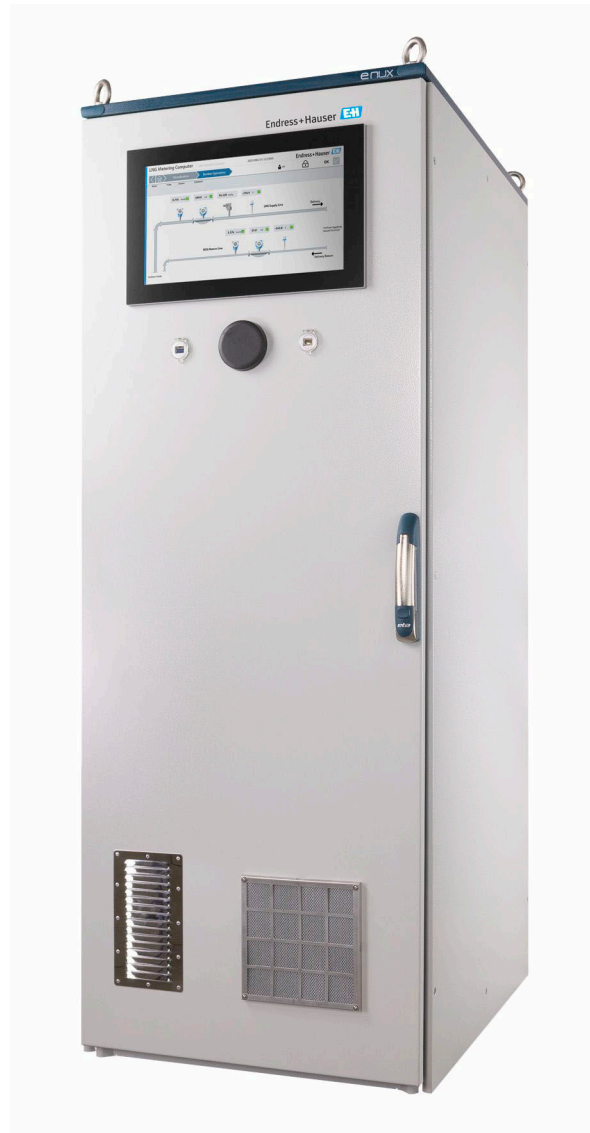


Operating Instructions

LNG bunkering control system

Mass measurement and energy calculation with integrated gas analysis in LNG bunker transfer operations



- Make sure the document is stored in a safe place such that it is always available when working on or with the device.
- To avoid danger to individuals or the facility, read the "Basic safety instructions" section carefully, as well as all other safety instructions in the document that are specific to working procedures.
- The manufacturer reserves the right to modify technical data without prior notice. Your Endress+Hauser sales organization will supply you with current information and updates to this manual.

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1 About this document

1.1 Document function

These Operating Instructions contain all the information required in the various life cycle phases of the device: from product identification, incoming acceptance and storage, to installation, connection, operation and commissioning, through to troubleshooting, maintenance and disposal.

1.2 Symbols

1.2.1 Safety symbols

DANGER

This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.

WARNING

This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.






CAUTION

This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.



NOTICE





This symbol contains information on procedures and other facts which do not result in personal injury.

1.2.2 Electrical symbols






Symbol	Meaning
	Direct current
	Alternating current
	Direct current and alternating current
	Ground connection A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.
	Potential equalization connection (PE: protective earth) Ground terminals that must be connected to ground prior to establishing any other connections. The ground terminals are located on the interior and exterior of the device: <ul style="list-style-type: none"> ▪ Interior ground terminal: potential equalization is connected to the supply network. ▪ Exterior ground terminal: device is connected to the plant grounding system.

1.2.3 Communication-specific symbols













Symbol	Meaning
	Wireless Local Area Network (WLAN) Communication via a wireless, local network.
 <small>A0044513</small>	Cellular radio Bidirectional data exchange via cellular network.

Symbol	Meaning
	Bluetooth Wireless data transmission between devices over a short distance.
	LED Light emitting diode is off.
	LED Light emitting diode is on.
	LED Light emitting diode is flashing.




1.2.4 Tool symbols

Symbol	Meaning
	Torx screwdriver
	Flat-blade screwdriver
	Phillips head screwdriver
	Allen key
	Open-ended wrench

1.2.5 Symbols for certain types of information

Symbol	Meaning
	Permitted Procedures, processes or actions that are permitted.
	Preferred Procedures, processes or actions that are preferred.
	Forbidden Procedures, processes or actions that are forbidden.
	Tip Indicates additional information.
	Reference to documentation
	Reference to page
	Reference to graphic
	Notice or individual step to be observed
	Series of steps
	Result of a step
	Help in the event of a problem
	Visual inspection

1.2.6 Symbols in graphics

Symbol	Meaning
1, 2, 3, ...	Item numbers
1, 2, 3, ...	Series of steps
A, B, C, ...	Views
A-A, B-B, C-C, ...	Sections
	Hazardous area
	Safe area (non-hazardous area)
	Flow direction

1.3 Highlighting of text

Emphasis	Meaning	Example
Bold	Keys, buttons, program icons, tabs, menus, commands	Start → Programs → Endress+Hauser In the File menu, select the Print option.

1.4 Acronyms used

Acronym	Meaning
BIOS	Basic Input/Output System
BOG	Boil-Off Gas
BTU	British Thermal Unit
CSV	Comma Separated Values
EIA (Electronic Industries Alliance)	Alliance of trade associations for electronics manufacturers in the United States
EU	European Union
FWA	Flow Weighted Average
HMI	Human-Machine Interface
IMO	International Maritime Organization
IP address	Internet Protocol address
IPPC	International Plant Protection Convention
LNG	Liquefied Natural Gas
OPC (Open Platform Communications)	Platform-independent data exchange
RoHS (Restriction of Hazardous Substances Directive)	Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment
RTU	Remote Terminal Unit
TCP	Transmission Control Protocol
TIA (Telecommunications Industry Association)	Association of United States government agencies and companies in the data technology and telecommunications industries
USB	Universal Serial Bus

1.5 Valid versions

Component	Version
HMI application, version	From 02.01.xx
Flow computer app, name	E+H LNG Metering Application

1.6 Registered trademarks

Microsoft®

Registered trademark of the Microsoft Corporation, Redmond, Washington, USA

All other brand and product names are trademarks or registered trademarks of the companies and organizations in question.

2 Safety instructions

2.1 Requirements for the personnel

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:

- ▶ Trained, qualified specialists must have a relevant qualification for this specific function and task.
- ▶ Are authorized by the plant owner/operator.
- ▶ Are familiar with federal/national regulations.
- ▶ Before starting work, read and understand the instructions in the manual and supplementary documentation as well as the certificates (depending on the application).
- ▶ Follow instructions and comply with basic conditions.

The operating personnel must fulfill the following requirements:

- ▶ Are instructed and authorized according to the requirements of the task by the facility's owner-operator.
- ▶ Follow the instructions in this manual.

2.2 Intended use

This user manual is intended for **operators** working with the HMI of the LNG bunkering control system. The functionality described in this user manual applies to users with the authorization level **Operator**.

The HMI of the LNG bunkering control system is designed for use with the Proline Promass F/Q 300/500 Coriolis flowmeter and the Raman Rxn4 analyzer. Any other use is regarded as improper use.

The manufacturer is not liable for losses or damages arising from use in violation of the intended use. In such cases, the user bears full responsibility.

Intended use also includes complying with the operating and maintenance conditions specified by the manufacturer.

To ensure that the control system remains in proper condition during operation, pay attention to the following points:

- ▶ Observe the specified temperature range.
- ▶ Operate the control system only in compliance with the data on the nameplate and the usage conditions listed in the Operating Instructions and supplementary documentation.
- ▶ Ensure that the control system is permanently protected against corrosion caused by environmental influences.

2.3 Workplace safety

When working on and with the device:

- ▶ Wear the required personal protective equipment as per national regulations.

2.4 Operational safety

Damage to the device!

- ▶ Operate the device in proper technical condition and fail-safe condition only.
- ▶ The operator is responsible for the interference-free operation of the device.

Modifications to the device

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers!

- ▶ If modifications are nevertheless required, consult with the manufacturer.

Repair

To ensure continued operational safety and reliability:

- ▶ Carry out repairs on the device only if they are expressly permitted.
- ▶ Observe federal/national regulations pertaining to the repair of an electrical device.
- ▶ Use only original spare parts and accessories.

2.5 Product safety

This measuring device is designed in accordance with good engineering practice to meet state-of-the-art safety requirements, has been tested, and left the factory in a condition in which it is safe to operate.

It meets general safety standards and legal requirements. It also complies with the EU directives listed in the device-specific EU Declaration of Conformity..

2.6 IT security

Our warranty is valid only if the product is installed and used as described in the Operating Instructions. The product is equipped with security mechanisms to protect it against any inadvertent changes to the settings.

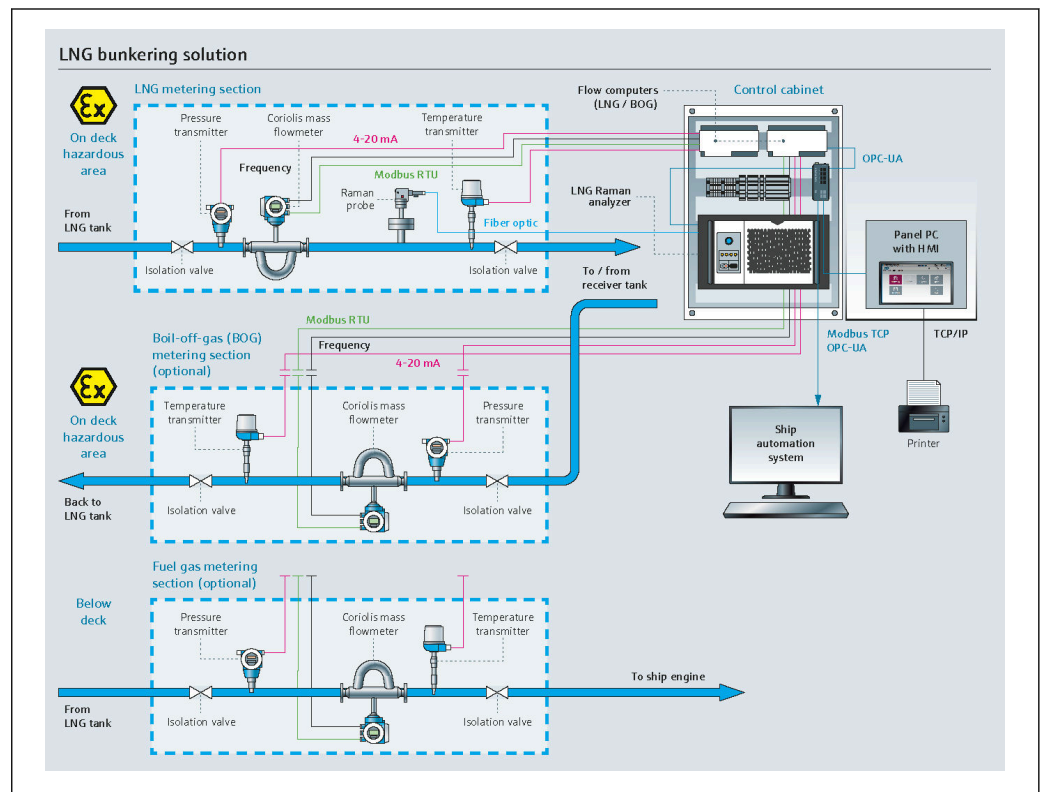
IT security measures, which provide additional protection for the product and associated data transfer, must be implemented by the operators themselves in line with their security standards.

3 Product description

The main functions of the LNG bunkering control system are operation, visualization of the bunkering process and data management. The control system's HMI offers user-friendly menu guidance for reliable operation.

3.1 System overview

The following is an overview of the entire LNG bunkering solution.



1 System overview

3.2 System design

As the heart of the system, the LNG/BOG/fuel gas flow computer acquires various process data from the respective LNG/BOG/fuel gas flowmeters. Various signal types are transmitted between the flow computer and the field devices and Raman analyzer via an Ethernet switch.

All real-time signals are synchronized on the panel PC and displayed to the operator via the touch-sensitive HMI. Reports including measurement results are also stored and can be retrieved, displayed and exported.

3.3 Changes to the control system

Only appropriately trained and qualified personnel are permitted to make changes to the control system. If you require further support, contact your local Endress+Hauser Sales Center.

3.4 Operating the LNG bunkering system

To ensure error-free operation and the best possible measuring accuracy, the specified installation instructions must be observed. For installations involved in custody transfer operations, care must be taken to operate the LNG Bunkering System only within the defined custody transfer limits.

4 Incoming acceptance and product identification

4.1 Incoming acceptance

Upon receipt of goods, check the following:

- Check the packaging for visible damage arising from transportation.
- To avoid damage, remove the packaging with care.
- Check the delivery and ensure that it is complete and consistent with the order.
- Retain all accompanying documents.

The documentation is included in the scope of delivery of the control cabinet and comprises:

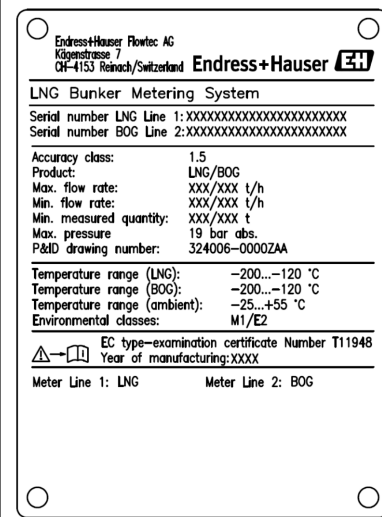
- These Operating Instructions
- Wiring drawing for the LNG bunkering control system


i The control system must not be put into operation if it has been established that the delivery is damaged. In this case, please contact the Endress+Hauser Sales Center. Return the control system to Endress+Hauser in the original packaging where possible.

4.2 Product identification

4.2.1 Nameplates on the control cabinet of the control system

There are two nameplates on the control cabinet, which serve to identify it clearly.




Endress+Hauser Flowtec AG
Köpenstrasse 7
CH-4153 Reinach/Switzerland **Endress+Hauser** 

LNG Bunker Metering System

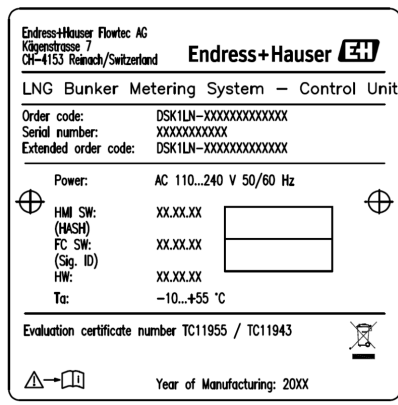
Serial number LNG Line 1:XXXXXXXXXXXXXXXXXXXX
Serial number BOG Line 2:XXXXXXXXXXXXXXXXXXXX


Accuracy class: 1.5
Product: LNG/BOG
Max. flow rate: XXX/XXX l/h
Min. flow rate: XXX/XXX l/h
Min. measured quantity: XXX/XXX t
Max. pressure: 19 bar abs.
P&ID drawing number: 324006-0000ZAA

Temperature range (LNG): -200...-120 °C
Temperature range (BOG): -200...-120 °C
Temperature range (ambient): -25...+55 °C
Environmental classes: M1/E2

 EC type-examination certificate Number T11948
Year of manufacturing:XXXX

Meter Line 1: LNG Meter Line 2: BOG





Endress+Hauser Flowtec AG
Köpenstrasse 7
CH-4153 Reinach/Switzerland **Endress+Hauser** 


LNG Bunker Metering System – Control Unit


Order code: DSK1LN-XXXXXXXXXXXX
Serial number: XXXXXXXXXXXX
Extended order code: DSK1LN-XXXXXXXXXXXX


Power: AC 110...240 V 50/60 Hz

HMI SW: XX.XX.XX
(HASH) 
FC SW: XX.XX.XX
(Sig. ID)
HW: XX.XX.XX
Ta: -10...+55 °C

Evaluation certificate number TC11955 / TC11943 

 Year of Manufacturing: 20XX

 2 Nameplate for LNG bunkering system

 3 Nameplate for control system

A0054014
A0054013

5 Storage and transport

5.1 Storage conditions

Observe the following notes for storage:

- ▶ Store in the original packaging for protection against impacts.
- ▶ Protect from direct sunlight to avoid unacceptably high surface temperatures.
- ▶ Store in a dry and dust-free place.
- ▶ Do not store outdoors.
- ▶ Storage temperature: -25 to +60 °C (-13 to +140 °F)

5.2 Transporting the product

Observe the following notes during transport:

- ▶ Store in the original packaging for protection against impacts.
- ▶ Protect from direct sunlight to avoid unacceptably high surface temperatures.
- ▶ Transport to the location of use in the transport box in which it was delivered.

5.3 Packaging disposal

All packaging materials are environmentally friendly and 100% recyclable:

- Outer packaging of device
 - Stretch wrap made of polymer in accordance with EU Directive 2002/95/EC (RoHS)
- Packaging
 - Wood crate treated in accordance with ISPM 15 standard, confirmed by IPPC logo
 - Cardboard box in accordance with European packaging guideline 94/62/EC, recyclability confirmed by Resy symbol
- Transport material and fastening fixtures
 - Disposable plastic pallet
 - Plastic straps
 - Plastic adhesive strips
- Filler material
 - Paper pads

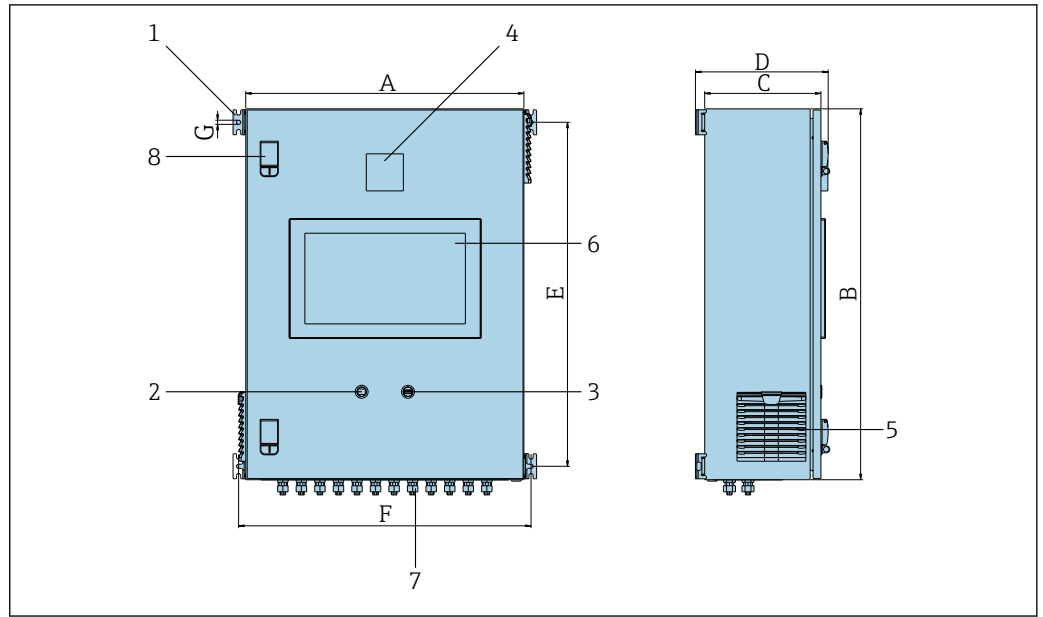
6 Installation

6.1 Mounting the control system control cabinet

The control system control cabinet is supplied with brackets for wall mounting and must be installed on a stable wall using suitable fastening materials.

The different versions of the control system with their associated mounting brackets are shown below.

6.1.1 Control cabinet without Raman analyzer



A0054057

- 1 Fastening lugs
- 2 Ethernet connection
- 3 USB port
- 4 Antenna
- 5 Filter
- 6 Display
- 7 Cable glands
- 8 Door lock

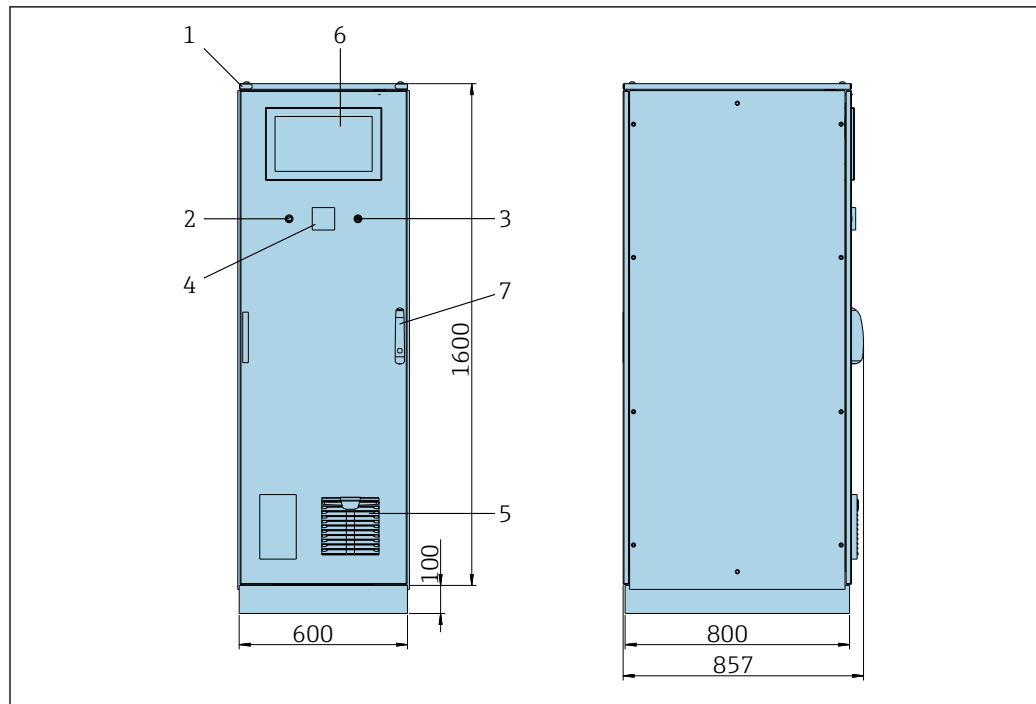
Dimensions in SI units

Version	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]
LNG/LNG+BOG	600	800	250	286	742	631	9
LNG+BOG+Fuel Gas	800	1000	300	336	942	831	9

Dimensions in US units

Version	A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [in]
LNG/LNG+BOG	23.6	31.5	9.85	11.26	29.21	24.85	0.36
LNG+BOG+Fuel Gas	31.5	39.4	11.82	13.23	37.09	32.72	0.36

6.1.2 Control cabinet with Raman analyzer



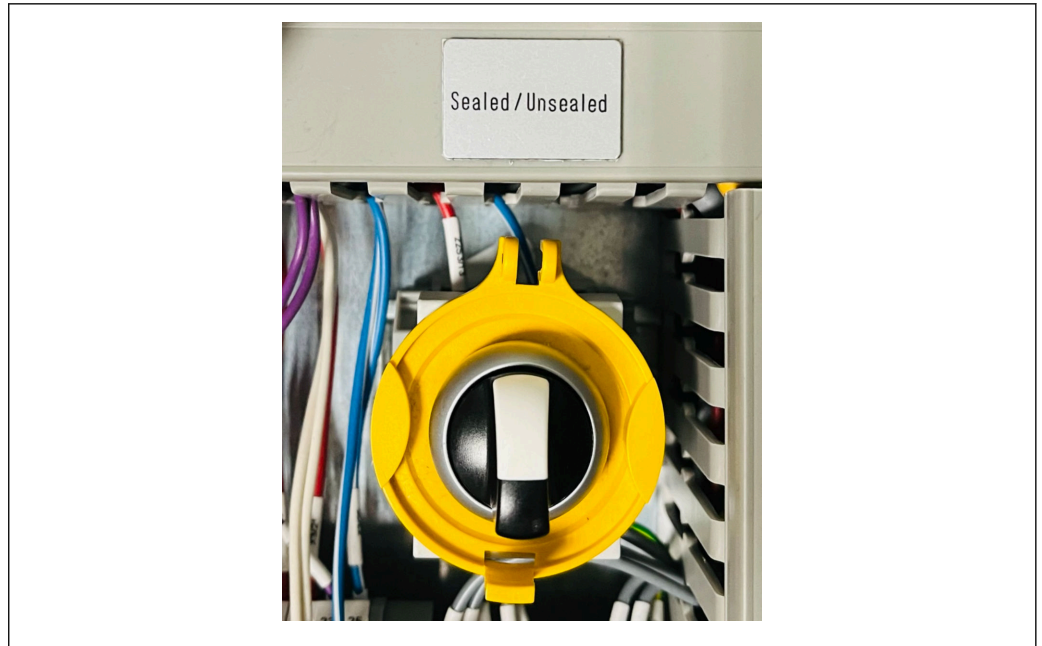
A0054058

- 1 Lifting lugs
- 2 Ethernet connection
- 3 USB port
- 4 Antenna
- 5 Filter
- 6 Display
- 7 Door lock

6.2 Sealing/locking

6.2.1 Locking of settings

The settings of the system are locked by a hardware switch inside the control cabinet. If the switch is set to **Sealed**, no custody-transfer-relevant settings can be changed. If the switch is set to **Unsealed**, the HMI displays a corresponding error message.



A0054010

4 Custody transfer switch

6.2.2 Sealing of the control cabinet

The cable entries in the control cabinet must be protected against unauthorized access. The plates with the cable entries are secured with sealing screws. The sealing screws must be sealed in accordance with the following diagram:



A0053084

5 Positions of the cable entries



A0053085

6 Sealing screws with tamper-proof seal

After system commissioning, the door lock can be sealed in accordance with the following diagram:



A0053086

7 Door lock with tamper-proof seal

6.2.3 USB/Ethernet interfaces

The Ethernet interface must be sealed for custody transfer. If access to the USB interface is not permitted, this can also be sealed.



A0054007

8 USB/Ethernet connections

6.3 Connecting requirements

6.3.1 Required tools

- For cable entries: use suitable tools
- For securing clamp (stainless steel housing): 8 mm wrench
- Wire stripper
- When using standard cables: use a crimper for wire end ferrules
- Crimper for keystone jack and plug cat. 6A
- Universal measuring device for cable testing

6.3.2 Connecting cable

WARNING

Since the cabinet is installed in a maritime environment, the connecting cables and cable entries must meet special requirements.

- ▶ The requirements in these Operating Instructions must be met.

All network and signal cables used must be approved for use in the maritime industry in accordance with the latest technology and generally recognized rules of technology:

- All cables laid must be specifically designed for use in the maritime industry. In addition, they must meet requirements relating to ship class and have other necessary approvals.
- The use of armored cables is recommended, and these should be laid in fixed or flexible conduits to protect them from mechanical damage.
- All signal cables must be grounded. If multi-core cables are used, the individual signal cables must be grounded individually.
- All Ethernet connection cables must be Cable Type S/FTP Category 7 (individual pairs with braided shield and overall cable with foil shield).
- Required wire cross-sections:
 - Signal cable: 0.75 mm²
 - Power cable for AC: 1.5 mm²


6.3.3 Ethernet connection

The RJ-45 Ethernet connections of the Ethernet cables must meet the following specifications: Keystone jack cat. 6A

6.3.4 Cable entries and distribution box

The cable entries must meet all safety requirements applicable at the place of installation. These may include:

- Protection against climatic conditions
- Protection against corrosion
- Sealing off of any unused cable entries using dummy plugs



 Additional use of a sealing compound to seal off connection seams or joints is common practice and has proven to be effective.

6.4 Special connection instructions

Wiring the cabinet

All field devices are directly powered by the LNG bunkering control system.

An uninterruptible power supply (UPS) is recommended for the LNG bunkering control system and the accompanying devices.

 Required ratings →  60


7 Commissioning



7.1 Software update

 If an update is required for any of the following programs, it must take place before commissioning.

- HMI
- Flow computer app

7.2 System settings

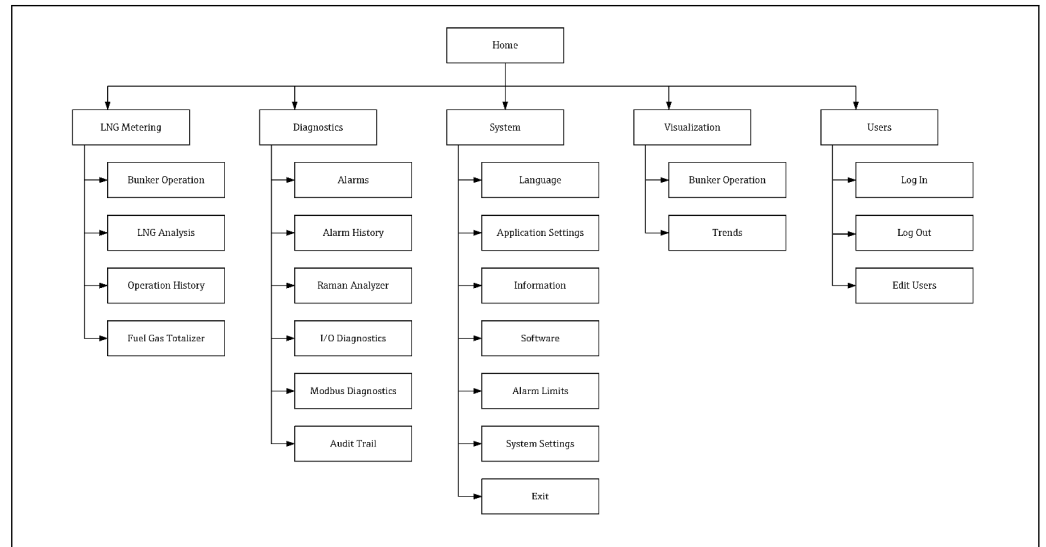
 The system settings generally include user settings (e.g. time and date, file path), communication (e.g. IP address) and other configurations.

 For further information →  21

8 Operation

8.1 HMI navigation

The following overview shows how the user can navigate between the screens. Depending on the user group, some screens may not be available and are therefore grayed out.



A0054073

8.2 General information

8.2.1 Status bar

The status bar is located at the top edge of the screen and contains the following information:

- System name
- Customer name
- System date, system time
- Endress+Hauser



A0052790

8.2.2 Navigation bar

The navigation bar is located at the top edge of the screen, directly below the status bar, and enables navigation between the individual displays.

The current screen is highlighted in blue.

The current screen also shows the currently logged-in user, the status of the custody transfer switch and the system status (OK, warning, error).



A0052789


8.3 Access rights

Certain functions are only available to users with higher-level access rights.

The following user levels are available:

User name	Password
operator	operator
supervisor	supervisor
administrator	administrator



For more information →  52

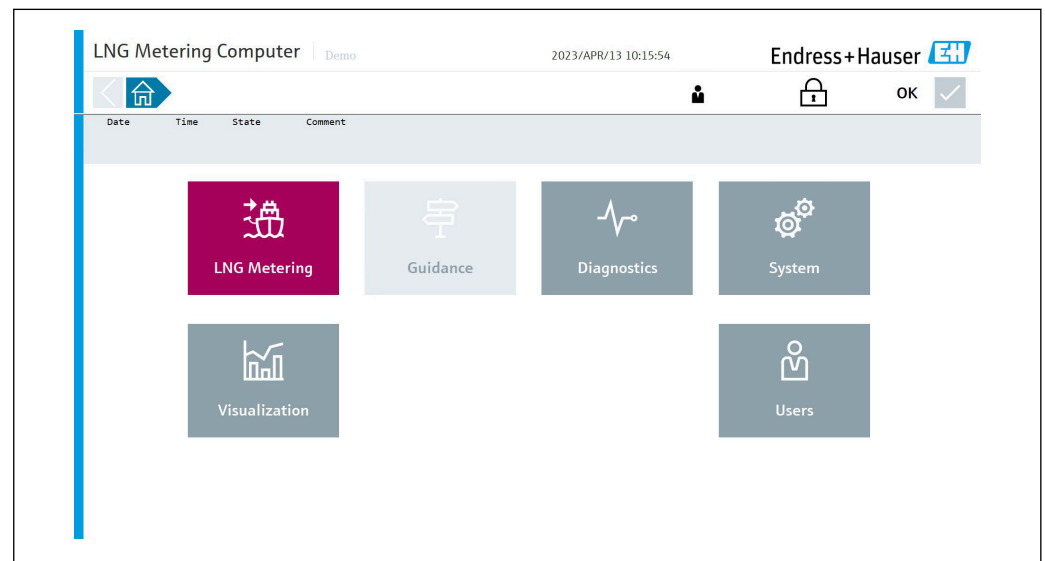
8.4 "Home" screen

Each time the LNG bunkering control system is switched on or restarted, the HMI program is automatically loaded and the start screen then displayed.

The operator can navigate from here to the following main sections:

- **LNG Metering**
- **Diagnostics**
- **System**
- **Visualization**
- **Users**

 The grayed out main area **Guidance** is temporarily not available.



A0052753

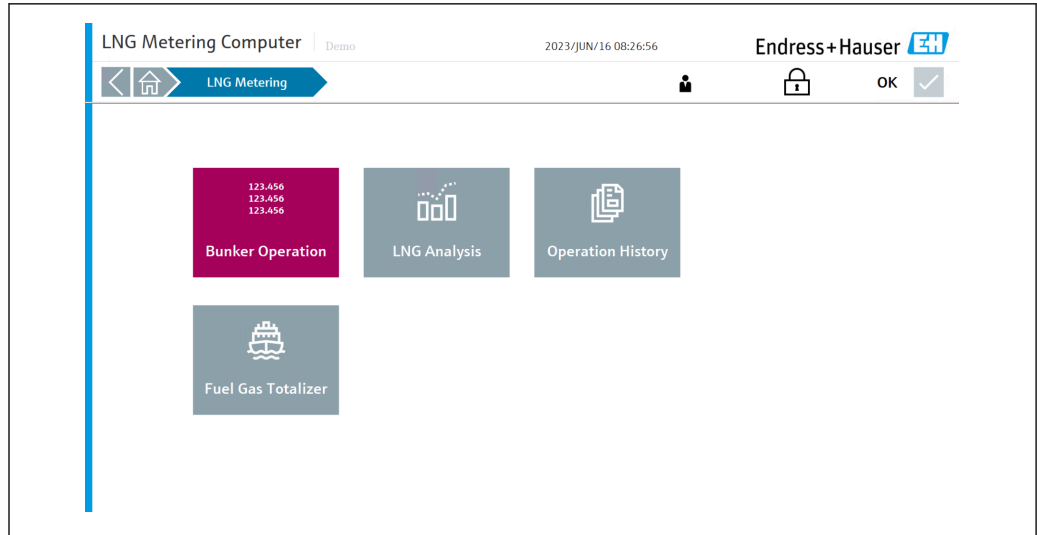
8.5 "LNG Metering" screen

The "LNG Metering" screen shows the details of a bunker operation.

On the "Home" screen, tap **LNG Metering**. The "LNG Metering" screen opens.

From here, the operator can navigate to the following subsections:

- **Bunker Operation**
- **LNG Analysis**
- **Operation History**
- **Fuel Gas Totalizer**

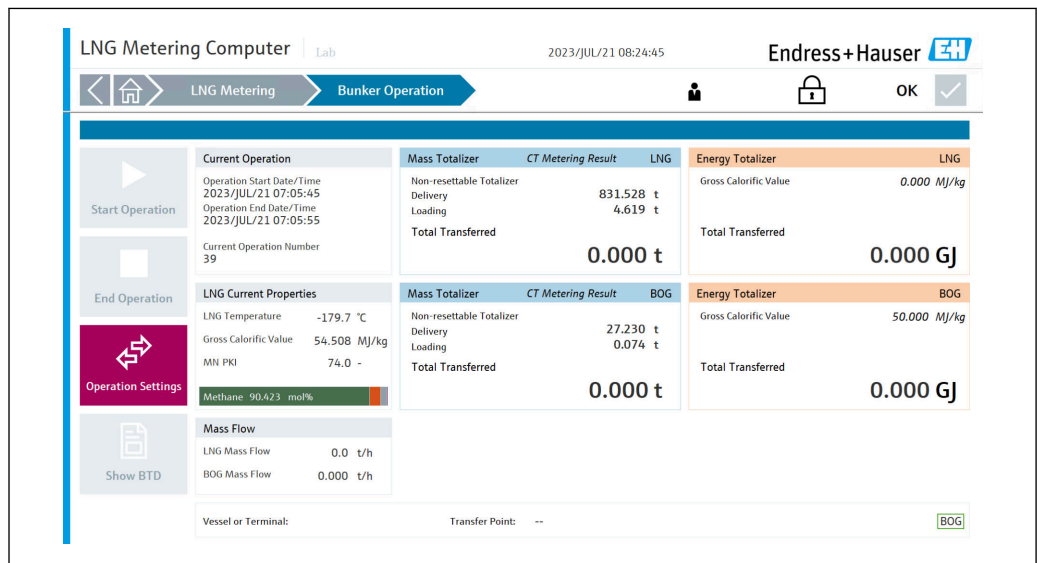


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8.5.1 "Bunker Operation" screen

Bunker Operation is the main screen in the software where the operator can manage and perform measurements.

On the "LNG Metering" screen, tap **Bunker Operation**. The "Bunker Operation" screen opens.



A0052755

The buttons for starting/ending the operation are located on the left. The start/end time/date of the operation and the current operation number are displayed accordingly. The relevant mass/energy counters for LNG and BOG metering are displayed on the right-hand side.

i The metering and the totalizers for BOG/energy/MMBTU/methane number can be switched on and off as required. For more information → [37](#)

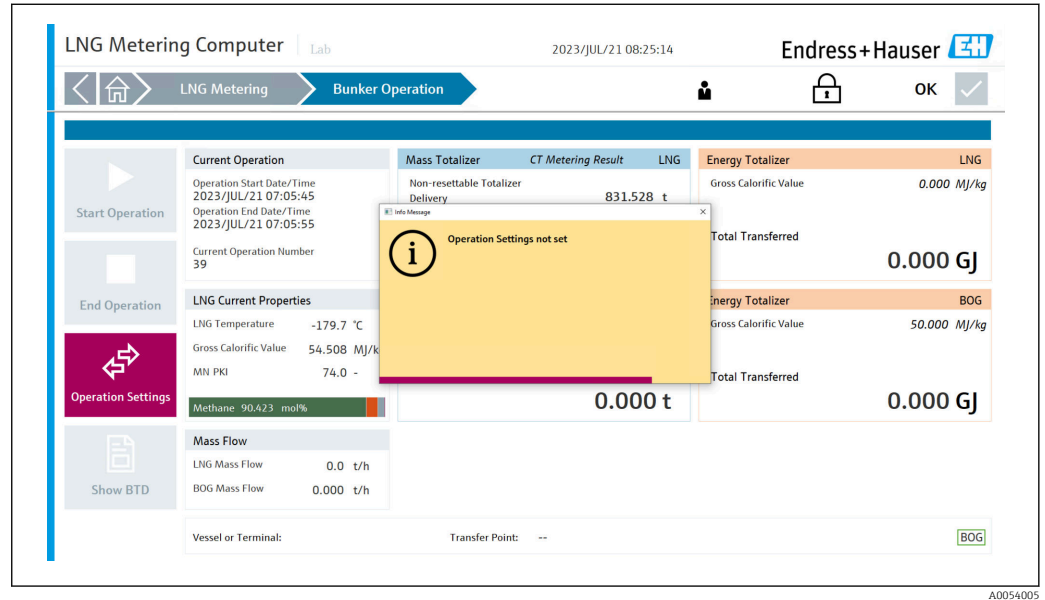
In Operation Settings, the operator can configure the following parameters:

- Name of receiving vessel
- Transfer point
- Enable/disable BOG
- Gross calorific value of the BOG

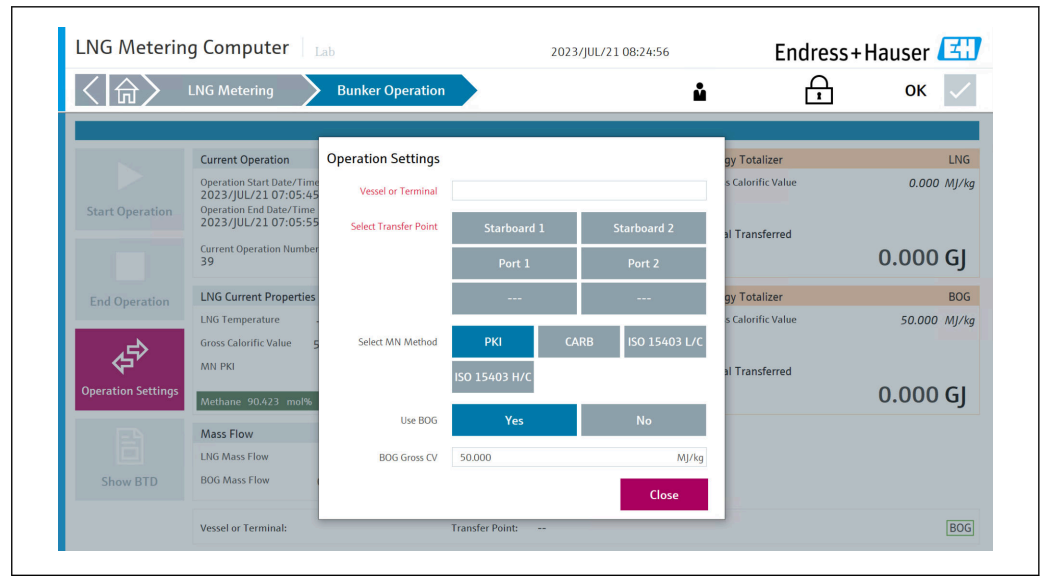
The system includes the following interlocks for starting the measurement procedure:

- Operating settings confirmed
- Flow must be zero
- No system error active

If any of the start conditions are not fulfilled, this is indicated to the operator.



When all conditions are fulfilled, press "Start Metering". The measurement begins and the corresponding totalizer also starts to count.



The measurement can only be terminated when the measured flow is zero. This is also an interlock, designed here as a stop condition.

When the flow is zero and the measurement has finished, press "Stop Metering".

LNG Metering Computer | Lab | 2023/JUL/21 08:27:37 | Endress+Hauser

Navigation: LNG Metering > Bunker Operation

Operation Running

Current Operation	Mass Totalizer	CT Metering Result	LNG	Energy Totalizer	LNG
Operation Start Date/Time: 2023/JUL/21 08:25:45	Non-resettable Totalizer			Gross Calorific Value	54.508 MJ/kg
Operation End Date/Time: ---	Delivery	838.819 t		Total Delivery	388.697 GJ
Current Operation Number: 40	Loading	4.779 t			
	Total Delivery	7.131 t			

LNG Current Properties	Mass Totalizer	CT Metering Result	BOG	Energy Totalizer	BOG
LNG Temperature: -179.7 °C	Non-resettable Totalizer			Gross Calorific Value	50.000 MJ/kg
Gross Calorific Value: 54.508 MJ/kg	Delivery	27.557 t		Total Delivery Return	16.200 GJ
MN PKI: 74.0 -	Loading	0.077 t			
Methane: 90.423 mol%	Total Delivery Return	0.324 t			

Mass Flow
LNG Mass Flow: 0.0 t/h
BOG Mass Flow: 0.000 t/h

Vessel or Terminal: Vessel 1 | Transfer Point: Starboard 1

A0052799

When the measurement has finished, the operator can display, save and print out a "Bunker Transfer Document (BTD)" by pressing "Show BTD".

LNG Metering Computer | Lab | 2023/JUL/21 08:28:09 | Endress+Hauser

Navigation: LNG Metering > Bunker Operation

Buttons: Print BTD, Save to USB Drive, Verify BTD File, Close

LNG Bunker Transfer Document BTD

Transfer To/From: Vessel 1

Operation Number: 40

Type of Operation: Delivery

Transfer Point: Starboard 1

Correction Volume: 0.000 m³

BOG Used for BTD: True

Operation Start Date/Time: 2023/JUL/21 08:25:45

Operation End Date/Time: 2023/JUL/21 08:27:52

Error During Operation: False

Mass Transferred (CT Result)	
LNG Totalizer Delivery Start	831.528 t
LNG Totalizer Loading Start	4.619 t
LNG Totalizer Delivery End	838.819 t
LNG Totalizer Loading End	4.779 t
LNG Mass Transferred	7.131 t
LNG Mass Transferred Corrected	7.131 t
BOG Totalizer Delivery Start	27.230 t
BOG Totalizer Loading Start	0.074 t
BOG Totalizer Delivery End	27.557 t
BOG Totalizer Loading End	0.077 t
BOG Mass Returned	0.324 t

Energy Transferred	
LNG Energy Transferred	388.697 GJ
BOG Energy Returned	16.200 GJ
Net Transferred Energy	372.497 GJ
Net Transferred Energy Corrected	372.497 GJ

Process Conditions (FWA)	
LNG Temperature	-179.7 °C
LNG Pressure	0.745 bar(a)
BOG Temperature	-160.8 °C
BOG Pressure	1.373 bar(a)

LNG Composition (FWA)	
Methane	CH ₄ 90.423 %
Ethane	C ₂ H ₆ 5.802 %
Propane	C ₃ H ₈ 3.472 %
i-Butane	i-C ₄ H ₁₀ 0.000 %
n-Butane	n-C ₄ H ₁₀ 0.000 %
i-Pentane	i-C ₅ H ₁₂ 0.000 %
n-Pentane	n-C ₅ H ₁₂ 0.000 %
Nitrogen	N ₂ 0.303 %

LNG Properties acc. ISO 6976:2016 for Real Gas (FWA)	
Gross Calorific Value	54.508 MJ/kg
Net Calorific Value	49.233 MJ/kg
Gross Wobbe Index	52.520 MJ/m ³
Net Wobbe Index	47.437 MJ/m ³
Density @ 15°C/1.01325 Bar	0.758 kg/m ³

LNG Density acc. ISO 6578:2017 (FWA)	
Density @ Process Conditions	481.833 kg/m ³

Methane Number - PKI (FWA)	
Methane Number	74 -

Calorific Value Applied to BOG Return Gas	
Gross Calorific Value	50.000 MJ/kg

A0054006

LNG Bunker Transfer Document

EXAMPLE BARGE

IMO Number 9812345
 Local Registration ID QG5277U
 Operation Number 43

Operation Information

Transfer To/From	Demo Vessel
Operation Start Date/Time	2023/SEP/06 11:52:53
Operation End Date/Time	2023/SEP/06 15:48:28
Type of Operation	Delivery
Transfer Point	Starboard 2
Correction Volume	0.723 m ³
Error During Operation	No
BOG Used for BTD	Yes

Mass Totalizer (CT Result)

LNG Totalizer Delivery Start	3155.719 t
LNG Totalizer Loading Start	5.772 t
LNG Totalizer Delivery End	5115.572 t
LNG Totalizer Loading End	5.772 t
BOG Totalizer Delivery Start	140.789 t
BOG Totalizer Loading Start	0.087 t
BOG Totalizer Delivery End	238.588 t
BOG Totalizer Loading End	0.087 t

Mass Transferred (CT Result)

LNG Mass Transferred	1959.853 t
Correction Mass	0.348 t
LNG Mass Transf. Corr.	1959.505 t
BOG Mass Returned	97.799 t

Energy Transferred

LNG Energy Transferred	106827.667 GJ
Correction Energy	18.989 GJ
LNG Energy Transf. Corr.	106808.678 GJ (101253.079 MMBTU)
BOG Energy Returned	4889.950 GJ (4634.778 MMBTU)

Net Results (LNG - BOG)

Net Transferred Mass	1861.706 t
Net Transferred Energy	101918.728 GJ (96600.303 MMBTU)

Cargo Officer Approval
Date:
Signature:

Process Conditions (FWA)

LNG Temperature	-179.7 °C
LNG Pressure	0.744 bar(a)
BOG Temperature	-160.8 °C
BOG Pressure	1.373 bar(a)

LNG Composition (FWA)

Methane	90.423 %
Ethane	5.802 %
Propane	3.472 %
i-Butane	0.000 %
n-Butane	0.000 %
i-Pentane	0.000 %
n-Pentane	0.000 %
Nitrogen	0.303 %

LNG Properties acc. ISO 6976:2016 for Real Gas (FWA)

Gross Calorific Value	54.508 MJ/kg
Net Calorific Value	49.233 MJ/kg
Gross Wobbe Index	52.520 MJ/m ³
Net Wobbe Index	47.437 MJ/m ³
Density @15C/1.01325 Bar	0.758 kg/m ³

LNG Density acc. ISO 6578:2017 (FWA)

Density @ Process Conditions	481.846 kg/m ³
------------------------------	---------------------------

Methane Number - PKI

Methane Number	74 -
----------------	------

Calorific Value Applied to BOG Return Gas

Gross Calorific Value	50.000 MJ/kg
-----------------------	--------------

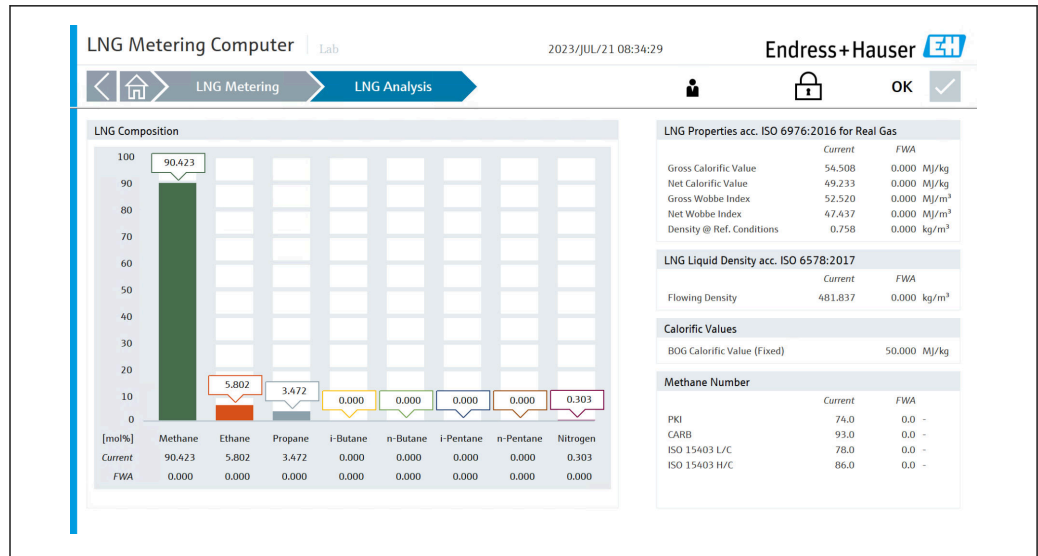
Chief Engineer Approval
Date:
Signature:

1 / 1

A0054009

8.5.2 "LNG Analysis" screen

On the "LNG Metering" screen, tap **LNG Analysis**. The "LNG Analysis" screen opens. The gas composition and other parameters for energy calculation are displayed here.



A0052759

8.5.3 "Operation History" screen

On the "LNG Metering" screen, tap **Operation History**. The "Operation History" screen opens. From here, the operator can retrieve, display and export reports on previous operations.


The individual report files are saved in .txt format and can be opened in the File Explorer and exported to an external drive in accordance with the instructions.

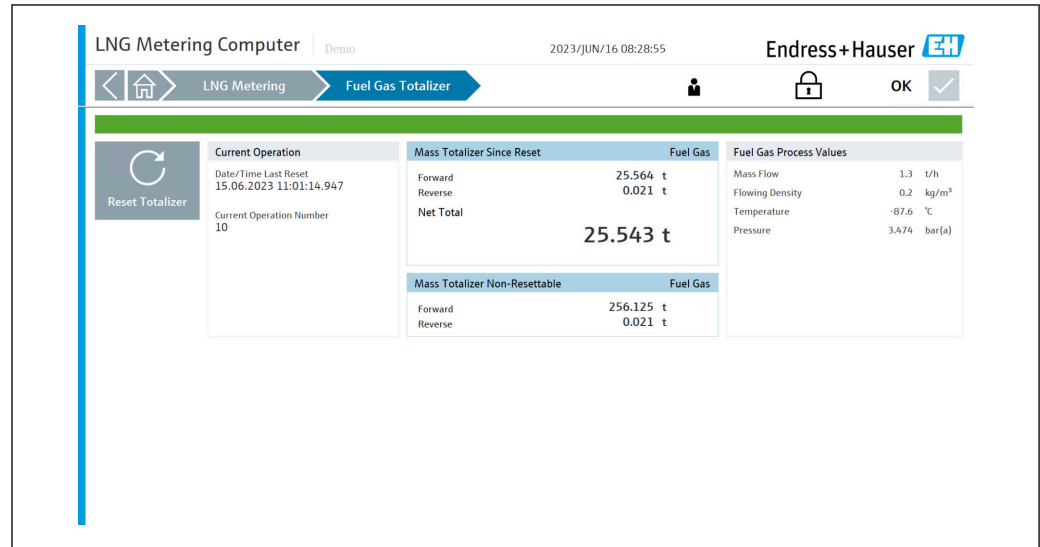
Operation Number	Type of Operation	Operation Start	Operation End	Delivered to/Loaded from
80	Delivery	2023/APR/13 10:19:01	2023/APR/13 10:20:29	Vessel 1
79	N/A	2023/APR/13 09:49:47	2023/APR/13 09:50:00	ii
78	N/A	2023/APR/13 09:49:04	2023/APR/13 09:49:24	99
77	N/A	2023/APR/13 09:44:01	2023/APR/13 09:44:14	88
76	N/A	2023/APR/13 09:32:43	2023/APR/13 09:32:55	u
75	Delivery	2023/APR/12 09:41:41	2023/APR/12 09:42:58	uu
74	Delivery	2023/APR/06 13:28:20	2023/APR/12 09:30:48	uu
73	Delivery	2023/APR/06 11:41:54	2023/APR/06 13:28:01	iii
72	Delivery	2023/APR/05 17:53:02	2023/APR/06 11:40:19	j
71	Delivery	2023/APR/05 17:39:05	2023/APR/05 17:52:31	8
70	Delivery	2023/APR/05 17:33:51	2023/APR/05 17:37:44	8
69	Delivery	2023/APR/05 17:21:40	2023/APR/05 17:32:01	i
68	Delivery	2023/APR/05 16:52:38	2023/APR/05 16:53:53	9
67	Delivery	2023/APR/05 16:46:25	2023/APR/05 16:52:25	k
66	N/A	2023/APR/04 16:40:35	2023/APR/05 16:45:35	l
65	N/A	2023/APR/04 14:50:34	2023/APR/04 15:15:44	7
64	N/A	2023/APR/04 14:43:15	2023/APR/04 14:49:09	jj
63	N/A	2023/APR/04 14:36:51	2023/APR/04 14:42:01	i
62	N/A	2023/APR/04 11:41:59	2023/APR/04 14:34:24	g
61	Delivery	2023/APR/04 11:08:53	2023/APR/04 11:41:49	jj
60	Loading	2023/APR/03 14:57:22	2023/APR/03 16:05:31	
59	Delivery	2023/MAR/23 08:36:13	2023/MAR/23 08:44:00	yyy
58	Delivery	2023/MAR/22 09:19:00	2023/MAR/22 13:05:23	j
56	Delivery	2023/MAR/06 10:13:15	2023/MAR/16 11:25:11	j
55	N/A	21.02.2023 12:12:15	21.02.2023 12:12:36	uu

A0052760

8.5.4 "Fuel Gas Totalizer" screen

On the "LNG Metering" screen, tap **Fuel Gas Totalizer**. The "Fuel Gas Totalizer" screen opens. From here, the operator can retrieve, display and reset the totalizers for the fuel gas measurement.

 Only available if a flowmeter is installed for fuel gas.



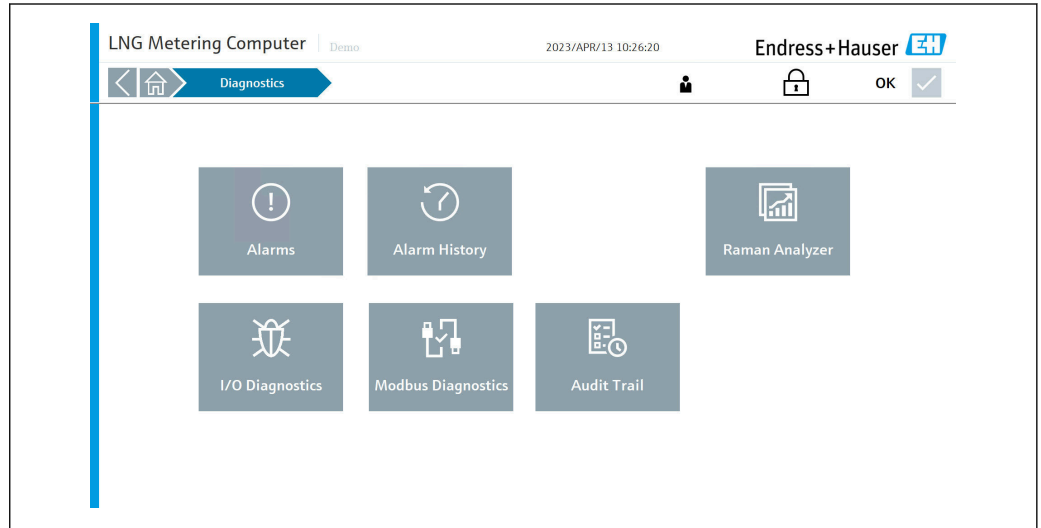
A0053083

8.6 "Diagnostics" screen

On the "Home" screen, tap **Diagnostics**. The "Diagnostics" screen opens.

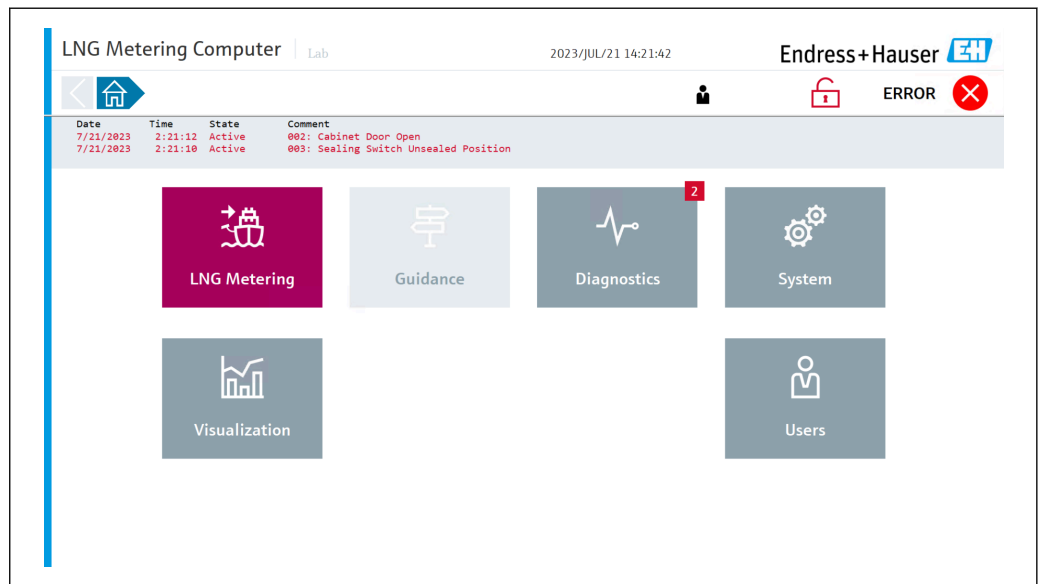
From here, the operator can navigate to the 6 following subsections:

- Alarms
- Alarm History
- Raman Analyzer
- I/O Diagnostics
- Modbus Diagnostics
- Audit Trail



A0052761

- i** When alarms occur, the number of alarms is displayed in red in the "Diagnostics" section and also in the "Alarms" subsection. The system status changes to "Warning" or "Error".

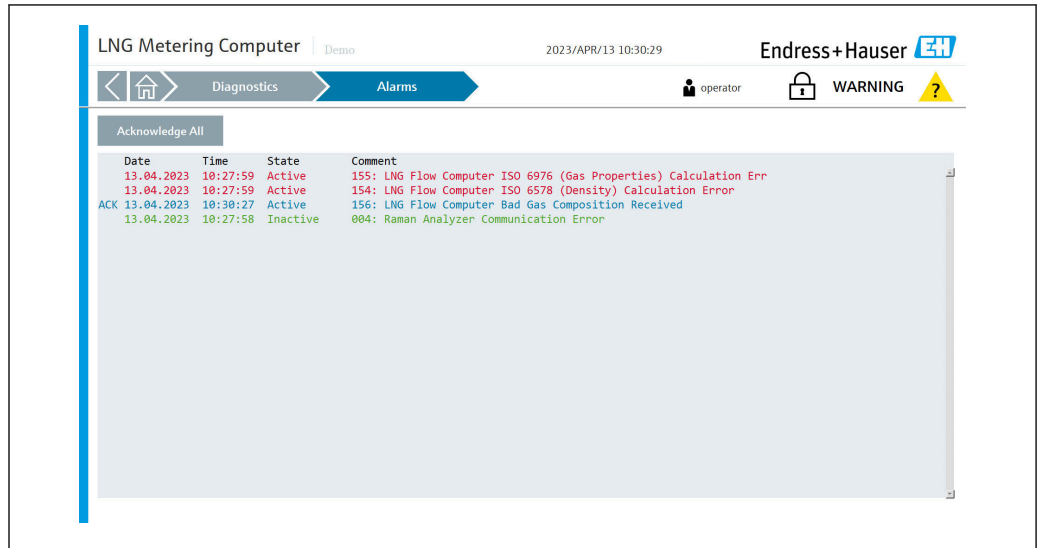


A0054003

8.6.1 "Alarms" screen

On the "Diagnostics" screen, tap **Alarms**. The "Alarms" screen opens.

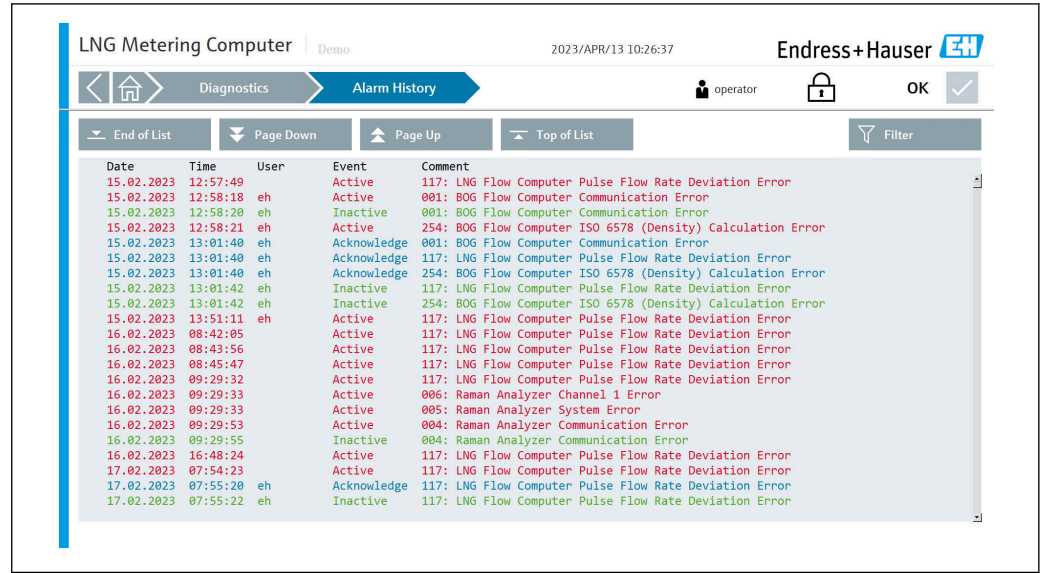
All active alarms are displayed as a list. Tap **Confirm All** to switch the status of the alarms from "Active" to "Inactive" and the system status from "Warning" to "OK". This is only possible if alarms are no longer active.



A0052762

8.6.2 "Alarm History" screen

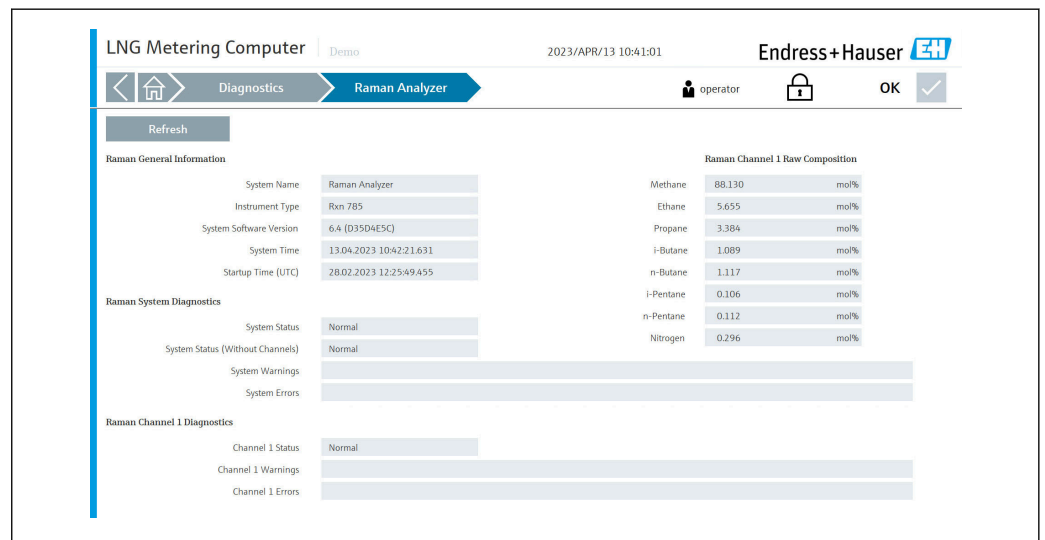
On the "Diagnostics" screen, tap **Alarm History**. The "Alarm History" screen opens. Past alarms of a chosen state are displayed as a list and can be filtered to the operator's needs.



A0052763

8.6.3 "Raman Analyzer" screen

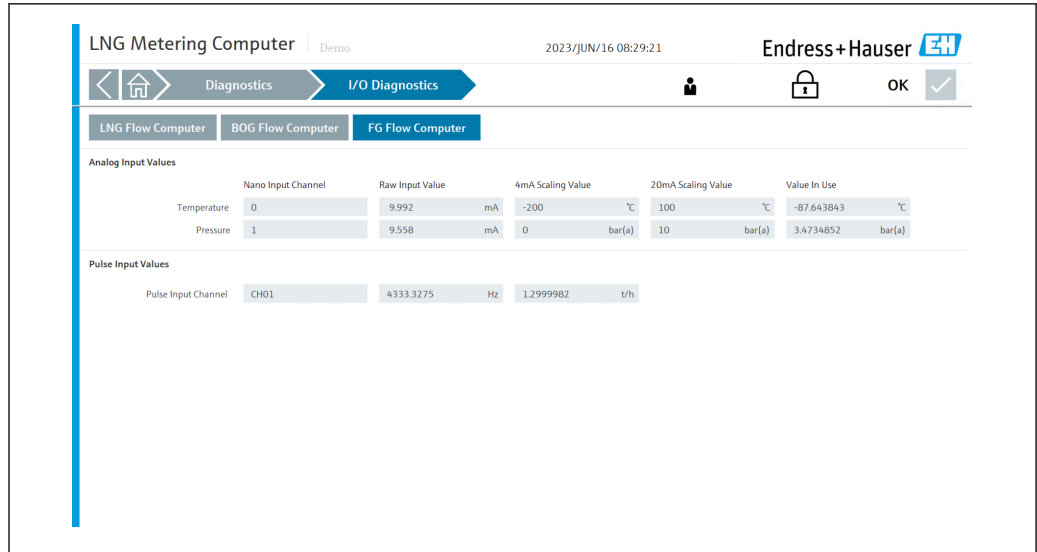
On the "Diagnostics" screen, tap **Raman Analyzer**. The "Raman Analyzer" screen opens. The diagnostics information for the Raman analyzer are displayed here.



A0052764

8.6.4 "I/O Diagnostics" screen

On the "Diagnostics" screen, tap **I/O Diagnostics**. The "I/O Diagnostics" screen opens. The "I/O Diagnostics" screen shows the process parameters transmitted by the relevant field device.

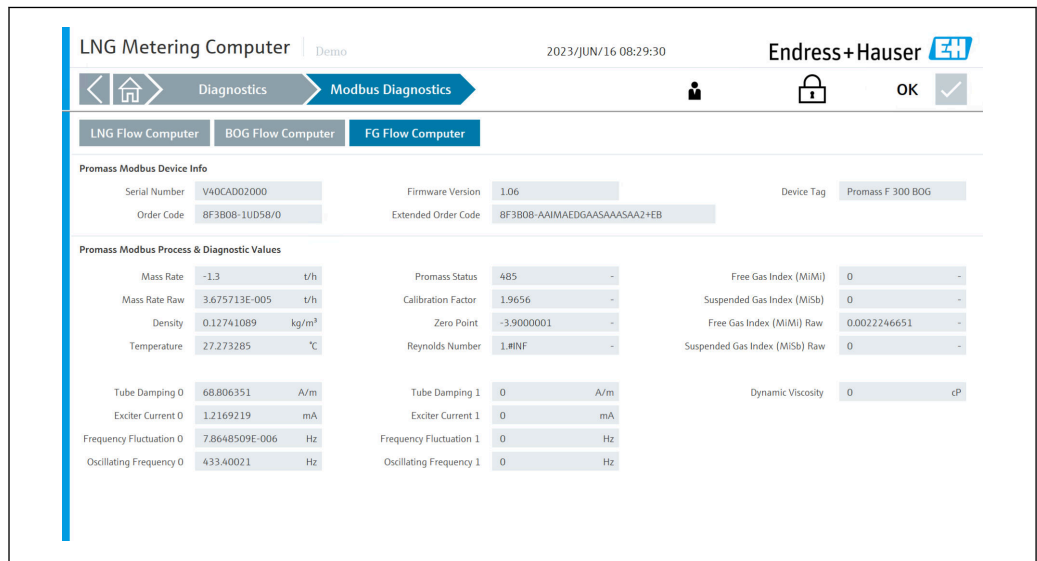


A0053070

8.6.5 "Modbus Diagnostics" screen

On the "Diagnostics" screen, tap **Modbus Diagnostics**. The "Modbus Diagnostics" screen opens.

The "Modbus Diagnostics" screen shows the process parameters transmitted by the relevant LNG/BOG/fuel gas flow meter via Modbus once Modbus communication has been successfully established. These advanced diagnostic parameters make it possible to assess the prevailing process conditions.

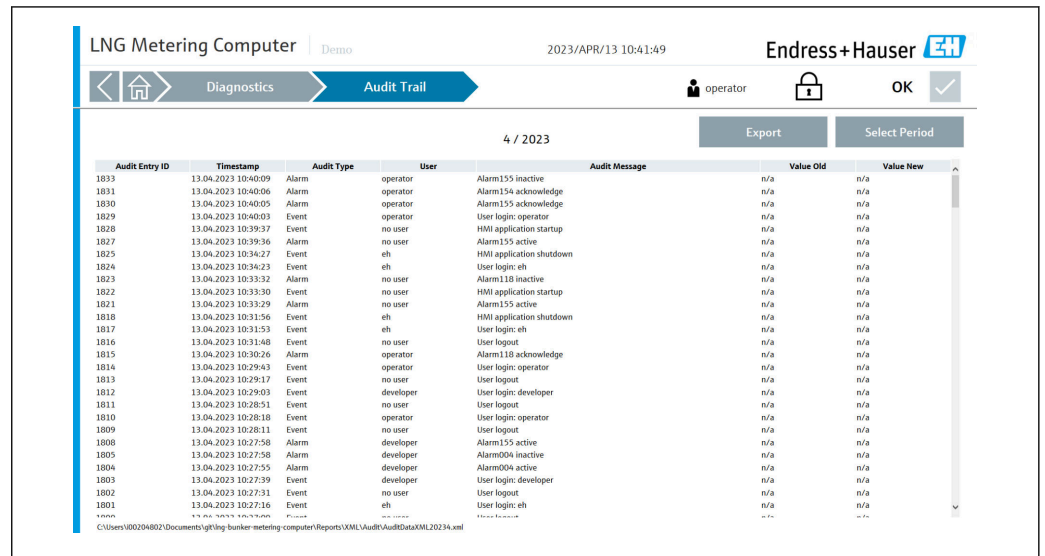


A0053071

8.6.6 "Audit Trail" screen

On the "Diagnostics" screen, tap **Audit Trail**. The "Audit Trail" screen opens.

The "Audit Trail" screen shows all the process-related changes made in the system.




A0053120

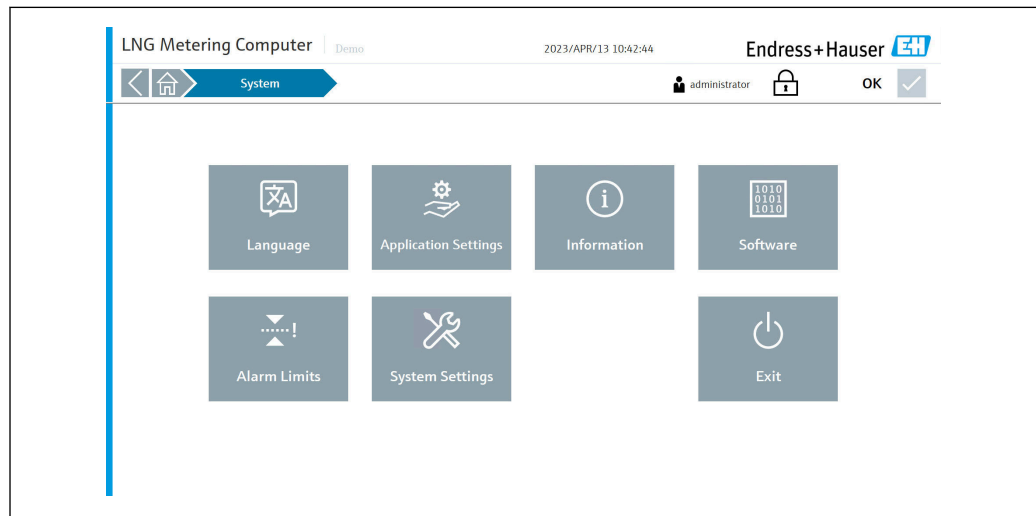
8.7 "System" screen

On the "Home" screen, tap **System**. The "System" screen opens.

From here, the operator can navigate to the 7 following subsections:

- Language
- Settings
- Information
- Software
- Alarm Limits
- System Settings
- Exit

 All HMI settings are configured in this section.

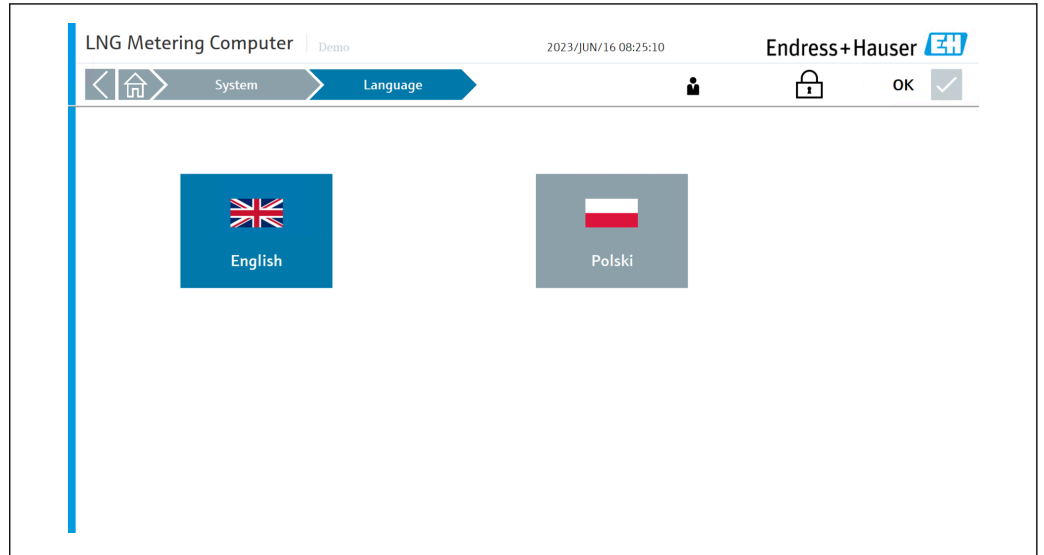


A0052768

8.7.1 "Language" screen

On the "System" screen, tap **Language**. The "Language" screen opens.

Here, the operator can choose between English and Polish as the menu language. The default system language at startup is English.



A0053072

8.7.2 "Settings" screen

On the "System" screen, tap **Settings**. The "Settings" screen opens.

From here, the operator can navigate to the 8 following subsections:

- General
- Promass
- Methane Number
- LNG Analyzer
- Units
- Transfer point
- I/O Configuration
- Reports

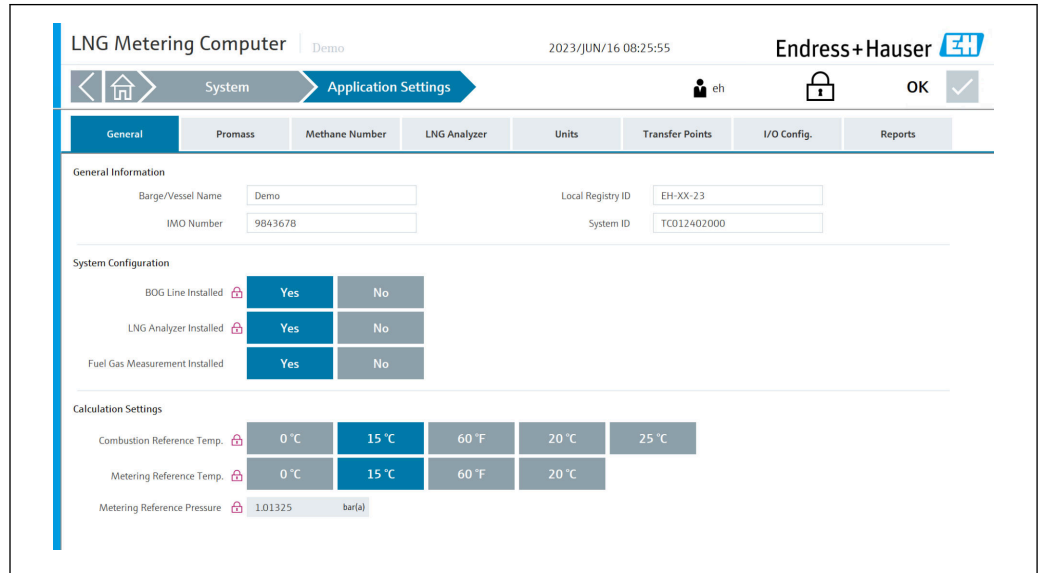


During the commissioning phase, before the control system can be put into operation, all settings must first be configured in accordance with the actual application .

"General" tab

Here, the operator define the "Vessel Name", which is displayed in the status bar on every page, as well as the "IMO Number", the "Local Registry ID" and the "System ID".

In addition, this tab also enables you to define the activation and deactivation of the BOG measuring path, the LNG analyzer, the fuel gas measurement and the calculation settings (including combustion temperature and measurement reference temperature).





A0053074

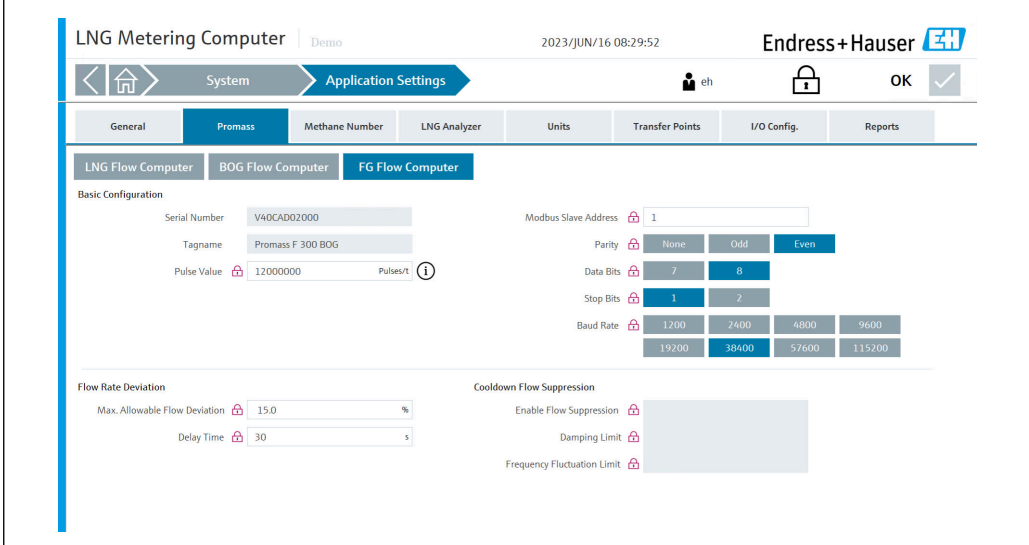
"Promass" tab

Here, the operator can configure the following parameters for the LNG/BOG/fuel gas flowmeter:

- Serial Number (not configurable, only shown)
- Tag Name (not configurable, only shown)
- Pulse Value (the pulse value must be entered as a mass pulse per tonne)
- Slave Address
- Parity
- Data Bits
- Stop Bits
- Baud Rate

 The parameter settings pulse value, slave address, parity, data bits, stop bits and baud rate must match the settings in the flowmeter.

 The settings for "Flow rate deviation" and "Cooldown flow suppression" may only be changed in consultation with Endress+Hauser.



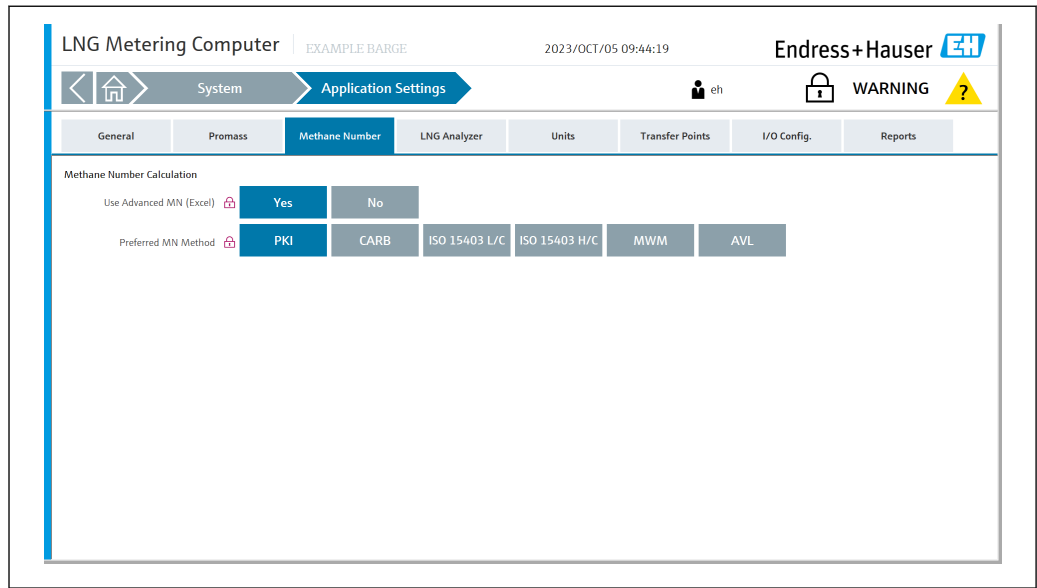
The screenshot shows the "Promass" configuration page for an "FG Flow Computer". The interface includes a navigation bar with "System" and "Application Settings" tabs, and a sub-menu with "General", "Promass", "Methane Number", "LNG Analyzer", "Units", "Transfer Points", "I/O Config.", and "Reports". The "Promass" tab is active, showing the following configuration options:

- Basic Configuration:**
 - Serial Number: V40CAD02000
 - Tagname: Promass F 300 BOG
 - Pulse Value: 12000000 (unit: Pulse/t)
 - Modbus Slave Address: 1
 - Parity: None, Odd, Even (Even is selected)
 - Data Bits: 7, 8 (8 is selected)
 - Stop Bits: 1, 2 (1 is selected)
 - Baud Rate: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 (38400 is selected)
- Flow Rate Deviation:**
 - Max. Allowable Flow Deviation: 15.0 %
 - Delay Time: 30 s
- Cooldown Flow Suppression:**
 - Enable Flow Suppression: [disabled]
 - Damping Limit: [disabled]
 - Frequency Fluctuation Limit: [disabled]

A0053078

"Methane Number" tab

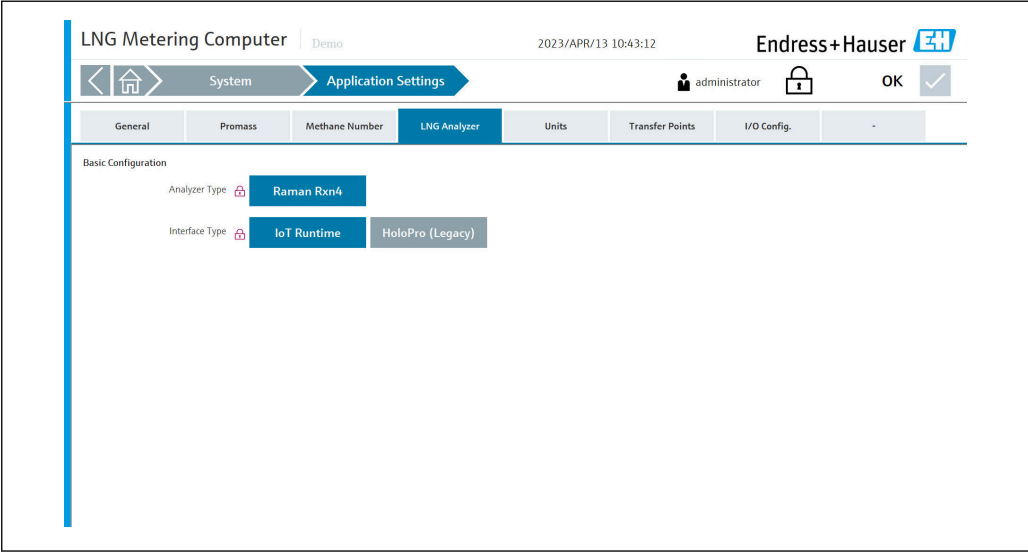
Here, the operator can select the use of the advanced methane number and the desired methane number calculation method.



A0054006

"LNG Analyzer" tab

Here, the operator can select the LNG analyzer type.

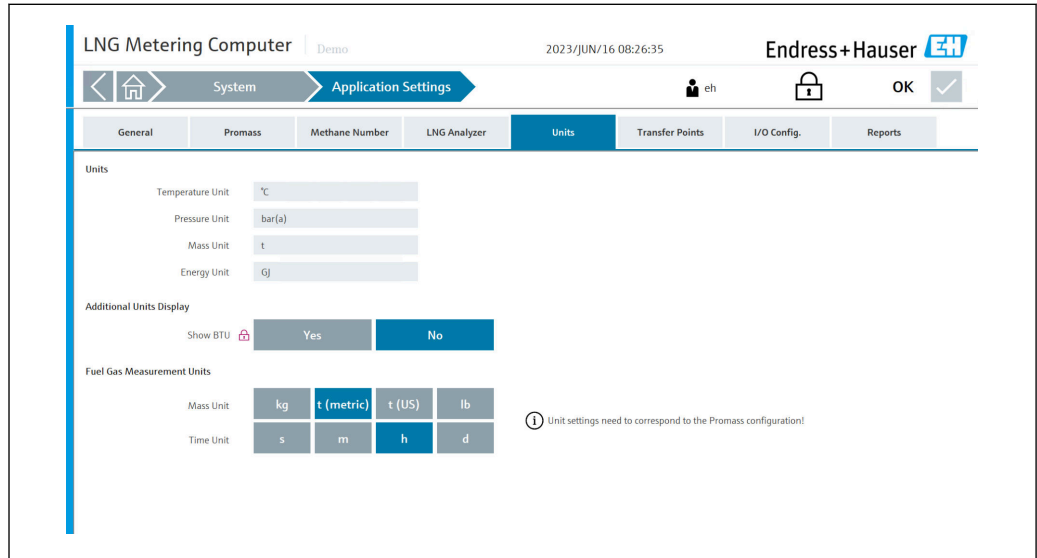


A0052771

"Units" tab

Here, the operator can configure the units for the following process variables:

- Temperature (not configurable, only shown)
- Pressure (not configurable, only shown)
- Mass (not configurable, only shown)
- Energy (not configurable, only shown)
- Enable/disable BTU
- Fuel Gas Measurement Units (mass and time)



A0053079

"Transfer Points" tab

Here, the operator can predefine up to a maximum of 6 different transfer points together with the corresponding correction volume.

The correction volume is used when a certain volume is measured but not delivered via the transfer point at the end of an operation.

For delivery operations, the correction volume is subtracted from the end result at the end of an operation. For loading operations, the correction volume is added to the end result at the end of an operation.

The screenshot shows the 'Transfer Points' configuration screen. At the top, it displays 'LNG Metering Computer' and 'Lab'. The date and time are '2023/JUL/21 14:29:36'. The user is 'eh'. The 'Endress+Hauser' logo is visible. The navigation bar includes 'System' and 'Application Settings'. Below this, there are tabs for 'General', 'Promass', 'Methane Number', 'LNG Analyzer', 'Units', 'Transfer Points', 'I/O Config.', and 'Reports'. The 'Transfer Points' tab is active. The main content area is titled 'Transfer Points Definition' and contains a table with the following data:


	Designation	Correction Volume	
Transfer Point 1	Starboard 1	0.000	m³
Transfer Point 2	Starboard 2	0.723	m³
Transfer Point 3	Port 1	0.452	m³
Transfer Point 4	Port 2	0.369	m³
Transfer Point 5	---	0.000	m³
Transfer Point 6	---	0.000	m³

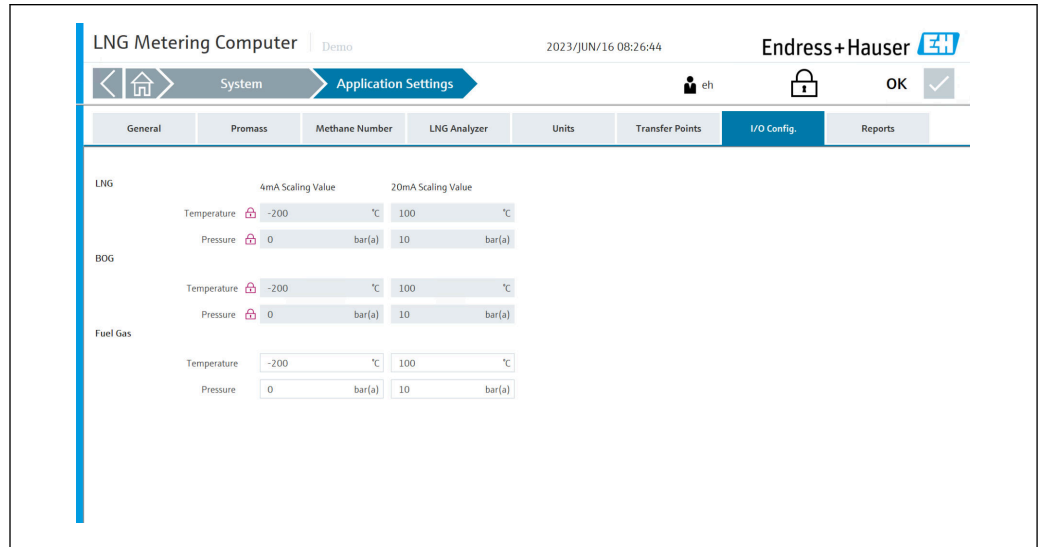
A0052775

"I/O Config." tab

Here, the operator can configure the following parameters for the field devices:

- LNG Temperature
- LNG Pressure
- BOG Temperature
- BOG Pressure
- Fuel Gas Temperature
- Fuel Gas Pressure

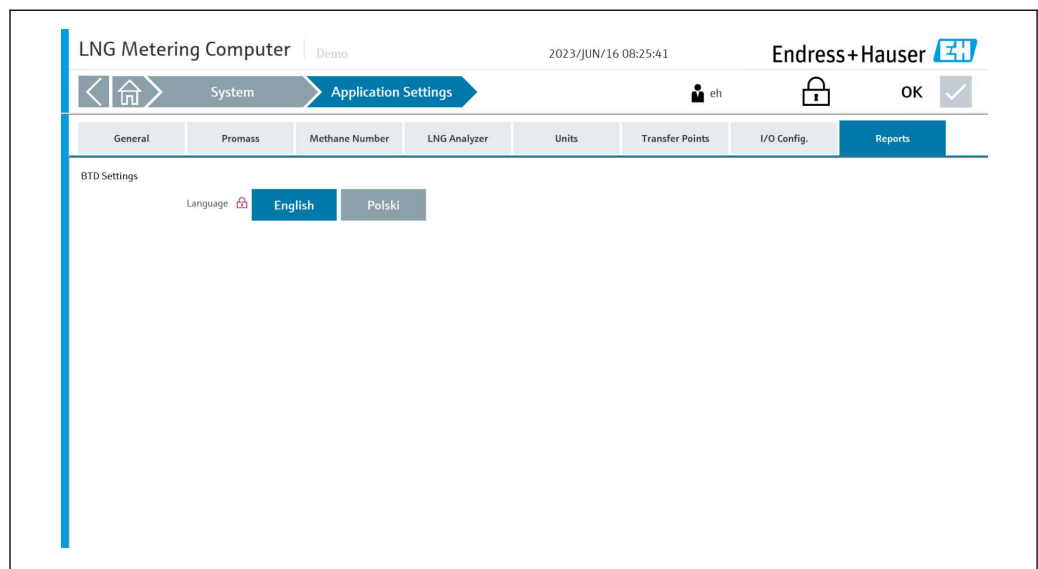
 These parameter settings must match the settings of the field devices.



A0053080

"Reports" tab

Here, the operator can select various language settings.

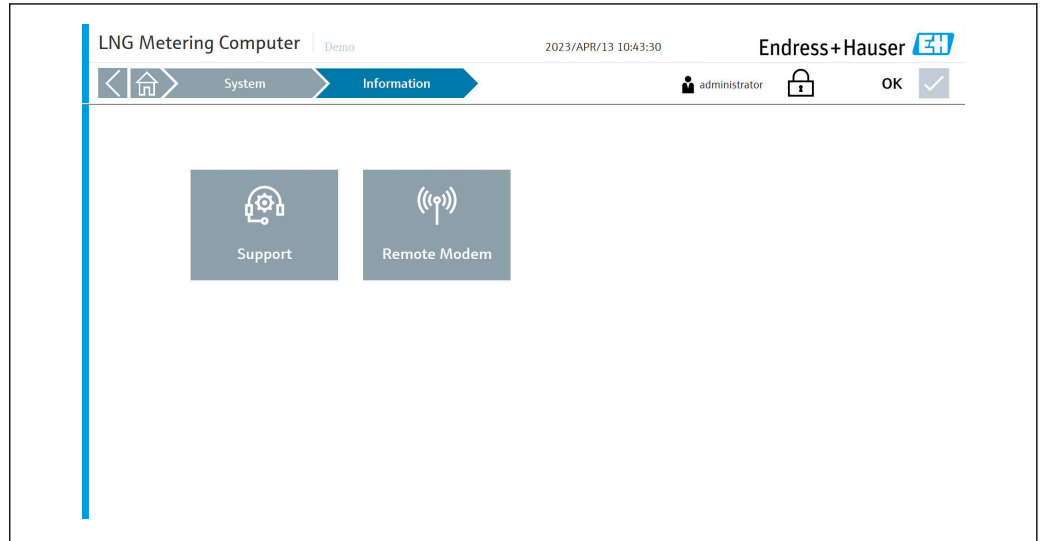


A0053081


8.7.3 "Information" screen

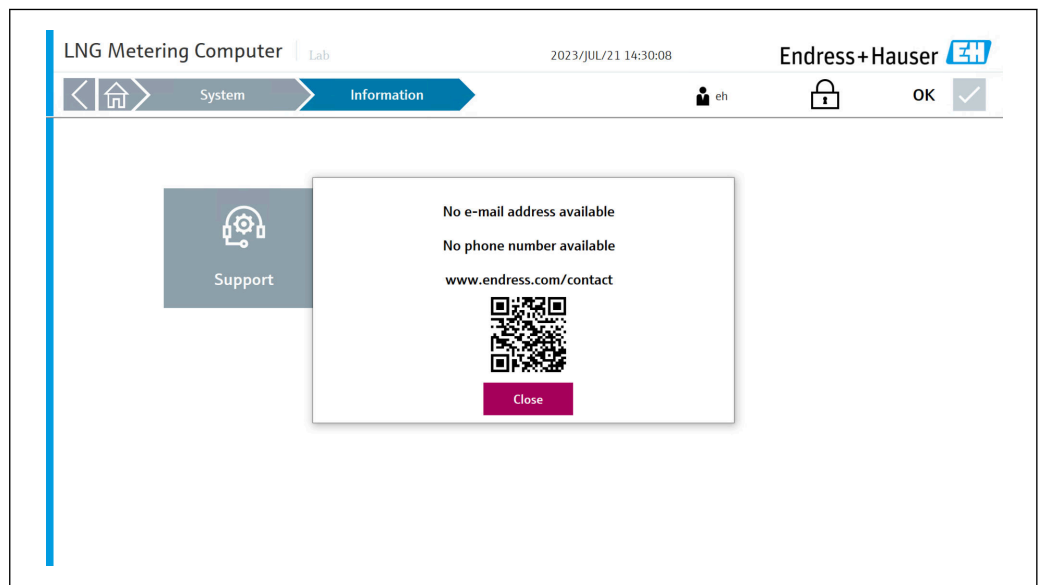
On the "System" screen, tap **Information**. The "Information" screen opens.

This is where the manufacturer's contact details are provided, which the operator can use if assistance is required.



A0052776

 Scan the QR code for contact information details.







A0054011

8.7.4 "Software" screen

On the "System" screen, tap **Software**. The "Software" screen opens.

This section displays important information such as the HMI application version, the flow computer app version, the firmware version and various checksums.

LNG Metering Computer | Lab 2023/JUL/21 14:32:16 Endress+Hauser 

System Software  eh  OK 

About Infilink

HMI Application Version	02.01.01	
HMI Checksum	b9936fc3edd23fa82d27b5207743eff	
Current Project Path	C:\lmg-bunker-metering-computer\	
Keyserver Version	6.12	
Keyserver Configuration Version	LNGMC 02.01.01	

	LNG Flow Computer	BOG Flow Computer
Flow Computer App Version	2v1r0	2v1r0
Flow Computer App Name	EHH LNG Metering Application	EHH LNG Metering Application
Flow Computer Firmware Version	4v7r9214-R	4v7r9214-R
Flow Computer System ID	28EC9AFF0FE	28EC9AFFE82
Flow Computer App Checksum	56FE1E5933B10F04	56FE1E5933B10F04
Flow Computer Constants Checksum	00F779675F87535D	9CEFDA946C07207C
Flow Computer Metrology Blocks Checksum	5956577C409BCBF2	5956577C409BCBF2

A0053082

8.7.5 "Alarm Limits" screen

On the "System" screen, tap **Alarm Limits**. The "Alarm Limits" screen opens.

Here, the operator can configure the required pressure limits and temperature limits for the LNG/BOG measuring path.

	Low Low	Low	High	High High	
Temperature		-200	100		°C
Pressure		0	10		bar(a)


A0052777

8.7.6 "System Settings" screen

On the "System" screen, tap **System Settings**. The "System Settings" screen opens.

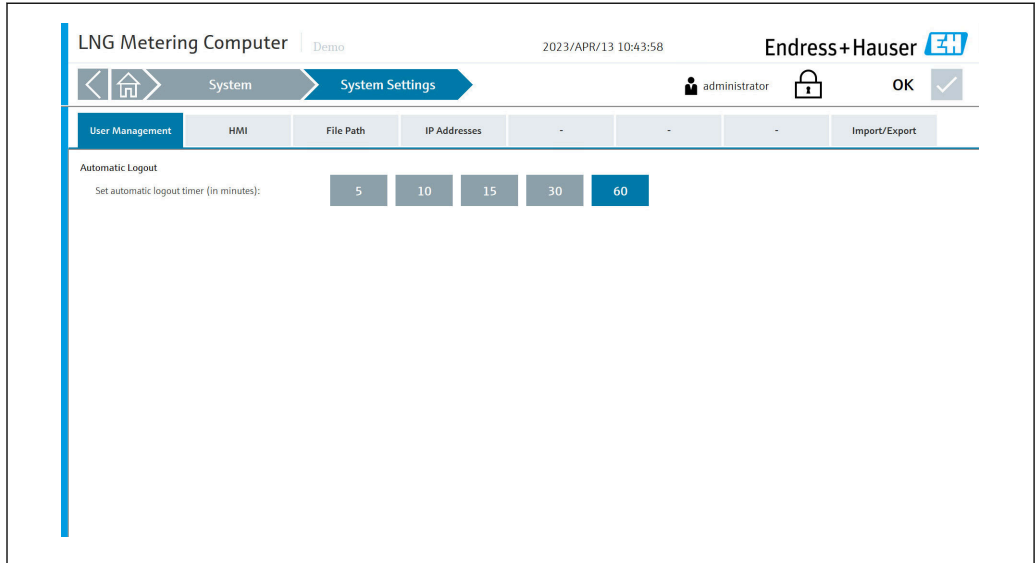
From here, the operator can navigate to the 5 following sections:

- User Management
- HMI
- File Path
- IP Addresses
- Import / Export

 During the commissioning phase, before the system can be put into operation, all settings must first be configured in accordance with the actual application in the field.

"User Management" tab

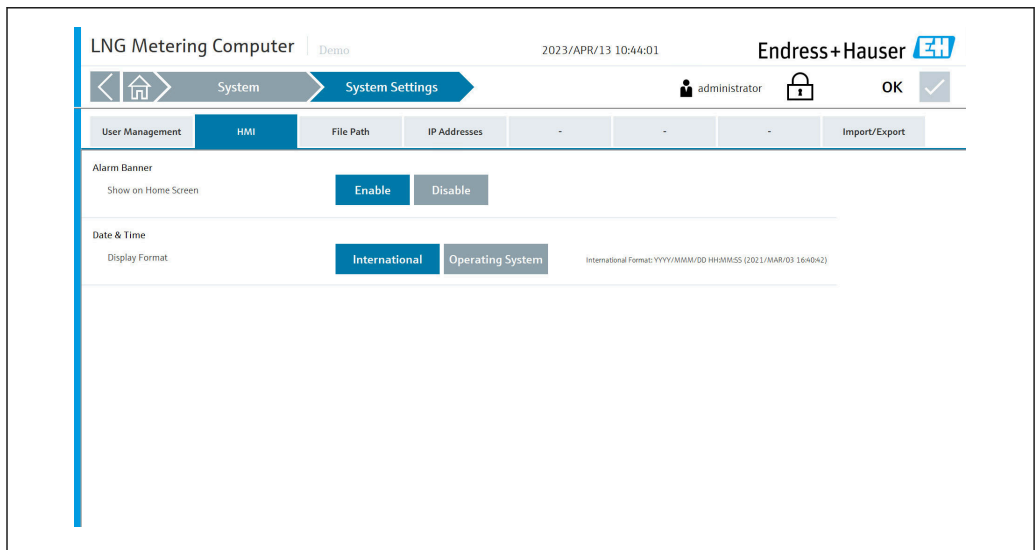
Here, the operator can set the automatic logout timer (in minutes).



A0052779

"HMI" tab


Here, the operator can configure whether the alarm banner should be shown on the home screen and can select the display format for the system date and time.

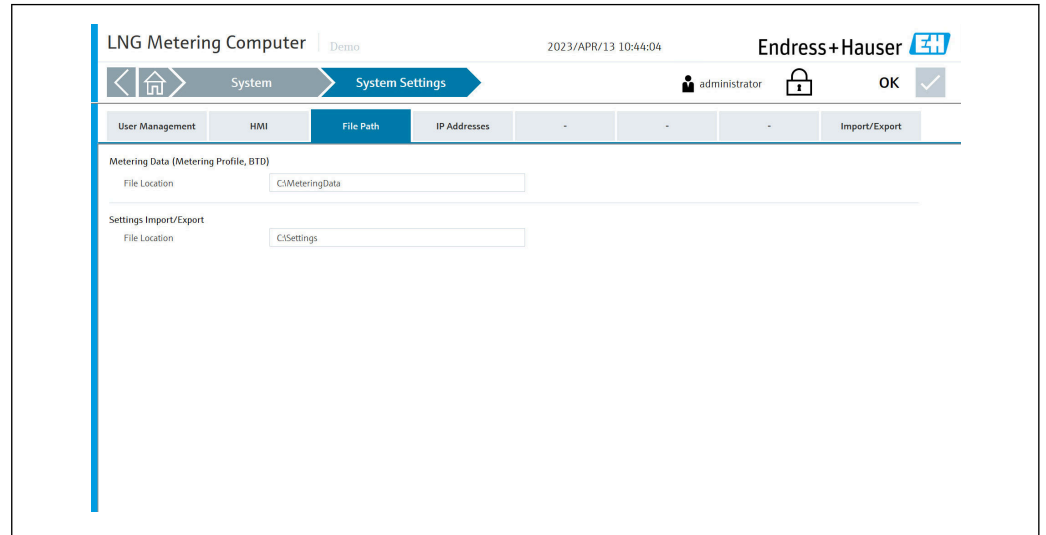


A0052781

"File Path" tab

Here, the operator can select the file path for "Metering Data" and "Settings Import/Export".

 These settings may only be changed after consultation with Endress+Hauser.

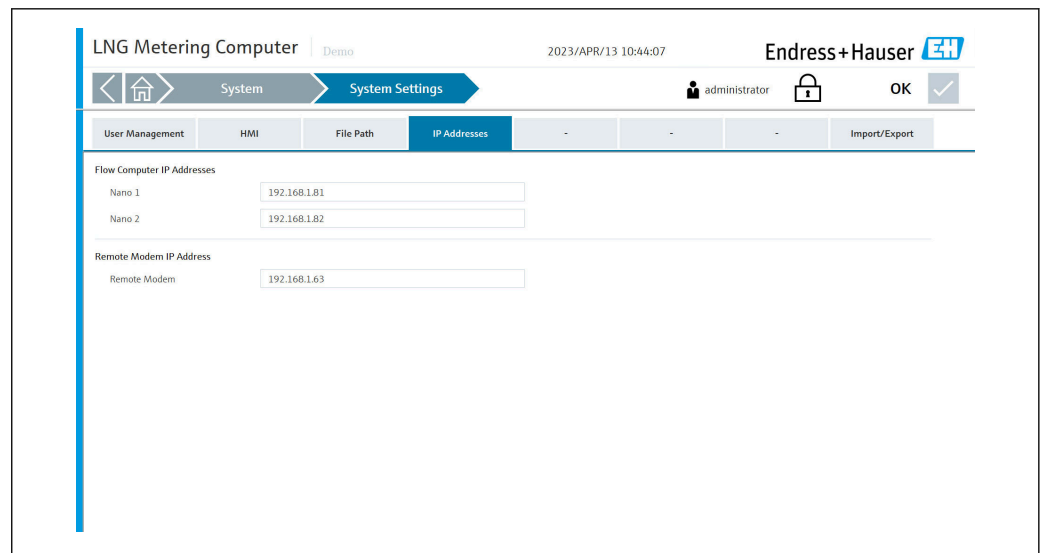


A0052780

"IP Addresses" tab

Here, the operator can define or change the IP address for the flow computer(s) .

 These settings may only be changed after consultation with Endress+Hauser.

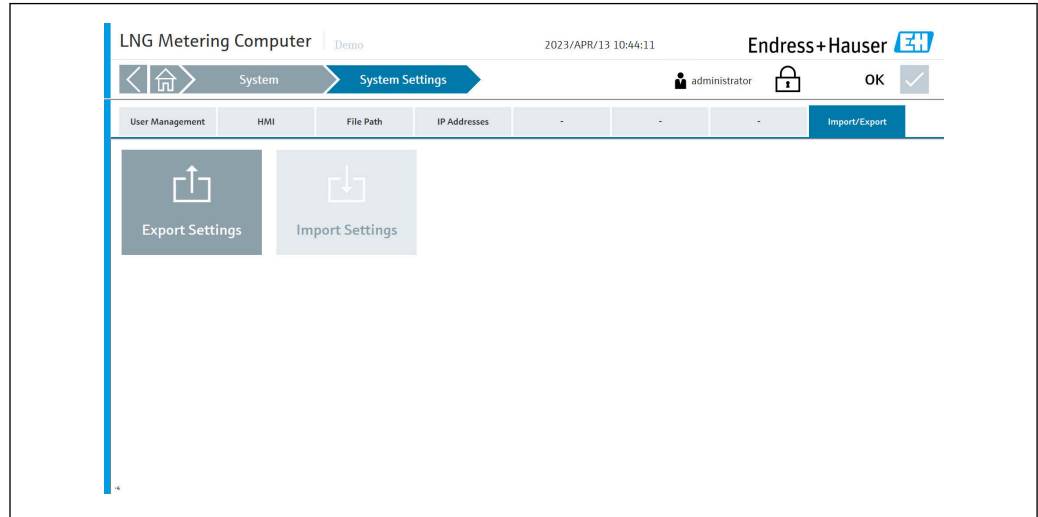


A0052783

"Import/Export" tab

From here, the operator can import or export settings.

i Only users with the highest access authorization level are permitted to import settings.

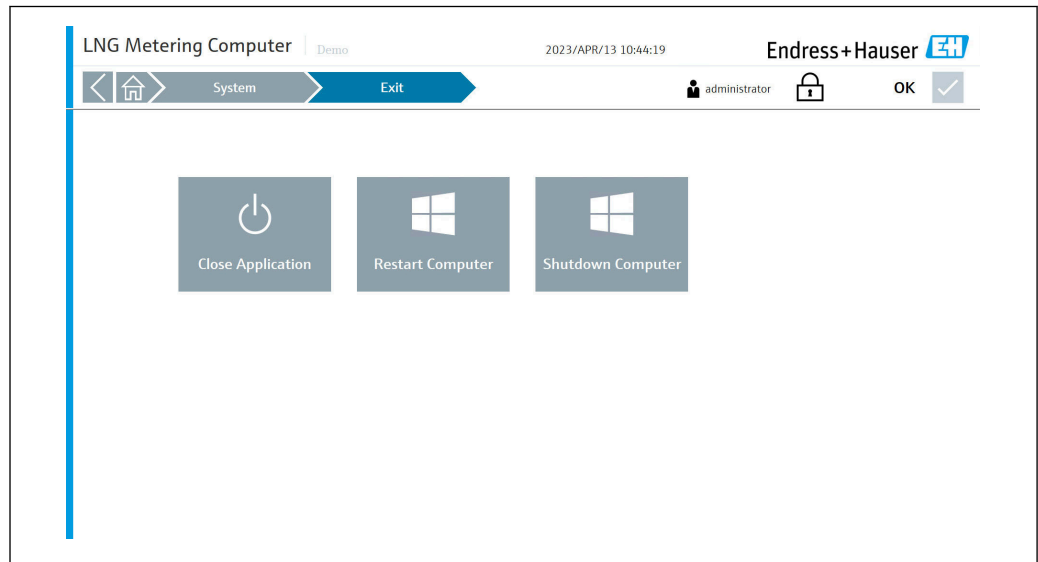


A0052782

8.7.7 "Exit" screen

On the "System" screen, tap **Exit**. The "Exit" screen opens.

i Only users with the "Administrator" authorization level or higher can close the application and return to the Windows desktop.



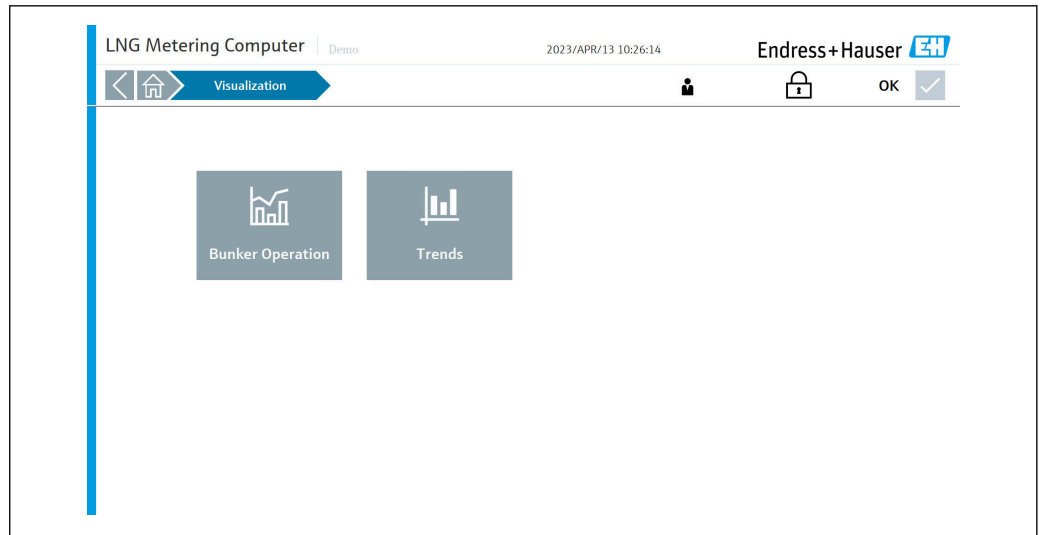
A0052784

8.8 "Visualization" screen

On the "Home" screen, tap **Visualization**. The "Visualization" screen opens.

From here, the operator can navigate to the 2 following subsections:

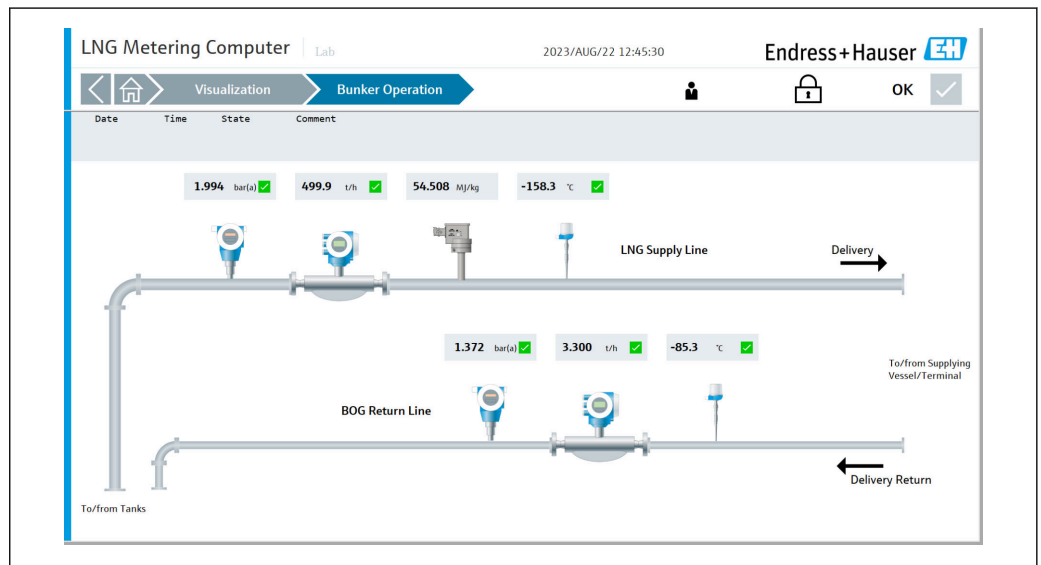
- Bunker Operation
- Trends



A0052786

8.9 "Bunker Operation" screen

On the "Visualization" screen, tap **Bunker Operation**. The "Bunker Operation" screen opens. Here, the operator can observe the real-time measured values and the status of the various field devices in the LNG/BOG measuring paths.

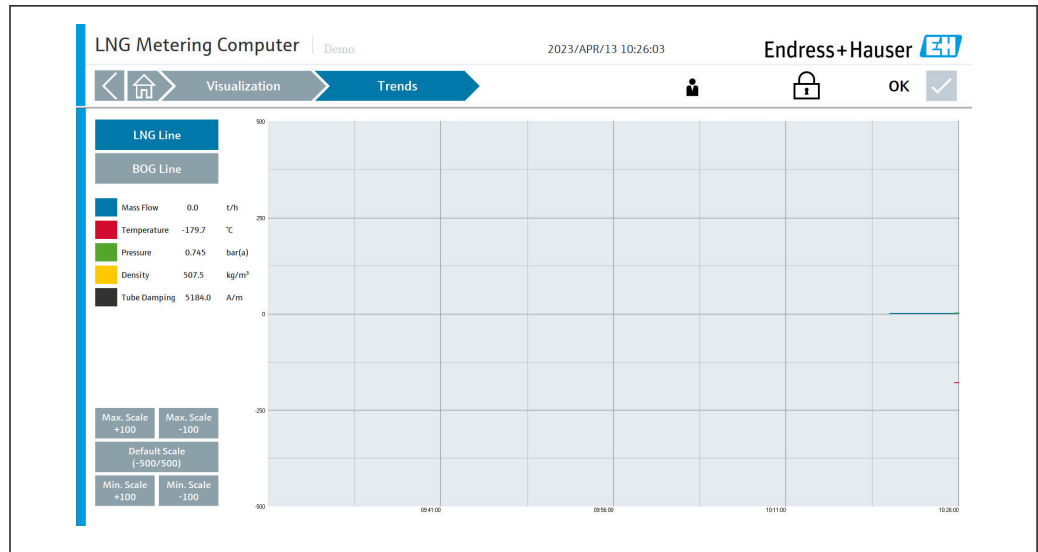


A0052785

8.10 "Trends" screen

On the "Visualization" screen, tap **Trends**. The "Trends" screen opens.

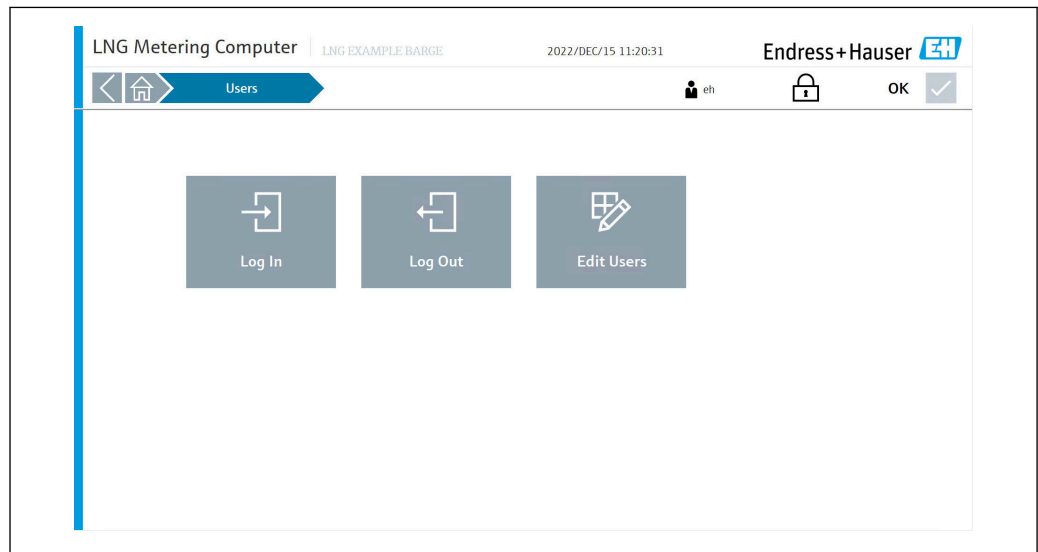
The course followed by process variables of the LNG/BOG measuring path is displayed in the form of real-time diagrams.



A0052788

8.11 "Users" screen

On the "Home" screen, tap **Users**. The "Users" screen opens. Here, the operator can log users in or out, or edit users.



A0052787

8.11.1 User management

The user management comprises 3 customer levels :

- Operator (basic operation)
- Supervisor (as above plus advanced operation, customer settings, operator management)
- Administrator (as above plus supervisor management)

8.11.2 User access matrix

Authorization	Non-registered user	Operator	Supervisor	Administrator
View screens	✓	✓	✓	✓
Start and end of operations	✓	✓	✓	✓
Access to operation history	✓	✓	✓	✓

Authorization	Non-registered user	Operator	Supervisor	Administrator
Acknowledge alarms	✗	✓	✓	✓
Scroll through and filter alarm history	✗	✓	✓	✓
Access to diagnostic data	✓	✓	✓	✓
System: Change language	✓	✓	✓	✓
Display & modify settings	✗	✗	✓	✓
Display & modify system settings	✗	✗	✗	✓
System: Exit HMI application	✗	✗	✗	✓
System: Restart computer	✗	✗	✓	✓
System: Shut down computer	✗	✗	✗	✓
System: Display support information	✓	✓	✓	✓
System: Change alarm limits	✗	✗	✓	✓
System: Display software information	✓	✓	✓	✓
System: Export settings	✗	✗	✗	✓
Change user settings	✗	✗	✗	✓

9 Diagnosis and troubleshooting

9.1 List of error messages

Diagnostic behavior:

- Error
- Warning

Diagnosis no.	Short text	Diagnostic behavior	Possible cause	Remedy
000	LNG Flow Computer Communication Error	Error	Communication between HMI and flow computer is interrupted.	Ensure that flow computer is operational and that Ethernet cables are connected.
001	BOG Flow Computer Communication Alarm	Error	Communication between HMI and flow computer is interrupted.	Ensure that flow computer is operational and that Ethernet cables are connected.
002	Cabinet Door Open	Error	The control cabinet door is open.	Close control cabinet door.
003	Sealing Switch Unsealed Position	Error	The custody transfer switch (sealing switch) has been activated and is in the "unsealed" position.	Set custody transfer switch to "sealed" position.
004	Raman Analyzer Communication Error	Error	Communication between HMI and Raman analyzer is interrupted.	Check that the Raman analyzer is operational and that Ethernet cables are connected.
005	Raman Analyzer System Error	Error	Raman analyzer system error.	Check the status of the Raman analyzer.
006	Raman Analyzer Channel 1 Error	Error	Error from channel 1 of Raman analyzer.	Check the status of the Raman analyzer.
007	Raman Analyzer Laser Not OK	Error	Raman analyzer laser error.	Check the status of the Raman analyzer.
008	Raman Analyzer Stream Not OK	Error	Raman analyzer current error.	Check the status of the Raman analyzer.
050	File Read/write Error	Warning	The HMI could not read or write to the file.	Restart HMI computer.
051	Power Supply 1 Alarm	Warning	No 24 V signal available at Power Supply 1.	Ensure that Power Supply 1 is switched on. Replace power supply if necessary.
052	Power Supply 2 Alarm	Warning	No 24 V signal available at Power Supply 2.	Ensure that Power Supply 2 is switched on. Replace power supply if necessary.
053	Raman Analyzer System Warning	Warning	Raman analyzer system warning.	Check the status of the Raman analyzer.
054	Raman Analyzer Channel 1 Warning	Warning	Raman analyzer channel 1 warning.	Check the status of the Raman analyzer.
055	LNG Temperature > Analyzer Limit	Warning	Process conditions exceed alarm limit.	Check process conditions.
056	Methane Number Calculation - Excel Error	Warning	Excel has crashed.	Restart HMI computer.
057	Fuel Gas Flow Computer Communication Error	Warning	Communication between HMI and flow computer is interrupted.	Ensure that flow computer is operational and that Ethernet cables are connected.
058	Software Checksum Error	Warning	Problem with software program or flow computer application.	Restart control system. If error persists, contact Endress+Hauser.
100	LNG Flow Computer Totalizer Fault	Error	A totalizer error has occurred in the flow computer.	Restart flow computer. If error persists, contact Endress+Hauser.
101	LNG Flow Computer Temperature Transmitter Fail	Error	No signal received at analog input of temperature sensor	Check wiring of 4 to 20-mA signal at analog input. Check sensor.

Diagnosis no.	Short text	Diagnostic behavior	Possible cause	Remedy
102	LNG Flow Computer Pressure Transmitter Fail	Error	No signal received at analog input of pressure sensor	Check wiring of 4 to 20-mA signal at analog input. Check sensor.
104	LNG Flow Computer FLASH Fail	Error	An internal flow computer error has occurred.	Restart flow computer. If error persists, contact Endress+Hauser.
105	LNG Flow Computer FRAM Fail	Error	An internal flow computer error has occurred.	Restart flow computer. If error persists, contact Endress+Hauser.
106	LNG Flow Computer I/O Comms Fail	Error	An internal flow computer error has occurred.	Restart flow computer. If error persists, contact Endress+Hauser.
109	LNG Flow Computer Invalid Hardware Version	Error	The application was installed on an incompatible flow computer.	Install application on a 3rd generation or newer flow computer.
110	LNG Flow Computer System Restart	Error	The flow computer has been restarted.	This is normal behavior following an intended restart. In any other case, contact Endress+Hauser.
111	LNG Flow Computer Promass Communications Fail	Error	Modbus RTU communication between the flow computer and the LNG Promass has failed.	Check wiring of Modbus RTU (RS-485) cables. Ensure that Promass is switched on. Check Modbus RTU communication settings.
112	LNG Flow Computer RAM Fail	Error	An internal flow computer error has occurred.	Restart flow computer. If error persists, contact Endress+Hauser.
113	LNG Flow Computer RTC Error	Error	An internal flow computer error has occurred.	Restart flow computer. If error persists, contact Endress+Hauser.
114	LNG Flow Computer SD Card Error	Error	An internal flow computer error has occurred.	Restart flow computer. If error persists, contact Endress+Hauser.
115	LNG Flow Computer Task Fail	Error	An internal flow computer error has occurred.	Restart flow computer. If error persists, contact Endress+Hauser.
117	LNG Flow Computer Pulse Flow Rate Deviation Error	Error	The pulse input signal of the Promass does not correspond to the Modbus mass flow signal.	Check the pulse input of the Promass and Modbus RTU communication. Check settings for flow discrepancy.
150	LNG Flow Computer Temperature High	Warning	Upper temperature limit has been exceeded.	Check process conditions. Check settings for alarm limits.
151	LNG Flow Computer Temperature Low	Warning	Lower temperature limit has been exceeded.	Check process conditions. Check settings for alarm limits.
152	LNG Flow Computer Pressure High	Warning	Upper pressure limit has been exceeded.	Check process conditions. Check settings for alarm limits.
153	LNG Flow Computer Pressure Low	Warning	Lower pressure limit has been exceeded.	Check process conditions. Check settings for alarm limits.
154	LNG Flow Computer ISO 6578 (Density) Calculation Error	Warning	An internal flow computer error has occurred.	Restart flow computer. If error persists, contact Endress+Hauser.
155	LNG Flow Computer ISO 6976 (Gas Properties) Calculation Error	Warning	An internal flow computer error has occurred.	Restart flow computer. If error persists, contact Endress+Hauser.
156	LNG Flow Computer Bad Gas Composition Received	Warning	An internal flow computer error has occurred.	Restart flow computer. If error persists, contact Endress+Hauser.
161	LNG Flow Computer Printer 1 Error	Warning	An error has occurred in a connected printer.	Check printer connection and settings.
162	LNG Flow Computer Printer 2 Error	Warning	An error has occurred in a connected printer.	Check printer connection and settings.
163	LNG Flow Computer Printer 3 Error	Warning	An error has occurred in a connected printer.	Check printer connection and settings.

Diagnosis no.	Short text	Diagnostic behavior	Possible cause	Remedy
164	LNG Flow Computer Printer Spool Full	Warning	Flow computer printer spool is full.	Check connected printers.
165	LNG Flow Computer FTP Error	Warning	The flow computer could not save the data to the HMI computer.	Check FTP settings on flow computer and HMI. Contact Endress+Hauser.
200	BOG Flow Computer Totalizer Fault	Error	A totalizer error has occurred in the flow computer.	Restart flow computer. If error persists, contact Endress+Hauser.
201	BOG Flow Computer Temperature Transmitter Fail	Error	No signal received at analog input of temperature sensor	Check wiring of 4 to 20-mA signal at analog input. Check sensor.
202	BOG Flow Computer Pressure Transmitter Fail	Error	No signal received at analog input of pressure sensor	Check wiring of 4 to 20-mA signal at analog input. Check sensor.
204	BOG Flow Computer FLASH Fail	Error	An internal flow computer error has occurred.	Restart flow computer. If error persists, contact Endress+Hauser.
205	BOG Flow Computer FRAM Fail	Error	An internal flow computer error has occurred.	Restart flow computer. If error persists, contact Endress+Hauser.
206	BOG Flow Computer I/O Comms Fail	Error	An internal flow computer error has occurred.	Restart flow computer. If error persists, contact Endress+Hauser.
209	BOG Flow Computer Invalid Hardware Version	Error	The application was installed on an incompatible flow computer.	Install application on a 3rd generation or newer flow computer.
210	BOG Flow Computer System Restart	Error	The flow computer has been restarted.	This is normal behavior following an intended restart. In any other case, contact Endress+Hauser.
211	BOG Flow Computer Promass Communications Fail	Error	Modbus RTU communication between flow computer and BOG Promass has failed.	Check wiring of Modbus RTU (RS-485) cables. Ensure that Promass is switched on. Check Modbus RTU communication settings.
212	BOG Flow Computer RAM Fail	Error	An internal flow computer error has occurred.	Restart flow computer. If error persists, contact Endress+Hauser.
213	BOG Flow Computer RTC Error	Error	An internal flow computer error has occurred.	Restart flow computer. If error persists, contact Endress+Hauser.
214	BOG Flow Computer SD Card Error	Error	An internal flow computer error has occurred.	Restart flow computer. If error persists, contact Endress+Hauser.
215	BOG Flow Computer Task Fail	Error	An internal flow computer error has occurred.	Restart flow computer. If error persists, contact Endress+Hauser.
217	BOG Flow Computer Pulse Flow Rate Deviation Error	Error	The pulse input signal of the Promass does not correspond to the Modbus mass flow signal.	Check the pulse input of the Promass and Modbus RTU communication. Check settings for flow discrepancy.
250	BOG Flow Computer Temperature High	Warning	Upper temperature limit has been exceeded.	Check process conditions. Check settings for alarm limits.
251	BOG Flow Computer Temperature Low	Warning	Lower temperature limit has been exceeded.	Check process conditions. Check settings for alarm limits.
252	BOG Flow Computer Pressure High	Warning	Upper pressure limit has been exceeded.	Check process conditions. Check settings for alarm limits.
253	BOG Flow Computer Pressure Low	Warning	Lower pressure limit has been exceeded.	Check process conditions. Check settings for alarm limits.
256	BOG Flow Computer Bad Gas Composition Received	Warning	An internal flow computer error has occurred.	Restart flow computer. If error persists, contact Endress+Hauser.
261	BOG Flow Computer Printer 1 Error	Warning	An error has occurred in a connected printer.	Check printer connection and settings.
262	BOG Flow Computer Printer 2 Error	Warning	An error has occurred in a connected printer.	Check printer connection and settings.

Diagnosis no.	Short text	Diagnostic behavior	Possible cause	Remedy
263	BOG Flow Computer Printer 3 Error	Warning	An error has occurred in a connected printer.	Check printer connection and settings.
264	BOG Flow Computer Printer Spool Full	Warning	Flow computer printer spool is full.	Check connected printers.
265	BOG Flow Computer FTP Error	Warning	The flow computer could not save the data to the HMI computer.	Check FTP settings on flow computer and HMI. Contact Endress+Hauser.
354	Fuel Gas Flow Computer Temperature Transmitter Fail	Warning	No signal received at analog input of temperature sensor	Check wiring of 4 to 20-mA signal at analog input. Check sensor.
355	Fuel Gas Flow Computer Pressure Transmitter Fail	Warning	No signal received at analog input of pressure sensor	Check wiring of 4 to 20-mA signal at analog input. Check sensor.
357	Fuel Gas Flow Computer System Restart	Warning	The flow computer has been restarted.	This is normal behavior following an intended restart. In any other case, contact Endress+Hauser.
358	Fuel Gas Flow Computer Promass Communications Fail	Warning	Modbus RTU communication between flow computer and fuel gas Promass has failed.	Check wiring of Modbus RTU (RS-485) cables. Ensure that Promass is switched on. Check Modbus RTU communication settings.
359	Fuel Gas Flow Computer Pulse Flow Rate Deviation Error	Warning	The pulse input signal of the Promass does not correspond to the Modbus mass flow signal.	Check the pulse input of the Promass and Modbus RTU communication. Check settings for flow discrepancy.

9.2 Troubleshooting

This section describes the actions that the user should take to rectify common computer problems caused by hardware or software errors.

If a problem occurs, the following first steps must be observed before further action is taken:

- On the panel PC, identify and isolate the component causing the problem.
- Before you switch on the panel PC, ensure that all peripheral devices have been switched on.
- In the event of problems with external devices, ensure that the cable connections are correct and secure.
- Ensure that the correct configuration information is configured in the BIOS setup program.
- Ensure that all device drivers are correctly installed.
- Take note of the user's observations. Are messages displayed on the display? Are indicator lamps lit? Are there any beeping sounds? If the user needs help, detailed descriptions for the service team are helpful.

If the problem persists after the user has followed the instructions in this section, the user should contact the local Endress+Hauser Sales Center.

10 Repair

10.1 General information

- Use only original Endress+Hauser spare parts.
- Observe the relevant standards, national regulations, certificates, and sealing regulations.
- Document all repairs and enter them in the W@M Lifecycle Management database.
- Repairs may be carried out only by Endress+Hauser service employees or by suitably trained customer staff.

10.2 Control cabinet fan

The filter mat of the control cabinet fan must be checked regularly. If necessary, clean the filter mat or replace it with the correct mat type.

10.3 Air conditioning

WARNING

Live parts!

Incorrect work on electrical components can result in electrical shock.

- ▶ Switch off the power supply before carrying out any work.

Regularly clean the ventilation circuit components using compressed air.

10.4 Spare parts

10.4.1 Spare parts

Description	Order number
Flow computer	DTSP-DP1PT1 (71607206)
Industrial SD memory card 32 GB	DTSP-DP1PT1 (71607209)
Ethernet switch	DTSP-DP1PT1 (71607210)
Antenna	DTSP-DP1PT1 (71607211)
Global 3G/4G/WLAN router	DTSP-DP1PT1 (71607212)
15.6" panel PC	DTSP-DP1PT1 (71607213)
Probe with 3.1 material certificate	KR41-8ABBAACACADBBBAGABJA
Probe with 3.2 material certificate (Lloyd's Register)	KR41-8ABBAACACADBBBAGABJB
Probe with 3.2 material certificate (American Bureau of Shipping)	KR41-8ABBAACACADBBBAGABJC
Probe with 3.2 material certificate (Bureau Veritas)	KR41-8ABBAACACADBBBAGABJD
Fiber optic cable (15 to 50 m)	KFOC1-BBC
Fiber optic cable (55 to 200 m)	KFOC1-BBD

10.5 Endress+Hauser services

It is recommended that the LNG bunkering control system be serviced regularly by the system manufacturer.



Your Endress+Hauser Sales Center can provide detailed information on the services.

10.6 Disposal

Incorrect disposal of system components can result in environmental damage.

- Do not dispose of system components as domestic waste.
- Always dispose of system components in accordance with applicable national regulations.
- Ensure proper separation and recycling of system components.

11 Technical data

11.1 Power supply

Supply voltage	110 to 230 V _{AC} at 50 to 60 Hz
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11.2 Input/output

LNG/BOG/flue gas flowmeter	Pulse 24 V _{DC} , Modbus RTU
LNG/BOG/flue gas temperature	Current signal 4 to 20 mA
LNG/BOG/flue gas pressure	Current signal 4 to 20 mA

 Detailed information on "Modbus TCP": supplemental documentation →  61

11.3 Cables

Power cable	Standard installation cable is sufficient.
Signal cable, current signal 4 to 20 mA	Shielded cable required.
Modbus RS485 cable	The EIA/TIA-485 standard specifies two cable types (A and B) for the bus line, which can be used for all transmission rates. Cable type A is recommended.
Pulse/frequency output	Shielded cable required.

11.4 Environment

Ambient temperature range	-10 to +55 °C (+14 to +131 °F)
Relative humidity	25 to 75 %

11.5 Degree of protection

Control cabinet without Raman analyzer	IP54
Control cabinet with Raman analyzer	IP20

11.6 Weight

Control cabinet without Raman analyzer	50 kg
Control cabinet with Raman analyzer	219 kg

11.7 Control cabinet standards

- Low voltage directive 2014/35/EU
- Electromagnetic compatibility 2014/30/EU
- RoHS directive 2011/65/EU

11.8 Custody transfer approval

- OIML R117
- MID MI-005

11.9 Supplemental documentation

Contents	Documentation code
Technical Information Raman Rxn4	TI01645C
Operating Instructions Raman Rxn4	BA02178C
Technical Information Proline Promass F 300	TI01221D
Operating Instructions Proline Promass F 300	BA01496D
Technical Information Proline Promass F 500	TI01222D
Operating Instructions Proline Promass F 500	BA01540
Technical Information Proline Promass Q 300	TI01277D
Operating Instructions Proline Promass Q 300	BA01501D
Technical Information Proline Promass Q 500	TI01287D
Operating Instructions Proline Promass Q 500	BA01545D
Technical Information Cerabar PMP71B	TI01509P
Operating Instructions Cerabar PMP71B	BA02012P
Technical Information TR66 resistance thermometer (RTD)	TI01032T
Data interface description Modbus TCP & OPC-UA	SD02946D

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