

Process Gas Chromatograph

MicroSAM

Operating Instructions · 03/2012



Process Gas Chromatography

SIEMENS



Process analytics

Process Gas Chromatograph MicroSAM

Operating Instructions

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Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

 DANGER
indicates that death or severe personal injury will result if proper precautions are not taken.
 WARNING
indicates that death or severe personal injury may result if proper precautions are not taken.
 CAUTION
with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.
CAUTION
without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.
NOTICE
indicates that an unintended result or situation can occur if the relevant information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

 WARNING
Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Purpose of this documentation

These instructions contain all information that you will require to commission and use the device.

It is aimed at persons who install the device mechanically, connect it electrically, parameterize and commission it, as well as at service and maintenance engineers.

Note

- Please read the operating instructions before you use this device. The operating instructions contain all important information for the device.
 - Observation of the information:
 - Guarantees correct device functioning
 - Provides reliable results
 - Saves you servicing costs
-

Information

The contents of these instructions are neither part of an earlier existing agreement, statement or legal commitment nor do they change this. All obligations on the part of Siemens AG are contained in the respective sales contract which also contains the complete and solely applicable warranty conditions. Any statements contained herein do not create new warranties or modify the existing warranty.

The content reflects the technical status at the time of printing. We reserve the right to make technical changes in the course of further development.

History

The following table shows the most important changes in the documentation compared to each previous edition:

Issue	Comment	Firmware
04 03/2012	Revision of contents and editing	FW: 3.10
03 02/2010	Revision of contents and editing	FW: 3.00
02 09/2008	Revision of contents and editing	FW: 02.08.00
01 08/2006	First edition	FW: 01.17.00

General information

2.1 Intended use

- This gas chromatograph is used to separate and quantitatively determine components in a gaseous sample.
- The device may only be used for the purposes specified in these instructions.
- Modifications to the device which are not expressly referred to in these instructions therefore result in an application which is **not in accordance with the intended use**. Such modifications to the device are then the exclusive responsibility of the user.

2.2 Safety information

The gas chromatograph complies with the applicable safety standards. If the handling instructions and safety information are observed, no dangers exist when using the device which could endanger the health of personnel or result in damage to property.

You will find the safety information:

- In these operating instructions and in the manual
- On the gas chromatograph
- On the chromatograph components

WARNING

Only appropriately qualified persons are permitted to make interventions on this device.

These persons must be thoroughly familiar with all sources of danger and service activities in accordance with these operating instructions.

For trouble-free and safe operation of this device, the following requirements must be met:

- Transportation in accordance with proper procedures
- Proper storage
- Proper installation and assembly
- Careful operation and maintenance

To avoid injury to persons and damage to the device, please observe the information in the manual.

 WARNING

Dangerous gases

- The gas chromatograph requires various gases for operation which have different danger potentials.
- The gas chromatograph may require gases for operation which produce an explosive mixture with air.
- Route all exhaust gases out of the gas chromatograph and away from the position of use using a common line.
- Always provide sufficient ventilation as soon as you allow the sample gas line to run empty and the sample gas contains corrosive or toxic components.

CAUTION

Corrosion danger

The housing and the pipelines are resistant to solvents as well as weak alkalis and acids.

Check the resistance of the housing and the pipelines when using in an environment with strong alkalis or acids and/or at higher temperatures.

Avoided corrosion and damage of the connection lines resulting from permanent contact with the following substances:

- Nitric acid
- Hydrochloric acid
- Carbon bisulfide
- Ethanol
- Formic acid
- Petroleum spirit
- Hydraulic oil
- Isopropanol

CAUTION**Electrostatic sensitive devices**

This device contains electrostatic sensitive devices. Electrostatic sensitive devices may be destroyed by voltages that are undetectable to a human. Voltages of this kind occur as soon as a component or an assembly is touched by a person who is not grounded against static electricity. The damage to a module as a result of overvoltage cannot usually be detected immediately. It may only become apparent after a long period of operation.

Protective measures against discharge of static electricity:

- Before you work with modules, first discharge any static charges from your body, for example by touching a grounded object.
- Devices and tools used must be free of static charge.
- Always pull the mains connector and disconnect the battery before installing or removing modules.
- Hold modules only by their edges, and do not touch pins or printed conductors.

2.3 Transportation

The gas chromatograph is supplied in various designs, and can also include a metal bracket as a protective unit for the connection pipes (see ⑦, Fig. 3.1). If the chromatograph is supplied with this metal bracket, it must only be transported or shipped together with it. Furthermore, we also recommend operation of the chromatograph with the metal bracket fitted.

If the chromatograph is transported or shipped without this metal bracket, the warranty is nullified.

Exception: The metal bracket is **not** required if the chromatograph is mounted in a protective casing approved by Siemens. In this case, transportation or shipping of the chromatograph is only permissible in this protective casing.

2.4 Protection against explosion

2.4.1 General regulations

The installation and operation of electrical equipment in potentially explosive atmospheres are regulated by the directive RL 99/92/EU (ATEX 137). This directive refers to the generally recognized process engineering regulations.



WARNING

Cancellation of the explosion protection

The test certificate for your explosion-proof gas chromatograph only applies to the original configuration as well as to connection and installation according to the switching and piping plans of Siemens AG. Changing one or more components will void the explosion protection for your device.

Conditions

The test certificate and any supplements contain all conditions and regulations specified for installation and operation of the device.

 WARNING**Explosion hazard**

- The device is designed to analyze flammable and non-flammable gaseous media. Hydrogen or inert gases are used as auxiliary gases.
- For the analysis of flammable gases or use of hydrogen as a carrier gas, oxygen may only be present in concentrations $\leq 2\%$ in the sample.
- Oxygen at concentrations up to 21% and pressure up to 1.1 bar (110 kPa) is permissible for operation only if an additional constructive explosion protection measure is implemented, for example, installation of a flame arrester between the process connection and gas chromatograph.
- Oxygen at concentrations up to 21% and pressure > 1.1 bar (110 kPa) is not allowed under normal operating conditions for explosive mixtures.
- The pneumatic conditions for the sample and the auxiliary gas must be strictly observed:
 - Sample gas ≤ 1.6 bar (160 kPa) absolute pressure
 - Auxiliary gas ≤ 8 bar (800 kPa) absolute pressure
- If flammable gases are connected at a pressure > 1.1 bar (110 kPa), the chromatograph and the gas line must be purged with process gas prior to analysis.
- Flammable gases which are explosive under the analysis conditions even with the exclusion of oxygen (acetylene and ethylene oxide), may only be present in the analyzed mixture in concentrations that are uncritical for safety-related engineering. Acetylene and ethylene oxide can be present in a concentration up to 100%.
- The permissible ambient temperature range is -30° to $+55^{\circ}$ C.
- The temperature range for continuous operation is -20° C to $+50^{\circ}$ C.

Table 2- 1 Case examples for explosion protection

Case no.	Concentration of oxygen in normal operation	Transient concentration of oxygen (not normal operation)	Permissible carrier gases	Sample pressure (absolute)	External flame arrester	Substances that are explosive under exclusion of oxygen	Process medium zone x	MicroSAM (7KQ3101)	SITRANS CV (7KQ3105)
1	0 ... 2 %	0 ... 2 %	H ₂ , He, N ₂ , Ar	1.0 ... 1.6 bar	Not required	Not allowed	Not explosive	x	x
2	0 ... 2 %	0 ... 21 %	H ₂ , He, N ₂ , Ar	1.0 ... 1.6 bar	Not necessary	Not allowed; with the exception of acetylene and ethylene oxide up to 100%	Zone 1	x	
3	0 ... 21 %	0 ... 21 %	H ₂ , He, N ₂ , Ar	1.0 ... 1.1 bar	Required		Zone 0	x	
4	0 ... 4 %	0 ... 4 %	He, N ₂ , Ar	1.0 ... 7 bar	Not necessary	Not allowed	Zone 1		x

x = applies to the product

Identification of explosion protection

The gas chromatograph has a flameproof enclosure. With the flameproof enclosure, the housing resists an internal explosion pressure.

The housing of your gas chromatograph has a rating plate which identifies the explosion protection.

This device is approved for a sample gas inlet pressure of 1.6 bar absolute (160 kPa) in accordance with ATEX II 2 G Ex d IIC T4.

Release version base device and the associated explosion protection

Release version base device	New features of the basic device	Protection against explosion	Explosion protection certificate Supplements
AS 08	Live dosing, range of supply voltage extended: 24 V DC (18.5 V ... 30.2 V)	ATEX II 2 G EEx d IIC T4	ATEX DMT 03 ATEX E 069 X Supplement 1 to 3
		FM Class I, Div 1, Groups A, B, C, D T4 Class I, Zone 1, Group IIC T4	FM Certificate 3017424 Date Issued 2005/12/14
		CSA Class I, Div 1, Groups B, C, D T4	CSA Certificate 1915614 Date Issued 2007/06/07
		Enclosure Type 4X	
AS 09	eLive injection: Introduction of a 5th solenoid valve, modification of the micro-diaphragm valve	ATEX II 2 G EEx d IIC T4	ATEX DMT 03 ATEX E 069 X Supplement 1 to 3
		FM Class I, Div 1, Groups A, B, C, D T4 Class I, Zone 1, Group IIC T4	FM Certificate 3017424 Date Issued 2005/12/14
		CSA Class I, Div 1, Groups B, C, D T4	CSA Certificate 1915614 Date Issued 2007/06/07
		Enclosure Type 4X	
AS 10	Modified 3rd temperature control system (model with temperature protection) Modified 4th temperature control system (model with temperature protection)	ATEX II 2G Ex d IIC T4 Gb DMT 03 ATEX E 069 X	ATEX DMT 03 ATEX E 069 X Supplement 1 to 4
			FM Certificate canceled
		CSA CLASS I, DIVISION 1 GROUPS B, C, D T4 CLASS I, ZONE 1 GROUPS IIC T4	CSA Certificate 1915614 Date Issued 2009/11/13
		ENCLOSURE TYPE 4X / IP65	

2.4.2 Directives for operation

Switching on the chromatograph

Only switch on the power supply to the device if this has been closed correctly.

Opening the housing with the power supply switched off

 WARNING

Explosions

If you open the housing prematurely, explosions may occur due to hot components and residual electrical charges in the gas chromatograph. A corresponding label informing you of this is present on the device.

Before opening the housing in a hazardous area, disconnect the device from the power supply.

It is essential that you wait for 60 minutes following switching off of the power supply.

 WARNING

Fire permission certificate

Replacement of the backup battery is only permissible if you have a fire permission certificate. This instruction applies regardless as to whether the gas chromatograph is switched on or off.

Opening the housing with the power supply switched on

A diagnostics connector is located behind the status display panel. You must open the housing in order to access it.

 WARNING

Fire permission certificate

Opening the housing in the hazardous area with the power supply switched on is only permissible if you have a fire permission certificate.

Maintenance and repair of components

 WARNING

Observe the directive

Observe the regulations of directive RL 99/92/EU (ATEX 137) when carrying out maintenance and repairs on parts associated with the explosion protection.

2.5 Qualified personnel

CAUTION

Qualified personnel

- Only qualified personnel are authorized to install and use the process gas chromatograph.
- Insufficient knowledge of the operating instructions, or the complete absence thereof, result in the deletion of all liability claims with regard to Siemens AG.
- We therefore recommend owners to have the instruction of personnel confirmed in writing.

Qualified personnel are people who are familiar with the installation, mounting, commissioning, and operation of the product. These people have the following qualifications:

- They are authorized, trained or instructed in operating and maintaining devices and systems according to the safety regulations for electrical circuits, high pressures and aggressive as well as hazardous media.
- For explosion-proof devices: they are authorized, trained, or instructed in carrying out work on electrical circuits for hazardous systems.
- They are trained or instructed in maintenance and use of appropriate safety equipment according to the safety regulations.

2.6 Limitation of liability for external accessories

If you wish to use or connect accessories in the chromatograph which are not specifically recommended by Siemens AG, please first obtain confirmation from Siemens AG that the operational safety of the chromatograph is not influenced by the external accessory. Without this confirmation, Siemens AG excludes all liability for the operational safety.

2.7 Final shutdown and disposal

It is essential to observe the environmental protection guidelines at the location of the operating company for the final shutdown and disposal of the process gas chromatograph!

Description

3.1 Applications

The process gas chromatograph is used in various industry sectors, for example:

- Chemical industry
- Oil & gas
- Iron & steel
- Pharmaceuticals
- Metals, basic materials, cement
- Glass

The process gas chromatograph is a device for determining the concentration of selected components in a process gas, and is used for measuring and analysis methods associated with process analysis.

3.2 Product features

Functions:

- Analysis using a micro electromechanical system (MEMS).
- Precision due to valveless live injection.
- High-resolution capillary columns.
- Very good detection limits due to high-performance detectors.
- Very good linearity throughout the complete measuring range; expensive calibration gases can therefore be saved. Reason: several calibration gases must be used if the linearity is poor.
- Operation:
 - Using Ethernet and a PC
 - Using the built-in control panel (MMI) of a MAXUM chromatograph
 - Using a network access unit (NAU)
- Device can be mounted directly at the sampling point, since it has a rugged and compact design and only a carrier gas supply and little power are required.
- Modular design and low energy consumption, thus low operating costs.

3.3 MicroSAM design

The following illustration provides an overview of the most important MicroSAM modules.

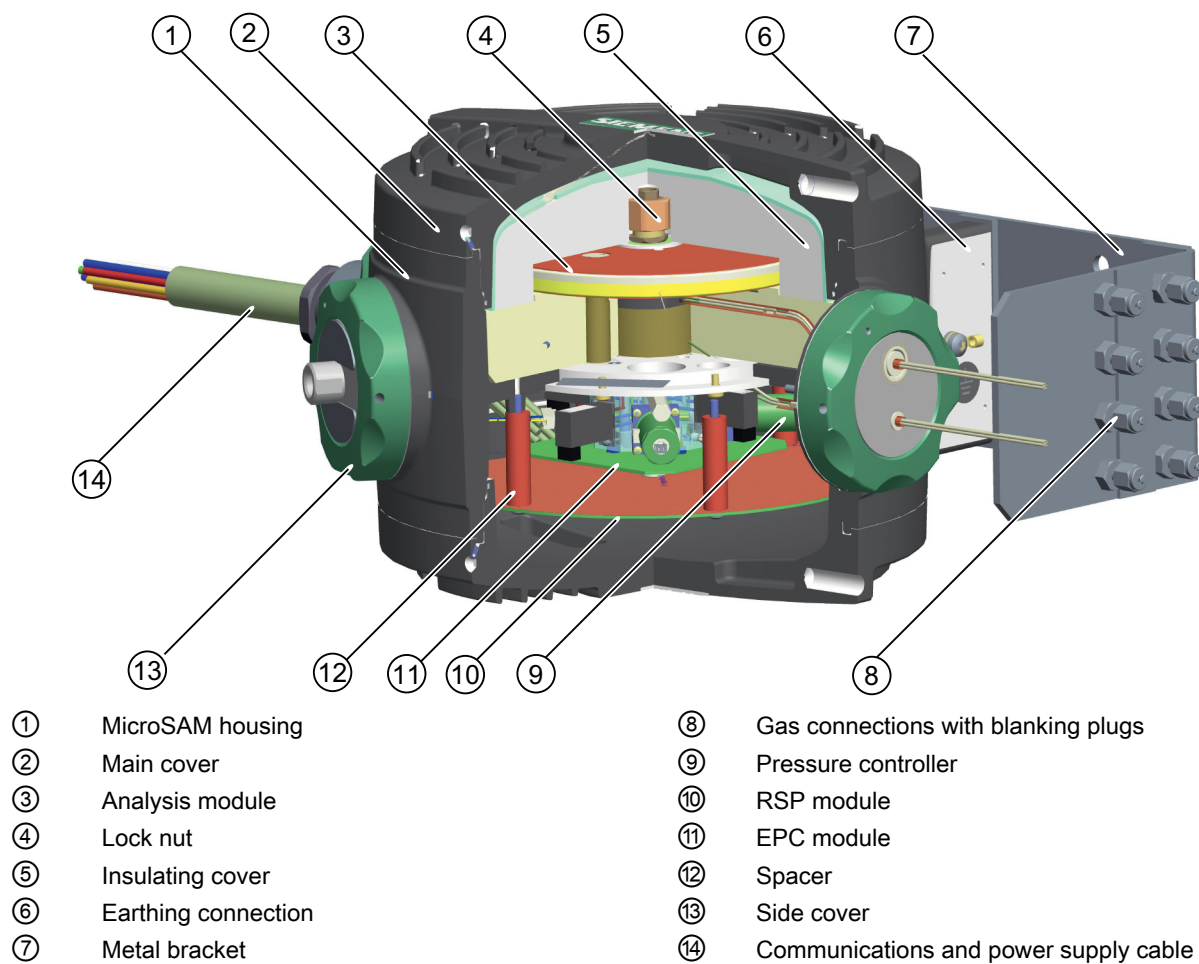


Figure 3-1 MicroSAM design

3.4 Rating plate design

The rating plate is located on the housing and contains the Order No. and other important product information.

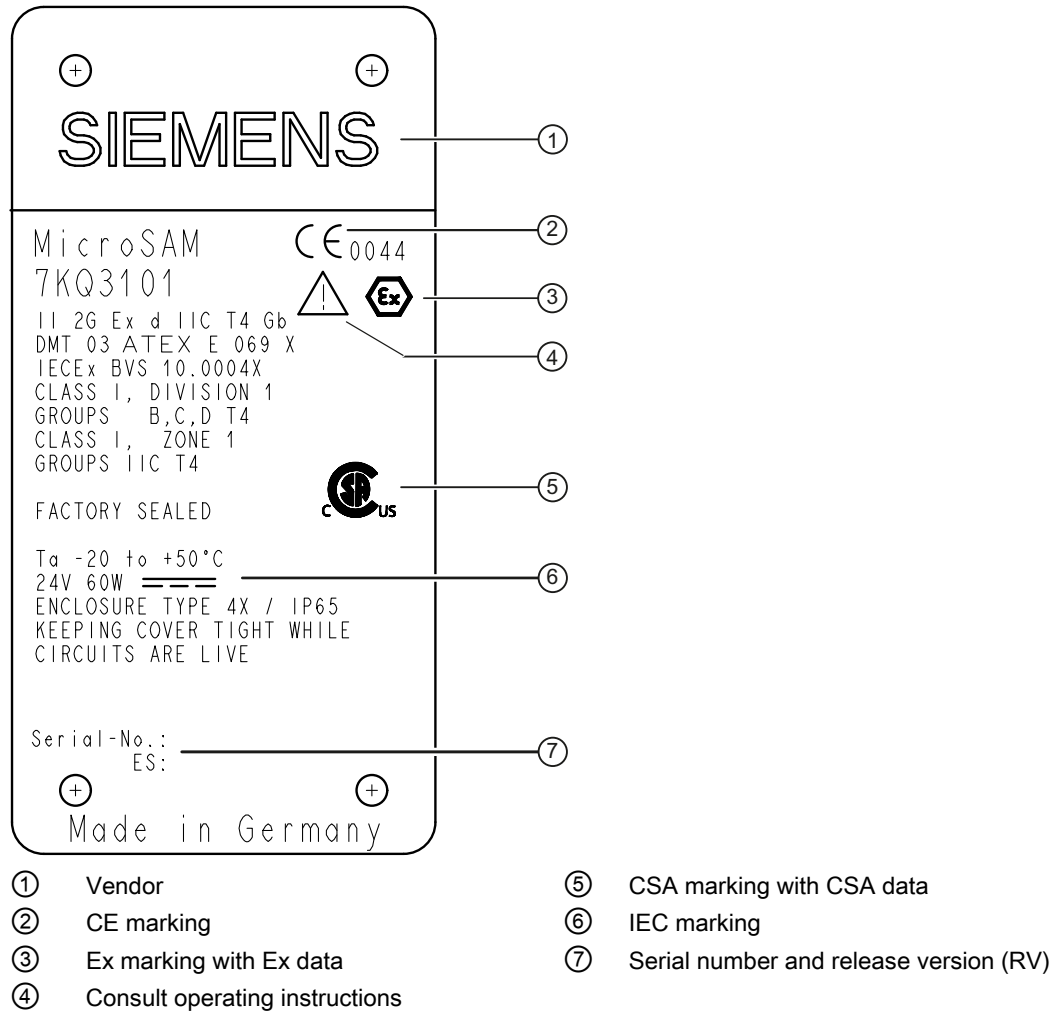
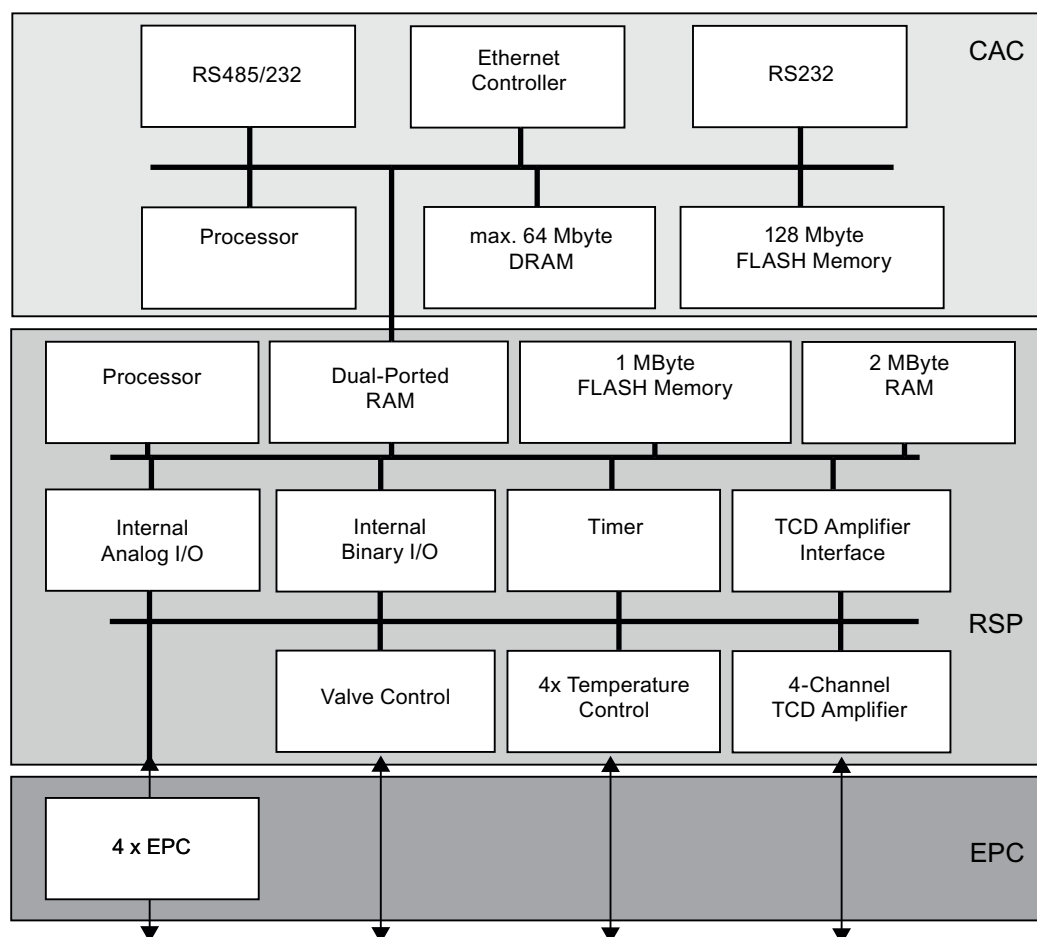


Figure 3-2 Rating plate

3.5 Functional description of the electronics

Overview

The following block diagram shows the basic design of the electronics:



RSP (real-time signal processing) and CAC (communication and analytical control)

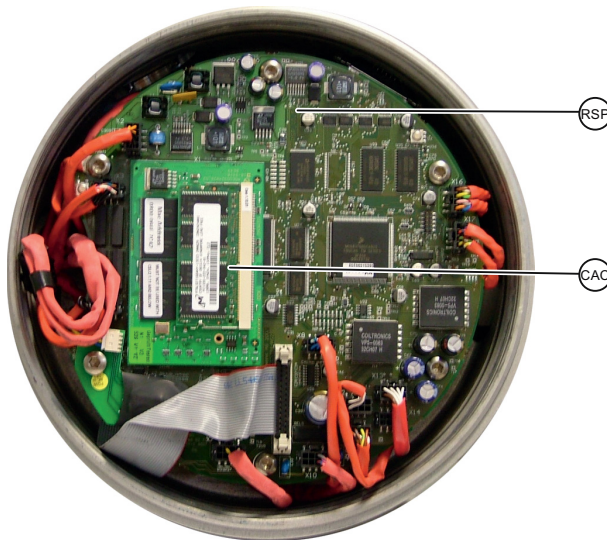


Figure 3-3 RSP and CAC

EPC (electronic pressure control)

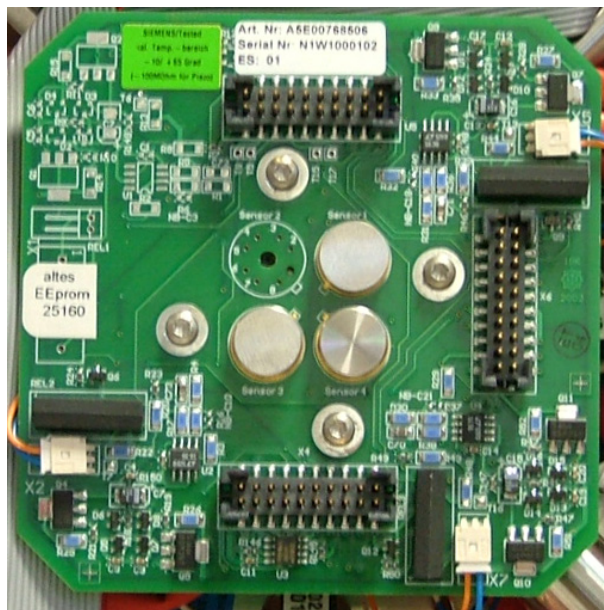


Figure 3-4 EPC

3.6 Functions

Predefined analysis modules are used in your gas chromatograph.

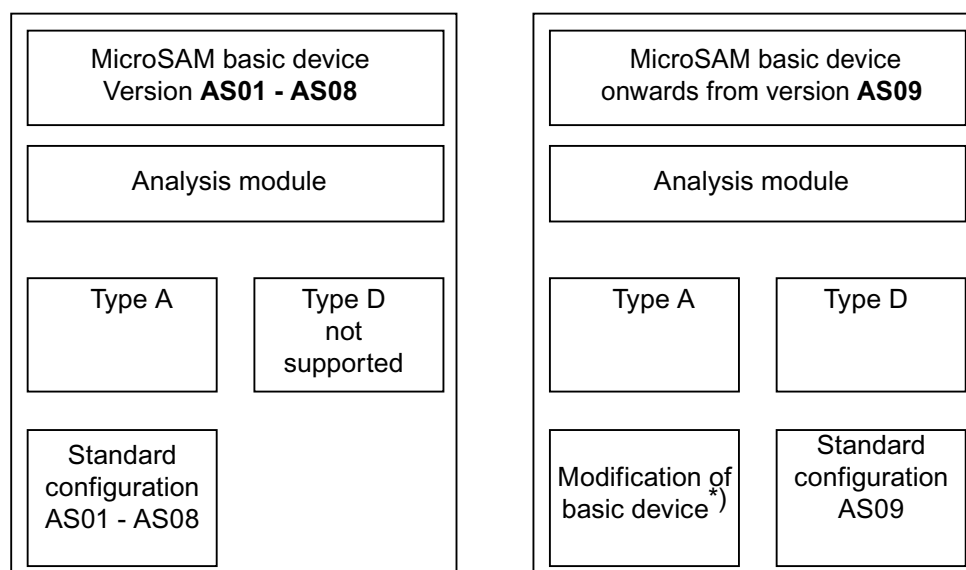
The main feature of the analysis module is the in-line detection. With the in-line detection, columns and thermal conductivity detectors (TCD) are connected in series so that measurements are carried out at the points where the separation of components is optimum.

The thermal conductivity detectors are half-bridges without an actual reference. Pairs of thermal conductivity detectors are combined into a complete bridge circuit such that signals are never superimposed.

The type and serial number of the analysis module are engraved on the rating plate on the breathing connector, e.g. A01 124 ES04 or higher. The supplement ES04 identifies product version 4 of the analysis module.

From release version 9 (AS09) onwards of the MicroSAM basic unit, the version eLive is produced. In this case the basic unit has an additional membrane valve function 5 for purging the sample loop. This extension improves control of the injection pulse position.

The following diagrams show permissible combinations of basic devices and types of analysis modules.



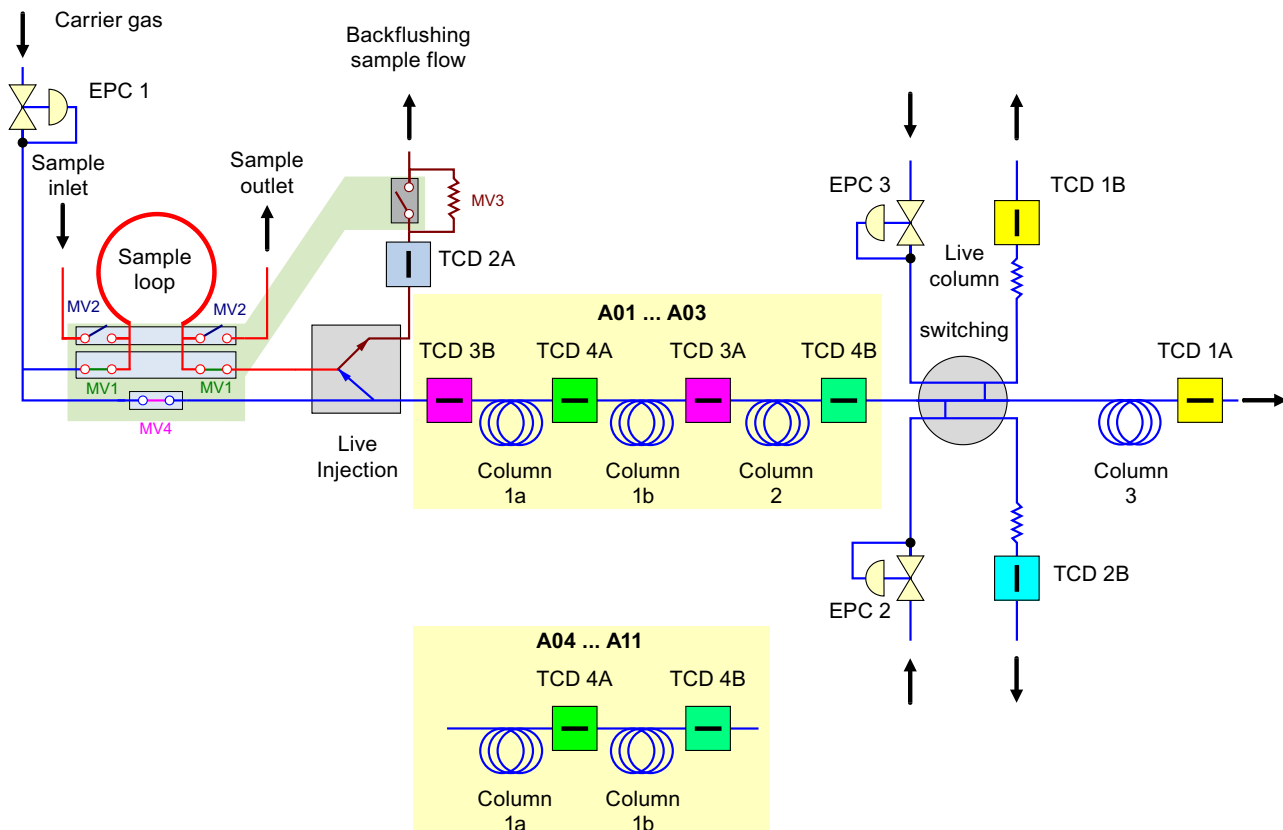
*) Modules of type A can also be used. It is necessary to modify the basic device in this case. The corresponding procedure can be found in Section Conversion of MicroSAM basic device AS09 (Page 94).

3.6.1 Gas flow charts

As of AS09, the MicroSAM gas chromatograph is manufactured as two versions: **Live** and **eLive**.

Solenoid valves control the respective functions in the multi-membrane valve.

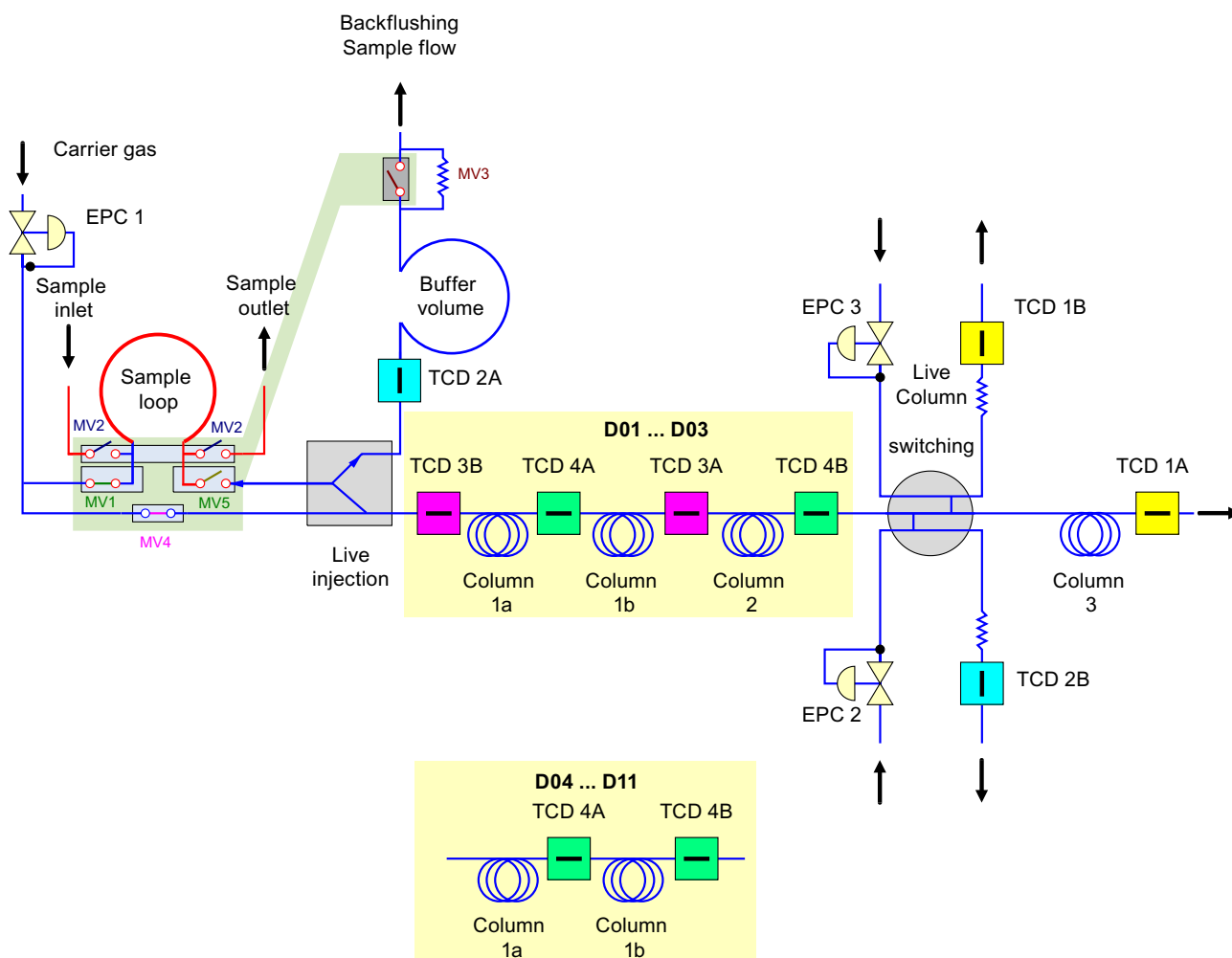
Gas flow chart for analysis modules A01 - A11 (live injection)



Solenoid valve 1 (MV1)	Membrane valve function 1: "Bring sample loop to pressure of EPC 1, and purge"
Solenoid valve 2 (MV2)	Membrane valve function 2: "Purge sample loop with sample"
Solenoid valve 3 (MV3)	Membrane valve function 3: "Empty sample loop completely"
Solenoid valve 4 (MV4)	Membrane valve function 4: "Inject"
EPC	Electronic pressure control
TCD	Thermal conductivity detector

Figure 3-5 Analysis module of type A with live injection

Gas flow chart for analysis modules D01 - D11 (eLive injection)



Solenoid valve 1 (MV1)	Membrane valve function 1: "Bring sample loop to pressure of EPC 1"
Solenoid valve 2 (MV2)	Membrane valve function 2: "Purge sample loop with sample"
Solenoid valve 3 (MV3)	Membrane valve function 3: "Empty sample loop completely"
Solenoid valve 4 (MV4)	Membrane valve function 4: "Inject"
Solenoid valve 5 (MV5)	Membrane valve function 5: "Purge sample loop"
EPC	Electronic pressure control
TCD	Thermal conductivity detector

Figure 3-6 Analysis module of type D with eLive injection

3.6.2 Analysis module

Analysis module

- All analysis modules contain live injection (Live-D) and live column switching (Live-T).
- The analysis modules of series D have eLive injection.
- From product version 05 (ES05) onwards, the system for numbering the columns has been changed.

Analysis modules up to ES04

The analysis modules up to ES04 are suitable for separating the following components:

	TS 1a components				TS 1b components			TS 2 components			TS 3 components		
A01	Injection	TCD	Sil5 C6+	TCD	Sil5 C3, C4, C5	TCD	Porabond Q CO2, C2, H2S, H2O	TCD	Live	Molecular filter H2, (Ar+O2), N2, C1, CO	TCD		
A02	Injection	TCD	Quartz glass	TCD	Sil5 C5+	TCD	SilicaPLOT C2, C3, C4 (saturated, unsaturated), C5+	TCD	Live	Molecular filter H2, (Ar+O2), N2, C1, CO	TCD		
A03	Injection	TCD	Quartz glass	TCD	Sil5 C5+	TCD	Wax Polar volatile components, alcohols, ether, ketones, aldehydes, C7+	TCD	Live	Molecular filter C1, C2, C3, C4 (saturated, unsaturated)	TCD		

Figure 3-7 Analysis modules A01 to A03 up to ES04

	TS 1a components			TS 1b components			TS 2 components		
A04	Injection	Fused silica	TCD	Wax	TCD	Live	SilicaPLOT	TCD	
				Polar volatile components: alcohols, ether, ketones, aldehydes, C7+			All components except molecular filter components		
A05	Injection	Fused silica	TCD	Wax	TCD	Live	Wax	TCD	
				Polar aromatic and aliphatic hydrocarbons			Polar aromatic and aliphatic hydrocarbons		
A06	Injection	Fused silica	TCD	Sil5	TCD	Live	Sil5	TCD	
				Nonpolar aromatic and aliphatic hydrocarbons			Nonpolar aromatic and aliphatic hydrocarbons		
A07	Injection	Fused silica	TCD	Wax	TCD	Live	Sil5	TCD	
				Polar aromatic and aliphatic hydrocarbons			Nonpolar aromatic and aliphatic hydrocarbons		
A08	Injection	Fused silica	TCD	Porabond Q	TCD	Live	Sil5	TCD	
				All components except molecular filter components			H2, (Ar+O2), N2, C1, CO		
A09	Injection	Sil5	TCD	Sil5	TCD	Live	Porabond Q	TCD	
		C6+		C3, C4, C5			All components except molecular filter components		
A10	Injection	Fused silica	TCD	Sil5	TCD	Live	Wax	TCD	
				Nonpolar aromatic and aliphatic hydrocarbons			Polar aromatic and aliphatic hydrocarbons		

Figure 3-8 Analysis modules A04 to A10 up to ES04

3.6 Functions

Analysis modules from ES05 onwards

The analysis modules from ES05 onwards are suitable for separating the following components:

Analysis module	Injection	TCD	TS 1a components	TCD	TS 1b components	TCD	TS 2 components	TCD	Distribution	TS 3 components	TCD
A01/D01	Live-D	3B	CP-Sil 5CB C6+	4A	CP-Sil 5CB C3, C4, C5	3A	CP-Porabond Q CO ₂ , C ₂ , H ₂ S, H ₂ O	4B	Live T	CP-Molsieve 5A H ₂ , (Ar+O ₂), N ₂ , C ₁ , CO	1A
A02/D02	Live-D	3B	CP-Sil 5CB C6+	4A	CP-Sil 5CB C3, C4, C5	3A	CP-SilicaPLOT C ₂ , C ₃ , C ₄ (saturated, unsaturated), C ₅ +	4B	Live T	CP-Molsieve 5A H ₂ , (Ar+O ₂), N ₂ , C ₁ , CO	1A
A03/D03	Live-D	3B	CP-Wax 52CB C6+	4A	CP-Wax 52CB C3, C4, C5	3A	CP-AL203 Polar volatile components, alcohols, ether, ketones, aldehydes, C ₇ +	4B	Live T	CP-AL203 C ₁ , C ₂ , C ₃ , C ₄ (saturated, unsaturated)	1A
A04/D04	Live-D			4A	CP-Wax 52CB 5CB Polar volatile components: alcohols, ether, ketones, aldehydes, C ₇ +			4B	Live T	CP-SilicaPlot All components except molecular filter components	1A
A05/D05	Live-D			4A	CP-Wax 52CB CBSil 5CB Polar aromatic and aliphatic hydrocarbons			4B	Live T	CP-Wax 52CB Polar aromatic and aliphatic hydrocarbons	1A

Figure 3-9 Analysis modules A01/D01 to A05/D05 from ES05 onwards

Analysis module	Injection	TCD	TS 1a components	TCD	TS 1b components	TCD	TS 2 components	TCD	Distribution	TS 3 components	TCD
A06/D06	Live-D			4A	CP-Sil 5CB CBSil 5CB Nonpolar aromatic and aliphatic hydrocarbons			4B	Live T	CP-Sil 5CB Nonpolar aromatic and aliphatic hydrocarbons	1A
A07/D07	Live-D			4A	CP-Wax 52CB 5CB CBSil 5CB Polar aromatic and aliphatic hydrocarbons			4B	Live T	CP-Sil 5CB Nonpolar aromatic and aliphatic hydrocarbons	1A
A08/D08	Live-D			4A	CP-Porabond Q 5CB CBSil 5CB All components except molecular filter components			4B	Live T	CP-Molsieve 5A H ₂ , (Ar+O ₂), N ₂ , C ₁ , CO	1A
A09/D09	Live-D		CP-Sil 5CB C6+	4A			CP-Sil 5CB C3, C4, C5	4B	Live T	CP-Porabond Q All components except molecular filter components	1A
A10/D10	Live-D			4A	CP-Sil 5CB Nonpolar aromatic and aliphatic hydrocarbons			4B	Live T	CP-Wax 52CB Polar aromatic and aliphatic hydrocarbons	1A
A11	Live-D			4A	RTX-5 + RTX-200 Silanes and hydrocarbons			4B	Live T	CP-SilicaPlot All components except molecular filter components	1A

Figure 3-10 Analysis modules A06/D06 to A11/D11 from ES05 onwards

3.6.3 Example of time switching commands

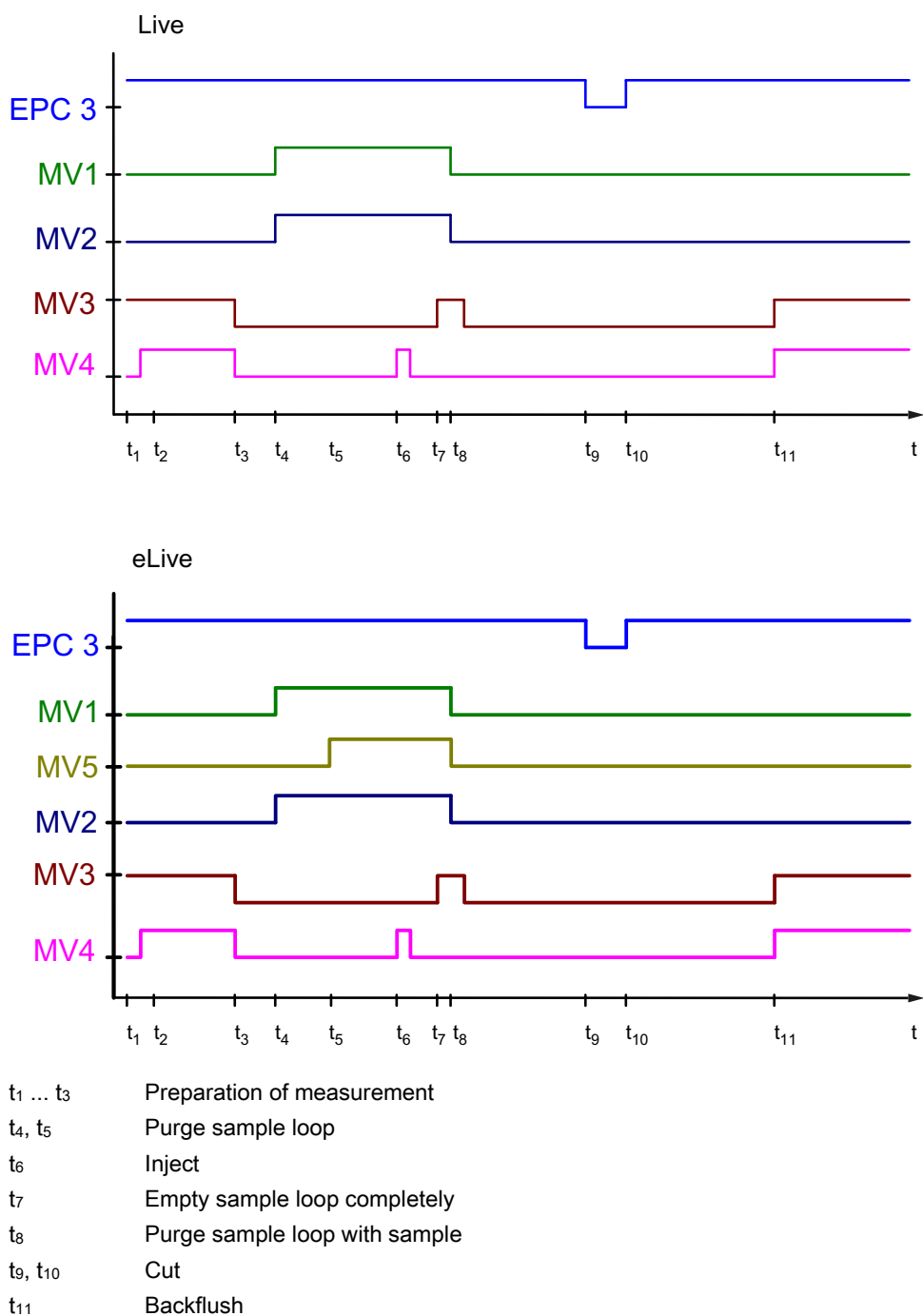


Figure 3-11 Example of time switching commands

3.6.4 Thermal release in the analysis module

A thermal release is fitted in the analysis module. This switches off the power supply for the complete device as soon as the maximum permissible temperature of the analysis module of 155 °C is exceeded.

Note

The thermal release used cannot be reset or replaced. If the thermal release is triggered, you must replace the analysis module.

3.6.5 Measuring sequence

The measuring sequence for live and eLive injection is always as follows:

1. Preparation of measurement (Page 35)
2. Purge sample loop (Page 39)
3. Injecting (Page 41)
4. Empty sample loop completely (Page 43)
5. Purge sample loop with sample (Page 44)
6. Cut - start (Page 45)
7. Cut - end (Page 46)
8. Backflushing (Page 47)

The terms in the following table have been taken from the original English versions of the operating software 'Maxum System Manager' and 'EZChrom'. They are used throughout the Section 'Measuring sequence'.

Abbreviation	Original English term	Further clarification
MV1	Solenoid Valve 1 – "Flush loop" or "Flush loop_1"	Solenoid valve 1 for the function: "Bring sample loop to pressure of EPC 1"
MV2	Solenoid Valve 2 – "Sample"	Solenoid valve 2 for the function: "Purge sample loop with sample"
MV3	Solenoid Valve 3 – "Back flush"	Solenoid valve 3 for the function: "Empty sample loop completely"
MV4	Solenoid Valve 4 – "Injection"	Solenoid valve 4 for the function: "Inject"
MV5	Solenoid Valve 5 – "Flush loop_2"	Solenoid valve 5 for the function: "Purge sample loop"
Column	Capillary Column	Column
CG	Carrier gas	Carrier gas
EPC	Electronic Pressure Control	Electronic pressure control
TCD	Thermal conductivity detector	Thermal conductivity detector
	Live injection	Live injection
	Live switching	Live column switching
	Pulse	Pulse duration in seconds for switch status ON
	ON	ON - switch status on membrane valve ¹⁾
	OFF	OFF - switch status on membrane valve ¹⁾

¹⁾ Logic values used in the operating software.

The following table lists the significance of the colors for the gas lines used in the Section "Measuring sequence".

Color of gas line	Assignment
Red	Sample gas
Blue	Carrier gas
Violet	Mixture of sample gas and carrier gas

Note**Types of solenoid valves**

The membrane valve functions are controlled by solenoid valves. Two types of solenoid valves are used: open when deenergized and closed when deenergized.

Closed when deenergized: MV2 - Sample, MV4 - Injection

Open when deenergized: MV1 - Flush loop, MV3 - Back flush

Open when deenergized: MV1 – Flush loop_1, MV5 – Flush loop_2

Result

The result of the measurement is e.g. a chromatogram with time switching points on detector TCD 2. This chromatogram shows the difference in the two procedures (live and eLive) between the switching points t_4 and t_6 .

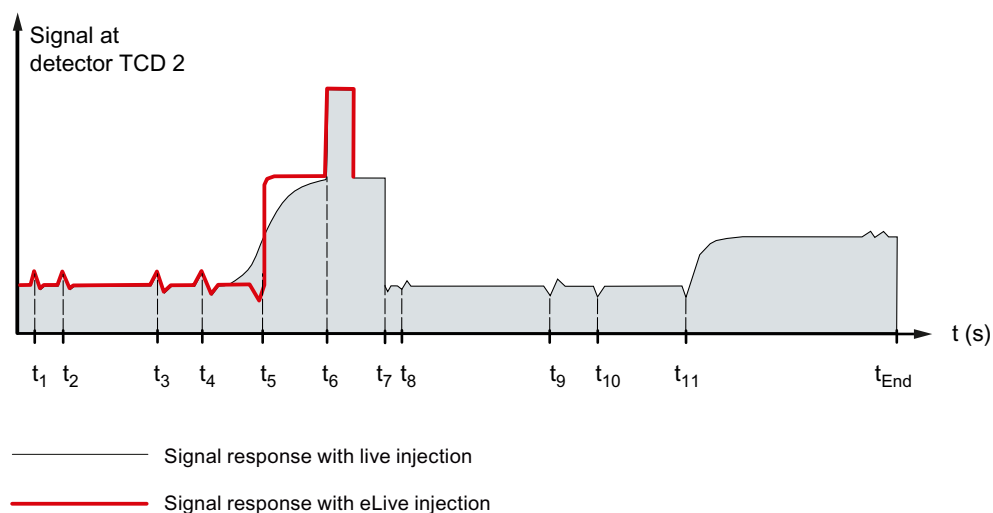


Figure 3-12 Example: chromatogram with time switching points

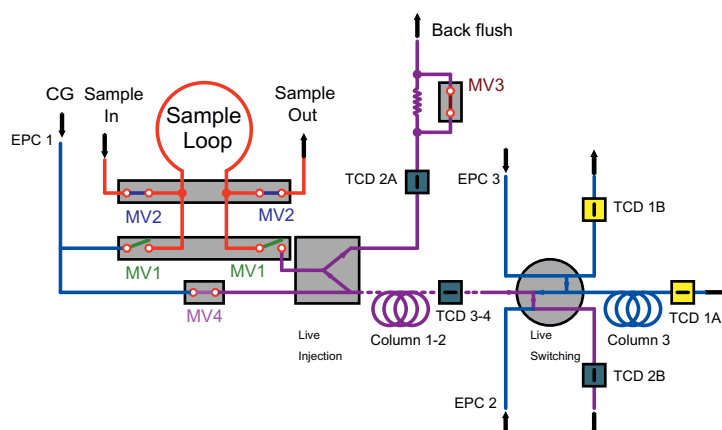
3.6.5.1 Preparation of measurement

Note**Time switching points**

The time switching points shown on the following pages all depend on the type of application. Only the time switching point t_6 for the injection is always **zero**.

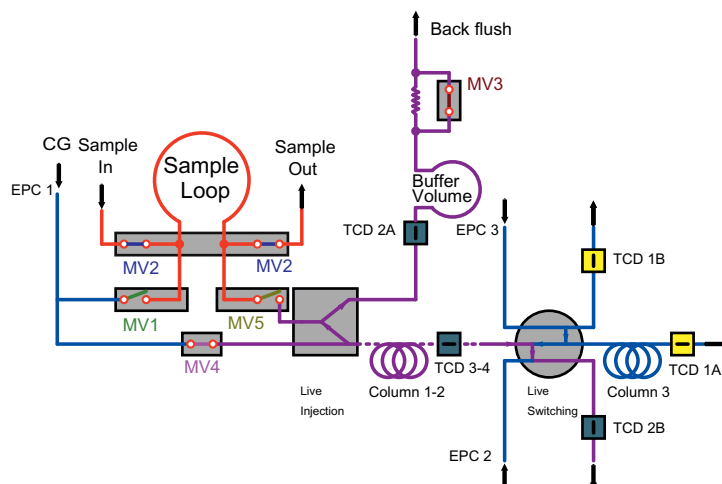
Time switching point $t_1 = -20$ s

Live



MV1	MV2	MV3	MV4
Flush loop	Sample	Backflush	Injection
OFF	OFF	ON	OFF

eLive

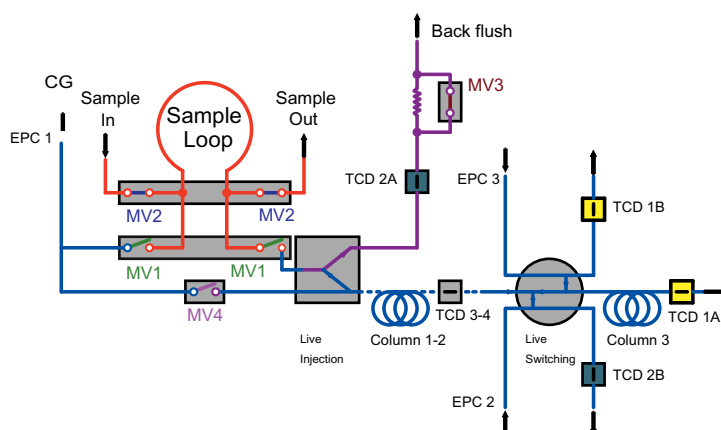


MV1	MV2	MV3	MV4	MV5
Flush loop_1	Sample	Backflush	Injection	Flush loop_2
OFF	OFF	ON	OFF	OFF

Backflushing of system

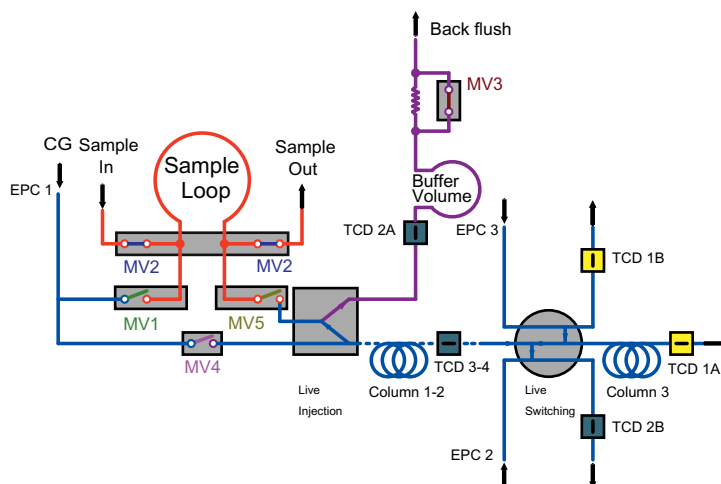
Time switching point $t_2 = -19$ s

Live



MV1	MV2	MV3	MV4
Flush loop	Sample	Backflush	Injection
OFF	OFF	ON	ON

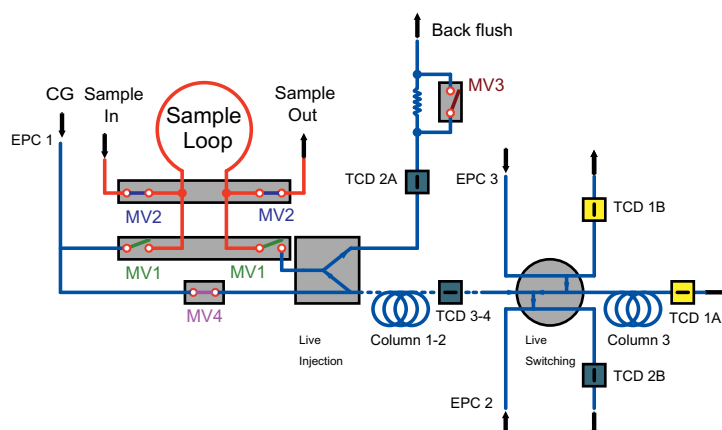
eLive



MV1	MV2	MV3	MV4	MV5
Flush loop_1	Sample	Backflush	Injection	Flush loop_2
OFF	OFF	ON	ON	OFF

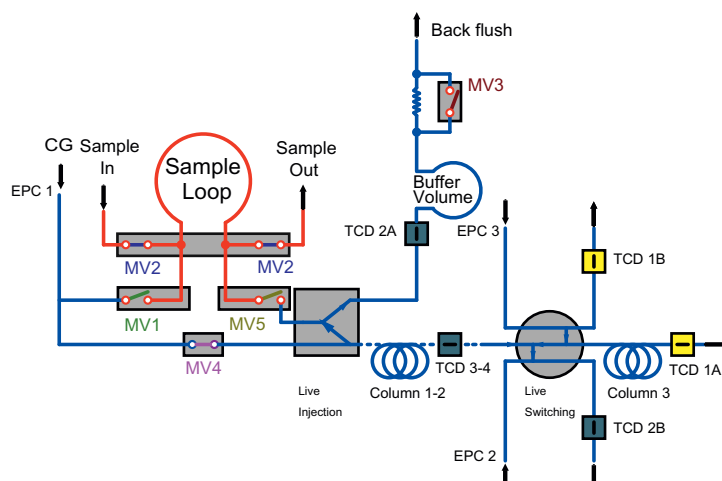
Time switching point $t_3 = -13$ s

Live



MV1	MV2	MV3	MV4
Flush loop	Sample	Backflush	Injection
OFF	OFF	OFF	OFF

eLive

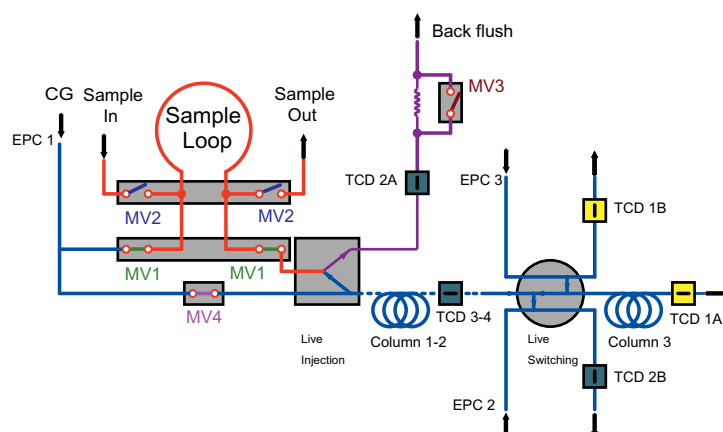


MV1	MV2	MV3	MV4	MV5
Flush loop_1	Sample	Backflush	Injection	Flush loop_2
OFF	OFF	OFF	OFF	OFF

3.6.5.2 Purge sample loop

Live

Time switching point $t_4 = -10$ s. The contents of the sample loop are transferred to the outlet "Backflush" by means of the live injection.

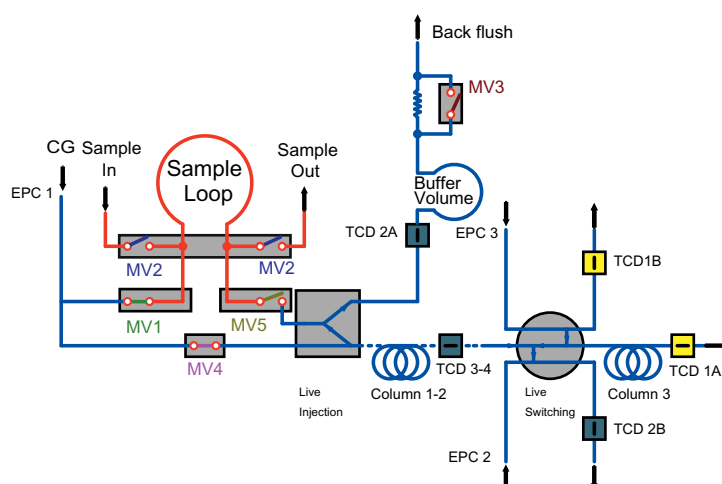


MV1	MV2	MV3	MV4
Flush loop	Sample	Backflush	Injection
ON	ON	OFF	OFF

eLive

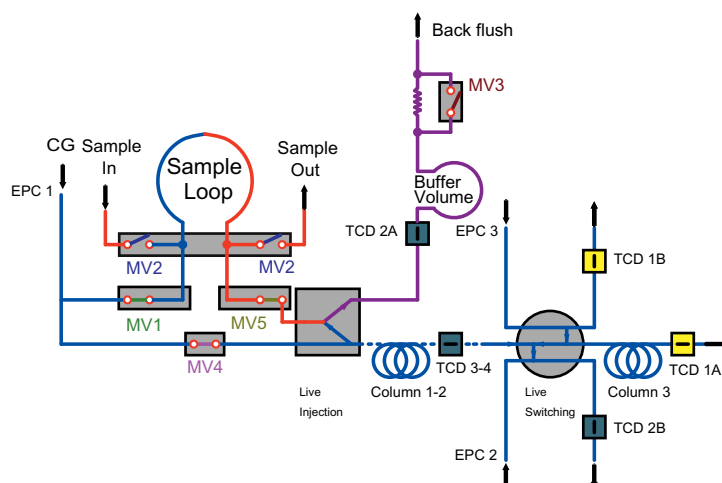
In this version, the procedure is carried out in two steps at different times:

Step - 1 - time switching point $t_4 = -10$ s: The contents of the sample loop are set to the pressure level of the carrier gas via MV1.



MV1	MV2	MV3	MV4	MV5
Flush loop_1	Sample	Backflush	Injection	Flush loop_2
ON	ON	OFF	OFF	OFF

Step 2 - time switching point $t_5 = -4$ s: The contents of the sample loop are transferred to the outlet "Backflush" by means of MV5 and the live injection.

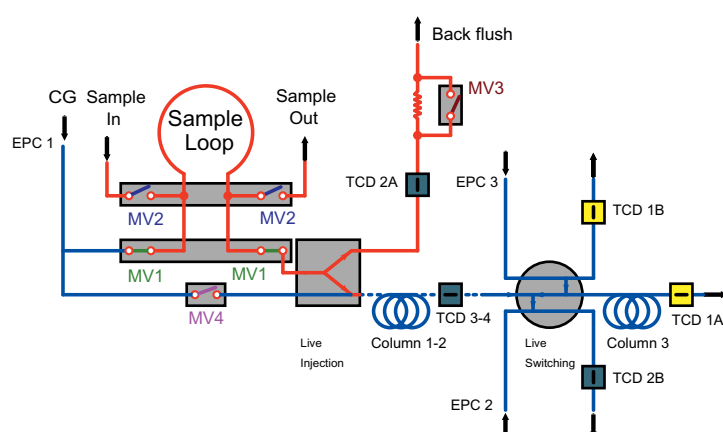


MV1	MV2	MV3	MV4	MV5
Flush loop_1	Sample	Backflush	Injection	Flush loop_2
ON	ON	OFF	OFF	ON

3.6.5.3 Injecting

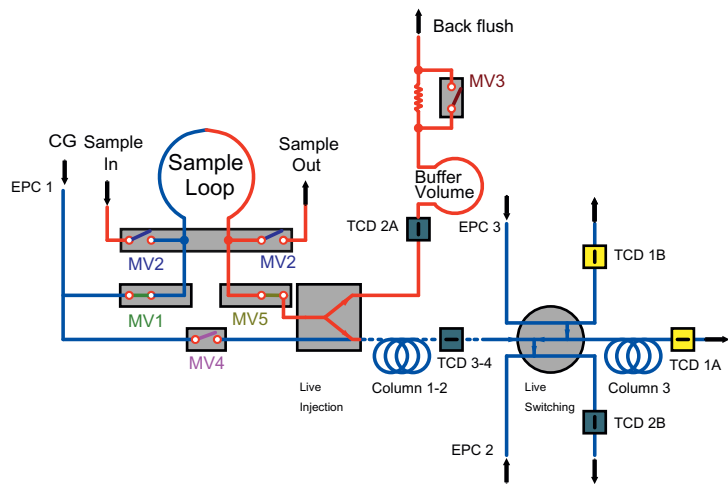
Injection time switching point $t_6 = 0$ s: A small quantity from the sample loop is directed onto the column system. This quantity can be changed by varying the pulse duration of the injection valve.

Live



MV1	MV2	MV3	MV4
Flush loop	Sample	Backflush	Injection
ON	ON	OFF	ON / Pulse

eLive

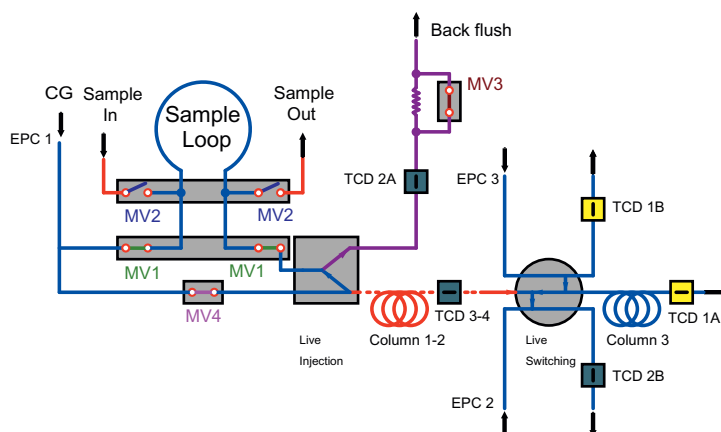


MV1	MV2	MV3	MV4	MV5
Flush loop_1	Sample	Backflush	Injection	Flush loop_2
ON	ON	OFF	ON / Pulse	ON

3.6.5.4 Empty sample loop completely

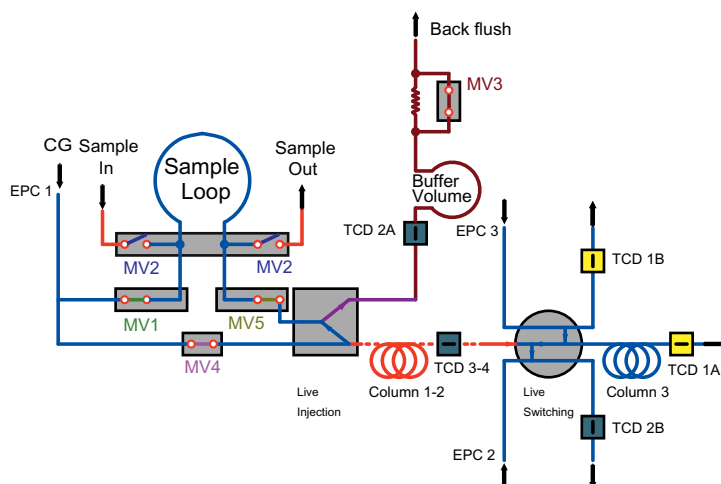
Time switching point $t_7 = 1.5$ s: Following an injection, the injection loop is briefly emptied via membrane valve function 3 (Backflush).

Live



eLive

MV1	MV2	MV3	MV4
Flush loop	Sample	Backflush	Injection
ON	ON	ON / Pulse 0.2 s	OFF

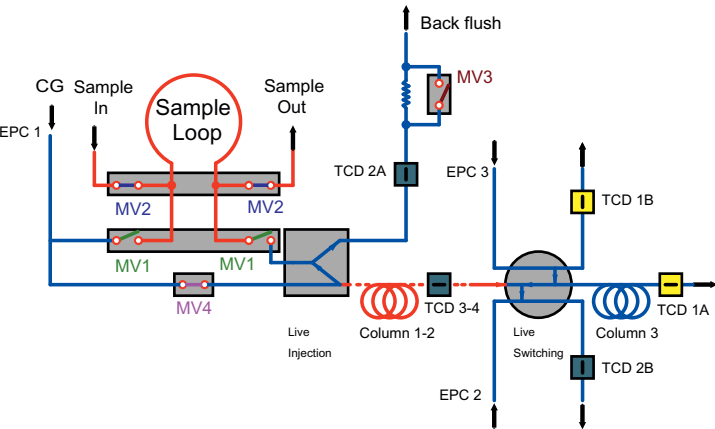


MV1	MV2	MV3	MV4	MV5
Flush loop_1	Sample	Backflush	Injection	Flush loop_2
ON	ON	ON / Pulse 0.2 s	OFF	ON

3.6.5.5 Purge sample loop with sample

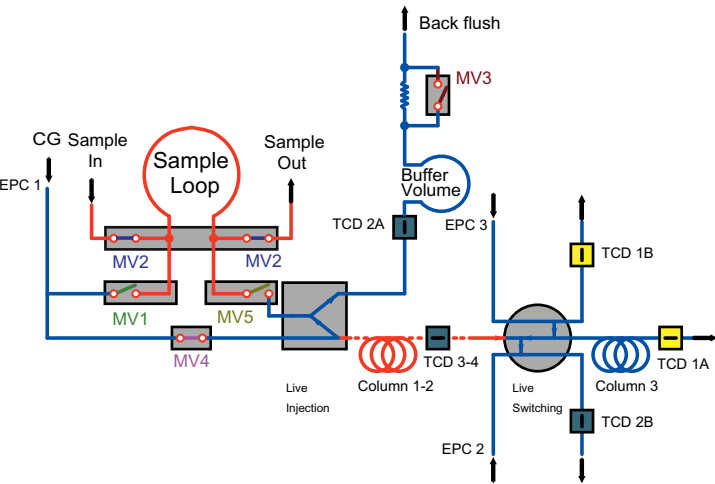
Time switching point $t_8 = 1.7$ s: The sample loop is filled with a new sample.

Live



MV1	MV2	MV3	MV4
Flush loop	Sample	Backflush	Injection
OFF	OFF	OFF	OFF

eLive

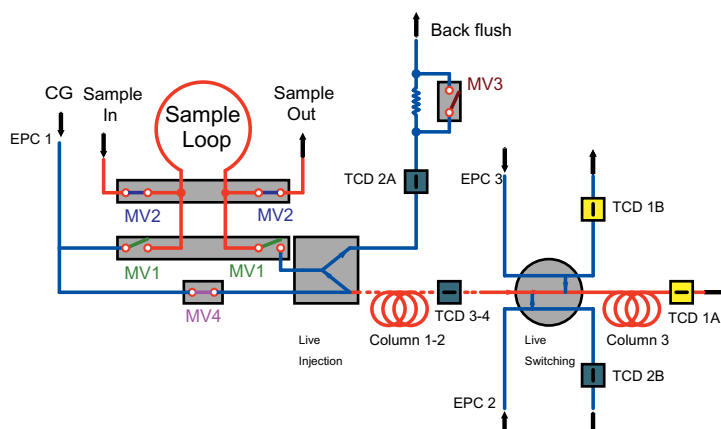


MV1	MV2	MV3	MV4	MV5
Flush loop_1	Sample	Backflush	Injection	Flush loop_2
OFF	OFF	OFF	OFF	OFF

3.6.5.6 Cut - start

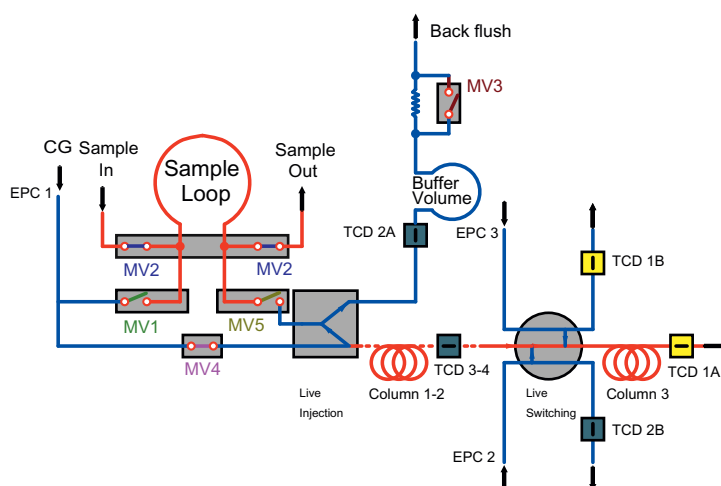
The time switching point t_9 depends on the application: By reducing the pressure on the electronic pressure control EPC 3, the sample components are transferred by live switching into column 3.

Live with pressure EPC 3 < pressure EPC 2



MV1	MV2	MV3	MV4
Flush loop	Sample	Backflush	Injection
OFF	OFF	OFF	OFF

eLive with pressure EPC 3 < pressure EPC 2

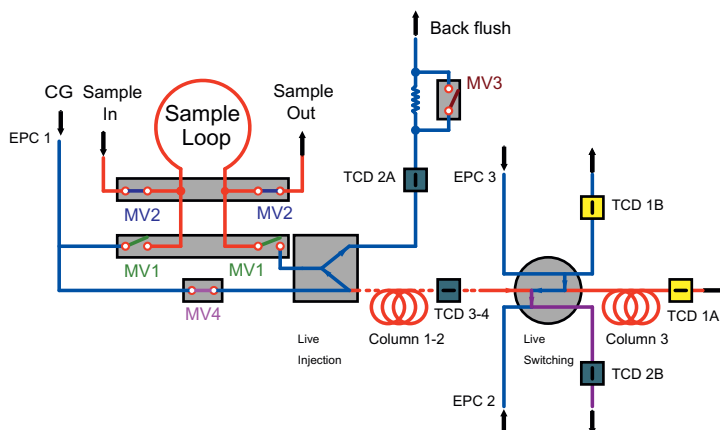


MV1	MV2	MV3	MV4	MV5
Flush loop_1	Sample	Backflush	Injection	Flush loop_2
OFF	OFF	OFF	OFF	OFF

3.6.5.7 Cut - end

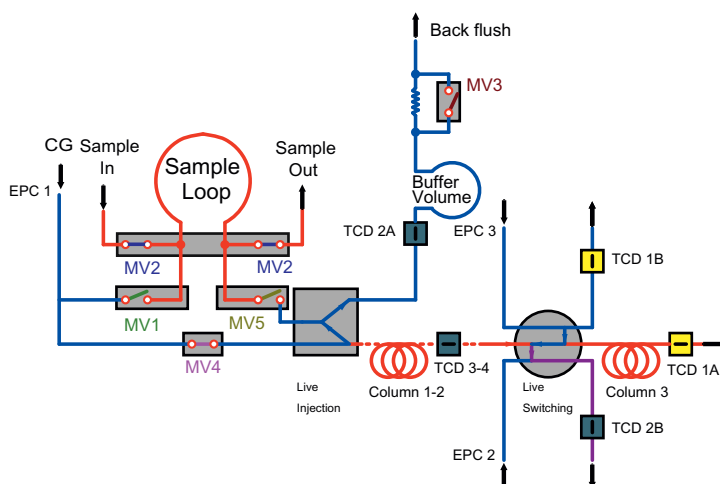
The time t_{10} depends on the application: By increasing the pressure on the electronic pressure control EPC 3, the gas components still present on column 2 are **not** transferred by live switching into column 3 but are purged via TCD 2B to the outlet of the analysis.

Live with pressure EPC 3 > pressure EPC 2



MV1	MV2	MV3	MV4
Flush loop	Sample	Backflush	Injection
OFF	OFF	OFF	OFF

eLive with pressure EPC 3 > pressure EPC 2

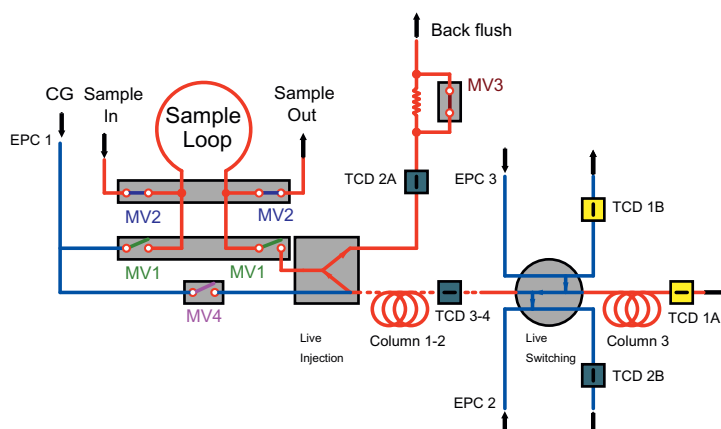


MV1	MV2	MV3	MV4	MV5
Flush loop_1	Sample	Backflush	Injection	Flush loop_2
OFF	OFF	OFF	OFF	OFF

3.6.5.8 Backflushing

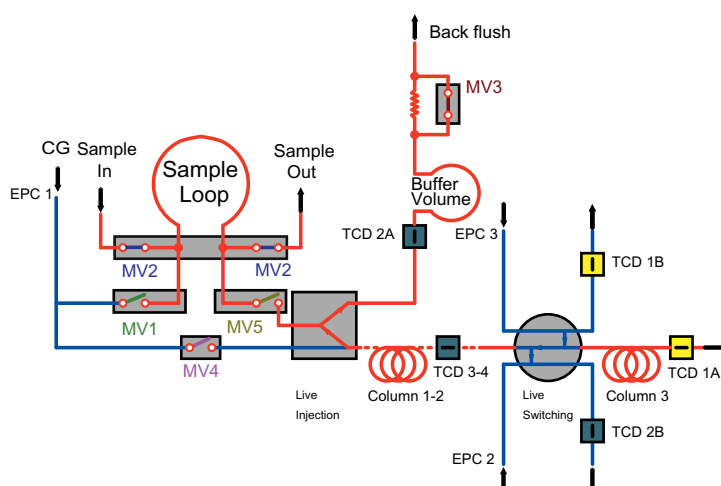
The time switching point t_{11} depends on the application: The contents of columns 1-2 are purged backwards via the outlet "Backflush". This step continues until the gas components which are still present are purged out of columns 1-2.

Live



MV1	MV2	MV3	MV4
Flush loop	Sample	Backflush	Injection
OFF	OFF	ON	ON

eLive



MV1	MV2	MV3	MV4	MV5
Flush loop_1	Sample	Backflush	Injection	Flush loop_2
OFF	OFF	ON	ON	OFF

Description

3.6 Functions

The measuring cycle is finished when all components have left the column system.

Note

Check that all components which have been backflushed have left the column system.

3.6.6 Cut - check

During the cut (t_{10} to t_{11}), part of the sample is transferred from column 2 to column 3, e.g. in the period from 29 s to 37 s (dashed line in the illustration).

The following illustration shows the signal response at the detectors TCD 4B, TCD 1B and TCD 2B.

The components still present in column 2 are purged following the cut via TCD 2B to the outlet.

You can check the setting of the live column switching at TCD 1B and TCD 2B during the cut.

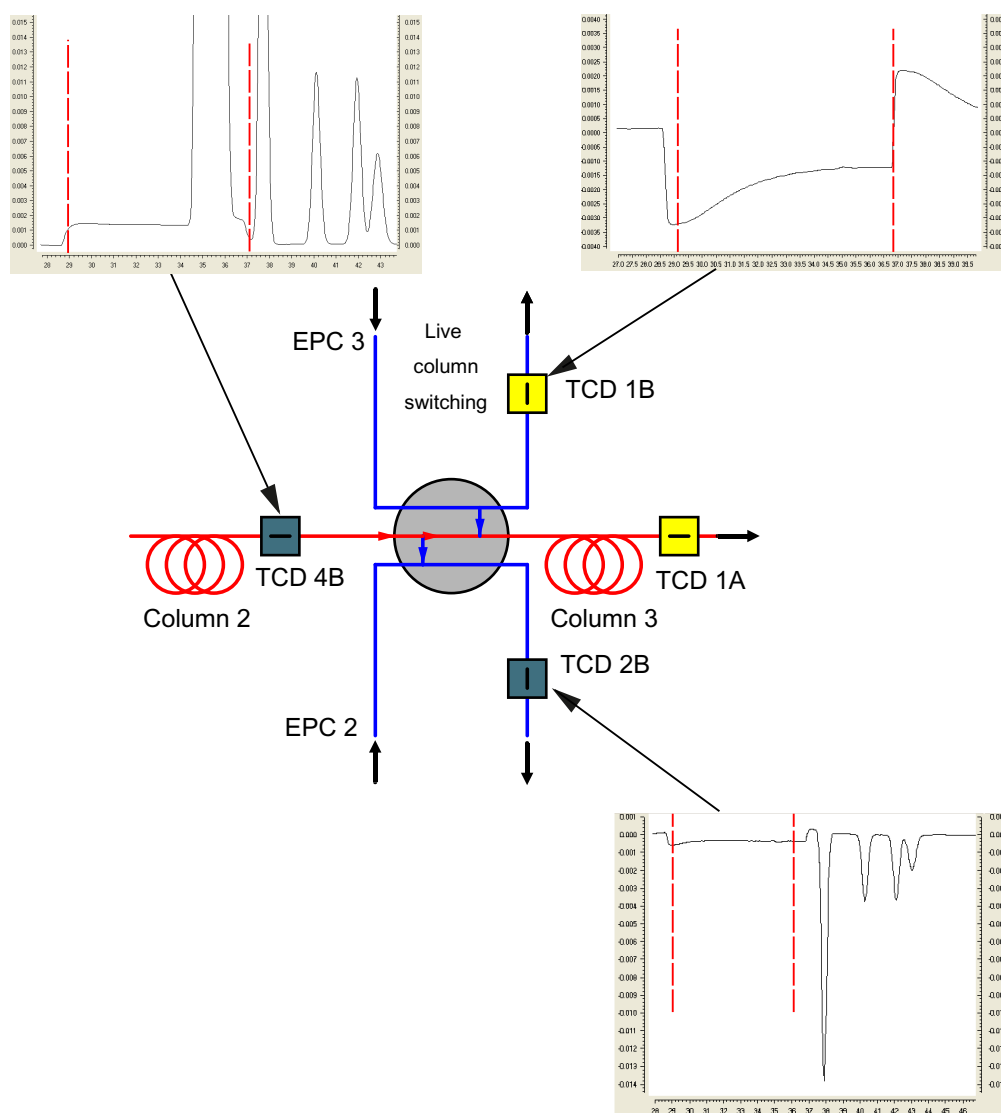


Figure 3-13 Cut - check

3.6.7 Backflushing - check

The components which are still present in columns 1 and 2 are removed from the analytical system by the backflush process. Checking of the backflushed components is carried out at TCD 2A.

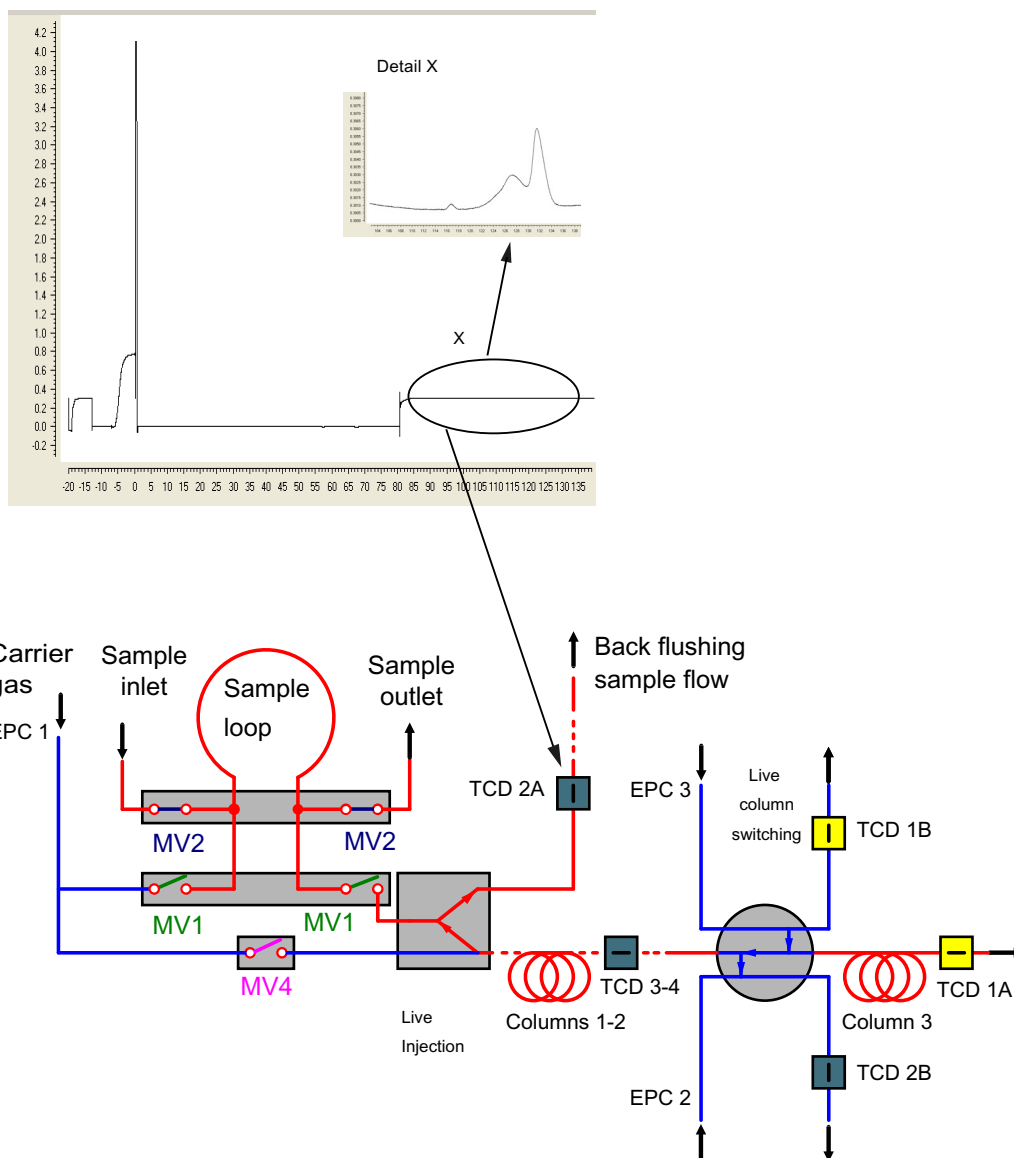


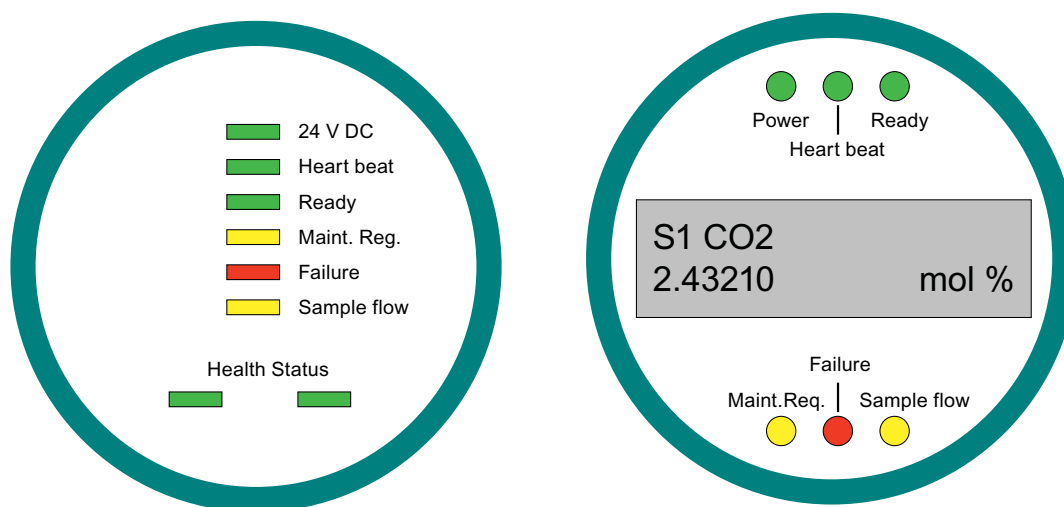
Figure 3-14 Backflushing - check

3.6.8 Monitoring of the chromatograph functions

The gas chromatograph is a measuring instrument for determining the concentration of selected components in a process gas. The intended use of the device includes checking of correct functioning at regular intervals.

Display

Up to release version 4, the display consists of 8 LEDs. From release version 5 onwards, the display consists of an alphanumeric display and 6 LEDs.



Display up to and including release version 4

Display from release version 5 onwards

Note

Release version

You can find the release version of your gas chromatograph on the rating plate under "AS".

The **LEDs** behind the inspection window of your chromatograph provide you with an initial overview of the status of your gas chromatograph. They have the following meanings:

LED	Meaning if the LED lights up
Power	24 V supply voltage present.
Heartbeat	Software sign-of-life
Ready	Chromatograph is ready.
Maint. Req.	Chromatograph has a maintenance request.
Failure	Chromatograph has an alarm.
Sample flow	No sample flow
Health status (left)	Ethernet connection has been established.
Health status (right)	Communication is taking place.

The **text box** displays the following information:

1. Sample stream: S1, S2, S3, S4
2. Sample components: e.g. CO₂, propane etc.
3. Measured value of sample as numeric value

3.6.9 Temperature control systems

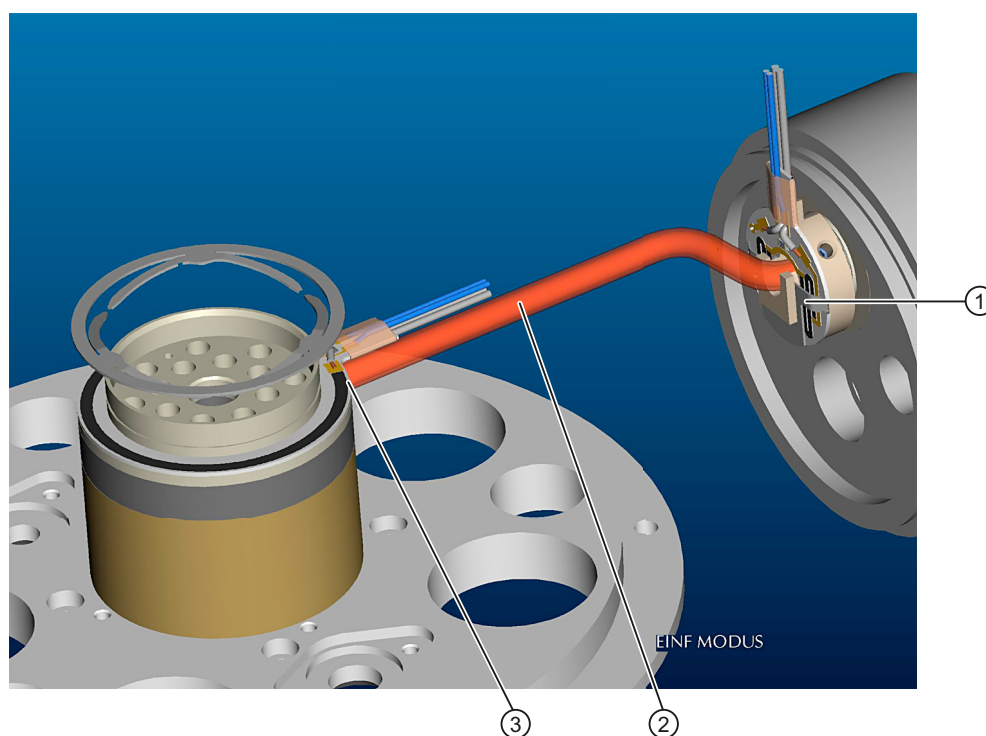
Previously available temperature control systems

The device previously featured three temperature control systems:

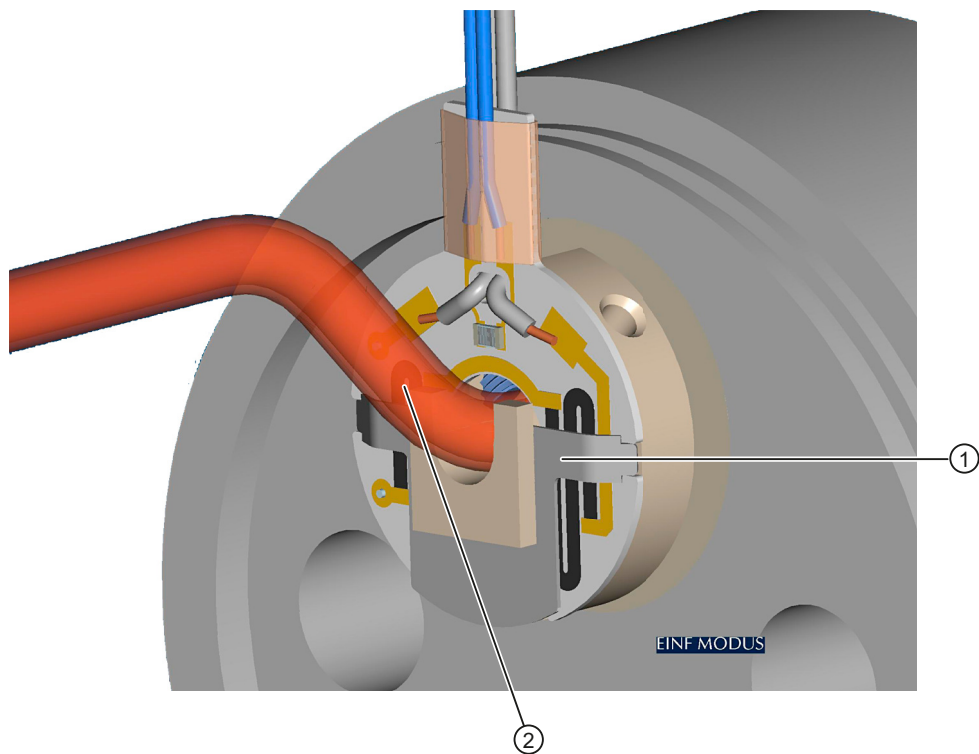
- Two temperature control systems heated the column and the detectors. They are located in the analysis module.
- The third temperature control system heated the pneumatic connectors.

Additional fourth temperature control system

The fourth temperature control system is located on devices as of release version 10 at the sample inlet of the MicroSAM:



- ① Fourth temperature control system at the sample inlet
- ② Sample path in the heated copper tube
- ③ Access to the pneumatic connector



- ① Fourth temperature control system at the sample inlet
- ② Sample path in the heated copper tube

Why an additional temperature control system?

Depending on the dew point of the process sample, condensate can form in the sample path. This can result in destruction of the analysis module.

From the entrance to the enclosure of MicroSAM, the preheated sample is thermostatically controlled to the correct temperature by the additional temperature control system. The sample path is heated by the additional temperature control system.

Mounting

4.1 On-site requirements

⚠ WARNING

Explosion hazard

Only make the terminal connections and only close the device when it is disconnected from the supply.

Only start up the device when it has been correctly connected and when the housing has been closed.

⚠ WARNING

Use in non-hazardous areas

Make the Ex symbol permanently illegible if the device is used in non-hazardous areas.

It is essential to observe the following conditions:

- Permissible ambient temperature from -20 to +55 °C
- Maximum permissible relative humidity 90%
- 24 V DC supply voltage
- Use of appropriate lightning protection equipment
- Grounding must be possible
- Use of gas connections and the gas purity requirements as described in sections Gas lines (Page 58) and Sample lines (Page 59).
- Protection against direct solar radiation, even when the sun is low

4.2 Space requirement

The spacing from a wall or the next chromatograph must be at least 300 mm on both sides.

The spacing from the ceiling and floor must be at least 200 mm.

4.3 Fixing

The gas chromatograph is supplied preassembled on a metal bracket.

The device is:

- Secured using four screws through four holes in the metal bracket.
- Secured using two screws through the two elongated holes in the metal bracket to allow simple removal.

NOTICE

Note the correct mounting position

The chromatograph must always be mounted horizontally with the analysis module at the top. When mounted correctly, the technical specifications are guaranteed, and the text can be read in the inspection window.

If you wish to mount the chromatograph in a different position, please first contact Siemens AG servicing personnel.

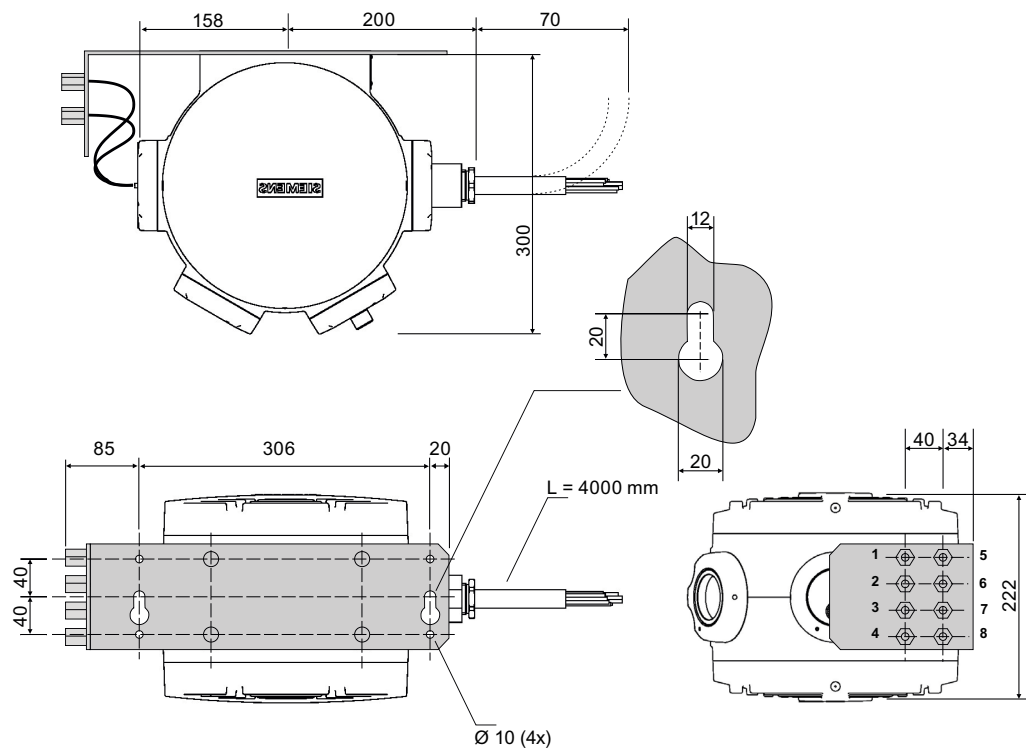


Figure 4-1 Gas chromatograph mounting

4.4 Mounting and connecting

4.4.1 Requirements for mounting:

The following are essential for mounting:

- Gas lines, sample lines, exhaust gas lines
- Power switch, line fuse, power cable
- Equipotential bonding cable
- Communications cable

CAUTION
Do not remove the dummy plug prior to startup • Leave the dummy plugs on the gas inputs until you start up the chromatograph. • Check the correct functioning of the gas lines before you connect them to the chromatograph!

CAUTION
Destruction of the thermal conductivity detectors • Only use the carrier gas specified in the device documentation! The thermal conductivity detectors could be destroyed. • Do not operate the thermal conductivity detectors with bridge voltages higher than those specified in the application data. The bridge voltages must be optimized at minimum values in order to guarantee a long service life for the thermal conductivity detectors. The maximum bridge power is 70 mW for helium.

Note

Increasing the detection limit

If you are satisfied with a shorter service life for a thermal conductivity detector, you can increase the maximum bridge power to more than 70 mW for helium.

Before increasing the bridge power, please first contact Siemens AG servicing personnel.

4.4.2 Gas lines

The gas lines are made of stainless steel with a 3 mm Ø (1/8").

- Use only very clean gas lines suitable for chromatography.
- Connect the gas lines to the gas chromatograph according to the piping diagram.
- Connect a stop valve upstream of each gas input to the gas chromatograph.

Gas connections on the gas chromatograph

- All gas inlets and outlets: Swagelok 1/8".
- The gas inlets and outlets are numbered.

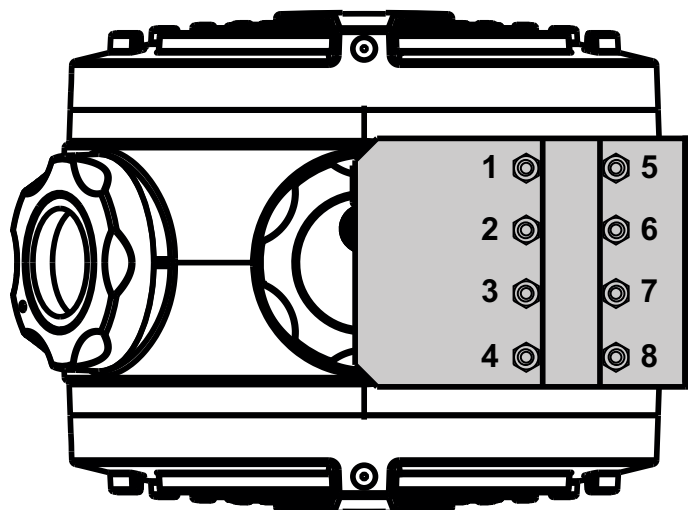


Figure 4-2 Gas connections

Number	Description	Comment
1	Analysis module output	Heated
2	Analysis module output	Heated
3	Sample	Heated
4	Sample	Heated
5	Carrier gas input	Not heated
6	Output from pneumatic connectors	Not heated
7	Discharge of control medium for solenoid valves and EPC flow inserts	Not heated
8	Reserved	Unheated, closed

Note

All device-specific piping and wiring diagrams are enclosed with the device in accordance with the order.

NOTICE

Shortening the preassembled gas lines between the housing and the mounting bracket will void the explosion protection for the gas chromatograph.

CAUTION**Do not remove the adapters**

- Filters are integrated in the connections for the sample stream and carrier gas.
- The adapters at gas connections 3, 4, 5 and 8 contain a R60 filter (order no. C70211-A1677-C56) pressed into the screwed gland, and must not be removed.

4.4.3

Sample lines

- Fit the sample preparation equipment as close as possible to the chromatograph so that the connection lines are short.
- The sample line to the chromatograph must have a downward gradient.

NOTICE**Filter for microdiaphragm valves**

The microdiaphragm valves have a shorter life if the sample contains particulates.

In such cases, a filter is required as part of the sample preparation equipment.

We recommend a filter with a degree of separation for a gaseous sample of 99.99% for 1.0 µm particles.

The sample preparation equipment from Siemens AG contains such filters.

4.4.4 Exhaust gas lines

All exhaust gases from the chromatograph must be routed into a common line. The individual exhaust gas lines must have a downward gradient to the common line. They must not have a diminishing diameter.

Material of the common exhaust gas line

Stainless steel piping:

- Inner diameter of at least 12 mm (1/2")
- With welded stubs and screwed glands
- With a gradient of at least 10%.

4.4.5 Equipotential bonding cable/grounding

An equipotential bonding cable is required for explosion-proof chromatographs irrespective of the local installation guidelines. Independent thereof, the chromatograph housing must be grounded for electromagnetic compatibility reasons.

Procedure

1. Connect the grounding screw (symbol $\perp$) at the bottom right on the chromatograph to a central grounding point. The permissible cable cross-section is 2.5 mm² to 6 mm².
2. It is essential to provide a contact washer between the cable lug and housing. The connection must be made in the following sequence:
 - Housing
 - Contact washer
 - Cable lug
 - Washer
 - M6 screw

4.4.6 Lightning protection

We recommend the installation of appropriate lightning protection equipment for the protection of personnel and devices!

4.4.7 Installing the communications cable

Type of cable

Siemens AG recommends twisted-pair cables, 0.14 mm² (AWG 26).

 CAUTION
Protection against explosion
All cores must be connected in the terminal box.

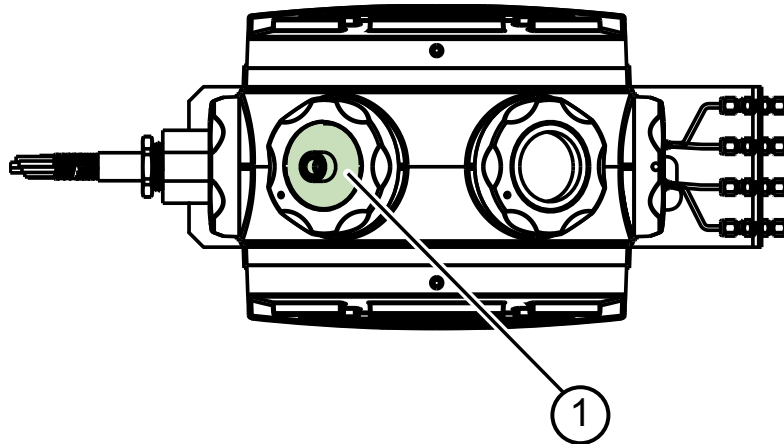
Core color	Description	Comment	
		Mounting with hub ¹⁾	Mounting without hub ²⁾
Violet	RS232 RxD / RS485 B+		
Black	RS232 TxD / RS485 A-		
Gray/pink	RS232 / RS485 shield		
Red/blue	RS232 / RS485 GND		
Brown/green	Ethernet 10BaseT TX+	Ethernet cable: Orange/white	Ethernet cable: Green/white
White/green	Ethernet 10BaseT TX-	Ethernet cable: Orange	Ethernet cable: Green
White/yellow	Ethernet 10BaseT RX+	Ethernet cable: Green/white	Ethernet cable: Orange/white
Yellow/brown	Ethernet 10BaseT RX-	Ethernet cable: Green	Ethernet cable: Orange

¹⁾ Standard EIA/TIA-T568A assignment

²⁾ Standard EIA/TIA-T568B assignment

4.4.8 Breathing device

The breathing device is used for pressure compensation during operation. Pressure compensation is required due to temperature variations during operation



① Breathing connector

Figure 4-3 Breathing device

Danger

DANGER

Danger of explosion through discharged gases

In the event of a fault, all gases supplied to the chromatograph (also samples and hydrogen as carrier gas) can be discharged via the breathing connector or a connected line. In such a case, there is a danger to personnel, equipment and the environment!

- For this reason, take appropriate measures to prevent this.
- Never connect the breathing connector to the exhaust gas system.

WARNING

Do not close off the breathing device

Ensure that the breathing device is not closed during operation, otherwise:

- Pressure compensation is no longer carried out.
- Ex protection is no longer guaranteed.
- Housing protection IP65 is only guaranteed if the pipeline connected to ① ends in a room which contains neither splashing water nor dust.

! DANGER**Danger of explosion through discharged gases**

In the event of a fault, all gases supplied to the chromatograph (also samples and hydrogen as carrier gas) can be discharged via the breathing connector or a connected line. In such a case, there is a danger to personnel, equipment and the environment!

For this reason, take appropriate measures to prevent this.

Never connect the breathing connector to the exhaust gas system.

4.4.9 Power switch and fuse

The gas chromatograph does not have a power switch. Therefore install an external power switch with a switching capacity of min. 2.5 A and a slow-blow fuse with a rating of 2.5 A.

Note

Fit the power switch such that it is readily accessible during operation.

4.4.10 Fitting the power cable

The chromatograph is supplied with a 4-m long cable. The cable has a diameter of 18 mm.

Connect **all** cores of the power supply in accordance with the following table since one single core is insufficient for the maximum current. The cable must be securely routed and terminate in a terminal box with approved type of protection.

Appropriate cable gland: M32 with a terminal areas from 13 to 21 mm.

Core color	Description
White	+24 V DC
Brown	+24 V DC
Green	+24 V DC
Yellow	+24 V DC
Gray	GND 24 V DC
Pink	GND 24 V DC
Blue	GND 24 V DC
Red	GND 24 V DC
Black	⊥

Permissible cable length

The power supply on the chromatograph must be

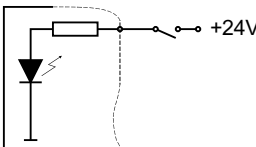
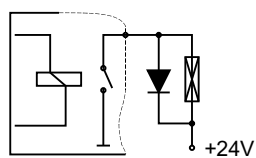
- up to AS07: 24 V DC (-15 ... +10%)
- from AS08 onwards: 24 V DC (18.5 ... 30.2 V)

If the power supply delivers exactly 24 V DC, and if only one chromatograph is connected, the following cable lengths are permissible between the power supply and the chromatograph depending on the cable cross-section (distance = half the cable length):

Core cross-section	Distance
1.5 mm ²	40 m
2.5 mm ²	70 m
4.0 mm ²	110 m
6.0 mm ²	170 m
10.0 mm ²	280 m
16.0 mm ²	450 m

4.4.11 Connecting of digital outputs and digital inputs

The following table is valid for devices from release version 4 onwards.

Core color	Description	Usage	Comment	Circuit diagram
White/gray	Digital input 1+	Sample flow, 24 V DC = OK, 0 V = too low	24 V DC to optocoupler Second connection to +24 V DC	
Gray/brown	Digital input 2+	Application programmable		
White/red	Digital input 3+ or SSSI* SCL-Rx	Application programmable		
Brown/red	Digital input 4+ or SSSI* SDA-Rx	Application programmable		
Brown/blue	Digital output 1+	Application programmable	Relay contact 0.5 A / 100 V / 10 W Second connection to +24 V DC	
White/blue	Digital output 2+	Application programmable		
White/pink	Digital output 3+ or SSSI* SCL-Tx	Application programmable		
Pink/brown	Digital output 4+ or SSSI* SDA-Tx	Application programmable		

* The SSSI signals from devices are available with release version 10. The signals are used, for example, to connect an IO extender (order no. A5E01494354). Refer to the documentation of the IO extender for more on this. If SSSI is not used, the lines are available for their original function as digital inputs and outputs.

The following table is valid for devices up to and including release version 3.

Core color	Description	Usage	Comment
White/gray	Digital output 1+		Relay contact 0.5 A / 100 V / 10 W
Gray/brown	Digital output 1-		
White/red	Digital output 2+		
Brown/red	Digital output 2-		
Brown/blue	Digital input 1+	Sample flow, 24 V DC = OK, 0 V = too low	24 V DC to optocoupler
White/blue	Digital input 1-		
White/pink	Digital input 2+		
Pink/brown	Digital input 2-		

Arc-suppression diode with inductive loads

If you connect inductive loads (e.g. valves) for **digital outputs**, you must connect the arc-suppression diodes in parallel.

Type of cable

Siemens AG recommends twisted-pair cables, 0.14 mm² (AWG 26).

4.4.12 Connecting the HMI device

The gas chromatograph is operated using a PC or laptop.

WARNING

Protection against explosion

- You require a fire permission certificate if you transport a PC or laptop through the hazardous zone.
- Opening the gas chromatograph in the hazardous area with the power supply switched on is only permissible if you have a fire permission certificate.

Connect the Ethernet port of the PC to the corresponding leads of the gas chromatograph (see table Installing the communications cable (Page 61)).

4.4.13 Connecting the HMI device on site (only for servicing purposes)

You must open the chromatograph in order to connect the HMI device for servicing purposes.

Procedure

WARNING

Hazardous area

- You require a fire permission certificate in order to carry out servicing work on the gas chromatograph in a hazardous area.
- Due to the hot components and residual electrical charges in the gas chromatograph, explosions may occur if you open the housing prematurely. A corresponding warning label is present on the device.
It is therefore essential that you wait for at least 65 minutes every time before you open the chromatograph!

Breathing device

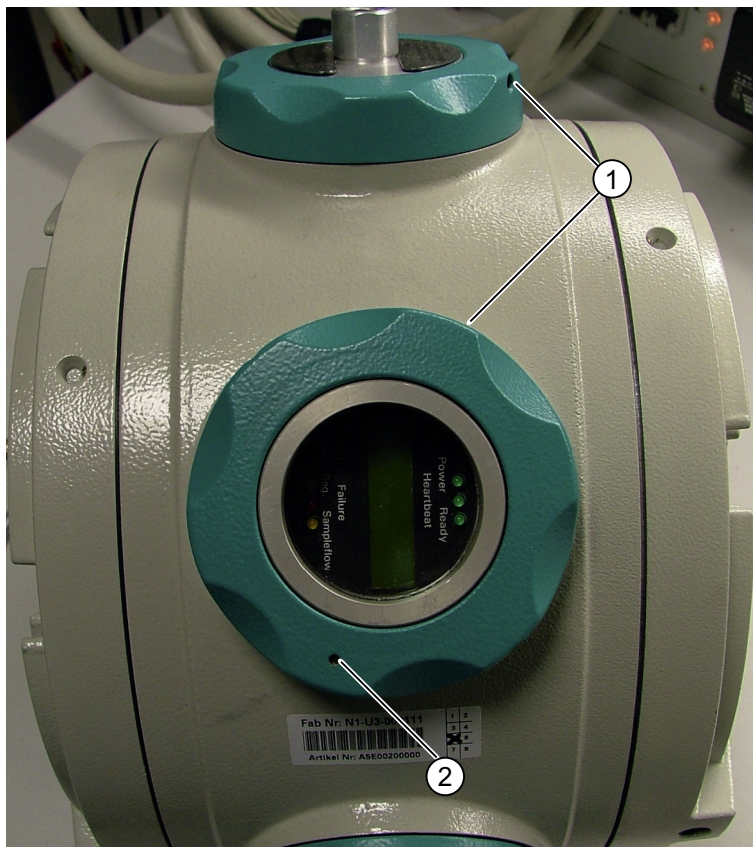
The breathing device must not be closed!

Only use tool to open the cover.

The directives for explosion protection specify that the cover of the chromatograph may only be opened using a tool. These directives are complied with using the hexagon socket-head bolt ②!

1. Loosen the hexagon socket-head bolt SW 1.5 ② on the securing ring of the inspection window.

2. Unscrew the securing ring. If the ring cannot be opened by hand, extend the lever arm. To do this, insert e.g. two appropriate screwdrivers into the holes on the edge of the ring ①.



3. Then carefully lever the insert out of the chromatograph as shown in the following picture.



A 25-contact Sub-D socket becomes visible.

4. Connect the Ethernet connection of the HMI PC to the corresponding pins of the chromatograph according to the following table. If the display board is removed, the Ethernet connection via the standard cable is interrupted.

Pin No.	Description	Comment	
		Mounting with hub ¹⁾	Mounting without hub ²⁾
22	Ethernet 10BaseT TX+	Ethernet cable: Orange/white	Ethernet cable: Green/white
23	Ethernet 10BaseT TX-	Ethernet cable: Orange	Ethernet cable: Green
24	Ethernet 10BaseT RX+	Ethernet cable: Green/white	Ethernet cable: Orange/white
25	Ethernet 10BaseT RX-	Ethernet cable: Green	Ethernet cable: Orange

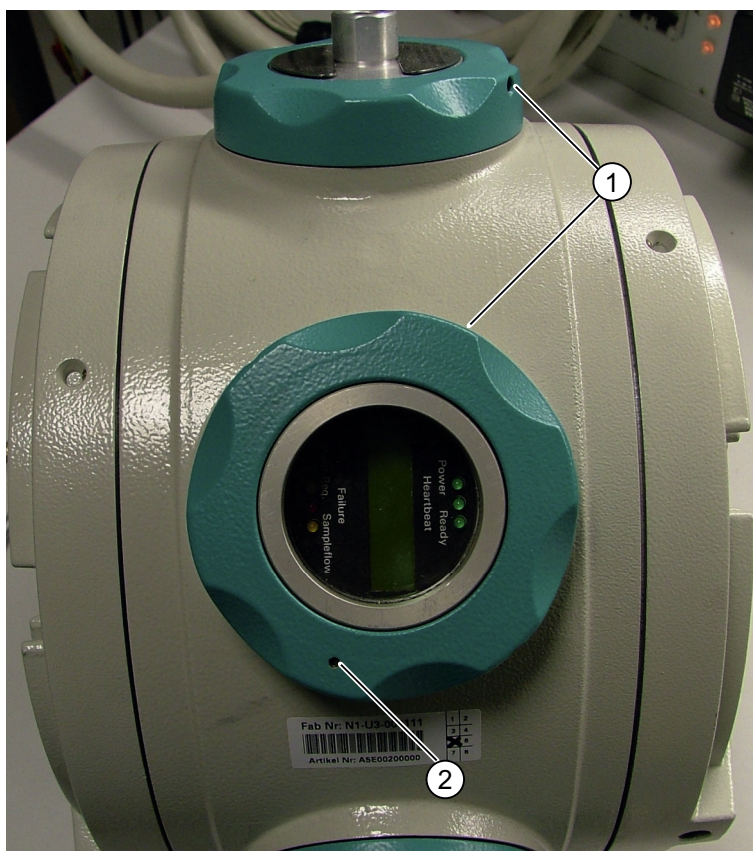
1) Standard EIA/TIA-T568A assignment

2) Standard EIA/TIA-T568B assignment

Following completion of on-site operation

1. Screw in the securing ring as far as possible.

2. Carefully rotate the 1.5 mm hexagon socket-head bolt ② in the ring in the clockwise direction as far as possible.



Commissioning and operation

The following description includes the procedures for starting up and shutting down the device, and the safety aspects which must be observed.

CAUTION

Observe the commissioning sequence!

To avoid damage to the gas chromatograph, carry out all work in the sequence given in these instructions.

Procedure

1. Connection of gas lines (Page 72)
2. Activating the gas supply (Page 72)
3. Switching on the chromatograph (Page 73)
4. Starting the PC and operating software (Page 74)

WARNING

Explosion hazard

- If you commission a gas chromatograph in an environment with an explosive atmosphere, you must observe the directives for explosion protection.
- Switch off the gas chromatograph when carrying out repairs or maintenance as soon as atmospheric air penetrates into it, in other words:
 - When the device is opened.
 - When work is carried out on carrier gas lines and sample gas lines.
- Also disconnect other energy sources, e.g. Ethernet and Modbus, if these do not have an appropriate explosion-proof design.
- You require a fire permission certificate if you transport a PC or laptop through a hazardous zone and/or if you wish to open a chromatograph in zone 1.
- It is essential to observe the information in Section General regulations (Page 12).

5.1 Connection of gas lines

Procedure

1. Remove the dummy plugs from the gas inlets and outlets "1" to "7" of the chromatograph.
2. Connect the exhaust and gas lines according to the piping diagram.

5.2 Activating the gas supply

Requirement

All gas lines are connected and leakproof.

Procedure

1. Turn the carrier gas up to a pressure of 600 to 700 kPa.
2. Turn the sample gas up to an absolute pressure of ≤ 160 kPa.
3. If applicable, turn the calibration gas up to an absolute pressure of ≤ 160 kPa.

5.3 Switching on the chromatograph

Requirement

The external power switch is fitted and connected as described in Section "Power switch and fuse (Page 63)".

Procedure

Switch on the external power switch.

Response on the display up to release version 4:

Response	LED
1.	24 V DC lights up.
2.	Health Status on the right and Health Status on the left light up.
3.	Sample flow and Maint.Reg. flash together until the MicroSAM is ready.
4.	Heartbeat starts to flash when the MicroSAM is ready.
5.	Failure lights up until the temperature and pressure have reached their operating values and any alarms have been acknowledged.
6.	Ready lights up at the end of the switch-on procedure as soon as the chromatograph is ready.

Response on the display from release version 09 onwards:

The gas chromatograph starts. The message "Starting... " is output in the text box of the display. When starting-up has been completed, the message disappears.

5.4 Starting the PC and operating software

The factor setting for the IP address of the gas chromatograph is 161.218.51.xx. The subnet mask is always set to 255.255.255.0.

Requirement

- Manually set the IP address of the PC to a value between 161.218.51.0 and 161.218.51.255 with the subnet mask 255.255.255.0.
The PC must not have the same IP address as the gas chromatograph.
We therefore recommend the IP address 161.218.51.254.
- The connection between the PC and gas chromatographs has been made, and the Windows XP operating system has been started.

Procedure

Start the program "Maxum System Manager" (start bar Start → Programs → Maxum System Tools → Maxum System Manager).

Start the function "Add Unit" (Menu "System" → Menu command "Add Unit") and enter the new gas chromatographs.

Note

Operating software

The following are described in detail in the Maxum System Manager manual:

- Installation of the Maxum System Manager and EZChrom operating software.
 - Establishment of connection between PC and gas chromatographs.
-

5.5 Shutting down

WARNING

Explosion hazard

- Switch off the gas chromatographs when carrying out repairs or maintenance as soon as atmospheric air penetrates into it, in other words:
 - When the device is opened.
 - When work is carried out on carrier gas lines and sample gas lines.
- Before switching the device on again, flush the gas lines again with inert gas following completion of the repair or maintenance work.

Note

The column system and the detector are contaminated least if the chromatograph remains in operation. Do not shut down the device if the system is only stationary for a short time, e.g. 3 weeks. Only switch off the output devices.

If you wish to shut down the gas chromatograph, Siemens AG recommends the following sequence:

1. Shut off all sample streams.
2. Switch off the power supply.
3. Allow the device to cool down for 65 minutes.
4. Shut off the carrier gas.
5. If you switch off the gas chromatograph for a longer period, close all outlets and inlets with the supplied blanking plugs. Sealing prevents oxygen or water from diffusing into the columns.

Service and maintenance

6.1 Maintenance of analysis module

6.1.1 Removal of analysis module

Procedure

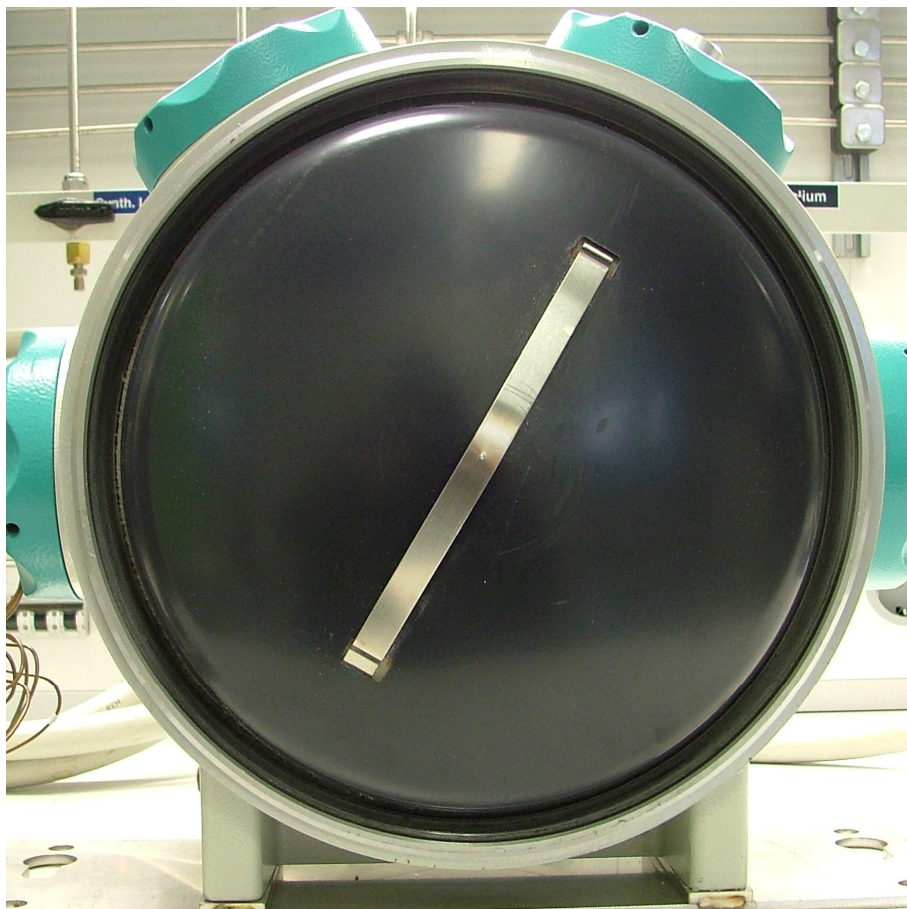
 WARNING
Explosion hazard • If the gas chromatograph is mounted in a hazardous area, observe the explosion protection regulations. • Before opening the housing in the hazardous area, switch off the power supply and then always wait for at least 65 minutes. • Following the waiting time: – When the surface temperatures inside the gas chromatograph have cooled down to a temperature corresponding to temperature class T4. – When the electric charge on the internal components has dropped to a voltage permissible for explosion protection.

1. Loosen the 1.5-mm hexagon socket-head bolt ③ in the top cover ② by two complete turns.

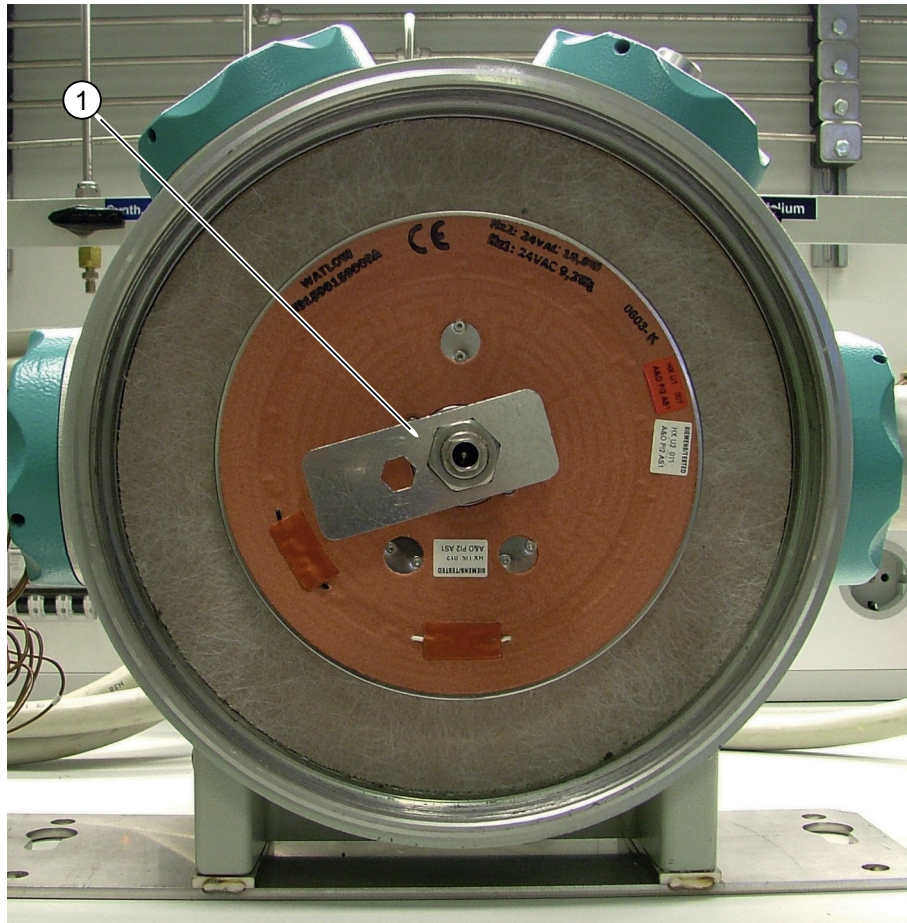


2. Unscrew the top cover ②. If the cover ② cannot be opened by hand, extend the lever arm. Insert e.g. two appropriate screwdrivers into the holes ① on the edge of the cover.

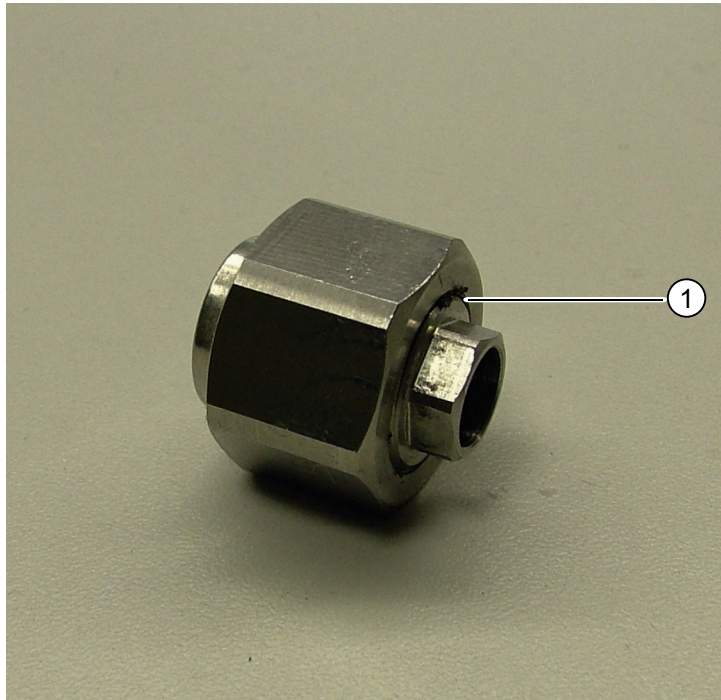
3. Pull out the insulating cover using the handle.



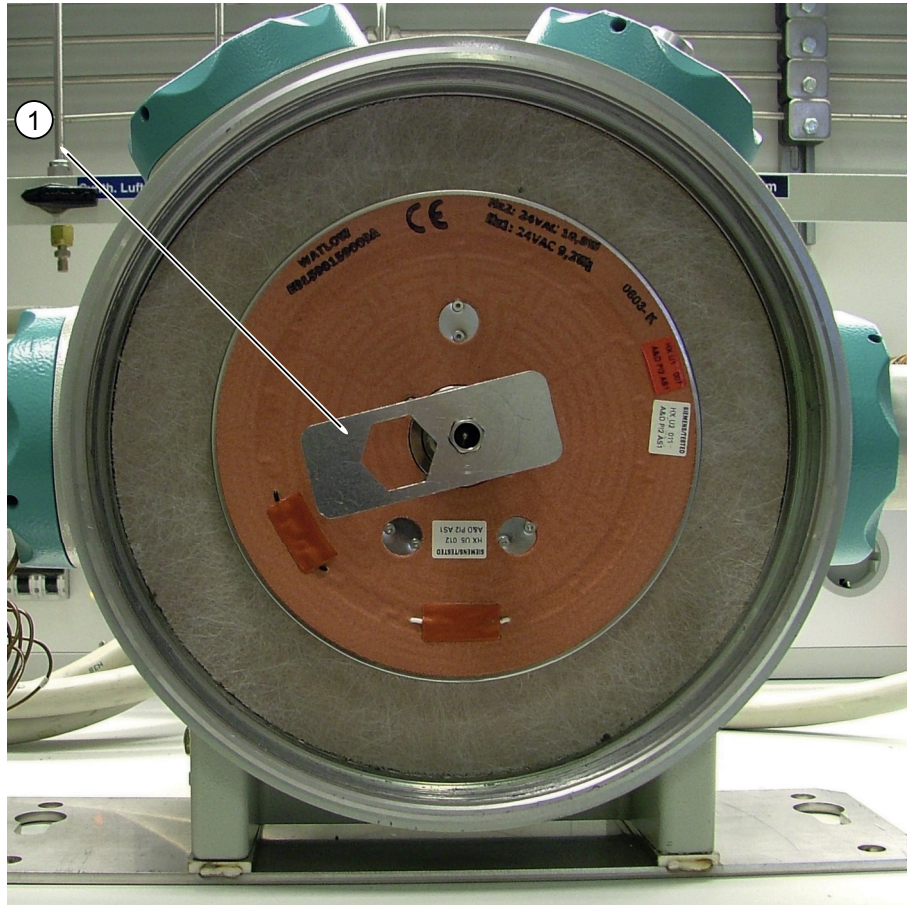
4. Loosen the M14 nut ① using the supplied ring spanner A/F 21.



5. Unscrew the M14 nut until it is flush ① as shown below.



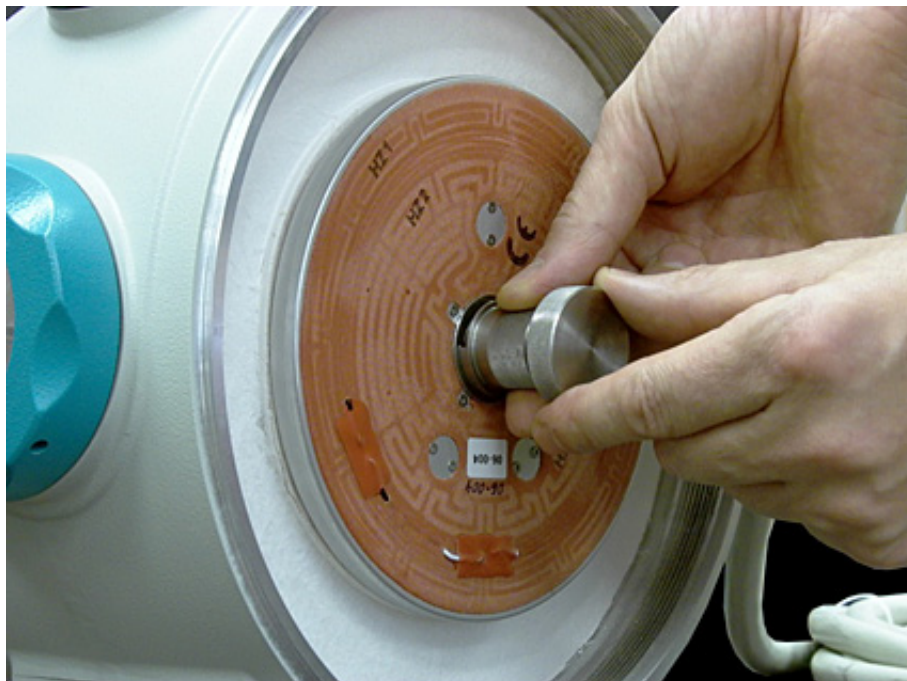
6. Loosen the M6 lock nut using a ring spanner A/F 10 ①.



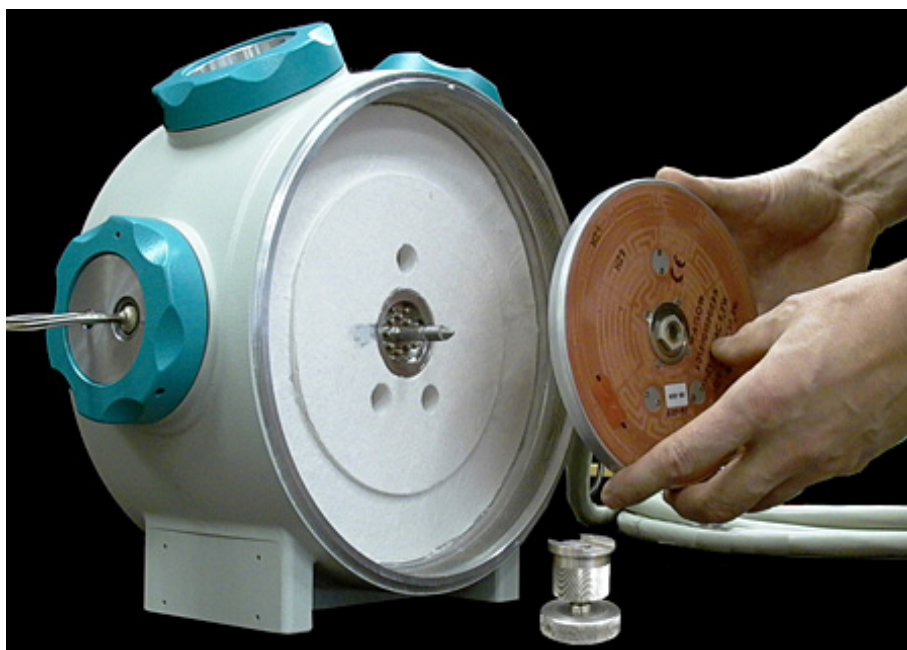
7. Completely unscrew the M14 nut.
8. Unscrew the screw on the pulling tool as shown below.



9. Insert the dovetail of the pulling tool behind the hexagon screw head on the analysis module.
10. Lock the pulling tool by rotating clockwise.
11. Hold the bottom part of the pulling tool tight, and rotate the screw clockwise until the analysis module is released.



12. Remove the analysis module from the guide pin.



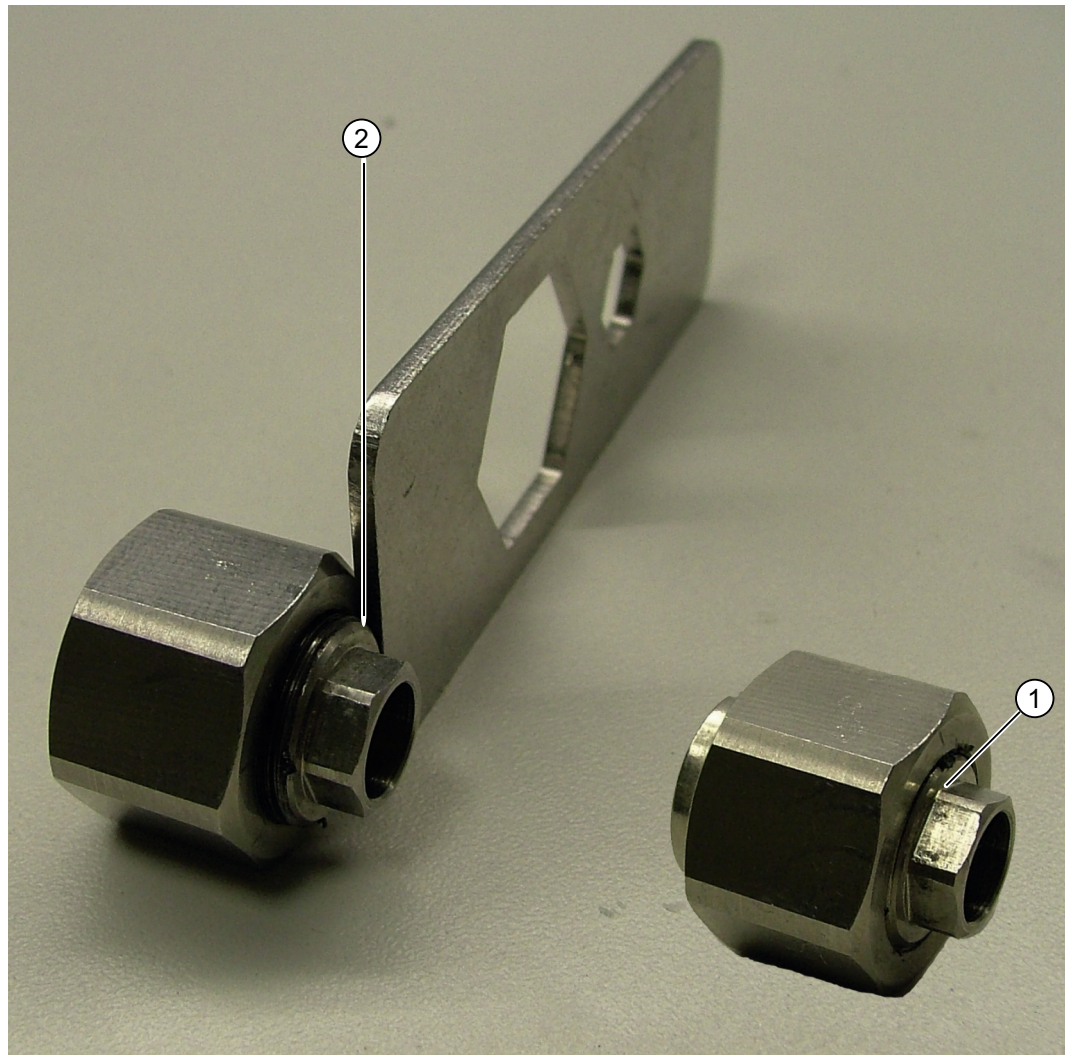
6.1.2 Installing the analysis module

Procedure

CAUTION
Identical type The type of new analysis module must be identical to that of the previous module. If the type is not identical, the device will malfunction. You can find the type ID: • On the white sticker of the analysis module. • On the rating plate on the ventilation opening of the device. Example: A05-126 ES02. The first block (A05 in this case) corresponds to the module type.

1. Slide the new analysis module onto the guide pin such that the three electric plugs on the bottom fit into the corresponding sockets.
2. Press the analysis module tight by hand.

3. Adjust the M14 nut flush as shown in the following photo at ①.



4. Screw the M14 nut by hand onto the guide pin. Make sure that the adjustment is retained.

⚠ CAUTION

Damage to the connection

When installing the analysis module, the packing glands of the module are sealed by the pneumatic connector. Only use the **supplied ring spanner**. If you apply too much force by using a different ring spanner with a longer lever arm, the connection will be damaged.

5. Tighten the M10 lock nut using the ring spanner A/F 10.
6. Rotate the M14 nut clockwise using the A/F 21 ring spanner until the 2.0 mm thread ② becomes visible.

7. Attach the insulating cover.
8. Carefully screw in the cover as far as possible.
9. Rotate the 2.0 mm hexagon socket-head bolt ② in the cover ① in the clockwise direction until it is closed.



! WARNING

Tightening the locking screw

According to the explosion protection regulations, all housing covers which have to be unscrewed to open the housing must each be secured against unintentional opening by a locking screw. This is achieved for this device using the hexagon socket-head bolt ②.

- Before opening, loosen this hexagon socket-head bolt ②.
- Following closing, tighten this hexagon socket-head bolt ②.

10. Restart the device. During the startup process, the analysis parameters are reestablished by downloading the individual setups supplied with the analysis module.

6.2 Replacing the carrier gas cylinders

Procedure

1. Save the operating data before switching off;
refer to the software description "Maxum System Manager".
2. Switch the MicroSAM off.
3. Switch off the 24 V DC power supply.
4. Close the main cylinder valve.
5. Replace the cylinder.
6. Purge the pressure reducer several times.
7. Open the main cylinder valve.
8. Switch on the 24 V DC power supply.
9. Carry out the calibration.

6.3 Installing and removing electronic components

WARNING

Observe waiting time

Observe the regulations for explosion protection if the chromatograph is installed in a hazardous area.

Before opening the housing in the hazardous area, switch off the power supply and then always wait for at least 65 minutes.

Following this time, the surface temperatures within the chromatograph have cooled down to a temperature corresponding to temperature class T4, and the electric charge of internal components has dropped to a noncritical value.

CAUTION

Electrostatic-sensitive device

Before touching such components or devices:

- Switch the chromatograph off.
- Remove all static from yourself by touching an earthed object or by using an ESD bracelet.
- Only use tools free of static charges.
- Do not touch pins or printed conductors. Hold modules only by their edges.

6.3.1 Removal of electronic modules

Replacing the backup battery

The gas chromatograph has a backup battery for the built-in clock.

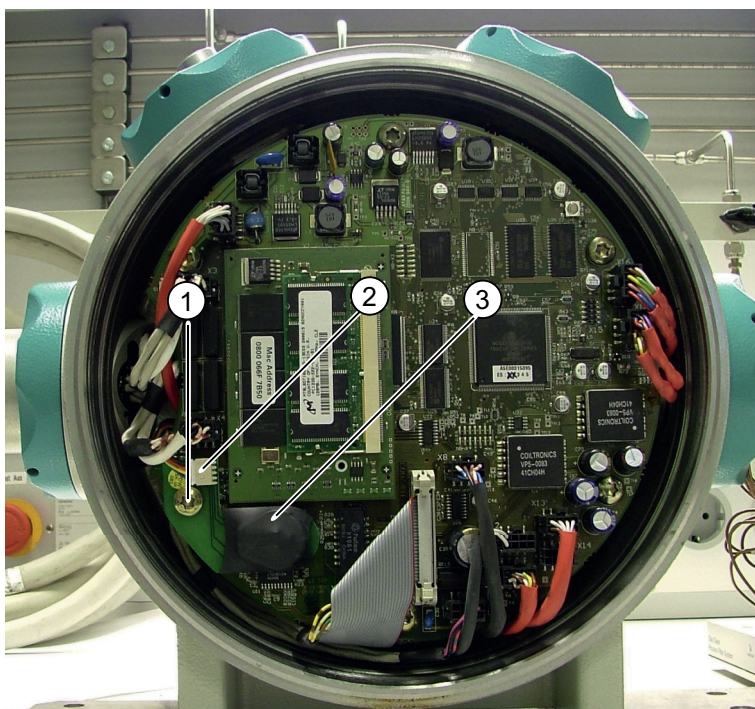
WARNING

Explosion hazard

Observe the regulations for explosion protection if the chromatograph is installed in a hazardous area. Replacement of this backup battery is only permissible in the hazardous area if you have a fire permission certificate. This applies whether the gas chromatograph is switched on or off.

Procedure

1. Remove the connector ② on the battery module.
2. Loosen the screw T30 ①.
3. Remove the backup battery ③.



4. Install the new backup battery in the reverse order.

Removing the CAC module

Procedure

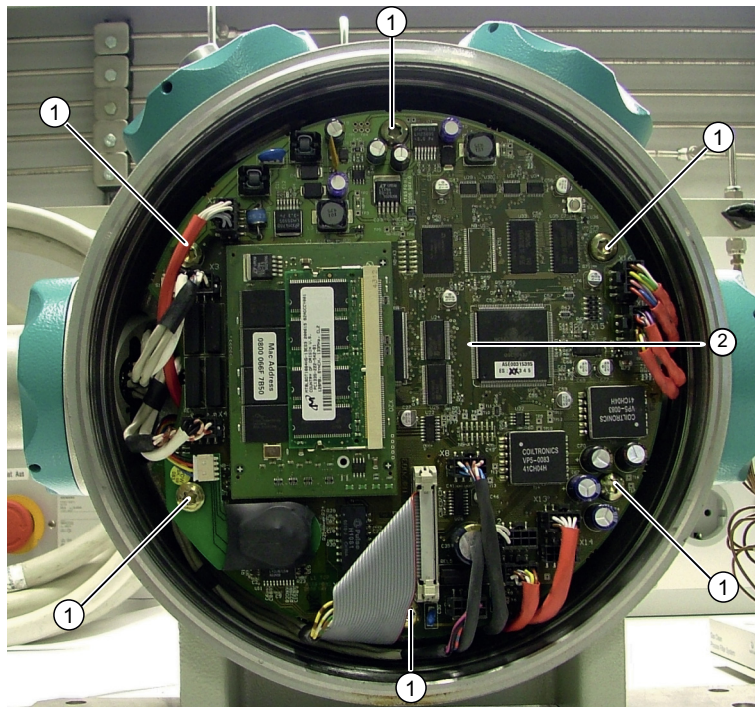
1. Hold the CAC module on the long side, and carefully lever out.
2. Make sure you do not bend the connector pins.



Removing the RSP module

Procedure

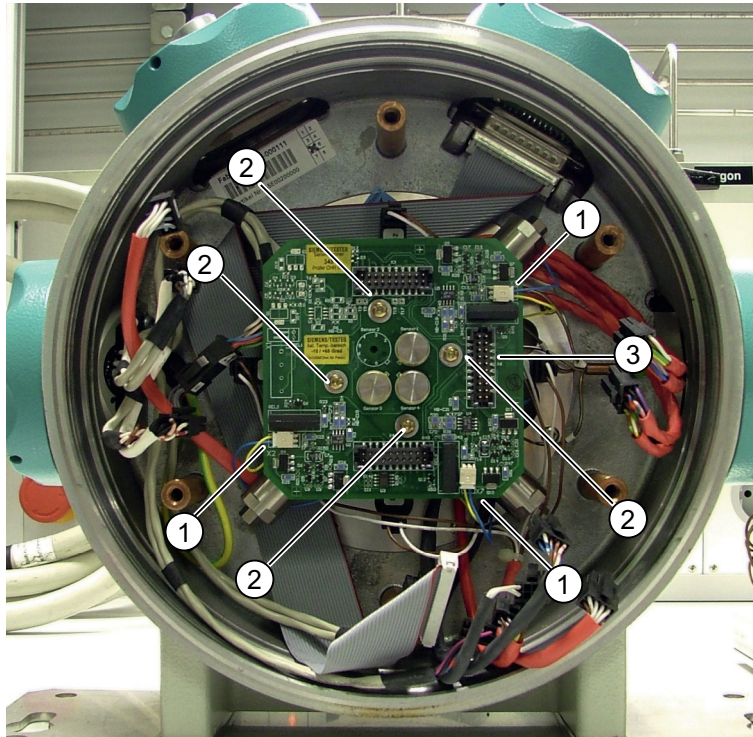
1. Disconnect all electric connections.
2. Loosen the six screws ① T30.
3. Carefully remove the RSP module ②.



Removing the EPC module

Procedure

1. Loosen the three connectors ①.
2. Loosen the four screws T10 ②.
3. Carefully remove the EPC module ③.



6.3.2 Installation of electronic modules

CAUTION

Note the correct mounting position

Make sure that the modules are correctly positioned when installing:

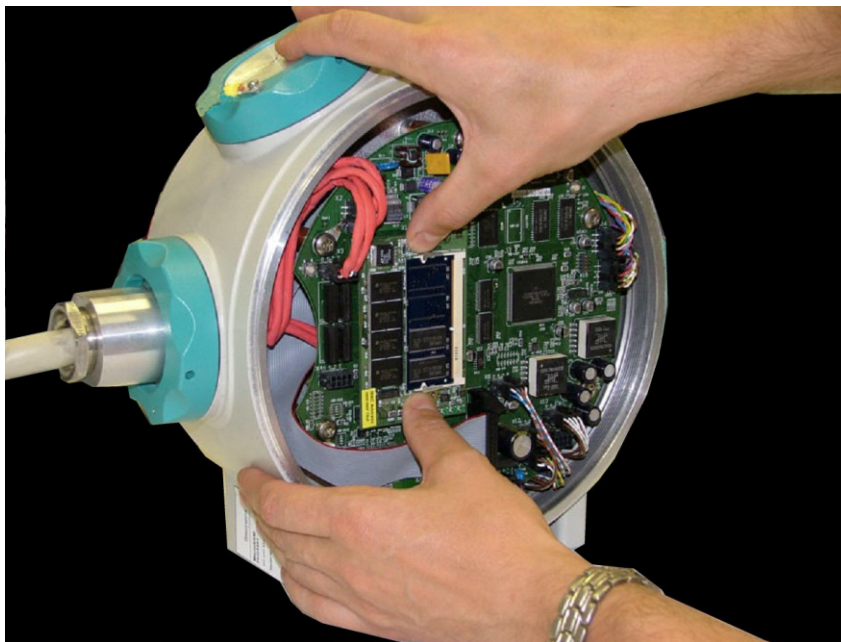
- The EPC module has three plug connectors. The side on which the plug connector is "missing" must point toward the cable gland of the chromatograph.
- The RSP module has one cutout. This cutout must point toward the cable gland of the chromatograph.

Installing the EPC and RSP modules

- Install the two modules in the reverse order to that when removing.

Installing a new CAC module

- Position the CAC module correctly above the connectors, and push in uniformly. Only press on the two short sides (above the connectors).



Closing the housing

1. Carefully screw in the cover as far as possible.

2. Rotate the 1.5 mm hexagon socket-head bolt in the cover ② in the clockwise direction as far as possible.



! WARNING

Tightening the locking screw

According to the explosion protection regulations, all housing covers which have to be unscrewed to open the housing must each be secured against unintentional opening by a locking screw ②.

- Before opening, loosen this hexagon socket-head bolt ②.
- Following closing, tighten this hexagon socket-head bolt ②.

3. The system parameters must be downloaded when the device is switched on again. The procedure is described in the "Maxum System Manager" operating software manual.

6.4 Conversion of MicroSAM basic device AS09

A solenoid valve MV5 is fitted in the MicroSAM basic device of release version 09 (AS09). You can also prepare the MicroSAM basic device as a GC which can be operated with analysis modules of type A.

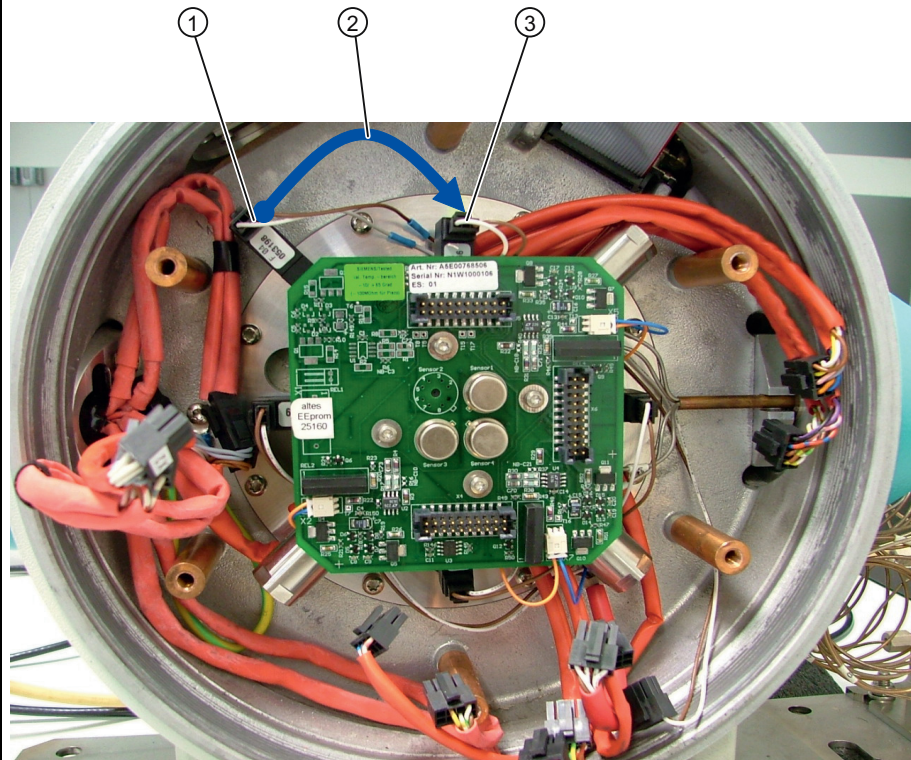
6.4.1 Preparation for use of analysis modules of type A

Procedure

1. Terminate measuring mode of the device.
2. Deactivate the detectors using the operating software.
3. Save the configuration in the flash memory.
4. Switch off the device.
5. Shut off the carrier gas and sample gas supplies.
6. Open the two housing covers.
7. Deinstall the analysis module type D.
8. Install the analysis module type A.
9. Remove the RSP module.

10. Interchange the plugs to the solenoid valves **MV3** and **MV5**.

Procedure: Preparation for use of analysis modules of type A



View of EPC module

- ① Disconnect the solenoid valve **MV5** (plug number 5).
- ① Disconnect the solenoid valve **MV3** (plug number 3).
- ③ Connect the cable number "3" to the solenoid valve **MV5**. The cable number "5" is not required in the configuration of type A.

11. Reinsert the RSP module.

12. Close the housing.

The basic device AS09 is now prepared for use of analysis modules of type A.

6.4.2 Restoring of data for AS09 type A

Requirement

Knowledge of the Maxum EZChrom und Maxum System Manager operating software.

Procedure

1. Start up the device.
2. Start the EZChrom program (start bar Start → Programs → Maxum System Tools → Maxum EZChrom).
3. Start the "Open" function (menu "File" → Menu command "Method" → "Open").
4. Download the AXX.met file from the CD "Parameter Backup CD".
5. Click in the toolbar of Maxum EZChrom on the "Instrument Setup" symbol, and select the "Valves" menu.
6. Click on "FlushLoop" in the "Name" column, and change the name in the drop-down list to "FlushLoop_1".

	Use	Time (sec)	Name	ID	Switch	Duration (sec)	Mode
1	☒	-24.00	Flushloop	1	Off	0.000	(All)
2	☒	4.00	FlushLoop_1	1	On	0.000	(All)
3	☒	24.00	FlushLoop_1	1	Off	0.000	(All)
4	☒	-29.50	Sample	133	On	0.000	(All)
5	☒	24.00	Backflush	133	Off	0.000	(All)
6	☒	-24.00	Injection	2	Off	0.000	(All)
7	☒	4.00	FlushLoop_2	2	On	0.000	(All)
8	☒	24.00	TCD_1 Invert Signal	2	Off	0.000	(All)
9	☒	-24.00	TCD_2 Invert Signal	3	Off	0.000	(All)
10	☒	67.31	TCD_2 BridgeEnable	3	On	0.000	(All)
11	☒	-24.00	TCD_3 Invert Signal	4	Off	0.000	(All)
12	☒	0.00	TCD_3 BridgeEnable	4	Pulse	0.300	(All)
13	☒	67.31	TCD_4 Invert Signal	4	On	0.000	(All)
14	☒	24.00	Injection	3	Pulse	0.500	(All)
15	☒	-29.50	BackFlush	103	Off	0.000	(All)
16	☒	-30.00	TCD_1 InvertSignal	4	Pulse	0.500	(All)
17	☐		Injection		On	0.000	(All)

7. Repeat step 6 for all other entries with the name "FlushLoop".
8. Change the remaining parameters according to your application.
9. Save the configuration (menu "File" → Menu command "Method" → "Save As").
10. Export the saved data to the GC (menu "File" → Menu command "Method" → "Export...").

The gas chromatograph has now been configured for type A analysis modules.

Note**Parameter settings**

The parameters on the CD are appropriate for basic devices up to AS08. The parameters include the settings for the solenoid valves MV1 to MV4. MV1 is preset in the software to "FlushLoop".

From AS09 onwards, the basic device contains an additional solenoid valve MV5, and MV1 and MV5 are preset to "FlushLoop_1" and "FlushLoop_2" respectively.

When reconfiguring to a gas chromatograph with type A analysis modules, you must therefore rename "FlushLoop" to "FlushLoop_1".

You do not require "FlushLoop_2" for a gas chromatograph with a type A analysis modules.

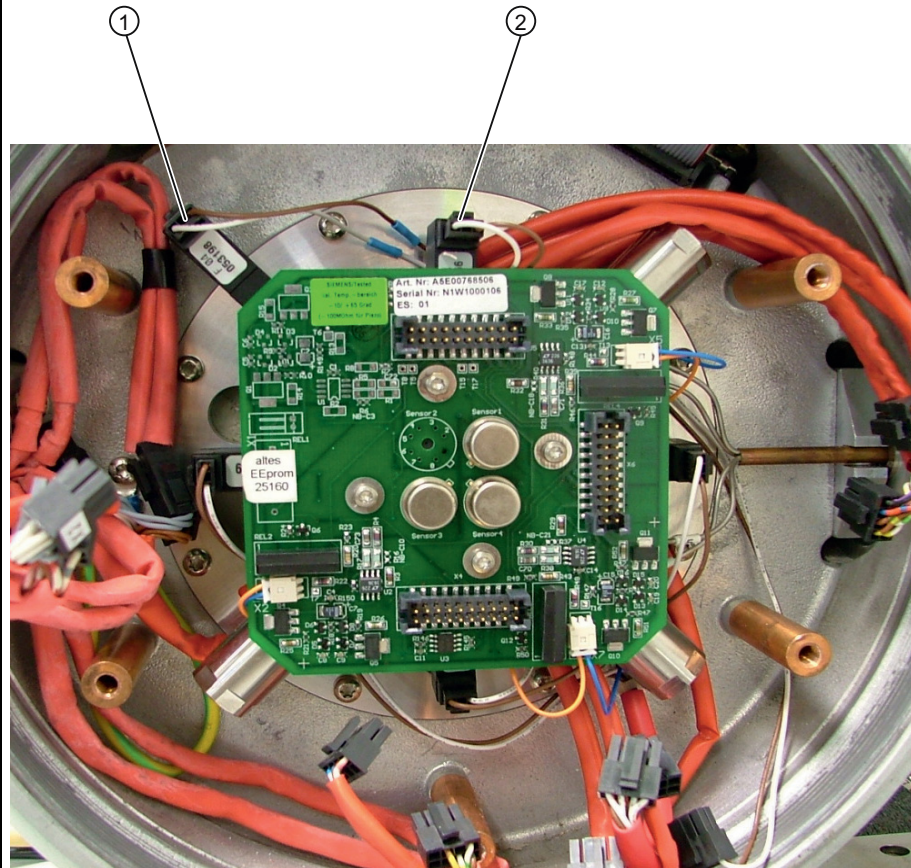
6.4.3 Returning for use of analysis modules of type D

Procedure

1. Terminate measuring mode of the device.
2. Deactivate the detectors using the operating software.
3. Save the configuration in the flash memory.
4. Switch off the device.
5. Shut off the carrier gas and sample gas supplies.
6. Open the housing.
7. Deinstall the analysis module type A.
8. Install the analysis module type D.
9. Remove the RSP module.

10. Connect the plugs to the solenoid valves **MV3** and **MV5**.

Procedure: Returning for use of analysis modules of type D.



View of EPC module

① Connect the plug number "3" to the solenoid valve **MV3**.

② Connect the plug number "5" to the solenoid valve **MV5**.

11. Reinsert the RSP module.

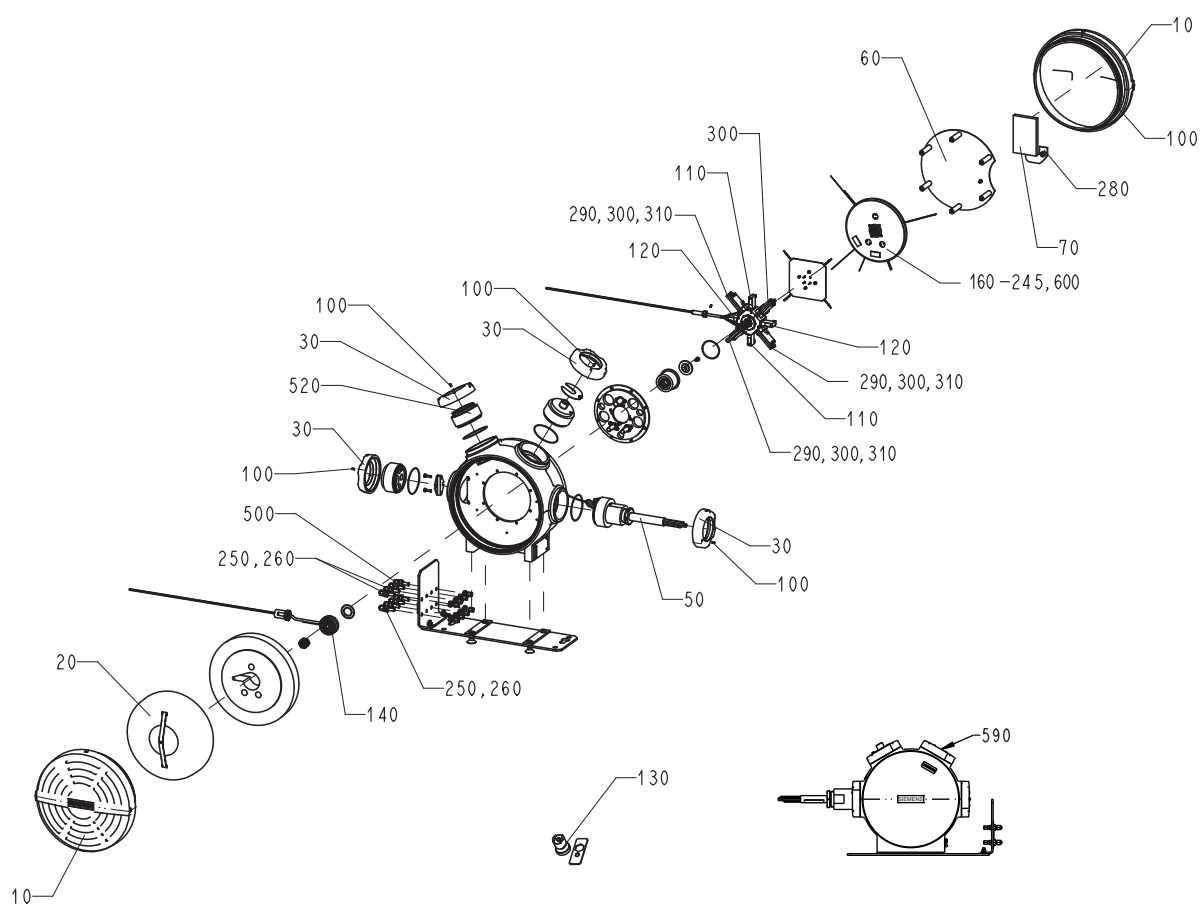
12. Close the housing.

13. Using the Maxum EZChrom and Maxum System Manager operating software, download the standard methods for the analysis modules of type D.

The basic device AS09 has now been returned and parameterized for use of analysis modules of type D.

Spare parts/accessories

7.1 Spare parts list



Item	Designation	Order No.
10	Main cover	A5E00117263
20	Insulating cover	A5E00146499
30	Side cover	A5E00117261
520	Inspection window, complete	A5E00481197
50	NPT cable gland, potted with cable	A5E00839837
60	RSP module	A5E00315395
70	CAC module	A5E00794337
280	Battery module	A5E00713507

Item	Designation	Order No.
100	O-ring set with 2 units each 200x2 and 63x1.5 as well as 6 units M3x6 threaded pin	A5E00209858
110	Solenoid valve 3/2-way "D"	A5E00162568
120	Solenoid valve 3/2-way "C"	A5E00105041
250	Swagelok 1/8" screwed gland with safety filter for sample input, sample output, carrier gas	A5E00198331
260	Swagelok 1/8" screwed gland for gas connection, with dummy plug	A5E00198046
290	Flow insert, type 1	A5E00146507
300	Flow insert, dummy	A5E00177777
310	Flow insert, type 2	A5E00191739
500	Sealing cap 1/8", brass	A5E00391322

Item	Designation	Order No.
130	Pulling tool for analysis module	A5E00209905
140	Conical pressure nut, complete	A5E00160856
160	Analysis module type A01	A5E00209700
170	Analysis module type A02	A5E00209753
180	Analysis module type A03	A5E00209756
190	Analysis module type A04	A5E00209765
200	Analysis module type A05	A5E00209774
210	Analysis module type A06	A5E00209800
220	Analysis module type A07	A5E00209802
230	Analysis module type A08	A5E00209808
235	Analysis module type A09	A5E00505612
240	Analysis module type A10	A5E00497962
245	Analysis module type A11	A5E00885119
600	Analysis module type D01	A5E02048228
580	RSP service cable	A5E00362332
590	MicroSAM basic device without analysis module, with rating plate and MicroSAM software package	A5E00881520

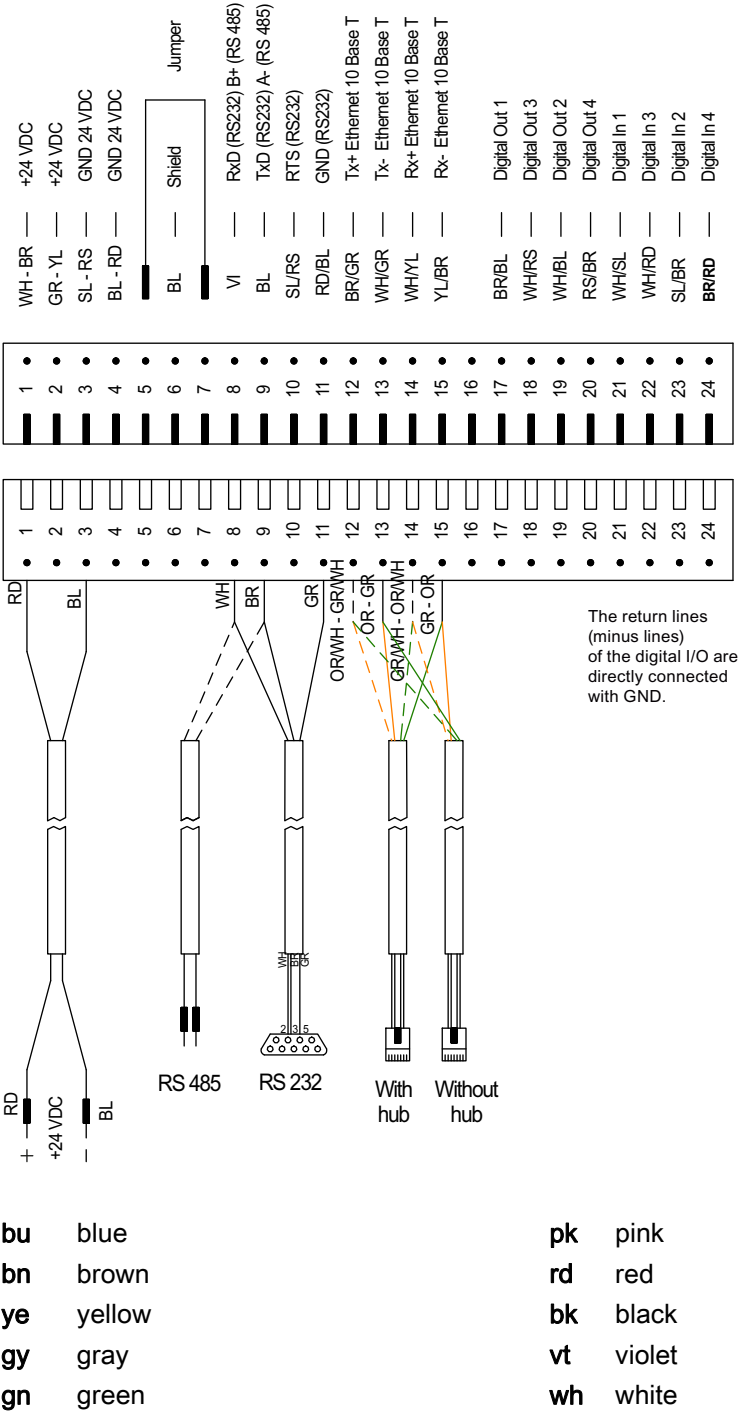
7.2 Accessories

Item	Designation	Order No.
151	Set of screwed glands for MicroSAM	A5E00399237
152	Carrier gas drying filter (1/8")	GWK-CHRTSCP17971
570	Filter support for carrier gas drying filter (1/8")	GWK-CHRFICP7988

Examples

8

Example: plug wiring



Technical data

Climatic conditions

Permissible ambient temperature	-20 to 50 °C (depending on oven temperature)
Permissible storage/transport temperature	-30 °C to +70 °C
Permissible relative humidity	Max. 90%
Protection against dust and moisture:	
• In accordance with EN 60529 / IEC 60529	IP 65
• In accordance with NEMA 250	NEMA 4X

Power supply

Supply voltage	Up to AS08: 24 V DC (+10% to -15%) From AS08 onwards: 24 V DC (18.5 V to 30.2 V)
External fuse	T 2.5 A
Power consumption, typical	18 W
Power consumption, maximum	60 W

Dimensions and weights

Dimensions	360 x 300 x 220 (width x depth x height in mm)
Weight	Approx. 20 kg

Mounting

Installation on	Post, pipe or wall
Distance from wall or next chromatograph	300 mm
Distance from ceiling or floor	200 mm

Electromagnetic compatibility

EMC immunity	In accordance with IEC 613261-1:2005, NAMUR NE 21
Conducted interference on the AC voltage supply lines:	
• IEC 61000-4-4	2 kV
• IEC 61000-4-5	Asymmetric/symmetric 2 kV/1 kV
• IEC 61000-4-6	10 V
• IEC 61000-4-11	passed
Conducted interference on signal lines:	
• IEC 61000-4-4	1 kV
• IEC 61000-4-5	Asymmetric/symmetric 1 kV/0.5 kV
• IEC 61000-4-6	10 V
Immunity to discharges of static electricity:	
• IEC 61000-4-2	Air/contact 8 kV
Immunity to fields:	
• IEC 61000-4-3	10 V/m
Emitted Interference:	
• CISPR 11/EN 55011	Class B (living accommodation)
KC marking for use in Korea only	
• A급 기기	이 기기는 업무용(A급) 전자파 적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며 가정 외의 지역에서 사용하는 것을 목적으로 합니다.

Safety

Electrical safety	IEC 61010 / DIN VDE 0411
Protection against explosion	ATEX and IEC Ex: II 2 G Ex d IIC T4 Class I, Zone 1, Group IIB + H2 T4 Class I, Div 1, Groups B, C, D T4 Factory Sealed

Oven

Number/type	1/isothermal
Purging with N ₂	possible
Dimensions	160 x 10 (diameter x height in mm)
Heat output	20 W
Tripping of thermal fuse	≥ 159 °C
Temperature range	60 ... 155 °C
Temperature stability	± 0.1 K (60 to 155 °C)
Temperature accuracy	± 3 K (60 to 155 °C)
Retention time variations per 10 °C change in ambient temperature	Approx. 0.3%
Heating-up period from 30 to 100 °C	10 minutes

Tripping of thermal fuse

ETC3	≥ 159 °C
ETC4	≥ 80 °C

Columns and gases

Column type	Capillary columns 0.15 to 0.25 mm Ø _{internal diameter}
Column switching	Multidimensional chromatography with backflushing and cut in live system
Multifunctional membrane valve	For injection and backflushing
Gas connections	Swagelok 1/8"
Pressure controller	Max. 4 single-channel electronic pressure controllers
Solenoid valves for control of multi-function membrane valve	2 NC contacts, 2/3 NO contacts
Carrier gas	H ₂ , N ₂ , He, Ar (application-dependent)
• Gas purity (minimum requirement)	≥ 99.999% (5.0)
• Particulates	< 1 µm
• Required filtration	Degree of separation 99.99 % for 1 µm particles
• Consumption	10 to 60 ml/min (application-dependent)
• Input pressure	500 ... 700 kPa (absolute)
Instrument air	Not required

Sample and injection

Sample streams	3 for devices of release version 4 onwards 1 for devices up to release version 3 Note: The release version is present on the rating plate at "AS".
Calibration sample streams	1
Phase	Gaseous
Permissible sample pressure	10 ... 60 kPa above atmospheric pressure
Sample flow	20 to 100 ml/min
Max. sample temperature	80 °C
Particulates	< 1 µm
Required filtration	Degree of separation 99.99 % for 1 µm particles
Material wetted by the sample	Stainless steel, fused silica, polyamide
Injection	Valveless live injection, i.e. no switching valves required in oven area.
• Control	with multifunctional membrane valve
• Injection volume adjustable using switching times	From 2 to 50 µl

Detectors, calibration and performance data

Detector type	TCD, max. 8 sensors
Cell volume	0.02 µl
Calibration	Manual or automatic, single-level or multi-level (only MicroSAM)
Permissible performance of carrier gases	
Repeatability for measuring ranges 2 ... 100%	± 0.5% of full-scale value (application-dependent)
Repeatability for measuring ranges 0.2 ... 1%	± 1% of full-scale value (application-dependent)
Repeatability for measuring ranges < 0.1%	± 2% of full-scale value (application-dependent)
Detection limit for measuring ranges > 1000 ppm	1% of full-scale value (application-dependent)
Smallest measuring range	1000 ppm (application-dependent)
Linear range	Typically ≥ 10 ⁴
Cycle time	Typically 30 ... 240 s
Ambient temperature influence	Negligible
Influence of vibrations	Negligible
Mean time to repair (MTTR)/ Mean time between failures (MTBF)	< 1 hour/3 years (without consumables)

Permissible bridge power

Carrier gas	Permissible bridge voltage	Permissible bridge power
Argon (Ar)	700 mV	25 mW
Nitrogen (N ₂)	700 mV	30 mW
Helium (He) / hydrogen (H ₂)	1100 mV	70 mW

Electronics: Communication and analytical controller (CAC)

Microprocessor	Intel 586 architecture
Flash EEPROM	128 MB
Dynamic RAM	64 MB
Operating system	Windows CE 3.0/5.0
Software	Preinstalled. Modifications or upgrades for operation PC locally or downloadable via network

Electronics: Real-time signal processor (RSP)

Microprocessor	Motorola 68376, 20 MHz
Flash EPROM	1 MB
Static RAM	1 MB
Operating system	Forth
Software	Preinstalled. Modifications or upgrades downloadable via internal service interface

Interfaces

Communication	1 x Ethernet 10BaseT / TCP/IP
Control system coupling	1 x RS485 or RS232 / MODBUS RTU, OPC (ODPC) over Ethernet (only MicroSAM)

Inputs/outputs: Basic equipment

Digital outputs (relay contact 0.4 A / 24 V DC)	For devices of release version 4 onwards: 4, freely-usable *) For devices up to release version 3: 2, freely-usable *) Note: The release version is present on the rating plate at "AS".
Digital inputs (24 V to optocoupler)	For devices of release version 4 onwards: 4, of which 3 freely-usable *) For devices up to release version 3: 2, of which 1 freely-usable *)

*) Extendable by NAU or I/O extender (only MicroSAM, SITRANS CV preassigned)

Status display

Display up to and including release version 4

LED displays for	• Supply voltage • Software sign-of-life • Ready for operation • Maintenance demanded • Fault • Sample flow • Ethernet connection status • Communication status
------------------	---

Display from release version 5 onwards

LED displays for	• Supply voltage • Software sign-of-life • Ready for operation • Maintenance demanded • Fault • Sample flow
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Recommended operator panel

See documentation of supplied software

Dimension drawings

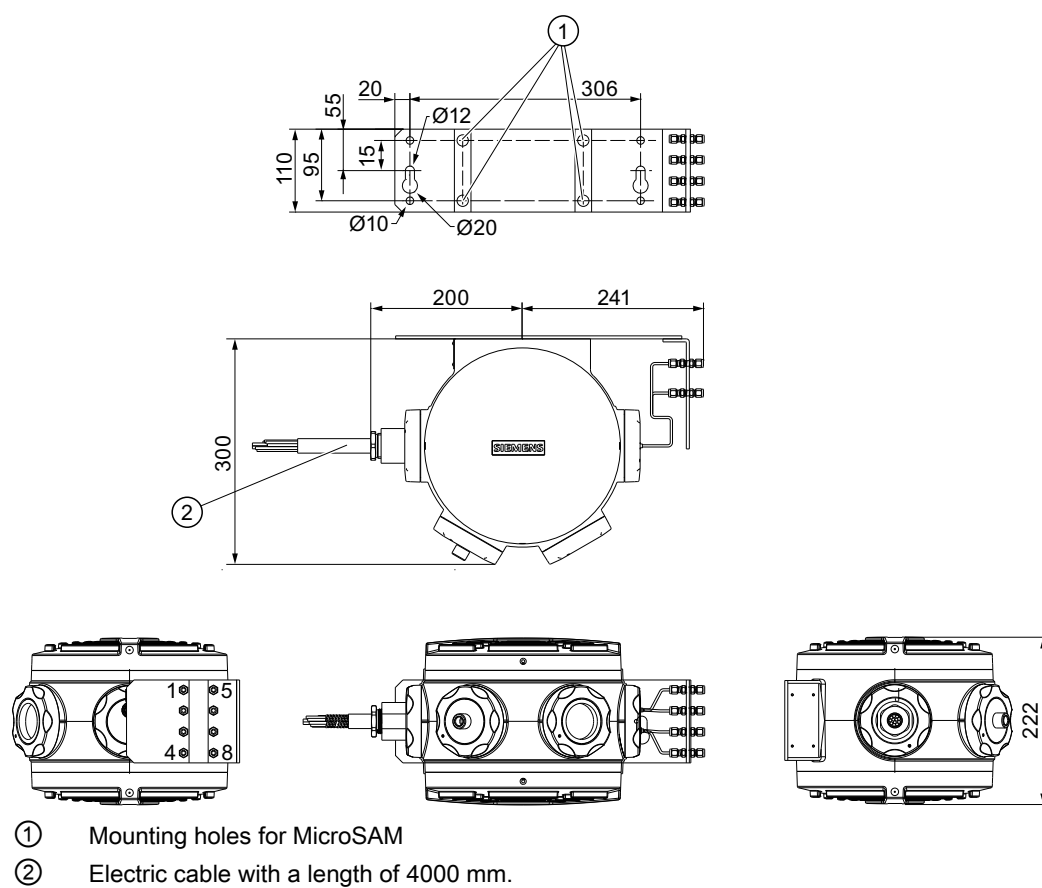


Figure 10-1 Dimension drawing of MicroSAM

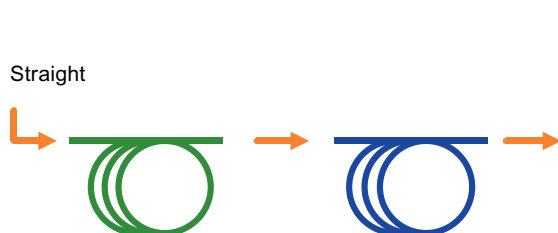
Appendix

A.1 Principle of live column switching

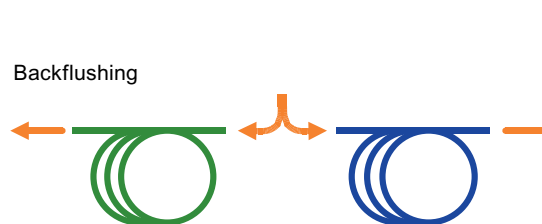
Two columns are connected in sequence with the live T-piece in between. The columns have different separating properties, for example. The three operating states of the live switching are selected by changing the pressure in the gas lines of the live T-piece:

- Straight
- Backflushing
- Cut.

To achieve this, the electronic pressure controllers are programmed at the factory using a time function.

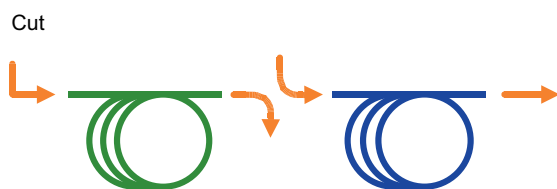


The components pass through the two columns in succession.



Once some of the components have passed through the first column, the flow direction in it is reversed. The components still present in the first column are returned to the beginning of it, and flushed into the atmosphere via the backflushing output.

This means that the analysis cycle can be drastically shortened: for example, if the components are only transported slowly through the first column, those of higher boiling point need not be heated up, which is time-consuming.



Once the components have passed through the first column, a number of them are flushed through the cut output. They never reach the second column. This operating state is used in the following cases:

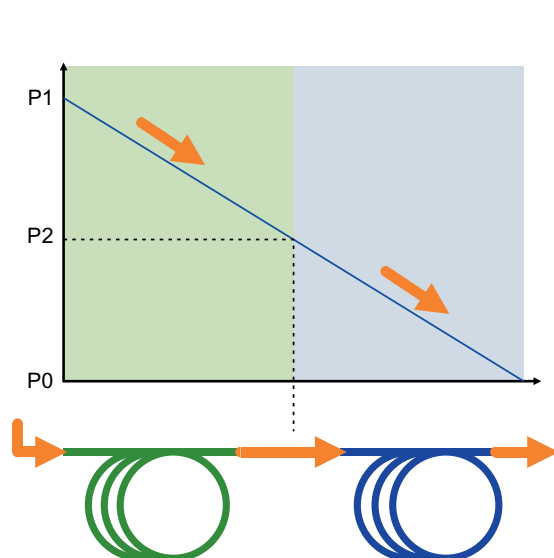
- To keep components which cannot be backflushed away from the second column, because these are followed by further components which are to be measured.
- If components would falsify the result or damage the second column.
- In order to directly pass components to a further detector, e.g. to shorten the duration of the analysis.

A.1.1 Advantages of live switching

- The sample only comes into contact with parts of the live T-piece, but not with valves.
- No switching valves are required in the oven, and the column switching does not result in any temperature limitations.
- The live switching is maintenance free since there are no moving parts.
- The live switching has a minimum dead volume, and is therefore particularly suitable for capillary columns.

A.1.2 Live switching function

Pressures and flows



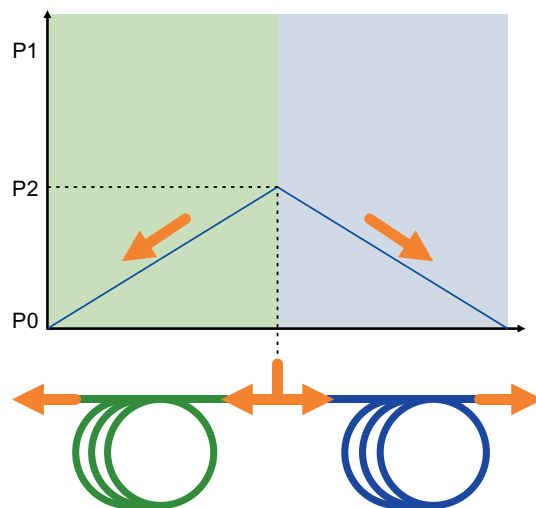
Two columns are connected in succession. Pressure P_1 is initially applied. The final pressure is the atmospheric pressure P_0 . This results in pressure distributions and flows as shown on the left.

Conclusion:
with the "straight operation" shown in the graphic, the pressure P_2 is produced in the middle between the two columns.

Note

In real processes, the curve for the pressure drop is nonlinear.

A thought experiment



The pressure P_2 from the previous figure is read on the y-axis. This pressure P_2 is then applied between the two columns. The input of the first column is left open. This results in a pressure distribution with the flows as shown on the left.

Conclusion:

the first column is now operated in backflushing mode.

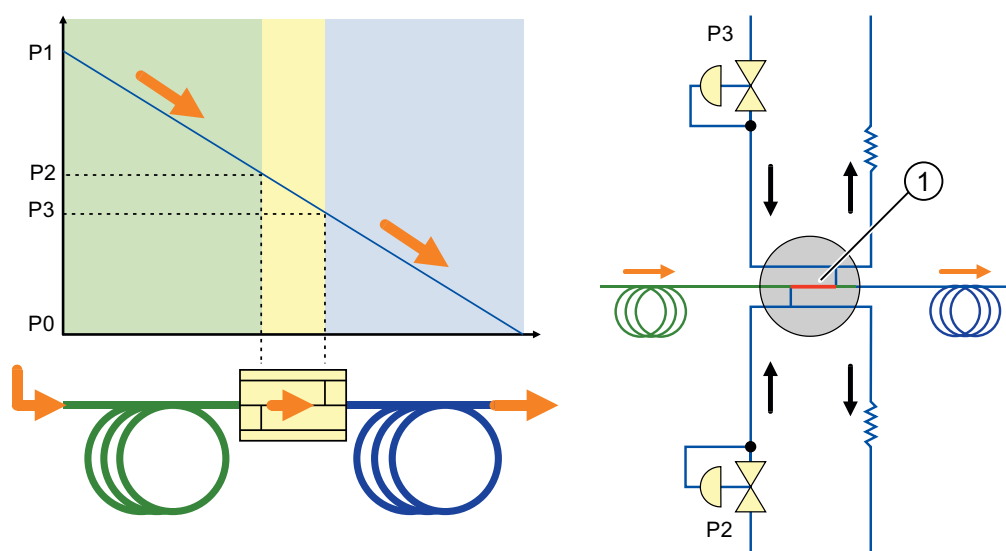
What hasn't been possible yet ...

If a particular peak must not reach the second column once it has left the first column, an output is required between the two columns (cut output). Furthermore, a connection is required for the pressure P2 from the "thought experiment" above. The solution to the problem is the live T-piece.

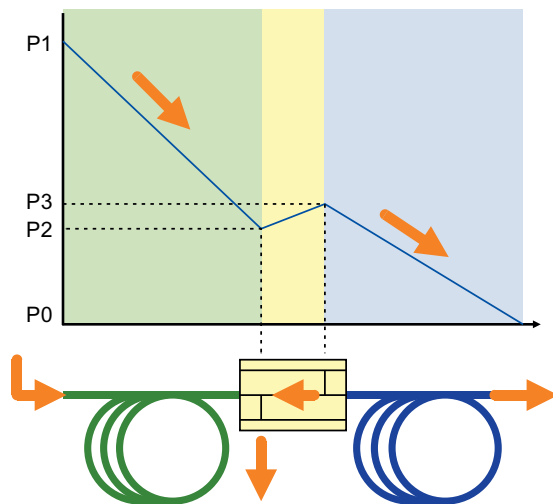
The two columns are connected in the live T-piece via a capillary ①. This coupling capillary has a flow resistance; two pressures must be considered:

- P3 downstream of the capillary
- P2 upstream of the capillary.

In "straight operation", everything remains as described in the section "Pressures and flows". Only the pressure P3 must be additionally considered.



Time for the cut



The pressure P_2 is set a little lower than pressure P_3 .

The result:

- the components are flushed into the atmosphere as soon as they leave the first column.

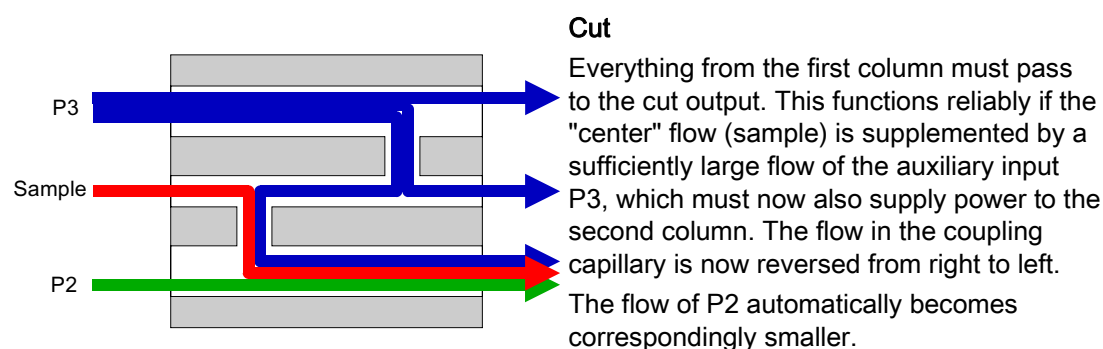
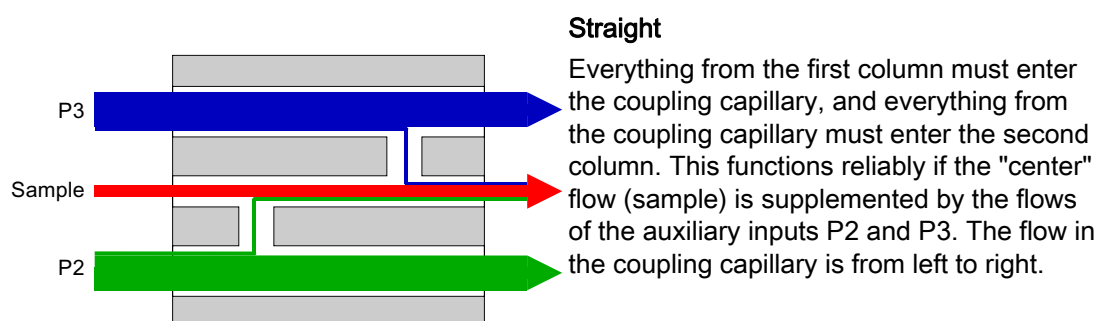
Since the pressure on the left of the coupling capillary is lower than that on the right, the gas present in the first column is transported to the cut output!

If everything were that simple ...

... then the process would now be finished. However, the live switching must first be adjusted. Adjustment of the live switching has already been carried out by Siemens AG.

Description of the adjustment function for live switching:

The live T-piece has six connections, of which the three right-hand ones can be outputs. This means that a peak can also simultaneously leave the device via two or even three outputs. This state is not desired during operation! You must therefore inject a test mixture, and observe the detector signals at the three outputs. You must then decide on how to change the pressures P2 and P3 such that unambiguous flow conditions exist for "straight operation" and "cut":



Backflushing

Backflushing functions exactly as described earlier in the section "A thought experiment". This is irrespective of the position in which the live T-piece is currently being operated.

A.2 ESD guidelines

Definition of ESD

All electronic modules are equipped with large-scale integrated ICs or components. Due to their design, these electronic elements are highly sensitive to overvoltage, and thus to any electrostatic discharge.

The electrostatic sensitive components/modules are commonly referred to as ESD devices. This is also the international abbreviation for such devices.

ESD modules are identified by the following symbol:



CAUTION
ESD devices can be destroyed by voltages well below the threshold of human perception. These static voltages develop when you touch a component or electrical connection of a device without having drained the static charges present on your body. The electrostatic discharge current may lead to latent failure of a module, that is, this damage may not be significant immediately, but in operation may cause malfunction.

Electrostatic charging

Anyone who is not connected to the electrical potential of their surroundings can be electrostatically charged.

The figure below shows the maximum electrostatic voltage which may build up on a person coming into contact with the materials indicated. These values correspond to IEC 801-2 specifications.

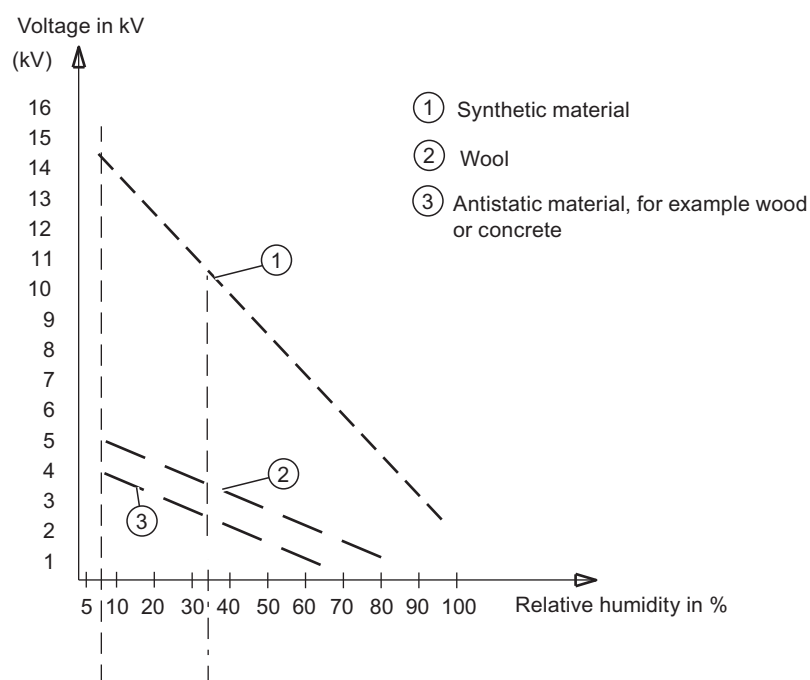


Figure A-1 Electrostatic voltages on an operator

Basic protective measures against electrostatic discharge

- Ensure good equipotential bonding:
When handling electrostatic sensitive devices, ensure that your body, the workplace and packaging are grounded. This prevents electrostatic charge.
- Avoid direct contact:
As a general rule, only touch electrostatic sensitive devices when this is unavoidable (e.g. during maintenance work). Handle the modules without touching any chip pins or PCB traces. In this way, the discharged energy can not affect the sensitive devices.

Discharge your body before you start taking any measurements on a module. Do so by touching grounded metallic parts. Always use grounded measuring instruments.

A.3 EC Declaration of Conformity

The original of the EC Declaration of Conformity be seen at:

Siemens AG
I IA SC PA RD
Karlsruhe

A.4 A marking in accordance with KC (Korea)

KC marking for use in Korea only

Device version	Operating instructions
A급 기기	이 기기는 업무용(A급) 전자파 적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며 가정 외의 지역에서 사용하는 것을 목적으로 합니다.
Class A device	This device is classified as having electromagnetic resistance suitable for industrial use (Class A) and may be used universally, apart from in domestic use.

A.5 Service and Support

Worldwide contact partners

If you have any further questions relating to the products described in this documentation, contact your local representative at the Siemens office nearest you.

You will find information on whom to contact at this Internet address www.siemens.com/automation/partner (<http://www.siemens.com/automation/partner>).

Product information on the Internet

The instructions are included on the CDs which are already supplied or may be ordered. In addition, the instructions are available on the Internet on the Siemens homepage.

A signpost to the range of technical documentation, the online catalog, and the online ordering system for individual SIMATIC products and systems is available at www.siemens.com/processanalytics (<http://www.siemens.com/processanalytics>)

Here you will find:

- Products & solutions, including our newsletter containing up-to-date information on your products.
- Electronic trading over the Internet.
- Support with e.g. instructions and manuals, certificates, brochures and catalogs.

Training center

Siemens offers corresponding courses for newcomers to process gas chromatography. Please contact the central Training Center in Karlsruhe.

Training Center Europe
Process Instrumentation and Analytics
Siemensallee 84
D-76181 Karlsruhe, Germany
Internet: www.sitrain.siemens.com (http://www.sitrain.siemens.com/index_en.html)

Technical support

- You can reach the "Technical Support" for all A&D products using:
 - the Web form for "Support Request" at www.siemens.com/automation/support-request (<http://www.siemens.com/automation/support-request>) .
 - Phone: +49 180 5050 222
 - Fax: +49 180 5050 223
(0.14 € / min from German landline, mobile charges may differ)
- You can find the latest information concerning your device on the Internet at www.automation.siemens.com/ (<http://www.automation.siemens.com/>).

A.6 List of abbreviations

Abbreviation/symbol	Description
°	Degrees
°C	Degrees Celsius
Ar	A rgon
AS	Release version
ATEX	A tmosphère e xplosible (French for explosive atmosphere)
AWG	A merican W ire G auge
Bit	b inary digit
ca.	approx.
CAC	C ommunication and A nalytical C ontrol
CD	C ompact D isk
CE	C ommunautés E uropéennes (French for European Community)
CH ₄	CH ₄ = methane
cm ²	Square centimeter
CO ₂	CO ₂ = carbon dioxide
CS ₂	Carbon bisulfide
CSA	C anadian S tandards A ssociation
DC	D irect C urrent
DIN	D eutsches I nstitut für N ormung e. V. (German standards association)
DVD	D igital V ersatile D isk
DVGW	D eutsche V ereinigung des G as- und W asserfaches e. V. (German technical/scientific association)
EEPROM	E lectrically E rasable P rogrammable R ead O nly M emory
e.g.	For example
EIA	E lectronic I ndustries A lliance
eLive	e nhanced L ive injection
EMC	E lectro M agnetic C ompatibility
EN	E uropäische N orm (European standard)
EPC	E lectronic p ressure c ontroller (
ES	Product version
ESD	E lectrostatic D ischarge
FM	F actory M utual, USA certification organization
GC	G as C hromatograph
H ₂	H ₂ = hydrogen
H ₂ O	H ₂ O = water
H ₂ S	H ₂ S = hydrogen sulfide
He	H elium

Abbreviation/symbol	Description
IEC	International E lectrotechnical Commission
IEEE	Institute of E lectrical and E lectronics E ngineers
IP	Internet P rotocol
ISO	International Standards Organization (from Greek: " isos ": "equal")
kPa	K ilo p ascal
kg	K ilo g ram
l	L iter
LED	L ight e mitting d iode
m	M eter
m ³	Cubic meter
max.	M aximum
MB = Mbit	10 ⁶ bits
MEMS	M icro e lectromechanical s ystem
MHz	M egahertz
min	M inute
ml	M illiliter
MMI	M an- M achine Interface
MPa	M egapascal
MTBF	M ean operating T ime B etween F ailures
MTTR	M ean T ime T o R ecover
MV	Solenoid valve
N ₂	N ₂ = nitrogen
NAU	N etwork A ccess U nit
NEMA	N ational E lectrical M anufacturers A ssociation
PC	P ersonal C omputer, a stationary single-user computer
Porabond Q	Name of a type of column
ppm	p arts p er m illion ($\pm 10^{-6}$)
PTB	P hysikalisch- T echnische B undesanstalt (German technical inspectorate)
PWM	P ulse w idth m odulation
RAM	R andom A ccess M emory
ROM	R ead O nly M emory
RS	R ecommended S tandard
RS -232	(also EIA-232) Identifies an interface standard for a sequential, serial data transmission
RS-485	(also EIA-485) Identifies an interface standard for a differential, serial data transmission
RSP	R ead T ime S ignal P rocessing
s	S econd
Sil5	Name of a type of column

Abbreviation/symbol	Description
t	time
T	Temperature
TCD	Thermal Conductivity Detector
TCP/IP	Transmission Control Protocol/Internet Protocol; a reference module for communication on the Internet
TS	Column
V	Volt
VDE	Verband der Elektrotechnik, Elektronik und Informationstechnik (German Association for Electrical, Electronic and Information Technologies)

Glossary

Aldehyde

Aldehydes are chemical compounds containing a terminal carbonyl group (or more exactly an aldehyde group, CHO) as the functional group. The series of aldehydes derived from the alkanes form the homogenous series of alkanals.

Aliphatic hydrocarbons

Aliphatic hydrocarbons (Greek: aleiphar, fatty) are organic hydrocarbon chains. Aliphatic compounds are "acyclic or cyclic, saturated or unsaturated carbon compounds except aromatic compounds". The simplest group of aliphatic hydrocarbons are the alkanes. Like all pure hydrocarbons, aliphatic hydrocarbons are **nonpolar**, lipophilic compounds.

American wire gauge (AWG)

American Wire Gauge is a specification for wire diameters, and mainly used in North America. It identifies electric cables made of stranded or solid wire and is used in electrical engineering to identify the cross-section of conductors.

Analog

Continuous representation of a variable, e.g. voltage, using a scale, in contrast to "Digital".

Aromatic compounds

Aromatic compounds, or also **arenes**, are an important class of compounds in organic chemistry. They feature a specific bonding structure.

ATEX

ATEX is the abbreviation of the French term "Atmosphère explosible". ATEX stands for both the directives of the European Community for the field of explosion protection: the ATEX product directive 94/9/EC and the ATEX operation directive 1999/92/EC.

Breathing device

The breathing device is used for pressure compensation during operation. This pressure compensation is required due to temperature variations during operation

Carbon bisulfide

Carbon bisulfide (trivial name: **bisulfide of carbon**) is a colorless liquid with the total formula CS_2 . Carbon bisulfide is a highly refracting and extremely flammable liquid which is as pleasant as ether when pure, but which almost always smells extremely unpleasant due to contamination.

Chromatography

Chromatography or Chromatografie (Greek) is a procedure used in chemistry which allows a mixture to be separated as a result the different distribution of its individual components between a stationary phase and a mobile phase.

Cut

Two columns are connected in sequence with a live T-piece in between. The columns have different separating properties, for example. The three operating states of the live switching are selected by changing the pressure in the gas lines of the live T-piece:

- Straight
- Backflushing
- Cut.

Cut is the name of the process where the components have passed through the first column and some of them are flushed through the cut output. They never reach the second column.

Detection limit

The detection limit refers to the extreme value of a measuring method down to which the variable can just still be reliably detected.

The measured value at the detection limit has an increased inaccuracy which, however, does not exceed a defined statistical confidence interval. Measured values with an inaccuracy greater than the defined confidence interval are outside the detection limit, and are referred to as immeasurable or nondetectable in the sense of the measuring method.

The criterion for "reliable detection" generally refers to the precision of the measuring method for a zero or blank measurement. This therefore means the statistical error or the variation in the measured signal if a sample is not present (e.g. the standard deviation of background signal, noise, blank value, zero value etc.).

A measured value is frequently considered as valid or detected if the inaccuracy of the value is less than three times the standard deviation of the zero measurement.

Digital

Representation of a variable, e.g. time, in the form of characters or numbers. In its digital representation, this variable can be changed only in pre-defined steps, in contrast to "Analog".

EEPROM

Electrically **E**rasable **P**rogrammable **R**ead **O**nly **M**emory

EEPROMs are often used where individual bytes of data (e.g. configuration data or runtime meters) change over time and must be stored safely in the event of a mains power failure.

ElectroMagnetic Compatibility

Definition as per the EMC law:

EMC is the capability of a device to operate satisfactorily in an electromagnetic environment without itself emitting electromagnetic signals which interfere with other devices in that environment.

eLive

As of release version 09, MicroSAM features the eLive injection, which controls the position of the injection content, prevents the mixing with carrier gas, and prevents the influences of viscosity during injection in the case of certain gas compositions.

Ethane

Ethane is a chemical compound belonging to the group of alkanes (saturated hydrocarbons). Ethane is a colorless and odorless gas with the formula C_2H_6 . Ethane is primarily used for heating and combustion purposes. Ethane is a main component of natural gas, in addition to methane.

Ethine

Ethine (or **acetylene**) is a colorless gas with the formula C_2H_2 . Ethine is the simplest representative from the group of alkynes.

Firmware

Firmware (FW) is software which is embedded in a chip in electronic devices – unlike software that is stored on hard drives, CD ROMs, or other media. These days, the firmware is mostly stored in a flash memory or an EEPROM.

The firmware mostly contains elementary control functions of the device, as well as input and output routines.

Gas chromatography (GC)

Gas chromatography is an analytical method used worldwide to separate mixtures into individual chemical compounds. GC can only be used for components which are gaseous or can be vaporized. With this type of chromatography, an inert gas is used as the mobile phase, usually nitrogen, helium or hydrogen. The carrier gas is passed through a tube or capillary with a defined internal diameter, the so-called "Column". Older columns are made of metal, newer columns of quartz glass which are coated to increase the resistance to breakage. The column is internally lined with a defined stationary phase, frequently with viscous polysiloxanes.

Ketones

Ketones are chemical compounds containing a non-terminal carbonyl group ($>C=O$) as the functional group. Ketones are oxidation products of secondary alcohols. The ketones derived from the alkanes are also referred to as **alkanones**. The simplest ketone is **acetone** (propanone or dimethyl ketone).

MEMS: Micro Electro-Mechanical System

MEMS is a combination of:

- mechanical elements,
- sensors,
- actuators,
- electronic circuits

on a substrate or chip.

Modbus

The Modbus protocol is a communications protocol based on a master/slave or client/server architecture. The Modbus protocol was defined by Modicon in 1979 for communication with its programmable controllers. Modbus is a de facto standard in industry, since it is an open protocol.

Modbus is used to connect a master (e.g. a PC) and several slaves (e.g. measuring and control systems). There are two versions of Modbus: one for the serial interface and one for Ethernet.

Molecular filter

Molecular filter (or also **molecular sieve**) is the term for naturally occurring and synthetic zeolites which have a strong adsorption capacity for gases, vapors and dissolved materials with certain molecular sizes. Appropriate selection of the molecular sieve permits molecules of different sizes to be separated.

Nonpolar

A nonpolar molecule does not have a permanent dipole moment. Nonpolar compounds are highly soluble in nonpolar solvents. The solubility increases along with the similarity of the interacting forces between the particles of the solvent and between those of the dissolved compound.

Polarity

Polarity with regard to chemical compounds refers to the generation of separate charge centers produced by the shifting of charges in groups of atoms, the result being that a group of atoms is no longer electrically neutral. The electrical **dipole moment** is a measure of the "polarity" of the molecule.

Process Gas Chromatography

Process gas chromatography:

- Is one of the most powerful measuring and analysis methods for process analytics.
- Is a procedure that is both discrete and extractive.
- Is frequently used for online monitoring of processes since the sequences are easy to automate and a large number of components can be measured simultaneously.
- Can be used to separate and quantify the components of almost all homogenous gaseous or liquid mixtures. It must be possible to vaporize the liquid components without decomposition.

The individual components of a discrete sample pass through the column system at different velocities, and are recorded in succession by a detector.

The time between sample introduction and recording of a substance at the detector (the retention time) is characteristic of the substance and is used to identify it. The magnitude of the detector signal is a measure of the volume concentration of the component in the gas.

Propanone

Propanone (also **acetone**) is the simplest ketone. **Acetone** is a colorless liquid used as an aprotic solvent and as an educt for organic syntheses.

Real-time

Real-time is the time which sequences require in the real world. The term defines that a system must respond to an event within a defined time. The term does not provide any information on the speed or processing performance of a system.

RS 232

A recognized industrial standard for serial data transmission, and applies to cable lengths up to 15 m. Differential evaluation is not possible with RS 232. The sending and receiving of data take place on different lines.

RS 485

RS 485 is an interface standard for line-based, differential, serial data transmission. RS 485 uses a pair of cables in order to transmit one inverted version and one non-inverted version of the data signal. The original data signal is reconstructed at the receiver from the difference between these two signals. It is then possible to use significantly longer transmission links and higher speeds than with RS 232. Furthermore, several transmitters and several receivers can be connected to one pair of conductors.

Silanes

The name silanes refers to a group of chemical compounds consisting of a silicon matrix and hydrogen. Silanes can have a branched (iso- and neo-silanes) or unbranched (n-silanes) structure. The general total formula of these compounds combined under the generic term catena silanes is $\text{Si}_n\text{H}_{2n+2}$. Ring-shaped hydrosilicon compounds are referred to as cyclosilanes (general total formula: Si_nH_{2n}).

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