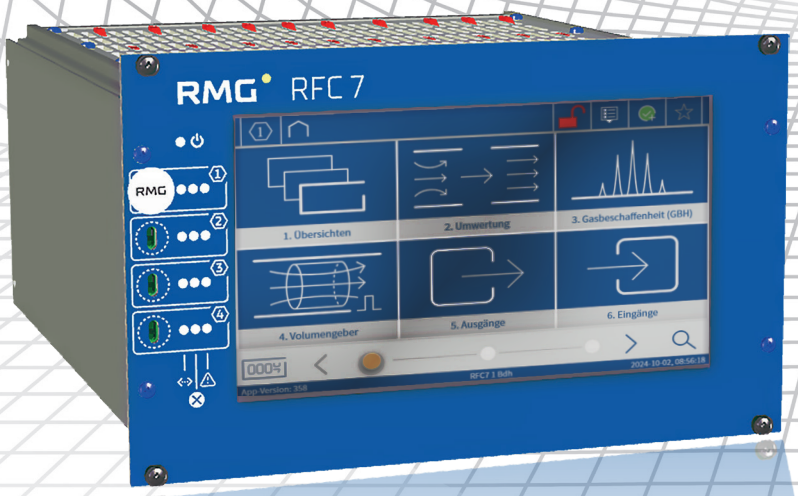
RMG
ONE STEP AHEAD

RMG FLOW COMPUTER

RFC 7

Operating Manual



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Document information

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

Version	Version date	Changes
V00	December 2024	Initial creation

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, the so-called platform for 19" device technology.

These operating instructions provide the information required for the proper, trouble-free and safe operation of the Flow Computer RFC 7.

It is part of the RFC 7 and must be kept near the device and accessible to personnel at all times.

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

These instructions apply to the RFC 7 variants listed below:

- Single stream (1 stream, the data from one measuring point is processed in RFC 7.
- Multi-stream (2 - 4 streams, the data from up to four independent measuring points are processed in RFC 7).

The aforementioned variants are available with different software and parameterisation in the following versions:

- -Vol: Status flow computer
- -Energy: Calorific value flow computer

The Flow Computer RFC 7 is used as an individual component in a complete system. The instructions for other components used therefore also apply in addition to these instructions. If you find contradictory instructions in the various manuals, 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 (DGRL)	**P**ressure **E**quipment **D**irective 2014/68/EU
DVGW	German Association for Gas and Water (**D**eutscher **V**erein des **G**as- und **W**asserfaches)
ATEX	Explosion protection in accordance with ATEX product directive 2014/34/EU (**AT**mosphères **EX**plosives)
MessEG	German Weights and Measures Act (**Mess**- und **E**ich**g**esetz)
MessEV	German Weights and Measures Ordinance (**Mess**- und **E**ich**v**erordnung)

Table 1: Abbreviations

PTB	Federal Institute of Physics and Technology (**P**hysikalisch **T**echnische **B**unde-sanstalt)
CoM	**C**omputer **o**n **M**odule
IOC	**I**nput **O**utput **C**ontroller
GUI	**G**raphical **U**ser **I**nterface
DSfG	Digital Interface for Gas Measurement Equipment (**D**igitale **S**chnittstelle **f**ür **G**asmessgeräte)
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 gas meter
Vo	Original totaliser
ENCO	Encoder for digital transmission of the original totaliser
HART	**H**ighway **A**ddressable **R**emote **T**ransducer Protocol: Standardised, digital communication overlaid on the 4…20 mA analogue signal for data exchange with encoder devices

Table 1: Abbreviations

1.3 Symbols

This manual uses the following symbols:

1., 2., ...	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 consequence of an implemented measure or action 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 RFC 7 flow computer is used to record and analyse signals and measurement results from gas meters and gas analysis devices as well as pressure and temperature sensors from up to four measuring points in order to determine standard volume flows and energy quantities, among other things. The measurement results and calculated output variables can be monitored and archived with the RFC 7. It can be used in various applications as:

- Status flow computer for determining the K-number1) and the standard volume of gas mixtures, such as natural gas and biogas (version: -Vol)
- Calorific value flow computer for determining the K-number1) and the energy content of gas mixtures, such as natural gas and biogas (version: -Energy)

[1)] Compressibility number: correction factor for the deviation of the actual, real gas behaviour from the ideal gas behaviour

When the device is first placed on the market, the settings required for custody transfer applications are made at the factory and secured against significant changes with seals and software and hardware locks.

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

The RFC 7 has been designed and manufactured in accordance with the state of the art and recognised safety standards and guidelines, but its use may nevertheless result in hazards or damage to the appliance and other property. You may only use the RFC 7 as intended and in a technically perfect condition.

Observe the operating instructions and comply with the instructions for handling, installation, commissioning, operation and maintenance.

Clean and maintain the appliance regularly and observe the regulations for wearing personal protective equipment (e.g. safety helmet, safety goggles, safety shoes).

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 seals, software and hardware locks on devices intended for custody transfer applications.
- Unauthorised changes to settings in the device, especially for devices with custody transfer applications.

NOTE

Use other than as intended

Using the device in a way other than intended renders all commercial guarantee claims void, in addition, the Flow Computer RFC 7 may lose its authorisations.

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 is authorised and placed on the market in accordance with the following directives:

- Measuring Instruments Directive 2014/32/EU
- EMC Directive 2014/30/EU
- Rohs guideline 2011/65/EU

Variants of the RFC 7, which have an input card that realises the safe isolation of signals from intrinsically safe field devices (Ex-i), are additionally approved and placed on the market in accordance with the following directive:

- ATEX Directive 2014/34/EU

For operation in custody transfer applications within Germany, approval is sought in accordance with the following laws and regulations:

- German Weights and Measures Act – MessEG, from 25/07/2013
- German Weights and Measures Ordinance – MessEV, from 11/12/2014

Depending on the device variant, the required harmonised standards were applied. The following list contains all standards that can 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 are also approved in accordance with the ATEX Directive also bear the following labelling:

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

Please contact RMG Messtechnik GmbH if you have any questions or require additional information.

2.5 Type label

The Flow Computer RFC 7 has different type plates on the front panel depending on the approval, the number of streams present and the intended function. A distinction is essentially made between

- Type plate basic unit RFC 7
- Type plate for each stream

2.5.1 Type plate basic device

Depending on the version, the RFC 7 basic device is fitted with the following type plates as examples.

Approval according to the Measuring Instruments Directive (MID)

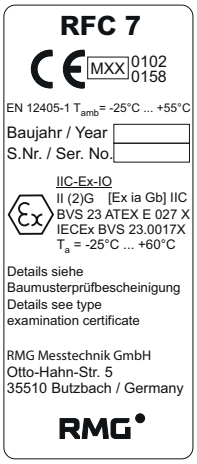


Fig. 1: Type plate with Ex equipment (exemplary)

Approval according to MessEG and MessEV

Fig. 2: Type plate with Ex equipment (exemplary)

2.5.2 Stream type plate

Depending on the approval and function carried out, each stream is given the following type plates as examples.

Approval according to the Measuring Instruments Directive (MID)

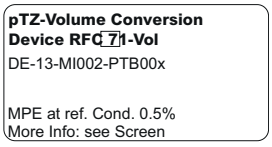


Fig. 3: Nameplate status volume corrector (stream 1 as an example)

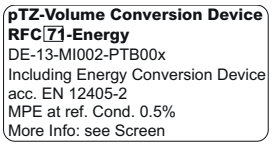


Fig. 4: Nameplate calorific value volume corrector (stream 1 as an example)

Approval according to MessEG and MessEV

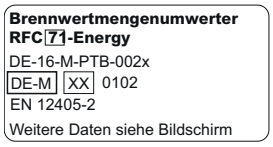


Fig. 5: Nameplate calorific value volume corrector (stream 1 as an example)

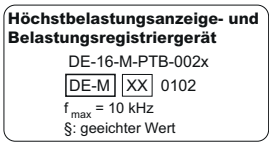


Fig. 6: Type plate maximum load indicator and load recorder (Steam 1 as an example)

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 undergone training 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
Complete plug set	1
Operating manual	1

Table 3: Scope of delivery

For further information on the device, 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

Custody transfer applications

If the Flow Computer RFC 7 is intended for custody transfer applications, it is preset in the factory before delivery in accordance with the approval and secured against unauthorised changes with seals, software and hardware locks. If these security devices are removed or damaged, the RFC 7 loses its approval and may no longer be used in custody transfer applications.

- ▶ Never remove or damage the seals and other protection!
- ▶ However, if a seal has been removed or damaged, a check by a state-recognised body or a calibration officer and an additional check of the other settings at the factory are required. After locking, the verification officer must restore the seals so that the RFC 7 can be used in custody transfer operation 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 galvanic 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.
- ▶ Only have the initial commissioning carried out by qualified 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 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 12 "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 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.

⚠ 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 galvanic isolation if they are connected to the RFC 7.
- Check the safety-related data of the RFC 7 and the connected intrinsically safe components and record the test in a corresponding intrinsic safety certificate.

4 Product description

The device concept - the platform - is designed as a universal system to cover many applications and the connection of all individual RMG Messtechnik devices.

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

- Single stream (1 stream; the data of one measuring point is processed in RFC 7).
- Multi-stream (2 - 4 streams; the data from up to four independent measuring points are processed in RFC 7).

A stream means that the signals and measurement data of a measuring point are registered, saved, converted and output. Each stream has its own hardware, but all streams share the same touchscreen. The individual streams are labelled as follows:

Designation	Variation	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 accommodated in the following housing sizes depending on the number of streams selected:

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

Both sizes have the actual housing (item 3), a housing cover (item 1) with ventilation slots, a housing base (item 4), a front panel for operation (item 5) and a rear panel with connections (item 2).

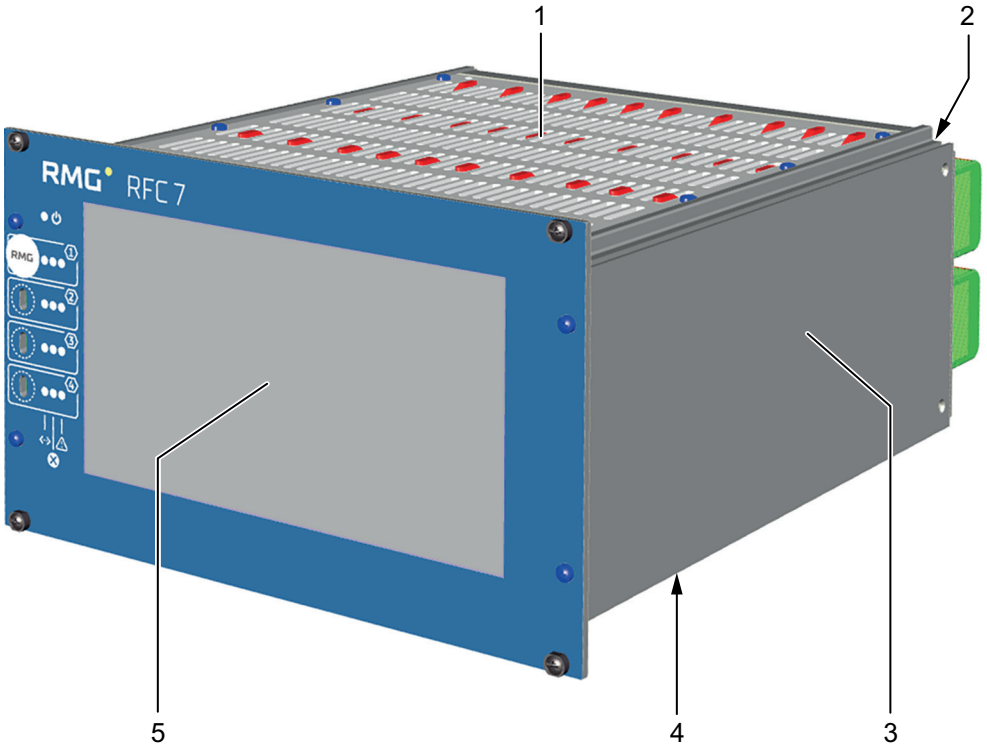


Fig. 7: RFC 7 – 19" housing for 1 to 2 streams

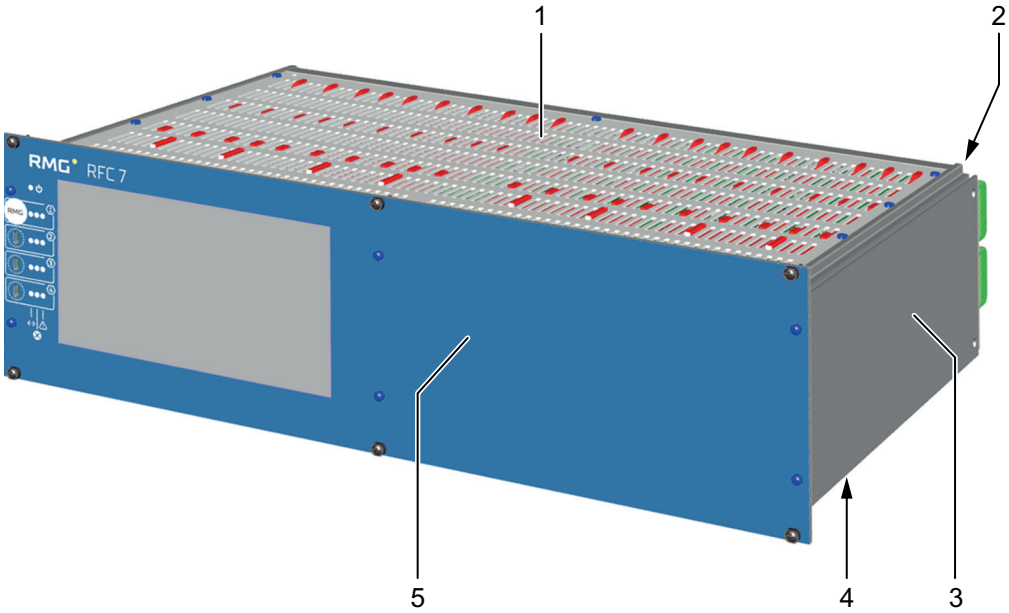


Fig. 8: RFC 7 – 19" housing for 3 to 4 streams

Item	Designation	Item	Designation
1	Housing cover with venting slits	2	Device back panel with connections
3	19"-Housing	4	Housing base
5	Front panel		

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

4.1.2 Front panel

The front panels of both housings each contain:

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

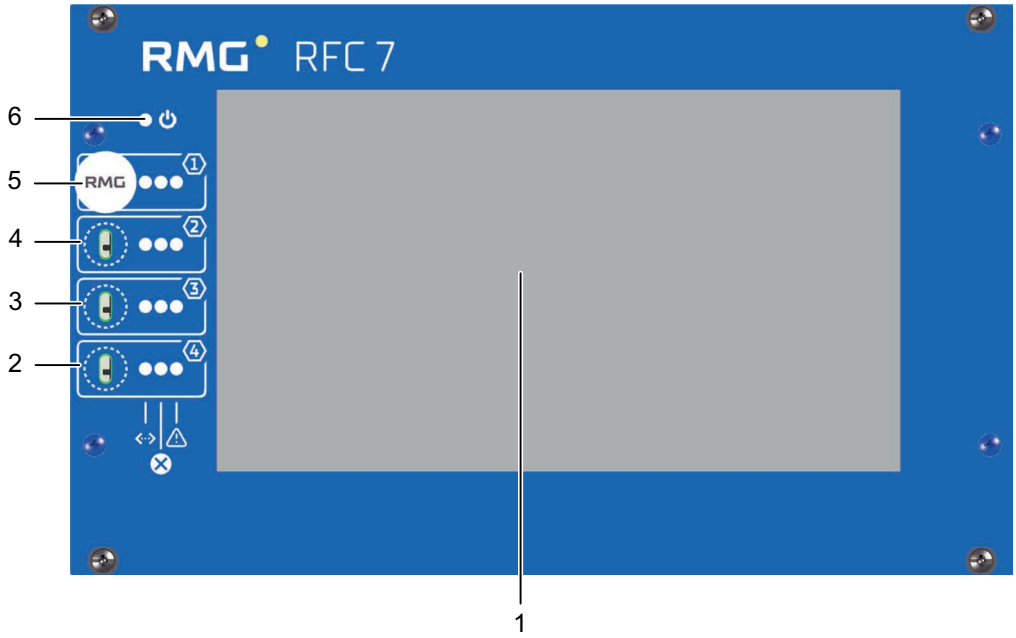


Fig. 9: Front panel RFC 7 - ½ 19" housing

Item	Designation	Item	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	Power supply LED on (blue)

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

- Measurement running (green), cf. fig. 10, item 1
- Warning (yellow), cf. fig. 10, item 2
- Alarm/fault/error (red), cf. fig. 10, item 3

The calibration switch (cf. fig. 10, item 4) is used to lock the calibration settings made for the respective stream. It can be moved up and down vertically using an additional tool and is secured with a calibration seal for custody transfer applications.

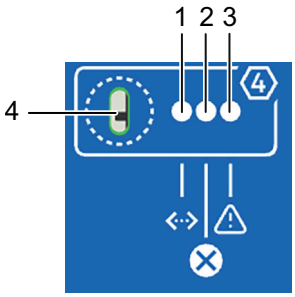


Fig. 10: Status LEDs and calibration switch, exemplary for Stream 4

Item	Designation	Function
1	LED **measurement running** (green)	■ Lit up continuously: the measurement is running smoothly
2	LED **Warning** (yellow)	■ Lit up continuously: There is a warning.
3	LED **Fault/error** (red)	■ Not lit: there is no fault/error ■ Flashing: there is a current fault/error ■ Lit up continuously: there was a fault/ error
4	Calibration switch	■ Locking of the custody transfer parameters and functions. The calibration switch can be moved up and down using an additional tool.

4.1.3 Components in the housing

Regardless of the number of streams, each housing variant contains a power supply unit (24 V DC). The multi-stream variants also have an intercom board. The components for each stream are arranged next to each other in the housing, cf. fig. 11 and fig. 12.

Each stream has the same components, i.e. identical hardware, which is described in detail in the next section 4.1.4 "Components of one stream".

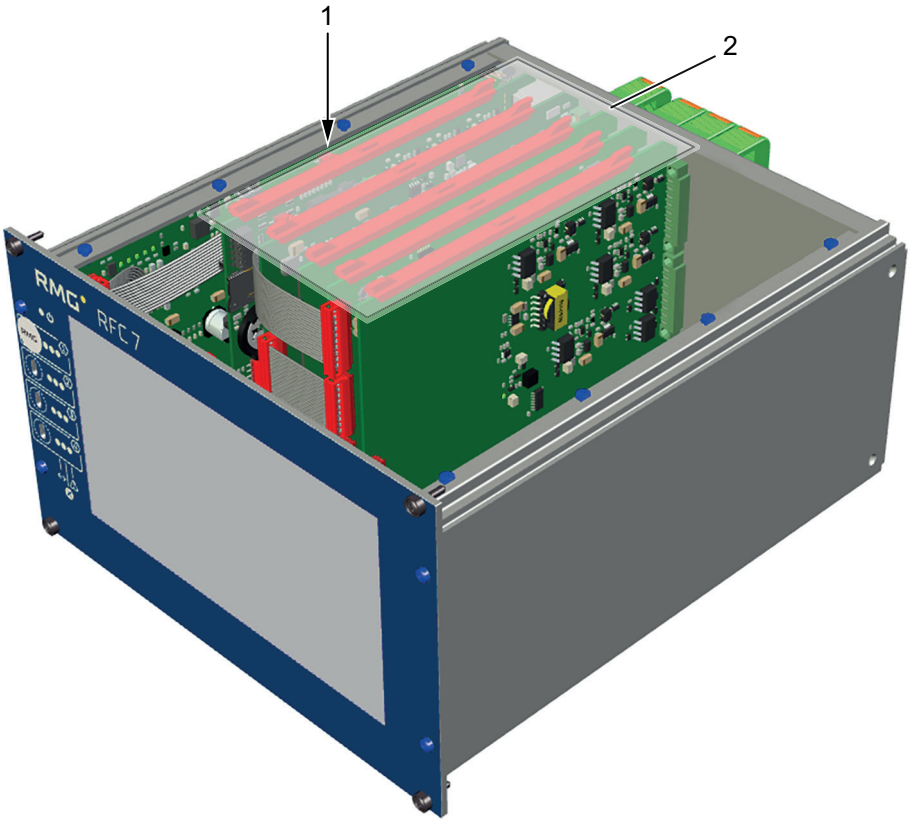


Fig. 11: Single-stream: Arrangement of the components of one stream in the housing

Item	Desigation	Item	Designation
1	24 V DC power supply unit	2	Stream unit

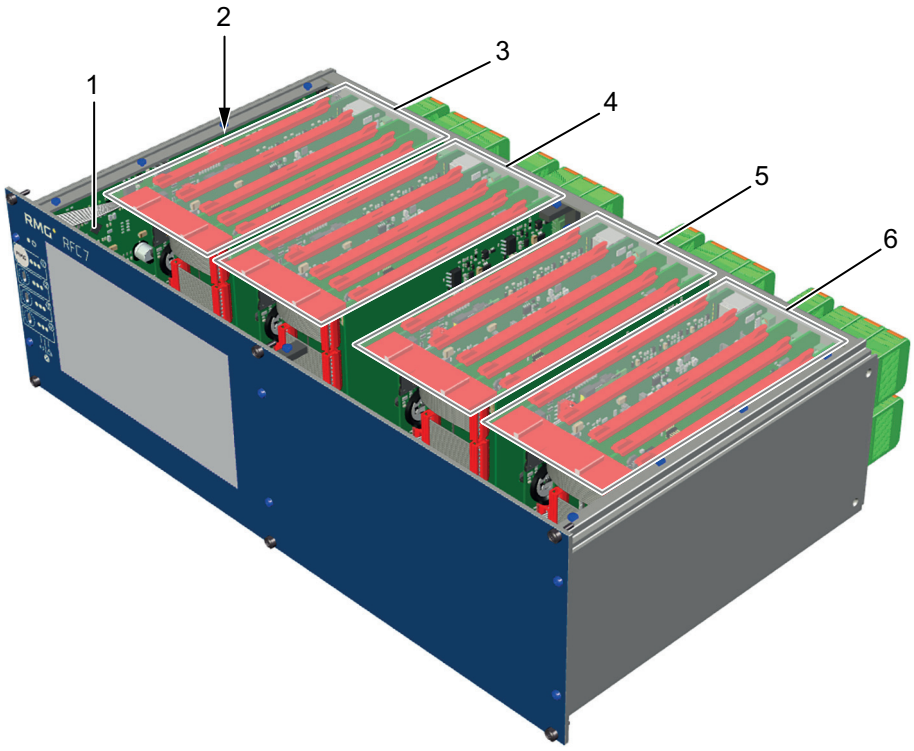


Fig. 12: Multi-Stream: Anordnung der Komponenten von 4 Streams im Gehäuse

Item	Designation	Item	Designation
1	Intercom	2	24 V DC power supply unit
3	Stream unit 1	4	Stream unit 2
5	Stream unit 3	6	Stream unit 4

4.1.4 Components of one stream

The hardware (components) of a stream consists of a total of 5 plug-in boards that fulfil different functions:

- **CoM basis** for communication and calculation (fig. 13, item 1)
- **IO system** consisting of the following boards:
  - **IOC EX-IO** as an interface to the Ex zone with safely separated inputs and outputs (fig. 13, item 2)
  - **IOC digital IO** as an interface for digital inputs and outputs outside the Ex zone (fig. 13, item 3)
  - **IOC CPU** for processing all analogue and digital inputs and outputs (fig. 13, item 4)
  - **IOC analogue out** as an interface for analogue outputs outside the Ex zone (fig. 13, item 5)

All the intended functions can be carried out with these plug-in boards. An extension with plug-in boards for additional functions is not planned.

The **CoM base** (Computer on Module) is used for communication, controls the touch-screen and provides the computing power for volume conversion.

The **IO system** handles the complete measurement technology with actuators and sensors.

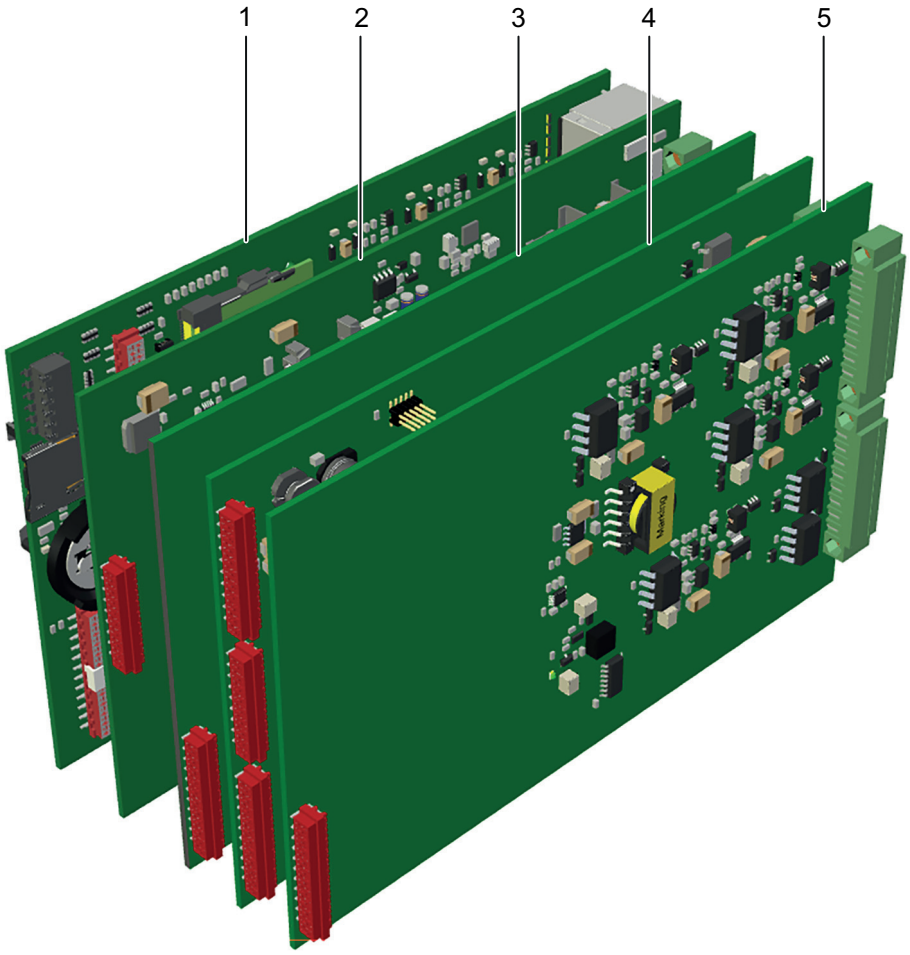


Fig. 13: Components of a stream (front view)

Item	Designation	Item	Designation
1	CoM base	2	IOC EX-IO
3	IOC digital IO	4	IOC CPU
5	IOC analogue out		

4.1.5 Connections

The connections of the RFC 7 are located in the rear panel of the appliance. Each single or multi-stream variant has the following connections (cf. fig. 14 and fig. 15):

Power supply unit connections:

- Power supply 24 V DC
- USB connection (cannot be used for custody transfer applications as it is sealed)
- Optional 1 alarm and 1 warning output, NO or NC (cannot be used in RFC 7)
- Fuse

Connections per stream (COM basis and IO system):

- 5 analogue inputs, of which 2 analogue inputs are safely isolated
- 4 analogue outputs
- 2 alarm and 2 warning outputs, each NO and NC
- 4 digital inputs

- 6 digital outputs, including 2 pulse outputs
- 2 pulse inputs (Reed/Namur) and one encoder input, safely separated
- 4-wire connection for PT100, safely isolated
- 3 RS485 serial interfaces
- 4 Ethernet connections

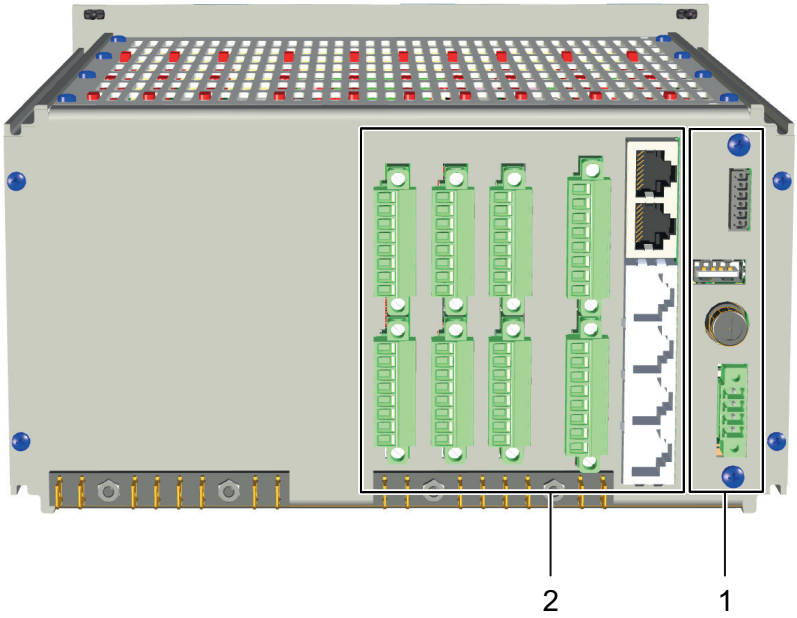


Fig. 14: Single Stream: Arrangement of the connections in the rear panel

Item	Designation	Item	Designation
1	Power supply connections	2	Connections and terminal strips Stream 1

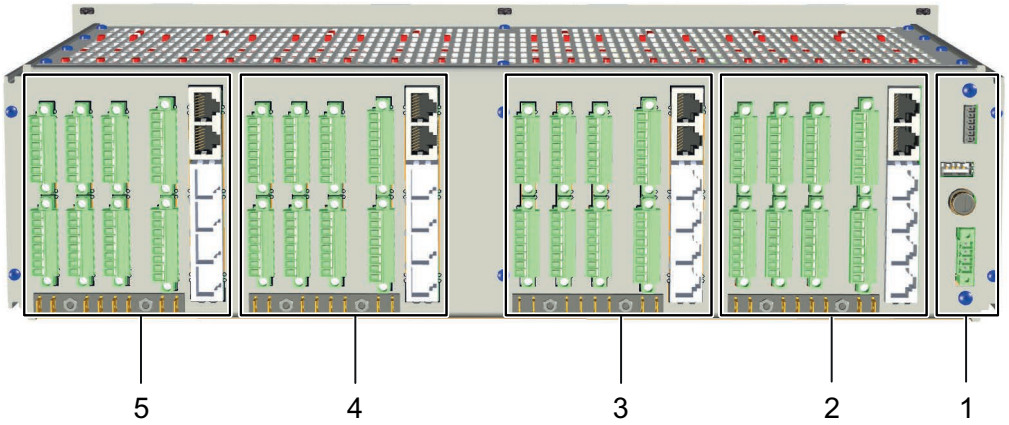


Fig. 15: Multi Stream: Arrangement of the connections in the rear panel

Item	Designation	Item	Designation
1	Power supply connections	2	Connections and terminal strips Stream 1
2	Stream 2 connections and terminal strips	4	Stream 3 connections and terminal strips
5	Connections and terminal strips Stream 4		

The assignment of the individual terminal strips and further information on the connection options can be found in section 6.2 "Electrical installation".

4.2 Function of the RFC 7

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

- Measurement data recording from gas meters, gas analysers, pressure and temperature sensors and monitoring of measurement data acquisition.
- Processing of measurement data and calculation of process variables such as standard volume flow, K-number and energy quantities using suitable calculation methods for various gas models.
- Archiving and output of the measured values and calculated process variables or visualisation in graphical form, as well as sending alarm and warning messages in the event of limit value violations.

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:

- Status flow computer for determining the K-number1) and the standard volume of gas mixtures, such as natural gas and biogas (version: -Vol)
- Calorific value flow computer for determining the K-number1) and the energy content of gas mixtures, such as natural gas and biogas (version: -Energy)

[1)] Compressibility number: correction factor for the deviation of the actual, real gas behaviour from the ideal gas behaviour

The following calculation methods are available for calculating the K-number for both applications:

- k = constant
- Full analsysis:
  - AGA 8 DC92
  - AGA 8:2017
  - GERG-2004
  - GERG-2008
- Gross values:
  - GERG-88 S
  - GERG-88 S Satz B
  - GERG-88 S Satz 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 the operation, the individual menus of the user interface and the parameter setting options, please refer to section 7 "Usage" 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. First of all, the delivery should 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").

- In the event of damage, please contact RMG Messtechnik immediately.

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 when energised.

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-Ex area (safe area). It is connected to gas meters, gas analysers, pressure and/or temperature sensors installed in a hazardous area via appropriate connection lines.

The following diagram illustrates the separation of the installation locations on a gas station into the hazardous area and the non-hazardous area.

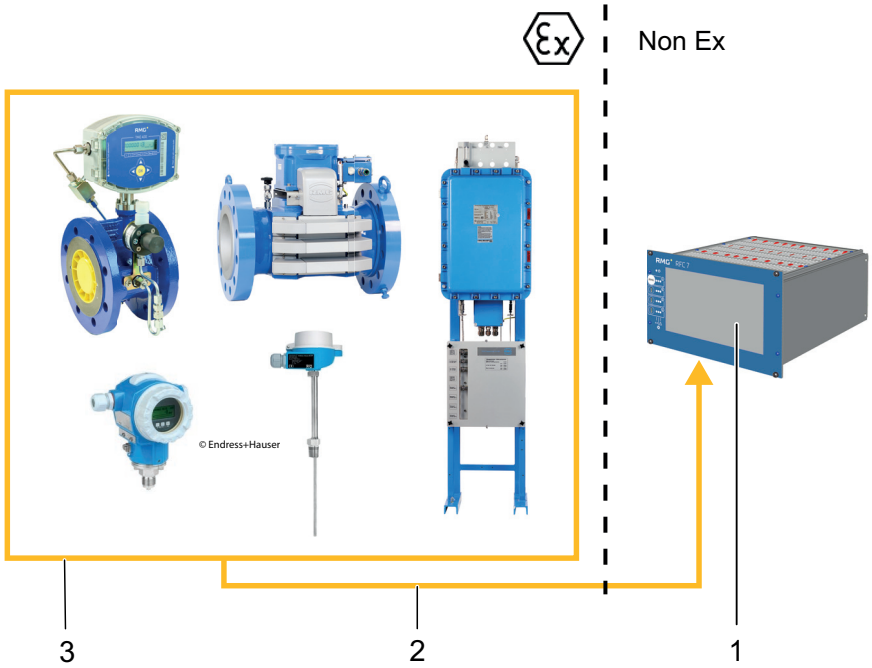


Fig. 16: Separation of the places of installation in a gas station

Item	Designation	Item	Designation
1	Flow Computer RFC 7	2	Connection cables
3	Gas meter, gas analyser, pressure 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 subrack in a control cabinet (non-Ex area), but can alternatively also be used 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 U) x 230 mm (W x H x D) (without connector on the rear)
- 19" housing (3 - 4 streams):
  426.72 mm (84 HP) x 133.35 mm (3 U) x 230 mm (W x H x D) (without connector on the rear)

The weight also varies, depending on the device variant, 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.

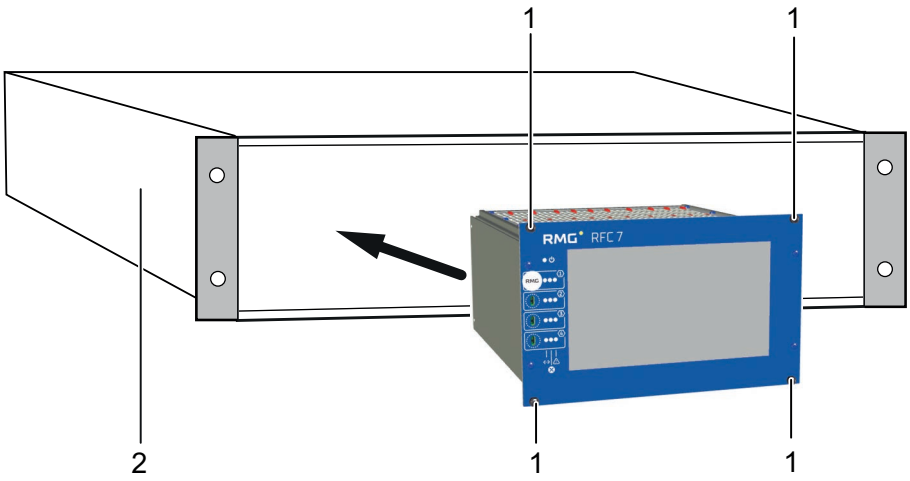


Fig. 17: Position of the screws on the front panel of the RFC 7

Item	Designation	Item	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, item 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 the section 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 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 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 numerous electrical and signal connections for each stream, which are located in the rear panel of the device. The connections are described below as an example for the single-stream device variant (cf. fig. 18).

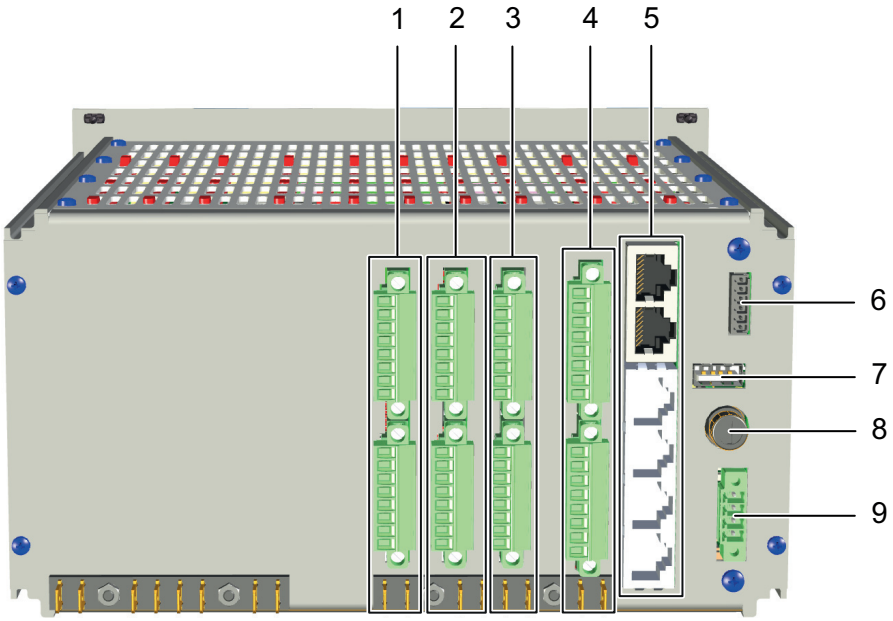


Fig. 18: Connections in the rear panel of the device (example for single-stream device variant)

Item	Designation	Item	Designation
1	**IOC analogue 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 base** connections with **X9A/B** and **X10A-D**	6	Reserve
7	USB connection	8	Fuse
9	Power supply 24 V DC		

6.2.2 Terminal assignments of the terminal strips

All connections and terminal strips on the rear panel of the appliance are labelled as follows (cf. fig. 19).

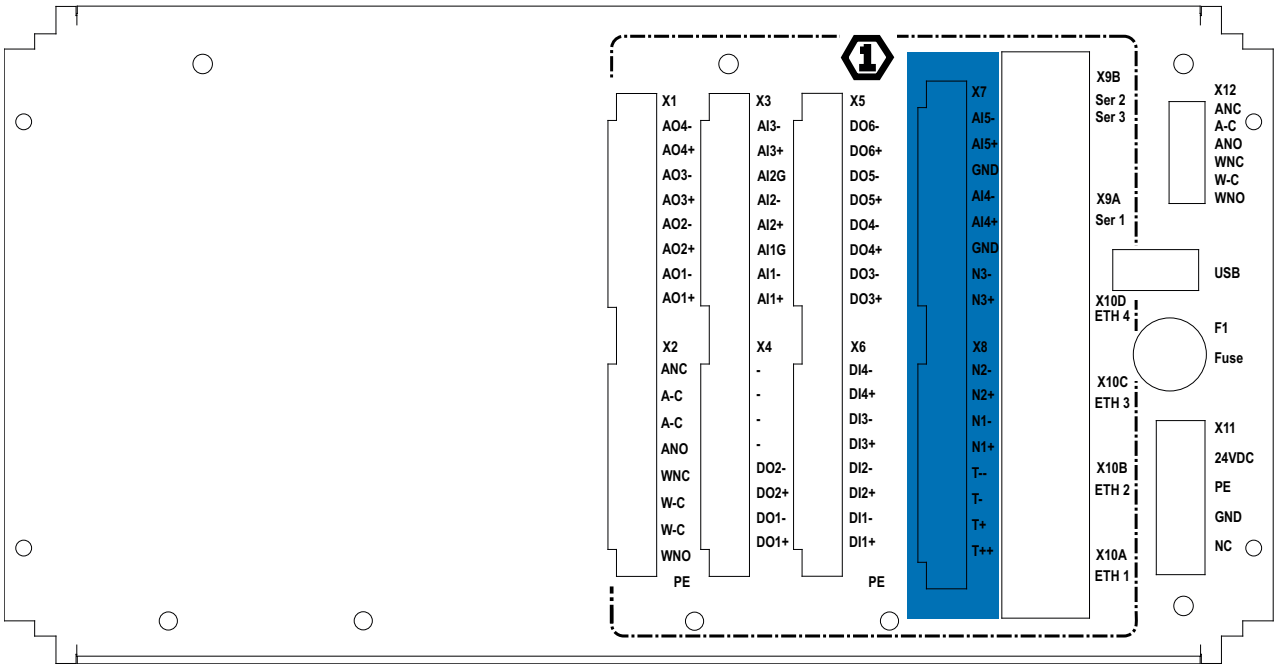


Fig. 19: Labelling of the connections on the rear panel of the appliance (example for single-stream appliance variant)

The connection assignment of the individual wires of terminal strips X1 to X12 is listed below. The terminal numbers highlighted in light red represent the coding of the corresponding connectors (Phoenix):

IOC analogue out, terminal strip X1 and X2

Core 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, a measured value or a default value must be assigned to each analogue output in the user interface in menu 5 Outputs.
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 the event of an alarm.
7	A-C		
6	A-C	Alarm output NO	Contact opened in the event of an alarm. (closed-circuit current principle)
5	ANO		

Table 6: Terminal assignment IOC analogue out

Core no.	Des. short	Designation long	Function
4	WNC	Warning output NC	Contact closed in the event of a warning.
3	W-C		
2	W-C	Warning output NO	Contact opened in the event of a warning. (closed-circuit current principle)
1	WNO		

Table 6: Terminal assignment IOC analogue out

IOC CPU, terminal strip X3 and X4

Core no.	Des. short	Designation long	Function
Terminal strip X3			
8	AI3-	Analogue input 3	The analogue inputs 1 to 3 can be used to record analogue measurement signals. (4-20 mA). Do enable this, they must be parameterised accordingly in the menu 6. Inputs.
7	AI3+		
6	AI2G	Analogue input 2	
5	AI2-		
4	AI2+		
3	AI1G	Analogue input 1	
2	AI1-		
1	AI1+		
Terminal strip X4			
8	–		
7	–		
6	–		
5	–		
4	DO2-	Digital / pulse output 2	
3	DO2+		
2	DO1-	Digital / pulse output 1	
1	DO1+		

Table 7: Terminal assignment IOC CPU

IOC digital IO, terminal strip X5 and X6

Core no.	Des. short	Designation long	Function
Terminal strip X5			
8	DO6-	Digital output 6	Digital outputs 3 to 6 can be used for signalling limit value violations or error numbers. To enable this, the outputs must be parameterised accordingly in menu 5 Outputs.
7	DO6+		
6	DO5-	Digital output 5	
5	DO5+		
4	DO4-	Digital output 4	
3	DO4+		
2	DO3-	Digital output 3	
1	DO3+		
Terminal strip X6			
8	DI4-	Digital input 4	Digital inputs 1 to 4 can be used to output errors or warnings. To enable this, the inputs must be parameterised accordingly in menu 6 Inputs.
7	DI4+		
6	DI3-	Digital input 3	
5	DI3+		
4	DI2-	Digital input 2	
3	DI2+		
2	DI1-	Digital input 1	
1	DI1+		

Table 8: Terminal assignment IOC digital IO

IOC Ex-IO, terminal strip X7 and X8, intrinsically safe

Core no.	Des. short	Designation long	Function
Terminal strip X7			
8	AI5-	Analogue input 5 (with HART interface)	Analogue input 5 can be used to record both analogue measurement signals (4-20 mA) and digital signals. (Use for temperature measurement is recommended.)
7	AI5+		
6	GND		
5	AI4-	Analogue input 4 (with HART interface)	Analogue input 4 can be used to record 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 assignment IOC Ex-IO

Core no.	Des. short	Designation long	Function
Terminal strip X8			
8	N2-	Pulse input Reed/ Namur 2	Digital pulse input for Reed or Namur
7	N2+		
6	N1-	Pulse input Reed/ Namur 1	Digital pulse input for Reed or Namur
5	N1+		
4	T--	4-wire PT100	Connection of a PT100 with 4-wire technology for precise temperature measurement.
3	T-		
2	T+		
1	T++		

Table 9: Terminal assignment IOC Ex-IO

CoM base, terminal strip X9 A/B and X10 A-D

Core no.	Des. short	Designation long	Function
Terminal X9B (type RJ45)			
	Ser2	Serial interface 2 RS485	ModbusClient for Gas quality / ModbusClient for USM / ModbusServer RTU / Modbus-Server ASCII
	(Ser3 optional)	(Serial interface 3 RS485 optional via adapter)	ModbusClient for Gas quality / ModbusClient for US / ModbusServer RTU / ModbusServer ASCII
Terminal X9A (type RJ45)			
	Ser1	Serial interface 1 RS485	ModbusClient / ModbusClient for Gas quality / ModbusClient for USM / ModbusServer RTU / ModbusServer ASCII /DSfG-A
Terminal X10D (type RJ45)			
	ETH 4	Ethernet 4	For connecting a PC or local network, RJ45 socket 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 assignment CoM base

Core no.	Des. short	Designation long	Function
Terminal X10A (type RJ45)			
	ETH 1	Ethernet 1	see Ethernet 4

Table 10: Terminal assignment CoM base

Power supply unit, terminal strip X11 and X12, USB connection, fuse

Core 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	Connection of USB components (e.g. a computer mouse) If the RFC 7 is used in custody transfer mode, the USB port is sealed and cannot be used.
F1			
	Fuse	Fuse	Protection of the RFC 7 against overcurrent
Terminal strip X11			
1	24VDC	Power supply +24 V	Power supply of the RFC 7
2	PE	Potential equalisation	
3	GND	0 V	
4	NC	not used	

Table 11: Terminal assignment power supply unit

6.2.3 Power supply and fuse protection

The RFC 7 must be supplied with 24 V (DC) power. 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 Ampère.

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 Connect temperature measurement

The following temperature measurements can be used to determine the current operating temperature of the gas to be measured:

- PT100 sensor: A PT100 is a platinum resistance thermometer that changes its resistance depending on the temperature. At 0 °C it has a resistance of 100 ohms. If a 4-wire circuit is used for the connection, this fully compensates for the lead resistance and offers maximum accuracy. A PT100 without lead break resistors is used.
- Temperature transmitter: A temperature transmitter converts the signal from a temperature sensor (such as a PT100) into a standardised analogue or digital output signal that can be easily processed by the Flow Computer RFC 7 (4-20 mA and/or HART).

Both the PT100 and the temperature transmitter are generally located in a potentially explosive atmosphere and must therefore be safely disconnected when connected to the flow computer.

In principle, a temperature transmitter could be connected to all analogue inputs of the RFC 7, but an additional isolation module would then be required for analogue inputs 1 - 3 for safe isolation. Furthermore, these inputs do not have the option of using the digital HART protocol, i.e. only temperature transmitters with an analogue output signal could be connected.

For this reason, connection to the IOC-EX-IO card (terminal strip 7 and 8 in the rear panel of the device) is recommended, which already has the necessary safe isolation and the option of using the HART protocol.

NOTE

Observe the operating instructions for the temperature sensor/transmitter!

As a wide variety of temperature sensors/transmitters can be used together with the RFC 7 flow computer, only the wiring on the flow computer is considered below.

▶ For further information on the connection to the temperature sensor/transmitter used, please refer to the operating instructions of the relevant manufacturer.

Connection of a PT100 with 4-wire technology to terminal strip X8, terminal no. 1 - 4

A PT100 must be connected to the above terminals as shown in fig. 20.

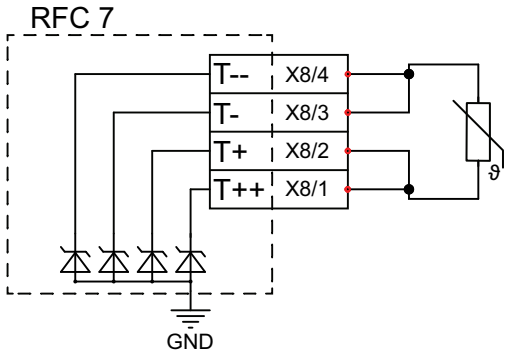


Fig. 20: el. PT100 connection

To be able to use the PT100, it must be connected as shown and parameterised accordingly in menu page 6.120 PT100 (see section 8.6.2 "PT100 - Set parameters").

Connection of an analogue or digital temperature transmitter to analogue input 5, terminal strip X7, terminal no. 6 - 8

When connecting a temperature transmitter to analogue input 5, it is important to consider whether the transmitter has its own power supply (active sensor) or whether it must be supplied with power via the flow computer (passive sensor). The connection must then be made accordingly, cf. fig. 21 and fig. 22.

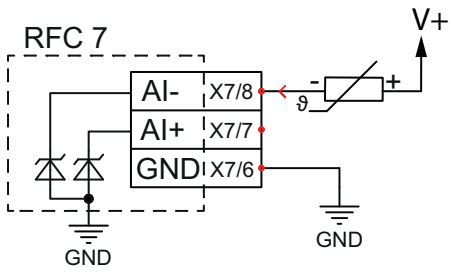


Fig. 21: Connection of active temperature transmitters

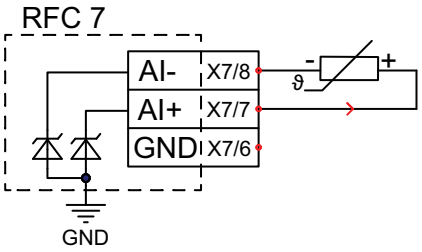


Fig. 22: Connection of passive temperature transmitter

To be able to use analogue input 5 for a digital temperature transmitter, it must be connected as shown above and parameterised accordingly in menu page **6.115 Analogue input 5 with HART** (see section 8.6.1 "Analogue inputs - Set parameters").

6.2.5 Connect pressure measurement

To determine the current operating pressure of the gas to be measured, a pressure transmitter is used whose measuring range and accuracy depend on the given operating conditions.

The pressure transmitter is also generally located in a potentially explosive area and must therefore be safely disconnected when connected to the flow computer.

Connection to the IO CEX-IO card (terminal strip 7 in the rear panel of the device), which already has the required safe isolation and HART protocol capability, is recom-

mended.

NOTE

Observe the operating instructions for the pressure transmitter!

As a wide variety of pressure transmitters can be used together with the RFC 7 flow computer, only the wiring on the flow computer is considered below.

- ▶ For further information on the connection to the pressure transmitter used, please refer to the operating instructions of the relevant manufacturer.

Connection of an analogue or digital pressure transmitter to analogue input 4, terminal strip X7, terminal no. 3 - 5

When connecting a pressure transmitter to analogue input 4, it is important to consider whether the transmitter has its own power supply (active sensor) or whether it must be supplied with power via the flow computer (passive sensor). The connection must then be made accordingly, cf. fig. 23 and fig. 24.

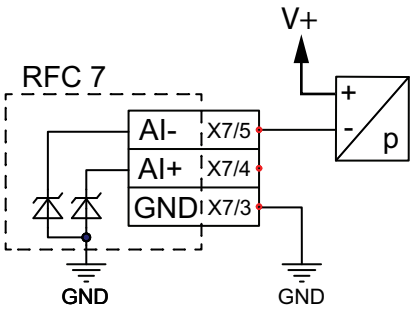


Fig. 23: Connection of active pressure transmitters

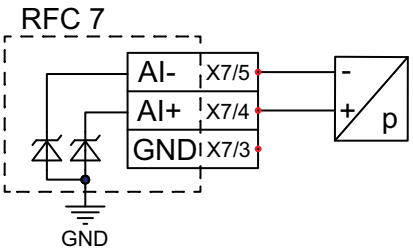


Fig. 24: Connection of passive pressure transmitter

To be able to use analogue input 4 for a digital pressure transmitter, it must be connected as shown above and parameterised accordingly in menu page **6.114 Analogue input 4 with HART** (see section 8.6.1 "Analogue inputs - Set parameters").

6.2.6 Connecting the mechanical gas meter

For example, turbine meters can be used as mechanical gas meters. Their mode of operation is based on measuring the gas velocity with a turbine wheel. The speed of the turbine wheel is (approximately) proportional to the average gas velocity and therefore to the flow rate within the measuring range (Qmin - Qmax). The number of revolutions is therefore a measure of the volume of gas flowing through.

Various signal or pulse generators are available for recording the speed, which transmit low-frequency (LF) or high-frequency (HF) pulses to the flow computer. The following schematic diagram provides an overview of their possible arrangement in a turbine meter (cf. fig. 25).

In principle, the processing of low-frequency or high-frequency pulses in the RFC 7 is independent of the measuring principle of the connected gas meter; rotary piston gas meters or other flow meters with frequency output can also be connected to the flow computer.

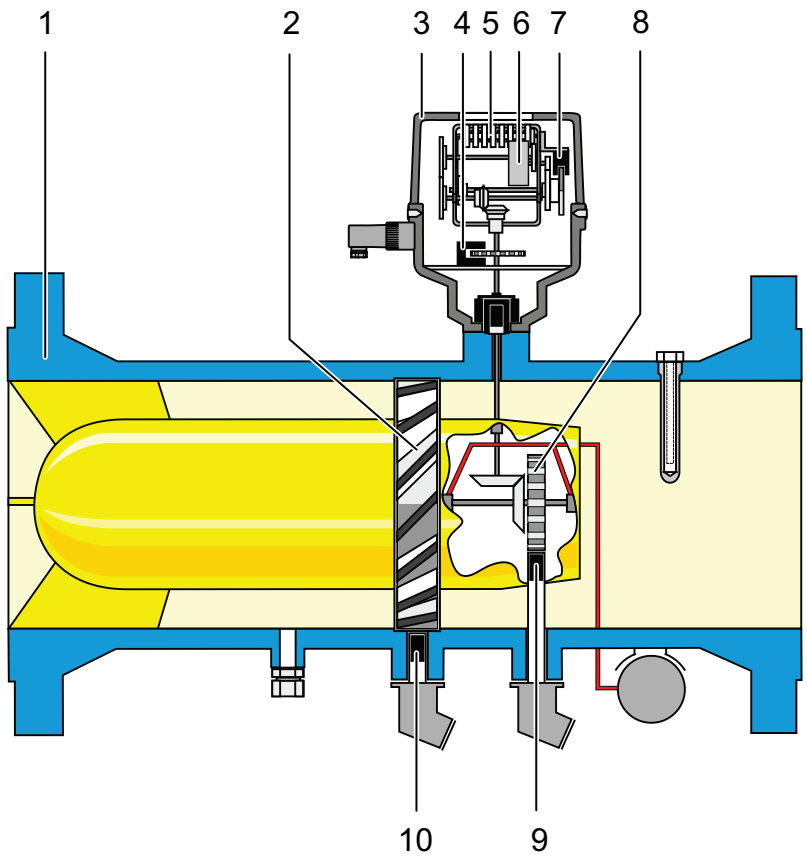


Fig. 25: Sectional drawing of turbine meter (example)

Item	Designation	Item	Designation
1	Housing turbine meter	2	Turbine wheel
3	Totaliser head	4	Pulse generator 3 (adjusting gear-wheel)
5	Mechanical totaliser	6	Encoder
7	Pulse generator 4 (mechanical totaliser)	8	Reference wheel
9	Pulse generator 2 (reference wheel)	10	Pulse generator 1 (turbine wheel)

Which pulse generators are connected to the flow computer must be decided according to the existing requirements.

NOTE

Observe the operating instructions for mechanical gas meters!

As a wide variety of mechanical gas meters can be used together with the RFC 7 flow computer, only the wiring on the flow computer is considered below.

- ▶ For further information on the connection to the mechanical gas meter used, please refer to the operating instructions of the relevant manufacturer.

The mechanical gas meter is usually installed in a potentially explosive area, so it must be safely disconnected when connected to the flow computer.

The Flow Computer RFC 7 offers the following connection options on the IOC-EX-IO card for this purpose, see also the figures 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**

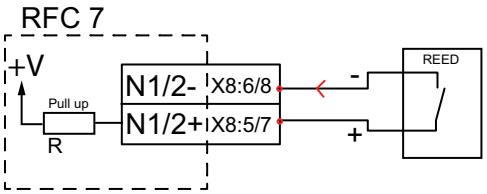


Fig. 26: Connection of mech. meter via REED

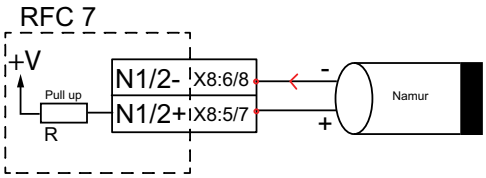


Fig. 27: Connection of mech. meter via Namur

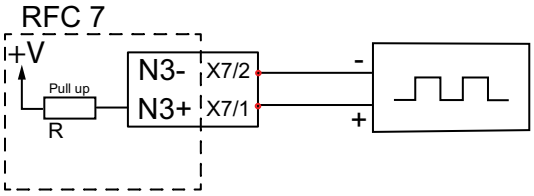


Fig. 28: Encoder connection

Pulse inputs 1 and 2 are used to record the speed or frequency regardless of the direction of rotation of the turbine wheel and the operating volume flow is determined from this. The result is written to the totalisers. Pulse inputs 1 and 2 are also used for synchronisation monitoring when two different pulse generators are connected.

The encoder input is used to digitally transmit the counter reading of the mechanical totaliser to the flow computer. This also records whether the turbine wheel, i.e. the gas meter, is running forwards or backwards, which is relevant in applications with a gas storage tank, for example. In addition, in the event of a fault, the encoder continues to supply the original meter reading while the fault totalisers are running instead of the volume totalisers.

To be able to use the pulse inputs and the encoder input, these must be connected as shown above and parameterised accordingly in the corresponding menu pages:

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

6.2.7 Connecting the ultrasonic gas meter

To determine the volume flow, an ultrasonic meter utilises the physical principle that an ultrasonic pulse propagates faster in the direction of flow of a gas than in the opposite direction. By measuring the transit time of the ultrasonic pulses between two ultrasonic transducers arranged opposite each other, the flow velocity and thus the flow rate can be determined. In order to achieve greater accuracy, several pairs of ultrasonic transducers are generally used, which form so-called measurement paths with their opposing arrangement in different planes of the gas meter cross-section (cf. fig. 29).

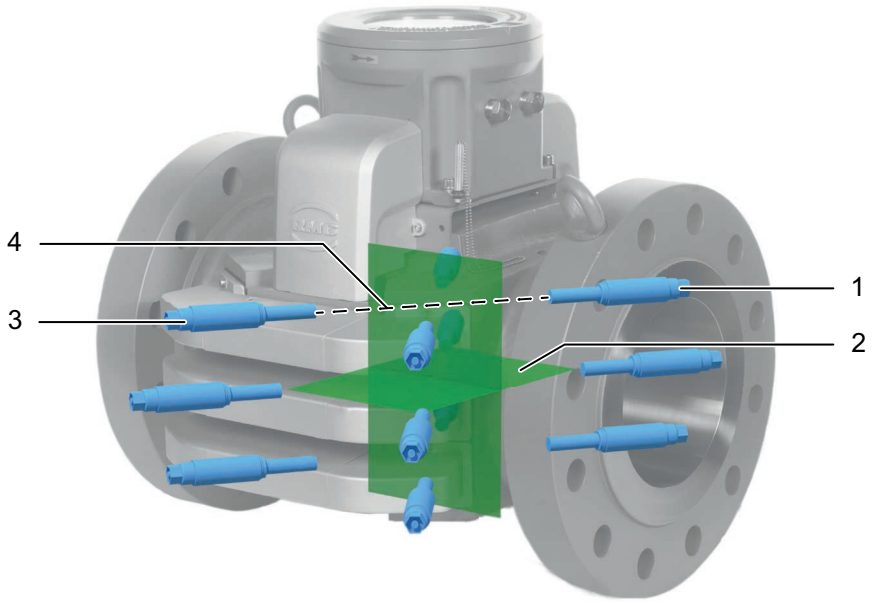


Fig. 29: Schematic diagram of the arrangement of ultrasonic transducers

Item	Designation	Item	Designation
1	Ultrasonic transducer	2	Measuring level
3	Ultrasonic transducer	4	Measuring path

To connect an ultrasonic gas meter, the Flow Computer RFC 7 offers the following connection options on the CoM base in the rear panel of the device:

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

To connect, proceed as follows:

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

To be able to use the serial interfaces, they must be parameterised accordingly in the corresponding menu page **9.7 Serial interfaces**.

To be able to use the Ethernet interfaces, they must be parameterised accordingly in the corresponding menu pages **9.11 - 9.14 Ethernet 1 - 4**.

NOTE

Observe the operating instructions for the ultrasonic gas meter!

As a wide variety of ultrasonic gas meters can be used together with the RFC 7 flow computer, only the connection to the flow computer is considered here.

▶ For further information on the connection to the ultrasonic gas meter used, please refer to the operating instructions of the relevant manufacturer.

6.2.8 Connect gas quality measurement

A gas quality measurement is used to analyse the composition and quality of a gas, such as natural gas, biogas and other gas mixtures. For this purpose, gas chromatographs are used to identify and quantify the various components of the gas. Important properties such as calorific value, standard density and the Wobbe index are calculated by a controller from the measured proportions.

To retrieve the various data from the gas quality measurement controller, the Flow Computer RFC 7 offers the following connection options on the CoM base in the rear panel of the device:

- Serial interface RS485 (Ser 1), terminal strip **X9A,** type RJ45
- Serial interface RS485 (Ser 2), terminal strip **X9B,** type RJ45
- (optional 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 connect, proceed as follows:

▶ Connect a patch cable from the gas quality measurement controller to the desired serial interface or Ethernet interface.

To be able to use the serial interfaces, they must be parameterised accordingly in the corresponding menu page **9.7 Serial interfaces**.

To be able to use the Ethernet interfaces, they must be parameterised accordingly in the corresponding menu pages **9.11 - 9.14 Ethernet 1 - 4**.

NOTE

Observe the operating instructions of the gas quality measurement controller!

As a wide variety of controllers can be used together with the Flow Computer RFC 7, only the connection to the Flow Computer is considered here.

▶ For further information on connecting to the controller used, please refer to the operating instructions of the relevant manufacturer.

7 Usage

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

Both operating options essentially offer the same functionality. However, there are differences in the structure of the menu pages and navigation between the menus.

The differences in the operating options are described in more detail below in sections 7.1 "Usage with touchscreen" and 7.2 "Usage with PC". Functions and symbols that are identical for both operating options can be found in sections 7.3 "Control elements in the header" and 7.4 "Control elements in the display panel".

7.1 Usage with touchscreen

Operating the RFC 7 with the touchscreen enables simple operation via a graphical user interface and easy-to-understand menus. After booting up the device, the start menu automatically appears on the touchscreen.

NOTE

Damage to the touchscreen

Handling the touchscreen incorrectly could cause it to become damaged.

- ▶ Operate the touchscreen with your fingers or use the plastic stylus included in delivery.
- ▶ 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

The menu pages are all structured identically (cf. fig. 30).

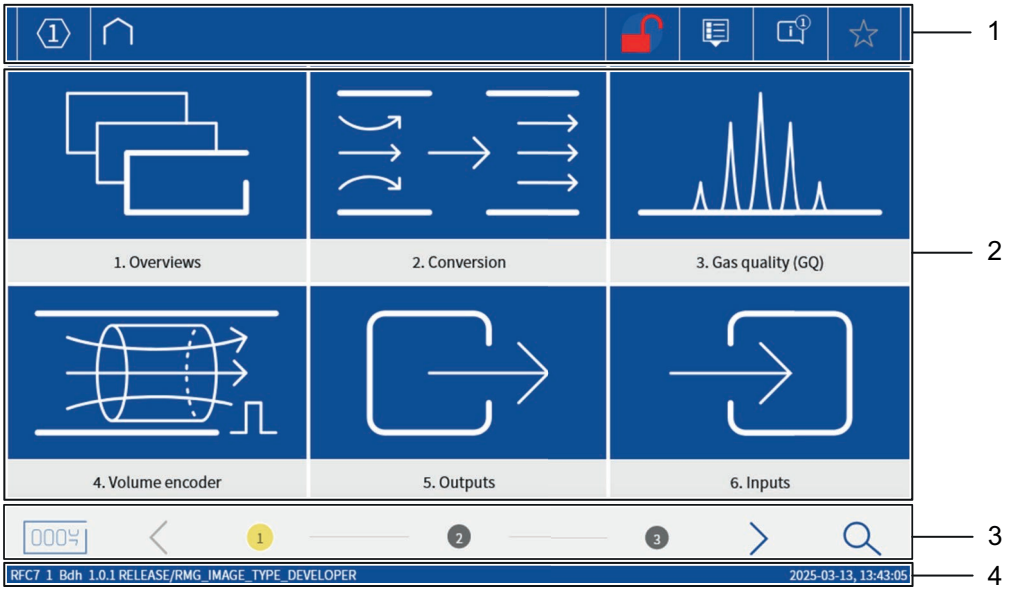


Fig. 30: Start menu - Touchscreen

Item	Designation	Item	Designation
1	Header	2	Display field

Item	Designation	Item	Designation
3	Footer	4	Info line

Header (item 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 (see section 7.2.2 "Navigating between the menus") and has various buttons whose functions are described in more detail in section 7.3 "Control elements in the header".

Display field (item 2)

The displayed content and the executable functions in the display field change depending on the selected menu.

Footer (item 3)

The footer is used to navigate between the individual menu pages of a level. You can also use the corresponding button to switch to menu 1.40 totalisers at any time (see section 7.2.2 "Navigating between the menus").

Info line (item 4)

The app version, the name of the device and the date and time are displayed in the info line.

7.1.2 Navigating between the menus

The menus for operation are arranged in three levels (cf. fig. 31).

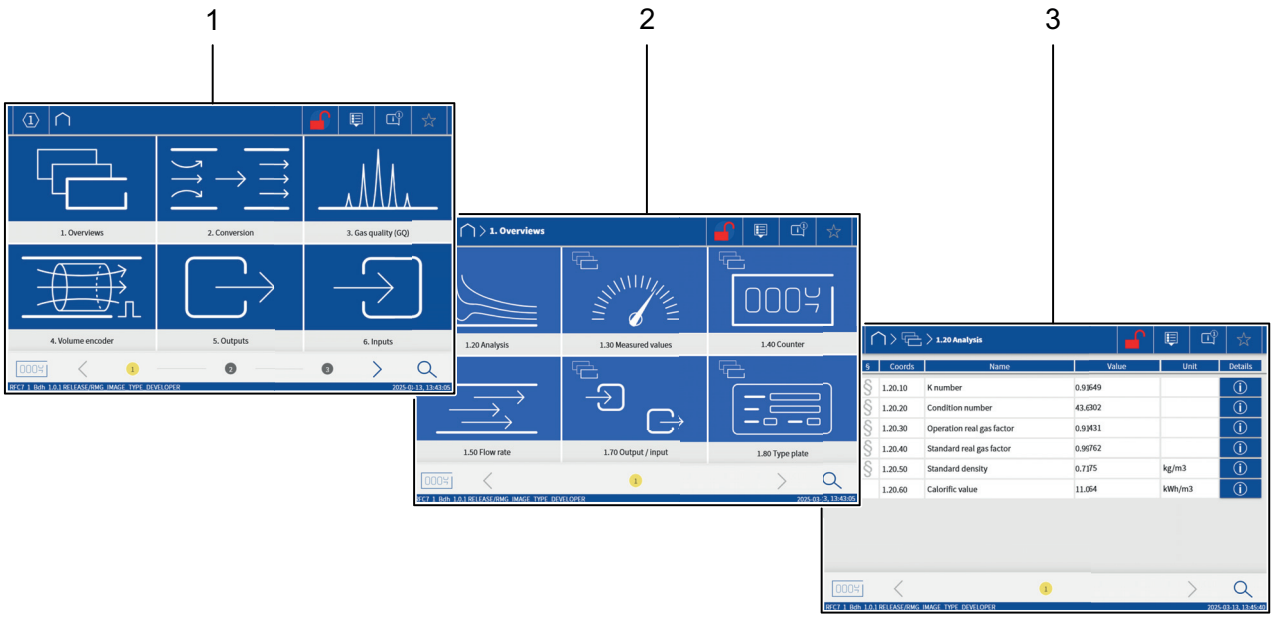


Fig. 31: Menu levels

Item	Designation	Item	Designation
1	Chapter level (upper level)	2	Sub-chapter level (middle level)
3	Parameter level (lower level)		

Chapter level (item 1)

This level provides an overview of the available subject areas (chapters). It can consist of several menu pages. The first page of the chapter level is also the **start menu** that is displayed after booting up RFC 7.

Each chapter is designed as a **button** with an easily understandable symbol (see fig. 32, example). Pressing it opens the corresponding sub-chapter level.

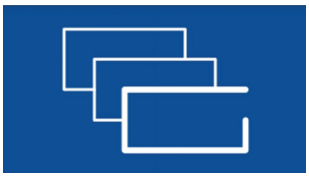


Fig. 32: Button Chapter (1. Overviews, exemplary)

Sub-chapter level (item 2)

This level provides an overview of the available sub-chapters. It can also consist of several menu pages.

Each sub-chapter is designed as a button that bears both the symbol of the superordinate chapter level (see fig. 33, item 1) and an easily understandable symbol of its subject area (see fig. 33, item 2). Pressing it opens the corresponding parameter level.

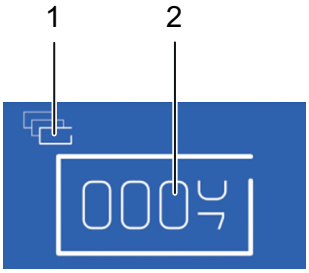


Fig. 33: Button Sub-chapter (1.40 Totalisers, exemplary)

Item	Designation	Item	Designation
1	Symbol chapter level	2	Symbol sub-chapter level

Parameter level (item 3)

At this level, the required data for the individual parameters is arranged line by line in a table, which can also extend over several menu pages.

Navigating between the menu levels and pages

Navigation from the start menu (chapter level) towards parameter level is carried out as described above using the respective buttons in the display field.

To navigate back to the next higher menu level, the header with its buttons is available on each menu page (see fig. 34, items 1 - 3). You can navigate between the individual menu pages of a level using the buttons in the footer (see fig. 34, items 5 - 8).

Fig. 34: Navigating between the menu levels and pages

Item	Designation	Function
1	**Home** button	■ Switch back to the **start menu** in the chapter level
2	**Chapter level** button	■ Display of the open chapter level ■ Switch from the open parameter level back to the corresponding sub-chapter level
3	Display **sub-chapter level**	■ Display of the open sub-chapter level
4	**Search** button	■ Open the input window to search for text or coordinates
5	**Right arrow** button	■ Switch to the next menu page: - Coloured grey: a change is **not** possible - Coloured blue: a change is possible
6	Position indicator	■ Displays the position of the open menu page in the current level. ■ By touching a free position field, the indicator jumps to the selected position and the corresponding menu page opens.
7	**Left arrow** button	■ Switch to the previous menu page: - Coloured grey: a change is **not** possible - Coloured blue: a change is possible
8	**Totalisers** button	■ Switch to menu **1.40 Totalisers**

- By pressing the various buttons in the display field, as well as in the header and footer, you can navigate to any menu, open it, view it and make changes to it.

7.2 Usage with PC

To operate the RFC 7 using a PC, it must be connected to a PC or an Ethernet network and the IP address of the device must be entered in the Internet browser (see section 8.3.1 "Establishing a network connection").

You can operate the device via the web view of the user interface using the PC keyboard and mouse.

7.2.1 Structure of the menu pages

The menu pages of the web view are all structured identically (cf. fig. 35).

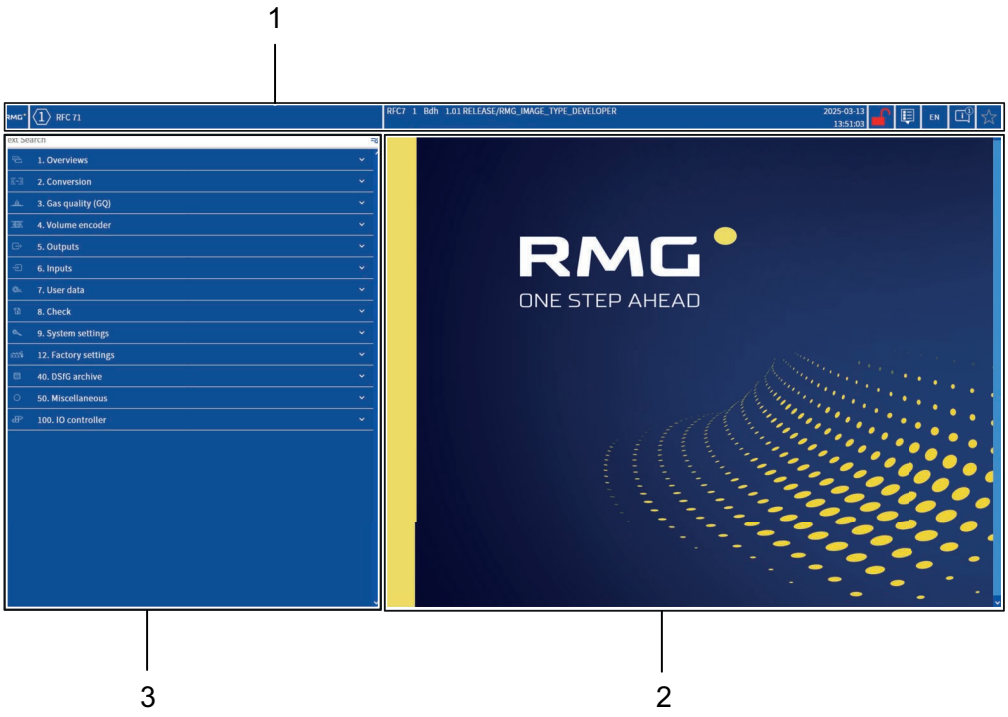


Fig. 35: Start menu - Web view

Item	Designation	Item	Designation
1	Header	2	Display field
3	Navigation field		

Header (item 1)

The header is available on every menu page and always has the same structure. It has various buttons whose functions are described in more detail in section 7.3 "Control elements in the header".

Display field (item 2)

The displayed content and the executable functions in the display field change depend-

ing on the selected sub-chapter.

Navigation field (item 3)

The navigation panel is used to navigate between the individual chapters/sub-chapters and to select the parameter level menu that is to be opened in the display field.

7.2.2 Navigating between the menus

The menus for operation are also divided into three levels here (cf. fig. 36).

However, all three levels can be displayed simultaneously in the menu in the web view.

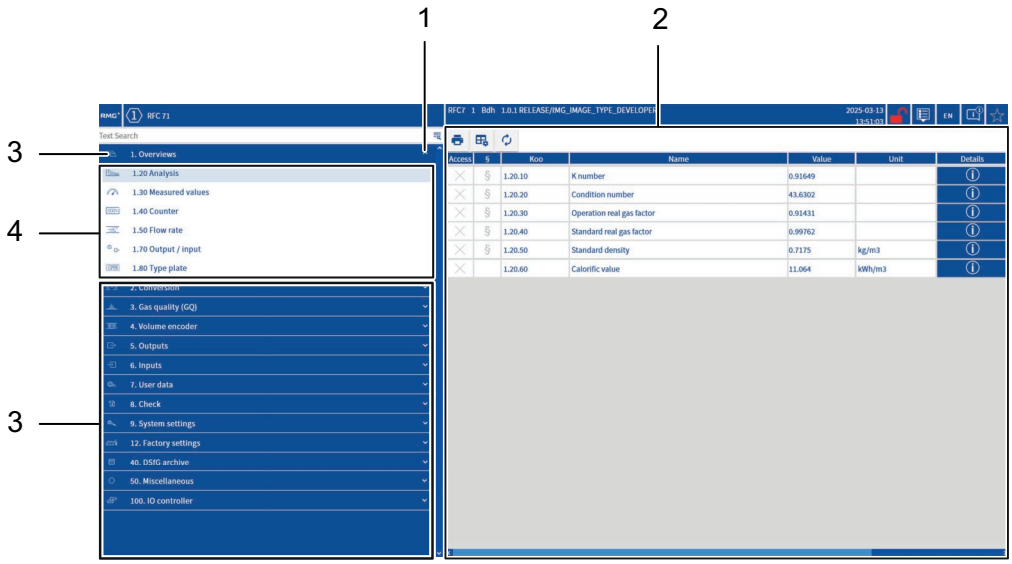


Fig. 36: Menu navigation - Web view

Item	Designation	Item	Designation
1	Selection arrow	2	Parameter level (lower level)
3	Chapter level (upper level)	4	Sub-chapter level (middle level)

To open a menu at parameter level, proceed as follows:

1. Select the required chapter (item 3) in the navigation field and click on the corresponding selection arrow (item 1) with the mouse (here: Chapter 1. Overviews).
   ➡ The sub-chapter level (item 4) is opened and all further chapters are moved downwards.
2. Use the mouse to select a sub-chapter (here: 1.20 Analysis).
   ➡ The sub-chapter is highlighted in grey and the corresponding parameter level menu (item 2) opens in the display field.

You can use the side scroll bars to navigate both in the navigation field at chapter and sub-chapter level and in the display field at parameter level.

In this way, you can open, view and make changes to any menus, depending on the access authorisation of the logged-in user.

7.3 Control elements in the header

The operating elements are largely identical on the touchscreen and in the web view and are therefore described together.

They are explained using the web view. Deviating displays on the touchscreen will be dealt with accordingly where applicable.

Fig. 37: Menu page header - Web view

Item	Designation	Function
1	**Home** button	■ Jump back to the start page
2	**Stream** button	■ Display of the currently selected stream ■ Switch to another stream (only possible with device variant Multi-stream)
3	Info field	■ Path indication of which subchapter is currently open. ■ Display of: - Date and time - App version
4	**Log in user** button	■ Displays which user is logged in. ■ Indicates whether the calibration lock is open. ■ Opens user login window.
5	**View** button	■ Change the view at parameter level: - All parameters are displayed. - Only important parameters are displayed.
6	**Language** button	■ Display of the currently selected language ■ Switch to language: - DE (German) - EN (English) - ZH (Chinese)
7	**Messages** button	■ Display of the message with the highest priority. ■ Opens list of messages.
8	**Favourites** button	■ Indicates whether the open menu is a favourite. ■ Opens the favourites list.

Fig. 38: Header of the menu pages - Touchscreen

Item	Designation	Function
1	**Stream** button	■ Display of the currently selected stream ■ Switch to another stream (only possible with device variant Multi-stream)
2	**Home** button	■ Switch back to the start menu in the chapter level
3	**Chapter level** button	■ Display of the open chapter level ■ Switch from the open parameter level back to the corresponding subchapter level
4	Display **sub-chapter level**	■ Display of the open sub-chapter level
5	**Log in user** button	■ Displays which user is logged in ■ Indicates whether the calibration lock is open. ■ Opens user login window.
6	**View** button	■ Change the view at parameter level: - All parameters are displayed - Only important parameters are displayed
7	**Messages** button	■ Display of the message with the highest priority ■ Open the message list (see section 7.3.3).
8	**Favourites** button	■ Indicates whether the open menu is a favourite. ■ Opens the favourites list

7.3.1 Log in user

The **Log in user** button has three functions:

1. Display of 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. Indicates whether the calibration lock is open

	Calibration lock open
	Calibration lock opened and Admin 1 logged in at the same time
	Calibration lock opened and Admin 2 logged in at the same time

3. Logging a user/administrator on/off

A total of 5 different users (User) and 2 administrators (Admin) are available for logging in.

Authorisations of a user (User)

- The authorisations of the 5 users created are identical, i.e. there is no gradation of access authorisations between these users.
- A separate password can be created for each user.
- Each user has change access to parameters that are labelled with the corresponding symbol in the **Access** column of the menu page at parameter level (see section 7.4 "Control elements in the display panel").
- Parameters that require the authorisation of an administrator to change are **not** displayed to a user on the menu pages.

Authorisations of an administrator (Admin)

- The authorisations of the 2 administrators created are identical, i.e. there is no gradation of access authorisations between the administrators.
- A separate password can be created for each administrator.
- Every administrator has change access to parameters that are labelled with the corresponding symbol in the Access column of the menu page at parameter level (see section 7.4 "Control elements in the display panel").

Proceed as follows to log in a user/administrator:

▶ Click on the **Log in user** button.

➡ The user login window opens (see fig. 39)

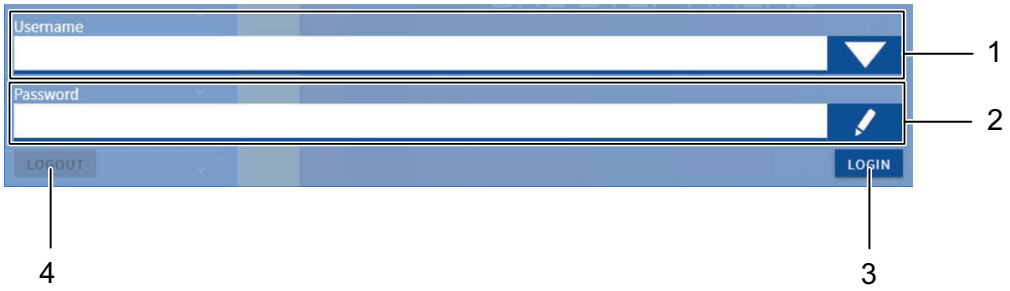


Fig. 39: User login window

Item	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	Enter **password**	■ Open the input window for the password (see fig. 40) - the default password setting for all users/admins is: **User1**
3	**Login** button	■ Confirm the login data (user and password)
4	**Log out** button	■ Logging out the current user ■ (this button can only be used if a user is already logged in).

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

➡ The selected user is displayed in the selection.

▶ Select the input password.

➡ The input window opens (see fig. 40).

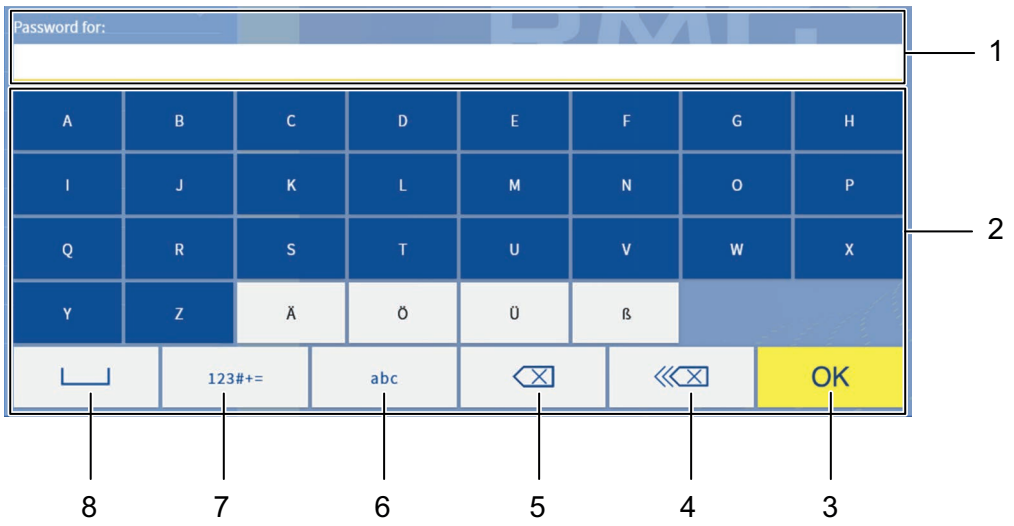


Fig. 40: Password input window

Item	Designation	Function
1	**Password** input field	■ Display the characters entered
2	Letter/number and character field	■ Keyboard function
3	**OK** button	■ Confirm the entry and log in the user at the same time
4	**Delete input** button	■ Delete the entire input field
5	**Delete character** button	■ Delete the last character in the input field
6	**Shift** button	■ Switch between upper and lower case letters ■ Switch between digits and characters
7	**Select** button	■ Selection between the display of numbers/characters or letters
8	**Space** button	■ Insert a space in the Password input field

▶ First enter the password **User1** (factory setting) and confirm with **OK**.

➥ The selected user is logged in.

Password change

Proceed as follows to change the password of a user/admin:

▶ First log in the user/admin whose password is to be changed as described above.

▶ Click on the **Log in user** button to open the login window again.

➥ The **Change password** button is now visible in the login window.

▶ Click on the new **Change password** button.

➥ The **Set new password** window opens (see fig. 41).

Fig. 41: Set new password window

Item	Designation	Function
1	Enter **new password**	■ Open the input window for the new password (see fig. 40)
2	Enter **Confirm new password**	■ Open the input window for confirming the new password (see fig. 40)
3	**BACK** button	■ Return to the login window
4	**SET NEW PASSWORD** button	■ Setting the new password

▶ Enter the new password in both input fields (fig. 41, items 1 and 2) and set the password by pressing the corresponding button (fig. 41, item 4).

7.3.2 Set language

In the web view, there is a separate button in the header that can be used to temporarily select the language in a selection menu (cf. fig. 37, item 6).

To select the general system language, proceed as follows:

▶ Select chapter **9 System settings**.

▶ Navigate to the last menu page and select sub-chapter **9.500 System EN**.

▶ You can now select the desired language in the selection menu for coordinate **9.500.10 System language**.

7.3.3 Messages

The **Messages** button has two functions.

1. Display of the message with the highest priority

The displayed symbols have the following meaning and are listed below in order of priority from high to low:

Symbol	Designation	Meaning
	Alarm	There is an active alarm message that is entered in the message list.
	Warning	There is an active warning message that is entered in the message list.

Symbol	Designation	Meaning
	Hint	There is an active notification that has been entered in the notification list.
	OK+	There are only inactive entries that are entered in the entry list.
	OK	No message has been received.

2. Opening the entry list

Click on the **Messages** button to open the message list.

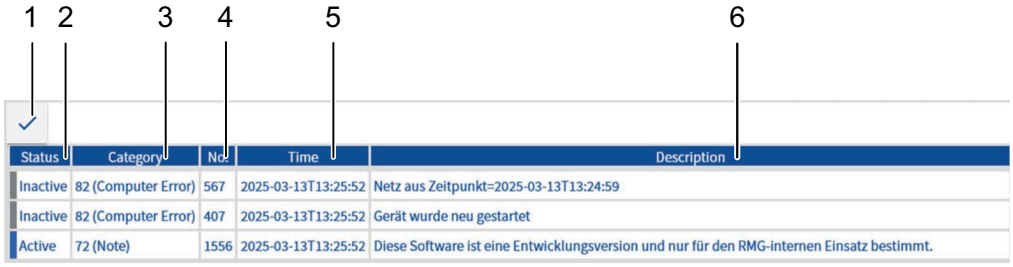


Fig. 42: Message list

Item	Designation	Function
1	Hook	■ Delete inactive messages
2	Status	■ Display of the message status
3	Category	■ Display of the message category
4	No.	■ Display of the message number
5	Time	■ Display date/time when the message occurred
6	Description	■ Display of the message or error description

In the status field, the type of message is also indicated by a 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 when a user is logged in and has two functions.

1. Display whether the current menu page is stored in the favourites list.

The symbols displayed have the following meaning:

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

2. Open the favourites list

Clicking the **Favourites** button opens the favourites list. A favourite can be selected for display or a favourite can be created.

A maximum of 7 favourites can be created in the list. If another favourite is to be added, an old favourite must first be deleted.

The following buttons are available for this purpose:

	Add current menu page as a favourite
	Remove favourite

7.4 Control elements in the display panel

The operating elements in the display panel are largely identical on the touchscreen and in the web view and are therefore described together.

They are explained using the web view. Deviating displays on the touchscreen will be dealt with accordingly where necessary.

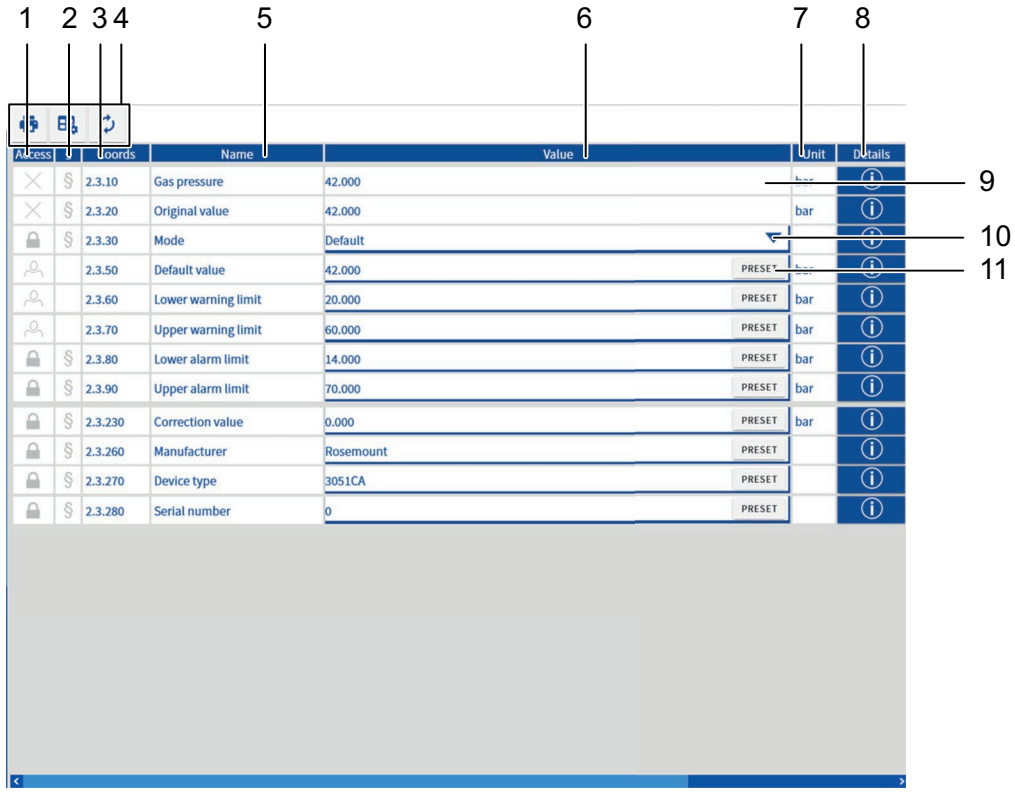


Fig. 43: Web view Display panel

Item	Designation	Function
1	**Access** column	■ Display of the access authorisation required to change the parameter
2	Column **§**	■ Indicates whether the parameter is used for a custody transfer measurement.
3	Column **Coords**	■ Display of the corresponding coordinate of the parameter
4	Buttons (only in web view)	■ Functions: - Print parameter page - Change column selection - Deactivate update - Save entry (only visible after successful data entry) - Discard entry (only visible after data entry)
5	**Name** column	■ Name of the parameter
6	**Value** column	■ Value of the parameter
7	**Unit** column	■ Unit of the parameter
8	**Details** column	■ Open and close a window with detailed information on the associated parameter, e.g. default value (defaultValue)
9	**Display** field	■ No input, display only
10	**Selection** field	■ Input via selection menu

Item	Designation	Function
11	**Input** field	■ Input - via keyboard (web view) - via Preset button (web view) - via input dialogue window (touch-screen)

Access column (item 1)

The Access column shows whether the associated parameter can be changed and which access authorisation is required for this:

	Parameter cannot be edited/changed.
	Parameter is freely editable/changeable.
	Parameter can be edited/changed with user rights.
	Parameter can be edited/changed with admin rights.
	Parameter can only be edited/changed with the calibration lock open.

Column § (item 2)

This column indicates whether the associated parameter is used in a custody transfer application:

	Parameter or measured value is custody transfer.

Column Koo (item 3)

Each parameter is uniquely determined or assigned via its coordinate. A coordinate is structured as follows:

- Chapter.sub-chapter.parameter number

Example: 2.3.50 "Default value"

➧ 2 = Chapter 2 Reassessment
➧ 3 = Sub-chapter 3 Gas pressure
➧ 50 = Parameter number
➧ "Name of the parameter, here: Default value"

Buttons (item 4)

These buttons are only displayed in the web view and have the following functions:

	Change column selection.
	Print parameter page.
	Deactivate automatic update
	Save entries (this symbol is only visible if one or more entries have been made; in addition, entries are highlighted in colour and can be saved together).
	Discard entries (this symbol is only visible if one or more entries have been made).

Changes made on the touchscreen are automatically saved!

Detail column (item 8)

The Detail column contains an info button for each parameter (cf. fig. 44).

Fig. 44: Info button

Pressing this button opens a detailed info window below the line of the selected parameter, which contains information about the parameter or coordinate. Among other things, the default value and the system-internal name for this parameter can also be viewed here (fig. 45, item 2). Pressing the **Close** button (fig. 45, item 1) closes the detailed info window and the info button is displayed again in the corresponding line.

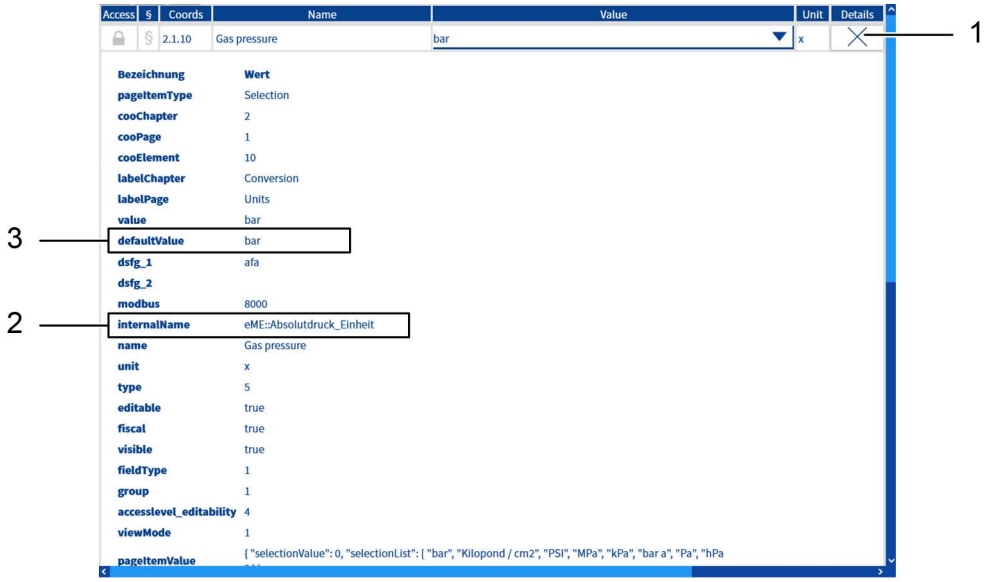


Fig. 45: Detail info window for parameter "2.1.10 Gas pressure"

Item	Designation	Function
1	Close button	■ Closing the detail info window
2	Internal name (internalName)	■ Displays the system-internal name of this parameter; can be used, for example, to assign a measured value to an analogue output. In the web view, this name can be entered elsewhere using the copy & paste function.
3	Default value (defaultValue)	■ Display of the preset value for the selected parameter

Selection field (item 10)

Pressing the arrow in the Selection field opens a selection menu that displays all available selection options (see fig. 46). The stored default value is always displayed in bold in the selection menu.

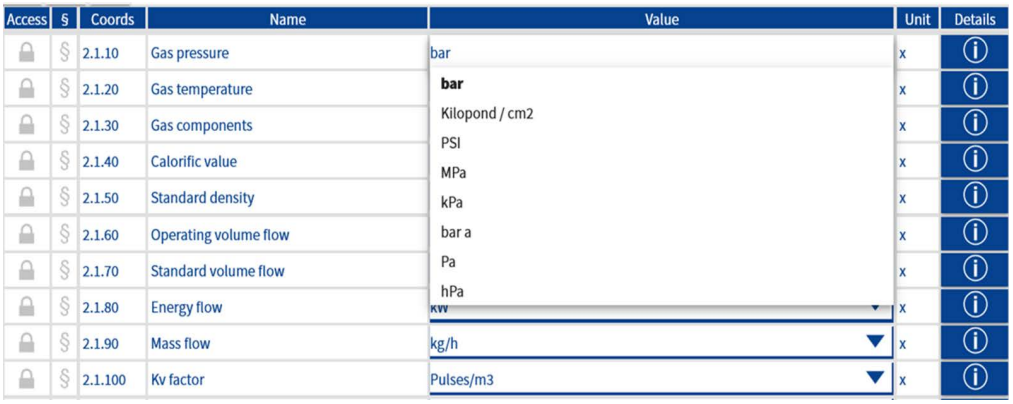


Fig. 46: Selection menu for coordinate 2.1.10 Gas pressure unit

Input field (item 11)

In the web view, input values can simply be entered using the keyboard after selecting a field of the "Input" type. Alternatively, the default value (defaultValue, visible in the

detail info window) can be entered by clicking the **Preset** button.

After selecting a field of the "Input" type, a so-called input dialogue window opens on the touchscreen (see fig. 47).

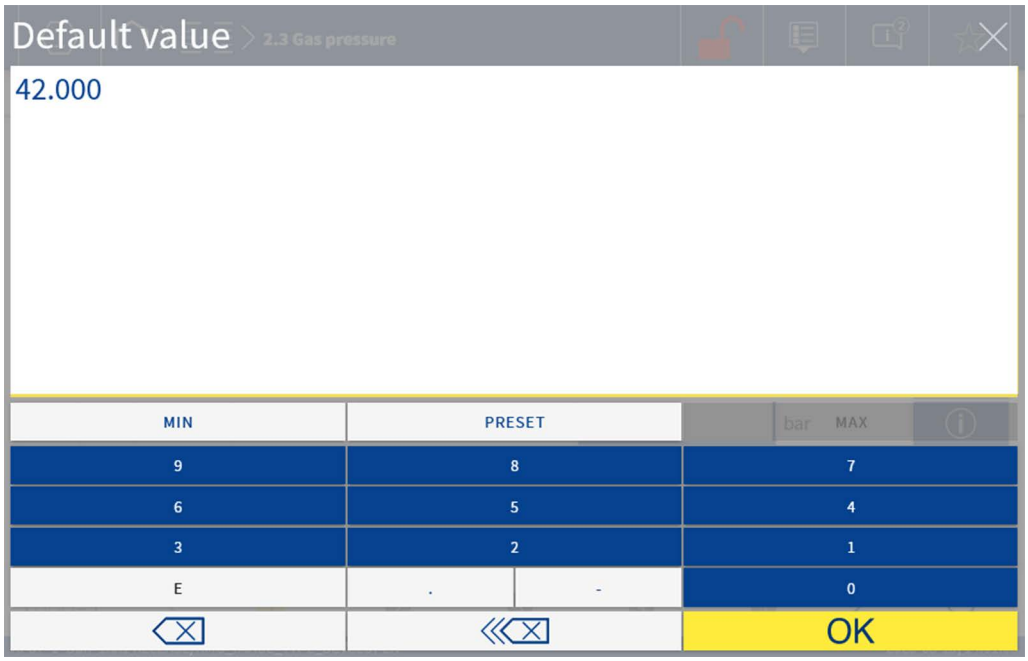


Fig. 47: Input dialogue window

The input value can either be entered here using the numeric keypad or the default value can be entered by pressing the **Preset** button. The entry is confirmed with the **OK** button 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 the "2. Conversion" menu

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

Chapter level		Sub-chapter level		Parameter level Touchscreen Number of pages
Symbol	Designation	Symbol	Designation	
	1. Overviews		1.20 Analysis	1
			1.30 Measured values	1
			1.40 Counter	5
			1.50 Flow rate	2
			1.70 Output / Input	5
	2. Conversion		2.1 Units	3
			2.2 Formats	3
			2.3 Gas pressure	5
			2.4 Gas temperature	5
			2.5 Flow rate parameters	3
			2.6 Operating volume flow	4
			2.7 Corrected operating volume flow	3
			2.8 K number	5
			2.9 Standard volume flow	3
			2.10 Energy flow	3

Table 12: Overview of menu pages

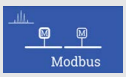
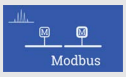
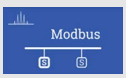
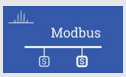
Chapter level		Sub-chapter level		Parameter level Touchscreen Number of pages
Symbol	Designation	Symbol	Designation	
			2.17 Counter mode	3
			2,100 Counters - billing mode 1	6
			2.200 Fault counters - billing mode 1	6
			2.300 Counters - billing mode 2	6
			2.400 Fault counters - billing mode 2	6
			2.500 Counters - billing mode undefined	6
			2.800 Cycle quantities	2
	3. Gas quality (GQ)		3.10 Gas quality setting	4
			3.20 Current gas quality	9
			3.30 Lower gas quality warning limits	4
			3.40 Upper gas quality warning limits	4
			3.50 Gas quality default	4
			3.60 Main gas quality Modbus client	30
			3.70 Replacement gas quality Modbus client	30
			3.80 Main gas quality Modbus server	4
			3.90 Replacement gas quality Modbus server	4
			3.100 ISO 6976 Gas quality	1

Table 12: Overview of menu pages

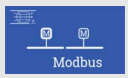
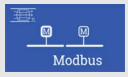
Chapter level		Sub-chapter level		Parameter level Touchscreen Number of pages
Symbol	Designation	Symbol	Designation	
	4. Volume encoder		4.12 Meter factor	1
			4.14 Characteristic curve	7
			4.15 Modbus client / instance F	2
			4.100 Counter readings instance F	
			4.500 Synchronisation monitoring	3
	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
	6. Inputs		6.10 Digital input 1 (DI1)	1
			6.11 Digital input 2 (DI2)	1

Table 12: Overview of menu pages

Chapter level		Sub-chapter level		Parameter level Touchscreen Number of pages
Symbol	Designation	Symbol	Designation	
			6.12 Digital input 3 (DI3)	1
			6.13 Digital input 4 (DI4)	1
			6.100 Analogue input 1 (AI1)	2
			6.101 Analogue input 2 (AI2)	2
			6.102 Analogue input3 (AI3)	2
			6.114 Analogue input 4 with HART (AI4)	2
			6.115 Analogue input 5 with HART (AI5)	2
			6.120 PT100	3
			6.200 Frequency and pulse input 1	3
			6.201 Frequency and pulse input 2	1
			6.300 Encoder settings	8
	7. User data		7.10 Measurement location	1
			7.20 Configuration	3
	8. Check		8.10 Freeze	1
			8.30 Functional test	2
			8.40 Functional test result	
			8.200 Functional test mean values	2

Table 12: Overview of menu pages

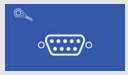
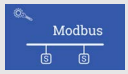
Chapter level		Sub-chapter level		Parameter level Touchscreen Number of pages
Symbol	Designation	Symbol	Designation	
	9. System settings		9.1 Software Update	
			9.2 Time and date	2
			9.3 Time synchronisation	4
			9.4 Memory management	1
			9.7 Serial interfaces	6
			9.9 Firewall	3
			9.11 Ethernet 1	8
			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	1
			9.100 Access privileges	3
			9.110 User management	2
			9.250 Software ID	1
			9.400 System info HW/OS	2

Table 12: Overview of menu pages

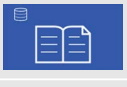
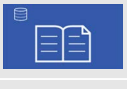
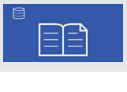
Chapter level		Sub-chapter level		Parameter level Touchscreen Number of pages
Symbol	Designation	Symbol	Designation	
			9.410 Screen/Screensaver	1
			9.500 System en	9
	12. Factory settings		12.10 Set counters	5
			12.20 Deletion processes	2
	40. Archives		40.5 Archive settings	1
			40.10 AG 1 - AM1 counter + measured values	
			40.20 AG 2 - AM1 fault counter	
			40.30 AG 3 - AM2 counter + measured values	
			40.40 AG 4 - AM2 fault counter	
			40.120 AG12 – Gas quality	
			40.130 AG 13 - Counter for undefined AM	
			40.170 AG 17 - functional test part 1	
			40.180 AG 18 - functional test part 2	
			40.190 AG 19 - functional test part 3	
			40.210 AG 21 - Logbook	
			40.500 AG 50 - Official calibration Logbook	
			40.510 AG 51 - Non official calibration Logbook	

Table 12: Overview of menu pages

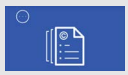
Chapter level		Sub-chapter level		Parameter level Touchscreen Number of pages
Symbol	Designation	Symbol	Designation	
	50. Miscellaneous		50.10 Error messages	3
			50.800 List of licences	2
			50.900 Header	2
	100. IO Controller		100.1 Digital Inputs	9
			100.2 Current Inputs 1-3	5
			100.3 Current Inputs 4-5 PT100	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	9

Table 12: Overview of menu pages

8 Initial start-up

8.1 General initial start-up information

Before commissioning, ensure that all the safety instructions listed have been observed and that the installation of the RFC 7 itself and the connection of all the necessary devices and sensors have been carried out in accordance with the information in these instructions.

During commissioning, the regulations on explosion protection and all safety instructions for working in areas with potentially explosive atmospheres must also be observed.

As far as possible, commissioning is carried out in the factory and, if necessary, additionally on site by qualified technicians or field staff. RMG offers training and commissioning services for this purpose.

All newly delivered devices already have factory parameterisation, which may have already been carried out according to customer requirements. This parameterisation should usually be sufficient; some settings and parameters may need to be adjusted on site via the user interface. Initially, only parameters that are not under the protection of the calibration switch can be changed.

If, due to the local situation, it is necessary to change parameters that are protected by the calibration lock, this may only be carried out by persons with test centre authorisation or by calibration officers.

NOTE

Custody transfer application

If the Flow Computer RFC 7 is intended for custody transfer applications, it is preset in the factory before delivery in accordance with the approval and secured against unauthorised changes with seals, software and hardware locks. The approvals valid for the device and its function are listed on the type plate. If the seals and locks are removed or damaged, the RFC 7 loses its approval and may no longer be used in custody transfer applications.

- Never remove or damage the seals and other locks!
- However, if a seal has to be removed or has been damaged, an inspection by a state-recognised body or a calibration officer and, if necessary, an additional inspection of the other settings at the factory is required. After locking, the verification officer must restore the seals so that the RFC 7 can be used in custody transfer operation again.

NOTE

Acceptance certificate

During commissioning, an acceptance certificate must be issued to document correct commissioning and, if applicable, setting values.

The following sections also describe the setting of parameters that are under the protection of the calibration switch. These settings should only be carried out by persons with the appropriate authorisation! You can see which parameters are under the protection of the calibration switch in the menu pages of the parameter level in the **Access** column.

8.2 Requirements for commissioning

Before commissioning can be carried out, the installation must have been tested in accordance with the following regulations, directives and standards:

- BetrSichV, §15: "Inspection before commissioning and before recommissioning after changes requiring inspection"
- DGUV regulation 3 "Electrical systems and equipment", §5: "Tests"
- VDE 0100-100 "Erection of low-voltage installations"
- DIN EN 60079-14 VDE 0165-1 "Potentially explosive atmospheres"

8.3 Executing the initial start-up

Commissioning can be carried out either on the touchscreen or with a PC/notebook via a network connection.

The settings can be made very easily using the browser available on the PC (e.g. Microsoft Edge, Mozilla Firefox, etc.).

▶ Commissioning with a PC is recommended!

Detailed information on the user interface on the touchscreen and on the PC and how to use it can be found in the section 7 "Usage".

8.3.1 Establishing a network connection

The network connection between the RFC 7 and a PC or notebook can be established as follows:

- **Local:** a network cable (LAN cable) is connected to one of the Ethernet interfaces Eth 1 - 4 in the rear panel of the device and to an Ethernet interface of the PC/notebook. The local network of the PC is used here.
- **Remote:** the RFC 7 is connected to an existing network from one of the Ethernet interfaces Eth 1 - 4 in the rear panel of the device using a network cable (LAN cable).

NOTE

Integration of the RFC 7 into an existing network

To be able to integrate the RFC 7 into an existing network, the network must allow the integration of third-party devices. Protected company networks may prevent access under certain circumstances.

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

NOTE

Simultaneous use of RFC 7 with different networks

The RFC 7 can be used simultaneously by up to four networks with Ethernet interfaces 1 - 4. A connection between the different networks is prevented by software and firewalls.

To be able to use the network connection (local or remote), the correct IP address of

the RFC 7 must be entered in the browser of the PC before connecting the Ethernet interface.

Procedure for entering the IP address:

After connecting the power supply to the RFC 7, the device starts up automatically and the start menu appears on the touchscreen. Entering the IP address is explained below using the Ethernet interface Eth 1 as an example. The description applies analogously to all other Ethernet interfaces.

- ▶ Depending on the Ethernet interface of the RFC 7 to which the network is to be connected, navigate to the corresponding menu page on the device, here **9.11 Ethernet 1**.

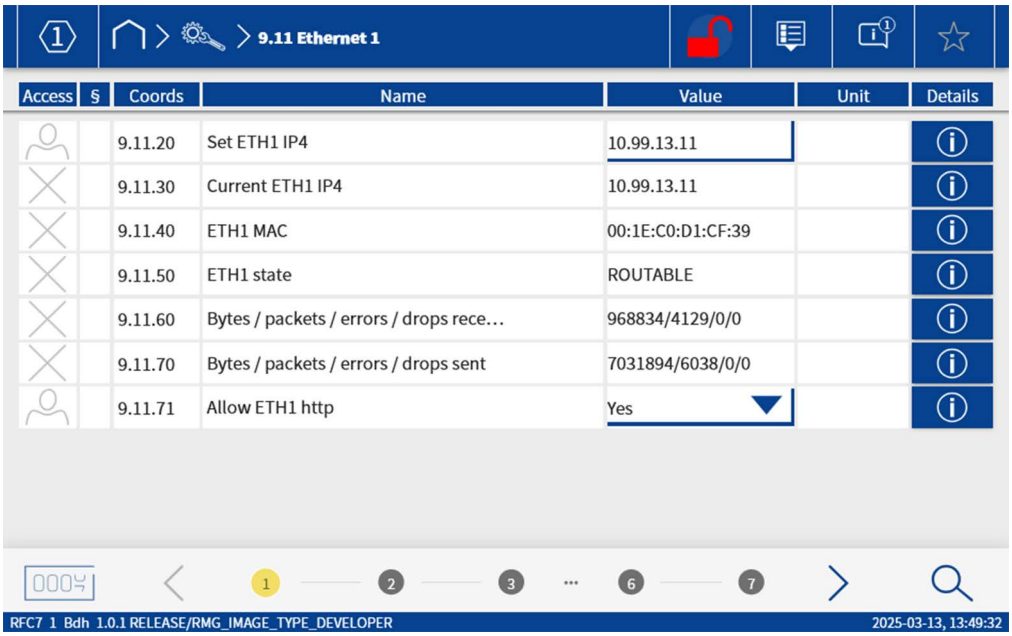


Fig. 48: Menu 9.11 Ethernet 1 on the touchscreen

- ▶ Navigate to the next page and check the DHCP setting of the Ethernet interface in the coordinate **9.11.75 Set ETH1 DHCP**. The following settings can be selected:
  - **Yes**: automatic assignment of the IP address if a DHCP server is available in the network.
  - **No**: the IP address must be entered manually if there is no DHCP server in the network.

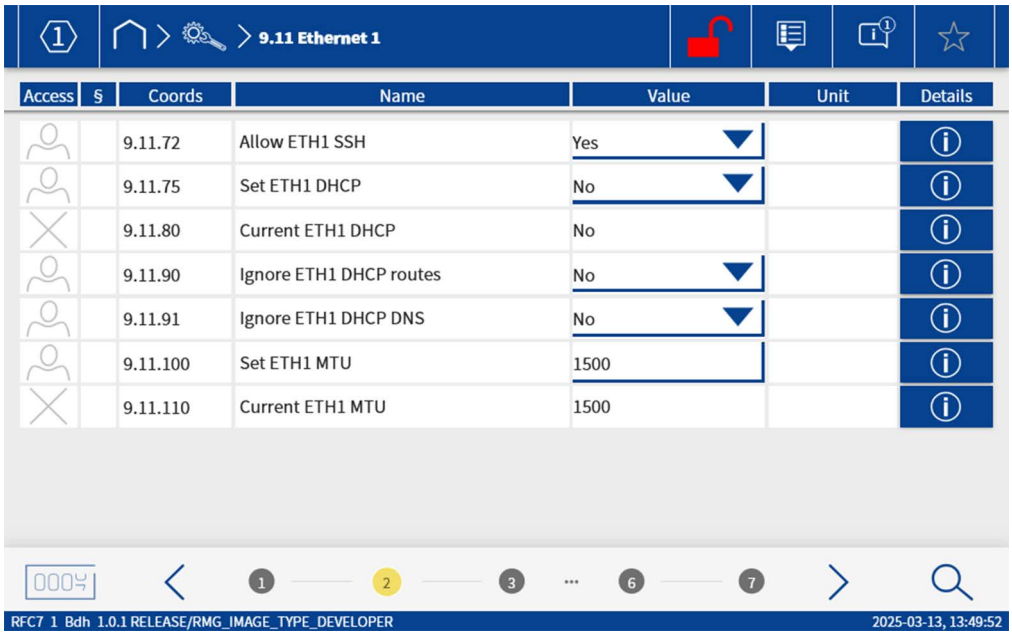


Fig. 49: Menu 9.11 Ethernet 1 - Page 2 on the touchscreen

- With the **Yes** setting, you can now read the IP address in the **coordinate 9.11.30**. If you select **No**, you must enter the IP address in the **coordinate 9.11.20** manually.
- Connect the RFC 7 to your computer or network via the Ethernet interface.
- Then enter the IP address in the address bar (URL bar) of the browser and confirm the entry with the Enter key on your keyboard.
  - ➥ The web view of the user interface appears in the browser.

8.3.2 Log in user

To be able to make parameter or commissioning settings, a user with the appropriate authorisation must be logged in.

- Log in as a user with the corresponding password.

By default, all users and admins have the password **User1**.

- Please create and document new passwords when you log in for the first time. Keep the list of passwords in a safe place and only issue passwords according to the required authorisation level!

For detailed information on user login and password changes, please refer to section 7.3.1 "Log in user".

8.4 Enter user data

8.4.1 Enter measurement location details

First enter the required details for the measurement location. To do this, proceed as follows:

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

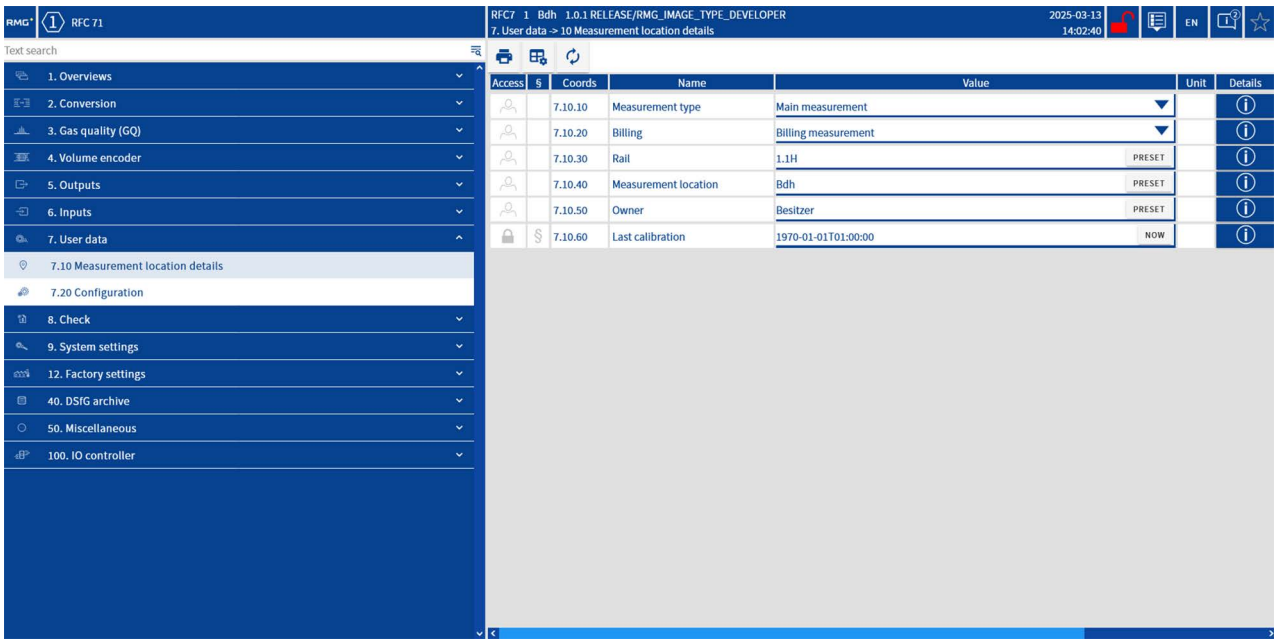


Fig. 50: Menu page 7.10 Measurement location details

- ▶ In coordinate **7.10.10 Measurement type**, select whether the measuring point is a main measurement or a comparison measurement.
- ▶ In coordinate **7.10.20 Billing**, specify whether it is a "normal" billing measurement or a lead measurement. A pre-stock measurement is, for example, a measuring line that is not operated in summer but only in winter.
- ▶ Enter descriptive information about the measuring point in the coordinates **7.10.30 Rail**, **7.10.40 Measurement location** and **7.10.50 Owner** in order to be able to clearly identify it.
- ▶ Enter the corresponding date in the coordinate **7.10.60 Last calibration**.
- ▶ Save your entries by pressing the corresponding button. (see section 7.4 "Control elements in the display panel")

8.5 Conversion - Set parameters

8.5.1 Set units

During commissioning, it is very important to select the correct units for physical input variables, as otherwise calculations may be falsified.

Example:

If a measuring point has an operating pressure of approx. 100 bar, then there is a factor of approx. 100 between the two physical variables when converting the operating volume flow to the standard volume flow.

If the unit m^3 is selected for the operating volume, which is a typical unit for a volume, it is recommended to select the unit x100 m^3 for the standard volume. This selection takes into account the difference due to the operating pressure.

p ≈ 100 bar; operating volume = 1 m^3 ➡ standard volume = 100 m^3

MWh is usually a suitable unit for the energy, although a factor in front of the unit can also be useful for large nominal diameters and volume flows.

For small nominal sizes and volume flows, the unit kWh may be sufficient.

Table 13 below provides an overview of the recommended unit settings. However, the information in the table does not exempt you from checking the operating conditions of your measuring point and selecting the units accordingly.

Operating pressure	Unit Operating volume	Pipe diameter	Unit Standard volume	Energy unit
p ≈ 100 bar	m^3	< DN 80	100 m^3	10 kWh or 100 kWh
p ≈ 100 bar	m^3	> DN 50 to < DN150	100 m^3	MWh
p ≈ 100 bar	m^3	> DN 100	100 m^3	10 MWh or 100 MWh

Table 13: Recommendations for the selection of units

NOTE

Observe counter overflow!

The units selected for the counters also determine their overflow frequency.

- ▶ Please select the units in such a way that there is a maximum of one counter overflow per billing period at maximum flow rate.

To select the units, proceed as follows:

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

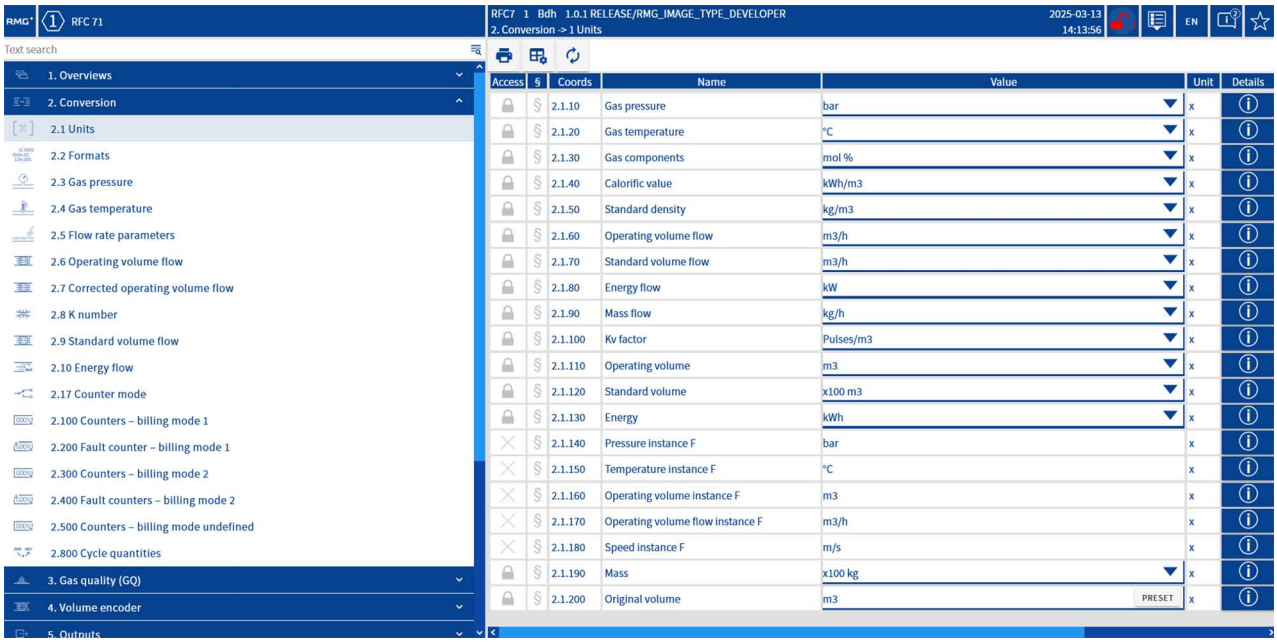


Fig. 51: Menu page 2.1 Units

▶ Specify the required unit for each physical input variable (**coordinates 2.1.10 to 2.1.200**) via the selection menu.

The following table shows the available unit selection 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 the 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	■ Pulse/m³ ■ Pulse/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
2.1.190	Mass	■ kg ■ g ■ lb ■ ton ■ Tonne ■ oz ■ x10 kg ■ x100 kg
2.1.200	Original volume	registrable Default value: m³

Table 14: Overview of the available units

8.5.2 Set formats

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

To select the formats, proceed as follows:

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

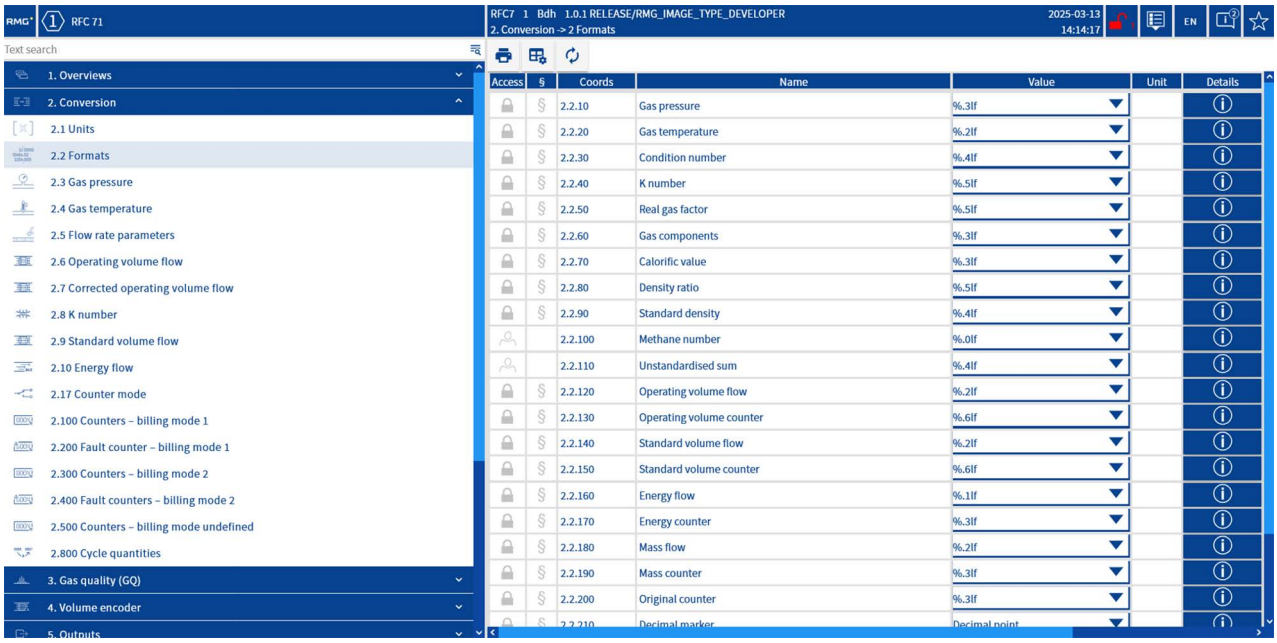


Fig. 52: Menu page 2.2 Formats

The following formats are available for each parameter in the selection menu:

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

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

Example:

The number 12.345 is displayed as follows for various selections:

- at %.0lf than 12
- at %.1lf than 12.3
- at %.2lf as 12.35 (the rounding of the third decimal place is correctly taken into account here).

Internal calculations are always carried out with 8 digits, whereby the eighth digit is subject to rounding errors. Therefore, 7 digits are relevant, regardless of whether they appear before or after the decimal point.

▶ Nevertheless, define the selection of decimal places sensibly.

Example:

If a parameter has 5 digits before the decimal point, it makes no sense to select 3 or more decimal places.

▶ If necessary, adjust the decimal places to the values of the sensors.

➥ More decimal places only deceive you into believing that there is no accuracy.

The internal calculations are independent of your selection of decimal places and are always carried out with the greatest possible accuracy!

NOTE

Change unit

If a measured value (e.g. pressure) has more than 7 digits before the decimal point, then the unit of the measured value has been selected unfavourably.

- ▶ Select a suitable unit for the measured value, e.g. MPa instead of Pa for the pressure.
- ▶ To change the unit, proceed as described in section 8.5.1 "Set units".

Selection in coordinate 2.2.210 Decimal marker

The following selections are available in the selection menu for coordinate **2.2.210 Decimal marker**:

- Decimal comma
- Decimal point

NOTE

Selection of the decimal marker

The selection of the decimal marker can easily lead to errors if numbers from English-speaking countries (use of the decimal point) are mixed with numbers from German-speaking countries (use of the decimal comma).

- ▶ Be particularly careful when transferring numbers from sensors in both language areas!

8.5.3 Gas pressure - Set parameters

The pressure sensor or transmitter can sometimes only be selected and the associated parameters defined when the calibration lock is open.

Proceed as follows:

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

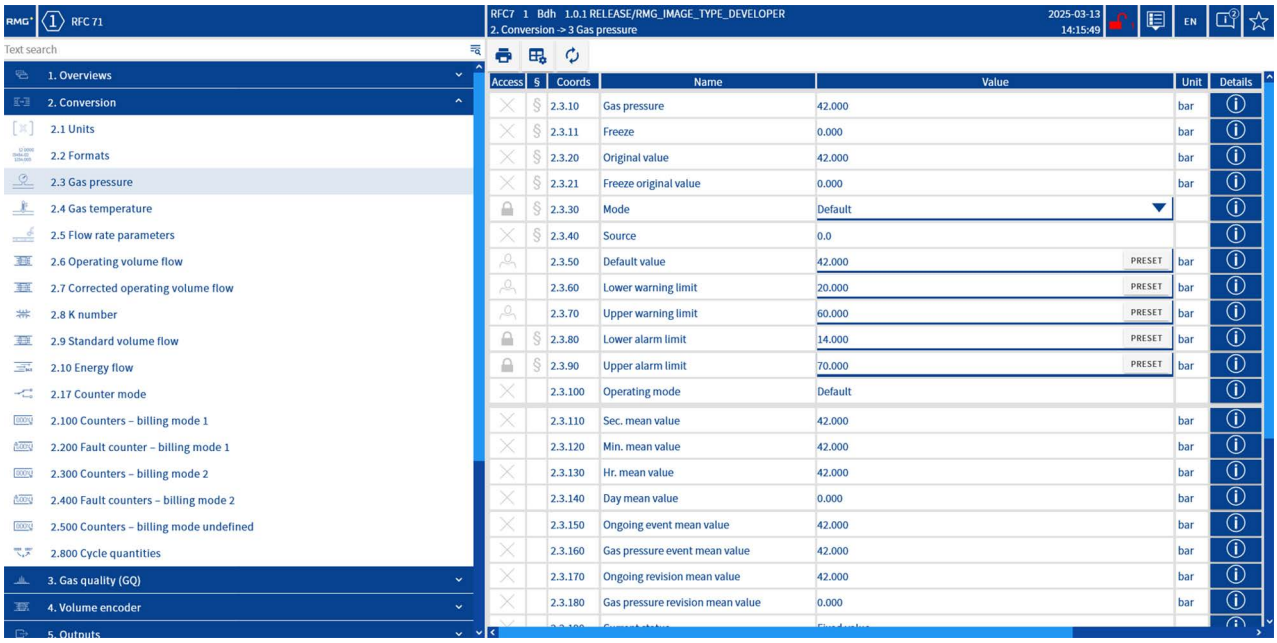


Fig. 53: Menu page 2.3 Gas pressure

- ▶ In coordinate **2.3.30 Mode**, specify from which input the measurement signal for the gas pressure is to be supplied or whether a default value is to be used. The following options are available:
  - Default
  - Analogue input 1 (AI1)
  - Analogue input 2 (AI2)
  - Analogue input 3 (AI3)
  - Analogue input 4 (AI4)
  - Analogue input 5 (AI5)
  - HART 4
  - HART 5
- ▶ Define the **default value** to be used for the gas pressure in coordinate **2.3.50**.
- ▶ In coordinate **2.3.60**, define the **Lower warning limit** for the gas pressure at which a warning message is to be issued.
- ▶ In coordinate **2.3.70**, define the **Upper warning limit** for the gas pressure at which a warning message is to be issued.
- ▶ In coordinate **2.3.80**, define the **Lower alarm limit** for the gas pressure at which an alarm should be triggered.
- ▶ In coordinate **2.3.90**, define the **Upper alarm limit** for the gas pressure at which an alarm should be triggered.
- ▶ Specify the **Correction value** for the gas pressure in coordinate **2.3.230**.
- ▶ Enter the **Manufacturer** of the connected pressure sensor/transmitter in coordinate **2.3.260**.
- ▶ Enter the **Device type** of the connected pressure sensor/transmitter in coordinate **2.3.270**.
- ▶ Enter the **Serial number** of the connected pressure sensor/transmitter in coordinate **2.3.280**.

8.5.4 Gas temperature - Set parameters

In some cases, the temperature sensor/transmitter can only be selected and the associated parameters defined when the calibration lock is open.

Proceed as follows:

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

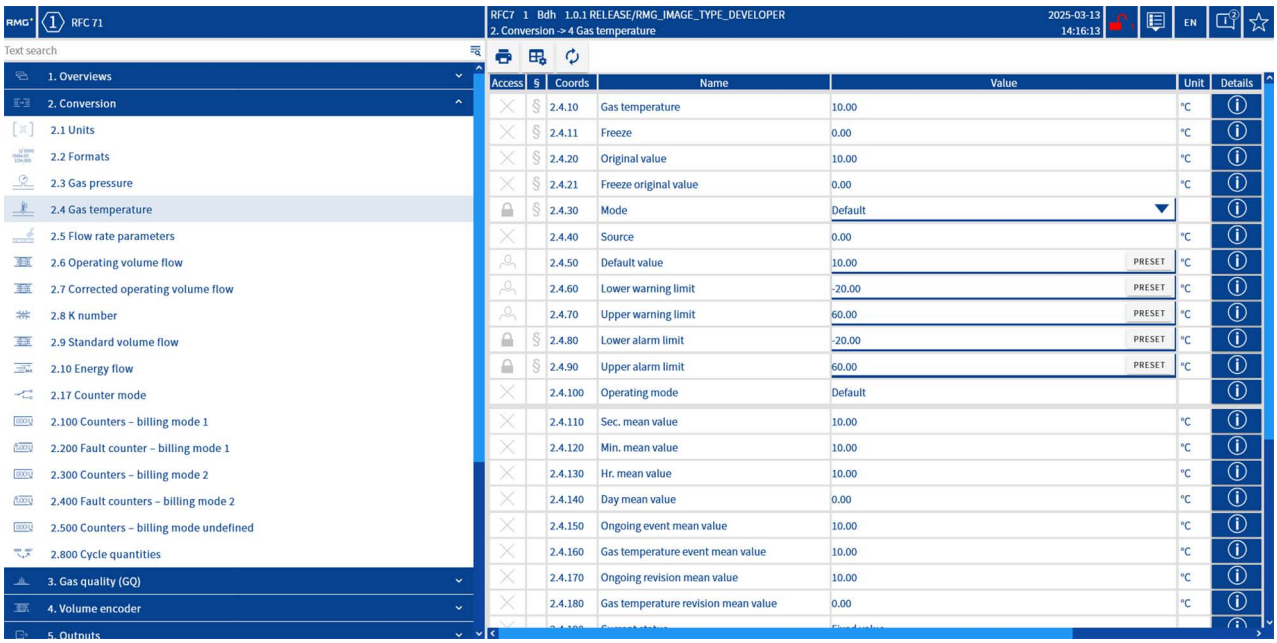


Fig. 54: Menu page 2.4 Gas temperature

- ▶ In coordinate **2.4.30 Mode**, specify from which input the measurement signal for the gas temperature is to be supplied or whether a default value is to be used. The following options are available:
  - Default
  - Analogue input 1 (AI1)
  - Analogue input 2 (AI2)
  - Analogue input 3 (AI3)
  - Analogue input 4 (AI4)
  - Analogue input 5 (AI5)
  - HART 4
  - HART 5
  - PT100
- ▶ Define the **Default value** to be used for the gas temperature in coordinate **2.4.50**.
- ▶ In coordinate **2.4.60**, set the **Lower warning limit** for the gas temperature at which a warning message is to be issued.
- ▶ In coordinate **2.4.70**, set the **Upper warning limit** for the gas temperature at which a warning message is to be issued.
- ▶ In coordinate **2.4.80**, define the **Lower alarm limit** for the gas temperature at which an alarm should be triggered.
- ▶ In coordinate **2.4.90**, define the **Upper alarm limit** for the gas temperature at which an alarm should be triggered.
- ▶ Specify the **Correction value** for the gas temperature in coordinate **2.4.230**.

- ▶ Enter the **Manufacturer** of the connected temperature sensor/transmitter in the coordinate **2.4.260**.
- ▶ Enter the **Device type** of the connected temperature sensor/transmitter in coordinate **2.4.270**.
- ▶ Enter the **Serial number** of the connected temperature sensor/transmitter in coordinate **2.4.280**.

8.5.5 Set flow rate parameters

The parameters for the flow rate can sometimes only be set when the calibration lock is open.

Proceed as follows to specify:

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

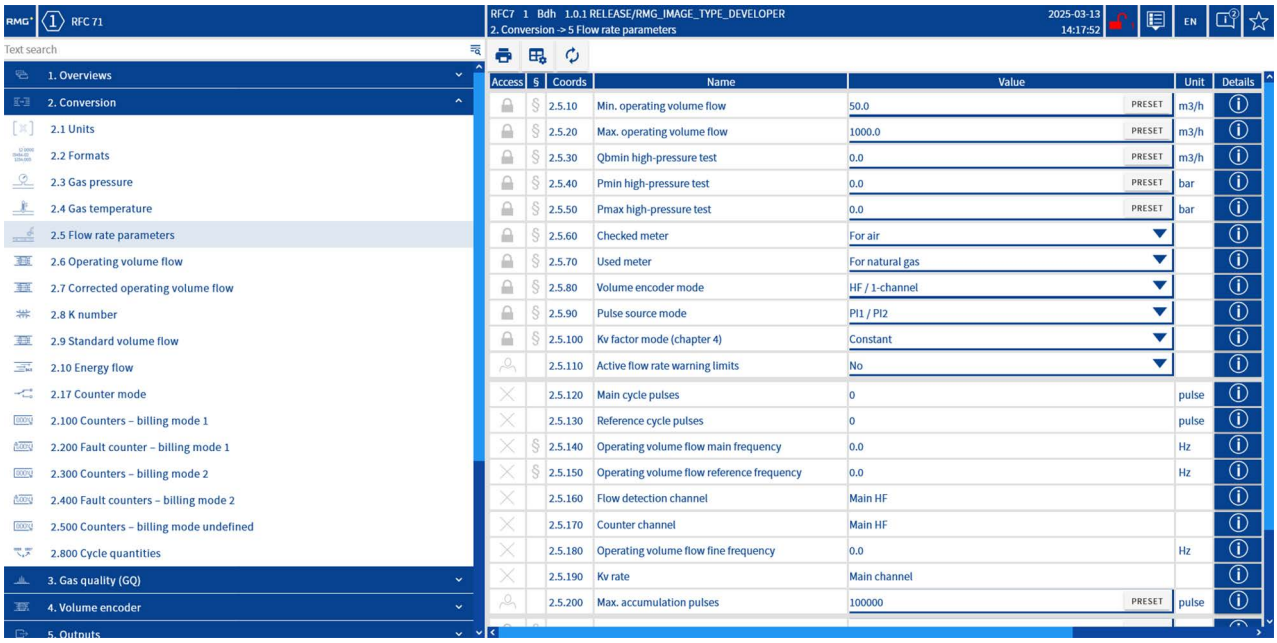


Fig. 55: Menu page 2.5 Flow rate parameters

- ▶ Enter the minimum operating volume flow in coordinate **2.5.10 Min. operating volume flow**.
- ▶ Enter the maximum operating volume flow under high pressure conditions in coordinate **2.5.20 Max. operating volume flow**.
- ▶ In the selection menu of coordinate **2.5.80 Volume encoder mode**, select the transfer type of the flow values to the RFC 7. The following table contains an overview of the possible transfer types, some of which are combined with each other in the selection menu.

Handover type	Description of the function
1-Channel	Single-channel transfer of flow values
2-Channel	Two-channel transfer of flow values
LF	Low frequency; since a very low frequency may be present, no current flow rate is calculated when transmitting at low frequency.
HF	High frequency; this type of transmission is used to calculate a current flow rate.

Table 15: Coordinate 2.5.80 Volume encoder mode - Transfer types of flow values

Handover type	Description of the function
Enco	Original totaliser, direct value of the encoder; no calculation of the current flow rate.
Modbus client/F-instance	Digital meter reading transmission. The current flow rate is determined in an ultrasonic gas meter and transmitted digitally. The digital data transmission **F-instance** ensures a standardised, manufacturer-independent data assignment of the digital addresses as well as the secure transmission of all essential and required data of the meter.
1 to 1	Direct transfer of the frequency in the ratio "1 to 1", i.e. the frequency of the input signal is transferred directly to the output signal without changing the frequency.
X to Y	Transmission of the frequency in the ratio "X to Y", i.e. the frequency of one signal is multiplied or divided in comparison to the other signal in the specified ratio. For example, a ratio of "2 to 1" means that the output frequency is twice as high as the input frequency.

Table 15: Coordinate 2.5.80 Volume encoder mode - Transfer types of flow values

- ▶ Specify the method of characteristic curve correction in the coordinate **2.50.100 Kv factor mode (chapter 4)**. The following options are available:
  - **Constant**; the characteristic curve of the flowmeter is not corrected, i.e. it remains unchanged.
  - **Polynomial**; the characteristic curve of the flowmeter is adjusted via a polynomial correction.
  - **Interpolation point**; the characteristic curve of the flowmeter is adjusted via an interpolation point correction.

NOTE

Explanation of the characteristic curve correction methods

The device-dependent percentage deviation from a constant flow characteristic curve is known from corresponding test measurements. Two different methods of characteristic curve correction can be used to correct this deviation:

- The interpolation point correction uses a defined number of interpolation points at which the curve is corrected. The linear approximation is used for correction between the interpolation points.
- A typical polynomial curve is used for the polynomial correction in order to precisely describe the course of the deviation and correct it accordingly. This method is generally more accurate than a simple interpolation point correction.

However, both methods have their justification for use, especially as the interpolation point correction within the measuring range (Qmin - Qmax) usually only deviates from the polynomial correction by less than 0.1 %. In the flow rate range < Qmin, the polynomial correction usually provides better values. The method for correcting the characteristic curve should be selected depending on the most frequently occurring operating conditions.

Both methods are authorised under calibration law!

- ▶ In coordinate **2.5.110**, select whether the flow warning limits should be active. Active flow warning limits help to check the flow values; it is displayed whether the values are above or below the limits.

- ▶ Set the **Pulse Max. Accumulation** in the coordinate **2.5.200**. Set the maximum number of incoming pulses after which a warning is issued when the calibration switch is open.

  If the calibration switch is opened when the flow is present, the conversion stops as soon as the first calibratable parameter has been entered. The pulses that continue to come in are totalised and only converted when the calibration switch is closed again. If the calibration switch is not closed within the specified maximum number of incoming pulses, the warning message will remind you of this.

8.5.6 Operating volume flow - Set parameters

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

Proceed as follows to specify:

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

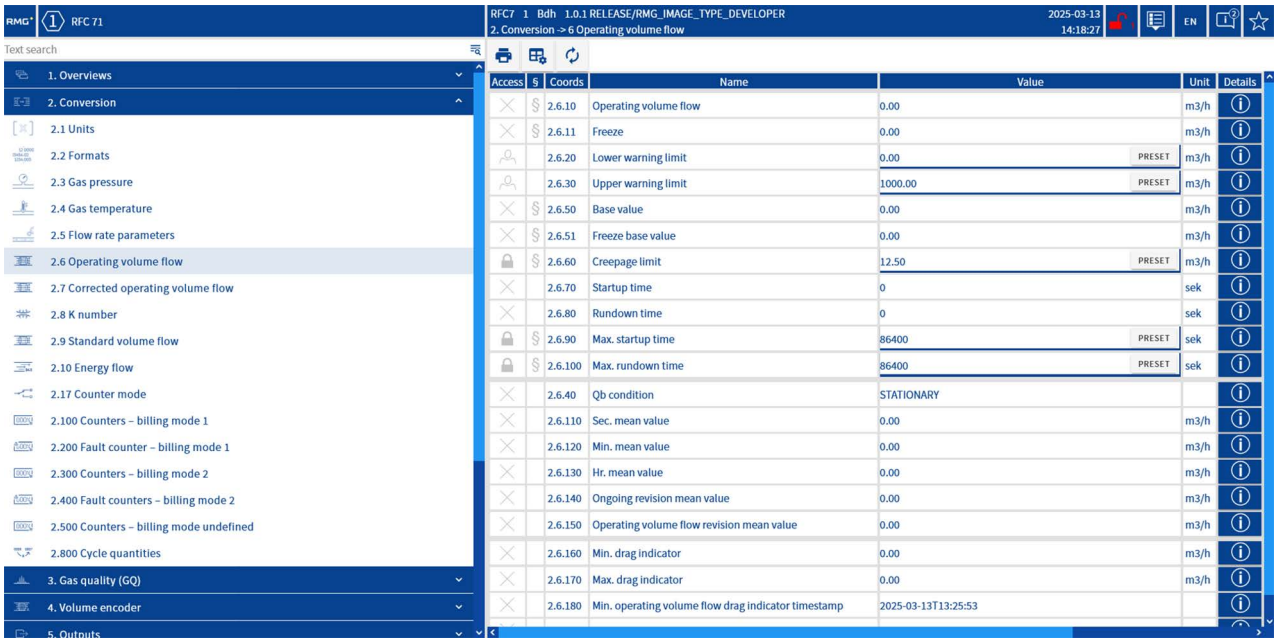


Fig. 56: Menu page 2.6 Operating volume flow

- ▶ In coordinate **2.6.20**, define the **Lower warning limit** for the operating volume flow at which a warning message (no alarm yet) is to be sent.
- ▶ In coordinate **2.6.30**, define the **Upper warning limit** for the operating volume flow at which a warning message (no alarm yet) is to be sent.
- ▶ Enter the **Creepage limit** in the coordinate **2.6.60**. The creepage limit is the lowest flow rate that the connected flowmeter can still measure reliably and accurately.
- ▶ In the coordinate **2.6.90 Max. startup time**, define the time interval in which the flow rate may fall below the lower volume flow rate limit values during start-up of the entire system without an alarm being triggered. Fault-free start-up is when the operating volume flow passes through the range from the creep flow limit to the lower alarm limit within the specified start-up time. If the operating volume flow is still in the range between the creep flow limit and the lower alarm limit after the start-up time has elapsed, an alarm message is triggered.

- In the coordinate **2.6.100 Max. rundown time**, define the time interval in which the flow rate may fall below the lower volume flow rate limit values during start-up or shut-down of the entire system without an alarm being triggered. A fault-free shutdown is deemed to have occurred if the operating volume flow passes through the range from the lower alarm limit to the creep flow limit within the specified shutdown time. If the operating volume flow is still in the range between the lower alarm limit and the creep flow limit after the run-down time has elapsed, an alarm message is triggered.

8.5.7 Operating volume flow corrected - Set parameters

The corrected operating volume flow is calculated from the uncorrected operating volume flow and, if necessary, a characteristic curve correction.

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

- Navigate to menu page **2.7 Corrected operating volume flow**.

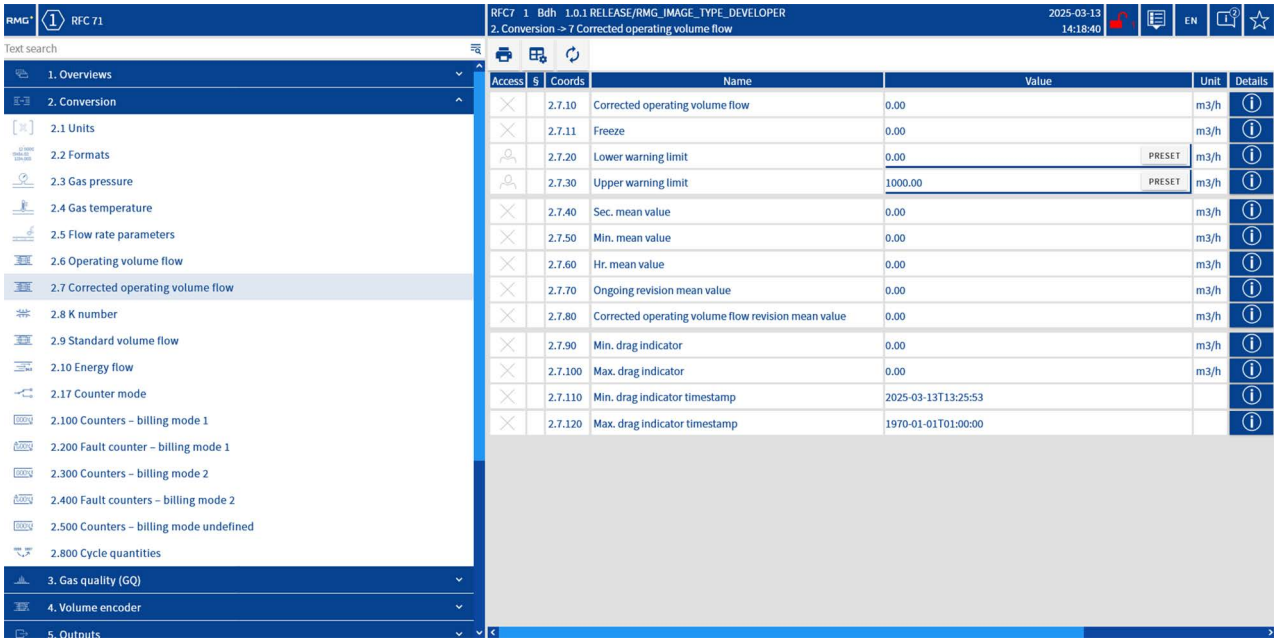


Fig. 57: Menu page 2.7 Corrected operating volume flow

- In coordinate **2.7.20**, define the **Lower warning limit** for the operating volume flow corrected at which a warning message (no alarm yet) is to be sent.
- In coordinate **2.7.30**, define the **Upper warning limit** for the operating volume flow corrected at which a warning message (no alarm yet) is to be sent.

8.5.8 K-number calculation - define parameters

The parameters for the K-number calculation can only be set when the calibration lock is open.

Proceed as follows to specify:

- Navigate to menu page **2.8 K number**.

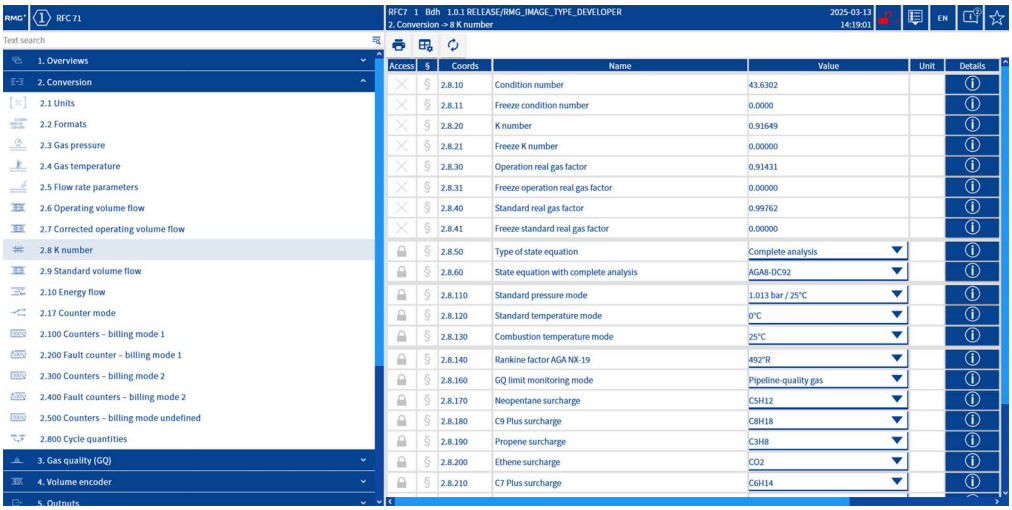


Fig. 58: Menu page 2.8 K number

- ▶ Specify the **Type of state equation** in the selection menu for coordinate **2.8.50** and save the selection. The following are available:
  - **Complete analysis**: all components of the sample gas are used for the calculation. The values are determined by a gas chromatograph, for example, or processed as default values in the flow computer.
  - **Gross values**: only individual values of the sample gas are used for the calculation.
  - **Pure substance**: the sample gas is a pure industrial gas, e.g. oxygen, nitrogen, argon, helium
  - **Simple**: the sample gas is an ideal gas or the same sample gas is always used, the K-number of which is known and constant.

Depending on the saved selection described above, the name and the selection menu of coordinates **2.8.60 to 90** will change. The following tables show the various options:

2.8.60 State equation with complete analysis	
selectable equation of state	**Explanation**
AGA 8:2017	**AGA 8:2017** is a standard of the American Gas Association (AGA) that defines an equation of state for calculating the thermodynamic properties of natural gases. This equation enables the precise determination of properties such as density and compressibility number for natural gas mixtures, which can consist of up to 21 different components.
AGA 8 DC92	The **AGA 8 DC92** method is used to calculate the K-number of "normal" natural gas. It is currently the latest accepted and approved gas model description (as of 2017) and is therefore often used as a gas model.
GERG-2004	The **GERG-2004** is a far-reaching equation of state 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 equation of state	**Explanation**
GERG-2008	The **GERG-2008** is an extension of the GERG-2004 and includes four additional gas components. It also offers greater accuracy and an extended application range in terms of temperatures and pressures. It provides more precise results for the thermodynamic properties of natural gases and other mixtures.

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

2.8.90 State equation with gross values	
selectable equation of state	**Explanation**
AGA8 GM1	**AGA 8 Gross Method 1** is used in the American region. The equation is used if the following values of the gas to be measured are known: ■ Calorific value (Ho) ■ Standard density (Rn) ■ Portion carbon dioxide (CO_2) ■ Portion hydrogen (H_2)
AGA8 GM2	**AGA 8 Gross Method 2** is used in the American region. The equation is used if the following values of the gas to be measured are known: ■ Standard density (Rn) ■ Portion carbon dioxide (CO_2) ■ Portion hydrogen (H_2) ■ Portion nitrogen (N_2)
AGA8 GM3	**AGA 8 Gross Method 3** is used in the American region. The equation is used if the complete composition of the gas to be measured is known.
SGERG-88	**GERG 88 S** is used in Europe. The equation is used if the following values of the gas to be measured are known: ■ Calorific value (Ho) ■ Standard density (Rn) ■ Portion carbon dioxide (CO_2) ■ Portion hydrogen (H_2)
GERG B	**GERG 88 S set B** is used in Europe. The equation is used if the following values of the gas to be measured are known: ■ Calorific value (Ho) ■ Standard density (Rn) ■ Portion hydrogen (H_2) ■ Portion nitrogen (N_2)
GERG C	**GERG 88 S set C** is used in Europe. The equation is used if the following values of the gas to be measured are known: ■ Standard density (Rn) ■ Portion carbon dioxide (CO_2) ■ Portion hydrogen (H_2) ■ Portion nitrogen (N_2)

Table 17: Selection options for 2.8.90 State equation with gross values

2.8.90 State equation with gross values	
selectable equation of state	**Explanation**
GERG-mod-H2	**GERG-mod-H2** is a modified equation of state based on the SGERG-88 and was specially developed for calculating the thermodynamic properties of natural gases with higher hydrogen contents. This equation enables precise calculations of compression factors and gas law deviation factors for natural gas-hydrogen mixtures, which is particularly important for the integration of hydrogen into existing natural gas infrastructures.
AGA NX-19L	**AGA NX-19L** is a revision of the AGA 8 especially for L-gas (natural gas with low energy content).
AGA NX-19H	**AGA NX-19H** is a revision of the AGA 8 especially for H-gas (natural gas with high energy content).

Table 17: Selection options for 2.8.90 State equation with gross values

2.8.80 State equation with pure substance	
selectable equation of state	**Explanation**
Van der Waals	The **Van der Waals** equation of state is a mathematical equation that describes the behaviour of real gases and extends the ideal gas equation. This equation enables a better approximation of the behaviour of real gases, especially at high pressures and low temperatures, where the ideal gas equation becomes inaccurate.
Beattie & Bridgeman	The **Beattie-Bridgeman** equation of state is also a mathematical equation that describes the behaviour of real gases and extends the ideal gas equation. However, it is a more complex equation than the Van der Waals equation, as it introduces additional empirical constants to increase accuracy.

Table 18: Selection options for 2.8.80 State equation with pure substance

2.8.70 Simple state equations	
selectable equation of state	**Explanation**
Constant	If the same sample gas is always used and the K value of this gas is known, the Constant selection can be used. A constant default value is then used for the K number. ▶ Enter the value for the K-number in the coordinate 2.8.100 Default value K-number and confirm your entry by saving.
Ideal gas	For an ideal gas (e.g. gases at low pressure), you must set the K number to "1" for this selection. ▶ Enter the value "1" for the K-number in the coordinate 2.8.100 Default value K-number and confirm your entry by saving.

Table 19: Selection options for 2.8.70 Simple state equations

▶ In the selection menu for coordinate **2.8.60** to **90**, specify the required **State equation** according to which the K number is to be calculated.

- ▶ In the selection menu for coordinate **2.8.110 Standard pressure mode**, specify which standard pressure is to be used for the calculation. The following options are available:
  - 1.01325 bar (valid in Germany)
  - 1 bar
  - 14.73 psi
  - 14.696 psi
  - 14.503 psi
- ▶ In the selection menu for coordinate **2.8.120**, specify the **Standard temperature mode** to be used for the calculation. The following options are available:
  - 0 °C (valid in Germany)
  - 15 °C
  - 20 °C
  - 59 °F
  - 60 °F
- ▶ In the selection menu for coordinate **2.8.130**, specify theV**combustion temperature mode** to be used for the calculation. The following options are available:
  - 0 °C
  - 15 °C
  - 20 °C
  - 25 °C (valid in Germany)
  - 60 °F
- ▶ Select the **Rankine factor** to be used for the **AGA NX-19** equation of state in the selection menu for coordinate **2.8.140**. The following options are available:
  - 492 °R
  - 491.67 °R
- ▶ In the selection menu for coordinate **2.8.140 Gas quality limit monitoring mode**, specify whether limit value monitoring of the gas quality should be carried out in accordance with the standard if the SGERG-88 equation of state is used. The following limit value options are available for selection:
  - **No Limits**: there is no limit value monitoring.
  - **Pipeline Quality Gas**: the associated limit values are defined in the ISO 13686:2013 standard. This setting must be selected for custody transfer operation.
  - **Wider ranges of app**: the associated limit values are defined in the ISO 12213-1:2006 standard. This setting can be selected for extended temperature and pressure ranges, but with increased uncertainty.

8.5.9 Standard volume flow - Set parameters

The standard volume flow is calculated from the corrected operating volume flow and a pressure and temperature correction with consideration of the real gas factor.

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

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

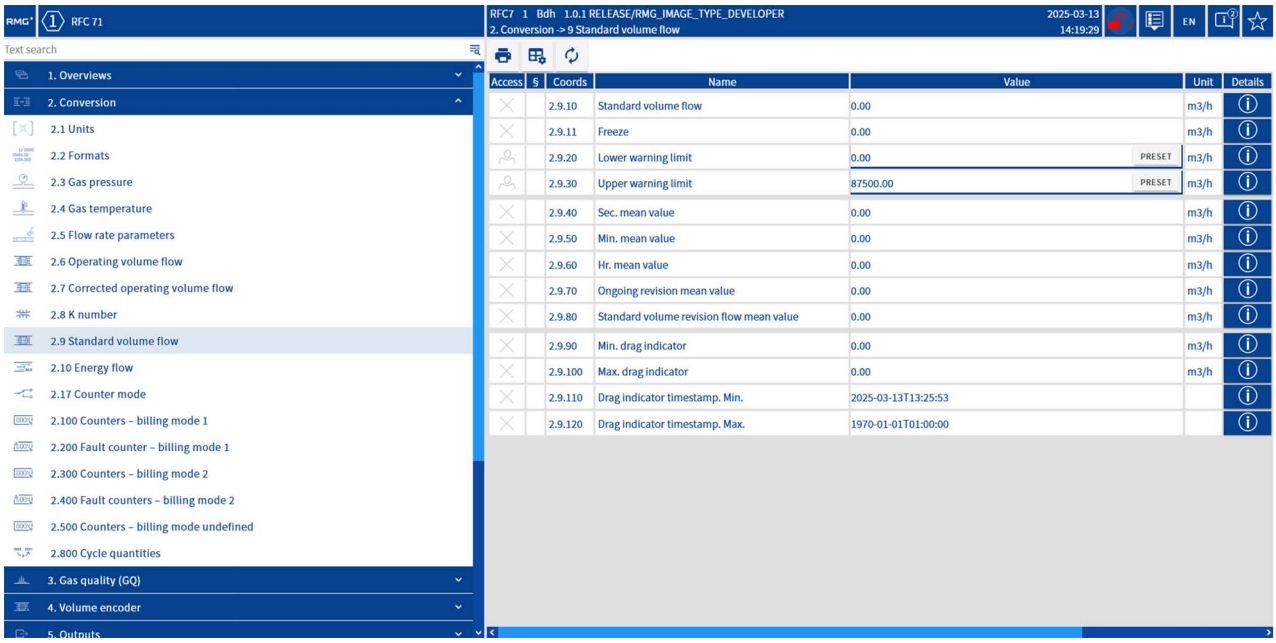


Fig. 59: Menu page 2.9 Standard volume flow

- ▶ In coordinate **2.9.20**, define the **Lower warning limit** for the standard volume flow at which a warning message (no alarm yet) is to be sent.
- ▶ In coordinate **2.9.30**, define the **Upper warning limit** for the standard volume flow at which a warning message (no alarm yet) is to be sent.

8.5.10 Energy flow - define parameters

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

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

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

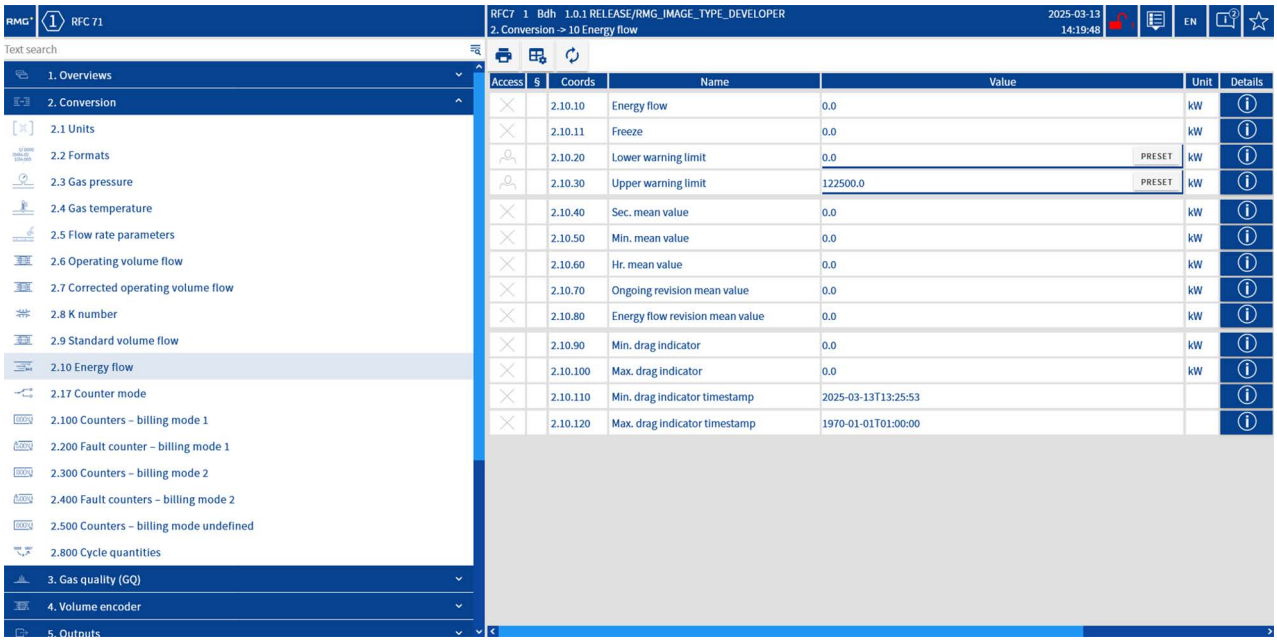


Fig. 60: Menu page 2.10 Energy flow

- ▶ In coordinate **2.10.20**, define the **Lower warning limit** for the energy flow at which a warning message (no alarm yet) is to be sent.
- ▶ In coordinate **2.10.30**, define the **Upper warning limit** for the energy flow at which a warning message (no alarm yet) is to be sent.

8.5.11 Counter mode - Set parameters

The RFC 7 generally has two sets of counters that can fulfil different tasks, e.g:

- Use of a counter in forward and reverse operation:
  - Filling and emptying a gas storage tank.
  - When switching between lines with different pressures, temporary return flows may occur, which should be recorded separately.
- Determination of the flow rate in various pipes:
  - Utilisation of two pipes with different cross-sections and corresponding gas meters for winter and summer operation.
  - Gas from two different sources is fed into the downstream network.

To set the parameters for the totaliser modes, proceed as follows:

- ▶ Navigate to menu page **2.17 Counter mode**.

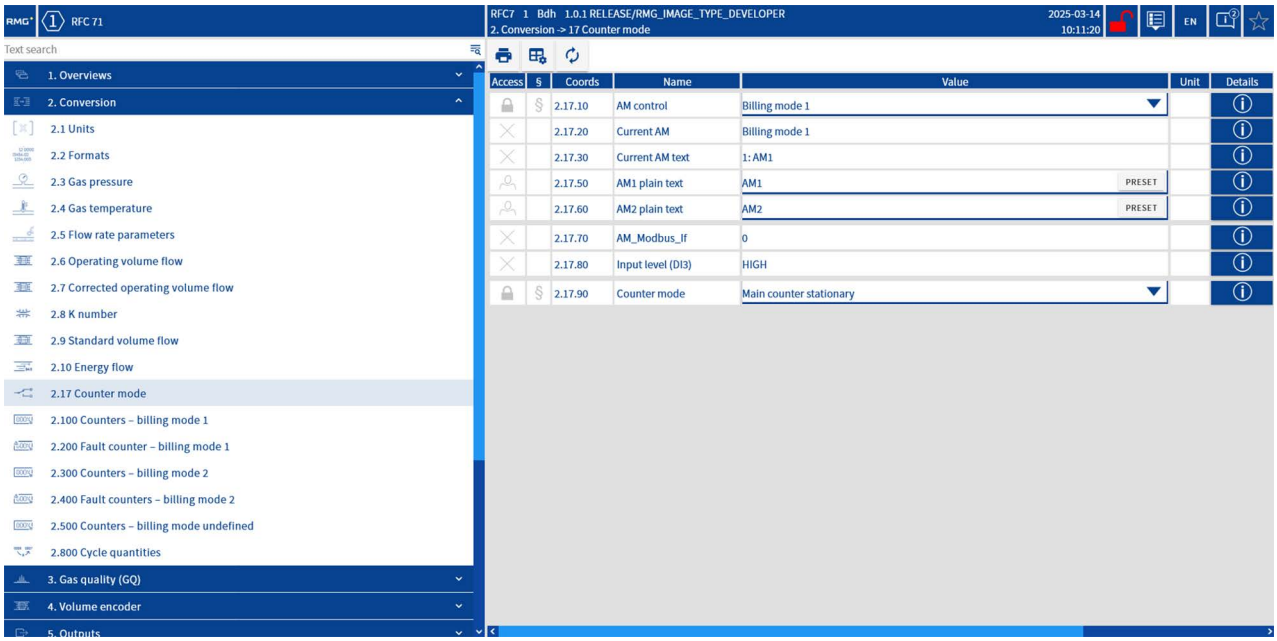


Fig. 61: Menu page 2.17 Counter mode

NOTE

Abbreviation AM

The abbreviation AM stands for "billing mode".

- ▶ Define the control of the billing mode in coordinate **2.17.10 AM control** according to your application. The following options are available:
  - Billing mode 1
  - Billing mode 2
  - undefined billing mode
  - Modbus
  - DI1=HIGH switches to BM1, DI1=LOW switches to BM2
  - Instance F direction
- ▶ Name the billing modes 1 and 2 in the coordinates **2.17.50 AM1 plain text** and **2.17.60 AM 2 plain text** according to your application (e.g. winter mode/summer mode, etc.).
- ▶ Specify the **Counter mode** in coordinate **2.17.90**. The following options are available:
  - Main counter stationary
  - Main counter running
  - Main counter under the MID

8.6 Inputs - Set parameters

To be able to use the inputs on the back of the device, the IOC system must be active and the input terminals must be supplied with power for connected passive sensors. Please make the following settings for this:

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

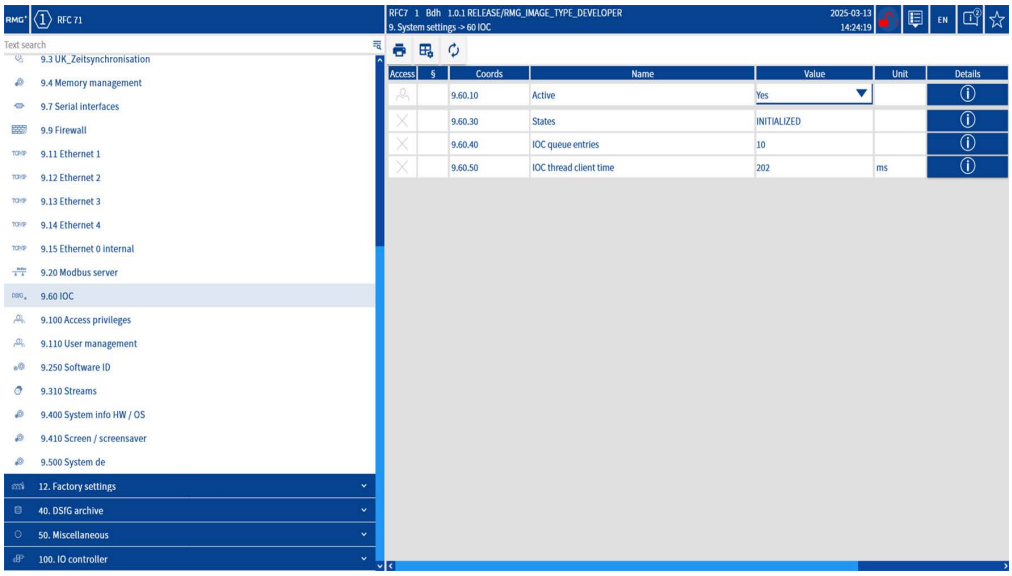


Fig. 62: Menu page 9.60 IOC

▶ Select **Yes** in the selection menu for coordinate **9.60.10 Active**.

8.6.1 Analogue inputs - Set parameters

The parameters for the analogue inputs AI1 - AI5 can be changed by a logged-in user.

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

- Analogue input AI1 - AI3 on terminal strip X3
- Analogue input AI4 - AI5 on terminal strip X7 (intrinsically safe version)

Proceed as follows to set the parameters:

▶ Depending on the analogue input to be set, navigate to the corresponding menu page, here **6.100 Analogue input 1 with HART (AI1)** as an example.

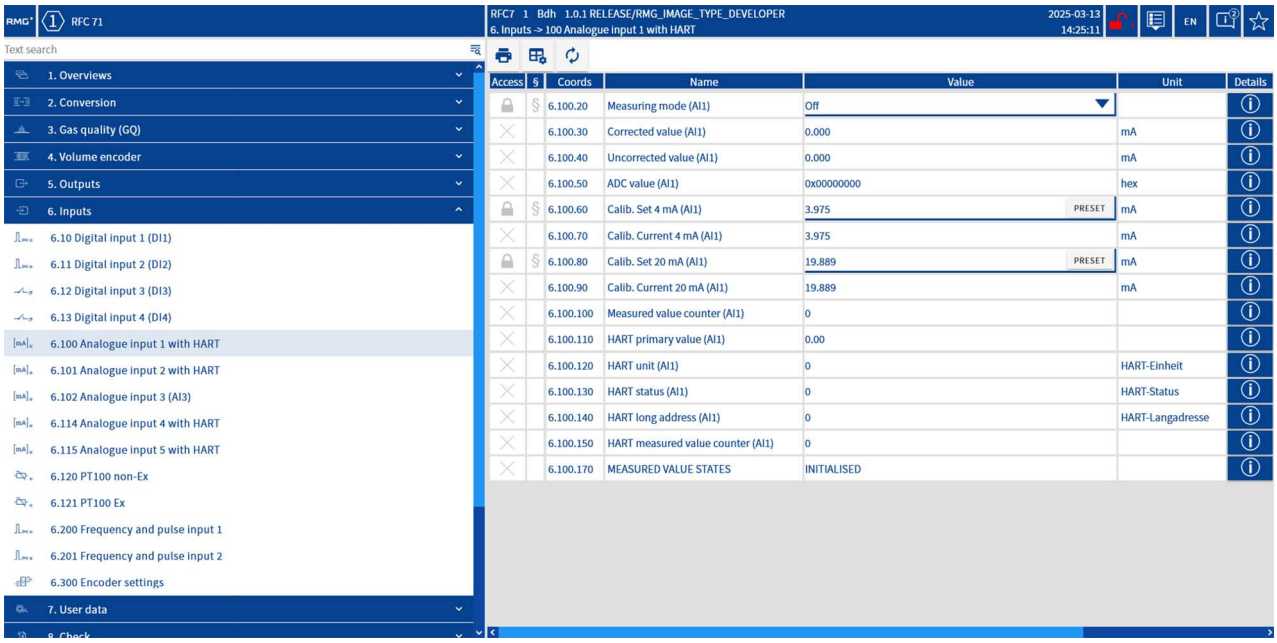


Fig. 63: Menu page 6.100 Analogue input (AI1)

- ▶ Select the corresponding setting in the selection menu for coordinate **6.100.20 Measuring mode (AI1)**:
  - Off
  - Analogue 4-20 mA
  - HART
  - Calib. 4 mA
  - Calib. 20 mA
- ▶ For all unused analogue inputs, please set the setting in the **Measurement mode** coordinate on the respective menu page to **Off**.

If the analogue inputs AI1/AI2 and AI4/AI5 with HART interface are to be used for processing digital signals, the setting must HART:

➡ The corresponding analogue input is now used with the HART interface.

The HART interface or protocol enables the transmission of digital data via the existing 4-20 mA analogue connection. A digital signal is modulated onto an analogue input according to 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 onto the analogue 4-20 mA signal without interfering with the analogue signal. This means that the analogue measurement (in this case the temperature signal) continues to be transmitted continuously while the digital data is superimposed.
3. Reception and processing: The HART-capable analogue input can detect and decode these superimposed digital signals. This enables bidirectional communication between the temperature sensor and the RFC 7, allowing additional information such as diagnostic and configuration data to be transmitted.
4. Advantage: This method makes it possible to use the existing 4-20 mA analogue input.

8.6.2 PT100 - Set parameters

The parameters of the PT100 (resistance measurement) can be changed by a logged-in user.

The connections on terminal strip X8 are intrinsically safe (see section 6.2.2 "Terminal assignments of the terminal strips").

Proceed as follows to set the parameters:

- ▶ Navigate to menu page **6.121 PT100 Ex**.

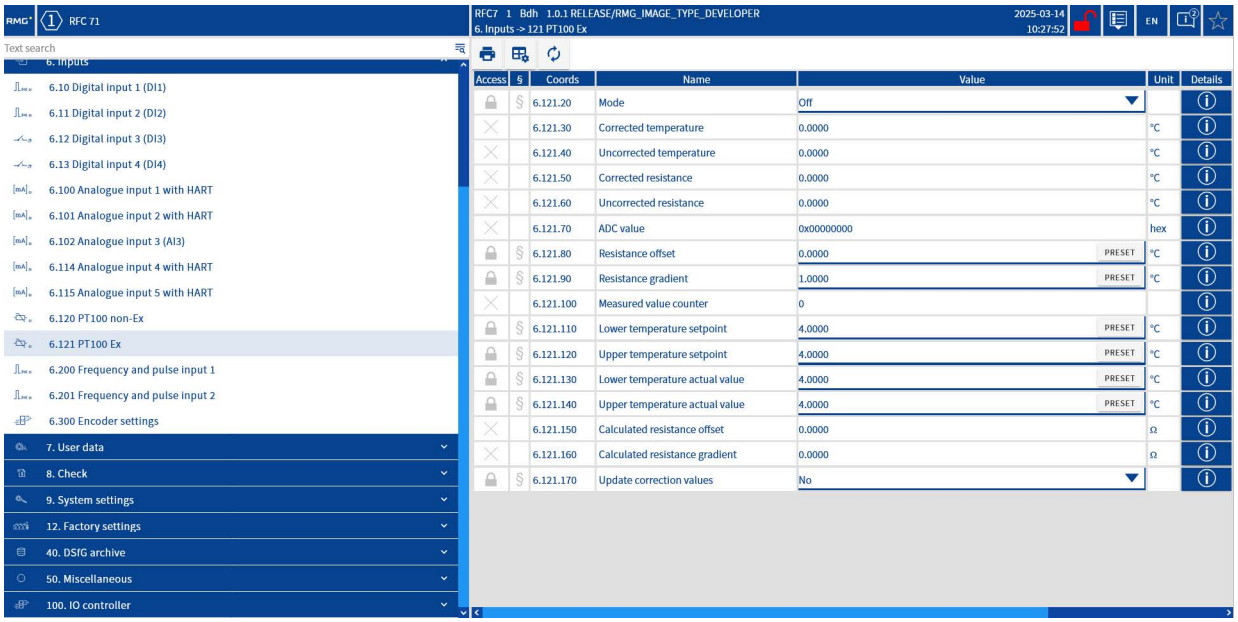


Fig. 64: Menu page 6.120 PT100 Ex

- ▶ Set the mode of the PT100 in the selection menu of coordinate **6.120.10 Mode**. The following modes are available:
  - Off
  - PT100
  - Calibration
  - Simulation

A 4-wire resistor must be used if cable break monitoring is to take place.

- ▶ Enter the parameters for the resistance in the coordinates **6.120.80 Resistance offset** and **6.120.90 Resistance gradient**.
- ▶ Confirm the acceptance of the values for a resistance correction in the selection menu of the coordinate **6.120.170 PT100 Update correction values** by selecting Yes.

9 Operation

Once the RFC 7 has been put into operation, it runs without interruption.

Observe the following instructions to ensure trouble-free operation:

- Read these operating instructions carefully to avoid operating errors and only use the RFC 7 as intended (see section 2.1 "Intended use").
- Only operate the RFC 7 within the performance limits specified in the technical data (see section 13 "Technical data") and do not exceed these limits.
- Protect the device from heat sources (e.g. direct sunlight).
- Take a damaged or unsafe appliance out of circulation immediately and label it accordingly to prevent it from being used again unintentionally.
- Only have the defective device 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 for warnings via the "Administrator" access authorisation and for alarms only via the calibration lock.

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 to life due to electrical voltage

Before dismantling, the appliance must be switched off or disconnected from the mains; failure to do so may result in serious injury or even death.

- ▶ Switch off the power supply to the appliance or disconnect it from the mains before starting any work.
- ▶ Only carry out work on the appliance that is described in these instructions. Ensure that the appliance is not energised when doing so.

12.1 Dismantling

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

1. Remove all saved data from the device by deleting all archives.
2. Switch off the power supply to the device.
3. Loosen the fixing screws of the device and carefully pull it forwards out of the subrack.
4. Disconnect the connection cables.
5. Remove the appliance completely from the switch cabinet.

12.2 Waste disposal

Dispose of appliance components and packaging materials in an environmentally friendly manner and in accordance with the respective waste treatment and national disposal regulations and standards of the region or country to which the appliance is delivered.

The following applies within the EU:

Appliances that are no longer required must, in accordance with the EU Directive

2012/19/EU or ElektroG for recycling at a recycling centre.

The appliance must not be disposed of with household waste!

13 Technical data

Structure	
Device variants	■ Single-Stream (1 Stream; the data from one measuring point is processed by the RFC 7.) ■ Multi-Stream (2 – 4 Streams; the data from up to four measuring points is processed by the RFC 7.) **(Please note: The Multi-Stream variant is currently not available!)**
Housing variants	■ 19" housing for 1 - 2 streams, Dimensions: 213.36 (42 HP) x 133.35 (3 U) x 230 mm (W x H x D) (without connectors on the rear) ■ 19" housing for 3 - 4 streams 426.72 (84 HP) x 133.35 (3 U) x 230 mm (W x H x D) (without connectors on the rear)
Weight	■ 1 Stream: 1.75 kg ■ 2 Streams: 2.25 kg
Material	FR4 (front panel) and aluminium (enclosure)
Protection class	IP 20 (protection against foreign bodies > 12.5 mm, no splash protection)
Components in the housing	■ Power supply 24 V DC ■ Intercom (for Multi-Stream variants) additionally 5 plug-in boards per stream: ■ **CoM base** for communication and calculation ■ **IO system** for time-critical communication with actuators and sensors, consisting of: - **IOC-EX-IO** as an interface to the Ex zone with galvanically isolated inputs - **IOC-Digital-IO** as an interface for digital inputs and outputs outside the E-zones - **IOC-CPU** for processing all analogue and digital inputs and outputs - **IOC-Analogue-Out** as an interface for analogue outputs outside the Ex zone All the intended functions can be executed with these plug-in boards. An extension with plug-in boards for additional functions is not planned.
Range of application	
Ambient, operating and storage temperature	-20…50°C
Humidity class	EN12405-3 SL1 inside 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 located in a potentially explosive area (Ex zone 1) can be connected to the Ex inputs and outputs of the RFC 7.

Approvals according to	
EU directive	■ Measuring Instruments Directive 2014/32/EU ■ EMC Directive 2014/30/EU ■ Rohs Directive 2011/65/EU
EX approvals	**Interface for Ex zone 1 devices:** ■ ATEX Directive 2014/34/EU ■ IECEX
National laws and regulations	■ Measurement and Calibtration Act - MessEG, from 25/07/2013 ■ Measurement and Calibration Regulation - MessEV, from 11/12/2014
Calculation methods for the compressibility coefficient K	
Available methods	■ k = constant ■ Full analysis: - AGA 8 DC92 - AGA 8:2017 - GERG-2004 - GERG-2008 ■ Gross values: - GERG-88 S - GERG-88 S Satz B - GERG-88 S Satz 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	
Via front panel:	
Display	7" touchscreen Active area of the touchscreen: 154.2 x 85.92 mm (W x H) 1024 x 600 pixel
LEDs	■ Alarm/fault/error (red) ■ Warning (yellow) ■ Measurement (green) ■ Power supply on (blue)
Calibration Switch	■ can be moved up and down with additional tool ■ is sealed for custody transfer use
Software	integrierte GUI
Via PC or local network:	
Connection to ethernet interface	■ Connect network cable optionally to Eth 1 - 4 ■ Enter the IP address of the RFC 7 in the 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 power	max. 20 W
Overvoltage protection	yes
Design of system hardware	
System controller (CoM basis)	
Processor	Quad Core ARM Cortex®-A53 based NXP: i.MX8M mini
CPU clock frequency	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 memory
	4 GB eMMC programme (permanent) memory
Serial interfaces (2x per stream, 1x optional)	
SER 1 (RJ45)	RS 485
SER 2 (RJ45)	RS 485
(SER 3 optional über Adapter)	(RS 485 optional)
Available communication protocols	■ Modbus-RTU Client/Server ■ Modbus-ASCII Client/Server ■ Modbus-Client for USM (Instance F) ■ Modbus-Client for gas quality
Baud rate	9600 – 115,200 depending on the 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 clock frequency	100 MHz
Memory	1 MB Flash
Digital inputs per stream	
Quantity	4 x status inputs, optically isolated ■ DI1 – DI4
U_{max}	5 V
I_{max}	15 mA
f_{max}	2 Hz

Digital outputs per stream	
Quantity	6 x digital outputs: ■ DO1 – DO2: Pulse output with max. 5 kHz ■ DO3 – DO6: Digital output
U_{max}	24 VDC +10%
I_{max}	20 mA
Analogue inputs per stream	
Quantity	5 x analogue inputs, safely separated: ■ AI1 – AI3: Analogue input ■ AI4 – AI5: Analogue input in intrinsically safe design, - Ex limit values must be observed! - Recommended for pressure and temperature measurement. - Can also be used digitally via HART interface.
Range	4 – 20 mA
Resolution	24 Bit ADC
U_{max}	22 V
I_{max}	21 mA
Measuring time	~ 500 ms
Measuring rate	2 Hz
Analogue outputs per stream	
Quantity	4 x Analogue outputs: ■ AO1 – AO4: Analogue output
Range	4 – 20 mA
Resolution	PWM 14 Bit
Pulse inputs per stream	
Quantity	3 x pulse input in intrinsically safe design, Ex limit values must be observed: ■ N1 – N2: Digital pulse input for reed (LF) or Namur (HF) ■ N3: Digital encoder input
Measuring range	■ Reed: 0 – 5 Hz ■ Namur: 0 – 10 kHz
U_{max}	8.2 V
I_{max}	16 mA
4-wire PT100 input per stream	
Quantity	1 x PT100 input with 4 terminals for resistance measurement (PT --, PT-, PT+, PT++) - The PT100 input is intrinsically safe, Ex limit values must be observed!
Temperature range	-20°C…60°C
Resolution	24 Bit ADC
U_{max}	5 V
I_{max}	1.6 mA, typ. 0.8 mA
Measuring rate	>2 Hz

Notes

ONE STEP AHEAD

Subject to change without notice!

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Additional information

If you would like to find out more about RMG's products and solutions, visit our website: **www.rmg.com**
or contact your customer adviser.

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