Operating Instructions
FLOWSIC500

Ultrasonic Gas Flow Meter with
Optional Volume Conversion

Endress+Hauser

Described product
Product name: FLOWSIC600

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

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

CE

Glossary

AC	Alternating Current
Al	Aluminum
ATEX	ATEX: Atmosphères Explosifs. Abbreviation for European directives regarding explosion protection and explosive atmospheres
CSA	Canadian Standards Association (www.csa.ca)
DC	Direct Current
HF	High frequency, e. g. HF modes
IEC	International Electrotechnical Commission
IECEx	IEC system for certification in accordance with standards for devices for use in potentially explosive atmospheres
IP xx	Ingress Protection. Degree of protection of a device in accordance with IEC 60529 or EN 60529. It specifies the protection against contact and intrusion / protection against moisture
LF	Low frequency, e. g. LF modes
NAMUR	Abbreviation for "Normen-Arbeitsgemeinschaft für Mess- und Regeltechnik in der chemischen Industrie". Also: "Interessengemeinschaft Automatisierungstechnik der Prozessindustrie" (www.namur.de)
pTC	Volume correction as a function of the pressure, the temperature and with consideration of the compressibility factor
TC	Volume correction as a function of the temperature and a fixed pressure value and with consideration of the compressibility factor

Warning symbols

INDICATES A HAZARD
of severe injury or death

Hazard (general)

Hazard by electrical voltage

Hazard in potentially explosive atmospheres

Hazard by explosive substances, mixtures

Hazard by unhealthy substances

Hazard by toxic substances

Warning levels / signal words

DANGER
Risk of hazardous situation which will result in severe personal injury or death

WARNING
Risk of hazardous situation which could result in severe personal injury or death

CAUTION
Hazard of unsafe practice which could result in less severe or minor injuries

NOTICE
Hazards which could result in property damage

Information symbols

FLOWSIC500

1 Important Information

1.1 Main hazards

DANGER: Risk of explosion when the gas flow meter is damaged

Natural gas flows with the pressure through the gas flow meter. Natural gas can escape when the gas flow meter is damaged which creates a risk of explosion.

- Prevent any possible damage to the gas flow meter. When necessary, fit protection devices.
- If the gas flow meter is damaged: Stop natural gas feed immediately and purge the FLOWSIC500 with inert gas.

WARNING: Hazards through leaks

Operation in leaky condition is not allowed and potentially dangerous.

- Regularly check leak tightness of equipment.

1.2 About this document

This manual describes:

- Device components
- Installation
- Operation of the FLOWSIC500.

It contains the main safety information for safe operation of the FLOWSIC500.

Application area of the document:

This document is valid for FLOWSIC500 with firmware version 2.16.00 and higher.

FLOWSIC500 with Ex approval acc. ISA

NOTICE

For a French translation of this document, please refer to document 8020T354 "Manuel d'utilisation FLOWSIC500".

1.3 Intended use

1.3.1 Purpose of the device

The FLOWSIC600 serves for measuring the gas volume, volume flow rate and gas velocity of natural gas in pipelines.

The FLOWSIC600 with optional volume conversion serves for measuring the gas volume and converting the gas volume measured to base conditions as well as registering data on totalizer levels, maximums and other data.

1.3.2 Product identification

Product name:	FLOWSIC600
Manufacturer:	Endress+Hauser SICK GmbH+Co. KG Berghofer Ring 27 D-1458 Ottendorf-Okrilla Germany

The type plates for metrological and electrical parameters are located on the gas flow meter. The type plate for the Pressure Equipment Directive is located on the adapter.

Type plate examples, see ⇨ p. 155, § 5.

Fig. 1 Location of type plates

Marking according to ATEX / IECEx

Marking according to CSA

1 Type plate, metrological and electrical parameters (metering and electronics)
2 Pin assignment of plug-in connectors
3 Type plate, Pressure Equipment Directive
4 Type plate, electrical parameters (electronics)
5 Type plate, metrological parameters (metering)

1.2.3 Operation in potentially explosive atmospheres

EX

The FLOWSIC600 is suitable for use in potentially explosive atmospheres:
ATEX: II 2G Ex ia [ia] IIB T4 Gb, II 2G Ex ia [ia] IIC T4 Gb, II 2G Ex op is IIC T4 Gb
IECEx: Ex ia [ia] IIB T4 Gb, Ex ia [ia] IIC T4 Gb, Ex op is IIC T4 Gb
cULus: Class I Division 1, Groups C, D T4, Ex IIA ia IIB T4 Ga

Further information on potentially explosive atmospheres → p. 48, § 3.4.1

Specific conditions of use (denoted by X after the certificate number):

1. Plastic parts of the electronics enclosure. Under certain extreme circumstances, in Gas Group IIC, exposed plastic and unearthed metal parts of the enclosure may store an ignition-capable level of electrostatic charge. Therefore, the user / installer shall implement precautions to prevent the build up of electrostatic charge, e. g. locate the equipment where a charge-generating mechanism (such as wind-blown dust) is unlikely to be present and clean with a damp cloth.
2. Plastic portable battery pack. No precautions against electrostatic discharge are necessary for portable equipment that has an enclosure made of plastic, metal or a combination of the two, except where a significant static-generating mechanism has been identified. Activities such as placing the item in a pocket or on a belt, operating a keypad or cleaning with a damp cloth, do not present a significant electrostatic risk. However, where a static-generating mechanism is identified, such as repeated brushing against clothing, then suitable precautions shall be taken, e. g. the use of anti-static footwear.
3. The ultrasonic sensors are manufactured from titanium. The pipeline adapter and part of the electronic enclosure may be made from aluminium. In rare cases, ignition sources due to impact or friction sparks could occur. This shall be considered during installation.
4. The maximum piezo-electric energy released by impact on the ultrasonic sensors exceeds the limit for Gas Group IIC specified in Clause 10.7 of EN 60079-11:2012. This shall be considered during installation.
5. The apparatus is not capable of withstanding the 500 V insulation test required by clause 6.3.13 of EN 60079-11:2012 (except at the optically isolated input / outputs). This must be taken into account when installing the equipment.

1.2.4 Combustible gas

- The FLOWSIC600 is suitable for measuring combustible and occasionally ignitable gases corresponding to zones 1 and 2.

1.3.3 Restrictions of use

- Refer to the type plate for the configuration of your FLOWSIC500.
- Check the FLOWSIC500 is suitably equipped for your application (e.g., gas conditions).

WARNING: Hazard through material fatigue

The FLOWSIC500 has been designed for use under mainly static loads.

- Maximum allowed gradient of static pressure: 3 bar / s (44 psi / sec).

The number of complete pressure application and release processes should be kept low during operation.

- Replace the device when 500 cycles have been reached.

NOTICE

The FLOWSIC500 is designed for measuring clean and dry natural gas.

- The operating company should install a suitable filter or core screen ahead of the gas flow meter when the gas is contaminated.

NOTICE

- The FLOWSIC500 is suitable for use in pressurized lines within the parameters specified in the device. The device conforms to Pressure Device Equipment 2014/68/EC.
- It is the user's responsibility to ensure the maximum values specified for pressure and temperature on the type plate are not exceeded during operation.

1.3.4 Cleaning

NOTICE: Cleaning information

- Only clean the FLOWSIC500 with a damp cloth.
- Do not use solvents for cleaning.
- Only use materials for cleaning which do not damage the surface of the FLOWSIC500.

NOTICE

Please observe the specific conditions of use in potentially explosive atmospheres. → p. 12, § 1.3.5

1.4 Responsibility of user

- Only put the FLOWSIC600 into operation after reading the Operating Instructions.
- Observe all safety information.
- If anything is not clear: Please contact the Endress+Hauser Customer Service.

Designated users

The FLOWSIC600 may only be operated by skilled technicians who, based on their technical training and knowledge as well as knowledge of the relevant regulations, can assess the tasks given and recognize the hazards involved.

NOTICE

Skilled persons are persons in accordance with DIN VDE 0105 or IEC 364, or directly comparable standards.
These persons must have exact knowledge on hazards arising from operation, e.g. through hot, toxic, explosive gases or gases under pressure, gas/liquid mixtures or other media as well as adequate knowledge of the measuring system gained through training.

Correct use

- Only use the FLOWSIC600 as described in these Operating Instructions (→ p. 11, § 2.1). The manufacturer bears no responsibility for any other use.
- Do not carry out any work or repairs on the FLOWSIC600 not described in this manual.
- Do not remove, add or change any components in or on the FLOWSIC600 unless such changes are officially allowed and specified by the manufacturer.
  Otherwise:
  - Any warranty by the manufacturer becomes void.
  - The FLOWSIC600 can become dangerous.
  - The approval for use in potentially explosive atmospheres is no longer valid.
  - The approval for use in lines pressurized above 0.8 bar (11.26 psi) gain is no longer valid.

Danger identification on device

WARNING: Danger identification on device

The following symbol draws attention to important dangers directly on the device:

- Consult the Operating Instructions in all cases where the symbol is attached to the device or shown on the display.

Special local conditions

- Follow all local laws, regulations and company-internal operating directives applicable at the installation location.

Retention of documents

These Operating Instructions must be:

- Kept available for reference.
- Passed on to new owners.

1.5 Additional documentation/information

Some parameter settings, device components and characteristics depend on the individual device configuration. This individual device configuration is described in the device documentation delivered with the device.

- Conformity declaration
- Material certificate
- Inspection certificate
  - Device configuration sheet
  - Encoder test protocol (optional)
  - Low pressure calibration test protocol (optional)
  - Labels according to Pressure Equipment Directive 2014/68/EC Annex I Part 3.3
- Primus Parameter report
- Available for download:
  - Operating instructions
  - FLOWgate™ operating software
  - FLOWgate™ Software Manual
  - Certificates
  - Instructions/information for accessories
  - Calibration instructions
  - Modbus specification

1.3 Information on cybersecurity threats

Protection against cybersecurity threats requires a comprehensive cybersecurity concept that must be continuously reviewed and maintained. A suitable concept consists of organizational, technical, procedural, electronic and physical levels of defense and takes into account appropriate measures for the different types of risk. The measures implemented in this product can only support protection against cybersecurity threats if the product is used as part of such a concept.

Visit the manufacturer website for more information, such as:

- General information on cybersecurity
- Contact option for reporting vulnerabilities
- Information on known vulnerabilities (Security Advisories)

FLOWSIC500

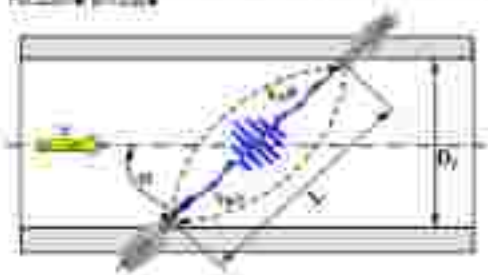
2 Product description

3.1 Measuring principle

3.1.1 Gas flow meter

The FLOWSIC600 works according to the principle of ultrasonic transit time difference measurement.

Fig. 1 FLOWSIC600 principle



v = Gas velocity
L = Measuring path
α = Angle of inclination in °
t_{AB} = Sound transit time in flow direction
t_{BA} = Sound transit time against flow direction
D_I = Pipe inner diameter
Q = Volume flow

Measured signal transit times t_{AB} and t_{BA} are defined by the current sound and gas velocity.
Gas velocity v is determined from the difference between the signal transit times. Therefore changes in the sound velocity caused by pressure or temperature fluctuations do not affect the calculated gas velocity with this measurement method.
The FLOWSIC600 calculates the volume flow rate internally from the gas velocity and the diameter of the measuring section of the gas flow meter.

$$Q = \frac{\pi}{4} D_I^2 \cdot \frac{L}{2\cos\alpha} \cdot \frac{t_{BA} - t_{AB}}{t_{AB} \cdot t_{BA}}$$

3.1.2 Volume conversion (optional)

The integrated volume conversion converts the measured gas volume from measurement conditions to base conditions.
Calculation according to EN 12405:

$$V_b = C \cdot V_m$$

V_b = Volume at base conditions
C = Conversion factor
V_m = Volume at measurement conditions

$$C = \frac{p}{p_b} \cdot \frac{T_b}{T} \cdot \frac{Z_b}{Z}$$

p = Gas pressure at measurement conditions
p_b = Pressure at base conditions
T = Gas temperature at measurement conditions
T_b = Temperature at base conditions
Z_b = Compressibility factor at base conditions
Z = Compressibility factor at measurement conditions

The measurement conditions are either determined with pressure and temperature sensors or entered as fixed value.

The following short forms are used in this document for better readability:
- Volume at base conditions = base volume
- Volume at flowing conditions = measurement volume

2.2 System components

The FLOWSIC600 measuring system comprises:

- FLOWSIC600 gas flow meter
- Adapter for installation in pipeline end
- Optional pair sensors for the volume correction device option

Fig. 3 FLOWSIC600 components

2.2.1 Adapter

The meter body is available in various flange standards and fitting lengths to connect the gas flow meter to the system pipeline.

Depending on the version, the adapter is designed for assembly on line flanges PN16 in accordance with DIN EN1092-1, CL150 in accordance with ASME B16.5, or 1.6MPa in accordance with GOST 12815-80.

Fitting lengths available → p. 46, 3.4.1

3.2.1 Gas flow meter

An internal flow conditioner rectifies the gas flow in the gas flow meter so that flow profile disturbances caused by pipe bends in the inlet or outlet sections or components projecting into the pipe (e.g., a thermowell) have no influence on measuring results.

The gas flow meter can be exchanged without taking the adapter out of the pipeline.

The gas flow meter is fitted with:

- Control unit
- Optical and electrical interfaces
- Measuring cell with ultrasonic transducers
- Electronics

The product variant with volume conversion and integrated pressure and temperature sensors also has the calibrated pressure sensor and calibrated temperature sensor fitted in the gas flow meter.

3.2.2 Meter sizes

Available meter sizes → p. 135, § 9.6.

2.3 FLOWgate™ operating software

The FLOWgate™ operating software allows user-friendly access to all measured values of the device.

For FLOWgate™ operating software, see "Software Manual FLOWgate™". The software manual is available for download.
The Software Manual is also available using the Help function of the FLOWgate™ operating software.

2.3.1 Overview

Software functions

- Measured values overview
- Field setup wizard
- Parameter modification
- Logbook and archive management
- Calibration
- Diagnostics data
- Service actions
- Session browser

Fig. 4 Software platform FLOWgate™ - FLOWSIC500 "Overview"

[illegible] System requirements

- Microsoft Windows 7/8/10
- Min. 1.3 GHz CPU
- Min. 2 GB RAM
- Approx. 100 MB free memory without .NET framework
- USB or serial interface
- Recommended minimum screen resolution 1024 x 768 pixels, optimum screen resolution 1366 x 768 pixels
- Microsoft .NET framework 4.6 or higher

> If the user is not an administrator, the following entries in the registry must exist or be configured for installation of the system:
> - AlwaysInstallElevated = 1
> - EnableUserControl = 1
>
> Support: http://msdn.microsoft.com/en-us/library/aa367852(v=vs.85).aspx

[illegible] Access rights

Device function	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Standard password	–	1111	1111	1111	2222	2222	2222
User can be deactivated	–	x	x	x	x	x	–
Read parameters and measured values	x	x	x	x	x	x	x
Read data archive	–	x	x	x	x	x	x
Change parameters not custody relevant	–	x	x	x	x	x	x
Change custody relevant parameters	–	–	–	–	x	x	x
User management	–	–	–	–	–	–	x
Calibration mode	–	–	–	–	x	x	x
Configuration mode	–	–	–	–	x	x	x
Test digital outputs	–	–	–	–	x	x	x

2.4 Interfaces

The FLOWSIC500 supports various digital and serial interfaces.

The configuration of the interfaces as delivered is described in the delivery documents provided with the respective device.

Table 1 Interface configurations

Type code	I/O 1	I/O 2	I/O 4	I/O 5 (HART)	I/O 6	I/O 7	I/O 8	I/O 9
	LF	HF	Encoder + LF	RS485	Encoder + HF	2 x LF	RS485 + HF	RS485 + HF
DO_0	-	HF pulses	Encoder	-	Encoder	-	HF pulses	-
DO_1	Normal operation: Diagnosis warning; test mode: Test pulses				HF pulses	Auto-config. F_G, H_L	-	-
DO_2	LF pulses	-	-	-	-	LF pulses	-	HF pulses
DO_3	Malfunction	Malfunction	LF pulses	-	Malfunction	LF pulses	-	-
Serial	-	-	-	RS485	-	-	RS485	RS485

- Information on application technical characteristics and rated voltage → p. 46, § 3.4
- Details on standard interface configurations available → p. 51, § 3.4.8

2.4.1 Pulse and status outputs

FLOWSIC500 has 4 digital switching outputs. Digital switching outputs DO_0, DO_2 and DO_3 are electrically isolated according to EN 60947-5-6.

Alternatively, digital switching outputs DO_2 and DO_3 can also be configured as Open Collector.

When used as pulse output, maximum 2 kHz can be output on digital switching output DO_0 and maximum 400 Hz on digital switching outputs DO_2 and DO_3. When used as status output, status information "Validity of measurement" or the result of the self-diagnosis can be represented.

Digital switching output DO_1 is not electrically isolated. In normal mode, the diagnosis warning is output on DO_1, test pulses are output in test mode.

The digital switching outputs are updated synchronously once per second.

2.4.2 Encoder totalizer

Alternatively, HART® switching output DO_0 can be configured so that the totalizer level of the totalizer (m, the meter state and a meter identification are output via asynchronous serial communication. This allows the connection of volume correctors with a suitable input for encoder totalizers.

> **NOTICE**
>
> With encoder communication, it must be ensured that the transmitted digit count or totalizer resolution can be processed by the connected volume corrector.
>
> A parameter modification can be carried out on the FLOWSIC500 with the FLOWgate™ operating software when the parameter locking switch is open.

2.4.3 Serial data interface

The serial interface is designed as externally powered RS485 and requires an external intrinsically safe power supply for operation.

Maximum cable length for the RS485 interface: 300 m

2.4.4 Optical data interface

An optical interface according to IEC 62056-21 with serial bit, asynchronous data transmission is located on the front of the FLOWSIC500.

This interface can be used to read out data and parameter settings and to configure the FLOWSIC500.

2.5 Totalizers

2.5.1 Device status and totalizers used

Various volume totalizers are fitted on the FLOWSIC500 depending on the configuration.

Meter V is used in the configuration as gas flow meter. If the gas flow meter has a malfunction, the measured volume is also recorded in the error volume counter eV.

Table 2 Device status and totalizers used

Status	Totalizer	
	V	eV
Operation	•	
Malfunction	•	•

A gas flow meter Vm, a base volume meter Vb and a total volume meter Vbtot are used in the configuration as gas flow meter with integrated volume conversion (device option). If malfunctions occur, the measured values are not recorded in the base volume meter Vb, but the converted volume is recorded in the malfunction volume encoder totalizer eVb.

Table 3 Device status and totalizers used with device option volume conversion

Status	Totalizer				
	Vb	eVb	Vbtot	Vm	eVm
Operation	•		•	•	
Malfunction		•	•	•	•

Authorized users (user level "Authorized user") can reset the error volume counters → p. 100, §5.2.11.

2.5.2 Reverse flow

The FLOWSIC500 is designed as unidirectional and has a configurable zero-flow cutoff which is factory set to a value of 1 m³ (35 ft³) as default.

The totalizers are stopped during reverse flow and this volume is counted in a separate buffer totalizer. When normal operation resumes, the buffer totalizer is first computed with the flow rate.

The totalizers are first incremented again after the reverse flow volume has passed through.

During reverse flow, the meter first switches to malfunction after the preconfigured buffer volume has been exceeded. An error message is output on the device.

The zero-flow cutoff (measuring threshold for low flow rate) and the buffer volume (limit value for reverse flow volume) can be adjusted with the FLOWgate™ operating software during commissioning (→ p. 75, §4.3.2.3) or after commissioning in the "Metrology" area in the "Parameter Modification" menu.

2.8 Data processing in

2.8.1 Logbooks

The FLOWSIC500 stores events and parameter changes in the following logbooks:

- Event logbook

  All events with timestamp, user logged on and totalizer level, max. number of entries: 1500

  When the Event logbook is 80% full, the FLOWSIC500 changes to device status "Warning", warning W-2003 is shown on the display.

  When the Event logbook is full, the FLOWSIC500 changes to device status "Malfunction", error E-6003 is shown on the display (→ p. 104, § 8.2, "Status messages").

> **NOTICE**
> If the optional feature "Load recording device with maximum load display" feature is activated and the event logbook is full, the device time can be corrected even if the operation is not logged. That the time has been set is evident from the status of the measuring period entry. Updating is the responsibility of the plant operator.

- Parameter logbook

  All parameter changes with timestamp, user logged on, totalizer level, old and new parameter value and register number, maximum number of entries: 250

  The oldest entries are overwritten when the Parameter logbook is full.

- Metrology logbook

  All changes to selected custody-relevant parameters (→ p. 31, § 4.5.2), with parameter locking switch activated with timestamp, user logged on, totalizer level, old and new parameter value and register number, maximum number of entries: 250

  When the Metrology logbook is full, custody-relevant parameters can be modified only after the parameter locking switch has been opened. The FLOWSIC500 changes to device status "Warning", warning W-2002 is shown on the display (→ p. 104, § 8.2, "Status messages").

- Gas composition logbook

  All parameter changes of the gas composition for the volume conversion with timestamp, user logged on, totalizer level, old and new parameter values and register number, maximum number of entries: 250

  The oldest entries are overwritten when the Gas composition logbook is full.

The data are stored in non-volatile memory, all logbooks can be viewed, stored and reset with the FLOWgate™ operating software. The Event logbook can be viewed after logon as "User" or "Authorized user" on the device.

The following parameters are displayed:

- Event type
- Number of events
- Short description
- Timestamp

2.6.2 Archives

The integrated data registration stores totalizer levels, maximums and other data in the following archives:

- Measuring period archive
  Totalizers and data saved after the measuring period elapses (standard = 60 min). The measuring period can be adjusted → p. 99, § 5.2.5.3
- Daily archive
  Totalizers and data saved at the defined gas hour time (standard = 06:00).
- Monthly archive
  Totalizers and data saved at the defined gas day time (standard = 1st day of month).

> Explanations of data structure and storage depth are available in Technical Bulletin "Data Registration".
> You will find the document available for download.

2.7 Device option

2.7.1 Volume conversion

The FLOWSIC600 gas flow meter with volume conversion captures the gas volume under measurement conditions and converts it to a volume under base conditions.

Gas volume conversion can run selectively (set at the factory) as PTZ or TZ volume conversion. The configuration as temperature volume conversion uses the default value for measurement pressure for calculations.

Measurement conditions are recorded with the pressure and temperature sensors or entered as fixed values.

By default, measured values recording and subsequent calculation of the conversion factor are performed every 30 seconds. The update interval can be adjusted → p. 99, § 5.2.5.5 "Calculation".

Depending on the configuration, the compressibility factor (K-factor) is determined with one of the following calculation methods or can be entered as a fixed value.

- Fixed value
- SGERG88
- AGA 8 Gross method 1
- AGA 8 Gross method 2
- AGA NX-19
- AGA NX-19 mod.
- AGA NX-19 mod. 1997
- SGERG mod.
- AGA8-DZ92 (AGA-8 Detail)

The FLOWSIC600 checks the permissible entry limits of the parameters for the selected calculation method. If one of the entry values is outside the limit values, the FLOWSIC600 switches to malfunction state and uses the fixed value of the compressibility factor for calculation of the base volume.

An absolute pressure sensor (optional: with a pressure sensor EC133 or the functionally compatible successor model EC736) and a temperature sensor EC754 or the functionally compatible successor model EC767 measure current measurement conditions and transfer the sensor type, measured value as well as the sensor status via a digital interface.

The FLOWSIC600 reads the valid measuring range automatically and, periodically, the current status and measured value.

A sensor is only activated for measurement when the configured serial number matches the serial number transferred for this sensor.

If no sensor is detected or a sensor is not functioning correctly, the FLOWSIC500 automatically uses the stored default value (= fixed value) of the state variable.
In this case, the FLOWSIC500 switches to malfunction state and, using the default value, stores the volume under base conditions calculated for pressure or temperature in the error volume counter.

If not specified otherwise, the FLOWSIC500 is supplied with the following standard settings.

Table 4 Standard settings

Unit system	SI	Imperial
T unit	°C	°F
P unit	bar	psi
Gas code according to	EN 12405	API
Calculation method	GERG88S	AGA 8 Gross method 1
Reference conditions for density and heating value	T1, T2, p2 25 °C/0 °C/1.01325 bar(a)	T1, T2, p2 85 °F/60 °F/14.7300 psi (a)
Basic pressure	1.01325 bar (a)	14.7300 psi (a)
Basic temperature	0 °C	60 °F

2.7.1.1 Integrated pressure and temperature sensors

The FLOWSIC500 with volume conversion and integrated pressure and temperature sensors does not have any external components. The internal pressure and temperature sensors are already fitted and calibrated at the factory. The measuring ports are located in the gas flow meter.
This means the FLOWSIC500 does not require any additional installation of sensors to determine the measurement conditions and is immediately ready for operation after volume conversion has been configured.

2.7.1.2 External pressure and temperature sensors

The FLOWSIC500 with volume conversion and external sensors is used at measuring points where a test calibration of the pressure or temperature sensor in the system may be required.
It is recommended to install a three-way test valve that separates the pressure sensor from the measurement pressure and provides a test connection to test the pressure sensor.
→ Fig. 5 shows a FLOWSIC500 with external sensors and test valve 8324-4 for gas temperatures to -25 °F.

Fig. 5 FLOWSIC500 with external sensors and terminal EC424

1 Pressure sensor
2 Terminal EC424
3 Temperature sensor

A three-way test valve (→ Fig. 6) that is fitted next to the FLOWSIC500 is used for gas temperatures to 400 °C.

Fig. 6 Three-way test valve with pressure and temperature couplings

1 Pipe screw fitting 1/4" NPT or pipe DN8
or pipe screw fitting 1/4" NPT or pipe 1/4"
2 Hand lever
3 Test connection (thimble coupling)
4 Pressure sensor connection thread G 1/4"

2.1.2 Load recording device with maximum load display

The optional feature "Load recording device with maximum load display" is available for FLOWSIC500 with integrated volume conversion. The feature is optionally activated at the factory and extends the archive entries of the measuring period archive, daily archive and monthly archive by additional details, e. g. time stamps of measurement and process variables T_{min}...T_{max} and flowtime.

> Explanations on data structure and storage depth are available in Technical Bulletin "Data Registration".
> You will find the document available for download.

The archive contents can be shown on the display. A search function is also available, see → p. 101, § 5.2.18. Querying the measurement data and external time synchronization are also possible via the RS485 interface.

When the current measuring period elapses, the consumption and process values of this period are used for updating the daily and monthly extreme values related to the measuring period.

When the current day is ended, the consumption and process values of this day are used for updating the daily related monthly extreme values.

If the feature "Load recording device with maximum load display" is activated, the FLOWSIC500 checks if the measuring period or the daily period is still valid when ending the measuring period or the daily period. If the period is valid, the consumption of this period is used for updating the daily and monthly extreme values.
A period entry is marked as invalid when the following events occur:

- when there is a device malfunction,
- when the target recording duration has not been observed,
- when the time has been set beyond the synchronization limit,
- if the difference between the start and end time stamps does not match the target period duration.

For the maximum load function, the stored measured values for the currently running and the previous, i.e. last completed, periods can be shown on the display, see → p. 88, § 5.2.8.10.

The maximum (↑) of the last 24 months in each case are stored in the monthly archive and can also be viewed on the display.

3.1.3 Extension measurement capability up to 30% hydrogen

By default, the FLOW@CODO has the ability to measure a hydrogen content of up to 10% in natural gas. Starting with firmware version 2.1.7.00, this range can be extended up to 30% with an additional license. Accuracy class 2.0 is always maintained.

The license can be activated as work when ordering the device or can be obtained from Endress+Hauser at a later date. When activating the license for gas flow meters in the field, the national regulations must be taken into account.

3.1.4 Gas Quality Indicator (GQI)

When commissioning the FLOW@CODO from FW2.03., the current gas composition and a permissible deviation can be parameterized via the Gas Quality Indicator (GQI) in FLOWgate™. The gas quality is continuously monitored. If the gas composition is changed by admixing other gas types, e.g. biogas, the operator receives status information as soon as the Gas Quality Indicator (GQI) of the FLOW@CODO exceeds the parameterized permissible deviation. Changes in the gas quality can thus be detected.

As of firmware 2.1.7, the hydrogen content in the natural gas can be monitored via an option, license with the gas quality indicator. As a basis for monitoring, the gas composition of the natural gas in the meter must be parameterized with FLOWgate™. If the set limit value is exceeded with fluctuating hydrogen feed-in, the FLOW@CODO reports this back to the operator via the status. In this way, changes in the hydrogen content and thus also the heating values can be detected in real time. The Gas Quality Indicator based on Heliograph® forms the basis for ensuring consistently agreed gas qualities where no gas quality measurement by means of a gas chromatograph or no measurement of the hydrogen content is available.

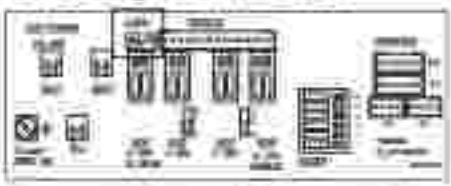
For a meter in the field, activation of the feature via an Endress+Hauser license is only possible in compliance with national regulations.

2.8 Parameter protection

2.8.1 Parameter locking switch

A parameter locking switch is located on the circuit board to secure the custody relevant parameters. This comprises all values that influence volume measuring and volume conversion.

Fig. 7 Parameter locking switch on the circuit board



The parameter locking switch is secured by the terminal compartment cover and a seal.

2.8.2 Metrology logbook

Selected custody relevant parameters can be modified when the parameter locking switch is closed and after logging in as authorized user.

An entry in the metrology logbook is generated to ensure the traceability of these parameter changes. The entry contains the timestamp, old and new value, totalizer level (for gas flow meters) or Vb (for gas flow meters with device optoN volume conversion) and the logged on user.

The Metrology logbook can have a maximum of 100 entries. The FLOWSIC500 switches to status "Warning" when the Metrology logbook is full.

The Metrology logbook can be cleared when the parameter locking switch is open. Parameter changes to the following parameters are entered in the Metrology logbook as long as entries are possible.

Table 8 Custody relevant parameters - gas flow meter

Parameter	Description
Vbl, reverse flow volume	Buffer volume for reverse flow
Symbols for measured value display	Symbols used on the display, format, symbols

Table 6 Custody transfer parameters - gas flow meter with volume conversion

Parameter	Description
Max. reverse flow volume	Buffer volume for reverse flow
Symbols for measured value displays	Symbols used on the display, formula symbols
Calculation interval	Cycle time for updating measured values pressure, temperature and calculation of the compressibility factor
Calculation method	Calculation method for the compressibility factor
Value range check	Checking the input parameters for the conversion algorithms
Reference conditions	Reference conditions for density and heating value
Heating value unit	Heating value unit
Density value selection	Selection of relative density or standard density
Basic pressure	Pressure standard conditions
Basic temperature	Temperature standard conditions
H-factor (fixed)	Figure for method "Fixed value" when the calculation of the H-factor is incorrect
Default value for molar mass	Default value, when the calculation of the molar mass is incorrect
p Lower alarm limit	Lower warning limit for the pressure which can be set by the customer
p Upper alarm limit	Upper warning limit for the pressure which can be set by the customer
p Default value	Fixed value of measurement pressure
p Unit	Unit for pressure values
Atmospheric pressure	Ambient pressure
p Serial number	Serial number of pressure sensor
p Offset	Offset for pressure sensor adjustment
p Adjust factor	Factor for pressure sensor adjustment
T Lower alarm limit	Lower warning limit for the temperature which can be set by the customer
T Upper alarm limit	Upper warning limit for the temperature which can be set by the customer
TD default value	Fixed value of measurement temperature
T Unit	Unit for temperature values, used for entry and display
T Serial number	Serial number of temperature sensor
T Offset	Offset for temperature sensor adjustment
T Adjust factor	Factor for temperature sensor adjustment
Measuring period	Period for closing archive
Set hour	Setting hour for the day archive
Set day	Setting day for month archive

2.8.3 Gas composition logbook

All changes of gas composition parameters for volume correction are saved in the Gas composition logbook.

The entry contain a timestamp, old and new value of the changed parameter, counter level (1), logbook user and the register number. The Gas composition logbook can have a maximum of 1250 entries. The oldest entries are overwritten when the Gas composition logbook is full.

The Gas composition logbook can only be cleared when the parameter locking switch is open.

Table 7 Gas composition parameters for volume correction

Parameter	Description
Relative density	Relation between gas density and air density under reference conditions
Reference density	Gas reference density under reference conditions
Heating value	Gas heating (under reference conditions)
Carbon dioxide (CO_2)	CO_2 proportion in gas
Hydrogen H_2	H_2 proportion in gas
Nitrogen N_2	N_2 proportion in gas
Methane CH_4	Methane proportion in gas
Ethane C_2H_6	Ethane proportion in gas
Propane	Propane proportion in gas
Water H_2O	Water vapor proportion in gas
Hydrogen sulfide H_2S	Hydrogen sulfide proportion in gas
Carbon monoxide CO	Carbon monoxide proportion in gas
Oxygen O_2	Oxygen proportion in gas
Hexane	Hexane proportion in gas
n-butane	n-butane proportion in gas
i-pentane	i-pentane proportion in gas
n-pentane	n-pentane proportion in gas
n-hexane	n-hexane proportion in gas
n-heptane	n-heptane proportion in gas
n-octane	Octane proportion in gas
n-nonane	Nonane proportion in gas
n-decane	Decane proportion in gas
Helium	Helium proportion in gas
Argon	Argon proportion in gas

2.9 Sealing

The FLOWSIC600 is secured at the factory with a seal on the cover.

Gas flow meter and adapter can be secured at the joint by a user seal (adhesive label, glued with approximately equal spread on gas flow meter and adapter).

Optionally, the electronics cover can also be protected by the customer after the end of the installation against unauthorized opening.

Fig. 9: Factory seal of the cover on the gas flow meter

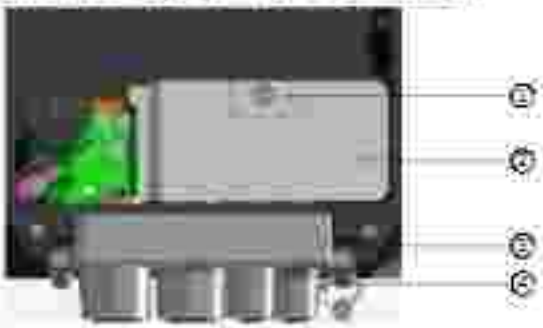
1 Seal position
2 Possible position of the adapter seal
3 Possible position of the electronic cover seal

In addition, the FLOWSIC600 has seal positions on the terminal compartment cover and the plug-in connector cover.

An adhesive label secures the interfaces and the parameter lock to the terminal cover compartment.

During commissioning, the plug-in connector cover must be secured according to national regulations. This can be performed with an adhesive label which is glued with approximately equal spread on the cover and the enclosure or alternatively by using captive screws and a tensioned sealing wire and a wire seal.

Fig. 9 Seals on the terminal compartment and plug-in connection cover



1 Seal position
2 Terminal compartment cover (securing the terminal compartment)
3 Plug-in connection cover
4 Cabinet screw, nuts and bracket (securing of plug-in connection cover)

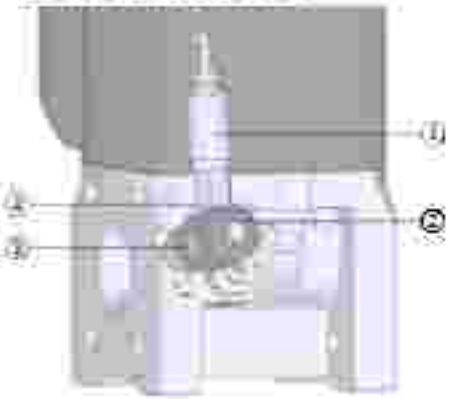
NOTICE

- Secure the terminal compartment cover and the plug-in connection cover with at least one verification seal against unauthorized removal of the cover.

Fig. 10 Seal on the temperature sensor (example)

1 Temperature sensor
2 Locknut
3 Wire seal

Fig. 3.2 Set of the pressure sensor assembly



1 Pressure sensor
2 Retainer 60404
3 Washer
4 Wire loop

NOTICE
Make sure that the wire loop is placed tight around the pressure sensor.

3.10 PowerIn Technology™

The FLOWSIC600 is available with two configurations:

- For operation with external intrinsically safe power supply with backup battery (backup duration: Approx. 3 months)
- Self-sufficient power configuration: 2 internal lithium battery packs (typical service life: at least 8 years)

  The second battery pack is activated automatically when the first pack is empty and a message displayed (→ p. 33) (E53).

FLOWSIC500

3 Installation

3.1 Hazards during installation

CAUTION: General risks during installation

- Observe applicable valid regulations, general standards and guidelines.
- Observe local safety regulations, operating instructions and special regulations.
- Observe the safety information in → p. 10, § 1.2.
- Comply with the safety requirements of Pressure Equipment Directive 2014/68/EC or AS/IE 831.3 when installing pressure devices including connection of various pressure devices.
- Persons carrying out installation work must be familiar with the directives and standards applicable for pipeline construction and have the corresponding qualifications, e.g. in accordance with DIN EN 1594-4.

WARNING: Hazards through the gas in the system

The following conditions can increase the risk:

- Toxic gas or gas dangerous to health
- Explosive gas
- High gas pressure

- Only carry out installation, maintenance and repair work when the system is non-pressurized.

WARNING: Hazards during installation work

- Do not carry out any welding work on lines with meters fitted.
- Comply exactly with mandatory and approved methods.
- Observe and comply with regulations of the plant operator.
- Meticulously check completed work. Ensure leak tightness and strength.

Otherwise hazards are possible and safe operation is not ensured.

3.2 General information

3.2.1 Delivery

The FLOW-SIC500 is delivered preassembled in sturdy packaging.

- Inspect for transport damage when unpacking the device.
- Document any damage found and report this to the manufacturer.

NOTICE!
Do not put the FLOW-SIC500 into operation if you notice any damage.

- Check the scope of delivery for completeness.

The standard scope of delivery comprises:

- FLOW-SIC500, gas flow meter as a swapper, already fitted
- Backup battery (if device is configured for external power supply) or
- 3 battery packs (if device is configured for battery operation).

6.2.2 Transport

- During all transport and storage work, ensure:
  - The FLOWSIC600 is always well secured.
  - Measures to prevent mechanical damage have been taken.
  - Ambient conditions are within specified limits.

6.3 Mechanical installation

CAUTION: General rules during installation

- Observe applicable valid regulations, general standards and guidelines.
- Observe local safety regulations, operating instructions and special regulations.
- Observe the safety information in ⟶ p. 13 § 1.1.
- Comply with the safety requirements of Pressure Equipment Directive 2014/68/EU or ASME B31.3 when installing pressure devices including connection of remote pressure devices.
- Persons carrying out installation work must be familiar with the directives and standards applicable for pipeline construction and have the corresponding qualifications, e.g. in accordance with DIN EN 3834-4.

The FLOWSIC600 normally does not need straight inlet and outlet sections and can be fitted directly after bends in the pipe.

NOTICE: Installation requirements

- The following elements must not be present within a distance of 5 DN to the adapter in upstream direction:
  - A valve not always operated fully open.
  - A pressure regulator.
- The pressure sensor must be maximum 5 DN behind the gas flow meter. Alternatively, the temperature sensor in the optional immersion sleeve can be used in the adapter.
- In concrete application, observe limitations resulting from type approval!

NOTICE

The device shall be protected from direct sunlight and atmospheric influences in accordance with IEC 60079-14 or other local installation requirements. Furthermore, the maximum permissible operating conditions shall be observed. This includes compliance with the specified ambient temperature, which may be affected by the surrounding air temperature, by additional heating due to solar radiation, and by the gas temperature.

5.5.1 Preparations

- Select a suitable installation location. Ensure adequate assembly clearances (→ Table 12).
- The following tools and materials are required to install the FLOWSIC600:
  - Hoisting equipment (lifting capacity according to the weight specifications → p. 158, 9.6)
  - Box wrench with size suitable for flange installation
  - Torque wrench
  - Flange gaskets
  - Lubricant, metal-free or suitable for aluminum, e.g. DHS 225 to prevent thread mountings seizing up

> **NOTICE!**
> Do not use copper paste!

  - SW8 Allen key
  - Leak detection

5.5.2 Choosing flanges, gaskets and other components

For flange connections only use pipeline flanges, bolts, nuts and gaskets suitable for the maximum operating pressure, maximum operating temperature as well as ambient and operating conditions (external and internal corrosion).

→ Table 8 contains a list of recommended bolts and → Table 9 contains a list of recommended gaskets.

For devices with approval according to GOST, → Table 10 contains a list of recommended bolts and → Table 11 contains a list of recommended gaskets.

Fig. 13 Dimensions of gaskets

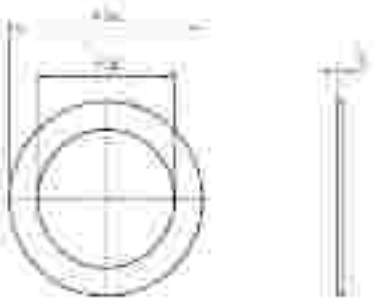


Table 8 Bolts and tightening torques

Device / flange type	Bolts	Washers	Nuts	Tightening torque	
PN16 / EN1092-1					
DN80 PN16	4 pc. DIN939-M16x45-42CrMo4	4 pc. DIN125-A17-44	4 pc. ISO4032-M16-44-70	120 Nm	88 lbf ft
DN80 PN16 DN100 PN16	8 pc. DIN939-M16x45-42CrMo4	8 pc. DIN125-A17-44	8 pc. ISO4032-M16-44-70	120 Nm	88 lbf ft
DN150 PN16	8 pc. DIN939-M20x55-42CrMo4	8 pc. DIN125-A21-A2	8 pc. ISO4032-M20-42-70	250 Nm	184 lbf ft

Class 150 / ASME B16.5

Device flange size	Bolts	Washers	Nuts	Tightening torque	
2" / CL150 3" / CL150	4 pc. Double end threaded stud 5/8" length 3.5" - ASME B18.31.2 ASTM A193 Grade B8M	4 pc. Type A plain washer (narrow series) 5/8" - ANSI B18.22.1, grade 8 stainless steel	4 pc. Hex flat nut (UNC series) 5/8" - ANSI B18.2.2 ASTM A194 Grade 8M	140 Nm	103 lbf·ft
4" / CL150	8 pc. Double end threaded stud 5/8" length 3.5" - ASME B18.31.2 ASTM A193 Grade B8M	8 pc. Type A plain washer (narrow series) 5/8" - ANSI B18.22.1, grade 8 stainless steel	8 pc. Hex flat nut (UNC series) 5/8" - ANSI B18.2.2 ASTM A194 Grade 8M	140 Nm	103 lbf·ft
6" / CL150	8 pc. Double end threaded stud 3/4" length 4.0" - ASME B18.31.2 ASTM A193 Grade B8M	8 pc. Type A plain washer (narrow series) 3/4" - ANSI B18.22.1, grade 8 stainless steel	8 pc. Hex flat nut (UNC series) 3/4" - ANSI B18.2.2 ASTM A194 Grade 8M	240 Nm	177 lbf·ft

Table 6 Gaskets

Device flange size	Da* [mm]	Di [mm]	S [mm]	Material
PN16 / EN 1092-1				
DN50 / PN16	107	61	2	novapress® FLEXIBLE 815
DN80 / PN16	142	90	2	novapress® FLEXIBLE 815
DN100 / PN16	162	115	2	novapress® FLEXIBLE 815
DN150 / PN16	218	169	2	novapress® FLEXIBLE 815
Class 150 / ASME B16.5				
2" / CL150	105	60	2	novapress® FLEXIBLE 815
3" / CL150	127	89	2	novapress® FLEXIBLE 815
4" / CL150	175	114	2	novapress® FLEXIBLE 815
6" / CL150	222	168	2	novapress® FLEXIBLE 815

[*] Da = outer diameter, Di = inner diameter, S = thickness → Fig. 12

Recommended bolts and gaskets according to GOST

Table 10 Bolts and tightening torques

Device flange type	Bolts	Washers	Nuts	Tightening torque
PN16 / GOST 12815-80				
DN50 / PN16 Series 1+2	4 pc. DIN933-M16x45-A2-70	4 pc. DIN125-A17-A4	4 pc. ISO4032-M16-A4-70	120 Nm
DN65 / PN16 Series 1	8 pc. DIN933-M16x45-A2-70	8 pc. DIN125-A17-A4	8 pc. ISO4032-M16-A4-70	120 Nm
DN80 / PN16 Series 2	4 pc. DIN933-M16x45-A2-70	4 pc. DIN125-A17-A4	4 pc. ISO4032-M16-A4-70	120 Nm
DN100 / PN16 Series 1+2	8 pc. DIN933-M16x45-A2-70	8 pc. DIN125-A17-A4	8 pc. ISO4032-M16-A4-70	120 Nm
DN150 / PN16	8 pc. DIN933-M20x55-A2-70	8 pc. DIN125-A21-A2	8 pc. ISO4032-M20-A2-70	280 Nm
PN16 / EN1092-1				
DN50 / PN16	4 pc. DIN933-M16x45-A2-70	4 pc. DIN125-A17-A4	4 pc. ISO4032-M16-A4-70	120 Nm
DN80 / PN16	8 pc. DIN933-M16x45-A2-70	8 pc. DIN125-A17-A4	8 pc. ISO4032-M16-A4-70	120 Nm
DN100 / PN16	8 pc. DIN933-M16x45-A2-70	8 pc. DIN125-A17-A4	8 pc. ISO4032-M16-A4-70	120 Nm
DN150 / PN16	8 pc. DIN933-M20x55-A2-70	8 pc. DIN125-A21-A2	8 pc. ISO4032-M20-A2-70	280 Nm

Table 11 Gaskets

Device flange type	Da[1] (mm)	Di (mm)	S (mm)	Material
PN16 / GOST 12815-80				
DN50 / PN16 Series 1+2	107	61	2	novapress® FLEXIBLE/815
DN65 / PN16 Series 1	142	90		
DN80 / PN16 Series 2	142	90		
DN100 / PN16 Series 1+2	162	115		
DN150 / PN16 Series 1+2	218	168		
PN16 / EN1092-1				
DN50 / PN16	107	61	2	novapress® FLEXIBLE/815
DN80 / PN16	142	90		
DN100 / PN16	162	115		
DN150 / PN16	218	168		

[1] Da = outer diameter, Di = inner diameter, S = thickness → Fig. 13

5.5.3 Fitting in the pipeline

> **NOTICE**
> The lifting lug is designed for transporting the measuring device only.
> Do not lift or transport the FLOWSIC600 with additional loads using the lug.
> - The FLOWSIC600 must not swing or tilt on the hoisting equipment during transport.
> - The FLOWSIC600 must not turn during transport otherwise the lifting lug could be screwed out.

> **NOTICE: Observe the gas flow direction**
> The prescribed flow direction is marked on the adapter with an arrow.
> Arrow direction and gas flow direction must match.
> - Install the FLOWSIC600 in flow direction.
> The device signals a malfunction when the FLOWSIC600 is installed against the prescribed flow direction.

The FLOWSIC600 can be installed horizontal or vertical.
The control unit can be rotated ± 90° (→ p. 49, § 5.6.4).

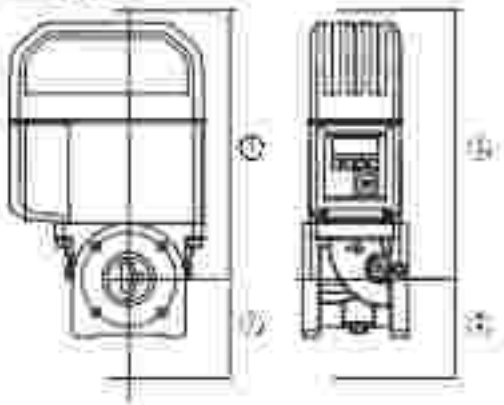
Fig. 13 Installation examples

8.3.3.1 Assembly clearances

Maintain adequate assembly clearances to ensure there is enough room to accurately the gas flow meter. The upward clearance is needed to remove the gas flow meter from the adapter and to put it back on again. The downward clearance is needed to loosen the screws, take these out or insert these again and to fit the tool correctly.

> **NOTICE**
> Depending on the tool used and the installation location, adequate clearances to the sides are also required.

Fig. 14 Assembly clearances



1 Upward clearance
2 Downward clearance

Table 12 Minimum clearance required starting from the pipe axis

Meter size	Upward clearance, without fitting (1)		Upward clearance, with fitting (1)		Downward clearance (2)	
	[mm]	[in]	[mm]	[in]	[mm]	[in]
DN 80 / 3"	300	11.81	340	13.39	200	7.87
DN 80 / 3"	460	18.11	510	20.08	250	9.84
DN 100 / 4"	520	20.47	570	22.44	320	12.6
DN 150 / 6"	520	20.47	570	22.44	320	12.6

3.3.3.2 Pipeline torque

NOTICE
If the FLOWSIC500 is installed so that the gas flow meter projects sideways from the pipeline, the gas flow meter weight creates a torque on the pipeline.
- Make sure the pipeline is capable of holding the gas flow meter → p. 46, Table 13.

Table 23 Pipeline torque

Reference	Torque	
	[Nm]	[lbft]
DN 80 / 3"	16	12
DN 100 / 4"	28	21
DN 150 / 6"	31	23

3.3.3.3 Installation in pipeline

1. Select suitable bolts.
   Recommended bolts → Table 5.
2. Use the holding equipment to position the FLOWSIC500 in the desired location in the pipeline.
   Lay the pipelines without tension to the device to be installed.
3. Insert and align the gaskets.
4. Apply lubricant to the bolts.
5. First screw the bolts by hand into the adapter to the stop.
   - Screw in the bolts according to DIN/ISO with the shorter thread end.
   - The bolts according to ASME B16.5/1.2 can be screwed in with any end.
6. Check the thread length in the adapter is fully utilized.
7. Then install the washers and nuts, and tighten them by hand.
8. Check whether the thread length of the nut is fully utilized.
   If necessary, use a different bolt length.
9. Check correct positioning of flange gaskets.
10. Tighten nuts evenly and crosswise in small steps until the specified tightening torque is reached → Table 5.
    Make sure the flange sits free of tension.
11. Slowly increase the pressure in the pipeline.
    Stabilize: max. 3 bar/min (45 psi/min)
12. Carry out a leak tightness check on the pipeline in accordance with the pipeline operating company's specifications.

3.4 Electrical installation

3.4.1 Requirements for use in potentially explosive atmospheres

The FLOW-SIC500 is suitable for use in potentially explosive atmospheres:
ATEX: II 2G Ex ia [ia] IIB T4 Gb, II 2G Ex ia [ia] IIC T4 Gb; II 2G Ex op is IIC T4 Gb
IECEx: Ex ia [ia] IIB T4 Gb, Ex ia [ia] IIC T4 Gb; Ex op is IIC T4 Gb
US/C: Class I Division 1, Groups C, D T4; Ex ia IIB is IIB T4 Ga

For a FLOW-SIC500 used in potentially explosive atmospheres:

- Installation, commissioning, maintenance and inspection may only be carried out by skilled persons having knowledge of the relevant rules and regulations for potentially explosive atmospheres, especially:
  - Ignition protection types
  - Installation regulations
  - Category classification
- Comply with all valid IEC standards.

The FLOW-SIC500 is suitable for measuring combustible and occasionally ignitable gases corresponding to zones 1 and 2.

Basic requirements:

- The documentation for zone categorization in accordance with IEC60079-10 must be available.
- The FLOW-SIC500 must have been checked for suitability for the actual installation location and the Ex marking of the device must match the requirements.
- After installation and before initial commissioning, the complete equipment and the system must be inspected in compliance with IEC 60079-17.

WARNING: Risk of explosion

All electrical connections of the FLOW-SIC500 are approved for connection to the certified intrinsically safe power circuits only.

- Proof of the intrinsic safety in compliance with IEC 60079-14 must be presented for interconnection with the associated intrinsically safe equipment.

  Otherwise the intrinsic safety of the FLOW-SIC500 can be endangered, i.e. the ignition protection for the FLOW-SIC500 can no longer be ensured.

Operating conditions for the ultrasonic sensors

The FLOWSIC500 is designed for use in potentially explosive atmospheres safely under normal atmospheric conditions within the following limits:

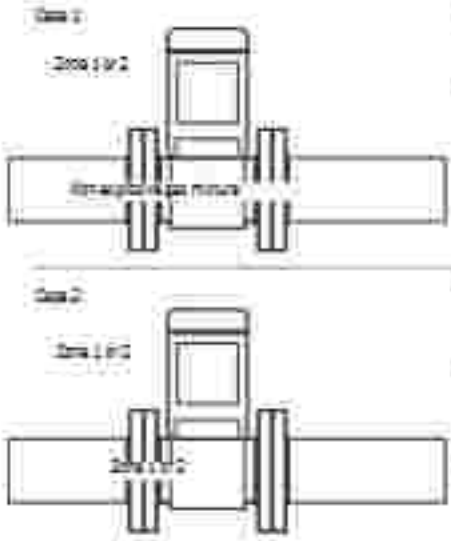
- Ambient pressure range 0.8 bar (11.6 psi) to 1.1 bar (15.95 psi)
- Air with normal oxygen content, normally 21 percent by volume

The ambient temperature must be within the range specified on the type plate.

The gas flow meter becomes part of the pipeline as soon as the FLOWSIC500 is installed in the pipeline.

The walls of the pipeline and the gas flow meter then serve as zone-separating barrier. The following Figure shows the different situations for a possible application and the operating conditions that apply.

Fig. 15 Ex zones



Case 1:

- The pipeline contains a non-explosive mixture. The gas mixture can be combustible.
- Gas pressure and gas temperature can be within the range specified on the type plate of the gas flow meter.

Case 2:

- The area inside the pipeline is classified as potential explosive atmosphere Zone 1 or 2.
- The gas pressure must be within the range 0.8 bar (11.6 psi) to 1.1 bar (15.95 psi) (normal atmospheric conditions).
- Gas temperature must be within the permitted ambient temperature range specified by the type plate on the gas flow meter.

EX NOTICE

Please observe the specific conditions of use in potentially explosive atmospheres. → p. 22, § 2.2.3.

3.4.3 Criteria for electrical connection

Installation work → p. 39, § 3.3 must be completed.

> **WARNING: Risk of explosion - hazard for intrinsic safety**
> ► The following work may only be carried out by skilled technicians familiar with the special characteristics of the intrinsic safety of the ignition protection type and who have knowledge of the relevant standards and regulations for interconnection of intrinsically safe power circuits.

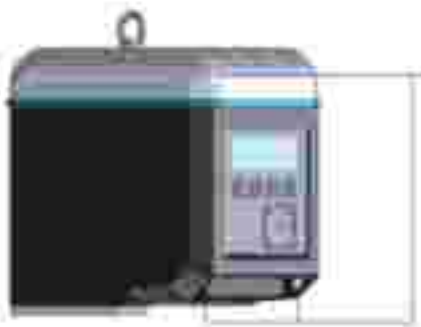
3.4.4 Opening and closing the electronics cover

> EX The Ex i terminal compartment of the FLOWSIC600 can be accessed after the electronics cover has been opened. The cover may also be opened in the hazardous area when under voltage. However, safe separation between the various intrinsically safe power circuits must not be breached.

Opening the electronics cover

1. Loosen the 4 screws (captive) on the electronics cover using an SW3 Allen® key.

Fig. 16 Position of electronics cover screws



2. Open the electronics cover.

Closing the electronic cover

1. Close the electronics cover.

> ► Make sure no battery and display cables are pinched.

2. Screw the electronics cover tight again.
   Tightening torque: 2.5 Nm (1.8 lbf ft)

3.4.4 Rotating the control unit

1. Open the electronics cover (→ p. 46, 3.5.4)
2. Loosen the 4 display screws with an SW3 Allen key (→ Fig. 17).

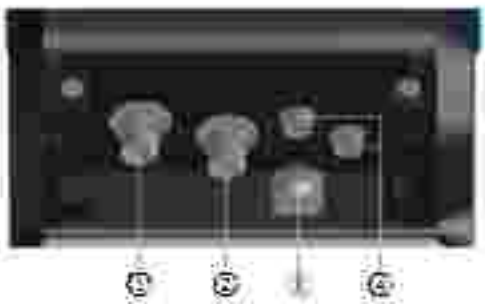
Fig. 17 Rotation of display screws

3. Check the display seal for intactness and correct fitting.
4. A new seal is available as spare part when the display seal is damaged (Part no. 2069177).
5. Rotate the display in the desired direction and reposition.
6. Tighten the display screws evenly.
   Tightening torque: 1.0 Nm (9 lbf in)
7. Close the electronics cover again.

3.4.3 Electrical connections

The FLOWSIC500 interfaces are accessible from the outside via external plug-in connectors.

Fig. 28 Connectors



1 Plug-in connector 1 (5-pole): External power supply and digital output
2 Plug-in connector 2 (4-pole): Signal output
3 Grounding screw
4 Connections for pressure/temperature sensors (optional)

Fig. 29 M12 plug-in connector coding

NOTICE
Safety relevant parameters are valid for connecting all pins of a plug-in connector.

Plug-in connector 2 (4-pole) can be configured when ordered, configurable options → p. 50, § 3.4.5.
The respective configuration is printed on the type plate, → p. 50.

The external power supply need not be connected when the FLOWSIC500 is operated with internal batteries.

3.4.8 Pin assignment of plug-in connectors

3.4.8.1 Plug-in connector 1: External power supply and signal output

Pin assignment for configuration F, G, H, I, J, K, L

Table 14 Pin assignment for M12 plug-in connector 1 (male, B-coded, 4-poles)

M12 pin	Input/output	Function/signal	Operating parameters	Safety-relevant parameters
1	PWR-	Voltage supply	Rated input voltage 4.5 ... 16 V	U_i = 20 V I_i = 667 mA P_i = 733 mW U_o = 8.2 V I_o = 6.58 mA P_o = 13.7 mW C_o = 7.6 µF L_o = 100 mH
2	PWR+			
3	DO_1-	Diagnosis warning, Pulse output in test mode (→ Table 1) and for configuration K, f_{max} = 2 kHz at 120% Q_{max}	OC (Open Collector) Passive, not electrically isolated Max. 16 V Max. 100 mA R_{on} < 110 Ω R_{off} > 1 MΩ	
4	DO_1+			

Pin assignment for configuration M

Table 15 Pin assignment for M12 plug-in connector 1 (male, B-coded, 4-poles)

M12 pin	Input/output	Function/signal	Operating parameters	Safety-relevant parameters
1	PWR-	Voltage supply	Rated input voltage 4.5 ... 16 V	U_i = 20 V I_i = 667 mA P_i = 733 mW
2	PWR+			
3	DO_0-	HF pulses f_{max} configurable to 2 kHz at 120% Q_{max}	NAMUR, electrically isolated (optically isolated) Rated input voltage 8.2 V I_{on} = 3.4 mA I_{off} = 0.7 mA	
4	DO_0+			

Pin assignment for configuration N

Table 16 Pin assignment for M12 plug-in connector 1 (male, B-coded, 4-poles)

M12 pin	Input/output	Function/signal	Operating parameters	Safety-relevant parameters
1	PWR-	Voltage supply	Rated input voltage 4.5 ... 16 V	U_i = 20 V I_i = 667 mA P_i = 733 mW
2	PWR+			
3	DO_2-	LF pulses f_{max} configurable to 100 Hz at 120% Q_{max}	Passive, electrically isolated configurable as: OC (Open Collector)*, Max. 16 V Rated current 20 mA or NAMUR Rated input voltage 8.2 V I_{on} = 3.4 mA I_{off} = 0.7 mA	
4	DO_2+			

3.4.2.2 Plug-in connector 2: Signal output

Table 17 Pin assignment for M12 plug-in connector 2 (male, A-coded, 4-pole)

M12 pin	Input/output	Function/signal	Operating parameters	Safety relevant parameters
Pin assignment configuration 1: LF pulses and malfunction (electrically isolated), type code (/0) F				
1	DO_1+	LF pulses	Passive, electrically isolated, configurable as: OC (Open Collector)* (Ref. 1E) Rated current 20 mA or HART®: Rated input voltage 8.2 V I_{on} = 3.4 mA I_{off} = 3.7 mA	t_i = 20 s P_i = 750 mW
2	DO_2-	f_{max} configurable to 1 kHz at 100% Q_{max}		
3	DO_3-	Malfunction		
4	DO_3+			
Pin assignment configuration 2: HF pulses and malfunction (electrically isolated), type code (/0) G				
1	DO_1+	HF pulses	HART® electrically isolated, optically isolated Rated input voltage 8.2 V I_{on} = 3.4 mA I_{off} = 3.7 mA	t_i = 20 s P_i = 750 mW
2	DO_2-	f_{max} configurable to 2 kHz at 100% Q_{max}		
3	DO_3-	Malfunction	Passive, electrically isolated, configurable as OC (Open Collector)* or HART®, see Configuration 1 for operating parameters	
4	DO_3+			
Pin assignment configuration 3: Encoder and LF pulses (electrically isolated), type code (/0) H				
1	DO_1+	Encoder+/-	HART® electrically isolated, optically isolated Rated input voltage 8.2 V I_{on} = 3.4 mA I_{off} = 3.7 mA	t_i = 20 s P_i = 750 mW
2	DO_2-			
3	DO_3-	LF pulses	Passive, electrically isolated, configurable as OC (Open Collector)* or HART®, see Configuration 1 for operating parameters	
4	DO_3+			
* Standard configuration				
Pin assignment configuration 4: RS-485 modbus (universal input), standard version. Type code (/0) J, low voltage version. Type code (/0) I				
1	RxB+	RS-485 modbus (electrically isolated)	Electrically isolated Standard version: Rated input voltage U_B = 4 ... 15 V Low voltage version: Rated input voltage U_B = 2.7 ... 5 V	t_i = 20 s P_i = 1.1 W C_i = 0.22 µF L_i = 1.35 µH U_i = 0.03 mV
2	Data A			
3	RxB-			
4	Data B			

Table 17 Pin assignment for M12 plug-in connector 2 (male A-coded, 4-poles)

M12 pin	Digital output	Function signal	Operating parameters	Safety-related parameters
Pin assignment configuration B: Encoder and HF pulses (not electrically isolated), type code I/O: K				
The HF pulses are output via plug-in connector 1 (DO_1) → Table 14.				
1	DO_0+	Encoder sig.	NAMUR, electrically isolated, partially isolated Reed, input voltage 8.2 V I_{on} = 3.5 mA I_{off} = 2.1 mA	U_i = 20 V P_i = 750 mW
2	DO_0-			
3	DO_3-	Malfunction	Passive, electrically isolated, configurable as OC (Open Collector)* or NAMUR, see Configuration 1 for operating parameters	
4	DO_3+			
* Standard configuration				
Pin assignment configuration C: LF pulses and malfunction (electrically isolated), type code I/O: L				
1	DO_1+	LF pulses	Passive, electrically isolated, configurable as: OC (Open Collector)*: Max. 18 V Rated current 20 mA or NAMUR Rated input voltage 8.2 V I_{on} = 3.5 mA I_{off} = 2.1 mA	U_i = 20 V P_i = 750 mW
2	DO_2-	$f_{neg.}$ configurable to 100 Hz at 120% Q_{max}		
3	DO_1-	LF pulses		
4	DO_2+	$f_{neg.}$ configurable to 100 Hz at 120% Q_{max}		
Pin assignment configuration T: RS485 module + HF pulses, type code I/O: M				
The HF pulses are output via plug-in connector 1 (DO_0) → Table 15.				
1	RS485+	RS485 module (internally provided)	Electrically isolated Standard version: Rated input voltage U_N = 4 ... 15 V	U_i = 20 V P_i = 1.1 W C_i = 0.22 µF L_i = 1.35 µF L_i = 0.03 mH
2	Data A			
3	RS485-			
4	Data B			
Pin assignment configuration S: RS485 module + LF pulses, type code I/O: N				
The LF pulses are output via plug-in connector 1 (DO_3) → Table 16.				
1	RS485+	RS485 module (internally provided)	Electrically isolated Standard version: Rated input voltage U_N = 4 ... 15 V	U_i = 20 V P_i = 1.1 W C_i = 0.22 µF L_i = 1.35 µF L_i = 0.03 mH
2	Data A			
3	RS485-			
4	Data B			

Fig. 20 Wiring of the cycle check interface

→ Internal flushing equipment → p. 139, § 6.7

3.4.7 DO configuration switch (Open Collector - Namur)

Fig. 21 Open Collector - Namur

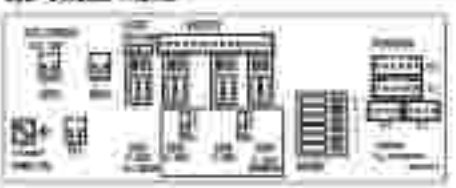
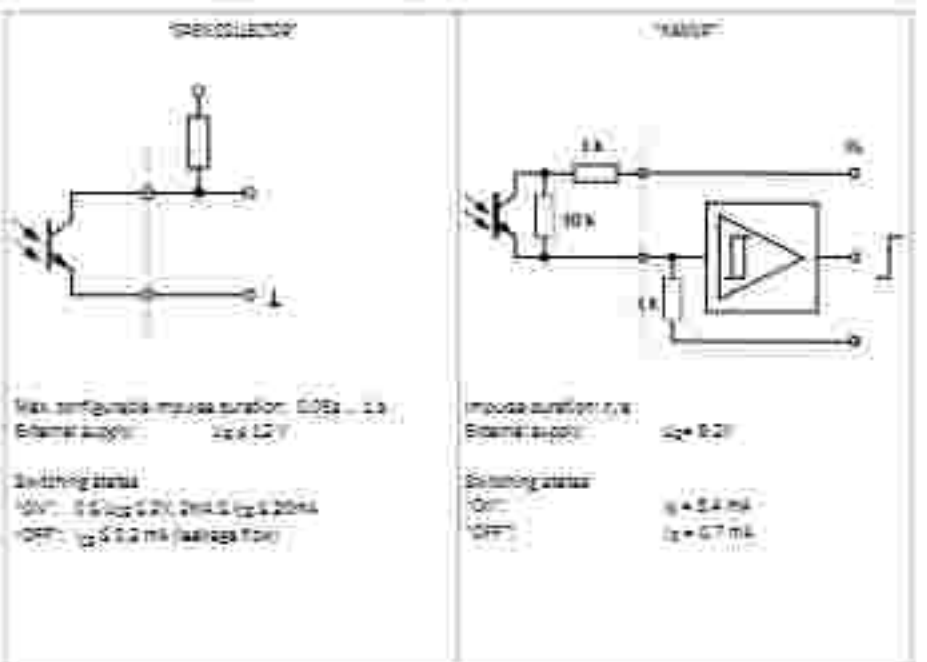


Figure 22 DO switching (Open Collector - Namur)



Max. configurable impulse duration: 0.05 s ... 2 s
External supply: U_B ≤ 32 V

Switching states
"On": 0 V ≤ U_{DO} ≤ 2 V, 2 mA ≤ I_{DO} ≤ 20 mA
"Off": I_{DO} ≤ 0.2 mA (leakage flow)

Impulse duration: 2 s
External supply: U_B = 8.2 V

Switching states
"On": I_S = 5.4 mA
"Off": I_S = 0.7 mA

5.4.3 Cable specifications

When the plug-in cable from Endress+Hauser are used, a shielded control cable with 4x0.25 mm² cross-section, with PVC insulation and approx. 8 mm outer diameter is required.

WARNING! Requirements on cables and installation

- Pay attention to the requirements in EN 60079-14 when selecting the cables and during installation.
- Further legal requirements must be observed for use in explosive atmospheres.

Endress+Hauser recommends the ready-made cables available as accessories (→ p. 133, 10.1).

Wire colors of the cable available as spare part

Table 5.8 Power supply cable for connection to plug-in connector 1 (socket)

Part No.	Pin	Wire color	Plug
2067424 2067425	1	Brown	
	2	White	
	3	Blue	
	4	Black or yellow (jack)	
2067832 2067833	1	White	
	2	Brown	
	3	Green	
	4	Yellow	

Table 5.9 Data cable for connection to plug-in connector 2 (socket)

Part No.	Pin	Wire color	Plug
2067422 2067423	1	Brown	
	2	White	
	3	Blue	
	4	Black or yellow (jack)	
2067830 2067831	1	White	
	2	Brown	
	3	Green	
	4	Yellow	

3.4.3 Operation with external power supply

EX
The FLOWSIC600 is designed electrically intrinsically safe.
► After correct installation has been checked, the plug connections in the hazardous area can be connected and disconnected under voltage as well.

3.4.3.1 Connecting the external power supply

1 Connect the external intrinsically safe power supply to the X12 plug-in connector of the FLOWSIC600.
Safety-relevant parameters → p. 51, § 3.4.6.

Fig. 23: Connection for external power supply, underneath the gas flow meter

1 External power supply and signal output

2 Switch the power supply on.
The FLOWSIC600 is initialized.
3 Measurement starts and the current measured value for the gas volume appears.
4 Set the date and time (→ p. 70, § 4.2).

3.4.3.2 Connecting the backup battery

1 Open the electronics cover (→ p. 46, § 4.3).
2 Connect the backup battery (Part No. 2066826) to connection BAT2 in the terminal compartment (→ Fig. 24).
3 Close the electronics cover again.

Fig. 24: Connected backup batteries

5.4.10 Battery operation

WARNING: Hazard through wrong spare parts
The FLOWSIC500 and the delivered battery packs are designed intrinsically safe.

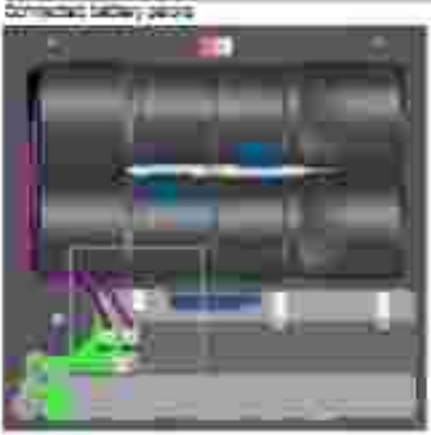
- Only the exchangeable battery packs from Endress+Hauser with Part No. 2084018 and the backup battery with Part No. 2065935 may be used for the power supply of the device.
- The battery packs can be connected and disconnected in the hazardous area as well.
- Only connect the battery packs to the connectors marked for this purpose in the terminal compartment of the FLOWSIC500.
- Modifying the electrical connection parts is not allowed.

NOTICE
Please observe the specific conditions of use in potentially explosive atmospheres → p. 12, § 1.3.3.

3.4.10.1 Connecting the batteries to supply the FLOWSIC500

1. Open the electronics cover (→ p. 49, § 3.4.3).
2. Insert the battery packs (Part. No. 2084018) as shown and connect to connections BAT1 and BAT2 in the terminal compartment.
   The FLOWSIC500 is initialized.

Fig. 28 Connected battery packs



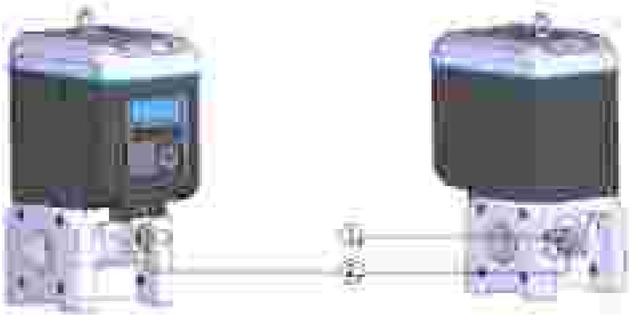
3. Close the electronics cover again.
4. Set the date and time (→ p. 70, § 4.2).

3.5 Installing the external pressure and temperature sensors

The adapter of FLOWSIC500 has measuring ports for pressure and temperature.

> **NOTICE:**
> - The pressure measuring port to be used for measurement is marked "p_M". On meters with flow direction "left/right" (→), the marked pressure measuring port is on the rear of the adapter, on meters with flow direction "right/left" (←), it is on the front.
> - The pressure and temperature sensors can only be replaced when the parameter locking switch is open.

Fig. 26 Pressure and temperature measuring ports (front and rear side)



1 Pressure measuring port
2 Alternative temperature measuring port

> **NOTICE: Ensure sufficient assembly clearance!**
> Ensure sufficient clearance to the wall or other components at the rear measuring ports when installing the sensors.
> The recommended minimum clearance to the wall is 0.3 m.

3.5.1 Fitting the plug-in connector cover

Fit the plug-in connector cover before installing the sensors.

1 Guide the sensor plugs through the openings in the plug-in connector cover.

Fig. 27 Plug-in connector cover

2. Connect the plugs to the pin/mat connections.

For meter sizes DN 50 and DN 80, it is recommended to connect the pressure sensor to the right M8 connection and the temperature sensor to the left M8 connection.

The FLOWSIC500 automatically detects whether a pressure or temperature sensor has been connected to a connection.

Fig. 23 Connections for pressure and temperature sensors

1 Connections for pressure and temperature sensors

3. Push the plug-in connector cover over the plugs and fasten with both captive screws.

Fig. 24 Fastening the plug-in connector cover

1 Captive screw
2 Plug-in connector cover

3.5.2 Installing the pressure sensor

A three-way ball valve is normally fitted to be able to test the pressure sensor each when installed.

> **NOTICE: Fitting information**
> It is recommended to connect the pressure sensor with the three-way test valve or with the FLOWSIC500 so that there is a downward slope from the pressure sensor to the connection point and from the three-way test valve to the FLOWSIC500.

- Before installing a pressure sensor, check if there is a G 1 ¼" or NPT 1 ¼" thread on the meter body.
- The thread type is marked on the meter body:

Fig. 3.5 Marking on meter body
Thread G 1 ¼" Thread 1 ¼" NPT

- When the meter body has an NPT 1 ¼" thread, screw in the adapter from NPT 1 ¼" to G 1 ¼" (Part No. 2075882) before using the accessory parts available from Endress+Hauser.

> **NOTICE**
> The thread on the meter body is damaged when a wrong thread type is screwed in.
> Observe the marking on the meter body!

Variant 1: Installation with test valve BD404 (up to -30 °C dynamic, up to -30 °C static)

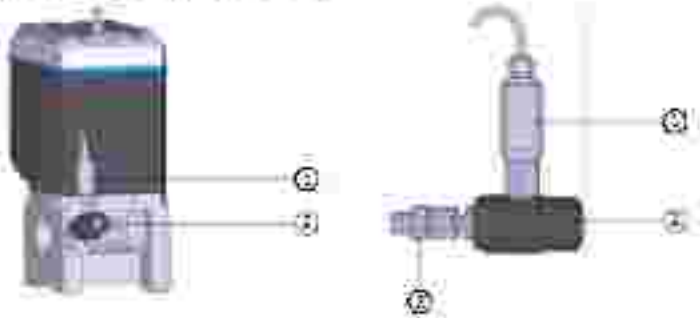
> For details on installation with test valve BD404, see manufacturer Operating Instructions.
> You will find the document available for download.

1. Remove the dummy plug on the pressure measuring port marked "P_m".
2. When the meter body has an NPT 1 ¼" thread, first screw in the adapter from NPT 1 ¼" to G 1 ¼" (Part No. 2075882).
3. Fit the test valve BD404.

Pay attention to the alignment of the connection for the pressure sensor.

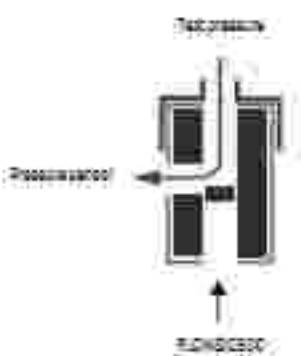
4. Fit the pressure sensor on the test valve EDA04 (→ Fig. 31).

Fig. 31: Test valve EDA04 with pressure sensor fitted



1: Pressure sensor, connection thread G 1/4"
2: Test valve EDA04
3: FLOW3000 connection (G 1/4" male thread)

Table 21: Test valve EDA04 positions

Measuring position	
Test position	

Variant 2: Installation with three-way test valve (to -40 °C)

Here, a conventional three-way test valve is used.

Install the three-way test valve with pressure sensor fitted at a suitable location next to the FLOWSIC600. A pressure line serves to connect the pressure measuring connection of the FLOWSIC600 to the three-way test valve.

Two variants of the pressure connection set with three-way test valve are available. The type code indicates which variant must be selected.

- Check type code, position 6 "pressure connection", on the type plate ↦ Fig. 1) of your FLOWSIC600.
- Select the connection set suitable for the pressure connection on the FLOWSIC600. ↦ p. 133, § 8.1.

"pressure connection" in type code:	Pressure connection
3	Pipe screw fitting pipe 1/4"
4	Pipe screw fitting pipe D6

- For the complete type code description, see ↦ p. 133, § 8.4.

Fig. 12 Pressure connection on FLOWSIC600

1. Fasten the three-way test valve at a suitable location.
1. Remove the dummy plug of the pressure measuring port marked "P_m".
2. When the meter body has an NPT 1/4" thread: first screw in the adapter from NPT 1/4" to G 1/4" (Part No. 2073960).
3. Screw in the pipe screw fitting for pipe 1/4" or pipe D6.
4. Install the pressure line between the FLOWSIC600 and the three-way test valve.
5. Fit the pressure sensor to the three-way test valve.

Fig. 13 Pressure sensor installation on the three-way test valve (-40 °C)

1 Pipe screw fitting 1/4" NPT or pipe D6
or pipe screw fitting 1/4" MPT or pipe 1/4"
2 Hand lever
3 Test connection (Schmalz coupling)
4 Pressure sensor connection thread G 1/4"

Table 21 Three-way ball valve positions

Measuring position	FLOWSIC600 → ← Test pressure
Test position	FLOWSIC600 → ← Test pressure
Closed position	FLOWSIC600 → ← Test pressure

Variant 3: Installation without a three-way test valve

Here, the pressure sensor is connected directly to the FLOWSIC600.

1. Remove the dummy plug on the pressure measuring port marked "P_{ab}".
2. Unless the meter body has an NPT 3/4" thread, first screw in the adapter (Part No. 2077 6882).
3. Fit the pressure sensor.

Fig. 54 Installation without three-way test valve

1 Pressure sensor, connection thread 3/4"

3.5.3 Installing the temperature sensor

NOTICE
Endress+Hauser recommends to install the temperature sensor on the temperature measuring port which is on the same side as the display.

NOTICE: Pay attention to the flow direction
The required length of the thermowell for meters with nominal diameter DN80 ... 2" depends on the flow direction.
Pay attention to the flow direction when selecting thermowell:
- 75 mm on the side of the adapter with flow direction left/right
- 125 mm on the side of the adapter with flow direction right/left

The temperature sensor can be greased with heat conducting oil or paste to improve its performance.

1. Insert the temperature sensor into the thermowell to the stop.
2. Tighten the coupnut.
3. Place the wire seal attached to a calibration inspector (→ Fig. 32).

Fig. 33 Installing the temperature sensor

1 Temperature sensor

3.4 Fitting a display protector (option)

Display protector (Part No. 2066547) is available as an option for protection of the display from UV light.

Fig. 26 Display protector

Tools required

- Allen keys SW 3 and 5
- Jaw wrench SW 6

EX	The Ex i terminal compartment of the FLOWSIC600 can be accessed after the electronics cover has been opened. The cover may also be opened in the hazardous area when under voltage. However, safe separation between the various intrinsically safe power circuits must not be breached.
1 Loosen and unscrew the two upper screws of the electronics cover with an Allen key SW 3.	
2 Instead, mount the delivered screws with a SW 6 jaw wrench.	

3. Mount the display cover with the pre-mounted screws (captive) using an Allen key SW 2.5.

FLOWSIC500

4 Commissioning

General information
Commissioning on the display
Commissioning with the FLOWgate™ operating software

4.1 General information

- All activities described in § 3 "Installation" must be completed before commissioning.
- Commissioning can be carried out directly on the device via the display → p. 70, § 4.2.
- The field setup wizard in the FLOWgate™ operating software supports an advanced commissioning → p. 73, § 4.3.

> **NOTICE: Measures in a metrologically secured area**
> If stipulated by national regulations, measures on the device in the metrologically secured area after commissioning may be carried out only under official supervision.
> - This must be coordinated with the authorities before carrying out the measures.
> - All measures must be carried out based on this manual.

4.2 Commissioning on the display

4.2.1 Commissioning sequence

4.2.1.1 Gas flow meter commissioning

FLOWSIC600 commissioning is normally performed in the following sequence:

- Log on as "Authorized user" (→ p. 69, § 3.2.7)
- Set the date and time (→ p. 71, § 4.2.3)
- Check the device status (→ p. 72, § 4.2.4)

4.2.1.2 Gas flow meter commissioning with device option volume conversion

- Log on as "Authorized user" (→ p. 69, § 3.2.7)
- Set the date and time (→ p. 71, § 4.2.3)
- Activate the configuration mode (→ p. 69, § 3.2.8)
- Set fixed values for pressure and temperature (→ p. 71, § 4.2.5.1)
- Set reference values (already configured – Table 4)
- Select the calculation method (already configured) (→ p. 81, § 4.2.5.4)
- Set the fixed value of the compressibility factor (→ p. 83, § 4.2.5.5)
- Check the configuration (→ p. 72, § 4.2.5.6)
- Configure the gas composition (→ p. 72, § 4.2.5.6)
- Adapt alarm limits for pressure and temperature (→ p. 84, § 4.2.5.6 and → p. 84, § 4.2.5.7)

> The alarm limits are set in the factory to the measuring range of the selected sensor.

- Terminate configuration mode (→ p. 69, § 3.2.8)
- Check the device status (→ p. 72, § 4.2.4)

4.2.2 Setting the date and time

Date and time must be set after the power supply has been connected. The FLOWSIC500 displays error 8.2007 ("Time invalid") until the time has been set.

Detailed information on operating using the display and on menu navigation → p. 33, § 5.2.

- The time zone function adapts the time to the new time zone.
  If you want to change date and time as well as the time zone, change the time zone first.
- Date and time can be changed without starting configuration mode.

1. Log on as "Authorized user" (→ p. 33, § 5.2.1).
2. Switch to the "System settings" submenu in the FLOWSIC500 menu.
3. Call up "Date".
4. Press ENTER to start the edit mode.
   The cursor now jumps under the first position of the date.
5. Use the arrow buttons to increment or decrement the selected position by 1 until the correct digit is shown.
6. Confirm with ENTER.
   The cursor now jumps under the second position of the date.
7. Repeat for the remaining positions of the date.
   The date is saved when you confirm the last position with ENTER.
8. Switch to "Time".
9. Use the arrow buttons to increment or decrement the first position of the time by 1 until the correct digit is shown.
10. Confirm with ENTER.
11. Repeat for the remaining positions of the time.
    The time is saved when you confirm the last position with ENTER.

4.2.3 Configuring volume conversion (device option)

4.2.3.1 Setting fixed values

The fixed values must be set to the average measurement conditions of pressure and temperature.

1. Log on as "Authorized user" (→ p. 33, § 5.2.1).
2. Start the configuration mode (→ p. 34).
3. In the FLOWSIC500 menu, switch to submenu "Pressure parameters" or "Temperature parameters".
4. Select the item "p Fixed value" or "T Fixed value".
5. Press ENTER to start the edit mode.
   The cursor now blinks under the first position of the parameter.
6. Use the arrow buttons to increment or decrement the selected position by 1 until the correct digit is shown.
7. Confirm with ENTER.
   The cursor now blinks under the second position of the parameter.
8. Repeat for all remaining positions of the parameter.
   The fixed value is saved when you confirm the last position with ENTER.

4.2.2.2 Checking the configuration

The FLOW-IDC600 is delivered already configured according to customer specifications.

It is recommended to check the custody-relevant parameters and settings. The custody-relevant parameters are shown in the delivered Parameter report and can be compared against the current configuration on the display.

A new Parameter report can be created using the FLOWgate™ operating software:

- Open the menu "Parameter change" in the FLOWgate™ operating software.
- Click "Create Parameter report". The report is generated.
- File the report with the device documentation.

4.2.2.3 Configuring the gas composition

1. Log on as "Authorized user" (→ p. 99, § 5.2.1).
2. Start the configuration mode (→ p. 99).
3. Switch to submenu "Conversion | Gas composition" in the FLOW-IDC600 menu.
4. Set the parameters to characterize the gas to be measured according to the selected K-number calculation method.

> **NOTICE!**
> Configuration of gas composition may only be changed once a day.
> More frequent changes may damage the internal parameter memory (EEPROM) and thus shorten the service life of the FLOW-IDC600.

Parameter changes of the gas composition are stored in the Gas composition logbook.
The Gas composition logbook can be viewed using the FLOWgate™ operating software menu "Logbook management" > "Gas composition logbook".

4.2.4 Checking the device status

Make sure the FLOW-IDC600 is in error-free operating status.

1. Log on as "Authorized user" (→ p. 99, § 5.2.1).
2. Check whether warnings or errors are shown in the symbol bar on the display.

⚠	The device has a warning. The FLOW-IDC600 is in "Warning" status.
✱	The device has an error. The FLOW-IDC600 is in "Malfunction" status.

3. If warnings or malfunctions exist, change to view "Current events" on the main display:
   - Clear existing malfunctions (→ p. 134, § 6.2, "Status messages").
   - Contact Endress+Hauser Customer Service for any malfunctions you cannot clear yourself (→ p. 104, § 5.1, "Contacting Customer Service").
4. The event overview can be reset when all warnings and errors have been cleared (→ p. 105, § 5.2.13).

4.3 Commissioning with the FLOWgate™ operating software

4.3.1 Connect to the device

A data connection can be established with the device using the optical data interface and the infrared USB adapter IrIS-04 (Part no. 6053602).
This interface serves to configure the FLOWSIC600. The infrared USB adapter has a USB 2.0 interface. This interface provides the connection to the PC and transfers the FLOWSIC600 data.

> A device driver software must first be installed to operate the adapter on a PC. The device driver software is available for download.

1. Install the device driver software before connecting the USB plug to the PC.
2. Connect the USB plug to the PC.
3. Fit the infrared USB adapter to the infrared interface as shown (→ Fig. 27), a magnet integrated in the reading head retains the adapter.

Fig. 27 Alignment of the infrared adapter

Correct alignment

Wrong alignment

4. Install the FLOWgate™ operating software.
The FLOWgate™ operating software and the associated manual are also available on the manufacturer website.
5. Press any button on the display to activate the optical data interface on the FLOWSIC600.
When a connection has been established with the infrared USB adapter, the optical data interface on the FLOWSIC600 remains active until the infrared USB adapter is removed.
6. The display and the optical interface remain active during the connection.
7. Click on the FLOWgate™ icon to start FLOWgate™.

8. Add the FLOWSIC600 to the Device Manager of the FLOWgate™ operating software and create a connection to the device.
9. Login as "Authorized User" on the device.

> Standard password for "Authorized User": 0003

10. Start the field setup wizard and follow the step-by-step instructions.

4.3.1 Field setup wizard

NOTICE
Configuration mode must be active to change parameters.
▶ Click on the symbol in the toolbar to activate configuration mode.

4.3.2.1 Device identification

▶ Check the device serial number and type code. Compare the entries against the type plate.
▶ Enter a device name. The device name is freely selectable.

4.3.2.2 System/ User

Date and time

▶ Enter the date and time or synchronize with the PC.

After completing commissioning, the daylight saving time settings can be activated and configured, see → ⌂ 78, § 4.3.3.

User management

NOTICE
Endress+Hauser recommends changing the initial password provided for the "Authorized User" for security reasons.

Further users can be activated here when desired.

▶ Activate the associated checkbox of the desired user.
▶ Specify a password. The password must comprise 4 digits.
Up to three users and three authorized users can be activated. "Authorized User 1" and "User 1" are always activated.
For access rights for single user levels, see → ⌂ 22, § 2.3.3.

Fig. 32 Example

4.2.2.3 Warnings

The "Warnings" area serves to set the limit values outside of which the FLOWSIC500 is to output warnings (flow rate) or errors (pressure and temperature).

Limit values can be set for:

- Flow rate
- Pressure
- Temperature
- Reverse flow volume (buffer volume)
- Limit value for low flow rate (zero-flow cutoff)

In addition, the warnings signaled by the device can be individually activated or deactivated in the "User warnings activation" area.

The Gas Quality indicator allows the gas quality to be monitored in real time. By clicking on "Set reference point" the reference point is set automatically based on the current measured values. The permissible deviation in percent can be configured. If the limit value is exceeded or falls below, the FLOWSIC500 generates a warning. Setting the reference point requires that gas of typical quality flows through the FLOWSIC500. If this is not given during commissioning the reference point can be set afterwards in the menu "Parameter modification, Warnings".

5.0.56 Gas Quality Indicator

4.2.2.4 Communication

- The configuration of the single plug-in connectors is preset according to the configuration ordered. Check the configuration and adapt when necessary.
- For pulse outputs, the maximum frequency and the minimum pulse width must be set during commissioning.
- The status outputs are configured as standard so that status "Measurement invalid" is output. Selecting status "Measurement valid" shortens the battery service life considerably because the output is then permanently activated.

Plug 2: Encoded

- Configuration as status or pulse output possible. Select the desired configuration.
- Enter the maximum frequency and minimum pulse width in the "Pulse 2" area when configuring as a pulse output.

When configured as a pulse output, make sure the overload frequency at ≥20% Q_{max} is observed and the connected device understands the frequency.

The following conditions must be satisfied:

- The "Maximum frequency" must be set to a value higher or equal to the "Frequency at Q_{max}".
- The "Minimum pulse width" must be set to a value lower or equal to 1/(2 x "Frequency at Q_{max}").

Example
Frequency at Qr = 382 Hz
Maximum frequency:
Set "Maximum frequency" to a value ≥ 382 Hz.
Recommendation: Round up to 400 Hz.

Minimum pulse width:
1 Hz corresponds to 1000 ms
382 Hz corresponds to 2.6 ms
1/2 x "Frequency at Qr" = 1.3 ms
Set "Minimum pulse width" to an integer value< 1.3 ms.
Recommendation: set 1 ms.

Fig. 42 Pulse settings example

Plug 3: R-coded
- Configuration as analog or pulse output possible. Select the desired configuration.
- Enter the maximum frequency and minimum pulse width in the "Pulse 2" area when configuring as a pulse output.
  For configuration, see Section "Plug 3: R-coded".

Communication tests
- Pulse output
  - Enter the desired test frequency.
  - Push the slider to "On" to start the test. The test frequency is output on all pulse outputs.

Fig. 43 Pulse output test

- Flow rate
  - Enter the desired test flow rate and start the test.
- Digital output
  - Select the desired digital output.
  - Push the slider to "On".

4.2.2.3 Volume correction (only for device option volume corrector)

For a detailed description of the single parameters see the FLOWSIC500 menu description, p. 85, 5.6.2.3.6.

- Determine the reference values
- Enter the specifications for gas characteristics
- Select the algorithm and parameters for calculating the compressibility factor
- Enter fixed values

4.2.2.6 Totalizers

Totalizers

- Setting or resetting the totalizer levels
- Determine the limits for the reverse flow volume

Meter settings

- Configure the significant digits for the meters:

  All meters have up to 9 significant digits, without sign. The number of significant digits can be varied between 6 to 9.
- Determine the resolution for the meters:

  The totalizer resolution can be set in the range 0.001 to 100 in increments of factor 10 for the volume at flowing conditions and the volume at base conditions of the meter. It is therefore necessary to multiply the totalizer level with the corresponding totalizer resolution to interpret the totalizer level.

> **NOTICE**
> The totalizer levels are stored in the unit system set in the device. The unit and resolution are stored in the data records so that the logbooks remain consistent when these settings are changed and need not be reset.
> All totalizer levels are deleted when the unit or totalizer resolution are changed.

4.2.2.7 Completion

- If desired, empty the logbooks and archive:
  - Activate the checkbox of the logbooks or archive to be emptied
  - Click "Clear selected".
- Check the collection status. If desired, reset the Event overview.
- Create a Parameter report:
  - Click "Create Parameter report". The report is generated.
  - File the report with the device documentation.

4.2.2 Activate and configure the daylight saving time

> **Notice**
> If the optional feature "Load recording device with maximum load display" feature is activated, the periods for daylight saving time are preset at the factory for 10 years.
> The periods for daylight saving time must be updated before the preset times expire. This is the responsibility of the plant operator.
> To ensure that the archive entries are displayed correctly, the last two years must be retained when updating.

1. Open the file "System_User" in the "Parameter Modification" area.
2. Activate Configuration mode.
3. Activate the daylight saving time.

Fig. 42: Activating the daylight saving time settings

4. Click ↵ to enter a new time period for daylight saving time.
5. Use the arrow buttons to set the start of the daylight saving time.
   The FLOWgate™ operating software always increases or reduces the position you clicked beforehand, e.g. the month is increased when the month is clicked. The year is increased when the year is clicked. The FLOWgate™ operating software increases the day by 1 when the text box is not clicked.
   The data can also be entered using the keyboard.

Fig. 43: Setting the time period for the daylight saving time

6. Then set the end of the daylight saving time.
7. Click "Write to device" to write the daylight saving time to the FLOWSIC600.
8. Enter further time periods when desired. Daylight saving time start and end can be configured for up to 10 years in advance.

4.5.4 Configure the power management

Select the type of power supply corresponding to the configuration of the FLOWSIC500:

- Dynamic Mode (External + Backup):
  Measuring rate: 4 Hz
- Battery Mode (2 x Battery):
  Measuring rate: 1 Hz, to maximize the battery service life
- Eco Mode (External + Backup):
  Standard setting: Measuring rate is 4 Hz when the external voltage supply is available. The measuring rate is set automatically to 1 Hz if the external voltage supply fails in order to maximize the backup battery service life.

Fig. 44 Power management

4.2.3 Function check after commissioning

- Check the device status.

Table 22: Signaling the device status in FLOWgate™

Status	Description
	Normal operation, neither warnings nor errors exist
	Device status warning: At least one warning is pending in the device, the measured value is still valid
	Device status error: At least one error is pending in the device, the measured value is invalid

- Click on the symbol in the Status bar when warnings or errors exist.

  The current Status overview opens and shows details and information on how to proceed.

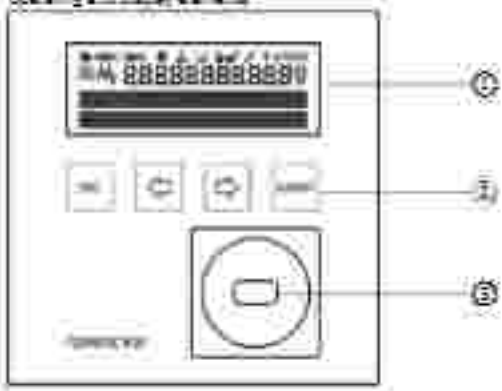
FLOWSIC500

5 Operation

Control unit
Operating using the display

5.1 Control unit

Fig. 45 Operating and display elements



1 Display
2 Buttons
3 Optical data interface

5.2 Operating using the display

- Press any button to switch the display on.

In battery operation, the display and the optical data interface have a timeout and switch off after approx. 60 seconds (default setting) when no button has been pressed and no data transmission takes place.
The display and the optical interface are permanently active when an external power supply is connected.

Table 23 Buttons

	In menu	In Edit mode
Esc	Returns to next higher level of the operator menu	Aborts input of new value and returns to the next higher level of the operator menu.
⇦ a)	Toggles between single menu entries on one level	Increments or decrements a parameter by 1, toggles between several selection options
ENTER	Calls a submenu, starts edit mode.	Confirms an input

9.2.1 Display in the symbol bar

Table 24 Symbols

Symbol	Significance	Description
	External power supply	ON: Displayed when the device is configured with external power supply
	Battery fill level, battery 1	Displayed when the FLOWSIC500 is configured for battery operation: Status of the first battery pack Details on the battery fill level → p. 83, § 9.2.2.
	Battery fill level, battery 2	With external power supply: Backup battery status With battery operation: Second battery pack status Details on the battery fill level → p. 83, § 9.2.2.
	Device status: Malfunction	The device has an error, the measured value is invalid.
	Device status: Warning	The device has a warning, the measured value is still valid.
	Registered events	Events have occurred since the last event summary reset.
	Parameter locking switch closed	Metrologically relevant parameters are protected against changing; modifications are registered in the Metrology logbook → p. 84, § 9.3.3.
	Parameter locking switch open	Metrologically relevant parameters can be changed; the modifications are not saved in the Metrology logbook.
	Configuration mode	Device parameters can be changed.

NOTICE
If device status "malfunction" or "warning", the respective symbols are shown blinking on the display.

9.2.2 Battery fill level display

The battery symbol changes as the battery is discharged.

Table 25 Battery fill level display

	Battery fill level > 75%
	Battery fill level > 50%
	Battery fill level > 25%
	Battery fill level > 25%
	Battery almost empty but still in use

- The last segment of the battery symbol starts to blink when the battery fill level drops below 10%.
- When the battery is completely empty, the empty battery symbol blinks and the FLOWSIC500 has switched to the second battery.

5.2.2 Main screen (without device option volume conversion)

- Use buttons ⇦ and ⇨ to toggle between the menu entries on a level.
- Press ENTER to go down one menu level.

Main display

The following information is displayed on the top display menu level:

Main display	Description
V 888888888 m³ 20.08.2021 10:30:52	V = volume actuals, cannot be reset
↦ Pressing ENTER opens the FLOWSIC500 menu.	
error 888888888 m³ 20.08.2021 10:30:52	*V = Error volume. Volume counted during a malfunction, can be reset.
↦ Pressing ENTER opens the action "Reset error volume". → "Resetting the error volume" (p. 100)	
Q 8.888 m3/h VOS 8.888 m/s	Q = Volume flow VOS = Gas velocity
Current event(s) event is reported	Current event(s) event is reported
↦ Pressing ENTER opens a list of current reported events. Use the arrow buttons to toggle through the reported events.	
Event Summary 2 Events	Stored status messages: Events since the last time the event summary was reset (2 events have occurred).
↦ Pressing ENTER opens a list of stored events. Use the arrow buttons to toggle through the stored events.	
Last Event Reset 20.08.2021 10:30:52	Last reset of event summary
↦ Pressing ENTER opens the action "Reset Event Summary". → "Resetting the event summary" (p. 100)	

NOTICE

A parameter with malfunction status is shown on the display by a blinking exclamation mark after the parameter (e. g. 0!).

Menu navigation (without device option volume conversion)

Some menu functions are only available when you are logged in with user level "User" or "Authorized User".

User level	G	Guest (standard)	U	User (1) User (2) User (3)	AU	Authorized user (1) Authorized user (2) Authorized user (3)	
Access rights	–	Hidden	◉	View	●	Read/write	

Path	G	U	AU1-3	AU	Explanation
Main display: Volume under measurement conditions V	◉	◉	◉	◉	
FLOWSIC500 menu: User	◉	◉	◉	◉	
Logged in user level	●	●	●	●	→ p. 80, §5.2.4.1
Login	●	●	●	●	
Logout	–	●	●	●	
FLOWSIC500 menu: Device mode	◉	◉	◉	◉	→ p. 81, §5.2.4.2
Calibration mode	◉	◉	●	●	
Comparison mode	◉	◉	●	●	
FLOWSIC500 menu: Device information	◉	◉	◉	◉	→ p. 81, §5.2.4.3
Measuring point	◉	◉	◉	◉	
Serial number	◉	◉	◉	◉	
Firmware version	◉	◉	◉	◉	
Firmware Date	◉	◉	◉	◉	
Firmware CRC	◉	◉	◉	◉	
Metrology CRC	◉	◉	◉	◉	
Min. oper. pressure	◉	◉	◉	◉	
Max. oper. pressure	◉	◉	◉	◉	
Meter factor	◉	◉	◉	◉	
Frequency at Qmax [Hz]	◉	◉	◉	◉	
Meter factor 2	◉	◉	◉	◉	
FLOWSIC500 menu: System settings	◉	◉	◉	◉	→ p. 83, §5.2.4.4
Power supply (1) [%]	◉	◉	●	●	
Power supply (2) [%]	◉	◉	●	●	
Date	◉	◉	●	●	
Time	◉	◉	●	●	
Timezone	◉	◉	●	●	
Language	◉	●	●	●	
Symbols	◉	◉	◉	◉	
LCD test	◉	●	●	●	
FLOWSIC500 menu: Logbooks	◉	◉	◉	◉	
Event logbook	◉	◉	◉	◉	
List of stored events	–	◉	◉	◉	
Parameter logbook	◉	◉	◉	◉	
Metrology logbook	◉	◉	◉	◉	
Main display: Error Warnings [illegible]	◉	◉	●	●	
Main display: Volume flow under measurement conditions / gas velocity	◉	◉	◉	◉	
Main display: Current Events	◉	◉	◉	◉	
List of current events	◉	◉	◉	◉	
Main display: Event Summary	◉	◉	◉	◉	
List of stored events	◉	◉	◉	◉	
Main display: Last Event Reset	◉	◉	●	●	→ p. 108, §5.3.12

5.2.4 Main display (with device option volume conversion)

- Use buttons ⇦ and ⇨ to toggle between the menu entries on a level.

Press ENTER to go down one menu level.

> The symbols on the display are shown as examples in accordance with EN 12405.
> Symbols with regional deviations can be configured.
> These Operating Instructions use symbols in accordance with EN 12405.

Main display (with device option volume conversion)

The following information is displayed on the top display menu level:

Main display	Description
V_b 00000000 m³ 26.08.2021 10:30:52	V_b = Volume at base conditions, uninterrupted
↦ Pressing ENTER opens the FLOWSIC500 menu.	
$error_b$ 00000000 m³ 26.08.2021 10:30:52	$error_b$ = Error volume at base conditions
↦ Pressing ENTER opens the action "Reset error volume". ↦ Pulsating the error volume (s. 100).	
$total_b$ 00000000 m³ 26.08.2021 10:30:52	$total_b$ = Total volume at base conditions = V_b + $error_b$
V_m 00000000 m³ 26.08.2021 10:30:52	V_m = Total volume at measurement conditions
$error_m$ 00000000 m³ 26.08.2021 10:30:52	$error_m$ = Error volume Volume counted at measurement conditions during a malfunction, can be reset
Q_m 0.000 m³/h Q_b 0.000 m³/h	Q_m = Volume flow at measurement conditions Q_b = Volume flow at base conditions
SOS 430.00 m/s VOS 0.000 m/s	SOS = Sound velocity currently measured VOS = Gas velocity currently measured

User menu	Description
p 1.532 bar T 25.42 °C	p = Pressure currently used for volume conversion T = Temperature currently used for volume conversion
C 25.7368 K 1.0581	C = Conversion factor K = Compressibility factor
Z 0.99830 Zb 0.99812	Z = Compression factor at measurement conditions currently used for volume conversion Zb = Compression factor at base conditions currently used for volume conversion
Current events 1 Event	Current events (1 event is reported)
└ Pressing ENTER opens a list of current reported events. Use the arrow buttons to toggle through the reported events.	
Event memory 2 Events	Stored status messages. Events since the last time the event summary was read (2 events have occurred).
└ Pressing ENTER opens a list of stored events. Use the arrow buttons to toggle through the stored events.	
Last Event Event 27.08.2021 10:38:53	Last read of event summary
└ Pressing ENTER opens the action "Read Event Summary". → "Reading the event summary" (▷ 100)	

NOTICE

A parameter with Malfunction status is shown on the display by a blinking exclamation mark after the parameter (e. g. Qv).

Menu navigation (with device option volume conversion)

Some menu functions are only available when you are logged in with user level "User" or "Authorized User".

User level	G Guest (password)	U User 1 User 2 User 3	A1 Authorized user 1 A2 Authorized user 2 A3 Authorized user 3
Access rights	– Hidden	○ Read	● Can edit

Path	[illegible]	[illegible]	[illegible]	[illegible]	Explanation
Main display: Base volume Vb	○	○	○	○	
FLOWSIC500 menu: User	○	○	○	○	→ p. 90, §5.2.6.1
Logged-in user level	●	●	●	●	
Login	●	●	●	●	
Logout	–	●	●	●	
FLOWSIC500 menu: Device mode	○	○	○	○	→ p. 91, §5.2.6.2
Calibration mode	○	○	●	●	
Configuration mode	○	○	●	●	
FLOWSIC500 menu: Device information	○	○	○	○	p. 92, §5.2.6.3
Measuring point	○	○	○	○	
Serial number	○	○	○	○	
Firmware version	○	○	○	○	
Firmware date	○	○	○	○	
Firmware CRC	○	○	○	○	
Metrology CRC	○	○	○	○	
Min. oper. pressure	○	○	○	○	
Max. oper. pressure	○	○	○	○	
Meter factor	○	○	○	○	
Frequency at Q	○	○	○	○	
Meter factor 2	○	○	○	○	
FLOWSIC500 menu: System settings	○	○	○	○	→ p. 92, §5.2.6.4
Power supply 1	○	○	●	●	
Power supply 2	○	○	●	●	
Date	○	○	●	●	
Time	○	○	●	●	
Timezone	○	○	●	●	
Language	○	●	●	●	
Summer time	○	○	○	○	
LCD test	○	●	●	●	
FLOWSIC500 menu: Parameter	○	○	○	○	→ p. 93, §5.2.6.5
Conversion: Reference	○	○	○	○	
Base pressure	○	○	●	●	
Base temperature	○	○	●	●	
Ref. conditions	○	○	●	●	
Atmospheric pressure	○	○	●	●	
Conversion: Calculation	○	○	○	○	
Calc. method	○	○	●	●	
Calc. interval	○	○	●	●	
K-factor fixed	○	○	●	●	
Conversion: Gas composition	○	○	○	○	
Density entry type	○	○	●	●	
Reference density	○	○	●	●	
Relative density	○	○	●	●	
CO_2 [mol%]	○	○	●	●	
N_2 [mol%]	○	○	●	●	
H_2 [mol%]	○	○	●	●	
Heating value	○	○	●	●	
Heating value unit	○	○	●	●	
FLOWSIC500 menu: Integrity parameters	○	○	○	○	→ p. 94, §5.2.6.6

Path	[illegible]	[illegible]	[illegible]	[illegible]	Explanation
p Sensor type	○	○	○	○	
p Sensor serial number	○	○	○	○	
p Lower alarm limit	○	○	●	●	
p Upper alarm limit	○	○	●	●	
p Default value	○	○	●	●	
p Unit	○	○	●	●	
p Adjust offset	○	○	●	●	
p Adjust factor	○	○	●	●	
FLOWSIC500 menu: Temperature parameters	○	○	○	○	→ p. 94, §5.2.8.7
T Sensor type	○	○	○	○	
T Sensor serial number	○	○	○	○	
T Lower alarm limit	○	○	●	●	
T Upper alarm limit	○	○	●	●	
T Default value	○	○	●	●	
T Unit	○	○	●	●	
T Adjust offset	○	○	●	●	
T Adjust factor	○	○	●	●	
FLOWSIC500 menu: Logbooks	○	○	○	○	
Event logbook	○	○	○	○	
List of stored events	○	○	○	○	
Parameter logbook	○	○	○	○	
Metrology logbook	○	○	○	○	
Gas composition logbook	○	○	○	○	
FLOWSIC500 menu: Archives	○	○	○	○	→ p. 95, §5.3.2.8
Configuration	○	○	○	○	
Day start	○	○	●	●	
Day end	○	○	●	●	
Measuring period	○	○	●	●	
Measuring period archive	○	○	○	○	
List of stored entries	○	○	○	○	
Daily archive	○	○	○	○	
List of stored entries	○	○	○	○	
Monthly archive	○	○	○	○	
List of stored entries	○	○	○	○	
FLOWSIC500 menu: Maximum load	○	○	○	○	→ p. 98, §5.2.8.10
Current periods	○	○	○	○	
List of identified data	○	○	○	○	
Previous periods	○	○	○	○	
List of identified data	○	○	○	○	
Main display: m³/h	○	○	●	●	→ p. 100, §5.2.11
Main display: Totalizers	○	○	○	○	
Main display: [illegible]	○	○	○	○	
Main display: m³/h	○	○	○	○	
Main display: Q/Qb	○	○	○	○	
Main display: SOS/VOG	○	○	○	○	
Main display: p, T	○	○	○	○	
Main display: C-factor	○	○	○	○	
Main display: Z, Zb	○	○	○	○	
Main display: Current Events	○	○	○	○	
List of current events	○	○	○	○	
Main display: Event Summary	○	○	○	○	
List of stored events	○	○	○	○	
Main display: Last Event Reset	○	○	●	●	→ p. 105, §5.2.12

5.2.5 Configuration of main display

The configuration of the main display can be performed using the FLOWgate™ operating software.

The following contents are available:

- Empty (line 1 - set at the factory)
- Date, time (line 2 - set at the factory)
- Pressure p
- Temperature T
- Conversion factor C
- Compressibility factor K
- Operational flow rate Q
- Flow rate Qb relative to the base conditions
- VOS
- SOS

Configuring:

1. Connect to device → p. 73, § 4.3.1.
2. Open the tile "System, user" in the "Parameter modification" area.
3. Start the configuration mode.
4. Select the desired parameters in the selection boxes "Contents display line" and "Contents bottom display line".
5. Click "Write to device".
   The parameters are written to the device and the display contents adjusted to match the selection.
6. Return to the operating mode.

5.2.6 FLOWSICS00 menu

5.2.6.1 User

User	Logged in user level, without login: Guest → "Changing the user level" (p. 99) Logged in as: • User (1) • User (2) * • User (3) * • Authorized user (1) • Authorized user (2) * • Authorized user (3) * * when activated

8.2.8.2 Device modes

Calibration mode	Display whether calibration mode for the flow platform is activated or off; start and end calibration mode In calibration mode, message "CALIBRATION MODE" shows on the main display. All the meter factor has effect for the calibration test of the factory. The FLOWSIC500 outputs test pulses in the maximum possible frequency of 2 kHz at 20% Q_{max} on digital switching output DO_1 (→ p. 51, § 5.4.5.1). For flow rate check and calibration, see document "8123000: Calibration Instructions for the Ultrasonic Gas Flow Meter FLOWSIC500"
Configuration mode	Display whether configuration mode is activated on or off. Starting and terminating configuration mode. → "Start configuration mode" (p. 66)

8.2.8.3 Device information

Measuring path	Measuring path identifier
Serial number	Device serial number
Firmware version	Firmware version installed on the device
Firmware Date	Firmware release date
Firmware CRC	Firmware check sum
Hardware CRC	Check sum of metrologically relevant parameters
Min. oper. pressure	Minimum absolute pressure
Max. oper. pressure	Maximum absolute pressure
Meter factor	Pulse (electr. isolated) relation between frequency and flow rate [imp/m³]
Frequency at Q	Frequency for overload flow rate Q_s = 1.2 Q_{max}
Meter factor 2	Pulse (electr. isolated) relation between frequency and flow rate [imp/m³] for second pulse output (for meter tube configuration I, 2 x HF pulse)

8.2.8.4 System settings

Power supply (1)	• For battery operation: – Fit seal for battery pack 1 [fit] – Confirm battery exchange for battery pack 1 → "Confirming battery replacement" (p. 101) • With external power supply: – Display: 100% → "Checking the external power supply" (p. 101)
Power supply (2)	• For battery operation: – Fit seal for battery pack 2 [fit] – Confirm battery exchange for battery pack 2 • With external power supply: – Fit seal for backup battery – Confirm battery exchange for backup battery → "Confirming battery replacement" (p. 101)
Date	Device date → "Commissioning on the display" (p. 70)
Time	Device time → "Commissioning on the display" (p. 70)
Timezone	Time zone set on device
Language	Language for displays Available: English, German, Russian → "Setting the language" (p. 69)

Symbols according to	Symbols for the measuring screens; the setting can be changed with the FLOWgate™ operating software.

Gas flow meter

	EN12405	PTB	GOST	API
Volume total	V	V	V	Vf
Error volume	eVc	eVc	eVy	eVg
Flow rate	Q	Q	Q	Qf
Velocity of gas	VOG	VOG	VOG	VOG
Speed of sound	SOS	SOS	SOS	SOS

Gas flow meter with volume conversion

	EN12405	PTB	GOST	API
Volume (measurement) total	Vm	Vp	V	Vf
Error volume (measurement)	eVm	eVp	eV	eVf
Volume (base) without interruption	Vb	Vn	Vc	Vb
Error volume (base)	eVb	eVn	eVc	eVb
Volume (base) total	[illegible]	[illegible]	[illegible]	[illegible]
Flow rate (measurement)	Q	Q	Q	Qf
Flow rate (base)	Qb	Qn	Qc	Qb
Pressure (measurement)	p	p	P	Pf
Pressure (base)	Pb	Pn	Pc	Pb
Temperature (measurement)	T	T	T	Tf
Temperature (base)	Tb	Tn	Tc	Tb
Velocity of gas	VOG	VOG	VOG	VOG
Speed of sound	SOS	SOS	SOS	SOS
Compressibility	K	K	K	K
Conversion factor	C	C	C	C
Compression factor (measurement)	Z	z	Z	Zf
Compression factor (base)	Zb	Zn	Zc	Zb

LCD test	Display test → "Testing the display" (p. 101)

6.2.6.3 Conversion (only for device types with volume conversion)

References

Base pressure	Base pressure (unit acc. to display)
Base temperature	Base temperature (unit acc. to display)
Ref. conditions	Reference conditions for density and heating value Display: T1, T2, p2 T1 = Reference temperature, heating value T2 = Reference temperature, str. density / reference density p2 = Reference pressure, str. density / reference density

	T1	T2	p2
Set 1	25 °C	0 °C	1.01325 bar(a)
Set 2	0 °C	0 °C	1.01325 bar(a)
Set 3	15 °C	15 °C	1.01325 bar(a)
Set 4	60 °F	60 °F	14.7347 psi(a)
Set 5	60 °F	60 °F	14.7300 psi(a)
Set 6	25 °C	25 °C	1.01325 bar(a)

Atmospheric pressure	Ambient pressure (unit acc. to display) must be set for device with absolute pressure sensor

Calculation

Calculation method	Calculation method for the compressibility factor Select from: • Standard • AGA 8 Gross method 1 • AGA 8 Gross method 2 • AGA NX-19 • AGA NX-19 mod. • AGA NX-19 mod. 1997 • GERG91 mod. • AGA8-S04 • Fixed value
Calculation interval	Cycle time for updating measured values (pressure, temperature), calculation of the compressibility factor Select from: 3 s, 10 s, 20 s, 30 s, 60 s
F-factor (fixed)	Entry of fix factor for method "Fixed value" when the calculation of the F-factor is inactive.

Gas composition (only for device option volume conversion)

Density entry type	Select from: Reference density, real m.s. density Either menu item "Reference density" or menu item "Relative density" is displayed depending on the selection.
Reference density	Gas reference density under reference conditions
Relative density	Relative density, relation between gas density and air density under reference conditions
CO2	CO_2 - proportion in gas [mol%]
N2	N_2 - proportion in gas [mol%]
H2	H_2 - proportion in gas [mol%]

Heating value	Gas heating value reference conditions
Heating value unit	Heating value unit Select from: Default, kJ/m³, kWh/m³, BTU, ft³ Default = Standard setting according to selected unit system (SI or US) configured in accordance with the order

The calculation method selected determines the parameters entry, namely the gas proportions as well as pressure and temperature.

5.2.6.6 Pressure parameters (only for device option volume correction)

p Sensor type	Display of configured pressure sensor
p Sensor serial number	Pressure sensor serial number predefined by the device preset
p Lower alarm limit	Lower alarm limit for pressure sensor
p Upper alarm limit	Upper alarm limit for pressure sensor
p Default value	Fixed value for measurement pressure (unit acc. to display) This entry value is used as fixed value for configuration as fix conversion and for pressure measurement malfunctions.
p Unit	Unit for pressure values used for entry and display Select from: Default, bar, psia, kPa, hPa, kgf/cm², psig Default = Standard setting according to selected unit system (SI or Imperial), configured in accordance with the order
p Adjust offset	Calibration offset for pressure sensor (unit acc. to display)
p Adjust factor	Calibration factor for pressure sensor

5.2.6.7 Temperature parameters (only for device option volume conversion)

T Sensor type	Display of configured temperature sensor
T Sensor serial number	Temperature sensor serial number expected by the device preset
T Lower alarm limit	Lower alarm limit for temperature sensor
T Upper alarm limit	Upper alarm limit for temperature sensor
T Default value	Fixed value for measurement temperature (unit acc. to display) This entry value is used as fixed value for malfunctions of temperature measurement.
T Unit	Unit for temperature values used for entry and display Select from: Default, °C, °F, K, °R Default = Standard setting according to selected unit system (SI or Imperial), configured in accordance with the order
T Adjust offset	Calibration offset for temperature sensor (unit acc. to display)
T Adjust factor	Calibration factor for temperature sensor

5.2.6.8 Logbooks

Event logbook	Number of entries currently stored / max. number Pressing ENTER opens the detailed view. The detailed view shows the event type, a short text and the timestamp.
Parameter logbook	Number of entries currently stored / max. number
Malfunction logbook	Number of entries currently stored / max. number
Gas composition logbook	Number of entries currently stored / max. number

6.2.6.3 Archives (only for device option volume conversion)

Configuration

Day hour	Billing hour for the day archive Entry range: 00:00 ... 23:59 Default: 06:00
Day bill	Billing day for month archive Measuring range: 1 ... 28 Default: 1
Measuring period	Defines the period for the billing archive Select from: 3 min, 5 min, 15 min, 30 min, 60 min Default: 60 min

Measuring period archive

List of entries 0 ... 8000	Entry #: Entry index, timestamp Checksum status OK or invalid
Date/Time	Entry timestamp To start the action of the search function, press ENTER.
Entry ID	Entry ID. Identical to the ID in FLOWgate archive. To start the action of the search function, press ENTER.
Entry status	Status as a hex value and verbal "valid/invalid".
Device status	Cumulative system status at the time of the end of the measuring period.
VbMP	Volume at base conditions V_b counter reading To start the action of the search function, press ENTER.
VbMPΔ	V_b counter progress of the measuring period
VbErrMP	Error volume at base conditions eV_b
VbErrMPΔ	eV_b counter progress of the measuring period
VmMP	Volume at measurement conditions V_m counter reading
VmMPΔ	V_m counter progress of the measuring period
VmErrMP	Error volume at measurement conditions eV_m counter reading
VmErrMPΔ	eV_m counter progress of the measuring period
QbMP ↑	Maximum flow rate at base conditions during measuring period
QMP ↑	Maximum flow rate at measurement conditions during measuring period
pMP ↑ pMP ↓	Maximum and minimum pressure during measuring period
pMPØ TMPØ	Average pressure and temperature (flow-weighted)
KMPØ CMPØ	Average compressibility and conversion factor (flow-weighted)
SOSMPØ FlowTime	Average speed of sound Flow time time with Q > LowFlowCutOff

Daily archive

List of entries (0 ... 800)	Entry: Entry index, timestamp Checksum status OK or invalid
Date/Time	Entry timestamp To start the editor of the search function, press ENTER.
Entry ID	Entry ID, identical to the ID in FLOWgate memory To start the editor of the search function, press ENTER.
Entry status	Status as a hex value and words "valid, invalid"
Device status	Cumulative system status at the time of the end of the day
V_b(t)	Volume at base conditions V_b counter reading To start the editor of the search function, press ENTER.
V_b(t)-Δ	V_b counter progress of the day (t)
εV_b(t)	Error volume at base conditions εV_b
εV_b(t)-Δ	εV_b counter progress of the day
V_m(t)	Volume at measurement conditions V_m counter reading
V_m(t)-Δ	V_m counter progress of the day
εV_m(t)	Error volume at measurement conditions εV_m counter reading
εV_m(t)-Δ	εV_m counter progress of the day
Q_b(t) ↑	Maximum flow rate at base conditions during day
Q_b(t) ↑ Date/Time	Timestamp of maximum flow rate at base conditions during day
Q_b(t) ↓	Minimum flow rate at base conditions during day
Q_b(t) ↓ Date/Time	Timestamp of minimum flow rate at base conditions during day
Q_m(t) ↑	Maximum flow rate at measurement conditions during day
Q_m(t) ↑ Date/Time	Timestamp of maximum flow rate at measurement conditions during day
Q_m(t) ↓	Minimum flow rate at measurement conditions during day
Q_m(t) ↓ Date/Time	Timestamp of minimum flow rate at measurement conditions during day
p_b(t) ↑	Maximum pressure during day
p_b(t) ↑ Date/Time	Timestamp of maximum pressure during day
p_b(t) ↓	Minimum pressure during day
p_b(t) ↓ Date/Time	Timestamp of minimum pressure during day
p_b(t)	Average pressure during day (flow-weighted)
T_b(t)	Average temperature during day
T_b(t) ↑	Maximum temperature during day
T_b(t) ↑ Date/Time	Timestamp of maximum temperature during day
T_b(t) ↓	Minimum temperature during day
T_b(t) ↓ Date/Time	Timestamp of minimum temperature during day
K_b(t) Z_b(t)	Average compressibility and correction factor (flow-weighted) during day
v_{sound}(t)	Average speed of sound during day

Monthly archive

List of entries [0...25]	Entry nr. Entry index, timestamp Checksum status OK or invalid
Date/Time	Entry timestamp To start the action of the search function, press ENTER.
Entry ID	Entry ID, identical to the ID in FLOWgate Archive To start the action of the search function, press ENTER.
Entry status	Status as a hex value and status "valid/invalid"
Device status	Cumulative system status at the time of the end of the month
VbMo	Volume at base conditions V_b counter reading To start the action of the search function, press ENTER.
VbMoΔ	V_b counter progress per month (Δ)
VbMP↑	Maximum progress of V_b per measuring period
VbMP↑ Date/Time	Timestamp of maximum progress of V_b per measuring period during month
VbDy↑	Maximum progress of V_b per day during month
VbDy↑ Date/Time	Timestamp of maximum progress of V_b per day during month
VbErrMo	Error volume at base conditions $**V_b$
VbErrMoΔ	$**V_b$ counter progress of the month
VmMo	Volume at measurement conditions V_m counter reading
VmMoΔ	V_m counter progress of the month
VmMP↑	Maximum progress of V_m in a measuring period of the month
VmMP↑ Date/Time	Timestamp of maximum progress of V_m in a measuring period of the month
VmDy↑	Maximum progress of V_m in a day of the month
VmDy↑ Date/Time	Timestamp of maximum progress of V_m in a day of the month
VmErrMo	Betriebsvolumen gestört $**V_m$ Zählerstand
VmErrMoΔ	$**V_m$ counter progress of the month
QbMo↑	Maximum flow rate at base conditions during month
QbMo↑ Date/Time	Timestamp of maximum flow rate at base conditions during month
QbMo↓	Minimum flow rate at base conditions during month
QbMo↓ Date/Time	Timestamp of minimum flow rate at base conditions during month
QMo↑	Maximum flow rate at measurement conditions during month
QMo↑ Date/Time	Timestamp of maximum flow rate at measurement conditions during month
QMo↓	Minimum flow rate at measurement conditions during month
QMo↓ Date/Time	Timestamp of minimum flow rate at measurement conditions during month
pMo↑	Maximum pressure occurred during month
pMo↑ Date/Time	Timestamp of maximum pressure occurred during month
pMo↓	Minimum pressure occurred during month
pMo↓ Date/Time	Timestamp of minimum pressure occurred during month
pMoØ	Average pressure during month (flow-weighted)
TMoØ	Average temperature during month
TMo↑	Maximum temperature occurred during month
TMo↑ Date/Time	Timestamp of maximum temperature occurred during month
TMo↓	Minimum temperature occurred during month
TMo↓ Date/Time	Timestamp of minimum temperature occurred during month
KMoØ CMoØ	Average compressibility and conversion factor (flow-weighted) during month

[illegible] Maximum load (only for device option volume conversion)

Current periods:

VbMPcu.	V_b counter progress of the current measuring period
MP remaining time	Remaining time of the current measuring period
VbDycu.	V_b counter progress of the current day
VbMocu.	V_b counter progress of the current month
VbMPcM	Maximum progress of V_b in a measuring period of the current month
VbMPcM Date/Time	Timestamp of maximum progress of V_b in a measuring period of the current month
VbDycM	Maximum progress of V_b in a day of the current month
VbDycM Date/Time	Timestamp of maximum progress of V_b in a day of the current month
VmMPcu.	V_m counter progress of the current measuring period
VmDycu.	Measurement volume V_m counter progress of the current day
VmMocu.	V_m counter progress of the current month
VmMPcM	Maximum progress of V_m in a measuring period of the current month
VmMPcM Date/Time	Timestamp of maximum progress of V_m in a measuring period of the current month
VmDycM	Maximum progress of V_m in a day of the current month
VmDycM Date/Time	Timestamp of maximum progress of V_m in a day of the current month

Previous periods:

> Maximum values from days and months further in the past are available in the corresponding daily and monthly archives → p. [illegible]

VbMPp.	V_b counter progress of the previous measuring period
VbMPp. Date/Time	Timestamp of maximum progress of V_b in the previous measuring period
VbDyp.	V_b counter progress of the previous day
VbDyp. Date/Time	Timestamp of V_b counter progress of the previous day
VbMop.	V_b counter progress of the previous month
VbMop. Date/Time	Timestamp of V_b counter progress of the previous month
VbMPpM	Maximum progress of V_b in a measuring period of the previous month
VbMPpM Date/Time	Timestamp of maximum progress of V_b in a measuring period of the previous month
VbDypM	Maximum progress of V_b in a day of the previous month
VbDypM Date/Time	Timestamp of maximum progress of V_b in a day of the previous month
VmMPp.	V_m counter progress of the previous measuring period
VmMPp. Date/Time	Timestamp of V_m counter progress of the previous measuring period
VmDyp.	V_m counter progress of the previous day
VmDyp. Date/Time	Timestamp of V_m counter progress of the previous day
VmMop.	V_m counter progress of the previous month
VmMop. Date/Time	Timestamp of V_m counter progress of the previous month
VmMPpM	Maximum progress of V_m in a measuring period of the previous month
VmMPpM Date/Time	Timestamp of maximum progress of V_m in a measuring period of the previous month
VmDypM	Maximum progress of V_m in a day of the previous month
VmDypM Date/Time	Timestamp of maximum progress of V_m in a day of the previous month

6.2.7 Changing the user level

1. Call up menu function "user"
2. Press ENTER to start the edit mode.
3. Use the arrow buttons to select the desired user level.
4. Confirm with ENTER.
   The cursor now blinks under the first position of the password.
5. To enter the password:
   - Use the arrow buttons to increment or decrement the first position of the password by 1 until the correct digit is shown.
   - Confirm with ENTER.
     The cursor now blinks under the second position of the password.
   - Repeat for the remaining positions of the password.
   - You are logged in with the selected user level after the last position of the password is confirmed.

> The following users are set at the factory:
> - User (0), password: 0315
> - Authorized user (3), password: 3036
>
> ▪ Change the password after the first login using the FLOWgate™ operating software.

6.2.8 Setting the language

1. Switch to the "System settings" submenu in the FLOWSIC500 menu.
2. Call up "Language".
3. Press ENTER to start the edit mode.
4. Use the arrow buttons to select the desired language.
5. Confirm with ENTER.
   The display texts are now shown in the selected language.

6.2.9 Changing the device mode

On the FLOWSIC500, the device modes Configuration and Calibration can be activated independently from each other.

6.2.9.1 Starting and terminating configuration mode

Start configuration mode

1. Switch to the "Device mode" submenu in the FLOWSIC500 menu.
2. Call up "Configuration mode".
3. Press ENTER to start the edit mode.
4. Use the arrow buttons to select On.
5. Confirm with ENTER.
   The configuration mode is started.
   Symbol is displayed in the symbol bar.

Terminate configuration mode

1. Call up "Configuration mode".
2. Use the arrow buttons to select OFF.
3. Confirm with ENTER.
   The configuration mode is terminated.

8.2.9.2 Starting and terminating calibration mode

Calibration mode can be started and terminated in the same manner as the configuration mode (→ p. 100, § 8.2.9.1).

In calibration mode, message "CALIBRATION MODE" blinks on the main display with the meter factor not effective for the calibration (set at the factory).
The FLOW-SENSOR outputs test pulses with a maximum possible frequency of 2 Hz at 100% Q_{max} on digital switching output DO_1 (→ p. 34, § 8.4.6.1).

8.2.10 Changing parameters

Numerical values

1. Start the configuration mode (→ p. 99).
2. Select the desired parameter in the menu.
3. Press ENTER to start the edit mode.
   The cursor now blinks under the first position of the parameter.
4. Use the arrow buttons to increment or decrement the selected position by 1 until the correct digit is shown.
5. Confirm with ENTER.
   The cursor now blinks under the second position of the parameter.
6. Repeat for all remaining positions of the parameter.

Selection lists

1. Start the configuration mode (→ p. 99).
2. Select the desired parameter in the menu.
3. Press ENTER to start the edit mode.
4. Use the arrow buttons to switch to the desired selection.
5. Confirm with ENTER.

8.2.11 Resetting the error volume

1. Switch to the error volume display on the main screen.
2. Press ENTER to start the edit mode.
3. Use the arrow buttons to select OK.
4. Confirm with ENTER.
   The error volume is reset.

8.2.12 Resetting the event summary

1. Switch to the "Event Summary" display on the main display.
2. Press ENTER to open a list of the stored events.
3. Press ENTER to start the edit mode.
4. Use the arrow buttons to select OK.
5. Confirm with ENTER.
   The event summary is reset.

5.2.13 Confirming battery replacement

Confirm battery replacement on the display after you have changed a battery.

1. Switch to the "System settings" submenu in the FLOWSIC600 menu.
2. Switch to the status indicator of the replaced batteries, e.g. "Power Supply (L)".
3. Press ENTER to start the edit mode.
4. Use the arrow buttons to select OK.
5. Confirm with ENTER.

5.2.14 Checking the external power supply

An external power supply connected to the meter can be checked as follows:

1. Switch to the "System settings" submenu in the FLOWSIC600 menu.
2. Select "Power supply (L)" with the arrow buttons and confirm with ENTER.
3. Select "Check ext.power supply" and confirm with ENTER.

5.2.15 Testing the display

1. Switch to the "System settings" submenu in the FLOWSIC600 menu.
2. Call up "LCD Test".
3. Press ENTER to start the display test.
   All display segments on the display are activated and deactivated three times. Defective display segments can thus be detected.

5.2.16 Searching archive entries

The archive entries in the measuring period archive, daily archive and monthly archives can be searched using the following values:

- Timestamp (input format: YY.MM.DD hh:mm)
- Entry ID (input format: 00000000)
- Counter readings base volume (input format: fvvvvvvvvv.xxx)

The search function is only available if the displayed archive contains at least two entries.

The search masks (editors) used are designed the same for all archives and are operated identically.

1. To start the editor, press ENTER at the desired entry type in the menu to be searched.
   Press ENTER for the desired entry type.
   In the bottom line, the value from the current archive entry is preset as the start value for the change.
2. In the bottom line of the display, from left to right, use the arrow buttons to set the desired value.
   Press ENTER after each digit to confirm the entry.
3. To start the search, confirm the last digit with ENTER.
   As long as the search is running, the display shows "Search... %hits" (hits: ▸ number of entries already searched).
   To cancel editing or a running search, press ESC. The display then returns to the last archive entry displayed.
   The first exact match is displayed as the search result.
   If there is no exact match, the archive entry will be determined for which the difference to the searched value is the smallest. If there is no matching entry, the system returns to the last archive entry displayed.

FLOWSIC500

6 Clearing malfunctions

8.1 Contacting Customer Service

Contact Endress+Hauser Customer Service for any malfunctions you cannot clear yourself.

To help Customer Service understand malfunctions that have occurred, the FLOWgate™ operating software provides the option to create a diagnostics session. → p. 107, §8.4

8.2 Status messages

- Active errors or warnings are shown flashing on the LC display. Current errors or warnings can be retrieved under "Device status" / "Current events" with error code.
- Detailed information on the status messages is available via the FLOWgate™ operating software in the "Diagnostics" menu, via the "Status Diagnostics" link.

Table 23 Information messages

Status message	Description / clearance
I-1017	The device firmware has been changed.
I-1018	The device has been started.
I-1019	Configuration mode is active. → p. 90, § 6.2.5.1 "Starting and terminating configuration mode"
I-1020	The parameter locking switch is open. → p. 31, § 2.8.1 "Parameter locking switch"

Table 24 Warning messages

Status message	Description / clearance
W-2001	The Event logbook is up to 80% full. The Event logbook can be viewed, stored and reset with the FLOWgate™ operating software.
W-2002	The Maintenance logbook is full. Custody transfer parameters can only be modified after the parameter locking switch has been opened. The Maintenance logbook can be reset with the FLOWgate™ operating software. → p. 102, § 8 "Clearing malfunctions"
W-2003	More pulses than permissible should be output on the pulse output. Check whether the current flow rate is higher than the maximum flow rate. If the flow rate is within the permissible range, check whether the selected output scaling (= Meter factor) is correct. → p. 104, § 8.1 "Contacting Customer Service"
W-2008	Flow rate measurement is in status "Warning". Have the device checked by Customer Service. → p. 104, § 8.1 "Contacting Customer Service"
W-2009	The measured flow rate is outside the set warning limits. Check the current measuring conditions or adjust the limits. The warning limits can be set with the FLOWgate™ operating software.
W-2010	W-2009 = flow rate below warning limit W-2010 = flow rate above warning limit
W-2016	Battery 1 failure. → p. 113, § 7.3.2 "Changing the battery pack"
W-2017	Battery 2 failure. • With external power supply: → p. 113, § 7.3.3 "Changing the backup battery" • For battery operation: → p. 113, § 7.3.2 "Changing the battery pack"
W-2018	External power supply failure. Check the connection and function of the external power supply. → p. 36, § 3.4.5 "Operation with external power supply"

Table 33 Error messages

Status message	Description/measure
E-3001	The Event logbook is full. Check the Event logbook. The Event logbook can be reset with the FLOWgate™ operating software.
E-3006	Checksum error. → p. 104, §8.1 "Contacting Customer Service".
E-3007	Time invalid. → p. 70, §4.2 "Commissioning on the display".
E-3009	The FLOWSIC500 is in calibration mode. → p. 100, §6.3.6.1, "Starting and terminating calibration mode".
E-3010	Temperature sensor failure. The FLOWSIC500 uses the default value specified. → p. 104, §7.6 "Exchanging an external pressure or temperature sensor" → p. 104, §8.1 "Contacting Customer Service".
E-3012	Pressure sensor failure. The FLOWSIC500 uses the default value specified. → p. 104, §7.6 "Exchanging an external pressure or temperature sensor" → p. 104, §8.1 "Contacting Customer Service".
E-3013	Pressure is outside the permissible measurement pressure range. Check Pmin / Pmax vs. pressure.
E-3014	Flow rate measurement is in status "Malfunction". → p. 104, §8.1 "Contacting Customer Service".
E-3017	The K-factor cannot be calculated. Check the values entered for gas composition against the reference conditions and the base conditions. → p. 86, §5.2.4 "Main display with device option volume conversion".
E-3018	Reverse flow. The measured creep volume (reverse flow) is larger than the preconfigured buffer volume → p. 23. If larger reverse flows occur regularly, contact Customer Service to have the preconfigured volume adapted. → p. 104, §8.1 "Contacting Customer Service".
E-3019 E-3020 E-3021 E-3022	The measured gas temperature / gas pressure is outside the permissible limits: E-3019 = Gas temperature is below the alarm limit E-3020 = Gas temperature is above the alarm limit E-3021 = Gas pressure is below the alarm limit E-3022 = Gas pressure is above the alarm limit Check the set alarm limit values. → p. 94, §5.2.6.7 "Temperature parameters".
E-3023	Time is inaccurate. Check time synchronization.

9.3 Additional messages in the Event logbook

The FLOWSIC600 saves all status messages (→ p. 134, §8.2) as well as further supplemental messages concerning events and status changes in the Event logbook.

Each message code is supplemented with a (+) or (-) to identify an incoming message ● (+) or an outgoing message ○ (-).

Table 9.8 Information messages in the Event logbook

Status message	Description/clearance
I-1001	Event logbook has been read.
I-1002	Parameter logbook has been read.
I-1003	Interrupt logbook has been read.
I-1004	Measuring period archive has been read.
I-1005	Daily archive has been read.
I-1006	Monthly archive has been read.
I-1007	Event counter has been read.*
I-1011	Time has been read.*
I-1012	Totalizers have been read.
I-1013	Error counter totalizers have been read.*
I-1014	All parameters have been read or a group of parameters have been read.*
I-1021	Battery (1) has been replaced.
I-1022	Battery (2) has been replaced.
I-1031	Totalizers have been preset.*
I-1034	Gas composition logbook read.
I-1035	Gas parameters changed.

Table 9.9 Warning messages in the Event logbook

Status message	Description/clearance
● W-2011	The number of valid measurements (performance of flow rate measurement) is significantly lower than normal.*
● W-2012	Flow rate measurement is performed with reduced precision.*
● W-2013	Flow rate higher than 110% q_{max}
● W-2021	Entry with invalid CRC in the measuring period archive.
● W-2022	Entry with invalid CRC in the daily archive.
● W-2023	Entry with invalid CRC in the monthly archive.

Table 9.10 Error messages in Event logbook

Status message	Description/clearance
E-3001	Check sum of totalizers is invalid.
E-3002	Check sum of firmware is invalid.
E-3004	Parameter is invalid.*
E-3005	Check sum of logbooks and values invalid.*
E-3013	Hardware error in flow rate measurement.*
E-3014	Number of valid measurements (performance of flow rate measurement) insufficient.*

In the Event logbook, additional data, e.g. status, totalizer values, measured values and parameters at the time of certain events are saved.

These events or messages are identified with *. The data can be viewed and saved with the FLOWgate™ operating software (→ p. 80, §4.3.5).

9.4 Starting a diagnostic session

1. Click the icon in the tool bar to start a diagnostic session.
2. Select the desired data collection duration and enter a description.
   It is recommended to select a data collection duration of at least 5 minutes.

Fig. 46 Data collection duration for the diagnostic session

3. Click "Start" to start recording.
   The following message with the current storage location of the data collection is shown after successful creation of the diagnostic session.

Fig. 47 Diagnostic record is compressed

4. Click "OK" to confirm the message.
5. Store the diagnostic session or send per e-mail.

> The diagnostic sessions are saved as zip-archive as files with the ending .sfdiagsession under:
> C:\Users\Public\Documents\SICK\FLOWgate
> The name of the storage folder consists of device type and serial number of the device.

Fig. 48 Store the diagnostic session or send per e-mail

6. Click "Close" to save the file at the standard storage location.
   - Click "Save as" to select a different storage location for the diagnostic recording. Selecting the option "Save zip as" stores the parameter recordings and logbook files as single files in a zip archive.

– Click "Email" to send the file per e-mail. The file is appended to an e-mail when an e-mail client is available. Click "Save as" to select a storage location for the diagnostic recording. Selecting the option "Save .zip as" stores the parameter records and options files as single files in a zip archive.

FLOWSIC500

7 Maintenance and meter exchange

7.1 Information on handling lithium batteries

WARNING: Risk of explosion - hazard for intrinsic safety

- Only the exchangeable battery packs from Elster-Instromet with Part no. 2084018 and the backup battery with Part no. 2085529 may be used for the power supply of the device.
- Do not use damaged batteries; they must be disposed of correctly!

WARNING:

- Comply with the national regulations when transporting used battery packs by air freight!

The battery packs are marked with important information concerning storage and disposal.

Table 30 Marking

Symbol	Significance
	Do not dispose with household trash
	Recycling

Fig. 49 Identification of battery packs

Variable	Description	
[01]	Serial No.	Part No.
[11]	Date	Serial No.
[02] Date Code	→ Part No. + [02]	→ [01] + [11]
[03]		Date

7.11 Information on storage and transport

- Prevent a short circuit of the battery terminals:
  - Store and transport the batteries in their original packaging
  - or tape the battery terminals.
- Store cool (under 21 °C | 70 °F), dry and without major temperature fluctuations.
- Protect against permanent sunlight.
- Do not store near the heating.

7.12 Disposal information

In the EU:

- Dispose of lithium batteries in accordance with the Battery Directive 2006/66/EU.
- In Germany, you can hand in the batteries at your local recycling center.
  Alternatively, the battery manufacturer Tadiran Germany offers a return service on request.
  Contact data:
  Phone: +49 (0)6042 954-322
  Fax: +49 (0)6042 954-330
  www.tadiranbatteries.de

In the USA:

- Batteries have to be disposed of by an authorized waste disposal company.
  Identification of lithium batteries:
  - Proper shipping name: Waste lithium batteries
  - UN number: 3090
  - Label requirements: MISCELLANEOUS, HAZARDOUS WASTE
  - Disposal code: D003
- If anything is unclear, contact the local office of the Environmental Protection Agency (EPA).

In other countries:

Please observe national regulations for the disposal of lithium batteries.

7.2 Maintenance when using external power supply

7.2.1 Service life of backup battery

When new, the capacity of the backup battery has been calculated for bridging up to 3 months failure of the supply voltage. When voltage supply is not interrupted, the service life is at least 10 years when stored at approx. 25 °C (77 °F).
Repeated, even short-time voltage failure reduces the remaining buffer capacity of the battery so that exchange is recommended.

> If both the supply voltage and the backup battery fail, the clock setting is lost and the FLOW[SICK]200 does not measure anymore. Totalizer values determined until then and parameter settings remain permanently stored.

7.2.2 Changing the backup battery

> **WARNING: Risk of explosion - hazard for intrinsic safety!**
> - Only the exchangeable battery packs from Endress+Hauser with Part No. 2064018 and the backup battery with Part No. 2065928 may be used.

1. Ensure external voltage supply.
2. Open the electronics cover (→ p. 48, § 8.4.3)
3. Loosen the connection of the backup battery.
4. Remove the backup battery.
5. Insert a new backup battery and connect the battery to connection BAT2.
6. Close the electronics cover (→ p. 48, § 8.4.3)
7. Confirm battery replacement on the display (→ p. 101, § 9.2.12).
8. Alternatively, confirm battery replacement with the FLOWgate™ operating software:
   - Connect to device, → p. 70, § 9.3 ...
   - Open the file "System Data" in the "Parameter Modification" area.
   - Start the configuration mode.
   - Click "Battery exchange source 2" in the area "Power supply".
   - Return to the operating mode.

> NOTICE
> The battery symbol on the display shows full straight away after the battery change.
> The check whether the battery is ready operational then takes 20 minutes.

7.3 Maintenance when using battery power supply

7.3.1 Service life of battery packs

Under typical operating conditions, the expected total service life of both battery packs is 5 years.

> The complete failure of both battery packs results in the loss of the clock settings and the FLOWSIC500 does not measure anymore.
>
> Counter values determined until then as well as the parameter settings remain permanently stored.

The FLOWSIC500 needs more power

- when the display is used frequently,
- when the infrared interface is used,
- when the encoder output is frequently used (scanning cycles < 15 min).

When the electrically isolated HART® output (CO_2) is used, an external voltage supply is recommended due to the significantly higher power requirement.

The capacity of the batteries is reduced in unfavorable climatic conditions, for example when the temperatures are significantly higher or lower than 25 °C (77 °F).

7.3.2 Changing the battery packs

> **WARNING: Risk of explosion – hazard for intrinsic safety**
>
> - Only the exchangeable battery packs from Endress+Hauser with Part no. 2064038 and the backup battery with Part no. 2065928 may be used for the power supply of the device.
> - Do not use damaged batteries, they must be disposed of correctly!

The charge level of the battery packs is shown as a symbol on the display.

Table 33 Battery fill level

Symbol	Significance	Description
	Battery pack 1 fill level (connection BAT1)	Detail on the battery fill level → p. 83, §6.2.2.
	Battery pack 2 fill level (connection BAT2)	

The second battery pack is activated automatically when the first pack is completely empty. When one battery pack is empty, at least this battery pack should be changed. Both battery packs must be changed at the latest when the second battery pack is running out.

1. Check on the display which battery pack is empty.
2. Open the electronics cover (→ p. 46, §3.4.2).
3. Loosen only the respective terminal connection of the empty battery pack.

> **NOTICE**
>
> Only loosen one connection at a time to ensure continuous voltage supply!
>
> If both battery packs are to be exchanged at the same time, first replace the empty battery pack and then the still used battery pack.

Fig. 51 Battery connector on the circuit board

4 Remove the battery pack and replace by the new one.

5 Reconnect the electrical system.
The FLOWSIC500 now continues to use the second battery pack and then switches back to the new battery pack.

6 Close the electronics cover (→ p. 48, § 5.4.2).

7 Confirm battery replacement on the display (→ p. 101, § 8.2.12).

8 Alternatively, confirm battery replacement with the FLOWgate™ operating software.
- Connect to device. → p. 73, § 6.3.1.
- Login as "Authorized User" on the device.
- Open the tile "System User" in the "Parameter Modification" area.
- Start the configuration mode.
- When the battery pack on "BAT2" has been exchanged, click "Battery change Source 2" in area "Power supply".
- When the battery pack on "BAT1" has been exchanged, click "Battery change Source 1" in area "Power supply".

9 Return to the operating mode.

NOTICE:
The battery symbol on the display shows full straight away after the battery change.
The check whether the battery is really operational then takes 20 minutes.

7.4 Meter exchange

7.4.1 Prerequisites for meter exchange

NOTICE

Ensure that the meter exchange is carried out according to the national regulations for Ex and pressure applications of your country.

7.4.2 Hazards during meter exchange

WARNING: Hazards due to combustible gases or high pressure

Natural gas under line pressure flows through the gas flow meter during running operation. The gas flow meter may only be exchanged when the equipment is at a standstill.

Before commencing (re)assembly work:

- Ensure the pipeline is free from pressure and free from combustible gases.
- Purge the pipeline with inert gas if necessary.
- Observe the safety information in §1.1 (→ p. 12) and §2.1 (→ p. 28).

NOTICE

The gas flow meter may only be exchanged by skilled persons who, based on their technical training and knowledge in pipeline construction as well as knowledge of the relevant regulations, can assess the tasks given and recognize the hazards involved.

- Observe the information in §1.4 (→ p. 14).
- In case of doubt, please contact the local Endress+Hauser Customer Service.

7.4.3 Sequence of meter exchange

To exchange the gas flow meter, proceed as follows:

1. Download the user-specific configuration of the installed gas flow meter (→ p. 118, §7.4.6).
2. Disconnecting electrical connections (→ p. 119, §7.4.7).
3. Removing the installed gas flow meter (→ p. 120, §7.4.8).
4. Installing the replacement gas flow meter (→ p. 124, §7.4.9).
5. Perform a leak tightness check (→ p. 126, §7.4.10).
6. Connect the new gas flow meter to the electric system (→ p. 46, §3.4).
7. Upload the user-specific configuration of the previously installed gas flow meter to the new gas flow meter (→ p. 129, §7.4.11).
8. Check the function of the gas flow meter (→ p. 133, §7.4.12).
9. If necessary, secure metrologically (→ p. 133, §7.4.12).

7.4.2 Required tools and auxiliary material

- Meter exchange set (item numbers → p. 140 §9.2.1) with:
  - Test cap for the respective meter size (→ Fig. 51, component no. 5)
  - Socket wrench
  - Allen key

Table 54: Openings

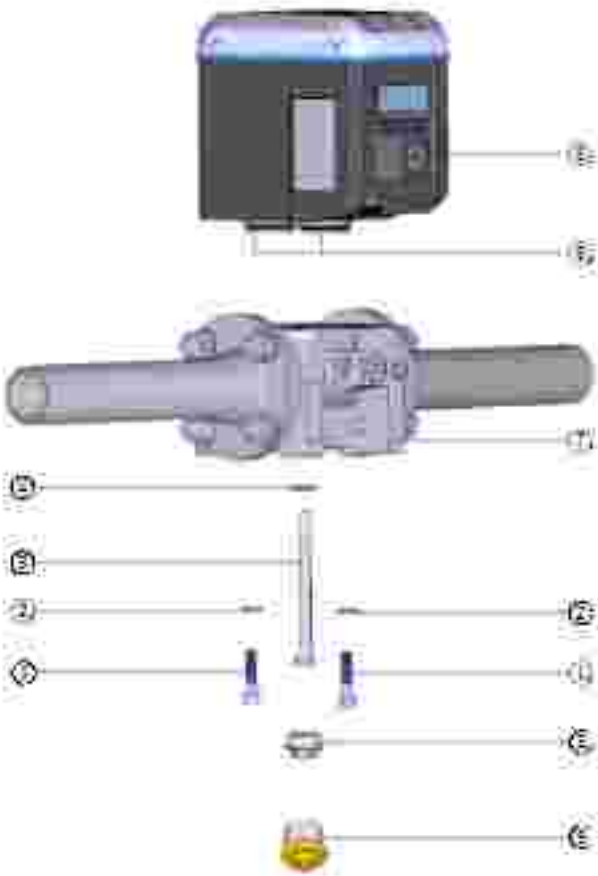
Meter size	Socket wrench	Allen key
DN50/2"	19	8
DN80/3"	24	10
DN100/4"	30	14
DN150/6"		

- Torque wrench
- Transport protection for the gas flow meter with a safety strap (item numbers → p. 139 §9.2.2)
- Silicone grease
- Leak detection spray
- Lubricant, metal-free or suitable for aluminum, e.g. OKS 235, to prevent thread mountings seizing up

> **NOTICE!**
> Do not use copper paste.

7.4.2 **Overview**

Fig. 51: Components for meter exchange using SICK 2" as example



1. Securing screws
2. Bypass manifold
3. Spacer bolt
4. Bypass heater
5. Gasket meter
6. Connecting piston with seals
7. Adapter
8. Locking pin
9. Test nut

7.4.3 Backup of user-specific configuration of installed gas flow meter

1. Connect to device → p. 72 § 4.3.3.
2. Open the "Meter Replacement" tile in the "Service" menu.
3. Click "Backup Parameter" to backup the parameters of the currently installed gas flow meter.

Fig. 62: Perform backup

4. Save the parameter file:
   - Click "Save as" to choose a storage location for the parameter file.
   - Click "Email" to send the file per email. The file is supposed to an e-mail when an e-mail client is available.

Fig. 63: Save the parameter file

5. Click "Close" after storing the csv file.

NOTICE
The parameter set is required after exchanging the gas flow meter to transfer the customer-specific or device-specific parameters to the new gas flow meter.

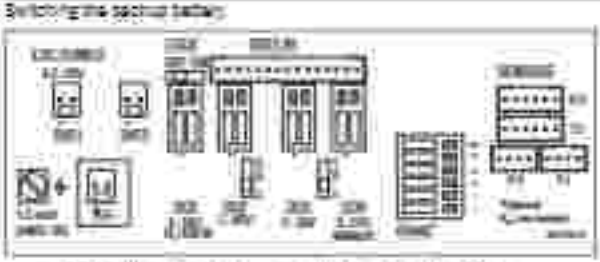
7.4.7 Disconnecting electrical connections

Observe the safety information in §2.4 (→ p. 48)

Depending on the configuration of your FLOWSIC600, proceed as follows:

1. Disconnect the potential equalization line at the outer ground terminal (on the right of the M12 plug-in connections) of the electronic housing (→ Fig. 13, p. 60).
2. If installed, remove the plug-in connector cover. To do so, loosen the captive screws (→ Fig. 26, p. 80).
3. If installed, manually loosen and remove the M12 plug-in connectors for external power supply and the signal output (→ Fig. 13, p. 60).
4. If installed, manually loosen and remove the plug-in connectors of the pressure and temperature sensors (→ Fig. 13, p. 60).
5. Open the electronics cover (→ p. 48, §3.4.3).
   - Configuration with external power supply and backup battery:
     Switch the backup battery to "b.o.".

Fig. 84: Switching the backup battery



   - Self-sufficient power configuration with battery packs:
     Remove the battery packs and dispose of or store properly according to (→ p. 112, §7.1).

> Endress+Hauser recommends inserting new batteries during every meter exchange.

6. Close the electronics cover again (→ p. 48, §3.4.3).

7.4.2 Removing the installed gas flow meter

1 Ensure safe conditions.

WARNING: Hazards due to combustible gases or high pressure
Natural gas under the pressure flows through the gas flow meter during running operation. The gas flow meter may only be exchanged when the equipment is at a standstill.
Before commencing installation work:
- Ensure the pipeline is free from pressure and free from combustible gases.
- Purge the pipeline with inert gas if necessary.
- Observe the safety information in §1.1 and §2.2.

WARNING: Hazard due to the gas flow meter falling down
- Secure the gas flow meter before loosening the screw fitting, e.g. by supporting the gas flow meter or with the help of another person holding the gas flow meter.

2 Unscrew the closure cap.

3 Remove securing screws (1) with the Allen key.

Meter size	Number of securing screws
DN50 / 2"	2
DN80 / 3"	3
DN100 / 4"	4
DN150 / 6"	4

4 Loosen center bolt (2) five to six turns.

5 Instead of the closure cap, at first manually screw the test cap for the respective meter size in until the test cap touches the center bolt.

6 Keep on screwing the test cap in with the socket wrench against the resistance of the center bolt until the test cap is completely screwed in. The center bolt pushes the seals upwards and lifts the gas flow meter up.

7. Unscrew the test cap and the center bolt completely with the socket wrench.

8. Pull the gas flow meter straight upwards and remove it.
9. Ensure that the connecting pieces with the O-rings are still on the gas flow meter.

10. Ensure that the gas flow meter can not be contaminated or damaged at any time.
11. Secure the removed gas flow meter with the transport protection before shipping.
    - Fit the gas flow meter on the transport protection.
    - Secure the gas flow meter with the strap provided.

12. Check the sealing surfaces on the adapter (marked green):
   - When the sealing surfaces are contaminated, clean carefully.
   - Ensure that the sealing surfaces are undamaged. They have to be free of scratches or grooves.

WARNING: Hazard of leaks

There is a risk of the installation becoming leak when the sealing surfaces of the adapter are damaged. Operation in leaky condition is not allowed and potentially dangerous.

- ► In this case, the adapter has to be exchanged.
- ► Please contact your local Endress+Hauser Customer Service.

7.4.5 Installing the replacement gas flow meter

NOTICE
When the sealing surfaces of the adapter have been cleaned with a detergent, let it evaporate completely.

1. Carefully remove the transport protection of the new gas flow meter. Pay attention to the arrangement of O-ring seals (1) and support plates (2).

2. Check the outside of the replacement gas flow meter for transport damage.
   Only undamaged gas flow meters may be installed.
3. Ensure that flat sealing (1) and the O-rings on connection pieces (2) are not damaged.
4. Check all threads on the components for damage.

5. Apply silicone grease to the sealing surfaces of the adapter.
6. Apply silicone grease to the O-rings on the connection pieces.

7. Carefully fit the gas flow meter on the adapter.
   Pay attention to the correct orientation of the gas flow meter. The position of the center bolt allows only one fitting direction.

8. Carefully plug the connection pieces with the O-rings into the openings of the adapter.

9. First screw the pre-coated new center bolt with Ripplock washer in manually.
   Endress+Hauser recommends using lubricant.
10. Then tighten the center bolt with the socket wrench to the specified tightening torque.

Meter size	Tightening torque	
DN50/2"	45 Nm	34 lbf ft
DN80/3"	100 Nm	74 lbf ft
DN100/4" DN150/6"	145 Nm	107 lbf ft

11. First screw the pre-coated securing screws with Ripplock washers in manually.
12. Then tighten the securing screws with the Allen key to the specified tightening torque.

Meter size	Tightening torque	
DN50/2"	20 Nm	15 lbf ft
DN80/3"	45 Nm	34 lbf ft
DN100/4" DN150/6"	100 Nm	74 lbf ft

13. Check the leak tightness → p. 126, 9.7.4.2).

§4: After a successful leak tightness check, connect the replacement gas flow meter to the electric system, see §3.4 "Electrical installation"
§5: If desired, upload the configuration of the previously installed gas flow meter to the replacement gas flow meter (→ p. 118, §7.4.8)
§6: Checking the function of the new gas flow meter, → p. 133, §7.4.10
§7: If necessary, secure metrologically (→ p. 133, §7.4.11)

7.4.9 Perform a leak tightness check

After each exchange of the gas flow meter, the correct installation of the gas flow meter and the leak tightness of the measuring device has to be checked.

To check the leak tightness, the corresponding test cap for the respective meter size is needed (→ p. 118, §7.4.8).

1: First screw the test cap for the respective meter size in manually. 2: Then tighten the test cap with the socket wrench until the test cap is completely screwed in.	
3: Slowly increase the pressure in the device (max. gradient 3 bar/min or 45 psi/min) up to the line pressure.	
4: Apply leak detection spray to the opening of the test cap. 5: Check over an issue of 10 min whether gas escapes at the opening of the test cap. → When no gas escapes from the opening of the test cap: see → p. 127, §7.4.09.1. → When gas escapes from the opening of the test cap: see → p. 127, §7.4.10.2.	

7.4.2.1 **Leak tightness check successful**

1. Remove the test cap with the socket wrench.
2. Screw in the closure cap.
3. Then connect the replacement gas flow meter to the electrical system, see §3.4 "Electrical installation".

7.4.2.2 **Leak tightness check not successful**

1. Close the line and depressurize the device.
2. Vent the environment.
3. Remove the gas flow meter from the adapter as described, see → p. 120, §7.4.3.
4. Check flat seal (1) and the O-rings on connections pieces (2) for completeness, intactness and correct installation. When the sealing elements are damaged, a new seal set is available as spare part.

Pipe size	Set number
DN80	2087354
DN90	2087355
DN100 DN150	2087356

6 Check the sealing surfaces of the adapter (marked green) for contamination and damage.

5 When the sealing surfaces are damaged:
e.g. due to corrosion or external force, the adapter has to be exchanged.

7 When the adapter is damaged, it has to be removed and a new adapter installed → p. 39, § 5.3.
Then install the gas flow meter again → p. 104, § 7.4.5.

8 When the components do not seem to be damaged but leak tightness can not be established, please contact Elster-Instromet Customer Service (→ p. 104, § 8.1).

7.4.2 Loading the parameter backup

NOTICE: Parameter protection
- Check the position of the parameter locking switch, see → p. 83, § 8.2.1.
- When open: proceed with step 1.
- When closed: the counter values and the configuration of the digital outputs cannot be written to the meter.
  An information message is output when the parameters are being written. If the further parameters are blocked to be written, click "OK" to confirm the information message.

1 Connect to device, → p. 73, § 8.5.1.
2 Open the "Meter Replacement" tile in the "Service" menu.
3 Set the source for the parameter exchange to "Parameter file".
4 Select the parameter file stored before exchanging the meter, → p. 118, § 7.4.5.

Fig. 63 Parameter file

5 An overview of the old and new values is shown under "Values to replace". Activate the "Show only differences" check box to show only the differences.
6 Activate Configuration mode.
7 Click "Start value exchange" to load the parameter backup.

Fig. 64 Starting the exchange

9. In the dialog that opens, select whether the totalizer levels are to be used from the saved parameter set or should be reset. The operating company is responsible for deciding whether to accept or reset the volume counters.

Fig. 47: Counter values

9. Confirm with "OK".
10. The serial numbers of the pressure and temperature sensor are queried for gas flow meters with external pressure and temperature technology.

Fig. 48: Serial numbers for pressure and temperature sensors

11. Check the serial numbers.
12. Enter the new serial numbers when the numbers do not match the serial numbers of the installed pressure and temperature sensors.
13. Confirm with "OK".
14. Check the serial number of the adapter when the serial number when different from the one stored.

Fig. 49: Adapter serial number

15. During transfer of the parameter values, the sequence is shown in a progress bar.
16. Confirm the upload with "OK" after completion of the upload.

The "Meter exchange report" is created.

17 Save the report as pdf file or run the program by e-mail

Fig. 61: Saving the meter exchange report

Fig. 61

Meter exchange report, example

7.4.2 Checking the function of the new gas flow meter

- Check on the display if there are any malfunctions or warnings.

✱	Device status: Malfunction	The device has an error, the measured value is invalid.
⚠	Device status: Warning	The device has a warning, the measured value is still valid.

- When malfunctions or warnings exist, clear the cause (→ p. 133, § 8).
- Alternatively, check the device status with the FLOWgate™ operating software. (→ p. 80, § 6.3.2).
- Create a diagnostics session and file with the device documentation. (→ p. 137, § 8.4).

7.4.3 Securing metrologically

- Gas flow meter and adapter can be secured at the joint by a user seal (adhesive label) (→ p. 34, § 2.5).
- When the parameter locking switch has been opened during the meter exchange, secure the parameter locking switch again metrologically (→ Fig. 9, p. 35).

7.2 Function check of a pressure or temperature sensor

The error status of a sensor is displayed on the device as an event.

1. Switch to main display "Current events".
2. Check the list for a current event with type S-0312 "temperature sensor failure" or S-0313 "pressure sensor failure".
   Exchange the sensor involved when one of these errors is displayed → p. 134, § 7.3.

> Replace the gas flow meter in the device configuration with internal pressure and temperature sensors.

If an error is not displayed, the sensor function can be checked by comparing the measured value on the FLOW-SIC500 with the measured value of a reference sensor.

7.3 Exchanging an external pressure or temperature sensor

> **WARNING. Hazard through wrong spare parts**
> The FLOW-SIC500 and the dedicated pressure and temperature sensors are designed intrinsically safe.
> - Only pressure and temperature sensors from Endress+Hauser may be used → p. 141, § 8.2.2.
> - The pressure and temperature sensors can be connected and disconnected in the hazardous area as well.
> - The pressure and temperature sensors may only be connected using the I2C plugin connectors marked accordingly on the FLOW-SIC500.
> - Modifying the electrical connection parts is not allowed.

> **NOTICE**
> The pressure and temperature sensors can only be replaced when the parameter locking switch is open.

7.3.1 Exchanging the pressure sensor

1. Three-way test valve: Move the lever to the test position (→ fig. 2).
   Test valve: Fit the adaptor on the test connection (Part no. 2071841).
2. Unscrew the sensor from the three-way test valve.
   Here, loosen the screw fitting slowly so that any overpressure can escape under control.
3. Loosen the plug-in connector cover.
4. Disconnect the plug.
5. Connect the plug to the I2C connector on the FLOW-SIC500.
6. Screw the plug-in connector cover tight.
7. Install a new pressure sensor on the pressure measuring port marked "P_{up}" → p. 61, § 3.6.2.
8. Enter the serial number of the new sensor in the FLOW-SIC500 with the FLOWgate™ operating software.
   - Connect to device, → p. 76, § 4.3.1.
   - Open the "Device identification" tile in the "Parameter modification" menu.
   - Start the configuration mode.
   - Enter the new serial number in the field "Pressure sensor serial number".
   - Return to the operating mode. The new serial number is written to the device.

9 Check the function by comparing the operating point or checking the display value (remote adapter or test connection) against a reference measurement.

NOTICE: Leak tightness check
Endress+Hauser recommends a leak tightness check after sensor replacement.

14.2 Exchanging the temperature sensor

The temperature sensor can be greased with heat-conductive oil or paste to improve its performance.

1 Loosen the locknut and pull the temperature sensor out of the protective tube.
2 Loosen the plug-in connector cover.
3 Disconnect the plug.
4 Guide the plug of the new sensor through the plug-in connector cover.
5 Connect the plug to the MB connection on the FLOWSIC500.
6 Screw the plug-in connector cover tight.
7 Fit the new temperature sensor in the protective tube → p. 65, 3.3.3.2.
8 Enter the serial number of the new sensor in the FLOWSIC500 with the FLOWgate™ operating software:
   - Connect to device → p. 73, 3.4.3.1.
   - Open the "Device identification" tile in the "Parameter identification" menu.
   - Start the configuration mode.
   - Enter the new serial number in the field "Temperature sensor serial number".
   - Return to the operating mode. The new serial number is written to the device.
9 Check the function by comparing the operating point or checking the display value (remote adapter or test connection) against a reference measurement.

FLOWSIC500

8 Accessories and spare parts

11.1 Accessories

11.1.1 Gas flow meter accessories

Description	Part No.
Mounting set for meter installation 2" (DN50 with flange type PN 50/150 (ASME B16.5)	2067402
Mounting set for meter installation 3" (DN80 with flange type PN 50/150 (ASME B16.5)	2067403
Mounting set for meter installation 4" (DN100 with flange type PN 50/150 (ASME B16.5)	2067404
Mounting set for meter installation 6" (DN150 with flange type PN 50/150 (ASME B16.5)	2067405
Mounting set for meter installation 2" (DN50 with flange type PN16 (EN1092-1)	2067406
Mounting set for meter installation 3" (DN80 with flange type PN16 (EN1092-1)	2067407
Mounting set for meter installation 4" (DN100 with flange type PN16 (EN1092-1)	2067408
Mounting set for meter installation 6" (DN150 with flange type PN16 (EN1092-1)	2067409
Mounting set for meter installation 2" (DN50 with flange type PN16 (GOST 12815-80 and GOST 33259–2015), flange face (1 series 1/2	2067411
Mounting set for meter installation 3" (DN80 with flange type PN16 (GOST 12815-80) for flange face (1 series 1, or with flange type PN16 (GOST 33259–2015) for flange face version B series 2	2067412
Mounting set for meter installation 3" (DN80 with flange type PN16 (GOST 12815-80) for flange face (1 series 2, or with flange type PN16 (GOST 33259–2015) for flange face version B series 2	2067413
Mounting set for meter installation 4" (DN100 with flange type PN16 (GOST 12815-80 and GOST 33259–2015), flange face (1 series 1/2	2067414
Mounting set for meter installation 6" (DN150 with flange type PN16 (GOST 12815-80 and GOST 33259–2015), flange face (1 series 1/2	2067415
Dummy plug for pressure connection NPT 1/4"	2067398
Dummy plug for temperature connection G1/2"	2067401
M12 plug (A-coded) for data transfer	2067419
M12 connector (B-coded) for power supply	2067420
2 m connection cable for data transfer -25 °C ... +60 °C / -13 °F ... +140 °F, with connector (A-coded) and ferrules	2067422
5 m connection cable for data transfer -25 °C ... +60 °C / -13 °F ... +140 °F, with connector (A-coded) and ferrules	2067423
2 m connection cable for data transfer -40 °C ... +70 °C / -40 °F ... +158 °F, with connector (A-coded) and ferrules	2068830
5 m connection cable for data transfer -40 °C ... +70 °C / -40 °F ... +158 °F, with connector (A-coded) and ferrules	2068831
10 m connection cable for power supply -25 °C ... +60 °C / -13 °F ... +140 °F, with connector (B-coded) and ferrules	2067424
20 m connection cable for power supply -25 °C ... +60 °C / -13 °F ... +140 °F, with connector (B-coded) and ferrules	2067425
10 m connection cable for power supply -40 °C ... +70 °C / -40 °F ... +158 °F, with connector (B-coded) and ferrules	2068832
20 m connection cable for electrical supply -40 °C ... +70 °C / -40 °F ... +158 °F, with plug (B-coded) and connector sleeves	2068833
Zener Barrier Z715, working voltage 13 V at 10 µA; 253 V ... DIN rail mounting Protection class IP20; Operating temperature -20 to +60 °C / -4 to +140 °F	6075581
Single-channel safety barrier series 9001; operating voltage 12 V DC ... [illegible] ... Class I, Division 2, Groups A, B, C, D; degree of protection IP20; operating temperature -20 °C ... +60 °C	6050859

Description	Part No.
Power supply unit 230 V AC / 12 V DC, operating voltage 12 V DC, 1 A, 1-phase, screw connection, DIN rail mounting NS 35, EN 60715, UL listed, degree of protection IP20, operating temperature -25 °C ... 70 °C	6050642
Infrared USB adapter HIE-04, data transfer up to 38400 baud, USB 2.0, cable length 2.25 m, ATEX II 2G Ex mb IIC T4 operating temperature -25 °C ... +60 °C, degree of protection IP30	6050502
Tamper-proof protection of connectors	2071237
Display protector for FLOWSIC500, weatherproof	2069547

8.1.2 Volume conversion (device option) accessories

Description	Part No.
Pressure connection set, -40 °C to 70 °C, Three-way cock, fitting with ferrule 6 mm, test connection (Minimess) coupling	2068021
Pressure connection set, -40 °C to 70 °C, Three-way cock, fitting with ferrule 1/4", test connection (Minimess) coupling	2071770
Pressure connection set, -25 °C to 50 °C, Test valve BDA04 (G1/4"), fitting with ferrule	2071098
Hose connection set DN4-EP1/4	2071840
Thermowell for nominal widths DN80 and DN100 / 3" and 4", 75 mm length, all directions, seal for use in -40 °C to 70 °C	2068309
Thermowell for nominal width DN150 / 6", 75 mm length, all directions, seal for use in -40 °C to 70 °C	2068687
Thermowell for nominal widths DN80 and DN100 / 3" and 4", 75 mm length, all directions, seal for use in -40 °C to 70 °C incl. leak tightness / strength test according to DIN 30690-1	2068133
Thermowell for nominal width DN150 / 6", 75 mm length, all directions, seal for use in -40 °C to 70 °C incl. leak tightness / strength test according to DIN 30690-1	2068135
Thermowell for nominal width DN80 / 3", 125mm length, direction right/left, seal for use in -40 °C to 70 °C	2151358
Thermowell for nominal width DN80 / 3", 125mm length, direction right/left, seal for use in -40 °C to 70 °C, incl. leak tightness / strength test according to DIN 30690-1	2151359
Thermowell for nominal width DN80 / 3", 75mm length, direction left/right, seal for use in -40 °C to 70 °C	2151360
Thermowell for nominal width DN80 / 3", 75mm length, direction left/right, seal for use in -40 °C to 70 °C, incl. leak tightness / strength test according to DIN 30690-1	2151361

8.1.3 Transport accessories

Description	Part No.
Transport protection for gas flow meter, rated width DN50, 2"	2079001
Transport protection for gas flow meter, rated width DN80, 3"	2079002
Transport protection for gas flow meter, rated width DN100, 4"	2079003
Transport protection for gas flow meter, rated width DN150, 6"	

9.2 Spare parts

9.2.1 Gas flow meter spare parts

Description	Part no.
Battery (7.2 V, 38 Ah) for self-sufficient meter operation (Battery pack 2R20 – 8080432 Tadiran SL-2880)	2094418
Backup battery (7.2 V, 2.7 Ah) for intrinsically safe main power supply (Battery pack 2R6 – 8048958 Tadiran SL-580)	2065828
Display module for FLOWSIC500, for output configuration "4-B" (type code)	2066577
Display module for FLOWSIC500, for output configuration "F-L" (type code)	2083847
Display seal	2085177
RS485 module, rated input voltage 4 ... 16 V, for output configuration "J" (type code)	2067948
RS485 module, rated input voltage 2.7 ... 5 V, for output configuration "F" (type code)	2067949
Tool set for gas flow meter exchange 2" / DN50	2067510
Tool set for gas flow meter exchange 3" / DN80	2067511
Tool set for gas flow meter exchange 4" / DN 100 and 6" / DN150	2067512
Gasket set for gas flow meter exchange 2" / DN50	2067394
Gasket set for gas flow meter exchange 3" / DN80	2067395
Gasket set for gas flow meter exchange 4" / DN100 and 6" / DN150	2067396

9.2.2 Volume conversion (device option) spare parts

Description	Part no.
EDT23 – digital pressure sensor, overpressure 0 to 4 bar, G1/4" male thread	2071176
EDT23 – digital pressure sensor, overpressure 0 to 10 bar, G1/4" male thread	2071174
EDT23 – digital pressure sensor, overpressure 0 to 20 bar, G1/4" male thread	2071178
EDT23 – digital pressure sensor, absolute pressure 0.8 to 5.2 bar, G1/4" male thread	2071179
EDT23 – digital pressure sensor, absolute pressure 2 to 10 bar, G1/4" male thread	[illegible]
EDT23 – digital pressure sensor, absolute pressure 4 to 20 bar, G1/4" male thread	2071180
EDT96 – digital pressure sensor, absolute pressure 0.8 to 20 bar, G1/4" male thread	2113920
EDT34 – digital temperature sensor, -25 °C to +60 °C	2071181
EDT34 – digital temperature sensor, -40 °C to +70 °C	2071777
Sealing plug NPT 1/4"	2067398
Sealing plug G1/4"	2067406
Pipe screw fitting for pipe diameter 6 mm	2071771
Pipe screw fitting for pipe diameter 1/4"	2069071
Adapter from NPT 1/4" male thread to G1/4" female thread	2075825

FLOWSIC500

9 Annex

Conformities and Technical Data
Application ranges
Volume conversion: input variables and limit values of the algorithms
Type code
Type plates
Dimensional drawings
Internal terminal assignment
Installation examples
Connection diagrams for operation of the FLOWSIC500 in accordance with CSA
Connection diagrams for operation of the FLOWSIC500 in accordance with ATEX/IECEx

9.1 Conformities and Technical Data

9.1.1 CE certificate

The FLOWSIC500 has been developed, manufactured and tested in accordance with the following EU Directives:

- Pressure Equipment Directive 2014/68/EU
- ATEX Directive 2014/34/EU
- EMC Directive 2014/30/EU
- Measuring Instrument Directive 2014/32/EU

Conformity with the above Directives has been determined and the CE label attached to the device.

9.1.2 Standards compatibility

The FLOWSIC500 conforms to the following standards or recommendations:

- OIML R137-1&2: 2012
  Gas Meters - Part 1: Metrological And Technical Requirements; Part 2: Metrological Controls And Performance Tests
- EN 60079-0:2012+A11:2013, EN 60079-11:2012, EN 60079-28:2007
  Explosive atmospheres – Part 0: Equipment - General requirements; Part 11: Equipment protection by intrinsic safety "i"; Part 28: Protection of equipment and transmission systems using optical radiation
- IEC 60079-0: 2011, IEC 60079-28: 2013 (6th Edition)
  Explosive atmospheres - Part 0: Equipment - General requirements; Part 28: Protection of equipment and transmission systems using optical radiation
- IEC 60079-11: 2011+Cor.: 2012 (6th Edition)
  Explosive atmospheres - Part 11: Equipment protection by 'intrinsic safety "i"
- EN 61326-1:2006
  Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements (IEC 61326-1:2005)
- IEC 61326:2005
  Electrical equipment for measurement, control and laboratory use – EMC requirements
- EN 61010-1:2010
  Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements (IEC 61010-1:2010)
- ISO 61010-1:2010 + Cor.: 2011
  Safety requirements for electrical equipment for measurement, control and laboratory use - Part 1: General requirements
- EN 12405-1+A2:2010-10
  Gas meters - Conversion devices - Part 1: Volume conversion

8.1.1 Technical Data

Meter characteristics and measuring parameters		
Measured variable	Volume a.c., volume flow a.c.	
Measuring principle	Ultrasonic transit time difference measurement	
Measured medium	Natural gas (dry, odorised), nitrogen, air, up to 30 % hydrogen in natural gas	
Measuring ranges	Volume flow a.c., DN50/2"	1.0 ... 160 m^3/h (35 ... 5,650 cfh)
	Volume flow a.c., DN80/3"	2.5 ... 400 m^3/h (88 ... 14,126 cfh)
	Volume flow a.c., DN100/4"	4.0 ... 650 m^3/h (141 ... 22,955 cfh)
	Volume flow a.c., DN150/6"	4.0 ... 1,000 m^3/h (141 ... 35,314 cfh)
Repeatability	≤ 0.1%	
Accuracy	Accuracy class 1, typical error limits: Q_{min} up to 0.1 Q_{max}: ≤ ± 1.0 % 0.1 Q_{max} up to Q_{max}: ≤ ± 0.5 %	
	Accuracy class 1, maximum allowed error limits: Q_{min} up to 0.1 Q_{max}: ≤ ± 2% 0.1 Q_{max} up to Q_{max}: ≤ ± 1% After HP flow rate calibration: ± 0.2% with test pressure, otherwise ± 0.3%	
Diagnostics functions	Permanent monitoring of measured values	
Gas temperature	−25 °C ... +60 °C (−13 °F ... 140 °F); optional: −40 °C ... +70 °C (−40 °F ... 158 °F)	
Operating pressure	PN 16 (EN 1092-1, GOST 12815-80): 0 bar(g) ... 16 bar(g) Class 150 (ASME B16.5): 0 bar(g) ... 20 bar(g)	
Ambient conditions		
Ambient temperature	−25 °C ... +60 °C (−13 °F ... 140 °F); optional: −40 °C ... +70 °C (−40 °F ... 158 °F)	
Storage temperature	−40 °C ... +80 °C (−40 °F ... 176 °F)	
Electromagnetic Conditions (EMC)	E2 in accordance with OIML R137-1&2: 2012	
Mechanical conditions	M2 in accordance with OIML R137-1&2: 2012	
Approvals		
Conformities	→ p. 142, §8.1	
Ex approvals	IECEx	Ex ia [ia] IIB T4 Gb, Ex ia [ia] IIC T4 Gb, Ex op is IIC T4 Gb
	ATEX	II 2G Ex ia [ia] IIB T4 Gb, II 2G Ex ia [ia] IIC T4 Gb, II 2G Ex op is IIC T4 Gb
	NEC/CEC (US/CA)	CSA [illegible] Class I, Division 1, Groups C, D T4, Ex/AEx ia IIB T4 Gb
IP classification	IP 66	
Outputs and interfaces		
Digital outputs and interfaces	Configurations: • LF pulses + malfunction, electrically isolated f_{max} = 100 Hz • HF pulses + malfunction, electrically isolated f_{max} = 2 kHz • Encoder + LF pulses, electrically isolated f_{max} = 100 Hz • Encoder, electrically isolated + HF pulses, not electrically isolated f_{max} = 2 kHz • 2 x LF pulses, electrically isolated f_{max} = 100 Hz • RS-485 module, externally powered, alternative to digital outputs Protocol Modbus RTU Register allocations: Modbus ENRON, [illegible] • RS-485 module, externally powered + HF pulses, electrically isolated f_{max} = 2 kHz • RS-485 module, externally powered + LF pulses, electrically isolated f_{max} = 100 Hz • Optical interface (according to EN 62056-21, Section 4.3) • Device option: RS-485 module, internally powered	

Installation	
Dimensions (W x H x D)	See dimensional drawings → p. 153, § 8.5
Weight	See dimensional drawings → p. 153, § 8.5
Material in contact with media	Aluminium AC-42100-S-T6
Mounting	Horizontal or vertical installation with 0-D straight inlet outlet piping
Electrical connection	
Voltage	Intrinsically safe supply: 4.5 ... 16 V DC
	Including 3-months backup battery
Power input	≤ 100 mW
General	
Options	Self-sufficient meter design: Typical battery service life: More than 5 years
Scope of delivery	The scope of delivery is dependent on the application and the customer specification.
General	
Battery type	Battery pack 2XS → 2043336 Tadiran SL-360
	Battery pack 2XDD → 2065482 Tadiran SL-2880
Battery chemistry	Lithium-thionyl chloride cell → [illegible]

[1] Volume flow a.c. according to AGA 8
DN50 (2"): 1.6 ... 160 m³/h (57 ... 5,650 cf/h)
DN80 (3"): 4.0 ... 400 m³/h (141 ... 14,126 cf/h)
DN100 (4"): 6.5 ... 650 m³/h (230 ... 22,955 cf/h)
DN150 (6"): 6.5 ... 1,000 m³/h (230 ... 35,314 cf/h)

Table 33: Technical Data (additional for device option volume conversion)

Volume conversion		
Accuracy	Accuracy class 0.5 Maximum absolute error of conversion factor C: ≤ ± 0.5% (at reference conditions)	
Conversion method	PTZ or TZ	
Calculation methods	• Fixed value • SGERG88 • AGA 8 Gross method 1 • AGA 8 Gross method 2 • AGA NX-19	• AGA NX-19 mod. • AGA NX-19 mod. GOST • GERG91 mod. • AGA8-92DC (AGA 8 Detail)
Logbooks and archives		
Logbooks	• Event logbook (1000 entries) • Parameter logbook (250 entries) • Metrology logbook (100 entries) • Gas composition logbook (150 entries)	
Archives	• Billing archive (6000 entries) • Day archive (600 entries) • Month archive (24 entries)	
Pressure sensor (only for device option volume conversion)[1]		
Measuring ranges	Absolute pressure sensors	Relative pressure sensors
	0.8 ... 5.2 bar (a)	0 ... 4 bar (g)
	2.0 ... 10.0 bar (a)	0 ... 10 bar (g)
	4.0 ... 20.0 bar (a)	0 ... 20 bar (g)
	0.8 ... 20.0 bar (a)	
Temperature sensor (only for device option volume conversion)		
Measuring ranges	-25 ... +60 °C	
	-40 ... +70 °C (optional)	

[1] For meter configuration with integrated volume correction, the max operating pressure may be limited by the pressure sensor. In this case, the pressure rating indicated on the sensor type plate applies.

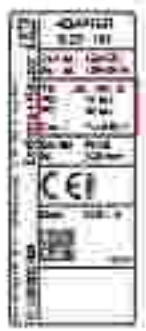
9.1.4 Design pressure and design temperature

Please refer to the supplied acceptance test certificate (EN 10204 - 3.1) and the type plate on the adapter for the actual values for the design pressure and design temperature for your specific device.

Fig. 9.2 Example acceptance test certificate (EN 10204 - 3.1)

FLOWSIC500; Inspection Certificate

Fig. 9.3 Example adapter type plate



(1) Minimum / Maximum design temperature
(2) Maximum design pressure
(3) Test pressure

[illegible] Flow rates

Table [illegible] Flow rates

Meter size	G class	Measuring range [m³/h]	Measuring range [cf/h]	Turndown ratio
DN50 / 2"	G 40	1.3 – 65	45.9 – 2,295.5	1 : 50
	G 65	2.0 – 100	70.6 – 3,531.5	1 : 50
	G 100	3.2 – 160	113.0 – 5,650.4	1 : 50
	G 100	1.6 – 160	56.5 – 5,650.4	1 : 100
	G 100	1.0 – 160	35.3 – 5,650.4	1 : 160
DN80 / 3"	G 100	3.2 – 160	113.0 – 5,650.4	1 : 50
	G 160	5.0 – 250	176.6 – 8,828.7	1 : 50
	G 160	2.5 – 250	88.3 – 8,828.7	1 : 100
	G 250	8.0 – 400	282.5 – 14,125.9	1 : 50
	G 250	4.0 – 400	141.3 – 14,125.9	1 : 100
	G 250	2.5 – 400	88.3 – 14,125.9	1 : 160
DN100 / 4"	G 160	5.0 – 250	176.6 – 8,828.7	1 : 50
	G 250	8.0 – 400	282.5 – 14,125.9	1 : 50
	G 250	4.0 – 400	141.3 – 14,125.9	1 : 100
	G 400	13.0 – 650	459.1 – 22,954.6	1 : 50
	G 400	6.5 – 650	229.5 – 22,954.6	1 : 100
	G 400	4.0 – 650	141.3 – 22,954.6	1 : 160
DN150 / 6"	G 250	8.0 – 400	282.5 – 14,125.9	1 : 50
	G 250	4.0 – 400	141.3 – 14,125.9	1 : 100
	G 400	13.0 – 650	459.1 – 22,954.6	1 : 50
	G 400	6.5 – 650	229.5 – 22,954.6	1 : 100
	G 400	4.0 – 650	141.3 – 22,954.6	1 : 160
	G 650	20.0 – 1,000	706.3 – 35,314.7	1 : 50
	G 650	10.0 – 1,000	353.1 – 35,314.7	1 : 100
	G 650	6.3 – 1,000	222.5 – 35,314.7	1 : 160
	G 650	5.0 – 1,000	176.6 – 35,314.7	1 : 200
	G 650	4.0 – 1,000	141.3 – 35,314.7	1 : 250

[illegible] Overload protection

Table [illegible] Overload protection

Meter size	Q_{max}		Overload protection		
	[m³/h]	[cf/h]		[m³/h]	[cf/h]
DN50 / 2"	160	5,650	150% Q_{max}	240	8,475
DN80 / 3"	400	14,125	150% Q_{max}	600	21,187.5
DN100 / 4"	650	22,955	150% Q_{max}	975	34,432.5
DN150 / 6"	1,000	35,314	120% Q_{max}	1200	42,376.8

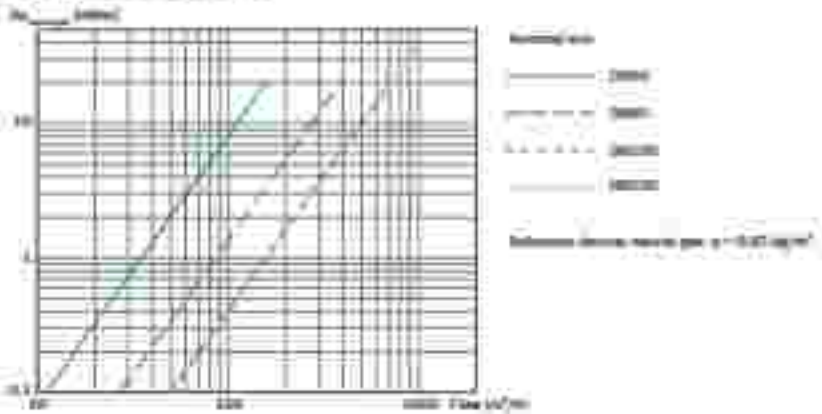
9.1 Application ranges

The following diagrams describe the promised measuring characteristics of the FLOWSIC500 in relation to different gas compositions and process conditions. The diagrams are used to better check the suitability of the device before installation.

The characteristics in the diagrams should be interpreted as guidelines, not as absolute limit values. Please contact your Endress+Hauser representative for evaluation of your specific application.

9.2.1 Pressure loss

Fig. 9-1 Typical pressure loss FLOWSIC500

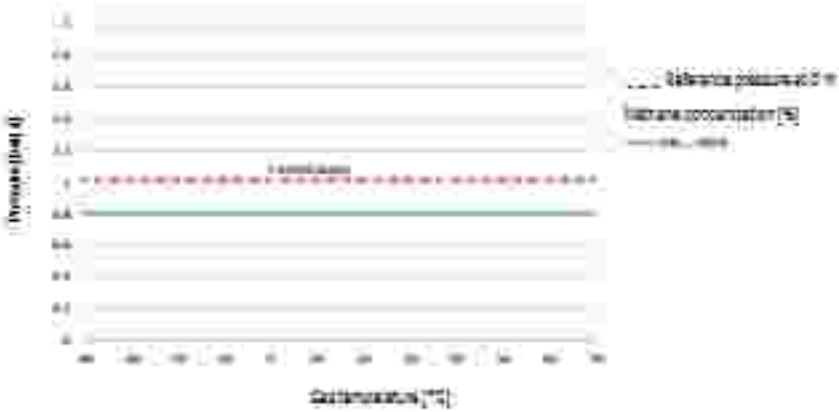


8.2.1 Methane concentration (CH_4) in natural gas

At very high methane concentrations, the FLOWSIC600 requires a minimum operating pressure for meter size DN80 up to DN300. Methane has a damping effect on the signal transmission.

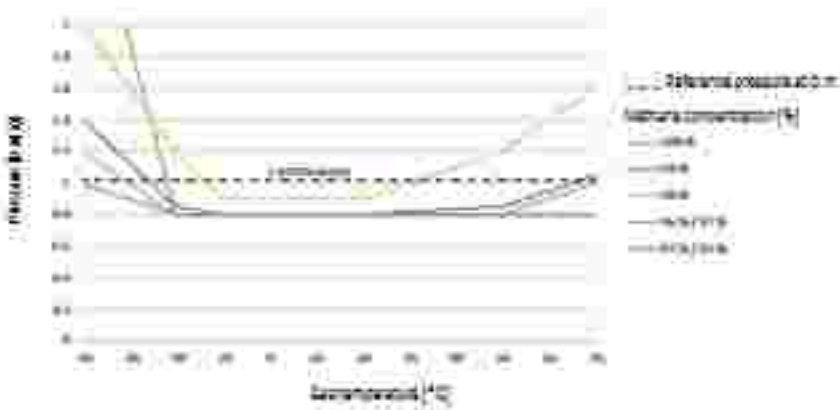
Meter size DN80

Fig. 88: Minimum operating pressure DN80



Meter size DN80, DN100, DN150

Fig. 89: Minimum operating pressure DN80, DN100, DN150

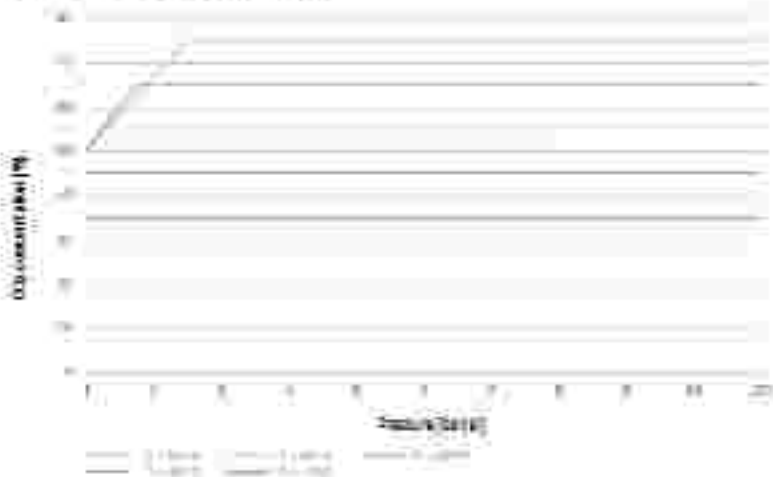


9.2.3 Carbon dioxide concentration (CO_2) in natural gas

The measuring capability of the FLOWSIC500 is limited by a maximum carbon dioxide concentration.

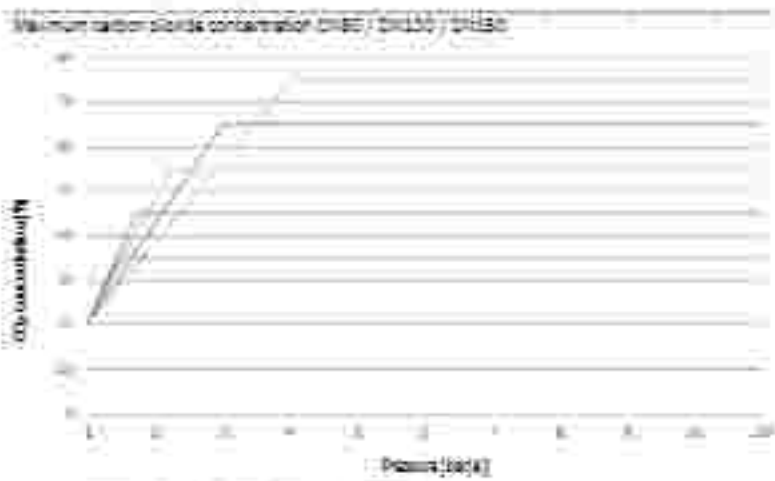
Meter size DN80

Fig. 87 Maximum carbon dioxide concentration DN80



Meter size DN80 / DN100 / DN150

Fig. 88 Maximum carbon dioxide concentration DN80 / DN100 / DN150



8.2.4 Speed of sound

The speed of sound of the measured gas needs to be in a range of 300 m/s to 600 m/s.

9.3 Volume conversion: input variables and limit values of the algorithms

9.3.1 SGERG88

Parameter	Normal range	Expanded range	unit
Heating value	30...45	22...48	MJ/m³
Relative density	0.55...0.8	0.55...0.8	-
Mole fraction CO2	0...0.3	0...0.3	mol/mol
Mole fraction H2	0...0.1	0...0.1	mol/mol
Pressure	0...120	0...120	barg
Temperature	-10...60	-10...60	°C

9.3.2 AGA 8 Gross method 1 und 2

Parameter	AGA 8 Gross 1	AGA 8 Gross 2	unit
Heating value	35.7...48.1	-	MJ/m³
Relative density	0.554...0.87	0.554...0.87	-
Mole fraction CO2	0...0.3	0...0.3	mol/mol
Mole fraction H2	-	0...0.19	mol/mol
Mole fraction H2	0...0.1	0...0.1	mol/mol
Pressure	0...120	0...120	barg
Temperature	-8...60	-8...60	°C

9.3.3 AGA NX-19 und NX-19 mod.

Parameter	NX19	NX19mod	NX19mod 88 extension	Unit
Heating value	-	31.8...39.8	29.6...48.1	MJ/m³
Relative density	0.554...1.0	0.554...0.75	0.554...0.891	-
Mole fraction CO2	0...0.15	0...0.15	0...0.3	mol/mol
Mole fraction H2	0...0.15	0...0.15	0...0.7	mol/mol
Pressure	0...344.74	0...137.9	0...30	barg
Temperature	-40...115.56	-40...115.6	0...30	°C

9.3.4 AGA NX-19 mod. GOST

Parameter	NX19mod GOST	unit
Reference density	0.68...1.0	kg/m³
Mole fraction CO2	0...0.15	mol/mol
Mole fraction H2	0...0.2	mol/mol
Pressure	0...120	barg
Temperature	-21.15...66.85	°C

9.3.5 GERG91 mod.

Parameter	Normal range	Expanded range	unit
Reference density	0.55...1.05	0.55...1.05	kg/m³
Mole fraction CO2	0...0.3	0...0.3	mol/mol
Mole fraction H2	0...0.2	0...0.2	mol/mol
Pressure	0...75	0...120	barg
Temperature	-23.15...76.85	-23.15...76.85	°C

5.2.2 AGA8-92DC (AGA-8 Detail)

Parameter	Normal range	Expanded range	Unit
Mole fraction methane	0.45 - 1.0	0 - 1	mol / mol
Mole fraction N_2	0 - 0.5	0 - 1	mol / mol
Mole fraction CO_2	0 - 0.3	0 - 1	mol / mol
Mole fraction Ethane	0 - 0.1	0 - 1	mol / mol
Mole fraction Propane	0 - 0.04	0 - 0.12	mol / mol
Mole fraction Water	0 - 0.0006	0 - dew point[4]	mol / mol
Mole fraction Hydrogen Sulfide	0 - 0.0002	0 - 1	mol / mol
Mole fraction H_2	0 - 0.1	0 - 1	mol / mol
Mole fraction Carbon Monoxide	0 - 0.03	0 - 0.03	mol / mol
Mole fraction Oxygen	-	0 - 0.21	mol / mol
Mole fraction i-Butane	0 - 0.01[1]	0 - 0.06[1]	mol / mol
Mole fraction n-Butane	0 - 0.01[1]	0 - 0.06[1]	mol / mol
Mole fraction i-Pentane	0 - 0.003[2]	0 - 0.04[2]	mol / mol
Mole fraction n-Pentane	0 - 0.003[2]	0 - 0.04[2]	mol / mol
Mole fraction n-Hexane	0 - 0.002[3]	0 - dew point[4][5]	mol / mol
Mole fraction n-Heptane	0 - 0.002[3]	0 - dew point[4][5]	mol / mol
Mole fraction n-Octane	0 - 0.002[3]	0 - dew point[4][5]	mol / mol
Mole fraction n-Nonane	0 - 0.002[3]	0 - dew point[4][5]	mol / mol
Mole fraction n-Decane	0 - 0.002[3]	0 - dew point[4][5]	mol / mol
Mole fraction Helium	0 - 0.005	0 - 0.03	mol / mol
Mole fraction Argon	-	0 - 0.01	mol / mol
Pressure	0 - 1379	0 - 1379	bar(a)
Temperature	-120 - 204	-120 - 204	°C

[1] The sum of all butane fractions must not exceed the specified limit.
[2] The sum of all pentane fractions must not exceed the specified limit.
[3] The sum of all hydrocarbon fractions Hexane must not exceed the specified limit.
[4] The algorithm is only valid up to the dew point! Before applying the algorithm make sure that the gas is completely in the gas phase (below dew point).

9.4 Type code

Fig. 69 Type code FLOWSIC500 (overview)

Fig. 75 Type code FLOWSIC500 [illegible]

9.5 Type plates

9.5.1 Metrology and electronics type plates

Fig. 71 Legend for type plates

Number	Identification	Description
[illegible]		

9.5.1.1 Identification according to ATEX/IECEx

Fig. 72 Metrology and electronics type plate (example)

Fig. 73 [illegible]

8.8.1.2 Identification according to CSA

Fig. 74 [illegible]

Fig. 75 Example for type plate position

9.3.2 Type plate: Pressure Equipment Directive

Fig. 76 Type plate: Pressure Equipment Directive (example)

8.4 Dimensional drawings

Fig. 77 Dimensions

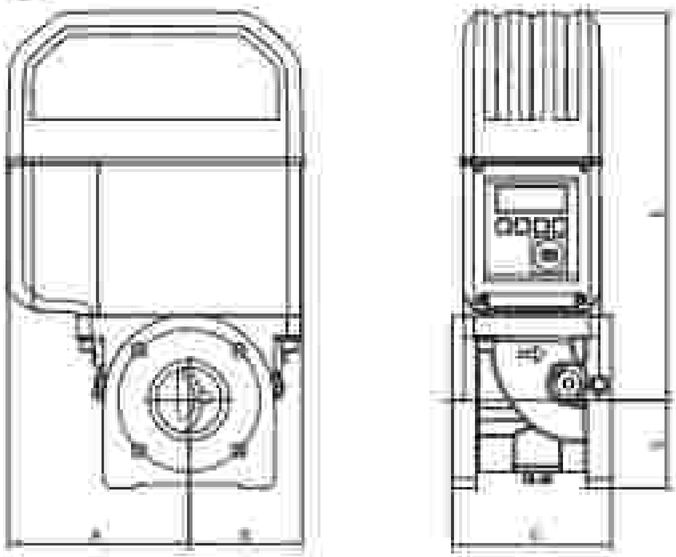


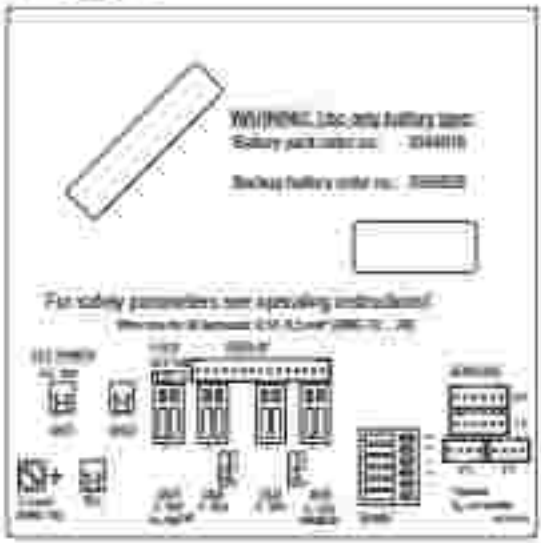
Table 38 Dimensions metric (imperial)[1]

	DN50 (2")		DN80 (3")		DN100 (4")		DN150 (6")
A	153 (6.02)		184 (7.24)		231 (9.09)		232 (9.13)
B	78 (3.07)		121 (4.76)		133 (5.24)		133 (5.24)
C[2]	150 (5.91)	171 (6.73)	171 (6.73)	241 (9.49)	241 (9.49)	300 (11.81)	450 (17.72)
D	71 (2.80)		94 (3.70)		108 (4.25)		140 (5.51)
E	272 (10.71)		417 (16.42)		476 (18.74)		476 (18.74)
Weight	11 (24.25)	11 (24.25)	14 (31)	21 (46.3)	28 (61.7)	30 (66.1)	35 (77.2)

[1] All dimensions in mm (inch), weights in kg (lb)
[2] One fitting length, two fitting lengths are available for meter sizes DN50 (2") to DN100 (4").

E.7 Internal terminal assignment

Fig. 78 Terminal assignment



A 2 Installation examples

Fig. 79 [illegible]

FLOWSIC500 with LF output connected to electronic volume corrector (both battery powered and intrinsically safe)

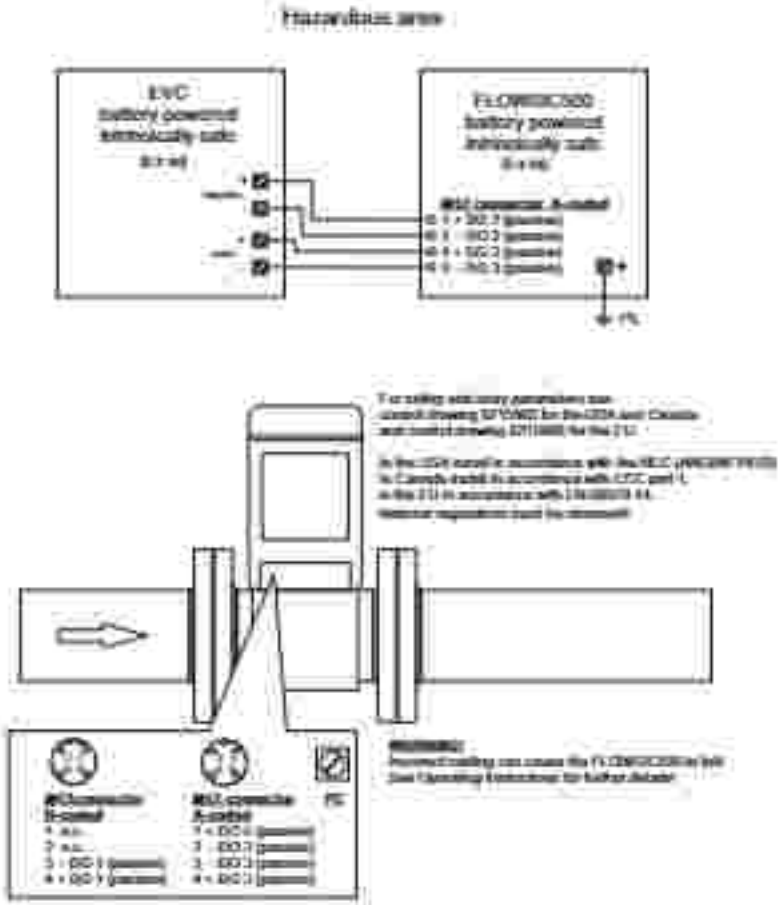


Fig. 37 Connection with safety barrier and external power supply

FLOWSIC500 with HF output powered with safety barrier and external power supply, connected to electronic volume corrector

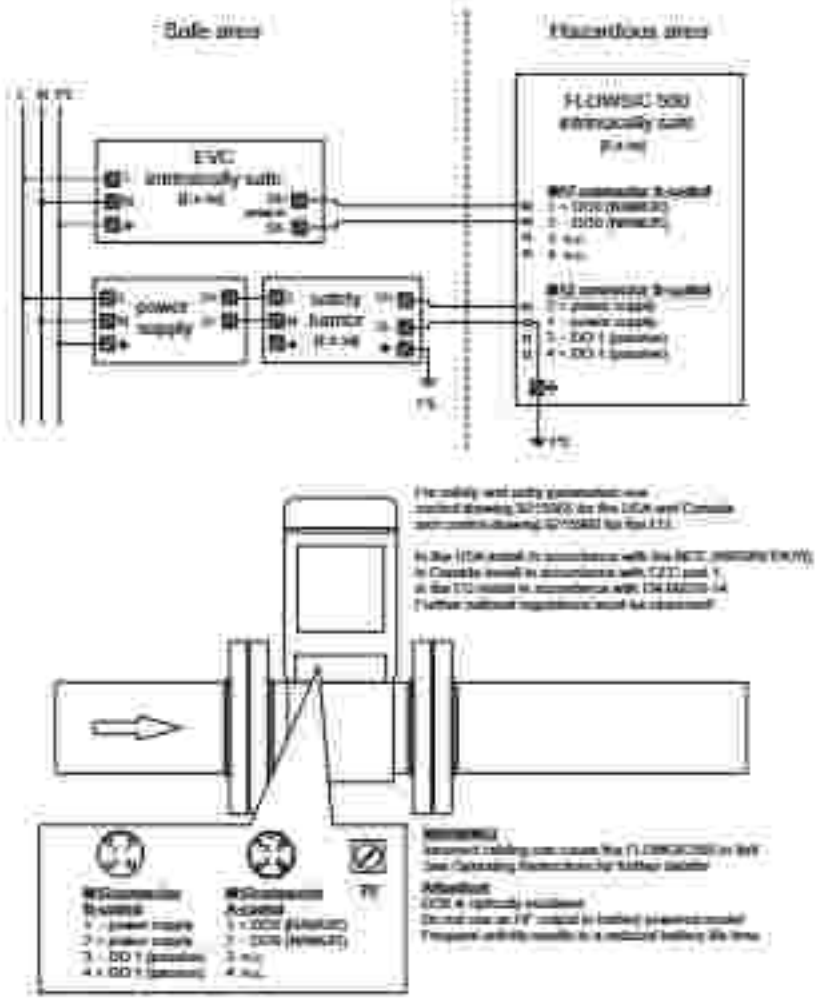
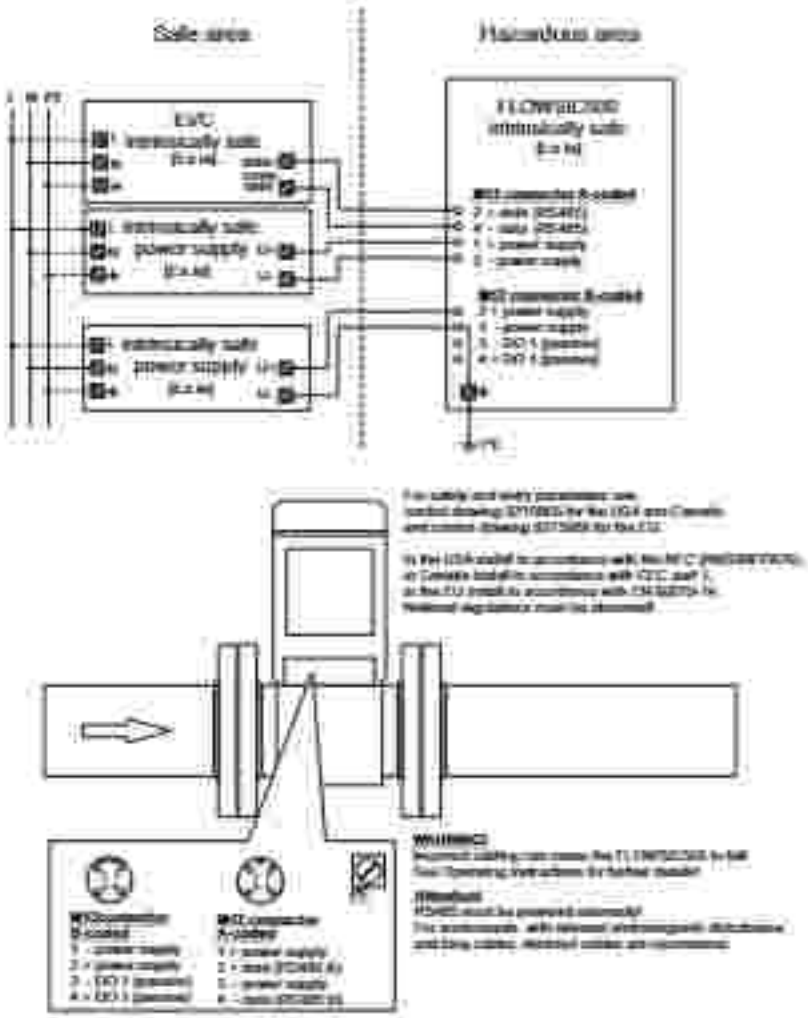


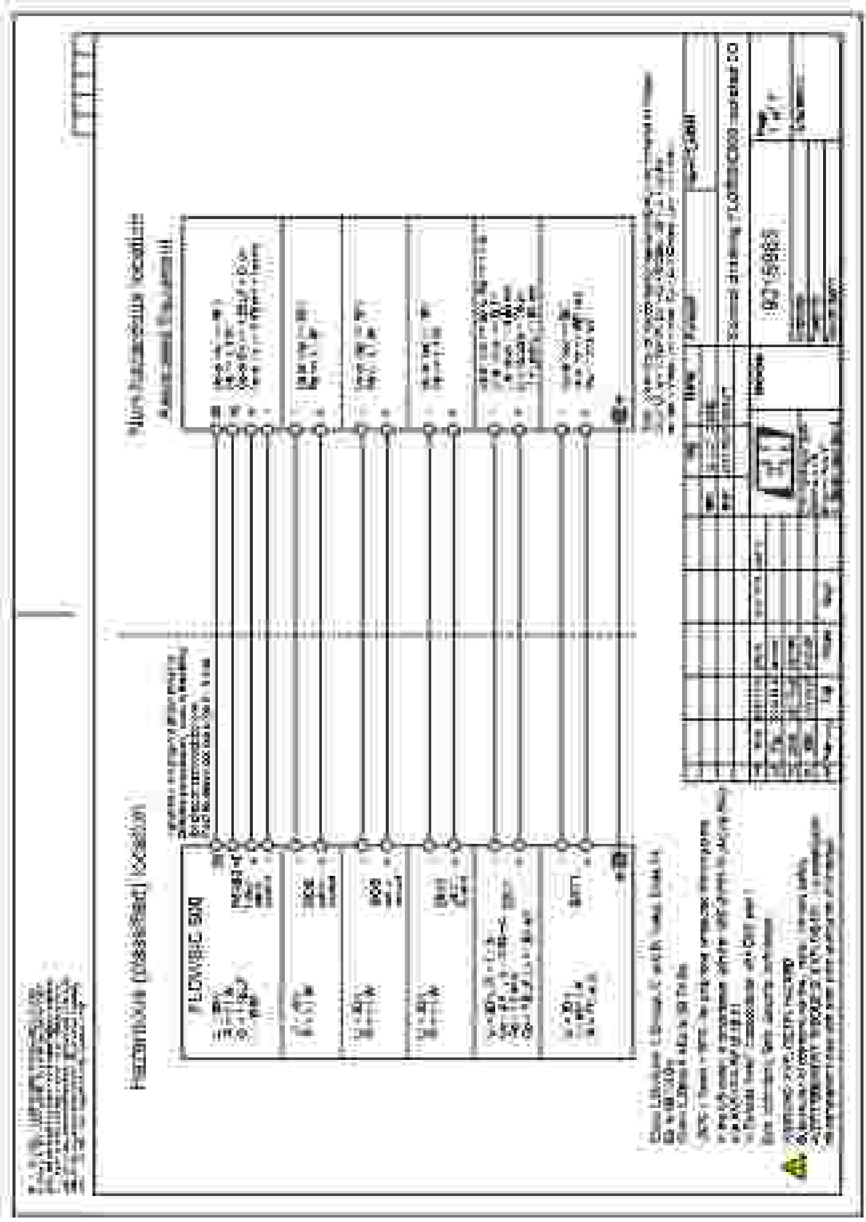
Fig. 31: Operation with external power supply (intrinsically safe)

FLOWSIC530 externally powered (IS) and connected to electronic volume corrector, RS485 externally powered



Connection diagrams for operation of the FLOWSIC500 in accordance with CSA

Fig. 32 Control diagram 9215985 page 1



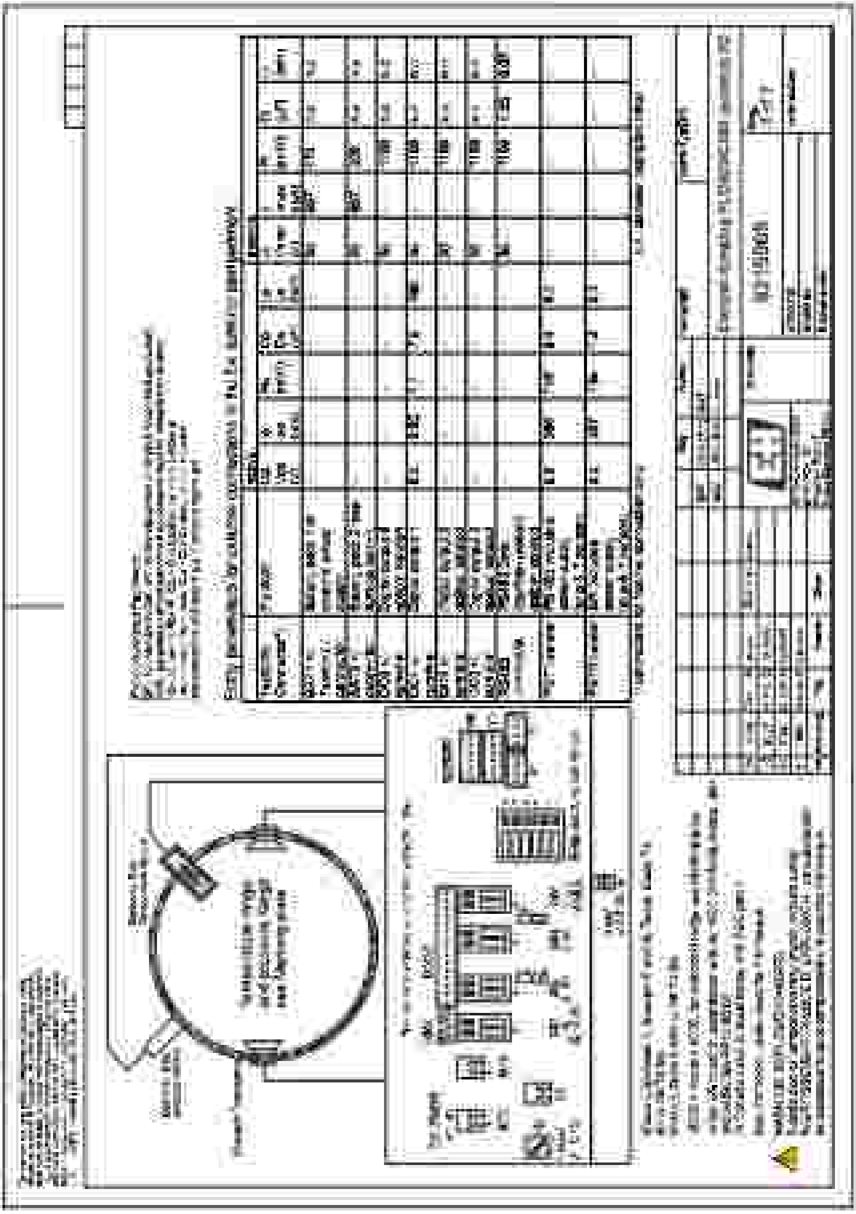


Fig. 80 Control diagram 9212365 (page 2)

Fig. 64 Connection diagram 8216866 (page 2)

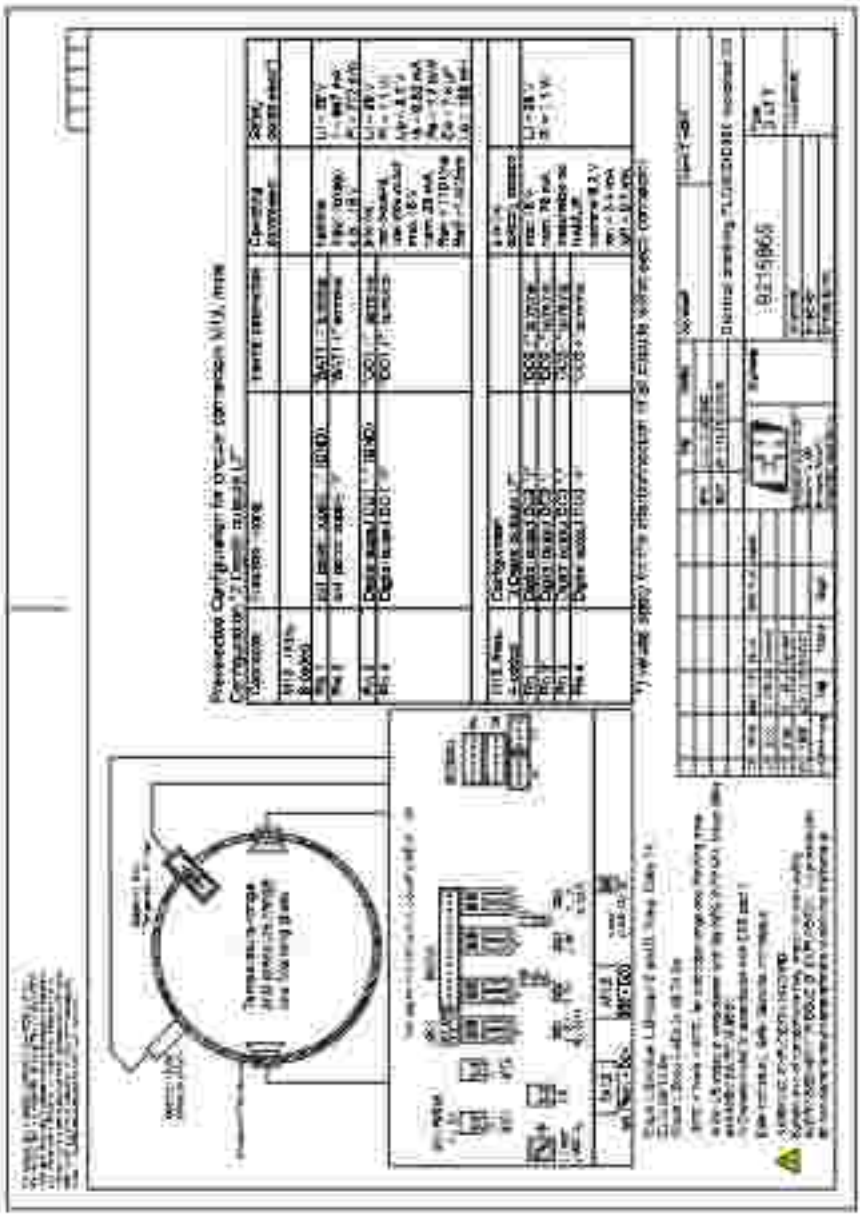


Fig. 01 : Control diagram (page 4)

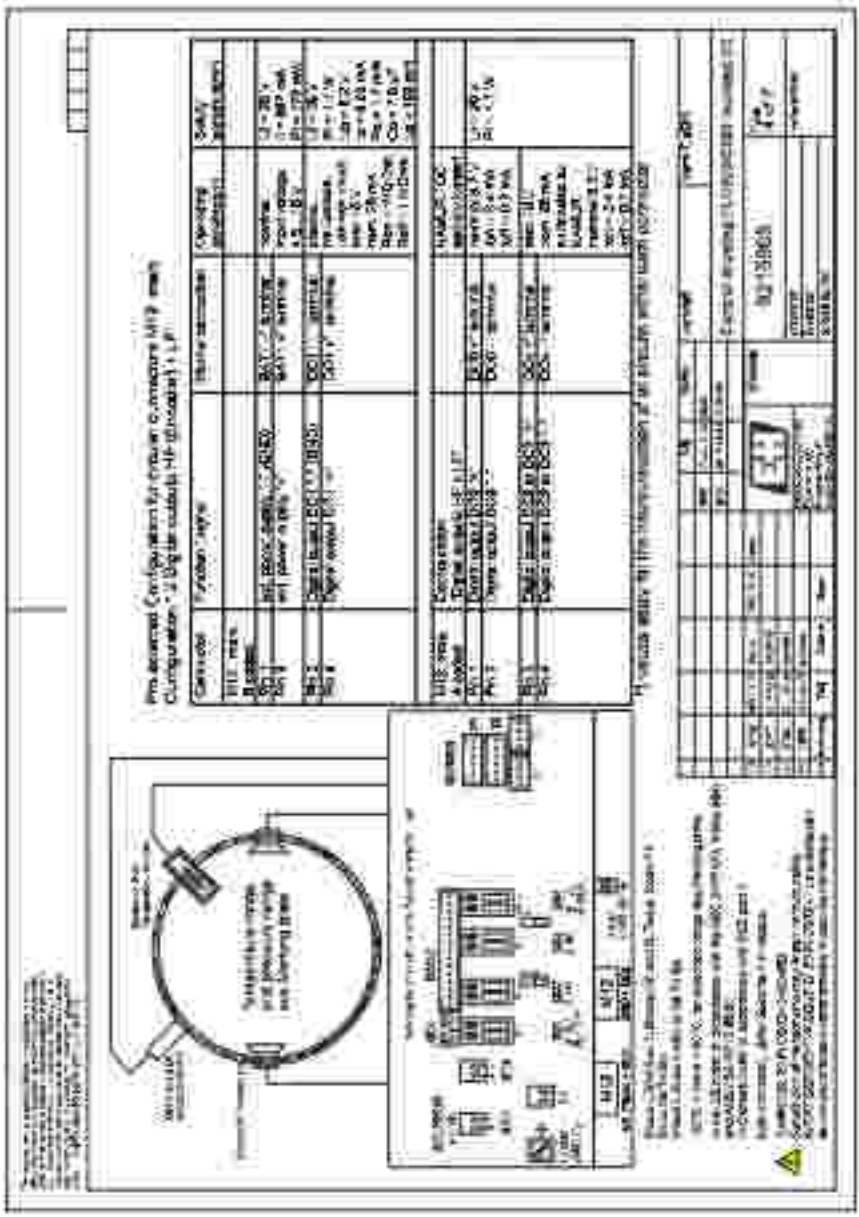


Fig. 68 Connection diagram SC500/600 (page 2)

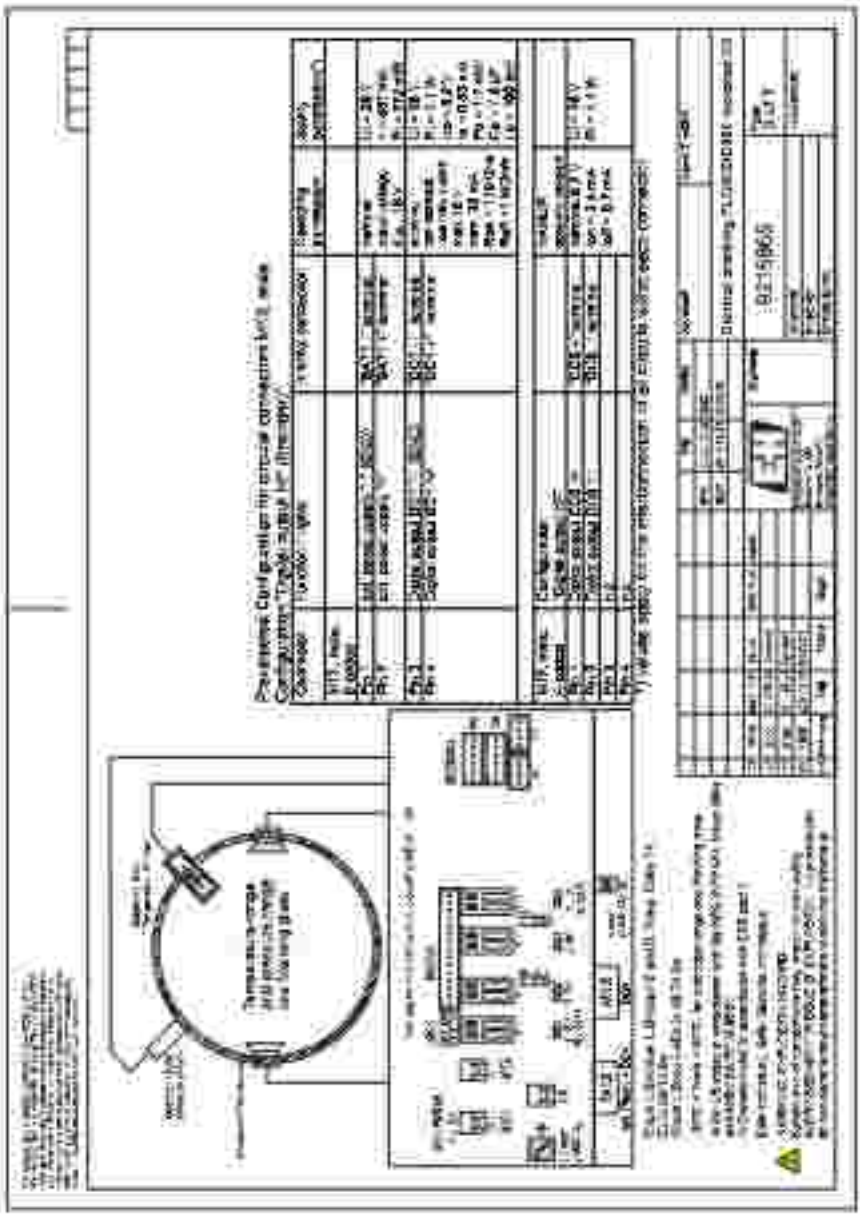


Fig 87 Control diagram 9212355 (page 8)

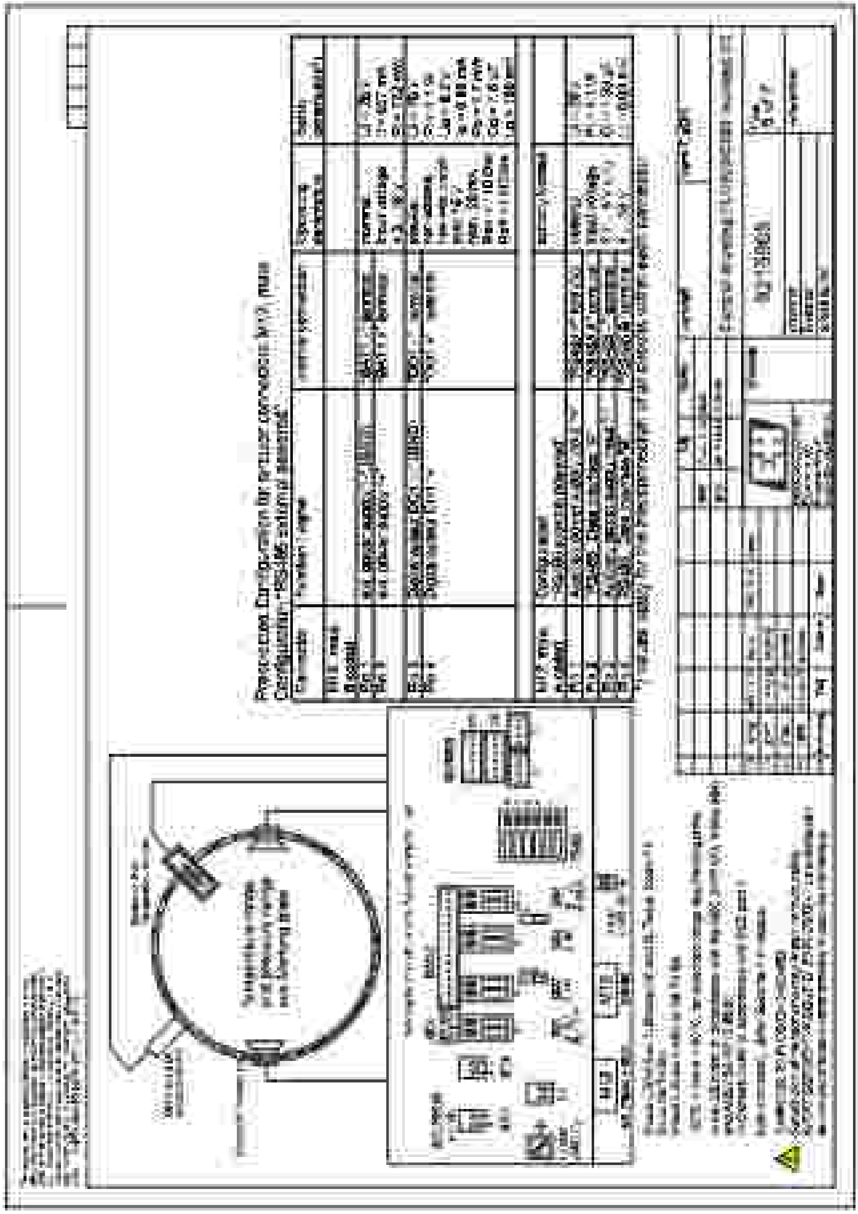
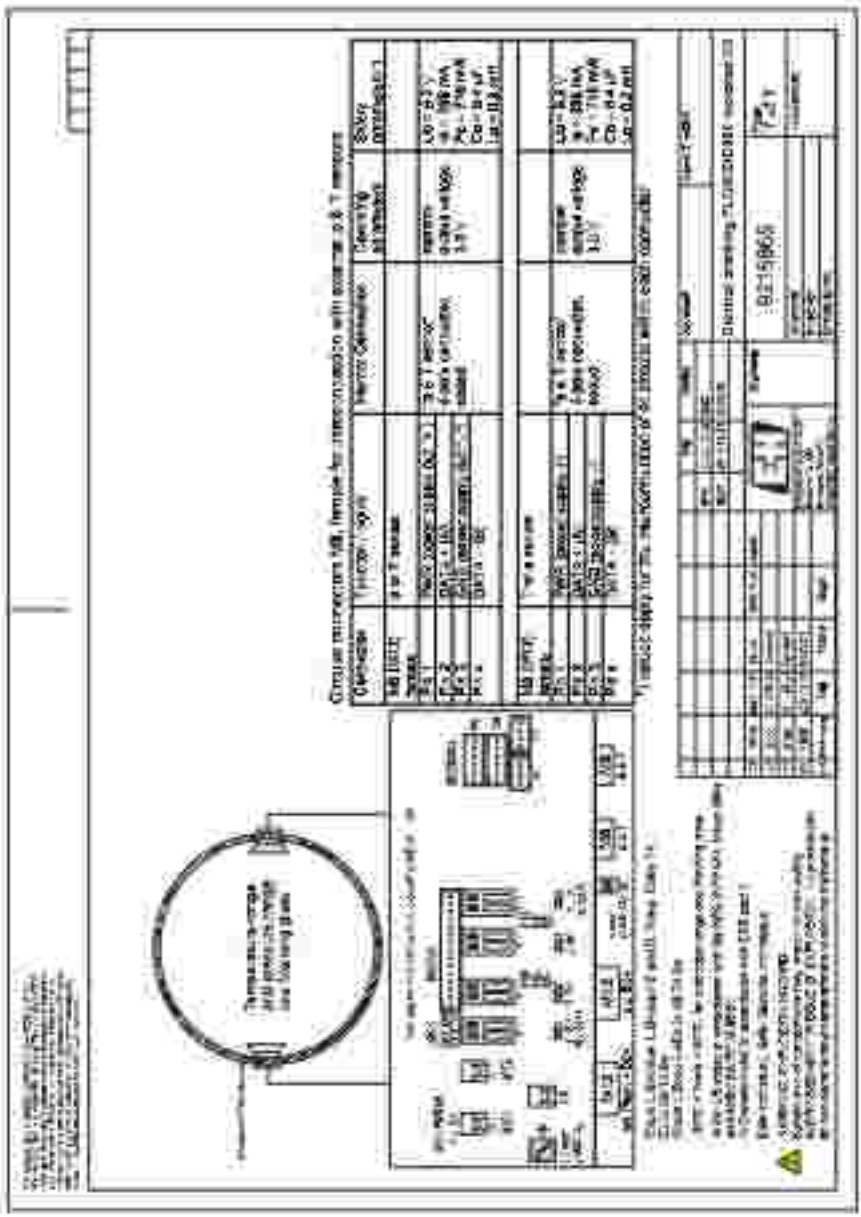


Fig. 66 Connection diagram 8216866 (page 7)



8.10 Connection diagrams for operation of the FLOWSIC500 in accordance with ATEX/IECEx

Fig. 69 Control diagram 8215666 (page 1)

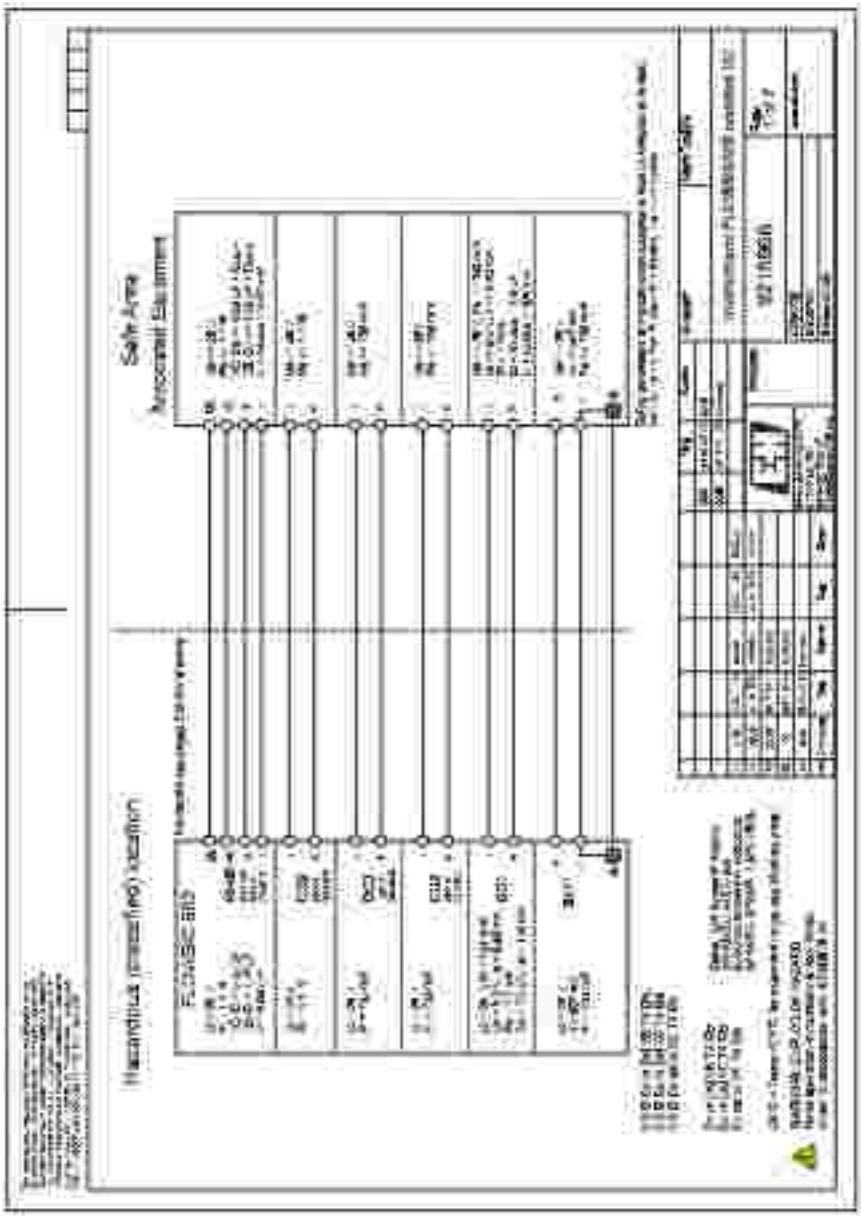


Fig. 50 Connection diagram 8020866 (page 2)

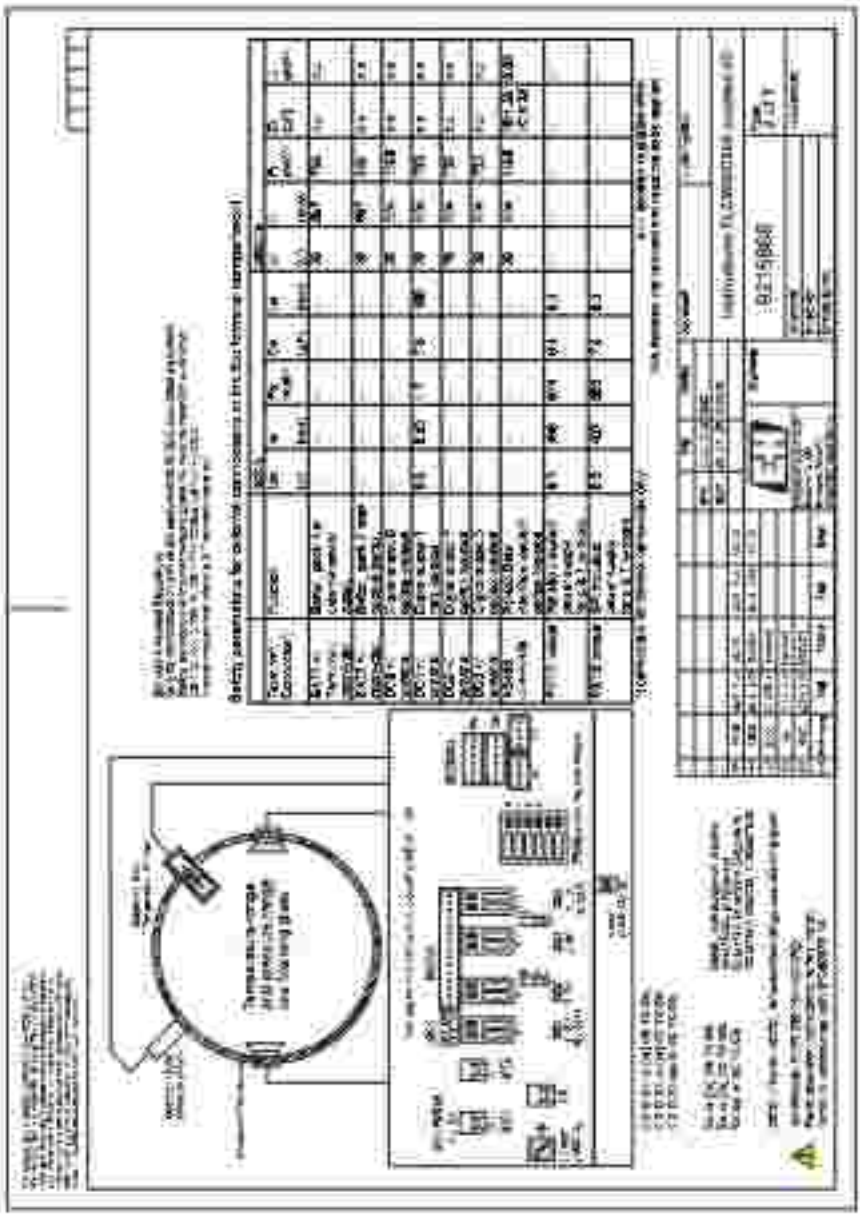


Fig 31: Control diagram 50125888 (page 5)

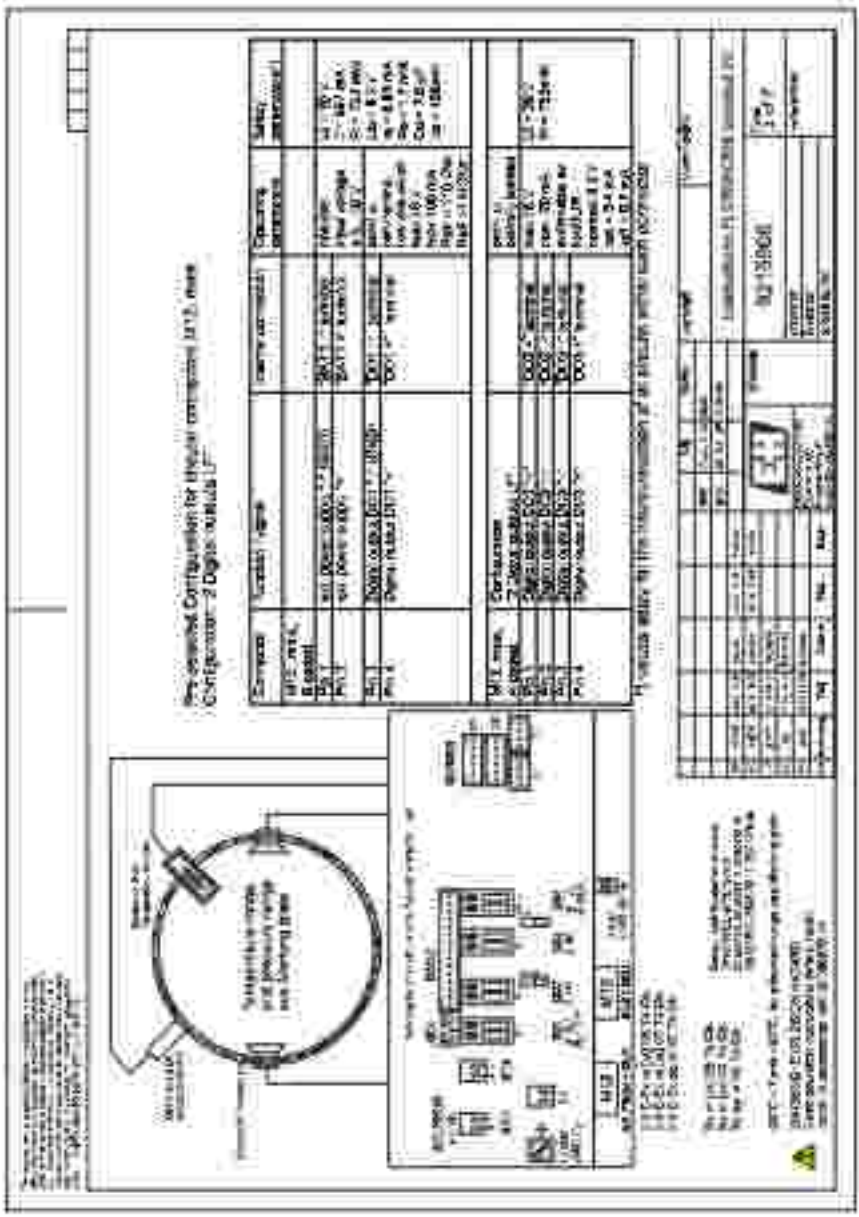


Fig. 50 Dimension diagram 8020866 (page 4)

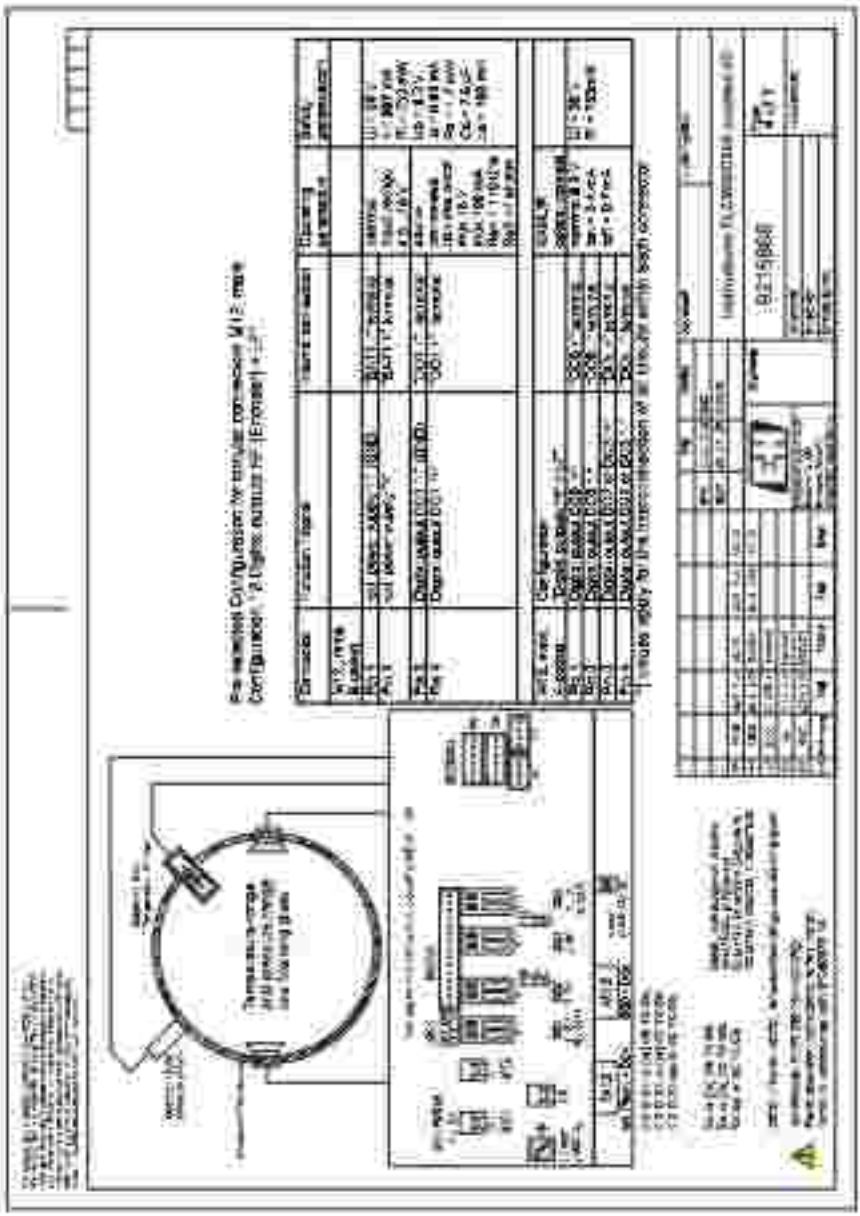


Fig 59 Control diagram 82135668 (page 1)

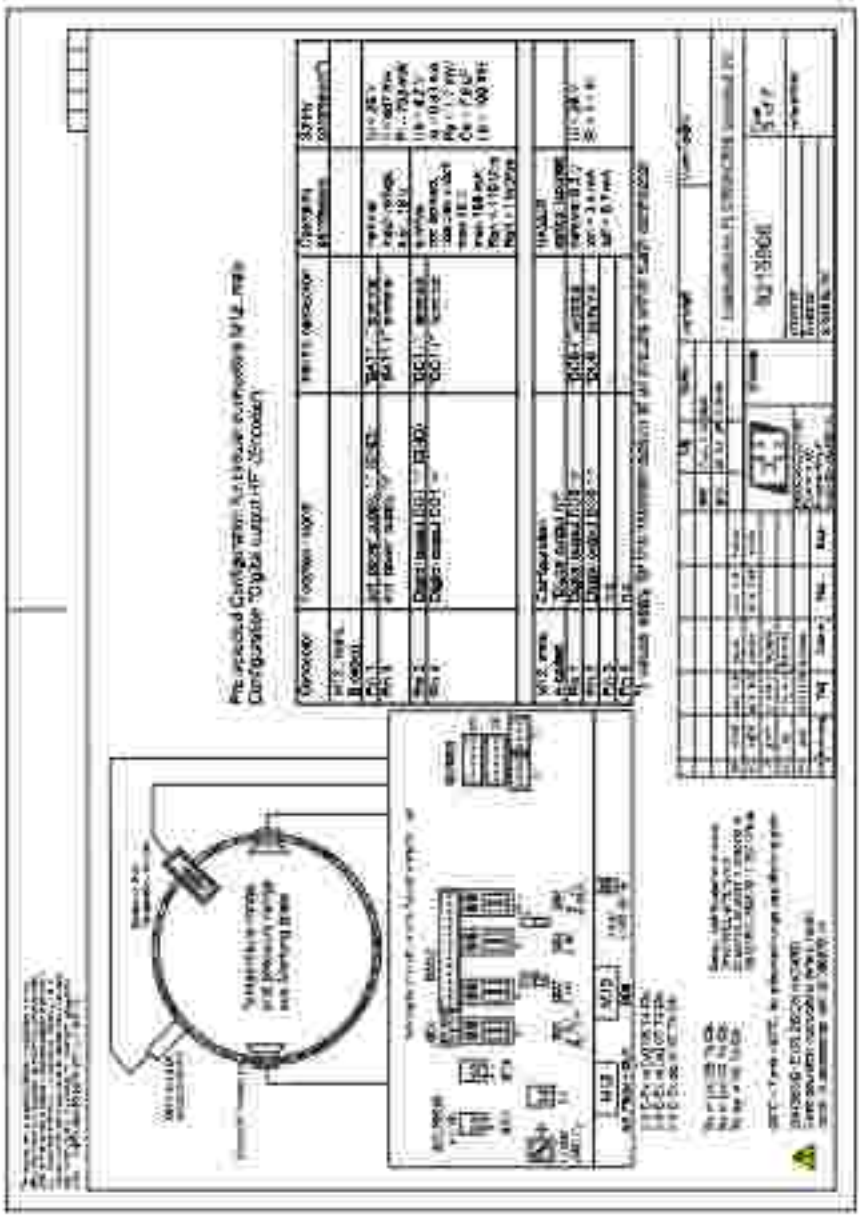
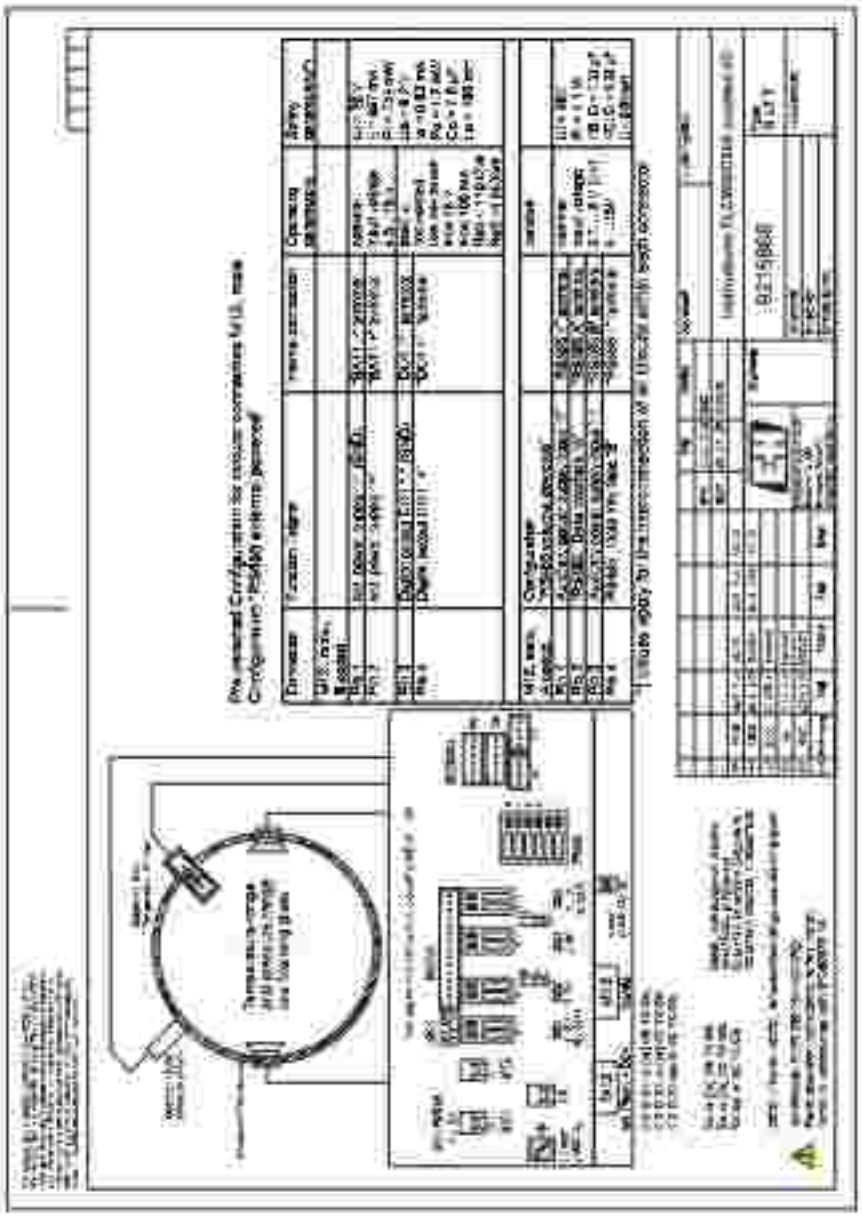
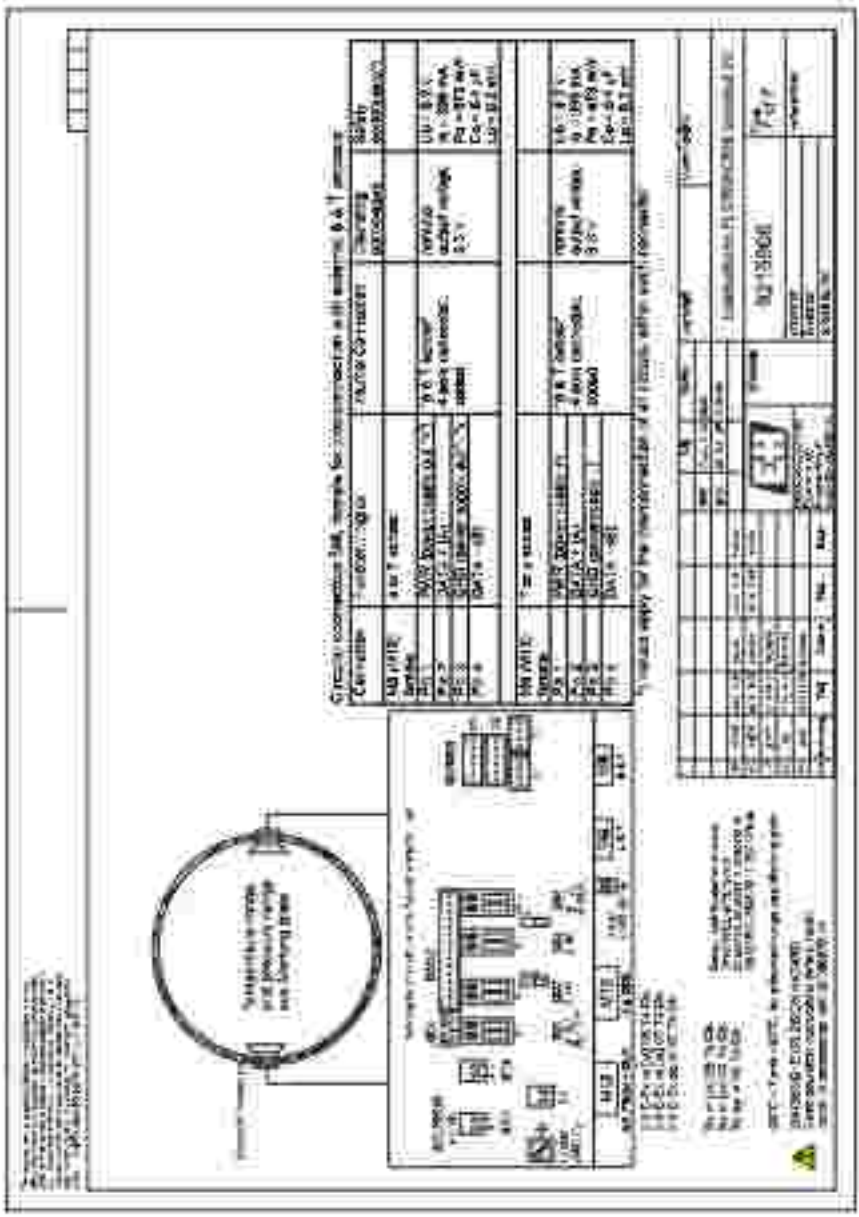


Fig. 34 Connection diagram 8020866 (page 4)



Pg 86 Control diagram 50125888 (page 1)



[illegible]

www.addresses.endress.com

Endress+Hauser