

# Operating Instructions

## FLOWSIC600 DRU/DRU-S

Gas Flow Meters



**Described product**

Product name: FLOWSIC600 DRU/DRU-S

**Manufacturer**

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**Original document**

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## 1 About this document

### 1.1 Function of this document

These Operating Instructions describe the FLOWsIC600 DRU/DRU-S measuring system to measure the volumetric flow a.c., volume a.c. and the sound velocity of gases in pipelines. They contain basic information on the measuring method used, the layout and function of the overall system and its components, as well as planning, assembly, installation, commissioning, maintenance, troubleshooting and fault clearance. The comparison of characteristic properties of the available system variants is intended to facilitate the decision in the planning phase for a configuration optimally adapted to the measurement task.

These Operating Instructions cover standard applications conforming with the technical data specified. Additional information and assistance for special applications are available from your Endress+Hauser representative. Consultation with Endress+Hauser specialists for your specific application is recommended in all cases.

### 1.2 Scope of application

These Operating Instructions apply exclusively to the following firmware and software versions:

Device / software	Firmware or software version
FLWSIC600 DRU/DRU-S	3.6.84 or higher
FLWgate™	1.17.00 or higher

It does not apply to other measuring devices from Endress+Hauser.

The standards specified in the Operating Instructions must be observed in their currently valid version.

### 1.3 Target groups

This Manual is intended for persons who install, operate and maintain the device.

#### Operation

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

#### Installation and maintenance

Skilled persons are required for installation and maintenance.  
Observe the information at the beginning of the respective Sections.

### 1.4 Further information

Document	Part No.
FLWSIC600 DRU Short Manual MODBUS	E134768
FLWSIC600 Technical Bulletin ENCODER Output	E_40492
FLWSIC600 DRU Service Manual	8023840

## 1.5 Abbreviations used

Abbreviation	Significance
s.c.	In standard condition
a.c.	In operating condition
SOS	Speed of sound, sound velocity
VOG	Velocity of gas, gas velocity
SPU	Signal processing unit
DRU	Differential replacement Unit
DRU-S	Differential replacement Unit - short
FRAM	Ferroelectric random access memory, non - volatile memory
LVF	Liquid volume fraction
FLASH PROM	Flash programmable read - only memory




## 1.6 Abbreviations for measured variables

Measured variables	Abbreviations and units for FLOWSIC600 DRU/DRU-S			Abbreviations used on the LCD signal processing unit		
Volume in operating conditions	Vf	m <sup>3</sup>	acf	Vf	m <sup>3</sup>	cf
Volume in standard conditions	Vb	Nm <sup>3</sup>	scf	Vb	m <sup>3</sup>	cf
Error volume in operating conditions	Ef	m <sup>3</sup>	acf	Ef	m <sup>3</sup>	cf
Error volume in standard conditions	Eb	Nm <sup>3</sup>	scf	Eb	m <sup>3</sup>	cf
Total volume, original	Vo	m <sup>3</sup>	acf	Vo	m <sup>3</sup>	cf
Operating volume flow	Qf	m <sup>3</sup> /h	acf/h	Qf	m <sup>3</sup> /h	cf/h
Volume flow rate in standard state	Qb	Nm <sup>3</sup> /h	scf/h	Qb	m <sup>3</sup> /h	cf/h
Mass counters	M	t	lbs	M	t	lbs
Error mass	Me	t	lbs	M	t	lbs
Mass flow rate s.c.	Mf	t/h	lbs/h	M	t/h	lbs/h

Table 1: Abbreviations for measured variables

## 1.7 Symbols and document conventions

### 1.7.1 Warning symbols

Symbol	Significance
	Hazard (general)
	Hazard by electrical voltage
	Hazard in potentially explosive atmospheres

### 1.7.2 Warning levels and signal words

**DANGER:**

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

**WARNING:**

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

**CAUTION:**

Hazard or unsafe practice which *could* result in less severe or minor injuries.




**NOTICE:**

Hazard which *could* result in property damage.

**NOTICE:**

Hints.

### 1.7.3 Information symbols

Symbol	Significance
	Information on product design with regard to protection against explosions (general)
	Important technical information for this product
	Important information on electrical or electronic functions



## 2 For your safety

### 2.1 Basic safety information



#### **WARNING: Hazards through hot, aggressive or explosive gases or high pressure**

The FLOWSIC600 DRU/DRU-S is fitted directly in the gas-carrying line.

- ▶ In systems with gases harmful to health, explosion hazard, high pressure, high temperatures, the FLOWSIC600 DRU/DRU-S may only be installed and removed when the line is vented or the system is at a standstill.
- ▶ The same requirement applies to carrying out repair and maintenance work that requires opening the measuring channel and/or the explosion-proof signal processing unit.
- ▶ The responsibility for safe operation lies with the operator; in particular, additional applicable national and company regulations must be observed.



#### **WARNING: Danger due to heavy loads**

- ▶ The device must be securely fastened to the support structure during transport and assembly.
- ▶ Only use hoisting equipment and equipment (e.g. lifting straps) suitable for the weight to be lifted. Maximum load information can be found on the type plate of the hoisting equipment.
- ▶ The eyebolts attached to the meter body are suitable for transporting the measuring device. However, additional loads (e.g. dummy covers for closing the device, filling for pressure tests or associated pipelines) must not be lifted and transported together with the measuring system without additional support using the hoisting equipment.
- ▶ No hoisting equipment may be attached to or interfere with the signal processing unit or its mounting.



#### **WARNING: Hazards when flushing the line**

If it is necessary to flush the FLOWSIC600 DRU/DRU-S, contact the responsible Endress+Hauser subsidiary beforehand and also follow the instructions below exactly:

- ▶ The pressure during flushing must not be higher than 1.2 times the nominal pressure (with built-in sensors).

### 2.1.1 General safety instructions and protective measures

Improper use or improper handling can cause damage to health or material damage. Therefore, please read this Section thoroughly and observe this information for all tasks on the FLOWSIC600 DRU/DRU-S as well as the caution and warning information in the individual Sections of these Operating Instructions.

**The following is basically applicable:**

- When preparing and carrying out tasks, the legal regulations applicable to the respective plant as well as the technical rules and guidelines implementing these regulations must be observed. Special care must be taken on plants with increased hazard potential (pressure lines, explosion protection zones). Particular attention should be paid to the rules applicable for such plants.
- All work must be carried out in accordance with local, plant-specific conditions and operational hazards and regulations.
- Operating Instructions and system documentation belonging to the measuring system must be available on site. The instructions contained therein for the avoidance of hazards and damage must be observed at all times.
- In accordance with the respective hazard potential, suitable protective devices and personal safety equipment must be available in sufficient quantity and used by the personnel.

### 2.1.2 Environmental protection information and disposal instructions

The FLOWSIC600 DRU/DRU-S components are easy to disassemble and contain no toxic, radioactive or other environmentally harmful substances. The device is mainly made of steel, stainless steel, plastic and aluminium, and there are therefore few restrictions on disposal. Only the circuit boards have to be disposed of as electronic waste.

Batteries must not be disposed of with household waste! The battery and the device must be disposed of separately in accordance with the locally applicable waste disposal regulations.

## 2.2 Intended use

The FLOWSIC600 DRU/DRU-S serves to measure the volumetric flow rate of gases in pipelines. The FLOWSIC600 DRU/DRU-S can also be used to determine the sound velocity.

The measuring system may only be used in the manner specified by the manufacturer and described below. It should be noted in particular that:

- The application complies with the technical data, the information on the permissible use as well as the assembly, connection, ambient and operating conditions. Relevant information is provided in the order documentation, type plate, certification documents and this manual.
- Observe all measures necessary for conservation of value, e.g., for maintenance and inspection and/or transport and storage.
- The device is not subjected to any unallowed mechanical stress, e.g. through pig cleaning.
- Flushing the FLOWSIC600 DRU/DRU-S with liquid (e.g. for pressure or leak tests) constitutes improper use. The consequences of such actions are neither foreseeable nor can they be assessed. The result of improper use can be the failure of the ultrasonic sensors and consequently the failure of the entire gas flow meter.

## 2.3 Authorized personnel

It is essential that those responsible for safety ensure the following:

- Any work on the measuring system may only be carried out by qualified persons and be approved by skilled persons responsible for the plant. Qualified persons are those who, based on their training, experience or instruction as well as their knowledge of relevant standards, regulations, accident prevention rules and plant conditions have been authorized by those responsible for persons and plants to carry out such work. It is decisive that these persons can recognize and avoid any possible hazards in good time.
- Skilled persons must have precise knowledge of process-specific dangers, e.g. due to the effects of hot, toxic and pressurized gases, gas-liquid mixtures and other process media, as well as the design and working principle of the measuring system and adequate knowledge of the measuring system gained through documented training.
- In hazardous areas with potentially explosive atmospheres, wiring / installation shall only be carried out by trained staff and under consideration of national regulations.

## 2.4 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 [www.endress.com/cybersecurity](http://www.endress.com/cybersecurity) for more information, such as:

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

### 3 Product description

#### 3.1 FLOWSIC600 DRU overview

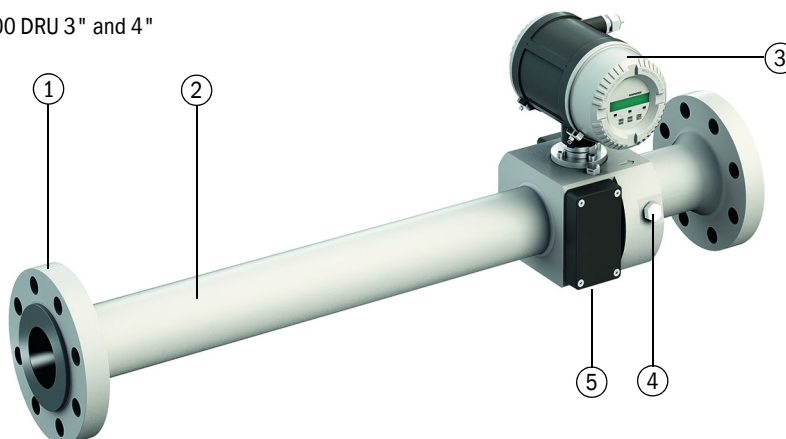
FLWSIC600 DRU is an innovative ultrasonic 2-path gas flow meter for use in natural gas production. The meter has a full-bore design and includes a 10D inlet piping for piping diameters  $\leq 4"$ . For larger diameters, an additional 10D inlet piping specially manufactured for the FLOWSIC600 DRU is included in the scope of delivery.

With a measuring range span of  $> 50:1^{[1]}$ , the FLOWSIC600 DRU covers a wide flow range which normally requires several orifice plates. Due to its special design, the FLOWSIC600 DRU provides low measurement uncertainty without need for a high-pressure flow calibration.

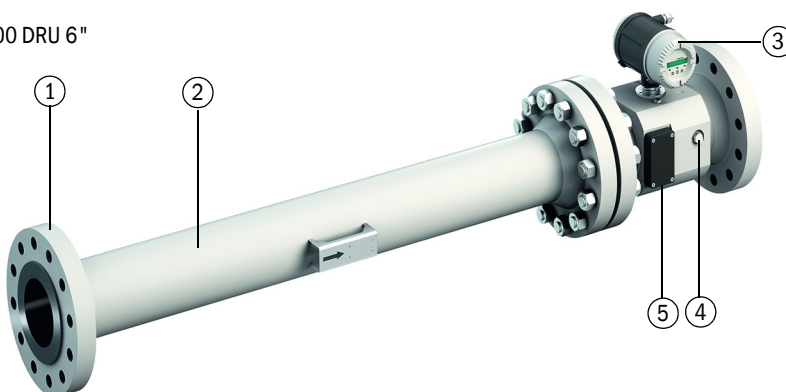
High-quality components with the highest manufacturing precision and wet gas tolerant sensors ensure long-term reliable measurement, even under difficult conditions. The FLOWSIC600 DRU has advanced diagnostic functions for real-time monitoring of the measuring device and process. The ultrasonic measurement principle with direct path layout makes the FLOWSIC600 DRU virtually maintenance-free – even with high liquid loads.

<sup>[1]</sup> 100:1 can be achieved with high pressure calibration

FLWSIC600 DRU 3" and 4"



FLWSIC600 DRU 6"



- |              |                |
|--------------|----------------|
| 1 Flange     | 4 Pressure tap |
| 2 Meter body | 5 Sensor cover |
| 3 SPU        |                |

Fig. 1: FLOWSIC600 DRU components

### 3.1.1 Technical features of the FLOWSIC600 DRU

- Special 10D inlet piping (integrated or separate)
- “Full-bore” design
- Diagnostic feature, wet gas detection
- Wet gas tolerant meter design
- Wet gas tolerant sensors

### 3.1.2 FLOWSIC600 DRU application range

Maximum volume flow rate  $Q_{max}$  is limited for gas pressures above 31 bar (450 psi(g)). The application range of the FLOWSIC600 DRU for different diameters is shown in the following diagram.

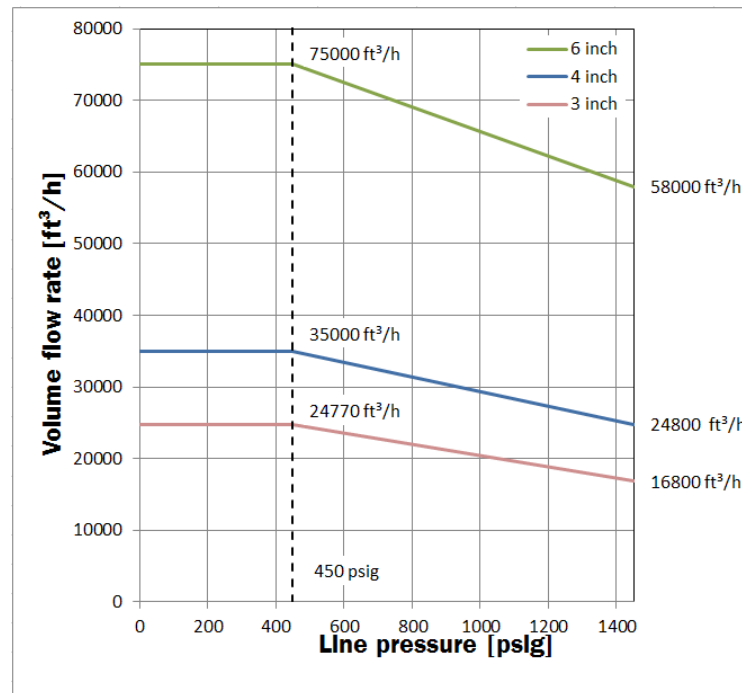


Fig. 2: Application range DRU

### 3.2 FLOWSIC600 DRU-S overview

FLWSIC600 DRU-S is an innovative ultrasonic 2-path gas flow meter for use in natural gas production.

With its large measuring range, FLOWSIC600 DRU-S covers a wide flow range that usually requires several orifice plates. Due to its special design, the FLOWSIC600 DRU-S provides reliable measurement performance, with high accuracy without need for a high-pressure flow calibration.

High quality components with superior manufacturing precision and wet gas robust sensors ensure long-term measurement reliability even in challenging conditions.

FLWSIC600 DRU-S provides advanced diagnostic capabilities for real-time monitoring of the measuring device and process. The ultrasonic measurement principle with direct path layout makes the FLOWSIC600 DRU-S virtually maintenance-free – even with high liquid loads.

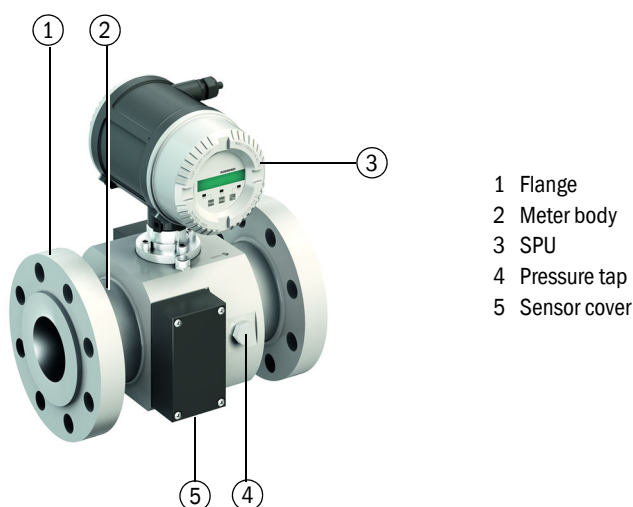


Fig. 3: FLOWSIC600 DRU-S

#### 3.2.1 Technical features of the FLOWSIC600 DRU-S

- Wet gas robust meter design
- Wet gas robust sensors
- “Full-bore” design
- Diagnostic feature wet gas detection (option)

### 3.3 FLOWSIC600 DRU/DRU-S system components

#### 3.3.1 Meter body

The meter body consists of a section for mounting the ultrasonic sensors and flanges for fitting in the respective pipeline. The meter body is made from a casting blank or forging piece machined on precision machining equipment to ensure high reproducibility of the geometric parameters.

The inner diameter, sealing surface shape and dimensional standard of the connecting flanges are manufactured according to the specifications in the type code. The meter body material is chosen to suit customer requirements. Steel meter bodies are available as standard.

#### 3.3.2 Ultrasonic sensors

Ultrasonic sensors optimally tuned to system requirements are fitted on the FLOWSIC600 DRU/DRU-S. The high quality of the sensor design provides the basis for accurate and highly stable transit time measurements with nanosecond precision. The ultrasonic sensors are electrically intrinsically safe ("Ex ia", with equipment protection level Ga).

#### 3.3.3 Signal processing unit (SPU)



##### NOTICE:

For an operation and menu structure of the meter body with LCD display see: → [page 79, 8.7](#)

The SPU contains all the electrical and electronic components for controlling the ultrasonic sensors. It generates the transmission signals and analyzes the received signals to calculate the measured value. The SPU also contains several interfaces for communication with a PC or standardized process control system.

Current meter levels, logbooks (errors, warnings, parameter changes) and Data Logs are written to non-volatile memory (FRAM) with a timestamp. On system restart, the meter level last saved is restored as the start values for the volume counter. The FRAM backup provides an unlimited number of writing cycles and guarantees saved data protection for a minimum of 10 years.

The SPU is equipped with a front panel containing a two-line LCD display to display current measured values, diagnostics and logbook data. Selection using a magnetic pen is possible with the window cover closed.

The power supply and interface terminals are located on the back of the SPU in a separate terminal compartment → [page 40, 4.4.4](#).

The electronics are housed in an enclosure certified to CSA Std. C22.2 No. 30-M1986 or UL Std. No. 1203 with the "Explosion-Proof Enclosure" type of ignition protection. The ultrasonic sensors are electrically intrinsically safe and non-sparking.

### 3.4 Operating modes, meter states and signal output

The FLOWSIC600 DRU/DRU-S has the following two operating modes:

- Operation mode
- Configuration mode

In Operation mode, the meter can have the following meter status:

- Measurement valid
- Maintenance request
- Measurement invalid

#### 3.4.1 Operation mode and Configuration mode

The meter can be used in two modes: Operation or Configuration mode.

##### Operation mode

In Operation mode, the meter runs in one of three meter statuses previously mentioned depending on the measurement conditions.

##### Configuration mode

Configuration mode serves to modify parameters that directly influence measurement and to test the system and output signals. Configuration mode forcibly sets the meter to the “Measurement invalid” status and the “Measurement valid” digital output is disabled. Invalid measured values may occur. The system continues operation using the current sample rate and executes all calculations as in Operation mode. Frequency output and analog output may be set to test values and do thus not necessarily indicate measured values. All parameter changes are immediately taken into account in the current calculations with the following exception: Changes to the measuring rate or the configuration of the serial interface are applied after the meter switches to Operation mode.



The meter switches automatically to Operation mode when the meter is in Configuration mode and no activities occur for longer than 15 minutes on the LCD display or via FLOWgate™.

#### 3.4.2 Meter status

##### Status: Measurement valid

Status “Measurement valid” is the normal meter status of the FLOWSIC600 DRU/DRU-S. Frequency output and current output are updated cyclically and deliver the volumes and actual volume flow rate. Apart from that, the analog signal can display the actual volume flow rate, the corrected volume flow rate, the sound velocity (SOS) or the gas velocity (VOG). The digital output “Direction of flow” is updated in accordance with the direction of the volume flow. The digital output “Measurement valid” (active) represents the status of the measurement. Positive (forward) and negative (reverse) volume flow rates are integrated and saved in separate internal memory sections.

The Modbus interface serves to inquire all parameters and signal shapes at any time without influencing system functions.

Each measurement initiated by the system controller includes one full transit time measurement with, and one against the direction of flow, on each path. The result of each measurement is written to a mean value memory to be used in further calculations. The size of this memory block and thus the device response delay can be modified through the parameter in register #3502 “AvgBlockSize”. If no result can be calculated due to poor



signal quality, this measurement is registered as an invalid attempt in the mean value memory. The mean value is formed in a variable averaging process including all valid measured values in the memory.

The measuring system switches to status “Maintenance request” when the number of invalid measurements in one path exceeds the prescribed threshold (parameter register #3514 “Performance”).

#### **Status: Maintenance request**

This meter status is active when a measuring path has failed and the adaptive path failure compensation is activated. This failure is compensated by the multi-path system FLOWSIC600 DRU/DRU-S. Measurement continues with slightly reduced accuracy and the volume continues to be counted in the volume counters. If a path fails when path compensation is deactivated, the measuring system switches to the “Measurement invalid” state.

Status “Maintenance request” is also active when system alarms 2002 (“No HART communication with temperature sensor”), 2003 (“No HART communication with pressure sensor”) or 2004 (“Maximum pulse output frequency exceeded”) are active.

#### **Status: Measurement invalid**

If the quality of the signals received from several measuring paths is insufficient, or the Logbook is full or the measured values are outside the calibration range, the device must mark the measured value as invalid and activate meter status “Measurement invalid”. Measuring volumes are counted in the error volume counter. However, the device will cyclically attempt to reestablish valid measurements. As soon as the signal quality and the number of valid measurements allow it, the device switches automatically back to status “Measurement valid” or “Maintenance request”.

### 3.4.3 Impulse output and status signaling


**Type approval**

Pulse output signals can be parameterized according to requirements, as shown in the following Table.

Output signal / LCD / port			Signal behavior			
			Measurement	Maintenance request	Configuration mode	Measurement invalid*
Impulse output signal	Inverted with error signal **					
	Phase shift 90° ***	Positive flow rate				
		Negative flow rate				
	Separate direction outputs ***	Positive flow rate				
		Negative flow rate				
	Single pulse output ***					

Table 2: Impulse output

\* The device can be configured so that it outputs a fixed frequency for “Measurement invalid”. The frequency to be output in this case can be configured in Reg.#3034 “ErrorFreq” (0-6 kHz).

\*\* Default setting on delivery.

\*\*\* Optional setting on customer request.

The default setting for “Maintenance request”, “Configuration” and “Measurement invalid” is “normally closed”.

Output signal / LCD / port	Signal behavior			
	Measurement	Maintenance request	Configuration mode	Measurement invalid
“Maintenance request” Status signal	Status “active / inactive” * Measurement valid	Status “active / inactive” * Compensation of path failure	“Undefined”	“Undefined”
“Flow direction” Status signal	Status “active / inactive” * Positive or negative direction of flow	Status “active / inactive” * Positive or negative direction of flow	“Undefined”	“Undefined”
“Warning”	Status “active / inactive” *	Status “active / inactive” *	“Undefined”	“Undefined”
LCD display	<div>+V 123456 m<sup>3</sup> -V 1234 m<sup>3</sup></div>	<div>1234 m<sup>3</sup></div> <div>Display blinks</div>	<div>FLOWSIC600 Configuration</div>	<div>+V 123456 m<sup>3</sup> E -V 1234 m<sup>3</sup></div> <div>Display blinks</div>
RS485 serial interface	<ul style="list-style-type: none"> <li>Measured values, diagnosis information and parameters</li> <li>Measured data logging, diagnosis and configuration using the program FLOWgate™</li> <li>Connection with external process control equipment through implemented MODBUS protocol (data polling)</li> </ul>			

Table 3: Status output

\* State “active” or “inactive” can be assigned the electrical switching state “normal open” or “normal closed” using the configuration in FLOWgate™ (settings for Reg. #5101 on page “Parameters”).

Measured values, parameters, messages and other information can be displayed on the LCD display.

A blinking character in the top right corner of the LCD display indicates that a logbook contains unacknowledged logbook entries. Depending on the type of entry this will be:

- “I” for Information
- “W” for Warning
- “E” for Error

### 3.5 Self-diagnosis with user warnings

During normal operation, the ratios of sound and path velocities, amplification values, performance, and signal-to-noise ratios are continuously monitored. If these values exceed set limits (customized User Warning limits), a warning signal will be generated. This allows immediate measures to be taken to address a problem which could potentially impact measurement quality. A message in the Warning Logbook documents the time of the event and the specific User Warning limit which was exceeded.



- The “Warning” signal does not affect the functionality of the meter.
- All User Warning parameters - except for the parameter “Min. VOG for warnings” - can be configured in the User Access Level “Operator” and without switching the meter to Configuration mode.

A User Warning becomes active only if a User Warning limit has been continuously exceeded for a certain time (the User Warning limit can be set in parameter “Warning/Averaging Duration”).

During commissioning or operation, the User Warning limits can be adapted and activated or deactivated in the “User Warnings” window in FLOWgate™ to suit individual application requirements.

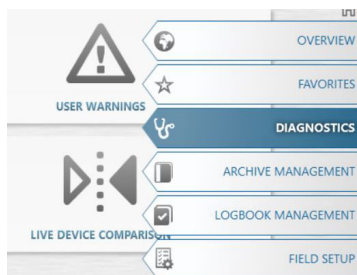


Fig. 4: Tab: “Diagnostics”

SYSTEM / PROFILE		PATH WARNINGS		DIAGNOSTIC COMPARISON	
System Warnings	Unit	User Limit	Live Value	Active	
Profile Factor Valid Value		1	1.000	<input checked="" type="checkbox"/>	
Profile Factor Range	%	5			
Symmetry Valid Value		1	1.000	<input checked="" type="checkbox"/>	
Symmetry Range	%	5			
Theoretical SOS Deviation	%	0.3	-	<input type="checkbox"/>	
VOG Limit	ft/s	154.199	0.013	<input checked="" type="checkbox"/>	
Input Voltage Warning	mV	11000	21248	<input checked="" type="checkbox"/>	
Configuration Mode				<input type="checkbox"/>	
Logbook unackn. Entries				<input type="checkbox"/>	
Logbook Full				<input checked="" type="checkbox"/>	

Precondition	Unit	User Limit	Live Value
Warning/Averaging Duration	s	30	
Min. VOG for Warnings	ft/s	8.99	0.013
SOS Profile Rising	%/s	0	0

Fig. 5: Menu “System/Profile”

SYSTEM / PROFILE		PATH WARNINGS		DIAGNOSTIC COMPARISON	
Path Warnings	Unit	User Limit	P1	P2	Active
Path Turbulence	%	6	0.00	0.00	<input checked="" type="checkbox"/>
SNR Limit	dB	13	A → B	26.88	24.36
			B → A	26.92	24.00
AGC Limit	dB	80	A → B	60	59
			B → A	60	59
AGC Deviation	dB	10	0.00	0.00	<input checked="" type="checkbox"/>
SOS Deviation	%	0.25	0.00	0.00	<input checked="" type="checkbox"/>
Performance Limit	%	80	100	100	<input checked="" type="checkbox"/>

Fig. 6: Menu “Path Warnings”

### 3.6 Wet gas detection

The FLOWSIC600 DRU/DRU-S firmware has a diagnostic function for detection of wet gas inside the meter (wet gas detection). The wet gas detection uses real-time monitoring of multiple diagnostic parameters of the FLOWSIC600 DRU/DRU-S in order to identify wet gas conditions (liquids in the gas stream such as liquid hydrocarbons, water and oil). Liquids in the gas stream are usually undesired in the gas production process and may require appropriate actions such as process optimization or consideration for meter readings. The wet gas detection typically detects wet gas with more than 0.5% of LVF (Liquid Volume Fraction) in continuous gas flow conditions.



Since the wet gas detection uses common standard diagnostic meter parameters, the wet gas warning may be activated in parallel to other user-warnings. In this case, a thorough analysis of the operating and process conditions may be beneficial to find the root cause. Consult your local Endress+Hauser subsidiary for support.

#### 3.6.1 Activating or deactivating wet gas detection

Wet gas detection is activated or deactivated as follows:

- 1 Open FLOWgate™.
- 2 Log in as user level “Operator” or higher.
- 3 Go to the “Parameter Modification” tab.



Fig. 7: Tab “Modification”

- 4 Go to the parameter tree.



Fig. 8: Tile “Parameter tree”

- 5 Switch to Configuration mode.
- 6 Switch wet gas detection on/off via register #3840.

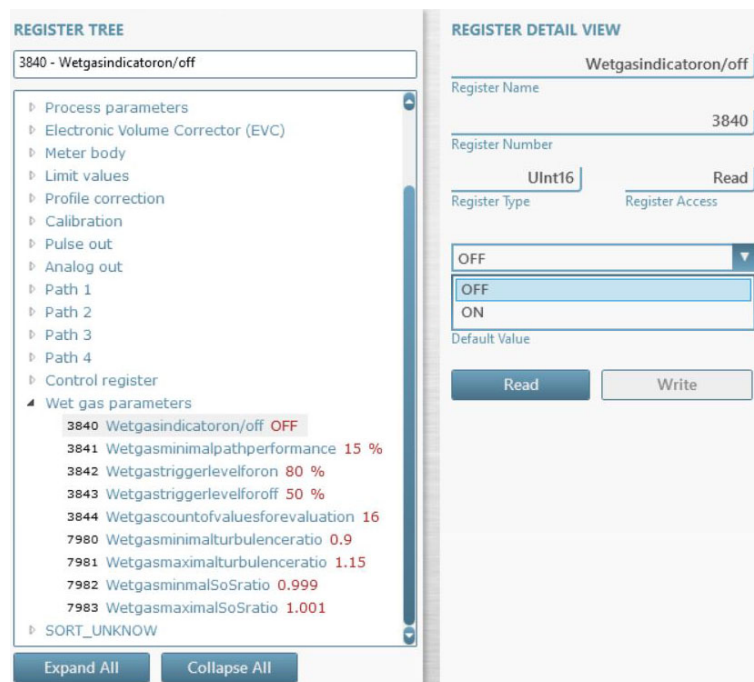



Fig. 9: Menu “Wet gas indicator on/off”

- 7 Click “Write” to save the change.
- 8 Switch to Measuring mode.

3.6.2      **Signalization of wet gas detection**

LCD (SPU)	Warning 2008: Wet gas
MODBUS Connection	#5069 (Bit 0x00000200UL) (see FLOWSIC600 Short Manual MODBUS)
Meter logbook	Entry in Warning logbook [2] with time stamp “Wet gas indication” (wet gas display).

Table 4: Signalization of wet gas detection



If the wet gas detection generates a warning frequently, the activation thresholds can be adjusted. Consult your local Endress+Hauser subsidiary for support. It is recommended to set the Warning logbook [2] to “rolling” to avoid rapid filling of logbook in this case.

### 3.7 Data processing in FLOW SIC600 DRU/DRU-S

#### 3.7.1 Integrated volume counters

The FLOW SIC600 DRU/DRU-S has integrated volume counters which can be displayed on both the LCD display and in FLOWgate™.

##### Integrated volume counters

Volume counter	Abbreviation
Volume at flowing conditions (forward)	+ Vf
Volume at flowing conditions (reverse)	- Vf
Error volume at flowing conditions (forward)	+ Ef
Error volume at flowing conditions (reverse)	- Ef
Total volume at flowing conditions (forward)	+ Vo
Total volume at flowing conditions (reverse)	- Vo
Total volume at flowing conditions (all)	Vo

##### Last hour/day registers

Volume counter	Abbreviation
Forward volume of last hour	Last hour forw.
Reverse volume of last hour	Last hour rev.
Forward volume of last day	Last day forw.
Reverse volume of last day	Last day rev.

##### Additional counters in gas flow meters with integrated Electronic Volume Corrector (EVC)

Volume counter	Abbreviation
Volume at base conditions (forward)	+Vb
Volume at base conditions (reverse)	- Vb
Error volume at base conditions (forward)	+ Eb
Error volume at base conditions (reverse)	- Eb

##### Mass counters

Mass counters	Abbreviation
Mass counter (forward)	+ M
Mass counter (reverse)	- M
Mass total (forward)	M+
Mass total (reverse)	M-
Error mass (forward)	Me+
Error mass (reverse)	Me-

### 3.7.2 Logbooks

Important system events are stored in three logbooks in the SPU memory of the meter.

Each logbook entry consists of a running index number, the event, a time stamp and the acknowledgment status. Entries in Custody logbook [1] and Warning logbook [2] also include the volume counter readings valid at that time. The events are logged continuously in order of occurrence into one of the three logbooks:

- Logbook 1 (Custody logbook [1], max. 1000 entries)
- Logbook 2 (Warning logbook [2], max. 500 entries)
- Logbook 3 (Parameter logbook [3], max. 250 entries)

Each logbook has its own index counter. Logbook entries are classified on the LCD display according to the event type.

#### Event types in logbooks

Display	Event type
E	Error
W	Warning
I	Information

A list of possible logbook entries can be found in the Table 'Overview of event entries' in the Appendix, → [page 91, 8.8.1](#).

#### Logbook overflow

If the FLOWSIC600 DRU/DRU-S is not configured as a custody meter, all logbooks are configured as overflowing by default. This means the index number continues increasing, and after the logbook has reached its maximum number of entries, each new entry overwrites the oldest entry.



In the event of a logbook overflow, the oldest data is lost. Data loss can be prevented by regularly saving the logbook entries in the database using FLOWgate™ and deleting the entries in the meter itself. The logbook index counter on the gas flow meter is reset when entries are deleted via FLOWgate™.

#### Index counter overflow

The index number displayed in the LCD display runs up to 9999 and then overflows. In case of an index overflow, all logbook entries are deleted and all logbook index counters reset.

#### Acknowledging entries

Each entry can be acknowledged manually on the LCD display as well as in FLOWgate™. It is possible to acknowledge individual entries or all entries at once.



Individual logbooks (Custody, Warning, Parameter Logbook) can be selected in FLOWgate™ in Tab “Logbook Management”. After the logbook entries have been loaded from the device, they can be confirmed with the button “Ackn. All” (Acknowledge all).

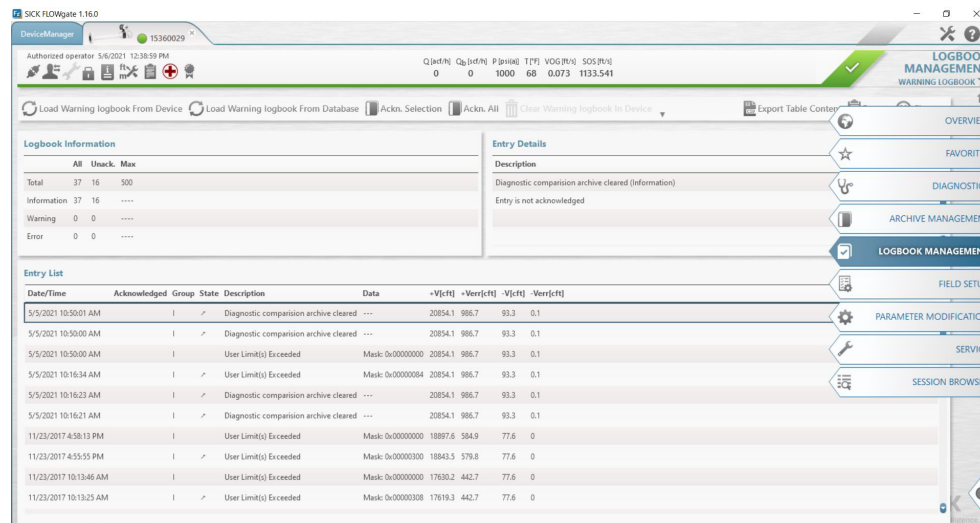


Fig. 10: Menu “Logbook Management”

### 3.7.3 DataLogs / Archives



This feature may be deactivated. Please contact your local Endress+Hauser representative.

FLWSIC600 DRU/DRU-S has two DataLogs (Hourly Log and Daily Log). They save averaged measured values and are stored in the SPU's non-volatile memory (FRAM). All data can be downloaded and exported to Excel files with FLOWgate™ in the Tab "Archive Management".



The following Sections describe the default configuration of the DataLogs. The DataLogs can be configured to best suit your application.



In FLOWgate™ the word "Archive" may be used as synonym for "Log". Hourly Logs and Daily Logs may be synonymously called Hourly Archives and Daily Archives.

#### Hourly Log (DataLog 2 / Hourly Archive)

The Hourly Log logs hourly diagnostic values by default for the forward flow. As long as the flow is valid and the VOG is above Vmin, all diagnostic and flow values are averaged over one hour and saved every full hour. The Hourly Log stores these values for more than a month (38 days) by default. They are then overwritten with new values.

#### Daily Log (DataLog 3 / Daily Archive)

The Daily Log logs the daily diagnosis values by default for the forward flow. All flow values are averaged over one day and saved at the (configurable) "Accounting Hour". The Daily Log stores these values for approximately 2 years by default (1 year and 361 days). They are then overwritten with new values.

#### DataLog storage cycle

Hourly Log and Daily Log can be configured to save entries in a storage cycle of: 3 min, 5 min, 15 min, 30 min, 1 hour, 12 hours or 24 hours.

Hourly Log (DataLog 2) defaults to one hour (register #3044). Daily Log (DataLog 3) defaults to one day (register #3047).

If a DataLog is set to a storage cycle of 12 or 24 hours, the "Accounting Hour" parameter takes effect.

#### DataLog storage behavior

Hourly Log and Daily Log can be configured for the following storage behavior:

- Overflow (Default)
- Stopping



#### Storage Behavior "Stopping"

If a DataLog is configured with the storage behavior "Stopping", a warning will be shown in the Meter Status Table when the DataLog is full.

#### Types of datasets stored in the DataLogs

Hourly Log and Daily Log can be configured to store one of the following data record types:

- Diagnostic values
- Volume counter
- Standard Volume Counters
- Mass Flow Counters

### 3.7.4 Diagnostics Comparison Log



This feature may be deactivated on delivery. Please contact your local Endress+Hauser representative when you wish to use this function.

The Diagnostics Comparison Log provides a comparison between current diagnostic values (current fingerprint) and those of a reference time (reference fingerprint), for example, at time of commissioning. Since the diagnostic values are velocity-dependent, it is necessary to use a velocity-adaptive comparison. Five gas velocity range classes are calculated from the velocity range of the meter. The current diagnosis values are stored in Current Classes 1 to 5, while the reference values are stored in Reference Classes 1 to 5.

Reference values are collected after the meter has been commissioned or after the classes have been cleared. Reference values are stored in the Reference Classes 1 to 5. If a Reference Class is filled with an entry, the next valid entry is stored into the same velocity range but in the corresponding Current Class (e.g. if Reference Class 1 is filled, the next value from within this velocity range will be stored in Current Class 1). During operation, the Current Classes are continually overwritten with new entries. The Reference Classes stay unchanged until they are manually cleared.

Per default the Diagnostics Comparison Log operates bidirectional, saving separate data for both flow directions. The values are stored in the gas velocity classes 1 to 5, depending on the gas velocity.

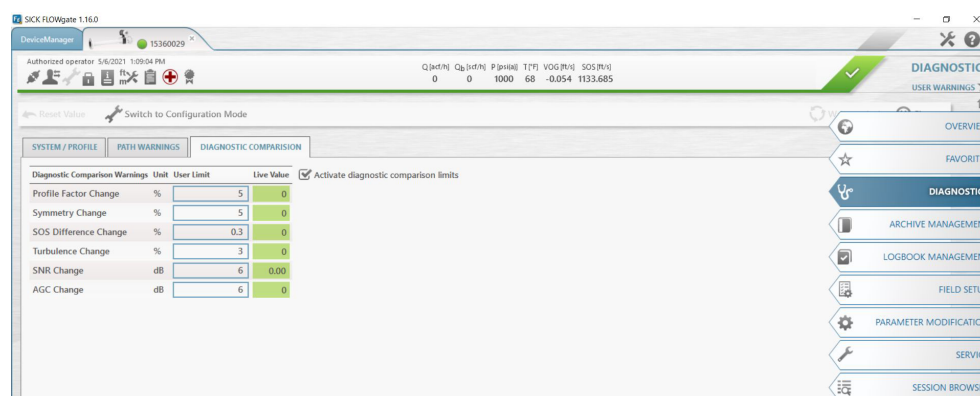


Fig. 11: Diagnostics Comparison Log

### 3.8 FLOWgate™



For the FLOWgate™ operating software, see “Software Manual FLOWgate™”. The Software Manual is available using the Help function of the FLOWgate™ operating software.

Most of the data delivered from the device (such as displays, logbook entries and parameters) can be accessed via the LCD display of the meter. The FLOWgate™ program provides a more user-friendly access to the diagnostic, configuration and measurement data of the flow meter.

#### 3.8.1 Overview

##### Software functions

- Measured values overview
- Diagnostic data
- Logbook and archive management
- Commissioning
- Parameter modification
- Session browser
- Calibration

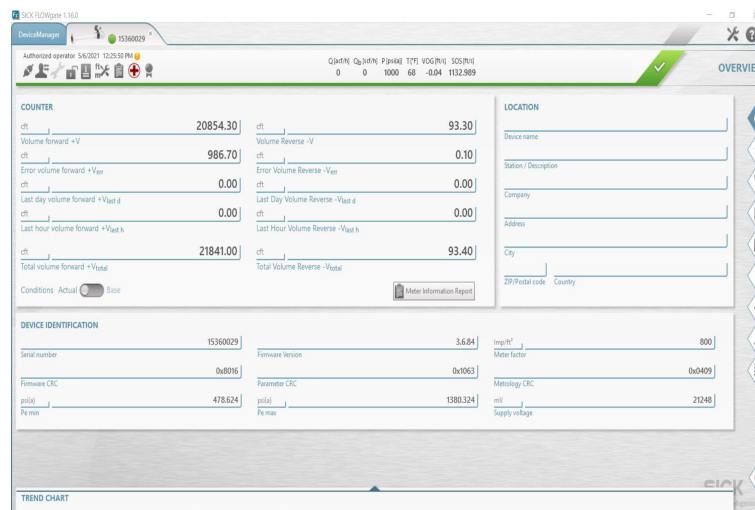


Fig. 12: Overview operating software

#### 3.8.2 System requirements

- Microsoft Windows 7/8/10
- Min. 1 GHz CPU
- Min. 512 MB RAM
- About 100 MB free disk capacity (without .NET framework)
- USB or serial interface
- Recommended minimum screen resolution: 1024 x 768 pixels, optimum screen resolution 1368 x 768 pixels
- Microsoft .NET framework 4.6

### 3.8.3 Installation

The software can be found on the Product CD or can be downloaded free of charge from the website [www.endress.com](http://www.endress.com) (search FLOWgate). After downloading the software, execute Installer exe and follow the instructions of the installation Wizard.



Administrator rights are required to install FLOWgate™. Ensure the user has write access to the specified database path in FLOWgate™.

### 3.8.4 Access rights

FLOWgate™ differentiates between three different user access levels. These support different setting and information depth within the program. The following functions are available depending on the active access level:

Device function	Operator	Auth. operator	Service
Standard password	-	sickoptic	See Service instructions
Overview	x	x	x
Read parameters and measured values	x	x	x
Read archives	x	x	x
Change non-custody-relevant parameters	-	x	x
Change custody relevant parameters	-	x	x
Air test mode	-	x	x
Configuration mode	-	x	x
I/O check	-	x	x
Regional device adaptation	-	x	x
User management	-	-	x

Table 5: Overview of access rights

## 4 Installation

### 4.1 General information

#### 4.1.1 Delivery

The FLOW SIC600 DRU/DRU-S is delivered preassembled in sturdy packaging. Inspect for damage after unpacking the device. In particular, the interior of the meter body, all visible sensor parts and the flange sealing surfaces must be checked for integrity. Document any damage found and report this to the manufacturer.

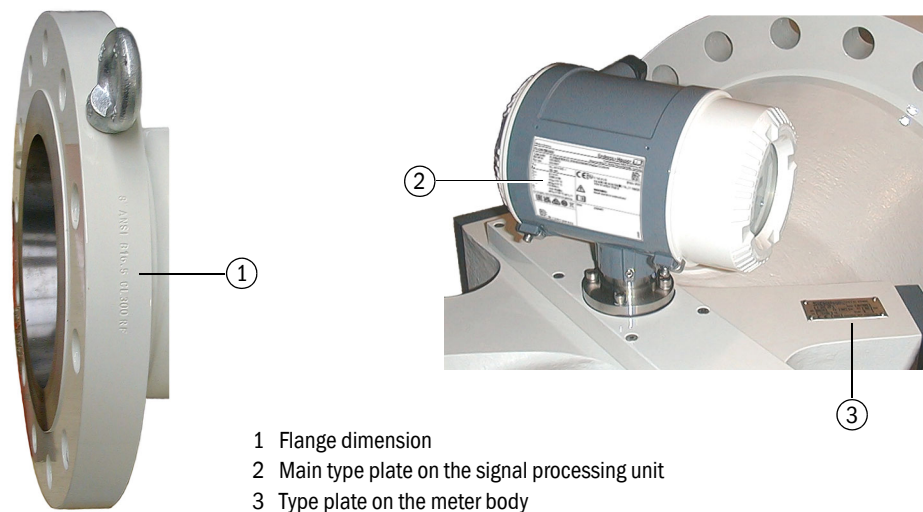
In addition, check the scope of delivery for completeness. The standard scope of delivery comprises:

- Measuring system FLOW SIC600 DRU resp. FLOW SIC600 DRU-S (meter body with signal processing unit and sensors)
- Program FLOWgate™ for operation, configuration and diagnostics
- Operating Instructions
- Delivery documentation



#### NOTICE:

To ensure safe operation of the measuring instrument, the markings on the signal processing unit and meter body must be checked for conformity with the conditions of use (→ Fig. 13).



- 1 Flange dimension
- 2 Main type plate on the signal processing unit
- 3 Type plate on the meter body

Fig. 13: Markings on FLOW SIC600 DRU/DRU-S

#### 4.1.2 Transport and storage



**WARNING: Danger due to asymmetric meter construction**

When transporting the FLOWSIC600 DRU, pay attention to uneven weight distribution because of the asymmetric meter construction.



**WARNING:**

Only use hoisting equipment and accessories (e.g. lifting straps) suitable for the weight to be lifted. Maximum load information can be found on the type plate of the hoisting equipment. It is strongly recommended that only the lifting lugs be used to lift the meter. Follow the instructions below to lift the FLOWSIC600 DRU/DRU-S.

When transporting and storing the FLOWSIC600 DRU/DRU-S, make sure:

- The measuring device is securely fixed at all times
- Mechanical damage is avoided
- Humidity and ambient temperature are within the specifications (→ [page 71, 8.3](#) or → [page 73, 8.4](#)).

If the device is stored outdoors for longer than 1 day, the sealing surfaces of the flanges and the inside of the meter body must be protected with a corrosion protection agent (e.g. Anticorit spray or similar) (not necessary for meter bodies made of stainless steel). The same applies to dry storage over a longer period of time (>1 week).



**NOTICE:**

Due to the natural temperature differences during the course of a day or the transport of the measuring device between locations of different temperatures, condensates form on any material. Unprotected carbon steel surfaces can corrode as a result.

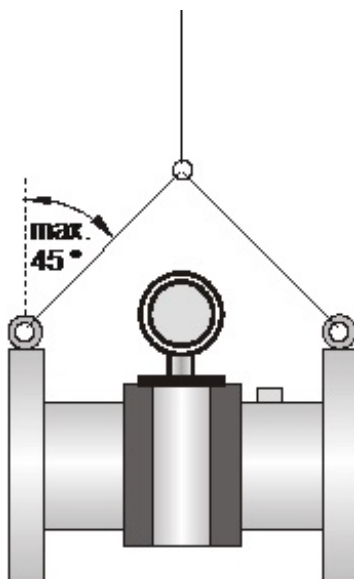


Fig. 14: Lifting requirements

## 4.2 Installation

Generally, the installation layout is determined during the project planning phase, before the system is installed. This means the nominal width, material and flange type of the meter body are matched to the design of the existing system. In particular, it must be ensured that the internal diameter of the meter body is identical to the internal diameter of the adjacent pipe sections.

Connecting bolts, nuts and flange gaskets used must comply with the conditions of use, statutory regulations and standards.



The installation requirements were evaluated according to pre-interference sensitivity tests according to

- OIML R 137-1&2, 2012 "Gas meters", Annex B mild



Any deviations from the intended design of the FLOWSIC600 DRU/DRU-S and the planned installation arrangement must be agreed with the supplier and documented before installation.

### 4.2.1 Measuring port

General requirements:

- The FLOWSIC600 DRU/DRU-S can be installed in conventional straight inlet and outlet pipes. These must have the same nominal size as the meter body. The inner diameter can be found in the dimensional drawings (→ [page 76, 8.6](#)). The maximum permitted difference of the inner diameter of the inlet pipe from that of the meter body is 3%. Any welding beads and burrs on the flanges of the inlet pipe must be removed.
- The meter body may be installed in a horizontal or vertical position. In case of horizontal installation, the meter body must be aligned so that the planes formed by the measuring paths are horizontal. This prevents dirt in the pipeline penetrating the sensor supports. Vertical installation is only possible when the measuring system is used for dry, non-condensing gases. The gas flow must be free from any foreign material, dust and liquids. Otherwise use filters and traps.
- Do not mount equipment or fittings which may adversely affect the gas flow directly before the FLOWSIC600 DRU/DRU-S.
- Seals on the flange connections between meter body and pipeline must not protrude into the pipeline. Any protrusion into the flowing gas stream may change the flow profile and thus adversely affect measuring accuracy.
- Connect pressure measuring devices to the pressure tap provided.
- For the leak-proof connection on the pressure line, use a suitable thread sealing agent (e.g. PTFE tape) when the pressure connection adapter is screwed in. Check the leak tightness after installation and commissioning. Repair all leaks.
- Arrange temperature measuring devices in accordance with the specified installation configuration → [page 33, 4.2.2](#).



#### 4.2.2 Installation configurations

- Make sure the meter is mounted in the correct orientation. The flow direction is marked on the meter body.
- FLOWSIC600 DRU is only suitable for unidirectional use.
- FLOWSIC600 DRU-S is suitable for unidirectional and bidirectional use.
- FLOWSIC600 DRU must be installed with upstream flow conditioner type CPA 55E. Installation without upstream flow conditioner or with another type of flow conditioner will cause higher uncertainty of measurement.

##### Installation configurations FLOWSIC600 DRU

###### Unidirectional use

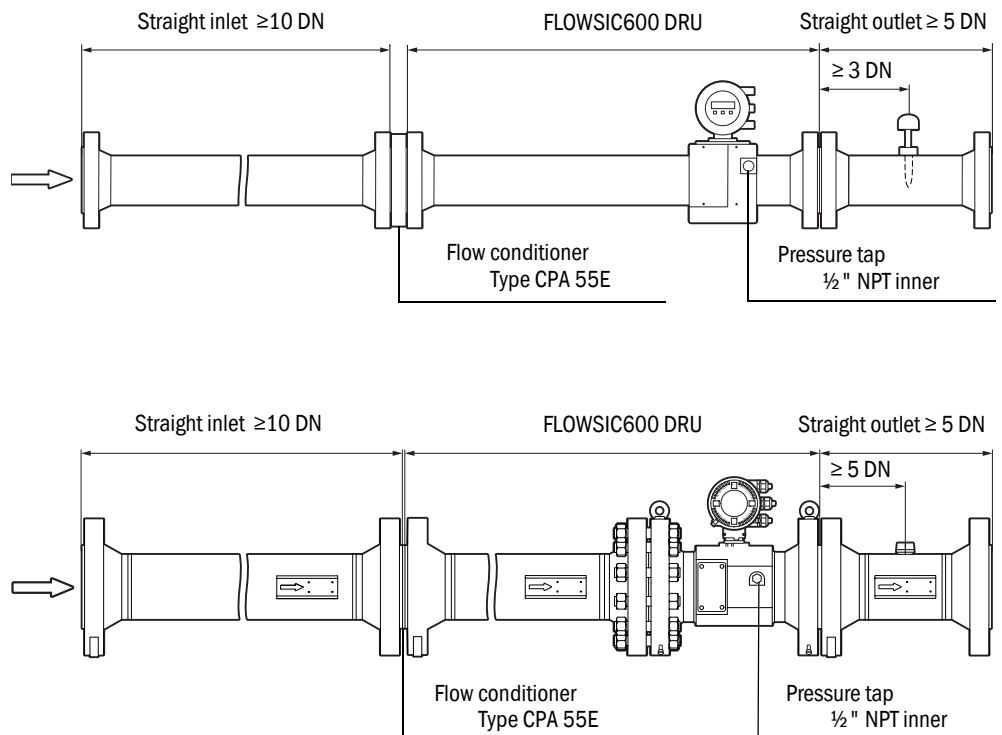


Fig. 15: Installation scheme FLOWSIC600 DRU, (diameters 3\"/>

### Installation configuration FLOWSIC600 DRU-S

#### Unidirectional use

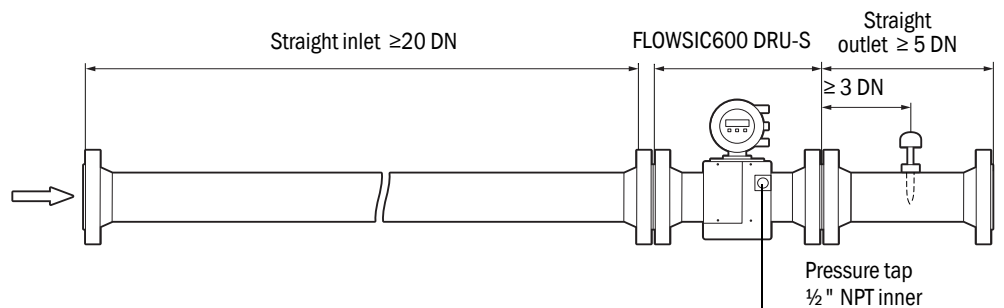


Fig. 16: Installation scheme FLOWSIC600 DRU-S, unidirectional

#### Bidirectional use

For bidirectional use of the FLOWSIC600 DRU-S, the requirements shown in → Fig. 17 are valid.

Install the temperature measuring point in the most frequently used flow direction downstream from the FLOWSIC600 DRU-S. In the figure, for example, the main flow direction is “from left to right”, so the temperature measuring point must be to the right of the FLOWSIC600 DRU-S.

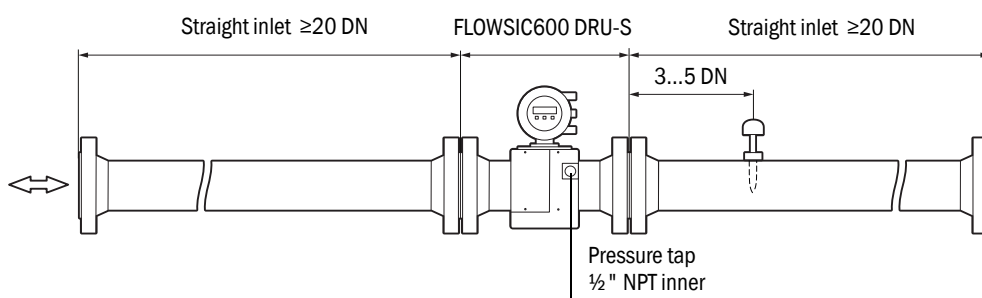


Fig. 17: Installation scheme FLOWSIC600 DRU-S, bidirectional

## 4.3 Mechanical installation



### WARNING:

- Always observe the general safety regulations and safety instructions given in Section 1 when carrying out any installation work.
- Only install the FLOWSIC600 DRU/DRU-S when the pipeline is pressure-free and vented.
- Take all necessary precautions to avoid local or plant-specific dangers.

The work on the piping required to install the gas flow meter is not included in the scope of delivery.

We recommend using the following tools for proper installation of the FLOWSIC600 DRU/DRU-S:

- Lifting gear or fork lift (load according to the weight specification on the type plate)
- Box wrench with size suitable for flange installation
- Thread seal (e.g. PTFE tape) and flange gaskets
- Bolt lubricant
- Leak detection spray

### 4.3.1 Choosing flanges, gaskets and other components



### WARNING:

- Comply with the safety requirements of Pressure Equipment Directive 2014/68/EC 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.

For flange connections use pipeline flanges, bolts, nuts and gaskets suitable for the maximum measurement pressure, maximum operating temperature as well as ambient and operating conditions (external and internal corrosion) (refer to the delivery documentation for fitting lengths and flange sizes).

### 4.3.2 Fitting the FLOWSIC600 DRU/DRU-S in the pipeline

An arrow on the meter body indicates the main direction of flow. For unidirectional use, the FLOWSIC600 DRU/DRU-S must be installed in the pipeline according to this specification. If the meter is to be used in the bidirectional mode, the arrow indicates the positive direction of flow.

#### Work to be performed



### WARNING:

- The lifting lugs are designed for transporting the meter only. The FLOWSIC600 DRU/DRU-S must not be lifted and transported using these lugs with additional loads (e.g. dummy cover for closing the device, filling for pressure test).
- Never attach hoisting equipment to the signal processing unit or its mounting bracket and avoid contact between these parts.
- The FLOWSIC600 DRU/DRU-S must not swing or tilt on the hoisting equipment during transport. Flange sealing surfaces, SPU enclosure and sensor cover caps may be damaged when the hoisting equipment is not attached properly.
- Take suitable protective measures to prevent any damage when carrying out other work (e.g. welding, painting) near the FLOWSIC600 DRU/DRU-S.

- ▶ Use the hoisting equipment to position the FLOWSIC600 DRU/DRU-S in the desired location in the pipeline. Only use the lifting lugs provided to lift and transport the device. If slings are used, these must always be placed around the meter body.
- ▶ Check for correct seating and alignment of the flange gaskets after installing the first flange bolts, but prior to tightening.

- ▶ Align the FLOWSIC600 DRU/DRU-S such that the offsets between inlet pipe, meter body and outlet pipe are minimized.
- ▶ Insert the remaining fastening bolts and tighten the nuts cross-wise. The tightening torque applied must not be lower than specified in the project planning.
- ▶ Fit the pressure sensing line between the pressure tap and pressure transmitter.
- ▶ Fill the pipeline and check the installed FLOWSIC600 DRU/DRU-S and piping connections for leaks.

**NOTICE:****Observe allowed pressure change**

The pressure change within the measuring section must not exceed 0.5 MPa/min in order to protect sensors and seals.



After completion of the mechanical installation, we recommend carrying out a leak test in accordance with the applicable regulations and standards.

### 4.3.3 SPU alignment

The SPU can be turned so that the display can be easily read and secure cable routing ensured. A stop on the enclosure prevents the SPU from being turned by more than 330°.

**NOTICE:**

Always tighten the hexagon socket screw after positioning the SPU.

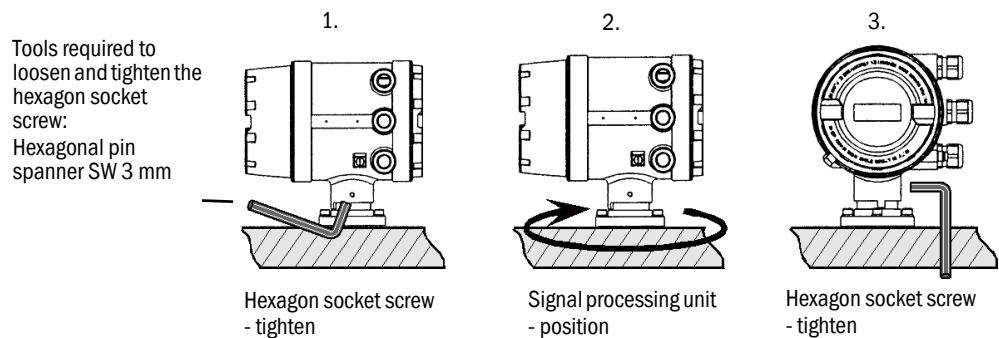


Fig. 18: Positioning the SPU

## 4.4 Electrical installation



### WARNING:

- ▶ Always observe the general safety regulations and safety instructions given in Section 1 when carrying out any installation work.
- ▶ Installation work shall only be carried out by trained staff and in accordance with the relevant regulations issued by the operating company.
- ▶ Take all necessary precautions to avoid possible local or plant-specific dangers.

### 4.4.1 General information

#### Prerequisites

Wiring work (routing and connecting the power supply and signal cables), which is necessary when installing the FLOWIC600 DRU/DRU-S, is not included in the scope of delivery. The assembly work described in Section → 4.3 must be completed first. Comply with the minimum cable specification requirements set out in Section → 4.4.2.



The initial configuration of the FLOWIC600 DRU-S can be taken from the delivery documentation and the circuit diagram in the rear enclosure cover.

#### Cable routing

- ▶ Keep cables in conduits or laid on cable trays to provide protection from mechanical damage.
- ▶ Observe the bending radii permitted for multi-conductor cables (generally, at least six times the cable diameter).
- ▶ Keep all connections outside of conduits as short as possible.

#### Basic connection of the FLOWIC600 DRU/DRU-S

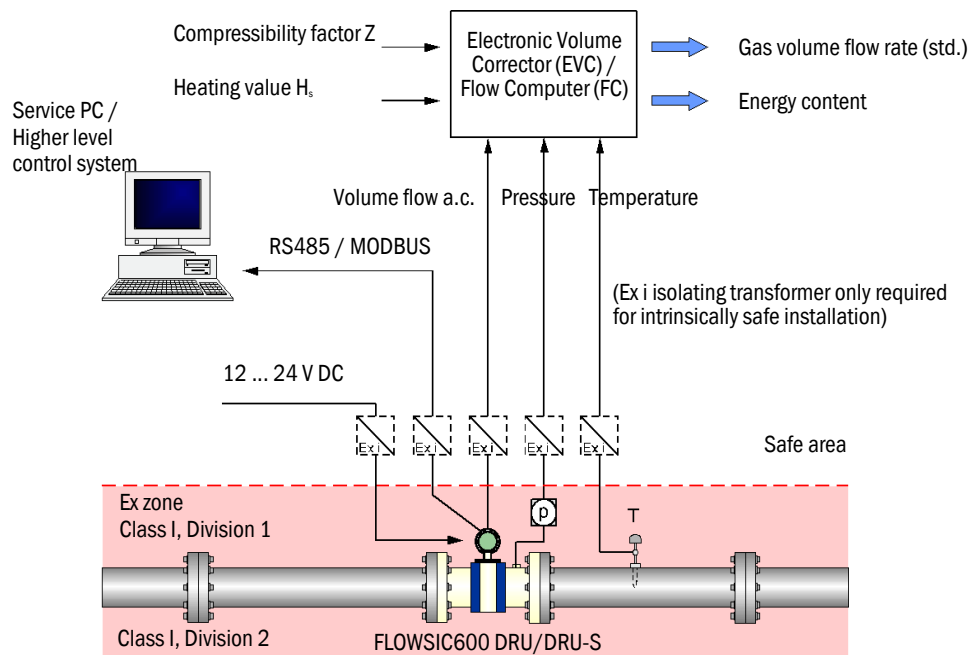


Fig. 19: FLOWIC600 DRU/DRU-S connection diagram

#### 4.4.2 Cable specifications

**WARNING:**

The cables must comply with the relevant standards and laws for use in potentially explosive atmospheres.

#### Power supply 12 ... 28.8 V DC

**NOTICE:**

Only the lower residual current may be used when the analog output is supplied internally and HART communication is used.

	Specification	Remark
Cable type	2 leads	Connect shielding (if present) to ground terminal
Min./max. cross-section	0.5 mm <sup>2</sup> / 2.5 mm <sup>2</sup> (20 - 12 AWG)	
Maximum cable length	Depending on loop resistance; The minimum input voltage on the FLOWSIC600 DRU/DRU-S must be 12 V DC.	Max. current 150 mA (peaks)
Cable diameter	6 ... 12 mm	Fixing range of cable glands

#### Digital output / current output

	Specification	Remark
Cable type	Twisted pair, shielded	Connect shielding at other end to ground terminal
Min./max. cross-section	2 x 0.5/1 mm <sup>2</sup> (2 x 20-18 AWG)	Do not connect unused conductor pairs and prevent them from accidental short-circuit
Maximum cable length	Loop resistance ≤ 250 Ω	
Cable diameter	6 ... 12 mm (1/4 to 1/2 inch)	Fixing range of cable glands

#### Serial interface (RS485)

	Specification	Remark
Cable type	Twisted pair, shielded, Cable impedance approx. 100...150 Ω Low cable capacitance: ≤ 100 pF/m	Connect shielding at other end to ground terminal
Min./ max. cross-section	2 x 0.5/1 mm <sup>2</sup> (2 x 20-18 AWG)	
Maximum cable length	300 m for 0.5 mm <sup>2</sup> 500 m for 0.75 mm <sup>2</sup>	Do not connect unused conductor pairs and prevent them from accidental short-circuit
Cable diameter	6 ... 12 mm (1/4 to 1/2 inch)	Fixing range of cable glands

#### 4.4.3 Checking the cable loops



**WARNING: Risk of explosion**

- In non-intrinsically safe installations, the terminal boxes may only be opened when the system is disconnected from the power supply.
- In non-intrinsically safe installations, the cables may only be disconnected when the system is disconnected from the power supply.
- The window cover must only be opened when the system is disconnected from the power supply and only 10 minutes or more after the system has been switched off, or the area is known to be Non-Ex.



**NOTICE:**

Applying test voltage to the cables before disconnecting them from the electronics module seriously damages the electronics module.



**NOTICE:**

Incorrect cabling may cause failure of the FLOWSIC600 DRU/DRU-S ! This will invalidate warranty claims. The manufacturer assumes no liability for consequential damage.

Check the cable loops to verify that the cables are connected correctly. Proceed as follows:

- ▶ Disconnect both ends of the cable of the loop to be tested. This is to prevent connected devices from interfering with the measurement.
- ▶ Test the entire cable loop between SPU and terminal device by measuring the loop resistance.
- ▶ To test the insulation resistance as well, the cables must be disconnected from the electronic module before using the insulation resistance tester.
- ▶ Reconnect all cables after the loop resistance test.

#### 4.4.4 Terminal compartment on the SPU

##### Opening the rear enclosure cover

- ▶ Loosen the securing clip using a 3 mm Allen key.
- ▶ Turn the rear enclosure cover counter-clockwise and take it off.



##### NOTICE:

Only use LOCTITE 8156 as lubricant for front and rear enclosure cover.

The connection plan is shown on the inside of the cover (schematic).

Open the cover

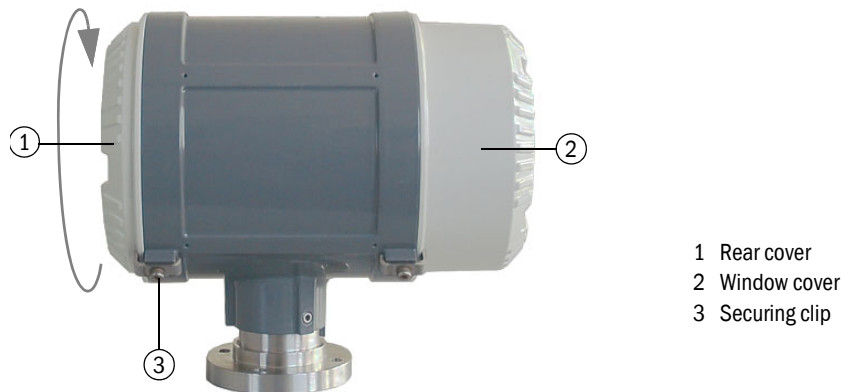
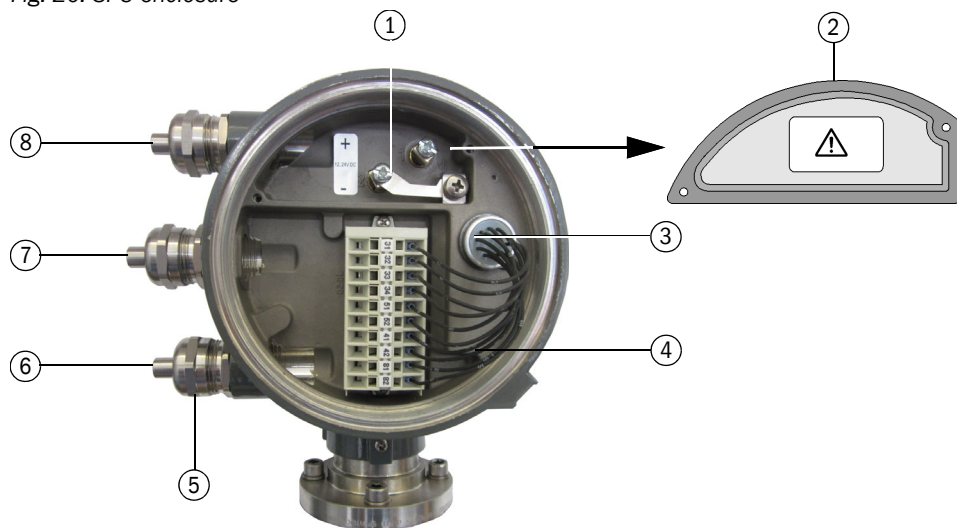


Fig. 20: SPU enclosure



- 1 Bridge
- 2 Cover for power supply connections
- 3 Cable duct for internal 10-pole cable
- 4 Terminal strip 10-pin for signal inputs and outputs
- 5 Cable gland HSK M M 20 x 1.5 (EU) or 1/2 in NPT (North America)
- 6 MODBUS 4 x 2 x 0.5 mm² (Li2YCY [TP] or similar)
- 7 Digital output / power output 4 x 2 x 0.5 mm² (Li2YCY [TP] or similar)
- 8 Power supply 2 x 1.5 mm² (LiYCY or similar)

Fig. 21: Terminal compartment at the rear of the SPU (see Section → 4.4.2 for North American wiring specification equivalents)



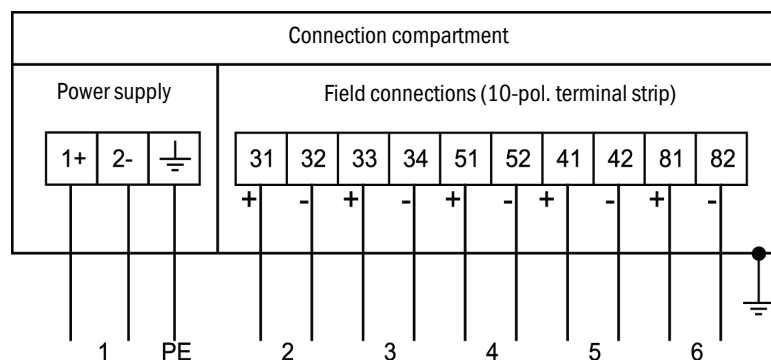


Fig. 22: Terminal assignment for Non-Ex operation



**NOTICE:**

**Potential equalization**

PE: Potential equalization terminal must be connected to ground.



**NOTICE:**

**Device internal bridge**

Terminals 2 and PE are bridged internally, i.e. there is no galvanic separation between PE and negative potential (→ Fig. 21).

- This bridge is an integral part of the device and absolutely necessary. It must not be removed or modified.
- Modifying the bridge voids the manufacturer's warranty



**NOTICE:**

**Termination of the Modbus lines**

Start and end of the Modbus lines must be terminated.

- Terminal 81/82 Always terminated
- Terminal 33/34 Switchable, terminated at the factory

Detailed information, see the Service Manual FLOWSIC600 DRU.

#### 4.4.5 Operation in Non-Ex areas:

Assign the terminals in the SPU terminal compartment (→ Fig. 22) as shown in the following Table.

No.	Connection for	Function	Terminal	Value	Remark
1	Power supply		1+, 2-	12 ... 24 (+20%) V DC	
2	Digital output DO 0 (HF 2)	Passive	31, 32	$f_{\max} = 6 \text{ kHz}$ , configurable pulse width 0.05 s - 1 s Range: Variable number of pulses per volume unit "Closed": $0 \text{ V} \leq U_{\text{CE L}} \leq 2 \text{ V}$ , $2 \text{ mA} \leq I_{\text{CE L}} \leq 20 \text{ mA}$ (L=Low) "Open": $16 \text{ V} \leq U_{\text{CE H}} \leq 30 \text{ V}$ , $0 \text{ mA} \leq I_{\text{CE H}} \leq 0.2 \text{ mA}$ (H=High)	As NAMUR contact for connection to switching amplifier (acc. to EN 60947-5-6:2000)
3	Serial interface	MODBUS (RS485)	33, 34	9600 baud, 8 data bits, no parity, 1 stop bit	Baud rate to be set through software
4	Digital output DO 1 (HF 1)	Passive	51, 52	$f_{\max} = 6 \text{ kHz}$ , configurable pulse width 0.05 s - 1 s Range: Variable number of pulses per volume unit "Closed": $0 \text{ V} \leq U_{\text{CE L}} \leq 2 \text{ V}$ , $2 \text{ mA} \leq I_{\text{CE L}} \leq 20 \text{ mA}$ (L=Low) "Open": $16 \text{ V} \leq U_{\text{CE H}} \leq 30 \text{ V}$ , $0 \text{ mA} \leq I_{\text{CE H}} \leq 0.2 \text{ mA}$ (H=High)	As NAMUR contact for connection to switching amplifier (acc. to EN 60947-5-6:2000)
5	Digital output DO 2	Passive	41, 42	"Closed": $0 \text{ V} \leq U_{\text{CE L}} \leq 2 \text{ V}$ , $2 \text{ mA} \leq I_{\text{CE L}} \leq 20 \text{ mA}$ (L=Low) "Open": $16 \text{ V} \leq U_{\text{CE H}} \leq 30 \text{ V}$ , $0 \text{ mA} \leq I_{\text{CE H}} \leq 0.2 \text{ mA}$ (H=High) "Maintenance request" (standard)	
6	Digital output DO 3	Passive	81, 82	"Closed": $0 \text{ V} \leq U_{\text{CE L}} \leq 2 \text{ V}$ , $2 \text{ mA} \leq I_{\text{CE L}} \leq 20 \text{ mA}$ (L=Low) "Open": $16 \text{ V} \leq U_{\text{CE H}} \leq 30 \text{ V}$ , $0 \text{ mA} \leq I_{\text{CE H}} \leq 0.2 \text{ mA}$ (H=High) "Flow direction" (standard) (alternative "Warning")	
	Alternative assignment with second serial output (RS485)			9600 baud, 8 data bits, no parity, 1 stop bit	Baud rate to be set with software

Table 6: Terminals in the signal processing unit terminal compartment

#### 4.4.6 Operation in Ex zones

##### Intended use

The FLOW SIC600 DRU/DRU-S is for use in hazardous areas classified as Zone 1 and Zone 2 as specified in Sections → 8.3 and → 8.4.

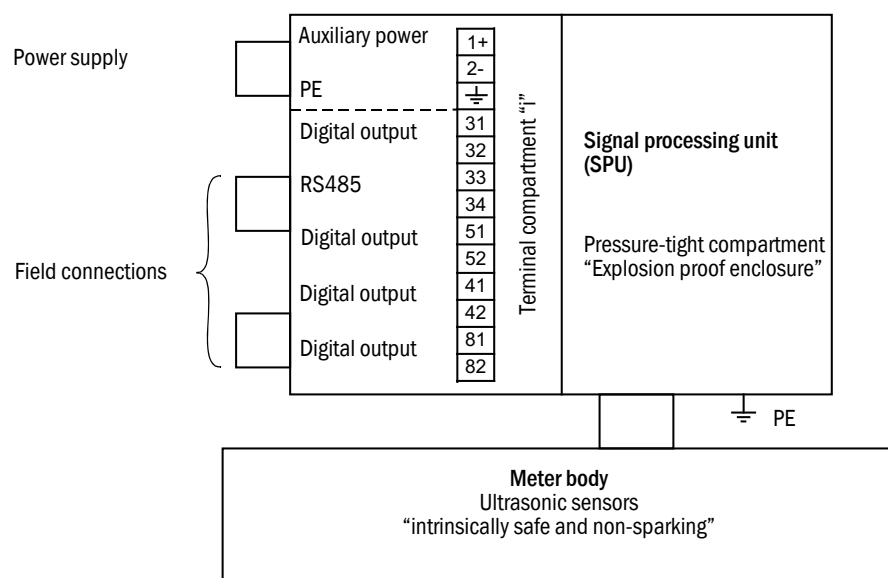


Fig. 23: FLOW SIC600 DRU/DRU-S components and their type of protection

### Operating conditions for the ultrasonic sensors

The FLOWSIC600 DRU/DRU-S is designed for use in hazardous areas with potentially explosive atmospheres only under normal atmospheric conditions. The atmospheric conditions must be within the following ranges:

- Ambient pressure range 0.8 bar(a) (11.6 psi(a)) to 1.1 bar(a) (16 psi(a))
- Air with normal oxygen content, typically 21% v/v

The ambient temperature must be within the range specified on the SPU type plate: e.g. -40 °C to 60 °C (-40 °F to 140 °F).

The meter body becomes part of the pipeline as soon as the FLOWSIC600 DRU/DRU-S is installed in the pipeline. The wall of the pipeline and the meter body are then deemed a zone-separating barrier. The Figure below helps in understanding the different situations for a possible application and shows which operating conditions apply.

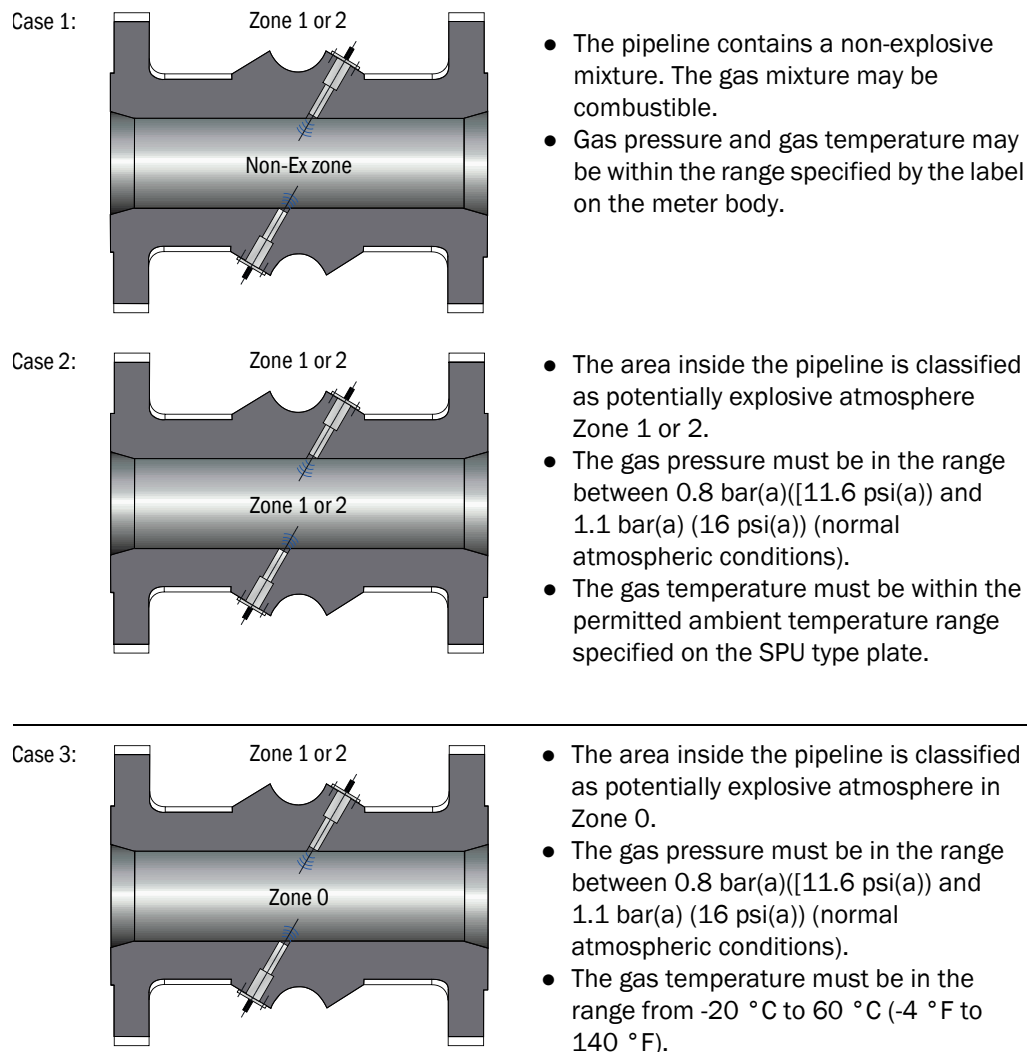


Fig. 24: Ex-Zones

## Operating the ultrasonic sensors in Zone 0 and Class I Division 1



### NOTICE:

The rise in the ambient temperature outside the pipeline due to a hot pipeline must be taken into account.

The user must ensure the ambient temperature around the electronics housing does not exceed the maximum permitted ambient temperature specified on the FLOWSIC600 DRU/DRU-S type plate.

The ultrasonic sensors are suitable for operation in Zone 0 at atmospheric conditions, i.e. ambient temperature -20 °C to 60 °C (-4 °F to 140 °F) and ambient pressure 0.8 bar(a) to 1.1 bar(a) (11.6 psi(a) and 16 psi(a)). If ultrasonic sensors with titanium enclosure are to be used in Zone 0, it must be assured that the medium does not transport solid parts (such as dust or other particles) which could cause an ignition hazard. Otherwise, sensors made of stainless steel must be used.

Check the sealing efficiency in a suitable manner after installing the ultrasonic sensors and every time these are deinstalled and reinstalled. Check the leak-tightness periodically during operation and replace the seals replaced if necessary. Replace the seals after removal and before reinstallation in accordance with the original assembly. Seals can be ordered from Endress+Hauser (part number and serial number on the SPU type plate).

### Requirements regarding cabling

- The cables must meet the requirements of the relevant standards.
- Cables subject to exceptional thermal, mechanical or chemical stress must be specially protected, e.g. by laying them in conduits.
- Observe the clamping range of the cable glands for cable selection.
- For intrinsically safe wiring and an ambient temperature range between -20 °C to +60 °C (-4 °F to 140 °F), the existing metal cable glands may be replaced with light-blue plastic cable glands (available on request).
- Replace the existing cable glands with suitable cable glands if installation with armored cables is intended.
- Protect stranded wires against fraying with ferrules.
- Connect unused wires to ground or safeguard so that a short circuit with other conductive parts is excluded.
- Carry out equipotential bonding.
- The meter body and the enclosure must be connected to the potential equalization.
- Where the FLOWSIC600 DRU/DRU-S is installed in a grounded metal duct, no additional grounding is required for the meter body. The electronics housing must nevertheless be separately grounded.

---

**Connection of the FLOWSIC600 DRU/DRU-S with associated equipment**

---

**WARNING: Risk of explosion**

- Do not open the enclosure while the device is energized.
  - Wait 10 minutes after power has been removed before opening the window cover.
  - Do not open the cover of the terminal compartment while energized unless wiring is intrinsically safe.
  - Do not remove the cover of the power supply while energized unless wiring is intrinsically safe.
  - Do not connect or disconnect while circuits are live unless the area is known to be non-hazardous or wiring is intrinsically safe.
  - Do not use the equipment if damaged (includes cables or terminals).
- 

The terminal compartment of the FLOWSIC600 DRU/DRU-S meets the requirements of CAN/CSA-C22.2 No. 157-92 and UL Std. No. 913.

The FLOWSIC600 DRU/DRU-S provides non-intrinsically safe wiring as well as intrinsically safe wiring with the interconnected associated equipment in the following manner:

- 1 Power supply connection and all other field connections as non-intrinsically safe wiring.
- 2 Power supply connection and all other field connections as intrinsically safe wiring to Exi certified equipment in a Zone 1 or Zone 2 classified hazardous area or to [Exi] certified associated equipment in the safe area.
- 3 Power supply connection as non-intrinsically safe wiring and all other field connections as intrinsically safe wiring.

A combination of intrinsically safe and non-intrinsically safe wiring for the field connections is not permitted. Maximum voltage in the safe area must not exceed 253 V ( $U_m = 253 \text{ V}$ ).

For intrinsically safe wiring:

- The safety-relevant data in the EC Type Examination Certificate and the IECEx Certificate of Conformity must be observed.
- The intrinsic safety for each circuit must be assessed in accordance with the relevant standards.
- The safety-relevant parameters of interconnected equipment must comply with the following values:  $U_o < U_i$ ,  $I_o < I_i$ ,  $P_o < P_i$ ,  $C_i + C_{\text{cable}} < C_o$ ,  $L_i + L_{\text{cable}} < L_o$ .
- The interconnection of two or more intrinsically safe outputs may require an additional assessment of intrinsic safety in accordance with the relevant standards.

Ensure the cover on the power supply connection is properly sealed for regular operation.

In the case of intrinsically safe wiring, the rear cover can be removed and live connection and disconnection are permitted as long as there is safe isolation between the power circuits.

### Terminal assignment

The terminals in the terminal compartment of the signal processing unit (→ Fig. 22) must be assigned as when using the FLOW SIC600 DRU/DRU-S in the Non-Ex area (→ page 42, Table 6:).



#### NOTICE:

For measurement reasons, the equipotential bonding should, as far as possible, be identical to the pipeline potential or protective ground. Additional grounding with the protective conductor via the terminals is not permitted!

The connections of the ultrasonic sensors are intrinsically safe and safely separated from one another and from other non-intrinsically safe circuits. The sensors may be connected and disconnected during operation as long as safe separation of circuits is ensured in every respect. In order to ensure this, the respective sensor connection cable should be disconnected at both ends (disconnect the electronics side first, and then if necessary, the sensor side unless the MCX connector is suitably fixed to prevent any uncontrolled movement). Operation using sensors or cables not part of the original delivery or with sensors/components from other manufacturers is not permitted.



#### NOTICE:

Only allow qualified personnel to replace the buffer battery with PANASONIC type BR2032, Endress+Hauser part number 7048533.

### Specific requirements for installation and use in North America

The FLOW SIC600 DRU/DRU-S is intended for use in hazardous locations classified as Class I Division 1 and Class I Zone 1 as follows:

- Cl. I, Div. 1, Groups B, C and D, T4 resp. Cl. I, Zone 1, Group IIB + Hydrogene, T4
- Cl. I, Div. 1 Group D, T4 resp. Cl. I, Zone 1, Group IIA, T4

The FLOW SIC600 DRU/DRU-S is still intended for use in hazardous locations classified as Class I Division 2 and Class I Zone 2 as follows:

- Cl. I, Div. 2, Groups A, B, C and D, T4 resp. Cl. I, Zone 2, Group IIC, T4
- Cl. I, Div. 2 Group D, T4 resp. Cl. I, Zone 2, Group IIA, T4

### Installation

- Install in the US acc. to NEC.
- Install In Canada acc. to CEC part 1.

For further details, see drawing no. 781.00.02 (→ page 96, 8.10).

## Notes for safe operation in hazardous areas

**WARNING:**

Always observe the temperature specifications according to the Ex-approval.

**WARNING: Risk of explosion**

The ultrasonic probes are preferably made of titanium.

In the event that Zone 0 or Zone 1 is defined within the pipeline, operation may only take place when ignition hazards due to impact or friction can be excluded.

**WARNING: Ignition hazards through electrostatic discharges**

Ignition hazards through electrostatic discharges can exist when gas flow meters with special paint and a layer thickness >0.2 mm are used in applications with ignition group IIC in accordance with ATEX and IECEx.

- For installation, the risk of electrostatic charging of the surface must be reduced to a minimum.
- Use appropriate caution when performing maintenance and cleaning work. For example, the surfaces should only be cleaned with a damp cloth.
- A warning sign fitted at the factory identifies this type of device:



Approval of the ultrasonic sensors in Zone 0 is only valid for operation under atmospheric conditions.

- Ambient temperature range from -40 °C to 60 °C (-4 °F to 140 °F).
- If terminals are switched with intrinsically safe circuits, it is recommended that the metal cable glands are replaced with the light-blue plastic ones.
- The type of protection for the field connections and power supply connection is determined by the external circuits connected (for options, see "Connection variants").
- Refer to "Control Drawings" for the safety-related data for intrinsically safe circuits.
- Ensure the cover on the power supply connection is properly sealed. In intrinsically safe installations, the terminal compartment can be opened and cables connected and disconnected while the system is live. In this case the safe separation of the circuits from each other must be observed.
- If the meter body is thermally insulated, the insulation thickness must not exceed 100 mm. The SPU enclosure must not be insulated.
- The FLOWSIC600 DRU/DRU-S meter body receives a double coat of paint at the factory: Epoxy and Acrylic RAL9002. This combination ideally protects the meter body from corrosion. The layer thickness is less than 0.2 mm.



**Safety-relevant data of inputs and outputs only for FLOW SIC600 DRU/DRU-S according to Class-Division and Class-Zone certification**



**WARNING:**

$U_m = 253 \text{ V}$ : Maximum voltage in the safe area must not exceed 253 V for intrinsically safe installation.

Power circuit	Ignition protection type intrinsically safe Ex ia/ib IIA/IIB/ IIC								Not intrinsically safe
Power supply	U <sub>I</sub> = 20 V, P <sub>I</sub> = 2.6 W								12 ... 24 V DC
Current output Terminals 31/32	U <sub>O</sub> = 22.1 V								
	I <sub>O</sub>	P <sub>O</sub>	Ex ia/ib IIA		Ex ia/ib IIB		Ex ia/ib IIC		
	[mA]	[mW]	C <sub>O</sub> [μF]	L <sub>O</sub> [mH]	C <sub>O</sub> [μF]	L <sub>O</sub> [mH]	C <sub>O</sub> [nF]	L <sub>O</sub> [mH]	
All hardware variants	87	481	2	7	0.5	4	77	1	
	Characteristic curve: Linear or with the following maximum values for connection to certified intrinsically safe power circuits: U <sub>I</sub> = 30 V I <sub>I</sub> = 100 mA P <sub>I</sub> = 750 mW Effective internal capacity: C <sub>i</sub> = 4 nF Effective internal inductance: Negligible								U <sub>B</sub> = 18 V I <sub>B</sub> = 35 mA
Digital output Terminals 51/52 Terminals 41/42 Terminals 81/82	For connection to certified intrinsically safe power circuits with the following maximum values: U <sub>I</sub> = 30 V I <sub>I</sub> = 100 mA P <sub>I</sub> = 750 mW Effective internal capacity: C <sub>i</sub> = 4 nF Effective internal inductance: Negligible								U <sub>B</sub> = 30 V I <sub>B</sub> = 100 mA
RS485 Terminals 33/34 Terminals 81/82	Characteristic curve: Linear U <sub>O</sub> = 5.88 V I <sub>O</sub> = 313 mA P <sub>O</sub> = 460 mW C <sub>O</sub> = 1000 μF for IIA resp. 43 μF for IIC L <sub>O</sub> = 1.5 mH for IIA resp. 0.2 mH for IIC or with the following maximum values for connection to certified intrinsically safe power circuits: U <sub>I</sub> = 10 V I <sub>I</sub> = 275 mA P <sub>I</sub> = 1420 mW Effective internal capacity: C <sub>i</sub> = 4 nF Effective internal inductance: Negligible								U <sub>B</sub> = 5 V I <sub>B</sub> = 175 mA
Ultrasonic sensor connections (for connecting Endress+Hauser ultrasonic sensors only)	Ex ia/ib IIA			Ex ia/ib IIB		Ex ia/ib IIC			
	Characteristic curve: Linear Max. transmission voltage: U <sub>O</sub> = ±60.8 V U <sub>O</sub> = 60.8 V Short-circuit current: I <sub>O</sub> = 92 mA P <sub>O</sub> = 388 mW Effective internal capacity C <sub>i</sub> = v.k. (negligible) Effective internal inductance: L <sub>i</sub> = 20.6 mH			U <sub>O</sub> = 51.2 V I <sub>O</sub> = 77 mA P <sub>O</sub> = 372 mW negligible L <sub>i</sub> = 15.5 mH		U <sub>O</sub> = 38.9 V I <sub>O</sub> = 59 mA P <sub>O</sub> = 248 mW negligible L <sub>i</sub> = 6.7 mH			

Table 7: Safety-relevant data of inputs and outputs only for FLOW SIC600 DRU/DRU-S according to Class-Division and Class-Zone certification

## 5 Commissioning

### 5.1 General information

**NOTICE: Measures in a metrologically secured area**

If stipulated by national regulations, after commissioning, measures on the device in the metrologically secured area may only be carried out under official supervision. This must be coordinated with the authorities before carrying out the measures. All measures must be carried out on the basis of this Manual and, when necessary, the Service Manual for the product.

- All activities described in Section → [page 30, 4](#) must be completed before commissioning. A laptop/PC with the FLOWgate™ operating software installed is required for commissioning.
- The commissioning should be documented with a Commissioning Protocol. The document “FLWSIC600 Commissioning Protocol” is part of the scope of delivery of the FLWSIC600 DRU/DRU-S and can be found on the Product CD. File the completed Commissioning Protocol with the FLWSIC600 DRU/DRU-S device documentation.
- The FLWSIC600 DRU/DRU-S is zero adjusted or flow calibrated when delivered to the end user. The zero adjust comprises the 3-D measurement of the meter body, zero-flow and sound velocity test as well as other system specific tests belonging to the manufacturing and quality assurance process. The flow calibration is performed on a flow calibration test stand (calibration test facility).
- All parameters, determined by the aforementioned tests, as well as design specific data are preset and stored in the FLWSIC600 DRU/DRU-S in non-volatile memory before delivery. Generally, the parameters are protected by a password. Additionally, a Parameter write lock in the signal processing unit prevents custody relevant parameter changes.
- In all other cases, the FLWSIC600 DRU/DRU-S can be adapted on site by trained staff.
- Commissioning the FLWSIC600 DRU/DRU-S is supported by the Field Setup wizard in the FLOWgate™.

## 5.2 Connecting to the device

### 5.2.1 Connecting the FLOWsIC600 DRU/DRU-S via an RS485/USB converter

The FLOWsIC600 DRU/DRU-S can be connected and configured with the laptop/PC using a separate RS485/USB converter.

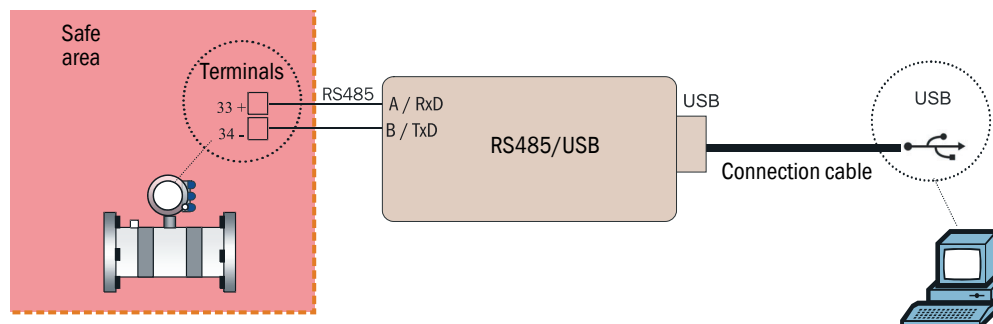


Fig. 25: Wiring example for “Interface set RS485/USB”, non-intrinsically safe



Possible terminals for the RS485 connection are:

- 33(+) and 34(-)
- 81(+) and 82(-)

If necessary, the RS485 ports can be assigned to a specific bus address (Reg. #5020 “DeviceBusaddress”). The service port always has bus address “1”.

The RS485/USB converter is available from Endress+Hauser using the following Part No.:

Description	Part No.
“MEPA interface set RS485/USB” (Converter, cable, terminal plug, CD-ROM with software driver), non-intrinsically safe	6030669

Table 8: Interface set to connect the FLOWsIC600 DRU/DRU-S to a network

### 5.2.2 Connecting devices with FLOWgate™ for commissioning

- 1 Connect the RS485 cable to the FLOWsIC600 DRU/DRU-S.
- 2 Connect the USB cable with the laptop/PC.
- 3 Start FLOWgate™.
- 4 Click “Start Scan”.
- 5 Check the “Serial Port” box.

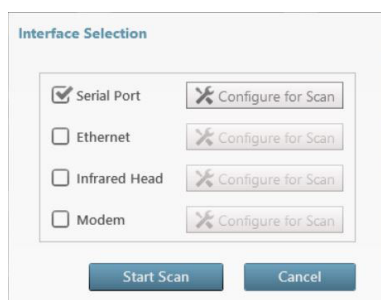


Fig. 26: Menu “Interface Selection”

- 6 Select the Com Port used and accept the following default settings.

**Configure Serial Connection**

<b>ComPorts</b> <input checked="" type="checkbox"/> COM3 USB Serial Port	<b>Baudrates</b> <input type="checkbox"/> 1200 <input type="checkbox"/> 2400 <input type="checkbox"/> 4800 <input type="checkbox"/> 9600 <input type="checkbox"/> 19200 <input type="checkbox"/> 38400 <input checked="" type="checkbox"/> 57600 <input type="checkbox"/> 115200	<b>Parity</b> <input checked="" type="checkbox"/> None <input type="checkbox"/> Odd <input type="checkbox"/> Even
<b>Protocols</b> <input type="checkbox"/> MODBUS RTU <input type="checkbox"/> MODBUS ASCII <input type="checkbox"/> SICK MODBUS RTU <input checked="" type="checkbox"/> SICK MODBUS ASCII	<b>DataBits</b> <input type="checkbox"/> 7 <input checked="" type="checkbox"/> 8	<b>StopBits</b> <input checked="" type="checkbox"/> 1 <input type="checkbox"/> 2
<b>Info</b> Scan will take approx. 1 seconds.	<b>Address</b> <input checked="" type="checkbox"/> 1 <input type="checkbox"/> All (1-254) <input type="checkbox"/> 1-32	<b>Timeout</b> 1000 [ms]

OK Set to Default Select All Cancel

Fig. 27: Menu "Configure Serial Connection"

- 7 Click "OK".  
 8 Click "Start Scan".

If all settings are correct, a connection can be established with the device.

- 9 Click "Connect".

**Scan Connected Devices**

FLOWSIC600 DRU  
 SN: 15360029, SICK MODBUS ASCII, COM3

Device already present in DeviceManager

Connect

Fig. 28: Connecting FLOWgate™ with the device

- The device FLOWSIC600 DRU/DRU-S is connected with the FLOWgate™ device manager.

- 10 Login with user "Authorized operator". → [page 29, 3.8.4](#)

## 5.3 Identification

### Checking identification, operation / design data and firmware version

Before commissioning, the FLOWIC600 DRU/DRU-S data must be compared against the data in the Test protocols contained in the delivery documentation. This can be done on the LCD display on the FLOWIC600 DRU/DRU-S → [page 79, 8.7](#) or with FLOWgate™.

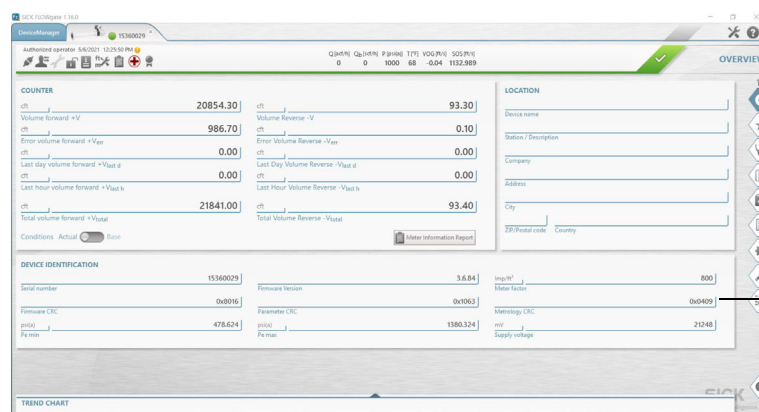
- Open tab “Overview” and compare the data in Section “Device identification” with the Test protocols in the delivery documentation.



If the FLOWIC600 DRU/DRU-S has been precalibrated, use the Calibration report and Parameter report instead of the delivery documentation.

### Firmware

The FLOWIC600 DRU/DRU-S firmware is stored in non-volatile memory (FLASH PROM). The program codes for the signal processor and system micro-controller are identified by a version number (Reg. #5002 “FirmwareVersion”) and a check sum (Reg. #5005 “ProgramCRC”) and can be verified as mentioned above.



Device identification

Fig. 29: FLOWgate™ overview

## 5.4 Field Setup wizard



- Parameter changes are first written to the device when commissioning has been completed when using the Field Setup wizard.
- Configuration mode must be active to change parameters.

### 5.4.1 System + LCD

#### Date and time

- Enter the date and time or synchronize with the laptop/PC.

#### Identification

- Serves to enter an individual name for the device.

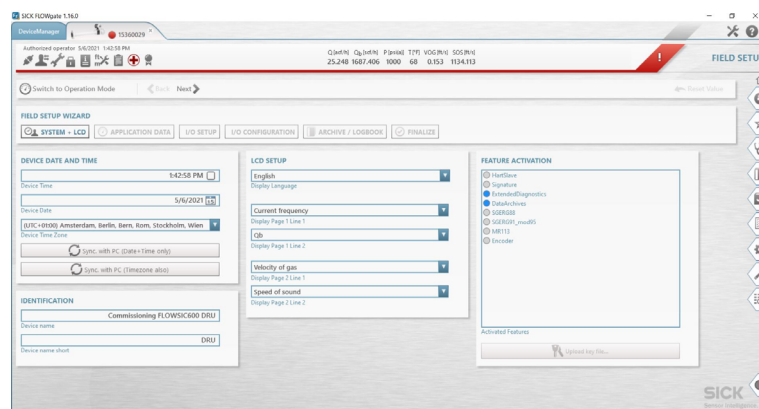


Fig. 30: Field Setup wizard menu "System + LCD"

#### LCD settings

The display is preconfigured at the factory.

- Check the settings and adapt when necessary.

### 5.4.2 Operating parameters

#### Operating data

- Check the data and adapt when necessary.



The values are preset for high-pressure calibrated devices.

### 5.4.3 I/O setup

- Compare the data with the delivery documentation and adapt as necessary.

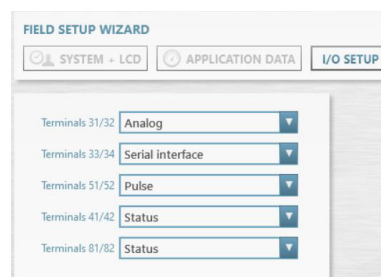


Fig. 31: Field Setup wizard menu "I/O Setup"

#### 5.4.4 I/O configuration

- ▶ Adjust the respective I/O interfaces if necessary.

#### 5.4.5 Archive/Logbooks

##### Logbooks

- ▶ Configure the logbooks' behavior.
- **Overflow:** The oldest entries are overwritten when the logbook is full.
- **Hold:** A warning is output when the logbook is full.
- **Active:** Parameter changes are recorded.
- **Inactive:** Parameter changes are not recorded.

##### Hourly Log (data book 2 / hourly archives) and Daily Log (data book 3 / daily archives)

As standard, the archives are configured so that the “Hourly Log” records hourly and the “Daily Log” daily in forward flow direction. Recording periods and recording direction as well as the data record type to be recorded can be configured:

- **Data record type:** Setting the respective desired data record type
- **Measuring cycle:** Recording period
- **Rolling:** Behavior of archives (see logbooks)
- **Direction:** Recording direction
- **Storage timepoint:** Time for daily archive entry in full hours.

#### 5.4.6 Finish

- ▶ First write the data to the device.



##### NOTICE:

The data must be written to the device before the report is created, otherwise the reports are created using the data before commissioning.

---

If desired: Reset the error counters and clear the logbooks.

Endress+Hauser recommends creating a Parameter report and Status report and archiving the reports with the delivery documentation.

## 5.5 Functional test on the device

The major system parameters are configured at the factory. The standard settings should allow FLOW SIC600 DRU/DRU-S operation without errors. Nevertheless, correct meter operation should be verified on site when the meter is installed and is subject to actual operating conditions.

### 5.5.1 Function test FLOW SIC600 DRU/DRU-S with LCD front panel

The FLOW SIC600 DRU/DRU-S is working properly when the standard display shows two pages of measured variables and current readings and the pages change every 5 seconds.

If a current error or warning is active, the display is interrupted every 2 seconds by an error message. As soon as the cause of the error/warning has been eliminated, the standard display of the FLOW SIC600 DRU/DRU-S automatically appears.

If the logbooks contain unacknowledged errors (E), warnings (W) or information (I), the corresponding letter flashes in the upper right corner of the display. The letter stops flashing as soon as the measurement has been acknowledged in the logbook. It disappears when the entries have been deleted from the logbook.

The logbook contains detailed error information. For troubleshooting, see → [page 66, 7](#).



## 5.6 Function check with FLOWgate™

The major system parameters are configured at the factory. The standard settings should allow FLOWSIC600 DRU/DRU-S operation without errors. Nevertheless, correct meter operation should be verified on site when the meter is installed and subjected to actual operating conditions.

### Recommended checks:

- Checking the device status
- Checking performance
- Checking the gas velocity
- Checking the sound velocity
- Checking zero phases
- Comparing the theoretical and measured sound velocities

### Checking the device status




Status	Description
	Normal operation: Neither warnings nor errors exist in the device.
	Warning: The device has at least one warning, the measured value is still valid.
	Error: The device has at least one error, the measured value is invalid.

Table 9: Signaling the device state

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.

### Checking performance

- Open tile “Meter values” in menu “Diagnostics”.

Check the performance rate of the individual paths (widget: Performance). The performance rate should be at least 75% on all paths. If the velocity of gas is greater than 30 m/s (98 ft/s), the performance values may be significantly lower.

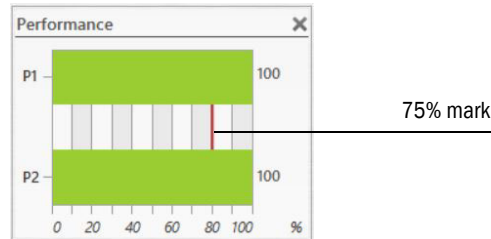


Fig. 32: Performance widget

### Checking velocity of gas

- Open tile “Meter values” in menu “Diagnostics”.

Velocity of gas (VOG) should be evenly distributed over all paths.

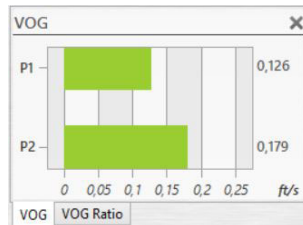


Fig. 33: Velocity of gas widget (VOG)

### Checking speed of sound

- Open tile “Meter values” in menu “Diagnostics”.

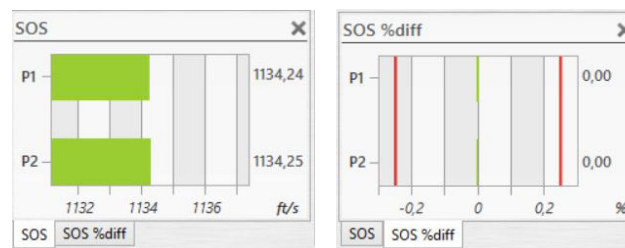


Fig. 34: Sound velocity widget (left) and SOS % diff (right)

The speed of sound values must be almost identical on all paths and may only differ by less than 0.1%. When moving the mouse over the bar graphs, the current measured values are shown in the diagram.

In the case of very low gas velocities ( $< 1$  m/s [ $3.3$  ft/s]), there may be more significant differences between the sound velocities of the paths due to thermal stratification. In this case, larger differences between the paths can also occur. Ensure the measured SOS deviates no more than 0.3% from a theoretical SOS calculated from gas composition, pressure and temperature, → [page 63](#), .

### Checking zero phases

Properly adjusted zero phases of the individual paths are the basis for accurate measurement of the ultrasonic signals' transit time. An adjustment coordinated with Endress+Hauser Service is recommended when the zero phases do not meet the specified criteria.

- ▶ Open tile "Path Diagnosis" in menu "Diagnostics".
- ▶ Check "transit time". The "transit time" (red circle) must be within the "Transit time plausibility area" (green strip).

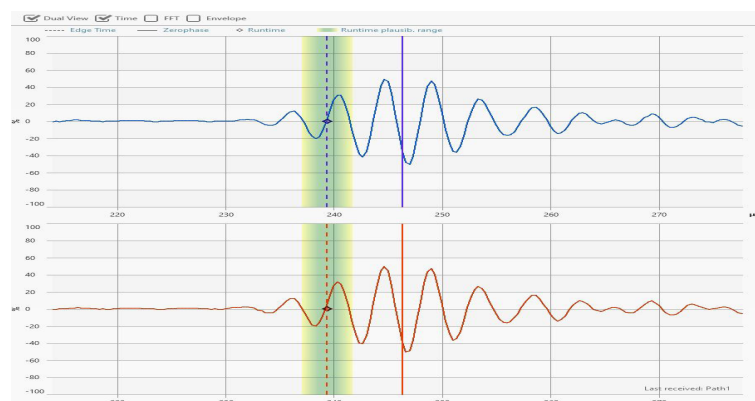


Fig. 35: Zero phase check



Perform check of zero phases for each individual path of the FLOWSIC600 DRU/DRU-S.

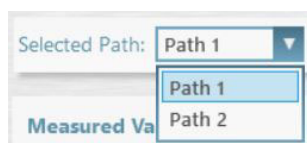


Fig. 36: Selection of path to be checked

### Comparing the theoretical and measured sound velocities

The Speed of Sound Calculator (SOS Calculator) available in the FLOWgate™ operating software calculates a theoretical SOS for a specific gas composition at a specified temperature and pressure (→ Fig. 37). The calculation of thermodynamic properties is based optionally on the “GERG-2008” or “AGA10” algorithm.

- Open tile “SOS Calculator” in menu “Diagnostics”.
- Select the gas composition and confirm with “Apply”. The gas composition can be entered manually or loaded as file.
- Enter the current process conditions and select “Calculate SOS”.

**Method Selection**  
GERG-2008 XT08 ☒ AGA 10

**Gas Composition**  
Quickload Samples: Ambient air

Name	Formula	Fraction [%]
Methane	CH <sub>4</sub>	0.0000
Nitrogen	N <sub>2</sub>	78.0997
Carbon Dioxide	CO <sub>2</sub>	0.0297
Ethane	C <sub>2</sub> H <sub>6</sub>	0.0000
Propane	C <sub>3</sub> H <sub>8</sub>	0.0000
n-Butane	N-C <sub>4</sub> H <sub>10</sub>	0.0000
i-Butane	I-C <sub>4</sub> H <sub>10</sub>	0.0000
n-Pentane	N-C <sub>5</sub> H <sub>12</sub>	0.0000
i-Pentane	I-C <sub>5</sub> H <sub>12</sub>	0.0000
n-Hexane	N-C <sub>6</sub> H <sub>14</sub>	0.0000
n-Heptane	N-C <sub>7</sub> H <sub>16</sub>	0.0000
n-Octane	N-C <sub>8</sub> H <sub>18</sub>	0.0000
n-Nonane	N-C <sub>9</sub> H <sub>20</sub>	0.0000
n-Decane	N-C <sub>10</sub> H <sub>22</sub>	0.0000
Hydrogen	H <sub>2</sub>	0.0005
Oxygen	O <sub>2</sub>	20.9433
Carbon Monoxide	CO	0.0000
Water	H <sub>2</sub> O	0.0000
Hydrogen Sulphide	H <sub>2</sub> S	0.0000
Helium	He	0.0000
Argon	Ar	0.0254

% Fraction Sum: 100.00

**Process Conditions**  
Temperature: 25 °C    
Pressure: 1 bar(a)

**Results**  
Compressibility: 0.9997  
Speed of Sound (calculated): 346.267 m/s  
% Deviation: 0.01

Fig. 37: SOS Calculator

- Compare the theoretical sound velocity with the sound velocity measured with the FLOWSIC600 DRU/DRU-S. The deviation of the measured SOS from the calculated SOS is shown for each path in the “Deviations per Path” area.

Deviations Per Path			
Path	SOS meas. [ m/s ]	SOS calc. [ m/s ]	Deviation [ % ]
Global	346.261	346.27	0.00%
AvgC1	346.287	346.27	0.01%
AvgC2	346.235	346.27	-0.01%

Fig. 38: Deviation per path

The deviation between the two sound velocities should be less than  $\pm 0.1\%$ . If the deviation exceeds 0.3%: Check the plausibility of the pressure, temperature and gas composition values.

## 5.7 Activating path compensation

The FLOWSIC600 DRU/DRU-S can compensate a path failure when Status bit “Path relations valid” is active. After approximately 20 minutes of operation with error-free measurement on all paths at a gas velocity between 1 m/s to 8 m/s (3.3 ft/s and 26 ft/s) and also after approximately 20 minutes at a gas velocity of more than 8 m/s (26 ft/s), the meter automatically sets this bit to “active”.



### Determining path relations during commissioning

As a result of the specific path relations of each installation configuration, the path relations of each meter must be determined during commissioning to ensure the system can compensate for path failure at both high and low flow velocities and it is therefore recommended, during commissioning, to operate the FLOWSIC600 DRU/DRU-S first at low gas velocities (< 8 m/s [26 ft/s]) for 20 minutes and then at high gas velocities (> 8 m/s [26 ft/s]) for 20 minutes.

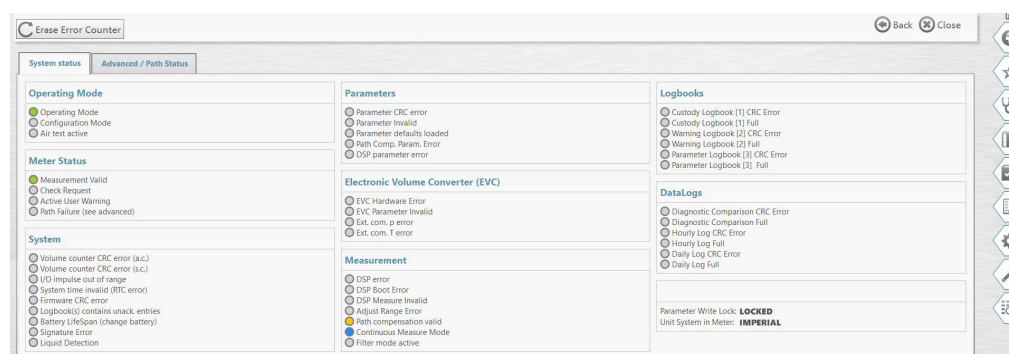


Fig. 39: Page “Meter Status” with active Status bit “Path relations valid”

## 5.8 Documentation

The commissioning should be documented with a Commissioning Protocol. The document “FLOWSIC600 Commissioning Protocol” belongs to the scope of delivery of the FLOWSIC600 DRU/DRU-S and exist on paper and on the Product CD.

- File the completed Commissioning protocol together with the delivery documentation.

## 6 Maintenance

### 6.1 General information



The stated routine checks only apply to working with FLOWgate™.

The FLOWSIC600 DRU/DRU-S does not include mechanical moving parts. The meter body and ultrasonic sensors are the only components that come into contact with the gaseous media. Titanium and high-quality stainless steel ensure that these components are resistant to corrosion, provided that the meter is installed and operated in accordance with the relevant specifications. The FLOWSIC600 DRU/DRU-S is therefore a very low maintenance system.

User Warning Limits can be configured to provide early warnings for possible issues with contamination or blockage. Maintenance is limited mainly to routine checks to determine the plausibility of the measured values and diagnostic results produced by the system.

We recommend creating and filing Maintenance reports on a regular basis. Over a period of time, this provides a comparison data base useful when diagnosing problems.



The operating conditions (gas composition, pressure, temperature, flow velocity) of the individual Maintenance Reports should be comparable or documented separately and taken into account when the data is analyzed.

## 6.2 Routine checks with FLOWgate™



The FLOWSIC600 DRU/DRU-S must be connected with FLOWgate™ for all the following routine checks.

### 6.2.1 Function check (device status)



#### NOTICE:

For a detailed function check, see Section “Function check with FLOWgate™”  
→ page 57, 5.6

Status	Description
	Normal operation: Neither warnings nor errors exist in the device.
	Warning: The device has at least one warning, the measured value is still valid.
	Error: The device has at least one error, the measured value is invalid.

Table 10: Signaling of device state

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.

<b>System status</b> <b>Advanced / Path Status</b> <b>Operating Mode</b> <ul style="list-style-type: none"> <li>Operating Mode</li> <li>Configuration Mode</li> <li>Air test active</li> </ul> <b>Meter Status</b> <ul style="list-style-type: none"> <li>Measurement Valid</li> <li>Check Request</li> <li>Active User Warning</li> <li>Path Failure (see advanced)</li> </ul> <b>System</b> <ul style="list-style-type: none"> <li>Volume counter CRC error (s.c.)</li> <li>Volume counter CRC error (s.c.)</li> <li>IO impulse out of range</li> <li>System time invalid (RTC error)</li> <li>Parameter CRC error</li> <li>Logbook(s) contains unack. entries</li> <li>Battery 1 (Open Charge Battery)</li> <li>Signature Error</li> <li>Liquid Detection</li> </ul>	<b>Parameters</b> <ul style="list-style-type: none"> <li>Parameter CRC error</li> <li>Parameter invalid</li> <li>Parameter defaults loaded</li> <li>Path Comp. Param. Error</li> <li>DSP parameter error</li> </ul> <b>Electronic Volume Converter (EVC)</b> <ul style="list-style-type: none"> <li>EVC Hardware Error</li> <li>EVC Parameter Invalid</li> <li>EVC com. p. error</li> <li>EVC com. T error</li> </ul> <b>Measurement</b> <ul style="list-style-type: none"> <li>DSP error</li> <li>DSP Root Error</li> <li>DSP Measure Invalid</li> <li>Adjust Range Error</li> <li>Path compensation valid</li> <li>Continuous Measure Mode</li> <li>Filter mode active</li> </ul>	<b>Logbooks</b> <ul style="list-style-type: none"> <li>Control Logbook [1] CRC Error</li> <li>Control Logbook [1] Full</li> <li>Warning Logbook [2] CRC Error</li> <li>Warning Logbook [2] Full</li> <li>Parameter Logbook [3] CRC Error</li> <li>Parameter Logbook [3] Full</li> </ul> <b>Data Logs</b> <ul style="list-style-type: none"> <li>Diagnostic Comparison CRC Error</li> <li>Diagnostic Comparison Full</li> <li>Hourly Log CRC Error</li> <li>Hourly Log Full</li> <li>Daily Log CRC Error</li> <li>Daily Log Full</li> </ul> <b>Parameter Write Lock: UNLOCKED</b> <b>Unit System in Meter: METRIC</b>
--	--	---

Fig. 40: Overview of system status

The “Diagnostics” menu shows under tile “Meter values” in various profiles all diagnostic values providing information on the status of the device.

### 6.2.2 Time synchronization

All entries in logbooks or data logs saved in the meter's memory (FRAM) are written with a time stamp containing the meter time. Date and time can be synchronized in the FLOWgate™ operating software with the connected PC during commissioning or in menu “Parameter Modification” and “System/User”.



A synchronization only triggers a logbook entry in the Custody logbook [1] when the time change is greater than 3% of the time elapsed since the last synchronization.

- Open the tile “System + LCD” in the menu “Parameter Modification”.

Fig. 41: Date and time parameter modification

### 6.2.3 Status report

It is advisable to regularly create and archive a Status report. This serves to create a comparison database and supports diagnostics.



The operating conditions (gas composition, pressure, temperature, flow velocity) of the individual Status Reports should be similar. It is recommended to evaluate and document deviations when the individual reports are compared.

- Click on “Create Status Report” (clipboard icon) in the status bar.



- The “Status Report” dialog opens.

It is recommended to set the duration of data collection to 5 minutes, but it can also be changed in the selection list.

Fig. 42: Status Report

- After the end of data collection, the report opens automatically and can be printed, saved as PDF document or sent via e-mail.
- Finally close the report with the “Close” button.



It is recommended to file the printed report with the device delivery documentation.

#### 6.2.4 Optional data backup



To prevent an overflow of the logbooks and possible data loss, logbook entries can be saved to the Meter database with the FLOWgate™ operating software. The entries on the meter can then be deleted.

##### Logbook check and data backup

Menu “Logbooks” provides an overview and a general introduction to the logbooks.

The following functions are available here:

- Reading the respective logbooks from the device.
- Loading the respective logbooks from the database.
- Acknowledging entries.
- Deleting logbooks on the device or in the data base.
- Outputting logbooks as CSV file.
- Outputting a report of the respective logbook.

##### Checking the data archives (data logs)

The FLOWsIC600 DRU/DRU-S has a Diagnosis Log, an Hourly Log and a Daily Log. The measured data archives are saved accordingly in the non-volatile memory of the device.

Tab “Archive Management” provides an overview and a general introduction to the logbooks.

The following functions are available here:

- Reading the respective archive from the device.
- Loading the respective archive from the database.
- Deleting entries.
- Deleting archives on the device or in the data base.
- Outputting an archive as CSV file.
- Outputting a report of the respective archive.

## 7 Troubleshooting

This Section contains solutions to problems found during routine tests during maintenance → [page 62, 6](#) or during functional tests after commissioning. → [page 50, 5](#).

If the cause of the problem cannot be localized, it is recommended to use FLOWgate™ to record the current parameter set and diagnosis values in a diagnosis session file → [page 67, 7.3](#) and send this to the local Endress+Hauser representative.

### 7.1 General troubleshooting

Problem	Possible causes	Measures
<ul style="list-style-type: none"> <li>No display</li> <li>No pulse frequency</li> <li>No active status signal</li> </ul>	Incorrect power supply	<ul style="list-style-type: none"> <li>▶ Check input voltage on terminals 1 and 2.</li> <li>▶ Check cables and terminal connections.</li> </ul> <b>Caution</b> Take the relevant safety precautions!
	Device defective	<ul style="list-style-type: none"> <li>▶ Start a Diagnosis Session as described in → <a href="#">page 67, 7.3</a> and contact your local Endress+Hauser representative.</li> </ul>

### 7.2 Displaying meter status, system alarms and warnings

The FLOWIC600 DRU/DRU-S signals alarms and warnings as follows:

- The LCD display indicates active system alarms and warnings. When a current error or warning is active, the display flashes and a message with a message number is shown in the upper right corner → [page 91, 8.8.1](#).
- A status output can be configured to signal whether meter status “Measurement invalid”, “Maintenance request” or “Warning” will be active.
- The impulse output can be configured to indicate whether the meter is in Configuration mode or whether counter status “Measurement invalid” becomes active.
- The meter status registers can be read via MODBUS (see document “FLOWIC600 DRU Short Manual MODBUS”).
- The FLOWgate™ program can be used to test the meter health. System alarms and User warnings are indicated in the main System bar.

It is recommended to use FLOWgate™ to obtain further information on the meter's health.

### 7.3 Creating a diagnostic session with FLOWgate™

- Click “Start Diagnostic Session” (red cross icon) in the Status bar to start a diagnostic session.



Fig. 43: Button “Red cross”

- Select the desired data collection duration.  
It is recommended to select a minimum data collection time of 5 minutes and to load the logbooks archives (set checkmark at “Load logbooks”).

Fig. 44: Starting a diagnostic session

- 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. 45: Diagnostic session finished

- Click “OK” to confirm the message.
  - Click “Save as” to select a storage location for the diagnostic recording.
  - Click “E-mail” to send the file per e-mail. The file is appended to an e-mail when an e-mail client is available.
  - Click “Close” to leave the file at the standard storage location.

Fig. 46: Saving the diagnostic session



The diagnostic sessions are saved as files with suffix .sfgsession. The files are saved by default under:  
C:\Users\Public\Documents\SICK\FLOWgate  
The name of the storage folder consists of device type and serial number of the device.

## 7.4 Troubleshooting when connecting meters

Meter not found on first connection/connection lost during session.

- ▶ Check all cables and the hardware. Also check that the adapters have been installed correctly → [page 51, 5.2.1.](#)
- ▶ Try to re-establish the connection via the “Meter connection lost” window.
- ▶ Use the options in the window displayed to allow FLOWgate™ to search with advanced options → [Fig. 47](#), especially when parameters have possibly been changed (e.g. baudrate).



If necessary, the RS485 ports can be assigned to a specific bus address (Reg. #5020 “DeviceBusaddress”). The service port always has Bus address “1”.

Fig. 47: Dialog window “Configure Serial Connection” for specifying advanced search options

## 8 Annex

### 8.1 Conformities and technical data

#### 8.1.1 Standards conformity and type approvals

The FLOWSIC600 DRU/DRU-S conforms to the following standards or recommendations:

- OIML D 11: 2013, “General requirements for electronic measuring instruments”
- API MPMS 21.1: 2013 “Flow Measurement Using Electronic Metering Systems”

#### 8.1.2 WELMEC conformity

The interfaces and software of the FLOWSIC600 DRU/DRU-S are designed without retroactive effects in the sense of the Verification Ordinance, Annex 7 “Measuring instruments for gas” and the requirements of WELMEC Guideline 7.2 and are fully documented in the document “Interface description”.

The test results have been archived in a traceable manner and can be made available on request.

## 8.2 Type code

Group	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<b>Key code</b>	FL600-														
<b>METER BODY</b>															
<b>Path configuration</b>															
1-Path	1	P													
2-Path	2	P													
4-Path	4	P													
1+1-Path redundant	1	R													
2+2-Path redundant	2	R													
4+4-Path (Quatro)	4	R													
4+1-Path (2plex)	5	C													
2-Path crossed	2	X													
4-Path crossed	4	X													
2-Path Special	2	S													
<b>Overall length</b>															
2D		2	D												
3D		3	D												
4D		4	D												
5D		5	D												
6D		6	D												
Shortened Meter body		S	D												
Other size		X	D												
<b>Nominal size</b>															
2" / DN 50			0	2											
3" / DN 80			0	3											
4" / DN 100			0	4											
6" / DN 150			0	6											
8" / DN 200			0	8											
10" / DN 250			1	0											
12" / DN 300			1	2											
16" / DN 400			1	6											
Other size			#	#											
<b>Connection flange type</b>															
ASME B16.5 / ASME B16.47 (>24")			C	L	#	#	#	#							
DIN EN 1092-1			P	N	#	#	#	#							
GOST 12815-80 / 12821-80 / GOST-R 54432-2011			P	N	#	#	#	#							
NORSOK L 005			N	K	#	#	#	#							
TECHLOK			I	N	X	X	#	#							
Grayloc			G	R	X	X	#	#							
EN 1759-1			C	L	#	#	#	#							
Other type			X	X	X	X	X	X							
<b>Connection diameter</b>															
Schedule ###					S	C	#	#	#	#					
Specified in [mm] (DIN)					#	#	#	#	#	#					
<b>Flange type / sealing face</b>															
Raised Face (ASME B16.5 / B16.47)									R	F					
Ring Type Joint (ASME B16.5 / B16.47)									R	J					
Form B1 (EN 1092-1 / 1759-1)									B	1					
Form B2 (EN 1092-1 / 1759-1)									B	2					
Form # Inlet / Form # Outlet (EN 1092-1 / 1759-1)									#	#					
Version V# (GOST 12815-80 / 12821-80)									V	#					
Type T# (GOST-R 54432-2011)									T	#					
Special design									X	X					
<b>Material</b>															
Carbon Steel										0					
Stainless steel										1					
LT-CS										2					
Duplex										3					
Superduplex										4					
Superaustenit										5					
Aluminium										6					
Other material										X					
<b>Connection for Extraction Tool</b>															
Yes														Y	
No														N	
<b>ULTRASONIC TRANSDUCER</b>															
(Will be selected by SICK on the basis of the technical data)															
<b>SIGNAL PROCESSING UNIT</b>															
<b>Ex-proof-design</b>															
None										0					
CSA Group D T4										1					
CSA Group B, C, D T4										2					
ATEX IIA T4, M20x1.5										3					
ATEX IIC T4, M20x1.5										4					
ATEX IIA T4, 1/2 NPT										5					
ATEX IIC T4, 1/2 NPT										6					
IECEx IIA T4, M20x1.5										7					
IECEx IIC T4, M20x1.5										8					
IECEx IIA T4, 1/2 NPT										9					
IECEx IIC T4, 1/2 NPT										A					
<b>Power supply</b>															
12 ... 24V DC											D	C			
<b>Data outputs</b>															
Hardware variant 1 (4 digital outputs)														1	
Hardware variant 2 (1 analog current output and 3 digital outputs)														2	
Hardware variant 4 (1 analog current output and 2 RS485)														4	
Hardware variant 5 (with integrated EVC, p- and T-transmitters externally power supplied, I/O board with DSP)														5	
Hardware variant 6 (with integrated EVC, p- and T-transmitters internally power supplied, I/O board with DSP)														6	
Hardware variant 7 (same as hardware variant 1, but with LowPressureAnalogBoard)														7	
Hardware variant 8 (same as hardware variant 2, but with LowPressureAnalogBoard)														8	
Hardware variant 9 (same as hardware variant 4, but with LowPressureAnalogBoard)														9	
Hardware variant A (same as hardware variant 5, but with LowPressureAnalogBoard)														A	
Hardware variant B (same as hardware variant 6, but with LowPressureAnalogBoard)														B	
<b>HART-Protocol</b> (By selection of hardware variant 2 and 8 only)															
Yes														Y	
No														N	
<b>Front panel</b>															
LED SICK															0
LCD SICK															1
<b>Custody transfer design meter</b>															
Yes															Y
No															N

Rev. 1.12

2013/05

# ... to be specified by SICK

\* ... only design of USM, no restriction to type approval  
( 4P; 5C; 4R -> Y / other path configurations -> N)

E\_69423

Fig. 48: Exemplary type code as used for a brief description of the meter design (indicated on type plate and Device Data Sheet\*)

\* The Device Data Sheet is included in the delivery documentation.

### 8.3 Technical data FLOWIC600 DRU

Meter characteristics and measuring parameters				
Measured values	Volume flow a.c., volume a. c., gas velocity, sound velocity			
Measuring principle	Ultrasonic transit time difference measurement			
Number of measuring paths	2			
Measuring medium	Natural gas			
Measuring ranges	In operation:			
	3 inch:	$Q_{min}^1$	$Q_t$	$Q_{max}^2$
	Flow velocity [m/s]	0.9	3	45
	Flow velocity [ft/s]	3	10	150
	Volume flow rate [m³/h]	14	47	700
	Volume flow rate [ft³/h]	495	1650	24770
	4 inch:	$Q_{min}^1$	$Q_t$	$Q_{max}^2$
	Flow velocity [m/s]	0.9	3	37
	Flow velocity [ft/s]	3	10	122
	Volume flow rate [m³/h]	25	81	1000
	Volume flow rate [ft³/h]	860	2875	35000
	6 inch:	$Q_{min}^1$	$Q_t$	$Q_{max}^2$
	Flow velocity [m/s]	0.9	3	35
	Flow velocity [ft/s]	3	10	115
	Volume flow rate [m³/h]	55	185	2125
	Volume flow rate [ft³/h]	1950	6500	75000
	1 Increased uncertainty below 0.9 m/s (3 ft/s). 2 $Q_{max}$ can be limited by the working pressure and attenuation of the gas medium.			
Repeatability	± 0.2% of measured value (within $Q_t$ to $Q_{max}$ under consideration of installation requirements)			
Uncertainty	± 1% from $Q_t$ to $Q_{max}$ (± 2% from $Q_{min}$ to $Q_t$ )			
Gas temperature	-40 °C ... 85 °C (-40 °F ... 185 °F)			
Operating pressure	0 bar(g) ... 102 bar(g) at 38 °C (0 psi(g) ... 1480 psi(g) at 100 °F) 0 bar(g) ... 93.2 bar(g) at 85 °C (0 psi(g) ... 1380 psi(g) at 185 °F)			
Nominal pipe size	3" / 4" / 6" Schedule 80			
Flange connection	ANSI B16.5, Cl.600 RF			
Ambient conditions				
Ambient temperature	-40 °C ... 60 °C (-40 °F ... 140 °F)			
Storage temperature	-40 °C ... 70 °C (-40 °F ... 158 °F)			
Ambient humidity	≤ 95% relative humidity			
Approvals				
Ex certifications	NEC/CEC	Class I, Division 1, Group D, T4; Class I, Division 2, Group D, T4; Ultrasonic sensors, intrinsically safe and non-sparking		
Enclosure rating	IP66/IP67			

Table 11: Technical data FLOWIC600 DRU

Meter characteristics and measuring parameters	
Outputs and interfaces	
Digital outputs	2 DO and 1 FO: 30 V, 10 mA Passive, galvanically isolated, Open Collector, fmax = 6 kHz (scalable)
Interfaces	2 x RS485 (2x for configuration, data output and diagnosis)
Bus protocol	MODBUS ASCII, MODBUS RTU
Dimensions and Weight	
Dimensions (W x H x D)	See dimensional drawings
Weight	3 inch: 48 kg (105.8 lbs) 4 inch: 85 kg (187.4 lbs) 6 inch: 250 kg (550 lbs)
Electrical connection	
Voltage	12 V...28.8 V DC
Power consumption	≤ 1 W
Battery	
Battery type	Coin cell, type BR2032, manufacturer PANASONIC
Battery chemistry	Lithium poly carbon monofluoride Li-(CF) <sub>x</sub>

Table 11: Technical data FLOWSIC600 DRU



## 8.4 Technical data FLOWSIC600 DRU-S

Meter characteristics and measuring parameters				
Measured values	Volume flow a.c., volume a. c., gas velocity, sound velocity			
Measuring principle	Ultrasonic transit time difference measurement			
Number of measuring paths	2			
Nominal pipe size	2" / 3" / 4" Larger sizes up to 12" on request			
Measuring medium	Natural gas			
Measuring ranges 1,2,3	In operation:			
		Q <sub>min</sub> <sup>1</sup>	Q <sub>t</sub>	Q <sub>max</sub> <sup>2</sup>
	Volume flow rate [m³/h]			
	2 inch	4	20	400
	3 inch	8	40	1000
	4 inch	13	65	1600
	Volume flow rate [ft³/h]			
	2 inch	140	700	14000
	3 inch	280	1400	35000
	4 inch	460	2300	56000
Repeatability <sup>3</sup>	± 0.2% of measured value			
Accuracy <sup>4</sup>	± 2 % from Q <sub>t</sub> to Q <sub>max</sub> (± 4 % from Q <sub>min</sub> to Q <sub>t</sub> )			
Gas temperature	-40 °C ... 100 °C (-40 °F ... 212 °F) Maximum temperature 120 °C (248 °F) on request			
Operating pressure	0 bar(g) ... 16 bar(g) (0 psi(g) ... 1480 psi(g)) for ANSI CL150 0 bar(g) ... 100 bar(g) (0 psi(g) ... 1350 psi(g)) for ANSI CL600 CL900/CL1500 - on request			
Min. piping requirements	20D straight inlet and 5D outlet. Details and drawings → <a href="#">page 33, 4.2.2</a>			
Wetness of the gas (LVF limits)	up to 0.1% LVF      no influence on measurement accuracy 0.1% ... 0.5% LVF    decreased accuracy (up to 5%) 0.5% ... 1.5% LVF    decreased accuracy (up to 10%) > 10% LVF            average level when temporary signal loss is to be expected			
Flange type /schedule	ASME B16.5 ANSI CL150 RF / Sch 40 ASME B16.5 ANSI CL600 RF / Sch 80 CL900, CL1500 - on request			
	<sup>1</sup> Reduced accuracy below Q <sub>min</sub> <sup>2</sup> Q <sub>max</sub> can be limited by the working pressure and damping effects of the gas medium <sup>3</sup> From Q <sub>t</sub> to Q <sub>max</sub> <sup>4</sup> Verified with pipe configurations according to OIML R-137:2012 Annex B (mild)			
Ambient conditions				
Ambient temperature	-40 °C ... 60 °C (-40 °F ... 140 °F)			
Storage temperature	-40 °C ... 70 °C (-40 °F ... 158 °F)			
Ambient humidity	≤ 95 % relative humidity			
Approvals				
Ex approvals	NEC/CEC	Class I, Division 1, Group D, T4; Class I, Division 2, Group D, T4; Ultrasonic sensors, intrinsically safe		

Table 12: Technical data FLOWSIC600 DRU-S

Meter characteristics and measuring parameters		
Enclosure rating	IP66/IP67	
Outputs and interfaces		
Digital outputs	2 DO and 1 FO: 30 V, 10 mA Passive, galvanically isolated, Open Collector, fmax = 6 kHz (scalable)	
Interfaces	RS-485 (2x, for configuration, data output and diagnosis)	
Bus protocol	MODBUS ASCII, MODBUS RTU	
Dimensions and Weight		
Dimensions (W x H x D)	See dimensional drawings	
Weight	ANSI CL150	2": 30 kg (66 lbs) 3": 46 kg (101 lbs) 4": 65 kg (143 lbs)
	ANSI CL600	2": 34 kg (77 lbs) 3": 46 kg (101 lbs) 4": 66 kg (146 lbs)
Electrical connection		
Voltage	12 V...28.8 V DC	
Power consumption	≤ 1 W	
Battery		
Battery type	Coin cell, type BR2032, manufacturer PANASONIC	
Battery chemistry	Lithium poly carbon monofluoride Li-(CF) <sub>x</sub>	

Table 12: Technical data FLOWSIC600 DRU-S

## 8.5 Design pressure and design temperature

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


**Abnahmeprüfzeugnis / Inspection certificate**  
**EN10204 - 3.1**

**Zeugnis Nr. / Certificate No.: 12345678**

**1 Allgemeine Angaben / General**

<b>Typ / Type</b>	FL600-.....	
<b>Serien-Nr. / Serial No:</b>	12345678	
<b>Baujahr / Year of manufacturing:</b>	2025	
<b>Max. Betriebsdruck / Max. Operating pressure</b>	1380 psi	
<b>Arbeitstemperatur / Working temperature</b>	Min.: -40 °F	Max.: 185 °F

Fig. 49: Example acceptance test certificate (EN10204 - 3.1)

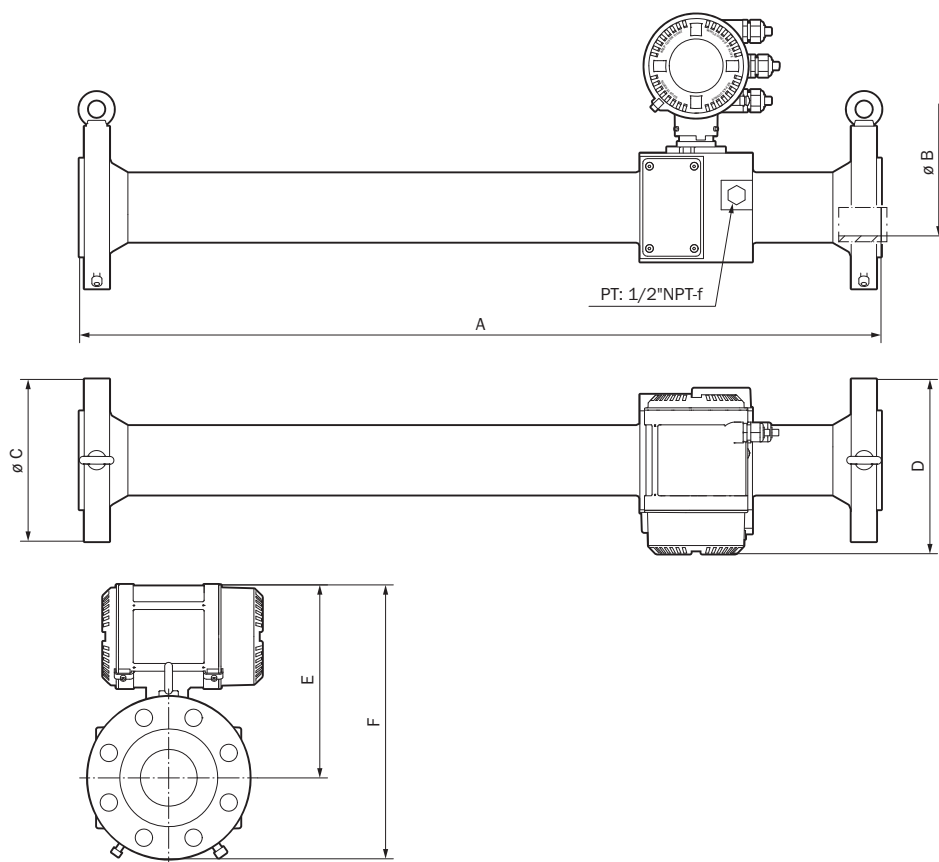
<b>Endress+Hauser</b> <small>Made in Germany</small> <b>FLOWSIC600</b> <small>Endress+Hauser ZICX GmbH &amp; Co. KG          Durrweg 27   73450 Ulm, Germany</small>	ID	12345678		
	TS	-40...+185 °F		
	PS	1380 psi		
	PT	2233 psi		
	DN / NPS	150 / 06"		
	Weight	331 lbs		
			Date	2025-06
			7041653	

TS Minimum/Maximum design temperature  
 PS Maximum design pressure  
 PT Test pressure

Fig. 50: Meter body type plate (example)

## 8.6 Dimensional drawings

### 8.6.1 Dimensional drawing FLOWsIC600 DRU 3 and 4 inch



Variant	A	B	C	D	E	F
Dimensions in mm (inch)						
3 inch	1040 (40.94)	73.66 (2.90)	210 (8.27)	226.3 (8.91)	250.5 (9.86)	355.5 (14.00)
4 inch	1300 (51.18)	97.18 (3.83)	275 (10.83)	258.8 (10.19)	259 (10.20)	396 (15.60)

Fig. 51: Dimensional drawing FLOWsIC600 DRU 3 and 4 inch

## 8.6.2 Dimensional drawing FLOWSIC600 DRU 6 inch

Dimensions in mm (inch)

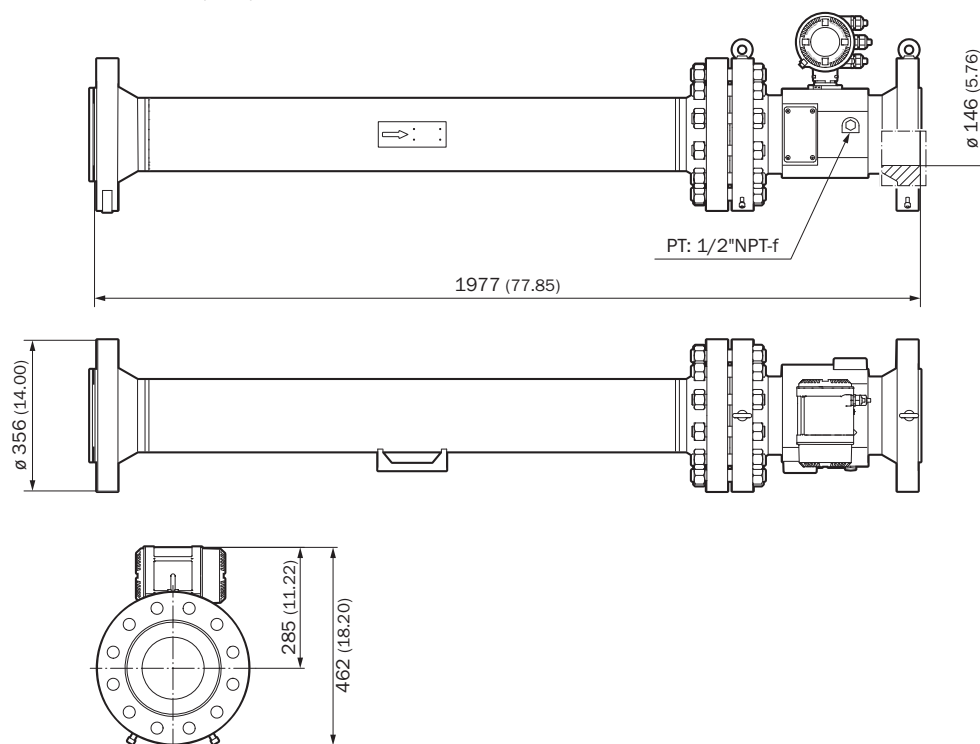


Fig. 52: Dimensional drawing FLOWSIC600 DRU 6 inch

### 8.6.3 Dimensional drawing FLOWIC600 DRU-S

Dimensions in mm (inch)

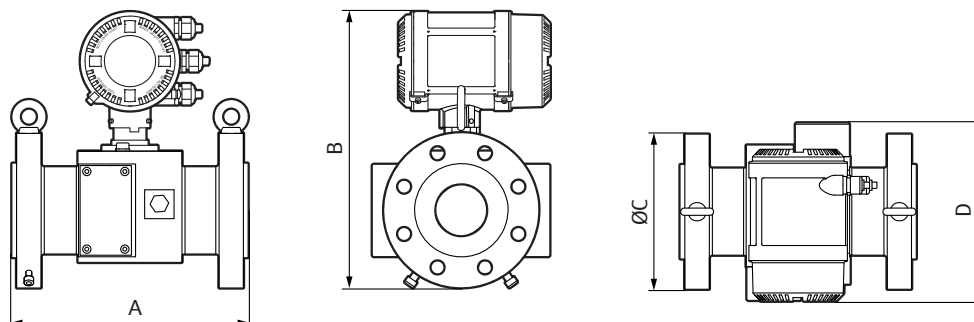


Fig. 53: Dimensional drawing FLOWIC600 DRU-S

#### Dimensions for ANSI CL150

Variant	A	B	C	D
Dimensions in mm (inch)				
2 inch	250 (9.8)	327 (12.8)	152.4 (6)	228 (8.9)
3 inch	320 (12.6)	365 (14.3)	190.5 (7.5)	241 (9.5)
4 inch	300 (11.8)	377 (14.8)	228.6 (9)	274 (10.8)

#### Dimensions for ANSI CL600

Variant	A	B	C	D
Dimensions in mm (inch)				
2 inch	250 (9.8)	335 (13.2)	165 (6.5)	230 (9)
3 inch	320 (12.6)	375 (14.7)	210 (8.2)	240 (9.5)
4 inch	300 (11.8)	390 (15.3)	270 (10.7)	275 (10.8)

## 8.7 Operation and menu structure of the meter body with LCD display

### 8.7.1 Operation



**WARNING: Risk of explosion**  
Only open the window cover when it is a Non-Ex area.



**WARNING:**  
EMC and accidental contact protection cannot be guaranteed with the cover open.

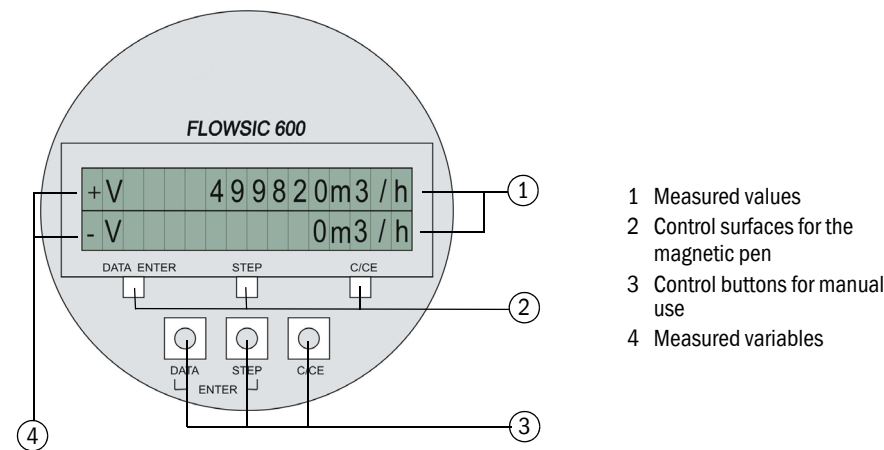






Fig. 54: LCD front panel for FLOWSIC600 DRU/DRU-S

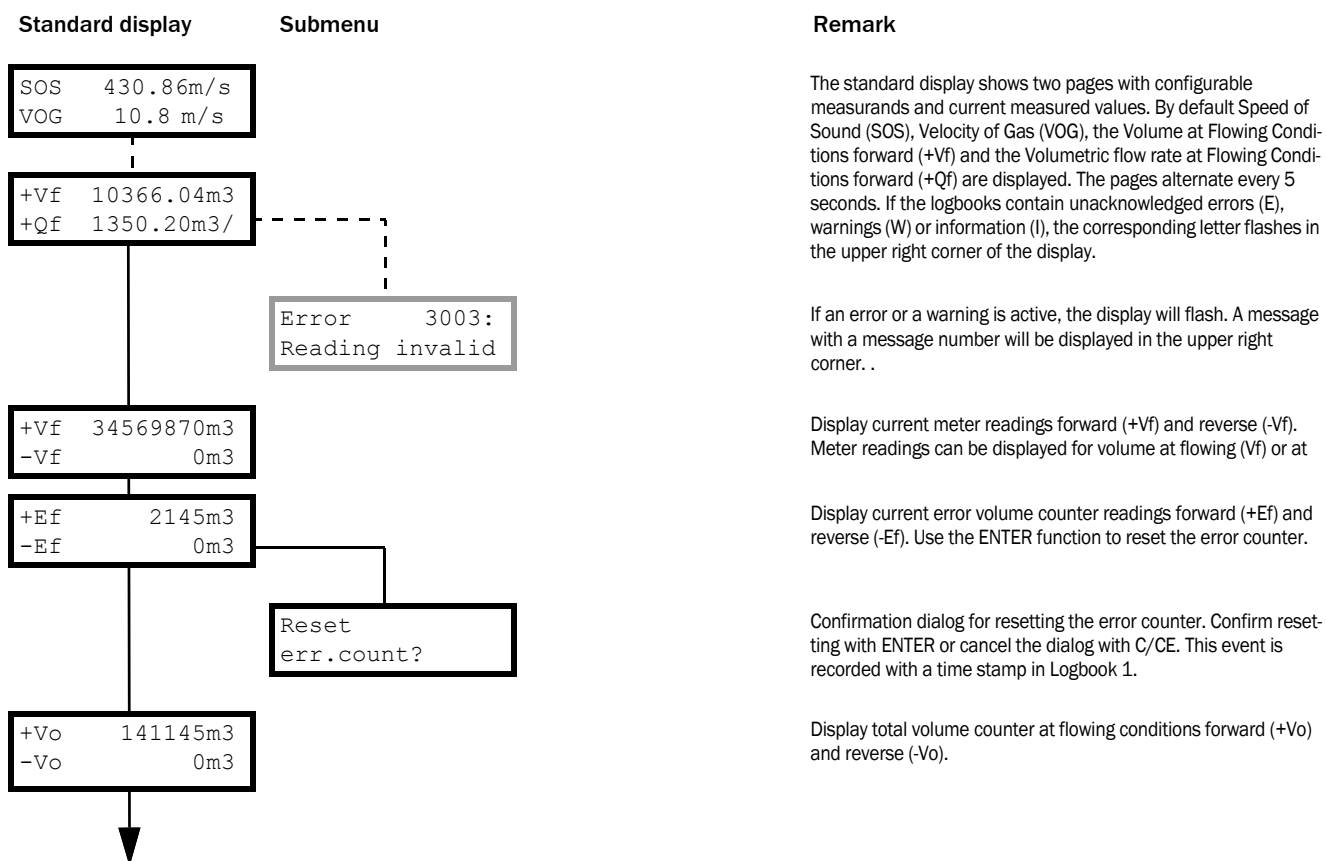
Button	Magnetic sensor	Function	Description
C/CE	C/CE	Menu level up	Button C/CE serves to go from any menu to the next higher level. Keep the button pressed to go back to the original display
STEP	STEP	Move forward	Press STEP to move forward in the menu
DATA	DATA ENTER	Move back	Press DATA to move back in the menu
Press STEP + DATA simultaneously or press and hold DATA for more than 2 seconds	Press and hold DATA ENTER for more than 2 seconds	ENTER	The ENTER function serves to select a menu level, confirm logbook entries, reset the error volume counters or edit any modifiable parameter (after disabling the parameter write lock).

Table 13: Button explanation

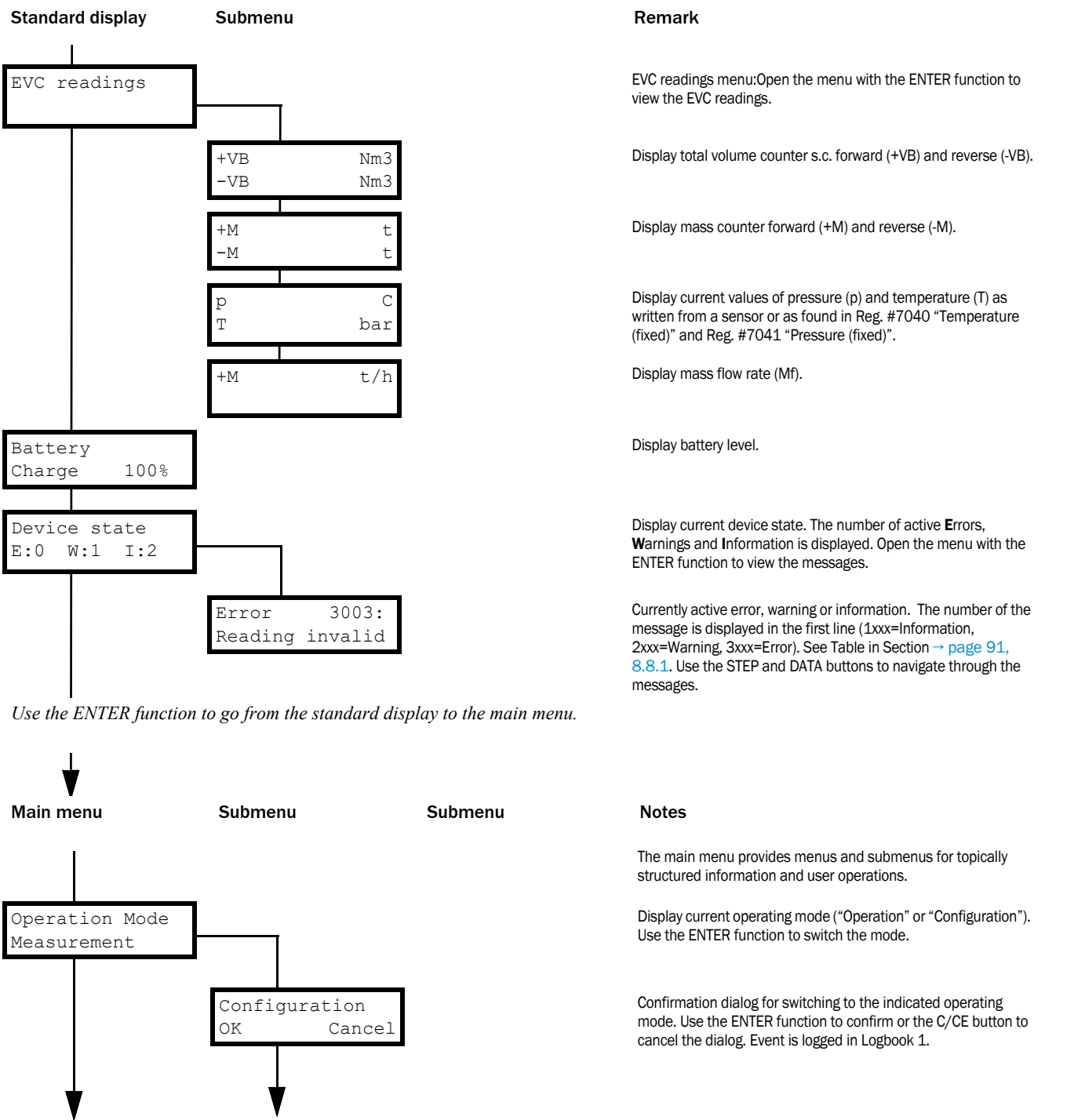


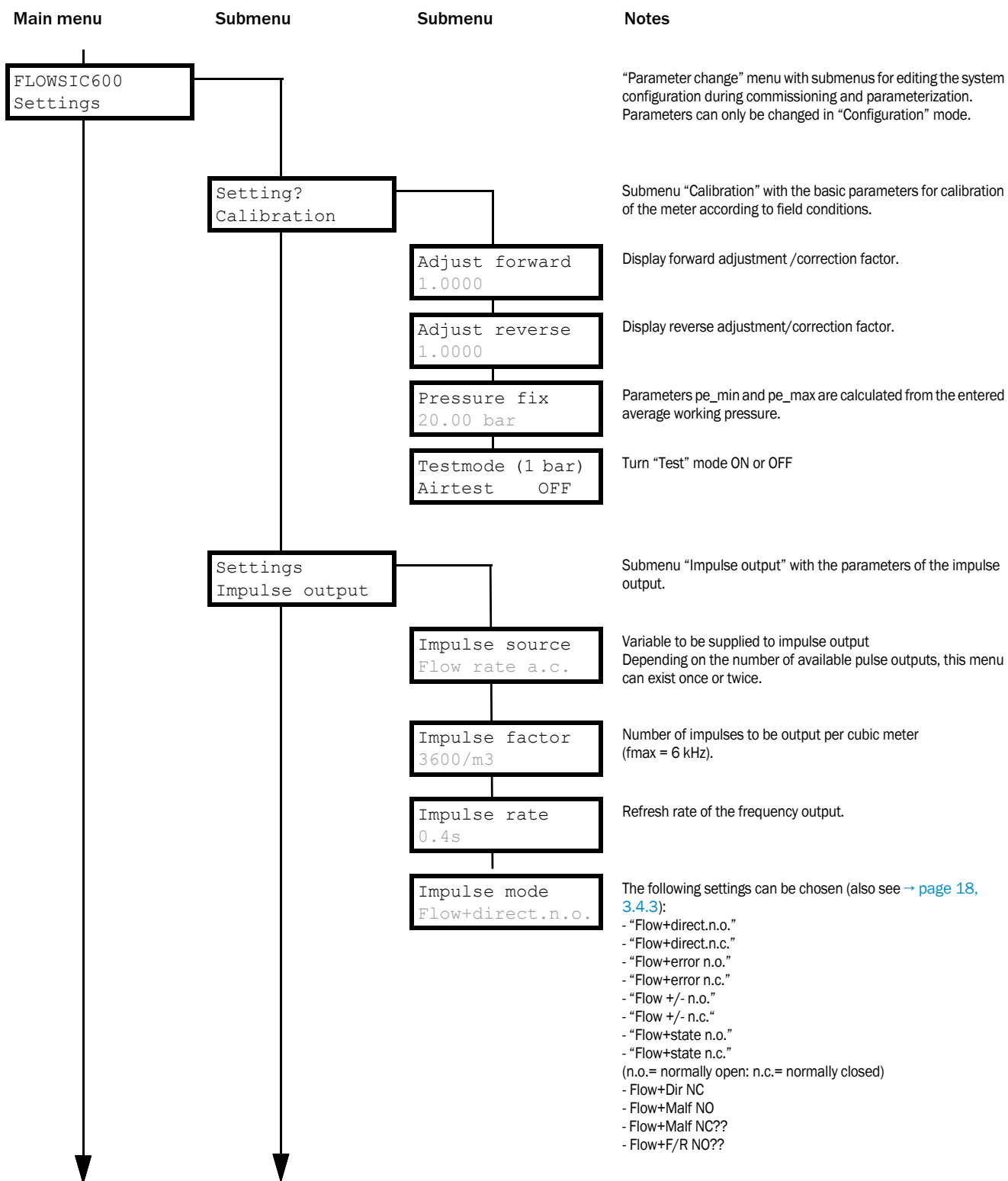
Parameters can only be changed in "Configuration mode".

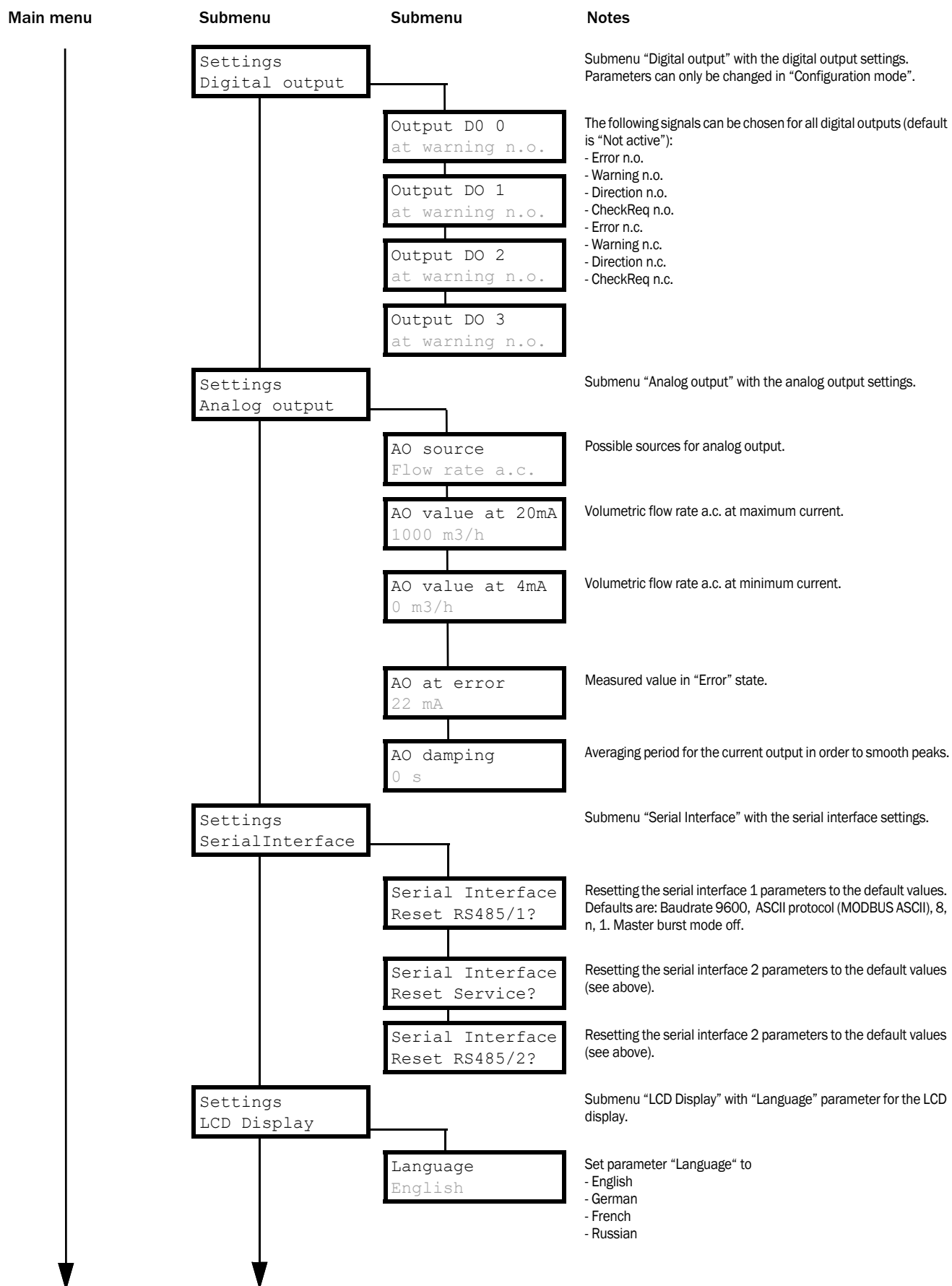
Graphical representation	Description
	Vertical lines represent connections between menu items on a menu level. The STEP button serves to move forward between the menu items and the DATA key to move backward.
	Horizontal lines represent connections between different menu levels. The ENTER function takes you to a lower menu level. The C/CE button takes you back to a higher menu level.
	Dashed lines show connections between alternating display pages.
	Boxes with a thick border represent the display of a menu item.
	Boxes with a grey border represent a flashing display (e.g. if an error or an unacknowledged logbook entry is present).

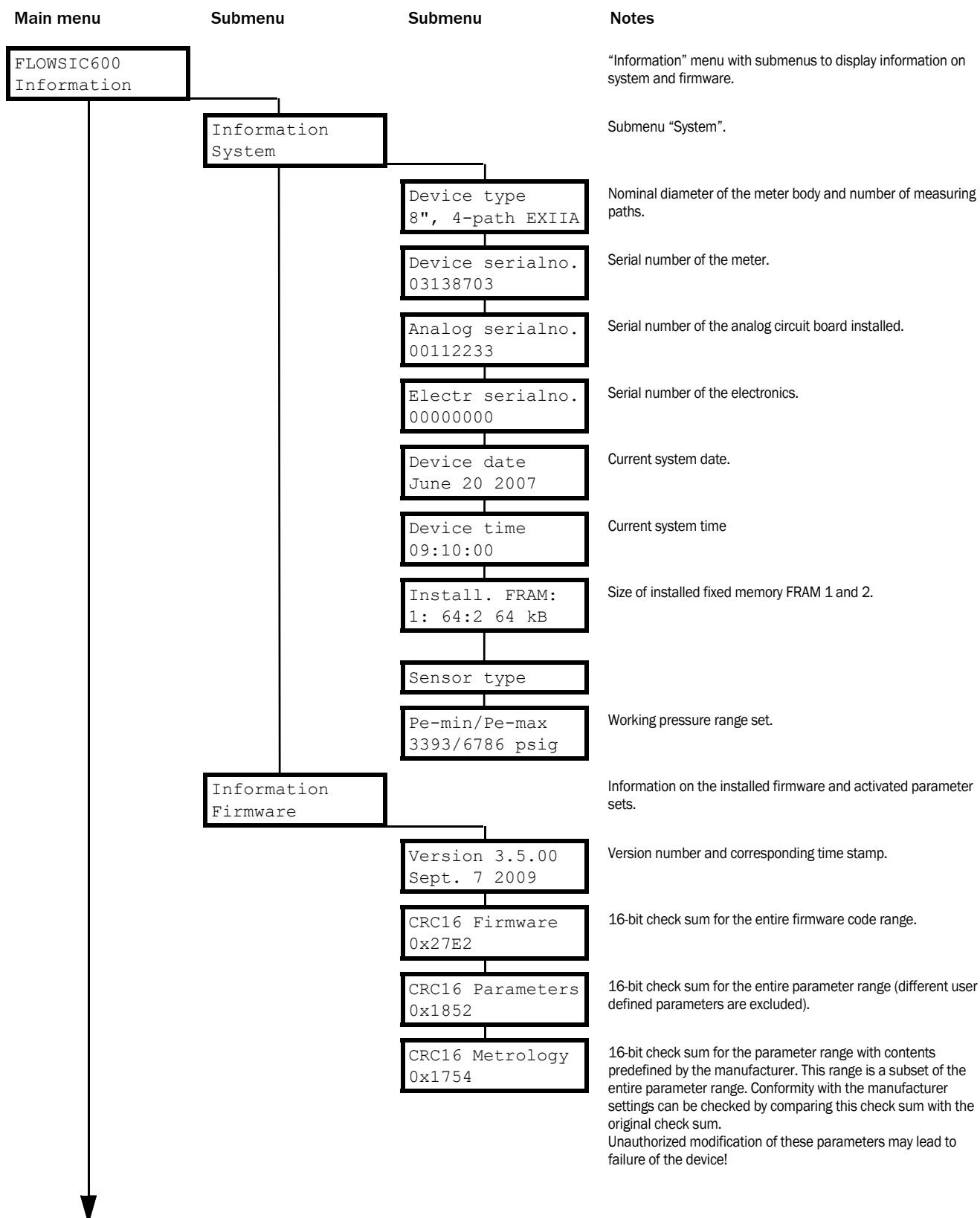


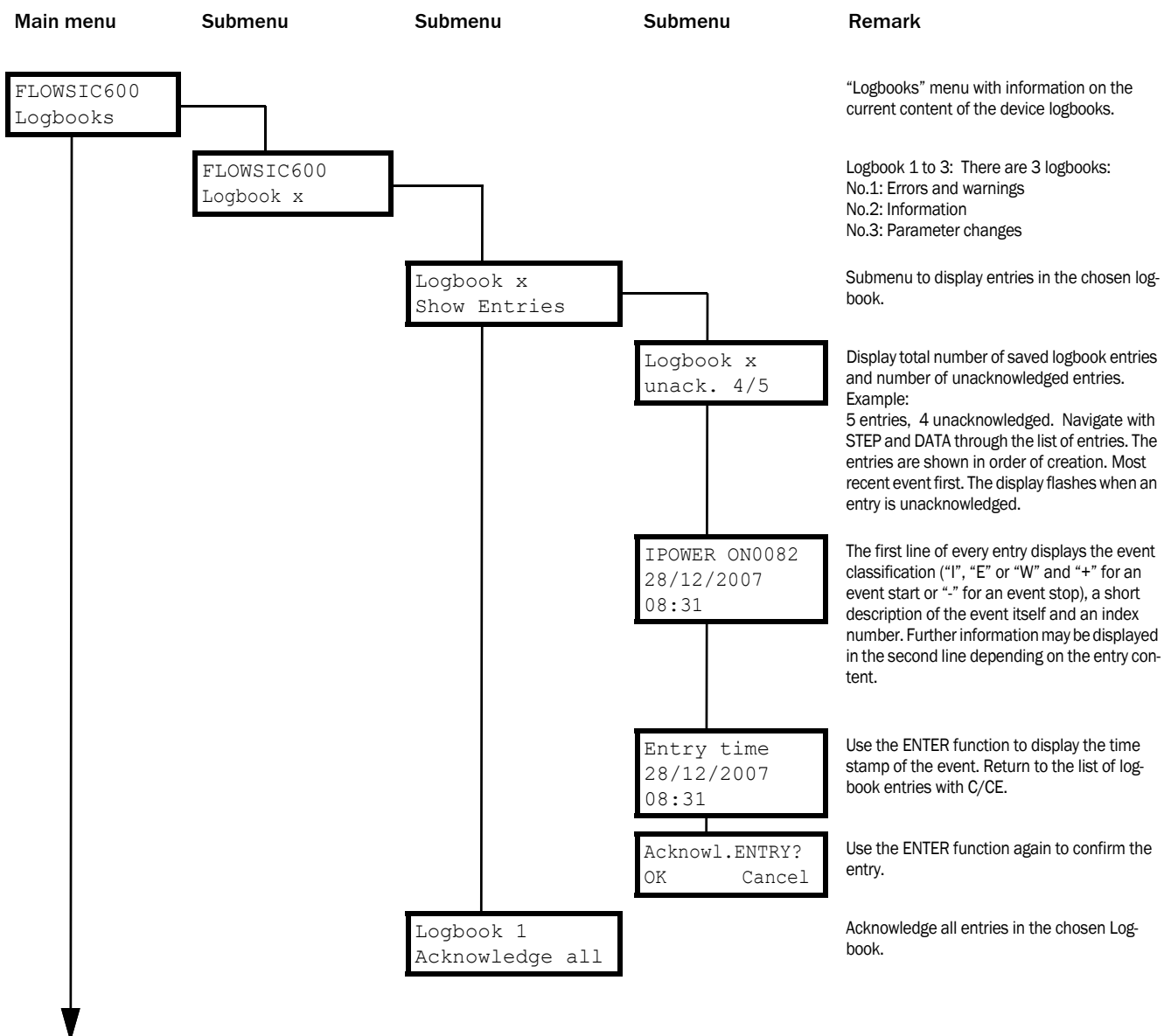


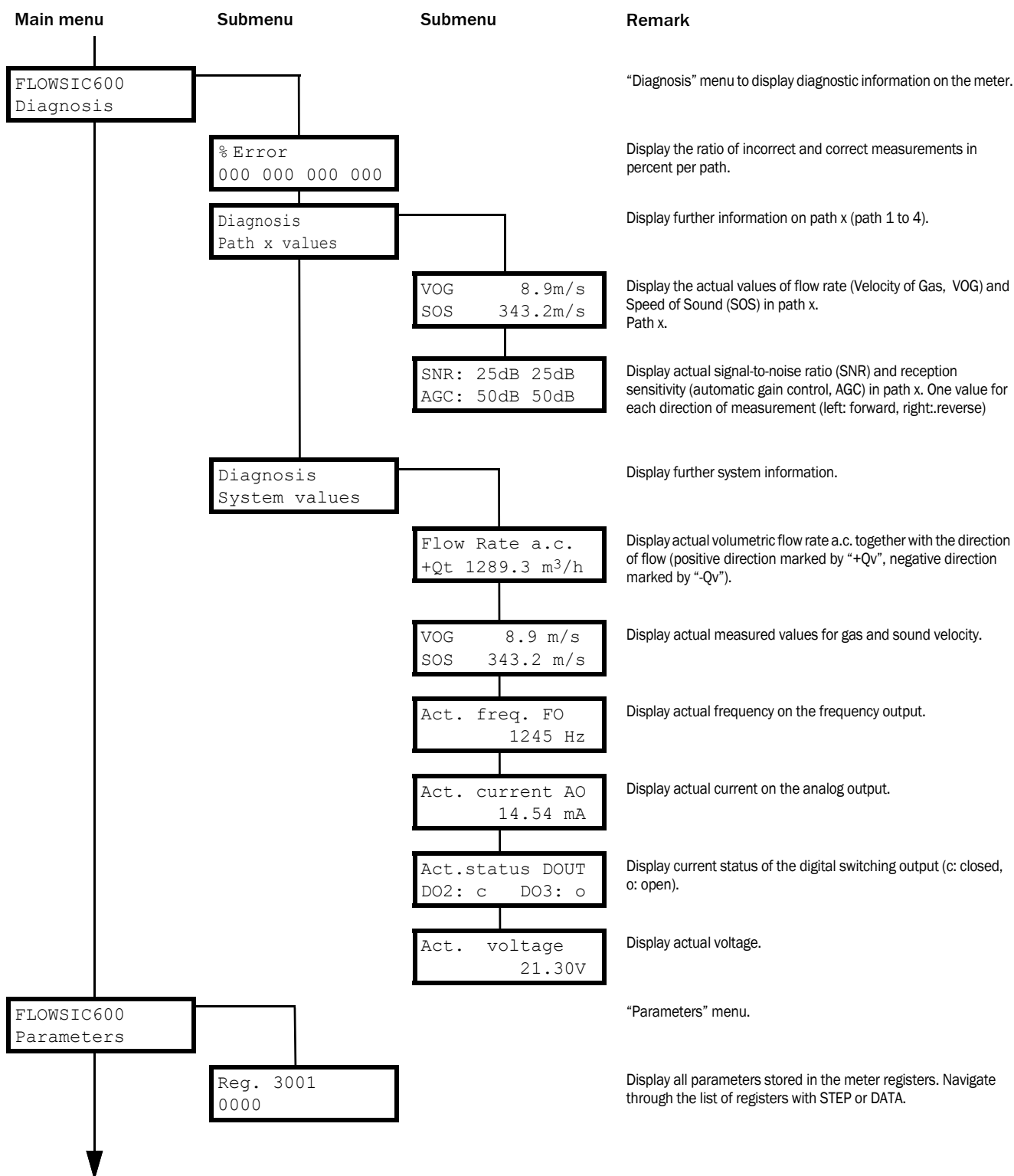


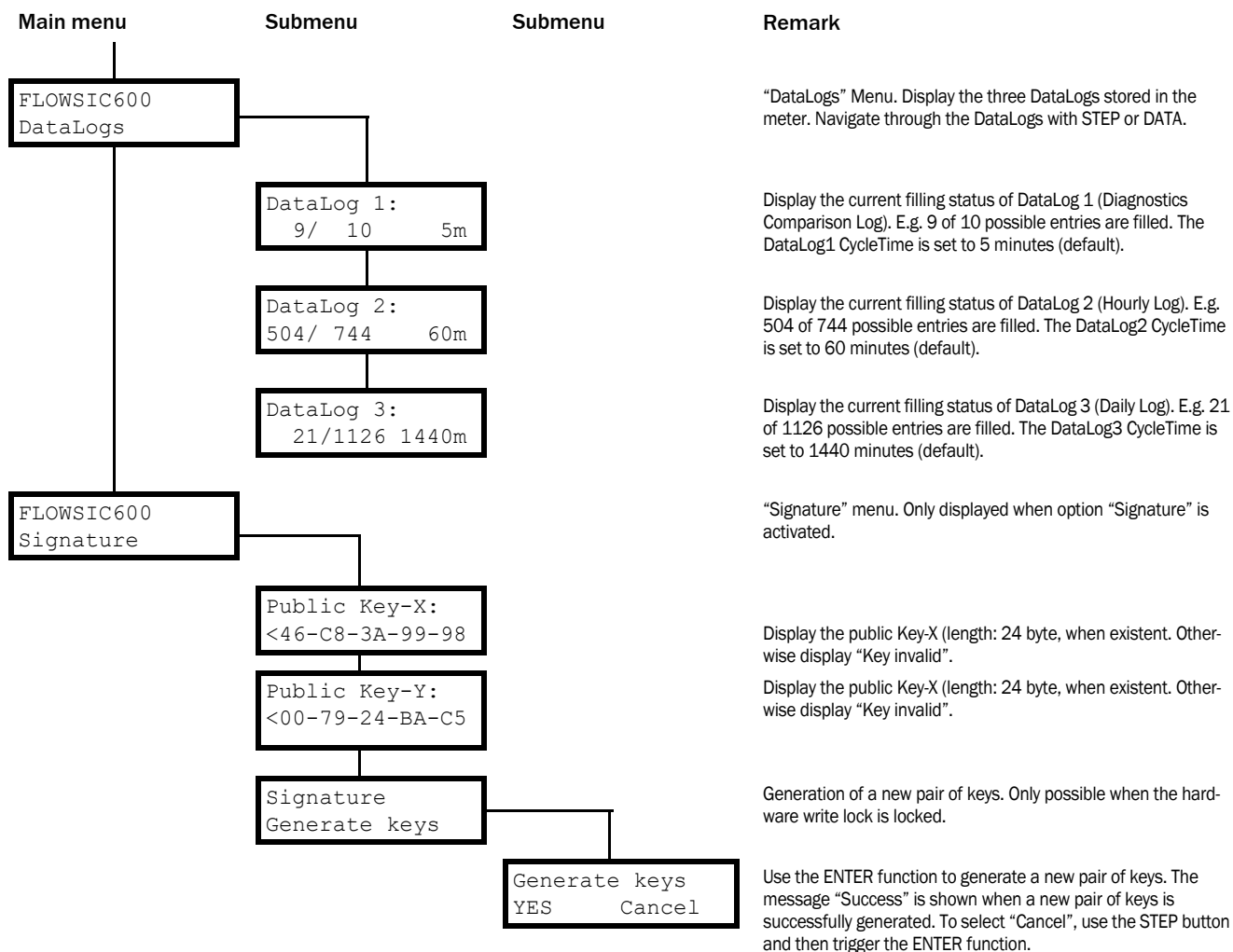












### 8.7.2 Displaying measured values

Use FLOWgate™ to select the measured values to be displayed on the standard display. The values can be assigned to the desired page and line of the standard display. The two display pages alternate every 5 seconds.

### 8.7.3 Data editing in Configuration mode

Editing parameters. The Parameter locking switch must be open and the ENTER function activated after selecting the respective parameter.

Selection options depending on the type of data:

- Integer: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, sign
- Floating point: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, space, decimal point, sign
- List of registers: List of all registers plausible (for this value)

*Example: Switching the meter to Configuration mode and editing a parameter ( e.g. the impulse factor).*

Action	Buttons	Display
Standard display	-	<div>+V 34569870 m3</div> <div>-V 0 m3</div>
Switch to menu	ENTER	<div>Operation Mode</div> <div>Operation</div>
Edit parameter "Operation Mode"	ENTER	<div>Configuration?</div> <div>OK <input type="checkbox"/> Cancel</div>
Confirm change to "Configuration Mode"	ENTER -> Change mode	<div>Configuration?</div> <div>Success!</div>
Scroll through the menu structure to the parameter you want to edit	(ENTER, STEP, DATA)	
In this example, the impulse factor is edited		<div>Impulse factor</div> <div>115/m3</div>
Select the parameter	ENTER	<div>Impulse factor</div> <div>115 <input type="checkbox"/></div>
Move cursor to the digit you want to change	1 * STEP	<div>Impulse factor</div> <div>11 <input type="checkbox"/></div>
Switch to Edit mode	2 * DATA	<div>Impulse factor</div> <div>115</div>
Enter desired value	x * DATA	<div>Impulse factor</div> <div>110</div>
Confirm new value	ENTER	<div>Impulse factor</div> <div>110/m3</div>
Return to standard display	3 x CE/C	<div>+V 34569870 m3</div> <div>-V 0 m3</div>



### 8.7.4 Resetting the error volume counters

To reset the error volume counters, password level “Authorized Operator” is required.

+Ef	70 m³
-Ef	0 m³

Select the error volume display. Use the ENTER function to enter the dialog for resetting the error volume counters.

<ENTER>

Counter reset	
OK	Cancel

Confirm the reset with the ENTER function. The error volume counter will be reset to zero. The reset will be recorded in the logbook. Press C/CE to cancel the reset.

<ENTER>

+EV	0 m³
-EV	0 m³

### 8.7.5 Acknowledging a battery replacement

The following message flashes on the LCD display after battery replacement:



#### WARNING: Risk of explosion

- ▶ Only replace the battery when the FLOWSIC600 DRU/DRU-S is separated from the power supply or there is no risk of an explosion.
- ▶ Replacing components can impair intrinsic safety.
- ▶ Replacement battery must be type Panasonic BR 2032.



Refer to the Service Manual for the description of battery replacement.

INFORMATION 1030 LifeSpan Battery
--------------------------------------

The date and time of the FLOWSIC600 DRU/DRU-S are invalid after switching the operating voltage back on so they have to be set to valid values. The easiest way to do this is via the FLOWgate™ user software.

The LCD message can be acknowledged after setting date and time. The acknowledgment sets the life span cycle of the new battery to zero. Carry out the following step on the LCD-display:

Press DATA

INFORMATION 1030 LifeSpan Battery
--------------------------------------

Press ENTER twice

Device state E:x W:x I:x
-----------------------------

Press ENTER once

Battery replaced OK Cancel
-------------------------------

(This message only appears for about one second.)

## 8.8 Logbooks

### Classification of logbook entries

Entries are split into three classes and identified by the initial character in the first line.

- "I" Information
- "W" Warning
- "E" Error/Malfunction

### Type of occurrence

- "+" Event timepoint marking the start of a state
- "-" Event timepoint marking the end of a state

### 8.8.1 Overview of event entries in Meter logbooks

Message No. on LCD	Logbook message	Logbook	LCD text
Metrology logbook [1]			
3002	No DSP communication	1	E+System 0001 NO DSP-Communic.
			E-System 0001 NO DSP-Communic.
3003	Measurement invalid	1	E+DSP 0001 Reading invalid
			E-DSP 0001 Reading invalid
3004	Firmware CRC invalid	1	E+Firmware 0001 CRC invalid
			E-Firmware 0001 CRC invalid
3005	Parameter CRC invalid	1	E+Parameter 0001 CRC invalid
			E-Parameter 0001 CRC invalid
3006	Parameter out of range	1	E+Parameter 0001 #XXXX range error
			E-Parameter 0001 #XXXX range error
3007	Failure during storage of path compensation parameter	1	E+PathComp. 0001 Storage error
			E+PathComp. 0001 Storage error
3008	Meter clock time invalid	1	E+System 0001 ClockTime inval.
			E-System 0001 ClockTime inval.
3009	Custody logbook [1] overflow	1	E+Logbook 1 0001 Overflow
			E-Logbook 1 0001 Overflow
3011	CRC volume counter (a.c) invalid	1	E+Count.ac 0001 CRC invalid
			E-Count.ac 0001 CRC invalid
3012	CRC volume counter (n.c) invalid	1	E+Count.sc 0001 CRC invalid
			E-Count.sc 0001 CRC invalid
3013	Transit time mode activated	1	E+System 0001 TransitTimeMode
			E-System 0001 TransitTimeMode

Table 14: Overview of event entries in Meter logbooks

Message No. on LCD	Logbook message	Logbook	LCD text
3014	No signature key	1	E+System 0001 No signature key
			E-System 0001 No signature key
2001	Path failure	1	W+PathError 0001 Path 1 2 3 4
			W-PathError 0001 All paths OK
2002	No HART communication to temperature transmitter	1	W+HART T 0001 No communication
			W-HART T 0001 No communication
2003	No HART communication to pressure transmitter	1	W+HART P 0001 No communication
			W-HART P 0001 No communication
2004	Maximum pulse output frequency exceeded (6kHz)	1	W+PulseOut 0001 6000 Hz exceeded
			W-PulseOut 0001 6000 Hz exceeded
2005	EVC parameter invalid	1	W+EVC 0001 EVC para.invalid
			W+EVC 0001 EVC para.invalid
2006	EVC hardware error	1	W+EVC 0001 EVC module error
			W+EVC 0001 EVC module error
1001	Flow meter power ON	1	I Power ON 0001 dd/mm/yy mm:ss
1002	Meter clock adjusted	1	I Set Time 0001 dd/mm/yy mm:ss
1003	Configuration Mode active	1	I+Meas.Mode 0001 Configurat. ON 1
			I-Meas.Mode 0001 Measurement ON 1
1004	Firmware changed	1	I Update FW 0001 3104 -> 3200
1007	Custody logbook [1] erased and intialized	1	I Logbook 1 0001 Reset and Init
1014	Overflow volume counter (a.c.)	1	I Count.ac 0001 Overflow
1015	Overflow volume counter (s.c.)	1	I Count.sc 0001 Overflow
1016	Error volume counter cleared	1	I Reset E 0001 01/01/07 10:47
1017	All volume counters cleared	1	I Reset V 0001 01/01/07 10:47

Table 14: Overview of event entries in Meter logbooks

Message No. on LCD	Logbook message	Logbook	LCD text
1027	Initialization error → Default parameter loaded	1	I+InitError 0001 DefaultParaLoad
			I-InitError 0001 DefaultParaLoad
1029	Air test mode activated	1	I+Airtest 0001 Active
			I-Airtest 0001 Not active
Warning logbook [2]			
1008	Warning logbook [2] erased and initialized	2	I Logbook 2 0001 Reset and Init
1010	Warning logbook [2] overflow	2	I+Logbook 2 0001 Overflow
			I-Logbook 2 0001 Overflow
1018	DataLog 1 cleared	2	I DataLog 1 0001 Reset
1019	DataLog 2 cleared	2	I DataLog 2 0001 Reset
1020	DataLog 3 cleared	2	I DataLog 3 0001 Reset
1021	DataLog 1 overflow	2	I+DataLog 1 0001 Overflow
			I-DataLog 1 0001 Overflow
1022	DataLog 2 overflow	2	I+DataLog 2 0001 Overflow
			I-DataLog 2 0001 Overflow
1023	DataLog 3 overflow	2	I+DataLog 3 0001 Overflow
			I-DataLog 3 0001 Overflow
1024	DataLog 1 CRC error	2	I+DataLog 1 0001 CRC invalid
			I-DataLog 1 0001 CRC invalid
1025	DataLog 2 CRC error	2	I+DataLog 2 0001 CRC invalid
			I-DataLog 2 0001 CRC invalid
1026	DataLog 3 CRC error	2	I+DataLog 3 0001 CRC invalid
			I-DataLog 3 0001 CRC invalid

Table 14: Overview of event entries in Meter logbooks

Message No. on LCD	Logbook message	Logbook	LCD text
1028	Customer limit exceeded	2	I+Userlimit 0001 Limit XXXXXXXXXX
			I-Userlimit 0001 Limits OK
Parameter logbook [3]			
1005	Parameter changed	3	I Parameter 0001 Change Reg3001
1006	All parameters to default (Reset)	3	I Parameter 0001 Reset all
1009	Parameter logbook [3] erased and initialized	3	I-Logbook 3 0001 Reset and Init
1011	Parameter logbook [3] overflow	3	I+Logbook 3 0001 Overflow
			I-Logbook 3 0001 Overflow

Table 14: Overview of event entries in Meter logbooks

## 8.9 SPU terminal assignment

### Connection acc. to ATEX IIA

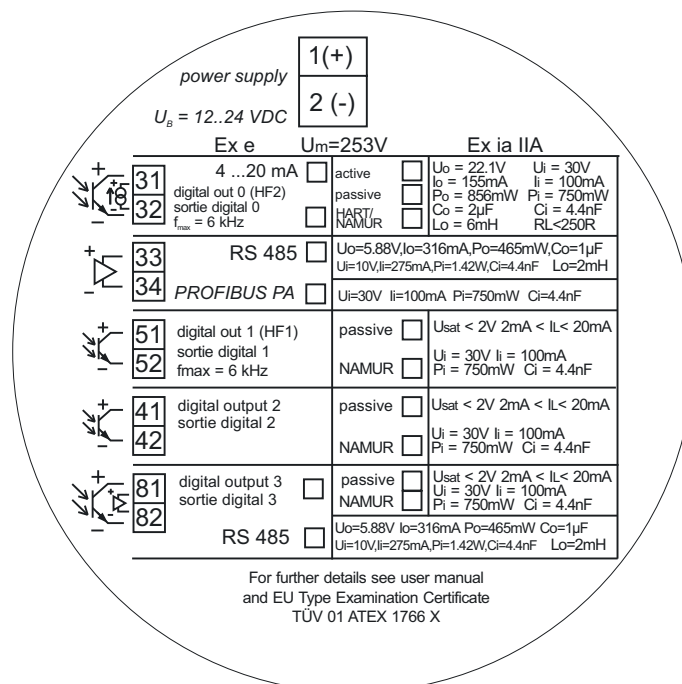


Fig. 55: Terminal assignment acc. to ATEX IIA

### Connection acc. to ATEX /IECEx IIA

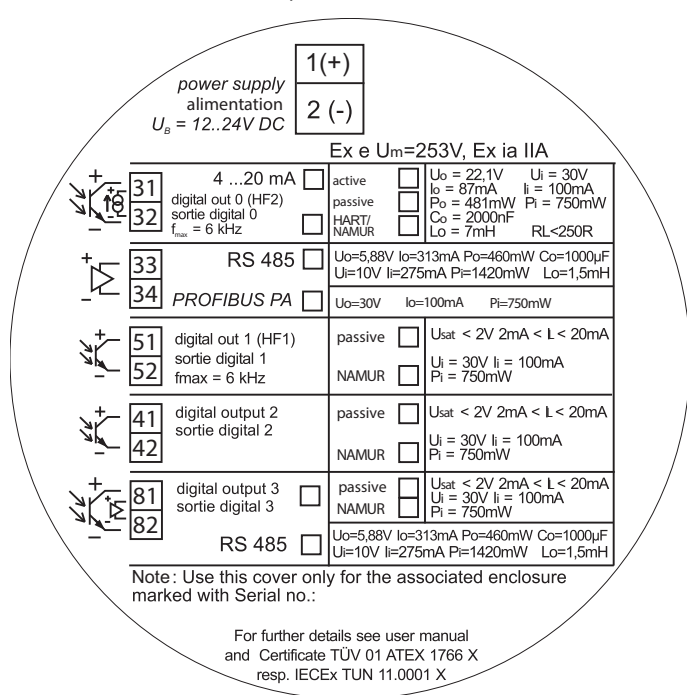


Fig. 56: Terminal assignment acc. to ATEX IIA

CSA SPU assignment → Fig. 60 and following pages.

8.10 Connection diagram for operation of the FLOWsic600 DRU/DRU-S in Ex-zones acc. to North American Directives (NEC, CEC)

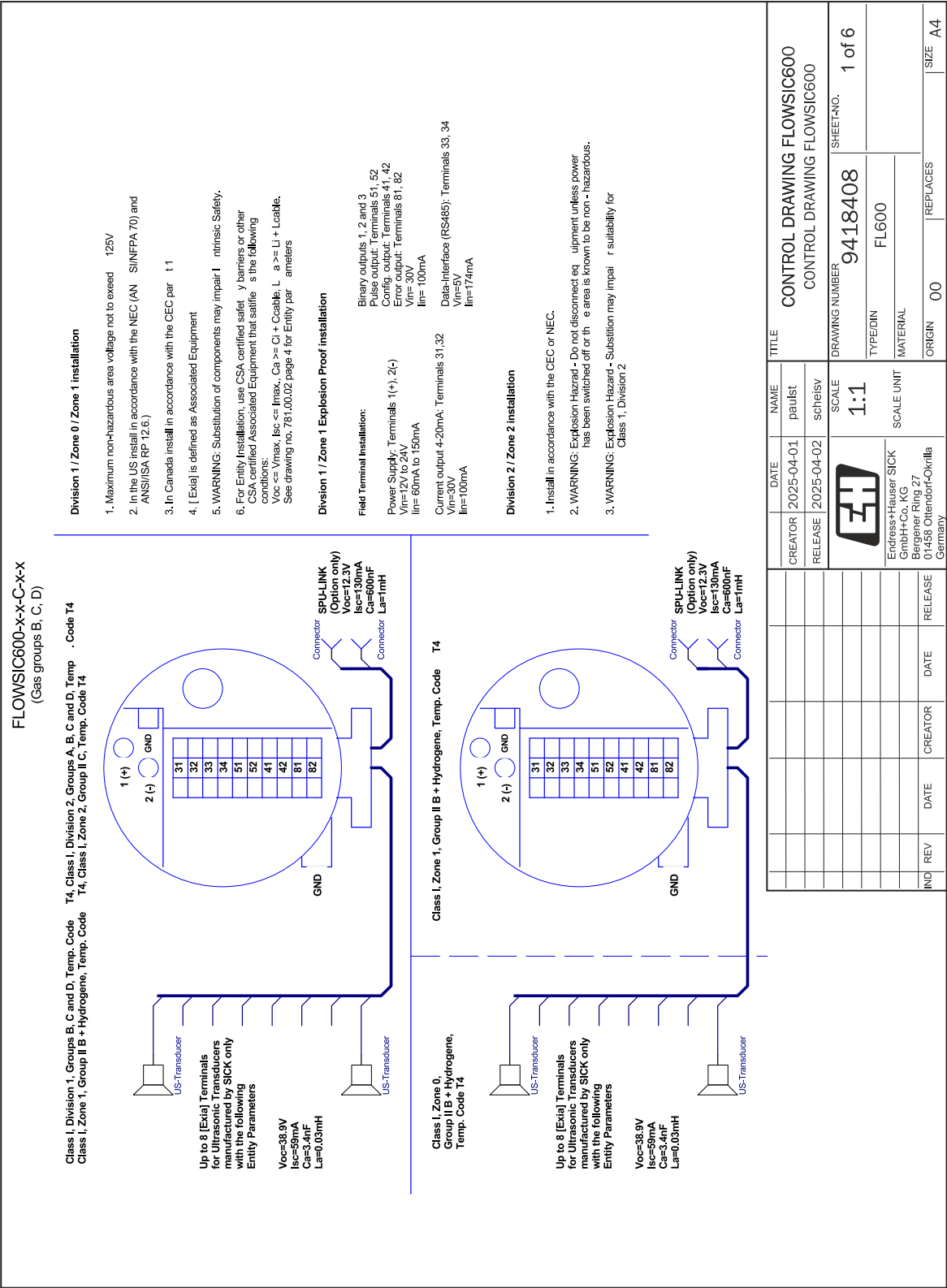
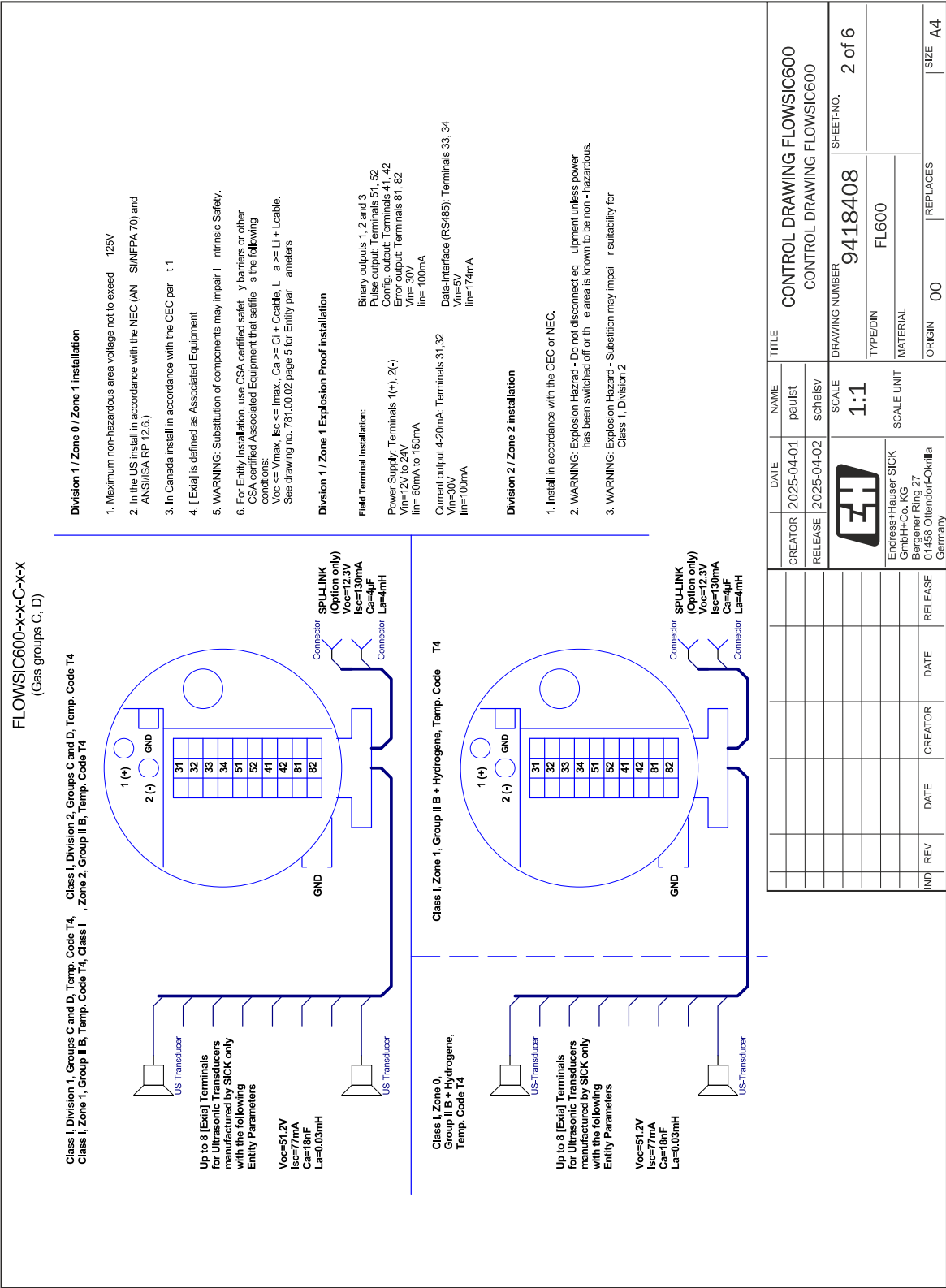


Fig. 57: Control drawing 9418408 (page 1)





**Division 1 / Zone 0 / Zone 1 Installation**  
 1. Maximum non-hazardous area voltage not to exceed 125V  
 2. In the US install in accordance with the NEC (AN SINFFPA 70) and ANSI/ISA RP 12.6 )  
 3. In Canada install in accordance with the CEC par t 1  
 4. [ Exia] is defined as Associated Equipment  
 5. WARNING: Substitution of components may impair intrinsic Safety.  
 6. For Entity Installation, use CSA certified safety barriers or other CSA certified Associated Equipment that satisfies the following conditions:  
 Voc <= Vmax, Isc <= Ci + Ccable, La >= Li + Lcable.  
 See drawing no. 781,00,02 page 5 for Entity parameters

**Division 1 / Zone 1 Explosion Proof Installation**  
**Field Terminal Installation:**  
 Binary outputs 1, 2 and 3  
 Pulse output: Terminals 51, 52  
 Config. output: Terminals 41, 42  
 Error output: Terminals 81, 82  
 VIn= 30V  
 IIn= 100mA  
 Current output 4-20mA: Terminals 31, 32  
 VIn=30V  
 IIn=100mA  
 Data-Interface (RS485): Terminals 33, 34  
 VIn=5V  
 IIn=174mA

**Division 2 / Zone 2 Installation**  
 1. Install in accordance with the CEC or NEC.  
 2. WARNING: Explosion Hazard - Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.  
 3. WARNING: Explosion Hazard - Substitution may impair suitability for Class 1, Division 2

CREATOR	DATE	NAME	TITLE
	2025-04-01	paulst	CONTROL DRAWING FLOWSIC600
RELEASE	2025-04-02	scheisv	CONTROL DRAWING FLOWSIC600

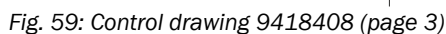
DRAWING NUMBER	SHEET-NO.
9418408	2 of 6

TYPED IN	REPLACES	SIZE
FL600		A4

SCALE	SCALE UNIT
1:1	

IND	REV	DATE	CREATOR	DATE	RELEASE

Fig. 58: Control drawing 9418408 (page 2)



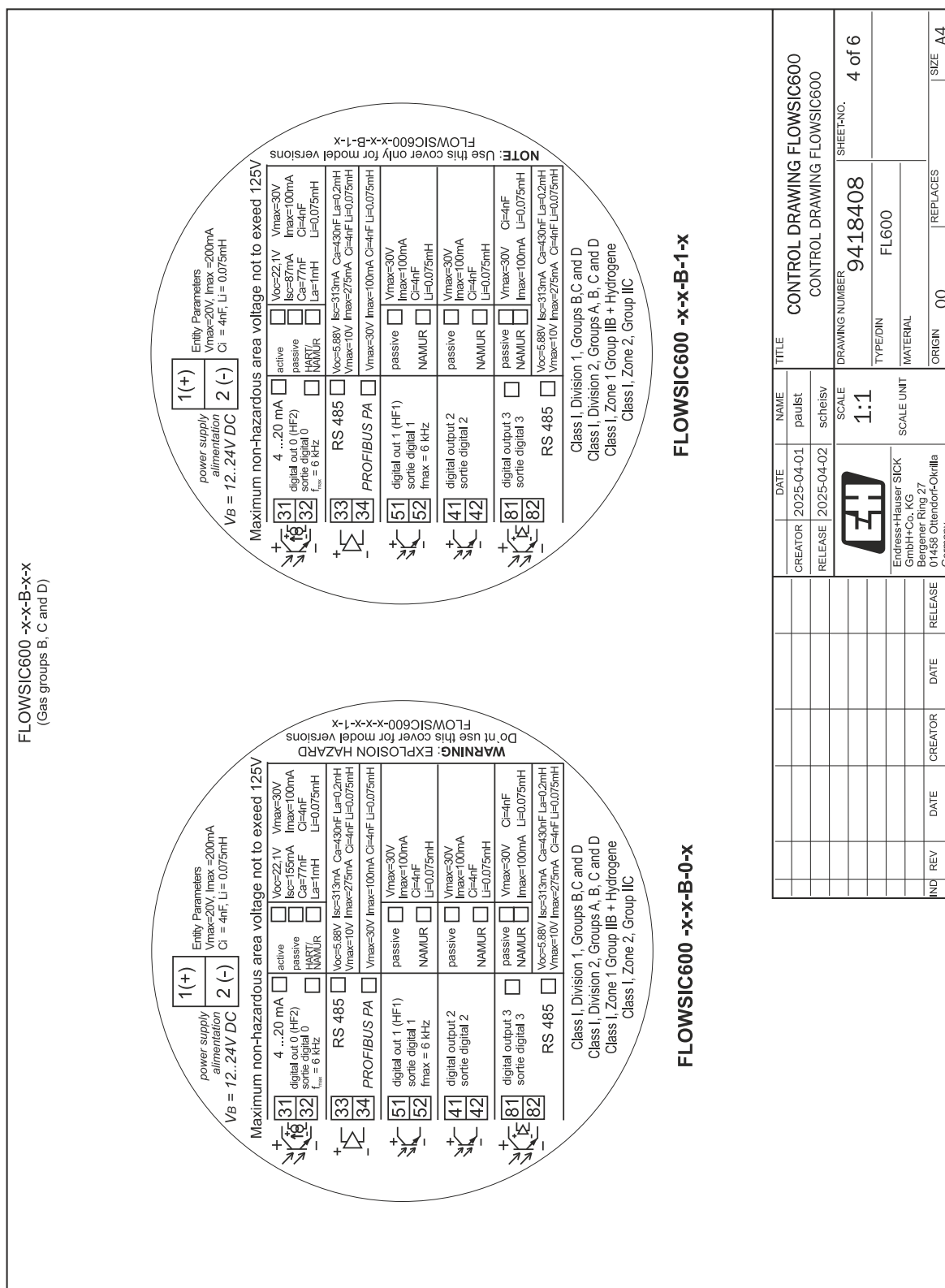
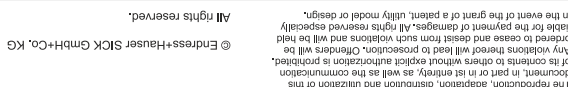
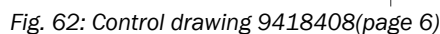


Fig. 60: Control drawing 9418408 (page 4)



100



### 8.11.1 Intrinsically safe installation

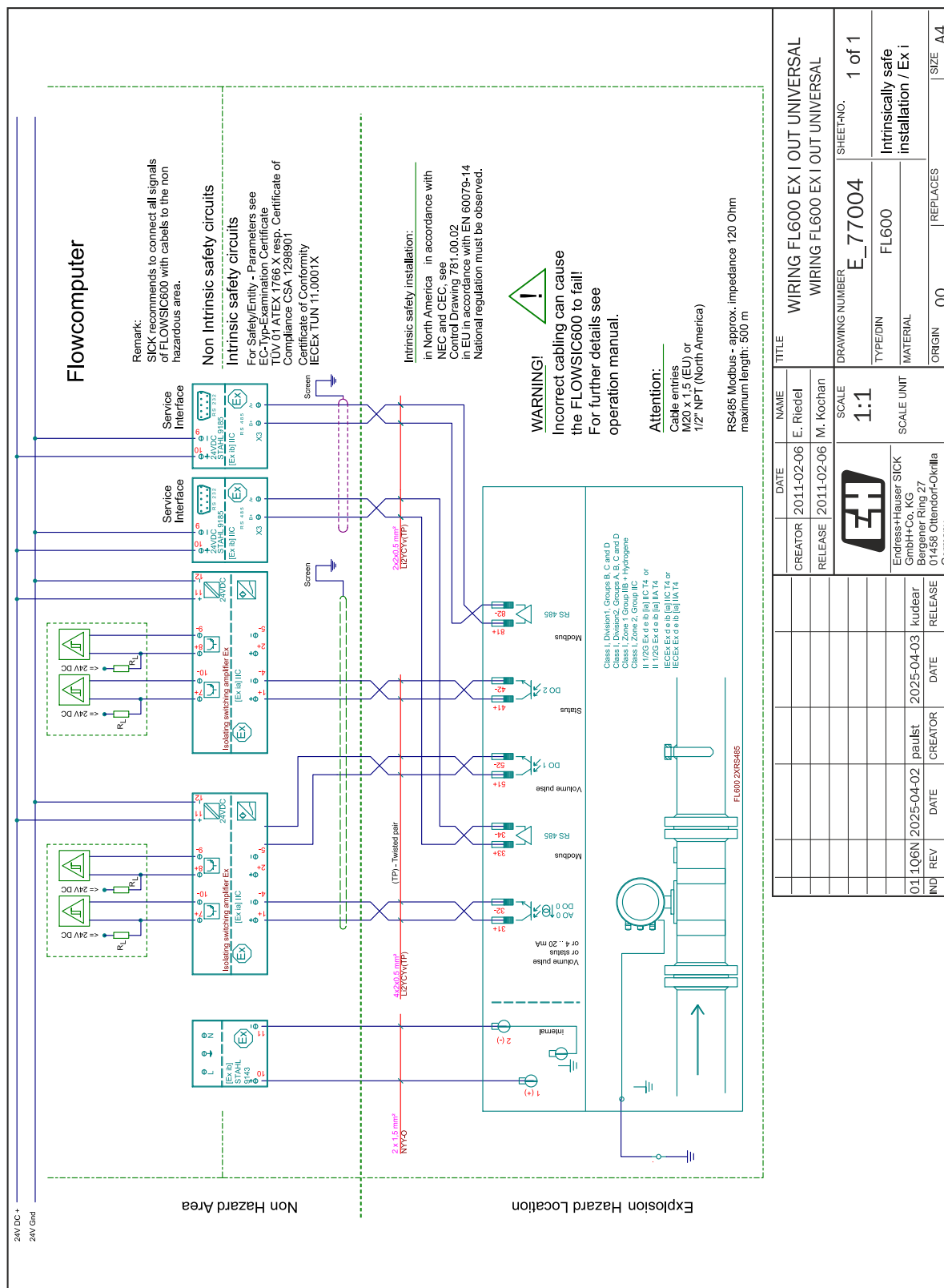


Fig. 63: Intrinsically safe installation of the FLOWSIC600 DRU/DRU-S

### 8.11.2 Non-intrinsically safe installation

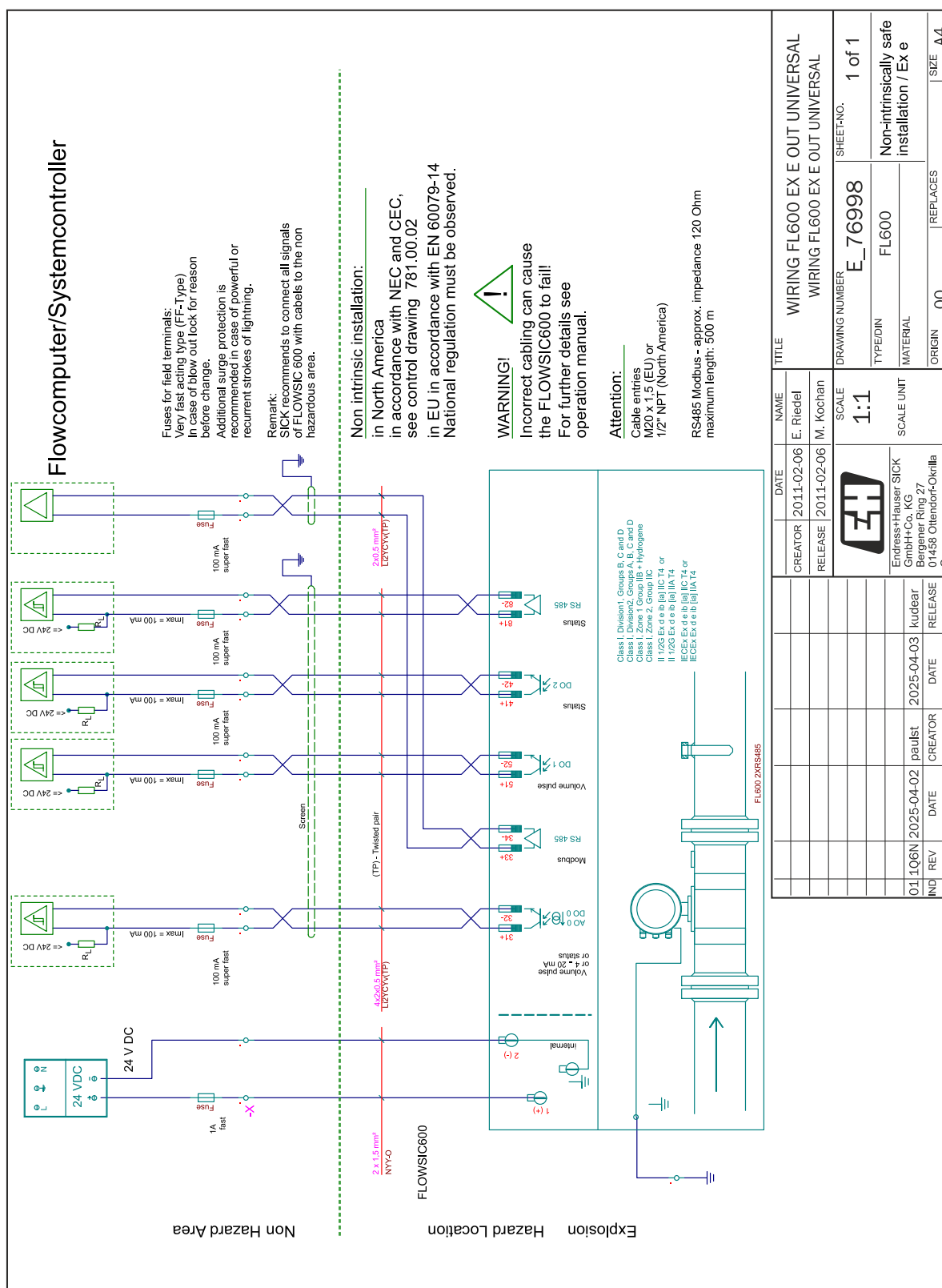


Fig. 64: Non-intrinsically safe installation of the FLOWSIC600 DRU/DRÜ-S

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