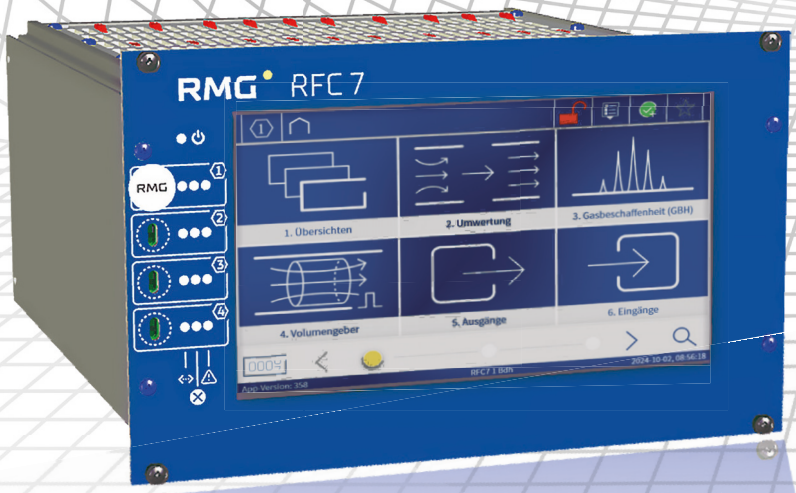
RMG
ONE STEP AHEAD

RMG FLOW COMPUTER

RFC 7

Operating Manual



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Document information

This document is a translation of the original German operating instructions.

We reserve the right to make changes to the content. Minor and editorial errors not caused by gross negligence or wilful misconduct shall not give rise to any liability or indemnification claims. RMG Messtechnik GmbH assumes that the documentation and operating instructions are used by competent personnel.

The latest version of this manual and the manuals of other devices can be downloaded conveniently from our website.

Version	Version date	Changes
V00	November 2024	Initial creation
V01	April 2025	Addition further contents

Protection notice pursuant to DIN ISO 16016

Preface

Dear Customer,

Thank you for deciding to purchase a product from RMG Messtechnik GmbH.

We would like to ask you to take the time to read this manual carefully, paying special attention to the safety information provided throughout the text and the section on ‘safety information’.

This is essential for handling and working with the product safely.

Our products are continuously developed, so there may be some minor differences between the product you have received and the depictions provided in this operating manual.

If you have any questions that are not answered by this manual, please contact us; we will be happy to help.

If you have any suggestions for improvements we could make, please let us know.

RMG Messtechnik GmbH

Table of contents

1 About this manual

The Flow Computer RFC 7 is a device from the universal device concept developed by RMG Messtechnik, referred to as the platform for 19" device technology.

This operating manual contains essential information on operating the Flow Computer RFC 7 safely, reliably and as intended.

It forms an integral part of the RFC 7 and must be kept close to the device in a place where it can be accessed by the personnel easily at any time.

The manual is intended for technically qualified personnel who have been trained for installation, operation, maintenance and repair.

The personnel must have carefully read and understood this manual before commencing any work. Compliance with all the specified safety information and instructions is essential for safe work.

Illustrations provided in this manual are intended to provide a general understanding and may not correspond precisely to the actual product.

1.1 Scope of the manual

This manual applies to the variants of the RFC 7 listed below:

- Single-Stream (one stream – data from one measurement point are processed in the RFC 7)
- Multi-Stream (two to four streams – data from up to four independent measurement points are processed in the RFC 7)

The above-mentioned variants are available in the following versions, with different software and parameterisation:

- -Vol: Condition volume corrector
- -Energy: calorific value volume corrector

The Flow Computer RFC 7 is used as an individual component in an overall system. The manuals of the other components used therefore apply in addition to this manual. In the event of the manuals containing contradictory instructions, please contact RMG Messtechnik GmbH and/or the manufacturers of the other components.

1.2 Abbreviations

This manual uses the following abbreviations:

RFC	**R**MG **F**low **C**omputer
MID	**M**easurement **I**nstruments **D**irective 2014/32/EU
PED	**P**ressure **E**quipment **D**irective 2014/68/EU
DVGW	**D**eutscher **V**erein des **G**as- und **W**asserfaches (German Association for Gas and Water)
ATEX	Explosion protection in accordance with ATEX Product Directive 2014/34/EU (**AT**mosphères **EX**plosives)
MessEG	**Mess**- und **Eichg**esetz (German Weights and Measures Act)
MessEV	**Mess**- und **Eichv**erordnung (German Weights and Measures Ordinance)
PTB	**P**hysikalisch **T**echnische **B**undesanstalt (German National Metrology Institute)

Table 1: Abbreviations

CoM	**C**omputer **o**n **M**odule
IOC	**I**nput **O**utput **C**ontroller
GUI	**G**raphical **u**ser **i**nterface
DSfG	**D**igitale **S**chnittstelle **f**ür **G**asmessgeräte (Digital Interface for Gas Measurement Equipment)
TCP/IP	**T**ransmission **C**ontrol **P**rotocol/**I**nternet **P**rotocol Family of network protocols (Internet protocol family)
IP (address)	Address based on the Internet protocol (IP) and assigned to devices in the network so that they can be addressed and accessed.
LAN	**L**ocal **A**rea **N**etwork – a local computer network.
Eth	Ethernet interface Ethernet technology enables data to be exchanged between connected devices in the local network.
SNTP	(**S**imple) standard (NTP = **N**etwork **T**ime **P**rotocol) for synchronising clocks in computer systems
SNR	**S**ignal to **n**oise **r**atio
VOS or SoS	**S**peed **o**f **s**ound
TD	**T**rans**d**ucer (ultrasonic transmitter and receiver)
USM (USZ)	Ultrasonic flowmeter
Vo	Original counter
ENCO	Encoder for digital transmission of the original counter
HART	**H**ighway **A**ddressable **R**emote **T**ransducer protocol: standardised digital communication superimposed over the 4–20 mA analogue signal for data exchange with transmitter devices

Table 1: Abbreviations

1.3 Symbols

This manual uses the following symbols:

1., 2., etc.	Indicates steps that are to be performed in the specified sequence.
▶	Indicates a measure or an activity that is to be carried out.
➡	Indicates the sequences of a performed measure or a step
■	Indicates a general collection of information
	Indicates a reference to a specific section of this manual

Table 2: Symbols used

1.4 Structure of the safety information

In this manual, safety information is labelled with symbols and introduced with signal words.

The safety information specifies the type and the source of the danger and describes the consequences of failing to observe the safety information.

The safety information concludes by describing the measures and actions required to avoid the hazard.

The safety information in this manual is structured as follows:

⚠ DANGER

Imminent threat

Potential consequences of failing to observe the safety information: death or extremely severe injury

▶ Preventive measure or action

⚠ WARNING

Dangerous situation

Potential consequences of failing to observe the safety information: severe or irreversible injury

▶ Preventive measure or action

⚠ CAUTION

Potentially dangerous situation

Potential consequences of failing to observe the safety information: slight or minor injury

▶ Preventive measure or action

NOTE

Warning of property damage, and instructions for use

Instructions for use and useful or important information

2 General information

2.1 Intended use

The Flow Computer RFC 7 is used to collect and evaluate signals and measurements from gas meters and gas analysis devices and from pressure and temperature sensors from up to four measurement points in order to determine standard flow rates and energy volumes, for example. The measurement results and calculated output variables can be monitored and archived with the RFC 7. It can be used in a variety of applications, as:

- Condition volume corrector to determine the K number[1)] and the standard volume of gas mixtures such as natural gas and biogas (version: -Vol)
- Calorific value volume corrector to determine the K number[1)] and the standard volume and, in combination with the calorific value, the gas quality in order to determine the energy content of gas mixtures such as natural gas and biogas (version: -Energy)

[1)] Compressibility coefficient: correction factor for the difference between how the gas behaves in the actual situation at hand and the ideal gas behaviour

When the device is placed on the market for the first time, the settings that are required for approval in applications involving official calibration are made before delivery and secured against substantial alteration with lead seals and software and hardware locking.

The Flow Computer RFC 7 is **not** intended for use in potentially explosive atmospheres. Nevertheless, devices and sensors may be connected to the RFC 7 that are located in a potentially explosive atmosphere.

The RFC 7 was designed and manufactured in accordance with the latest technological developments and recognised safety standards and guidelines. Nevertheless, hazards or damage to the device or other property may occur during its use. The RFC 7 may only be used as intended as in a perfect technical condition.

Observe the operating manual and follow the instructions and installation, start-up, operation and maintenance guidelines.

Perform cleaning and care of the device on a regular basis and observe the guidelines for wearing personal protective equipment (e.g. safety helmet, safety goggles, safety boots).

2.2 Foreseeable misuse

Foreseeable misuse refers to any use for purposes other than those named above, in particular:

- Personnel who have not been given instructions engaging in activities on the device.
- Failure to follow the operating instructions issued by the owner.
- Failure to observe the operating manual.
- Using the RFC 7 in a potentially explosive atmosphere.
- Removing or damaging the lead seals or software or hardware locks in devices intended for applications involving official calibration.
- Unauthorised changes being made to the device settings, especially in the case of devices used for applications involving official calibration.

NOTE

Use other than as intended

Use other than as intended voids any guarantee claims and the Flow Computer RFC 7 may lose its approvals.

2.3 Liability disclaimer

All specifications and notes provided in this manual were compiled in accordance with the application standards and guidelines, the latest technological developments and many years of knowledge and experience.

RMG Messtechnik GmbH assumes no liability for loss or damage caused by:

- failure to observe this manual
- use other than as intended
- deployment of untrained personnel
- operating errors
- unauthorised modifications
- technical alterations
- use of non-permitted spare parts

The obligations arranged in the supply agreement, the general terms and conditions and the statutory regulations that applied at the time the agreement was concluded apply.

2.4 Conformity

The Flow Computer RFC 7 was approved and placed on the market in accordance with the following directives:

- Measurement Instruments Directive 2014/32/EU
- EMC Directive 2014/30/EU
- RoHS Directive 2011/65/EU

Variants of the RFC 7 that have an input card that enables the secure separation of signals of intrinsically safe field devices (Ex-i) are also approved and placed on the market in accordance with the following directive:

- ATEX Directive 2014/34/EU

For operation in applications involving official calibration in Germany, approval is being sought in accordance with the following laws and regulations:

- German Weights and Measures Act (MessEG) – dated 25 July 2013
- German Weights and Measures Ordinance (MessEV) – dated 11 Dec. 2014

In accordance with the individual device variants, the required harmonised standards have been applied. The following list contains all standards that could be applied:

- EN ISO 6976:2016
- DIN EN 12405-1:2021
- DIN EN 12405-2:2012
- DIN EN 12405-3:2015
- EN IEC 61000-6-2:2019

- EN IEC 61000-6-4:2019
- EN IEC 61000-4-2:2009
- EN 60068-2-2:2007
- EN 60068-2-78:2013
- EN 60068-2-30:2005
- EN IEC 60079-0:2018
- EN 60079-11:2012

The EU declaration of conformity is provided in the annex.

The device bears the following mark:

CE

Devices that also have ATEX directive approval bear the following additional mark:

IIC-Ex-IO
II (2)G [Ex ia Gb] IIC
BVS 23 ATEX E 027 X, IECEx BVS 23.0017X
T_a = -25 °C to +60 °C

For queries or for additional information, please contact RMG Messtechnik GmbH.

2.5 Type label

Depending on the approval, number of streams and intended function, the Flow Computer RFC 7 is given various nameplates, which are arranged on the front panel. The nameplates can fundamentally be split into two types:

- Nameplate, basic device RFC 7
- Nameplate for each stream

2.5.1 Nameplate, basic device

Depending on the version, the basic device RFC 7 is given the following nameplates (examples).

Approval in accordance with Measuring Instruments Directive (MID)

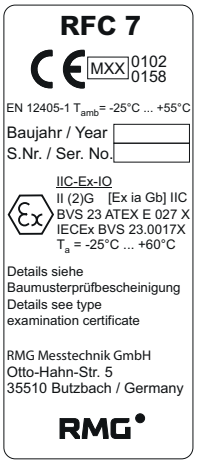


Fig. 1: Name plate with Ex equipment (example)

Approval in acc. with MessEG and MessEV

Fig. 2: Name plate with Ex equipment (example)

2.5.2 Nameplate, stream

In accordance with the completed approval and the function, each stream is given the nameplates listed below (examples).

Approval in accordance with Measuring Instruments Directive (MID)

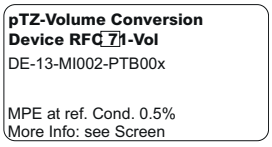


Fig. 3: Nameplate, condition volume corrector (stream 1, example)

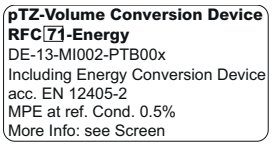


Fig. 4: Nameplate, calorific value volume corrector (stream 1, example)

Approval in acc. with MessEG and MessEV

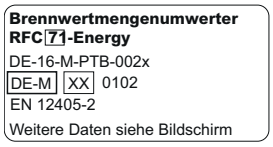


Fig. 5: Nameplate, calorific value volume corrector (stream 1, example)

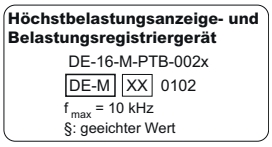


Fig. 6: Nameplate, peak load display and load registration device (stream 1, example)

2.6 Personnel qualifications

⚠ DANGER

Danger of death arising from insufficiently qualified personnel

If unqualified personnel perform work such as mechanical and/or electrical installation, and in initial start-up, in potentially explosive atmospheres hazards arise that could cause extremely severe injury or death.

- ▶ All activities must only be performed by personnel who have received training and instruction for work in potentially explosive atmospheres.
- ▶ Keep unqualified personnel away from the hazard zones.
- ▶ Have any work that has been performed checked by responsible experts.
- ▶ Mechanical installation must also only be performed by persons with the corresponding qualifications, who have the knowledge required for the activities to be performed and the tools to be used.

NOTE

Recommend qualifications for the personnel

In general the following qualifications are recommended for all persons working with or on the Flow Computer RFC 7:

- ▶ Education/training relating to work in potentially explosive atmospheres.
- ▶ Ability to correctly assess hazards and risks in handling the RFC 7 and all connected devices.
- ▶ Education/training provided by RMG Messtechnik GmbH for work with gas measuring instruments.
- ▶ Training/instruction in relation to all national standards and guidelines that need to be complied with for the work to be performed at the RFC 7.

The following personnel qualifications have been defined for the various activities in involving the RFC 7:

Operation:	The operating personnel use and operate the device within the scope of its intended use. The owner instructs the operating personnel regarding the tasks assigned to them and potential dangers.
Cleaning and care:	Cleaning and care of the device must only be performed by specialists with the corresponding qualifications.

Maintenance and repair:	Maintenance and repair work must only be performed by specialists who have received training from RMG in relation to the advanced operation and parameterisation of the device and the performance of preventive maintenance work. They are also able to perform the tasks assigned to them as the result of their specialist training and experience and knowledge of the relevant standards and provisions. These specialists are aware of the applicable legal regulations concerning accident prevention and are able to recognise and avoid potential hazards.
Installation and Electrical work:	Installation and electrical work must only be performed by a specialist electrician. A specialist electrician must have a specialist training, knowledge and experience in electrical engineering and be aware of the relevant standards and regulations (DIN VDE 0105, IEC 364, etc.). The specialist electrician is aware of the applicable legal regulations concerning accident prevention and is able to recognise and avoid potential hazards.

2.7 Responsibility of the owner

The device is used in the industrial sector. The owner of the device is therefore subject to the legal obligations relating to occupational health and safety.

In addition to the safety information provided in this manual, the safety, accident prevention and environmental regulations that apply to the device's field of application must be observed.

The following also applies in particular:

- As owner, ensure that only personnel with sufficient qualifications work on the device.
- Ensure that all employees who handle the device have read and understood this manual.
- Furthermore, you are obliged to train the personnel on a regular basis and to inform them of the risks and hazards involved in handling the device.
- Arrange for work performed by qualified personnel to be checked by responsible specialists.
- Clearly specify the responsibilities for installation, operation, troubleshooting, maintenance and cleaning.
- Make the required personal protective equipment available to the personnel.

2.8 Scope of delivery

The actual scope of delivery may differ from the explanations and depictions provided here in the case of custom designs or additional options being ordered or because of recent technical developments.

Nevertheless, the following table depicts the standard scope of delivery:

Component	Quantity
Flow Computer RFC 7	1
Connector set, complete	1
Operating manual	1

Table 3: Scope of delivery

For further information on the variants, see section 4 ‘Product description’.

3 Safety information

3.1 Risk assessment and risk minimisation

The RFC 7 was manufactured in accordance with the latest technical developments and recognised safety rules and standards, but its use does nevertheless pose some risks. Throughout the development process, these risks were identified and assessed by qualified employees. A corresponding risk analysis was compiled and used a basis for developing and implementing structural measures in order to minimise the risks.

This manual draws attention to the residual risks that cannot be prevented in safety information and instructions.

3.2 General safety information

⚠ DANGER

Danger – personal injury and property damage!

Failing to observe the safety information may result in danger to human life or health and environmental and property damage.

- ▶ Observe all the following safety information!

Bear in mind that the safety information in this manual and on the device is not able to cover all potential hazardous situations, as it is not possible to foresee how all the ways in which different circumstances may interact.

Exclusively observing the instructions provided may not be sufficient to ensure proper operation.

- ▶ Always remain attentive and think for yourself.
- ▶ Before working with the device for the first time, read this operating manual carefully, especially the safety information it contains.
- ▶ This operating manual provides warnings of unavoidable residual risks for users, third parties, devices and other property in its safety information.
- ▶ Only operate the device in a perfect technical condition, in compliance with the operating manual and in accordance with its intended use.
- ▶ In addition, observe the local legal regulations concerning accident prevention, installation and assembly.

NOTE

Applications involving official calibration

If the Flow Computer RFC 7 is to be used for applications involving official calibration, it will be preset before delivery in accordance with the approval and secured with lead seals, software and hardware locks to prevent unauthorised alteration. If these protective measures are removed or damaged, the RFC 7 will lose its approval and may no longer be used in applications involving official calibration.

- Never remove or damage the lead seals or other protective measures!
- If a protective measure is removed or damaged, however, the device must be inspected by a state-approved body or a calibration official and the further settings must also be checked at the factory. The calibration official must reseal the opened lead seals to enable the RFC 7 to be used for applications involving official calibration once again.

3.3 Safety information for installation and initial start-up

⚠ DANGER

Risk of explosion arising from unauthorised installation of the RFC 7 in potentially explosive atmospheres

The Flow Computer RFC 7 is **not** approved or designed for use in potentially explosive atmospheres. Using the RFC 7 in a potentially explosive atmosphere could, for example, cause it to become an ignition source as the result of sparking and trigger an explosion.

- Do not install the RFC 7 in a place where there is a potentially explosive atmosphere.
- Only install the RFC 7 in its original, complete and fault-free condition.
- Equalise the potential of the housing by connecting an earthing cable to the housing.
- When connecting auxiliary devices and sensors in potentially explosive atmospheres, ensure that corresponding explosion protection is provided for these components.
- For intrinsically safe components, provide secure isolation if they are connected to the RFC 7.
- Only allow devices and sensors to be connected to the RFC 7 by specialist personnel in accordance with EN 60079-14, in accordance with national regulations.
- Initial start-up must only be carried out by expert personnel or by RMG service personnel.
- To clean the housing, always use a slightly damp cloth to avoid static charging as the result of friction.

⚠ CAUTION

Danger – cutting injury

Although all sharp edges on the device have been removed as far as possible, there is a risk of minor cutting injuries.

- ▶ Wear appropriate personal protective equipment when performing any work on the device.
- ▶ Remove any burs that are still present on the device or on fastening points.

3.4 Safety information for normal operation

As a basic rule, the instructions of the owner of the system in which the RFC 7 is installed must be observed.

In addition, the safety information listed below must be observed:

⚠ WARNING

Risk of injury arising from incorrect operation

Incorrect operation or modifications being made to the Flow Computer may give rise to hazards that could cause severe injury.

- ▶ Read this operating manual carefully to avoid incorrect operation and only use the RFC 7 in accordance with its intended use (see section 2.1 "Intended use").
- ▶ For safe operation, observe the power limits specified in the technical data (see section 13 "Technical data") and ensure that they are not exceeded.
- ▶ Do not use the Flow Computer as a step to climb on or as a handrail to steady yourself with!

3.5 Safety information for servicing, maintenance and cleaning

Service and maintenance work or repairs that are not described in this operating manual must not be carried out without prior consultation with the manufacturer.

Tampering with or modifying the Flow Computer in ways not described in this operating manual is not permitted.

⚠ DANGER

Danger of death arising from electrical voltage

Before servicing, maintenance and cleaning work, it is essential to switch off the device or disconnect it from the mains power supply. Failing to do so may lead to extremely severe injury or death.

- ▶ Before any work is commenced, switch of the device’s power supply or disconnect it from the mains.
- ▶ Only carry out work on the device as described in this manual. Ensure that the device is not live while the work is being performed.

⚠ WARNING

Risk of injury arising from inappropriate servicing, maintenance and cleaning

If servicing, maintenance or cleaning work is performed incorrectly or if use of the device is resumed despite it being defective, damaged or unsafe, this may result in severe injury.

- ▶ Arrange for servicing, maintenance and cleaning work to be performed exclusively by specialists who have the required knowledge for the activities to be performed and the tools to be used.
- ▶ If a device is damaged or unsafe, it must be removed from circulation immediately and labelled accordingly to prevent it from being used accidentally.
- ▶ In general, it is recommended to have repairs or the exchange of a defective device performed only by RMG Service.

3.6 Special types of hazard – explosion protection

The Flow Computer RFC 7 is **not** approved or designed for use in potentially explosive atmospheres. However, auxiliary devices and sensors connected to the RFC 7 may be installed in potentially explosive atmospheres.

This symbol warns you of an explosive atmosphere; observe the information provided next to the symbol.

⚠ DANGER

Risk of explosion during installation and operation of devices and sensors in potentially explosive atmospheres

If devices and sensors connected to the RFC 7 are installed and operated in a potentially explosive atmosphere, even very low levels of ignition energy can result in an explosion that could cause extremely severe injury and death.

- ▶ Observe all applicable national regulations for installing devices and sensors in potentially explosive atmospheres (e.g. IEC 60079-10, IEC 60079-14, IEC 80079-20-1).
- ▶ When connecting auxiliary devices and sensors in potentially explosive atmospheres, ensure that corresponding explosion protection is provided for these components.
- ▶ For intrinsically safe components, provide secure isolation if they are connected to the RFC 7.
- ▶ Check the safety data of the RFC 7 and the connected intrinsically safe components and log the check in a corresponding Verification of Intrinsic Safety document.

4 Product description

The device concept – the platform – is a universal system intended to cover a large number of application cases and the connection of all individual RMG Messtechnik devices.

The Flow Computer RFC 7, as a volume corrector and an individual device from the platform, is available in the following variants:

- Single-Stream (one stream – data from one measurement point are processed in the RFC 7)
- Multi-Stream (two to four streams – data from up to four independent measurement points are processed in the RFC 7)

A **stream** means that the signals and measurement data of one measurement point are measured, registered, saved, converted and output. Each stream has its own hardware, but all streams share the same touchscreen and the power supply from the power pack. The individual streams are designated as follows:

Designation	Design	Display on the touchscreen
RFC 71	Flow Computer Stream 1	
RFC 72	Flow Computer Stream 2	
RFC 73	Flow Computer Stream 3	
RFC 74	Flow Computer Stream 4	

Table 4: Designation of the individual streams

4.1 Structure of the RFC 7

4.1.1 Housing variants

The RFC 7 is a Flow Computer that is encased in the housing of the following sizes, in accordance with the chosen number of streams:

- 19" housing for 1–2 streams, cf. fig. 7
- 19" housing for 3–4 streams, cf. fig. 8

Both sizes comprise the housing itself (no. 3), a housing cover (no. 1) with venting slits, a housing base (no. 4), a front panel for control (no. 5) and a back panel with connections (no. 2).

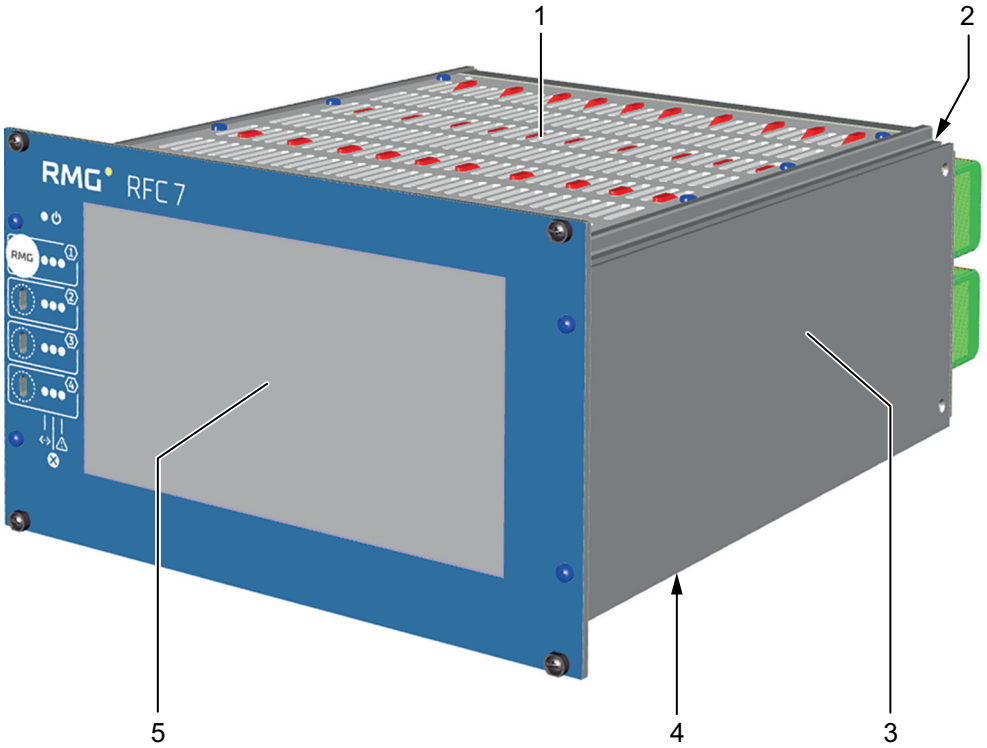


Fig. 7: RFC 7 – 19" housing for 1 to 2 streams

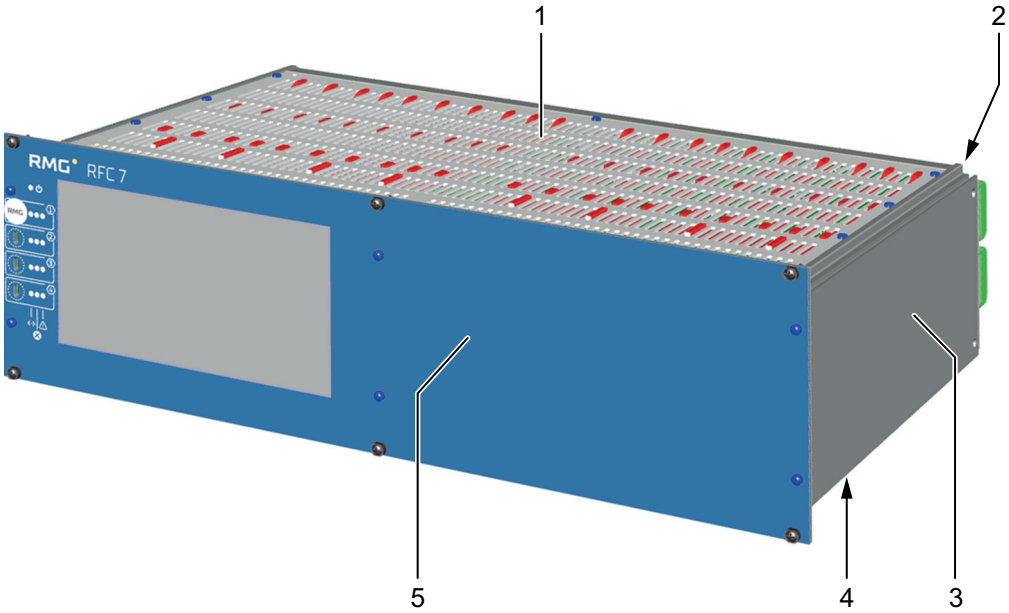


Fig. 8: RFC 7 – 19" housing for 3 to 4 streams

No.	Designation	No.	Designation
1	Housing cover with venting slits	2	Rear panel with connections
3	19" housing	4	Housing base
5	Front panel		

For the precise dimensions of both housing variants, please refer to section 6.1.2 "Unit dimensions and weight" or section 13 "Technical data".

4.1.2 Front panel

The front panels of both housing variants comprise:

- 7" touchscreen (1x)
- Status LEDs (3x) and calibration switch (1x) for each stream
- LED power supply (1x)

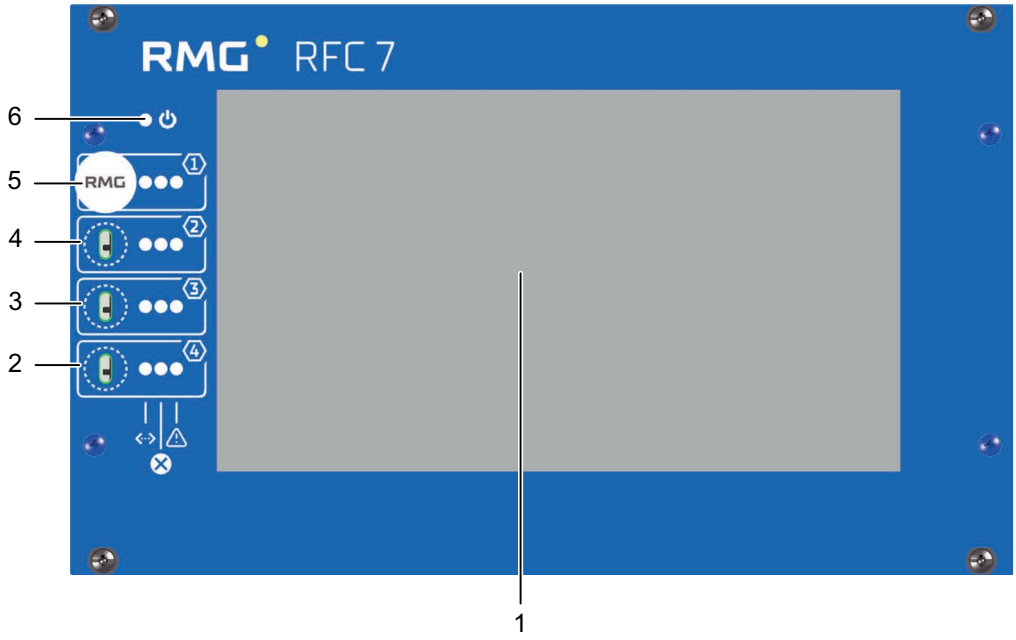


Fig. 9: Front panel RFC 7 – ½ 19" housing

No.	Designation	No.	Designation
1	7" touchscreen	2	Status LEDs and calibration switch for stream 4
3	Status LEDs and calibration switch for stream 3	4	Status LEDs and calibration switch for stream 2
5	Status LEDs and calibration switch for stream 1	6	LED power supply on (blue)

Each stream has its own calibration switch a separate status LEDs that signal the following operating statuses:

- Measurement in progress (green), cf. fig. 10, no. 1
- Warning (yellow), cf. fig. 10, no. 2
- Alarm/error/fault (red), cf. fig. 10, no. 3

The calibration switch (cf. fig. 10, no. 4) is used to lock the official calibration settings that have been set for the corresponding stream. It can be moved up and down in a vertical direction by means of an additional tool and is secured with a calibration seal (lead seal) for official calibration applications.

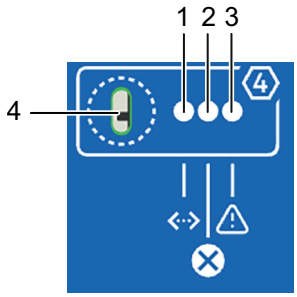


Fig. 10: Status LEDs and calibration switch, example for stream 4

No.	Designation	Function
1	**Measurement in progress** LED (green)	■ Lights up continuously: measurement in progress
2	**Warning** LED (yellow)	■ Lights up continuously: There is a warning.
3	**Error/fault** LED (red)	■ Not lit up: There is no error/fault ■ Flashing: There is a current error/fault ■ Lights up continuously: There has been an error/fault
4	Calibration switch	■ Locking of the official calibration parameters and functions. The calibration switch can be moved up and down by means of an additional tool.

4.1.3 Components in the housing

Regardless of the number of streams, each housing variant contains a power pack (24 V DC). The multi-stream variants also contain an intercom circuit board. The components for each stream are arranged side by side in the housing – cf. fig. 11 and fig. 12.

Each stream has the same components, i.e. identical hardware, as described in detail in the following section, 4.1.4 "Components of a stream".

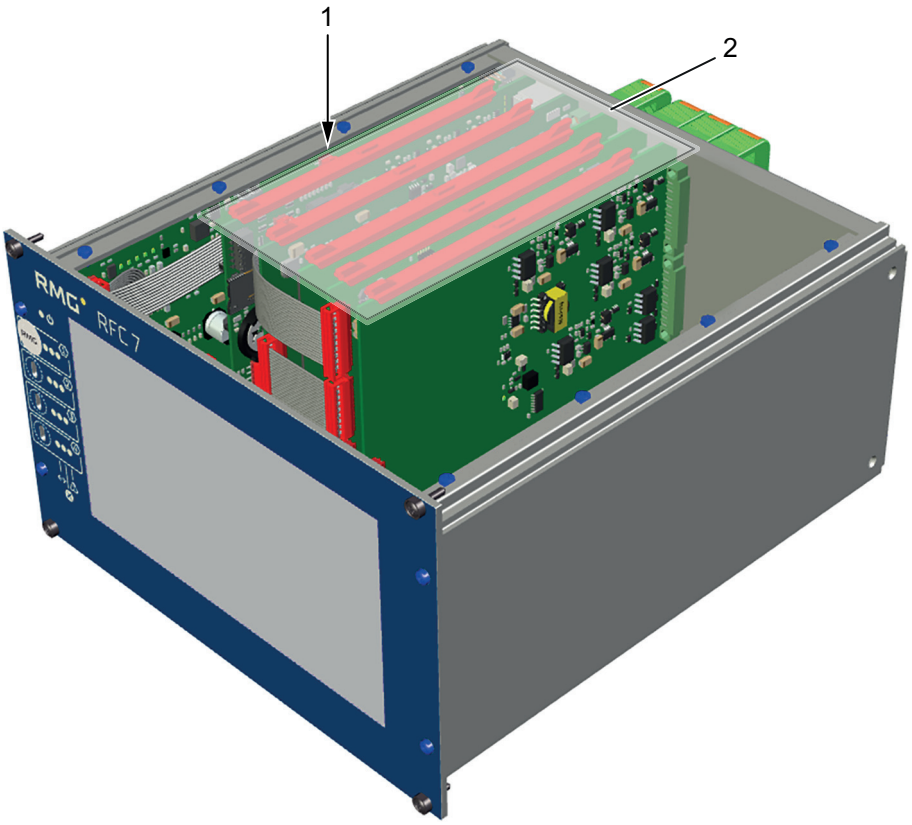


Fig. 11: Single-Stream: arrangement of components for one stream in the housing

No.	Designation	No.	Designation
1	Power pack 24 V DC	2	Stream unit

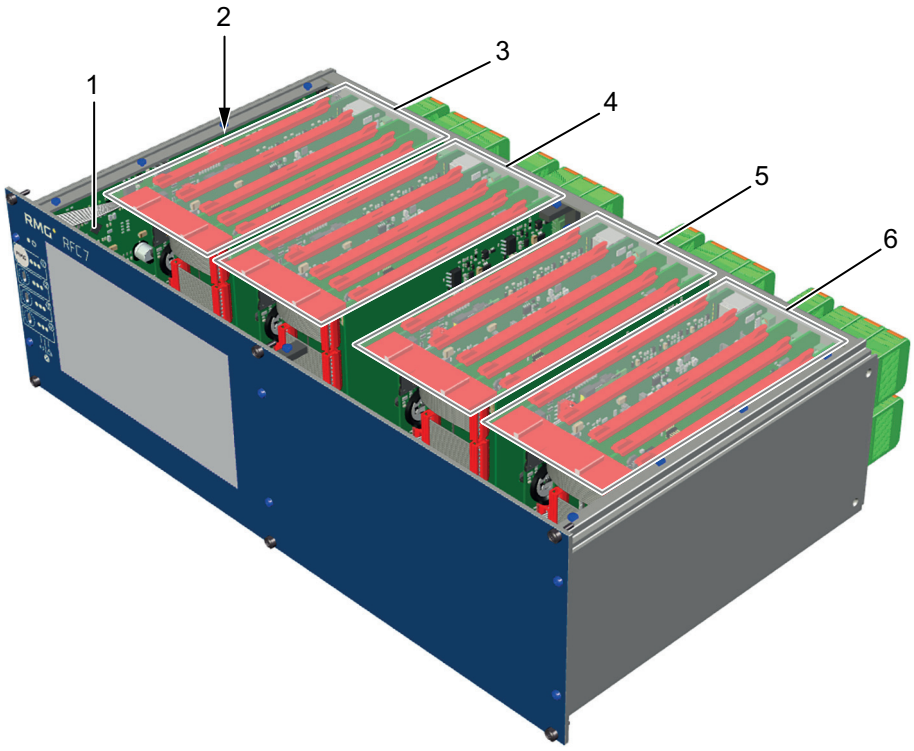


Fig. 12: Multi-Stream: arrangement of components for four streams in the housing

No.	Designation	No.	Designation
1	Intercom	2	Power pack 24 V DC
3	Stream unit 1	4	Stream unit 2
5	Stream unit 3	6	Stream unit 4

4.1.4 Components of a stream

The hardware (components) of a stream comprise a total of five plug-in circuit boards, which fulfil different functions:

- **CoM-Basis** for communication and computing (fig. 13, no. 1)
- **IO-System** comprising the following circuit boards:
  - **IOC-EX-IO** as interface to Ex zone with securely separated inputs and outputs (fig. 13, no. 2)
  - **IOC-Digital-IO** as interface for digital inputs and outputs outside of the Ex zone (fig. 13, no. 3)
  - **IOC-CPU** to process all analogue and digital inputs and outputs (fig. 13, no. 4)
  - **IOC-Analog-Out** as interface for analogue outputs outside of the Ex zone (fig. 13, no. 5)

With these plug-in circuit boards, all the intended functions can be executed. The hardware is not designed for expansion with plug-in circuit boards for additional functions.

The **CoM-Basis** (Computer on Module) is used for communication, including with a web server, provides the computing power for the volume conversion and manages archives.

The **IO-System** manages the entire measurement technology with actuators and sensors.

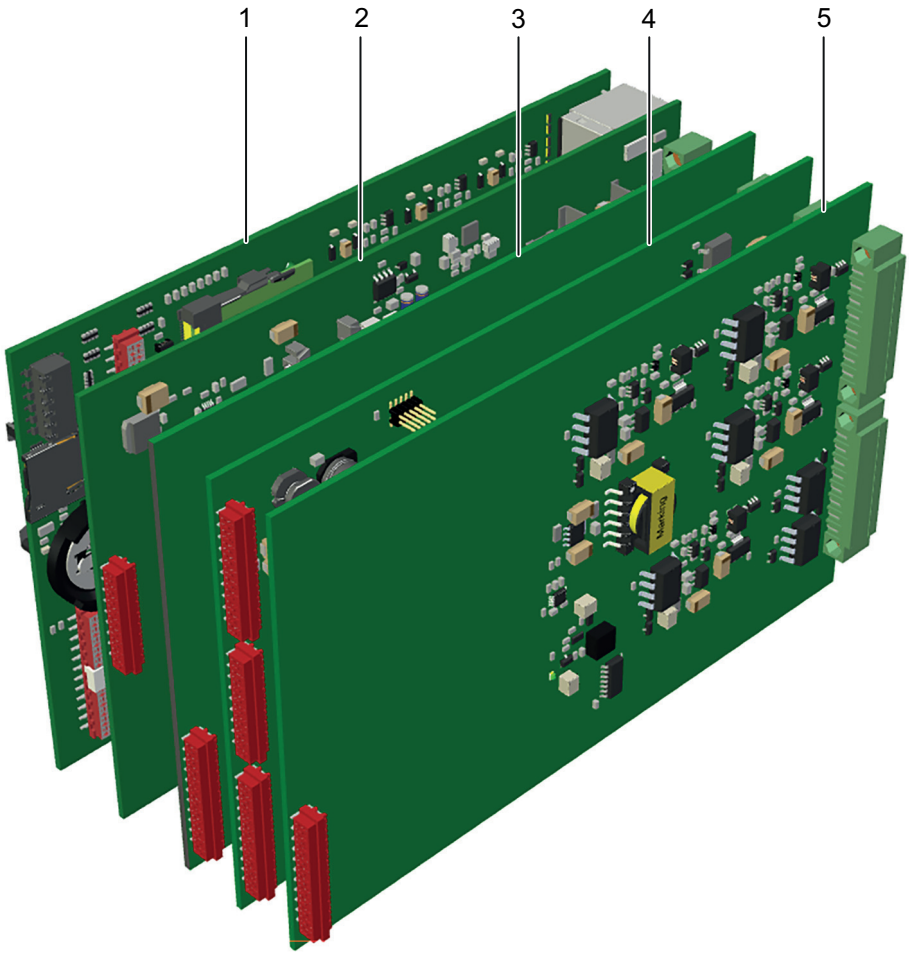


Fig. 13: Components of a stream (view from front)

No.	Designation	No.	Designation
1	CoM-Basis	2	IOC-EX-IO
3	IOC-Digital-IO	4	IOC-CPU
5	IOC-Analog-Out		

4.1.5 Connections

The connections of the RFC 7 are located on the device back panel. Each variant, Single- or Multi-Stream, has the following connections (cf. fig. 14 and fig. 15):

Power pack connections:

- Power supply 24 V DC
- USB port (not for use for official calibration applications, as lead-sealed)
- Fuse

Connections per stream (COM-Basis and IO-System):

- 5 analogue inputs, with 2 analogue inputs securely separated
- 4 analogue outputs
- 2 alarm and 2 warning outputs (comprising one NO and one NC in each case)
- 4 digital inputs, with 2 pulse inputs

- 6 digital inputs, with 2 pulse outputs
- 2 pulse inputs (reed/Namur) and 1 encoder input, securely separated
- 4-conductor connection for PT100, securely separated
- 3 serial interfaces RS485
- 4 Ethernet ports

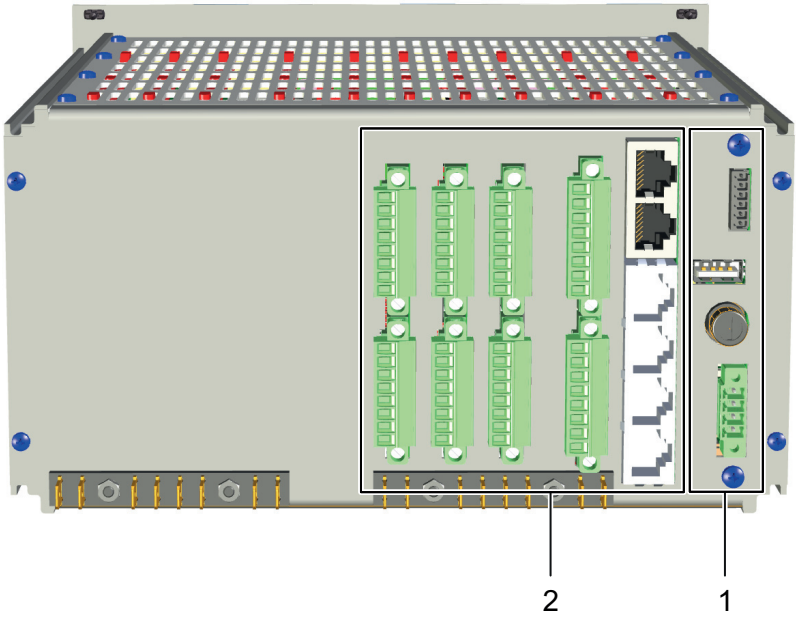


Fig. 14: Single-Stream: arrangement of connections on the back panel

No.	Designation	No.	Designation
1	Power pack connections	2	Connections and terminal strips, stream 1

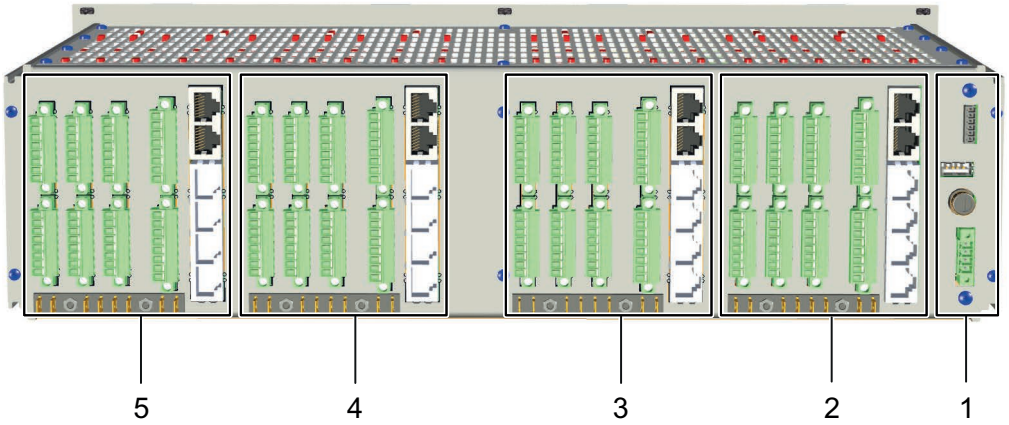


Fig. 15: Multi-Stream: arrangement of connections on the back panel

No.	Designation	No.	Designation
1	Power pack connections	2	Connections and terminal strips, stream 1
3	Connections and terminal strips, stream 2	4	Connections and terminal strips, stream 3
5	Connections and terminal strips, stream 4		

For the assignment of the individual terminal strips and additional information on the connection options, please refer to section 6.2 "Electrical installation".

4.2 Function of the RFC 7

The Flow Computer RFC 7 fulfils the following three key functions:

- Collecting the measurement data of gas meters, gas analysis devices and pressure and temperature sensors and monitoring the collection of measurement data.
- Processing the measurement data and calculating process variables such as standard flow rate, K number and energy volumes on the basis of appropriate calculation methods for various gas models.
- Archiving and outputting the measurement values and calculates process variables / depicting them in graphic form, and setting alarm and warning messages when limits are breached.

Depending on the connected devices and the recorded measurement data, the Flow Computer can be used with different software and parameterisation for the following applications:

- -Vol: Condition volume corrector to determine the K number[1)] and the standard volume of gas mixtures such as natural gas and biogas
- -Energy: Calorific value volume corrector to determine the K number[1)] and the standard volume and, in combination with the calorific value, the gas quality in order to determine the energy content of gas mixtures such as natural gas and biogas

[1)] Compressibility coefficient: correction factor for the difference between how the gas behaves in the actual situation at hand and the ideal gas behaviour.

To calculate the K number, the following calculation methods are available in both applications:

- k = constant
- Complete analysis:
  - AGA 8 DC92
  - AGA 8:2017
  - GERG-2004
  - GERG-2008
- Gross values:
  - GERG-88 S
  - GERG-88 S Set B
  - GERG-88 S Set C
  - AGA NX-19 L
  - AGA NX-19 H
  - AGA Gross Meth. 1
  - AGA Gross Meth. 2
  - SGERG-mod-H2
- Pure substances:
  - Van der Waals
  - Beattie & Bridgeman

For a detailed description of operation, the individual menus of the user interface and the options for setting parameters, please refer to section 7 "Operation" and section 8 "Initial start-up".

5 Transport and storage

5.1 Inspection following delivery

The Flow Computer RFC 7 is delivered in packaging that meets the customer's specific transport requirements. Nevertheless, the delivery should first be checked for completeness and damage. The device must be removed from its packaging for this check. The device is then installed (see section 6 "Installation") or placed in storage (see section 5.3 "Storing RFC 7").

- ▶ If damage has occurred, please contact RMG Messtechnik without delay.

5.2 Disposing of packaging material

Dispose of device components and packaging material in an environmentally sound manner in accordance with the applicable waste management and national waste disposal regulations and standards of the region or country to which the device is delivered.

NOTE

Reusing the packaging

Where possible, retain the packaging, as it provides optimal protection if the device is ever transported again (e.g. if the place of installation is changed or if the device is sent off for repair).

5.3 Storing RFC 7

If it is necessary to store the Flow Computer RFC 7, observe the following:

- ▶ Avoid long storage periods.
- ▶ After storage, check the RFC 7 for damage and correct functioning.
- ▶ After a storage period exceeding one year, have the device checked by RMG Service. Send the device to RMG or arrange an appointment with the RMG Service organisation.
- ▶ Maintain the storage conditions listed below:
  - Packaged in clean, dry rooms
  - Temperature range -20 °C to 50 °C
  - Agitation (vibrations) must not occur during the storage period.
  - The device must not be stored under tension.

5.4 Transporting RFC 7

For transport, it is essential for the device to be given secure packaging that can absorb minor impacts and agitation.

- ▶ Nevertheless, inform the transport company that impacts and vibrations of any type must be avoided during transport.
- ▶ Ensure that the device is not exposed to any extreme fluctuations in temperature.

6 Installation

For installation, observe the safety information provided in section 3.3 !

6.1 Mechanical installation

⚠ WARNING

Danger arising from incorrect mechanical installation

If the RFC 7 is not installed or mounted correctly, this may result in hazards to persons and property.

- ▶ Only specialists are permitted to perform the installation work.
- ▶ Only install the RFC 7 in accordance with the stipulations of this manual.
- ▶ For the installation, obtain permission from the system owner.

6.1.1 Place of installation and ambient conditions

The Flow Computer RFC 7 is intended for installation in a non-explosive atmosphere (safe area). It is connected via corresponding connection cables to gas meters, gas analysis devices, pressure sensors and/or temperature sensors that may be installed in an explosive atmosphere.

The following diagram illustrates the separation of the places of installation in a gas station into explosive zone and non-explosive zone.

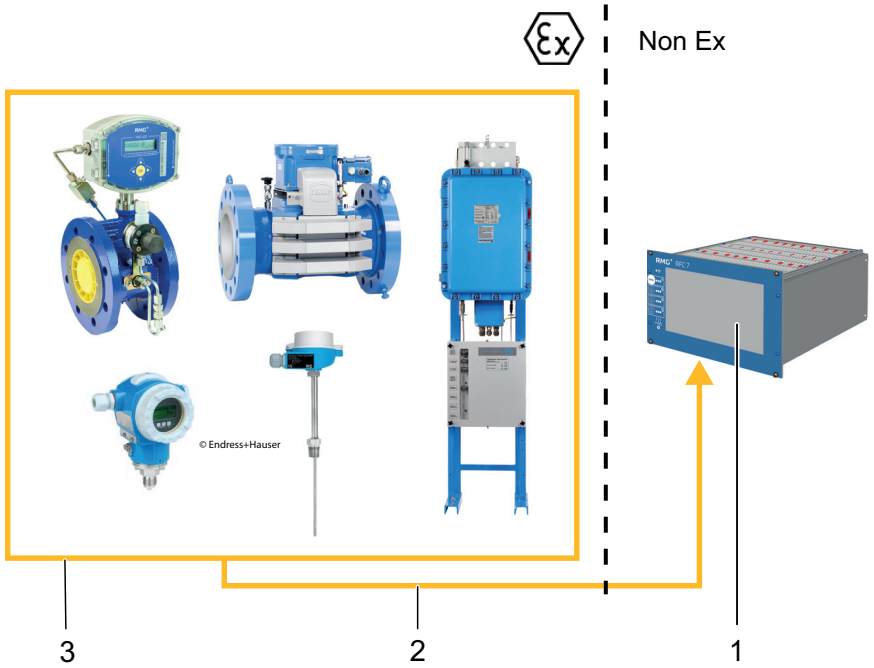


Fig. 16: Separation of the places of installation in a gas station

No.	Designation	No.	Designation
1	Flow Computer RFC 7	2	Connection cables
3	Gas meter, gas analysis device, pressure sensor and temperature sensor		

The following ambient conditions must be maintained at the place of installation:

Condition	Value
Humidity	0–95% relative humidity, non-condensing
Exposure to direct sunlight	Should be avoided where possible.
Ambient temperature	-20 to 55 °C
Temperature fluctuations	Large and rapid fluctuations in temperature should be avoided where possible.

Table 5: Ambient conditions for the RFC 7

6.1.2 Unit dimensions and weight

The Flow Computer RFC 7 is intended for installation in a rack inside a switch cabinet (non-explosive zone). Alternatively, it can be installed under other installation conditions. Depending on the device variant, it has the following dimensions:

- 19" housing (1–2 streams):
  213.36 mm (42 HP) x 133.35 mm (3 RU) x 230 mm (W x H x D) (without connector on the back)
- 19" housing (3–4 streams):
  426.72 mm (84 HP) x 133.35 mm (3 RU) x 230 mm (W x H x D) (without connector on the back)

The weight also varies, depending on the device, between approx. 1.75 kg (1 stream) and 2.25 kg (2 streams).

6.1.3 Installation

The RFC 7 is supplied with four screws for installation in a rack.

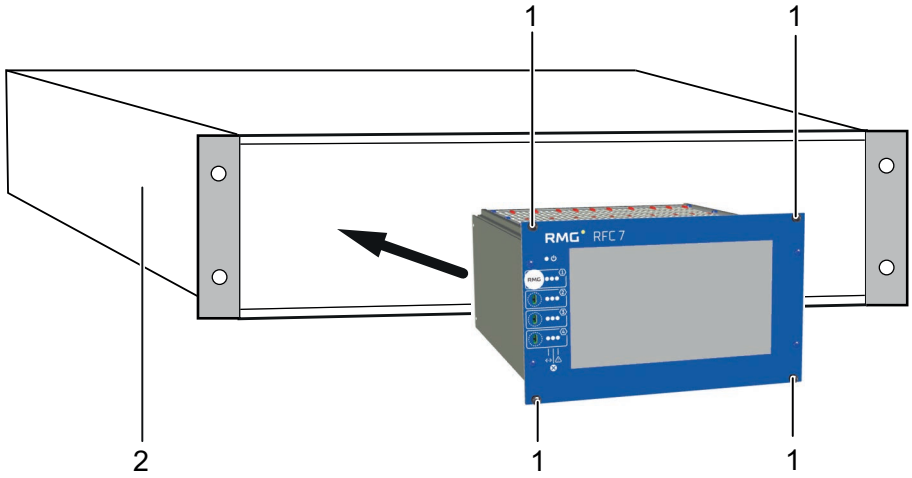


Fig. 17: Position of the screws on the front panel of the RFC 7

No.	Designation	No.	Designation
1	Screws, type M2.5x10	2	Rack

Procedure for installation:

1. Insert the RFC 7 into the rack with the front panel facing forwards.
2. Place the RFC 7 in the required position and slightly tighten the four screws (fig. 17, no. 1) with a cross-head screwdriver.

6.2 Electrical installation

Before commencing work, ensure that all information and warnings from the above sections, in particular those from 3 'Safety information' are observed and complied with. Ensure that the device is de-energised (power supply and signals) before any changes are made to the wiring. During work, it is essential to comply with the specifications given in the sections below.

⚠ DANGER

Danger of death arising from electrical voltage

Work that is not carried out correctly or on a de-energised device may result in extremely severe injury or death.

- Only have the electrical installation carried out by a specialist electrician, or a specialist electrician for specific activities, who can ensure that the installation is performed safely and correctly.
- Before any work is performed on the electrical installation, de-energise the device.
- Work on the device may only be performed after corresponding instruction with regard to the device has been provided.
- Ensure that the power data of the power supply connection corresponds to the specifications on the device's type label.
- Only use cables that correspond to the specifications and match the available cable glands.
- Equalise the potential of the housing by connecting an earthing cable to the housing.
- During installation, observe any national, regional and regulatory standards that may apply at the location of the device for electrical installation and explosion protection (e.g. EN, DIN, VDE).

6.2.1 Connections of the RFC 7

The RFC 7 has various electrical and signal connections for each stream, located on the device's back panel. The connections are described below, on the basis of the device Single-Stream device variant (cf. fig. 18).

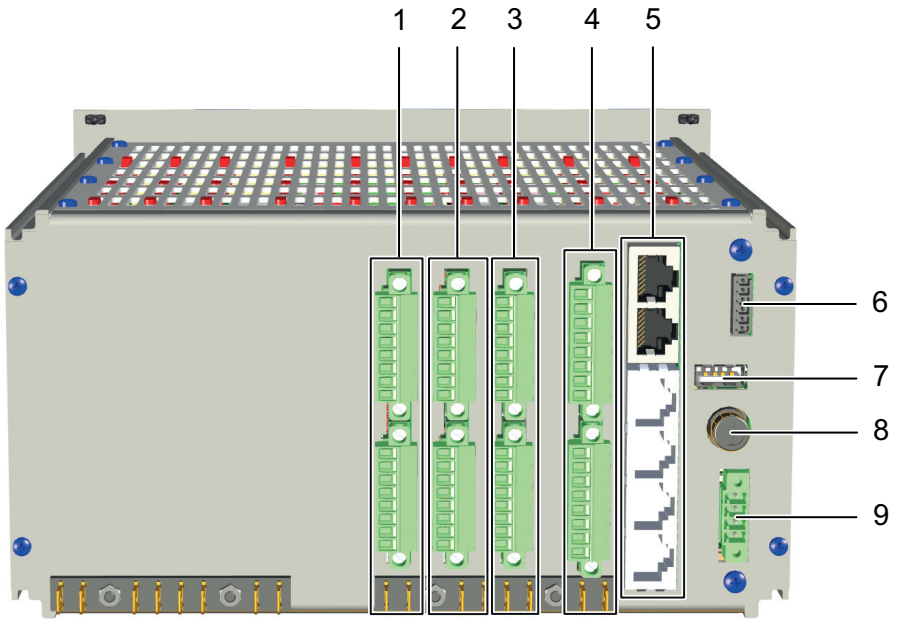


Fig. 18: Connections on the device's back panel (example: Single-Stream device variant)

No.	Designation	No.	Designation
1	**IOC-Analog-Out** connections with terminal strips **X1** and **X2**	2	**IOC-CPU** connections with terminal strips **X3** and **X4**
3	**IOC-Digital-IO** connections with terminal strips **X5** and **X6**	4	**IOC-EX-IO** connections with terminal strips **X7** and **X8**, **intrinsically safe**
5	**CoM-Basis** connections with **X9A/B** and **X10A-D**	6	Reserve
7	USB port	8	Fuse
9	Power supply 24 V DC		

6.2.2 Terminal assignments of the terminal strips

All connections / terminal strips on the device's back panel are labelled as follows (cf. fig. 19).

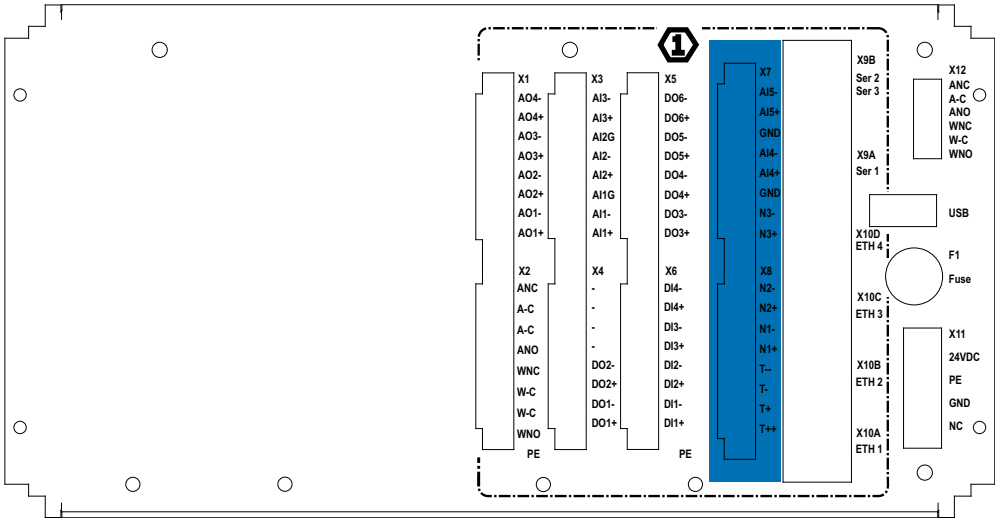


Fig. 19: Labelling of the connections on the device's back panel (example: Single-Stream device variant)

The terminal connections of the individual cores of terminal strips X1 to X12 are listed below. Terminal numbers depicted with a light red background represent the coding for the corresponding connector (Phoenix).

- ▶ If it has not yet been done, please remove the strips from the connector (fig. 20, no. 1) with a wire cutter at the required position (see table 6 to table 9) to allow the connector to be inserted into the corresponding terminal strip.

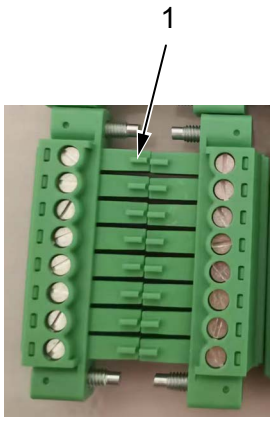


Fig. 20: Strip on connector (Phoenix)

IOC-Analog-Out, terminal strips X1 and X2

Terminal no.	Des. short	Designation long	Function
Terminal strip X1			
8	AO4-	Analogue output 4	The analogue outputs 1 to 4 can be used to output measured values. To enable this, each analogue output must be assigned a measurement value or a default value in menu 5. Outputs in the UI.
7	AO4+		
6	AO3-	Analogue output 3	
5	AO3+		
4	AO2-	Analogue output 2	
3	AO2+		
2	AO1-	Analogue output 1	
1	AO1+		
Terminal strip X2			
8	ANC	Alarm output NC	Contact closed in event of alarm.
7	A-C		
6	A-C	Alarm output NO	Contact open in event of alarm. (de-energise to trip)
5	ANO		
4	WNC	Warning output NC	Contact closed in event of a warning.
3	W-C		
2	W-C	Warning output NO	Contact open in event of a warning. (de-energise to trip)
1	WNO		

Table 6: Terminal connections, IOC-Analog-Out

IOC-CPU, terminal strips X3 and X4 (non-Ex)

Terminal no.	Des. short	Designation long	Function
Terminal strip X3			
8	AI3-	Analogue output 3	Analogue input 3 can be used to capture analogue measurement signals (4–20 mA). To enable this, the input in menu 6. Inputs must be parameterised accordingly.
7	AI3+		
6	AI2G	Analogue output 2 (with HART interface)	Analogue input 2 can be used to capture both analogue measurement signals (4–20 mA) and digital signals. (Use for temperature measurement is recommended.)
5	AI2-		
4	AI2+		
3	AI1G	Analogue output 1 (with HART interface)	Analogue input 1 can be used to capture both analogue measurement signals (4–20 mA) and digital signals. (Use for pressure measurement is recommended.)
2	AI1-		
1	AI1+		
Terminal strip X4			
8	T--	4-wire PT100 (without line break monitoring)	Connecting a PT100 with 4-wire technology for precise temperature measurement.
7	T-		
6	T+		
5	T++		
4	DO2-	Digital output 2	
3	DO2+		
2	DO1-	Digital output 1	
1	DO1+		

Table 7: Terminal connections, IOC-CPU

IOC-Digital-IO, terminal strips X5 and X6

Terminal no.	Des. short	Designation long	Function
Terminal strip X5			
8	DO6-	Digital output 6 (pulse output)	The digital outputs 3 to 6 can be used to output various calculation values. To enable this, the outputs in menu 5. Outputs must be parameterised accordingly.
7	DO6+		
6	DO5-	Digital output 5 (pulse output)	
5	DO5+		
4	DO4-	Digital output 4 (pulse output)	
3	DO4+		
2	DO3-	Digital output 3 (pulse output)	
1	DO3+		
Terminal strip X6			
8	DI4-	Digital input 4	The digital inputs 3 and 4 can be used to output errors or warnings.
7	DI4+		
6	DI3-	Digital input 3	
5	DI3+		
4	DI2-	Digital/pulse input 2 (PI4)	The digital inputs 1 and 2 can be used to process frequencies/pulses. To enable this, the inputs in menu 6. Inputs must be parameterised accordingly.
3	DI2+		
2	DI1-	Digital/pulse input 1 (PI3)	
1	DI1+		

Table 8: Terminal connections IOC-Digital-IO

IOC-Ex-IO, terminal strips X7 and X8 (intrinsically safe Ex I input card)

Terminal no.	Des. short	Designation long	Function
Terminal strip X7			
8	AI5-	Analogue output 5 (with HART interface)	Analogue input 5 can be used to capture both analogue measurement signals (4–20 mA) and digital signals. (Use for temperature measurement is recommended.)
7	AI5+		
6	GND		
5	AI4-	Analogue output 4 (with HART interface)	Analogue input 4 can be used to capture both analogue measurement signals (4–20 mA) and digital signals. (Use for pressure measurement is recommended.)
4	AI4+		
3	GND		
2	N3-	Encoder	Digital encoder input
1	N3+		

Table 9: Terminal connections, IOC-Ex-IO

Terminal no.	Des. short	Designation long	Function
Terminal strip X8			
8	N2-	Pulse input 2 Reed/Namur (PI2)	Digital pulse input for reed or Namur
7	N2+		
6	N1-	Pulse input 1 Reed/Namur (PI1)	Digital pulse input for reed or Namur
5	N1+		
4	T--	4-wire PT100-Ex (without line break monitoring)	Connecting a PT100 with 4-wire technology for precise temperature measurement.
3	T-		
2	T+		
1	T++		

Table 9: Terminal connections, IOC-Ex-IO

CoM-Basis, terminal strips X9 A/B and X10 A-D

Terminal no.	Des. short	Designation long	Function/protocols
Terminal X9B (type RJ45)			
	Ser2	Serial interface 2 RS485	ModbusClient for GBH / ModbusClient for USZ / ModbusServer RTU / ModbusServer ASCII
	(Ser3 optional)	(Serial interface 3 RS485 optionally via adapter)	ModbusClient for GBH / ModbusClient for USZ / ModbusServer RTU / ModbusServer ASCII
Terminal X9A (type RJ45)			
	Ser1	Serial interface 1 RS485	ModbusClient / ModbusClient for GBH / ModbusClient for USZ / ModbusServer RTU / ModbusServer ASCII /DSfG-A
Terminal X10D (type RJ45)			
	ETH 4	Ethernet 4	To connect a PC or local network, RJ45 port for Ethernet (DHCP client or fixed IP address) Protocols: - Modbus TCP/IP - http - SNTP
Terminal X10C (type RJ45)			
	ETH 3	Ethernet 3	See Ethernet 4
Terminal X10B (type RJ45)			
	ETH 2	Ethernet 2	See Ethernet 4

Table 10: Terminal connections, CoM-Basis

Terminal no.	Des. short	Designation long	Function/protocols
Terminal X10A (type RJ45)			
	ETH 1	Ethernet 1	See Ethernet 4

Table 10: Terminal connections, CoM-Basis

Power pack, terminal strips X11 and X12, USB port, fuse

Terminal no.	Des. short	Designation long	Function
Terminal strip X12			
6	ANC	Reserve	
5	A-C		
4	ANO		
3	WNC	Reserve	
2	W-C		
1	WNO		
USB			
	USB	Universal Serial Bus	Optional
F1			
	Fuse	Fuse	To protect the RFC 7 from excess current
Terminal strip X11			
1	24VDC	Power supply +24 V	Power supply of the RFC 7
2	PE	Equipotential bonding	
3	GND	0 V	
4	NC	Not assigned	

Table 11: Terminal connections, power pack

6.2.3 Power supply and fuse protection

The RFC 7 must be supplied with a supply voltage of 24 V (DC). The terminal strip X11 is intended to be used for this.

To provide protection from excess current, the device has a fuse (F1) that is triggered at 4 amps.

The voltage available at the place of use must be checked for correctness and usability. The following criteria must be observed:

- Voltage range: 24 V DC (±10%)
- The safety device with the above-mentioned properties must be functional.

6.2.4 Connecting the temperature measurement

To measure the current operating temperature of the measured gas, the following forms of temperature measurement may be used:

- PT100 sensor: A PT100 if a platinum resistance thermometer that chances its resistance in accordance with the temperature. At 0 °C it has a resistance of 100 ohms. If a 4-wire circuit is used for connection, this circuit will fully compensate for the line resistance and provide maximum precision. A PT100 is used **without** line break resistors.
- Temperature transmitter: A temperature transmitter converts a signal from a temperature sensor (such as a PT100) into a standardised analogue or digital output signal that can easily be processed by the Flow Computer RFC 7 (4–20 mA and/or HART).

Both the PT100 and the temperature transmitter are typically located in a potentially explosive atmosphere and therefore need to be operated with the correct protection class when connected to the Flow Computer.

Fundamentally, a temperature transmitter could be connected to any of the analogue inputs of the RFC 7. However, when selecting the connection, the protection class of the temperature transmitter must be taken into account.

Transmitters of protection class Ex i can be used exclusively via the IOC-EX-IO card (terminal strips 7 and 8 on the device's back panel).

If transmitters with HART protocol are used, it must be borne in mind that not all analogue inputs support the HART protocol (cf. section 6.2.2 "Terminal assignments of the terminal strips"). For HART transmitters for applications involving official calibration (MID), a Welmec type certificate is also necessary.

NOTE

Observe temperature sensor/transmitter operating instructions!

As a wide variety of temperature sensors/transmitters may be used in combination with the Flow Computer RFC 7, only the wiring at the Flow Computer is discussed below.

- ▶ For detailed information on connecting the specific temperature sensor/transmitter, please refer to the operating instructions of the corresponding manufacturer.

Connecting a PT100 with 4-wire technology with protection class Ex i to terminal strip X8, terminal no. 1–4

A PT100 is to be connected to the above-mentioned terminals in accordance with fig. 21.

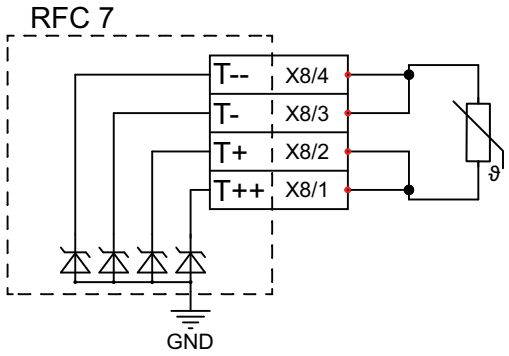


Fig. 21: El. connection PT100, protection class Ex i

In order to use the PT100, it must be connected as shown and parameterised accordingly on the menu page **6.121 PT100 Ex** (cf. section 8.8.3 "PT100 – specifying parameters").

Connecting a PT100 with 4-wire technology with protection class Ex d to terminal strip X4, terminal no. 5–8

A PT100 is to be connected to the above-mentioned terminals in accordance with fig. 22.

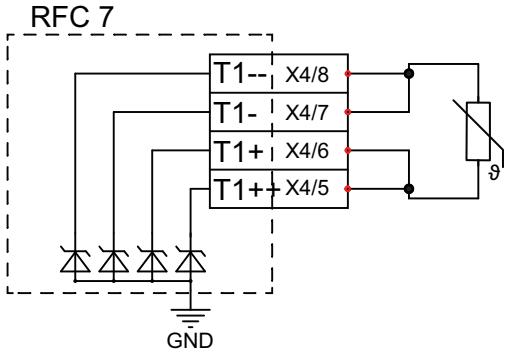


Fig. 22: El. connection PT100, protection class Ex d

In order to use the PT100, it must be connected as shown and parameterised accordingly on the menu page **6.120 PT100 Non-Ex** (cf. section 8.8.3 "PT100 – specifying parameters").

Connecting an analogue or digital temperature transmitter with protection class Ex i to analogue input 5, terminal strip X7, terminal no. 6–8

If a temperature transmitter is connected to analogue input 5, it is important to note whether the transmitter has its own power supply (active sensor) or whether it needs to be supplied with power via the Flow Computer (passive sensor). The connection must then be implemented accordingly – cf. fig. 23 and fig. 24.

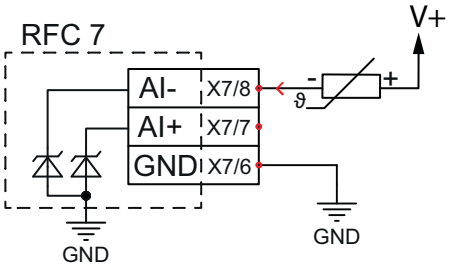


Fig. 23: Connecting an active temperature transmitter

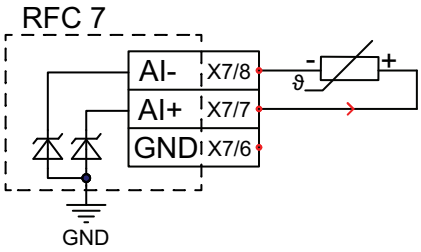


Fig. 24: Connecting a passive temperature transmitter

In order to use analogue input 5 for a digital temperature transmitter, the transmitter must be connected as shown and parameterised accordingly on the menu page **6.115 Analogue input 5 with HART** (cf. section 8.8.2 "Analogue inputs – specifying parameters").

Connecting an analogue or digital temperature transmitter with protection class Ex d to analogue input 2, terminal strip X3, terminal no. 3–5

If a temperature transmitter is connected to analogue input 2, it is important to note whether the transmitter has its own power supply (active sensor) or whether it needs to be supplied with power via the Flow Computer (passive sensor). The connection must then be implemented accordingly – cf. fig. 25 and fig. 26.

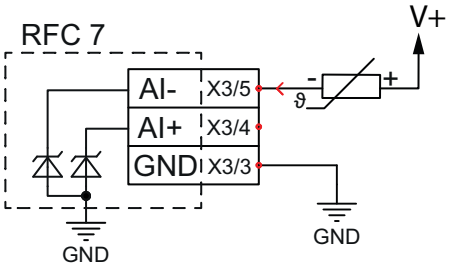


Fig. 25: Connecting an active temperature transmitter

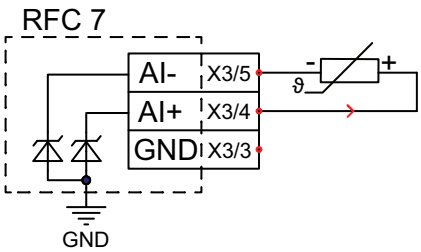


Fig. 26: Connecting a passive temperature transmitter

In order to use analogue input 2 for a digital temperature transmitter, the transmitter must be connected as shown and parameterised accordingly on the menu page **6.101 Analogue input 1 with HART** (cf. section 8.8.2 "Analogue inputs – specifying parameters").

6.2.5 Connecting pressure measurement

To measure the current operating pressure of the measured gas, a pressure transmitter is used. The pressure transmitter's measuring range and level precision are determined by the specific operating conditions.

The pressure transmitter is typically located in a potentially explosive atmosphere and therefore needs to be operated with the correct protection class when connected to the Flow Computer.

Fundamentally, a pressure transmitter could be connected to any of the analogue inputs of the RFC 7. However, when selecting the connection, the protection class of the pressure transmitter must be taken into account.

Transmitters of protection class **Ex i** can be used exclusively via the **IOC-EX-IO card** (terminal strips X7 and 8 on the device's back panel).

If transmitters with HART protocol are used, it must be borne in mind that not all analogue inputs support the HART protocol (cf. section 6.2.2 "Terminal assignments of the terminal strips"). For HART transmitters for applications involving official calibration (MID), a Welmec type certificate is also necessary.

NOTE

Observe the pressure transmitter operating instructions!

As a wide variety of pressure transmitters may be used in combination with the Flow Computer RFC 7, only the wiring at the Flow Computer is discussed below.

- ▶ For detailed information on connecting the specific pressure transmitter, please refer to the operating instructions of the corresponding manufacturer.

Connecting an analogue or digital pressure transmitter to analogue input 4, terminal strip X7, terminal no. 3–5

If a pressure transmitter is connected to analogue input 4, it is important to note whether the transmitter has its own power supply (active sensor) or whether it needs to be supplied with power via the Flow Computer (passive sensor). The connection must then be implemented accordingly – cf. fig. 27 and fig. 28.

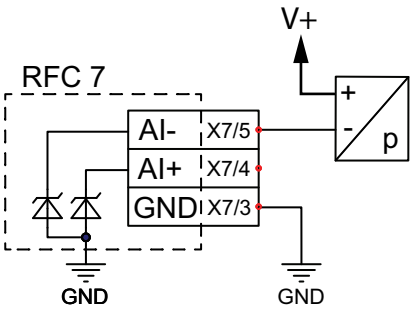


Fig. 27: Connecting an active pressure transmitter

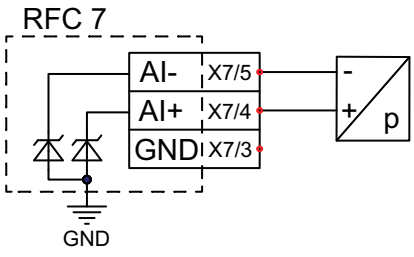


Fig. 28: Connecting a passive pressure transmitter

In order to use analogue input 4 for a digital pressure transmitter, the transmitter must be connected as shown and parameterised accordingly on the menu page **6.114 Analogue input 4 with HART** (cf. section 8.8.2 "Analogue inputs – specifying parameters").

Connecting an analogue or digital pressure transmitter to analogue input 1, terminal strip X3, terminal no. 1–3

If a pressure transmitter is connected to analogue input 1, it is important to note whether the transmitter has its own power supply (active sensor) or whether it needs to be supplied with power via the Flow Computer (passive sensor). The connection must then be implemented accordingly – cf. fig. 29 and fig. 30.

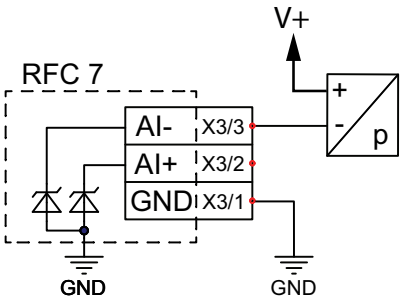


Fig. 29: Connecting an active pressure transmitter

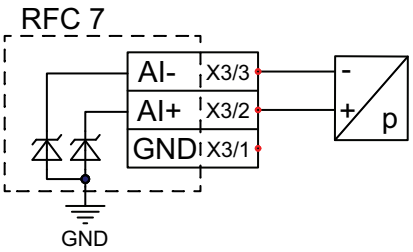


Fig. 30: Connecting a passive pressure transmitter

In order to use analogue input 1 for a digital pressure transmitter, the transmitter must be connected as shown and parameterised accordingly on the menu page **6.100 Analogue input 1 with HART** (cf. section 8.8.2 "Analogue inputs – specifying parameters").

6.2.6 Connecting mechanical gas meters

Mechanical gas meters that may be used include turbine meters, for example. The operating principle of a turbine gas meter involves using a turbine wheel to measure the gas speed. The rotational speed of the turbine wheel is (approximately) proportional to the mean gas speed and therefore to the flow within the measuring range (Qmin–Qmax). The number of rotations can thus be used to determine the flow rate of the gas.

To measure the rotational speed, various signal transmitters/pulse generators are available, which transmit low-frequency (LF) or high-frequency (HF) pulses to the Flow Computer. The following diagram gives an example overview of how they could be arranged in a turbine gas meter (cf. fig. 31).

In principle, the processing of the low-frequency (reed) or high-frequency (Namur, open collector) pulses in the RFC 7 is independent from the measurement principle used by the connected gas meter; even rotary piston gas meters and other flow meters with frequency output may be connected to the Flow Computer.

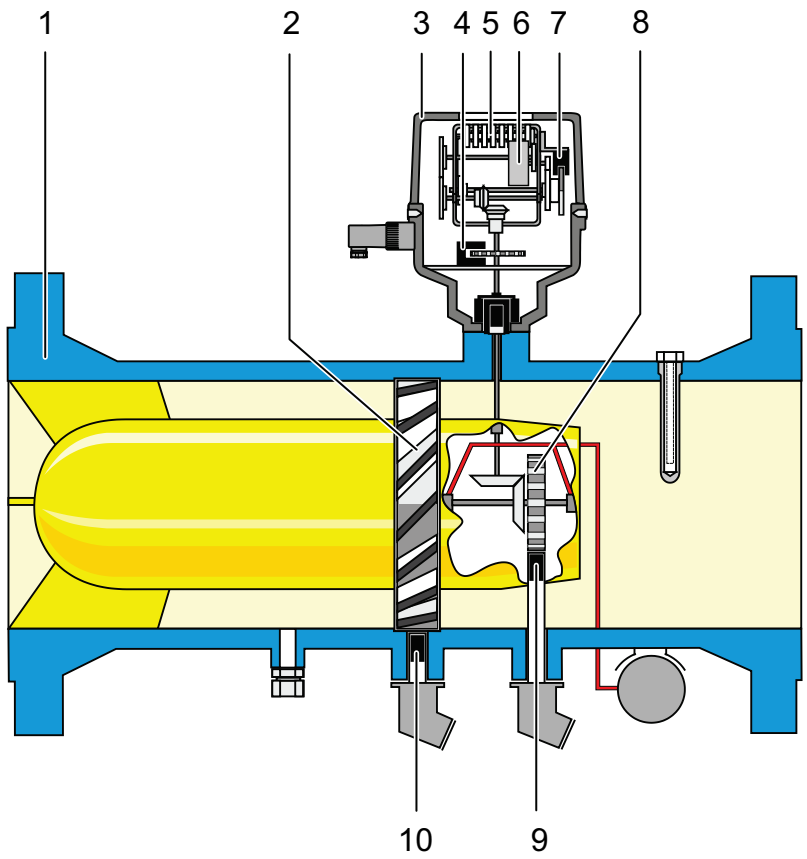


Fig. 31: Section drawing of a turbine gas meter (example)

No.	Designation	No.	Designation
1	Housing, turbine gas meter	2	Turbine wheel
3	Counter head	4	Pulse generator 3 (adjustment gear)
5	Mechanical counter	6	Encoder
7	Pulse generator 4 (mechanical counter)	8	Reference wheel
9	Pulse generator 2 (reference wheel)	10	Pulse generator 1 (turbine wheel)

The choice as to which pulse generator should be connected to the Flow Computer should be based on the individual requirements.

NOTE

Observe the mechanical gas meter operating instructions!

As a wide variety of mechanical gas meters may be used in combination with the Flow Computer RFC 7, only the wiring at the Flow Computer is discussed below.

- ▶ For detailed information on connecting the specific mechanical gas meter, please refer to the operating instructions of the corresponding manufacturer.

The mechanical gas meter is typically installed in a potentially explosive atmosphere, so it therefore needs to be securely separated when connected to the Flow Computer.

Accordingly, the Flow Computer RFC 7 provides the following connections at the IOC-EX-IO card – cf. the illustrations provided below:

- Pulse input reed/Namur 1, **terminal strip X8, terminal no. 5 and 6**
- Pulse input reed/Namur 2, **terminal strip X8, terminal no. 7 and 8**
- Encoder input, **terminal strip X7, terminal no. 1 and 2**

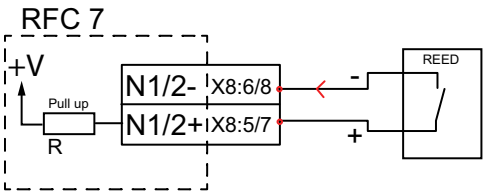


Fig. 32: Connection of mech. counter via reed

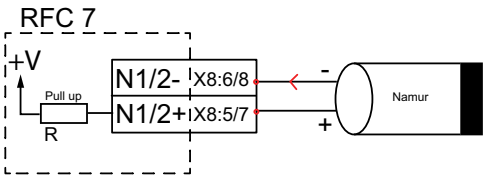


Fig. 33: Connection of mech. counter via Namur

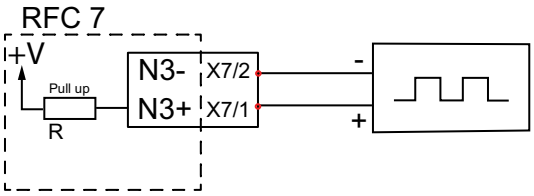


Fig. 34: Connection of encoder

Pulse inputs 1 and 2 are used to capture the rotational speed / frequency regardless of the turbine wheel's direction of travel, which serves as the basis for determining the operational flow rate. The result is written to the counters. In addition, pulse inputs 1 and 2 are used for synchronisation monitoring when two different pulse generators are connected.

The encoder input is used to transmit the counter reading of the mechanical counter to the Flow Computer digitally. It also captures whether the turbine wheel, i.e. the gas meter, is running forwards or backwards. In addition, the encoder provides the original counter reading in the event of a fault. However, during a fault, the fault counters run in place of the volume counters.

In order to use the pulse inputs and the encoder input, they must be connected as shown above and parameterised accordingly on the relevant menu pages (cf. sections 8.8.4 "Frequency and pulse input – specifying parameters" and 8.8.5 "Encoder settings"):

- **6.200 Frequency and pulse input 1**
- **6.201 Frequency and pulse input 2**
- **6.300 Encoder settings**

6.2.7 Connecting an ultrasonic gas meter

An ultrasonic gas meter determines the flow rate on the basis of the physical principle that an ultrasonic pulse is able to spread more quickly in a gas's direction of flow than in the opposite direction. A travel-time measurement of the ultrasonic pulses between two ultrasonic transducers arranged opposite one another can be used to determine the flow speed and thus the flow rate. To achieve greater accuracy, several pairs of ultrasonic transducers are typically used, arranged opposite one another at various levels of the gas meter cross-section, forming so-called measurement paths (cf. fig. 35).

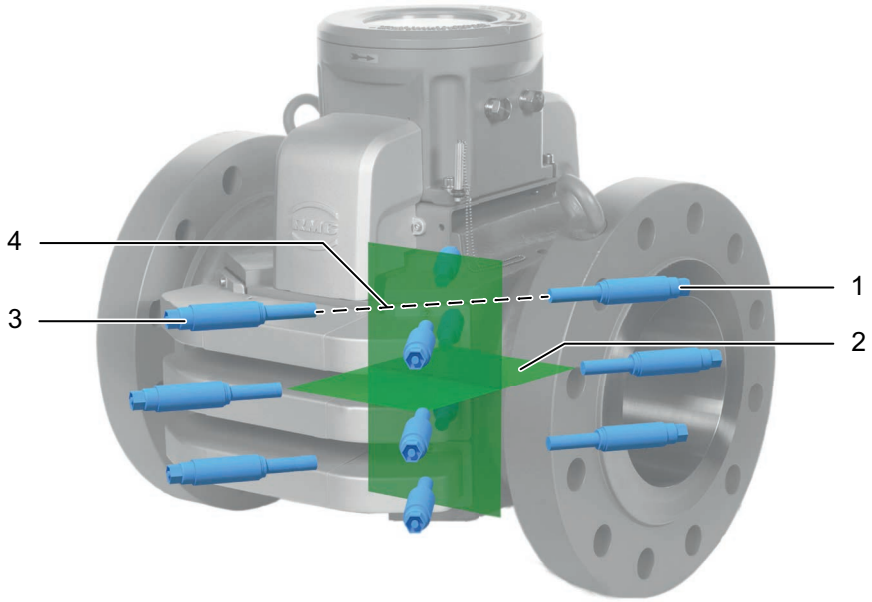


Fig. 35: Principle diagram of the arrangement of ultrasonic transducers

No.	Designation	No.	Designation
1	Ultrasonic transducer	2	Measurement level
3	Ultrasonic transducer	4	Measurement path

To connect an ultrasonic gas meter, the Flow Computer RFC 7 provides the following connections at the CoM-Basis in the device's back panel:

- Serial interface RS485 (Ser 1), **terminal strip X9A, type RJ45**
- Serial interface RS485 (Ser 2), **terminal strip X9B, type RJ45**
- (Optionally via adapter: serial interface RS485 (Ser 3), **terminal strip X9B, type RJ45)**
- Ethernet interfaces 1–4 (Eth1–Eth4), **terminal strip X10A-D, type RJ45**

To realise the connection, proceed as follows:

▶ Connect a patch cable of the ultrasonic gas meter to the desired serial interface or Ethernet port.

In order to use the serial interfaces, they must be parameterised accordingly on the relevant menu page **9.7 Serial interfaces**.

In order to use the Ethernet ports, they must be parameterised on the relevant menu pages **9.11–9.14 Ethernet 1–4**.

The serial and Ethernet interfaces do not have an intrinsically safe design.

In total, two interfaces can be used as USM client.

NOTE

Observe the operating instructions of the ultrasonic gas meter!

As a wide variety of ultrasonic gas meters may be used in combination with the Flow Computer RFC 7, only the connection at the Flow Computer is discussed here.

- ▶ For detailed information on connecting the specific ultrasonic gas meter, please refer to the operating instructions of the corresponding manufacturer.

6.2.8 Connecting gas quality measurement device

A gas quality measurement device serves to analyse the composition and quality of a gas, such as natural gas, biogas and other gas mixtures. To do this, gas chromatographs are used to identify and quantify the various components of the gas. A controller uses the measured percentages to calculate key characteristics such as the calorific value, standard density and Wobbe index.

To enable the various types of data to be retrieved by the gas quality measurement device's controller, the Flow Computer RFC 7 provides the following connections at the CoM-Basis in the device's back panel:

- Serial interface RS485 (Ser 1), **terminal strip X9A, type RJ45**
- Serial interface RS485 (Ser 2), **terminal strip X9B, type RJ45**
- (Optionally via adapter: serial interface RS485 (Ser 3), **terminal strip X9B, type RJ45)**
- Ethernet interfaces 1–4 (Eth1–Eth4), **terminal strip X10A-D, type RJ45**

To realise the connection, proceed as follows:

- ▶ Connect a patch cable of the gas quality measurement device's controller to the desired serial interface or Ethernet port.

In order to use the serial interfaces, they must be parameterised accordingly on the relevant menu page **9.7 Serial interfaces**.

In order to use the pulse inputs and the encoder input, they must be connected as shown above and parameterised as accordingly on the relevant menu pages **9.11–9.14 Ethernet 1–4**:

The serial and Ethernet interfaces do not have an intrinsically safe design.

In total, two interfaces can be used as gas quality client.

NOTE

Observe the operating instructions of the gas quality measurement device's controller!

As a wide variety of controllers may be used in combination with the Flow Computer RFC 7, only the connection at the Flow Computer is discussed here.

- ▶ For detailed information on connecting the specific controller, please refer to the operating instructions of the corresponding manufacturer.

7 Operation

The Flow Computer RFC 7 can be operated either from the touchscreen or from a PC.

Both options essentially provide the same functionality. There are some differences in how the menu pages are structured and how you navigate between the menus, however. Some functions such as the functional test can only be carried out from a PC!

The differences between the two forms of operation are described in detail below in sections 7.1 "Operation from the touchscreen" and 7.2 "Operation from PC". Functions and symbols that are identical for the two forms of operation are described in sections 7.3 "Controls in the header" and 7.4 "Controls in the display field".

7.1 Operation from the touchscreen

Operating the RFC 7 from the touchscreen enables simple operation via a graphic user interface and straightforward menus. After the device has started up, the start menu is displayed on the touchscreen automatically.

NOTE

Damage to the touchscreen

Handling the touchscreen incorrectly could cause it to become damaged.

- ▶ Operate the touchscreen with your fingers or use a suitable plastic stylus.
- ▶ Never use a hard or sharp-edged object such as a screwdriver or pencil, as this could scratch or fracture the touchscreen film.

7.1.1 Structure of the menu pages (touchscreen)

All the menu pages have an identical structure (cf. fig. 36).

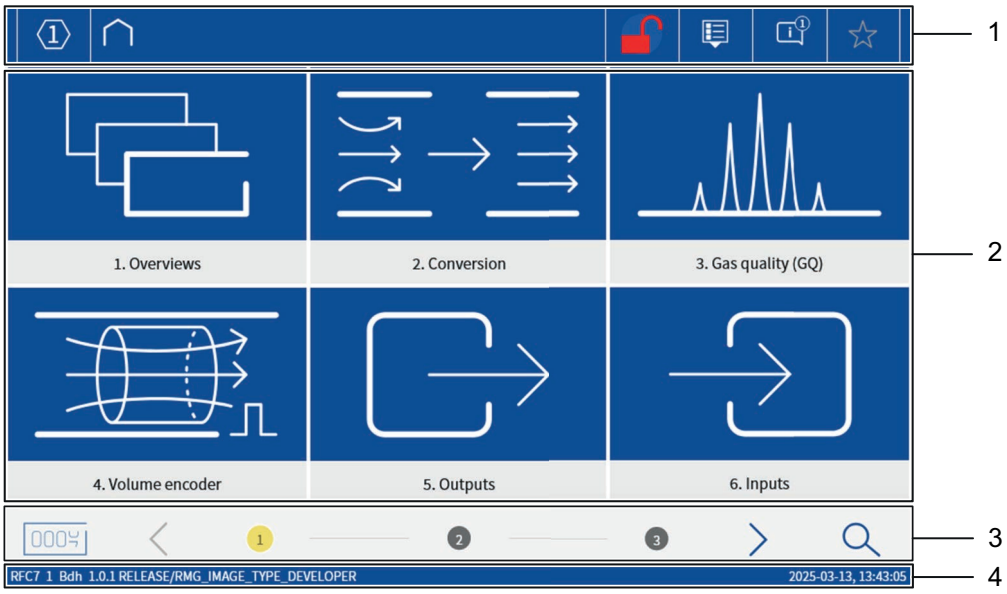


Fig. 36: Start menu – touchscreen

No.	Designation	No.	Designation
1	Header	2	Display field
3	Footer		Info line

Header (no. 1)

The header is available on every menu page and always has the same structure. It is used to jump back to a higher menu level (cf. section 7.2.2 "Navigating between the menus") and has various buttons; the functions of these buttons are described in detail in section 7.3 "Controls in the header".

Display field (no. 2)

The displayed content and the functions that can be executed in the display field change depending on which menu is currently selected.

Footer (no. 3)

The footer is used to navigate between the individual menu pages within a level. In addition, corresponding button can be used to switch to menu 1.40 Counters at any time (cf. section 7.2.2 "Navigating between the menus").

Info line (no. 4)

The info line displays the app version, the device designation and the date and time.

7.1.2 Navigating between the menus

The operation menus are arranged in three levels (cf. fig. 37).

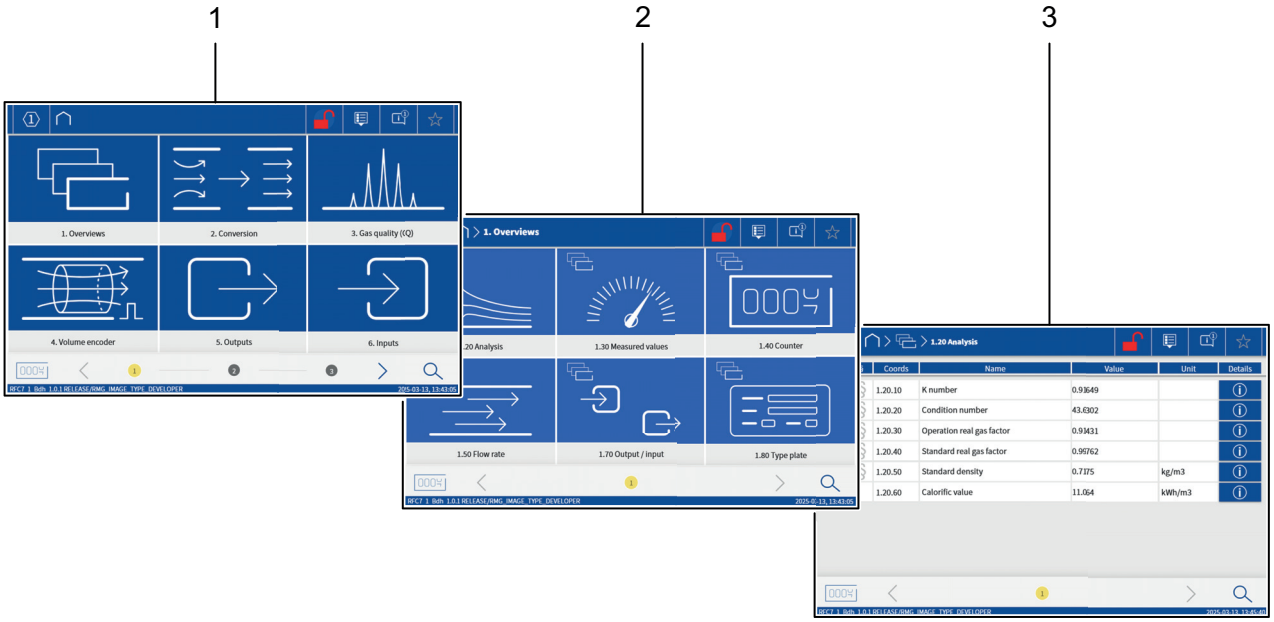


Fig. 37: Menu levels

No.	Designation	No.	Designation
1	Section level (top level)	2	Subsection level (middle level)
3	Parameter level (bottom level)		

Section level (no. 1)

This level provides an overview of the available topic areas, referred to as sections. It may contain multiple menu pages. The first page of the section level is also the **start menu**, which is displayed when the RFC 7 starts up.

Each section is designed as a **button** with an easy-to-understand icon (cf. fig. 38, example). Pressing the button opens the corresponding subsection level.

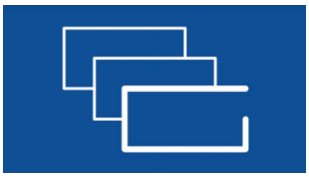


Fig. 38: Section button (1. Overviews, example)

Subsection level (no. 2)

This level provides an overview of the available subsections. This level may also contain multiple menu pages.

Each subsection is designed as a **button** with both the icon for the higher section level (cf. fig. 39, no. 1) and an easy-to-understand icon representing its topic area (cf. fig. 39, no. 2). Pressing the button opens the corresponding parameter level.

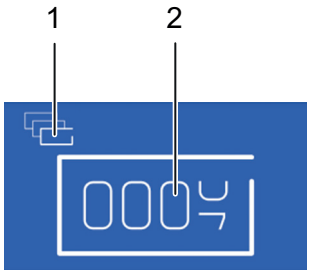


Fig. 39: Subsection button (1.40 Counters, example)

No.	Designation	No.	Designation
1	Section level icon	2	Subsection level icon

Parameter level (no. 3)

This level contains the required data for the individual parameters, arranged in lines in a table. This table may cover multiple menu pages.

Navigating between the menu levels and pages

You can navigate from the start menu (section level) to the parameter level as described above by clicking the corresponding buttons in the display field.

To navigate back to the next higher menu level, you can use the header and its buttons on any menu page (cf. fig. 40, nos. 1–3). You can navigate between the individual menu pages within a level by clicking the buttons in the footer (cf. fig. 40, nos. 5–8).

Fig. 40: Navigating between the menu levels and pages

No.	Designation	Function
1	**Home** button	■ Change back to the **start menu**in the section level
2	**Section level** button	■ Display the opened section level ■ Change from the open parameter level back to the corresponding subsection level
3	**Subsection level** display	■ Display the opened subsection level
4	**Search** button	■ Open the input window for text or coordinate search
5	**Right arrow** button	■ Change to next menu page: - Coloured grey: change is **not** possible - Coloured blue: change is possible
6	Position indicator	■ Displays the position of the opened menu page within the current level. ■ Pressing a free position field causes the indicator to jump to the selected position and the corresponding menu page opens.
7	**Left arrow** button	■ Change to prior menu page: - Coloured grey: change is **not** possible - Coloured blue: change is possible
8	**Counters** button	■ Change to menu **1.40 Counters**

▶ You can press the various buttons in the display field and in the header and footer to navigate to any menu, open it and make changes there.

7.2 Operation from PC

For operation from the PC, the RFC 7 must be connected to a PC or an Ethernet network and the device's IP address must be entered in the internet browser (cf. section 8.3.1 "Establishing a network connection").

You can use the PC's keyboard and mouse to operate the device from the web view of the user interface.

7.2.1 Structure of the menu pages

All the menu pages of the web view have an identical structure (cf. fig. 41).

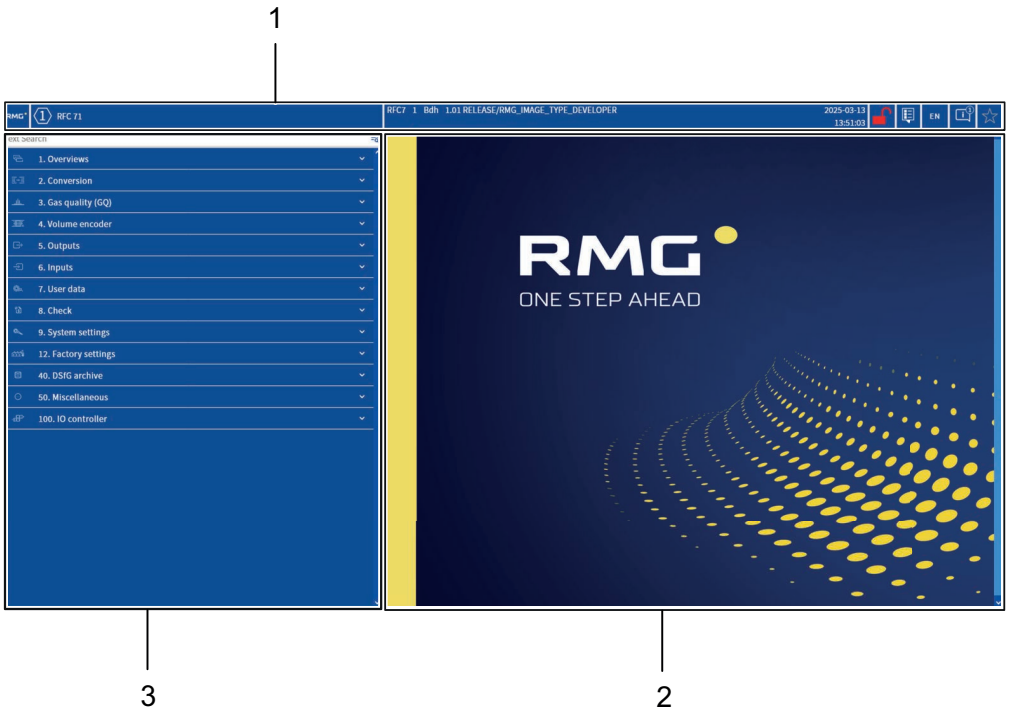


Fig. 41: Start menu – web view

No.	Designation	No.	Designation
1	Header	2	Display field
3	Navigation field		

Header (no. 1)

The header is available on every menu page and always has the same structure. It has various buttons. The functions of these buttons are described in detail in section 7.3 "Controls in the header".

Display field (no. 2)

The displayed content and the functions that can be executed in the display field change depending on which subsection is currently selected.

Navigation field (no. 3)

The navigation field is used to navigate between the individual sections/subsections and to select the menus of the parameter level that will then open in the display field.

7.2.2 Navigating between the menus

The operation menus, like those for touchscreen operation, are divided up into three levels (cf. fig. 42).

In the web view, however, all three levels can be displayed in the menu at the same time.

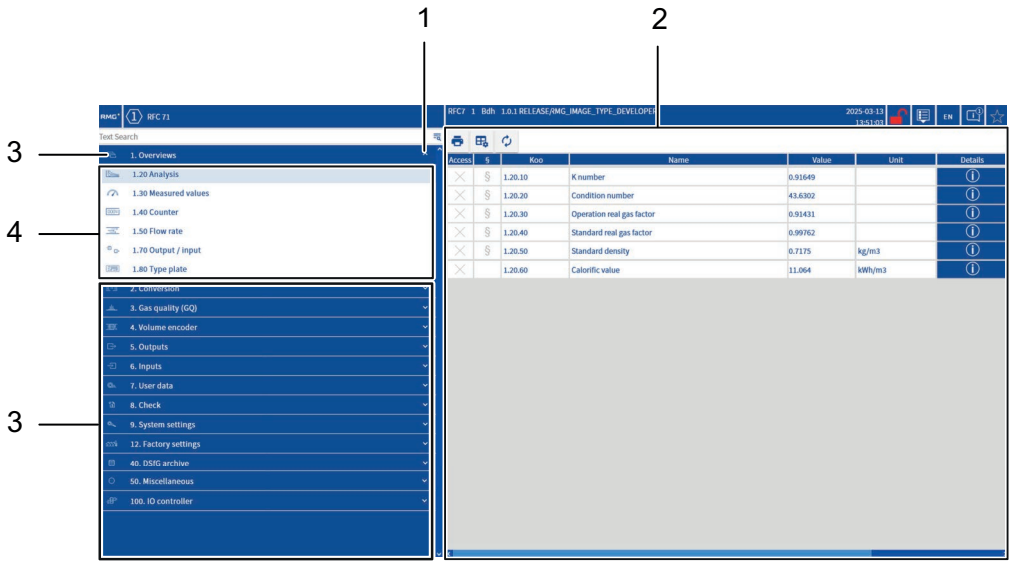


Fig. 42: Menu navigation – web view

No.	Designation	No.	Designation
1	Selection arrow	2	Parameter level (bottom level)
3	Section level (top level)	4	Subsection level (middle level)

To open a parameter level menu, proceed as follows:

1. In the navigation field, selected the required section (no. 3) and click the corresponding selection arrow (no. 1) with the mouse to confirm (here: Section 1. Overviews).
   ➡ The subsection level (no. 4) opens and all other sections move down.
2. Use the mouse to select a subsection (here: 1.20 Analysis).
   ➡ The subsection is displayed with a grey background and in the display field the corresponding parameter level menu opens (no. 2).

You can use the scrollbar on the side to navigate both in the navigation field in the section and subsection level and in the display field in the parameter level.

In this way, you can open, view and make changes in any menus, regardless of access rights of the logged-in user.

7.3 Controls in the header

The controls are generally identical on the touchscreen and in the web view and will be described together.

They will be explained on the basis of the web view. If the controls are displayed differently on the touchscreen, the differences will be described.

Fig. 43: Header of the menu page – web view

No.	Designation	Function
1	**Home** button	■ Jump back to start page
2	**Stream** button	■ Display of the currently selected stream ■ Change to another stream (only possible for Multi-Stream device variant)
3	Info field	■ Path describing which subsection is currently open ■ Display of: - Date and time - App version
4	**User log-in** button	■ Display which user is logged in ■ Display whether the calibration lock is open. ■ Open user log-in window.
5	**View** button	■ Check the view at parameter level: - All parameters are displayed - Only the main parameters are displayed
6	**Language** button	■ Display of the currently selected language ■ Change to language: - DE (German) - EN (English) - ZH (Chinese)
7	**Messages** button	■ Display the message with the highest priority ■ Open message list.
8	**Favourites** button	■ Display whether the open menu is saved as a favourite. ■ Open the favourite list

Fig. 44: Header of the menu pages – touchscreen

No.	Designation	Function
1	**Stream** button	■ Display of the currently selected stream ■ Change to another stream (only possible for Multi-Stream device variant)
2	**Home** button	■ Change back to the **start menu** in the section level
3	**Section level** button	■ Display the opened section level ■ Change from the open parameter level back to the corresponding subsection level
4	**Subsection level** display	■ Display the opened subsection level
5	**User log-in** button	■ Display which user is logged in ■ Display whether the calibration lock is open. ■ Open user log-in window.
6	**View** button	■ Check the view at parameter level: - All parameters are displayed - Only the main parameters are displayed
7	**Messages** button	■ Display the message with the highest priority ■ Open message list (cf. section 7.3.3).
8	**Favourites** button	■ Display whether the open menu is saved as a favourite. ■ Open the favourite list

7.3.1 User log-in

The **User log-in** button has three functions:

1. Display the logged-in user/administrator

	No user is logged in
	User 1 is logged in (the number changes depending on which user is logged in)
	Administrator 1 is logged in (the number changes depending on which admin is logged in)

2. Display whether the calibration lock is open

	Calibration lock open
	Calibration lock open while admin 1 is logged in
	Calibration lock open while admin 2 is logged in

3. A user/administrator logging in/out

A total of five different users and two administrators are available for log-in.

User rights

- The rights of the five saved users are identical, i.e. these users all have the same level of access rights.
- An individual password can be created for each user.
- Each user has change access to parameters marked with the corresponding icon in the **access** column of the menu page at parameter level (cf. section 7.4 "Controls in the display field").
- Parameters that can only be changed with admin rights are **not** displayed to users on the menu pages.

Admin rights

- The rights of the two saved admins are identical, i.e. these admins all have the same level of access rights.
- An individual password can be created for each admin.

- Each admin has change access to parameters marked with the corresponding icon in the **access** column of the menu page at parameter level (cf. section 7.4 "Controls in the display field").

To log in a user/admin, proceed as follows:

▶ Press the **User log-in** button.

➥ The user log-in window will open (cf. fig. 45)

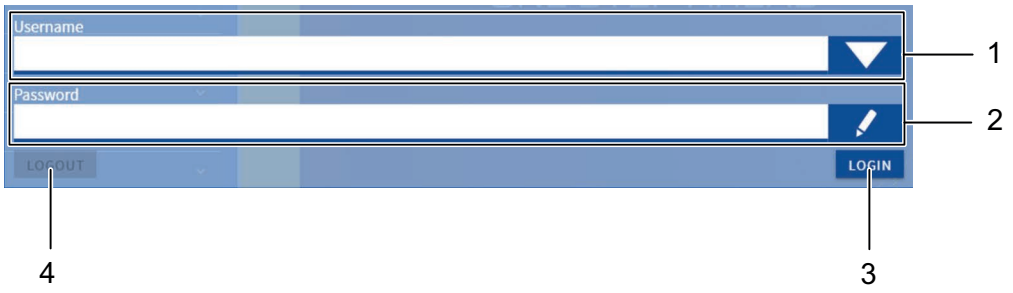


Fig. 45: User log-in window

No.	Designation	Function
1	**Username** selection	■ Open the selection list and select the required user: - User 1, User 2, User 3, User 4, User 5 - Admin 1, Admin 2
2	**Password** input	■ Open the input window for the password (cf. fig. 46) - The default setting of the password for all users/admins is: **User1**
3	**Log-in** button	■ Confirm the log-in details (user and password)
4	**Log-out** button	■ Log out the current user (This button can only be used if a user has logged in.)

▶ Select the required user or admin from the **Username** selection.

➥ The selected user is displayed in the selection.

▶ Select **Password** input.

➥ An input window will open (cf. fig. 46)

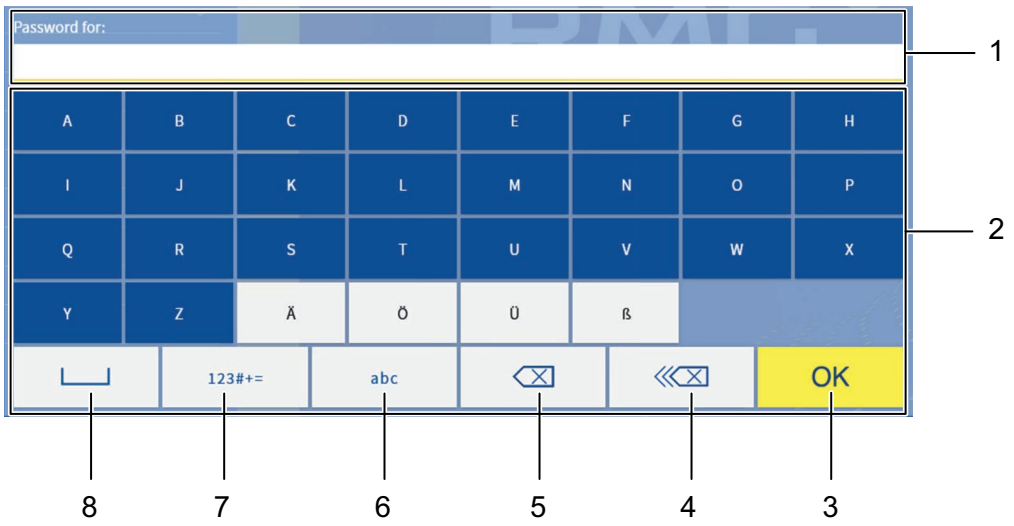


Fig. 46: Password input window

No.	Designation	Function
1	Input field **Password**	■ Display of the entered characters
2	Letters/numbers and symbols field	■ Keyboard function
3	**OK** button	■ Confirm the entry and log in the user
4	**Delete entry** button	■ Clears the entire input field
5	**Delete character** button	■ Deletes the last character in the input field
6	**Shift** button	■ Toggles between upper case and lower case letters ■ Toggles between numbers and symbols
7	**Selection** button	■ Select between display of numbers/symbols and letters
8	**Space** button	■ Enters a space in the password input field

▶ First enter the password **User1** (default setting) and press **OK** to confirm.

➥ The selected user is logged in.

NOTE

Password change on initial start-up

The RFC 7 is delivered with the password User1 (default setting) for all users and admins . During initial start-up, the passwords must be assigned/changed individually.

▶ Assign new passwords as described below.

Changing passwords

To change the password of a user/admin, proceed as follows:

▶ First log in the user/admin whose password you want to change, as described above.

▶ Press the **User log-in** button to open the log-in window again.

➥ The **Change password** button is now displayed in the log-in window.

▶ Press the new **Change password** button.

➥ The **Set new password** window will open (cf. fig. 47).

Fig. 47: Set new password window

No.	Designation	Function
1	**New password** input	■ Open the input window for the new password (cf. fig. 46)
2	**Confirm new password** input	■ Open the input window for confirming the new password (cf. fig. 46)
3	**BACK** button	■ Jump back to the log-in window
4	**SET NEW PASSWORD** button	■ Set the new password

▶ Enter the new password into the two input fields (fig. 47, nos. 1 and 2) and click the corresponding button (fig. 47, no. 4) to set the password.

7.3.2 Set language

In the web view, the header contains a separate button that you can use to temporarily select the language from a selection menu (cf. fig. 43, no. 6).

To select the general system language, proceed as follows:

▶ Select section **9. System settings**.

▶ Navigate to the last menu page and select the subsection **9.500 System DE**.

▶ In the coordinates selection menu **9.500.10 System language**, you can select your preferred language.

7.3.3 Messages

The **Messages** has two functions.

1. Display the message with the highest priority

The displayed icons have the following meanings and are listed below in order of priority, from high to low:

Icon	Designation	Meaning
	Alarm	There is an active alarm message, which has been added to the message list.
	Warning	There is an active warning message, which has been added to the message list.
	Note	There is an active note message, which has been added to the message list.
	OK+	There are only inactive messages, which has been added to the message list.
	OK	There are no messages.

2. Open the message list

Clicking the **Messages** button opens the message list.

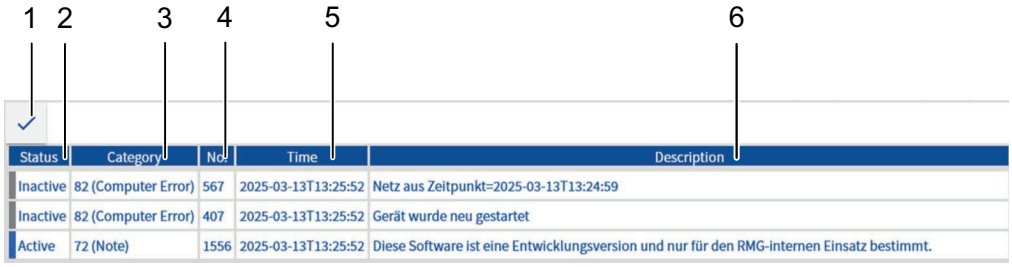


Fig. 48: Message list

No.	Designation	Function
1	Tick	■ Delete inactive messages
2	Status	■ Display message status
3	Category	■ Display message category
4	No.	■ Display message number
5	Time	■ Display date/time when the message was issued
6	Description	■ Display the message/window description

In the status field, the type of message is also indicated by colour coding:

	Alarm active (red)
	Warning active (yellow)
	Note active (blue)
	Message inactive (grey)

7.3.4 Favourites

The **Favourites** button can only be used if a user has logged in. It has two functions.

1. Display whether the current menu page has been added to the favourites list.

The icons displayed have the following meanings:

	Current menu page is not a favourite.
	Current menu page is a favourite.

2. Open the favourite list

Clicking the **Favourites** button opens the favourites list. A favourite can be selected in the list to be displayed or the current page can be saved as a favourite.

A maximum of seven favourites can be saved in the list. To save an additional favourite, you first need to delete one of the existing favourites.

The following buttons are available:

	Add current menu page as a favourite
	Remove favourite

7.4 Controls in the display field

The controls in the display field are generally identical on the touchscreen and in the web view and will be described together.

They will be explained on the basis of the web view. If the controls are displayed differently on the touchscreen, the differences will be described.

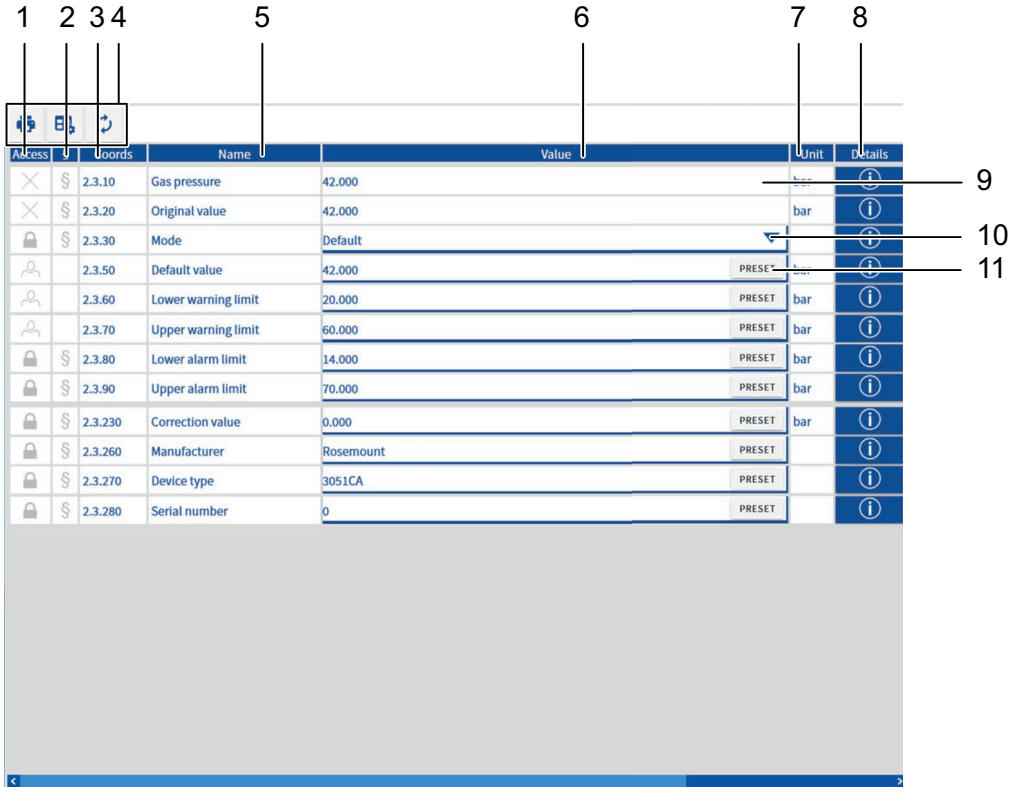


Fig. 49: Web view, display field

No.	Designation	Function
1	**Access** column	■ Display the access rights needed to change the parameter
2	**§** column	■ Display whether the parameter is used for an official calibration measurement.
3	**Koo** column	■ Display the corresponding coordinates of the parameter
4	Buttons (only in web view)	■ Functions: - Change column selection - Print parameter page - Save entry (only visible after data has been entered) - Discard entry (only visible after data has been entered)
5	**Name** column	■ Designation of the parameter
6	**Value** column	■ Value of the parameter
7	**Unit** column	■ Unit of the parameter
8	**Detail** column	■ Open and close a window with detailed information on the corresponding parameter, e.g. the default value
9	**Display** field	■ No entry, display only

No.	Designation	Function
10	**Selection** field	■ Selection menu for input
11	**Input** field	■ Input - Via keyboard (web view) - Via **default** button (web view) - Via input dialogue window (touch-screen)

Access column (no. 1)

The access column indicates whether the corresponding parameter can be changed and what access rights are needed to do so:

	Parameter cannot be edited/changed.
	Parameter can be edited/changed without restrictions.
	Parameter can be edited/changed with user rights.
	Parameter can be edited/changed with admin rights.
	Parameter can only be edited/changed when the calibration lock is open.

§ column (no. 2)

This column indicates whether the corresponding parameter can be used in applications involving official calibration:

	Parameter or measured value is officially calibrated.

Koo column (no. 3)

Every parameter can be uniquely identified or allocated by means of its coordinates. Coordinates are structured as follows:

- Section.subsection.parameter-number

Example: 2.3.50 'Default value'

➡ 2.= section 2. Conversion
➡ 3.= subsection 3. Gas pressure
➡ 50= parameter number
➡ 'Name of the parameter, here: Default value'

Buttons (no. 4)

These buttons are only displayed in the web view. They have the following functions.

	Change column selection
	Print parameter page
	Deactivate automatic refresh
	Save entries (this icon is only visible if one or more entries have been made – entries are also displayed with a coloured background and can be saved jointly.)
	Discard entries (this icon is only visible if one or more entries have been made)

On the touchscreen, any changed entries are saved automatically!

Detail column (no. 8)

The Detail column contains an info button for each parameter (cf. fig. 50).

Fig. 50: Info button

Pressing this button opens a detailed info window underneath the line of the selected parameter containing information on the parameter/coordinate. Its contents include the default value and the internal system name for the parameter (fig. 51, no. 2). Pressing the **Close** button (fig. 51, no. 1) closes the detailed info window and the info button is once again displayed in the corresponding line.

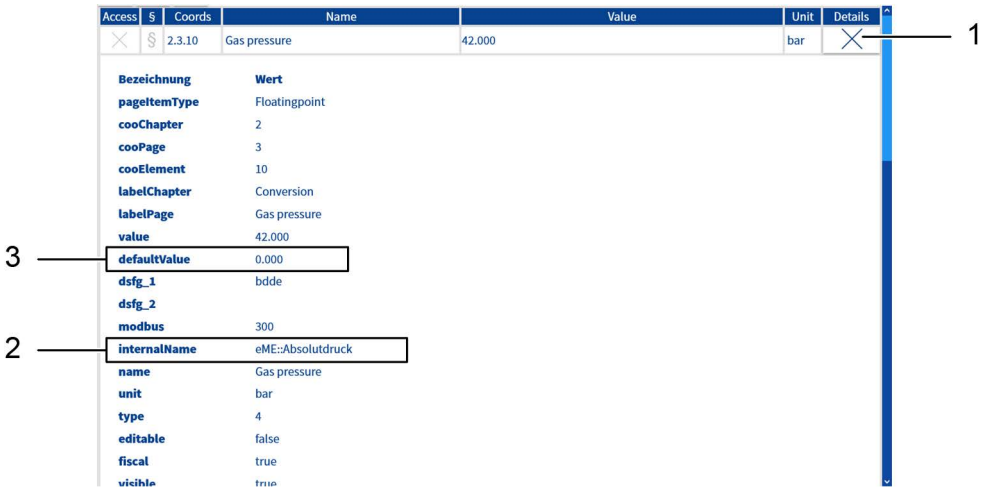


Fig. 51: Detailed info window for the parameter '2.3.10 Gas pressure'

No.	Designation	Function
1	**Close** button	■ Close the detailed info window
2	Internal name	■ Displays the system's internal name for this parameter; can be used to assign a measured value to an analogue output, for example. In the web view, this name can be entered at another location by using the copy & paste function.
3	Default value	■ Display the preset value for the selected parameter

Field Selection (no. 10)

Clicking the arrow in the selection field opens a selection menu that displayed all the available selection options (cf. fig. 52). The saved default value is always shown in bold in the selection menu.

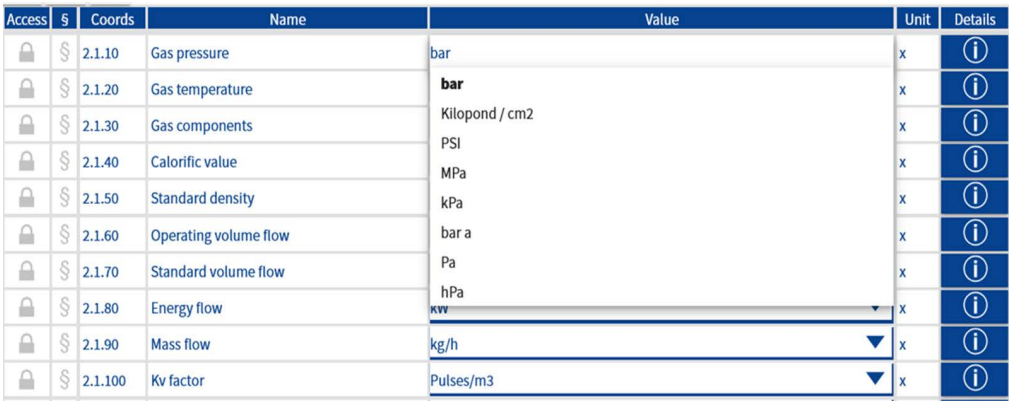


Fig. 52: Selection menu for coordinate 2.1.10 Gas pressure unit

Input field (no. 11)

In the **web view**, input values can simply be entered with the keyboard after you have selected a field of the type 'input'. Alternatively, you can enter the default value (visible in the detailed info window) by clicking the **Default** button.

To apply the entered values, you need to save them by clicking the corresponding button. If more than one value has been changed, a window opens automatically where you can save or discard the changes.

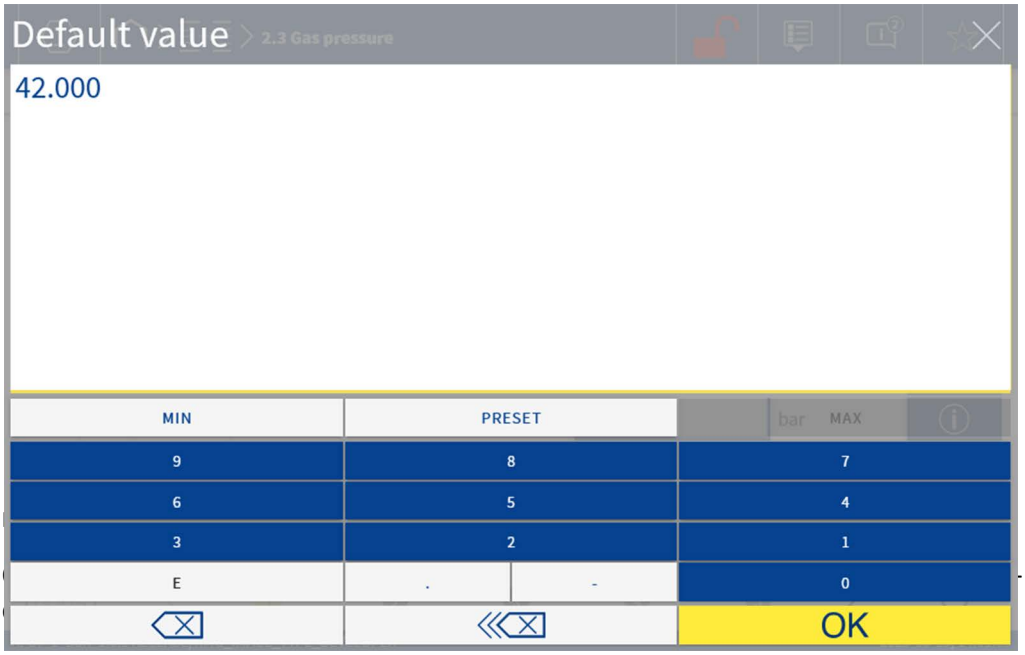


Fig. 54: Input dialogue window

The input value can be entered here either by using the numeric keypad or you can enter the default value by clicking the **Default** button. Clicking the **OK** button confirms and saves the entry and the window closes automatically.

7.5 Overview of the available menu pages

The following table provides an overview of the available menu pages and their structural arrangement.

NOTE

Display of menu '2. Conversion'

The menu **2. Conversion** is only displayed in the web view and on the touchscreen is a user is logged in!

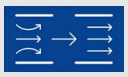
Section level		Subsection level		Parameter level Touchscreen Page number
Icon	Designation	Icon	Designation	
	1. Overviews		1.20 Analysis	1
			1.30 Measurement values	1
			1.40 Counters	5
			1.50 Flow	2
			1.70 Output/input	5
			1.80 Nameplate	1
	2. Conversion		2.1 Units	3
			2.2 Formats	4
			2.3 Gas pressure	5
			2.4 Gas temperature	5
			2.5 Flow rate parameters	5
			2.6 Operating volume flow	4
			2.7 Corrected operating volume flow	3
			2.8 K number	6

Table 12: Overview of menu pages

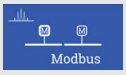
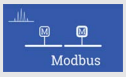
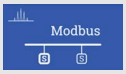
Section level		Subsection level		Parameter level Touchscreen Page number
Icon	Designation	Icon	Designation	
			2.9 Standard volume flow	3
			2.10 Energy flow	3
			2.17 Counter mode	3
			2.100 Counters – billing mode 1	5
			2.200 Fault counters – billing mode 1	5
			2.300 Counters – billing mode 2	5
			2.400 Fault counters – billing mode 2	5
			2.500 Counters – billing mode undefined	6
			2.800 Cycle quantities	2
	3. Gas quality (GQ)		3.10 GQ setting	5
			3.20 Current GQ	8
			3.30 Lower QG warning limits	4
			3.40 Upper GQ warning limits	4
			3.50 GQ default	4
			3.60 Main GQ Modbus client	30
			3.70 Replacement GQ Modbus client	30
			3.80 Main GQ Modbus server	4

Table 12: Overview of menu pages

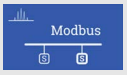
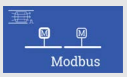
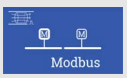
Section level		Subsection level		Parameter level Touchscreen Page number
Icon	Designation	Icon	Designation	
			3.90 Replacement GQ Modbus server	4
			3.100 ISO 6976 GQ	1
	4. Volume encoder		4.12 Meter factor	1
			4.14 Characteristic curve	7
			4.15 Modbus client/F instance	61
			4.100 Counter readings instance F	5
			4.500 Synchronisation monitoring	3
	5. Outputs		5.100 Digital output 1 (DO1)	1
			5.101 Digital output 2 (DO2)	1
			5.110 Digital output 3 (DO3)	1
			5.111 Digital output 4 (DO4)	1
			5.112 Digital output 5 (DO5)	1
			5.113 Digital output 6 (DO6)	1
			5.200 Analogue output 1 (AO1)	3
			5.201 Analogue output 2 (AO2)	3
			5.202 Analogue output 3 (AO3)	3
			5.203 Analogue output 4 (AO4)	3

Table 12: Overview of menu pages

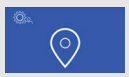
Section level		Subsection level		Parameter level Touchscreen Page number
Icon	Designation	Icon	Designation	
	6. Inputs		6.10 Digital input 1 (DI1)	1
			6.11 Digital input 2 (DI2)	1
			6.12 Digital input 3 (DI3)	1
			6.13 Digital input 4 (DI4)	1
			6.100 Analogue input 1 with HART (AI1)	2
			6.101 Analogue input 2 with HART (AI2)	2
			6.102 Analogue input 3 (AI3)	2
			6.114 Analogue input 4 with HART (AI4)	2
			6.115 Analogue input 5 with HART (AI5)	2
			6.120 PT100 Non-Ex	3
			6.121 PT100 Ex	3
			6.200 Frequency and pulse input 1	2
			6.201 Frequency and pulse input 2	1
			6.300 Encoder settings	8
	7. User data		7.10 Measurement location details	1
			7.20 Configuration	3
	8. Check		8.10 Freeze	1
			8.30 Functional test	10

Table 12: Overview of menu pages

Section level		Subsection level		Parameter level Touchscreen Page number
Icon	Designation	Icon	Designation	
			8.40 Functional test result	1
			8.200 Functional test averages	26
	9. System settings		9.1 Software update (only available in web view)	1
			9.2 Time and date	2
			9.3 Time synchronisation	4
			9.4 Memory management	1
			9.7 Serial interfaces	6
			9.9 Firewall	3
			9.11 Ethernet 1	7
			9.12 Ethernet 2	7
			9.13 Ethernet 3	7
			9.14 Ethernet 4	7
			9.15 Ethernet 0 internal	3
			9.20 Modbus server	5
			9.60 IOC	2
			9.100 Access rights	4
			9.110 User management	9
			9.250 Software ID	5

Table 12: Overview of menu pages

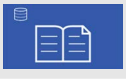
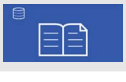
Section level		Subsection level		Parameter level Touchscreen Page number
Icon	Designation	Icon	Designation	
			9.400 System info HW/OS	14
			9.410 Screen/screensaver	2
			9.500 System de	9
	12. Factory settings		12.10 Set counters	5
			12.20 Deletions	2
	40. DSfG archive		40.10 AG 1 counter + measured values AM1	5
			40.20 AG 2 – fault counter AM1	5
			40.30 AG 3 – counter + measured values AM2	5
			40.40 AG 4– fault counter AM2	5
			40.120 AG12 – gas quality	2
			40.130 AG 13 – counter for undefined AM	5
			40.170 AG 17 – functional test part 1	1
			40.180 AG 18 – functional test part 2	1
			40.190 AG 19 – functional test part 3	1
			40.210 AG 21 – logbook	4
			40.500 AG 50 – official calibration logbook	1
			40.510 AG 51 – non-official calibration log-book	3

Table 12: Overview of menu pages

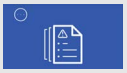
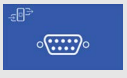
Section level		Subsection level		Parameter level Touchscreen Page number
Icon	Designation	Icon	Designation	
	50. Miscellaneous		50.10 Error messages	3
			50.800 List of licences	2
			50.850 Error log	1
			50.851 Temporary error log	1
			50.860 Flash IOC log	1
			50.870 Mount log	1
			50.900 Header	2
	100. IO controller		100.1 Digital inputs	9
			100.2 Current inputs 1-3, PT100_EX	10
			100.3 Current inputs 4, 5 PT100_NonEx	9
			100.5 Digital outputs	11
			100.6 Current outputs	4
			100.7 Encoder	5
			100.8 System values	4
			100.9 Communication	2
			100.26 System information	10

Table 12: Overview of menu pages

8 Initial start-up

8.1 General initial start-up information

Before initial start-up, ensure that all the safety information provided is observed and the installation of the RFC 7 itself and the connection of all required devices and sensors have been carried out in accordance with the specifications of this manual.

During initial start-up, the regulations on explosion protection and all safety warnings relating to working in areas with explosive atmospheres must be observed.

The initial start-up is performed before delivery as far as possible and additionally as needed on site by qualified technicians or sales staff. RMG provides training and initial start-up services for this purpose.

All newly delivery devices already have a factory parameterisation, possibly implemented in accordance with customer specifications. This parameterisation should normally be sufficient, but some settings and parameters may need to be adjusted on site in the user interface. Initially, parameters can only be changed if they are not covered by the official calibration switch protection.

If the on-site conditions make it necessary to change parameters that are protected by the calibration switch, this must only be performed by persons with inspection body authorisation or by calibration officials.

NOTE

Applications involving official calibration

If the Flow Computer RFC 7 is to be used for applications involving official calibration, it will be preset before delivery in accordance with the approval and secured with lead seals, software and hardware locks to prevent unauthorised alteration. The approvals that are valid for the device and its function are listed on the nameplate. If the lead seals and protective measures are removed or damaged, the RFC 7 will lose its approval and may no longer be used in applications involving official calibration.

- Never remove or damage the lead seals or other protective measures!
- If a protective measure needs to be removed or is damaged, however, the device must be inspected by a state-approved body or a calibration official and the further settings may also need to be checked at the factory. The calibration official must reseal the opened lead seals to enable the RFC 7 to be used for applications involving official calibration once again.

NOTE

Approval certificate

During initial start-up, an approval certificate must be created to document correct initial start-up and any setting values.

The following sections include descriptions of setting parameters that are protected by the official calibration switch. Only allow these settings to be made by persons with corresponding authorisation! Parameters that are subject to calibration switch protected are identified in the parameter level menu pages in the **access** column.

8.2 Requirements for initial start-up

Before initial start-up can be carried out, inspections must have been performed in accordance with the following ordinances, regulations and industrial standards:

- Safety and Health at Work Act (BetrSichV), section 15: 'Inspections before commissioning and before re-commissioning following changes that require inspection'
- DGUV regulation 3, 'Electric systems and materials', section 5: 'Inspections'
- VDE 0100-100 'Setting up low-voltage systems'
- DIN EN 60079-14 VDE 0165-1 'Explosive atmospheres'

8.3 Performing initial start-up

Initial start-up can be carried out either on the touchscreen or with a Pc/laptop via a network connection.

The settings can be configured very easily with the available PC browser (e.g. Microsoft Edge, Mozilla Firefox).

▶ Using a PC for initial start-up is recommended. This is described in the following sections.

Detailed information on the touchscreen and PC user interface and how to use it is provided in the section 7 "Operation".

8.3.1 Establishing a network connection

The network connection between the RFC 7 and a PC or laptop can be set up as follows:

- **Local**: a network cable (LAN cable) is connected to the Ethernet ports Eth 1–4 on the device's back panel and to an Ethernet port of the PC/laptop. The PC's local network is used for this.
- **Remote:** the RFC 7 is connected to an existing network with a network cable (LAN cable) at one of the Ethernet ports Eth 1–4 on the device's back panel.

NOTE

Incorporating the RFC 7 into an existing network

To incorporate the RFC 7 into an existing network, the network must permit the incorporation of external devices. Protected company networks may forbid access.

▶ Ask your IT department how you can integrate the RFC 7 into the company network.

NOTE

Using the RFC 7 with various networks simultaneously

With the Ethernet ports 1–4, the RFC 7 can be used by up to four networks simultaneously. Software and firewalls prevent connection between the various networks.

To use the network connection (local or remote), you need to enter the correct IP address of the RFC 7 in the PC's browser before connection to the Ethernet port.

Procedure for entering the IP address:

When the power supply is connected to the RFC 7, the device is automatically started up and the start menu is displayed on the touchscreen. Entering the IP address is described below, with the Ethernet port Eth 1 used as an example. The description applies for all other Ethernet ports accordingly.

- ▶ Navigate to the corresponding device menu page for the Ethernet port of the RFC 7 that you want to connect the network to – in this case **9.11 Ethernet 1.**

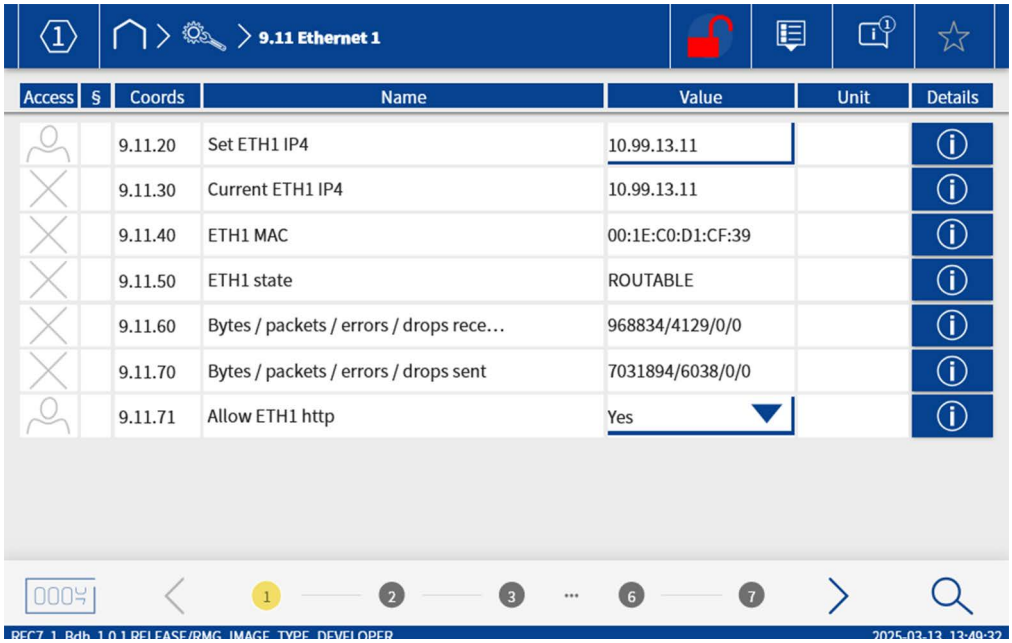


Fig. 55: Menu 9.11 Ethernet 1 on the touchscreen

- ▶ Navigate to the next page and check the DHCP setting of the Ethernet port in the coordinate **9.11.75 DHCP set.** The following settings can be selected:
  - **Yes:** automatic allocation of the IP address when a DHCP server is present in the network.
  - **No:** the IP address must be entered manually if **no** DHCP server is present in the network.

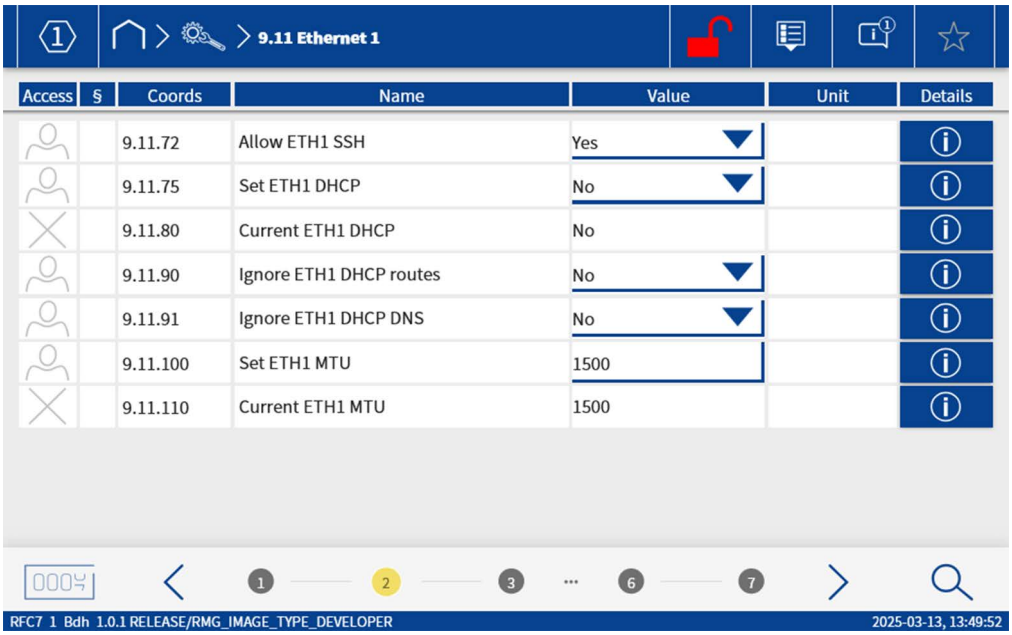


Fig. 56: Menu 9.11 Ethernet 1 – page 2 on the touchscreen

- ▶ With the setting **Yes** you can now read off the IP address in **coordinate 9.11.30**. With the setting **No** you will need to enter the IP address manually in **coordinate 9.11.20**.
- ▶ Connect the RFC 7 to your computer or network via the Ethernet port.
- ▶ Then enter the IP address in the address bar (URL bar) of the browser and press the Enter key on your keyboard to confirm.
  - ➥ The web view of the user interface will be displayed in the browser.

8.3.2 User log-in

In order to perform parameter or initial start-up settings, a user with corresponding rights must be logged in.

- ▶ Log in as a user with the corresponding password.

Initially, all users and admins have the password **User1**.

- ▶ When you log in for the first time, please set new passwords and document them. Keep the list of passwords safe and only disclose passwords in accordance with the required authorisation level!

For detailed information on user log-in and potentially changing passwords, please refer to section 7.3.1 "User log-in".

8.4 Entering user data

8.4.1 Entering measurement location details

First enter the required data for the measurement location. Do this as follows:

- ▶ Navigate to the menu page **7.10 Measurement location details**.

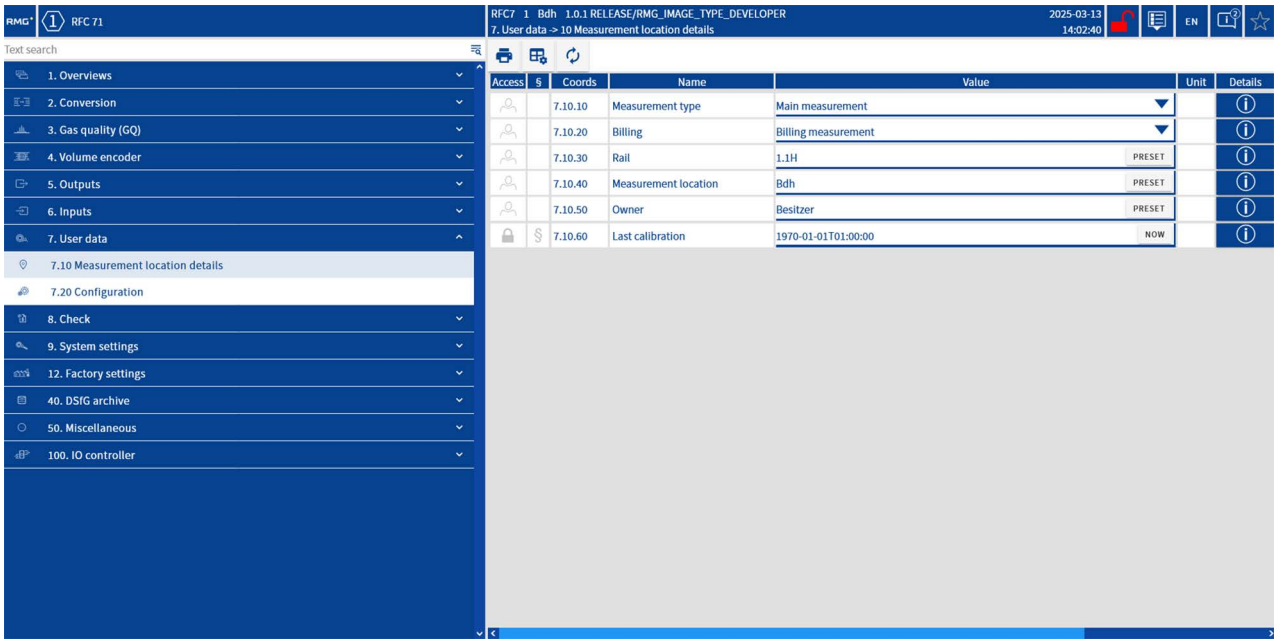


Fig. 57: Menu page 7.10 Measurement location details

- ▶ In coordinate **7.10.10 Measurement type**, selected whether the measurement point is a main measurement or a comparative measurement.
- ▶ In coordinate **7.10.20 Billing**, specify whether the measurement is a 'normal' billing measurement or a retention measurement. A retention measurement can refer to a measurement line that is operated only in winter and not in summer, for example.
- ▶ In the coordinates **7.10.30 Rail**, **7.10.40 Measurement location** and **7.10.50 Owner**, enter descriptive information about the measurement point to allow it to be identified precisely.
- ▶ In the coordinate **7.10.60 Last calibration**, enter the corresponding date.
- ▶ Save your entries by clicking the corresponding button. (cf. section 7.4 "Controls in the display field")

8.5 Conversion – specifying parameters

8.5.1 Specifying units

During initial start-up, it is very important to select the right units for the physical input variables, as the calculations could otherwise be distorted.

Example:

If a measurement point has an operating pressure of roughly 100 bar, then converting operating flow rate to standard flow rate will involve a factor of roughly 100 between the two physical variables.

If the unit **m³** is entered for the operating volume, which is a typical unit for volume, it makes sense to select the unit **x100 m³** for the standard volume. This selection takes into account the difference arising from the operating pressure.

p ≈ 100 bar; operating volume = 1 m³ ➡ standard volume = 100 m³

As a unit for energy, **MWh** is generally appropriate, although it may make sense to add a factor in front of the unit for large nominal widths and flow rates.

For small nominal widths and flow rates, the unit **kWh** may be sufficient.

The following table 13 provides an overview of the recommended unit settings. Even though information is provided in the table, you are still obliged to check the operating conditions of your measurement point and to configure the units accordingly.

Operating pressure	Operating volume unit	Pipeline diameter	Standard volume unit	Energy unit
p ≈ 100 bar	m³	<DN 80	100 m³	10 kWh or 100 kWh
p ≈ 100 bar	m³	>DN 50 to <DN 150	100 m³	MWh
p ≈ 100 bar	m³	>DN 100	100 m³	10 MWh or 100 MWh

Table 13: Recommendations for the selection of units

NOTE

Consider counter overrun!

The units selected for the counters have an effect on how often the counter will overrun.

- ▶ Please selects units that will result in no more than one counter overrun per billing period at maximum flow. The counters have up to 14 digits.

To select the units, proceed as follows:

- ▶ Navigate to the menu page **2.1 Units**.

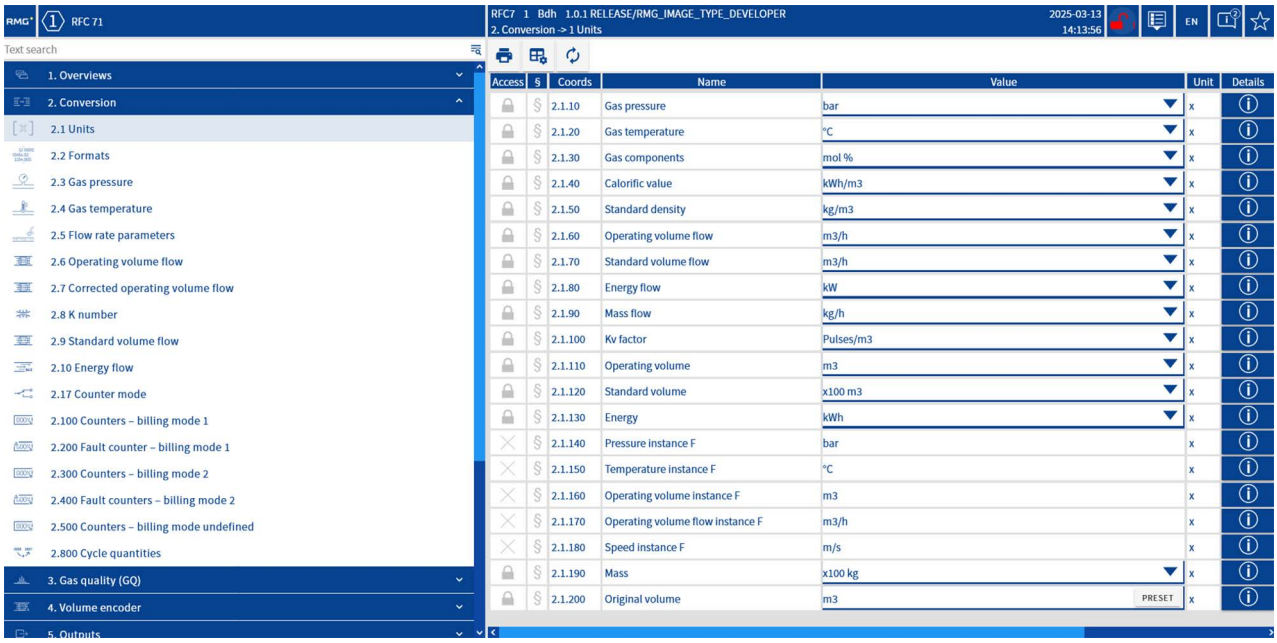


Fig. 58: Menu page 2.1 Units

▶ Use the selection menu to specify the required unit for each physical input variable (**coordinates 2.1.10 to 2.1.130**).

The following table shows the available unit options:

Coordinate	Name	Available units
2.1.10	Gas pressure	■ bar ■ Kilopond/cm² ■ psi ■ MPa ■ kPa ■ bar a ■ Pa ■ hPa
2.1.20	Gas temperature	■ °C ■ °F ■ K ■ R
2.1.30	Gas components	■ mol %
2.1.40	Calorific value	■ MJ/m³ ■ kWh/m³ ■ Mcal/m³ ■ MJ/m³ ■ BTU/ft³ ■ kcal/m³
2.1.50	Standard density	■ kg/m³ ■ lb/ft³
2.1.60 2.1.70	Operating volume flow Standard volume flow	■ m³/h ■ ft³/h ■ m³/s ■ ft³/s ■ mft³/h ■ mmft³/h

Table 14: Overview of available units

Coordinate	Name	Available units
2.1.80	Energy flow	■ kW ■ MW ■ BTU/s ■ kcal/s ■ GW ■ MJ/h ■ GJ/h ■ TJ/h ■ kBTU/h ■ kBTU/s
2.1.90	Mass flow	■ kg/h ■ lb/h ■ kg/s ■ lb/s
2.1.100	Kv factor	■ Pulses/m³ ■ Pulses/ft³
2.1.110 2.1.120	Operating volume Standard volume	■ m³ ■ ft³ ■ x10 m³ ■ x100 m³ ■ x1000 m³ ■ mft³ ■ mmft³
2.1.130	Energy	■ kWh ■ MJ ■ MWh ■ BTU ■ x10 kWh ■ x100 kWh ■ x10 MWh ■ x100 MWh ■ kcal ■ MBTU

Table 14: Overview of available units

8.5.2 Specifying formats

The format for parameters can only be changed when the calibration lock is open.

To select the formats, proceed as follows:

▶ Navigate to the menu page **2.2 Formats**.

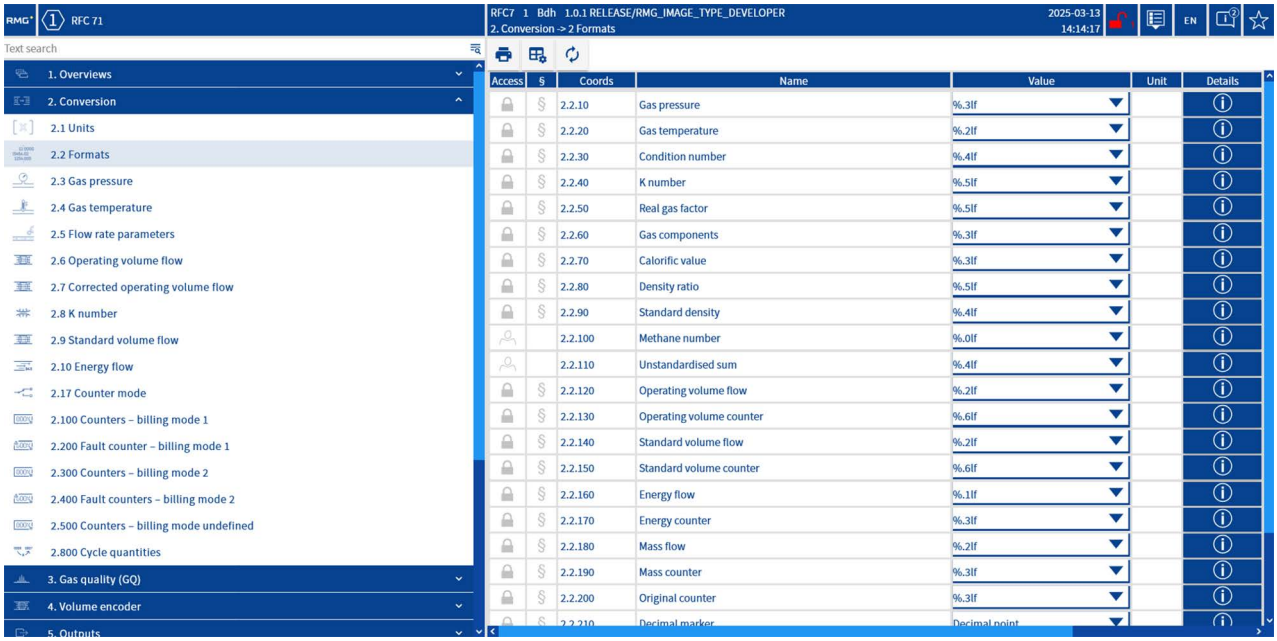


Fig. 59: Menu page 2.2 Formats

In the selection menu, the following formats are available for each parameter:

- %.0lf
- %.1lf
- %.2lf
- %.3lf
- %.4lf
- %.5lf
- %.6lf

The number in the selection represents the number of decimal places.

Example:

The number 12.345 is shown as follows for the various selections:

- For %.0lf as 12
- For %.1lf as 12.3
- For %.2lf as 12.35 (the rounding of the third decimal place is accounted for correctly)

Internal calculations are designed as float or double with 7 or 15 places. Seven places (digits) are therefore relevant, regardless of whether they occur before or after the decimal point.

▶ Select the decimal places accordingly.

NOTE

Changing unit

If a measured value (e.g. pressure) has more than seven digits before the decimal point, this means that the wrong unit was chosen for the value.

- ▶ Select an appropriate unit for the measured value, e.g. MPa rather than Pa for pressure.
- ▶ To change the unit, proceed as described in section 8.5.1 "Specifying units".

Selection in coordinate 2.2.210 Decimal marker

In the selection menu for the coordinate **2.2.210 Decimal marker**, the following selections for the decimal point character are available:

- Comma as decimal marker
- Full stop as decimal marker

NOTE

Selecting the decimal marker

The decimal marker selection can easily lead to errors if numbers from English-language sources (using a full stop as decimal point) are mixed with numbers from German-language sources (where a comma is used).

- ▶ Take particular care when importing numbers from sensors from the two language areas!

8.5.3 Gas pressure – specifying parameters

In some cases, it is only possible to select the pressure sensor/transmitter and specify the corresponding parameters when the calibration lock is open.

Proceed as follows:

▶ Navigate to the menu page **2.3 Gas pressure**.

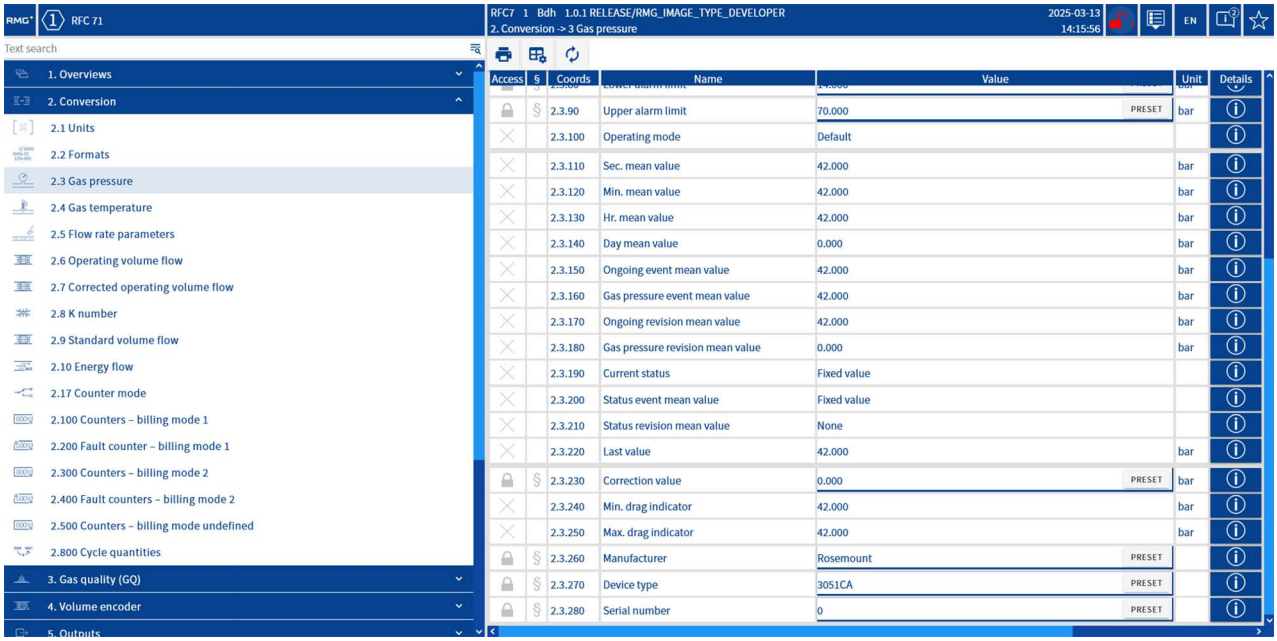


Fig. 60: Menu page 2.3 Gas pressure

▶ In the coordinate **2.3.30 Mode**, specify which input provides the measurement signal for the gas pressure or whether a default value should be used. The following options are available:
  - Default
  - Analogue input 1 (AI1)
  - Analogue input 2 (AI2)
  - HART 1
  - HART 2
  - Analogue input 3 (AI3)
  - Analogue input 4 (AI4)
  - Analogue input 5 (AI5)
  - HART 4
  - HART 5

▶ To use a default value, specify in the coordinate **2.3.50** the **default value** that is to be used for the gas pressure.

▶ In the coordinate **2.3.60**, specify the **lower warning limit** for the gas pressure at which a warning message is to be issued.

▶ In the coordinate **2.3.70**, specify the **upper warning limit** for the gas pressure at which a warning message is to be issued.

▶ In the coordinate **2.3.80**, specify the **lower alarm limit** for the gas pressure at which an alarm is to be issued.

▶ In the coordinate **2.3.90**, specify the **upper alarm limit** for the gas pressure at which an alarm is to be issued.

- ▶ In the coordinate **2.3.260**, enter the **manufacturer** of the connected pressure sensor/transmitter.
- ▶ In the coordinate **2.3.270**, enter the **device type** of the connected pressure sensor/transmitter.
- ▶ In the coordinate **2.3.280**, enter the **serial number** of the connected pressure sensor/transmitter.

8.5.4 Gas temperature – specifying parameters

In some cases, it is only possible to select the temperature sensor/transmitter and specify the corresponding parameters when the calibration lock is open.

Proceed as follows:

- ▶ Navigate to the menu page **2.4 Gas temperature**.

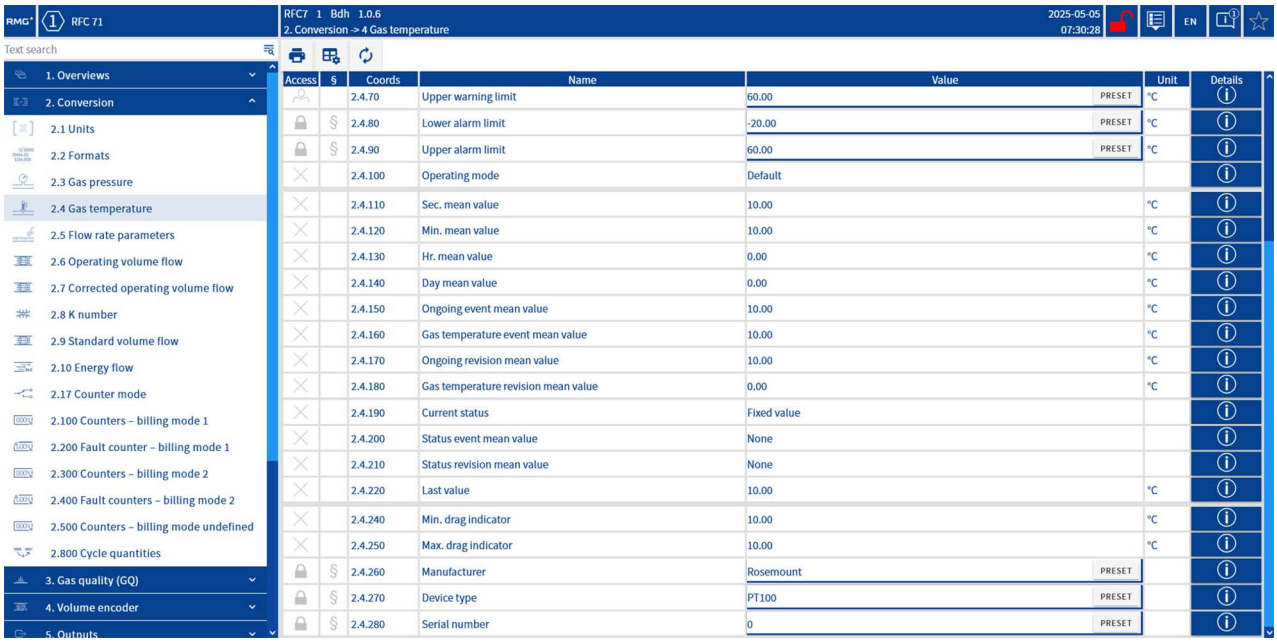


Fig. 61: Menu page 2.4 Gas temperature

- ▶ In the coordinate **2.4.30 Mode**, specify which input provides the measurement signal for the gas temperature or whether a default value should be used. The following options are available:
  - Default
  - Analogue input 1 (AI1)
  - Analogue input 2 (AI2)
  - HART 1
  - HART 2
  - Analogue input 3 (AI3)
  - Analogue input 4 (AI4)
  - Analogue input 5 (AI5)
  - HART 4
  - HART 5
  - PT100 non-Ex
  - PT100 Ex

- ▶ To use a default value, specify in the coordinate **2.4.50** the **default value** that is to be used for the gas temperature.
- ▶ In the coordinate **2.4.60**, specify the **lower warning limit** for the gas temperature at which a warning message is to be issued.
- ▶ In the coordinate **2.4.70**, specify the **upper warning limit** for the gas temperature at which a warning message is to be issued.
- ▶ In the coordinate **2.4.80**, specify the **lower alarm limit** for the gas temperature at which an alarm is to be issued.
- ▶ In the coordinate **2.4.90**, specify the **upper alarm limit** for the gas temperature at which an alarm is to be issued.
- ▶ In the coordinate **2.4.260**, enter the **manufacturer** of the connected temperature sensor/transmitter.
- ▶ In the coordinate **2.4.270**, enter the **device type** of the connected temperature sensor/transmitter.
- ▶ In the coordinate **2.4.280**, enter the **serial number** of the connected temperature sensor/transmitter.

8.5.5 Flow rate – specifying parameters

In some cases, the flow parameters can only be specified when the calibration lock is open.

To specify the parameters, proceed as follows:

- ▶ Navigate to the menu page **2.5 Flow rate parameters**.

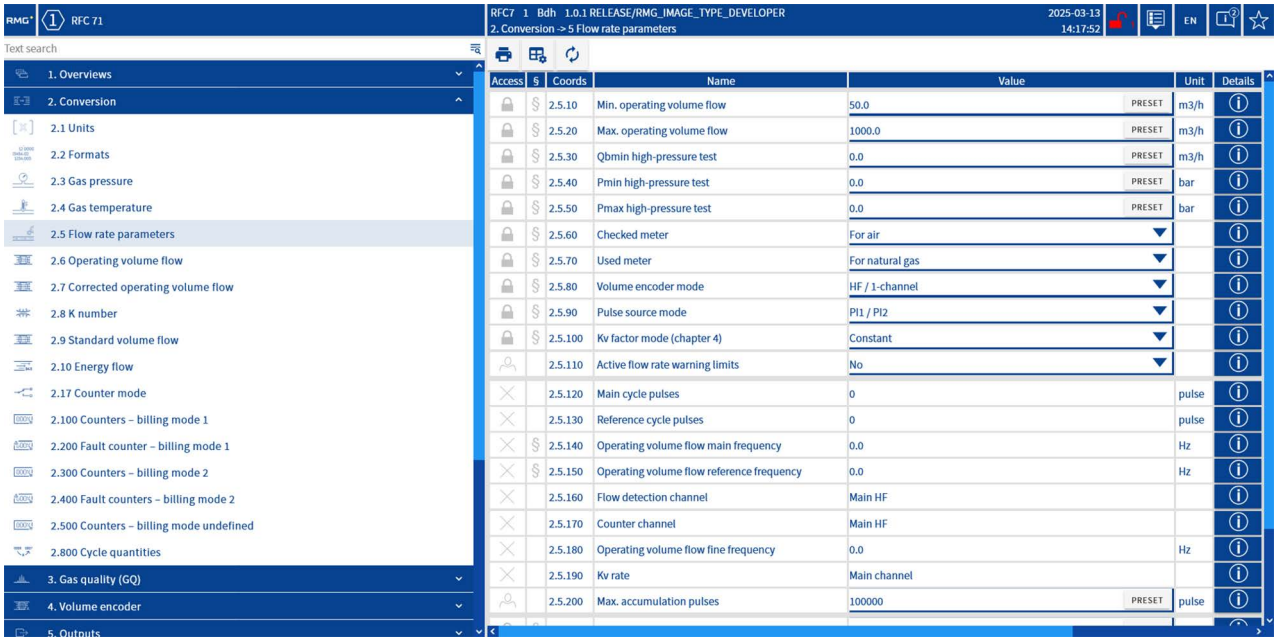


Fig. 62: Menu page 2.5 Flow rate parameters

- ▶ In the coordinate **2.5.10 Min. operating volume flow**, specify the permitted measurable minimum operating flow rate.
- ▶ In the coordinate **2.5.20 Max. operating volume flow**, specify the permitted measurable maximum operating flow rate.
- ▶ In the coordinate **2.5.30 Qbmin high pressure test**, enter the determined value from the gas meter's high pressure test.
  - ➥ The entered value is copied to the electronic nameplate.

- In the coordinates **2.5.40 Pmin high pressure test** and **2.5.50 Pmax high pressure test**, enter the limits for the permitted pressure range in which the measurement device is operated.
  - ➥ The entered values are copied to the electronic nameplate.
- In the selection menus of the coordinates **2.5.60 Checked meter** and **2.5.70 Used meter**, select the gas that was used for testing the measurement device and the gas that is used for the device. The following options are available:
  - For air
  - For natural gas
  - For ethylene
  - For nitrogen
  - For hydrogen
  - For oxygen
  - See gas meter
- In the selection menu of the coordinate **2.5.80 Volume encoder mode**, select the flow rate value transmission mode for the RFC 7. The following table provides an overview of the possible transmission modes, some of which are combined in the selection menu.

Transmission mode	Description of function
1-channel	Single-channel transmission of the flow rate values
2-channel	Double-channel transmission of the flow rate values
LF	Low frequency; as the frequency may be very low, no current flow rate is calculated for transmission with low frequency.
HF	High frequency; this transmission mode is used to calculate a current flow rate.
Enco	Original counter, direct value of the encoder; no calculation of the current flow rate.
Modbus client/F instance	Digital counter status transmission. The current flow rate is determined in an ultrasonic gas meter and transmitted digitally. The digital data transmission **F instance** ensures consistent, manufacturer-independent data allocation of the digital addresses and secure transmission of all key required data of the measurement device.
1 to 1	Two input channels provide two input frequencies to the RFC 7, in a relation of 1 to 1: $\frac{f1}{f2} = \frac{1}{1}$
X to Y	Two input channels provide two input frequencies (e.g. main wheel and reference wheel of a gas meter), in a relationship of X to Y: $\frac{f1}{f2} = \frac{X}{Y}$

Table 15: Coordinate 2.5.80 Volume encoder mode – transmission modes for flow rate values

- In the coordinate **2.5.90 Pulse source mode**, specify which signal inputs are to be used for conversion. The following options are available:
  - PI1/PI2 (pulse input 1 (N1) / pulse input 2 (N2))
  - PI3/PI4 (digital input 1 (DI1) / digital input 2 (DI2))

- ▶ In the coordinate **2.5.100 Kv factor mode (section 4)**, specify the method for characteristic curve correction. The following options are available:
  - **Constant**; the characteristic curve of the flow meter is not corrected, i.e. no changes are made.
  - **Polynomial**; the characteristic curve of the flow meter is adjusted with a polynomial correction.
  - **Support point**; the characteristic curve of the flow meter is adjusted with a support point correction.

NOTE

Explanation of the methods used for characteristic curve correction

As the result of corresponding test measurements, the device-specific percentage deviation from a constant characteristic flow curve is known. To perform a correction of this deviation, two different methods can be used to correct the characteristic curve:

- **Support point correction** uses a set number of support points at which the curve is corrected. Linear approximation is used for correction between the support points.
- For **polynomial correction**, a typical polynomial curve is used to describe the path of the deviation precisely and correct it accordingly. This method is generally more accurate than a simple support point correction.

Both methods have some merit, however, especially given that support point correction typically differs from the polynomial correction by less than 0.1% within the measurement range (Qmin–Qmax). In the flow range <Qmin, polynomial correction generally provides better values. The method for characteristic curve correction should be selected in accordance with the operating conditions that most frequently occur.

Both methods are approved in accordance with official calibration law!

For detailed information on performing characteristic curve correction, please refer to section 8.7.2 "Characteristic curve".

- ▶ In the coordinate **2.5.190 Max. accumulation pulses**, specify the maximum number of incoming pulses after which a warning is to be issued if the calibration switch is open.

  If the calibration switch is open in the presence of flow, the conversion stop as soon as the first official calibration parameter is entered. The remaining incoming pulses are added up and are not converted until the calibration switch has been closed again. If the calibration switch is **not** closed within the specified maximum number of incoming pulses, the set warning is issued as a reminder.
- ▶ In the coordinate **2.5.200**, enter the **manufacturer** of the connected gas meter.
- ▶ In the coordinate **2.5.210**, enter the **device type** of the connected gas meter.
- ▶ In the coordinate **2.5.220**, enter the **serial number** of the connected gas meter.
- ▶ In the coordinate **2.5.230**, enter the **size** of the connected gas meter.

8.5.6 Operating volume flow – specifying parameters

In some cases, the operating flow parameters can only be specified when the calibration lock is open.

To specify the parameters, proceed as follows:

- ▶ Navigate to the menu page **2.6 Operating volume flow**.

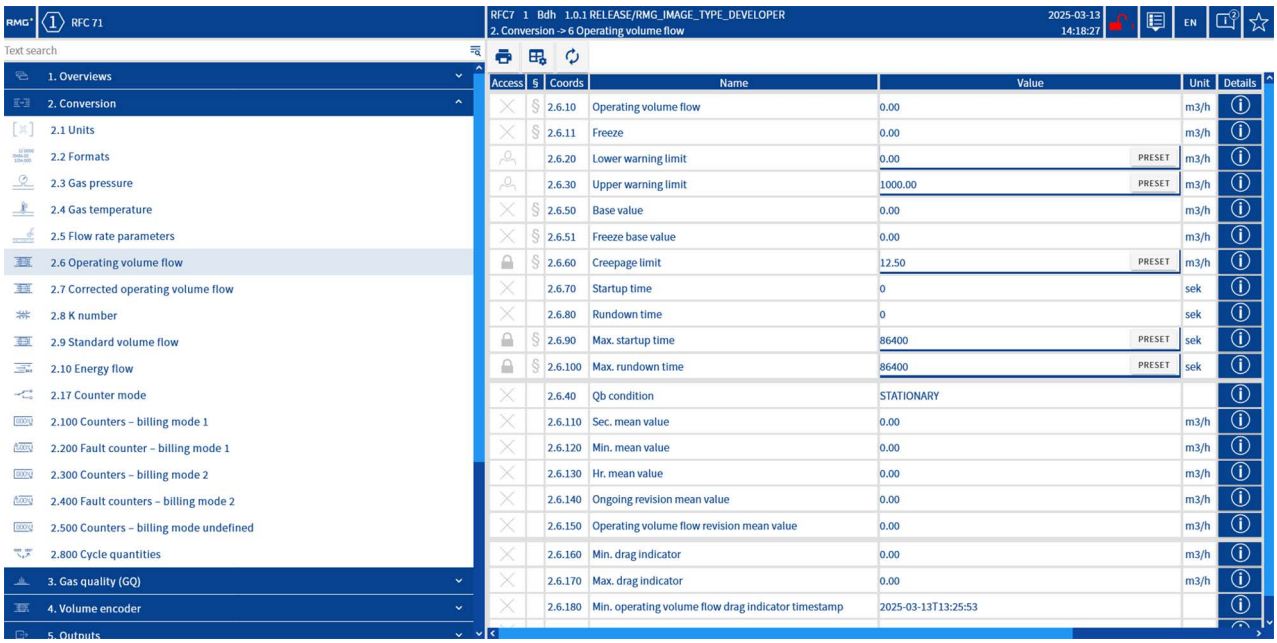


Fig. 63: Menu page 2.6 Operating volume flow

- ▶ In the coordinate **2.6.20**, specify the **lower warning limit** for the operating volume flow at which a warning message (but not an alarm) is to be issued.
- ▶ In the coordinate **2.6.30**, specify the **upper warning limit** for the operating volume flow at which a warning message (but not an alarm) is to be issued.
- ▶ In the coordinate **2.6.60**, enter the **creepage limit**. The creepage limit refers to the lowest flow volume that can be measured reliably and accurately by the connected flow meter.
- ▶ In the coordinate **2.6.90 Max. startup time**, specify the time interval during which the volume flow values can drop below the minimum limits while the overall system is started up without an alarm being triggered. Startup is considered fault-free if the operating volume flow remains within the range between the creepage limit and the lower alarm limit throughout the entered startup time. If the operating volume flow is still in the range between the creepage limit and the lower alarm limit after the startup time, an alarm message is issued.
- ▶ In the coordinate **2.6.100 Max. rundown time**, specify the time interval during which the volume flow values can drop below the minimum limits while the overall system is being closed down /run down without an alarm being triggered. Rundown is considered fault-free if the operating volume flow remains within the range between the lower alarm limit and the creepage limit throughout the entered rundown time. If the operating volume flow is still in the range between the lower alarm limit and the creepage limit after the rundown time, an alarm message is issued.

8.5.7 Operating volume flow corrected – specifying parameters

Operating volume flow corrected is calculated on the basis of the uncorrected operating volume flow and a potential characteristic curve correction.

To specify the parameters for the operating volume flow corrected, proceed as follows:

▶ Navigate to the menu page **2.7 Operating volume flow corrected**.

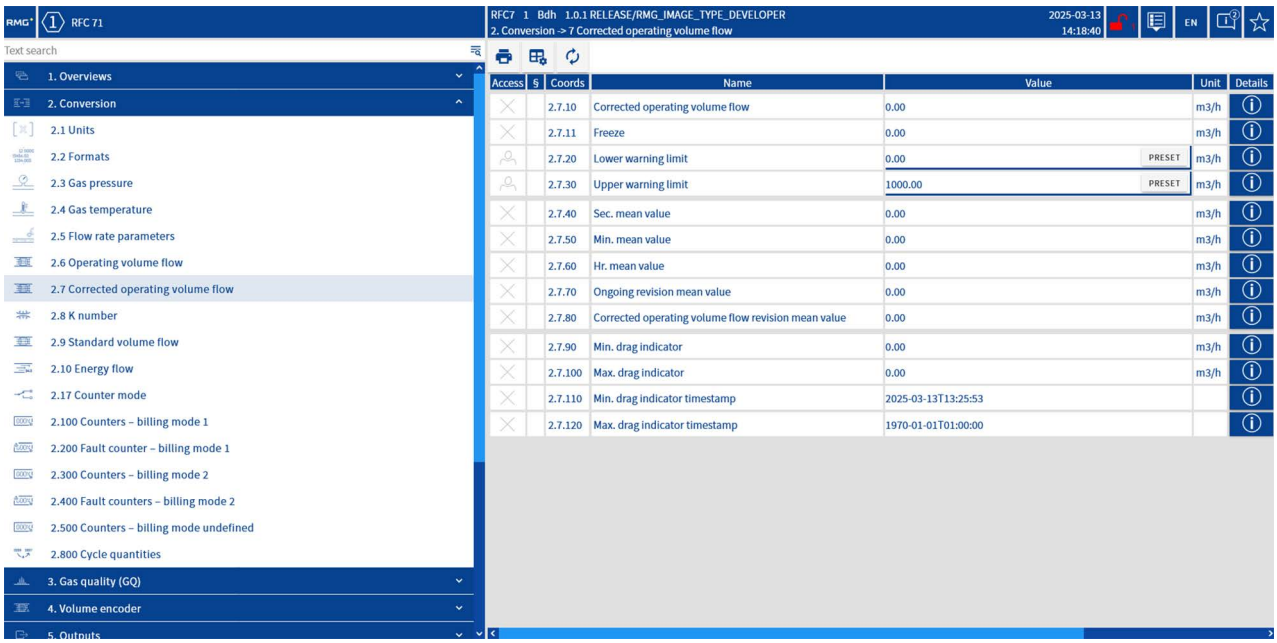


Fig. 64: Menu page 2.7 Operating volume flow corrected

▶ In the coordinate **2.7.20**, specify the **lower warning limit** for the corrected operating volume flow at which a warning message (but not an alarm) is to be issued.

▶ In the coordinate **2.7.30**, specify the **upper warning limit** for the corrected operating volume flow at which a warning message (but not an alarm) is to be issued.

8.5.8 K number calculation – specifying parameters

In some cases, the parameters for the K number calculation can only be specified when the calibration lock is open.

To specify the parameters, proceed as follows:

▶ Navigate to the menu page **2.8 K number**.

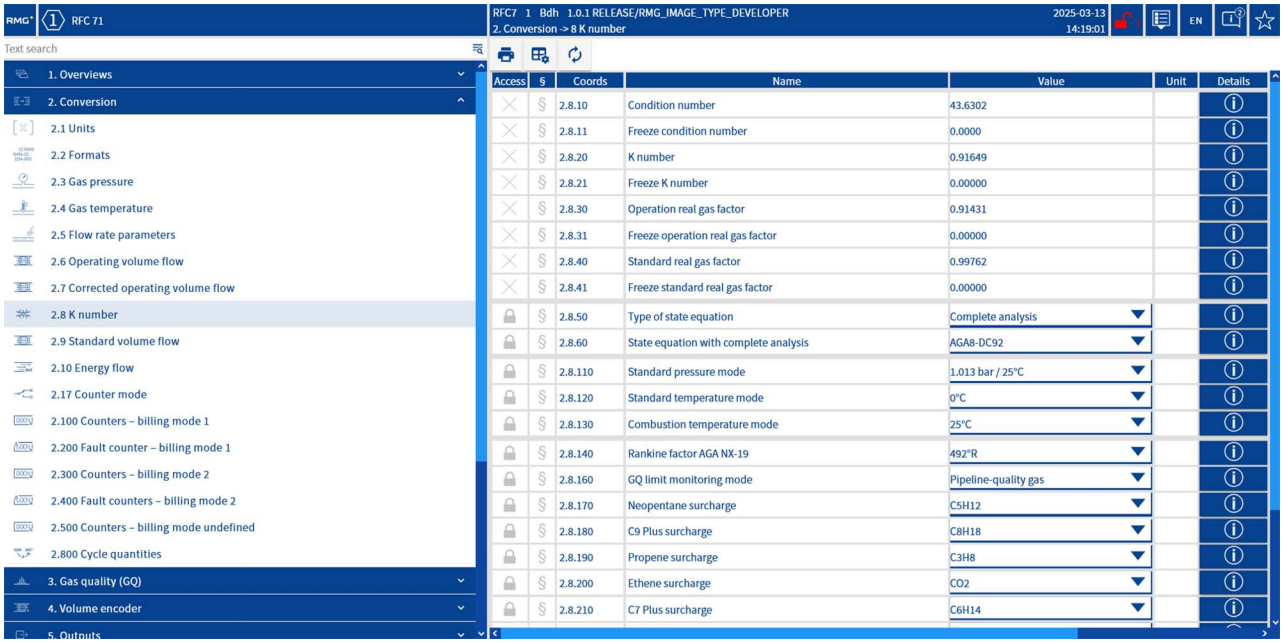


Fig. 65: Menu page 2.8 K number

▶ In the selection menu for the coordinate **2.8.50**, specify the **type of state equation** and save your selection. The following are available:

- **Complete analysis**: all components of the measurement gas are used for the calculation. The values are determined by a gas chromatograph, for example, or processed as a default value in the Flow Computer.
- **Gross values**: one selected values of the measurement gas are used for the calculation.
- **Pure substance**: the measurement gas is a pure substance, e.g. oxygen, nitrogen, argon, helium
- **Simple**: the measurement gas is an ideal gas or the same measurement gas is always used and its K number is known and constant.

Depending on the above-mentioned selection, the name and the selection menu for the coordinate **2.8.60** changes. The following tables show the various options:

2.8.60 State equation with complete analysis	
Selectable state equation	**Explanation**
AGA 8:2017	**AGA 8:2017** is a standard of the American Gas Association (AGA) that defines a state equation for calculating the thermodynamic properties of natural gases. This equation enables the accurate determination of properties such as density and compressibility coefficient for natural gas mixtures, which can be made up of up to 21 different components.
AGA 8 DC92	The method **AGA 8 DC92** is used to calculate the K number for 'normal' natural gas. It is the most recently accepted and approved gas model description (last updated 2017) and is therefore often used as a gas model.
GERG-2004	**GERG-2004** is a wide-ranging state equation that was developed by the European Gas Research Group (GERG). It is used to calculate the thermodynamic properties of natural gases and other mixtures. For precise calculations, 17 gas components are used.

Table 16: Selection options for 2.8.60 State equation with complete analysis

2.8.60 State equation with complete analysis	
Selectable state equation	**Explanation**
GERG-2008	**GERG-2008** is an extension of GERG-2004. It includes four additional gas components. It also offers greater accuracy and a broader range of application in terms of temperatures and pressures. It provides more accurate results for the thermodynamic properties of natural gases and other mixtures.

Table 16: Selection options for 2.8.60 State equation with complete analysis

2.8.60 State equation with gross values	
Selectable state equation	**Explanation**
AGA8 GM1	**AGA 8 Gross Method 1** is used in America. The equation is used when the following values of the measured gas are known: ■ Calorific value (Ho) ■ Standard density (Rn) ■ Percentage of carbon dioxide (CO_2) ■ Percentage of hydrogen (H_2)
AGA8 GM2	**AGA 8 Gross Method 2** is used in America. The equation is used when the following values of the measured gas are known: ■ Standard density (Rn) ■ Percentage of carbon dioxide (CO_2) ■ Percentage of hydrogen (H_2) ■ Percentage of nitrogen (N_2)
AGA8 GM3	**AGA 8 Gross Method 3** is used in America. The equation is used when the entire composition of the measured gas is known:
SGERG-88	**GERG 88 S** is used in Europe. The equation is used when the following values of the measured gas are known: ■ Calorific value (Ho) ■ Standard density (Rn) ■ Percentage of carbon dioxide (CO_2) ■ Percentage of hydrogen (H_2)
GERG B	**GERG 88 S Set B** is used in Europe. The equation is used when the following values of the measured gas are known: ■ Calorific value (Ho) ■ Standard density (Rn) ■ Percentage of hydrogen (H_2) ■ Percentage of nitrogen (N_2)
GERG C	**GERG 88 S Set C** is used in Europe. The equation is used when the following values of the measured gas are known: ■ Standard density (Rn) ■ Percentage of carbon dioxide (CO_2) ■ Percentage of hydrogen (H_2) ■ Percentage of nitrogen (N_2)

Table 17: Selection options for 2.8.60 State equation with gross values

2.8.60 State equation with gross values	
Selectable state equation	**Explanation**
GERG-mod-H2	**GERG-mod-H2** is a modified state equation based on SGERG-88 and specially developed for calculating thermodynamic properties of natural gases with high hydrogen content. This equation enables precise calculations of compression factors and deviation factors of gas law for mixtures of natural gas and hydrogen, which is especially important for integrating hydrogen into existing natural gas infrastructure.
AGA NX-19L	**AGA NX-19L** is a revised version of AGA 8 especially for L-gas (natural gas with low energy content).
AGA NX-19H	**AGA NX-19H** is a revised version of AGA 8 especially for H-gas (natural gas with high energy content).

Table 17: Selection options for 2.8.60 State equation with gross values

2.8.60 State equation with pure substance	
Selectable state equation	**Explanation**
Van der Waals	The **van der Waals** state equation is a mathematical equation that describes the behaviour of real gases and adds to the ideal gas equation. This equation enables better approximation of the behaviour of real gases, in particular at high pressures and low temperatures, where the ideal gas equation becomes inaccurate.
Beattie & Bridgeman	The **Beattie-Bridgeman** state equation is also a mathematical equation that describes the behaviour of real gases and adds to the ideal gas equation. It is more complex than the van der Waals equation, however, as it introduces additional empirical constants in order to achieve greater accuracy.

Table 18: Selection options for 2.8.60 State equation with pure substance

2.8.60 Simple state equations	
Selectable state equation	**Explanation**
Constant	If the same measurement gas is always used and its K number is known, **constant** can be selected. A constant default value for the K number is then used. ▶ In the coordinate **2.8.100 K number default value**, enter the value for the K number and save to confirm your entry.
Ideal gas	For an **ideal gas** (e.g. gases with low pressure), the K number for this selection must be set to '1'. ▶ In the coordinate **2.8.100 K number default value**, enter the value '1' for the K number and save to confirm your entry.

Table 19: Selection options for 2.8.60 Simple state equations

- ▶ In the selection menu for the coordinate **2.8.60**, specify the required **state equation** that should be used to calculate the K number.
- ▶ In the selection menu for the coordinate **2.8.110 Standard pressure mode**, specify what standard pressure should be used for the calculation. The following options are available:

- 1.01325 bar (applicable in Germany)
- 1 bar
- 14.73 psi
- 14.696 psi
- 14.503 psi

▶ In the selection menu for the coordinate **2.8.120**, specify the **standard temperature** that should be used for the calculation. The following options are available:

- 0 °C (applicable in Germany)
- 15 °C
- 20 °C
- 59 °F
- 60 °F

▶ In the selection menu for the coordinate **2.8.130**, specify the **combustion temperature** that should be used for the calculation. The following options are available:

- 0 °C
- 15 °C
- 20 °C
- 25 °C (applicable in Germany)
- 60 °F

▶ In the selection menu for the coordinate **2.8.140**, select the **Rankine factor** that is to be used for the **AGA NX-19** state equation. The following options are available:

- 492 °R
- 491.67 °R

▶ In the selection menu for the coordinate **2.8.160 GQ limit monitoring mode**, specify whether limit monitoring of the gas quality in accordance with the standard should be used if the state equation SGERG-88 is applied. The following limit options are available:

- **No limits**: No limit monitoring is performed, as the measured gas and its components are outside of the range in which quality can be assessed.
- **Pipeline-quality gas**: the corresponding limits are specified in the standard ISO 13686:2013 and are used for dried, purified natural gas. This setting should be selected for application involving official calibration.
- **Wider ranges of app**: the corresponding limits are specified in the standard ISO 12213-1:2006 and are used for biogases. In addition, this setting can be selected for extended temperature and pressure ranges, but with reduced accuracy.

8.5.9 Standard volume flow – specifying parameters

The standard volume form is calculated on the basis of the correct operating volume flow and a pressure and temperature correction, taking into account the real gas factor.

To specify the parameters for the standard volume flow, proceed as follows:

- ▶ Navigate to the menu page **2.9 Standard volume flow**.

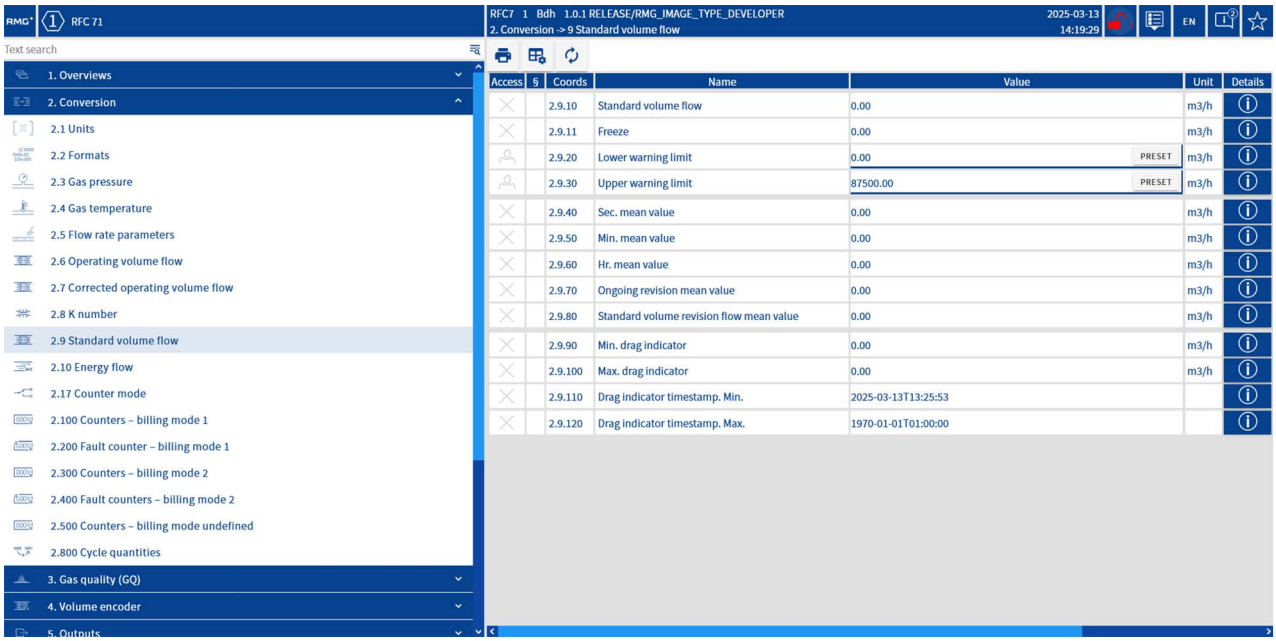


Fig. 66: Menu page 2.9 Standard volume flow

- ▶ In the coordinate **2.9.20**, specify the **lower warning limit** for the standard volume flow at which a warning message (but not an alarm) is to be issued.
- ▶ In the coordinate **2.9.30**, specify the **upper warning limit** for the standard volume flow at which a warning message (but not an alarm) is to be issued.

8.5.10 Energy flow – specifying parameters

The energy flow is calculated on the basis of the standard volume flow and the energy content of the measured gas. The energy content is determined on the basis of the gas composition and the applied state equation.

To specify the parameters for the energy flow, proceed as follows:

▶ Navigate to the menu page **2.10 Energy flow**.

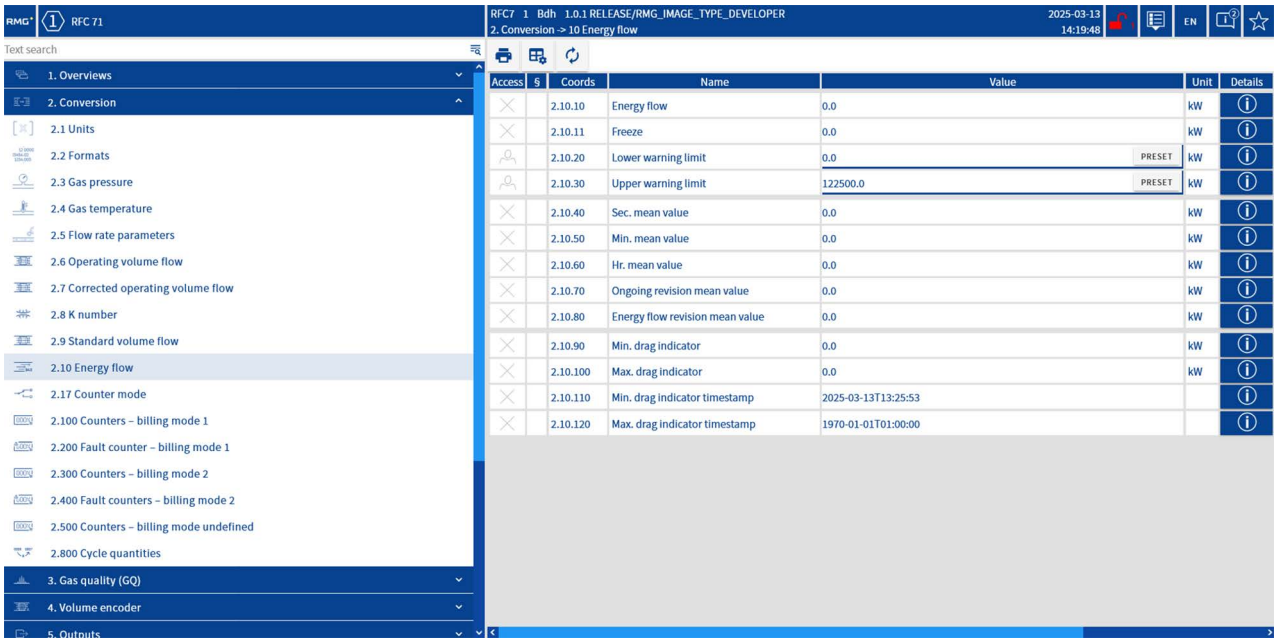


Fig. 67: Menu page 2.10 Energy flow

▶ In the coordinate **2.10.20**, specify the **lower warning limit** for the energy flow at which a warning message (but not an alarm) is to be issued.

▶ In the coordinate **2.10.30**, specify the **upper warning limit** for the energy flow at which a warning message (but not an alarm) is to be issued.

8.5.11 Counter mode – specifying parameters

The RFC 7 has in general two sets of counters, which can be used to perform different tasks, such as:

- Using one counter for forwards operation and one for reverse:
  - Charging and discharging a gas accumulator.
  - Switching between lines with different pressures can cause temporary backflow, which needs to be recorded separately.
- Determining the flow in different lines:
  - Using two lines with different cross-sections and corresponding gas meters for winter operation and summer operation.
  - Gas being fed into the downstream grid from two different sources.

To specify the parameters for the counter modes, proceed as follows:

▶ Navigate to the menu page **2.17 Counter flow**.

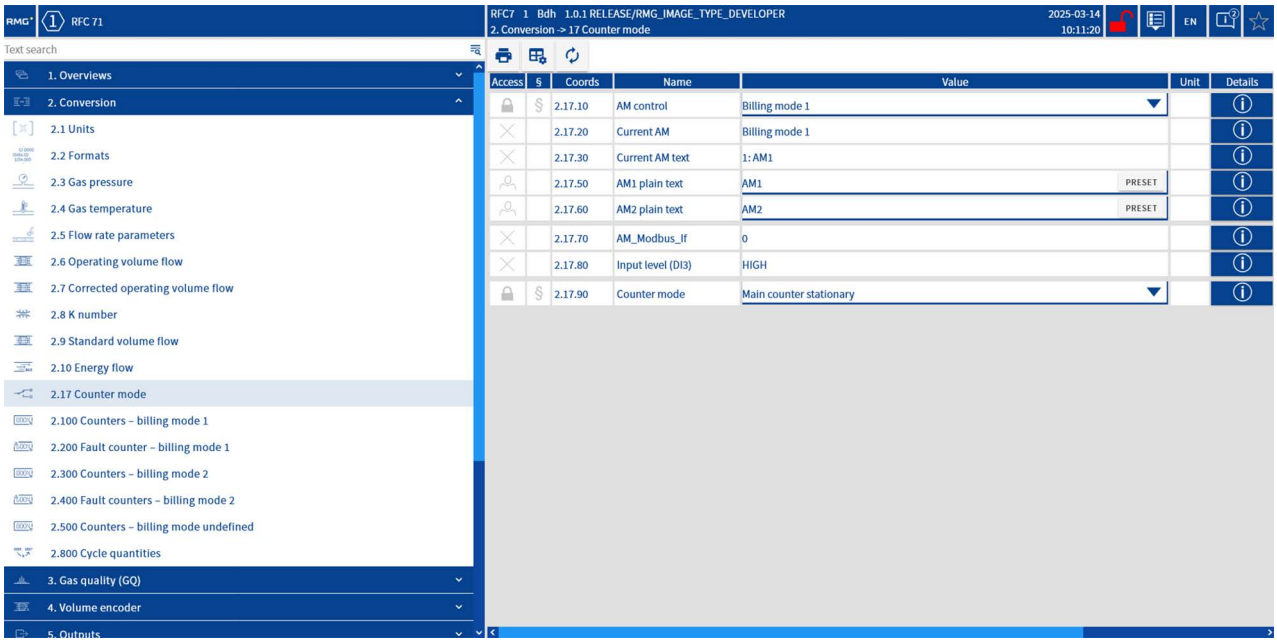


Fig. 68: Menu page 2.17 Counter mode

NOTE

The abbreviation AM

The abbreviation AM stands for ‘billing mode’.

- ▶ In the coordinate **2.17.10 AM control**, specify the control of the billing mode in accordance with your application. The following options are available:
  - Billing mode 1
  - Billing mode 2
  - Undefined billing mode
  - Modbus
  - DI3 = HIGH switches to AM1, DI3 = LOW switches to AM2
  - Instance F direction
- ▶ Name billing modes 1 and 2 in the coordinates **2.17.50 AM1 plain text** and **2.17.60 AM2 plain text** in accordance with your specific application (e.g. winter operation / summer operation).
- ▶ In the coordinate **2.17.90**, specify the **counter mode**. The following options are available:
  - Main counter mechanism stationary
  - Main counter mechanism running
  - Main counter mechanism under the MID

8.6 Gas quality (GQ) – specifying parameters

The values for the gas quality are normally determined by a connected gas analysis device and transmitted to the Flow Computer.

8.6.1 GQ setting

To configure the settings for the transmission of the gas quality values, proceed as follows:

▶ Navigate to the menu page **3.10 GQ setting**.

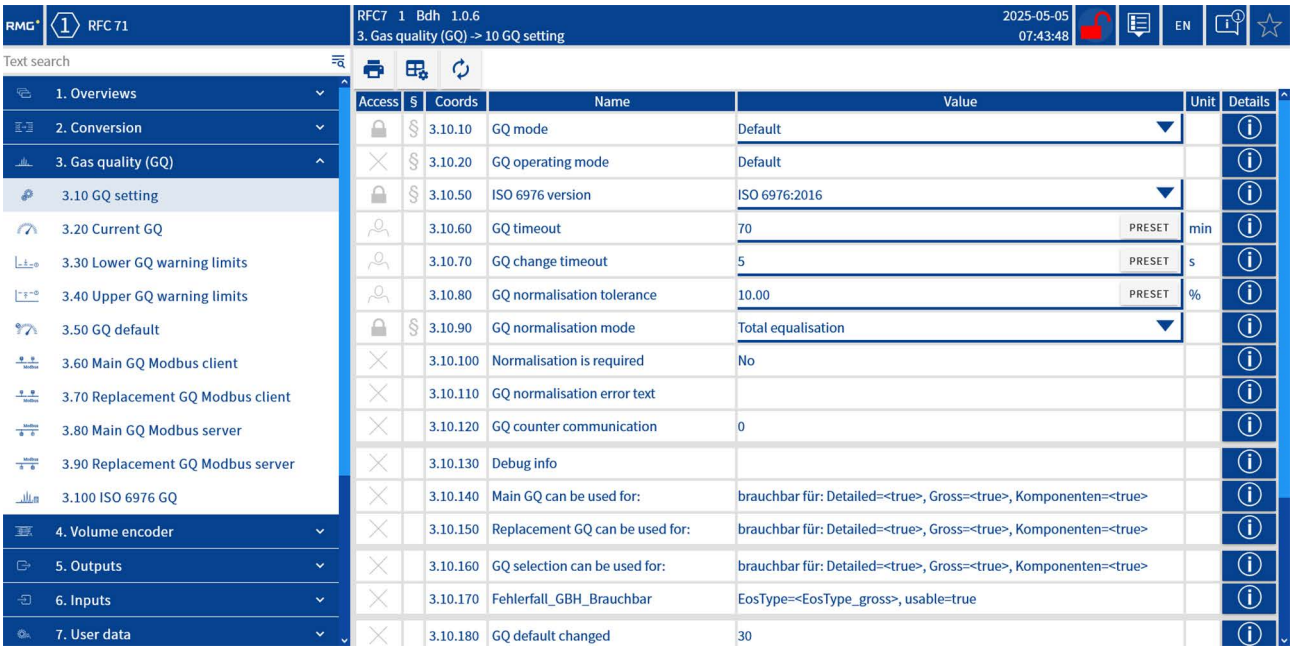


Fig. 69: Menu page 3.10 GQ setting

▶ In the selection menu for the coordinate **3.10.10**, specify the **GQ mode** for the transmission of the gas quality values. The following options are available:

- Default (set default values are used)
- DSfG setting telegram
- DSfG-A
- Modbus client
- Modbus server
- DSfG-A redundancy
- Modbus client redundancy
- Modbus server redundancy

The setting options change in accordance with the selected mode.

NOTE

New Modbus terms: client and server replacing master and slave

As recommended by the Modbus Organisation, for the RFC 7 and all other devices of the RMG platform, the terms 'Modbus master and slave' have been replaced by 'Modbus client and server', as the older terms are outdated and less inclusive. The main reasons for this change are:

- **Avoidance of discriminatory language:** Using the terms client and server promotes more respectful communication.
- **Clear description of the functionality:** Requests are initiated by the client and answered by the server, which better fits the actual workflows within the Modbus protocol.
- **Consistency with other protocols:** Many modern communication protocols are already using the terms client and server. Adjusting the Modbus terminology improves understanding and integration into existing systems.

If the transmitted data of the gas analysis device are needed for multiple gas models, for example for a gas distribution station located by a national border, the calculation in the gas analysis device may be based on different standard conditions. To adjust the values accordingly, proceed as follows:

▶ In the coordinate **3.1.50 ISO 6976 version**, specify the version of the standard this is to be used. The following are available:
  - ISO 6976:2005
  - ISO 6976:2016

  The difference between the two versions is the minimal (rounding) deviations in the calculation.

NOTE

Activating ISO 6976 use

The use of DIN EN ISO 6976:2005 or DIN EN ISO 6976:2016 may only be activated if the model for determining the gas quality uses complete gas analysis.

▶ Check that complete analysis is selected in the menu **2.8 K number** in the coordinate **2.8.50 Type of state equation**.

▶ In the coordinate **3.10.60 GQ timeout**, specify a time interval since the gas analysis device last received new gas data after which an alarm should be triggered.

▶ If, in the coordinate **3.10.10 GQ mode**, the mode **Modbus client redundancy** or **Modbus server redundancy** is selected, you will need to specify an error time in the coordinate **3.10.70 GQ change timeout** after which the operating mode automatically changes from Modbus client/server **main** to Modbus client/server **replacement**. The automatic change back to Modbus client/server **main** is only performed if an error occurs in the mode Modbus client/server **replacement**.

Once a gas quality has been determined by the gas analysis device, it is necessary for all gas models to normalise the total of all gas components to 100%. Do this as follows:

▶ In the selection menu for the coordinate **3.10.90 GQ normalisation mode**, specify the desired method. The following are available:
  - **Off:** No normalisation is performed. (Recommended for determining the K

number with the state equation type ‘gross values’ in the coordinate 2.8.50)

- **Total equalisation:** The percentages of the individual gas components are divided by the total of all non-normalised gas percentages and multiplied by 100.
- **Methane equalisation:** The percentages of the individual gas components are subtracted from 100%. The remaining amount represents the methane percentage.

▶ In the coordinate **3.10.80 GQ normalisation tolerance**, specify how high the percentage deviation of the total of all gas components can be before normalisation in relation to 100%.

The following potential errors in the gas quality determined by the gas analysis device can lead to errors in the normalisation:

- A gas component being negative.
- The total of the gas components being ≤0.
- The total of the gas components before normalisation deviating from 100% by more than the specified tolerance (coordinate 3.10.80).

The gas quality values determined **before** normalisation are written to archive group 12, and the normalised values are displayed in the menu **3.20 Current GQ**. At the same time, these normalised values are also used for the K number calculation.

8.6.2 Upper and lower GQ warning limits

To parameterise the warning limits for the individual gas components, proceed as follows:

▶ To enter the lower warning limits, navigate to the menu page **3.30 Lower GQ warning limits**.

▶ To enter the upper warning limits, navigate to the menu page **3.40 Upper GQ warning limits**.

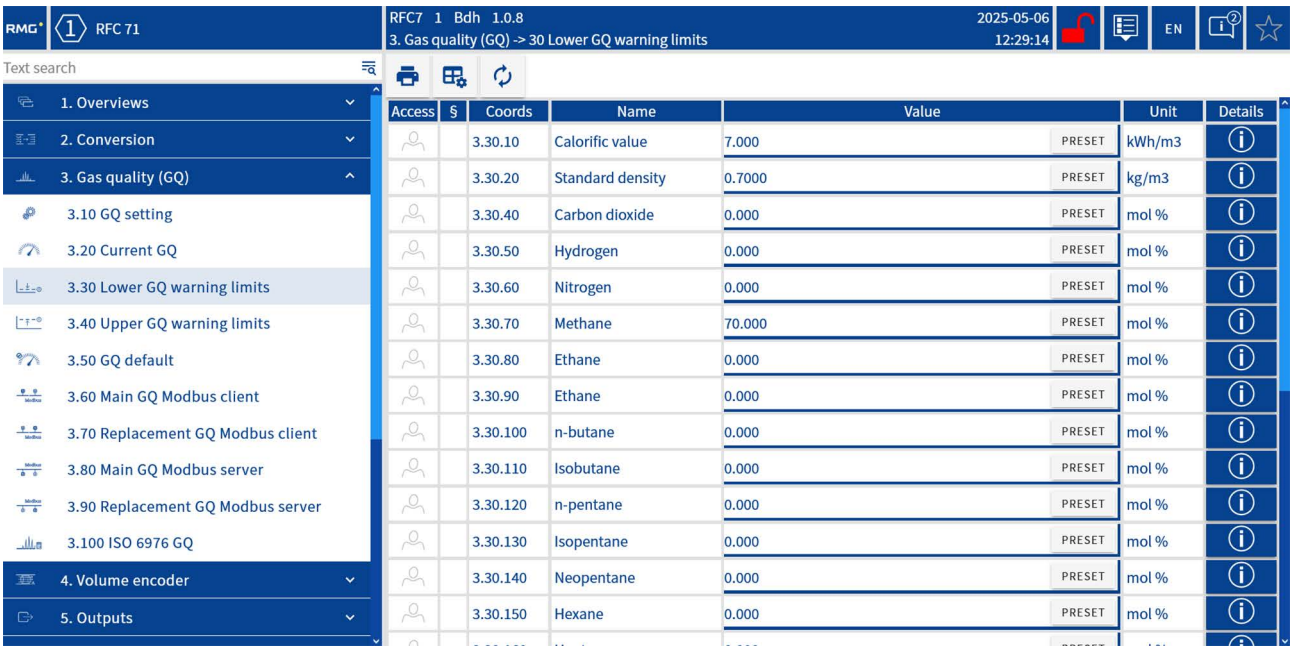


Fig. 70: Menu page 3.30 Lower GQ warning limits (example)

Entering the lower warning limits is described below, as an example. The upper warning limits can be entered in the same way on the corresponding menu page **3.40 Upper**

GQ warning limits.

- In the coordinate **3.30.10 Calorific value**, enter the value for the lower warning limit either manually with the keyboard or by using the default button.
- In the coordinate **3.30.20 Standard density**, enter the value for the lower warning limit.
- In the coordinate **3.30.40 to 3.30.270**, enter the lower warning limits for the molar fractions of the individual gas components (such as carbon dioxide, hydrogen, nitrogen, methane and ethane).

NOTE

Selecting state equation in menu 2.8 K number

The gas components listed here are dependent on the type of state equation selected in coordinate 2.8.50. All the gas components will be displayed for calculating the warning limits only if complete analysis has been selected there.

8.6.3 GQ defaults

Default values need to be entered for gas quality so that conversion can still be performed in the event of measurement transmission failure.

- **Therefore please be sure to enter the values for the gas you are measuring.**
- If you are using a bus connection for transmitting the gas values, read out the actual values and then enter them as default values.
- Please check these values on a regular basis and adjust them as necessary.

To enter the default values, proceed as follows:

- Navigate to the menu page **3.50 GQ default**.

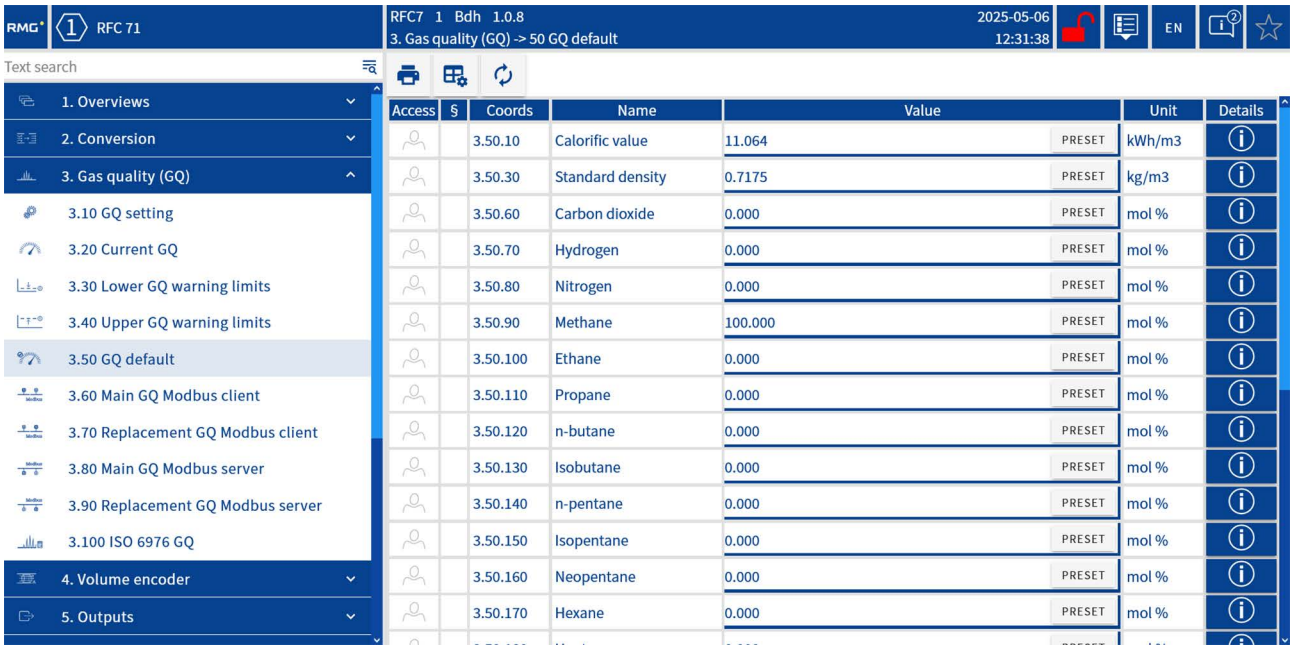


Fig. 71: Menu page 3.50 GQ default

- In the coordinate **3.50.10 Calorific value**, enter the value for the lower warning limit either manually with the keyboard or by using the default button.

- ▶ In the coordinate **3.50.30 Standard density**, enter the value for the lower warning limit.
- ▶ In the coordinates **3.50.60 to 3.50.290**, enter molar fractions of the individual gas components (such as carbon dioxide, hydrogen, nitrogen, methane and ethane).

8.6.4 Main GQ Modbus client

To configure the settings for the Modbus connection and define the Modbus addresses for the gas components, proceed as follows:

- ▶ Navigate to the menu page **3.60 Main GQ Modbus client**.

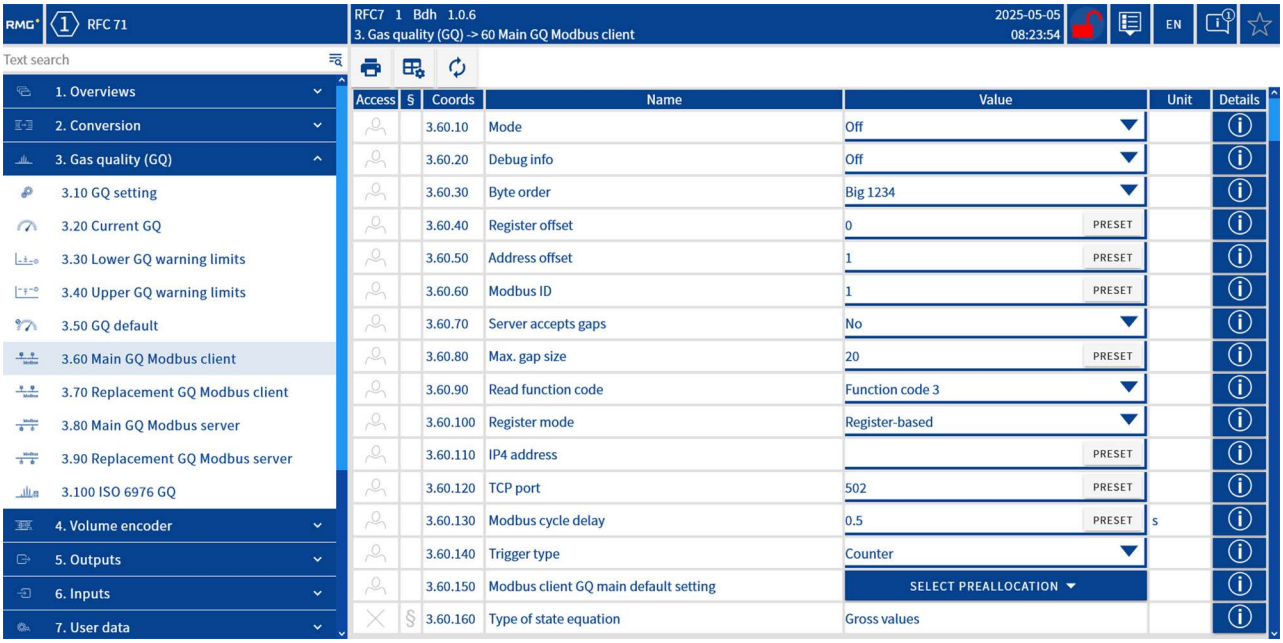


Fig. 72: Menu page 3.60 Main GQ Modbus client

- ▶ In the coordinate **3.60.10 Mode**, specify which interface should be used for the data exchange. The following are available:
  - Off
  - Ser 1
  - Ser 2
  - Ser 3
  - IP
- ▶ In the coordinate **3.60.20**, activate the **Debug info** data:
  - Off
  - On
- ▶ In the coordinate **3.60.30**, specify the **byte order**. The following are available:
  - Big 1234
  - Little 4321
  - LittleBig 2143
  - BigLittle 3412

- In the coordinate **3.60.40**, enter the **register offset**. The register offset is a relative position within the specified memory area. It determines how far away a specific register is from the starting address of this memory area. Example: For a register with an offset of 5, this means that this register is 5 positions away from the start of the memory area.
- In the coordinate **3.60.50**, enter the **address offset**. The address offset relates to the absolute address of a register within the Modbus protocol. Modbus uses different address ranges for different register types, such as hold register and input register. These addresses often begin with a specific number, which specifies the type of register. For example, a hold register could have the address 40010, with the '4' specifying the type of register (hold register) and the '0010' specifying the specific position within this type.
- In the coordinate **3.60.60**, enter the **Modbus ID**.
- In the coordinate **3.60.70 Server accepts gaps**, specify whether the server is able to process queries that are incomplete or contain gaps:
  - No
  - Yes
- In the coordinate **3.60.80**, enter the **maximum** size of these **gaps**.
- Define the query in the coordinate **3.60.90 Read function code**. The following options are available:
  - Function code 3
  - Function code 4
- In the coordinate **3.60.100**, specify the **register mode**. The following options are available:
  - Register-based
- Values-based
- If you selected IP mode in the coordinate 3.60.10, enter in the coordinate **3.60.110** the **IP4 address**.
- In the coordinate **3.60.120**, enter the corresponding **TCP port**.
- Specify the **Modbus cycle delay** in the coordinate **3.60.130**. The Modbus cycle delay is the time interval between the communication cycles in a Modbus network. It is influences by a number of factors, including the processing speed of the devices, network latency and the configuration of the Modbus client.
- Select the **trigger type** in the coordinate **3.60.140** for triggering the retrieval of gas quality measurement data. The following are available:
  - Off
  - Counter (the trigger type 'counter' uses a counter that is increased after every communication cycle. When the counter reaches a predefined value, data retrieval is triggered.)
  - Flag timer (the trigger type 'flag timer' uses a timer. A timer is started and runs for a predefined time. When the time is up, a flag is set that triggers data retrieval. A flag timer could be used to trigger data retrieval every 10 minutes, for example.)
  - Set flag (the trigger type 'set flag' uses a flag to trigger data retrieval. A flag is a Boolean indicator (true/false) that is set as the result of specific conditions or events. As soon as the flag is set, data retrieval is triggered.)

As RMG's gas analysis devices PGC and RGC 7 can serve up to four different measurement points (streams) in one measurement cycle, it must be possible to further process up to four different gas compositions.

Accordingly, in the selection menu of the coordinate 3.60.150 Modbus client GQ main default setting, various default settings can be selected (cf. fig. 73) to enable the corresponding default Modbus register to be entered for each gas component.

Do this as follows:

- ▶ Open the selection menu for the coordinate **3.60.150 Modbus client GQ main default setting**.

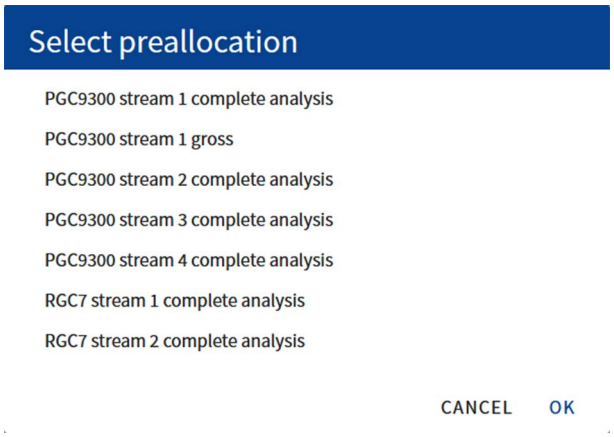


Fig. 73: Selection menu for coordinate 3.60.150

- ▶ Select the required stream and click the **OK** button to confirm your selection.
  - ➡ The Modbus registers are entered for each gas component – cf. fig. 74. All fields with changed values are marked with a light blue background.

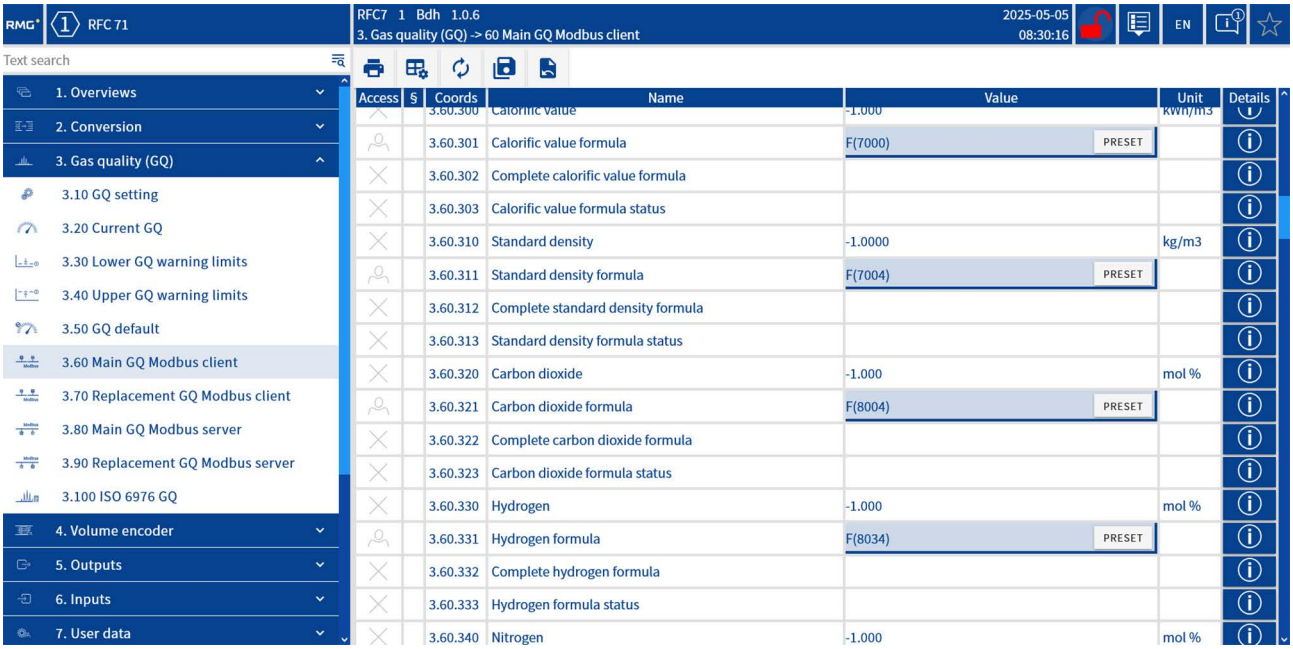


Fig. 74: Menu page 3.60 Main GQ Modbus client – entered Modbus registers

NOTE

Checking the Modbus addresses

Entering incorrect Modbus addresses can result in nonsensical calculation values.

- Carefully check the addresses for the individual gas components of your gas analysis device to ensure that they match the Modbus addresses entered in the flow computer.
- Once the Modbus-specific settings have been configured, please do not make any further changes to them, as this could prevent the gas values from being received from the gas analysis device correctly.

Regardless of the default settings lists, more extensive settings can be configured and mathematical calculated can be programmed in the input fields for the individual gas components if their coordinate name contains the word 'formula'. The options for programming are listed below.

Data types that can be used:

Input	Description	Example
U16(1000)	16 bit integer without polarity	61440
I16(1000)	16 bit integer with polarity	-4096
U32(3000)	32 bit integer without polarity	4026531840
I32(3000)	32 bit integer with polarity	-268435456
U64(9000)	64 bit integer without polarity	17293822569102705000
I64(9000)	64 bit integer with polarity	-1152921504606846976
F(7000)	32 bit float	1234.567
D(9004)	64 bit double	1234567890.123456

Table 20: Data types that can be used

The number in brackets (e.g. U16**(1000)**) represents the corresponding register number.

Mathematical and logical operations

Symbol	Description	Example calculation	Input
0	Set line to 0		
1	Set line to 1		
+	Addition	3+2 = 5.0	U16(3000)+U16(3002)
-	Subtraction	3-2 = 1.0	U32(5000)-U16(3002)
*	Multiplication	3*2 = 6.0	U16(3000)*I32(5002)
/	Division	3/2 = 1.5	U16(3000)/I32(5002)
<	Less than	3<2 = 0 | 2<3 = 1	U16(3000)<I32(5002)
>	Greater than	3>2 = 1 | 2>3 = 0	U16(3000)>I32(5002)
==	Equal to	3==2 = 0 | 3==3 = 1	U16(3000)==I32(5002)
<=	Less than or equal to	3<=2 = 0 | 2<=2 = 1	U16(3000)<=I32(5002)
>=	Greater than or equal to	3>=2 = 1 | 2>=3 = 0	U16(3000)>=I32(5002)

Table 21: Mathematical and logical operations

Symbol	Description	Example calculation	Input
or	OR operation	U16(1031) == 1 or U16(1031) == 2	
and	AND operation	U16(1031) >= 1 and U16(1031) < 3	
Division by 0			
A+B/0		sets an error in the status bar: err=<24/ERR_INVALID_ARGUMENT>	
F(5000)*F(5002)/F(5004)		sets an error in the status bar if register 5004 delivers '0'	

Table 21: Mathematical and logical operations

The number format of the result of a mathematical or logical operation is always dependent on the data type (pageltem type) of the specific field. While an 'integer' is a whole number with zero decimal places, a 'floating point' always has decimal places.

IF statements

An example of an IF statement is: Register 7000 must always be positive.

Input	Possible results
if F(7010) >= 0 then x = F(7010) else x = 0 end	■ F(7010) = 33.12345 ➞ 33.12345 ■ F(7010) = -33.1234 ➞ 0

Table 22: IF statement

Changing the Modbus byte order

The Modbus byte order is written as follows:

data type(register address, 8-digit byte order)

Example:Register U32(5000,12345678) = 89ABCDEF hex

Register U64(9000,12345678) = 1234567890ABCDEF hex

In order to change the byte order, the new byte order must always be specified with eight digits, even if the data type does not have this many bytes. Non-existing digits are ignored:

Format	Modbus byte order
U32(5000, **1234**5678)	➞ 89ABCDEF hex
U32(5000, 5678**1234**)	➞ 89ABCDEF hex
U32(5000, 8765**4321**)	➞ EFCDAB89 hex
U32(5000, **4321**8765)	➞ EFCDAB89 hex
U32(5000, **2134**8765)	➞ AB89CDEF hex
U32(5000, **3421**8765)	➞ CDEFAB89 hex
U32(5000, **4132**8765)	➞ EF89CDAB hex
U32(5000, 1234)	➞ Error: New byte order must have 8 digits
U64(9000, **12346578**)	➞ 1234567890ABCDEF hex
U64(9000, **87654321**)	➞ EFCDAB9078563412 hex

Table 23: Format for changing the Modbus byte order

8.6.5 Replacement GQ Modbus client

The menu page **3.70 Replacement GQ Modbus client** can be used to configure all settings described in the above section 8.6.4 "Main GQ Modbus client". It is used for redundancy, to ensure secure Modbus transmission of the data.

No settings can be configured on the menu pages 3.70 Main GQ Modbus server, 3.80 GBH Replacement GQ Modbus server or ISO 6976 GQ. They are used only to provide information.

8.7 Volume encoder – specifying parameters

Some parameters can only be specified when the calibration lock is open. Note the **calibration lock icon** in the **access** column on the specific menu page.

8.7.1 Counter factor

A counter factor is generally used for mechanical gas meters, such as turbine gas meters. It describes the parallel shift of the flow curve in accordance with the pulse number on the basis of adjustment wheels installed in the meter head. The value of the meter factor (Kv factor) is specified on the nameplate of each gas meter.

To signal to the flow computer that a counter factor is to be used for correction, in the selection menu of the coordinate **2.5.100 Kv factor mode (chapter 4)**, the setting '**constant**' must be selected (cf. section 8.5.5 "Flow rate – specifying parameters").

To enter the counter factor (Kv factor) for your gas meter, proceed as follows:

- ▶ Navigate to the menu page **4.12 Counter factor**.

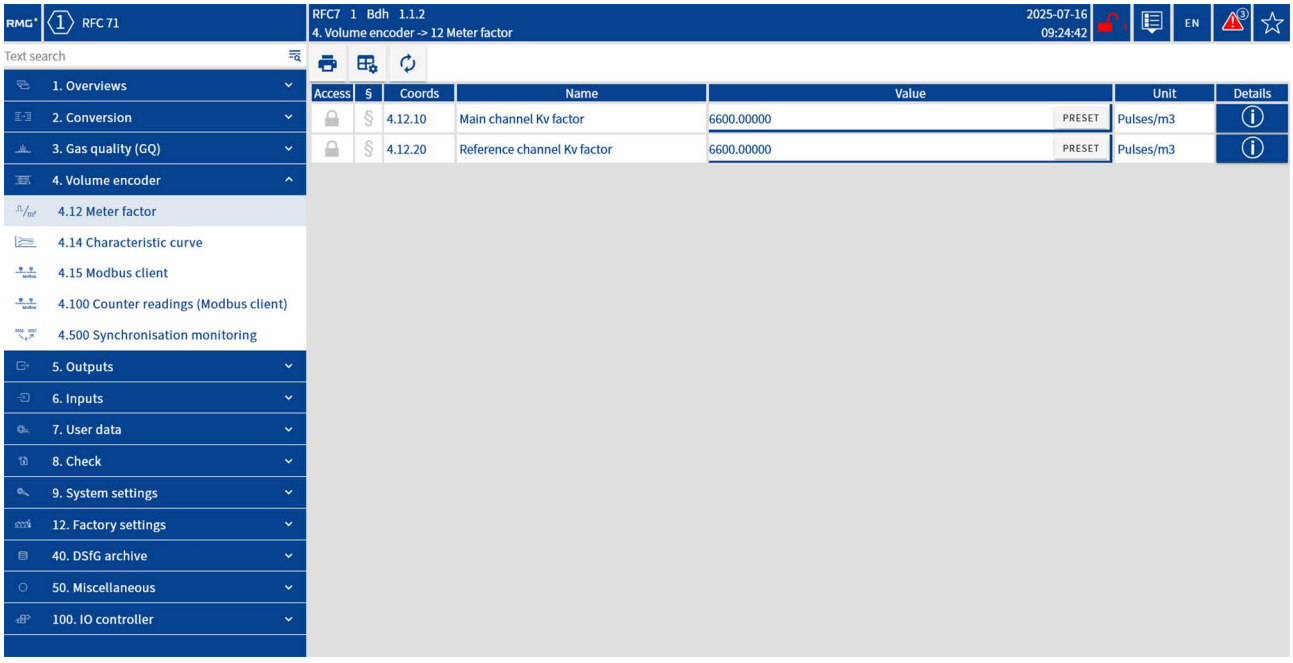


Fig. 75: Menu page 4.12 Counter factor

NOTE

Entering main channel and reference channel Kv factor

Whether it is necessary to enter two different Kv factors for main channel and reference channel depends on your selection in the coordinate **2.5.80 Volume encoder mode** on the menu page 2.5 Flow rate parameters.

- ▶ Check the setting for the coordinate **2.5.80**.
- ▶ If the mode **2-channel** is selected, Kv factors must be entered for the main channel **and** the reference channel.
- ▶ For the selection **Modbus client/F instance**, no Kv factors need to be entered.

- ▶ Enter the required Kv factors in the coordinates **4.12.10** and as required. **4.12.20**.

8.7.2 Characteristic curve

The characteristic curves for flow meters such as ultrasonic gas meters are generally not linear, and instead have a typical shape. To correct the characteristic flow curve, proceed as follows:

- ▶ Navigate to the menu page **4.14 Characteristic curve**.

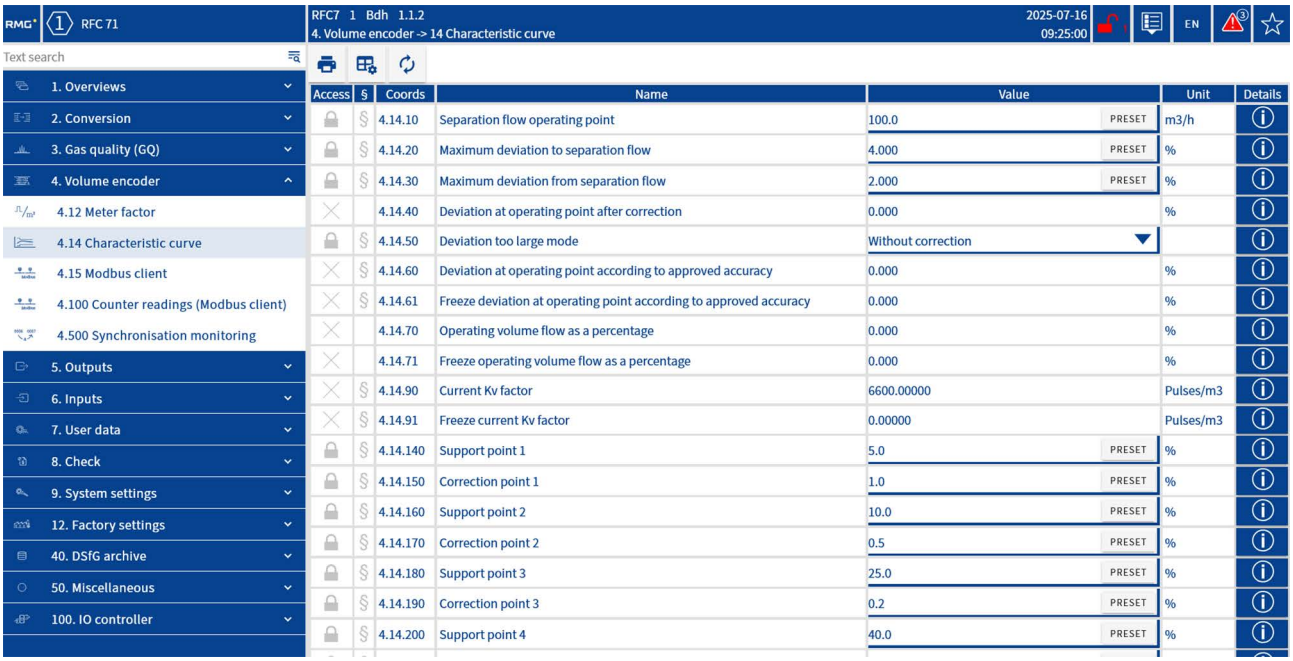


Fig. 76: Menu page 4.14 Characteristic curve

- ▶ In the coordinate **4.14.10 Separation flow operating point**, enter the value for Q_t from the calibration curve (Eichhammer) that was determined during calibration.
- ▶ In coordinate **4.14.20 Maximum deviation to separation flow**, enter the maximum permitted percentage deviation of the flow until the separation flow operating point is reached.
- ▶ In coordinate **4.14.30 Maximum deviation from separation flow**, enter the maximum permitted percentage deviation of the flow after the separation flow operating point has been reached.

NOTE

No characteristic curve correction for measurement devices with integrated electronics

Some measurement devices with integrated electronics perform a correction of the characteristic curve internally, so the transmitted values should not be corrected again.

▶ In the selection menu for coordinate **4.14.50 Deviation too large mode**, select the setting '**No correction**'.

For all other measurement methods, there are two correction variants:

- Support point correction
- Polynomial correction

The correction that is to be performed should be selected in the selection menu of the coordinate **2.5.100 Kv factor mode (chapter 4)** – cf. section 8.5.5 "Flow rate – specifying parameters".

1. Support point correction

The flow measurement range is divided up into as many as 15 subsections. The support points that demarcate these subsections can be distributed across the entire measurement range at user-defined positions by entering percentage values relating to the value of the end of the measurement range. This makes it possible to set more support points in the lower measurement range and fewer in the upper range, for example.

To set fewer support points, enter the value '-1' in the corresponding coordinates of the support points. Support points marked with this value will be ignored.

As an alternative to entering the support points manually, you can also work with default values, which can be entered by clicking the corresponding **Default** button.

The default works with six support points, which take into account the following different deviations:

	Support point 1	Support point 2	Support point 3	Support point 4	Support point 5	Support point 6
Support point position [%]	5	10	25	40	70	100
Deviation, correction point [%]	1.0	0.5	0.2	0.0	0.1	0.0

Table 24: Default values for support point correction

The figure below shows the curve:

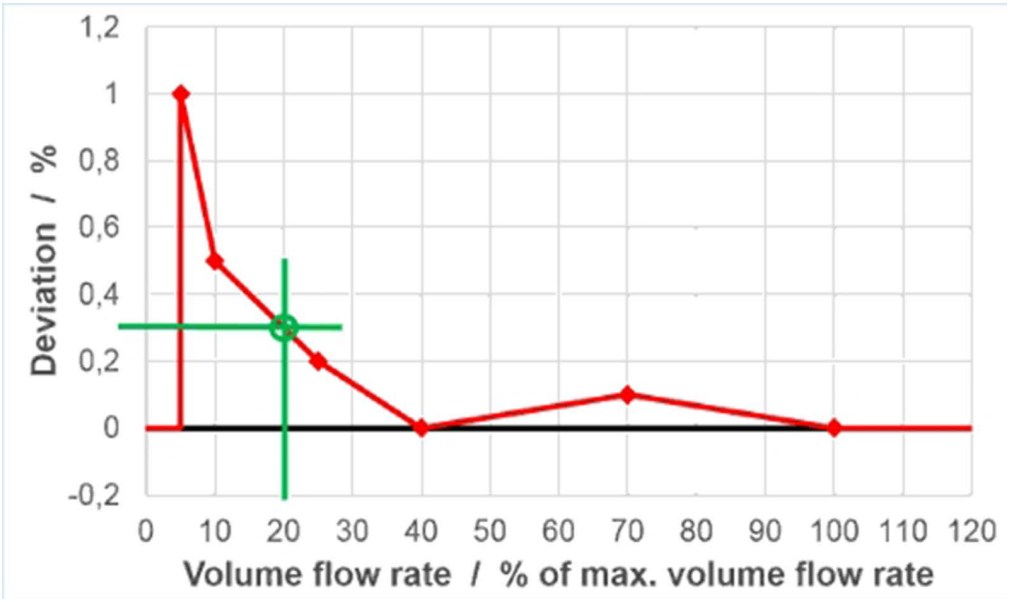


Fig. 77: Curve of the support point correction

The following calculation formula is used for the correction:

$$Displayed\,value = \frac{Measured\,value}{(1 + Deviation)}$$

Example calculation for a flow of 20% of the measurement range end value (marked in green in fig. 77):

$$Displayed\,value = \frac{Measured\,value}{(1 + 0,003)} = Measured\,value \times 0,997$$

Outside of the range of the correction values, i.e. below 5% and above 100%, no corrections are performed, i.e. the correction value is set to '0'.

A correction with a different number of support points is calculated in the same way as described above.

2. Polynomial correction

For a polynomial correction, the corresponding percentage deviations for fixed percentage flow values are determined by the manufacturer of the measurement device. These values are used to calculate a polynomial function that reflects these curve of these points as perfectly as possible. The value of the function is used as a reciprocal correction value, similar to support point correction. The coefficients of the polynomial are provided by the manufacturer.

- ▶ Enter the manufacturer's coefficients in the coordinates **4.14.460 to 4.14.500**.

Regardless of the type of correction (support point or polynomial), the maximum deviation set in the coordinate 4.14.30 applies. If the deviation for one operating point is greater than the set value, the correction is set to '0' for this operating point or operating range, i.e. no correction is performed.

NOTE

Behaviour of the polynomial correction at very low flow values

At very low flow values (X→0), the polynomial correction can display very large overshoots. These overshoots can easily be corrected, however, with creepage suppression.

▶ Specify a creepage limit in coordinate 2.6.60.

8.7.3 Modbus client

With the Modbus client protocol, measurement data are transmitted from an ultrasonic gas meter to the flow computer.

To configure the settings for the Modbus connection and define the Modbus addresses for the ultrasonic gas meter, proceed as follows:

▶ Navigate to the menu page **4.15 Modbus client**.

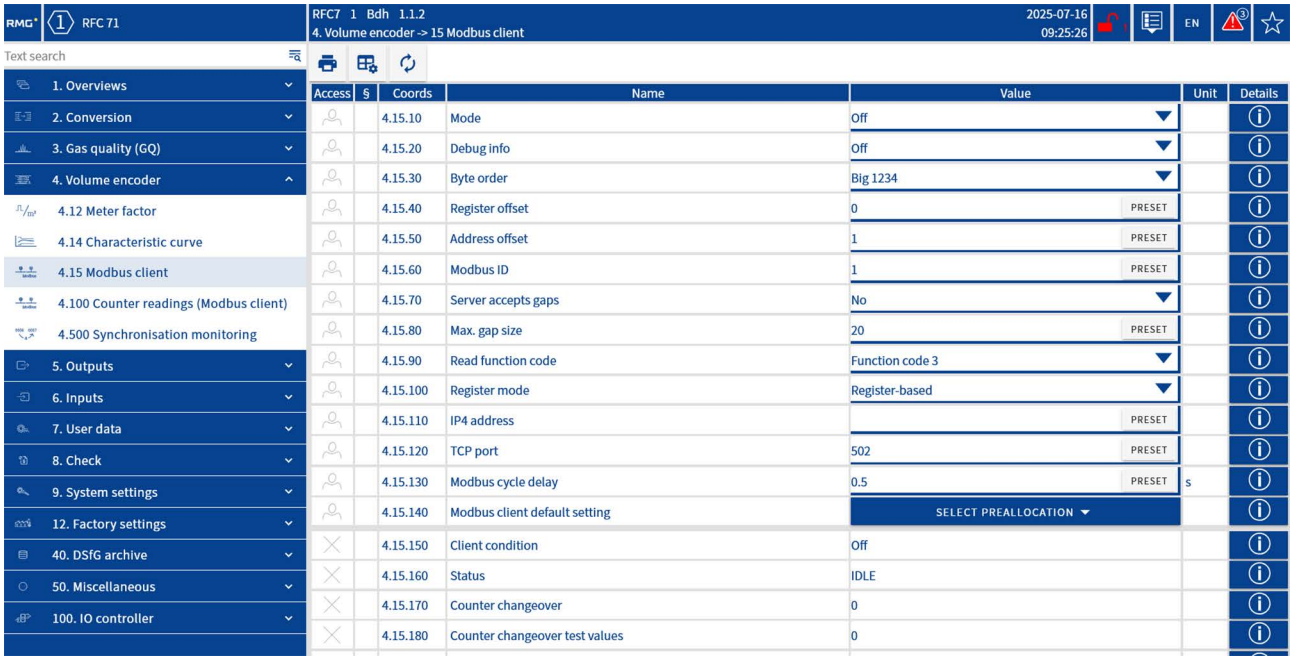


Fig. 78: Menu page 4.15 Modbus client

On the menu page **4.15 Modbus client**, you need to enter or select the individual parameters as described in section 8.6.4 "Main GQ Modbus client". The entry/selection will therefore not be described in detail at this point.

▶ Perform the required settings/selections in the coordinates **4.15.10 to 4.15.130**.

As various types of ultrasonic gas meters can be connected to the flow computer, the communication between the devices must also be parameterised in a tailored way.

Accordingly, in the selection menu of the coordinate **4.15.140 Modbus client default setting**, various default settings can be selected (cf. fig. 79) to enable the corresponding default Modbus register to be entered for each measurement component.

Do this as follows:

▶ Open the selection menu for the coordinate **4.15.140 Modbus client default setting**.

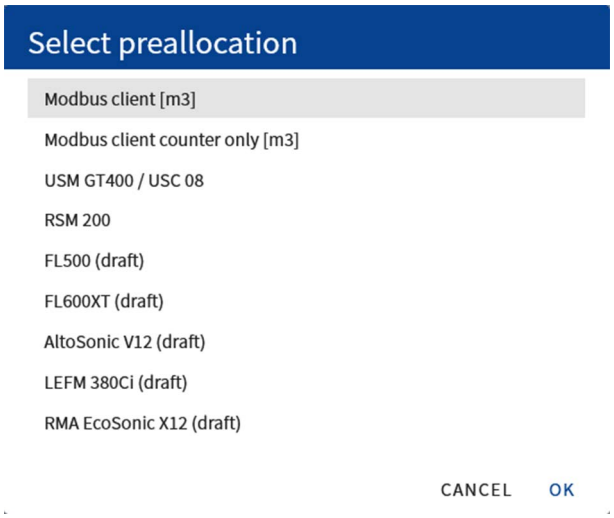


Fig. 79: Selection menu for coordinate 4.15.140

- ▶ Select the required communication channel and click the **OK** button to confirm your selection.
  - ➥ The Modbus registers are entered for each measurement component – cf. fig. 80. All fields with changed values are marked with a light blue background.

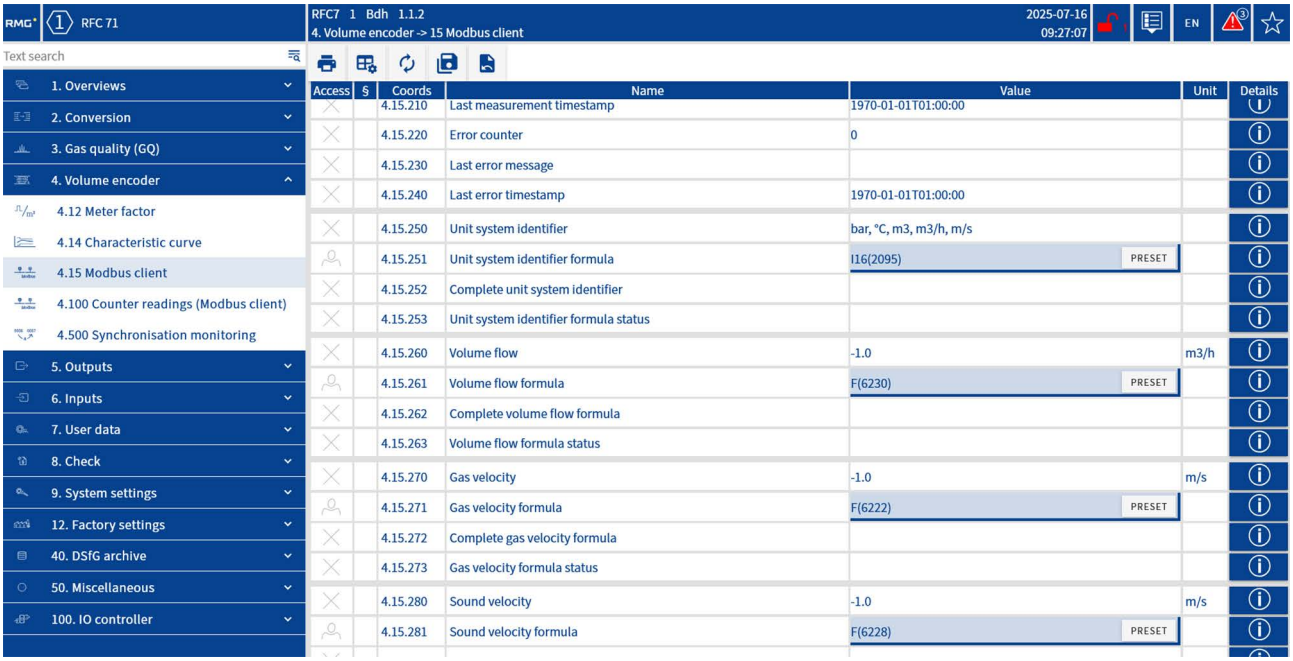


Fig. 80: Menu page 4.15 Modbus client – entered Modbus registers

The default setting **Modbus client** is used to allocate all ultrasonic gas meters to uniform Modbus addresses. If the manufacturer of an ultrasonic gas meter provides transmission of measurement values via Modbus client, this will ensure transmission of the key parameters.

NOTE

Checking the Modbus addresses

As ultrasonic gas meters from various manufacturers have different structures and measurement path configurations, some values may be identical but other calculation variables may be very different. Entering incorrect Modbus addresses can result in nonsensical calculation values.

- ▶ Please refer to the corresponding operating instructions for the ultrasonic gas meter of the specific manufacturer as needed.
- ▶ Carefully check the addresses for the individual measurement components of your volume encoder to ensure that they match the Modbus addresses in the flow computer. Where possible, use the original protocol of the Modbus addresses of the ultrasonic gas meter you are using.
- ▶ Once the Modbus-specific settings have been configured, please do not make any further changes to them, as this could prevent the values from being received from the ultrasonic gas meter correctly.

Regardless of the default settings lists, more extensive settings can be configured and mathematical calculated can be programmed in the input fields for the individual measurement components if their coordinate name contains the word ‘formula’.

The options for programming are described in detail in the section 8.6.4 "Main GQ Modbus client".

8.7.4 Counter readings (Modbus client)

To view the counter readings that are transmitted via the Modbus client protocol, proceed as follows:

- ▶ Navigate to the menu page **4.100 Counter readings (Modbus client)**.

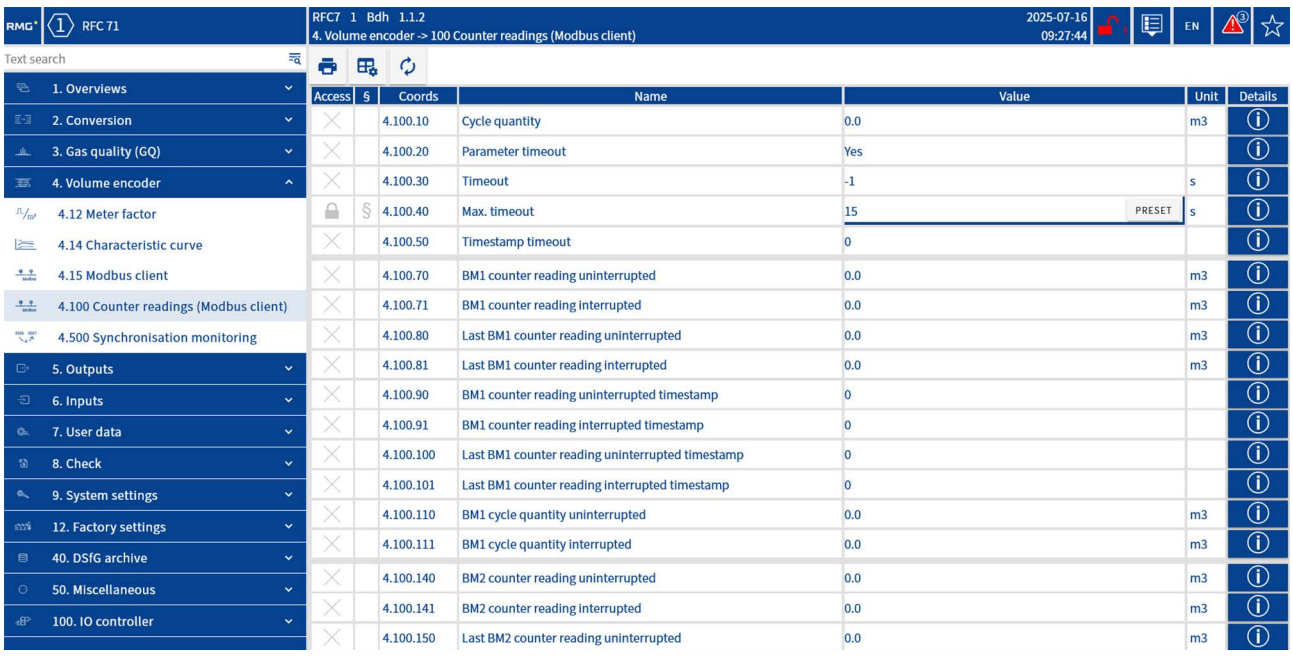


Fig. 81: Menu page 4.100 F Counter readings (Modbus client)

- ▶ In the coordinate **4.100.40 Max. timeout**, specify the corresponding value.

8.7.5 Synchronisation monitoring

The purpose of synchronisation monitoring is to check the frequency/flow of a multi-channel turbine gas meter. The gas meter may have different counter factors (cf. section 8.7.1 "Counter factor") or different flow data transmissions (cf. section 8.5.5 "Flow rate – specifying parameters").

For devices that exclusively transmit pulses, synchronisation monitoring is used for comparison purposes. The second pulse input can be used where necessary as redundancy in the event of first pulse input failure.

For data transmission by means of an encoder, the first value of the encoder is used as the calculation value. The operating volume (Vb) and the original counter (Vo, direct value of the encoder) are generally the same, although differences may occur if creepage suppression is activated.

To parameterise the synchronisation monitoring, proceed as follows:

▶ Navigate to the menu page **4.500 Synchronisation monitoring**.

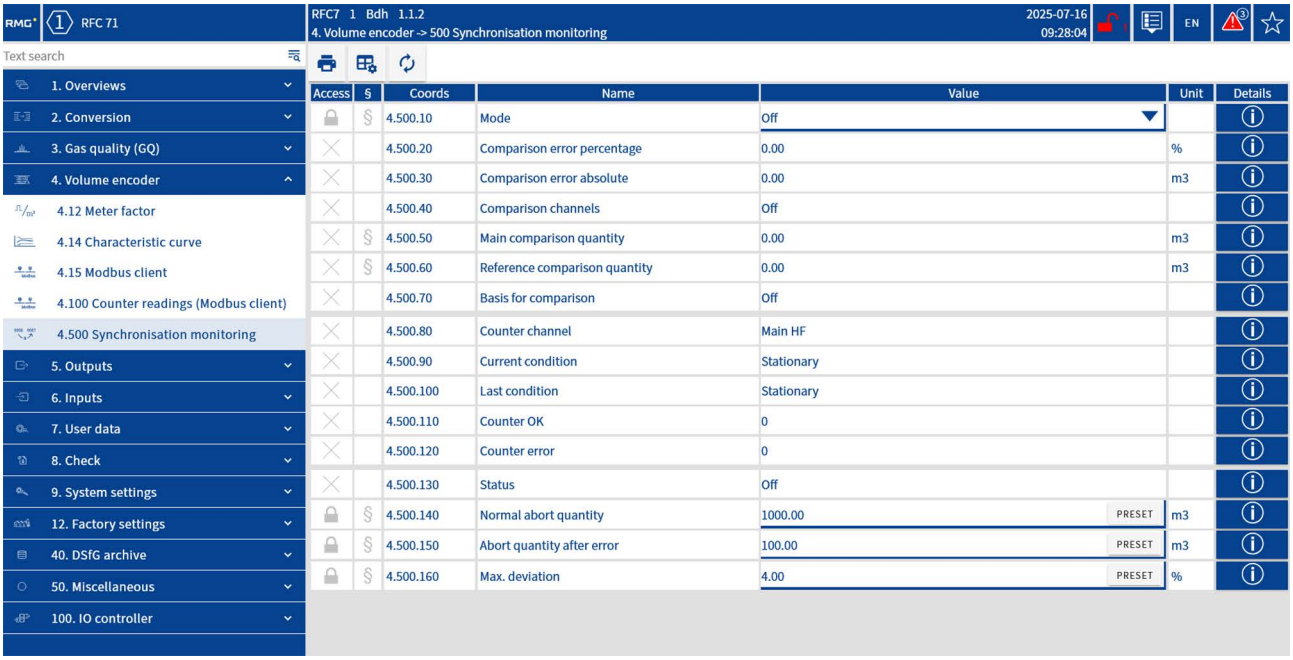


Fig. 82: Menu page 4.500 Synchronisation monitoring

▶ Activate synchronisation monitoring by selecting **On** in the coordinate **4.500.10 Mode**.

▶ In the coordinate **4.500.140**, specify **Normal abort quantity**. The associated unit corresponds to the selection made in coordinate 2.1.110 Operating volume.

▶ In the coordinate **4.500.150**, specify the **Abort quantity after error**. The associated unit corresponds to the selection made in coordinate 2.1.110 Operating volume.

▶ In the coordinate **4.500.160**, specify the percentage for **Max. deviation**.

8.8 Inputs – specifying parameters

In order to use the inputs on the device's back panel, the IOC system must be active. To enable this, please configure the following settings:

▶ Navigate to the menu page **9.60 IOC**.

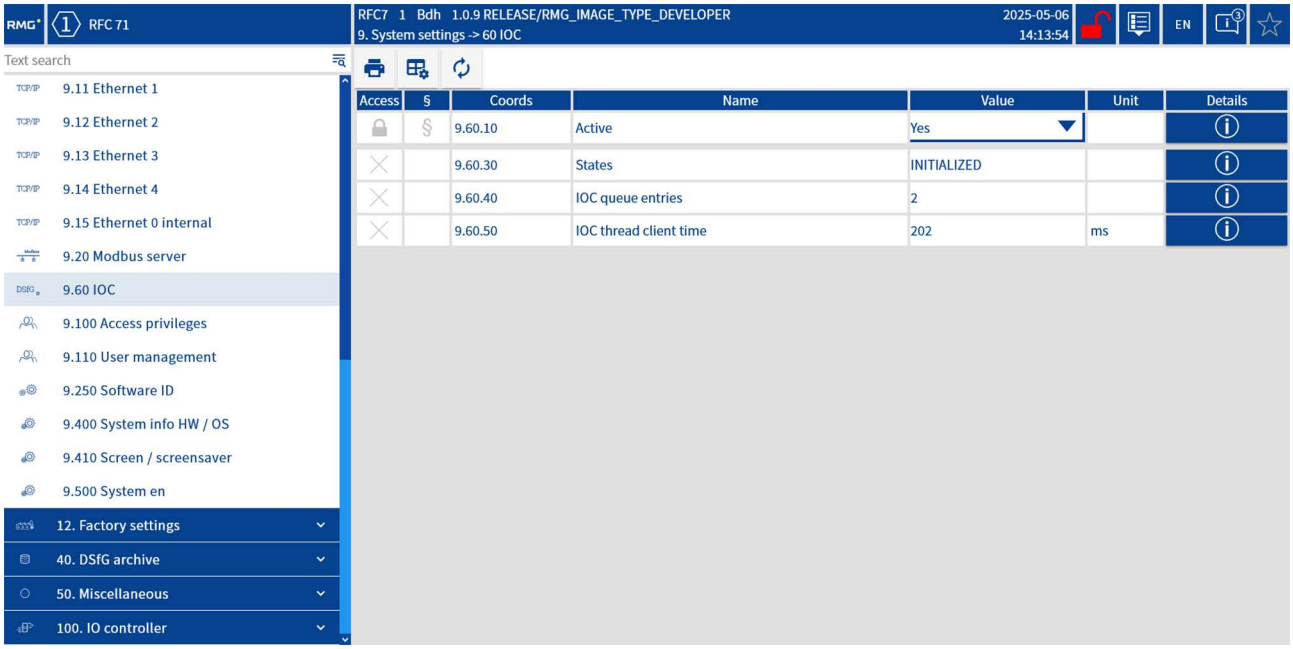


Fig. 83: Menu page 9.60 IOC

▶ In the selection menu for coordinate **9.60.10 Active**, select the setting **Yes**.

8.8.1 Digital inputs 1 and 2 – specifying parameters

The parameters for digital inputs DI1 and DI2 can only be changed if the calibration switch is open.

The digital inputs are located on the following terminal strips (cf. section 6.2.2 "Terminal assignments of the terminal strips"):

- Digital input DI1 on **terminal strip X6, terminal no. 1 and 2**
- Digital input DI2 on **terminal strip X6, terminal no. 3 and 4**

To set the parameters, proceed as follows:

▶ Navigate to the corresponding menu page for the digital input you want to configure, in this case **6.10 Digital input 1 (DI1)** (example).

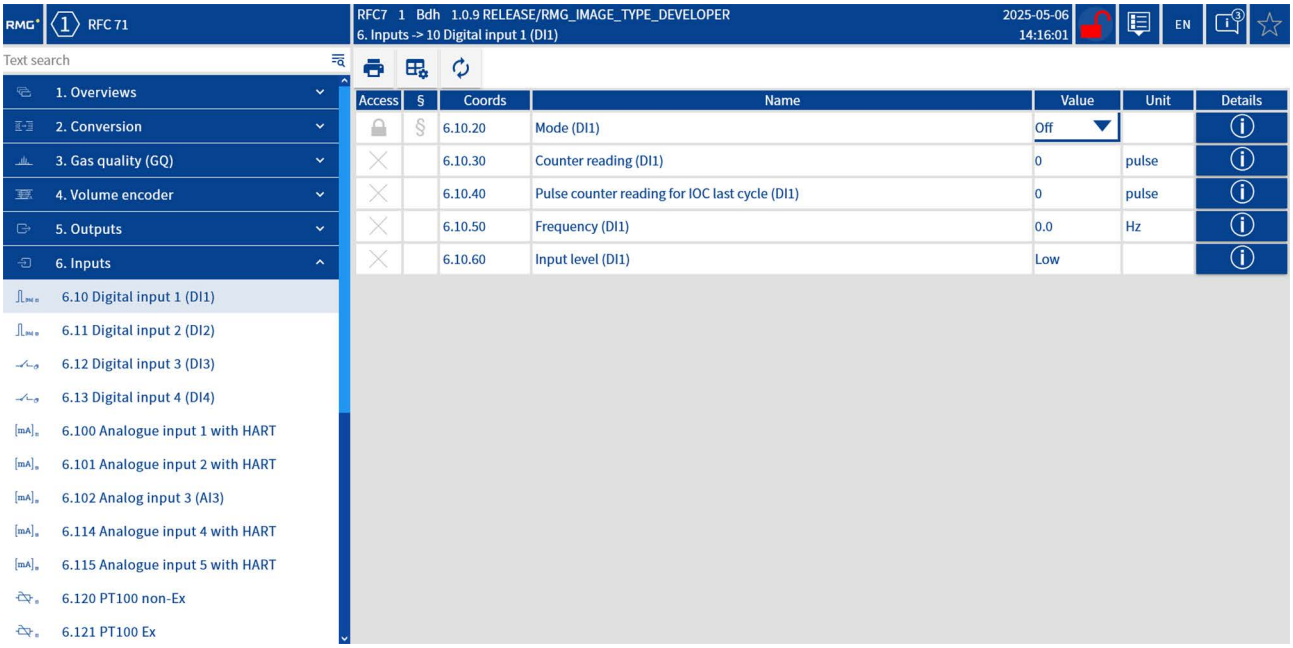


Fig. 84: Menu page 6.10 Digital input 1 (DI1)

▶ In the coordinate **6.10.20**, specify the **mode** for the digital input. The following options are available:

- Off
- HF
- Fixed simulation
- Dynamic simulation

8.8.2 Analogue inputs – specifying parameters

The parameters for analogue inputs AI1–AI5 can only be changed if the calibration lock is open.

The analogue inputs are located on following terminal strips (cf. section 6.2.2 "Terminal assignments of the terminal strips"):

- Analogue inputs AI1–AI3 on terminal strip X3
- Analogue inputs AI4–AI5 on terminal strip X7 (in intrinsically safe design)

To set the parameters, proceed as follows:

▶ Navigate to the corresponding menu page for the analogue input you want to configure, in this case **6.100 Analogue input 1 with HART (AI1)** (example).

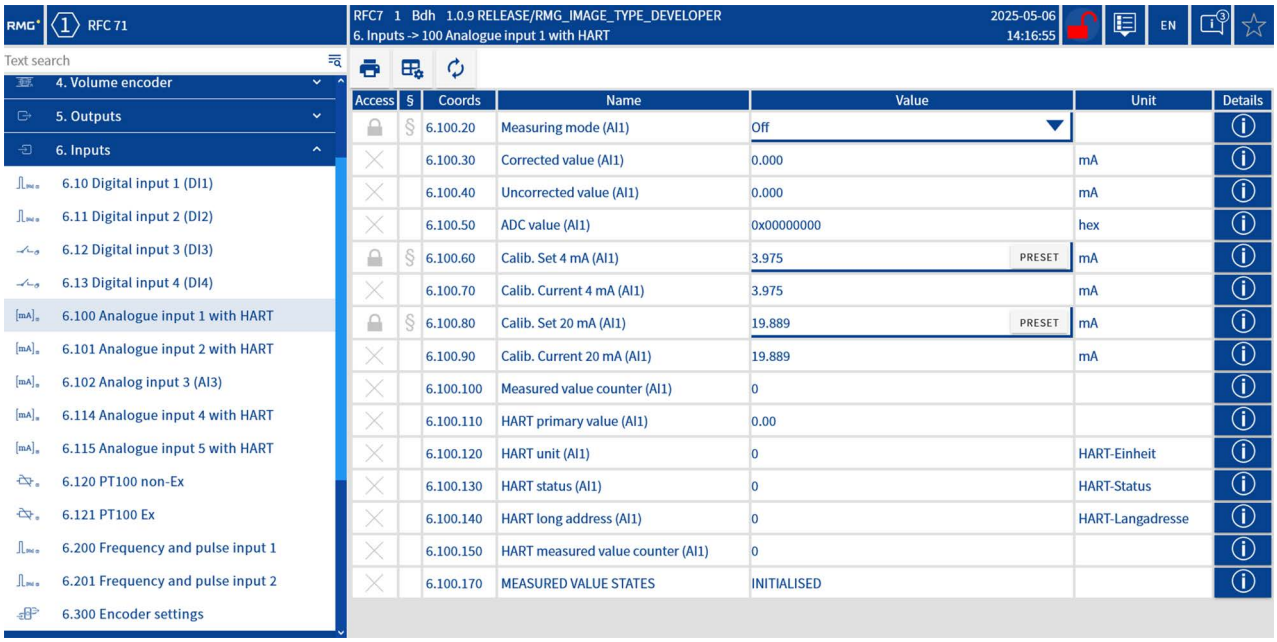


Fig. 85: Menu page 6.100 Analogue input 1 with HART (AI1)

- ▶ In the selection menu for the coordinate **6.100.20 Measuring mode (AI1)**, select the corresponding setting:
  - Off
  - Analogue 4–20 mA
  - HART
  - Calib. 4 mA
  - Calib. 20 mA
- ▶ For all unused analogue inputs or encoders that have their own power supply, please set the setting in the coordinate **Measuring mode** on the corresponding menu page to **Off**.
- ▶ If the analogue inputs AI1, AI2 and AI4, AI5 with HART interface are used to process digital signals, the setting **HART** should be selected.
  - ➥ The corresponding analogue input will then be used with HART interface.

The HART interface/protocol enables the transmission of digital data via the existing 4–20 mA analogue connection. The modulation of a digital signal to an analogue signal is performed on the basis of the following principle:

1. Basic principle: The HART protocol uses frequency shift keying to transmit digital information. Two different frequencies represent the binary states 1 and 0.
2. Superimposition: These digital signals are modulated to the analogue 4–20 mA signal without disrupting the analogue signal. This means that the analogue measurement (in this case the temperature signal) can still be transmitted continuously, with the digital data superimposed.
3. Reception and processing: The HART-enabled analogue input can recognise and decode these superimposed digital signals. This enables bidirectional communication between the temperature sensor and the RFC 7, allowing additional information to be transmitted, such as diagnostic and configuration data.
4. The advantage: This method makes it possible to use the existing 4–20 mA analogue input.

To calibrate the analogue input, proceed as follows:

1. In the coordinate **6.100.20 Measuring mode (AI1)**, select the setting **Calib. 4 mA**.
   ➥ In the coordinate **6.100.70 Calib. current 4 mA (AI1)**, the current value is displayed.
2. Enter the displayed value in the coordinate **6.100.60 Calib. set 4 mA (AI1)**.
3. Repeat steps 1 and 2 for the 20 mA value in the coordinates **6.100.80** and **6.100.90**.
4. Then, in the coordinate **6.100.20**, set the **measuring mode** back to the desired value.

8.8.3 PT100 – specifying parameters

The parameters for the PT100 (resistance measurement) can only be changed if the calibration lock is open.

The connections in the intrinsically safe version (Ex) are located on terminal strip X8 and the connections in the version that is **not** intrinsically safe are on terminal strip X4 (cf. section 6.2.2 "Terminal assignments of the terminal strips").

To set the parameters, proceed as follows:

- ▶ For the intrinsically safe version, navigate to the menu page **6.121 PT100 Ex**.
- ▶ For the version that is not intrinsically safe, navigate to the menu page **6.120 PT100 Non-Ex**.

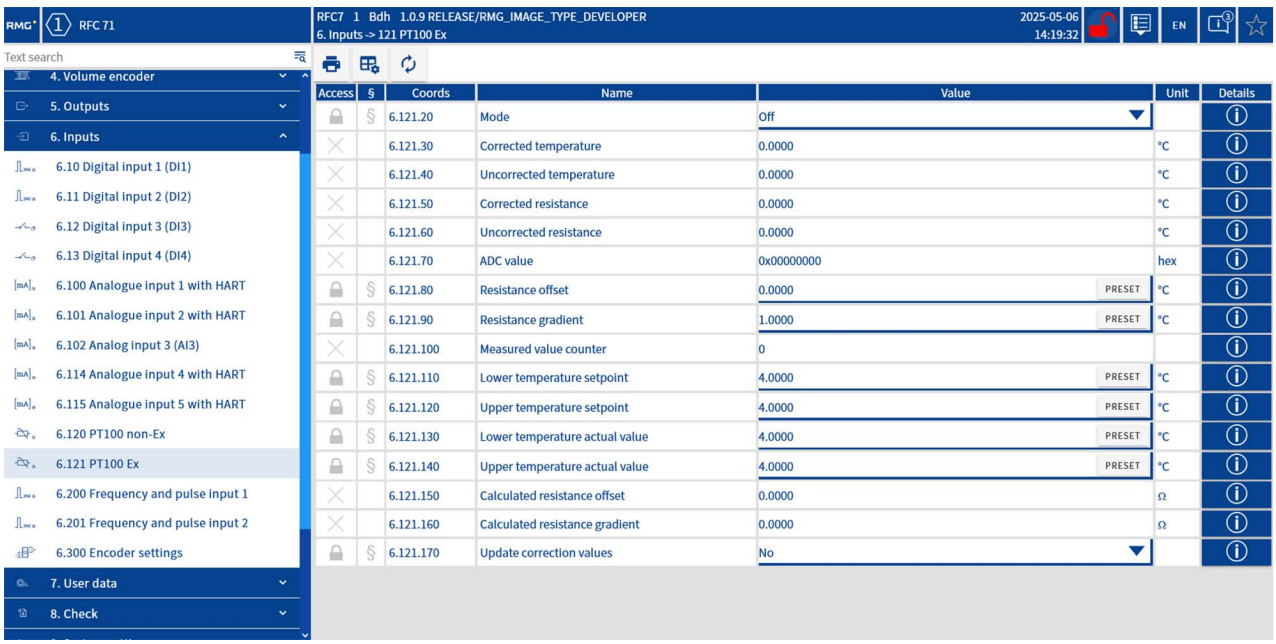


Fig. 86: Menu page 6.121 PT100 Ex

Below, the setting of the parameters is explained on the basis of menu page **6.121 PT100 Ex** (example):

- ▶ Set the mode of the PT100 in the selection menu for coordinate **6.121.10 PT100 mode**. The following modes are available:
  - Off
  - PT100
  - Calibration
  - Simulation

If line break monitoring is to be implemented, a 4-wire resistor must be used.

- ▶ Enter the parameters for the resistance in the coordinates **6.121.80 Resistance offset** and **6.121.90 Resistance gradient**.
- ▶ Confirm acceptance of the values for a resistance correction in the selection menu for the coordinate **6.121.170 PT100 Update correction values** by selecting the setting **Yes**.

8.8.4 Frequency and pulse input – specifying parameters

The parameters for frequency and pulse input 1 and 2 can only be changed if the calibration lock is open.

The inputs are located on following terminal strips (cf. section 6.2.2 "Terminal assignments of the terminal strips"):

- Pulse input reed/Namur 1, **terminal strip X8, terminal no. 5 and 6**
- Pulse input reed/Namur 2, **terminal strip X8, terminal no. 7 and 8**

To set the parameters, proceed as follows:

- ▶ Navigate to the menu page **6.200 Frequency and pulse input 1** for the setting of the main channel.
- ▶ Navigate to the menu page **6.201 Frequency and pulse input 2** for the setting of the reference channel.

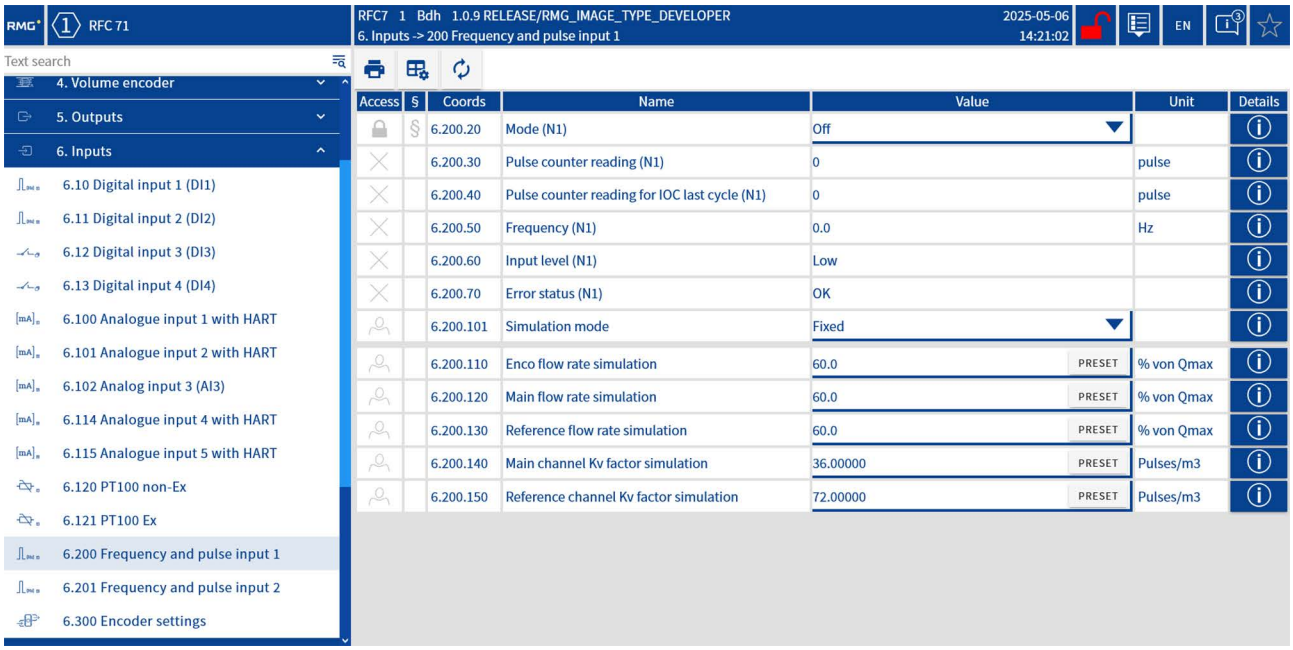


Fig. 87: Menu page 6.200 Frequency and pulse input 1

Below, the setting of the parameters is explained on the basis of menu page **6.200 Frequency and pulse input 1** (example):

- ▶ In the coordinate **6.200.20**, specify the **mode** of the frequency and pulse input. The following options are available:
  - Off
  - LF
  - HF
  - Fixed simulation
  - Dynamic simulation

If a simulation is selected, additional simulation settings can be configured in the coordinates **6.200.101** to **6.200.150**. Note that on this menu page the defaults for simulation need to be entered for frequency and pulse inputs 1 and 2 and for the encoder.

8.8.5 Encoder settings

The parameters for the encoder can only be changed if the calibration lock is open.

The input is located on following terminal strip (cf. section 6.2.2 "Terminal assignments of the terminal strips"):

- Encoder input, **terminal strip X7, terminal no. 1 and 2**

To set the parameters, proceed as follows:

▶ Navigate to the menu page **6.300 Encoder settings**.

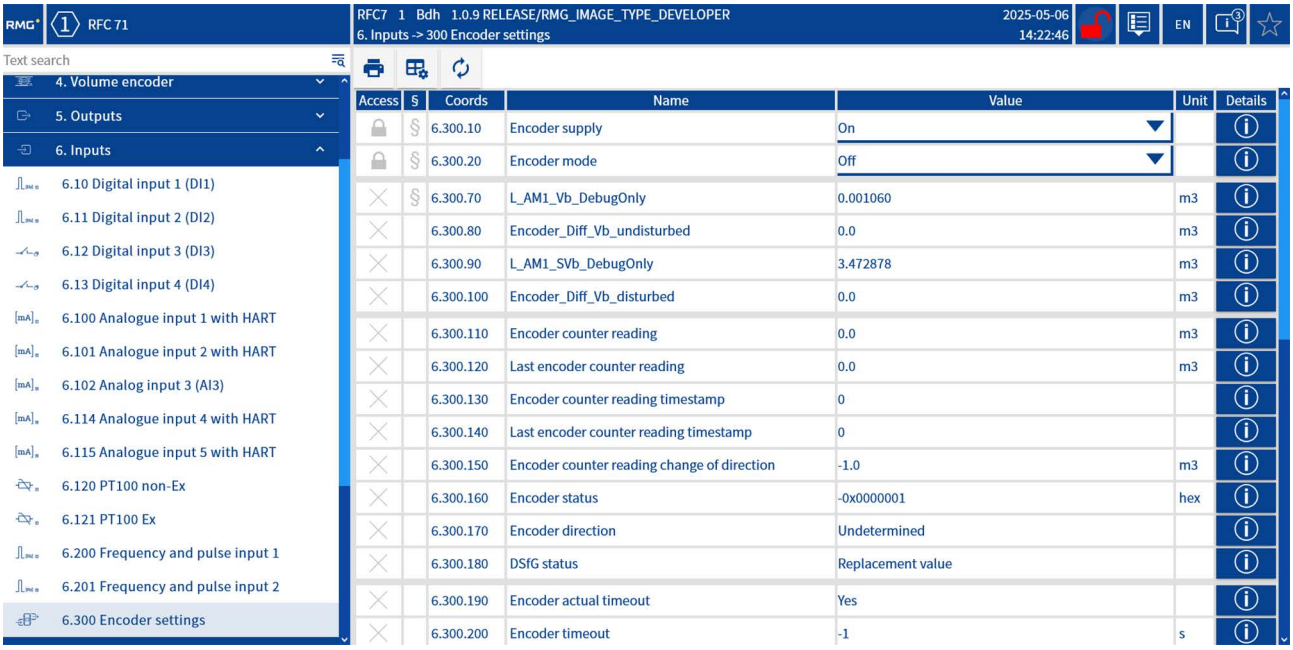


Fig. 88: Menu page 6.300 Encoder settings

▶ In the coordinate **6.300.10 Encoder supply**, select the setting **On** to switch on the power supply.

▶ In the coordinate **6.300.10**, specify the **mode** of the **encoder**. The following options are available:

- Off
- On
- Simulation

▶ In the coordinate **6.300.30 Encoder voltage supply mode**, select the operating mode.

▶ In the coordinate **6.300.210 Max. encoder timeout**, enter the corresponding value.

▶ Specify the **Encoder safety factor** in the coordinate **6.300.220**.

▶ In the coordinates **6.300.360** to **.380**, enter the following encoder data:

- Manufacturer
- Device type
- Serial number

- ▶ Some devices can transmit the nameplate information automatically. Activate transmission by selecting the setting **from device** in the coordinate **6.300.350 Type plate input**.

8.9 Outputs

The parameterisation of the digital and analogue outputs can be performed by a logged-in user.

8.9.1 Digital outputs – specifying parameters

The digital outputs are located on the following terminal strips (cf. section 6.2.2 "Terminal assignments of the terminal strips"):

- Digital output 1 and 2, **terminal strip X4, terminal no. 1 to 4**
- Digital output 3 to 6, **terminal strip X5, terminal no. 1 to 8**

To parameterise digital outputs 1 and 2, proceed as follows:

- ▶ Navigate to the menu page **5.100 Digital output 1 (DO1)** for the settings for the corresponding output.
- ▶ Navigate to the menu page **5.101 Digital output 2 (DO2)** to set the corresponding output.

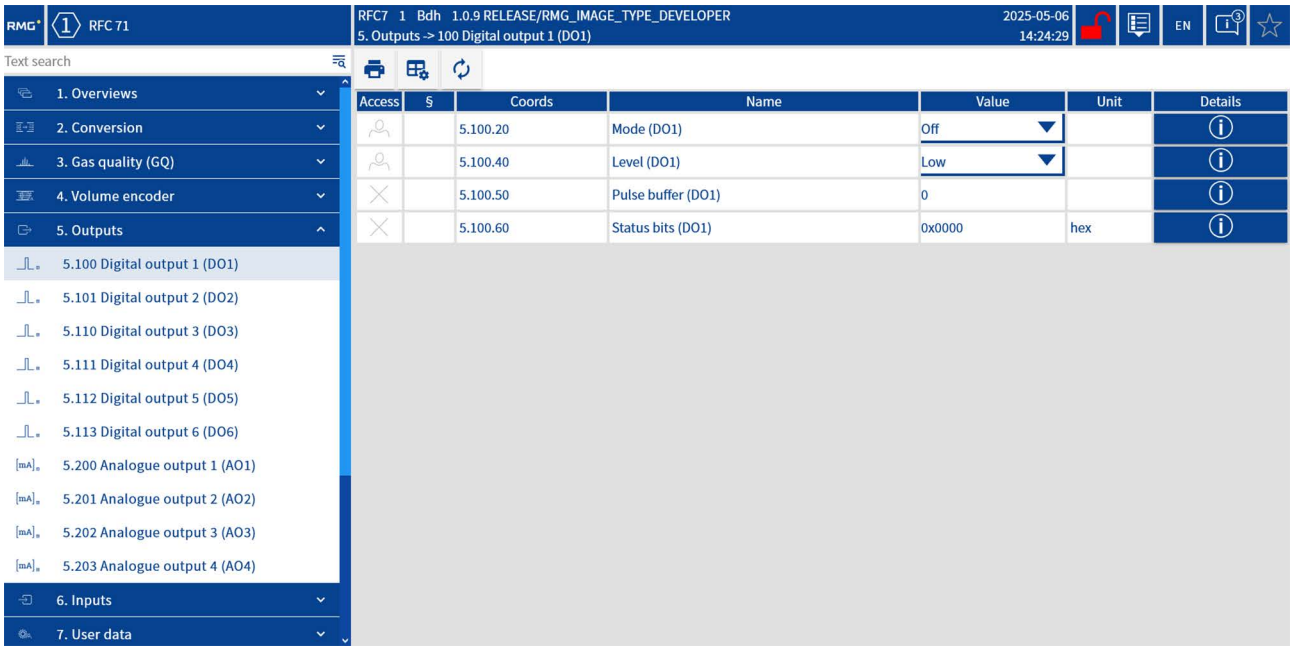


Fig. 89: Menu page 5.100 Digital output 1 (DO1)

The settings for **digital output 1 (DO1)** are explained below (example). The settings for digital output 2 can be configured in the same way:

- ▶ Specify the **mode** in the coordinate **5.100.20**. The following options are available:
  - Off
  - Static
- ▶ Specify the **Level** in the coordinate **5.100.40**. The following options are available:
  - Low

- High

To parameterise digital outputs 3 to 6, proceed as follows:

▶ Navigate to the corresponding menu page for the digital output you want to configure, in this case **5.110 Digital output 3 (DO3)** (example).

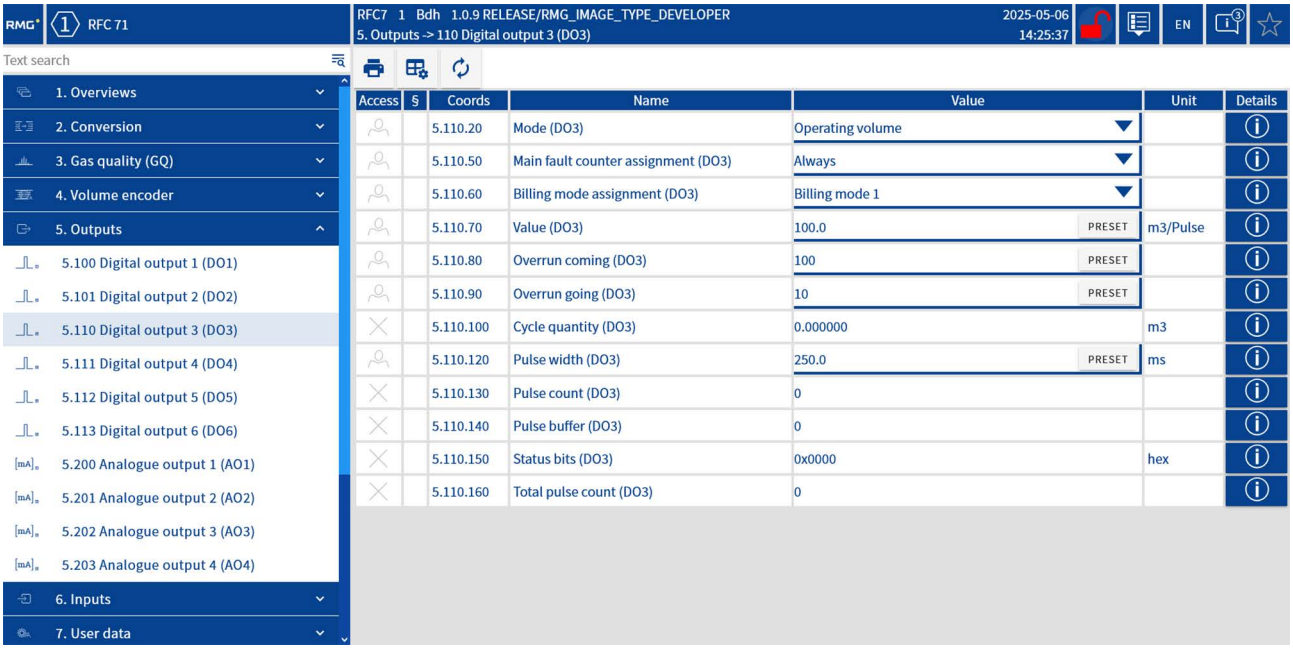


Fig. 90: Menu page 5.110 Digital output 3 (DO3)

The settings for **digital output 3 (DO3)** are explained below (example). The settings for digital outputs 4 to 6 can be configured in the same way:

▶ In the coordinate **5.110.20 Mode**, assign a physical value to the digital output. The following options are available:
- Off
- Static
- Operating volume
- Corrected operating volume
- Standard volume
- Energy

▶ In the coordinate **5.110.50**, specify the **Main fault counter assignment**. The following options are available:
- Always
- Uninterrupted
- Interrupted

▶ In coordinate **5.110.60**, specify the **Billing mode assignment**. The following options are available:
- Undefined billing mode
- Billing mode 1
- Billing mode 2

▶ In coordinate **5.110.70**, enter the **Value**.

▶ In coordinate **5.110.80**, enter the value for **Overrun coming**.

▶ In coordinate **5.110.90**, enter the value for **Overrun going**.

▶ In coordinate **5.110.120**, enter the value for the **Pulse width**.

8.9.2 Analogue outputs – specifying parameters

The analogue outputs are located on terminal strip X1 (cf. section 6.2.2 "Terminal assignments of the terminal strips"):

- Analogue inputs AO1–AO4, **terminal strip X1, terminal no. 1 to 8**

To set the parameters, proceed as follows:

▶ Navigate to the corresponding menu page for the analogue output you want to configure, in this case **5.200 Analogue output 1 (AO1)** (example).

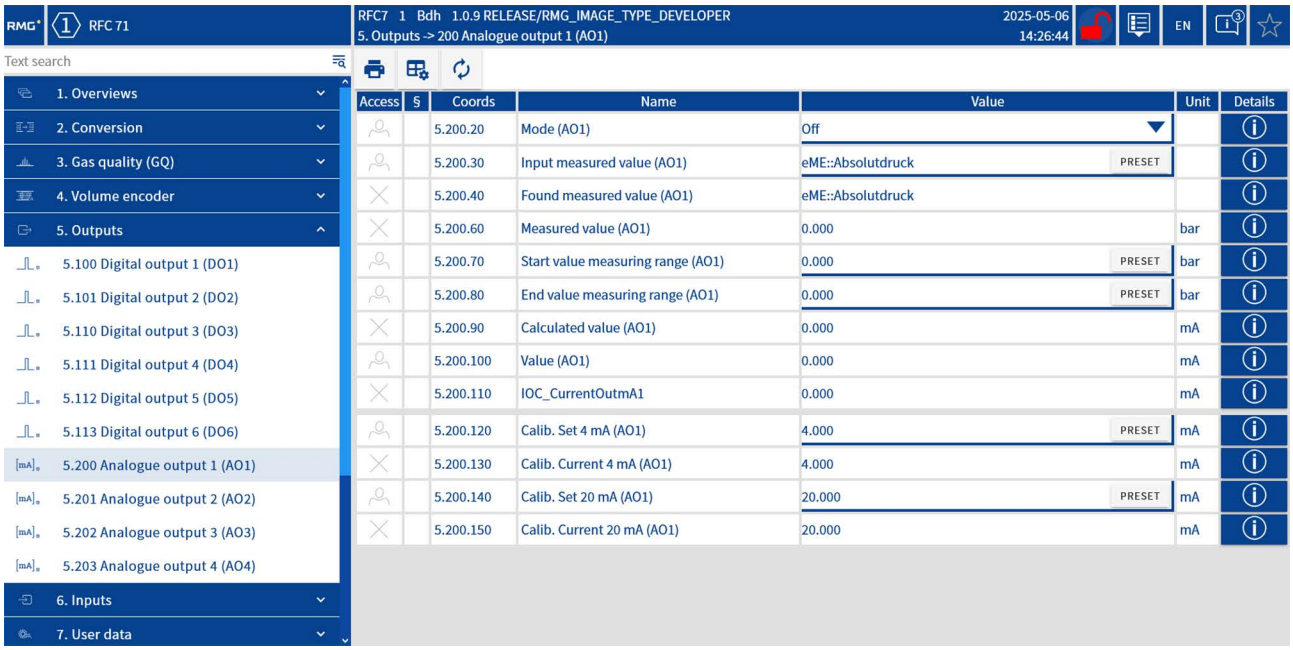


Fig. 91: Menu page 5.200 Analogue output 1 (AO1)

The settings for **analogue output 1 (AO1)** are explained below (example). The settings for analogue outputs 2 to 4 can be configured in the same way:

▶ In the coordinate **5.200.20**, specify the **mode** for analogue output 1 **(AO1)**. The following options are available:
  - Off
  - Default
  - Calib. 4 mA
  - Calib. 20 mA
  - Measured value 4–20 mA

▶ In coordinate **5.200.30 Input measured value (AO1)**, enter the physical variable that is to be output with the analogue output.

Procedure for entering the measured value in coordinate 5.200.30

▶ In the menu pages, navigate to section 2. Conversion.

▶ Open the menu page for the desired measured value, e.g. 2.3 Gas pressure.

▶ Click the info button in the Detail column.

➥ The detail info window opens.

▶ Select the value entered for **internalName**, in this example **eME::Absolutdruck** (cf. fig. 92) and insert the selected value using the copy & paste functions (keyboard shortcut: Ctrl+C & Ctrl+V) into coordinate **5.200.30**.

▶ The inserted measured value is display in the coordinate **5.200.40 Found measured value (AO1)**.

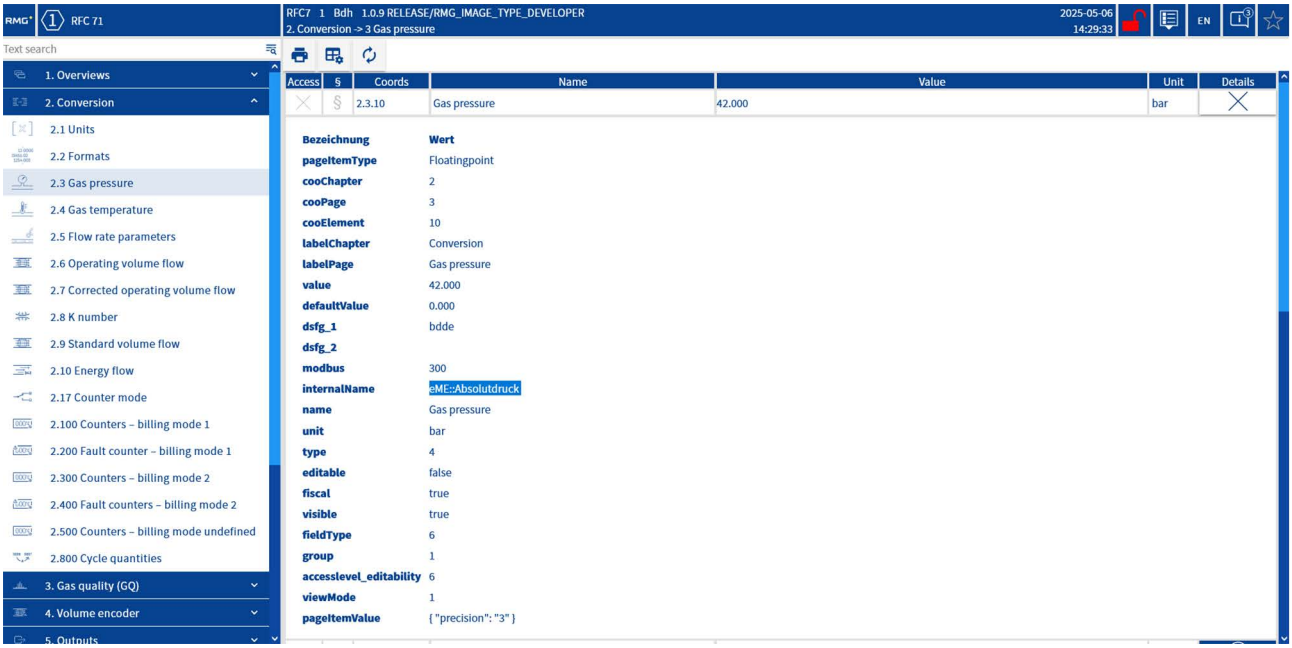


Fig. 92: Detail info window, gas pressure

▶ In the coordinates **5.200.70** and **5.200.80**, specify the **start and end value measuring range**.

To calibrate the analogue output, proceed as follows:

1. In the coordinate **5.200.20 Mode (AO1)**, select the setting **Calib. 4 mA**.
   ➥ In the coordinate **5.200.130 Calib. current 4 mA (AO1)**, the current value is displayed.
2. Enter the displayed value in the coordinate **5.200.120 Calib. set 4 mA (AO1)**.
3. Repeat steps 1 and 2 for the 20 mA value in the coordinates **5.200.140** and **5.200.150**.
4. Then, in the coordinate **5.200.20**, set the **mode** back to the desired value for analogue output 1.

8.10 Testing – performing a functional test

A functional test can be performed by a logged-in user.

8.10.1 Freeze – specifying parameters

Freeze mode makes it possible to save current data for later use. The freeze function effectively freezes the most recent volume and measurement values.

To configure settings for the freeze function, proceed as follows:

▶ Navigate to the menu page **8.10 Freeze**.

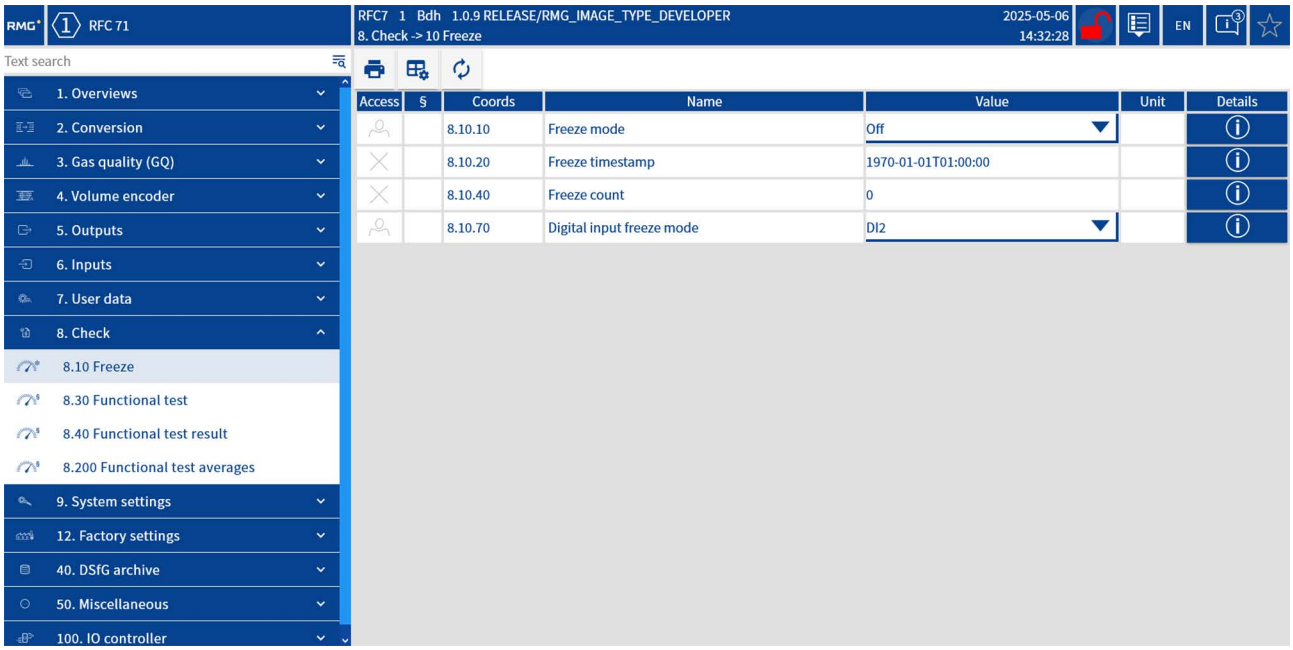


Fig. 93: Menu page 8.10 Freeze

▶ In the coordinate **8.10.10 Freeze mode**, specify when the freeze function should be carried out, and how often. The following options are available:
- Off
- Manual
- Cyclical
- Digital input
- Every minute
- Every hour
- Every day
- Every gas day
- Every month
- Every gas month

▶ If **digital input** has been selected, specify in the coordinate **8.10.70 Digital input freeze mode** which digital input should be used to trigger the freeze function. The following options are available:
- DI1
- DI2
- DI3
- DI4

8.10.2 Functional test – specifying parameters and performing the test

NOTE

Conditions for performing the functional test

A functional test can only be carried out if no alarms are pending!

- ▶ Before carrying out the functional test, check for any pending alarms/error messages and ensure that there are no alarms.

To specify the parameters for a functional test, a so-called revision, and to perform the test, proceed as follows:

- ▶ Navigate to the menu page **8.30 Functional test**.

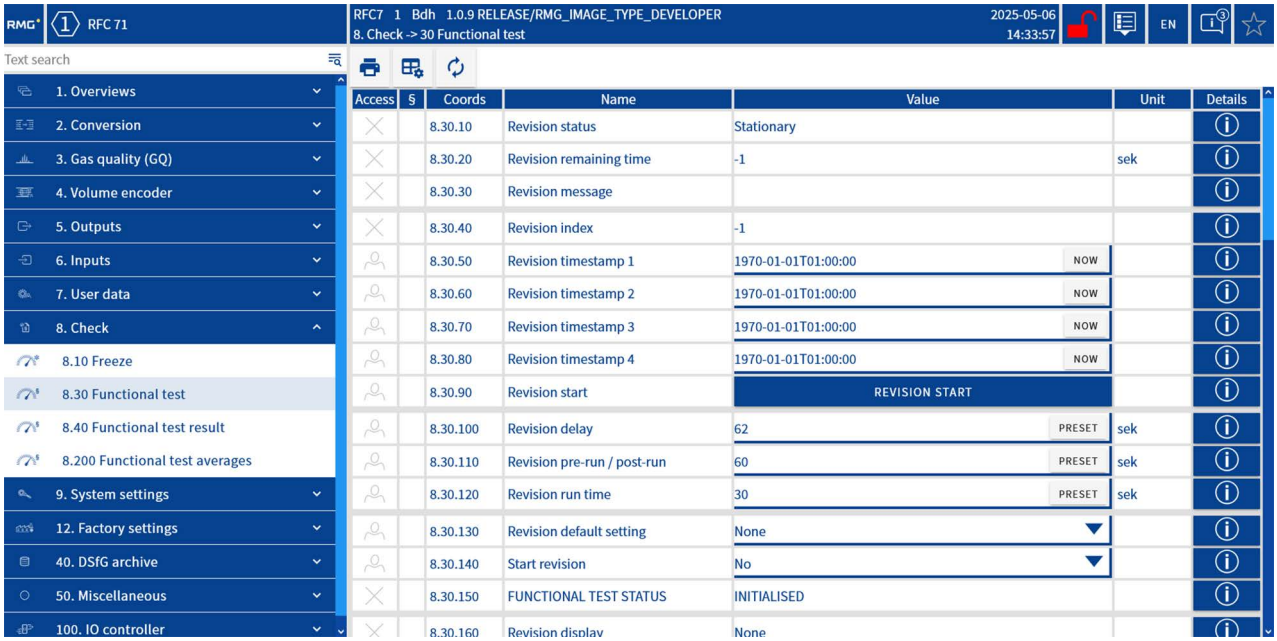


Fig. 94: Menu page 8.30 Functional test

- ▶ In the coordinate **8.30.100 Revision delay**, enter a time interval that will serve as a delay for the start of the test.
- ▶ In the coordinate **8.30.110 Revision pre-run/post-run**, specify a pre-run and post-run for the test.
- ▶ In the coordinate **8.30.120 Revision run time**, specify the duration of the test.

- ▶ Save your entries by clicking the corresponding button.
- ▶ In the selection menu for the coordinate **8.30.130 Revision default setting**, select the desired starting time for the test (the test starts with the entered delay period). The following options are available:
  - None
  - Now
  - Next minute
  - Next 10 minutes
  - Next hour

- ▶ Save your settings by clicking the corresponding button.

To start the functional test manually:

▶ Press the **Revision start** button.

To start the test automatically:

▶ In the selection menu for the coordinate **8.30.140 Start revision**, select the setting **Yes** and save your entry.

Regardless of whether a manual or an automatic start was selected, the following steps are performed:

➡ The required timestamps are set in accordance with your settings and the test starts:

- Coordinate **8.30.50 Revision timestamp 1** shows the time for the end of the delay and the start of the pre-run.
- Coordinate **8.30.60 Revision timestamp 2** shows the time for the end of the pre-run and the start of the test period.
- Coordinate **8.30.70 Revision timestamp 3** shows the time for the end of the test period and the start of the post-run.
- Coordinate **8.30.80 Revision timestamp 4** shows the time for the end of the post-run and thus the end of the test.

➡ The current **status** of the test is displayed in coordinate **8.30.10**.

➡ The **remaining time** of the test is displayed in coordinate **8.30.20**.

➡ The coordinate **8.30.30 Revision message** indicates the phase that the test is currently in. The possible displays are:

- Phase: Delay
- Phase: Pre-run
- Phase: Inspection
- Phase: Post-run
- Phase: Functional test completed

➡ The coordinate **8.30.150** shows the **status** of the overall **functional test**. Possible statuses are:

- INITIALISED
- ACTIVE
- WAIT AFTER INITIALISED

8.10.3 Functional test result

▶ To view the result of the completed functional test, navigate to the menu page **8.40 Functional test result**.

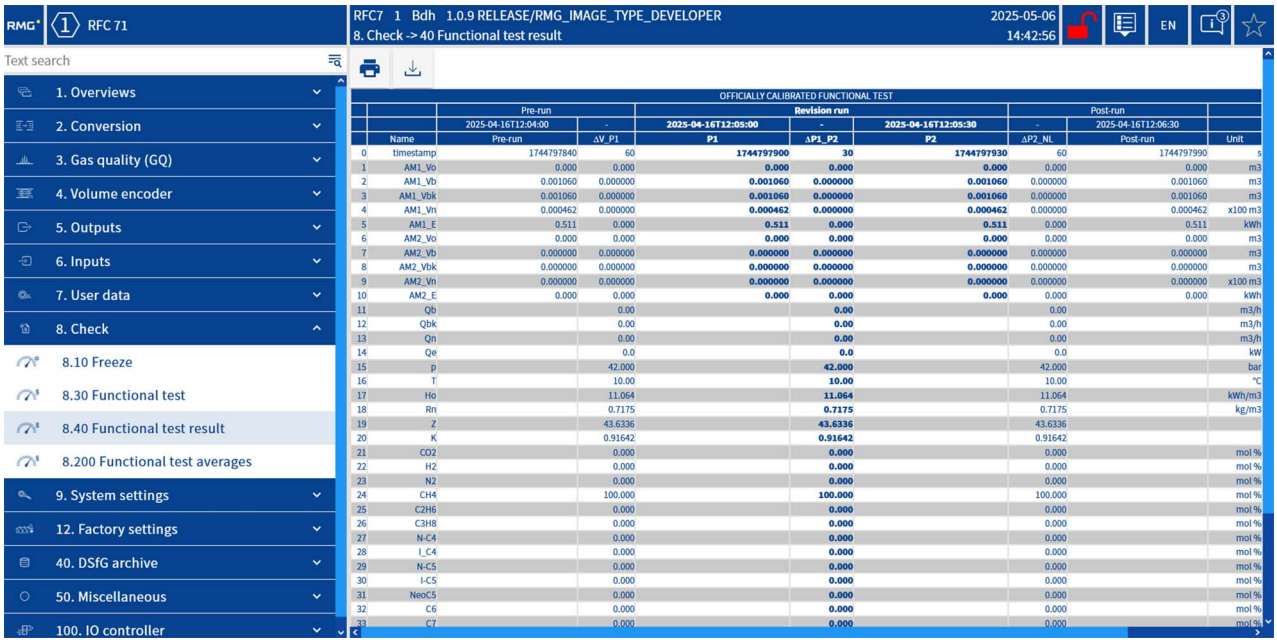


Fig. 95: Menu page 8.40 Functional test result

No.	Designation	Function
1	**Print** button	■ Print the results of the functional test, if a printer is available.
2	**CSV export** button	■ Export the results of the functional test in a file in CSV format
3	**Functional test result** display	■ Display the results of the most recent functional test in table form

The results of the most recent functional test are displayed here as a table.

▶ To print or export the results, click the corresponding button (fig. 95, no. 1 or no. 2)

8.11 System settings

On the menu pages of section 9. System settings, you can configure fundamental sitting for the following system areas:

Menu page	Setting options
9.1 Software update	■ Upload software update file and perform update (cf. section8.11.1)
9.2 Time and date	■ Settings for the time format, time tones and billing hours
9.3 Time synchronisation	■ Settings for time servers, connection to the time server, synchronisation planning
9.4 Memory management	■ Status display for the SD card, formatting of the SD card
9.7 Serial interfaces	■ Settings for the baud rate, mode, Modbus server register offset and Modbus server address offset, etc.
9.9 Firewall	■ Settings for the ports
9.11 Ethernet 1	■ Settings for the IP4, http, SSH, DHCP, route, gateway etc.
9.12 Ethernet 2	■ Settings for the IP4, http, SSH, DHCP, route, gateway etc.
9.13 Ethernet 3	■ Settings for the IP4, http, SSH, DHCP, route, gateway etc.
9.13 Ethernet 4	■ Settings for the IP4, http, SSH, DHCP, route, gateway etc.
9.15 Ethernet 0 internal	■ Setting for DHCP routes and DNS
9.20 Modbus server	■ Settings for the byte order, debug mode, ETH port, etc.
9.60 IOC	■ Activation of the IOC system (cf. section 8.8)
9.100 Access rights	■ Approve software calibration switch, reset admin password, overwrite FRAM
9.110 User management	■ Set admin rights
9.250 Software ID	■ Info page on installed software version
9.400 System info HW/OS	■ Info page on hardware / operating system
9.410 Screen/screensaver	■ Settings for screensaver, brightness, etc.
9.500 System de	■ Setting for system language (cf. section7.3.2), log level, factory number, device type

Table 25: Overview of the setting options in the System settings section

8.11.1 Software update

A software update can only be performed if the calibration lock is open.

Do this as follows:

▶ Navigate to the menu page **9.1 Software update**.

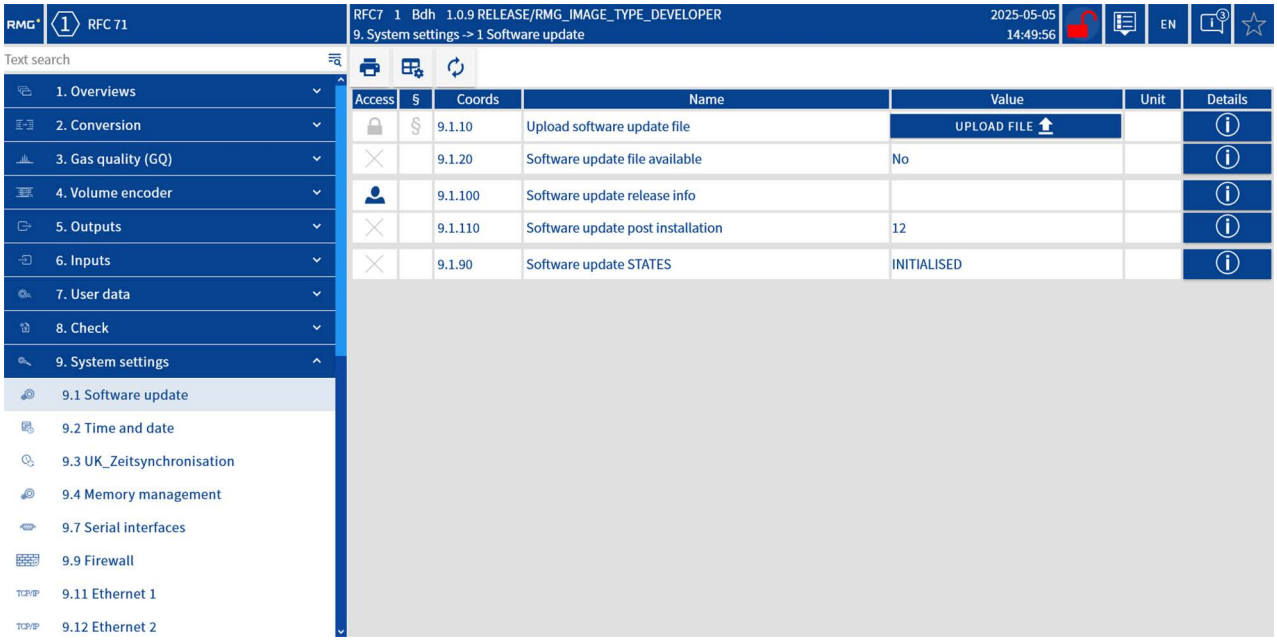


Fig. 96: Menu page 9.1 Software update

▶ Press the **UPLOAD FILE** button.

➥ A separate window will open (cf. fig. 97).

Fig. 97: Upload file window

▶ Tap or click **Select file**.

➥ A Windows Explorer window will open (cf. fig. 98)

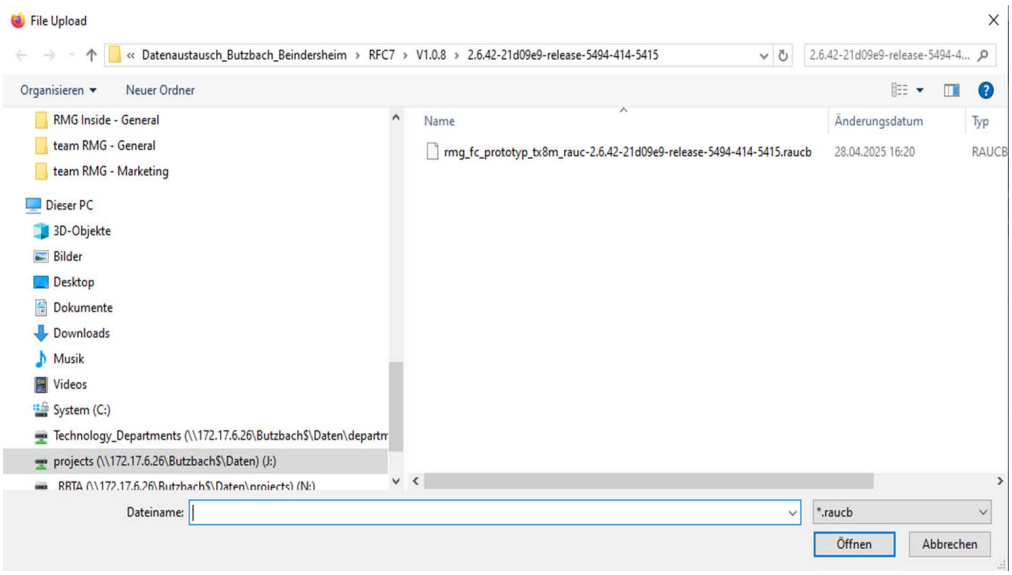


Fig. 98: Windows Explorer window

- ▶ Navigate to the directory where you saved the software update file, select it and press the Open button.
  - ➡ The selected file is displayed in the **Upload file** window (cf. fig. 99)

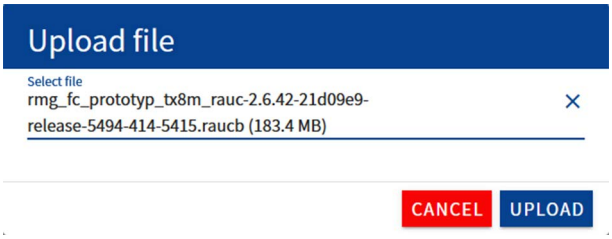


Fig. 99: Upload file window

- ▶ Press the **UPLOAD** button.
  - ➡ The selected file is uploaded. This may take several minutes (cf. fig. 100).

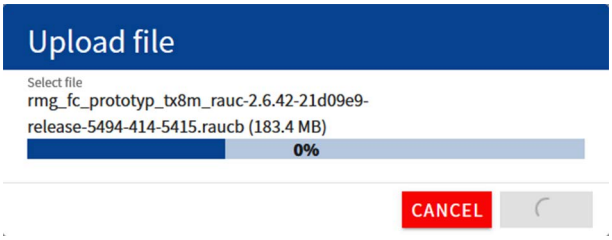


Fig. 100: Upload file window – progress bar

When the file has been uploaded, some additional coordinates are added to the menu page 9.1 Software update (cf. fig. 101).

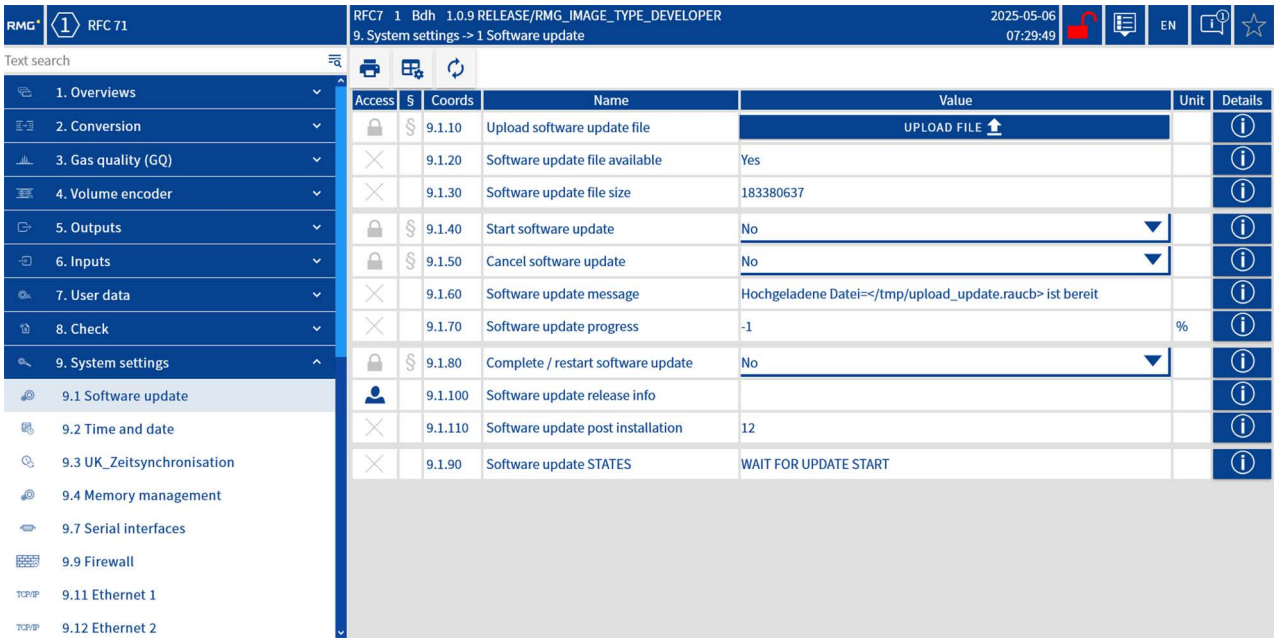


Fig. 101: Menu page 9.1 Software update after the software update file has been uploaded

- ▶ In the selection menu for coordinate **9.1.40 Software update**, select the setting **Yes**.
- ▶ In the selection menu for coordinate **9.1.80 Complete / restart software update**, select the setting **Yes**.

- ▶ Save your settings by clicking the corresponding button.
  - ➥ The software update is started. When the update is complete, the device will be restarted and the installed software version will be display in the header (web view) or the footer (touchscreen).

9 Operation

Once the RFC 7 is in operation, it runs continuously.

To ensure smooth operation, observe the following instructions:

- Read this operating manual carefully to avoid incorrect operation and only use the RFC 7 in accordance with its intended use (see section 2.1 "Intended use").
- Only operate the RFC 7 within the power limits specified in the technical data (see section 13 "Technical data") and ensure that they are not exceeded.
- Protect the device from heat sources (e.g. direct sunlight).
- If a device is damaged or unsafe, it must be removed from circulation immediately and labelled accordingly to prevent it from being used accidentally.
- Ensure that the defective device is only repaired by RMG Messtechnik GmbH.

10 Maintenance and regular checks

⚠ DANGER

Danger of death arising from electrical voltage

Before servicing, maintenance and cleaning work, it is essential to switch off the device and disconnect it from the mains power supply. Failing to do so may lead to extremely severe injury or death.

- ▶ Before any work is commenced, switch of the device's power supply and disconnect it from the mains.
- ▶ Only carry out work on the device as described in this manual. Ensure that the device is not live while the work is being performed.

⚠ DANGER

Danger of death arising from the device being damaged during maintenance and cleaning work

If the device is damaged because unsuitable tools were used or because cleaning was performed incorrectly, this may result in danger of death.

- ▶ Only use suitable tools to prevent damage to components.
- ▶ Only clean the device with a slightly damp cloth to avoid static charging of the housing.

⚠ DANGER

Danger of death arising from operating a defective device

If a defective, damaged or unsafe device is used after servicing, maintenance and cleaning work, this may result in danger of death.

- ▶ If a device is damaged or unsafe, it must be removed from circulation immediately and labelled accordingly to prevent it from being used accidentally.
- ▶ Ensure that the defective device is only repaired by RMG Messtechnik GmbH.

NOTE

Maintenance and repair work

In the case of normal use of the RFC 7, the device does not require regular maintenance.

- ▶ For more information, please contact RMG.
- ▶ Only have repairs performed by RMG, in order to avoid voiding guarantee claims as the result of incorrect repair work.

11 Potential errors and repairs

11.1 Error messages

The error messages are categorised as follows:

- E – alarms (error): Measurement error
- W – warnings: Error relating to functions
- H – information: Messages without errors

Some messages are listed as alarms and warnings. The corresponding limits can be set by means of ‘administrator’ access rights for warnings and only by means of the calibration lock for alarms.

11.2 Repairs

For spare parts and repairs, please contact our ‘Repairs & Spares’ department at:

Phone: +49 6033 897–897

Email: repairs-spares@rmg.com

12 Dismantling and disposal

⚠ DANGER

Danger of death arising from electrical voltage

Before dismantling work, it is essential to switch off the device or disconnect it from the mains power supply. Failing to do so may lead to extremely severe injury or death.

- ▶ Before any work is commenced, switch of the device's power supply or disconnect it from the mains.
- ▶ Only carry out work on the device as described in this manual. Ensure that the device is not live while the work is being performed.

12.1 Dismantling

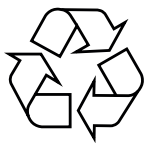
To dismantle the Flow Computer RFC 7, please proceed as follows:

1. Remove all data saved on the device by erasing all archives. To do this, navigate to menu 12. Factory settings. If you have the corresponding access rights, you can then erase the archive and reset the counters.
2. De-energise the device.
3. Loosen the device's fastening screws and carefully pull it forwards out of the rack.
4. Disconnect the connection cables.
5. Remove the device from the switch cabinet entirely.

12.2 Disposal

Dispose of device components and packaging material in an environmentally sound manner in accordance with the applicable waste management and national waste disposal regulations and standards of the region or country to which the device is delivered.

Within the EU, the following applies:



In accordance with EU Directive 2012/19/EU / the German Electrical and Electronic Equipment Act (ElektroG), devices that are no longer needed must be taken to recycling station.

The device must not be disposed of with household waste!

13 Technical data

Design	
Device variants	■ Single-Stream (one stream – data from one measurement point are processed by the RFC 7) ■ Multi-Stream (two to four streams – data from up to four measurement points are processed in the RFC 7) **(Please note: the Multi-Stream variant is not currently available!)**
Housing variants	■ 19" housing for 1–2 streams, Dimensions: 213.36 mm (42 HP) x 133.35 mm (3 RU) x 230 mm (W x H x D) (without connector on the back) ■ 19" housing for 3–4 streams 426.72 mm (84 HP) x 133.35 mm (3 RU) x 230 mm (W x H x D) (without connector on the back)
Weight	■ 1 stream: 1.75 kg ■ 2 streams: 2.25 kg
Material	FR4 (front panel) and aluminium (housing)
Protection class	IP 20 (protection from solid bodies >12.5 mm, not splash-proof)
Components in the housing	■ Power pack 24 V DC ■ Intercom (for Multi-Stream variants) Additionally five plug-in circuit boards per stream: ■ **CoM-Basis** for communication and computing ■ **IO-System** for time-critical communication with actuators and sensors, comprising: - **IOC-EX-IO** as interface to Ex zone with securely separated inputs - **IOC-Digital-IO** as interface for digital inputs and outputs outside of the Ex zone - **IOC-CPU** to process all analogue and digital inputs and outputs - **IOC-Analog-Out** as interface for analogue outputs outside of the Ex zone With these plug-in circuit boards, all the intended functions can be executed. The hardware is not designed for expansion with plug-in circuit boards for additional functions.
Field of application	
Ambient, operating and storage temperature	-20 to 50 °C
Humidity class	EN12405-3 SL1 internal 85% non-condensing
EMC class	Class A (radiated interference field strength) Class B (EN 55032)
Explosion protection	The device is not intended for use in potentially explosive atmospheres! Nevertheless, devices and sensors may be connected to the Ex inputs and outputs of the RFC 7 that are located in a potentially explosive atmosphere (Ex Zone 1).

Approvals in acc. with	
EU Directives	■ Measurement Instruments Directive 2014/32/EU ■ EMC Directive 2014/30/EU ■ RoHS Directive 2011/65/EU
EX approvals	Interface for devices in Ex Zone 1: ■ ATEX Directive 2014/34/EU ■ IECEX
National laws and ordinances	■ German Weights and Measures Act (MessEG) – dated 25 July 2013 ■ German Weights and Measures Ordinance (MessEV) – dated 11 Dec. 2014
Calculation methods of compressibility coefficient K	
Available methods	■ k = constant ■ Complete analysis: - AGA 8 DC92 - AGA 8:2017 - GERG-2004 - GERG-2008 ■ Gross values: - GERG-88 S - GERG-88 S Set B - GERG-88 S Set C - AGA NX-19 L - AGA NX-19 H - AGA Gross Meth. 1 - AGA Gross Meth. 2 - SGERG-mod-H2 ■ Pure substances: - Van der Waals - Beattie & Bridgeman
Operation	
From front panel:	
Display	7" touchscreen Active area of the touchscreen 154.2 x 85.92 mm (W x H) 1024 x 600 pixels
LEDs	■ Alarm/error/fault (red) ■ Warning (yellow) ■ Measurement (green) ■ Power supply on (blue)
Calibration switch	■ Can be moved up and down with additional tool ■ Lead-sealed for applications involving official calibration
Software	Integrated GUI
From PC or local network:	
Connection to Ethernet port	■ Connect network cable to Eth 1, 2, 3 or 4 ■ Enter IP address of the RFC 7 in address bar (URL bar)
Software	Integrated web UI
Available languages	German, English, Chinese

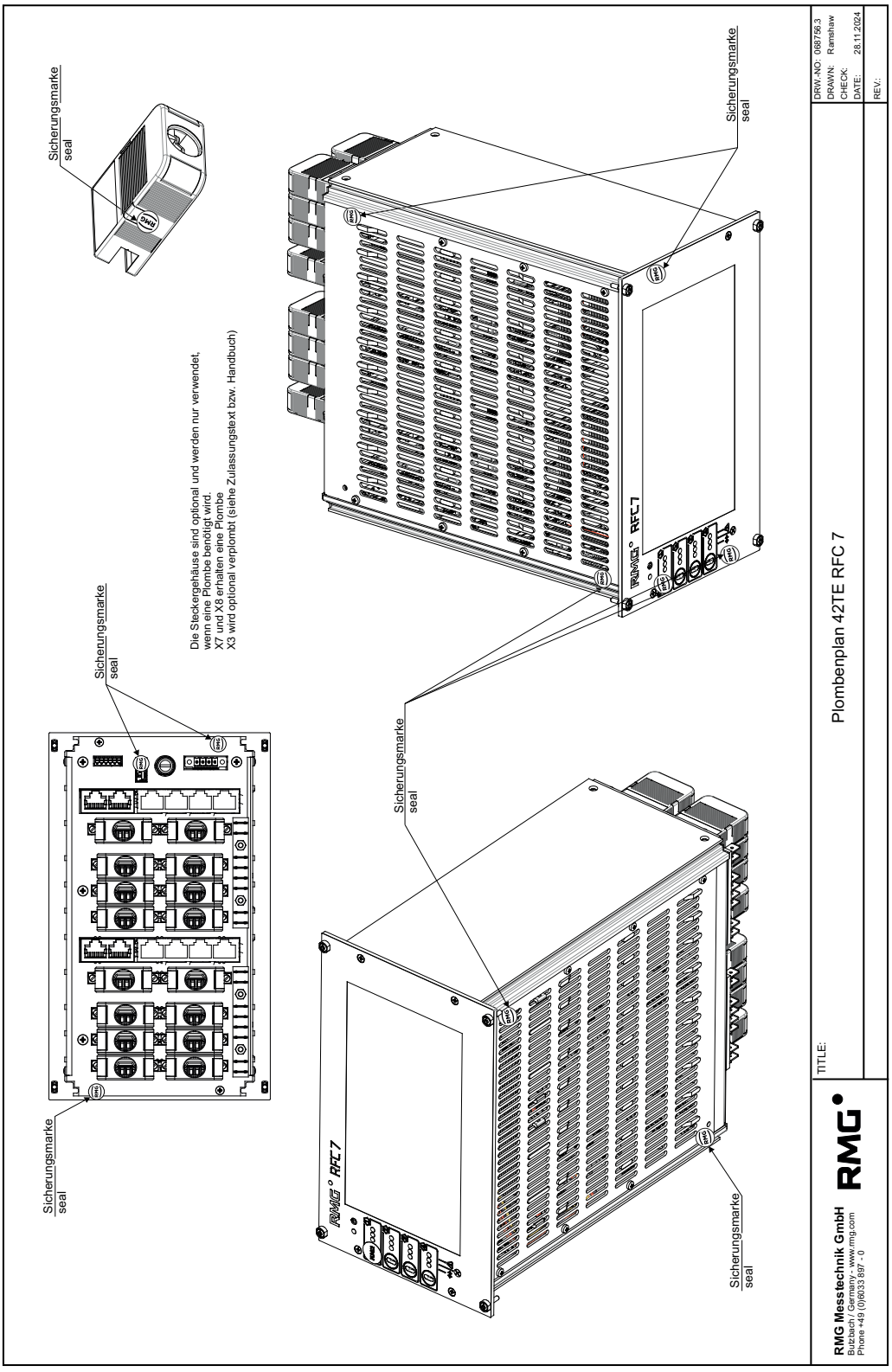
Technical data	
Power supply	24 V DC +10%/-15%
Power consumption	0.8 A, typical for 1 stream
Output	Max. 20 W
Overvoltage protection	2 A slow-blow (Single-Stream)
System hardware version	
System controller (CoM-Basis)	
Processor	Quad Core ARM Cortex®-A53 based NXP: i.MX8M mini
CPU speed	Up to 1.6 GHz
On-board operating system	Linux
Real-time clock	Battery-buffered
Watchdog timer	Yes
Safety function	Integrated firewall
Memory	2 GB SDRam working memory
	4 GB eMMC program (permanent) memory
Serial interfaces (2x per stream, 1x optional)	
SER 1 (RJ45)	RS 485
SER 2 (RJ45)	RS 485
(SER 3 optionally via adapter)	(RS 485 optional)
Available communication protocols	■ Modbus RTU client/server ■ Modbus ASCII client/server ■ Modbus client for USZ (F instance) ■ Modbus client for gas quality
Baud rate	9600–115,200 depending on communication protocol
Data interfaces (Ethernet 4 x per stream)	
Eth 1	RJ45
Eth 2	RJ45
Eth 3	RJ45
Eth 4	RJ45
Available communication protocols	■ Modbus TCP/IP ■ http ■ SNTP
IO controller IOC	
Microcontroller	STM32F429, ARM-Cortex M4
CPU speed	100 MHz
Memory	1 MB flash
Digital inputs per stream	
Quantity	4x status inputs, optically isolated: ■ DI1–DI4
U_{max}	5 V
I_{max}	15 mA
f_{max}	2 Hz

Digital outputs per stream	
Quantity	6x digital outputs: ■ DO1–DO2: Digital/frequency output with max. 5 kHz ■ DO3–DO6: Digital/pulse output with 500 Hz (min. pulse width 1 ms)
U_{max}	24 VDC +10%
I_{max}	20 mA
Analogue inputs per stream	
Quantity	5x analogue inputs, securely separated: ■ AI1–AI2: Analogue input with HART interface ■ AI3: Analogue input ■ AI4–AI5: Analogue input with intrinsically safe design with HART interface - Ex limits must be observed without fail! - Recommended for pressure and temperature measurement.
Range	4–20 mA
Resolution	24 bit ADC
U_{max}	22 V
I_{max}	21 mA
Measurement time	~ 500 ms
Measurement rate	2 Hz
Analogue outputs per stream	
Quantity	4x analogue outputs: ■ AO1–AO4: Analogue output
Range	4–20 mA
Resolution	PWM 14 bit
Pulse inputs per stream	
Quantity	■ 2x pulse inputs (PI1 and PI2) in intrinsically safe design, - Ex limits must be observed without fail - N1–N2: for reed (LF) or Namur (HF) ■ 1x encoder input in intrinsically safe design, - Ex limits must be observed without fail - N3 ■ 2x pulse inputs (PI3 and PI4) not intrinsically safe in open-collector design - DI1 and DI2
Measuring range	■ Reed: 0–5 Hz ■ Namur: 0–5 kHz ■ OC: 0–5 kHz
U_{max}	8.2 V
I_{max}	16 mA
4-wire PT100 input per stream	
Number intrinsically safe	1x PT100 input with 4 terminals for resistance measurement (T--, T-, T+, T++) - The PT100 input is intrinsically safe – Ex limits must be observed without fail!
Number **not** intrinsically safe	1x PT100 input with 4 terminals for resistance measurement (T1--, T1-, T1+, T1++)

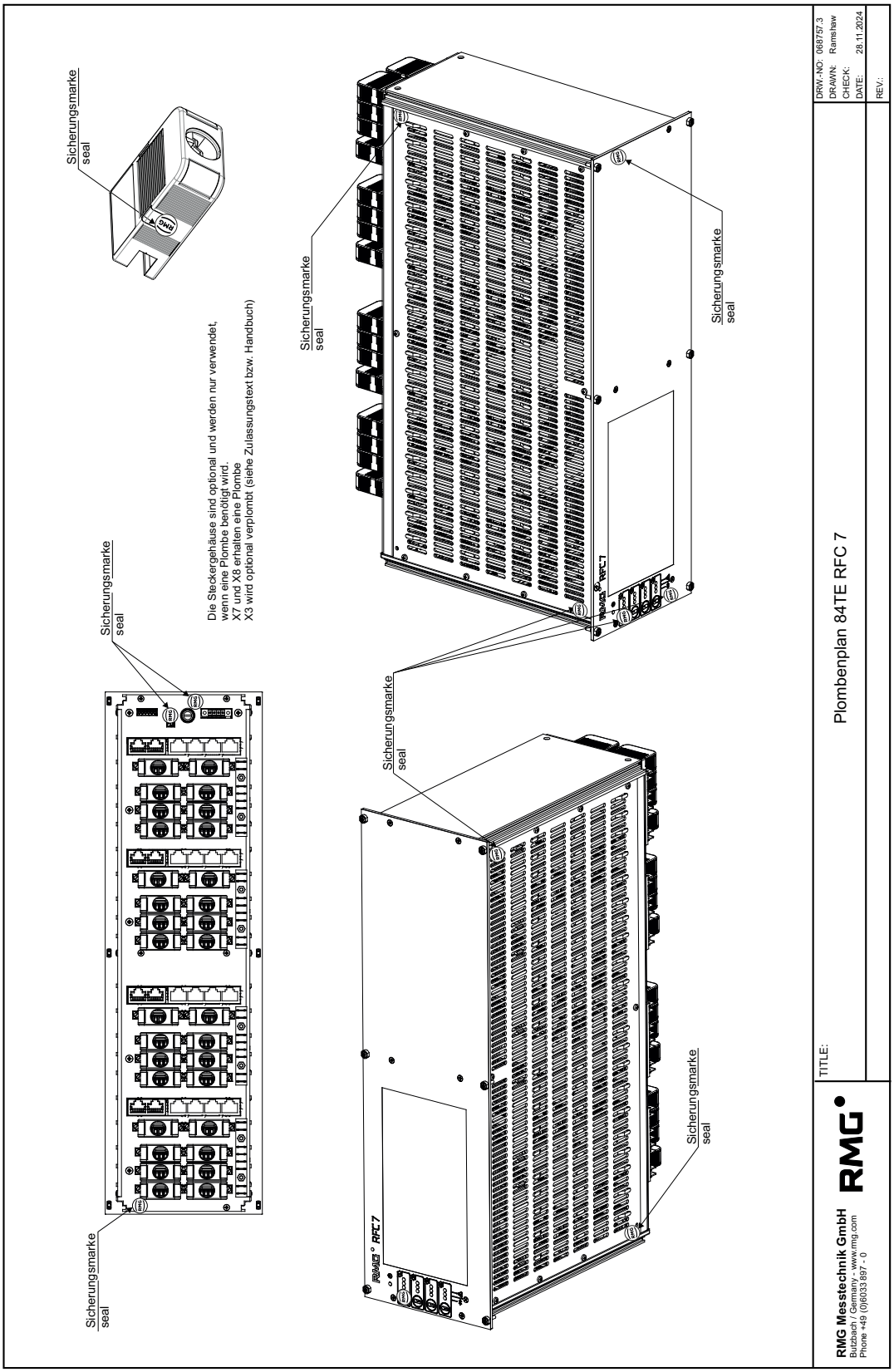
Temperature range	-20 °C to 60 °C
Resolution	24 bit ADC
U_{max}	5 V
I_{max}	1.6 mA, typ. 0.8 mA
Measurement rate	>2 Hz
Alarm/warning outputs per stream	
Quantity	2x warning outputs and 2x alarm outputs ■ W-NC and W-NO ■ A-NC and A-NO
U_{max}	24 V DC
I_{max}	30 mA
f_{max}	2 Hz

Annex A – lead seal plan

Single-Stream variant



Multi-Stream variant



Annex B – Declaration of conformity

NOTE

EU declaration of conformity

The declaration of conformity presented reflects the situation on the data when the operating manual was issued. The latest version of the EU declaration of conformity is available from our website www.rmg.com.

To be added!

ONE STEP AHEAD

Subject to change without notice!

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Additional information

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or contact your customer adviser.

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