life
Avoidance of volumetric errors thanks to constant measuring-gas dew point

Precision infrared sensors (IR sensors) are used to measure methane (CH_4) and carbon dioxide (CO_2). However, the measured values supplied by these sensors are strongly dependent on temperature and air pressure due to the underlying measuring process. Changes in air pressure due to changing climatic conditions, for example, can already cause relative changes in measured values in the order of up to 10%. Changes of a similar magnitude also occur if a device is calibrated, for example, in Berlin (40 m above mean sea level) and operated at an altitude of 600 m above mean sea level. With the SSM 6000, IR measurements are generally subjected to temperature and pressure compensation.

Advantage: Increased measuring precision.

Gas mixtures with critical concentration relationships between methane and oxygen are flammable. Although critical gas mixtures of this kind are very rare in biogas plants, the utmost must be done in order to avoid the risk of ignition. In the SSM 6000, a detonation protection unit separates the analyzer from the biogas plant. Furthermore, the interior of the device is flushed with ambient air, so that no flammable gas mixture can occur in the device even in the case of pipe leaks.

Advantage: Increased safety.

1.2 Importance of the measured variables

Methane CH_4

Methane is the only energy carrier in biogas worth mentioning. A high yield is hence vital for the profitability of the plant. Furthermore, the methane concentration provides important information concerning the fermentation process and hence the condition of the biogas plant. A decreasing concentration is the first sign of a disturbed fermentation process. Continuous monitoring of the methane content hence makes it possible to search for and identify the causes of a problem at an early stage. Depending on the purpose for which the biogas is used, the methane content must be within certain limits, for example, in order to permit its safe use as a fuel in pilot injection units or in gas-fuelled spark ignition engines. Too high or low a methane content can cause damage to the motor. Furthermore, too low a methane content strongly affects economic efficiency.

Hydrogen sulphide H_2S

The block cogeneration plant burns the hydrogen sulphide contained in biogas to form SOx from which sulphurous or sulphuric acid are produced in the presence of water. These acids lead to corrosion of those parts of your plant (for example, pilot injection unit or gas-fuelled spark ignition engine) which contain nonferrous heavy metals. This is why hydrogen sulphide must be eliminated to the largest extent possible.
Regular measurement of the hydrogen sulphide content provides a good indication of how good the biogas "desulphurization" process is working.

Oxygen O_2

In most plants, desulphurization of the biogas is accomplished by injecting additional ambient air oxygen into the process. Experience has shown that an ambient air oxygen content of more than 5Vol.%ume does not lead to any further reduction of the hydrogen sulphide content by biological degradation. Furthermore, higher concentration can reduce the reaction capability of bacteria and a flammable gas mixture can occur in the fermenter. Monitoring the oxygen content in the biogas hence makes sense. If too high a hydrogen sulphide level is measured even though the oxygen content is within the optimum range, insufficient desulphurization must then be due to other causes. Possible explanations then include too low an ambient temperature for the bacteria or too short a contact time during which the bacteria is exposed to the biogas.

Carbon dioxide CO_2

Besides methane, carbon dioxide is the second largest quantitative component of biogas. Both components account for around 98% of the volume. This is, however, only an approximate value because other gases, such as ammonia (NH_3) or hydrogen (H_2), can be produced in more than insignificant concentrations during the fermentation process and hence occur in biogas. The total concentration of methane, carbon dioxide, oxygen and nitrogen contained in the injected air should amount to around 100Vol.%ume. The nitrogen concentration corresponds to around 3.8 times the O_2 concentration.

Hydrogen H_2

The determination of the hydrogen content is becoming increasingly important for the assessment of the conversion processes in the fermenter. Hydrogen is a pre-product and/or intermediate product of methane during the process of anaerobic decomposition, so that monitoring of the hydrogen concentration enables an even faster detection of disturbances during the fermentation process.

2 HARDWARE DESCRIPTION

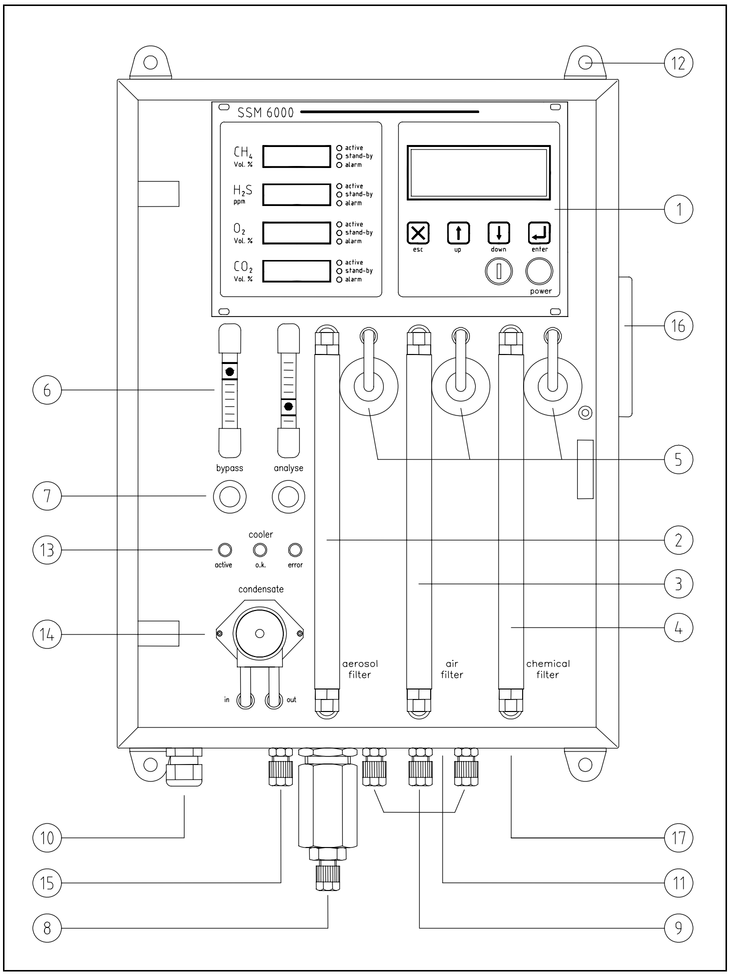
2.1 Measuring characteristics

The SSM 6000 analyzer was developed for the discontinuous measurement of CH_4, H_2S, O_2, CO_2 und H_2 in biogenic gases. The table below contains details concerning measuring ranges, etc.

Gas type	Measuring range		Resolution		Precision	Measuring method	Other
CH_4	0 ... 100	Vol.%.	0,1	Vol.%.	±2% FS	Two-beam IR	Temperature and pressure compensation
H_2S	0 ... 5.000	ppm	1 / 5	ppm	±5% FS	Electrochemical	Dilution stages 1:200/40/10/0
O_2	0 ... 25	Vol.%.	0,1	Vol.%.	±2% FS	Electrochemical	
CO_2	0 ... 100	Vol.%.	0,1	Vol.%.	±2% FS	Two-beam IR	Temperature and pressure compensation
H_2	0 ... 1.000	ppm	1	ppm	±5% FS	Electrochemical	(instead of CO_2)

The following sections deal with operation, calibration and menu structure of the analyzer.

2.2 Elements of the analyzer



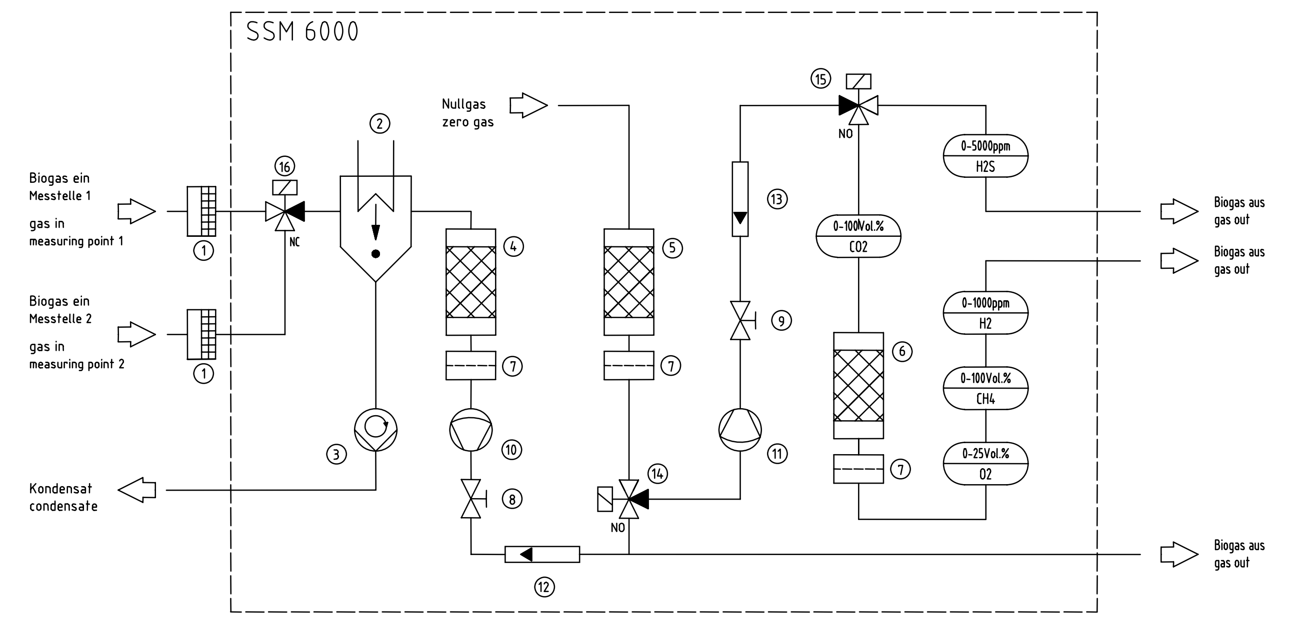
The front panel of the analyzer contains all the controls necessary for operation:

1 Control and display panel
2 Aerosol filter
3 Air filter
4 Chemical filter
5 Fine dust filter
6 Flowmeter
7 Needle valves
8 Measuring-gas input with detonation protection
9 Measuring-gas outputs
10 Screw-type cable connection with power cable
11 Interfaces
12 Wall-mount support
13 Status display LEDs for measuring-gas cooler
14 Condensate pump
15 Condensate output
16 Ventilation air inlet
17 Ventilation air outlet

All electrical connections and gas connections are located on the underside of the device.

Fig.: Front view of the analyzer

2.2.1 Process flow chart and measuring process



1	Detonation protection	6	Chemical filter	11	Measuring-gas pump (analysis)
2	Measuring-gas cooler	7	Fine dust filter	12	Flowmeter (bypass)
3	Hose pump	8	Needle valve (bypass)	13	Flowmeter (analysis)
4	Aerosol filter	9	Needle valve (analysis)	14/15	3/2-way solenoid valve
5	Air filter	10	Measuring-gas pump (bypass)	16	Measuring-point switch (option)

Fig.: Process flow chart with measuring-point switch option (2 measuring points)

The first operation after the start of a measuring cycle is to determine the zero points of the individual sensors using filtered ambient air. For this purpose, the ambient air is drawn in at the air filter (5) and directed through the 3/2-way solenoid valves (14) and (15) in a first step towards the H_2S sensor and in a second step, after switching of valve (15), to the other sensors.

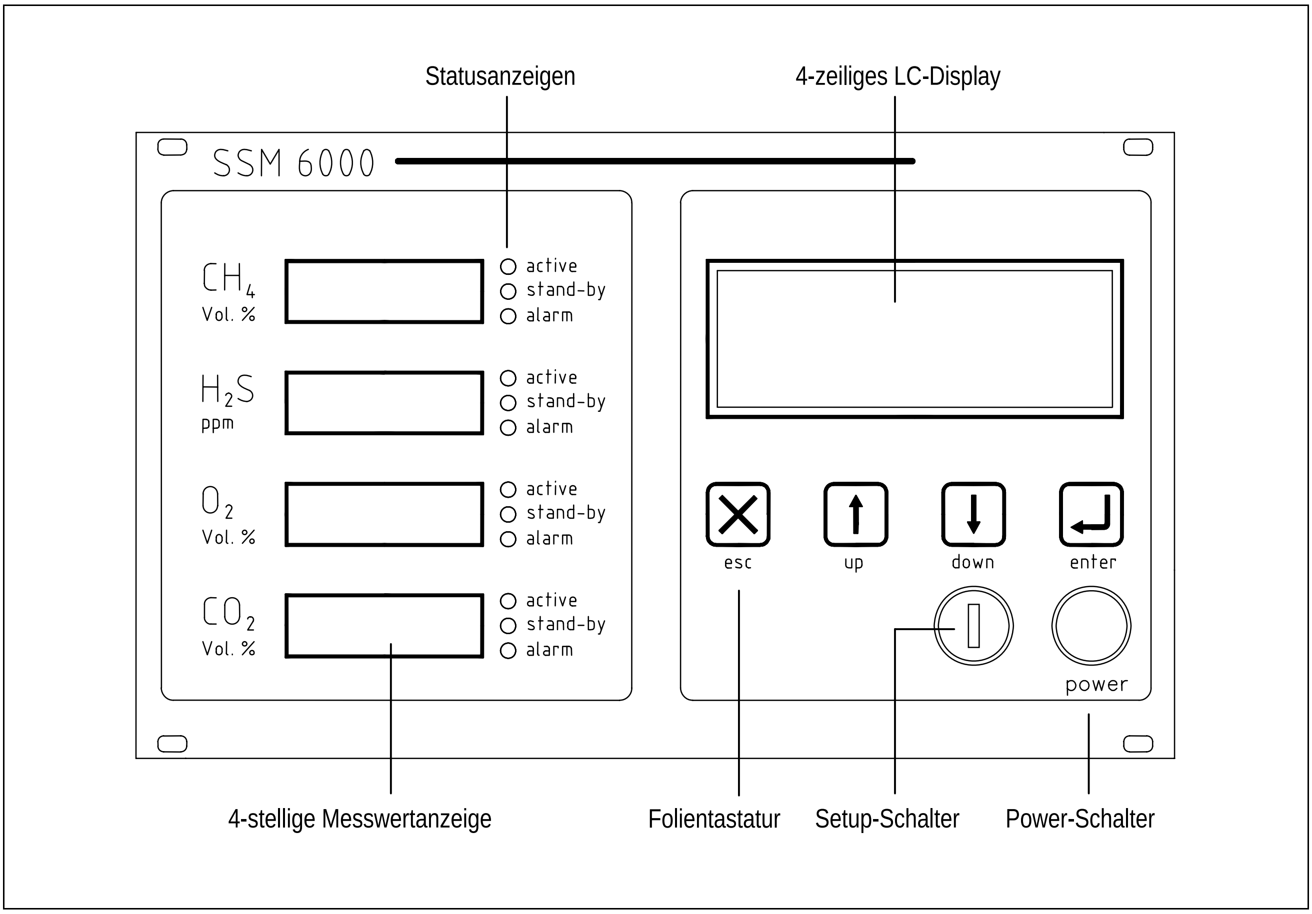
At the same time, biogas is already drawn in through the safety unit (1) during the zero-gas steps and discharged through the bypass outlet. This ensures that, even in the case of long measuring-gas pipes, the biogas is available at the analyzer when the subsequent biogas steps start. In the measuring-gas cooler (2), the biogas is cooled to 5°C and the resultant condensate is directed by the hose pump (3) towards the condensate discharge. The condensate must be discharged and disposed of by the plant owner. Behind the measuring-gas cooler, the dehumidified measuring gas passes through the aerosol filter (4) and a fine dust filter made of glass fiber. The measuring-gas pump (7) pumps the processed measuring gas through the "bypass" (12) flowmeter with needle valve (8) to the bypass outlet.

During the subsequent biogas steps, solenoid valve (14) switches to biogas, so that measuring gas initially flows through the CH4 gas system. A chemical filter (6) additionally protects the some of the sensors against hydrogen sulphide contained in the measuring gas. Following receipt of the sensor signals for CH_4, CO_2 and O_2, a microprocessor-controlled, concentration-dependent dilution system transports measuring gas to the H_2S sensor. Depending on the H_2S concentration in the measuring gas, up to four dilution stages (1:200 / 40 / 10 / 0) are passed through.

During steps 5 and 6, both gas paths of the analyzer are then once again flushed with ambient air and the values measured are displayed on the front panel at the end of the measuring process.

2.2.2 Display and control panel

The measured values are displayed for each gas type on the four-digit LED panels in the respective unit (Vol.% and ppm, respectively). In the case of devices with reduced functionality, the displays of gas types not included in the functionality remain inactive.



The status LEDs next to the measured values represent the status of the respective gas channel.

active	(green)	This gas type is currently being measured.
stand-by	(yellow)	The device is ready for operation, but the gas type in question in currently not being measured.
alarm	(red)	The last value measured was outside the set limits and hence triggered an alarm.

Settings and operating parameters of the analyzer can be entered and changed via the control panel. The user menus are displayed on the four-line, backlit LC display.
Navigation through the user menus is possible in setup mode via the membrane keypad (esc, up, down, enter). The setup mode is activated via the key-operated switch. Withdrawing the access key prevents manipulation by unauthorized persons.

The analyzer is switched on and off via the "power" button.

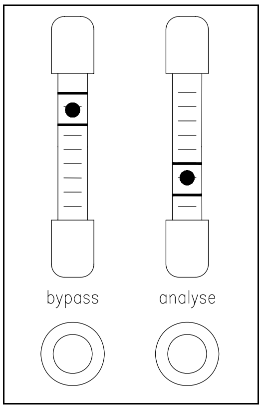
2.2.3 Measuring-gas filter

Several filters are integrated into the gas path of the SSM 6000 in order to protect the sensors and other components of the system. The filters clean the biogas and the ambient air drawn in, thereby increasing both the service life of the sensors and the measuring precision of the system.

Filter type	Function
Aerosol filter	Eliminates aerosols and larger dirt particles from the gas sample. Replacement is only necessary if filter contamination is visible. (Material: glass and steel wool)
Air filter	Filters the ambient air for zero-point determination. The zero-gas filter should be replaced at least once a year. (Material: activated carbon)
Chemical filter	Protects the sensors against hydrogen sulphide contained in the measuring gas. The filter is slowly used up which can be easily seen by gray discoloration of the filter material. The filter must be replaced by a new one at the latest when the pink color of the filter material has vanished.

Fine-dust filters are additionally located at the downstream end of the filter cartridges. These fine dust filters must also be replaced when strong contamination of the filter is found.

2.2.4 Flow rate display and control



The measuring precision depends, amongst other things, on the measuring-gas volume flows. The measuring-gas volume flows are measured by the two flowmeters on the front panel of the SSM 6000 and can be adjusted by means of the needle valves located below the flowmeters.

Adjust the flow rates in such a manner that the floating indicators are located between the upper and lower marks during measurement.

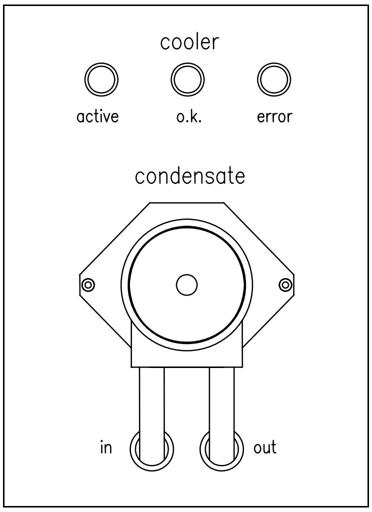
Flowmeter	"bypass" (left)	50 ... 65 liters per hour
	"analyse" (right)	15 ... 30 liters per hour

Volume flow adjustment is only possible during measurement because the measuring-gas pumps are inactive in "standby" mode.

2.2.5 Measuring gas cooler

Measuring-gas coolers are used in analyzer systems to process contaminated and humid measuring gases and to lower their dew point. This reliably rules out the generation of condensate as well as the accumulation of dirt particles in the analyzer and other system components. Adjusting a stable measuring-gas starting dew point avoids water vapor cross-sensitivity and volumetric errors.

The gas cooler works with an electronically controlled Peltier cooler. The design of the heat exchanger made of Duran glass favors ideal flow conditions and ensures optimum lowering of the dew point to a stable value of 5°C.
A hose pump discharges the condensate produced into an external collecting tank. Status LEDs on the front panel indicate the operating status of the gas processing unit. An alarm is generated when the set temperature is exceeded by 3°C.



The status LEDs indicate the current operating status of the cooler. When lit, the individual status LEDs have the following meanings.

cooler "o.k."	The measuring-gas cooler is ready for operation. The actual temperature of the cooler is within the pre-set temperature range of 5 ± 3°C.
cooler "active"	The Peltier element is active. The frequency provides an indication of the load exposure of the cooler.
cooler "error"	The actual temperature of the cooler is outside the pre-set range of 5 ± 3°C.

Fig.: Status LEDs and hose pump on the front panel

The error LED can be activated for several reasons.

- After power-on, the measuring-gas cooler is not yet ready for operation. The cooler should have reached its operating temperature and the "error" LED should go off after around 15 minutes.
- A measuring-gas cooler overload condition exists during operation as a result of the excessively high dew point of the inflowing gas, or as a result an excessive volume flow or ambient temperature.
- The device is defective. Contact the manufacturer of the device in such a case.

During the measuring process, the hose pump transports the condensate produced to the "condensate out" outlet of the device.

2.2.6 Housing rinsing

The SSM 6000 additionally comes with a fan unit that discharges the heat of the measuring-gas cooler and rinses the housing with ambient air.
The flow rate of the fan totals around 56 cubic meters per hour, so that the generation of a flammable gas mixture within the analyzer is safely prevented.

In order to avoid dirt accumulation inside the device, a particle filter at the air intake opening on the right side panel of the analyzer ensures reliable filtering of dust and other contaminants. The housing filter must be checked at process-dependent intervals and must be replaced when visible contamination is found.

2.2.7 Gas connections / safety features

All gas connections are located on the underside of the analyzer. The connections are clearly marked and may not be exchanged. The gas-carrying pipes are connected to the device by means of clamping-ring screw connections.

The following connections must be made:
- 1x Measuring gas in / 2 to 4x with the measuring-point switch option
- 3x Measuring gas out
- 1x Condensate out

The delivery includes 20 meters of PVC hose (an additional 10m per measuring point with the measuring-point switch option) and the required connections.

In order to protect the biogas plant against flashback, a safety unit is installed at the measuring-gas input of the analyzer which prevents flashback into the gas-carrying system of the plant in the case of pipe leakage.

Two different safety unit versions are currently in use.

Version 1	Safety unit E 460-3 according to EN 730-1	(material: brass / installation outside)
Version 2	F 510 detonation protection according to EN 12874	(material: stainless steel / installation outside)

The device is at present fitted with the F 510 detonation protection system according t EN 12874 / PTB 02 ATEX 4012X made of stainless steel. The manufacturer's conformity declarations and test certificates for the safety and protection equipment are shown in the appendix to this manual.

2.2.8 Measuring-point switch (option)

Analyzer version "A"

This option is implemented by a second measuring-gas input with a detonation protection unit and a 3/2-way solenoid valve for switching between the measuring points.
The valve is controlled and the measuring point is thereby selected by the customer via a potential-free switching contact at the plug connector, port 2 (pin 12/13) on the underside of the device.

Switching states of the valve:
Valve off (NO) → measuring point 1
Valve on (NC) → measuring point 2

The valve should be switched no later than five seconds after the start of a measurement. This switching status should remain unchanged throughout the entire measuring process. The digital input "External start of measurement" can be used to measure the two measuring points one after the other, irrespective of the measuring interval.

The current operating status of the analyzer can be detected by the controller via the digital "Measurement active" output. This status output (transistor output 12VDC, 300mA max.) is active from the start until the end of a measurement.

Analyzer version "B"

Analyzer version "B" enables the implementation of up to four measuring-gas inlets with detonation protection and 3/2-way solenoid valves for switching between the measuring points.
The solenoid valves are controlled and the measuring points selected by the SSM 6000. A measuring process can be triggered manually via the digital inputs at port 1 or the (optional) Profibus interface.

With the device in "MANUAL" mode, a measuring process can be started in stand-by mode at any time by pressing the <enter> key. You are first prompted to select the measuring point via the <up> and <down> keys. Thereafter, press the <enter> key once again in order to confirm the start of the measuring process.

Analyzer version "B" comes with four digital inputs at Port 1 which are used to start the measuring process and at the same time to select the measuring point. The digital optocoupler inputs are assigned as follows and must be activated for around 1.5 seconds:

DI 01	-	measuring point 1
DI 02	-	measuring point 2 / valve 1
DI 03	-	measuring point 3 / valve 2
DI 04	-	measuring point 4 / valve 3

After the start of the measuring process, the analyzer simultaneously activates the corresponding measuring-point valve and/or the pertinent digital output at port 2. The digital inputs are not read until a measuring process has been completed.

A measuring process can also be started via the PROFIBUS interface. If the measuring-point switch option is implemented, the measuring-point to be analyzed is additionally selected. Further details concerning the PROFIBUS interface can be found in the appendix to this documentation.

In the case of external control of the analyzer, the MANUAL mode should be selected in order to avoid overlapping with the measuring interval in automatic measuring mode.

2.2.9 Automatic shut-off unit (option)

The SSM 6000 biogas analyzer is designed for pressures of $–50 < p > 5$ hPa at the measuring-gas input. In the case of higher admission pressures which can, for example, occur with gas motors with supercharger, biogas flows through the measuring-gas cooler even during measuring pauses due to the elevated pressure level. Since the condensate pump is inactive in stand-by mode, condensate can accumulate in the cooler during longer measuring pauses. When a measuring process starts, this condensate would then be drawn into the gas system and can damage the analyzer. This means that the measuring-gas supply must be interrupted during measuring pauses admission pressures of > 5 hPa, using suitable means, such as an automatic stop valve. The solenoid valve can be controlled via the "Measurement active" status output of the SSM 6000 on the underside of the analyzer (port 2). Additional voltage supply is not required.

At the customer's request, the manufacturer can install a suitable stop valve in the analyzer. The valve is then controlled internally by the analyzer. This feature is explicitly mentioned in the test and calibration certificate.

2.2.10 Electrical connections

All electrical connections and the fuse are located on the underside of the analyzer.

Voltage supply

The analyzer system requires a voltage supply of 85 .. 264 VAC / 47.. 63 Hz and features a maximum power consumption of 85VA. A 1.5m long power cable with earthed-contact plug (3x0,75mm²) serves as a supply cable. A miniature fuse 4x20mm 1A (slow-blow) protects the mains connection. The main switch on the front panel is used to turn the system on and off. For further information, please refer to the terminal diagrams in the appendix.

We recommend installing a mains disconnector switch or a switched receptacle in the power supply circuit near the gas analyzer in order to be able to disconnect all poles of the gas analyzer from the power supply, if necessary. The mains disconnector switch must be marked in a manner that clearly shows the equipment to be disconnected.

Signals and interfaces

The SSM 6000 analyzer comes with the following connections for communicating with peripheral equipment.

Plug connector	Description
Port 1	Analyzer version "A" Analog measured-value outputs 4-20mA, one output per component measured Digital input for the external start of a measurement Analyzer version "B" Analog measured-value outputs 4-20mA, one output per component measured Digital inputs for starting a measuring process and controlling up to four measuring points 12VDC voltage output for controlling the digital inputs
Port 2	Analyzer version "A" Digital status outputs and limit-value alarms Digital input for controlling a solenoid valve for the measuring-point switch (option) Analyzer version "B" Digital status outputs and limit-value alarms Digital outputs for controlling up to three solenoid valves for the measuring-point switch 12VDC voltage output – for reading/driving the digital outputs
RS 232	RS 232 interface for the output of measured values with time stamp on a PC and/or data logger
Profibus (option)	Interfaces for the output of measuring data and status messages, as well as initialization of a measuring process and controlling the measuring-point switch via a Profibus system.
CAN bus (option)	Interfaces for the output of measured values and status messages, as well as initialization of a measuring process and controlling the measuring-point switch via a CAN bus system. This interface is not yet supported by the software.

For further information, please refer to the terminal diagrams in the appendix and to the "Installation" section.

3 Hardware installation

3.1 Requirements for the plant of installation, power supply

All major system components are installed in a wall-mounted housing with IP20 protection. The device is hence designed for installation in closed, air-conditioned rooms. The device should be typically installed on a vertical wall in the central machinery room of the biogas plant as close as possible to the point of sampling.

Air inlet and air outlet openings may not be obstructed by objects or walls in order to ensure sufficient air circulation and to avoid heat accumulation.

The analyzer system must be protected against adverse ambient conditions, such as:

- extreme cold,
- exposure to heat radiation, for example, sunlight, furnaces, boilers or gas motors,
- strong temperature fluctuations,
- accumulation and penetration of dust,
- aggressive atmosphere and
- shock/vibration.

Climatic conditions	Air pressure		850...1100 hPa
	Relative humidity		75 % max.
	Ambient temperature	during storage and transport	–25...+50 °C
		during operation	+10...+40 °C

Power supply	Input voltage	85 .. 264 VAC 47.. 63 Hz
	Power consumption	85 VA max.

3.2 Measuring input and output conditions, calibration gases

Measuring input conditions	Input dew point of the gas to be	40°C max.
	Measuring-gas temperature at the input	80°C max.
	Pressure at the measuring-gas input	-50 ... +5 hPa
Measuring output conditions	The measuring gas must be discharged into the outside atmosphere in a non-pressurized	

! If the pressure at the measuring-gas input exceeds 5 hPa, a shut-off unit must be installed by the customer that shuts off the measuring-gas input during measuring pauses (stand-by) and which opens the input when a measurement starts. Such a shut-off device is also optionally offered by the manufacturer and directly integrated into the analyzer.

Corrosive gases	The gas analyzer may not be used to measure corrosive gases. Certain gases, such as chlorine (Cl_2) or hydrogen chlorides (such as moist HCl), and chlorine-containing gases or aerosols must be cooled or pre-absorbed.

Calibration gases for calibration	For information concerning the calibration gases for calibrating the gas analyzer, please refer to the "Calibration" section.

3.3 Scope of delivery, rating plate and test certificates

Scope of delivery

Quantity	Description
1	SSM 6000 gas analyzer
1	Setup key
1	Housing key
20 m	PVC hose 4x1mm (plus an additional 10m per measuring point with the measuring-point switch option)
2	Replacement fuse for SSM 6000 (miniature fuse, 1A slow-blow, 4x20mm)
1	Data cable for RS232 interface (length: 3m)
1	User manual (German or English)
1	CD-ROM with operating manually (pdf format) with gsd file for Profibus connection
1	Test and calibration certificate of the SSM 6000 analyzer

Rating plate

SSM 6000 (B)	
CH_4 / H_2S / O_2 / CO_2	
S No.:	80025000 - 228
Mains:	85..264 VAC / 47..63 Hz 85 VA max.

The rating plate is located on the underside and on the door of the device.

It contains the following information:

- Analyzer identification → (B) = version B
  → Version "A" without the identification letter "(B)"
- Manufacturing and serial number
- Measuring components
- Power supply voltage, frequency and power consumption

Test and calibration certificate

The test and calibration certificate contains the following information

- Manufacturing and serial number
- Measuring components and options
- Software version
- Calibration and result of test measurements
- Result of the function test
- Test result, including test date

3.4 Dimension drawing of the SSM 6000 system

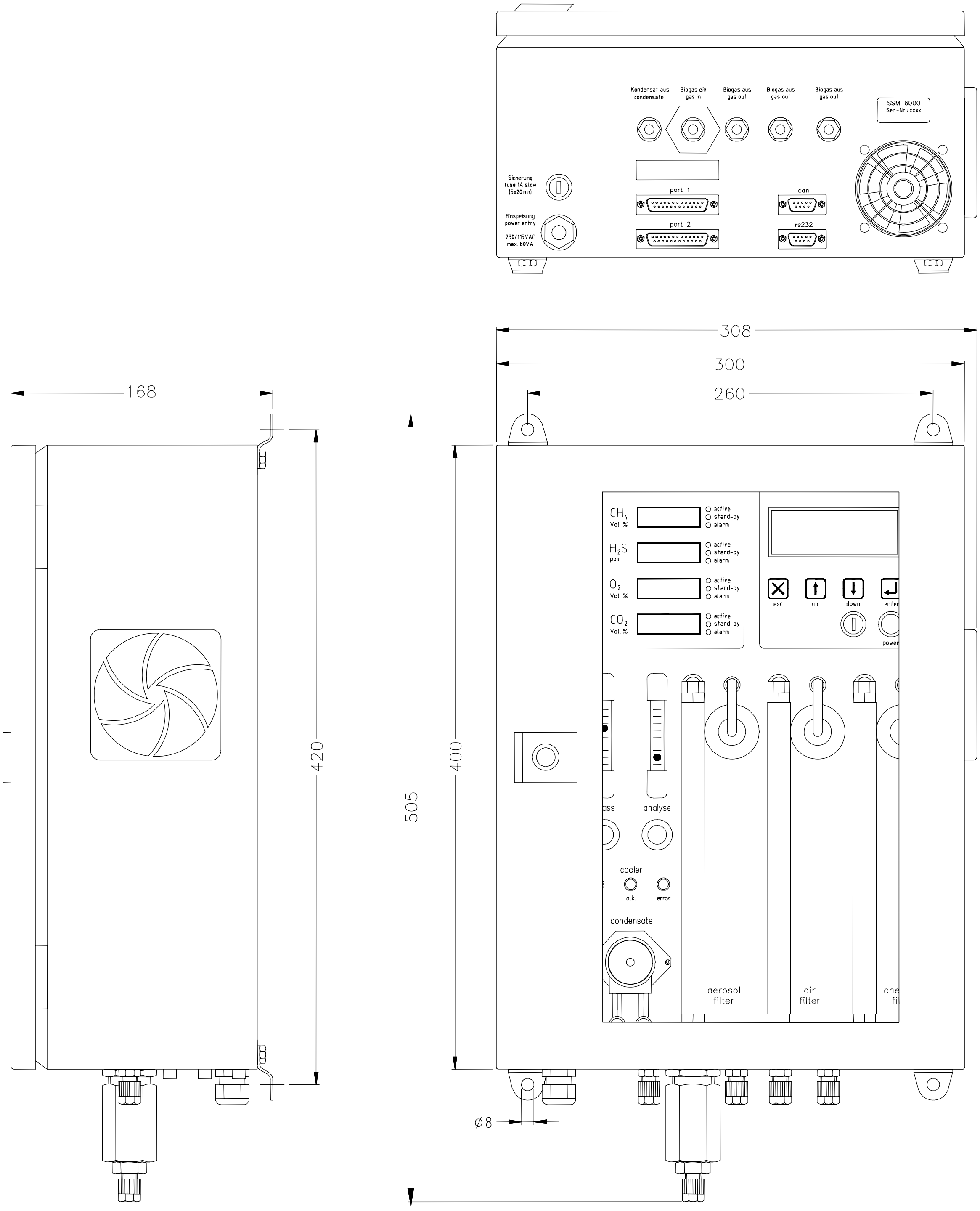


Fig.: Connection dimensions of the SSM 6000

During installation, free space of at least 15 cm must be left on the right hand side of the analyzer and at least 25 cm underneath the analyzer.

3.5 Installing the gas analyzer

3.5.1 Unpacking and assembling the gas analyzer

Unpacking the gas analyzer

Step	Action
1	Carefully remove the transport packaging of the analyzer, and store the analyzer in a clean place.
2	Remove the packaging foil from the analyzer system.
3	Visually check the analyzer system for transport damage before assembling.

The analyzer was carefully packed for shipment. Before installing and setting into operation, check for possible transport damage. In the case of transport damage with signs of incorrect handling, have the damage recorded by the carrier (rail, post, mover) within seven days.

Make sure not to lose the accessories enclosed (refer to the "Scope of delivery" section).

We recommend keeping the transport carton and the packing material for future transport which may become necessary.

The analyzer should be mounted on a vertical, stable wall using sufficiently sized fastening elements. When selecting the place of installation, please remember that free space of at least 25 cm is required underneath the device for electrical connections and hoses. A distance of at least 15 cm should be maintained between the right hand side of the device and the nearest wall in order to ensure sufficient air circulation and to enable the replacement of the housing filter.

3.5.2 Electrical connections

All electrical connections are located on the underside of the analyzer.

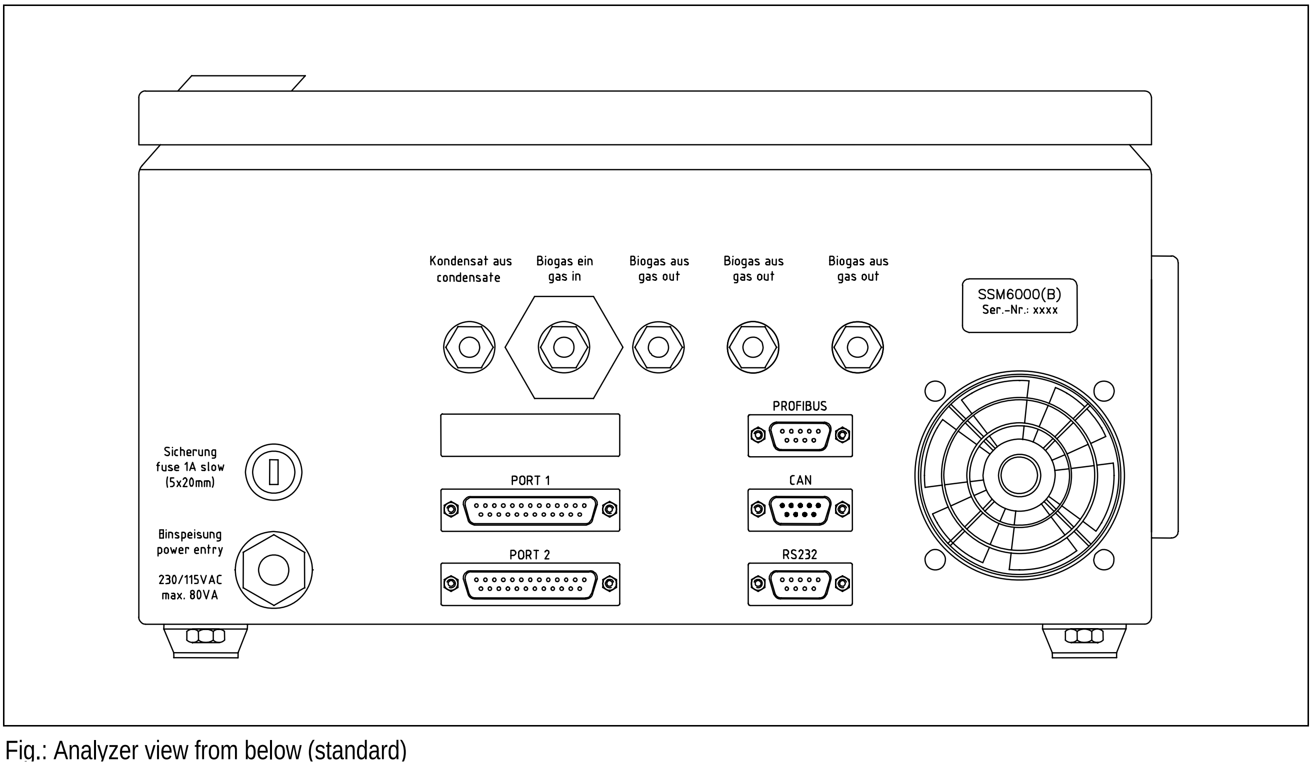


Fig.: Analyzer view from below (standard)

⚠ Proceed in accordance with the applicable national safety regulations for the construction and operation of electrical systems as well as the safety information below!
The connection between a protective earth connection and a protective earth conductor must be made before any other connections are made!
The gas analyzer can become a hazard if the protective earth conductor is interrupted inside or outside the gas analyzer or if the protective conductor connection is disconnected!
Live parts can be exposed when covers are opened or when parts are removed unless this can be carried out without the use of tools. Furthermore, connection points can also be live.

Voltage supply

The device comes with a power cable with earthed-contact plug and may only be connected to an earthed-contact receptacle. The protective effect may not be rendered ineffective by using an extension cable without PE conductor.

We recommend installing a mains disconnector switch or a switched receptacle in the power supply circuit near the gas analyzer in order to be able to disconnect all poles of the gas analyzer from the power supply, if necessary. The mains disconnector switch must be marked in a manner that clearly shows the equipment to be disconnected.

Mains voltage:	85 .. 264 VAC / 47.. 63 Hz
Power consumption:	85 VA max.

Two different cable entry versions are currently in use:

- Standard screw-type cable connection (color: light gray)
- and currently the QUICKON cable entry (color: (green).

If the analyzer is to be permanently installed in a stationary manner, we recommend using an external terminal box for analyzers with standard screw-type cable connection. In this case, the earthed-contact plug can be removed from the power cable and the individual wires can be directly connected to the terminals.

Permanent installation of analyzers with a QUICKON cable entry is possible directly to the screw-type connection. Proceed in accordance with the installation instructions given below. The screw-type cable connection is suitable for the following power cables:

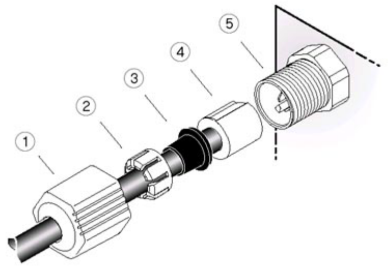
Cable specifications: Light to medium conduits, such as. H03VV-F / H05VV-F, number of poles = 3 (L/N/PE)
Flexible cross-section 0.75 to 1.5 mm² / conductor configuration according to VDE 0295 = class 2 to 5
Wire diameter, including insulation, up to 3mm / outside diameter 5.6 to 9 mm

Connecting the voltage supply within the device by the customer is not permitted by the manufacturer and will render the guarantee invalid.

Fitting the power cable using QUICKON

QUICKON components

1	Union nut
2	Crown
3	Rubber seal
4	Splice ring
5	Contact support

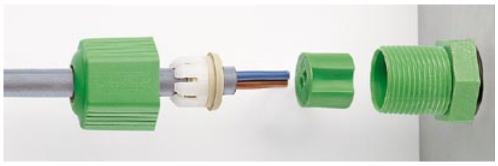


1. Remove power cable

- Open screw connection.
- Pull the cable in order to separate the wires from the terminals.
- Remove residues of insulating material before re-connecting.

2.. Preparation and installation

- Strip a section of around 15mm of the cable sheath.
- Assemble union nut, crown and rubber seal.



3. Install QUICKON components

- Push wire ends into the openings of the splice ring. In order to ensure correct assignment, the conductors are marked with numbers and may not be interchanged!

- Identification of the individual conductors:

1	→	N	(neutral)	blue
2	→	L	(phase)	brown
3	→	PE	(protective earth)	green/yellow

- Cut off excess wire ends (the wire ends may not project from the splice ring by more than 2mm).

4. Tighten

- Insert the prepared cable into the contact support.
- Tighten the union nut. During tightening, QUICKON automatically establishes the contact and the strain relief function.

Re-connecting the power cable

- Cut off wire ends approx. 20mm.
- Erneute Montage wie zuvor beschrieben.

Port 1 - analog measured-value outputs / digital inputs

One analog measured-value output is available at the plug connector, port 1. The maximum burden totals 550Ω.
Furthermore, up to four digital inputs are available at port 1, depending on the analyzer version and its features.

Analyzer version "A"

The current outputs of analyzer version "A" are active, differential 4-20-mA current outputs without galvanic isolation which, prior to being passed on to a controller with common reference, must be galvanically isolated by means of suitable isolation amplifiers.
The digital input enables a higher-level system (for example, a PLC), to start a measuring process via a potential-free contact – irrespective of the set measuring interval.

Analyzer version "B"

Analyzer version "B" comes with active 4-20 mA current outputs without galvanic isolation with a common reference potential, so that galvanic isolation against the analyzer is not absolutely necessary.
Via the digital inputs at port 1, the higher-level system controller can control up to four measuring points individually and trigger analyses.

The layout of the port 1 plug connector and detailed signal specifications are shown in the terminal diagrams in the appendix separately for the different analyzer versions. Ready-to-connect control cables measuring 10m and 20m in length, respectively, are optionally available.

Connector module at the analyzer: D-sub 25-pole, socket

Port 2 - digital outputs

The following digital outputs are available on the port 2 plug connector:

Status outputs	(3):	Measurement active, ready mode, stand-by and setup mode
Limit-value alarms	(6):	Violation of upper limit for all gas types as well as violation of lower limit for CH_4 and O_2

Analyzer version "B" comes with an additional four outputs as follows:

Measuring-point switch	(3)	Control of up to three externally installed solenoid valves (measuring points 2 to 4)
Test gas valve	(1):	Control of an externally installed test gas valves (for testing and calibration by the manufacturer only)

Analyzer version "A"

In the case of analyzer version "A", the outputs are 12-V transistor outputs which actively switch to GND with a maximum load rating of 300mA each. Short-circuiting of the outputs must be avoided under any conditions.
Analyzers with a second measuring point additionally include a digital input at port 2 for controlling a 3/2-way solenoid valve. The valve is controlled by customer equipment via a potential-free switching contact at pins 12 and 13.

Analyzer version "B"

The "open collector" transistor outputs of analyzer version "B" are short-circuit resistant and can be read and/or used to control the solenoid valves either by using the 12-V supply voltage of the analyzer or by an external voltage supply of 35VDC max.

The layout of the port 2 plug connector and detailed signal specifications are shown in the terminal diagrams in the appendix separately for the different analyzer versions. Ready-to-connect control cables measuring 10m and 20m in length, respectively, are optionally available.

Connector module at the analyzer: D-sub 25-pole, socket

RS 232 interface

The RS 232 interface is used for the digital output of measured values with time stamp on a PC or an external data logger. An IBM-compatible PC with serial R232 interface and a suitable terminal program are required for transmission. The terminal is a standard feature included in Microsoft operating systems, Windows 95 and higher.
Note that without additional amplifiers transmission via an RS232 interface only works perfectly with cable lengths of up to a maximum length of 20 meters.

Connector module at the analyzer: D-sub 9-pole, socket

PROFIBUS interface (option)

A suitable interface is available on the underside of the analyzer for the output of measuring data, limit-value alarms and status messages and for controlling the analyzer via a Profibus system. The test certificate contains a note stating whether this interface is activated / enabled. A detailed description of the interface, including installation information, is available in the appendix to this documentation.

Connector module at the analyzer: D-sub 9-pole, socket

CAN interface (option)

The CAN interface for the output of measured data via a CAN bus system is not yet supported by the software in its current version.

Connector module at the analyzer: D-sub 9-pole, plug connector

3.5.3 Connecting the gas pipes

All gas connections are located on the underside of the analyzer. The connections are clearly marked and may not be exchanged. The gas-carrying pipes are connected to the device by means of clamping-ring screw connections.

The following connections must be made:
- 1x Measuring gas in / 2 .. 4x (with measuring-point switch option)
- 3x Measuring gas out
- 1x Condensate out

The delivery includes 20 meters of PVC hose (an additional 10m per measuring point with the measuring-point switch option) and the required connections.

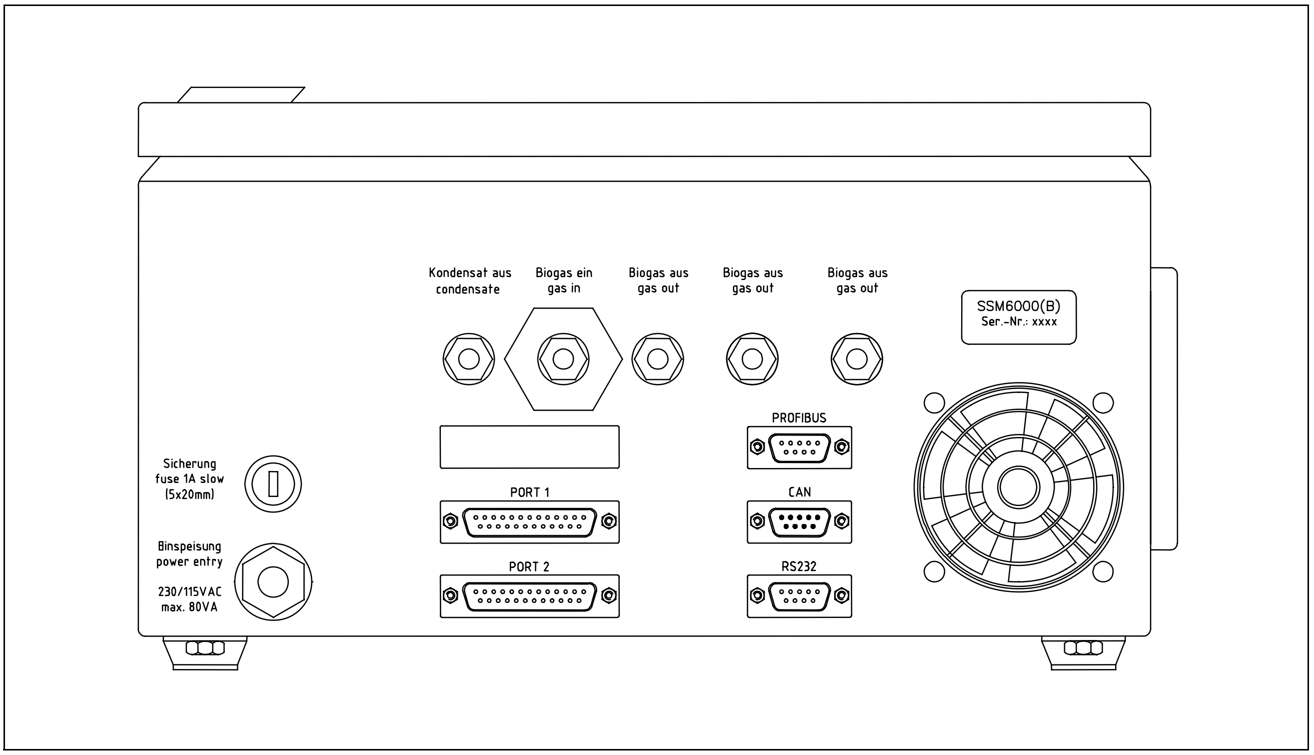


Fig.: Analyzer view from below

In order to connect the gas pipes and hoses, proceed as follows:

Connecting the gas pipes

Step	Action
1	Cut hose at a right angle.
2	Push knurled nut and clamping ring over the end of the hose.
3	Push the end of the hose fully onto the sleeve.
4	Screw on the knurled nut and tighten by hand.

Measuring-gas input:

The length of the biogas pipe should not exceed 20m. A stop valve should be installed at the point where the biogas is sampled from the biogas plant in order to prevent biogas from escaping when the measuring-gas hose is disconnected during calibration. The measuring-gas pipe should, if possible, slope towards the tapping point, so that any condensate produced can flow back into the process. The pipes must, on all accounts, be definitely protected against frost.

In order to protect the biogas plant against flashback, a safety unit is installed at the measuring-gas input of the analyzer which prevents flashback into the gas-carrying system of the plant in the case of pipe leakage.

Two different safety unit versions are currently in use.

Version 1	Safety unit E 460-3 according to EN 730-1	(material: brass / installation outside)
Version 2	F 510 detonation protection according to EN 12874	(material: stainless steel / installation outside)

The device is at present fitted with the F 510 detonation protection system according t EN 12874 / PTB 02 ATEX 4012X made of stainless steel. Its gas connection is identical to the other screw-type connections. In the case of devices with the E 460-3 safety unit, the hose supplied is already fitted with the gas connection.

The SSM 6000 biogas analyzer is designed for pressures of –50 < p >5 hPa at the measuring-gas input. In the case of higher admission pressures which can, for example, occur with gas motors with supercharger, biogas flows through the measuring-gas cooler even during measuring pauses due to the elevated pressure level. Since the condensate pump is inactive in stand-by mode, condensate can accumulate in the cooler during longer measuring pauses. When a measuring process starts, this condensate would then be drawn into the gas system and can damage the analyzer. This means that the measuring-gas supply must be interrupted during measuring pauses at admission pressures of >5 hPa, using, for example, the integrated automatic shut-off unit of the SSM 6000 or any other suitable component.

! If the pressure at the measuring-gas input does not exceed 5 hPa, installation of an automatic shut-off unit is not absolutely necessary if the sampling point is closed by the stop valve of the biogas plant in measuring pauses of more than 24 hours.

Exhaust air pipes:

Make sure that the length of the exhaust air pipes does not exceed 5 m in each case in order to ensure almost pressureless discharging of the measuring gas. The exhaust air pipes must extend **separately** into the open. Make sure that the pipes are laid in such a manner that they are protected against frost and that the outlets cannot freeze.

! The exhaust air contains biogas that generates a flammable gas mixture with air oxygen!
Make sure that this does not cause any hazards!

Condensate pipe:

The condensate produced during gas processing must be directed through a hose into a suitable collecting tank, and must be disposed of in accordance with the applicable laws and regulations. Make sure that the condensate pipe and the collecting tank cannot freeze.

! Important - aggressive condensate is possible!
Therefore proceed with care when handling condensate, and wear appropriate protective clothing.

→ Installation of the system is now complete, and the system can be set into operation as described in section 6.

4 Using the gas analyzer

This section contains a brief description of how to use the analyzer in order to enable users to quickly start working with the device. For a detailed description of the individual functions and menu items, please refer to the following "Menu and function description" section.

4.1 Function keys

The functions keys on the control panel activate the different user menus in order to select device settings. The user menus can be accessed in setup mode after operation of the key switch.

The function keys have the following meanings:

Symbol	Description	Function
	esc	Return from the current menu to the next higher menu
	up	Forward in the current selection (up or left, depending on the context)
	down	Back in the current selection (down or right, depending on the context)
	enter	Call current selection or confirm changed value

In order to change the settings in a menu, proceed as follows:

- Operate the key switch in order to activate the setup mode.
- Press the <up> and <down> keys in order to select the desired entry.
- Press <enter> in order to open the selected menu.

<u>Example:</u> Changing the measuring interval

Operate the key switch in order to access the setup mode. The cursor flashes in front of the sub-menu titled MEASURING PARAMETERS. In order to access this menu, press <enter> in order to confirm the selection. The LC display now shows the MEASURING PARAMETERS menu and the cursor is positioned in front of the first entry, i.e. MEASURING INTERVAL. Press the <enter> key once again in order to access the MEASURING INTERVAL editing level.

```
SETUP MODE:
_ MEASUREMENT
_ CALIBRIATION
_ SYSTEM
```

```
MEAS. OPTIONS:
_ MEAS. INTERVAL
_ ALARM VALUES
_ SINGLE MEAS.
```

```
MEAS.INTERVAL: [min]
_CH4:   720 _O2 : 720
_H2S:  1440 _CO2: 720
_RT:  12:00 _OFS:  30
```

Press <down> and <up> in order to select the desired parameter (such as H_2S). The cursor flashes in front of the respective entry.

Press <enter> in order to confirm the selection. The cursor moves to the first digit of the value that is currently adjusted (such as the numeral 1 of the value 1440).

Use the <down> and <up> keys in order to set the desired value, and press the <enter> key to confirm your entry. The cursor advances by one position that can now be changed.

After the last numeral of the input field, the cursor moves to the input field (for example, in front of the text H_2S) when you press the <enter> key. The changed value was saved. If you press <esc> in order to cancel the entry before the cursor is positioned in front of the input field, the changes made so far are not saved.

Not every interval is permitted. The interval must be a divisor of 1440, i.e. the number of minutes of a day. If the value entered does not fulfill this requirement, the SSM 6000 automatically uses the nearest setting. With the setting selected above, H_2S is measured every 480 minutes and hence three times a day at 4:00 a.m., 12:00 noon, and 8:00 p.m, for example.

Press the <esc> key in order to access the next higher menu.

In the same way, further sub-menus can be accessed by pressing these keys until the desired parameterization level is reached. Once all settings are made, you can operate the key switch in order to exit the setup mode.

4.2 Starting a measurement

Measurements can be started in different ways, depending on the mode which is currently active.

Manual measurement

With the device in "MANUAL" mode, a measuring process can be started in stand-by mode at any time by pressing the <enter> key. You are first prompted to select the measuring point via the <up> and <down> keys. Thereafter, press the <enter> key once again in order to confirm the start of the measuring process.
Note: In the case of analyzer version "A", measuring-point switching takes place by equipment provided by the customer, so that it does not matter which measuring point is selected.

Single measurement

Via the menu item MEASURING PARAMETERS -> SINGLE MEASUREMENT, a manual measurement can be performed at any time while the device is in automatic mode without having to vary the measuring interval or the reference time. Press the <enter> key in order to confirm the start of the measuring process after you have selected the measuring point. When prompted, operate the key switch in order to exit the setup mode. The measuring process starts immediately. On completion of the measuring process, the current measured values are display and the device returns to stand-by mode.
Note: In the case of analyzer version "A", measuring-point switching takes place by equipment provided by the customer, so that it does not matter which measuring point is selected.

Automatic measurement

When the device is in automatic measuring mode, measuring processes are triggered automatically depending on the set measuring interval, the reference time and the set offset. In automatic mode, measuring point 1 is generally analyzed. Single measurement (see above) is possible at any time.

External start via the digital inputs

Analyzer version "A"

The digital input at port 1 enables triggering of a measuring process via a potential-free normally-open contact (minimum closing time of 1.5 seconds). In the case of analyzers with the measuring-point switch option, it is thereby possible to successively measure both measuring points. On completion of the measuring process, the device returns to stand-by mode.
In the case of external control of the analyzer, the MANUAL mode should be selected in order to avoid overlapping with the measuring interval in automatic measuring mode.

Analyzer version "B"

Analyzer version "B" comes with four digital inputs at Port 1 which are used to start the measuring process and at the same time to select the measuring point. The digital optocoupler inputs are assigned as follows and must be activated for around 1.5 seconds:

DI 01 - measuring point 1
DI 02 - measuring point 2 / valve 1
DI 03 - measuring point 3 / valve 2
DI 04 - measuring point 4 / valve 3

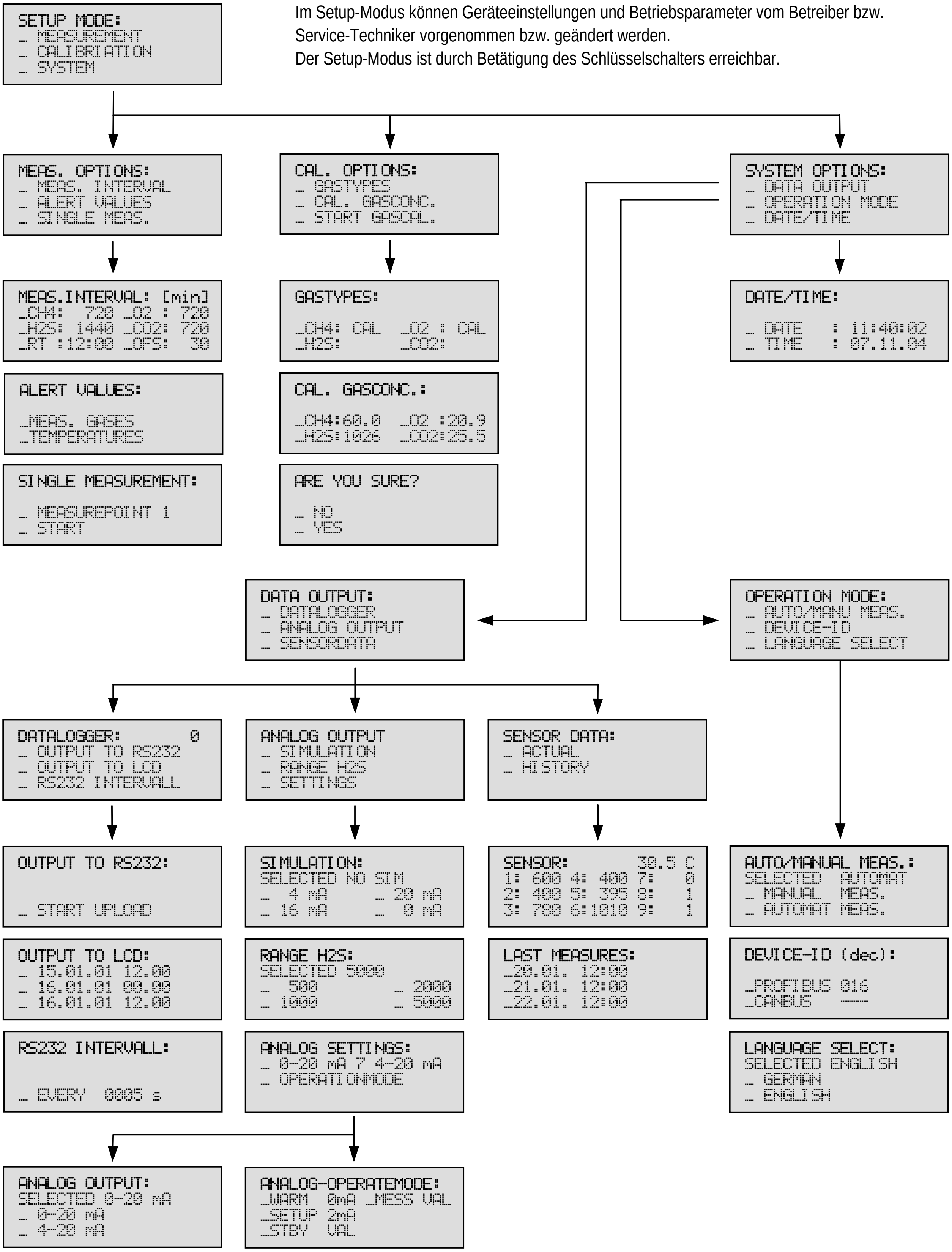
After the start of the measuring process, the analyzer simultaneously activates the corresponding measuring-point valve and/or the pertinent digital output at port 2. The digital inputs are not read until a measuring process has been completed.
In the case of external control of the analyzer, the MANUAL mode should be selected in order to avoid overlapping with the measuring interval in automatic measuring mode.

External start via the PROFIBUS interface

A measuring process can also be started via the PROFIBUS interface. If the measuring-point switch option is implemented, the measuring-point to be analyzed is additionally selected. Further details concerning the PROFIBUS interface can be found in the appendix to this documentation.
In the case of external control of the analyzer, the MANUAL mode should be selected in order to avoid overlapping with the measuring interval in automatic measuring mode.

4.3 Menu structure

Im Setup-Modus können Geräteeinstellungen und Betriebsparameter vom Betreiber bzw. Service-Techniker vorgenommen bzw. geändert werden.
Der Setup-Modus ist durch Betätigung des Schlüsselschalters erreichbar.



5 Menu and function overview

The following section describes the functions of all user menus that are available for adjusting the analyzer system to the conditions of the biogas plant.

The individual user menus can be accessed in setup mode. The setup mode, for its part, is accessed via the key switch.

```
SETUP MODE:
_ MEASUREMENT
_ CALIBRIATION
_ SYSTEM
```

The different menu items can now be selected via the membrane keypad.
For further details concerning operation, please refer to the "Using the gas analyzer" section.

5.1 Measuring parameters

The MEASURING PARAMETERS menu contains the following sub-menus.

MEASURING INTERVAL	- Setting the measuring interval for every component to be measured.
ALARM VALUES	- Setting the limit-value concentrations for the different gas types.
SINGLE MEASUREMENT	- Performing one manual measurement.

5.1.1 Measuring interval

```
MEAS.INTERVAL: [min]
_CH4:  720 _O2 : 720
_H2S: 1440 _CO2: 720
_RT :12:00 _OFS:  30
```

The measuring interval and the reference time for the individual measuring components are set with this menu item. We generally recommend measuring all gas types at the same time. Gas types which do not exist or which are not fitted, such as CO_2 (option), must be set to zero.
In automatic measuring mode, the reference time determines the time when the first measuring process starts. After this measuring process, the next measuring process is then started xxx minutes later, depending on the set measuring interval.
The "offset" selection (_OFS: 0000) enables the automatic starting of measuring processes in the intervals defined for the day with the "minutes" entry edited to this effect.

With the setting selected above, CH_4, H_2S und O_2 are measured every 480 minutes = three times a day at 4:00 a.m., 12:00 noon, and 8:00 p.m. If a value of 30 minutes is selected for the offset, the measuring processes are carried out as follows:

1st day	4:00 / 12:00 / 20:00
2nd day	4:30 / 12:30 / 20:30
3rd day	5:00 / 13:00 / 21:00

! Not every interval is permitted. The interval must be a divisor of 1440, i.e. the number of minutes of a day. If the value entered does not fulfill this requirement, the SSM 6000 automatically uses the nearest setting. However, the measuring interval should not be set at a value of less than 120 minutes. This corresponds to 12 measurements a day.

5.1.2 Alarm values

```
ALERT VALUES:

_MEAS. GASES
_TEMPERATURES
```

The MEASURING GASES and TEMPERATURES menu selections for setting limit-value alarms can be accessed via the MEASURING PARAMETES / ALARM SETTINGS menus.

```
ALARM VALUES:
_CH4<  50  _O2 < 0,5
_CH4>  70  _O2 >   5
_H2S> 250  _CO2>  55
```

In the ALARM VALUES menu, separate concentration alarm thresholds can be set for each gas type. The alarms are made available as digital transistor outputs at the plug connector, port 2, on the underside of the analyzer. Furthermore, the "Alarm" status LED on the display panel next to the measured value concerned is lit up in the case of a violation of the upper or lower limit.

The values for CH_4,, O_2 and CO_2 are expressed in percent by volume, whilst the H_2S value is expressed in ppm. Violation of an upper limit can be edited for all gas types; in the case of CH_4 and O_2, violation of a certain lower concentration limit can be additionally edited.

! The ex-works settings are non-binding recommendations. The manufacturer does not assume any liability for the alarm values set! Please contact the supplier of your plant in order to identify the values to be set in order to avoid damage to the equipment!

```
DEVICE INSIDE-TEMP:

_MAXWERT:     40.0
_MINWERT:     08:0
```

Analyzer version "B" additionally measures the temperature inside the device and makes this information available via the interfaces. The INTERNAL TEMP menu selection enables editing of an alarm which is transmitted via the interfaces in the case of a violation of the upper or lower limit value.

5.1.3 Single measurement

```
SINGLE MEASUREMENT:

_ MEASUREPOINT 1
_ START
```

Via the SINGLE MEASUREMENT menu, a manual measurement can be performed at any time while the device is in automatic mode without having to vary the measuring interval or the reference time. If the measuring-point switch (option) is implemented, the measuring point must be selected using the <up> and <down> keys before starting a measuring process. Press the <enter> key in order to confirm the start of the measuring process. When prompted, operate the key switch in order to exit the setup mode.

```
SINGLE MEASUREMENT:

    PLEASE LEAVE
       SETUP
```

The measuring process starts immediately. On completion of the measuring process, the current measured values are display and the device returns to stand-by mode.

Note: In the case of analyzer version "A", measuring-point switching takes place by equipment provided by the customer, so that it does not matter which measuring point is selected.

5.2 Calibration parameters

Proceed with utmost care when using the "START GASCAL" function! Inappropriate or thoughtless calibration can completely misadjust the analyzer. Please proceed in strict conformity with the information in the "Calibration" section.

The CALIBRATION PARAMETERS menu includes the following options:

GAS TYPES	- Determining the gas types to be calibrated.
CALGASCONC	- Editing the calibration gas concentrations of the individual gas types.
START GAS CAL	- Starting the gas calibration process.

5.2.1 Gas types

```
GASTYPES:

_CH4: CAL   _O2 : CAL
_H2S:       _CO2:
```

In the GAS TYPES menu, determine the measuring components to be calibrated.
If a suitable calibration gas mixture is available, we recommend calibrating all existing measuring components at the same time.

5.2.2 Calibration gas concentrations

```
CAL. GASCONC.:

_CH4:60.0   _O2 :20.9
_H2S:1026   _CO2:40:0
```

In the CALGAS CONCENTRATION menu, enter the calibration gas concentrations of the individual gas types according to the calibration gas supplier's analysis certificate. The concentrations for CH_4, O_2 and CO_2 are expressed in percent by volume, whilst the H_2S concentration is expressed in ppm.

For oxygen, set a calibration gas concentration of 20.9 percent by volume because the sensitivity of the sensor is calibrated using ambient air.

5.2.3 Start calibration

```
ARE YOU SURE?

_ NO
_ YES
```

In the START GASCAL menu, you are once again asked whether you are sure. When you confirm this, the calibration process starts. Only those gases that were activated in the GAS TYPES menu are considered. The settings in the CAL GAS CONCENTRATION menu are used as reference values.

5.3 Device options

```
SYSTEM OPTIONS:
_ DATA OUTPUT
_ OPERATION MODE
_ DATE/TIME
```

The DEVICE OPTIONS menu item contains the following options.

```
SYSTEM OPTIONS:
_ DATA OUTPUT
_ OPERATION MODE
_ DATE/TIME
```

DATA LOGGER → Digital output of measured values with time stamp
ANALOG OUTPUT → Editor level for analog measured-value outputs
SENSOR DATA → Display of sensor signals

```
OPERATION MODE:
_ AUTO/MANU MEAS.
_ DEVICE-ID
_ LANGUAGE SELECT
```

AUTO/MAN MEASUREMENT → Selection of automatic or manual measuring mode
DEVICE ID → Profibus/CANBUS: setting the device address
SELECT LANGUAGE → Setting the menu language (German or English)

```
DATE/TIME:

_ DATE    : 11:40:02
_ TIME    : 07.11.04
```

DATE/TIME
Setting time and date

5.3.1 Data logger

Output on LCD

Besides output of measured values via the RS232 interface, the OUTPUT ON LCD menu item additionally enables the display of the contents of the data logger on the device. The <down> and <up> keys can be used to select and display all measurements. When you press the <enter> key, the device temperature is displayed instead of [CH_4], the air pressure instead of [H_2S], and the measuring point of the selected measurement instead of [O_2]. The status LEDs flash yellow / red in this mode. The status LEDs flash green / yellow when the gas concentration values are displayed.

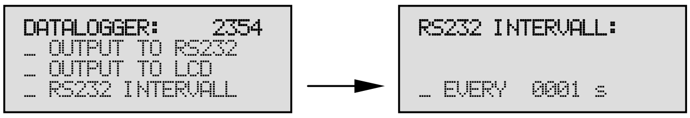
```
DATALOGGER:      3265
_ OUTPUT TO RS232
_ OUTPUT TO LCD
_ RS232 INTERVALL
```

→

```
OUTPUT TO LCD:
_ 15.01.01 12.00
_ 16.01.01 00.00
_ 16.01.01 12.00
```

Output on RS232

Via the serial interface, the measured values, including a time stamp, can be transmitted to a PC or to the general system controller and evaluated using a suitable program. In this way, trends and dependencies between the individual measured values can be identified.
The values of the last measuring process, including date and time information, are continuously output via the interface, depending on the RS232 interval selected, or can be exported as a block at a later point in time from the data logger of the analyzer. The data logger of the SSM 6000 can store around 4096 measurements / data records.



The measuring data is output in the csv/txt format via the RS232 interface as follows:

Date Time / CH_4 / H_2S / O_2 / CO_2 / Device temperature / Air pressure / Measuring-point No.

16.07.03 11:50;60,6;0282;00,0;40,4;23,4;1013;1;
16.07.03 11:59;60,6;0284;00,0;40,4;23,6;1013;2;
16.07.03 12:52;00,0;0019;00,0;00,0;23,7;1014;1;
16.07.03 13:02;00,0;0001;20,8;00,0;23,8;1014;4;

As a precondition for the transmission of data from the SSM 6000 to the PC, the terminal program must first be configured. This procedure is described here using the "HyperTerminal" program under MS Windows as an example. However, the properties of the serial interface can also be transferred to other terminal programs.

Configure HyperTerminal

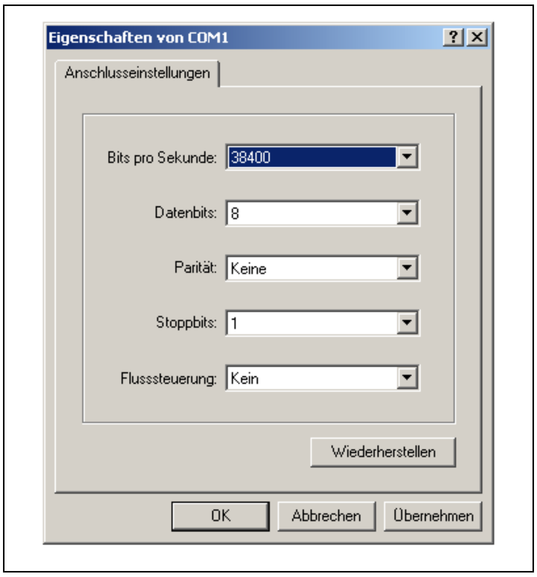
The terminal program is accessed via the start bar **Programs** → **Accessories** → **Communication** → **HyperTerminal**. Click the **HyperTerminal** icon whereupon you can now set up a new connection.

In this dialog field, enter a name (such as SSM 6000) for the new connection and select any icon you like.

Thereafter, click OK to confirm.

In the **Establish connection via:** list box, select the serial interface of the PC to which you wish to connect the SSM 6000, for example, **COM1**.

Thereafter, click OK to confirm.

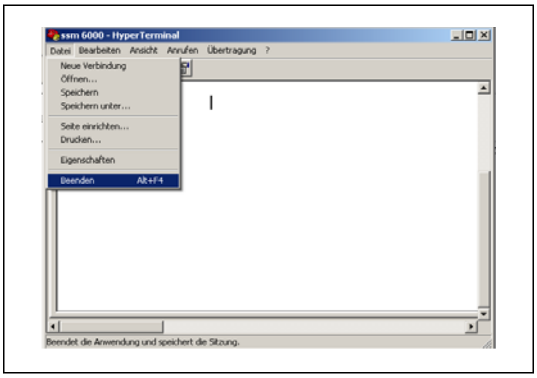


In this dialog, you must now configure the interface.

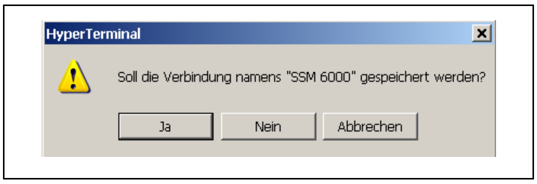
Edit the following parameters and subsequently click OK to confirm:

Bits per second	38400
Data bits	8
Parity	none
Stop bits	1
Protocol / flow control	none

The HyperTerminal is now completely configured and is opened.



Now select the **Exit** command in the **File** menu in order to exit and save the program.



Click **Yes** to confirm. Your HyperTerminal is now completely configured for data transmission. We recommend creating a link on the desktop in order to find the newly created connection more easily.

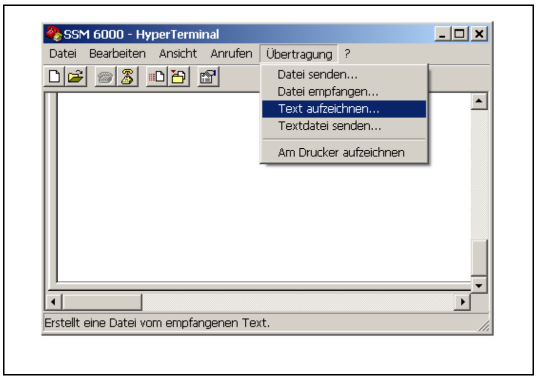
Transmitting measured data

As a precondition for transmitting measured values from the SSM 6000, the analyzer must be connected via the RS232 interface to the serial interface (COM1 or COM2) of the PC.

Note: Use a suitable serial cable (1:1 connector layout) for this connection. The exact connector layout of the interface is shown in the terminal diagrams in the appendix. Do not use a null modem cable because these cables feature an incorrect connector layout, so that data transmission is not possible.

At first, open the previously configured HyperTerminal connection from the start menu: **Programs** → **Accessories** → **Communication** → **HyperTerminal** → **SSM 6000** or via the link on the desktop.

The HyperTerminal window **SSM 6000** is opened:



HyperTerminal immediately and automatically establishes the connection to the SSM 6000.

Select the "Transmission – Record text" menu item.

During the next step, enter any file name, such as measurement_050322, and select the target directory in which the measured-value file is to be stored.

Click **Start** in order to confirm the entry.

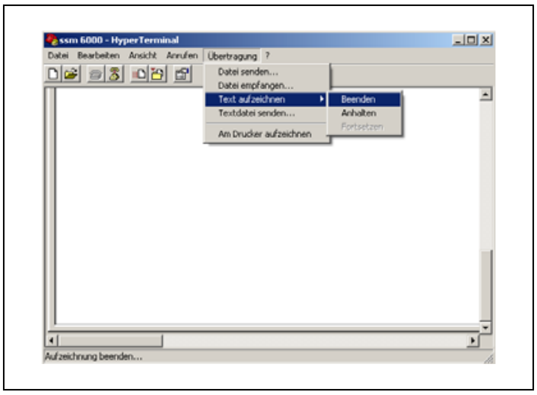
! In order to avoid a major loss of data in the case of a defect of the device, we recommend exporting the data at regular intervals. The measured data is also exported and archived by the manufacturer each time service work is carried out. This data is then available on demand.

In order to export the stored measured data from the data logger, select DEVICE OPTIONS – DATA OUTPUT – DATA LOGGER – OUTPUT TO RS232 and press <enter> in order to start the data transmission process.
The progress of the transmission process can be monitored on the screen of the PC and on the LC display.

```
DATALOGGER:     2345
_ OUTPUT TO RS232
_ OUTPUT TO LCD
_ RS232 INTERVALL
```

```
OUTPUT TO RS232:

_ START UPLOAD
```



In order to terminate the transmission process and save the data, select the Transmission – Record text – Exit menu item.

The stored data can now be imported to a suitable program and evaluated there.

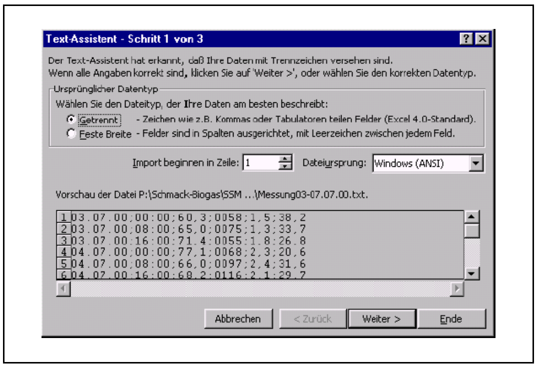
We recommend selecting a new file name for the transmission of new measuring data.

Importing the measured data to MS Excel

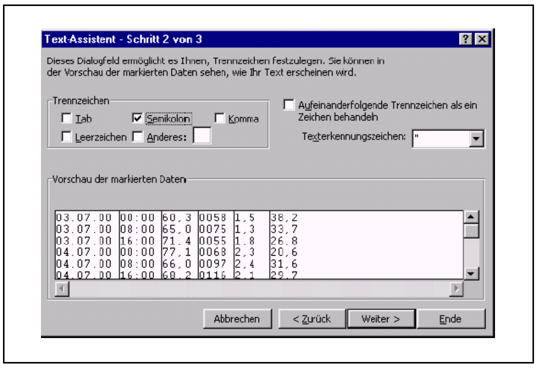
In order to import the transmitted measuring data, for example, to MS Excel, proceed as follows.

- Open the MS Excel spreadsheet program.
- Select the File – Open command in order to import the measured-value file (*.txt).
- (Important! Select "All files (*.*) for the file type in order to have the txt file displayed.)

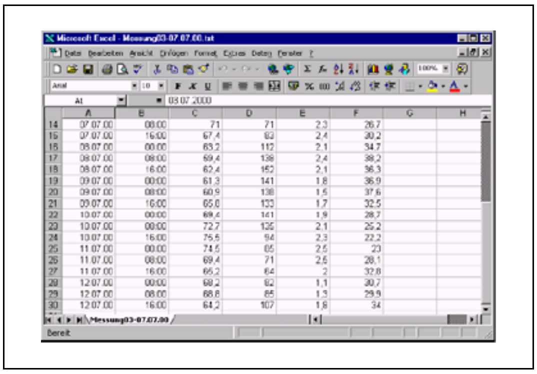
MS Excel starts a text wizard which performs the import operation.



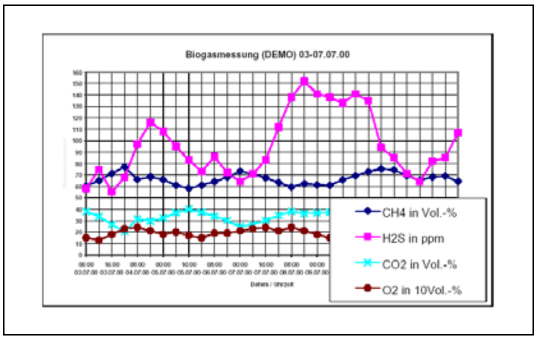
Select the "Separate" option and continue with Continue >.



Select the colon as separator, and click Exit in order to terminate the import process.



The measured values are imported to an Excel chart and can now be evaluated.



The measured data can be presented in diagrams and used for other calculations.

5.3.2 Analog measured-value outputs

```
ANALOG OUTPUT
_ SIMULATION
_ RANGE H2S
_ SETTINGS
```

In the ANALOG OUTPUT menu item, different settings can be made for the analog measured-value outputs. The parameterization level can be accessed in setup mode via Device options → Data output → Analog output.

Simulation

```
SIMULATION:
SELECTED NO SIM
_  4 mA      _ 20 mA
_ 16 mA      _  0 mA
```

The analyzer can simulate four analog values (0, 4, 16 and 20 mA) in order to adjust the analog output signals to external equipment. Downstream isolation amplifiers are usually fitted with potentiometers for adjusting the zero and end points, so that adjustment can be performed quickly and easily.

H2S measuring range

```
RANGE H2S:
SELECTED 5000
_  500        _ 2000
_ 1000        _ 5000
```

The standard measuring range for H_2S totals 0 to 5000 ppm which is represented by 0-20 mA or 4-20 mA, respectively, depending on the setting. Given an output range of 4-20 mA, the resolution is as low as 0.0032 mA/ppm.
If the expected H_2S concentrations are significantly lower, the upper limit of the analog output can be lowered from 5000 ppm H_2S to 2000, 1000 ppm or to 500 ppm H_2S. This enables better resolution of the analog signal (0.008 / 0.016 mA/ppm or 0.032 mA/ppm, respectively).

This setting only changes the resolution of the analog output. The H_2S measuring system additionally includes an automatic measuring-range switching function which is not affected by this setting. The measured-value display and the output of measured values via the RS232 interface continue to cover the range from 0 to 5000 ppm H_2S.

Analog settings

```
ANALOG SETTINGS:
_ 0-20 mA 7 4-20 mA
_ OPERATIONMODE
```

```
ANALOG OUTPUT:
SELECTED 0-20 mA
_ 0-20 mA
_ 4-20 mA
```

The 0-20 mA / 4-20 mA menu item permits toggling between the two output ranges of the analog interfaces.

```
ANALOG-OPERATEMODE:
_WARM  0mA _MESS VAL
_SETUP 2mA
_STBY  VAL
```

In this menu, the analog measured-value output is considered for the different operating states.

Operating states: _WARM = warm-up phase / _MESS = measurement active /
_STBY = Stand-by / _SETUP = configuration mode

The following values can be set:

- 0 / 2 / 4 mA or VAL (analog value of the last measuring process)
- XmA (0 or 4mA, zero value of the edited output range 0-20 / 4-20mA)

5.3.3 Sensor data

```
SENSOR DATA:
_ ACTUAL
_ HISTORY
```

The **Sensor data** menu serves the functional checking of the sensors and thereby supports remote diagnosis by the manufacturer.
The current sensor signals and the signals of the last three measurements (HISTORY) can be displayed.

Selecting the **Sensor data → Actual** activates the measuring-gas pumps in the analyzer whereupon the gas currently available at the measuring-gas input starts flowing through the CH_4 gas system. The display shows the current sensor signals in number blocks from 0 to 1023 dig.

The theoretical display can hence be calculated as follows at a defined calibration gas concentration.

$$Display\ [dig] = \frac{Gas\ concentration}{Measuring\ range} \cdot 1023\ dig$$

The measuring range totals 100 percent by volume for CH_4 and CO_2. The display of the sensor signal for H_2S depends on the dilution stage. With the 1:40 dilution stage, the measuring range totals 1000 ppm.

The above equation does not have to be fulfilled exactly. The equation neglects, for example, the fact that the signal should feature a slight offset with zero gas (living zero point). The actual sensor signals should be within the limits shown below.

```
SENSOR:          30.0.C
1: 600 4: 400 7:    0
2: 400 5: 434 8:
3: 780 6:1010 9:
```

Actual sensor signals [dig]		Ambient air [1)]	Calibration gas [2)]
1	Sensor signal CH_4	0001 - 0010	0525 – 0675
2	Sensor signal H_2S	0001 - 0075	0001- 0075
3	Sensor signal O_2	0650 - 1020	0001 – 0050
4	Sensor signal CO_2	0001 - 0010	0325 – 0475
	Sensor signal H_2 (instead of CO_2)	0001 - 0060	0750 – 0900
5	Cooler temperature		390
6	Pressure sensor [mbar]	0950 - 1050	0950 – 1050
7			
8			
9			

1) In order to determine the zero point of the sensor, the biogas hose must be disconnected from the detonation protection unit, so that ambient air is drawn in through the measuring-gas input.
2) A calibration gas / biogas with the following composition was used as a basis for the sensor signals indicated:
59.9 percent by volume of CH_4, / 300 ppm H_2S,/ 850 ppm H_2 / 0 percent by volume of O_2 / 40 percent by volume of CO_2.

In the case of analyzer version "B", the device temperature is additionally displayed in the first line.

By selecting the **Sensor data → History** menu item, you can check the sensor signals of the last three measurements.

```
LAST MEASURES:
_20.01. 12:00
_21.01. 12:00
_22.01. 12:00
```

↓

```
MEASURE 01.05. 17:57
A:  10 D: 400 G:  30
B: 600 E: 040 H:   8
C:  52 F: 780 I: 400
```

History – sensor signals of the last measurements [dig]			Sensor signals [2)]
A	Sensor signal CH_4	Zero gas	0001 - 0020
B		Biogas / calibration gas	0525 - 0675
C	Sensor signal H_2S	Zero gas	0001 - 0075
D		Biogas / calibration gas	< 1023
E	Dilution stage H_2S	Biogas / calibration gas	0, 10, 40 or 200
F	Sensor signal O_2	Test gas	0001 - 0050
G		Zero gas	0650 - 1023
H	Sensor signal CO_2	Zero gas	0001 - 0020
I		Biogas / calibration gas	0325 - 0475
H	Sensor signal H_2 (instead of CO_2)	Zero gas	0001 - 0060
I		Biogas / calibration gas	0750 - 0900

5.3.4 AUTO/MANUAL MODE

```
AUTO/MANUAL MEAS.:
SELECTED  AUTOMAT
_ MANUAL  MEAS.
_ AUTOMAT MEAS
```

The SSM 6000 features two different operating modes which can be selected under this menu item.

↓

```
NEXT MEASUREMENT IN:
[min]
CH4: 295    O2 : 295
H2S: 295    CO2:
```

In automatic measuring mode, the analyzer performs measurements automatically depending on the measuring interval set and the reference time. This setting is recommended for normal measuring operation. Manual measurement is possible at any time by starting a single measurement process under MEASURING PARAMETERS.

```
STAND-BY

meas. with <enter>
```

In manual measuring mode, measuring processes are started by the operator manually by pressing the <enter> key, or by the general system controller via the digital inputs and/or via the Profibus interface.

A measuring process can be started at any time via the digital input irrespective of the operating mode and the measuring interval set. However, the device must be in stand-by mode as a precondition for this.

5.3.5 DEVICE ID

```
OPERATION MODE:
_ AUTO/MANU MEAS.
_ DEVICE-ID
_ LANGUAGE SELECT
```

→

```
DEVICE-ID (dec):

_PROFIBUS 110
_CANBUS    16
```

This menu is used to set the device address for the PROFIBUS or CANBUS interface, respectively. The ex-factory device address settings are "110" for the PROFIBUS and "16" for the CANBUS. The "DEVICE ID" menu is only active if the corresponding interface was activated by the manufacturer. For further details, please refer to the appendix to this documentation.

5.3.6 Select language

```
LANGUAGE SELECT:
SELECTED ENGLISH
_ GERMAN
_ ENGLISH
```

The menu language, i.e. German or English, is selected here.

5.3.7 Date/Time

```
DATE/TIME:

_ DATE    : 11:40:02
_ TIME    : 07.11.04
```

In the device options → DATE/TIME menu, the current time can be set in the HH:MM:SS format and the current date in the DD:MM:YY format.

Note that the clock of the SSM 6000 does not automatically switch to daylight saving time and winter time. Leap years are, however, considered.

6 Setting into operation

When all the activities described in the "Installation" section have been completed and after all electrical connections and hose connections have been once again checked, the analyzer can be set into operation.

6.1 Switching the gas analyzer on

In order to set the SSM 6000 into operation, proceed as follows:

- Connect voltage supply.
- Press the power button on the front panel in order to switch the analyzer on.

After power-on, the display of the analyzer shows the version number for around 5 seconds. This is followed by a warm-up phase of around 30 minutes which ends automatically on expiration of this time.
Since the only initial operations carried out on the device are settings, the warm-up phase can be terminated by pressing the **esc** key. The device is now in stand-by mode and parameterization can start in setup mode after operation of the key switch.

6.2 Setting operating parameters

In order to adjust the analyzer to the requirements of the biogas plant, certain settings must first be made with the analyzer in setup mode. This mode is activated by operating the key switch on the control panel of the analyzer.

6.2.1 Setting date and time

First check and, if necessary, adjust the date and time. This setting is important for future activities which must be regularly triggered at a certain point in time.

```
SETUP MODE:
_ MEASUREMENT
_ CALIBRIATION
_ SYSTEM
```
→
```
SYSTEM OPTIONS:
_ DATA OUTPUT
_ OPERATION MODE
_ DATE/TIME
```
→
```
DATE/TIME:

_ DATE   : 11:40:02
_ TIME   : 07.11.04
```

6.2.2 Setting alarm values

In this menu item, you can edit the alarm thresholds for the individual gas types which are specified in the operating instructions issued by the plant manufacturer.

```
MEAS. OPTIONS:
_ MEAS. INTERVAL
_ ALERT VALUES
_ SINGLE MEAS
```
→
```
ALERT VALUES:

_MEAS. GASES
_TEMPERATURES
```
→
```
ALARM VALUES:
_CH4<   50  _O2 < 0,5
_CH4>   70  _O2 >   5
_H2S> 250   _CO2>  55
```

The values for CH_4, O_2 and CO_2 are expressed in percent by volume, whilst the H_2S value is expressed in ppm/vpm.

! The ex-works settings are non-binding recommendations. The manufacturer does not assume any liability for the alarm values set! Please contact the supplier of your plant in order to identify the values to be set in order to avoid damage to the equipment!

6.2.3 Setting the measuring interval

For the purpose of automatic measurement, the reference time and a measuring interval must be set for each gas type when the device is set into operation. We generally recommend measuring all gas types at the same time.

```
SETUP MODE:
_ MEASUREMENT
_ CALIBRIATION
_ SYSTEM
```
→
```
MEAS. OPTIONS:
_ MEAS. INTERVAL
_ ALERT VALUES
_ SINGLE MEAS.
```
→
```
MEAS.INTERVAL: [min]
_CH4:  240 _O2 : 240
_H2S:  480 _CO2: 240
_RT :12:00 _OFS:  30
```

Not every interval is permitted. The interval must be a divisor of 1440, i.e. the number of minutes of a day. If the value entered does not fulfill this requirement, the SSM 6000 automatically uses the nearest setting. With the setting selected above, H_2S is measured every 480 minutes = three times a day at 4:00 a.m., 12:00 noon, and 8:00 p.m.

However, the measuring interval should not be set at a value of less than 120 minutes. This corresponds to 12 measurements a day.

6.2.4 Other settings

If required, further device configuration settings can be made as required. For a more detailed description, please refer to the "Menu and function overview" section.

- Select the menu language, i.e. German / English	Default setting:	German
- Configuration of analog outputs 0 – 20 mA / 4 – 20 mA	Default setting:	4 – 20 mA
- Setting the analog operating modes	Default setting:	warm-up phase = XmA / rest = VAL
- Measuring range of the analog output for H_2S	Default setting:	0 – 5000 ppm H_2S
- Setting the RS232 interval	Default setting:	1 second

6.3 Checking the interface functions

The analyzer can simulate three analog output values in order to check the analog data output functionality and to adjust this to the higher-level plant control system, if necessary. This enables adjustment of external isolating switching amplifiers or arithmetic correction by the controller.

```
DATA OUTPUT:
_ DATALOGGER
_ ANALOG OUTPUT
_ SENSORDATA
```
→
```
ANALOG OUTPUT
_ SIMULATION
_ RANGE H2S
_ SETTINGS
```
→
```
SIMULATION:
SELECTED NO SIM
_  4 mA     _ 20 mA
_ 16 mA     _  0 mA
```

The data output via the RS232 interface is described in more detail in the "Menu and function overview" section.

Further possible function tests: Profibus interface
CANBUS interface
RS232 interface

6.4 Performing a test measurement

A measuring cycle can be started when all settings of the device are completed and when the "o.k." status LED of the measuring-gas cooler is lit up and thereby indicates that the unit is ready for operation.

The analyzer system was calibrated and tested by the manufacturer prior to shipment (refer to test certificate). In order to rule out any risk of transport damage to the analyzer, one measurement should, if possible, be performed with calibration gas and another measurement with ambient air when the unit is set into operation. Proceed as follows:

- Connect calibration gas with a maximum admission pressure of 0.4 bar to the calibration-gas inlet.
- Press <enter> in order to start a measuring process when the device is in stand-by mode.

During the measuring process, check and, if necessary, readjust the volume flows at the analyzer. On completion of the measuring process, the current measured values are displayed and the device returns to stand-by mode.
In order to check the zero points for CH_4, H_2S and CO_2 as well as the sensitivity of the O_2 channel, you should subsequently perform one measurement with ambient air. For this purpose, disconnect the calibration-gas hose from the measuring-gas input.

If the values measured are within the specified ranges, the system can be used for normal measurements. In the case of larger deviations, the analyzer should be re-calibrated using a suitable calibration gas as described in the "Calibration" section.

6.5 Starting normal measuring operations

After all functions of the device are checked and if the test measurements indicate correct operation of the system, the analyzer can be switched to normal measuring mode. For this purpose, switch the analyzer to automatic measurement.

```
SYSTEM OPTIONS:
_ DATA OUTPUT
_ OPERATION MODE
_ DATE/TIME
```
→
```
OPERATION MODE:
_ AUTO/MANU MEAS.
_ DEVICE-ID
_ LANGUAGE SELECT
```
→
```
AUTO/MANUAL MEAS.:
SELECTED  AUTOMAT
_ MANUAL  MEAS.
_ AUTOMAT MEAS.
```

Connect the biogas hose to the measuring-gas input of the analyzer and start a single measurement. When the stop valve of the biogas plant is closed, the flow rate as indicated by the left "bypass" flowmeter should drop to zero. This ensures that the system is free from leakage and that the analyzer does not draw in any leakage air. Open the stop valve of the biogas plant and check and, if necessary, readjust the flow rates once again.
On completion of the measuring process, the device returns to stand-by mode and starts a new measuring cycle when the set measuring interval has expired.

In the case of external control of the analyzer via the interfaces of the digital inputs, the MANUAL mode should be selected in order to avoid overlapping with the measuring interval in automatic measuring mode.

7 Calibration

7.1 General information

In order to ensure correct measuring results within the specified tolerances, analyzers and systems must be calibrated at regular intervals. With the SSM 6000, the individual gas types are calibrated using certified calibration gases and/or calibration gas mixtures.

! Note that incorrect calibration leads to incorrect results during subsequent measurements!

! Before any service or maintenance intervention, the higher-level system (plant control system) must be notified of any such work in advance in order to avoid emergency shut-down of the motor in response to incorrect measuring values.

The calibration procedure in general:

- Recording the actual condition
- Use calibration gas in order to calibrate the device.
- Perform a test measurement in order to check the calibration.
- Resume normal measuring operations.

7.2 Calibration setup and calibration gases

Certified calibration gases or calibration gas mixtures and a suitable cylinder pressure reducing valve with a setting range of the output / back pressure of equal to or less than 3 bar are required for calibration. During measurement / calibration, the inlet pressure at the device should range from 20 up to a maximum of 100 mbar. An output or back pressure of < 0.4 bar at the cylinder pressure reducing valve without flow is usually sufficient for this purpose.

! Please note that too high an admission pressure at the measuring input can cause damage to the device!

Furthermore, a hose with the appropriate connections is required in order to transport the gas to the analyzer.

Recommended calibration gas mixtures:

- 40 percent by volume of CO_2, 300 ppm H_2S, balance: CH_4 (60 percent by volume)
- 40 Vol.%ume of CO_2, 300 ppm H_2S, 850ppm H_2, rest CH_4 (59.9 Vol.%ume) ← analyzers with the "hydrogen" option

! The CH_4 channel must always be calibrated using a test gas mixture of methane and carbon dioxide. Other gas mixtures, such as methane in nitrogen, are unsuitable for calibration. This also applies to the "hydrogen" option.

With regard to calibrating the oxygen channel, it is important that the calibration gas used does <u>not</u> contain <u>any oxygen</u> because this would mean that it is not possible to determine the zero point of the sensor. The O_2 sensitivity is determined during the rinsing process using filtered ambient air.

Standard calibration gases usually feature a manufacturing accuracy of ±2% for gases expressed in percent by volume and ±3% for H_2S. When the calibration gas cylinder is changed, this can lead to display deviations of up to 4% or 6%, respectively, under worst-case conditions.

The process of calibrating the SSM 6000 consists of the following steps:

- Rinsing the gas ducts and pipes with ambient air in order to record the sensor zero points (steps 1 and 2)
- Determining the sensor sensitivity values using biogas / calibration gas (steps 3 and 4)
- Rinsing the system using filtered ambient air (steps 5 and 6).

The calibration gas is applied through the biogas inlet. The hose must be disconnected from the inlet of the analyzer for this purpose. In order to prevent biogas from escaping, the biogas outlet of the plant should be closed.

7.3 Recording the actual condition

In order to be able to assess the precision of the last biogas measurements, the actual condition of the device should be recorded prior to calibration. At least one calibration gas measurement must be performed for this purpose.

Proceed as follows for a single measurement using calibration gas.

- Disconnect the biogas hose from the measuring-gas inlet.
- Close the biogas outlet of the plant.
- Connect calibration gas with a maximum admission pressure of 0.4 bar to the calibration-gas inlet.
- Start a single measuring process.

```
SETUP MODE:
_ MEASUREMENT
_ CALIBRIATION
_ SYSTEM
```
→
```
MEAS. OPTIONS:
_ MEAS. INTERVAL
_ ALERT VALUES
_ SINGLE MEAS
```
→
```
SINGLE MEASUREMENT:

_ MEASUREPOINT 1
_ START
```

- Check and, if necessary, readjust flow rates.

The single measurement is now performed automatically. On completion of the measuring process, record the measured values displayed in the calibration report.

Since calibration of the analyzer only makes sense if the sensors are working properly, the digitized sensor signals should be checked using calibration gas and ambient air after a single measurement. The results should then be checked for plausibility as described in the "Sensor data" section.

```
SENSOR:         30.0.C
1: 600 4: 400 7:    0
2: 400 5: 434 8:    0
3: 780 6:1010 9:    0
```

For this purpose, select the Device options → Data output → Sensor data → Actual menu item in setup mode. Connect the calibration gas to the measuring input, read the values displayed after around 2 minutes, and record these values in the calibration report.
Thereafter, disconnect the calibration gas hose, so that ambient air is drawn in through the inlet. After around 2 minutes, read the values and record these too in the calibration report.

Larger deviations, such as a zero value of 1023, indicate a defect of the respective gas channel. Calibration of the gas type in question does not help in such a case. Please contact the manufacturer in cases like this.

7.4 Calibration procedure

Calibration of the system can start after you have determined the ACTUAL condition and checked the sensor signals. The calibration menus are accessed after operation of the key switch via the selection level SETUP MODE → CALIBRATION PARAMETERS.

```
SETUP MODE:                CAL. OPTIONS:
_ MEASUREMENT              _ GASTYPES
_ CALIBRIATION    ──►      _ CAL. GASCONC.
_ SYSTEM                   _ START GASCAL.
```

Select gas types

```
GASTYPES:

_CH4: CAL   _O2 : CAL
_H2S:       _CO2:
```

First select the gas types to be calibrated from the GAS TYPES editing level. The display shows the letters "CAL" behind the gas selected. If a suitable calibration gas mixture is available, we recommend calibrating all existing measuring components at the same time.

Edit calibration gas concentrations

```
CAL. GASCONC.:

_CH4:60.0   _O2 :20.9
_H2S:1026   _CO2:40,0
```

In the next step, enter the concentrations of the individual calibration gas components as shown in the supplier's analysis certificate. Enter the values in percent by volume for the CH_4, O_2 and CO_2 gases and in ppm / vpm for H_2S. The sensitivity of O_2 is determined during the rinsing process using filtered ambient air, so that, in deviation from the calibration gas concentration, a value of 20.9 percent by volume must be set for oxygen.

Now you can connect the calibration gas to the calibration gas inlet with a maximum admission pressure of 0.4 bar and start the calibration process as follows.

Start calibration

```
ARE YOU SURE?

_ NO
_ YES
```

When all necessary settings are completed and when the calibration gas is connected to the measuring-gas inlet, the calibration process can be started by confirming the "Are you sure" prompt by replying "Yes".

When calibration is started, the measuring-gas pumps of the analyzer are activated and ambient air is drawn in through the air filter in order to determine the zero point of the sensors. In step 1, the zero point of the H_2S sensor is determined first, followed by the determination of the zero points of the other sensors in the next step. During the following biogas steps 3 and 4, the calibration gas is used to determine the sensitivity values of the individual sensors. After the sensor sensitivities are taken over, both gas paths of the analyzer are once again rinsed with ambient air.

Completion of the calibration process must be confirmed once again. The device returns to stand-by mode on operation of the key switch.

7.5 Check measurement

Calibration of the device should be followed by at least one check measurement using calibration gas and ambient air in order to check whether the calibration process was performed correctly.
The single measurement must be performed and recorded in the calibration report in the same manner as during the determination of the ACTUAL condition. If the values measured are within the specified ranges, the device can be used for normal measurements again.

Close the calibration gas cylinder on completion of the calibration gas measurements!

7.6 Resuming measuring operations

On completion of the test measurements, the device can be used for normal measurements again. For this purpose, connect the biogas hose to the measuring-gas inlet of the analyzer and open the stop valve. This should be followed by another single measurement using biogas. During the measuring process, check and, if necessary, readjust the flow rates at the analyzer once again. A leakage test can be performed by briefly kinking the biogas hose. The flow rate in the left "bypass" flowmeter should drop to zero in this case. Record the values measured in the calibration report.

After measurement, the device returns to stand-by mode and starts the next measuring process depending on the AUTO/MANUAL setting.

8 Maintenance, repair, customer service

The SSM 6000 is a complex electronic measuring device and must hence be handled with care. The manufacturer is solely responsible for the original safety characteristics and features of the device. Any guarantee becomes void if the device is modified in any manner not performed or approved by the manufacturer.

Before performing any maintenance or repair work, observe the safety measures and precautions applicable to the specific plant and process!
Certain activities – such as replacing hardware components or internal settings – may only be carried out by qualified personnel. The only exception to this is changing parts subject to consumption, wear and tear in as far as this is explicitly stated in this manual.

! Before any service or maintenance intervention, the higher-level system (plant control system) must be notified of any such work in advance in order to avoid emergency shut-down of the motor in response to incorrect measuring values.

Checking the measuring-gas volume flows

Check and, if necessary, readjust the flow rates at the analyzer at regular intervals. Note that a flow rate is displayed at the analyzer during a measuring process only. However, checking is possible in automatic mode at any time by starting a single measurement.

E460-3 flame protection

The E460-3 safety unit (material: brass) can become clogged during the course of time depending on the H_2S concentration and moisture content of the measuring gas. This condition is indicated by a gradually reduced flow rate as shown by the left "bypass" flowmeter which cannot be compensated for by the needle valve (refer to section 9). In this case, the safety unit must be replaced by a new one.

- Use a gauge-12 open wrench in order to disconnect the "Biogas in" measuring-gas hose.
- Dismantle the flame protection unit (gauge-19 open wrench).

Without the flame protection device, the bypass flowmeter should display a significantly higher flow rate and should be adjustable without any problems. You can then install the new flame protection unit by proceeding in the opposite order. You should subsequently check the system for leakage by briefly kinking the biogas hose or by closing the stop valve of the biogas plant.

Replacing the measuring-gas filters

The measuring-gas filters must be checked and, if necessary, replaced at regular intervals. The following maintenance intervals should be observed for the individual filters.

Aerosol filter	Replacement is only necessary if filter contamination is visible. (Material: glass and steel wool)
Air filter	The zero-gas filter should be replaced at least once a year. (Material: activated carbon)
Chemical filter	The filter must be replaced by a new one at the latest when the pink color of the filter material has vanished.
Fine dust filter	The fine dust filters must be replaced when strong contamination is visible.

After a filter change, check and, if necessary, readjust the flow rate.

Changing the housing filter / filter cartridges

The filter mat on the right hand side wall must be checked at process-dependent intervals and replaced when strong contamination is found on the exterior side. Filter elements are disposal elements!

The analyzer should be checked and calibrated by the manufacturer or qualified technical personnel at least once a year. Defective devices must be taken out of operation and returned to the manufacturer after prior agreement.

Pronova Analysentechnik GmbH & Co. KG
Groninger Straße 25
13347 Berlin, Germany

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Fax	+49 (0)30 / 455 085 –90
E-mail	info@pronova.de
Web	www.pronova.de

9 Status messages, trouble-shooting

9.1 Limit-value alarms

When the set limit value for one or more gas types is exceeded during measurement, the red status LED is lit up on the measured-value display for the respective gas type. The alarm messages at port 2 are also output as digital outputs and via the Profibus / CAN interface.

The top priority with each alarm – stay calm!

! The ex-works settings are non-binding recommendations. The manufacturer does not assume any liability for the alarm values set! Please contact the supplier of your plant in order to identify the values to be set in order to avoid damage to the equipment!

9.2 Trouble-shooting

Measured values are not plausible

When the values measured are not plausible, you should first start a single measurement and check the flow rates. If it is not possible to adjust the bypass flow rate at the specified value, proceed in accordance with the section below titled "Low or lacking measuring-gas flow" in order to identify the cause.

The system can be checked for leakage by closing the stop valve at the biogas plant or kinking the biogas hose during measurement. The measuring-gas flow at the analyzer should drop to zero in this case. If this is not the case, leakage air is probably drawn into the system. This leads to elevated O_2 values and lower values for the other components measured.

If the analyzer shows atypical values despite correct flow rates, check the sensor signals and calibrate the analyzer, if necessary.

Low or lacking measured-gas flow

In order to obtain correct measuring values, the floating indicators must be contained within the marked ranges during measurement.

Flowmeter	"bypass"	(left)	50 ... 65 liters per hour
	"analyse"	(right)	15 ... 30 liters per hour

If it is not possible to set the flow rates, this can be due to the following reasons:

- The device is currently in stand-by mode. – Start a measurement!
- The needle valve below the flowmeter is closed.
- The flame protection unit and/or the measuring-gas pipe is/are clogged, or the stop valve of the biogas plant is closed. A simple and quick check is possible by removing the aerosol filter on the front panel during a measuring process.
- The exhaust air duct is clogged or frozen. Diagnosis is possible by disconnecting the exhaust air hose.
- The device is defective.

Measuring-gas cooler / cooler status "error"

- After power-on, the measuring-gas cooler is not yet ready for operation. The cooler should have reached its operating temperature and the "error" LED should go off after around 10 minutes.
- A measuring-gas cooler overload condition exists during operation as a result of the excessively high dew point of the inflowing gas, or as a result an excessive volume flow or ambient temperature.
- The device is defective.

If it is not possible to solve the problem, please contact the manufacturer.

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10 Warranty conditions

The manufacturer assumes a 24-month guarantee for all gas sensors beyond the statutory guarantee period for electric devices if the following conditions are fulfilled.

- The device must at all times have been handled properly and with the care necessary for an electronic device.
- All instructions and information contained in this manual must have been adhered to.
- The system must have been operated within the specified temperature range.
- No more than twelve measurements may have been performed per day.
- The measuring gas must be free from any other corrosive components.

No guarantee is assumed for parts subject to consumption, wear and tear, such as measuring-gas filters or the E460 flame protection unit (brass).

Appendix

11.1 Technical specifications

Analyzer SSM6000								
Gas type	Measuring range		Resolution		Precision	Measuring method	Other	
CH_4	0 ... 100	Vol.%.	0,1	Vol.%.	±2% FS	Two-beam IR	Temperature and pressure compensation	
H_2S	0 ... 5.000	ppm	1 / 5	ppm	±5% FS	Electrochemical	Dilution stages 1:200/40/10/0	
O_2	0 ... 25	Vol.%.	0.1	Vol.%.	±2% FS	Electrochemical		
CO_2	0 ... 100	Vol.%.	0.1	Vol.%.	±2% FS	Two-beam IR	Temperature and pressure compensation	
H_2	0 ... 1000	ppm	1	ppm	±5% FS	Electrochemical	Instead of CO_2	

Display and measured-value displays	4-digit LED measured-value display, status displays for each channel 4-line LC display, illuminated
Analog outputs	4–20 mA (1 output oper measuring component, linearized) Analyzer version "A": active, differential, max. burden 550Ω) Analyzer version "B": aktiv, common reference potential, max. burden 550Ω)
Digital outputs	Status signals: stand-by / measurement active / setup mode Limit-value alarms: violation of upper limit 1x per measuring component + violation of lower limit for CH_4 and O_2 Valve outputs: measuring-point switch / test gas valve Analyzer version "A": transistor, open collector type 12VDC / 300mA max. Analyzer version "B": transistor, open collector type, external supply 35VDC / 750mA max.
Digital inputs	Analyzer version "A": active input 12VDC, control via potential-free contact Analyzer version "B": optocoupler, typ. switching threshold 10VDC, external supply 24VDC max.
Interfaces	RS 232, digital output of measured values and program updates Profibus / CAN bus (option)
Flowmeter / control valve	2x Rotmater 7-70 l/h, gas connections Viton / needle valve , PA
Measuring-gas pump / valves	2x membrane pump / 2x solenoid valve + solenoid valves for measuring-point switch option

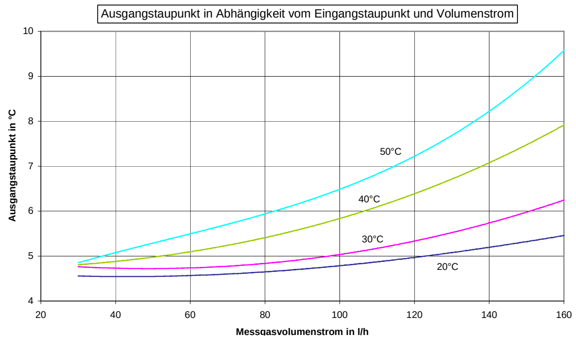
Housing/dimensions	
System housing	Steel sheet housing with front door and inspection window
Housing dimensions (WxHxD) - without	300 x 400 x 155 mm
Build-in dimensions (WxHxD)	500 x 700 x 500 mm
Weight	Approx. 13 kg
Protection	IP 20
Housing color / door frame	RAL 7035
Forced ventilation / housing rinsing	Housing fan 12VDC / 56 m³/h free-blowing

Requirements for the place of installation	
Operating temperature	+10 to +40°C
Lagertemperatur	-25 to +50°C
Rel. humidity	<=75% annual mean; minor and seldom condensation in de-energized condition
Air pressure	850 ... 1100 hPa

Measuring input and output conditions, calibration gases	
Input dew point of the gas to be measured	40°C max.
Measuring-gas temperature	80°C max.
Pressure at the measuring-gas input	-50 ... +5 hPa
	At admission pressure values of > 5 hPa, a shut-off unit is required at the inlet
Measuring-gas output pressure	Exhaust air must be discharged into the outside atmosphere in a non-pressurized condition / discharge hoses should be as short as possible
Test gas mixture for calibration (example)	40Vol.%. of CO_2 / 300ppm H_2S / 0 Vol.%. oif O_2 / 800ppm H_2 / rest CH_4

Electrical connection values	
Electrical connection, voltage suppy	Power cable 3x0.75 mm² with earthed-contact plug
Supply / incoming supply	85 .. 264 VAC / 47.. 63 Hz
Power consumption	85 VA max.
Fuses / overload protection	Miniature fuse 4x20mm
	1 A slow-blow

Gas connections			
Position of gas connections	Underside of control cabinet		
Gas inlet / safety equipment	E 460-3 flame protection	according to EN 730-1	Brass (installation outside)
	F 501 detonation protection	according to EN 12874	V2A stainless steel
Gas and condensate connections, type / design	Clamping-ring screw connection PA for hoses d_a x s = 6 x 1 mm		

Measuring-gas processing option	
Cooler type	Peltier cyclone cooler, Duran glass
Input dew point / inlet temperature	40°C / 80°C max.
Outlet dew point	5°C (ex-works setting)
Condensate pump	Hose pump, 16ml/min, Novoprene hose
System monitoring	Status displays (LED), alarm at ±3°C
Characteristic of measuring-gas cooler	

11.2 Parts subject to wear and tear; spare parts

Article No.	Description		
800 - 0001	Filter set for SSM 6000 (3x 0007 / 1x 0003, 0005 and 0006 / 2x 0002 each)		
800 - 0002	Filter mat for housing, 2-layer		
800 - 0003	Chemical filter (quantity: 1)		
800 - 0004	Chemical filter (1 set = 3 pieces)		
800 - 0005	Air filter (quantity: 1)		
800 - 0006	Aerosol filter (quantity: 1)		
800 - 0007	Fine dust filter (quantity: 1)		
800 - 0401	E 460-3 flame protection	according to EN 730-1	Brass
800 - 0410	F 501 detonation protection	according to EN 12874 / ATEX	V2A stainless steel
800 - 0703	Hose DN 4/6, PVC (for external hose connections only)		
800 - 0708	Hose DN 4/6, PTFE (for external hose connections only)		
800 - 0134	Fitting connection DN 4/6, PA (knurled nut + clamping ring)		
800 - 0788	Fitting connection for E 460, DN 4/6, brass (knurled but + clamping ring + support sleeve)		
800 - 606	Ready-to-connect control cable PORT 1, length: 10m		
800 - 607	Ready-to-connect control cable PORT 1, length: 20m		
800 - 608	Ready-to-connect control cable PORT 2, length: 10m		
800 - 609	Ready-to-connect control cable PORT 2, length: 20m		
800 - 1003	Setup key		
800 - 1002	Control cabinet key		
800 - 0114	Electric miniature fuse 1A slow-blow		
800 - 0104	Incandescent bulb 14 VCD (SSM 6000 / MGK 744)		
800 – 5007	SSM 6000 V01.06 User Manual - German		
800 – 5008	SSM 6000 V01.06 User Manual - English		

Further spare parts on request.

Calibration report template

Calibration report V1.0

Serial No.:

Analyzer condition / measuring conditions

	Pressure hPa (NN)	Temperature °C

Recording the actual condition

No	Gas type	Test gas concentration				BIOLYZER display				Sensor signal history (dig)									Present sensor signals (dig)			
		CH_4	H_2S	O_2	CO_2	CH_4 Vol.%	H_2S ppm	O_2 Vol.%	CO_2 Vol.%	A	B	C	D	E	F	G	H	I	1	2	3	4
1																						
2																						
3																						
4																						
5																						
6																						

Calibration / check measurement

No	Gas type	Test gas concentration				BIOLYZER display				Activity
		CH_4 (Vol.%)	H_2S (ppm)	O_2 (Vol.%)	CO_2 (Vol.%)	CH_4 (Vol.%)	H_2S (ppm)	O_2 (Vol.%)	CO_2 (Vol.%)	Measurement / calibration / remarks
1										
2										
3										
4										
5										
6										

Date:

Signature:

Calibration report V1.0

Serial No.: *80024000-128*

Sample

Analyzer condition / measuring conditions

- *Operator complaint: CH_4 / CO_2 measured values too low, O_2 too high for several days*

Pressure *1016* hPa (NN) | Temperature *28* °C

- *Condensate drops in the gas supply pipe*

Recording the actual condition

No	Gas type	Test gas concentration				Display SSM 6000				Sensor signal history (dig)									Present sensor signals (dig)			
		CH_4	H_2S	O_2	CO_2	CH_4 Vol.%.	H_2S ppm	O_2 Vol.%.	CO_2 Vol.%.	A	B	C	D	E	F	G	H	I	1	2	3	4
1	*Biogas*					*22,3*	*235*	*7,3*	*14,3*													
2	"					*54,2*	*539*	*0,2*	*44,8*	*0004*	*0529*	*0046*	*0546*	*40*	*890*	*0058*	*0003*	*0448*				
3	*Test*	*60.4*	*326*	*0.0*	*39.6*	*60.0*	*256*	*0.1*	*39.2*	*0004*	*0584*	*0046*	*0312*	*40*	*890*	*0052*	*0003*	*0392*				
4	"	"	"	"	"														*0584*	*0047*	*0043*	*0392*
5	*Air*	*0.0*	*0*	*20.9*	*0.0*														*0005*	*0047*	*0835*	*0003*
6																						

- *No. 1: Analyzer flow too low, adjustment not possible – measuring-gas pipe clogged – replaced – thereafter measurement (No.2) leakage / flow rates o.k.*
- *Nos. 4/5: Sensor signals with the specified ranges*

Calibration / Check measurement

No	Gas type	Test gas concentration				Anzeige SSM 6000				Activity
		CH_4 (Vol.%.)	H_2S (ppm)	O_2 (Vol.%.)	CO_2 (Vol.%.)	CH_4 (Vol.%.)	H_2S (ppm)	O_2 (Vol.%.)	CO_2 (Vol.%.)	Measurement / calibration/ remarks
1	*Test gas*	*60.4*	*326*	*0.0*	*39.6*	-	-	-	-	*Calibration all gases*
2	"	"	"	"	"	*60.3*	*318*	*0.0*	*39.7*	*Check measurement*
3	"	"	"	"	"	*60.4*	*323*	*0.0*	*39.8*	
4	*Air*	*0.0*	*0*	*20.9*	*0.0*	*0.0*	*0*	*20.9*	*0.1*	
5	*Biogas*					*54.9*	*664*	*0.1*	*44.8*	*Current biogas concentration*
6	"					*55.3*	*651*	*0.1*	*45.3*	

- *Analyzer ok after replacement of measuring-gas pipe and calibration*
- *Chemical filter replaced*

Date: *26.10.02*

Signature: *D. Müller*

11.4 Declarations of conformity

EC Declaration of Conformity

Manufacturer:	Pronova Analysentechnik GmbH & Co. KG Groninger Straße 25 13347 Berlin Germany
Product description:	SSM 6000 / SSM 6000 LT Determination of CH_4, H_2S, O_2, CO_2 and H_2 concentration
Manufacturer No.:	8002x000-xxx

The manufacturer herewith declares that the above-stated product is in conformity with the requirements in the following regulations, laws or other specifications:

EC Directive 89/336/EEC [1) 2)]	- EMC
EC Directive 73/23/EEC	- Low voltage

1) Testing on the basis of IEC 801-4 (VDE 0843 part 4) VDE 839, EN 50082-2, ENV 50141
(Immunity to fast transient interference (burst); level 4 fulfilled (4kV, 15ms, 300ms))

2) Testing on the basis of EN 55011 (interference emission) limit values according to EN 55022 for industrial applications

Berlin, date: 22 April 2004

Signature:

This declaration confirms conformity with the above-stated directive, but does not constitute any warranty of properties in the legal sense.

The safety information of the product documentation supplied must be adhered to.

WITT-GASETECHNIK GMBH & CO KG

WITT
TECHNOLOGY FOR GASES

PRONOVA Analysetechnik GmbH & Co. KG
zu Hd. Hr. Suchy
Groninger Str. 25

13347 Berlin

Ihre Bestellung	Unser Zeichen	Telefon	Datum
	AB-Nr. 1148870	02302/8901-0	16.06.04

Herstellerbescheinigung

Erzeugnis

10 Stück WITT Sicherheitseinrichtungen E 460-3, nach EN730/ISO5175 Cl.1 für Acetylen 1,5 bar für für Stadt-, Fern-, Erd- und Flüssiggas max. 5,0 bar

Sicherheitselemente: Flammensperre
Gasrücktrittventil

Artikel-Nr.: 135/120

Wir bestätigen, daß die Lieferung den Vereinbarungen bei der Bestellannahme entspricht.
Die Sicherungsautomaten wurden vor Auslieferung geprüft auf

a) Dichtheit gegen die Atmosphäre mit Luft bei 11,5 bar Überdruck.
b) Sicherheit gegen schleichenden und schlagartigen Gasrücktritt mit Luft im Druckbereich von 0 – 6 bar.
c) Sicherheit gegen Flammendurchschlag mit einem Gasgemisch aus 35 Vol.-% C_2H_2 und 65 Vol.-% 0_2 bei einem statischen Gemischüberdruck von 1,55 bar.

Im Rahmen der betrieblichen Prüfungen wurde an dem Fertigungslos in Stichproben der Öffnungsdruck des Gasrücktrittventiles und die Durchflußleistung überprüft.
Gemäß den Ergebnissen der Prüfungen sind die sicherheitstechnischen Anforderungen erfüllt.

Gemäß dem Schreiben von der Bundesanstalt für Materialforschung (Zeichen II-3419/2003), sind die hier aufgeführten Sicherheitseinrichtungen keine Flammensperren im Sinne der ATEX 95 Richtlinie 94/4/EG.

Im Zuge der ATEX 95, sind die oben genannten Sicherheitseinrichtungen einer Zündgefahrenanalyse unterzogen worden, entsprechend der EN 1127-1, DIN EN 13463-1 und ZH1/200.
Und dürfen somit eingesetzt werden in:

Einsatzbereich:

Gerätekategorie	2 G
Explosionsgruppe	II C
Temperaturklasse	T 4

(maximale erlaubte Oberflächentemperatur von einem Bauteile in der Zone, 134° C)

WITT GASETECHNIK
GmbH & Co KG
i.V.

QM-Beauftragter

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WITT-Gasetechnik GmbH & Co. Produktions- und Vertriebs-KG HRA 950 AG Witten • Persönlich haftende Gesellschafterin: Benning Beteiligungs-GmbH HRB 1582 AG Witten • Geschäftsführer: Dieter Benning, Dr. Richard Benning

TÜV CERT DIN EN ISO 14001 DIN EN ISO 9001

Physikalisch-Technische Bundesanstalt

Braunschweig und Berlin

PTB

(1) **EG-Baumusterprüfbescheinigung**

(2) Geräte und Schutzsysteme zur bestimmungsgemäßen Verwendung in explosionsgefährdeten Bereichen - **Richtlinie 94/9/EG**

(3) EG-Baumusterprüfbescheinigungsnummer

PTB 02 ATEX 4012 X

(4) Schutzsystem: Detonationssicherung Typ "F 501/.."

(5) Hersteller: Firma SBG Sicherungsgerätebau GmbH

(6) Anschrift: Hofstr.10, 57076 Siegen

(7) Die Bauart dieses Schutzsystems sowie die verschiedenen zulässigen Ausführungen sind in der Anlage zu dieser Baumusterprüfbescheinigung festgelegt.

(8) Die Physikalisch-Technische Bundesanstalt bescheinigt als benannte Stelle Nr. 0102 nach Artikel 9 der Richtlinie des Rates der Europäischen Gemeinschaften vom 23. März 1994 (94/9/EG) die Erfüllung der grundlegenden Sicherheits- und Gesundheitsanforderungen für die Konzeption und den Bau von Geräten und Schutzsystemen zur bestimmungsgemäßen Verwendung in explosionsgefährdeten Bereichen gemäß Anhang II der Richtlinie.

Die Ergebnisse der Prüfung sind in dem vertraulichen Prüfbericht PTB Ex 02-40019 festgehalten.

(9) Die grundlegenden Sicherheits- und Gesundheitsanforderungen werden erfüllt durch Übereinstimmung mit

EN 12874 "Flammendurchschlagsicherungen"

(10) Falls das Zeichen „X" hinter der Bescheinigungsnummer steht, wird auf besondere Bedingungen für die sichere Anwendung des Schutzsystems in der Anlage zu dieser Bescheinigung hingewiesen.

(11) Diese EG-Baumusterprüfbescheinigung bezieht sich nur auf Konzeption und Bau des festgelegten Schutzsystems gemäß Richtlinie 94/9/EG. Weitere Anforderungen dieser Richtlinie gelten für die Herstellung und das Inverkehrbringen dieses Schutzsystems.

(12) Die Kennzeichnung des Schutzsystems muß die folgenden Angaben enthalten:

Ex II G IIB3

Zertifizierungsstelle Explosionsschutz
Im Auftrag

Braunschweig, 2002-04-18

Dr. H. Förster
Regierungsdirektor

PHYSIKALISCH-TECHNISCHE BUNDESANSTALT 22

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Physikalisch-Technische Bundesanstalt

Braunschweig und Berlin

(13) **Anlage**

(14) **EG-Baumusterprüfbescheinigung PTB 02 ATEX 4012 X**

(15) Beschreibung des Schutzsystems

Detonationssicherung Typ "F 501/.." für den Einsatz im Zuge von Rohrleitungen ≤ DN 15 ($G^{1}/_{2}$) zur Verhinderung eines Flammendurchschlages bei Deflagrationen und stabilen Detonationen von explosionsfähigen Dampf-Luft- bzw. Gas-Gemischen.
Die Bauart, Werkstoffe und Abmessungen sind durch die im Prüfbericht PTB Ex 02-40019 aufgeführten Zeichnungen und Betriebsanleitung festgelegt.

Anforderungen an den Explosionsschutz:
Flammendurchschlagsicher im Zuge von Rohrleitungen ≤ DN 15 bei Deflagrationen und stabilen Detonationen brennbarer Gase und Flüssigkeiten, die der Explosionsgruppe IIA, IIB1, IIB2 und IIB3 mit einer Normspaltweite ≥ 0,65 mm angehören, bei einem max. absoluten Betriebsdruck von 110 kPa und einer max. Betriebstemperatur von 60 °C.

(16) Prüfbericht PTB Ex 02-40019 (bestehend aus 4 Seiten, 4 Zeichnungen und 1 Betriebsanleitung)

Ergebnis: Das Baumuster entspricht den Bestimmungen der Richtlinie 94/9/EG für Schutzsysteme (Unterteilung IIA, IIB1, IIB2 und IIB3 nach EN 50014). Die Sicherung erfüllt die Anforderungen an den Explosionsschutz, wie unter Punkt (15) beschrieben.

(17) Besondere Bedingungen

Beim Einsatz der Detonationssicherung Typ "F 501/.." müssen folgende Bedingungen eingehalten, bzw. erfüllt werden:
- Die Rohrleitung der ungeschützten Seite zwischen der möglichen Zündquelle und der Sicherung darf nicht größer als DN 15 ($G^{1}/_{2}$) sein.
- Die im Betrieb anfallenden brennbaren Gase bzw. brennbaren Flüssigkeiten müssen der Explosionsgruppe IIA, IIB1, IIB2 oder IIB3 mit einer Normspaltweite ≥ 0,65 mm angehören.
- Der max. Betriebsdruck darf nicht höher als 110 kPa (absoluter Druck) sein.
- Die Betriebstemperatur darf 60 °C nicht überschreiten.

Die genannten Bedingungen sind in die Betriebsanleitung jeder Detonationssicherung mit aufzunehmen und sind vom Betreiber zu erfüllen bzw. zu beachten.

Zertifizierungsstelle Explosionsschutz
Im Auftrag

Braunschweig, 2002-04-18

Dr. H. Förster
Regierungsdirektor

Physikalisch-Technische Bundesanstalt 22

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11.5 Accessory connection cables

11.5.1 PORT 1 connection cable

Ready-to-connect control cable, 10m or 20m long, for transmitting the signals to the general system controller. Other lengths on request.
The connector layout for the different analyzer versions is shown in the table below and in the terminal diagrams in the appendix.

PIN	Color code (DIN 47100)	Signals analyzer version	
		(A)	(B)
1	white	AO 1 -	AO 1 -
2	brown	AO 2 -	AO 2 -
3	green	AO 3 -	AO 3 -
4	yellow	AO 4 -	AO 4 -
5	gray		
6	pink		DI 1 - low
7	blue		DI 2 - low
8	red		DI 3 - low
9	black	GND	DI 4 - low
10	violet	DI 1	GND
11	gray/pink		
12	red/blue		
13	white/green		
14	brown/green	AO 1 +	AO 1 +
15	white/yellow	AO 2 +	AO 2 +
16	yellow/brown	AO 3 +	AO 3 +
17	white/gray	AO 4 +	AO 4 +
18	gray/brown		
19	white/pink		DI 1 - high
20	pink/brown		DI 2 - high
21	white/blue		DI 3 - high
22	brown/blue		DI 4 - high
23	white/red		12VDC
24	white/blue		
25			

Connection cable specifications:

Control cable
Type: LiYCY, common shield
Cross-section 0.25mm² / 80W/km max.
Max. operating voltage 250V_{RMS}.
Nominal current 2.5A max.

Connection 1 (SSM6000)
D-sub plug connector, 25-pole
D-sub metal housing

Connection 2
Open cable ends, length: 150 mm
Color-coded wires / wire end sleeves 0.25mm²

- Shield connected to D-sub housing
- At connection 2, the shield is made available via a green/yellow wire 0.5mm² with wire end sleeve (length: 200mm)
- Cable ends not conbnected must be insulated individually!

11.5.2 PORT 2 connection cable

Ready-to-connect control cable, 10m or 20m long, for transmitting the signals to the general system controller. Other lengths on request.
The connector layout for the different analyzer versions is shown in the table below and in the terminal diagrams in the appendix.

PIN	Color code (DIN 47100)	Signals analyzer version	
		(A)	(B)
1	white	12VDC	12VDC
2	brown	12VDC	DO-02
3	green	12VDC	DO-04
4	yellow	12VDC	DO-06
5	gray	12VDC	DO-08
6	pink	12VDC	DO-10
7	blue	12VDC	DO-12
8	red	12VDC	GND
9	black	12VDC	
10	violet	12VDC	
11	gray/pink		
12	red/blue	12VDC	
13	white/green	DI-02	
14	brown/green	DO-01	DO-01
15	white/yellow	DO-02	DO-03
16	yellow/brown	DO-03	DO-05
17	white/gray	DO-04	DO-07
18	gray/brown	DO-05	DO-09
19	white/pink	DO-06	DO-11
20	pink/brown	DO-07	DO-13
21	white/blue	DO-08	
22	brown/blue	DO-09	
23	white/red	DO-10	
24	white/blue		
25			

Connection cable specifications:

Control cable
Type: LiYCY, common shield
Cross-section 0.25mm² / 80W/km max.
Max. operating voltage 250V_{RMS}.
Nominal current 2.5A max.

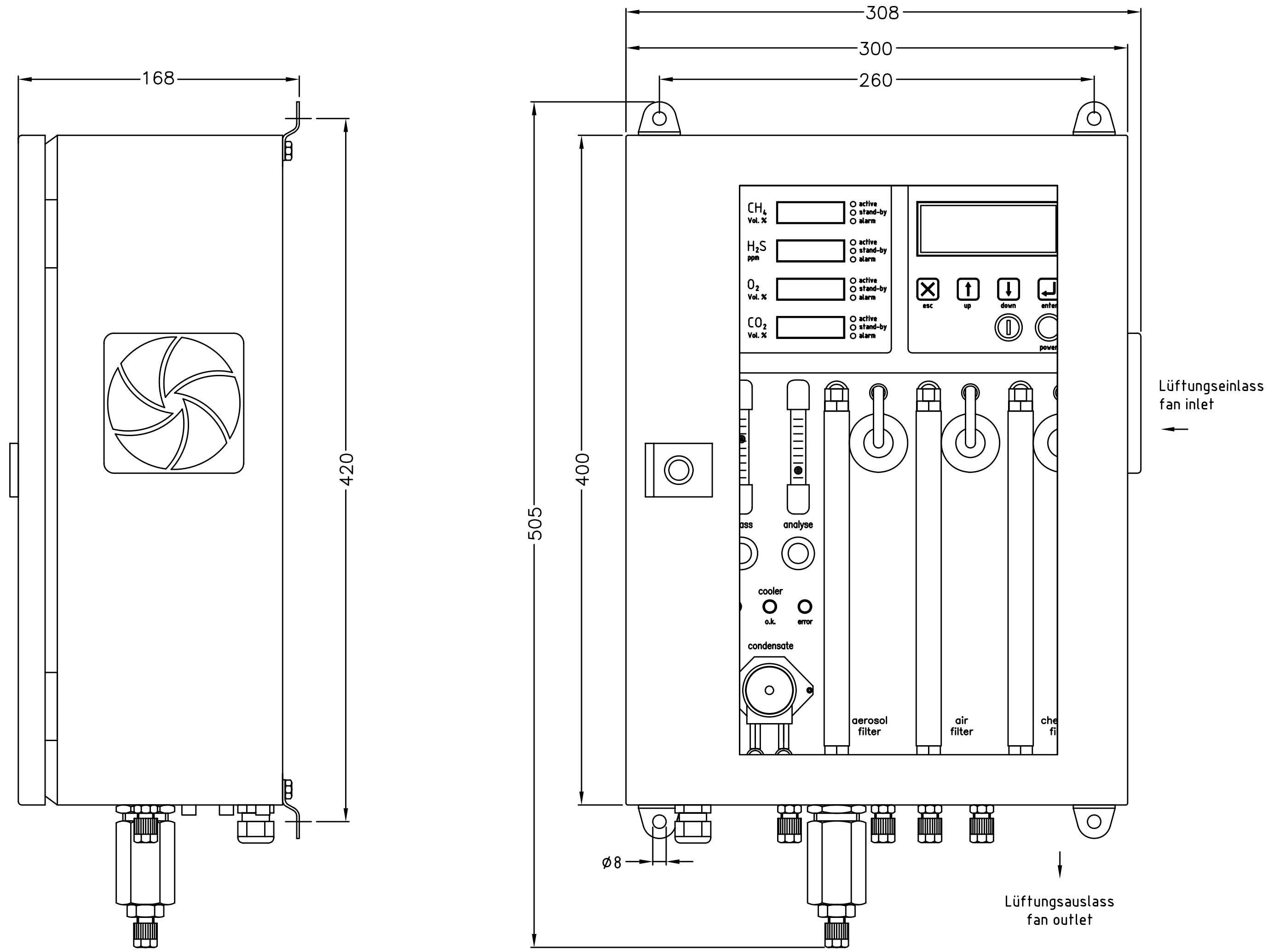
Connection 1 (SSM6000)
D-sub plug connector, 25-pole
D-sub metal housing

Connection 2
Open cable ends, length: 150 mm
Color-coded wires / wire end sleeves 0.25mm²

- Shield connected to D-sub housing
- At connection 2, the shield is made available via a green/yellow wire 0.5mm² with wire end sleeve (length: 200mm)
- Cable ends not conbnected must be insulated individually!

Connection diagrams

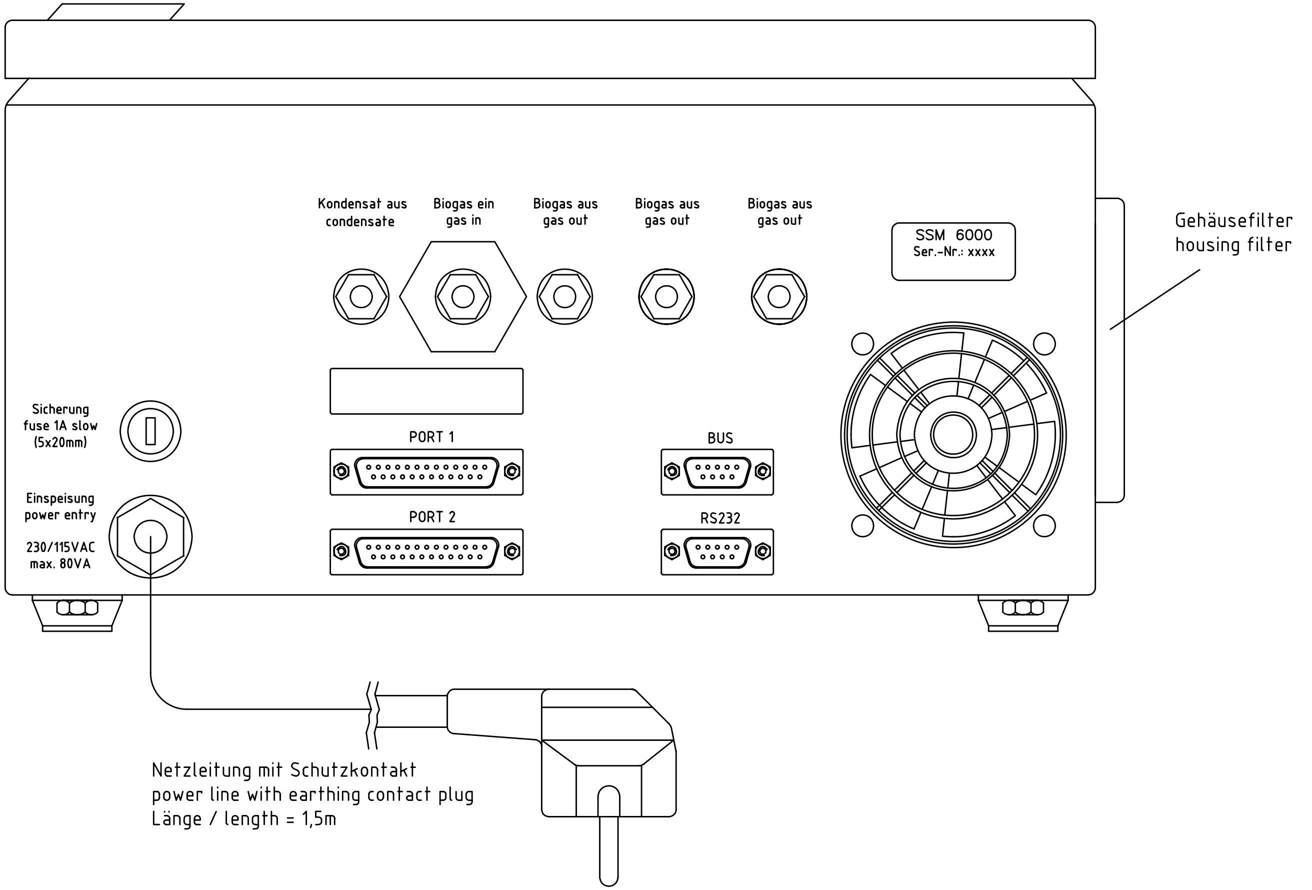
Analyzer version A



2

				Datum	06.01.06	SSM6000 (A) - Frontansicht		Anschlussmaße	Projektbezeichnung 800__SSM6000(A)
				Bearb.	rs	SSM6000 (A) - front view		Installation dimension	= / + SSM
				Gepr.	mk				Zeichnungsnummer 800-SSM6000(A)-Anschluss__060106
Zust.	Änderung	Datum	Name	Norm	DIN 40719	Urspr. / Ers. f.:	Ers.d.:		Blatt 1 + / 6 Bl.

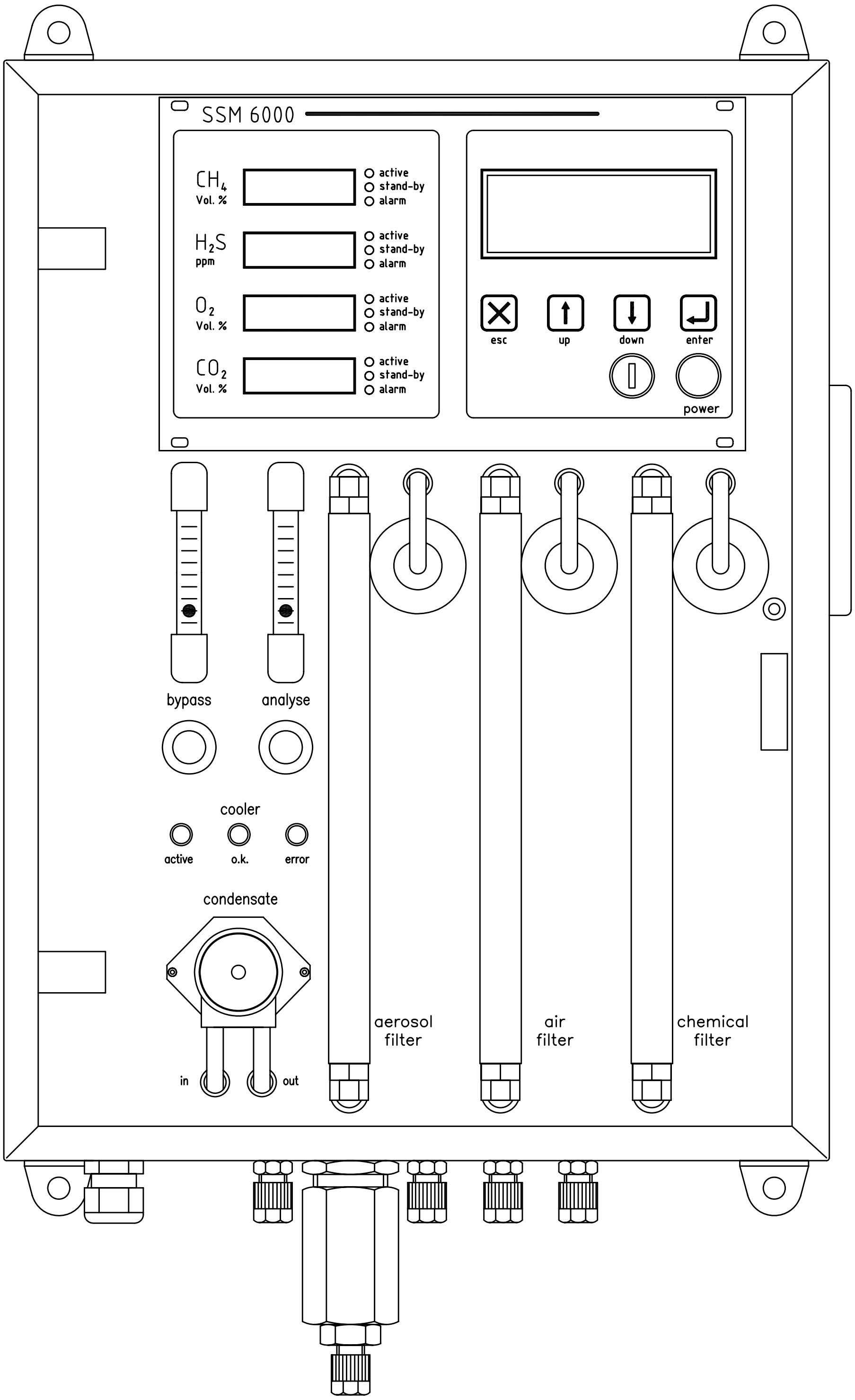
SSM6000 - Unterseite / bottom view



do not connect the single outlets to a common outlet air!
disposed non-pressurized

3

				Datum	06.01.06	SSM6000 (A) - bottom view		Anschlüsse Unterseite bottom connection	Projektbezeichnung 800__SSM6000(A)
				Bearb.	rs				= + SSM
				Gepr.	mk				Zeichnungsnummer 800-SSM6000(A)-Anschluss__060106
Zust.	Änderung	Datum	Name	Norm	DIN 40719	Urspr.	Ers. f.: Ers.d.:		Blatt 2 + 6 Bl.



SSM6000 (A) - Frontansicht
SSM6000 (A) - front view

Projektbezeichnung
800_SSM6000(A)

Zeichnungsnummer
800-SSM6000(A)-Anschluss_060106

=
+ SSM

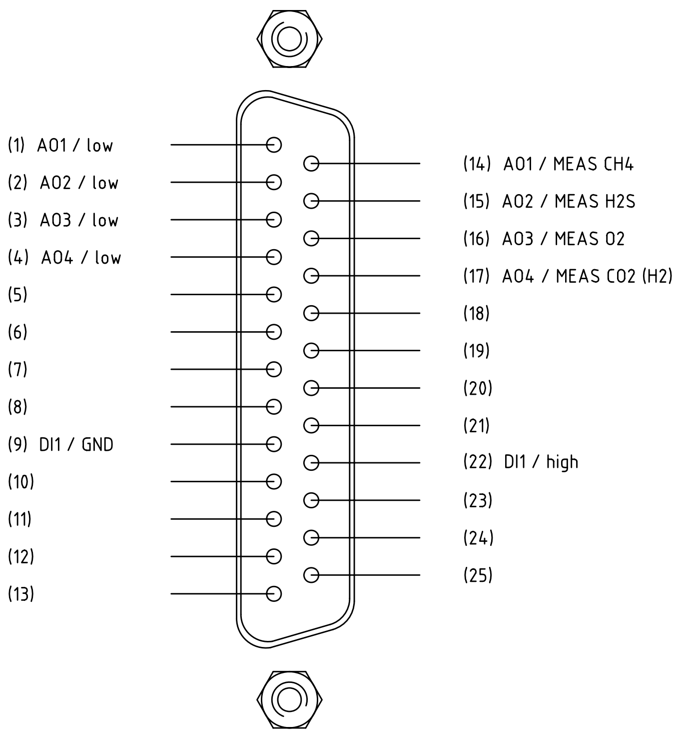
Blatt 3 +
6 Bl.

Datum	06.01.06	
Bearb.	rs	
Gepr.	mk	
Norm	DIN 40719	

Urspr. | Ersetzt f.: | Ers.d.:

Zust. | Änderung | Datum | Name

Port 1 - Analoge Ausgänge / Digitale Ein- und Ausgänge
(Sonderversion Messstellenumschaltung)



AO – Analoge Messwertausgänge / analog outputs
DI – Digitale Eingänge / digital inputs

Port 1 (Analoge Ausgänge / Digitale Eingänge)

Klemmen-Nr.		Bezeichnung/Signal		Bemerkung / Daten	
1		AO1	Analogausgang CH4	low [CH4]	Spezifikation der Analogausgänge: aktive, differentielle und nicht galvanisch getrennte Stromausgänge. Ein Zusammenfassen der low-Signale zu einem gemeinsamen analogen Ground ist erst nach einer galvanischen Trennung mit externen Trennschaltverstärkern möglich. max. Bürde 500 Ω
	14		0 - 100 Vol.%	high (0)4-20mA [CH4]	
2		AO2	Analogausgang H2S	low [H2S]	
	15		Skalierung editierbar	high (0)4-20mA [H2S]	
3		AO3	Analogausgang O2	low [O2]	
	16		0 - 25 Vol.%	high (0)4-20mA [O2]	
4		AO4	Analogausgang CO2 oder H2	low [CO2]	
	17		0 - 100 Vol.% CO2 / 0 - 1000 ppm H2	high (0)4-20mA [CO2/H2]	
5					
	18				
6					
	19				
7					
	20				
8					
	21				
9		DI1	Digital in	Langsamer Eingang mit Pullup (12VDC)	Start einer Messung durch übergeordnetes System möglich
	22			Betätigung über potentialfreien Taster	
10					
	23				
11					
	24				
12					
	25				
13					

Port 1 - Analoge out / Digital in

Terminal No.		Description/Signal		Remarks/Data	
1		AO1	Analoge output CH4	low [CH4]	Spezification Analoge output: active, differential and not indirect coupled mA output. Connection of the low-Signals to create a common ground is possible after realisation of an indirect-coupling via an external isolating switching amplifier. max. shunt 500 Ω
	14		0 - 100 Vol.%	high (0)4-20mA [CH4]	
2		AO2	Analoge output H2S	low [H2S]	
	15		scaling adjustable	high (0)4-20mA [H2S]	
3		AO3	Analoge outout O2	low [O2]	
	16		0 - 25 Vol.%	high (0)4-20mA [O2]	
4		AO4	Analog output CO2 or H2	low [CO2]	
	17		0 - 100 Vol.% CO2 / 0 - 1000 ppm H2	high (0)4-20mA [CO2/H2]	
5					
	18				
6					
	19				
7					
	20				
8					
	21				
9		DI1	Digital in	Slow Digital in with Pullup (12VDC)	Start of Measuring by higer-level system possible (for discont. measuring cycle)
	22			activated by potentialfree Switch	
10					
	23				
11					
	24				
12					
	25				
13					

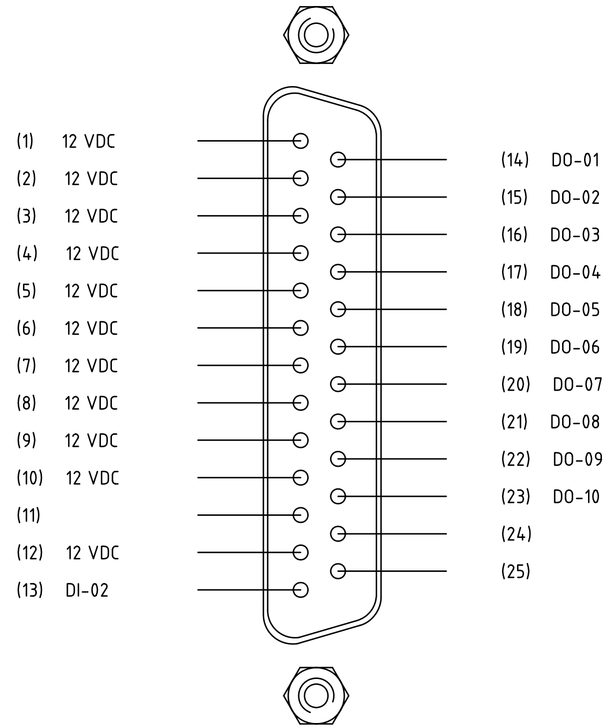
Anschlußklemmen: D-Sub, Buchse, 25-pol.

5

Datum	06.01.06	SSM6000 (A) - Port 1	Analog aus / Digital ein	Projektbezeichnung 800__SSM6000(A)	=
Bearb.	rs		Analoge out / Digital in		+ SSM
Gepr.	mk			Zeichnungsnummer 800-SSM6000(A)-Anschluss__060106	Blatt 4 +
Norm	DIN 40719	Urspr. / Ers. f.: / Ers.d.:			6 Bl.

Zust. | Anderung | Datum | Name

Port 2 Digitale Ausgänge / Digital out



DO – Digitale Ausgänge / digital outputs
DI – Digitale Eingänge / digital inputs

Port 2 - Digitale Ausgänge

Klemmen-Nr.			Bezeichnung/Signal	Bemerkung / Daten	
1	14	DO-01	Grenzwertalarm CH4 Überschreitung	12 VDC / max. 300 mA, schaltet nach GND	
2	15	DO-02	Grenzwertalarm CH4 Unterschreitung	12 VDC / max. 300 mA, schaltet nach GND	
3	16	DO-03	Prüfgasventil	12 VDC / max. 300 mA, schaltet nach GND	
4	17	DO-04	Grenzwertalarm H2S Überschreitung	12 VDC / max. 300 mA, schaltet nach GND	
5	18	DO-05	Grenzwertalarm O2 Überschreitung	12 VDC / max. 300 mA, schaltet nach GND	
6	19	DO-06	Grenzwertalarm O2 Unterschreitung	12 VDC / max. 300 mA, schaltet nach GND	
7	20	DO-07	Grenzwertalarm CO2 Überschreitung	12 VDC / max. 300 mA, schaltet nach GND	
8	21	DO-08	Status "Messung aktiv"	12 VDC / max. 300 mA, schaltet nach GND	
9	22	DO-09	Status "Stand-by"	12 VDC / max. 300 mA, schaltet nach GND	
10	23	DO-10	Status "Konfigurationsmodus"	12 VDC / max. 300 mA, schaltet nach GND	
11	24				
12	25	DI-02	Umschaltung Messtelle 1/2	12 VDC	Ansteuerung des Ventils extern über potentialfreien Schaltkontakt (nur bei Version mit Messstellenumschaltung)
13				Magnetventil 12V/4W	

Port 2- Digital out

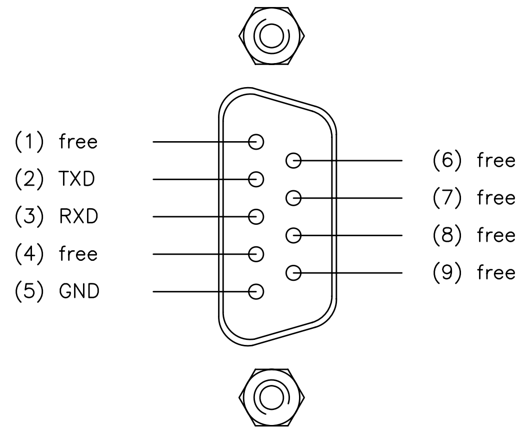
Terminal No.			Description/Signal	Remarks/Data	
1	14	DO-01	limit value alarm CH4 overflow	12 VDC / max. 300 mA, switch to GND	
2	15	DO-02	limit value alarm CH4 underflow	12 VDC / max. 300 mA, switch to GND	
3	16	DO-03	calibration gas valve	12 VDC / max. 300 mA, switch to GND	
4	17	DO-04	limit value alarm H2S overflow	12 VDC / max. 300 mA, switch to GND	
5	18	DO-05	limit value alarm O2 overflow	12 VDC / max. 300 mA, switch to GND	
6	19	DO-06	Grenzwertalarm O2 Unterschreitung	12 VDC / max. 300 mA, switch to GND	
7	20	DO-07	limit value alarm CO2 overflow	12 VDC / max. 300 mA, switch to GND	
8	21	DO-08	Status "Measurement active"	12 VDC / max. 300 mA, switch to GND	
9	22	DO-09	Status "Stand-by"	12 VDC / max. 300 mA, switch to GND	
10	23	DO-10	Status "Configuration mode"	12 VDC / max. 300 mA, switch to GND	
11	24				
12	25	DI-02	Umschaltung Messtelle 1/2	12 VDC	switching measuring point with potential free contact (option)
13				solenoid valve 12V/4W	

Connection Terminal: D-Sub, Buchse, 25-pol.

6

Datum	06.01.06	SSM6000 (A) - Port2	Digitale Ausgänge / Digital out	Projektbezeichnung 800__SSM6000(A)	= / + SSM
Bearb.	rs			Zeichnungsnummer 800-SSM6000(A)-Anschluss__060106	Blatt 5 + / 6 Bl.
Gepr.	mk				
Norm	DIN 40719	Urspr. / Ers. f.: / Ers.d.:			
Zust. / Änderung / Datum / Name					

Schnittstelle / Interface RS232



RS232 (Schnittstelle)

Klemmen-Nr.	Bezeichnung/Signal	Bemerkung / Daten	
1			Funktion und Spezifikation der RS232: Über die RS232 ist eine kontinuierliche Übertragung der aktuellen Messwerte mit Datum und Uhrzeit möglich. Das Zeitintervall ist von 0 bis 9999 Sekunden frei editierbar. Die Übertragungslänge beträgt max. 25m.
2	RS232 TXD	V24 - Schreiben	
3	RS232 RXD	V24 - Lesen	
4			
5	DGND		
6			
7			
8			
9			

RS232 (SSM6000)

Terminal No.	Description/Signal	Remarks/Data	
1			Function and Spezification RS232: Reading Datalogger via Menue LC-Display
2	RS232 TXD	V24 - Write	
3	RS232 RXD	V24 - Read	
4			
5	DGND		
6			
7			
8			
9			

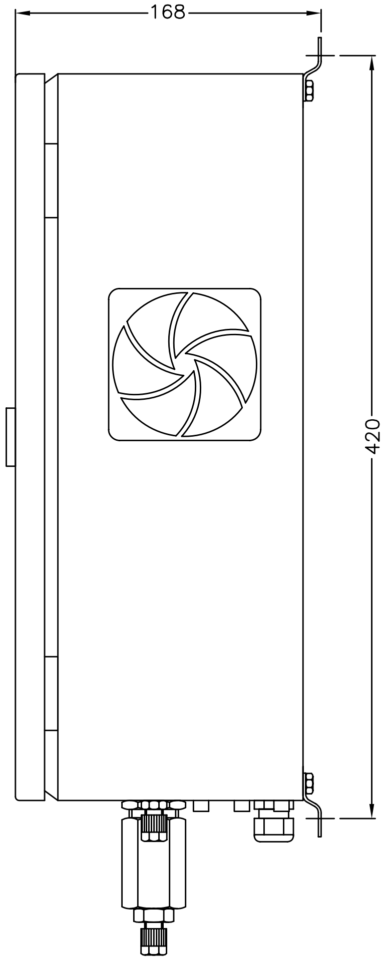
Connection Terminal: D-Sub, Buchse, 9-pol.

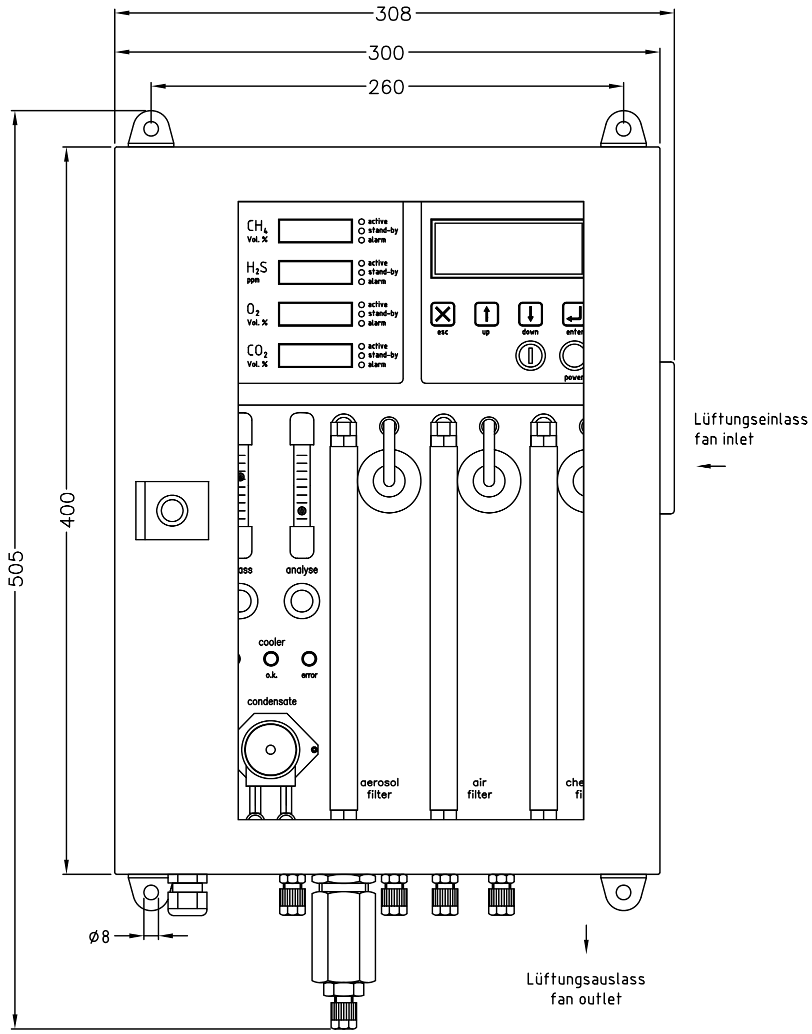
End

				Datum	06.01.06	SSM6000 (A) - RS232		Schnittstelle RS232 interface RS232	Projektbezeichnung 800__SSM6000(A)
				Bearb.	rs				=
				Gepr.	mk				+ SSM
Zust.	Änderung	Datum	Name	Norm	DIN 40719	Urspr.	Ers. f.:	Ers.d.:	Zeichnungsnummer 800-SSM6000(A)-Anschluss__060106 — Blatt 6 + / 6 Bl.

Connection diagrams

Analyzer version B

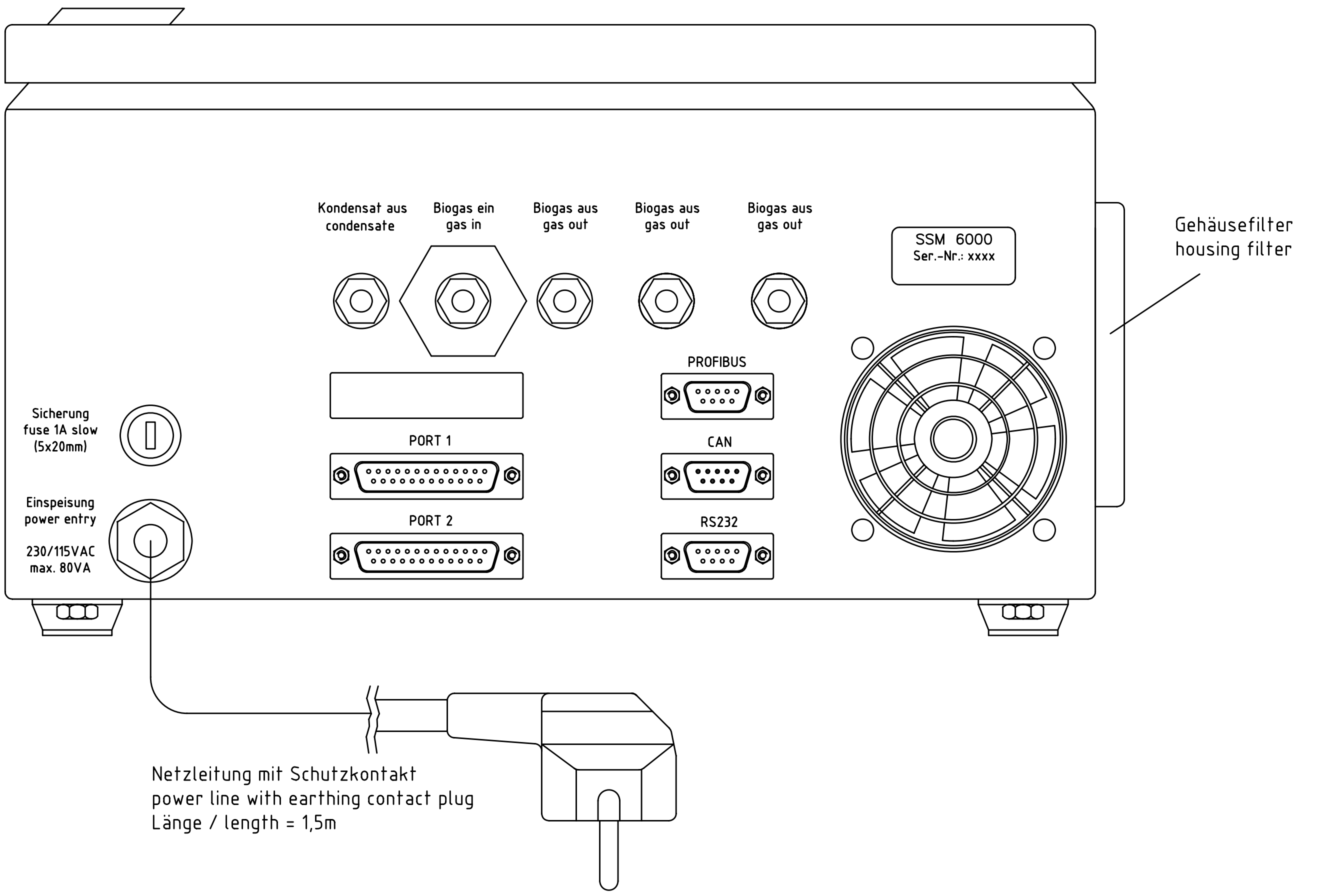




2

				Datum	06.01.06	SSM6000 (B) - Frontansicht	Anschlussmaße	Projektbezeichnung 800__SSM6000(B)	=
				Bearb.	rs	SSM6000 (B) - front view	Installation dimension		+ SSM
				Gepr.	mk			Zeichnungsnummer 800-Anschlussdaten-(B)__060106	Blatt 1 +
Zust.	Änderung	Datum	Name	Norm	DIN 40719	Urspr. / Ers. f.: / Ers.d.:			7 Bl.

SSM6000 - Unterseite / bottom view



do not connect the single outlets to a common outlet air!
disposed non-pressurized

3

Zust.	Anderung	Datum	Name	Datum	06.01.06
				Bearb.	rs
				Gepr.	mk
				Norm	DIN 40719

SSM6000 (B) - bottom view

Urspr. | Ers. f.: | Ers.d.:

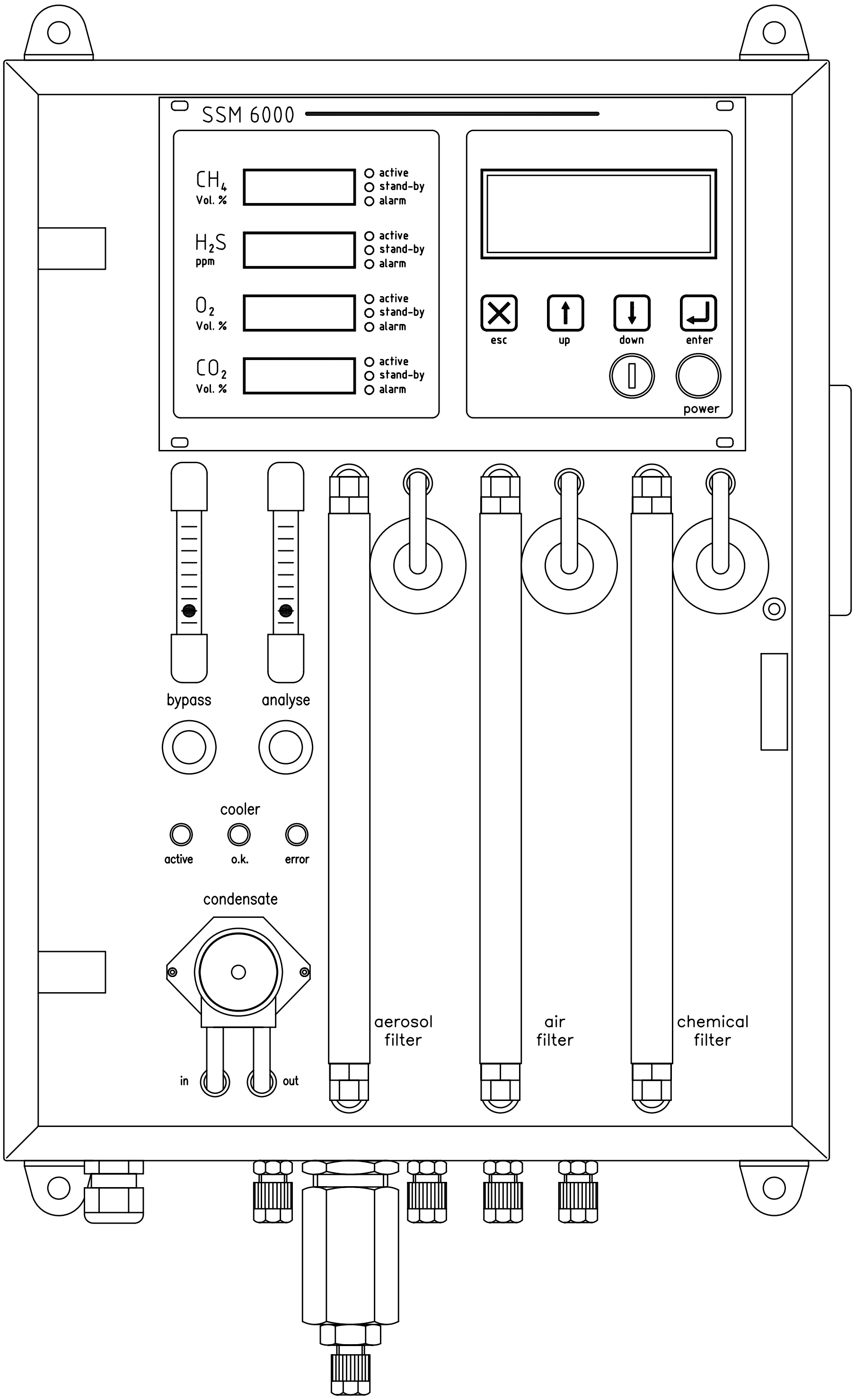
Anschlüsse Unterseite
bottom connection

Projektbezeichnung
800__SSM6000(B)

=
+ SSM

Zeichnungsnummer
800-Anschlussdaten-(B)__060106

Blatt 2 +
7 Bl.



SSM6000 (B) - Frontansicht
SSM6000 (B) - front view

Projektbezeichnung
800__SSM6000(B)

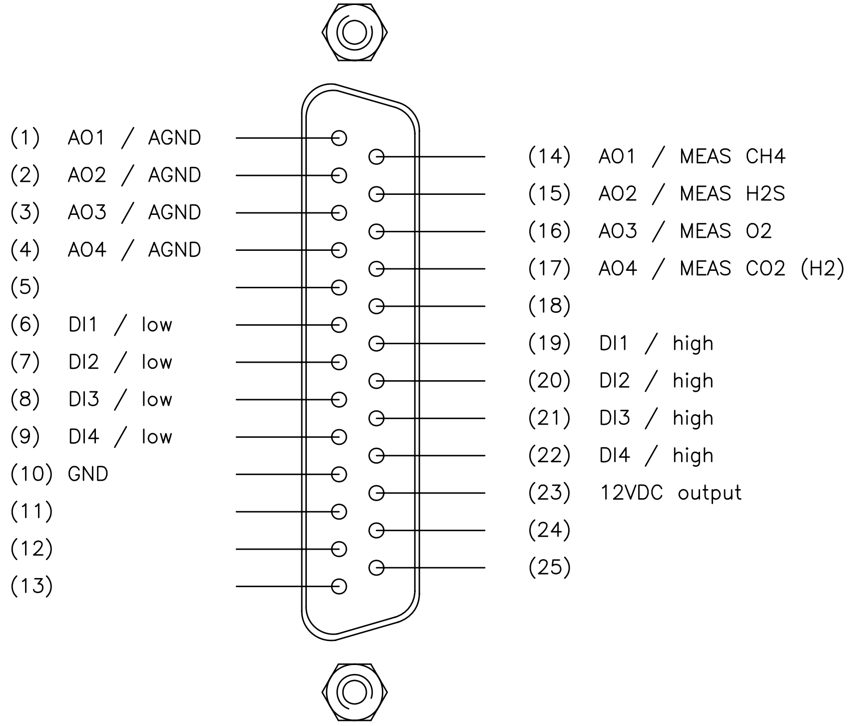
Zeichnungsnummer
800-Anschlussdaten-(B)_060106

=	
+	SSM
Blatt	3 +
	7 Bl.
Datum	06.01.06
Bearb.	rs
Gepr.	mk
Norm	DIN 40719

Ers.d.:
Ers. f.:
Urspr.

Zust.	Änderung	Datum	Name

Port 1 - Analoge Ausgänge / Digitale Eingänge
Analog outputs / digital inputs



AO – Analoge Messwertausgänge / analog outputs
DI – Digitale Eingänge / digital inputs

Port 1 (Analoge Ausgänge / Digitale Eingänge)

Klemmen-Nr.		Bezeichnung/Signal		Bemerkung / Daten	
1		AO1	Analogausgang CH4	AGND	Spezifikation der Analogausgänge:
	14		0 - 100 Vol.%	(0)4-20mA [CH4]	
2		AO2	Analogausgang H2S	AGND	aktive, nicht galvanisch getrennte Stromausgänge mit gemeinsamen GND-Bezug
	15		Skalierung editierbar	(0)4-20mA [H2S]	
3		AO3	Analogausgang O2	AGND	
	16		0 - 25 Vol.%	(0)4-20mA [O2]	
4		AO4	Analogausgang CO2 oder H2	AGND	max. Bürde 520 Ω
	17		0 - 100 Vol.% CO2 / 0 - 1000 ppm H2	(0)4-20mA [CO2/H2]	
5					
	18				
6		DI1	Start einer Messung	low	Optokoppler-Eingänge, passiv 12 .. 24 VDC / ca. 6mA @ 24VDC
	19		Messstelle 1	high	
7		DI2	Start einer Messung	low	Um eine Messung zu starten, muss das Signal für ca. 1 sec anliegen. Erst nach Abschluss der Messung wird der Eingang erneut eingelesen.
	20		Messstelle 2 (Option)	high	
8		DI3	Start einer Messung	low	
	21		Messstelle 3 (Option)	high	
9		DI4	Start einer Messung	low	
	22		Messstelle 4 (Option)	high	
10			Spannungsausgang	GND	Spannungsausgang zur Ansteuerung der Optokoppler-Eingänge über potentialfreien Kontakt nutzbar
	23		max. 5W	12 VDC	
11					
	24				
12					
	25				
13					

Port 1 - Analoge out / Digital in

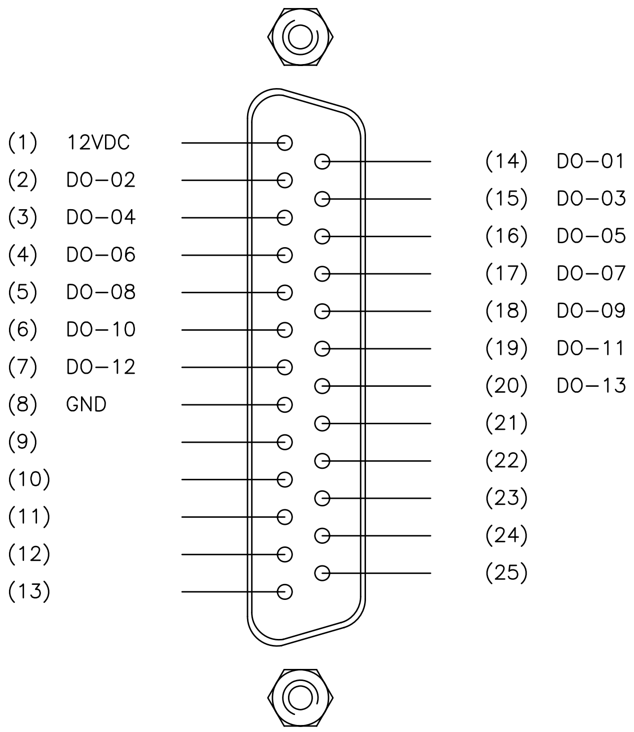
Terminal No.		Description/Signal		Remarks/Data	
1		AO1	Analoge output CH4	AGND	Spezification Analoge output:
	14		0 - 100 Vol.%	high (0)4-20mA [CH4]	
2		AO2	Analoge output H2S	AGND	active, not indirect coupled current output
	15		scaling adjustable	high (0)4-20mA [H2S]	
3		AO3	Analoge outout O2	AGND	
	16		0 - 25 Vol.%	high (0)4-20mA [O2]	max. shunt 500 Ω
4		AO4	Analog output CO2 or H2	AGND	
	17		0 - 100 Vol.% CO2 / 0 - 1000 ppm H2	high (0)4-20mA [CO2/H2]	
5					
	18				
6		DI1	Start of Measuring	low	Optocoupler input, passive 12 .. 24 VDC / ca. 6mA @ 24VDC
	19		Measuring point 1	high	
7		DI2	Start of Measuring	low	The input has to be set for at least 1sec to start a measurement. The input is read again after a measurement is completed.
	20		Measuring point 2 (Option)	high	
8		DI3	Start of Measuring	low	
	21		Measuring point 3 (Option)	high	
9		DI4	Start of Measuring	low	
	22		Measuring point 4 (Option)	high	
10			Voltage output	GND	Voltage output to activated by potentialfree Switch
	23		max. 5W	12 VDC	
11					
	24				
12					
	25				
13					

Anschlußklemmen: D-Sub, Buchse, 25-pol.

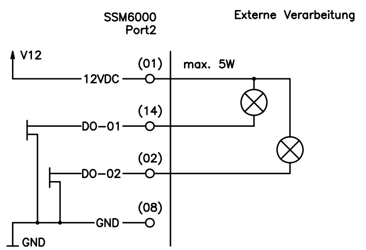
5

Zust.	Anderung	Datum	Name	Datum 06.01.06 / Bearb. rs / Gepr. mk / Norm DIN 40719	SSM6000 (B) - Port 1	Analog aus / Digital ein Analoge out / Digital in	Projektbezeichnung 800__SSM6000(B)
					Urspr. / Ers. f.: / Ers.d.:		Zeichnungsnummer 800-Anschlussdaten-(B)__060106
							= / + SSM / Blatt 4 + / 7 Bl.

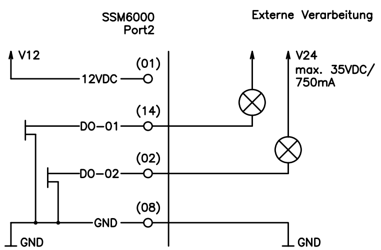
Port 2 Digitale Ausgänge / Digital outputs



Anschlussvariante 1



Anschlussvariante 2



Port 2 - Digitale Ausgänge					
Klemmen-Nr.			Bezeichnung/Signal	Bemerkung / Daten	
1			12 VDC	max. 5W	Spannungsausgang +
	14	DO-01	Grenzwertalarm CH4 +	schaltet nach GND	
2		DO-02	Grenzwertalarm CH4 -	schaltet nach GND	Spezifikation der digitalen Ausgänge:
	15	DO-03	Grenzwertalarm H2S +	schaltet nach GND	
3		DO-04	Grenzwertalarm O2 +	schaltet nach GND	kurzschlussfeste Transistoraosgänge
	16	DO-05	Grenzwertalarm O2 -	schaltet nach GND	Typ: Open collector
4		DO-06	Grenzwertalarm CO2 +	schaltet nach GND	
	17	DO-07	Status "Messung aktiv"	schaltet nach GND	Nutzung des SSM6000-Spannungsausgangs
5		DO-08	Status "Stand-by"	schaltet nach GND	(gesamt max. 5W) oder durch
	18	DO-09	Status "Konfigurationsmodus"	schaltet nach GND	Fremdeinspeisung 12..35VDC max.
6		DO-10	Messstelle 2	schaltet nach GND	750mA/Ausgang
	19	DO-11	Messsstelle 3	schaltet nach GND	
7		DO-12	Messsstelle 4	schaltet nach GND	Anschluss siehe Schaltbild
	20	DO-13	Prüfgasventil	schaltet nach GND	
8			GND		Spannungsausgang -
	21				
9					
	22				
10					
	23				
11					
	24				
12					
	25				
13					

Port 2- Digital outputs					
Terminal No.			Description/Signal	Remarks/Data	
1			12 VDC	max. 5W	voltage output +
	14	DO-01	limit value alarm CH4 +	switch to GND	
2		DO-02	limit value alarm CH4 -	switch to GND	specification of digital outputs:
	15	DO-03	limit value alarm H2S +	switch to GND	
3		DO-04	limit value alarm O2 +	switch to GND	short-circuit-proof
	16	DO-05	limit value alarm O2 -	switch to GND	transistor outputs
4		DO-06	limit value alarm CO2 +	switch to GND	type: open collector
	17	DO-07	Status "Measurement active"	switch to GND	
5		DO-08	Status "Stand-by"	switch to GND	use with 12V from terminal 1 (total load max.
	18	DO-09	Status "Configuration mode"	switch to GND	5W) or with externally supplied voltage
6		DO-10	Measuring point 2	switch to GND	12..35VDC max. 750mA/output
	19	DO-11	Measuring point 3	switch to GND	
7		DO-12	Measuring point 4	switch to GND	refer to connection diagram for details
	20	DO-13	Calibration gas valve	switch to GND	
8			GND		voltage output -
	21				
9					
	22				
10					
	23				
11					
	24				
12					
	25				
13					

Connection Terminal: D-Sub, Buchse, 25-pol.

6

				Datum	06.01.06
				Bearb.	rs
				Gepr.	mk
Zust.	Änderung	Datum	Name	Norm	DIN 40719

SSM6000 (B) - Port2

Urspr. | Ers. f.: | Ers.d.:

Digitale Ausgänge
Digital out

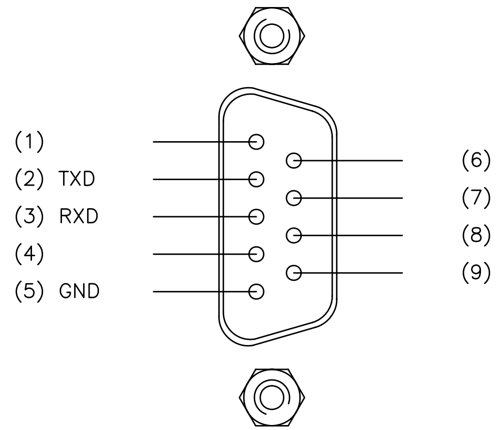
Projektbezeichnung
800__SSM6000(B)

=
+ SSM

Zeichnungsnummer
800-Anschlussdaten-(B)__060106

Blatt 5 +
7 Bl.

Schnittstelle / Interface RS232



RS232 (Schnittstelle)

Klemmen-Nr.	Bezeichnung/Signal		Bemerkung / Daten
1			
2	RS232 TXD	V24 - Schreiben	Funktion und Spezifikation der RS232:
3	RS232 RXD	V24 - Lesen	
4			Über die RS232 ist eine kontinuierliche Übertragung der aktuellen Messwerte mit Datum und Uhrzeit möglich. Das Zeitintervall ist von 0 bis 9999 Sekunden frei editierbar. Die Übertragungslänge beträgt max. 25m.
5	DGND		
6			
7			
8			
9			

RS232 (SSM6000)

Terminal No.	Description/Signal		Remarks/Data
1			
2	RS232 TXD	V24 - Write	Function and Spezification RS232:
3	RS232 RXD	V24 - Read	Reading Datalogger via Menue LC-Display
4			
5	DGND		
6			
7			
8			
9			

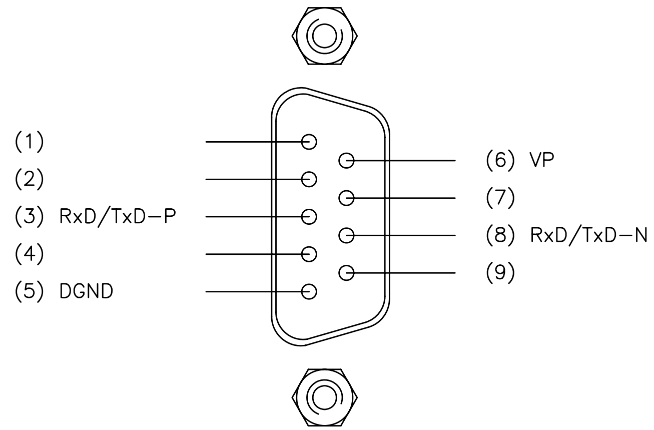
Connection Terminal: D-Sub, Buchse, 9-pol.

7

Datum	06.01.06	SSM6000 (B) - RS232	Schnittstelle RS232 interface RS232	Projektbezeichnung 800__SSM6000(B)	= + SSM
Bearb.	rs			Zeichnungsnummer 800-Anschlussdaten-(B)__060106	Blatt 6 + 7 Bl.
Gepr.	mk				
Norm	DIN 40719	Urspr. / Ers. f.: / Ers.d.:			

Zust. | Änderung | Datum | Name

Profibus-Schnittstelle / Profibus-Interface



Profibus-Schnittstelle

Klemmen-Nr.	Bezeichnung/Signal	Bemerkung / Daten
1		
2		
3	RxD/TxD-P	Empfang/Senden-P, B-Leitung
4		
5	DGND	Bezugspotential zu VP
6	VP	Versorgungsspannung (P5V)
7		
8	RxD/TxD-P	Empfang/Senden-N, A-Leitung
9		

Funktion:

- Digitale Übertragung von Messdaten
- Start einer Messung
- Umschaltung der Messstellen

Profibus interface

Terminal No.	Description/Signal	Remarks/Data
1		
2		
3	RxD/TxD-P	Empfang/Senden-P, B-Leitung
4		
5	DGND	Bezugspotential zu VP
6	VP	Versorgungsspannung (P5V)
7		
8	RxD/TxD-P	Empfang/Senden-N, A-Leitung
9		

Connection Terminal: D-Sub, Buchse, 9-pol.

End

Zust.	Anderung	Datum	Name	Datum / Bearb. / Gepr. / Norm	06.01.06 / rs / mk / DIN 40719

SSM6000 (B) -ProfibusDP

Urspr. | Ers. f.: | Ers.d.:

Profibus-Schnittstelle
profibus interface

Projektbezeichnung 800__SSM6000(B)

=
+ SSM

Zeichnungsnummer 800-Anschlussdaten-(B)__060106

Blatt 7 +
7 Bl.

SSM6000 Biogas Analyzer

Description of the Profibus Interface

1 Introduction

This technical description deals with the Profibus DP (DP Decentralized Periphery) slave interface of the SSM6000.

The correct description is as follows:
Profibus-DP: Compliance to IEC 61784 Ed.1:2002 CPF 3/1

2 Electrical transmission equipment

2.1 Interface properties of the SSM6000

The SSM6000 comes with a galvanically (optically) isolated Profibus interface according to IEC61784 Ed.1:2002 CPF3/2 (formerly EN50170). The output driver has a bus capacity of less than 10pF. The galvanic isolation offers overvoltage protection for up to 2500Vrms (1min.). The maximum data rate achieved totals 12Mbit.

2.2 Bus cable

All devices are connected in a line bus structure. Up to 32 stations (masters, slaves or repeaters) can be connected in one segment. The bus cable to be used should have the following properties:

	Permissible values	Units
Wave resistance	135..165	Ohm
Capacitance per unit length	< 30	pF/m
Loop resistance	110	Ohm/km
Line cross-section	> 0.34	mm^2

Example: Schuricht, article: 6XV1830-3BH10(1X2X0.25MM2)
Example: Profichip, article: FCC 2xAWG22 PB

2.3 Shielding

In order to achieve a high degree of system resistance to electromagnetic interference, the shield should be connected to protective earth at both ends, if possible, and in a highly conductive manner using large-surface shield clamps. This additionally serves as equipotential bonding for the devices.

2.4 Connector

A 9-pole D-SUB plug connector is preferably used for PROFIBUS networks with protection according to IP20. The SSM6000 comes with a 9-pole D-SUB socket. A supply voltage of 5V is made available via this plug connector for active Profibus connectors.
Example: VIPA, EasyConn PB

2.5 Bus termination

The PROFIBUS interface of the SSM6000 does not terminate the PROFIBUS at the device end. The SSM6000 does not set the open-circuit level of the bus at the device end. If this is required, the necessary measures must be implemented in the PROFIBUS connector. "EasyConn PB" plug connectors from VIPA offer these possibilities. The required auxiliary voltage is made available by the SSM6000 interface via the plug connector.

2.6 Connector layout

The 9-pole D-SUB socket features the following layout

Pin No.	Signal name	Description	Status
1	Shield	Shield	Not used
2	M24	24V reference potential	Not used
3	RxD/TxD-P	Bitbus B line (send data plus)	Used
4	CNTR-P	Repeater control signal	Used
5	DGND	5V reference potential	Used
6	VP (5V+)	5V supply voltage	Used
7	P24	24V supply voltage	Not used
8	RxD/TxD-N	Bitbus A line (send data minus)	Used
9	CNTR-N	Repeater control signal	Used

3 Data transmission

The PROFIBUS interface of the SSM6000 supports the DPV0 and DPV1 protocol extensions. This means that cyclic and/or acyclic data exchange is possible.

3.1 Parameter data

Since the SSM6000 DP slave features a modular design, each data module of the SSM6000 must be explicitly parameterized by the DP master. This means that following the seven parameter data bytes mandatory under the Profibus standards it is also necessary to write the three DPV1 bytes. The third byte must contain 08_h (bit3 set) as a precondition for transmission of the user-specific data. For each module selected, 5 bytes of parameter data are added to the telegram with the following structure:

Structure_Length	Structure_Type	Slot_Number	reserved	Module_No. (Pos.)

Example of module position1: 05_h 81_h 00_h 00_h 01_h
Example of module position2: 05_h 81_h 00_h 00_h 02_h
Example of module position8: 05_h 81_h 00_h 00_h 08_h and so forth.

In the parameter data telegram, the following pattern can appear for example 1:

Param.	DPV1-1	DPV1-2	DPV1-3	Module parameter				
P1..P7	80h	60h	08h	05h	81h	00h	00h	01h

3.2 Configuration data

The configuration data is transmitted in the "special format". The following example refers to CH4: 42 h, 83 h, 00 h, 01 h

The first byte with the contents of 42 h is made up as follows:

7	6	5	4	3	2	1	0	
		0	0					Header for special format
0	1							The length byte for inputs follows
				0	0	1	0	Number of manufacturer-specific bytes at the end

The second byte with the contents of 83 h is made up as follows:

7	6	5	4	3	2	1	0	
1								Consistency over the entire module
	0							=> Following length specification in byte
		0	0	0	0	1	1	Number (of bytes) = contents +1 (3+1 = 4)

00 h = manufacturer-specific => reserve
01 h = manufacturer-specific => module 1

<u>Default configuration of the SSM6000 DP slave:</u>

```
static const BYTE Config[40] = {
        0x42,0x83,0x00,0x01,   // CH4
        0x42,0x83,0x00,0x02,   // H2S
        0x42,0x83,0x00,0x03,   // O2
        0x42,0x83,0x00,0x04,   // CO2
        0x42,0x83,0x00,0x05,   // P
        0x42,0x83,0x00,0x06,   // T
        0x42,0x00,0x00,0x07,   // AL
        0x42,0x00,0x00,0x08,   // ST
        0xC1,0x00,0x00,0x09,   // MESS
        0x42,0x4A,0x00,0x0A,}; // AI
```

3.3 Cyclic mode

The SSM6000 DP slave features a modular design. The data modules can be combined in any order for cyclic operation. It is not necessary to insert blank modules, and it is possible to select several modules at the same time. The only restriction is that the maximum number of inputs and outputs (as specified in the GSD file) may not be exceeded.

The data modules selected for cyclic operation are communicated to the SSM6000 during initialization via the parameter telegram. These additional parameters are manufacturer-specific.

3.4 Acyclic mode

The SSM6000 also enables acyclic data exchange and/or access. Acyclic reading of all input data is generally possible.

Write access to output data is only possible as long as the module to be written has not yet started the cyclic exchange of data with the master.

If the master starts an acyclic write attempt to a data module parameterized as cyclic, the following error message is generated: "DPV1_ERRCL_ACC_INV_SLOT" (error code: $0B2_h$).

3.4.1 Read access

Two possibilities exist for acyclic read access to SSM6000 DP slave; these can be selected via the "index"':

DS_Read telegram:

0x5E	Slot_number	Index	Request length

The module to be read is selected via the slot number.

<u>Index 2:</u>

The modules selected for cyclic operation correspond to the readable slots for acyclic operation. Modules not selected for cyclic operation cannot be read in acyclic mode either.

<u>Index 3:</u>

The data modules can be read in the order of their basic configuration. All existing modules can be read as a corresponding slot, irrespective of the configuration of cyclic operation.

3.4.2 Write access

The data modules (the only module that can currently be written is the "Measurement" module) correspond to one slot each in the order of their basic configuration.

The current version permits writing of slot 9 only and corresponds to the "Measurement" module. In the case of an attempt to write other slot numbers, the master receives the "DPV1_ERRCL_ACC_INV_SLOT" error message (error code: $0B2_h$).

The same error message is generated if the "Measurement" data module was selected (parameterized) for cyclic data exchange. Otherwise the output value which is output in acyclic mode would be cyclically overwritten.

Write access is possible via index 2 only. Write access attempts with another index trigger the "DPV1_ERRCL_ACC_INV_INDEX" error message (error code: $0B0_h$).

DS_Write telegram:

0x5F	Slot_number	02_h	Data length	Data

3.5 Data modules of the SSM6000

The SSM6000 provides the following data modules:

Description	Data type / function	Data length (bytes)	Position (module)
CH4 (measuring gas)	Float / Input	4	1
H2S (measuring gas)	Float / Input	4	2
O2 (measuring gas)	Float / Input	4	3
CO2 (measuring gas)	Float / Input	4	4
Pressure	Float / Input	4	5
Temperature (inside)	Float / Input	4	6
Alarm	Word / Input	1	7
Status	Byte / Input	1	8
Measurement	Byte / IO	1	9
Analog Input 1..11	Word / Input	22	10

<u>CH4 measuring gas:</u>
The measuring range is from 0.0 to 99.9 % by volume. The measured value is updated after each measuring process and is then maintained until polled.

<u>H2S measuring gas:</u>
The measuring range is from 0 to 5000 ppm. The measured value is updated after each measuring process and is then maintained until polled.

<u>O2 measuring gas:</u>
The measuring range is from 0.0 to 25.0 % by volume. The measured value is updated after each measuring process and is then maintained until polled.

<u>CO2 measuring gas:</u>
The measuring range is from 0.0 to 99.9 % by volume. The measured value is updated after each measuring process and is then maintained until polled.

<u>Pressure measured value:</u>
The pressure value is updated every second and made available for polling.

<u>Temperature (inside) measured value:</u>
The temperature inside the unit is measured after each discontinuous measuring process or, during continuous measurement, every 2 seconds. Furthermore, the temperature is measured each time the key-operated switch is changed between measuring mode and setup mode.

Analyzer status
The analyzer status indicates whether the SSM6000 is in setup or measuring mode. The values transmitted have the following meanings:

Value transmitted	Mode
0x01	Setup mode
0x02	Measuring mode

Alarms
Table as an overview for the bit-coded alarms

B7	B6	B5	B4	B3	B2	B1	B0	Alarm type
							1	CH4 over
						1		CH4 under
					1			H2S over
				1				O2 over
			1					O2 under
		1						CO2 over
	1							Analyzer inside temperature alarm
1								Analyzer malfunction

Measurement
This module can be read or written. It indicates which measuring-gas point is activated and whether a measuring process is currently underway. The H2S measurement is displayed here in continuous mode. A measurement starts when a number is written. After a measuring processis started, the user must write a 0 again in order to prevent repeated measuring. 4 measuring-gas points are currently supported. A written "one" activates measuring-gas point "one" and starts a measuring process, and so forth. Selecting another measuring-gas point during an active measuring process has no effect.

Value of "Measurement" module	Response
0	No measurement
1	Measuring-gas point 1 activated, start measurement
2	Measuring-gas point 2 activated, start measurement
3	Measuring-gas point 3 activated, start measurement
4	Measuring-gas point 4 activated, start measurement

AI 1..11 – Analog inputs
Layout on request.

3.6 Data types and data format

The data transmitted via the Profibus is assigned to specific data types which, for their part, are stored in a specific data format.

3.6.1 FLOAT

The "float" data type is transmitted as a 32-bit float value. 4 data bytes are required for this purpose. The bytes are stored as follows:

<u>Example:</u>

Float value: 1234.56

	Byte1	Byte2	Byte3	Byte4
Hexadecimal notation (IEEE-574)	44_h	$9A_h$	51_h	EC_h

	Byte1	Byte2	Byte3	Byte4
Profibus SSM6000 data format	$9A_h$	44_h	EC_h	51_h

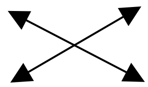
3.6.2 WORD

The "WORD" data type is transmitted as a 16-bit value. 2 data bytes are required for this purpose. The bytes are stored as follows:

<u>Example:</u>

Float value: 1234_h

	Byte1	Byte2
Hexadecimal notation	12_h	34_h



	Byte1	Byte2
Profibus SSM6000 data format	34_h	12_h

3.6.3 BYTE

The "BYTE" data type is transmitted as an 8-bit value. 1 data byte is required for this purpose.

4 Device address and ID number

4.1 Device address

The device address is used to distinguish between the different devices within a Profibus network. Each device must have a distinct address and all devices must have different addresses. Address changes via the Profibus in the "Wait-Parameter" (WPRM) state are currently not supported by the SSM6000.

The default device address of the SSM6000 is device address "110". This setting can be varied between the values "1" and "126" via the device control menu. For this purpose, turn the key-operated switch on the front panel of the device clockwise until the display shows "SETUP MODE". You can then use the "down" key in order to move the flashing cursor to the "MODE" selection. Thereafter, press the <Enter> key to confirm. The "DEVICE ID" menu is accessed in the same manner. The "_PROFIBUS" and "_CANBUS" options are offered. Move the flashing cursor to the "_PROFIBUS" option and press the <Enter> key to confirm. You can then use the "up" and "down" keys in order to set the desired device address. As soon as the cursor is once again positioned in front of the "_PROFIBUS" selection parameter, the Profibus is re-initialized with the changed address and then communicates under this address.

4.2 ID number

The ID number of the device is fixed and cannot be varied from outside. The number is assigned by the Profibus organization or can be freely selected by the manufacturer. The Profibus DP slave accepts only those parameterization telegrams where the ID number transmitted is identical to its own ID number. The ID number is known to the Profibus master from the GSD (device master data) file. The ID number of the SSM6000 it $0AFFE_h$.

5 GSD file

```
;* ========================================================================= *
;*                                                                           *
;* Vendor:   Novera Systemtechnik GmbH                                       *
;*           Groninger Str. 25                                               *
;*           13347 Berlin                                                    *
;*           Germany                                                         *
;*           Tel.: +49-30-45029354                                           *
;*           FAX.: +49-30-45029355                                           *
;*                                                                           *
;* ========================================================================= *
;*                                                                           *
;* Function:      SSM6K                                                      *
;*                                                                           *
;*                                                                           *
;* Order Number : 43235000-gsd                                               *
;*                                                                           *
;* ------------------------------------------------------------------------- *
;* Author: R. Pandel                                                         *
;*                                                                           *
;*           Tel.: +49-30-45029354                                           *
;*           FAX.: +49-30-45029355                                           *
;* ------------------------------------------------------------------------- *
;*                                                                           *
;* history                                                                   *
;* ========================================================================= *
;* 25.10.2005 [V1.00]  Urversion                                             *
;*                                                                           *
;* ------------------------------------------------------------------------- *
;*                                                                           *
;****************************************************************************
#Profibus_DP

;==============================================================================
;==== General DP Keywords =====================================================
;==============================================================================

GSD_Revision = 4
Vendor_Name = "Novera Systemtechnik GmbH"
Model_Name = "SSM6K"
Revision = "1.00"
Ident_Number = 0xAFFE
Protocol_Ident = 0
Station_Type = 0
FMS_supp = 0
Hardware_Release = "V1.00"
Software_Release = "V1.00"
Redundancy = 0
Repeater_Ctrl_Sig = 2
24V_Pins = 0


;=========================================================================
;==== Supported baudrates ================================================
;=========================================================================

9.6_supp = 1
19.2_supp = 1
93.75_supp = 1
187.5_supp = 1
500_supp = 1
1.5M_supp = 1
3M_supp = 1
6M_supp = 1
12M_supp = 1

MaxTsdr_9.6=15
MaxTsdr_19.2=15
MaxTsdr_93.75=15
MaxTsdr_187.5=15
```

```
MaxTsdr_500=15
MaxTsdr_1.5M=20
MaxTsdr_3M=35
MaxTsdr_6M=50
MaxTsdr_12M=95


;=============================================================================
;==== Slave specific values ==================================================
;=============================================================================

Slave_Family = 3@PRONOVA@SSM6000
Implementation_Type = "VPC3+"
Bitmap_Device = "ssm_AFFE"

Freeze_Mode_supp=1
Sync_Mode_supp=1
Fail_Safe=1
Auto_Baud_supp=1
Set_Slave_Add_supp=0

Min_Slave_Intervall=20

Modular_Station=1
Max_Module=10
Modul_Offset=1
Max_Input_Len=51
Max_Output_Len=1
Max_Data_Len=52
Max_Diag_Data_Len=17


;=============================================================================
;==== User-Prm-Data ==========================================================
;=============================================================================

Max_User_Prm_Data_Len = 50
Ext_User_Prm_Data_Const(0)= 0x00,0x00,0x08


;=============================================================================
;==== Module-Definition-List =================================================
;=============================================================================

Module="CH4 (float)           " 0x42,0x83,0x00,0x01
1
Ext_Module_Prm_Data_Len=5
Ext_User_Prm_Data_Const(0)=0x05,0x81,0x00,0x00,0x01
EndModule

Module="H2S (float)           " 0x42,0x83,0x00,0x02
2
Ext_Module_Prm_Data_Len=5
Ext_User_Prm_Data_Const(0)=0x05,0x81,0x00,0x00,0x02
EndModule

Module="O2  (float)           " 0x42,0x83,0x00,0x03
3
Ext_Module_Prm_Data_Len=5
Ext_User_Prm_Data_Const(0)=0x05,0x81,0x00,0x00,0x03
EndModule

Module="CO2 (float)           " 0x42,0x83,0x00,0x04
4
Ext_Module_Prm_Data_Len=5
Ext_User_Prm_Data_Const(0)=0x05,0x81,0x00,0x00,0x04
EndModule

Module="Druck (float)         " 0x42,0x83,0x00,0x05
5
Ext_Module_Prm_Data_Len=5
Ext_User_Prm_Data_Const(0)=0x05,0x81,0x00,0x00,0x05
EndModule
```

```
Module="Temp (float)           " 0x42,0x83,0x00,0x06
6
Ext_Module_Prm_Data_Len=5
Ext_User_Prm_Data_Const(0)=0x05,0x81,0x00,0x00,0x06
EndModule

Module="Status (Byte)         " 0x42,0x00,0x00,0x07
7
Ext_Module_Prm_Data_Len=5
Ext_User_Prm_Data_Const(0)=0x05,0x81,0x00,0x00,0x07
EndModule

Module="Alarm (Byte)          " 0x42,0x00,0x00,0x08
8
Ext_Module_Prm_Data_Len=5
Ext_User_Prm_Data_Const(0)=0x05,0x81,0x00,0x00,0x08
EndModule

Module="Messen (Byte)         " 0xC1,0x00,0x00,0x09
9
Ext_Module_Prm_Data_Len=5
Ext_User_Prm_Data_Const(0)=0x05,0x81,0x00,0x00,0x09
EndModule

Module="AI (WORD)             " 0x42,0x4A,0x00,0x0A
10
Ext_Module_Prm_Data_Len=5
Ext_User_Prm_Data_Const(0)=0x05,0x81,0x00,0x00,0x0A
EndModule


;===============================================================================
;==== DPV1 KEY WORDS ===========================================================
;===============================================================================

DPV1_Slave                          = 1
C1_Read_Write_supp                  = 1
C1_Max_Data_Len                     = 44       ;The parameter specifies the maximum length of user
data excluding
                                               ;Function_Num, Slot_number, Index, Length,
transferred on the
                                               ;MSAC_1 communication channel.
                                               ;Type: Unsigned8 (0 .. 240)
C1_Response_Timeout                 = 300
Diagnostic_Alarm_supp               = 1
Process_Alarm_supp                  = 1
Alarm_Type_Mode_supp                = 1
WD_Base_1ms_supp                    = 1
Publisher_supp                      = 1
Prm_Block_Structure_supp            = 1
Prm_Block_Structure_req             = 1

C2_Read_Write_supp                  = 1
C2_Max_Data_Len                     = 48       ;The parameter specifies the maximum length of user
data excluding
                                               ;Function_Num, Slot_number, Index, Length,
transferred on the
                                               ;MSAC_2 communication channel.
                                               ;Type: Unsigned8 (0,48 .. 240)
C2_Response_Timeout                 = 300
C2_Max_Count_Channels               = 3
Max_Initiate_PDU_Length             = 52       ;The parameter specifies the maximum length of an
Initiate Request
                                               ;PDU including the Function_Num to the Resource
Manager.
                                               ;Type: Unsigned8 (0,52.. 244)
DPV1_Data_Types                     = 0
```