Operating Instructions
ENERSIC600

Gas Chromatograph

Endress+Hauser
People for Process Automation

Described product

Product name: ENERSIC600
Variant: ENERSIC600 C6+ only
Variant: ENERSIC600 C6+ H2-ready
Variant: ENERSIC600 C6+ H2

Manufacturer

Endress+Hauser SICK GmbH+Co. KG
Bergener Ring 27
01458 Ottendorf-Okrilla
Germany

Legal information

Original document

This document is an original document of Endress+Hauser SICK GmbH+Co. KG.

Contents

1 About this document

1.1 Function of this document

These Operating Instructions describe:

- Device components
- Installation
- Operation
- Maintenance work required for reliable operation

1.2 Scope of application

These Operating Instructions are only applicable for the device described in the product identification.

They are not applicable for other Endress+Hauser devices.

The standards referred to in these Operating Instructions are to be observed in the respective valid version.

1.3 Target groups

This Manual is intended for persons installing, operating, and maintaining the device.

Operation

The device may only be operated by qualified persons who, based on their device-specific training and knowledge as well as knowledge of the relevant regulations, can assess the tasks given and recognize the hazards involved.

Installation and maintenance

Installation and maintenance may only be carried out by trained specialists familiar with the installation conditions.

Please observe the information at the beginning of the respective sections.

1.4 Further information

- User Instructions ENERSIC600 Software Manual
- Safety Sheet supplied by the manufacturer referring to the relevant CAS (Chemical Abstract Service) number and/or MSD (Material Safety Datasheet)

1.5 Symbols and document conventions

1.5.1 Warning symbols

Symbol	Significance
	Hazard (general)
	Hazard by voltage
	Hazard by high temperature

1.5.2 Warning levels and signal words

DANGER:
Risk or hazardous situation which *will* result in severe personal injury or death.

WARNING:
Risk or hazardous situation which *could* result in severe personal injury or death.

CAUTION:
Risk or hazardous situation which *could* result in less severe or minor injuries.

NOTICE:
Hazard which *could* result in property damage.

Note:
Tips

1.5.3 Information symbols

Symbol	Significance
	Important technical information for this product
	Important information concerning electrical or electronic functions

1.6 Data integrity

Endress+Hauser uses standardized data interfaces, such as standard IP technology, in its products. The focus here is on the availability of the products and their properties.

Endress+Hauser always assumes the integrity and confidentiality of data and rights affected in connection with the use of the products are ensured by the customer.

In all cases, the customer is responsible for the implementation of safety measures suitable for the respective situation, e.g., network separation, firewalls, virus protection and patch management.

2 For your safety

2.1 Basic safety information

- ▶ Read and observe these Operating Instructions.
- ▶ Observe all safety information.
- ▶ If anything is not clear: Please contact Endress+Hauser Customer Service.

Retention of documents

These Operating Instructions

- Must be available for reference.
- Must be passed on to new owners.

Correct project planning

- Basis of this Manual is the delivery of the measuring device according to the preceding project planning and the relevant delivery state of the measuring device (see delivered System Documentation).
- If you are not sure whether the measuring device corresponds to the state defined during project planning or to the delivered system documentation: Please contact Endress+Hauser Customer Service.

Correct use

- Use the device only as described in “Intended use”. The manufacturer bears no responsibility for any other use.
- Perform the specified maintenance work.
- Do not carry out any work or repairs on the device not described in this Manual. Do not remove, add or modify any components to or on the device unless described and specified in the official manufacturer information.
- Use only original spare parts and wear and tear parts from Endress+Hauser.

In case of non-compliance:

- Any warranty by the manufacturer becomes void.
- The device could become dangerous.
- The device no longer complies with the approval for the hazardous area.

Special local requirements

In addition to the information in this Manual, follow all local laws, technical rules and company-internal operating and installation directives applicable wherever the device is installed.

2.1.1 Electrical safety

Hazard through electrical shock

There is a risk of electric shock when working on the measuring device with the voltage supply switched on.

- ▶ Before starting work on the measuring device, ensure the power supply can be switched off using a power isolating switch or circuit breaker in accordance with the valid standard.
- ▶ Make sure the power isolating switch is easily accessible.
- ▶ An additional disconnecting device is mandatory when the power isolating switch cannot be accessed, or only with difficulty, after installation of the device connection.
- ▶ Switch off the power supply before carrying out any work on the measuring device.
- ▶ After completion of the work or for test purposes or calibration, the voltage supply may only be activated again by authorized personnel complying with the safety regulations.

2.1.2 Dangerous substances

Use of chemicals

- ▶ Before using process gases, carefully read the warning notices and information reported in the Safety Sheet supplied by the manufacturer referring to the CAS (Chemical Abstract Service) and/or MSD (Material Safety Datasheet) number.

Use of gases

- ▶ Before using gases, carefully read the warning notices and information reported in the Safety Sheet supplied by the manufacturer referring to the CAS (Chemical Abstract Service) and/or MSD (Material Safety Datasheet) number.
- ▶ The applied gas pressures should not exceed the upper tolerance of the pressure ranges given in this document.

2.2 Intended use

The gas chromatograph is a device that analyzes the concentrations of constituents in a gas mixture.

The chromatograph is suitable for installation in an explosive atmosphere according to Category 2 (ATEX), Zone 1 (IECEx), Class I Division 1 (pending).

The device identification is as follows:

- ⟨Ex⟩ II 2G Ex db IIB+H2 T4 Gb (-20 °C ≤ Tamb ≤ +55 °C)
- Ex db IIB+H2 T4 Gb (-20 °C ≤ Tamb ≤ +55 °C)

2.2.1 Specific conditions of use

According to the specific conditions of use of the Ex certificates, the flame paths of the ENERSIC600 are described as follows.

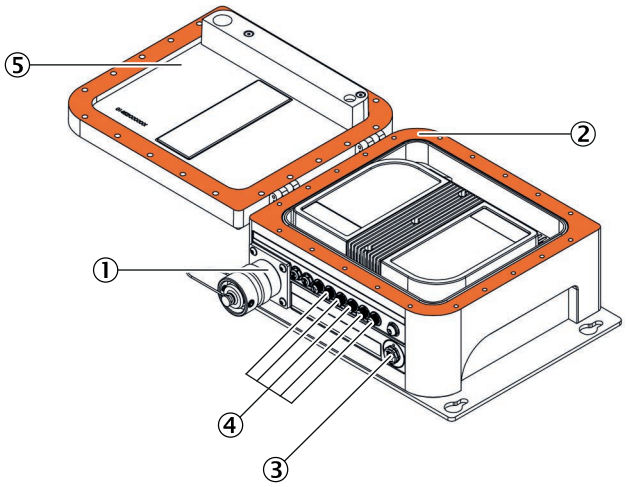


Fig. 1: Flame paths

① Depending on the device configuration either of the following:
- threaded flame path between Ex receptacle and Ex enclosure body
- threaded flame path between Ex cable gland and Ex enclosure body

② Flanged flame path between Ex enclosure body and Ex enclosure lid

③ Threaded flame path between Ex Breather and Ex enclosure body

④ Threaded flame path between Ex gas ports and Ex enclosure body

⑤ Cylindrical flame path between Ex indicator light glass and Ex enclosure lid

Dimensions of flameproof joints

All dimensions are in mm.

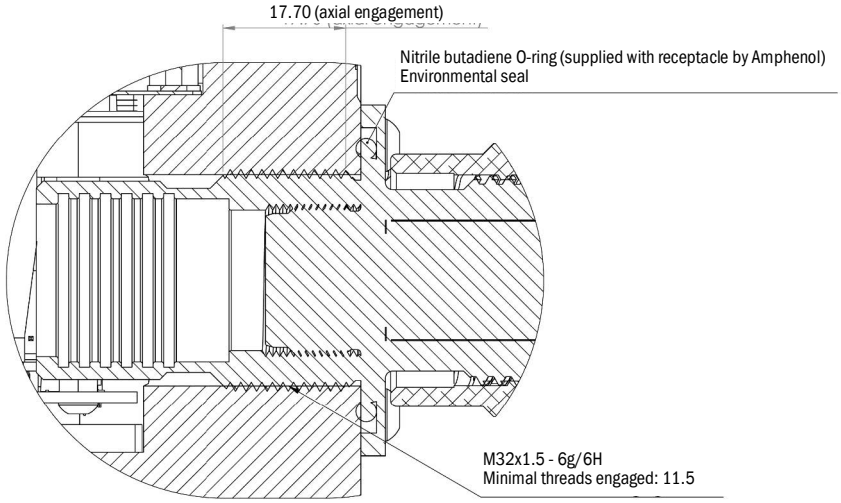


Fig. 2: Threaded flame path between Ex receptacle and Ex enclosure body

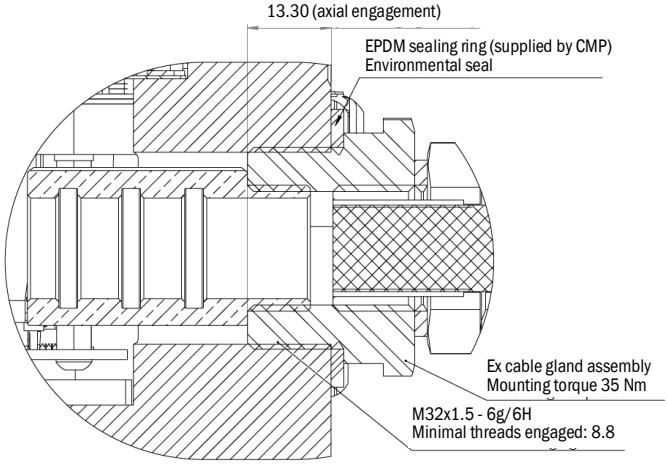


Fig. 3: Threaded flame path between Ex cable gland and Ex enclosure body

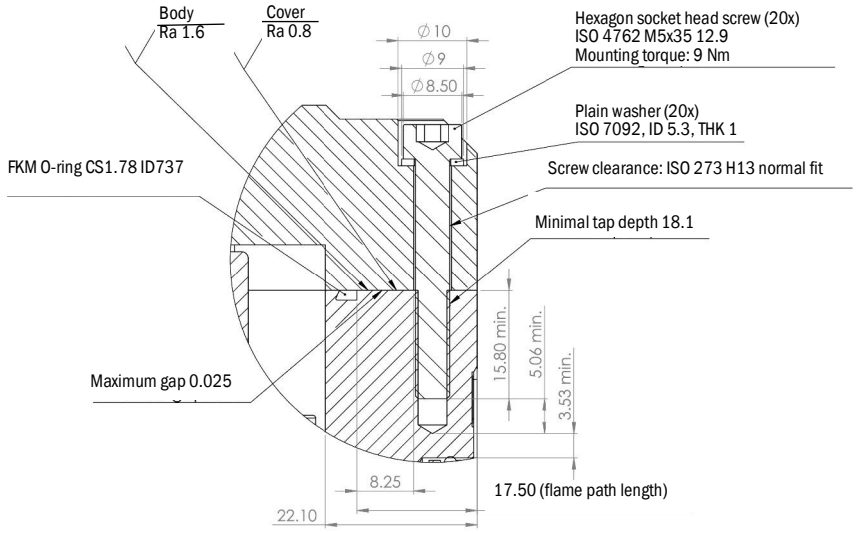


Fig. 4: Flanged flame path between Ex enclosure body and Ex enclosure lid

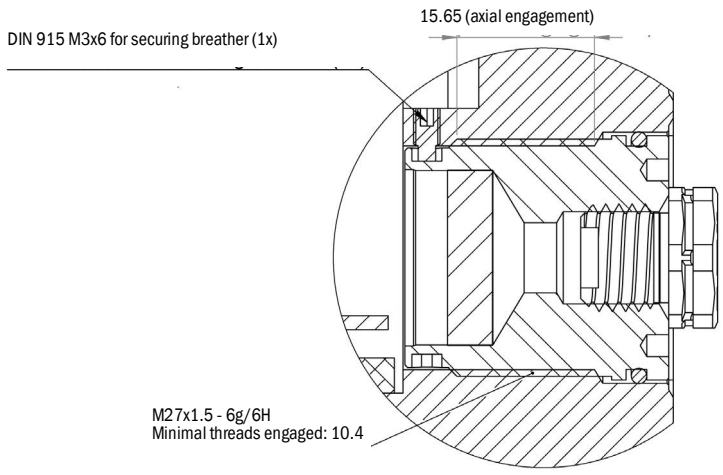


Fig. 5: Threaded flame path between Ex breather and Ex enclosure body

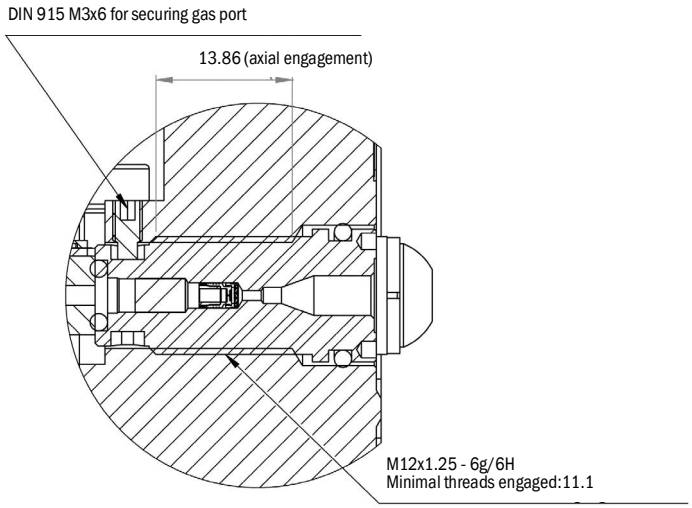


Fig. 6: Threaded flame path between Ex gas ports and Ex enclosure body

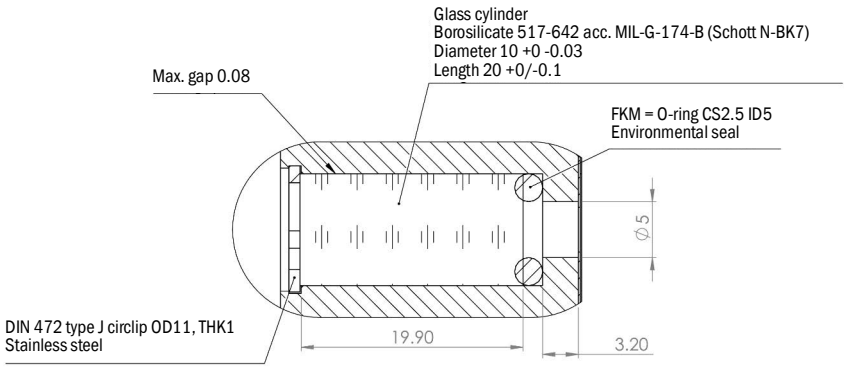


Fig. 7: Cylindrical flame path between Ex indicator light glass and Ex enclosure lid

NOTICE: The user shall provide additional clamping of the cable to ensure that pulling is not transmitted to the terminations

2.3 Requirements for the qualification of the personnel

Installation, commissioning, and maintaining the device should only be carried out by skilled persons who, based on their technical training and knowledge as well as knowledge of the relevant regulations, can assess the tasks given and recognize the dangers involved.

3 Product description

3.1 Product identification

Product name	Gas chromatograph
Manufacturer	Endress+Hauser SICK GmbH+Co. KG Bergener Ring 27 · D-01458 Ottendorf-Okrilla · Germany
Type plate	Bottom, beneath gas ports

3.1.1 Type plate

3.2 Product characteristics

The gas chromatograph is a device that analyzes the concentrations of constituents in a gas mixture. It can accommodate multiple gas chromatograph (GC) units, each performing a different analysis in parallel under individually optimized conditions.

The device is designed for continuous monitoring and therefore works stand-alone using the integrated processor with firmware, without the need of a separate controller giving commands. In addition, dedicated PC software can be used to analyze the collected data in further detail and to change operation settings.

3.3 Device variants

Variant	Application and measured components
ENERSIC600 C6+ only	2-channel natural gas C6+ (not upgradeable to 3-channel)
ENERSIC600 C6+ H2 - ready	2-channel natural gas C_{6+} (upgradeable to 3-channel)
ENERSIC600 C6+ H2	3-channel natural gas C_{6+} and H_2

For details, see “Device configuration”, page 53.

3.4 Layout and function

3.4.1 Functional principle

The analyzer is based on the functional principle of gas chromatography which is a chemical analysis method for determining the gas composition of gas mixtures. A gas chromatograph uses a flow-through narrow tube known as the column, through which different chemical constituents of a sample flow in a gas stream (carrier gas, mobile phase) at different rates. The rate depends on the various chemical and physical column properties and their interaction with a specific column filling, called the stationary phase. The function of the stationary phase in the column is to separate different components, causing each one to exit the column at a different time (retention time). Other parameters that can be used to alter the order or time of retention are the carrier gas pressure, column length, column diameter and column temperature. The chemicals exiting at the end of the column are detected electronically and identified with a data system.

The hardware generally comprises 3 building blocks: Injector, column, and detector which are schematically represented in the figure below.

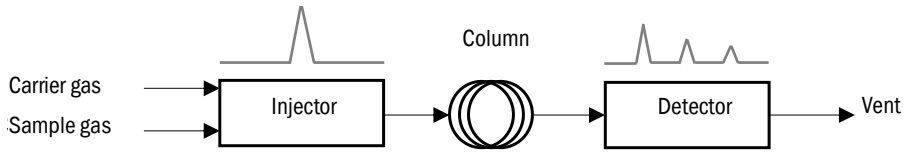


Fig. 8: Schematic representation of separation of gas components in a gas chromatograph

3.4.2 Layout

The ENERSIC600 can contain up to 4 GC units, each simultaneously performing their own analysis. Every GC unit contains an injector chip with micro channels, micro valves, columns, and micro detectors, and is specifically designed to analyze a range of components. The GC units are defined by their column type and parameters such as temperature, pressure, and injection time.

The block diagram below shows the typical layout of the ENERSIC600 C6+ H2 version with 3 GC units. Carrier gas, calibration gas, and up to 4 sample lines (streams) can be connected to the inlet of the stream selector.

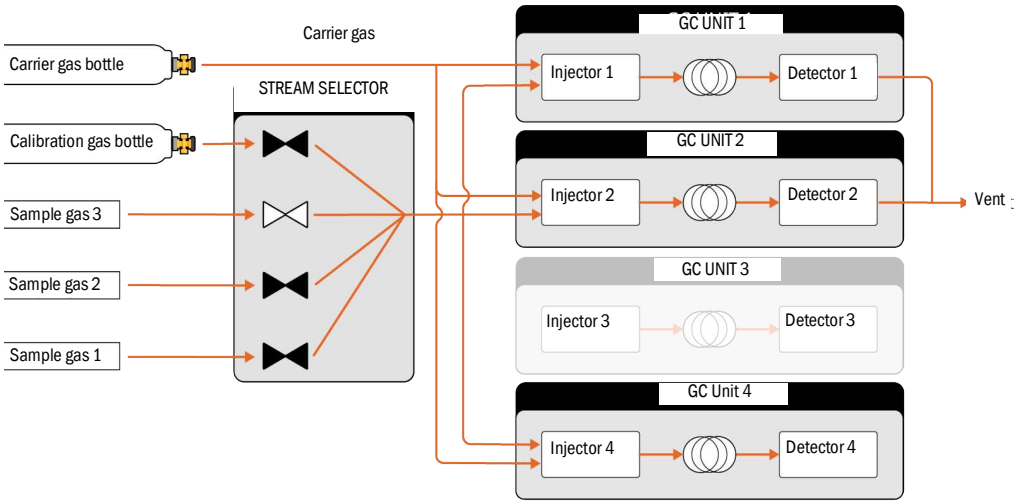


Fig. 9: Typical layout of the ENERSIC600 C6+ H2 version with 3 GC units

3.4.3 Hardware overview

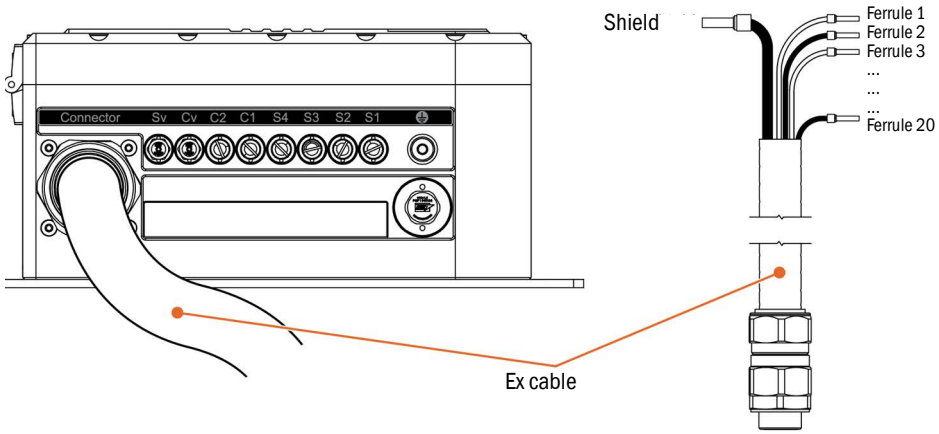


Fig. 10: Side view with fixed Ex cable

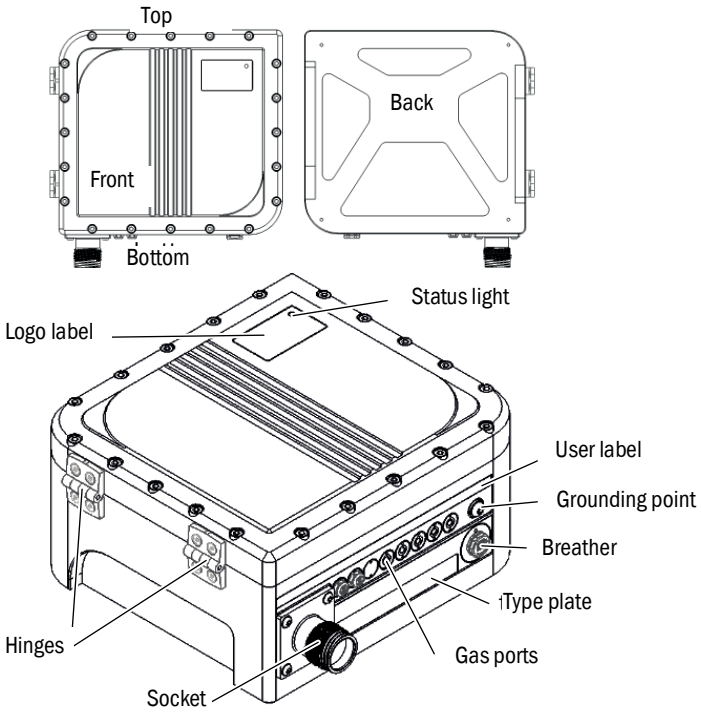


Fig. 11: External view

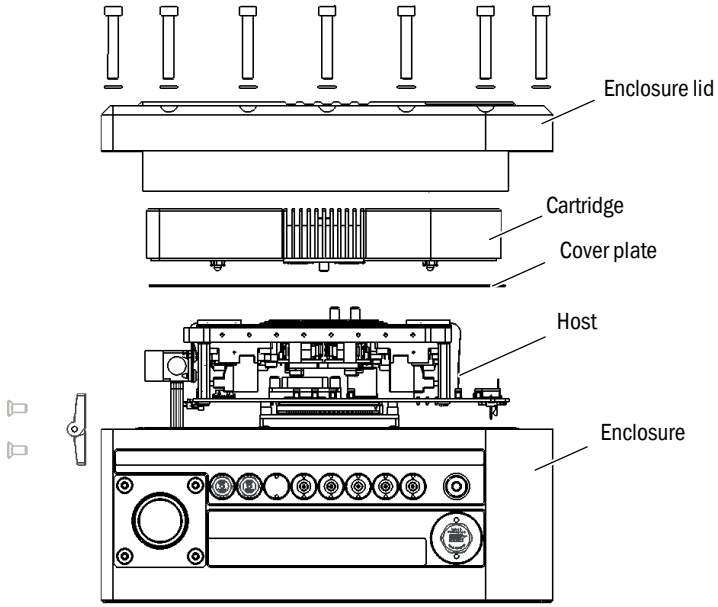


Fig. 12: Internal view

Main parts

- Cartridge: Contains all core GC hardware (injector, column, detector and heaters)
- Host: Contains fluidic and electronic connections, contains pneumatic and electronic control functionality

3.4.4 Cartridge

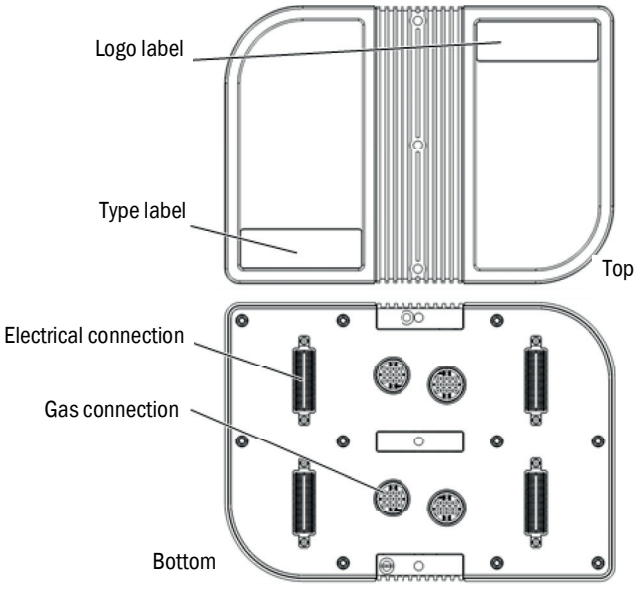


Fig. 13: Top and bottom view of cartridge containing four analytical units

Characteristics

- Exchangeable part which can be replaced by a trained technician
- Contains four separated areas for four analytical units (or GC channels)
- Number of installed analytical units in the cartridge depends on the application.

3.4.5 Host

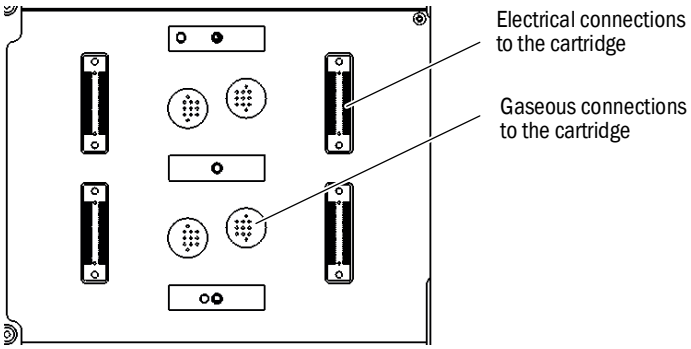


Fig. 14: Schematic representation of the host interface

Function

- Controls the sample injectors and read-out of the thermal conductivity detector (TCD) signals
- Controls valves for directing the incoming gases to the cartridge
- Provides the electrical connections between the cartridge and the socket (power supply and communication)

Characteristics

- Consists of electronics with processing power, pneumatic components and a gas distribution manifold

3.4.6 Cover plate

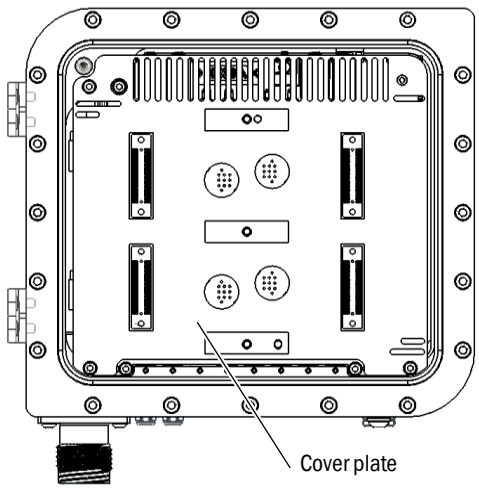


Fig. 15: Top view of cover plate

Function

- The cover plate prevents accidental access to the host when the analyzer is opened.
- It protects the host from being damaged by e.g. ESD, bumping, etc.

3.4.7 Gas connections

The type, amount and mapping of gas ports may vary dependent on the application. For details, see “Device configuration”, page 53 and see “Connecting gas lines”, page 29.

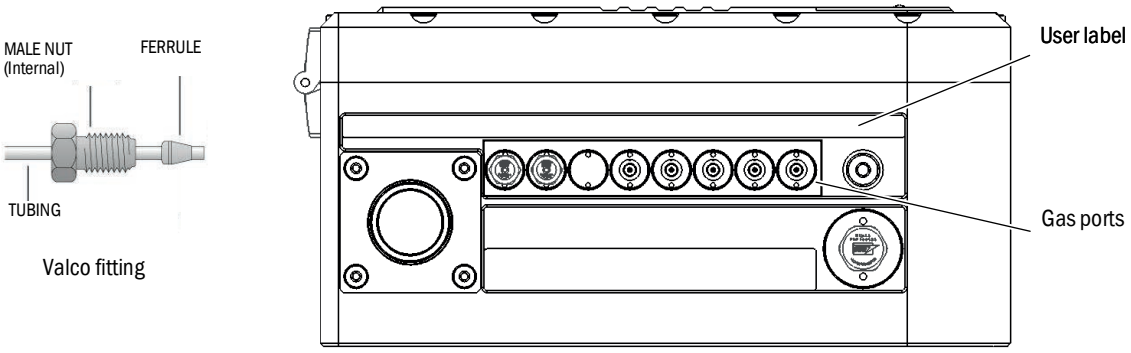


Fig. 16: Gas connections (example) and a Valco fitting

Gas ports

Fig. 17: Gas ports

Types of gas ports:

- Gas port inlet:
  - For connection of the sample, carrier and actuation gases
  - Contains an internal flame arrestor and flow restrictor
- Gas port vent:
  - For venting the outgoing gases
  - Contains an internal flame arrestor
  - Can be recognized by the black plastic plug which allows venting the gases into free space while providing weather protection
  - Optionally, the gas port vent of sample gas, for example, can be connected to a tube for further processing/transportation; contact Endress+Hauser for more information.
- Blind plug:
  - Not a gas connection
  - Used for shutting off an unused port in the enclosure

The gas ports are secured from the inside to prevent unauthorized removal.

Identification:

- The gas ports configuration can be derived from the user label on the enclosure.
- The type of gas port is indicated on the user label above the ports and is application specific.

Connection type:

The type of connection to the inlet is customizable but is normally a Valco fitting (VICI AG International) for 1/16" tubing. For exact instructions, refer to the Valco fitting instructions Manual on their website.

Optionally, the gas port vent(s) can be made suitable for connection to a tube for further processing or transportation of the vented gas. The default vent port has a female M6 x 0.75 thread and dedicated connectors are available for the analyzer.

3.4.7.1 *Carrier gas connections*

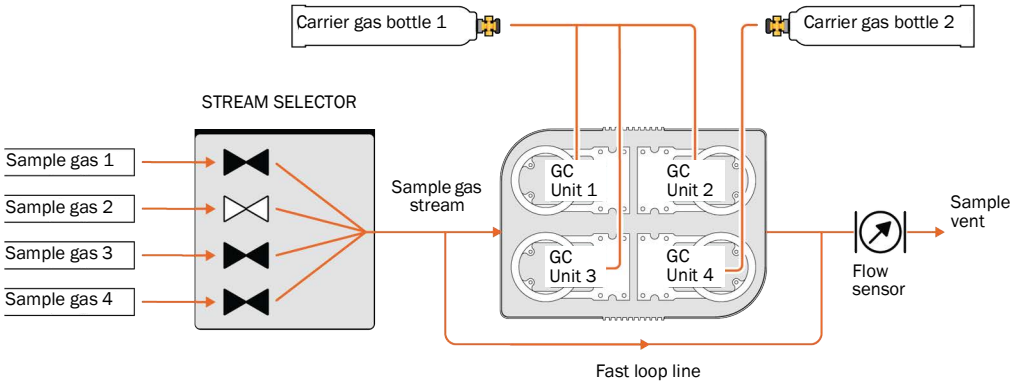


Fig. 18: Example with 4 GC units: gas connections and flow

- Carrier gas 1 (C1 gas inlet) is always connected to GC units 1, 2 and 3.
- Carrier gas 2 (C2 gas inlet) is always connected to GC unit 4.
- In case of a single carrier gas application, the same carrier gas source can be connected to C1 and C2 gas inlets by using a carrier gas inlet splitter $^{1}/_{16}$".

3.4.7.2 *Required gas supplies*

Carrier/actuation gas

- Externally regulated and conditioned carrier/actuation gas supply
- Pure (e.g. 99.999%), dry and free of particles
- Application-specific gas type, see "Device configuration", page 53
- Typical carrier gas: Helium, argon or nitrogen

Sample gas

- One or more sample gas supplies
- Dry and free of particles
- User-specified sample gas type, calibration gas also possible

3.4.8 Breather

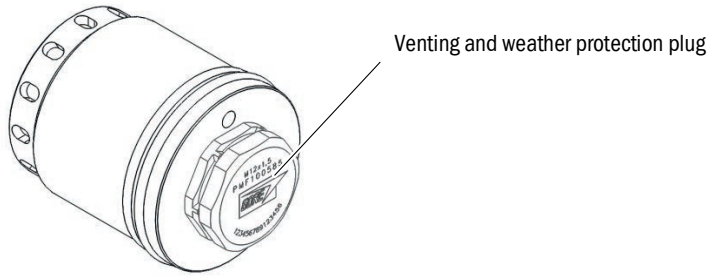


Fig. 19: Breather

Function

- Minimizes moisture accumulation inside the analyzer through ventilation
- Prevents the pressure inside the analyzer becoming higher than the external atmospheric pressure (in agreement with explosion safety regulations)

Characteristics

- Contains a plug with a gas permeable membrane which allows venting of the gases while providing weather protection
- Contains an internal flame arrestor
- Secured from the inside to prevent unauthorized removal

3.4.9 Electrical connections

The electrical connection, inputs and outputs (I/O), and communication are realized by the fixed Ex cable attached to the socket.

3.4.10 Internal grounding

Internal grounding of the analyzer is enabled via a grounding screw in the enclosure lid and a grounding spring in the enclosure.

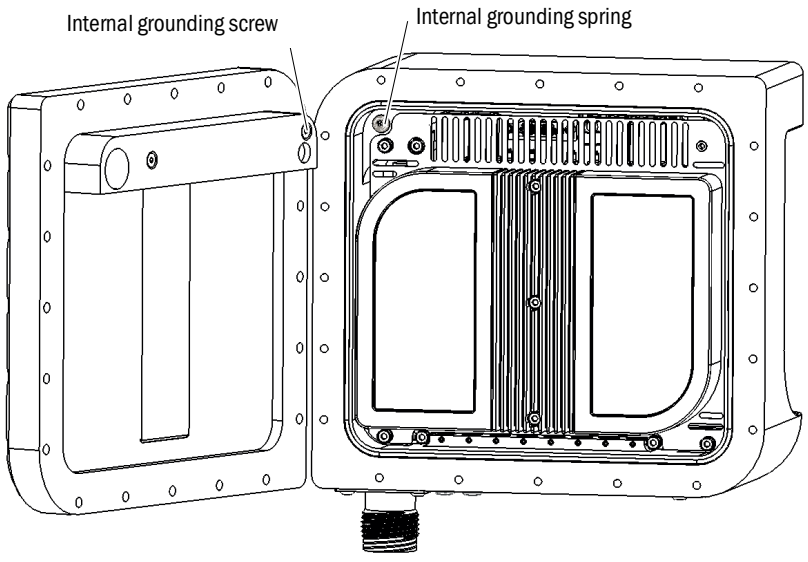


Fig. 20: Internal grounding of the enclosure

3.5 Options

3.5.1 Mounting wall plate

The analyzer is supplied with a backplate for mounting the analyzer to the wall or similar fixed installation. In addition, a mounting wall plate is available which enables quick mounting and removal of the analyzer. For proper operation of the analyzer, it is recommended to always use the mounting wall plate.

3.5.2 Electric connection unit

The analyzer can optionally be supplied with a connection unit. It enables users to easily connect the cables for power supply and communication.

It is an Ex e electrical connection unit that can be placed near the analyzer in the same zone as the analyzer. The connection unit has a cable gland for connecting the Ex cable of the analyzer.

There are two options available:

- Connection unit Class 1, Div 1, Groups B, C, D T6
- Connection unit Class 1, Div 2, Groups A, B, C, D T6

3.6 Interfaces

The analyzer contains two types of data connections: LAN and I/O. Both are connected via the socket.

LAN

The analyzer can be accessed via the ENERSIC software by any computer that is on the same network.

I/O

The I/O port can be used for:

- Communication interfaces: digital I/O, RS-232, RS-485 or Ethernet
- Supported protocols: Modbus or TCP

For details on the exact configured communication interface and protocol, see “Device configuration”, page 53.

3.6.1 Stand-alone operation

In stand-alone operation, different protocols for data read-out and control can run via a LAN, RS-232 or RS-485 bus.

The following standard protocols are available:

Name	Description	Compatible bus
Modbus serial (RTU)	Modbus over serial line (binary)	RS-232, RS-485
Modbus serial (ASCII)	Modbus over serial line (ASCII)	RS-232, RS-485
Modbus TCP	Modbus over LAN	LAN
VICI stream selector	Control external rotary valve VICI stream selector	

The analyzer does not have a standard analog output, but analog outputs can be implemented using an external converter.

3.6.2 Remote control operation

The analyzer can also be operated via a Windows PC on which the ENERSIC software is installed. The software can be used to analyze the collected data in further detail and to change operation settings.

For more information about the software, see the User Instructions ENERSIC600 Software Manual.

3.7 Modbus implementation

Three variants of the standard Modbus protocol have been implemented in accordance with the relevant protocol specifications (see http://www.modbus.org/specs.php):

- Modbus serial RTU (binary Modbus over RS-485 or RS-232)
- Modbus serial ASCII (ASCII Modbus over RS-485 or RS-232)
- Modbus TCP (binary Modbus over TCP/IP)

All protocol variants are based on the same message handler, but use a different message wrapper/ encoding system.

The Modbus specification defines 4 basic types of data:

- Coils: read/write boolean values
- Discrete inputs: read-only boolean values
- Holding registers: read/write 16-bit data values
- Input registers: read-only 16-bit data values

Extended data types can be constructed using multiple registers, e.g.:

- 32-bit integers consisting of two 16-bit registers
- 32-bit floating point numbers consisting of two 16-bit registers
- 64-bit floating point numbers consisting of four 16-bit registers
- 64-bit timestamp values consisting of four 16-bit registers
- Strings of N characters consisting of N/2 16-bit registers

Note that timestamps are represented as 64-bit integers, representing the number of seconds since timestamp 01/01/1904 00:00:00.00 UTC. Note further that data are formatted big-endian, i.e. the most significant byte at the lowest address position. Note finally that floating point numbers are stored in IEEE floating point number format.

The Modbus specification includes 20 possible commands. Not all commands need to be implemented. Typically, devices supporting Modbus only use a basic subset of these commands. The following commands have been implemented:

- 0×01 – Read coils
- 0×02 – Read discrete inputs
- 0×03 – Read holding registers
- 0×04 – Read input registers
- 0×05 – Write single coil
- 0×15 – Write multiple coils
- 0×06 – Write single register
- 0×16 – Write multiple registers

Modbus data is addressed using a two-byte data address, spanning a data address range of 0..65535. This data range is typically subdivided in accordance with the different data types:

- 0..9999 – Coils (R/W)
- 10000-19999 – Discrete inputs (R/O)
- 30000-39999 – Input registers (R/O)
- 40000-49999 – Holding registers (R/W)

Different device parameters and controls are available using Modbus, such as device status and identification information, device control parameters and actual result data. The parameters are organized in accordance with the associated data type (read/only or read/write, discrete or register data). The following table provides a global overview of the internal Modbus data structure.

Address(es)	Data type	Description
01000-01100	Coil (R/W)	Device control
10000-10099	Discrete input (R/O)	Device diagnostics (flags)
10100-10199	Discrete input (R/O)	Device configuration options
30000-30499	Input register (R/O)	Device identification and configuration info
30500-31999	Input register (R/O)	Device status
32000-32499	Input register (R/O)	Last analysis info
32500-34999	Input register (R/O)	Last analysis result
35000-39999	Input register (R/O)	Last analysis result by compound (max 40 peaks, 125 registers per compound)
40000-41999	Holding register (R/W)	Device control

For the complete Modbus register list, see “Modbus register overview”, page 55.

4 Transport and storage

4.1 Transport

Note:
- During shipping, dummy plugs are fitted into the gas port inlets.
- The dummy plugs must be removed before use.
- Store the dummy plugs for future transport.

For information on future transport, see “Transportation”, page 47.

4.2 Storage

NOTICE:
Improper storage can result in damage and necessitate a new factory calibration.

- Store at room temperature in a dry environment.
- Seal all gas ports with e.g. dummy plugs (condition as delivered).
- If applicable, seal the lines with sealing plugs or dummy plugs.

Protective measures for long-term storage

- Flush the device with nitrogen (5.0) at 100 kPa for at least 15 minutes on all inlets.
- Then seal all gas ports with e.g. dummy plugs.

5 Mounting

5.1 Safety

Qualification

Mounting may only be carried out by trained specialists.

5.2 Checking the scope of delivery

The analyzer is shipped in a carton box or an optional robust case together with gas port vent plugs and accessories kit consisting of Valco fittings, ferrules, nuts, and a ¼" combination spanner. Optionally, a connection unit is also supplied.

- ▶ Carefully remove all items from the case or box.
- ▶ The analyzer should be checked after every transport for evidence of damage.
  - – Check for dents, scratches, chipped paint, broken glass, loose parts, bent parts, etc.
- ▶ If there is any damage or defects, contact Endress+Hauser.

5.3 Mounting at target location

Prerequisites

- Make sure that the wall/fixed installation can support the weight of the analyzer.
- There must be at least 50 mm distance between device rear side and wall.
- There must be at least 250 mm spacing in front of the analyzer for convection.

Procedure

- ▶ Mount the analyzer via the backplate or optional mounting wall plate according to the following diagrams.

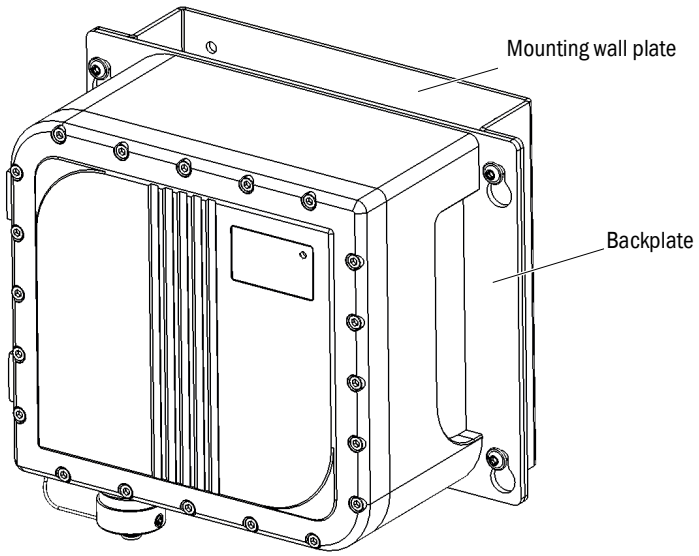


Fig. 21: Backplate and optional mounting wall plate

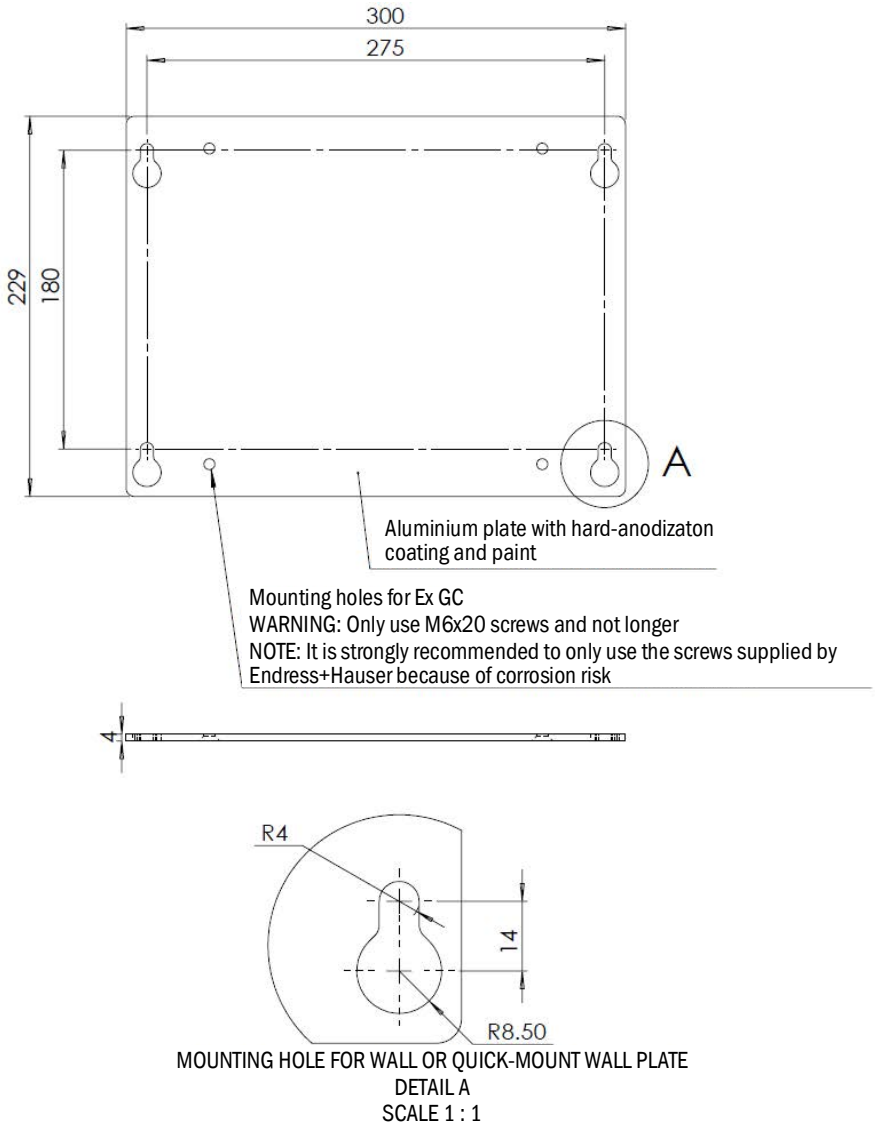


Fig. 22: Backplate (dimensions and mounting)

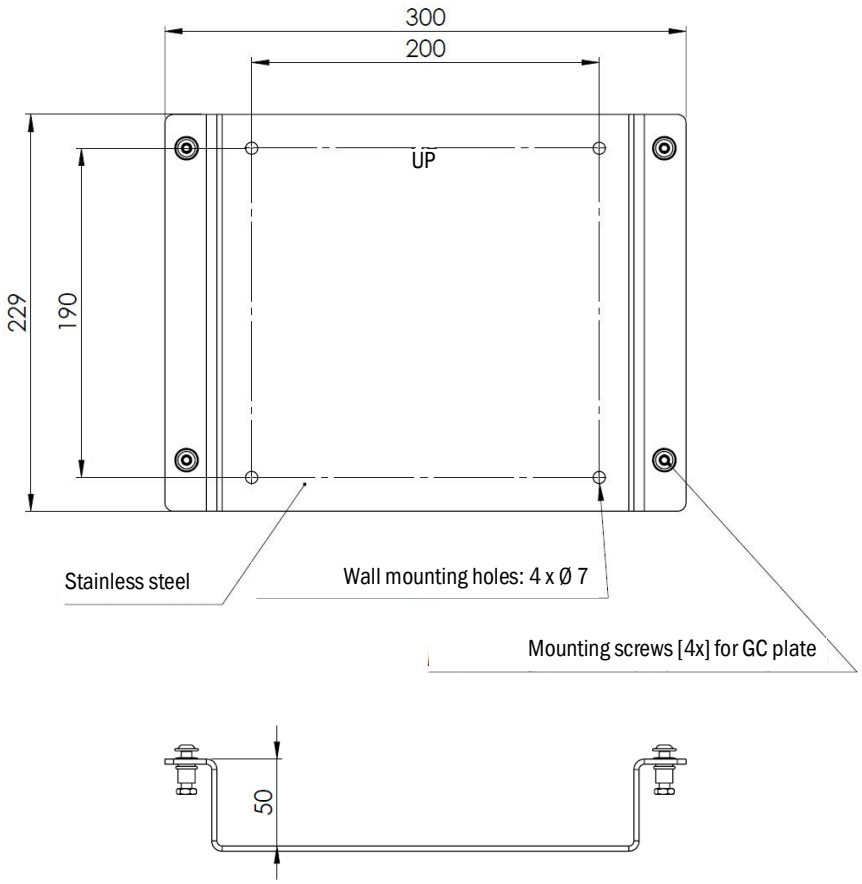


Fig. 23: Optional mounting wall plate (dimensions and mounting)

5.4 Connecting gas lines

Depending on the application, carrier and sample gases may vary. For details, see “Device configuration”, page 53.

Overview

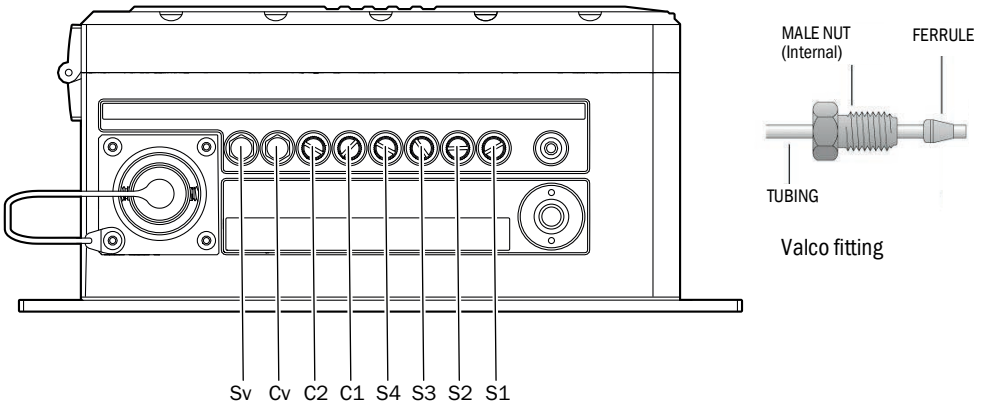


Fig. 24: Gas connections and a Valco fitting

Gas port	Information
Sv	Ventilation of outgoing gas sample. Without screw-in vent plug: internal thread M6x0.75. Screw-in vent plug tightening torque: 0.3 Nm
Cv	Ventilation of outgoing carrier gas. Without screw-in vent plug: internal thread M6x0.75. Screw-in vent plug tightening torque: 0.3 Nm
C1	Carrier gas 1, 1/16" Vici Valco fitting, 450±5% kPa gauge / 4.5 bar(g) (65 psi(g))
C2	Carrier gas 2, 1/16" Vici Valco fitting, 450±5% kPa gauge / 4.5 bar(g) (65 psi(g))
S1	Sample gas 1, 1/16" Vici Valco fitting, max. 10 ... 90 kPa / 0.1 ... 0.9 bar(g) (1.45 ... 13 psi(g))
S2	Sample gas 2, 1/16" Vici Valco fitting, max. 10 ... 90 kPa / 0.1 ... 0.9 bar(g) (1.45 ... 13 psi(g))
S3	Sample gas 3, 1/16" Vici Valco fitting, max. 10 ... 90 kPa / 0.1 ... 0.9 bar(g) (1.45 ... 13 psi(g))
S4	Sample gas 4, 1/16" Vici Valco fitting, max. 10 ... 90 kPa / 0.1 ... 0.9 bar(g) (1.45 ... 13 psi(g))

Important information

Note:
Do not use excessive force/torque when making a gas connection to a gas port.
If a gas port can be freely rotated, do not continue and contact Endress+Hauser.

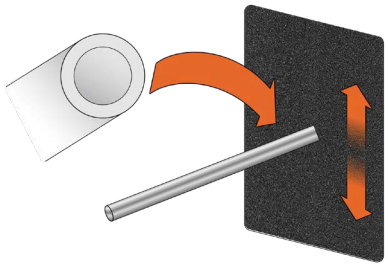
5.4.1 Assemble gas tube fittings

Tools and material required

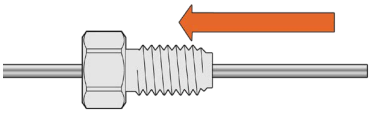
- 1/16'' stainless steel tubing (Vici recommended)
- File
- Stainless steel tubing cutter
- GC Analyzer accessories kit:
  - Vici stainless steel male nut 1/16" SS303
  - Vici stainless steel ferrule 1/16" SS303
  - Combination spanner 1/4"

Procedure

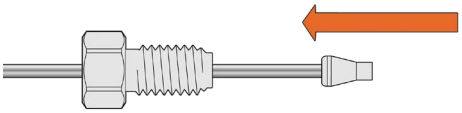
1 Measure the desired length of tubing to fit between the gas inlets and gas bottles and cut with a 1/16'' (1.6 mm) tubing cutter.
2 Ensure that the edges of the tube are flat with a visible hole. Use sandpaper if needed to flatten the edges of the cut tube.



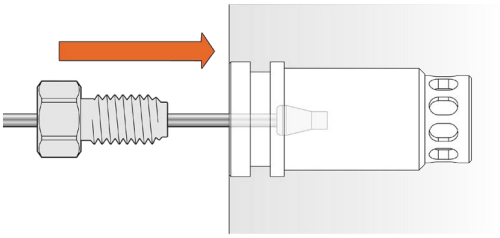
3 Place the male nut over the tube.



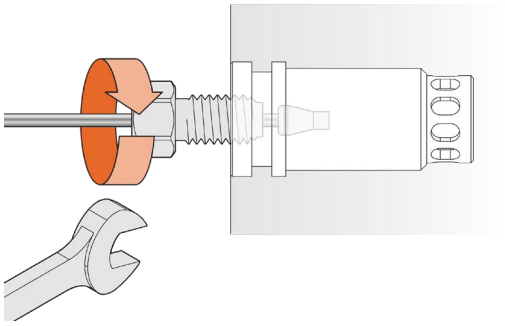
4 Place the ferrule over the tube.



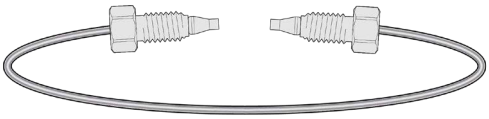
5 Now, insert the tube into the fitting, e.g., a gas inlet on the GC.



6 Apply pressure with the ¼'' combination spanner.



7 Repeat steps 2 to 6 on the other end of the tube.



The assembly of the gas tube is now complete.

5.4.2 Connect gas lines

Prerequisites

- Use 1/16'' metal tubing to connect the gases.
- Use only dual stage pressure regulators with metal seals.
- Flush all tubing and regulators before use and flush gas lines to remove air or other unwanted gases.
- Ensure that the applied pressures for sample and carrier/actuation gases stay below the maximum allowable value.
- Remove dummy plugs from the gas ports and store for future transportation.
- Use a vent tube material that does not chemically react with the gas sample.

Procedure

1 Connect a carrier gas bottle to the carrier gas inlet.
   – To connect the inlet gas lines, use the 1/16'' Valco fittings.
2 Connect the sample gas to the sample inlet.
   – To connect the inlet gas lines, use the 1/16'' Valco fittings.
3 Set the carrier gas pressure to 450 ±5 % kPa / 4.5 bar(g) (65 psi(g)) with the pressure controller on the carrier gas cylinder.
4 If an internal sample gas pump is **not** used: Set the sample gas pressure to 10 ... 200 kPa (gauge) / 0.1 ... 2 bar(g) (1.45 ... 29 psi(g))
5 To connect tubing to the vent outlets, the dedicated connectors that are available for the analyzer can be used.
6 A leakage test must be carried out (e.g. with a gas leak detector device) after all connections have been made.

6 Electrical installation

6.1 Safety

Qualification

The electronic installation may only be carried out by a trained electrician.

6.2 Grounding

Overview

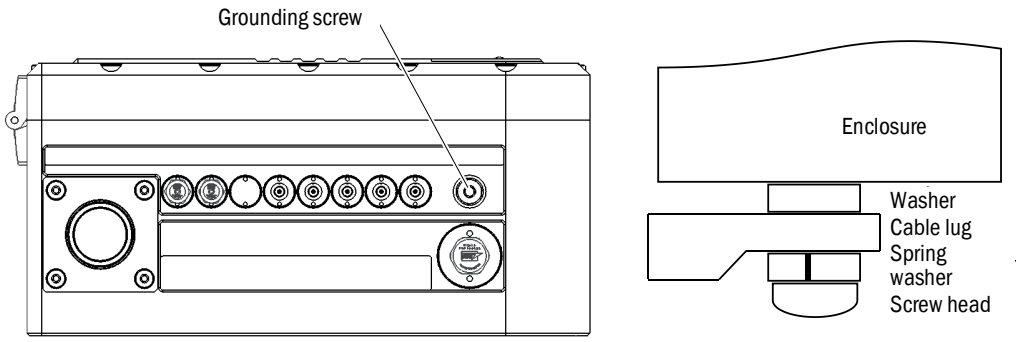


Fig. 25: Grounding the analyzer

Important information

Note: Only use the grounding screw and washers supplied otherwise proper electrical contact cannot be guaranteed (over time).

Note:

- It is prohibited to remove the internal grounding spring or screw.
- Always make sure there is no blockage between the grounding spring and the screw.
- In case of damaged grounding spring and/or screw, do not use.

Procedure

▶ Connect the grounding screw to a central grounding point as shown in the Figure.
  – The grounding screw (M6) is indicated with the ⏚ symbol.
  – An associated lug should be used between the two washers.
  – The minimum permissible cable cross-section is 4 mm².

6.3 Electrical connections

6.3.1 Connecting open end of cable

Important information

NOTICE: Do not use a higher or lower voltage power supply as proper operation of the device is no longer guaranteed or can harm the device's electronics.

Procedure

1 Make the necessary power connection and communication connections to the other end of the cable (or connection unit).
- If using the connection cable, see Section 6.3.2.
- If using the connection unit, see Section 6.3.3.
- For voltage specifications, see "Technical data", page 51.

6.3.2 Connection cable - electrical connections

Table 1: Ferrule assignment for connection cable

Ferrule	Value	Cable color
	Shield*	Shield
1	RS485 (2) A	White - 1
2	RS485 (2) B/ RS232 (2) Tx	Black - 1
3	DO (NO)	White - 2
4	DO (COM)	Black - 2
5	Ethernet TD+	White - 7
6	Ethernet TD-	Black - 7
7	Ethernet RD+	White - 8
8	Ethernet RD-	Black - 8
9	DI (COM)	White - 3
10	RS232 (2) Rx	White - 4
11	DI (24 VDC Max)	Black - 3
12	Reset	Black - 4
13	RS485 (1) A	White - 5
14	+24V DC**	White - 9
15	+24V DC**	Black - 9
16	GND***	White - 10
17	GND***	Black - 10
18	RS232 (1) Tx (analyzer)	White - 6
19	RS232 (1) Rx (analyzer)	Black - 6
20	RS485 (1) B	Black - 5
21	Not connected	Not connected

* Shielding must be connected, recommended to the PE rail in the connection unit
** Ferrules 14 & 15 must be connected and used together
** Ferrules 16 & 17 must be connected and used together

6.3.3 Connection units

Connection unit Class 1, Div 1, Groups B, C, D T6

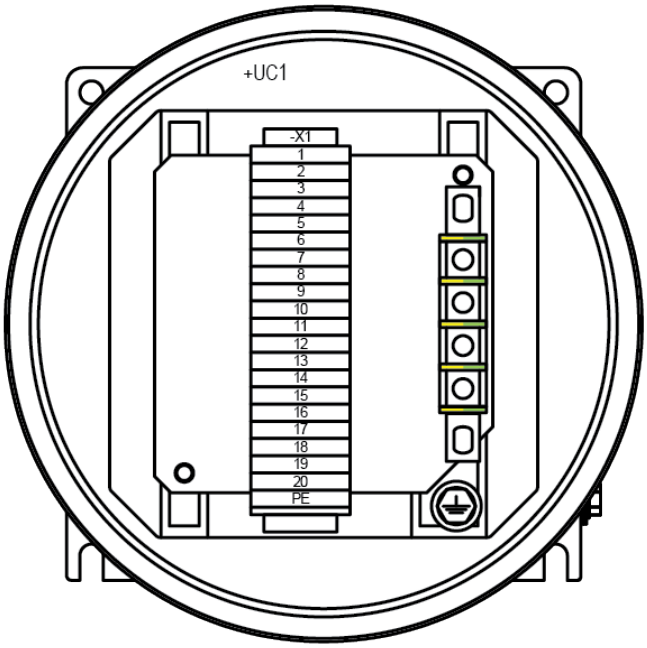


Fig. 26: Terminal layout

Connection unit Class 1, Div 2, Groups A, B, C, D T6

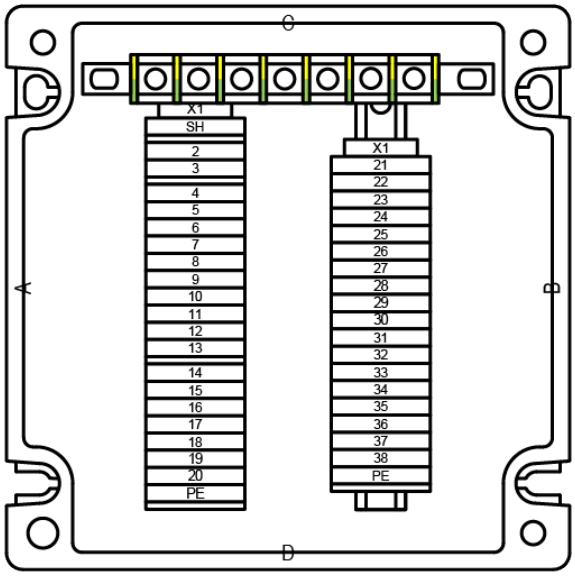


Fig. 27: Terminal layout

Electrical connections

Terminal assignment for both connection units: see Table 1: “Ferrule assignment for connection cable”, page 33.

7 Commissioning

Important information

NOTICE: The analyzer must be grounded before commissioning.

Prerequisites

- All activities described in Section “5 Mounting” and Section “6 Electrical installation” must be completed before commissioning.
- A laptop/PC with the ENERSIC operating software installed is required for commissioning.

7.1 Software installation

The ENERSIC software can be downloaded from www.de.endress.com/en/download.

For details, refer to the User Instructions ENERSIC600 Software Manual.

7.2 Connecting socket and cable

Important information

NOTICE: The IP rating of the socket is only guaranteed when the counter connector or cap is used.

Procedure

1 Remove the caps of electrical cable and socket and screw the cable connector to the socket.

7.3 Start-up

Procedure

1 Power on the device.
   – The device starts up automatically. During start-up, the status LED lights yellow.
   – After successful start-up, the status LED blinks **blue**/**white.**
2 Run the device for at least 2 hours in idle mode and with the carrier gas connected.
3 Check the pressure of the carrier gas again (450 ± 5 % kPa).
4 If an internal sample gas pump is **not** used: Set the sample gas pressure to 10 … 200 kPa (gauge) / 0.1 … 2 bar(g) (1.45 … 29 psi(g)).

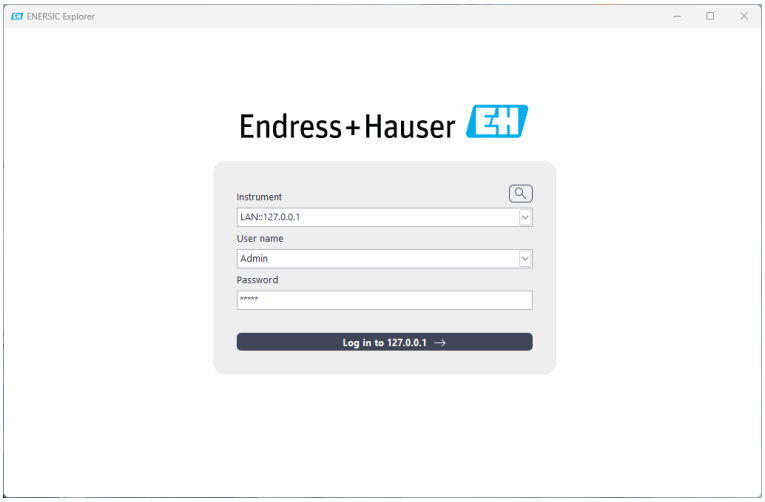
7.4 Connecting with the operating software

The communication between the analyzer and the PC runs via a (wired) LAN connection.

Procedure

1 Establish the data connection between the analyzer and the PC via an Ethernet cable type Cat 5 or higher.
   – Connect an Ethernet cable between your computer and the ENERSIC600.
   – Set up your computer’s Ethernet port.
   – Make sure the IP-address of your computer’s Ethernet card is in the same range (but not equal to) the IP-address of the corresponding Ethernet port of the ENERSIC600.
2 Click on the ENERSIC icon to start the ENERSIC operating software.

3 The device on the local network can be detected by clicking the “magnifying glass”.
4 When multiple device addresses are available, the device can be selected from the dropdown list according to the serial number of analyzer. The serial number can be found on the label of the device.
5 For initial set-up, login with username “Admin”. The password is “admin”.



6 Adjust the sample inlet pressure to reach a (stable) value < 200 kPa / 2 bar(g) und 29 psi (g) so that sufficient fresh sample is created for the application. For optimal accuracy, the sample pressure should be set within ±10% of the sample pressure at calibration.
7 For details, refer to the Software Manual.
8 If an **internal sample gas pump is not used**: The sample gas should be fed with a pressure between 10 ... 200 kPa (gauge) / 0.1 ... 2 bar(g) (1.45 ... 29 psi(g)).
9 For further details, refer to the Software Manual.

7.5 Conditioning of columns

Conditioning describes the purging of the columns with carrier gas.

- Typically, after every shipment, or after every cartridge replacement, a column conditioning needs to be executed.
- The duration of conditioning should be 5 to 24 hours.
- For further details, refer to the Software Manual.

7.6 Final tests

A leakage test must be carried out after all connections have been made and the device has been commissioned.

8 Operation

8.1 Operating and display elements

Overview

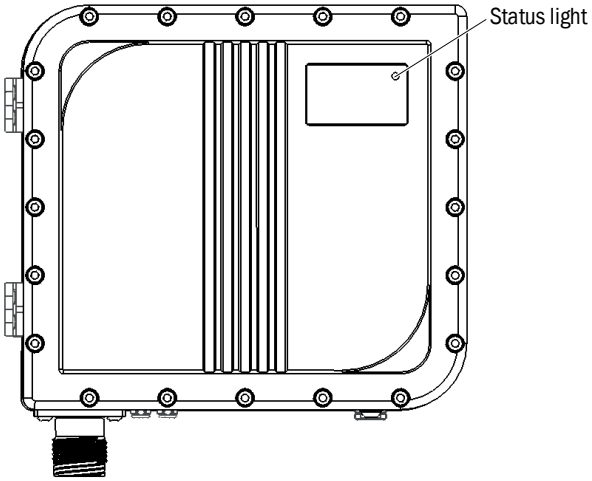


Fig. 28: Standard orientation of the analyzer

Function

The LED status light indicates the current status of the analyzer.

Color	Color pattern	Status
Off		Off
Solid red*		Standby and powered
Solid yellow		Processor booting
Blinking yellow/red		Processor error
Solid white		Normal, processor in run mode
Solid blue		Mode: analysis running
Blinking blue/white	Slow blinking (0.5 Hz)	Mode: idle
	Moderate blinking (1 Hz)	Mode: stabilizing
	Fast blinking (2.5 Hz)	Mode: sequence error
Solid yellow or Blinking yellow/white**	Fast blinking (2.5 Hz)	System error: power supply voltage critical, or sample flow out of range, or actuation pressure out of range
Blinking red/blue	Fast blinking (2.5 Hz)	Status error: hardware error, or low memory, or high equipment temperature

* Device is connected to a power source, but is not in use as it was turned off via the software.
** Color depends on analyzer main board type.

8.2 General operation

The analyzer operates autonomously after commissioning and configuration. For further configuration details, refer to the ENERSIC600 Software Manual.

9 Maintenance

9.1 Safety

Always turn off the electric power supply, remove power from the communication lines, and close off all gas supplies before doing any service, cleaning or maintenance on the device.

Do not open the device in a hazardous environment when energized or within 30 minutes after de-energizing.

In the event that materials are spilled in the device, immediately shut down the device and contact Endress+Hauser Service for proper instructions.

Avoid damaging the sealing O-ring between the enclosure and cover. The IP rating is no longer guaranteed when the device is used with a damaged O-ring.

9.2 Cleaning

Important information

NOTICE:
Incorrect cleaning can lead to device damage.
- ▶ Only use recommended cleaning agents.
- ▶ Do not use a water-jet nozzle for cleaning.

Procedure

- ▶ Clean the analyzer with a damp cloth wetted with water.
- ▶ Avoid liquids entering the device.

9.3 Checking the system

Procedure

- ▶ Check gas ports:
  - Make sure the gas connection ports are not blocked and/or clogged at any time (see Fig. 24: “Gas connections and a Valco fitting”, page 29).
- ▶ Check breather:
  - Make sure the breather is not blocked and/or clogged at any time (see Section “3.4.8 Breather”, page 20).
- ▶ Check cartridge:
  - Make sure electrical and gas connections are clean (see Section “3.4.4 Cartridge”, page 16).
- ▶ Check host:
  - Do not remove the cover plate, but make sure that electrical and gas connections are clean (see Section “3.4.5 Host”, page 17).

9.4 Replacing the cartridge

Overview

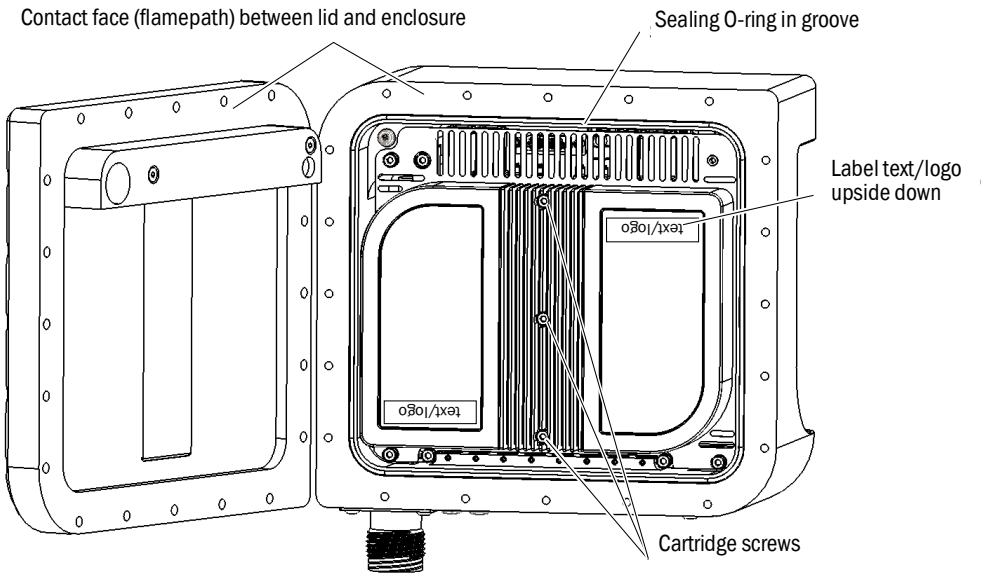


Fig. 29: Enclosure open with view of cartridge

Important information

WARNING: Risk of electric shock
There is a risk of electric shock when working on the device when the enclosure is opened prematurely.
▶ Only open enclosure after de-energizing and waiting at least 30 minutes.

CAUTION: Danger of burns due to hot surfaces
If the enclosure is opened prematurely, hot components may cause burns.
▶ Only open enclosure after de-energizing and waiting at least 30 minutes.

Tools required

- Allen key (3 and 4 mm)
- Torque screwdriver

Preparation

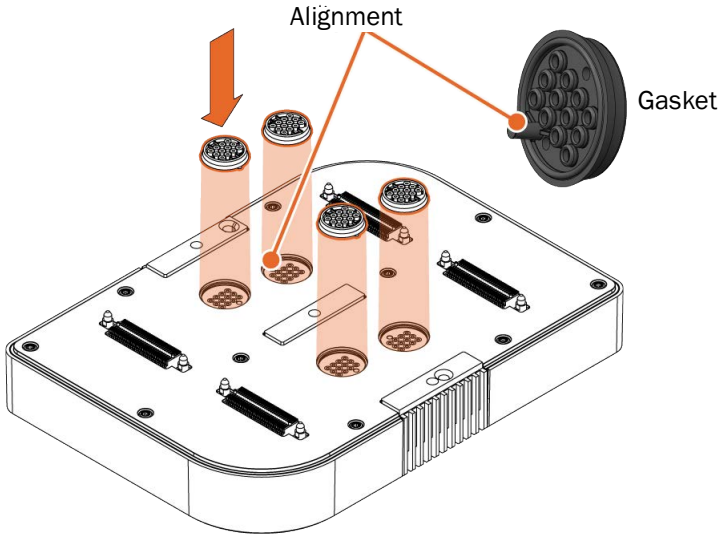
1 Stop the analysis process using the ENERSIC software (“Idle Mode”, see Software Manual).
2 Shut off the gas supplies.
3 De-energize the analyzer.
4 Wait at least 30 minutes without opening.
5 Make sure the device is still connected to ground and wear a properly connected ESD wristband.
6 Make sure the hinges are intact.

Opening the enclosure

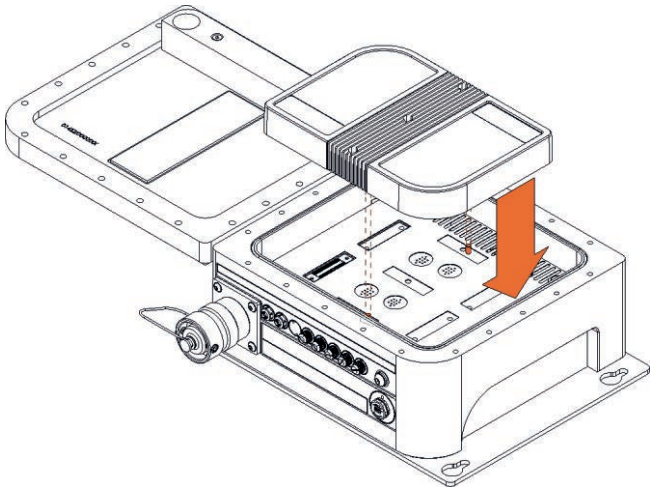
1 Unscrew the screws of the enclosure lid with the 4-mm Allen key.
2 Open the lid.

Exchanging the cartridge

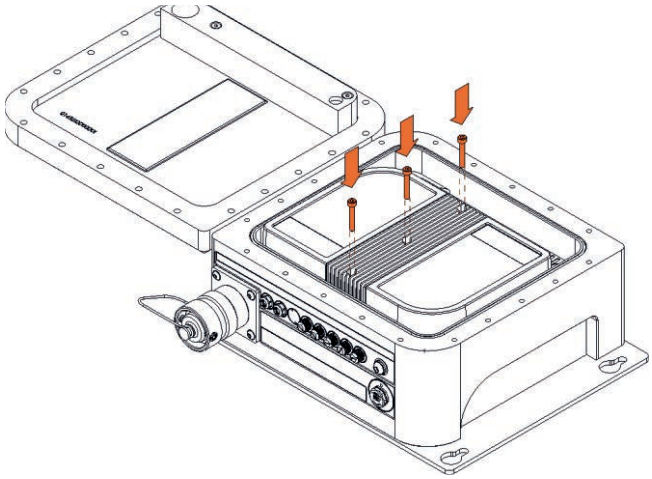
1 Unscrew the three cartridge screws with the 3-mm Allen key and take the cartridge out.
2 Before placing the cartridge back on the analyzer, make sure that the gaskets are securely in place and do not move.
If this is not the case, the gaskets must be exchanged as this could cause a bad cartridge connection.
Exchange the gasket:
- Use tweezers to carefully detach the gasket from the analytical unit.
- Once the gasket is removed, place another gasket aligning the gasket pin with the hole in the analytical unit.
- Apply slight pressure on the gasket and pinch the sides of the gasket into the analytical unit with tweezers.
- The gasket should be stuck into the analytical unit.



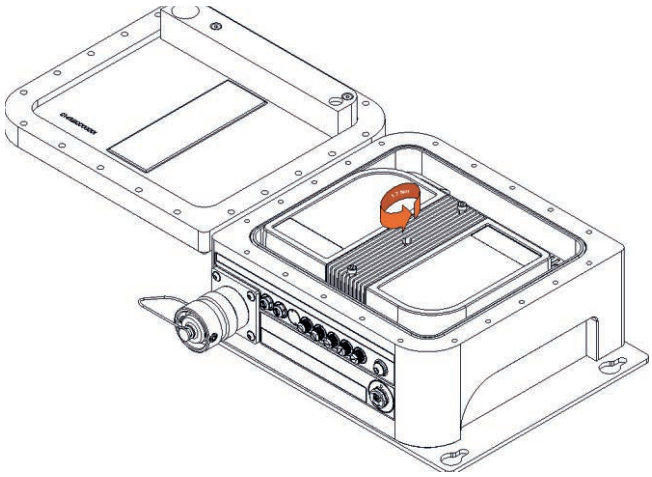
3 Place the new cartridge on the host via the two pins. Make sure the cartridge is correctly placed over the pins and is parallel to the analyzer.
- The cartridge can only be installed in one way. Dowel pins prevent incorrect installation.
- When wall-mounted, the cartridge labels (i.e. logo and text) are upside down.



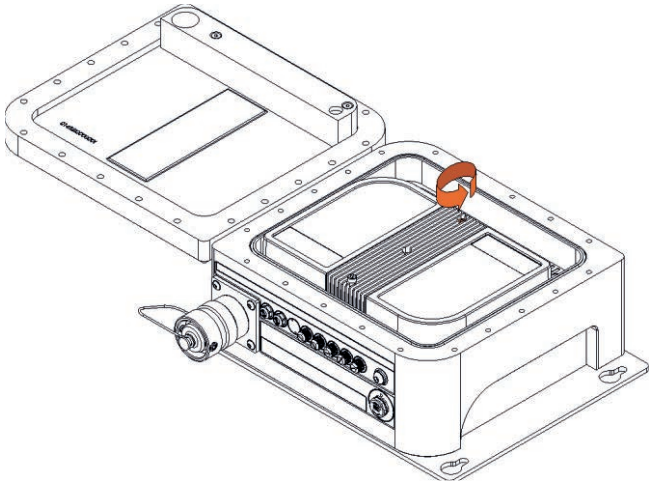
4 Place the three screws in the cartridge holes.



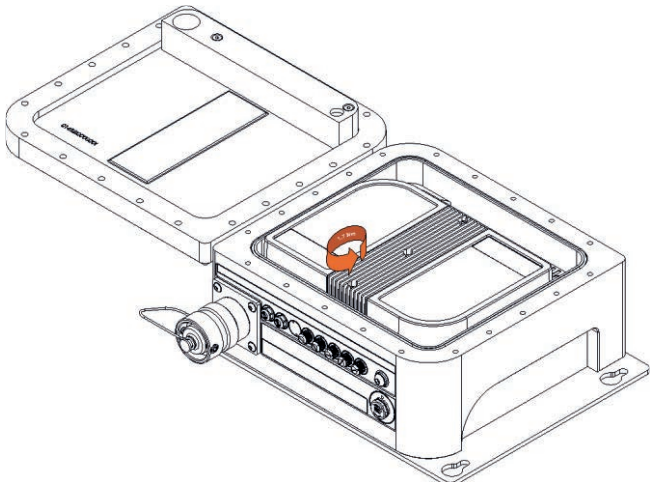
5 First tighten the center screw with tightening torque 1.7 Nm.



6 Tighten the top screw until a slight resistance is felt. Do not apply a tightening torque.



7 Tighten the bottom screw with tightening torque 1.7 Nm.



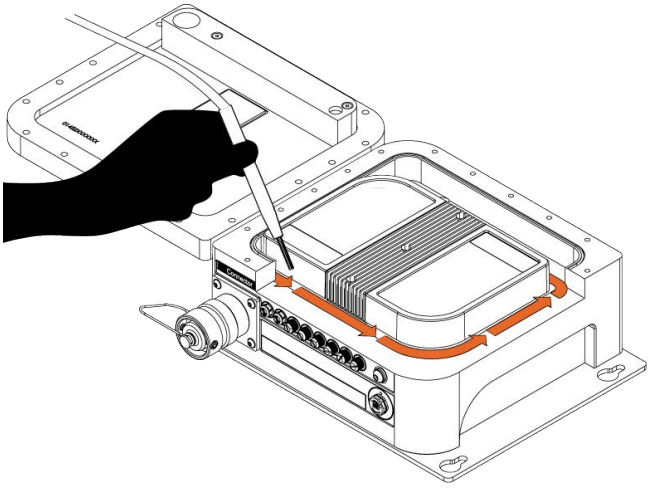
8 Now, tighten the **upper** screw with tightening torque 1.7 Nm.
9 Tighten the **center** screw again with tightening torque 1.7 Nm.

Leak test

It is strongly recommended to perform a leak test using an electronic leak testing device around the cartridge.

Note: This step can only be executed in a non-hazardous zone!
When the lid is open, explosion protection and the IP rating specified in the Technical Data is no longer valid.

1 Supply the instrument with carrier gas.
2 Perform leak test with electronic leak testing device.



Before closing check

1 Contact faces (flamepath) between lid and enclosure are clean and undamaged.
2 Sealing O-ring is intact and positioned in the dedicated groove.
3 Lid screws are fit for reuse, i.e. no damages, pollution, rust, etc. Otherwise, use new screws which can be obtained from Endress+Hauser.

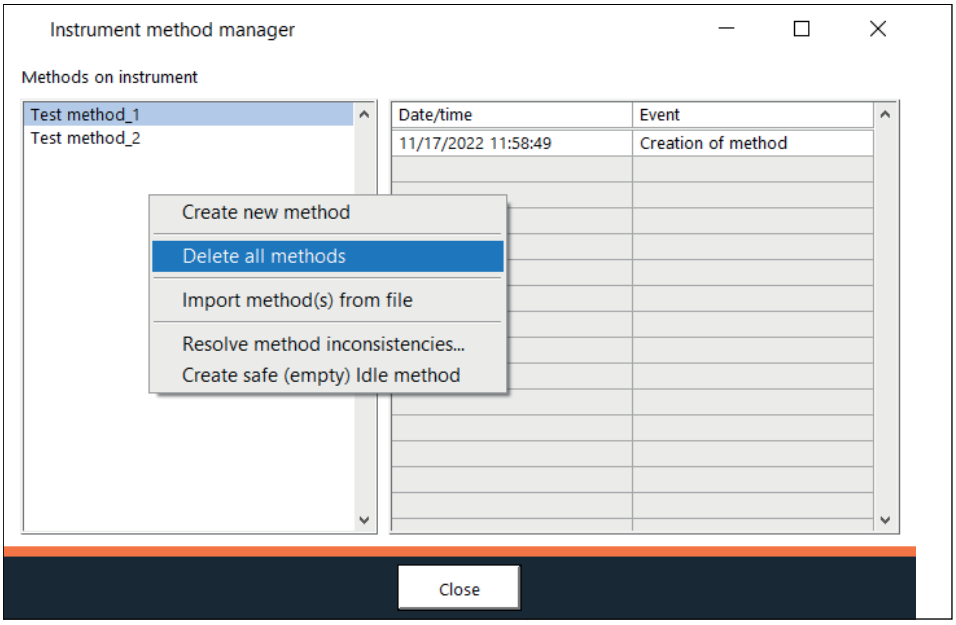
Closing the enclosure

1 Close the lid.
2 Tighten all lid screws with tightening torque 9 Nm.
3 The analyzer is now ready for commissioning.

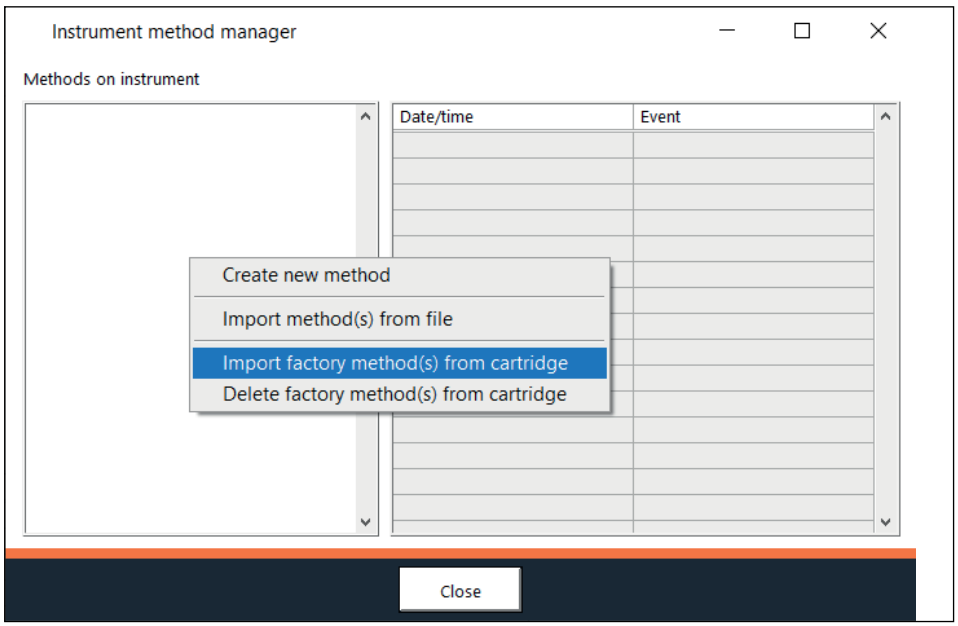
9.4.1 Commissioning after cartridge replacement

For cartridge with an application method

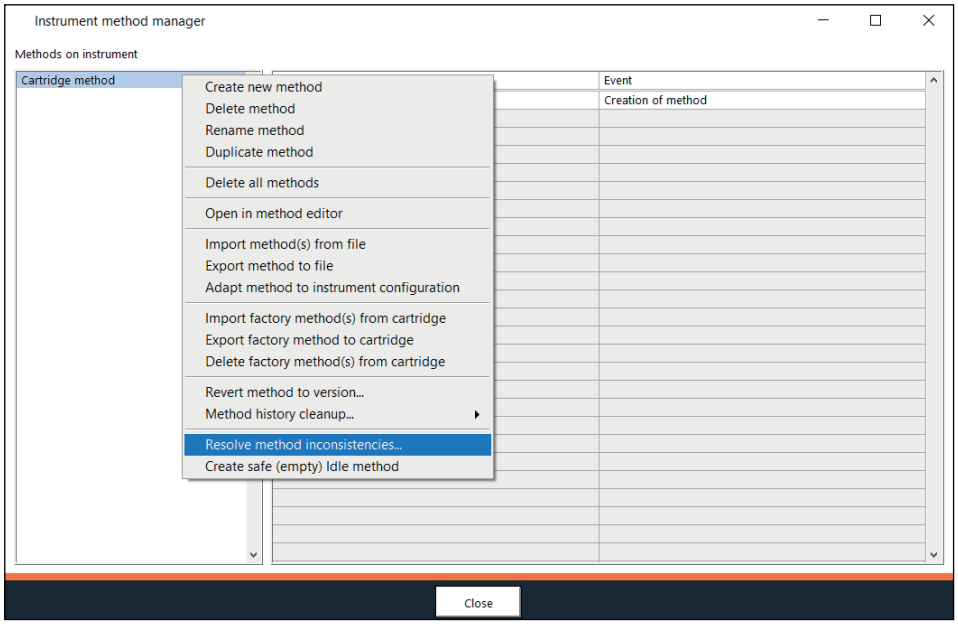
1 Switch on the analyzer.
2 Log in to the device via the ENERSIC software (see Software Manual).
3 Go to Instrument method manager (Ctrl+F9). Delete all existing methods by right click on a method and then click Delete all methods.



4 Go to Instrument method manager (Ctrl+F9) and import factory methods from cartridge by a right click on the Methods on instrument Table.



5 Go to Instrument method manager (Ctrl+F9) and resolve method inconsistencies by a right click the Methods on instrument Table.



6 Note that timing of integration events and/or identification windows may need to be adjusted (see Software Manual).

For cartridge without an application method

1 Switch on the analyzer.
2 Log in to the analyzer software (see Software Manual).
3 Let the analyzer stabilize in Idle state for at least 2 hours.
4 Connect the calibration or validation sample to the selected stream and open the bottle.
5 Run the analysis method with selected stream until stable.
6 Check the results of all analyzer units when the chromatograms are stabilized.
7 When the peaks are not identified as being correct, the carrier gas pressure and/or the column temperature should be adjusted.
   a) Adjust the carrier gas pressure accordingly to set the first peak of the chromatogram at its correct position. When the peak is on the right side of its identification window, increase the carrier gas pressure and when the peak is on the left side of its window, decrease the carrier gas pressure. Do this until the first peak is identified as its correct gas component.
   b) Then, adjust the column temperature to get the last peak in the chromatogram to its correct position. When the peak is on the right side of its identification window, increase the column temperature and when the peak is at the left side of its window, decrease the column temperature.
   c) Finally, adjust the carrier gas pressure a last time to get the first peak in its correct position as described under a).
8 Adjust the backflush timing when necessary (see Quick Guide Backflush).
9 Run the analysis method with the new settings and check the results of all GC units. When the concentrations in the analysis results are not as expected from the bottle, adjust the injection time to get the correct concentrations. When the concentrations in the results are lower than expected from the bottle, the injection time should be increased and when the concentrations are higher the injection time should be decreased.
10 Note that timing of integration events and/or identification windows may need to be adjusted (see Software Manual).

9.5 Replacing the hinges

The hinges can be replaced when worn.

Only use hinges and corresponding screws supplied by Endress+Hauser. It is strongly recommended to replace both the hinges and screws together.

When the lid is properly mounted to the enclosure, the hinges can be replaced using the countersunk screws.

Although the hinges do not contribute to the explosion safety, it is strongly recommended to not remove the hinges permanently.

9.6 Repairing

Except for the hinges, repair of the analyzer is prohibited. Flameproof joints are not intended to be repaired.

In case of defects or damage, always contact Endress+Hauser Service.

10 Troubleshooting

For assistance in troubleshooting, contact Endress+Hauser Service.

For software issues, refer to the Software Manual.

10.1 Overheating

If the analyzer gets too hot, it automatically shuts down via an internal thermal fuse. This is necessary to prevent the surface temperature from exceeding the T class. The thermal fuse is reset when the surface temperature decreases below 60 °C. The analyzer can then be commissioned again.

If overheating occurs repeatedly while the environmental temperature is below 55 °C and the correct mounting bracket is used with the prescribed minimal distance from wall/ ceiling, there may be a defect and it is recommended to contact Endress+Hauser.

10.2 Defect hinge

When one or both hinges are damaged or not functioning properly, the hinges should be replaced.

▶ For instructions: see “Replacing the hinges”, page 45.

11 Decommissioning

11.1 Dismounting

Procedure

1 Switch the analysis process off via the ENERSIC software (“Idle Mode”, see Software Manual).
2 Shut off the gas supplies.
3 Disconnect the analyzer from the power supply and make sure that all IO and communication lines are unpowered. Wait at least 60 minutes.
4 Disconnect the connector from the socket and place the protective cap on the socket. Also place the protective cap on the connector.
5 Disconnect the gas connections and screw the dust caps into the gas port inlets.
6 Disconnect the grounding wire.
7 Dismount the analyzer from the wall.

11.2 Transportation

It is strongly recommended to transport the analyzer in the original carton box/robust case with protective foam in which the analyzer was delivered.

Procedure

1 First, follow the instructions for dismounting.
2 Close the gas port inlets with the dummy plugs provided as delivered.
3 Place the analyzer in the dedicated protective case/box for transportation.

11.3 Disposal

Note:
The following sub-assemblies contain substances that may have to be disposed of separately:
- Electronics: capacitors, rechargeable batteries, batteries
- All parts with media contact can be contaminated with harmful substances.

Disposal of the device

The device can easily be disassembled into its components which can then be sent to the respective raw material recycling facilities.

- Dispose of electronic components as electronic waste.
- Check which materials having contact with the pipeline must be disposed of as hazardous waste.
- Batteries must not be disposed of with household waste. The battery and the device must be disposed of separately in accordance with local waste disposal regulations.

12 Technical data

12.1 Dimensions

12.1.1 Gas chromatograph

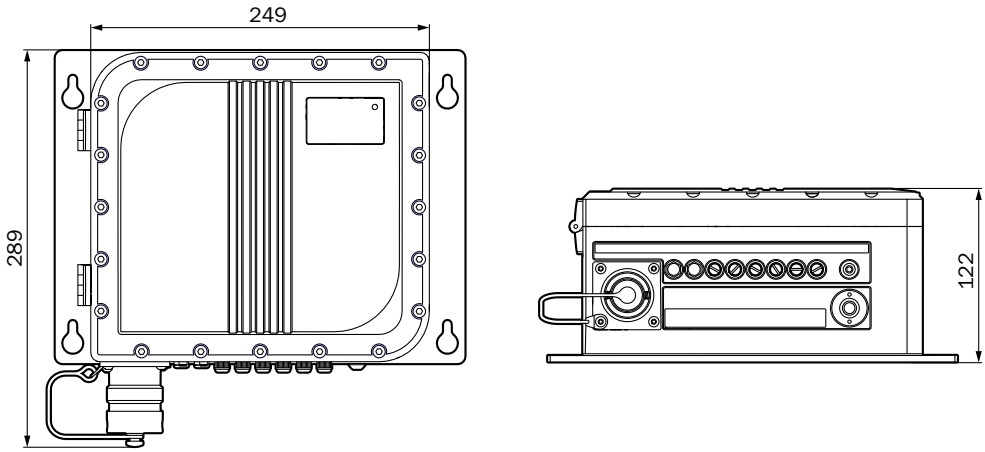
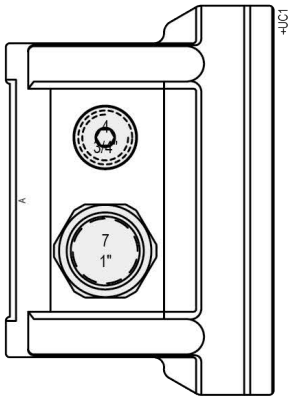
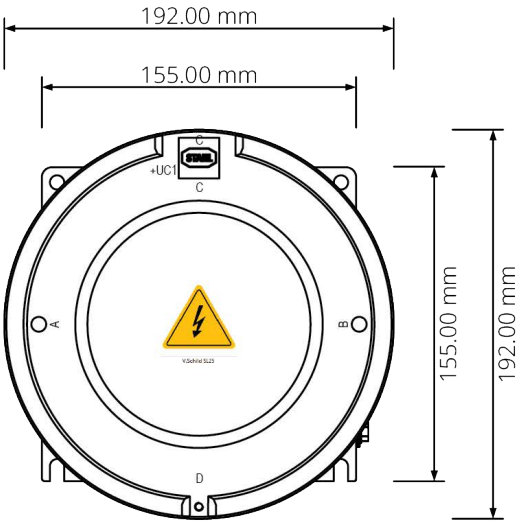


Fig. 30: Dimensions in mm

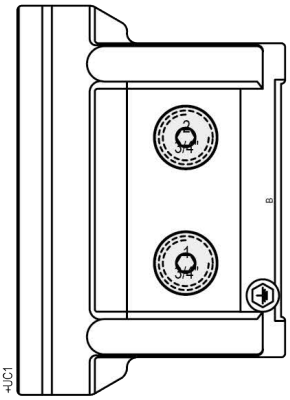
12.1.2 Connection unit Class 1, Div 1 (optional)



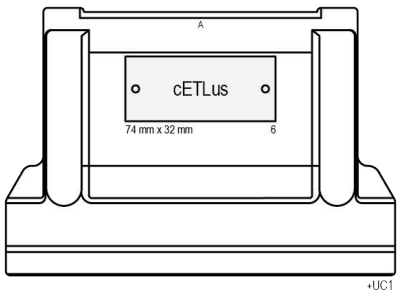
SIDE VIEW



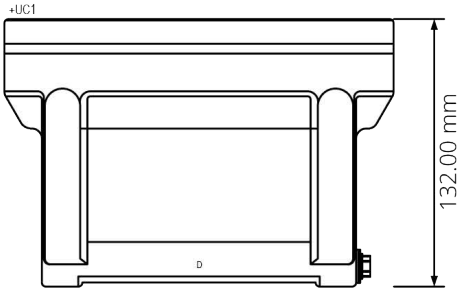
FRONT VIEW



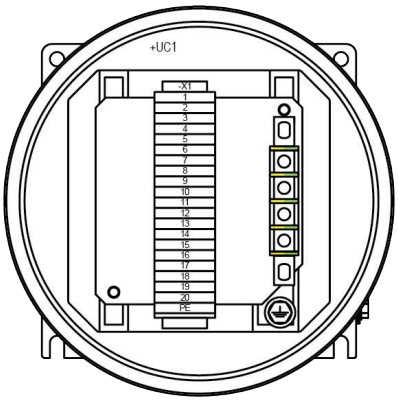
SIDE VIEW



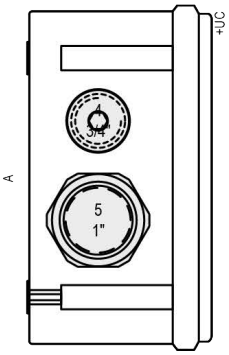
TOP VIEW



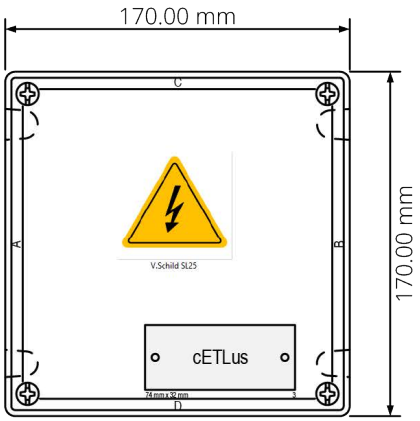
BOTTOM VIEW



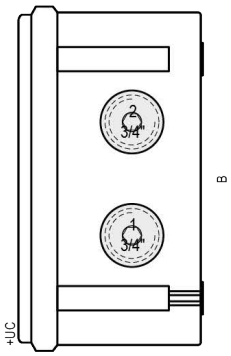
12.1.3 Connection unit Class 1, Div 2 (optional)



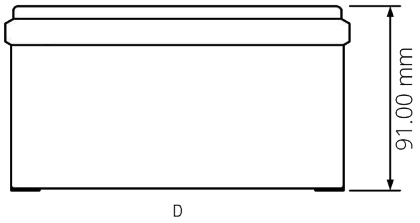
SIDE VIEW



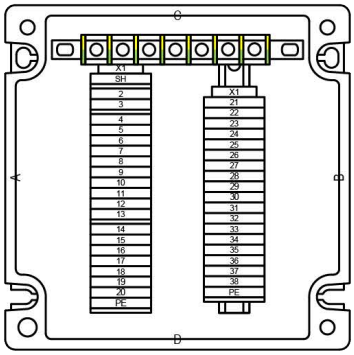
FRONT VIEW



SIDE VIEW



BOTTOM VIEW



ARRANGEMENT

12.2 Technical data

Measurand	Standardized gas components, calorific value, Wobbe index, density, molar mass, compressibility
Measured variables	Natural gas (C6+), air, H_2, H_2S, O_2, N_2
Analysis technology	"Fore-flush & back-flush" micro TCD
Analysis range	500 ppb ... 100% (application dependent)
Repeatability	±0.025% (6.15 kWh/m^3 - 16.15 kWh/m^3)
Cycle time	> = 45 sec
Calorific value calculation	ISO 6976:2016, GPA 2172, ASTM D3588
Conformities	OIML R 140 Class A compliant, EN IEC 60079-0:2018, EN 60079-1:2014, EN 55011 (2009) + A1 (2010)
Explosion protection ATEX / IECEx CSA US	 II 2G Ex db IIB+H2 T4 Gb Cl I, Div. 1 Groups B, C, D T4 / Ex db IIB+H2 T4 Gb / Cl I, Zone 1, AEx db IIB+H2 T4 Gb
Degree of protection	IP65
Number of gas samples	4x
Process connection	1/16" VICI Valco
Process pressure	10 ... 200 kPa (gauge) / 0.1 ... 2 bar(g) (1.45 ... 29 psi(g))
Carrier gas	He (Ar optional for H_2-measurement >20 Mol-%)
Carrier gas pressure	450 ±5% kPa / 4.5 bar(g) (65 psi(g))
Gas consumption	15 ml/min
Ambient operating temperature	-20 °C ... +55 °C (-4 to 131 °F)
Power supply	20 V DC ... 28 V DC, 75 W max
Battery	Lithium battery in the device
Digital outputs	2x
Modbus	TCP/LAN, RS-485 (2x), RS-323 (1x)
Ethernet	TCP/IP
Dimensions	289 × 258 × 122 mm / 11.4 × 10.2 × 4.8”
Weight	<15 kg / 33 lb. (without mounting brackets)

13 Annex

13.1 Applicable standards

The analyzer complies to the following standards:

Test description	Standard
Explosive atmospheres - Part 0: Equipment – General requirements	EN IEC 60079-0:2018
Explosive atmospheres - Part 0: Equipment – General requirements	IEC 60079-0:2017
Explosive atmospheres - Part 1: Equipment protection by flameproof enclosures “d”	EN 60079-1:2014
Explosive atmospheres - Part 1: Equipment protection by flameproof enclosures “d”	IEC 60079-1:2014
Conducted emission, test with a LISN	EN 55011 (2009) + A1 (2010)
Radiated emission up to 1 GHz (SAC)	EN 55011 (2009) + A1 (2010)
ESD	EN-IEC 61000-4-2 (2009)
Radiated Immunity	EN-IEC 61000-4-3 (2006) + A1 (2008) + A2 (2010)
EFT	EN-IEC 61000-4-4 (2012)
Surge	EN-IEC 61000-4-5 (2014)
Conducted Immunity	EN-IEC 61000-4-6 (2014)
Power frequency magnetic field	EN-IEC 61000-4-8 (2010)

13.2 Device configuration

13.2.1 ENERSIC600 C6+ only and ENERSIC600 C6+ H2 - ready

Table 2: Hardware overview

Feature	Value	Remark
Device	ENERSIC600 C6 + H2 - ready	Explosion safe, natural gas C6+
Device type	6086898	
Installed power mode	Industrial	Automatic on when powered
# of device channels	2	
# of gas samples	4	Integrated stream selector
# of carrier gases	1	A different carrier gas can be connected on each channel; Helium carrier gas will be applied as standard for both channels
Separated actuation gas	N	
Sample gas pump	N	
Communication	RS-232/485	
Protocol	MODBUS	

Table 3: Application: 2-channel cartridge method

Feature	Channel 1	Channel 2
Analysis time	45 s	
Fast loop	Off	
Components	Methane Carbon dioxide Ethane	Propane iso-Butane n-Butane neo-Pentane i-Pentane n-Pentane C6+ (in backflush mode)
Backflush on	Y	Y
After backflush	Ethane	n-Pentane
Backflush TCD	-	On

IDLE: Similar as standard but with carrier gas pressure 50 kPa and no injections

13.2.2 ENERSIC600 C6 + H2

Table 4: Hardware overview

Feature	Value	Remark
Device	ENERSIC600 C6 + H2	Explosion safe, natural gas C6+
Device type	6086899	
Installed power mode	Industrial	Automatic on when powered
# of device channels	3	
# of gas samples	4	Integrated stream selector
# of carrier gases	2	A different carrier gas can be connected on the third channel, standard Helium carrier gas and optional also Argon
Separated actuation gas	N	
Sample gas pump	N	
Communication	RS-232/485	
Protocol	MODBUS	

Table 5: Application: 3-channel cartridge method

Feature	Channel 1	Channel 2	Channel 3
Analysis time	45 s		
Fast loop	Off		
Components	Methane Carbon dioxide Ethane	Propane iso-Butane n-Butane neo-Pentane i-Pentane n-Pentane C6+ (on backflush)	Hydrogen Oxygen Nitrogen Carbon monoxide
Backflush on	Y	Y	Y
Backflush after	Ethane	n-Pentane	Carbon monoxide
Backflush TCD	-	on	-

IDLE: Similar as standard but with carrier gas pressure 50 kPa and no injections

13.3 Modbus register overview

Table 6: Coil registers

Address(es)	Reg. type	Data type	Description
01000	Coil	Boolean	Device reset
01001	Coil	Boolean	Device shutdown
01100	Coil	Boolean	Start sequence. The sequence to start is determined by the sequence index specified in holding register 40001. Possible values are 1..20, corresponding to the 1st, 2nd, etc sequence from the list of names given by registers 31602, 31612, ... 31792.
01101	Coil	Boolean	Stop running sequence
01102	Coil	Boolean	Stop running sequence and clear queue
01103	Coil	Boolean	As 01101, but complete current run
01104	Coil	Boolean	As 01102, but complete current run

Table 7: Discrete input registers

Address(es)	Reg. type	Data type	Description
10000	Discr. input	Boolean	Device safety error
10001	Discr. Input	Boolean	Device ready
10002	Discr. Input	Boolean	Device analysis running
10003	Discr. Input	Boolean	Device run error
10100	Discr. Input	Boolean	Channel 1 available
10101	Discr. Input	Boolean	Channel 2 available
10102	Discr. Input	Boolean	Channel 3 available
10103	Discr. Input	Boolean	Channel 4 available
10104	Discr. input	Boolean	Stream selector available
11000	Discr. input	Boolean	Channel 1 column temp. stabilized
11001	Discr. Input	Boolean	Channel 2 column temp. stabilized
11002	Discr. Input	Boolean	Channel 3 column temp. stabilized
11003	Discr. Input	Boolean	Channel 4 column temp. stabilized
11004	Discr. Input	Boolean	Channel 1 inj/det temp. stabilized
11005	Discr. Input	Boolean	Channel 2 inj/det temp. stabilized
11006	Discr. Input	Boolean	Channel 3 inj/det temp. stabilized
11007	Discr. Input	Boolean	Channel 4 inj/det temp. stabilized
11008	Discr. input	Boolean	Channel 1 carrier gas pressure stabilized
11009	Discr. input	Boolean	Channel 2 carrier gas pressure stabilized
11010	Discr. Input	Boolean	Channel 3 carrier gas pressure stabilized
11011	Discr. Input	Boolean	Channel 4 carrier gas pressure stabilized
11012	Discr. Input	Boolean	Channel 1 TCD1 ready
11013	Discr. Input	Boolean	Channel 2 TCD1 ready
11014	Discr. Input	Boolean	Channel 3 TCD1 ready
11015	Discr. Input	Boolean	Channel 4 TCD1 ready
11016	Discr. Input	Boolean	Channel 1 TCD2 ready
11017	Discr. input	Boolean	Channel 2 TCD2 ready
11018	Discr. Input	Boolean	Channel 3 TCD2 ready
11019	Discr. input	Boolean	Channel 4 TCD2 ready

Table 8: Input registers

Address(es)	Reg. type	Data type	Description
30000	Inp. register	uint64	Device S/N
30004	Inp. register	uint64	Device manufacturing date
30008	Inp. register	uint64	Cartridge S/N
30012	Inp. register	uint64	Channel 1 S/N
30016	Inp. register	uint64	Channel 1 manufacturing date
30020	Inp. register	uint64	Channel 2 S/N
30024	Inp. register	uint64	Channel 2 manufacturing date
30028	Inp. register	uint64	Channel 3 S/N
30032	Inp. register	uint64	Channel 3 manufacturing date
30036	Inp. register	uint64	Channel 4 S/N
30040	Inp. register	uint64	Channel 4 manufacturing date
30044	Inp. register	uint64	FPGA MD5 checksum (MSB)
30048	Inp. register	uint64	FPGA MD5 checksum (LSB)
30052	Inp. register	uint64	Firmware MD5 checksum (MSB)
30056	Inp. register	uint64	Firmware MD5 checksum (LSB)
30060	Inp. register	uint64	OS kernel MD5 checksum (MSB)
30064	Inp. register	uint64	OS kernel MD5 checksum (LSB)
30068	Inp. register	uint16	Firmware version (major release)
30069	Inp. register	uint16	Firmware version (minor release)
30070	Inp. register	uint16	Firmware version (patch level)
30071	Inp. register	uint16	Firmware version (build number)
30072	Inp. register	uint16	FPGA version (build number)
30073	Inp. register	uint64	Configuration MD5 checksum (MSB)
30077	Inp. register	uint64	Configuration MD5 checksum (LSB)
30100, 30102, ... 30198	Inp. register	float	Reserved
30200	Inp. register	uint16	Last result[1] valid
30201	Inp. register	uint16	Last result[1] valid without warnings
30202	Inp. register	uint16	Device lock status
30203	Inp. register	uint16	Device status (copy of discr. inputs 10000..10003)
30204	Inp. register	uint16	Device configuration 10100..10104)
30205	Inp. register	uint16	Controller status (copy of discr. inputs 11000..11011)
30206	Inp. register	uint16	TCD status (copy of discr. inputs 11012..11019)
30207	Inp. register	uint16	Last run[1] lock status
30208	Inp. register	uint16	Last run[1] result validation: number of invalid items
30209	Inp. register	uint16	Last run[1] result validation: number of valid items with warning
30210, 30211, ... 30299	Inp. register	int/uint16	Reserved
30300, 30302, ... 30338	Inp. register	int32	Error code of last 20 errors and warnings
30340, 30344, ... 30416	Inp. register	uint64	Time of last (max) 20 errors and warnings (from list of 50 most recent errors/warnings/ messages)
30500	Inp. register	uint64	Current device time[2]
30504	Inp. register	uint64	Device startup time[2]
30508	Inp. register	uint64	Last run[3] injection time[2] (any stream)
30512	Inp. register	uint64	Last run[1] start time[2]
30516	Inp. register	uint64	Last run[1] injection time[2] (selected stream)
30520	Inp. register	uint64	Time[2] of last calibration of method used in last run[1]
30524	Inp. register	uint64	Time[2] of last validation of method used in last run[1]
30528	Inp. register	uint16	Last run[1] injection time (UTC) – Years
30529	Inp. register	uint16	Last run[1] injection time (UTC) – Months
30530	Inp. register	uint16	Last run[1] injection time (UTC) – Days
30531	Inp. register	uint16	Last run[1] injection time (UTC) – Hours (24h clock)
30532	Inp. register	uint16	Last run[1] injection time (UTC) – Minutes
30533	Inp. register	uint16	Last run[1] injection time (UTC) – Seconds

Address(es)	Reg. type	Data type	Description
30534	Inp. register	uint32	Last run[3] total run index (any stream)
30536	Inp. register	uint32	Last run[1] total run index (selected stream)
30538	Inp. register	uint16	Current status (analysis); Possible values: 0=Init,1=Stabilization, 2=Ready, 3=Analysis, 4=Error
30539	Inp. register	uint16	Current status (sequence); Possible values: 0=Idle, 1=Running, 2=Aborted, 3=Error, 4=Paused
30540	Inp. register	float	Current analysis total run time [sec]
30542	Inp. register	uint16	Current analysis progress [%]
30543	Inp. register	Uint32	Total run index (any stream, any run type)
30700	Inp. register	float	Device temperature [°C]
30702	Inp. register	float	Ambient pressure [hPa]
30704	Inp. register	float	Ambient humidity [%RH]
30706	Inp. register	float	Flow sensor 1 [mL/min]
30708	Inp. register	float	Flow sensor 2 [mL/min]
30710	Inp. register	float	Pressure sensor 1 [kPa]
30712	Inp. register	float	Pressure sensor 2 [kPa]
30714	Inp. register	int16	Stream selector selected stream
30715, 30717, ... 30763	Inp. register	float	Sensor value external sensor <n=1..25>, units depend on sensor type; temperature: [°C], pressure: [kPa].
30765	Inp. register	int16	Current analysis selected stream
30766	Inp. register	uint16	Selected stream of connected external[4] stream selector
30767	Inp. register	uint16	Current analysis selected external[4] stream
30900	Inp. register	float	Channel 1 column temperature [°C]
30902	Inp. register	float	Channel 2 column temperature [°C]
30904	Inp. register	float	Channel 3 column temperature [°C]
30906	Inp. register	float	Channel 4 column temperature [°C]
30908	Inp. register	float	Channel 1 inj/det temperature [°C]
30910	Inp. register	float	Channel 2 inj/det temperature [°C]
30912	Inp. register	float	Channel 3 inj/det temperature [°C]
30914	Inp. register	float	Channel 4 inj/det temperature [°C]
30916	Inp. register	float	Channel 1 carrier gas pressure [kPa]
30918	Inp. register	float	Channel 2 carrier gas pressure [kPa]
30920	Inp. register	float	Channel 3 carrier gas pressure [kPa]
30922	Inp. register	float	Channel 4 carrier gas pressure [kPa]
31400	Inp. register	uint16	Number of methods on device
31401	Inp. register	uint16	Number of sequences on device
31402, 31412, ... 31592	Inp. register	string[20]	Method <n=1..20> name
31602, 31612, ... 31792	Inp. register	string[20]	Sequence <n=1..20> name
32000	Inp. register	string[20]	Name of method used in the last run[1]
32010	Inp. register	uint16	Last run[1] run type
32011	Inp. register	int16	Last run[1] used stream
32012	Inp. register	uint16	Last run[1] used standard index
32013	Inp. register	int16	Last run[3] used stream (any stream)
32014	Inp. register	uint16	Last run[1] used external[4] stream
32015	Inp. register	uint16	Last run[3] used external[4] stream (any stream)
32100	Inp. register	uint16	Number of standards in method used in the last run[1]
32101, 32111, ... 32291	Inp. register	string[20]	Last run[1] standard <n=1..20> name
32301	Inp. register	string[20]	Last run[1] used heating value standard
32311	Inp. register	string[20]	Last run[1] heating value unit string
32321	Inp. register	string[20]	Last run[1] Wobbe index unit string
32331	Inp. register	string[20]	Last run[1] density unit string
32341	Inp. register	string[20]	Last run[1] molar mass unit string
32351	Inp. register	uint16	Last run[1] heating value combustion condition
32352	Inp. register	uint16	Last run[1] heating value metering condition
32353	Inp. register	uint16	Last run[1] heating value calculation method

Address(es)	Reg. type	Data type	Description
32500	Inp. register	float	Last run[1] total sum of concentrations [mol%]
32502	Inp. register	float	Last run[1] heating value (superior), units: see reg. 32311
32504	Inp. register	float	Last run[1] heating value (inferior) , units: see reg. 32311
32506	Inp. register	float	Last run[1] Wobbe index, units: see reg. 32321
32508	Inp. register	float	Last run[1] relative density
32510	Inp. register	float	Last run[1] density, units: see reg. 32331
32512	Inp. register	float	Last run[1] molar mass, units: see reg. 32341
32514	Inp. register	float	Last run[1] compressibility factor
32516	Inp. register	float	Last run[1] water concentration [mol%]
32518	Inp. register	float	Last run[1] unnormalized sum of concentrations [mol%]
35000	Inp. register	uint16	Last run[1] number of compounds in analysis
35001, 35011, ... 35391	Inp. register	string[20]	Last run[1] compound <n=1..40> name
35401, 35403, ... 35479	Inp. register	float	Last run[1] compound <n=1..40> concentration [mol%]
35481, 35483, ... 35559	Inp. register	float	Last run[1] compound <n=1..40> retention time [sec]
35561, 35563, ... 35639	Inp. register	float	Last run[1] compound <n=1..40> peak area [mV×sec]
35641, 35643, ... 35719	Inp. register	float	Last run[1] compound <n=1..40> peak height [mV]
35721, 35723, ... 35799	Inp. register	float	Last run[1] compound <n=1..40> peak width [sec]
35801, 35803, ... 35879	Inp. register	float	Last run[1] compound <n=1..40> integration start [sec]
35881, 35883, ... 35959	Inp. register	float	Last run[1] compound <n=1..40> integration end [sec]
35961, 35963, ... 36039	Inp. register	float	Last run[1] compound <n=1..40> heating value (superior), units: see reg. 32311
36041, 36043, ... 36119	Inp. register	float	Last run[1] compound <n=1..40> heating value (inferior), units: see reg. 32311
36121, 36122, ... 36160	Inp. register	uint16	Last run[1] compound <n=1..40> channel number
36161, 36162, ... 36200	Inp. register	uint16	Last run[1] compound <n=1..40> detector number
36201, 36202, ... 36240	Inp. register	uint16	Last run[1] compound <n=1..40> regression type
36241, 36249, ... 36553 36243, 36251, ... 36555 36245, 36253, ... 36557 36247, 36255, ... 36559	Inp. register	float float float float	Last run[1] compound <n=1..40> regression coefficients P0..P3
36561, 36563, ... 36639	Inp. register	float	Last run[1] compound <n=1..40> regression confidence factor R2
36641, 36642, ... 36680	Inp. register	uint16	Last run[1] compound <n=1..40> number of calibration points
36681, 36683, ... 37479	Inp. register	float	Last run[1] compound <n=1..40>, calibration point <k=1..10>, concentration [mol%]
37481, 37483, ... 38279	Inp. register	float	Last run[1] compound <n=1..40>, calibration point <k=1..10>, response R
38281, 38282, ... 38680	Inp. register	uint16	Last run[1] compound <n=1..40>, calibration point <k=1..10>, standard number
38681, 38682, ... 38685	Inp. register	uint16	Last run[1] result validation top 5 invalid/valid with warning <n=1..5>: validation result (1=Invalid,2=Invalid with warning).
38686, 38687, ... 38690	Inp. register	uint16	Last run[1] result validation top 5 invalid/valid with warning <n=1..5>: item index in method (first item=index 0)
38691, 38701, ... 38731	Inp. register	string[20]	Last run[1] result validation top 5 invalid/valid with warning <n=1..5>: target string value (string items only)
38741, 38751, ... 38781	Inp. register	string[20]	Last run[1] result validation top 5 invalid/valid with warning <n=1..5>: actual string value (string items only)
38791, 38793, ... 38799	Inp. register	float	Last run[1] result validation top 5 invalid/valid with warning <n=1..5>: target numeric value (numeric items only)
38801, 38803, ... 38809	Inp. register	float	Last run[1] result validation top 5 invalid/valid with warning <n=1..5>: actual numeric value (numeric items only)
38811, 38813, ... 38819	Inp. register	float	Last run[1] result validation top 5 invalid/valid with warning <n=1..5>: lower alarm limit (numeric items only)
38821, 38823, ... 38829	Inp. register	float	Last run[1] result validation top 5 invalid/valid with warning <n=1..5>: upper alarm limit (numeric items only)
38831, 38833, ... 38839	Inp. register	float	Last run[1] result validation top 5 invalid/valid with warning <n=1..5>: lower warning limit (numeric items only)
38841, 38843, ... 38849	Inp. register	float	Last run[1] result validation top 5 invalid/valid with warning <n=1..5>: upper warning limit (numeric items only)

[1] Last result for selected result stream, selected stream controlled by holding register 40000
[2] Timestamp, representing the number of seconds since the timestamp 01/01/1904 00:00:00.00 UTC.
[3] Last result for any stream, independent of stream selected by holding register 40000
[4] Selected stream of a connected external stream selector, e.g. a VICI rotary valve

Table 9: Holding registers

Address(es)	Reg. type	Data type	Description
40000	Hold. register	uint16	Select last run result stream
40001	Hold. register	uint16	Select number of sequence to start
40100	Hold. register	uint16	Device reset (set value to 1, same functionality as Coil register 01000)
40101	Hold. register	uint16	Device shutdown (set value to 1, same functionality as Coil register 01001)
40200	Hold. register	uint16	Start sequence. The sequence to start is determined by the sequence index specified in holding register 40001. Possible values are 1..20, corresponding to the 1st, 2nd, etc sequence from the list of names given by registers 31602, 31612, ... 31792 (set value to 1, same functionality as Coil register 01100).
40201	Hold. register	uint16	Stop current running sequence (set value to 1, same functionality as Coil register 01101)
40202	Hold. register	uint16	Stop current running sequence, clear queue (set value to 1, same functionality as Coil register 01102)
40203	Hold. register	uint16	As 40201, but complete current run (set value to 1, same functionality as Coil register 01103)
40204	Hold. register	uint16	As 40202, but complete current run (set value to 1, same functionality as Coil register 01104)
41000, 41002, ... 41198	Hold. register	float	User defined numeric variable <n=1..100>, “MB_VAL_<n>”
41200, 41210, ... 41690	Hold. register	string[20]	User defined string variable <n=1..50>, “MB_STR_<n>”

Extended data types consist of multiple registers (numeric data is formatted big endian, i.e. the most significant byte at the lowest address position). The following extended data types are currently defined:

- 32-bit integers consisting of two 16-bit registers
- 32-bit floating point numbers consisting of two 16-bit registers
- 64-bit floating point numbers consisting of four 16-bit registers
  - Floating point numbers are stored in IEEE floating point number format.
- 64-bit timestamp values consisting of four 16-bit registers
  - Timestamps are represented as 64-bit integers, representing the number of seconds since the timestamp 01/01/1904 00:00:00.00 UTC.
- Strings of N characters consisting of N/2 16-bit registers

Data formatting depends on the selected formatting option, which describes the order in which data words and bytes are communicated:

Formatting option	Word (register) order	Byte order within each register
Big endian (default)	Most significant at lowest address	Most significant transferred first
Little endian	Least significant at lowest address	Most significant transferred first
Big endian, byte swap	Most significant at lowest address	Least significant transferred first
Little endian, byte swap	Least significant at lowest address	Least significant transferred first

As an example, consider a uint32 number with decimal value 123456789. The hexadecimal equivalent is 0×07 5B CD 15, with 0×07 the most significant byte. For the different formatting options, the transmission order of bytes for this number would be (from left to right):

- Big endian: 07 5B CD 15
- Little endian: CD 15 07 5B
- Big endian, byte swap: 5B 07 15 CD
- Little endian, byte swap: 15 CD 5B 07

8024146/AE00/V1-0/2025-08

www.addresses.endress.com

Endress+Hauser

People for Process Automation