SIEMENS energy

SITRAM®

Multisense 5

Installation and Operation Manual

siemens-energy.com

Document Revision History

	Revision-ID	Changes
☑	**2.0**	**SE Branding**

Bold = Does apply for this document / Not Bold = Does not apply for this document

Purpose

This manual is part of a documentation package for the Siemens Energy SITRAM® Multisense 5

The package is subdivided in 3 different manuals with individual main focuses:

	Main Focuses	Topics
☑	**Installation**	**Provides a comprehensive overview and guidelines to work steps of onsite system installation, connection layouts, checkups, preparation and mounting of the hardware components depending on individual situations. Photo material from real installation environment makes it easier to understand settings and points out the essentials.**
☑	**Commissioning**	**Describes the approach of configuration and start of the system step-by-step. Possible upcoming problems during the process are addressed in the different sections.**
☑	**Communication & Software**	**Provides a detailed overview and guidelines in the context of the system communication capabilities (protocols, interfaces, separate and optional communication units etc.) as well as the system related set of user software and superior monitoring landscape.**
Bold = Does apply for this document / Not Bold = Does not apply for this document		

Audience

See also “Qualified personnel“ section

	Main Focuses	Audience
☑	**Installation**	**Is intended for service technicians and installation staff with electrical background responsible for mounting the equipment and components.**
☑	**Commissioning**	**Is intended for normal operator users especially in context of standalone monitoring as well as commissioning engineers who are familiar with dealing with communication protocols and remote connection establishment for SCADA etc.**
☑	**Communication & Software**	**Is intended for normal operator users especially in context of standalone monitoring as well as commissioning engineers who are familiar with dealing with communication protocols and remote connection establishment for SCADA etc..**
In Bold = Does apply for this document / Not in Bold = Does not apply for this document		

Table of Content

Legal Provisions

Warning notice Concept

This manual contains notices that you must observe in the interests of your own personal safety and in order to avoid damage to property. The notices relating to your personal safety are highlighted with a warning triangle. Those relating to the prevention of damage to property only do not have a warning triangle. The warning notices are presented in decreasing order of severity based on the hazard level involved.

DANGER

Death or serious personal injury will occur if the corresponding precautionary measure is not taken.

Damage to property may occur if the corresponding precautionary measure is not taken.

An undesirable result or state may occur if the corresponding notice is not observed

In cases where two or more hazard levels apply, it is always only the warning notice for the most severe level which is used alone. A warning notice with a warning triangle primarily involves possible personal injury. But it also can mean damage to property at the same time.

Qualified personell

The product/system associated with this documentation may only be operated by qualified personnel trained for the task concerned, in accordance with the documentation associated with the task concerned and in particular the safety and warning notices contained in this documentation. Qualified personnel are capable, on the basis of their training and experience, of recognizing risks and avoiding potential hazards in their work with these products/systems.

Use of the Product

Please give due consideration to the following:

DANGER

The Siemens Energy SITRAM® Multisense 5 product may only be used for the application it is provided for in the cata-log and in the associated documentation. Using this product in a divergent way may have an impact on the protection provided by the system. Any third-party products and components used must be approved or recommended by Siemens Energy. Proper transportation, storage, assembly, installation, setup, commissioning, operation and maintenance are essen-tial for the safe and effective operation of the products. The specified environmental requirements must be met. Notices in the associated documentation must be ob-

Limitation of use

The equipment may only be used as secondary equipment at large stationary equipment as power transformers.

Trademarks

Microsoft, Microsoft Internet Explorer, Microsoft .NET and Windows are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.

All other trademarks, registered trademarks, service marks, and trade names are the property of their

respective owners.

Disclaimer of Liability

We have checked the contents of the document for

compliance with the described hardware and software. However discrepancies cannot be excluded and we accordingly do not guarantee absolute compliance. The information contained in this document is reviewed

regularly and any corrections necessary are incorporated into subsequent editions. The data and illustrations in this document which refer explicitly to devices and equipment from third-party providers are not obligatory. Together with our partners or the third-party providers we reserve the right to modify our service and products in line with our policy of continuous service and product development. The information in

this document is sub-ject to change without notice and should not be construed as a commitment by Siemens Energy.

Siemens Energy assumes no responsibility for any errors that may appear in this document. If you have any suggestions for im-provements or amendments or have found errors in this report, please notify us.

Waste and Recycling

Due to the limitation of use, the device is not subject to WEEE regulation.

Siemens Energy aims to fulfilling all applicable legislation and regulations. This includes also among many others WEEE and in case any applicable exemptions apply for our products, we will continuously review and update our assessment.

The specific requirements are covered by our Zero Harm Framework as part of our certified Integrated Management System and referenced and implemented with the Building Blocks defined therein, e.g. Waste and Recyclability.

Related Manuals

„SITRAM® Multisense Software Manual“

Further Siemens Energy and other OEM Manuals mentioned in body text

Customer Support Center

Phone: +49 911 6505 6505
(Charges depending on provider)

E-Mail:
support@siemens-energy.com

Website:
Please also visit our website for additional information:
siemens-energy.com/sitram-ms5-01

1. General

The SITRAM® Multisense 5 unit is a permanently installed multi-gas-in-oil analysis system with transformer monitoring functions. It allows the individual measurement of moisture in oil and the key gases hydrogen (H_2), carbon monoxide (CO), acetylene (C_2H_2) and ethylene (C_2H_4) dissolved in transformer oil.

As hydrogen (H_2) is involved in nearly every fault of the insulation system of power transformers and carbon monoxide (CO) is a sign of an involvement of the cellulosic / paper insulation the presence and increase of acetylene (C_2H_2) and ethylene (C_2H_4) further classifies the nature of a fault as overheating, partial discharge or high energy arcing.

The measurement values can be dumped on the analog outputs:

- 5 Analog outputs 0/4 ... 20 mADC

The unit can serve as a compact transformer monitoring system by the integration / connection of other sensors present on a transformer via its analog inputs:

- 6 Analog inputs 0 ... 20 mAAC +20% / 0 ... 80 VAC +20% (option) configurable by jumpers, standard: current
- 4 Analog inputs 0/4 ... 20 mADC (option)

It is further equipped with digital outputs for the transmission of alarms or the execution of control functions (e. g. control of a cooling system of a transformer):

- 5 Digital relay outputs
- 5 Digital opto-coupler outputs (option)

Key Advantages

- Individual measurements of hydrogen (H_2), carbon monoxide (CO), acetylene (C_2H_2) and ethylene (C_2H_4)
- Moisture in oil measurement (H_2O)
- Communication Interfaces ETHERNET 10/100 Mbit/s (copper-wired / RJ45 or fiber-optical / SC Duplex) and RS485 to support MODBUS® RTU/ASCII, MODBUS® TCP and proprietary communication protocol
- Optional DNP3 serial on-board modem for SCADA connection over DNP3 protocol
- Optional IEC 61850 on-board modem for substation communication over IEC 61850 protocol
- Optional on-board GSM-, GPRS- or analog modems for remote access over proprietary protocol
- Optional HV and LV bushing sensors for HV and LV bushing monitoring applications via communication interface

1.1 Warning signs on the device

1.1.1 General warning sign

The stickers „general warning sign“ on the device advice the user to read the Installation and Operation manual. Details following:

1.1.1.1 Cover

Removal of cover only by trained personnel. Before removal the power supply must be turned off! Danger because of dangerous voltage levels.

1.1.1.2 Heating

Do not route cables close to the heating. In case of malfunction, those can reach temperatures up to 80°C! Danger because of heat.

1.1.1.3 Relay contacts

Only use as potential free contacts and according to the ratings.

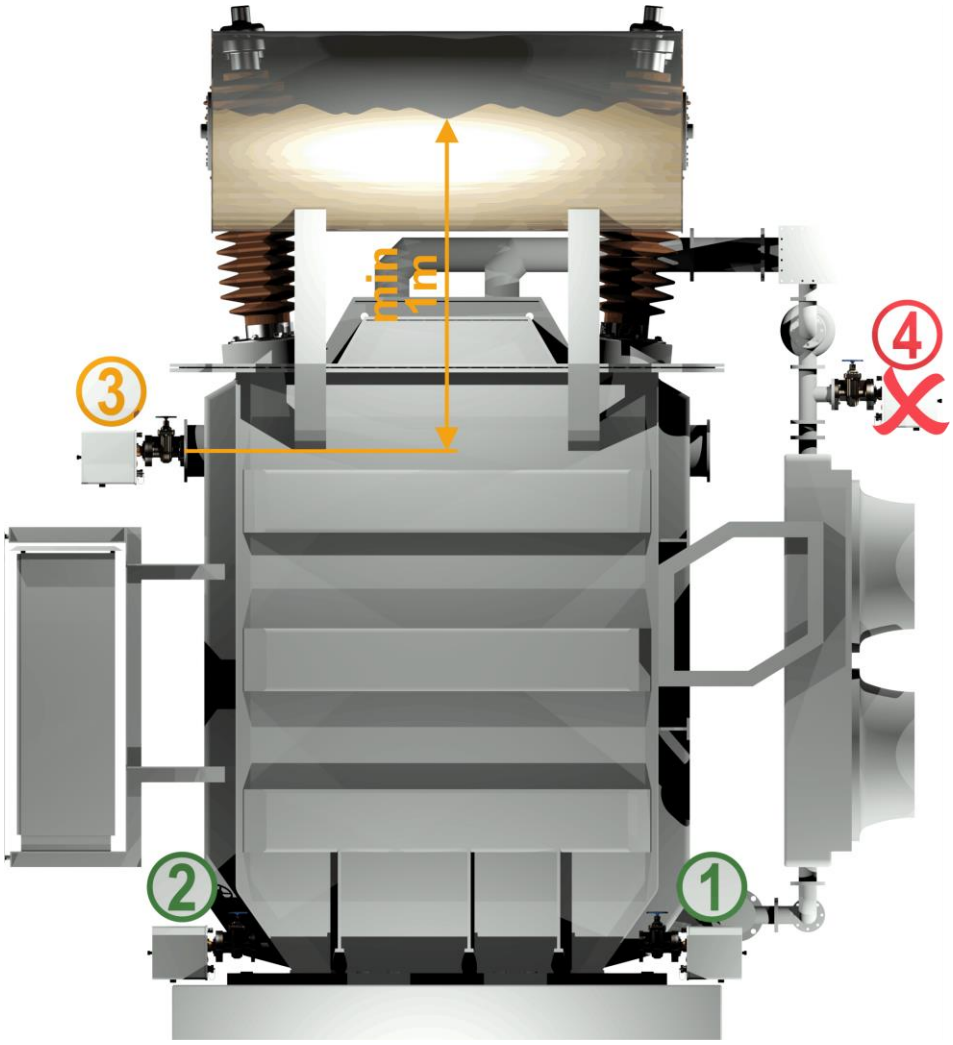
1.1.2 Danger by voltage

The stickers „Caution of voltage“ indicate danger voltage levels in the particular area.

2. Installation instructions

2.1 Installation positions

To ensure the correct function of a SITRAM® Multisense unit the installation position is very important. On a typical transformer three positions are possible:



Pos. 1 **Output side of cooling unit:**

Please install the unit on a straight piece of pipe on the cooler output between the cooler and the main oil tank. In order to avoid negative pressure, the unit must absolutely be mounted on the output of the oil circulation pump.

Note: Choose this position only if a continuous oil flux through the cooler is guaranteed

Pos. 2 **Draining valve on the transformer tank:**

The flange of the draining valve must be at minimum height of 40 cm in order to allow installation and mounting of SITRAM® Multisense unit.

Pos. 3 **Upper filling valve:**

It is possible to mount SITRAM® Multisense unit on this position, if the filling level of the oil is min. 100 cm higher than the center of the connection thread.

This position is not recommended, because the filling process is influenced by the hydrostatic pressure of the oil and it may be difficult to operate and read the data on the unit.

Pos. 4 Input side of cooling unit:
Never install the SITRAM® Multisense unit on top of the cooling unit or on the suction side of the cooler pump!

Note: On the installation position a good and continuous oil circulation must be present.

2.2 Safety precautions

The following security precautions must be strictly observed during the installation. Otherwise no warranty claims will be accepted.

Never remove the protection cap from the connection thread until you are ready to mount the unit on the transformer valve.

The protection cap protects the connection unit against dust and from other impurities. Additionally it protects the connection thread and/or the adapter.

Note: Use the protection cap also after dismounting the unit.

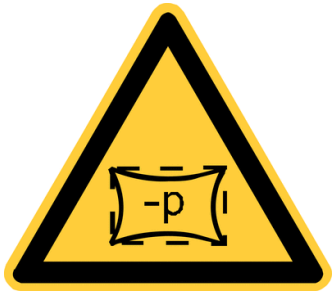
Never close the aeration holes for oxygenation. They are situated on the bottom side of the protection cover and on the back plate of the unit.

Never use or stock chemicals with hydrocarbon contents near the measurement sensor.

Never clean the SITRAM® Multisense unit with solvents, because its gases will strongly impair the measurement accuracy and the sensitivity of the sensors.

Never apply a negative pressure to the connection unit.

Negative pressure can cause problem during filling process.



Remove the SITRAM® Multisense unit from the valve every time you degas or refill the transformer. You can also close the transformer valve.

Never operate the SITRAM® Multisense unit on a valve that is closed for a long period of time. Remove the unit if this cannot be avoided. Please refer to the de-installation instructions.

Never install the SITRAM® Multisense unit on the suction side of the cooling pump!!

The SITRAM® Multisense unit should be installed on positions located 100 cm below the transformer oil level.

Never install the SITRAM® Multisense unit on an elbow or curve of a tube.

Turbulences in a tube curve can create a negative pressure, which can cause problems in the SITRAM® Multisense unit during filling process.

Never install or remove the SITRAM® Multisense unit without opening the aeration screw first.

Never use galvanized fittings or valves to mount the SITRAM® Multisense unit.

Galvanized fittings or valves can react with oil, this will produce incorrect measurement values.

Never clean the SITRAM® Multisense unit with high pressure cleaning equipment.

High pressure cleaning equipment used to clean transformers can seriously damage the SITRAM® Multisense unit.

Never use a chaining key tool for mounting.

Use of such tools can damage the surface of the connection unit and the threads. Please use a tin spanner M55 or an adjustable tin spanner for 1 ½“.

Attention!!!

Faulty or inappropriate handling of the connection unit, like malfunction by negative pressure, paint or solvent liquids make the warranty invalid.

2.3 Installation preparation

Before installation, a visual inspection of the unit must be carried out. Unscrew the two knurled thumb screws, remove the protection cover and check visually the components. All cables and tubes must be connected.

2.3.1 Mechanical connection

The external thread type of the SITRAM® Multisense connection unit is even G 1½" ISO DIN 228-1 or 1½" NPT ANSI B 1.20.1 (must be specified when ordering).

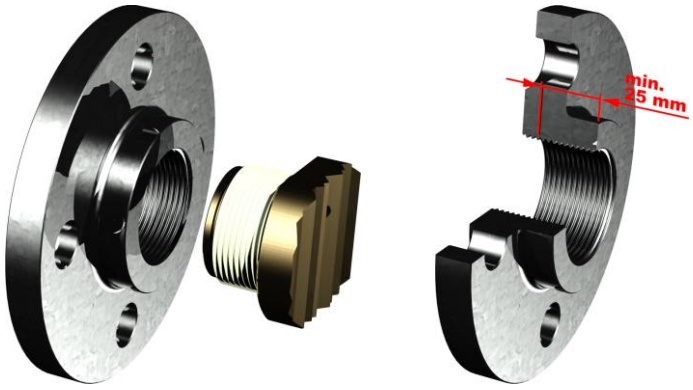
The SITRAM® Multisense unit should be installed on a gate valve with full bore or on a ball valve to the transformer.

These locking elements are usually provided with a blind flange. Therefore, they must be upgraded before mounting the SITRAM® Multisense unit with a corresponding threaded flange, connection adapter or a fitting with union nut.

This results in two different mounting ways (direct and indirect).

2.3.1.1 Flange connection

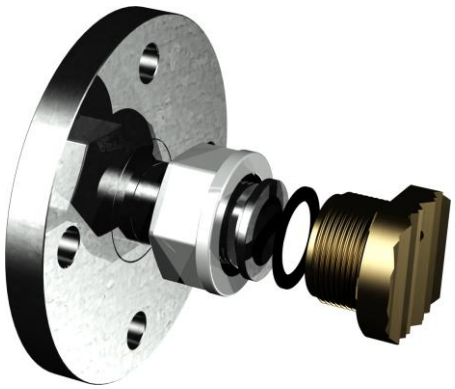
The device is screwed directly onto the threaded flange, i.e. the device is rotated around its own axis in order to fix it. In this type of installation, the space around the center of the connection unit must be free in a diameter of 430 mm.



Note: The thread depth of the threaded flange or the connection adapter should be at least 25 mm.

2.3.1.2 Fitting with union nut

We recommend installing the SITRAM® Multisense unit with a fitting with union nut (flat sealing) to the transformer gate / valve. This fitting consists of a threaded flange, a flat sealing union end and a union nut. In this case the union nut must be rotated to fix the SITRAM® Multisense unit and a gasket is used to seal the connection. An additional thread sealing with thread seal tape or thread sealant is not or rarely necessary in this case.



Note: Ball valves with union nut are also available (pump ball valve).

2.3.2 Auxiliary supply connection

The SITRAM® Multisense unit is available in 4 different voltage versions (must be specified when ordering). Depending on the used nominal voltage version there must be an AC or DC power supply with a 3 pin power cable (2.4.2) close to the SITRAM® Multisense unit:

Nominal voltage version SITRAM® Multisense	Auxiliary supply voltage
120 V -20% +15% **AC** 50/60Hz	96 V_{min} ... 138 V_{max} AC 50/60Hz
230 V -20% +15% **AC** 50/60Hz	184 V_{min} ... 264 V_{max} AC 50/60Hz
120 V -20% +15% **DC**	96 V_{min} ... 138 V_{max} DC
230 V -20% +15% **DC**	184 V_{min} ... 264 V_{max} DC

The power consumption of the SITRAM® Multisense 5 unit is max. 400VA.

Micro-fuse: 120V: T4A (slow blow) 230V: T2A (slow blow)

2.3.3 Required tools

The mechanical and electrical installation of the SITRAM® Multisense unit can be executed with following tools and utilities:

- Torque wrench with Allen key No. 4 ⇨ Aeration screw (bleeding screw)
- Digital Multimeter ⇨ Checking supply voltage
- Screw driver No. 2 ⇨ Main connectors supply voltage cable
- Brass brush ⇨ Connection unit
- Tin spanner M55 and / or adjustable tin spanner 1 ½" ⇨ Connection unit
- Bucket, oil absorber, cleaning rag, paper towel ⇨ To absorb/clean the out coming oil
- Plastic sheet ⇨ To collect dropping parts

2.3.4 Sealing the connection thread

Securing and sealing the connection threads may be implemented in various ways. It should be used either a thread seal tape or a thread sealant:

2.3.4.1 Thread seal tape

The thread seal tape, also known as Teflon tape or PTFE tape (Polytetrafluorethylen), is wrapped tightly around the external thread of the SITRAM® Multisense connection unit. We recommend using a Teflon tape for coarse thread (100g/m²).

Attention !!!

If you use Teflon tape for sealing the connection thread, nothing can be adjusted after wards.
!!!! Risk of leakage !!!!

2.3.4.2 Thread sealant

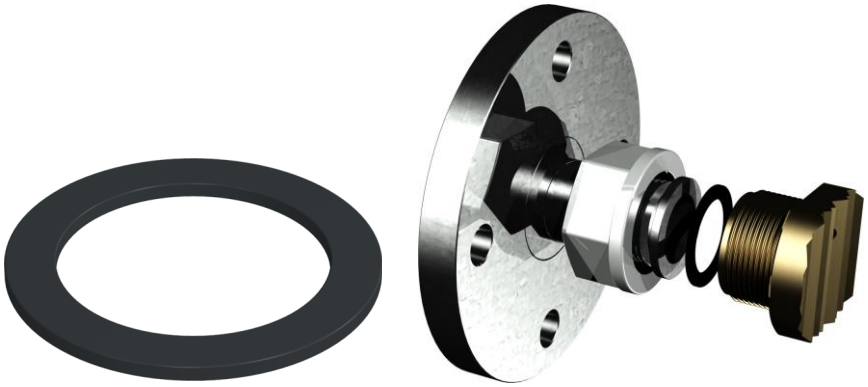
As a thread sealant we recommend the two Henkel products LOCTITE® 7471 (activate) and LOCTITE® 577 (seal and fix) in combination. The activator LOCTITE® 7471 is used to increase the rate of cure and is applied before the actual thread adhesive LOCTITE® 577 is applied on 3 to 4 turns of the external thread of the SITRAM® Multisense connection unit.

Attention !!!

Please follow the instructions of the manufacturer!!!

2.3.4.3 Flat sealing (gasket)

When using a fitting with union nut the sealing and locking of the threaded connection with thread seal tape or thread sealant is not necessary anymore. In this case the gasket serves as sealing and the union nut as fixation of the connection.



2.4 Installation

After the installation preparation is completed, the SITRAM® Multisense unit can be installed. The installation is divided into 3 steps:

- Mechanical installation (2.4.1)
- Electrical connection (2.4.2)
- Putting into operation (2.4.3)

2.4.1 Mechanical installation

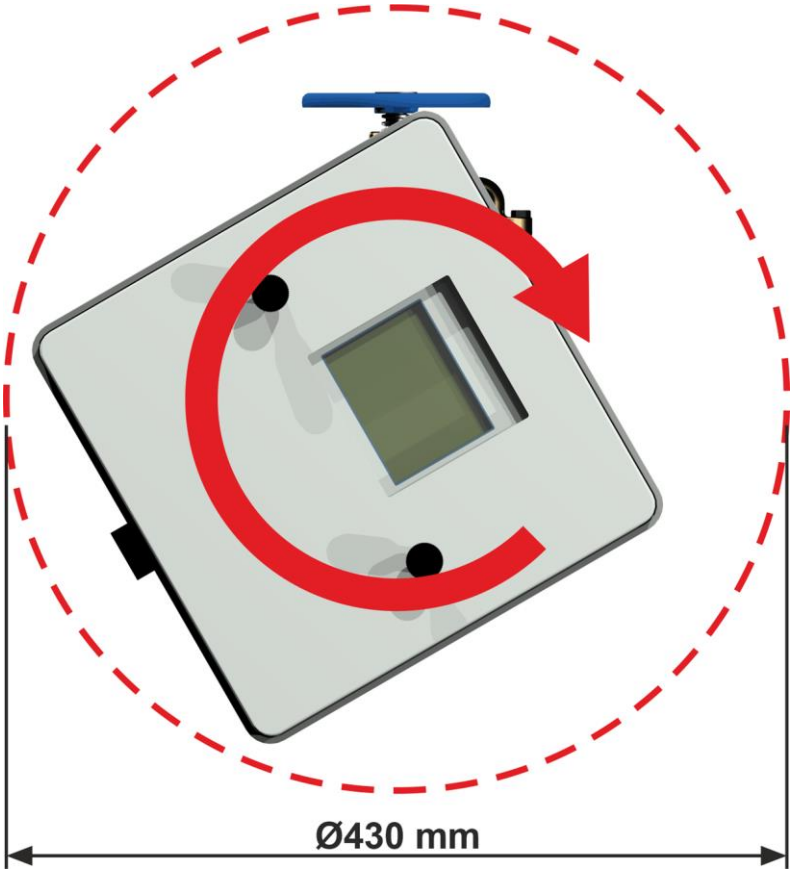
The sequence of the mechanical installation depends on which connection type is available on the transformer side. There are basically 2 types of mechanical installation:

- Direct installation (2.4.1.1)
- Indirect installation (2.4.1.2)

Note: In case there are strong vibrations on the connection valve, the valve should be relieved by a support.

2.4.1.1 Direct installation

Direct installation means, the unit is screwed directly onto the threaded flange, i.e. the unit is rotated around its own axis in order to fix it. In this type of installation, the space around the center of the connection unit must be free in a diameter of 430 mm.



The connection thread can be sealed and fixed using either a thread seal tape or a thread sealant.

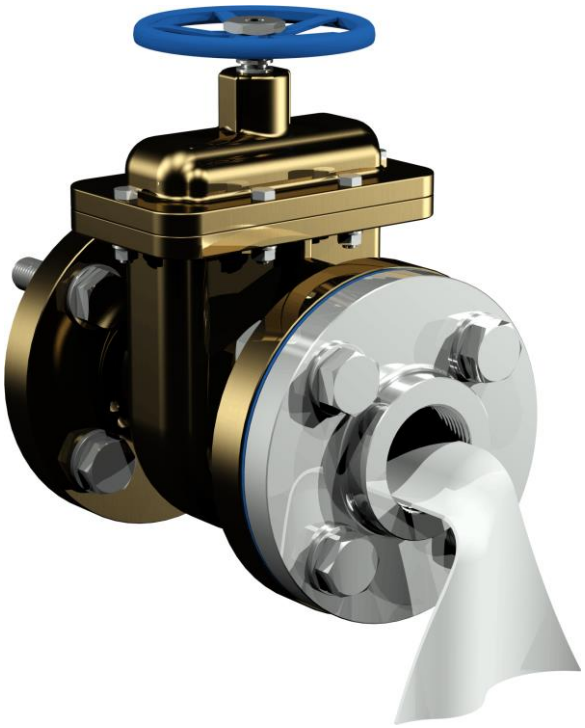
- Direct installation with thread seal tape (2.4.1.1.1)
- Direct installation with thread sealant (2.4.1.1.2)

Attention !!!

Only remove the protection cap (slowly while turning) when you are ready to mount the unit to the connection valve!

2.4.1.1.1 Direct installation with thread seal tape

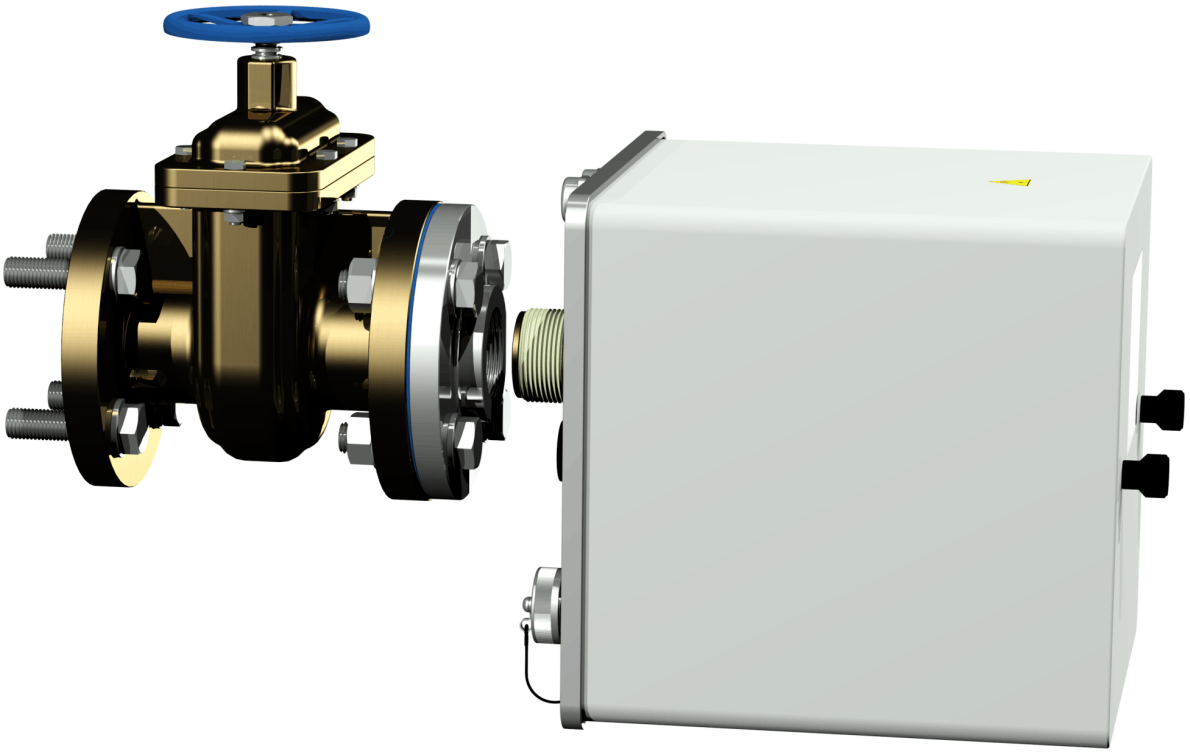
- Clean the inside of the threaded flange with a dry-cleaning rag or paper towel.



- Clean the outer thread of the connection unit with a dry-cleaning rag or paper towel. Remove any remaining of thread sealing tape completely from the threads. For persistent remaining you can use the brass brush or use white spirit (pure alcohol). White spirit must dry out completely before proceeding.

- Wrap 3 to 15 layers of Teflon tape (depending on the tolerance of the two threads) clockwise (rear view) tightly around the connection thread of SITRAM® Multisense unit. The first thread should remain free.

- Place the SITRAM® Multisense unit horizontally to the threaded flange. Make sure that the unit is leveled.

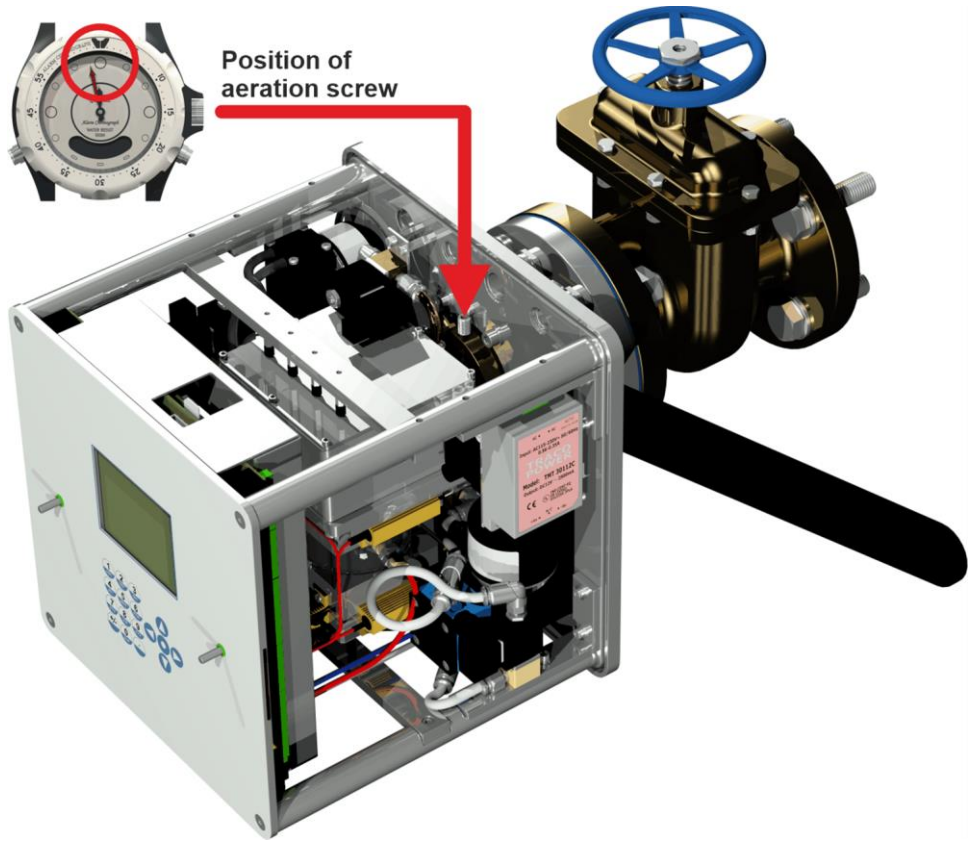


- Turn in the SITRAM® Multisense unit 2 to 3 turns clockwise by hand to the threaded flange.

- Now turn in the SITRAM® Multisense unit for another 5 to 6 turns clockwise using a tin spanner M55 or adjustable tin spanner 1 ½" and stop when the aeration screw is at about 9 o`clock.

Note: If the turn in was possible without major effort, too less Teflon tape was used. Turn out the unit, remove Teflon tape completely and perform the installation again.

- Unscrew the two knurled thumb screws and remove the protection cover.
- Now align the unit clockwise until the position of the aeration screw is at 12 o`clock. Make sure that the unit is tight in this position.



Note: The alignment of the unit must be only clockwise. Once the unit is turned counterclockwise during the alignment, the installation procedure must be performed once again! Risk of oil leakage!

Attention !!!

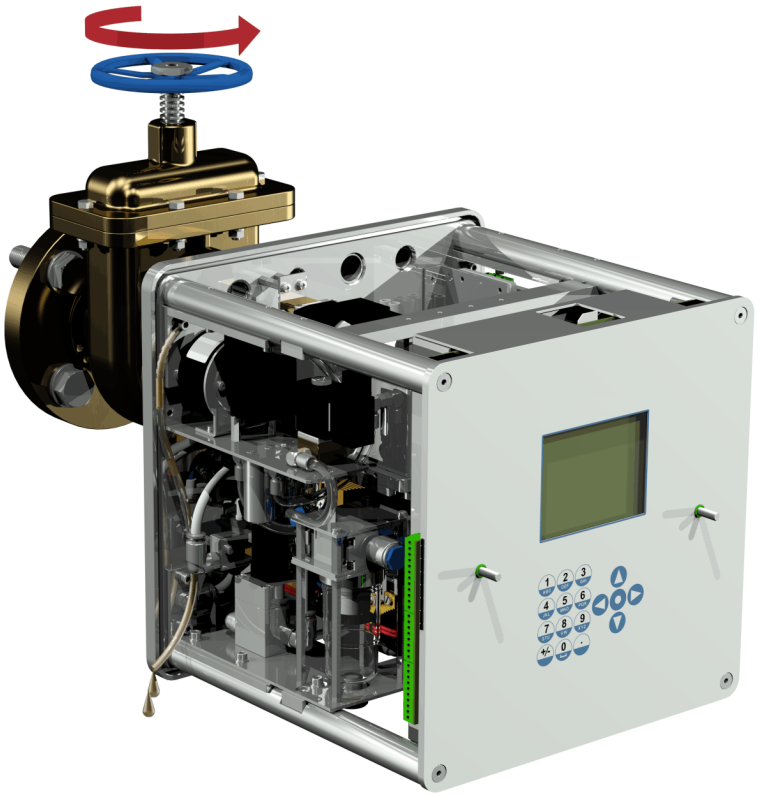
Do not exceed 12 o`clock position!
Otherwise you must remove the SITRAM® Multisense unit, completely remove the Teflon tape from the connection thread and perform the installation procedure again!

Attention !!!

The following steps must be done according to the company procedures. Work carefully in order to prevent air entering into the transformer. Use a bucket to catch the leaking oil

- Loosen the aeration screw 2 to 4 turns counterclockwise with a long Allen key No. 4 (aeration is active).

- Slowly open the transformer valve until oil runs out of the oil sample tube. Collect the leaking oil with a bucket.



- Close the aeration screw as soon as no air bubbles sort the sample tube.

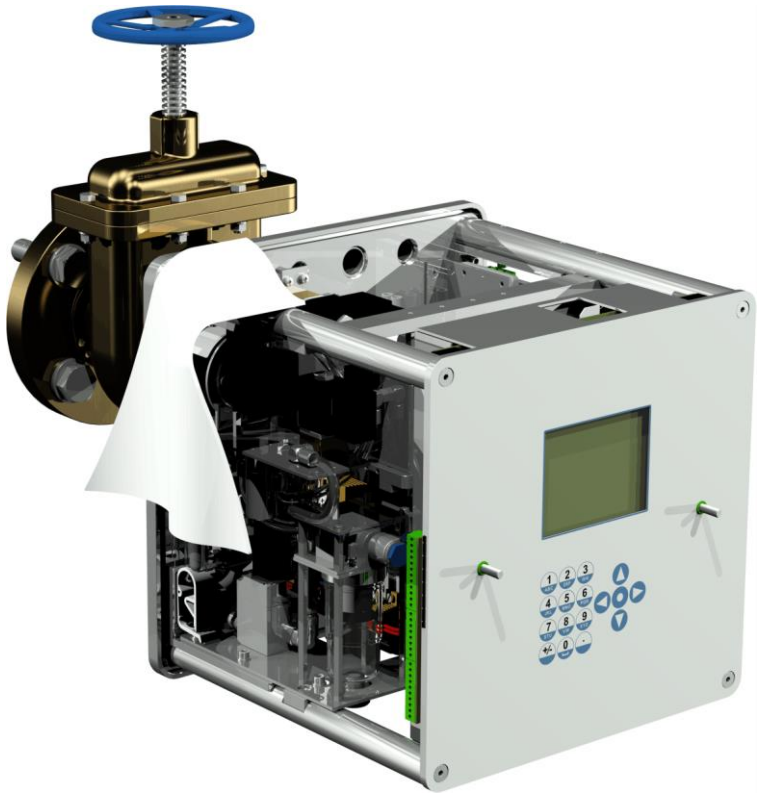
Attention !!!

Tighten the aeration screw with a torque of 9Nm.

- Now open the transformer valve completely.

- Secure the end of the sample tube with the provided tube clip.

- Remove thoroughly the oil residues with a dry-cleaning rag or paper towel from the unit.



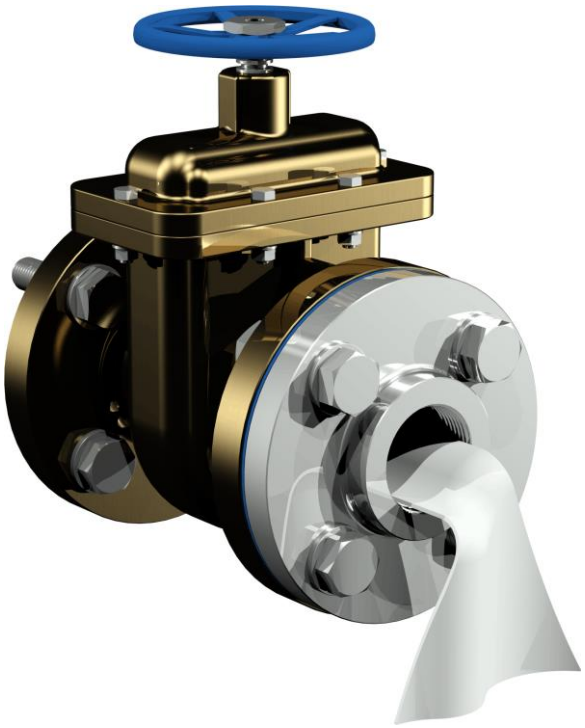
Attention !!!

Do not use solvents for cleaning!

- Check after 30 minutes if the threaded connection is tight (no leakage).

2.4.1.1.2 Direct installation with thread sealant

- Clean the inside of the threaded flange with a dry-cleaning rag or paper towel.



- Clean the outer thread of the connection unit with a dry-cleaning rag or paper towel. Remove any remaining of thread sealing tape completely from the threads. For persistent remaining you can use the brass brush or use white spirit (pure alcohol). White spirit must dry out completely before proceeding.

- Apply LOCTITE® 7471 (activator) 360° on both adherend surfaces by spraying or brushing. When spraying the holes (Transformer valve and SITRAM® Multisense unit) must be covered / closed with a clean cleaning rag or paper towel.

- Allow the solvent time to evaporate under good ventilation until the surfaces are completely dry.

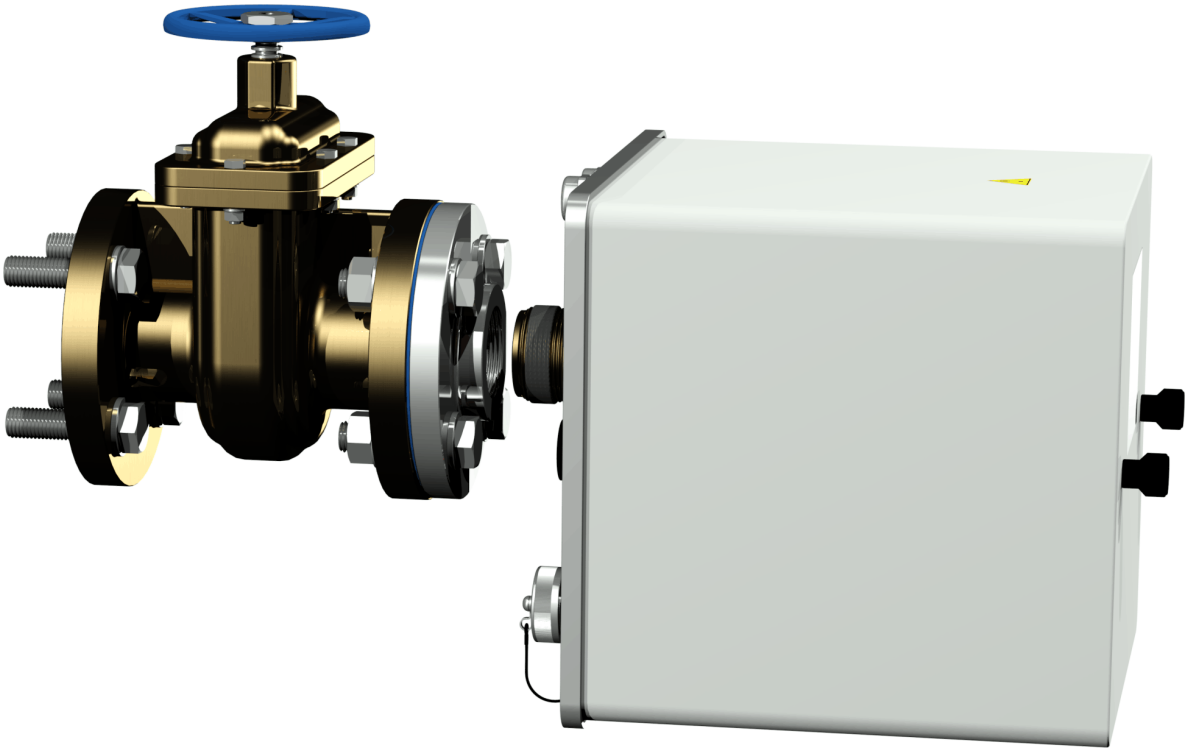
Note: After activating the threaded connection the next step should be performed at least within 7 days. Contamination before gluing should be prevented.

- Apply LOCTITE® 577 (sealer and security) 360° on 3 to 4 threads, leaving the first thread free.

- Use appropriate gloves to force the material into the threads to thoroughly fill the voids.

Note: For bigger voids, adjust the amount of the adhesive accordingly.

- Place the SITRAM® Multisense unit horizontally to the threaded flange. Make sure that the unit is leveled.

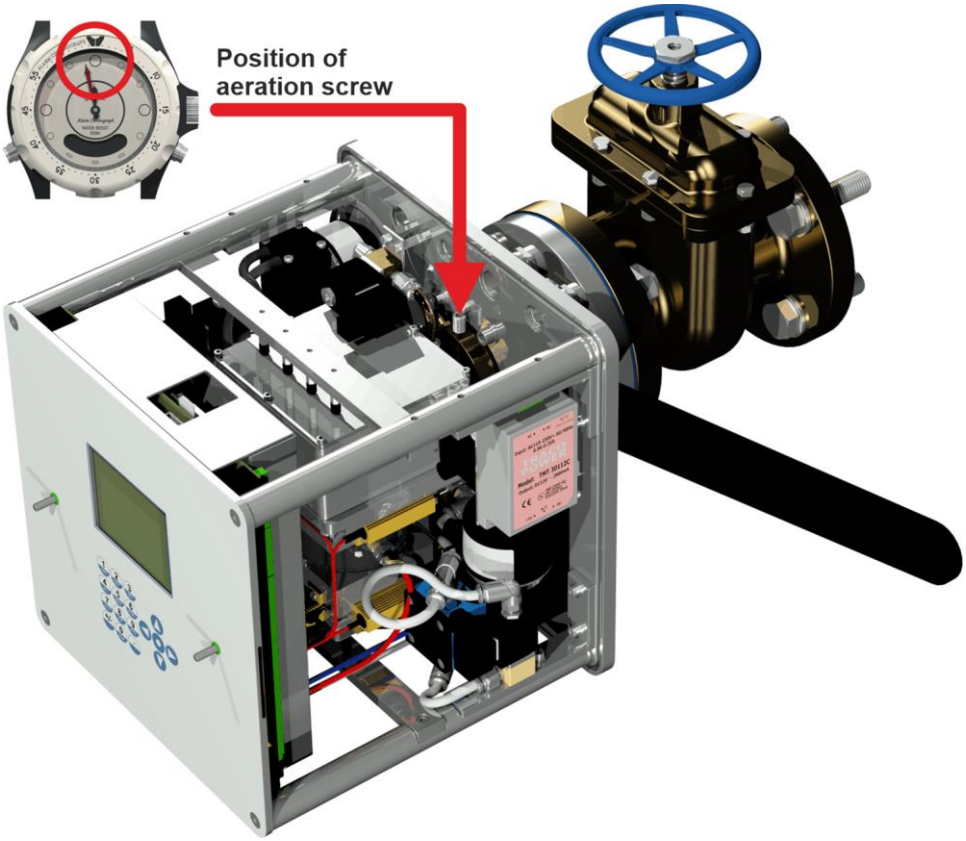


- Turn in the SITRAM® Multisense unit 2 to 3 turns clockwise by hand to the threaded flange.

- Now turn in the SITRAM® Multisense unit for another 5 to 6 turns clockwise using a tin spanner M55 or adjustable tin spanner 1 ½“ and stop when the aeration screw is at about 9 o`clock.

Note: If the turn in was possible without major effort, too less thread sealant was used. Turn out the unit, remove the thread sealant completely with a brass brush and perform the installation again.

- Unscrew the two knurled thumb screws and remove the protection cover.
- Now align the unit clockwise until the position of the aeration screw is at 12 o`clock. Make sure that the unit is tight in this position.



- It is recommended to wait 30 minutes before proceeding with the further installation steps. The thread adhesive cures only under pressure, i.e. in the threads of the pipe joint. For this reason, excessive thread sealant should be removed with a cleaning rag / paper towel.

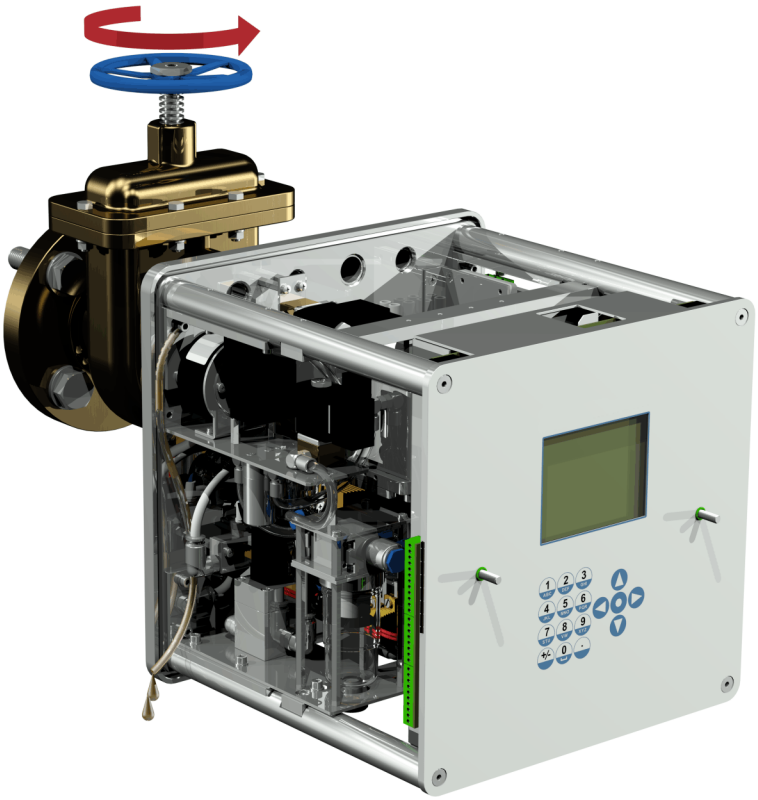
Note: The complete curing and environmental resistance of the thread sealant is reached after a week.

Attention !!!

The following steps must be done according to the company procedures. Work carefully in order to prevent air entering into the transformer. Use a bucket to catch the leaking oil

- Loosen the aeration screw 2 to 4 turns counterclockwise with a long Allen key No. 4 (aeration is active).

- Slowly open the transformer valve until oil runs out of the oil sample tube. Collect the leaking oil with a bucket.

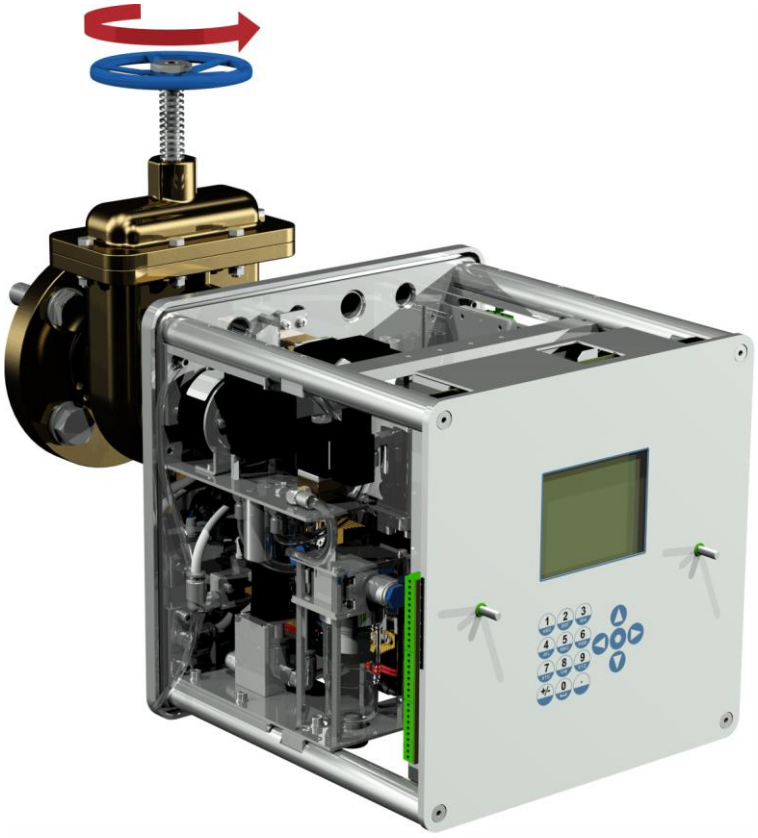


- Close the aeration screw as soon as no air bubbles sort the sample tube.

Attention !!!

Tighten the aeration screw with a torque of 9Nm.

- Now open the transformer valve completely.



- Secure the end of the sample tube with the provided tube clip.

- Remove thoroughly the oil residues with a dry-cleaning rag or paper towel from the unit.

Attention !!!

Do not use solvents for cleaning!

- Check after 30 minutes if the threaded connection is tight (no leakage).

2.4.1.3 Indirect installation

Indirect installation means the SITRAM® Multisense unit is fixed on the fitting by turning the union nut. A gasket is used to seal the connection.

Attention !!!

Only remove the protection cap (slowly while turning) when you are ready to mount the unit to the connection valve!

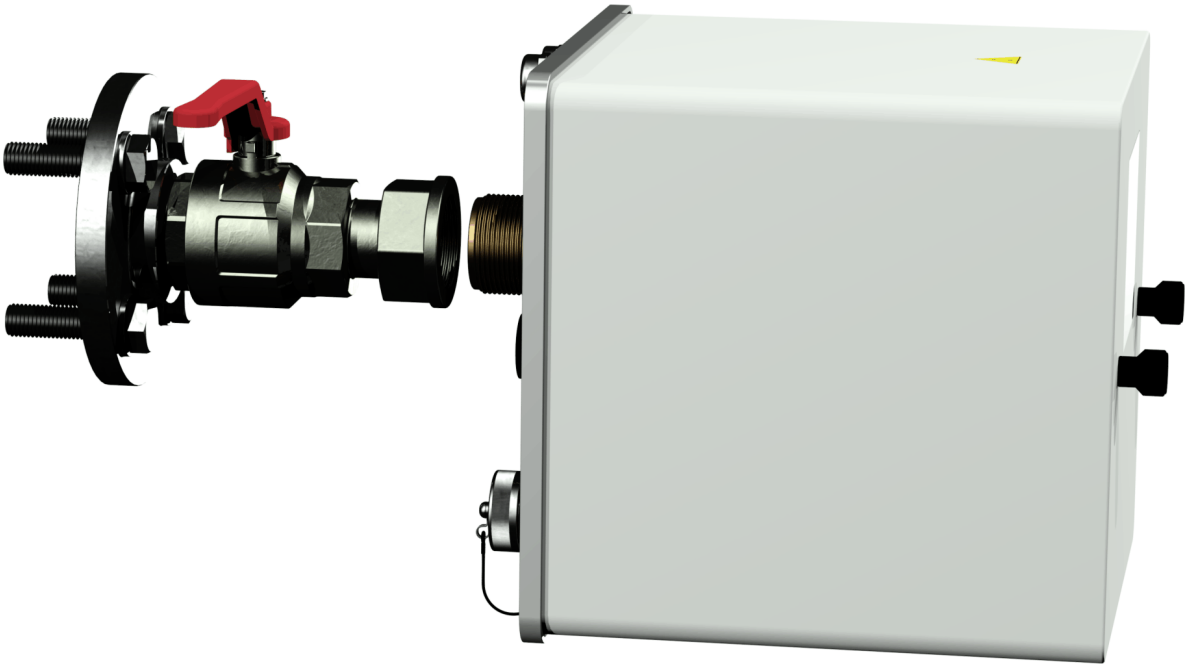
- Clean the inside of the union nut with a dry-cleaning rag or paper towel.

- Clean the outer thread of the connection unit with a dry-cleaning rag or paper towel. Remove any remaining of thread sealing tape completely from the threads. For persistent remaining you can use the brass brush or use white spirit (pure alcohol). White spirit must dry out completely before proceeding.

- Place the SITRAM® Multisense unit horizontally to the fitting. Make sure that the unit is leveled and the gasket inserted.

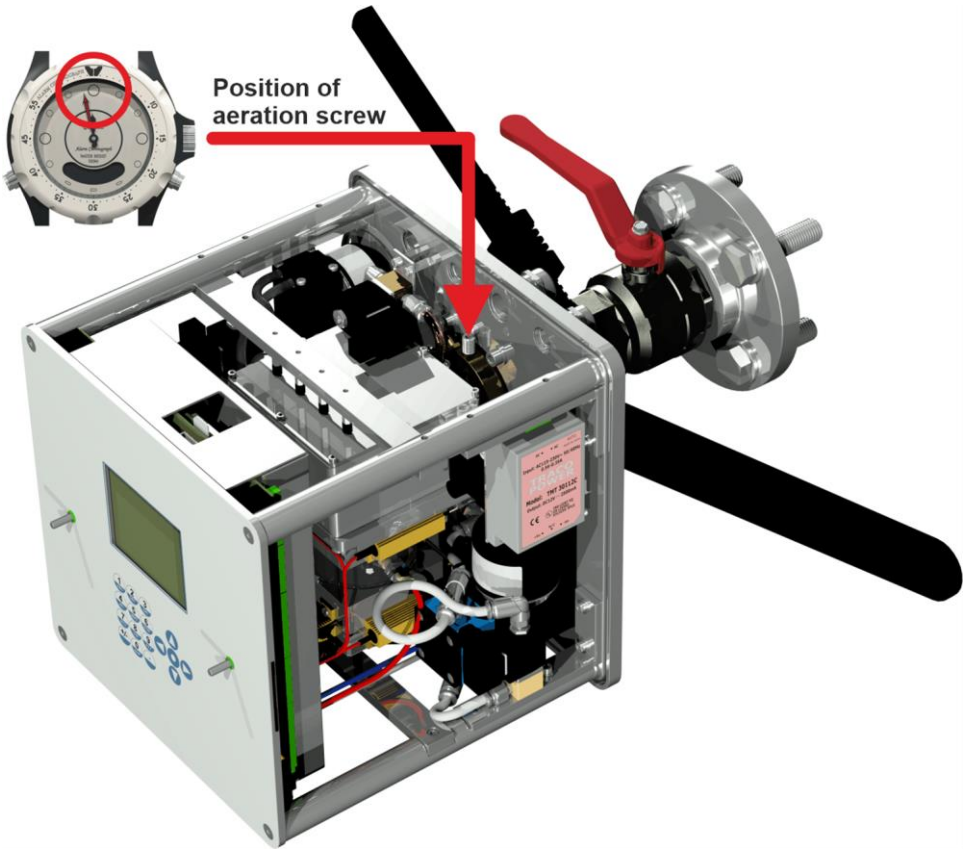
Attention !!!

Make sure that the gasket is inserted between SITRAM® Multisense unit and fitting.



- Turn in the union nut by hand to the external thread of the connection unit.

- Unscrew the two knurled thumb screws and remove the protection cover.
- Now align the unit until the position of the aeration screw is at 12 o`clock.
- Tighten the union nut with a tin spanner M55 or an adjustable tin spanner 1 ½“, while you hold the SITRAM® Multisense unit in position using a tin spanner M55 or an adjustable tin spanner 1 ½“. Make sure that the alignment of the SITRAM® Multisense unit is still correct afterwards.



Attention !!!

The following steps must be done according to the company procedures. Work carefully in order to prevent air entering into the transformer. Use a bucket to catch the leaking oil.

- Loosen the aeration screw 2 to 4 turns counterclockwise with a long Allen key No. 4 (aeration is active).

- Slowly open the transformer valve until oil runs out of the oil sample tube. Collect the leaking oil with a bucket.

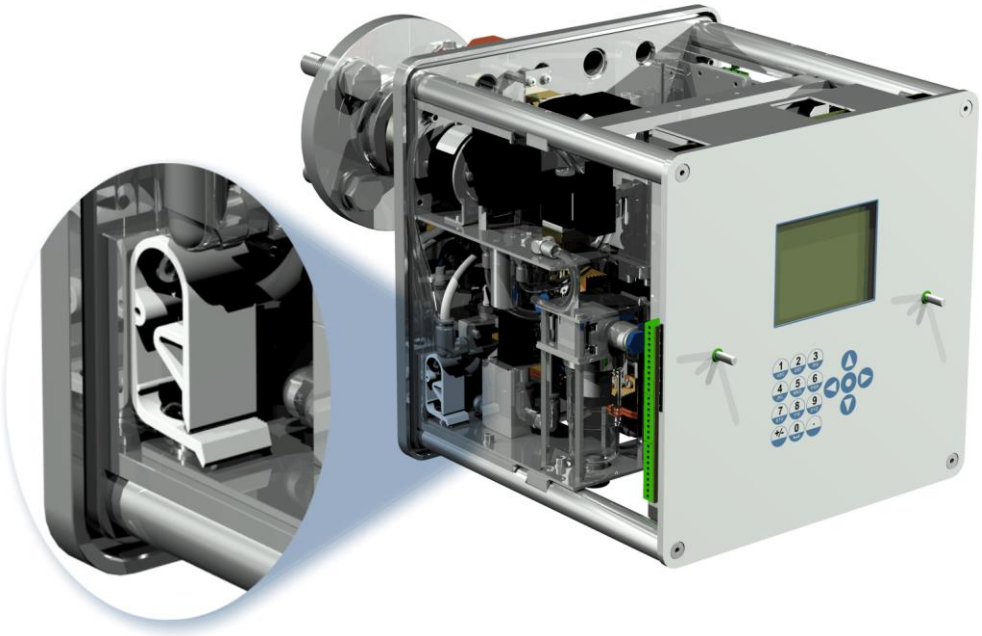
- Close the aeration screw as soon as no air bubbles sort the sample tube.

Attention !!!

Tighten the aeration screw with a torque of 9Nm.

- Now open the transformer valve completely.

- Secure the end of the sample tube with the provided tube clip.



- Remove thoroughly the oil residues with a dry cleaning rag or paper towel from the unit.

Attention !!!

Do not use solvents for cleaning!

- Check after 30 minutes if the threaded connection is tight (no leakage).

2.4.2 Electrical connection

Danger!

The electrical connection must be established by qualified personnel

Danger!

The connection must be stablished with cable cross section of at least 3 x 0,75 mm².

Danger!

There must be a 10 A overcurrent protective device within the installation.

Danger!

There must be a disconnector switch for the device which is easily reachable by the user and can be identified as such for the user.

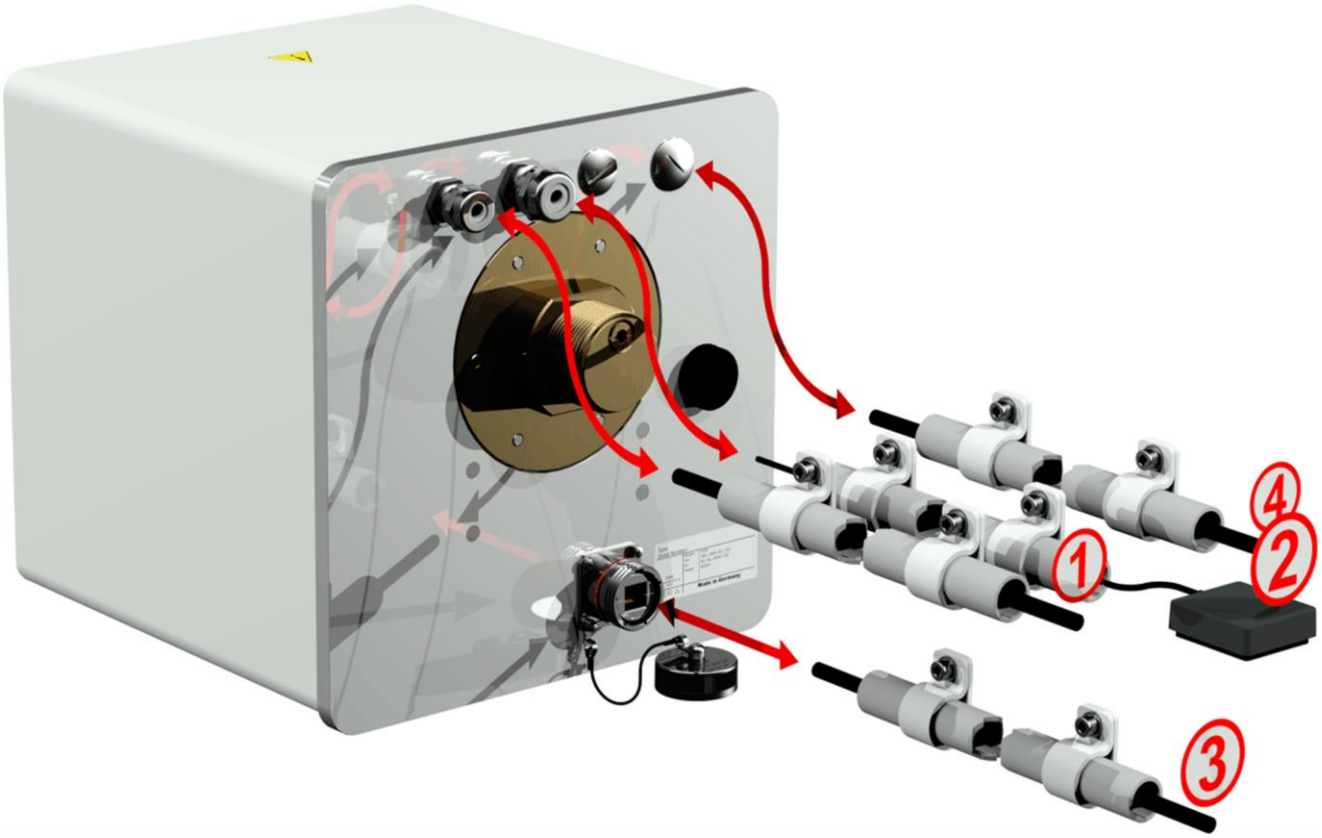
- Use protective conduits as protection for all cables and connect them to the corresponding connectors inside of the unit (3.3). All cables have to be provided by the customer, except GSM antenna cable (option).
- For feed through, following cable gland must be used for all cables:

1x M16 SKINTOP® cable gland (Clamping range 4,5 ... 10,0 mm)
2x M20 SKINTOP® cable gland (Clamping range 7,0 ... 13,0 mm)
1x M25 SKINTOP® cable gland (Clamping range 9,0 ... 17,0 mm)

Attention !!!

For cables with a smaller diameter please use reducing seal inserts to provide clamping and sealing!

Note: The unit comes with 2 SKINTOP® cable glands (M16 and M20) from the factory! The two remaining feed through are closed with blind plugs (M20 and M25).



① Supply voltage connection:

Recommendation for supply voltage cable:

Cable type:	PUR-PUR CEE JB 3x1.50 (or equivalent)
Cable diameter ∅:	8,1 mm
Cross section ⊗:	1,5 mm² (of 3 internal wires)

② Modem communication:

GSM antenna:

Cable diameter ∅:	2,7 mm

Analog line:

Recommendation for analog line cable:

Cable type:	U72 1x4x0,5 (or equivalent)
Cable diameter ∅:	3,8 mm
Cross section ⊗:	0,5 mm² (of 4 internal wires)

③ Ethernet communication:

The Ethernet communication is either connected via copper wire (RJ45) or fiber optical (SC Duplex) (must be specified when ordering). For the copper version, the connection socket (RJF TV) is located directly on the back plate. The connection for the fiber optical version must be routed through the cable gland and connect directly inside of the unit.

Copper wire:

Recommendation for Ethernet communication cable (copper):

Cable type:	Ethernet cable Cat. 5e with RJ45 connector (RJF TV)
Caber diameter ∅:	6,3 mm

Fiber optical:

Recommendation for Ethernet communication cable (fiber optical):

Cable type:	HITRONIC® HQN 1000 Multimode G4 62,5/125 with SC Duplex connector
Cable diameter ∅:	6,5 mm
Bending radius:	min. 15 x Ø

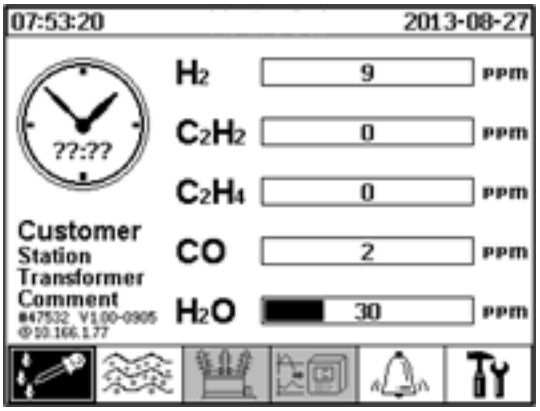
④ Alarms and additional Sensors:

Recommendation for alarms and additional sensors cable:

Cable type:	ÖLFLEX® FD855CP (or equivalent)
Cable diameter ∅:	13,3 mm
Cross section ⊗:	0,5 mm² (of 16 internal wires)

2.4.3 Putting into operation

When the supply voltage for the unit is switched on, a short beep is hearable and after a short time the main menu appears on the LCD display. First set time and date. Afterwards the unit must be activated / initialized by the operator.



Set time and date in the menu Date, Time & Clock Settings

Navigation through the menus is done using the cursor keys. The active field / menu is highlighted in black and can be selected by pressing the enter key.

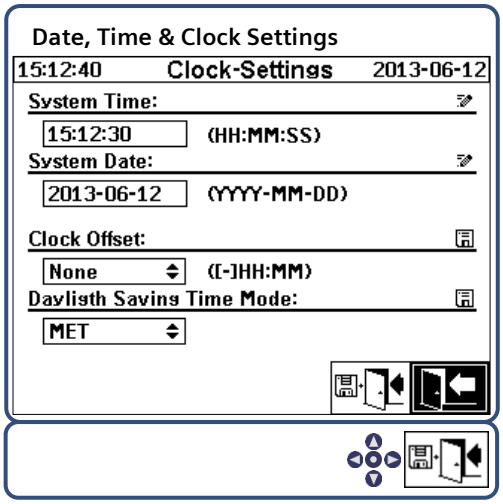
In order to access the submenu "Date, Time & Clock Settings" select the following menu / submenu icons:

Main menu

Device-Setup 9999 / Enter Passwort

Device-Setup

SITRAM® Multisense Setup



Setting up date and time is executed with the unit keyboard. This includes the alphanumeric key pad the cursor keys and the enter key (4.3). The numbers must be entered completely with delimiter symbol (e.g. 15:12:30). For the colon use the · key and for the minus use the +/- key. Complete the input with the enter key (4.8.5.4).

Save the settings by selecting the icon „Save & Exit".

SITRAM® Multisense Setup

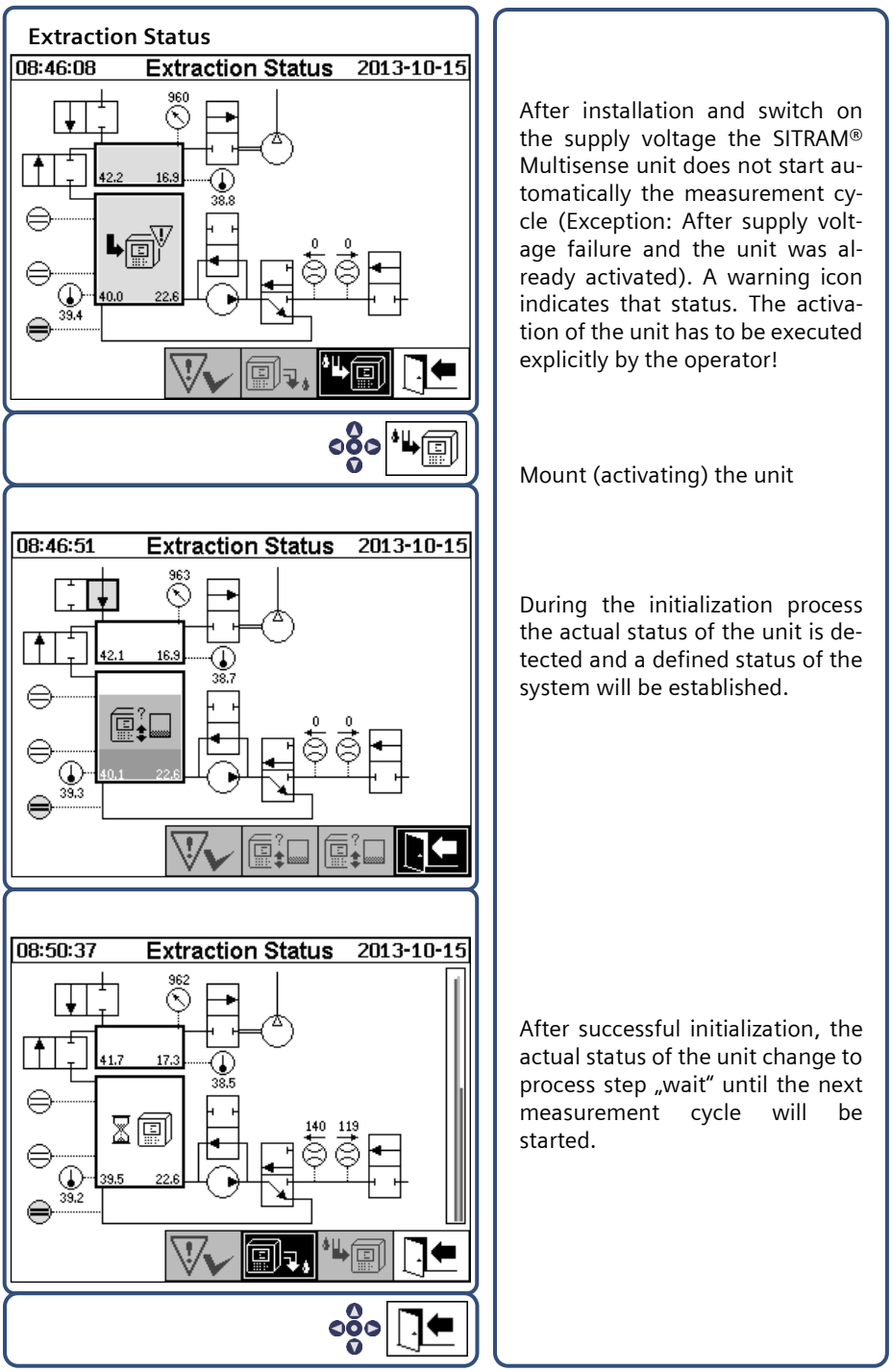
Device-Setup

Main menu

Activating / initializing the unit in Extraction Status menu

In order to access the submenu "Extraction Status" select the following menu / submenu icons:

Main menu



After installation and switch on the supply voltage the SITRAM® Multisense unit does not start automatically the measurement cycle (Exception: After supply voltage failure and the unit was already activated). A warning icon indicates that status. The activation of the unit has to be executed explicitly by the operator!

Mount (activating) the unit

During the initialization process the actual status of the unit is detected and a defined status of the system will be established.

After successful initialization, the actual status of the unit change to process step „wait“ until the next measurement cycle will be started.

Main menu

- After successful initialization, you can remount the protection cover and fix it with the two knurled thumb screws.
- Every 20 minutes a measurement is started. The start of the measurement is synchronized with the time (xx:00, xx:20 und xx:40). A measurement cycle takes a least 15 ... 18 minutes.

  See also 4.8.5.1.1.

Note: For activating / initializing the SITRAM® Multisense unit we commonly use the term “mount”.

2.4.4 Removing procedure

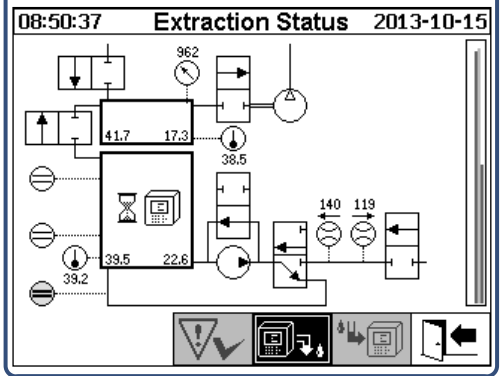
Attention !!!

Always press the key „Deactivation“ before you switch off the supply voltage and start to remove the HYDORCAL unit!!!!

Deactivating the unit in Extraction Status menu

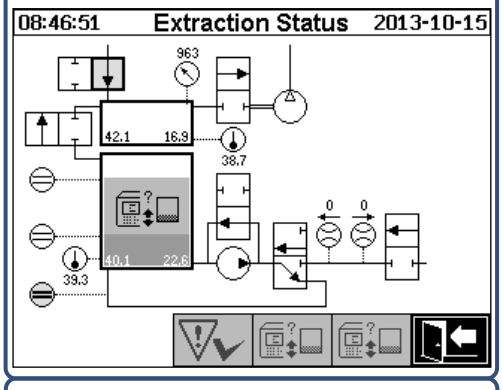
Main menu

Extraction Status

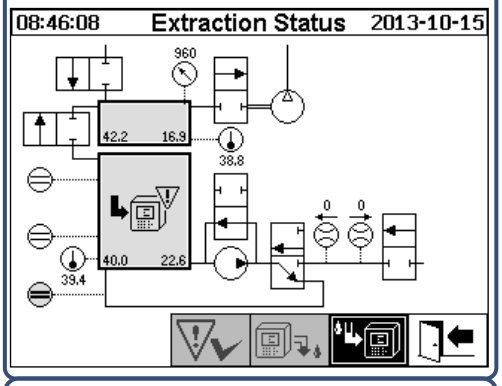


The deactivation of the unit has to be executed explicitly by the operator and can be carried out at any time.

Unmount (deactivating) the unit



With the deactivation of the unit, the actual process step stops and a controlled draining will be performed.



After successful deactivation, the unit is inactive. A warning icon indicates that status.

Main menu

- Now switch off the supply voltage and remove the unit from the transformer valve afterwards.

Note: For deactivating the SITRAM® Multisense unit we commonly use the term “unmount”.

2.4.5 Automatic Activation after Outage

If a unit was already activated, after an interruption of the supply voltage the automatic activation is started. A short beep sound is hearable and the special extraction chamber menu appears on the LCD display (Pollution warning!).

The wait time (... remaining time:) until automatic activation is started. This is illustrated with a down counter in seconds. In addition, short beep tones are hearable (the first 25 seconds every 5 seconds a short beep sound and the last 5 seconds every second a short beep sound is hearable).

It is possible within 30 seconds to cancel the automatic activation with the 

key and to activate the unit later by hand (2.4.3).

After the wait time has expired, the automatic activation starts and the main menu appear on the LCD display.

Cancel automatic activation of the unit


Initial cursor position (the key has no active function)

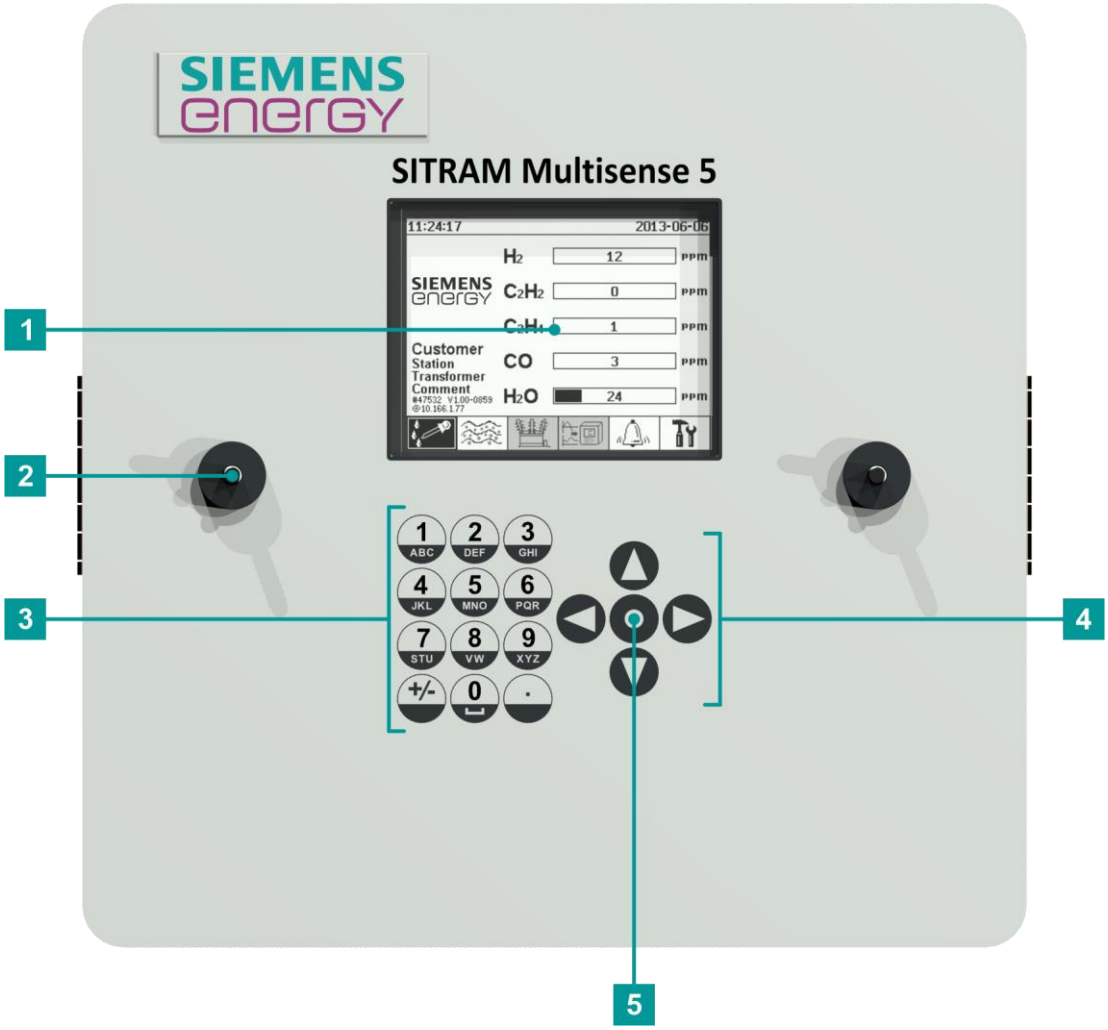

Exit menu

Note: After leaving the initial cursor position, it cannot be reached again.

3. Hardware components

3.1 Front view

The front plate consists of the following components:



[1] **LCD display** with 320 x 240 pixels

[2] **Screw mounting** to mount the protection cover

[3] **Alphanumeric keypad** to enter numbers and text

[4] **Cursor keys** to navigate in the menus, for data input and contrast set-up in the main menu (Up and Down)

[5] **Enter key** to confirm and stop functions and data

3.2 Rear view

[1] **Connection unit** with external thread
G 1½" DIN ISO 228-1
or
1½" NPT ANSI B 1.20.1

[2] **Supply voltage connection** with SKINTOP® cable gland M16

Nominal voltages: 120 V -20% +15% AC 50/60Hz [1] or
230 V -20% +15% AC 50/60Hz [1] or
120 V -20% +15% DC [1] or
230 V -20% +15% DC [1]
Other nominal voltages on request!

Power consumption: max. 400 VA

Micro-fuse at 120V: T4A

Micro-fuse at 230V: T2A

Connect the supply voltage cable as followed:

AC Version		**DC Version**	
Phase:	L	Plus conductor:	+
Neutral:	N	Minus conductor:	–
Protection earth:	PE	Protection earth:	PE

Note [1]:

120 V ⇨	120 V -20% = **96 V_{min}**	120 V +15% = **138 V_{max}**
230 V ⇨	230 V -20% = **184 V_{min}**	230 V +15% = **264 V_{max}**

[3] **System connection** with SKINTOP® cable gland M20
Communication / alarms and additional sensors

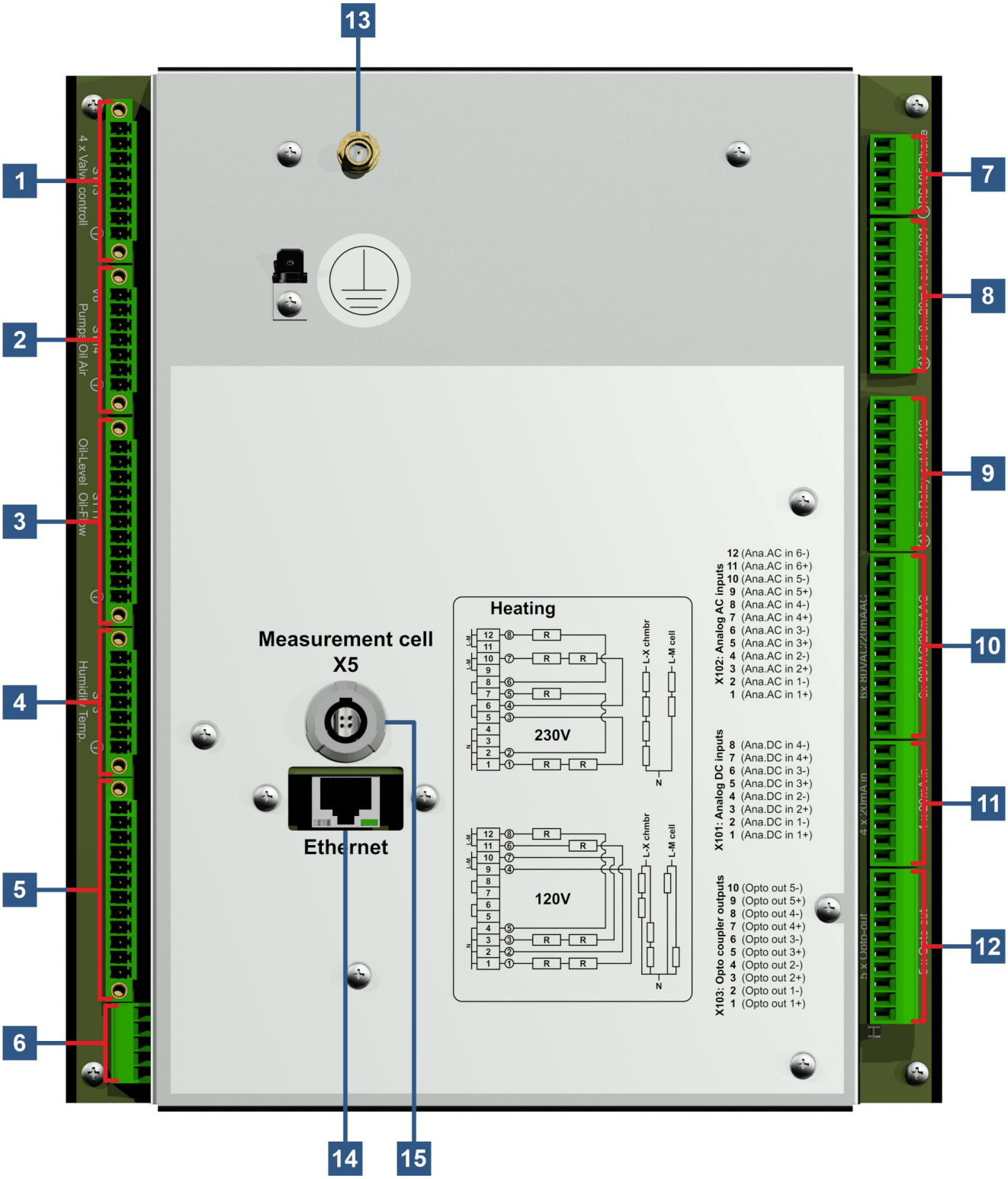
[4] **Feed through** with SKINTOP® blind plug M20

[5] **Feed through** with SKINTOP® blind plug M25

[6] **ETHERNET communication connection** with RJ45 socket (RJF TV)
Communication interface copper wired for ETHERNET 10/100 Mbit

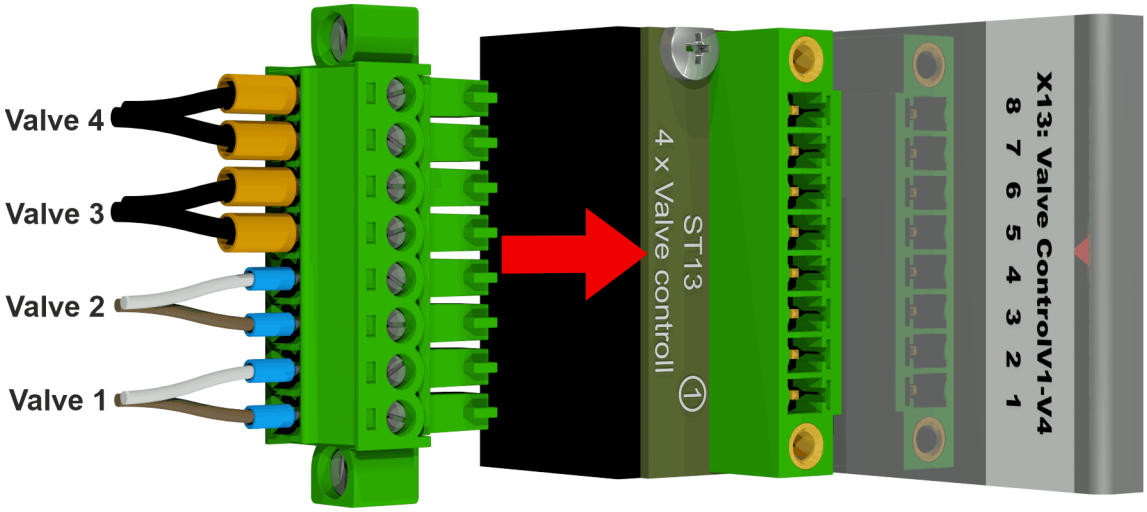
[7] **Gas air outlet**
Output of the under-pressure compressor (gas/air composite of measurement cell)

3.3 Connections of measurement- and controller card



[1] Connector X13: Valve Control [Valve control]

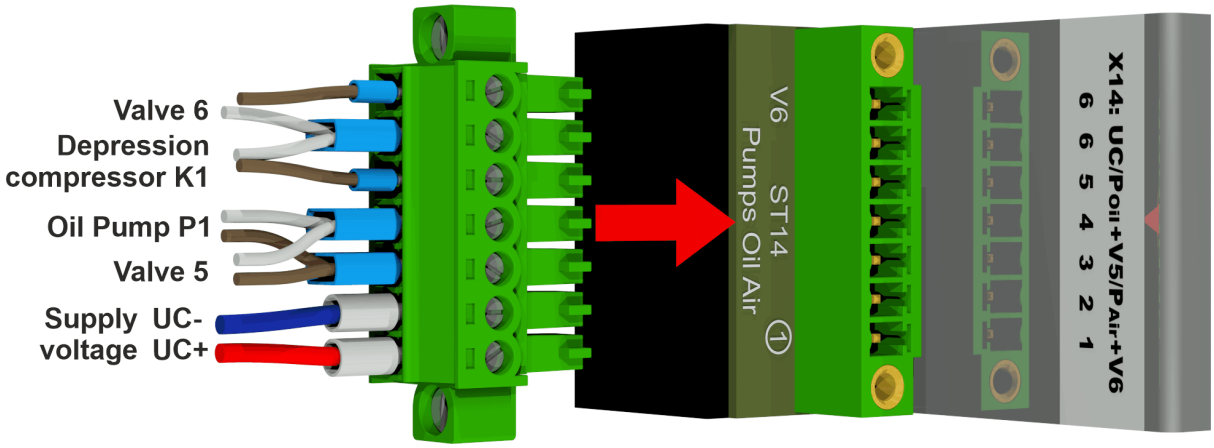
Connection for degassing-, measurement cell insulation-, depression- and ventilation valve



X13:8	⇨ V4 ⊖	⇨ Ventilation valve
X13:7	⇨ V4 ⊕	⇨ Ventilation valve
X13:6	⇨ V3 ⊖	⇨ Depression valve
X13:5	⇨ V3 ⊕	⇨ Depression valve
X13:4	⇨ V2 ⊖	⇨ Measurement cell insulation valve
X13:3	⇨ V2 ⊕	⇨ Measurement cell insulation valve
X13:2	⇨ V1 ⊖	⇨ Degassing valve
X13:1	⇨ V1 ⊕	⇨ Degassing valve

[2] Connector X14: Pump / compressor / valve [Pump/Comp./Valve]

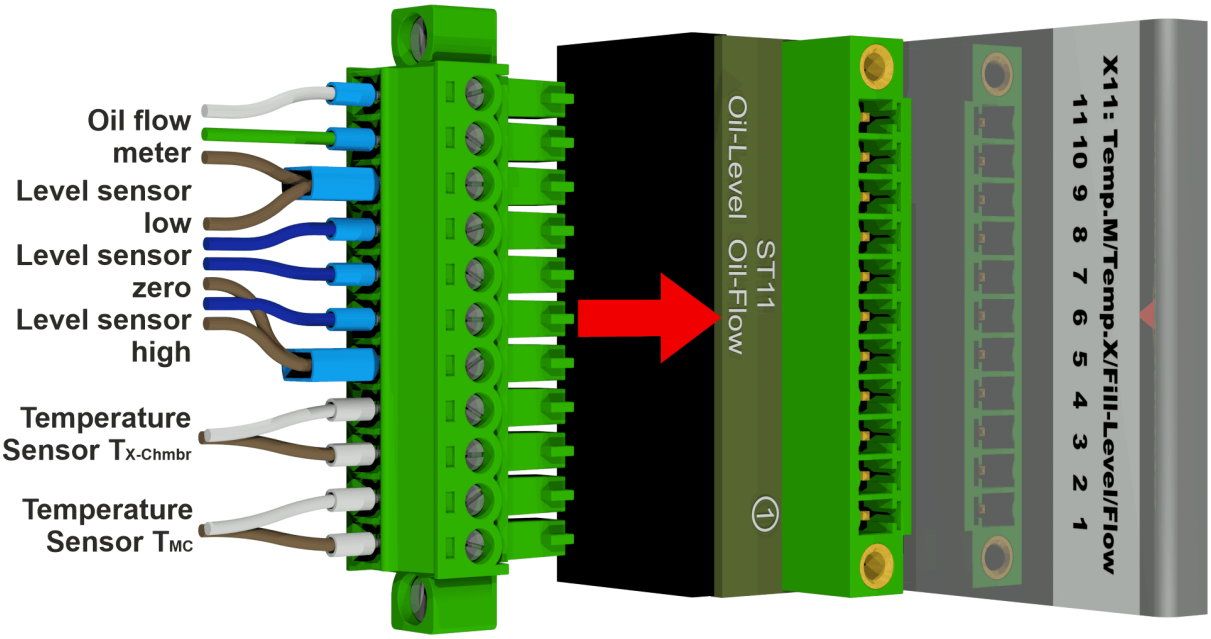
Connection for low voltage, oil pump, depression compressor and in-/ outlet valve



X14:7	⇨ V6 ⊕	⇨ In-/ outlet valve
X14:6	⇨ K1/V6 ⊖	⇨ Depression compressor and in-/ outlet valve
X14:5	⇨ K1 ⊕	⇨ Depression compressor
X14:4	⇨ P1/V5 ⊖	⇨ Oil pump and bypass valve oil pump
X14:3	⇨ P1/V5 ⊕	⇨ Oil pump and bypass valve oil pump
X14:2	⇨ UC ⊖	⇨ Low voltage
X14:1	⇨ UC ⊕	⇨ Low voltage

[3] Connector X11: Heating temperatures / oil levels / oil flow [H-Temp./Lev./Flow]

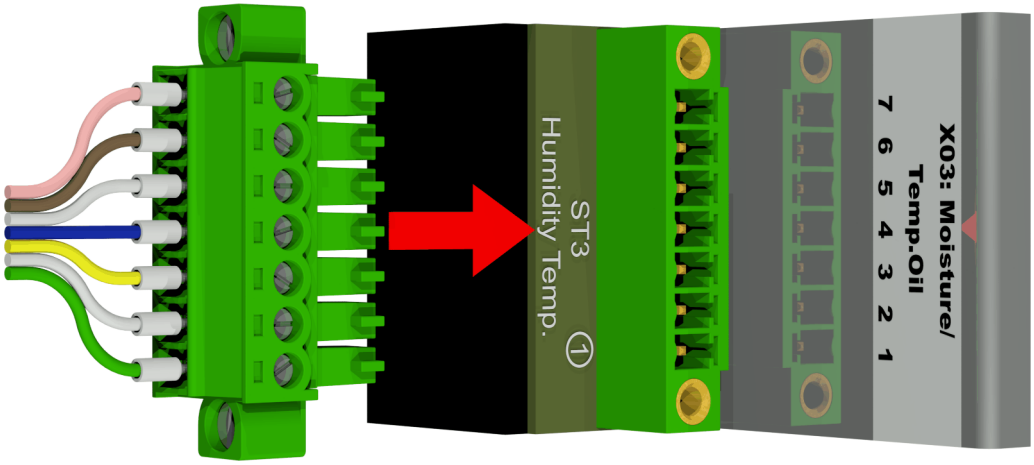
Connection for temperature sensors heating, level sensors and oil flow meter



X11:11	⇨ F1 ⊖	⇨ Oil flow meter
X11:10	⇨ F1 Impulse	⇨ Oil flow meter
X11:9	⇨ L1/F1 ⊕	⇨ Level sensor low / oil flow meter
X11:8	⇨ L1 out	⇨ Level sensor low
X11:7	⇨ L0 out	⇨ Level sensor zero detection
X11:6	⇨ L2 out	⇨ Level sensor high
X11:5	⇨ L2/L0 ⊕	⇨ Level sensor high / level sensor zero detection
X11:4	⇨ T X-Chmbr	⇨ Temperature sensor heating extraction chamber
X11:3	⇨ T X-Chmbr	⇨ Temperature sensor heating extraction chamber
X11:2	⇨ T MC	⇨ Temperature sensor heating measurement cell
X11:1	⇨ T MC	⇨ Temperature sensor heating measurement cell

[4] Connector X3: Moisture in oil / oil temperature [Oil-Moisture/Temp.]

Connection for moisture in oil sensor and oil temperature sensor extraction chamber

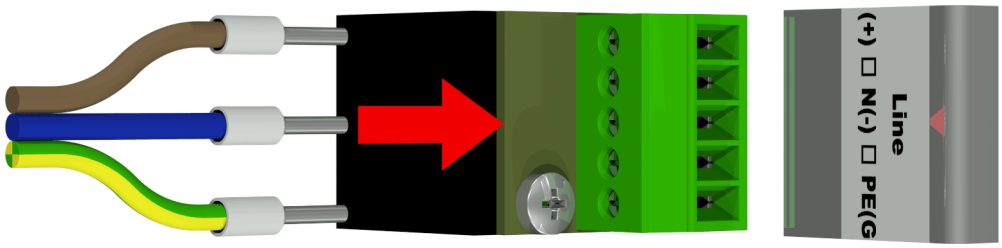


X3:7	⇨ T2	⇨ Oil temperature sensor extraction chamber
X3:6	⇨ T2	⇨ Oil temperature sensor extraction chamber
X3:5	⇨ M1 GND	⇨ Moisture in oil sensor extraction chamber
X3:4	⇨ M1 ⊕	⇨ Moisture in oil sensor extraction chamber
X3:3	⇨ M1 ⊖	⇨ Moisture in oil sensor extraction chamber

X3:2	⇨	M1 out	⇨ Moisture in oil sensor extraction chamber
X3:1	⇨	M1 in	⇨ Moisture in oil sensor extraction chamber

[5] Connection terminal X1: Supply voltage [Power supply]

Connection for supply voltage

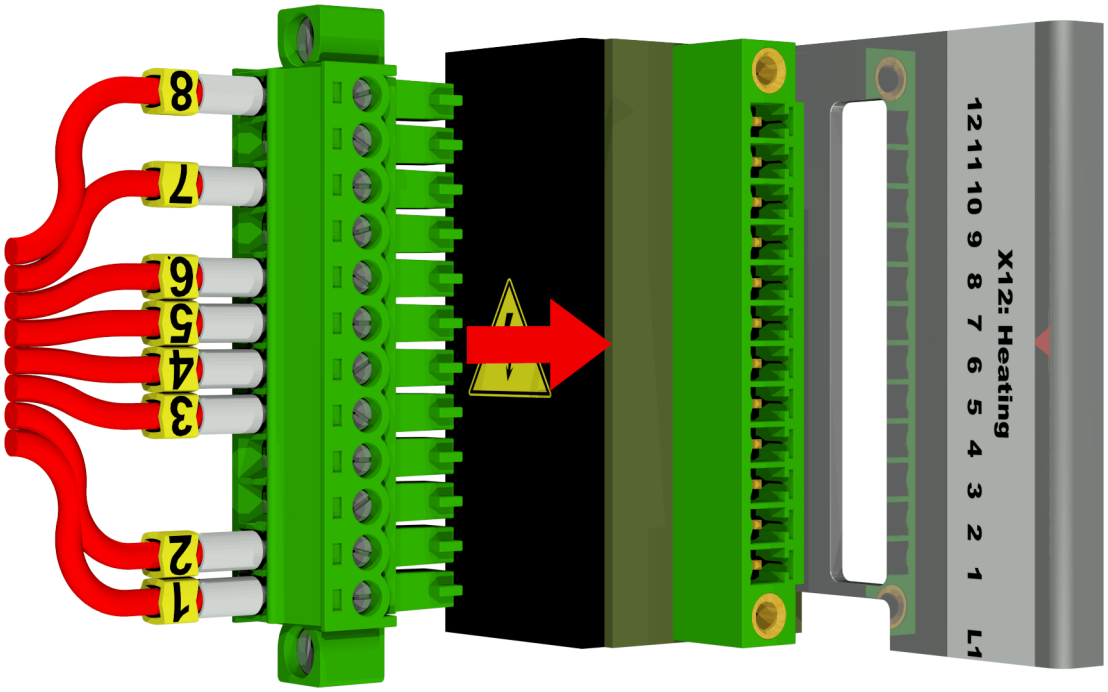


The connector X1:1 (L) is connected to the fuse holder, which is supplied from the main connector.

X1:1	⇨	L / +	⇨ Phase AC / Plus ⊕ DC
X1:2	⇨	-	
X1:3	⇨	N / -	⇨ Neutral AC / Minus ⊖ DC
X1:4	⇨	-	
X1:5	⇨	PE	⇨ Protection earth/ Protection earth

[6] Connector X12: Heating [Heating]

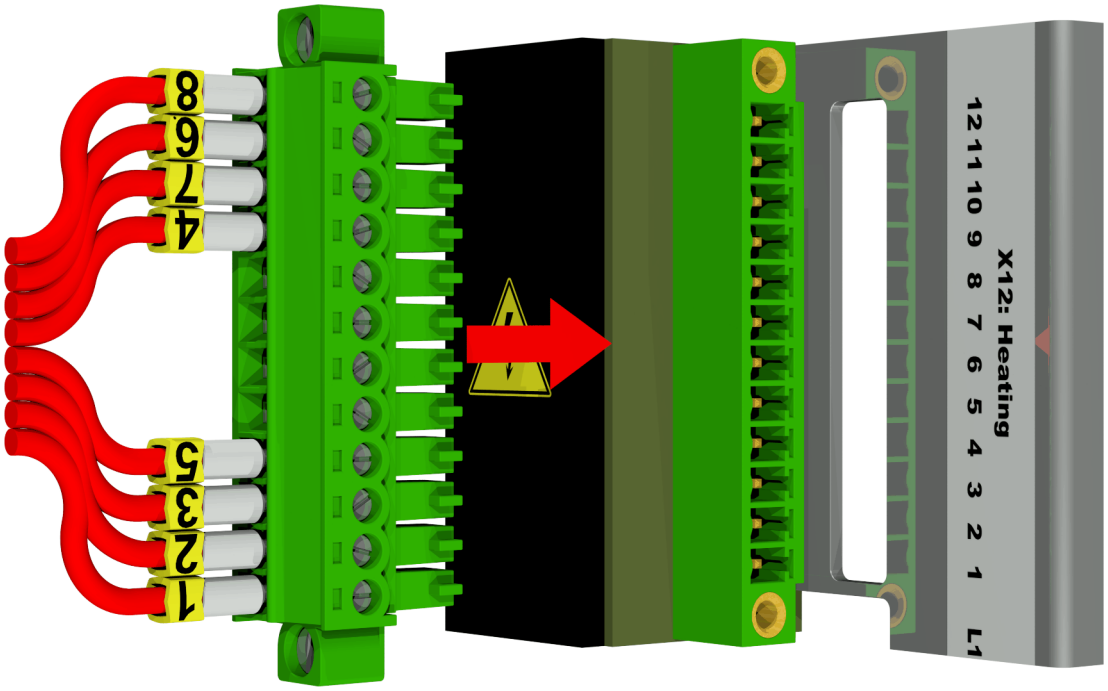
Connection for heating resistors at supply voltage of 230 V



X12:12	⇨	L	⇨ 8 Heater measurement cell
X12:11	⇨	L	⇨
X12:10	⇨	L	⇨ 7 Heater extraction chamber
X12:9	⇨	L	⇨
X12:8	⇨	[	⇨ 6 Heater measurement cell
X12:7	⇨		⇨ 5 Heater measurement cell
X12:6	⇨	[	⇨ 4 Heater extraction chamber
X12:5	⇨		⇨ 3 Heater extraction chamber
X12:4	⇨	N	⇨
X12:3	⇨	N	⇨

X12:2	⇨ N	⇨ **2**	Heater measurement cell
X12:1	⇨ N	⇨ **1**	Heater extraction chamber

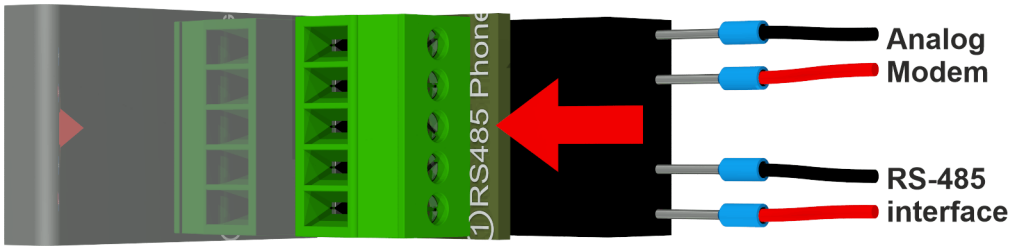
Connection for heating resistors at supply voltage of 120 V



X12:12	⇨ L	⇨ **8**	Heater measurement cell
X12:11	⇨ L	⇨ **6**	Heater measurement cell
X12:10	⇨ L	⇨ **7**	Heater extraction chamber
X12:9	⇨ L	⇨ **4**	Heater extraction chamber
X12:8	⇨ [	⇨	
X12:7	⇨ [	⇨	
X12:6	⇨ [	⇨	
X12:5	⇨ [	⇨	
X12:4	⇨ N	⇨ **5**	Heater measurement cell
X12:3	⇨ N	⇨ **3**	Heater extraction chamber
X12:2	⇨ N	⇨ **2**	Heater measurement cell
X12:1	⇨ N	⇨ **1**	Heater extraction chamber

[7] Connection terminal X302: RS485 interface / modem [RS485/Phone]

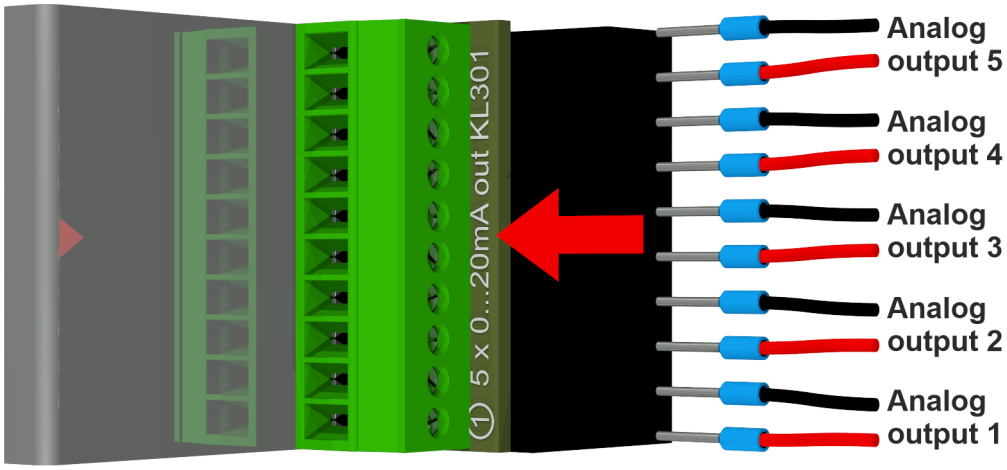
Connection for RS485 interface and analog phone modem



X302:5	⇨ Phone A	⇨ Analog phone modem
X302:4	⇨ Phone B	⇨ Analog phone modem
X302:3	⇨ GNDio	⇨ RS485 interface
X302:2	⇨ OUT A ⊖	⇨ RS485 interface
X302:1	⇨ OUT B ⊕	⇨ RS485 interface

[8] Connection terminal X301: Analog outputs [Analog outputs]

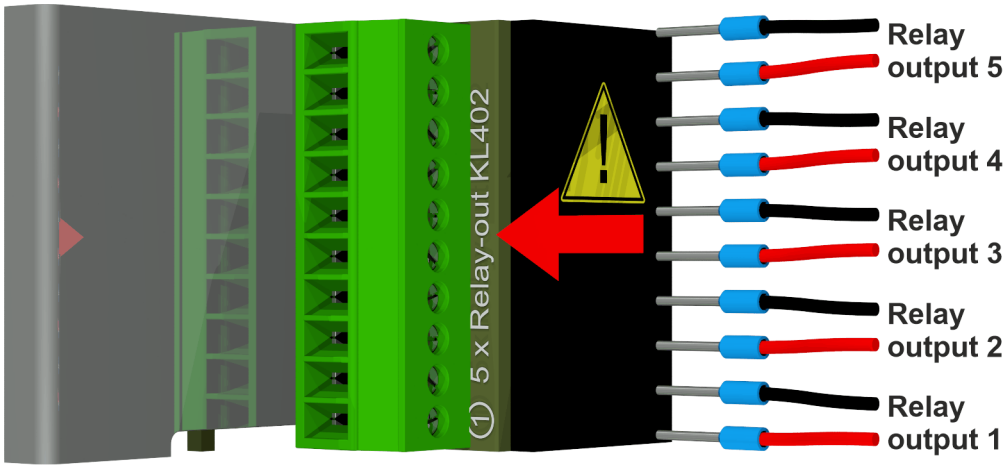
Connection for analog outputs DC (0/4.... 20 mA DC)



			Firmware
X301:10	⇨ AO5⊖	⇨ Analog output 5	⇨ Output # 5
X301:9	⇨ AO5⊕	⇨ Analog output 5	⇨ Output # 5
X301:8	⇨ AO4⊖	⇨ Analog output 4	⇨ Output # 4
X301:7	⇨ AO4⊕	⇨ Analog output 4	⇨ Output # 4
X301:6	⇨ AO3⊖	⇨ Analog output 3	⇨ Output # 3
X301:5	⇨ AO3⊕	⇨ Analog output 3	⇨ Output # 3
X301:4	⇨ AO2⊖	⇨ Analog output 2	⇨ Output # 2
X301:3	⇨ AO2⊕	⇨ Analog output 2	⇨ Output # 2
X301:2	⇨ AO1⊖	⇨ Analog output 1	⇨ Output # 1
X301:1	⇨ AO1⊕	⇨ Analog output 1	⇨ Output # 1

[9] Connection terminal X402: Relay outputs [Relay outputs]

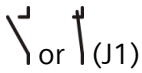
Connection for relay outputs (220 VDC/VAC / 2 A / 60 W)



			Firmware
X402:10	⇨ DOR5	⇨ Relay output 5	⇨ Out 5 Relay
X402:9	⇨ DOR5	⇨ Relay output 5	⇨ Out 5 Relay
X402:8	⇨ DOR4	⇨ Relay output 4	⇨ Out 4 Relay
X402:7	⇨ DOR4	⇨ Relay output 4	⇨ Out 4 Relay
X402:6	⇨ DOR3	⇨ Relay output 3	⇨ Out 3 Relay
X402:5	⇨ DOR3	⇨ Relay output 3	⇨ Out 3 Relay
X402:4	⇨ DOR2	⇨ Relay output 2	⇨ Out 2 Relay
X402:3	⇨ DOR2	⇨ Relay output 2	⇨ Out 2 Relay

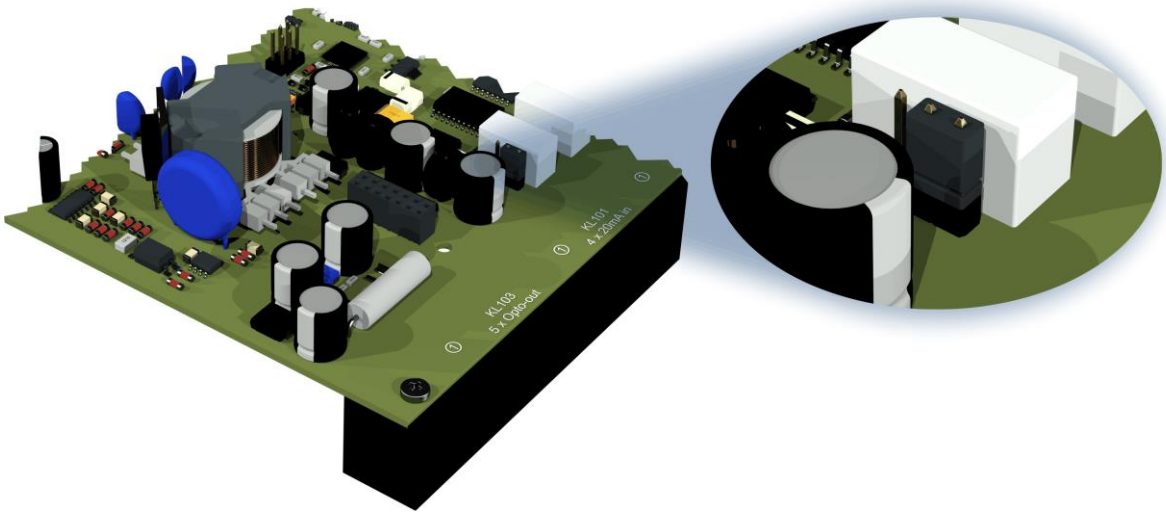
Relay contact

X402:2	⇨ DOR1	⇨ Relay output 1	⇨ Out 1 Relay
X402:1	⇨ DOR1	⇨ Relay output 1	⇨ Out 1 Relay



Configuration of relay output 1 with coding bridge 1 (J1)

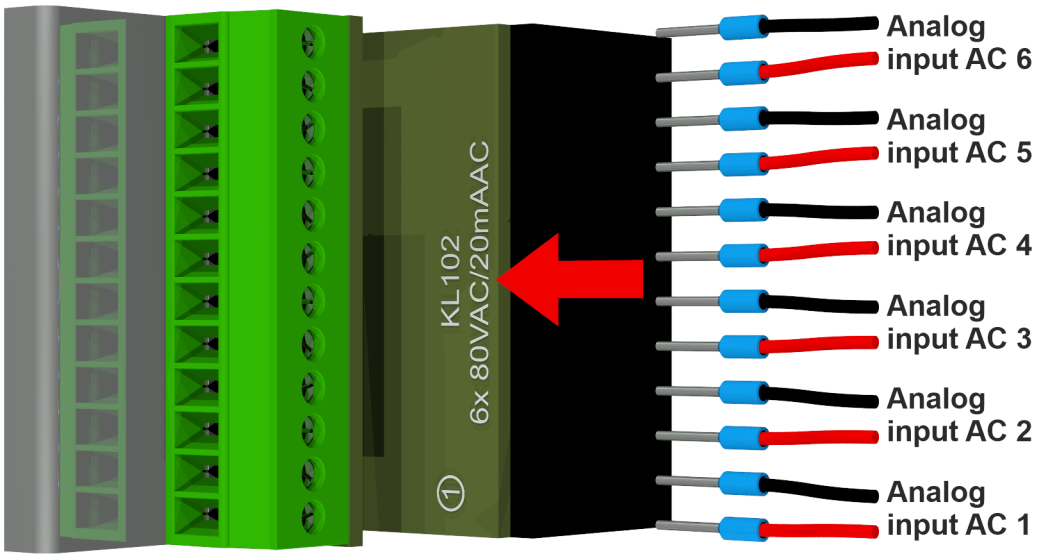
Jumper position for relay output 1



J1:1-2	⇨ NC	⇨ Normally closed contact
J1:2-3	⇨ NO	⇨ Normally open contact (Default)

[10] Connection terminal X102: Analog inputs AC [Analog AC inputs] (Option)

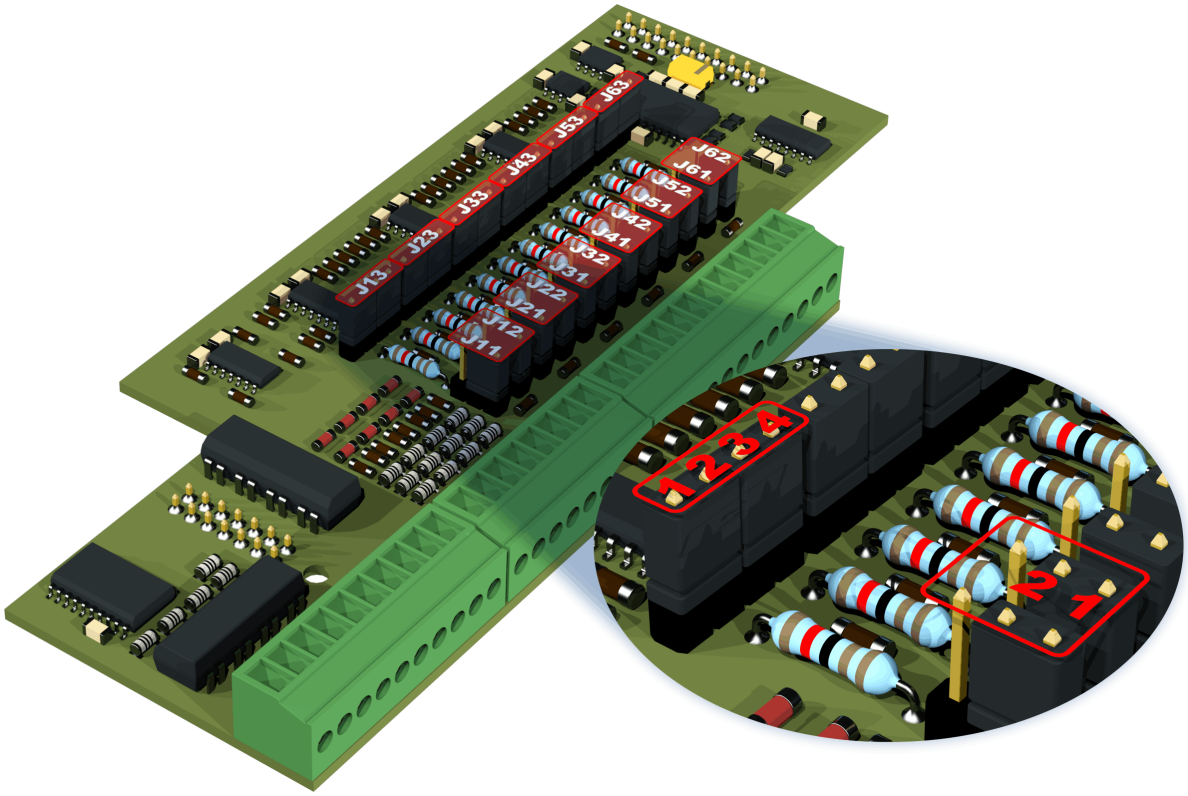
Connection for analog inputs AC (0 ... 80 VAC / 0/4 ... 20 mAAC, configurable by jumpers)



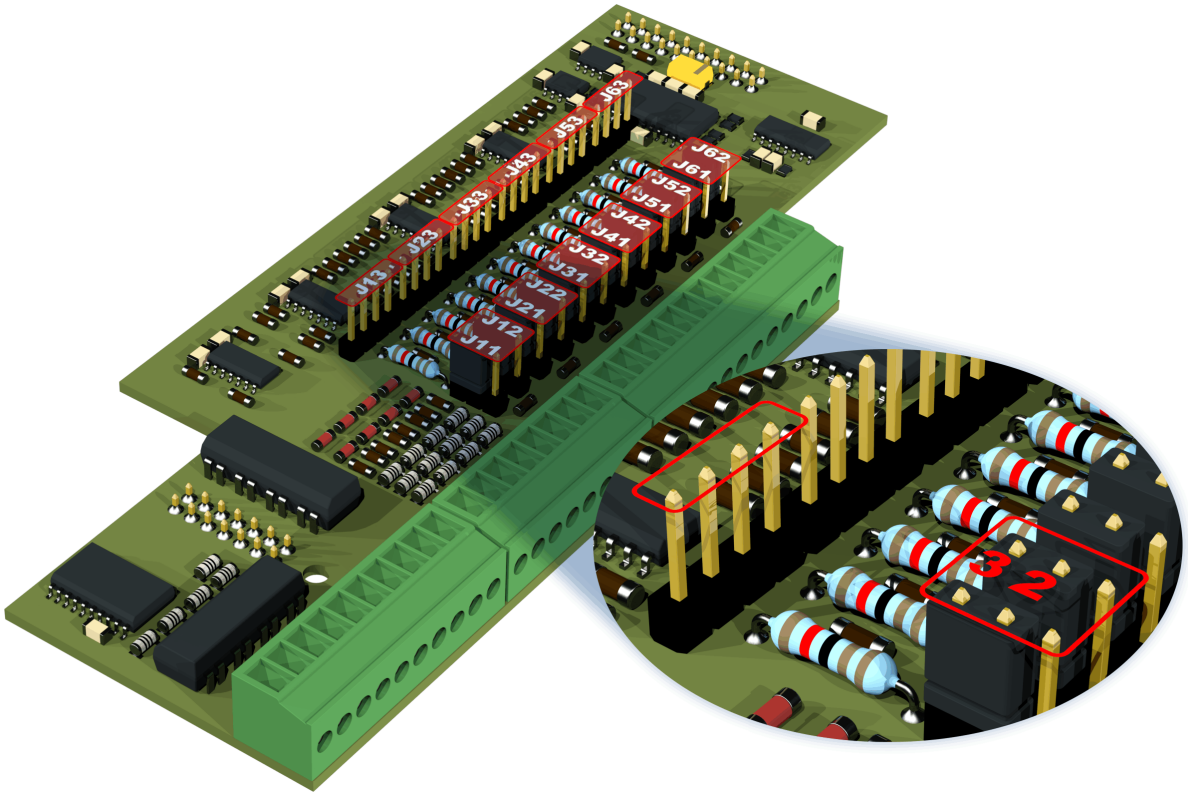
			Firmware
X102:12	⇨ AIAC6⊖	⇨ Analog input AC 6	⇨ Additional Sensor # 6
X102:11	⇨ AIAC6⊕	⇨ Analog input AC 6	⇨ Additional Sensor # 6
X102:10	⇨ AIAC5⊖	⇨ Analog input AC 5	⇨ Additional Sensor # 5
X102:9	⇨ AIAC5⊕	⇨ Analog input AC 5	⇨ Additional Sensor # 5
X102:8	⇨ AIAC4⊖	⇨ Analog input AC 4	⇨ Additional Sensor # 4
X102:7	⇨ AIAC4⊕	⇨ Analog input AC 4	⇨ Additional Sensor # 4
X102:6	⇨ AIAC3⊖	⇨ Analog input AC 3	⇨ Additional Sensor # 3
X102:5	⇨ AIAC3⊕	⇨ Analog input AC 3	⇨ Additional Sensor # 3
X102:4	⇨ AIAC2⊖	⇨ Analog input AC 2	⇨ Additional Sensor # 2
X102:3	⇨ AIAC2⊕	⇨ Analog input AC 2	⇨ Additional Sensor # 2

X102:2	⇨ AIAC1⊖	⇨ Analog input AC 1	⇨ Additional Sensor # 1
X102:1	⇨ AIAC1⊕	⇨ Analog input AC 1	⇨ Additional Sensor # 1

Jumper configuration for current (Default)

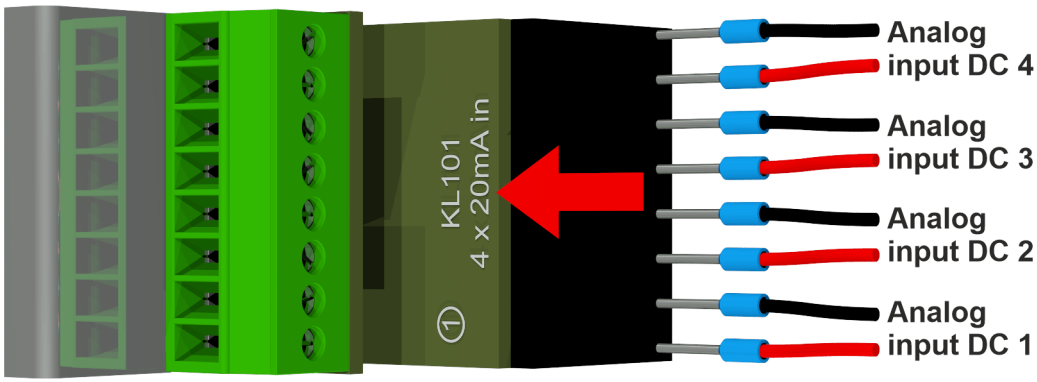


Jumper configuration for voltage



[11] Connection terminal X101: Analog inputs DC [Analog DC inputs] (Option)

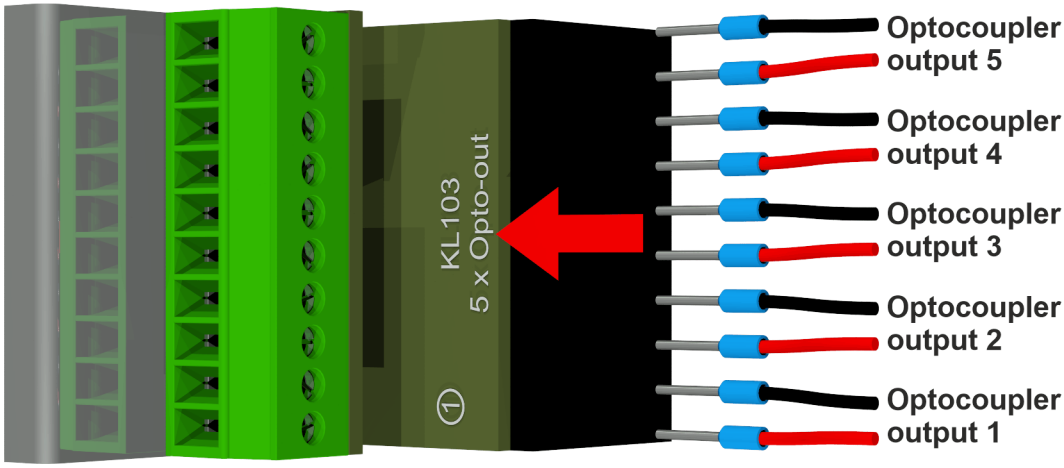
Connection for analog inputs DC (0/4 ... 20 mA)



			Firmware
X101:8	⇨ AIDC4⊖	⇨ Analog input DC 4	⇨ Additional Sensor # 10
X101:7	⇨ AIDC4⊕	⇨ Analog input DC 4	⇨ Additional Sensor # 10
X101:6	⇨ AIDC3⊖	⇨ Analog input DC 3	⇨ Additional Sensor # 9
X101:5	⇨ AIDC3⊕	⇨ Analog input DC 3	⇨ Additional Sensor # 9
X101:4	⇨ AIDC2⊖	⇨ Analog input DC 2	⇨ Additional Sensor # 8
X101:3	⇨ AIDC2⊕	⇨ Analog input DC 2	⇨ Additional Sensor # 8
X101:2	⇨ AIDC1⊖	⇨ Analog input DC 1	⇨ Additional Sensor # 7
X101:1	⇨ AIDC1⊕	⇨ Analog input DC 1	⇨ Additional Sensor # 7

[12] Connection terminal X103: Optocoupler outputs [Optocoupler outputs] (Option)

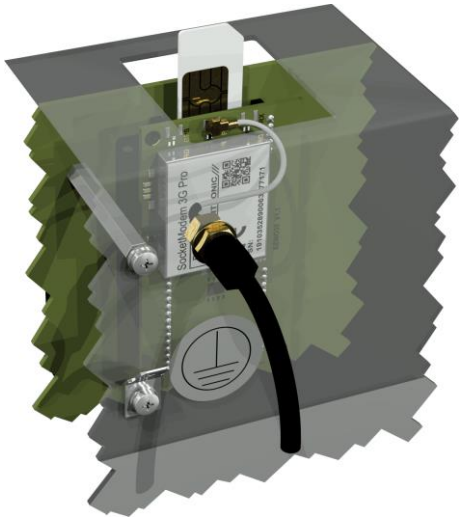
Connection for optocoupler outputs (U_{CE}: 24 V / U_{EC}: 7 V $_{max.}$ / I_{CE}: 40 mA $_{max.}$)



			Firmware
X103:10	⇨ DOO5⊖	⇨ Optocoupler output 5	⇨ Out 10 Opto
X103:9	⇨ DOO5⊕	⇨ Optocoupler output 5	⇨ Out 10 Opto
X103:8	⇨ DOO4⊖	⇨ Optocoupler output 4	⇨ Out 9 Opto
X103:7	⇨ DOO4⊕	⇨ Optocoupler output 4	⇨ Out 9 Opto
X103:6	⇨ DOO3⊖	⇨ Optocoupler output 3	⇨ Out 8 Opto
X103:5	⇨ DOO3⊕	⇨ Optocoupler output 3	⇨ Out 8 Opto
X103:4	⇨ DOO2⊖	⇨ Optocoupler output 2	⇨ Out 7 Opto
X103:3	⇨ DOO2⊕	⇨ Optocoupler output 2	⇨ Out 7 Opto
X103:2	⇨ DOO1⊖	⇨ Optocoupler output 1	⇨ Out 6 Opto
X103:1	⇨ DOO1⊕	⇨ Optocoupler output 1	⇨ Out 6 Opto

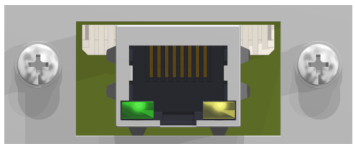
[13] Connection GSM antenna [GSM Antenna] (Option)

Mini-BNC connector for GSM/GPRS module



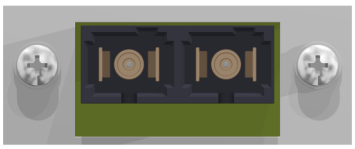
[14] Connection ETHERNET communication [Ethernet]

Communication connection via Ethernet



Copper wired (RJ45)

or

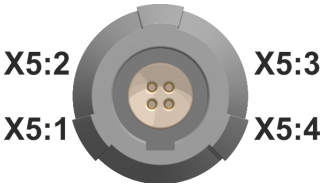


Fiber optic (SC-Duplex)

The connection sockets are mounted on the mainboard (measurement- and controller card).

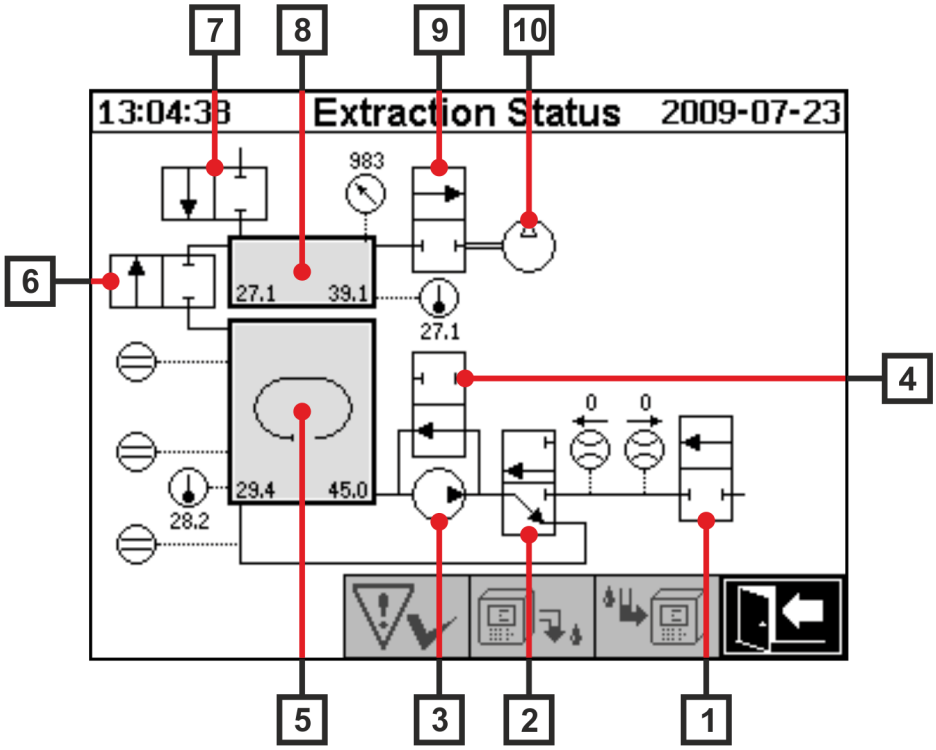
[15] Connection socket X5: Measurement cell [X5 Measurement cell]

Connection for measurement cell via REDEL connection socket 4 pin 0° encoded



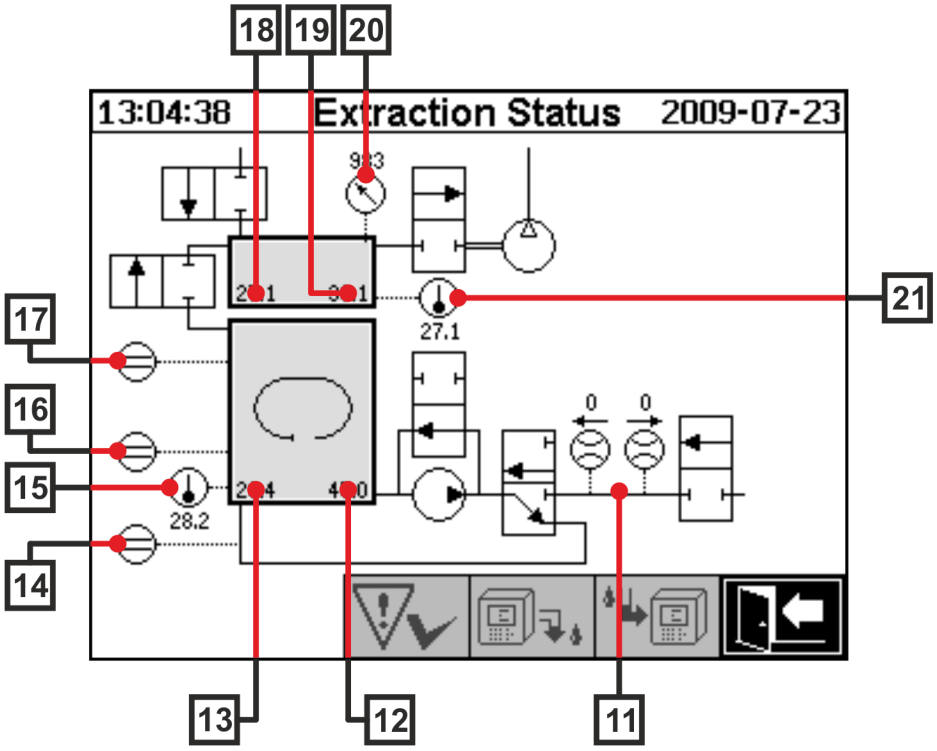
X5:4	⇨ Tx_{SENS}	⇨ Measurement cell send signal
X5:3	⇨ Rx_{SENS}	⇨ Measurement cell receive signal
X5:2	⇨ GND	⇨ Supply 8 Volt
X5:1	⇨ 8V⊕	⇨ Supply 8 Volt

3.4 Measurement- and extraction components

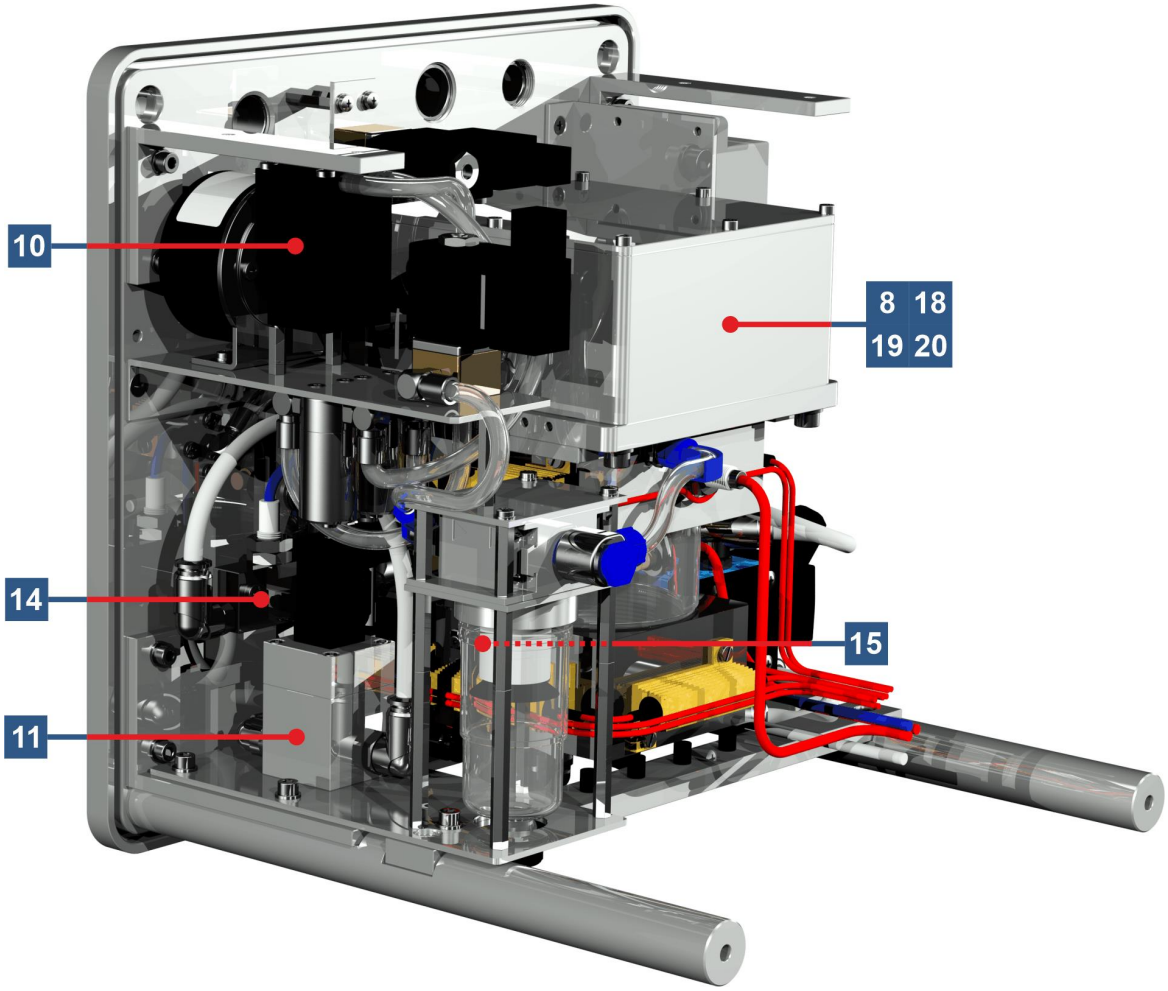


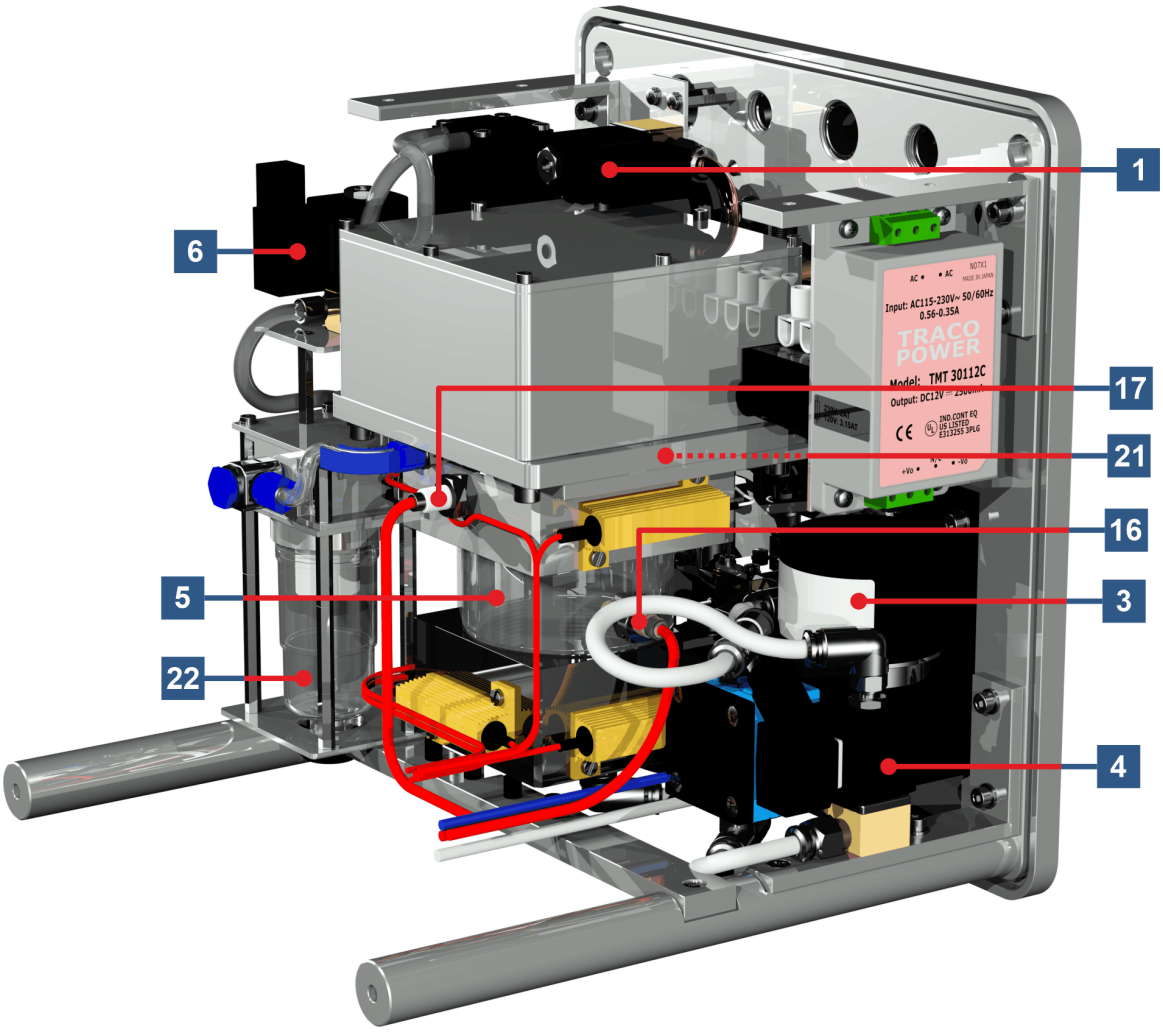
Legend	Name	Short name	(Valve function)
[1]	In- / outlet valve	Valve V6	(NC)
[2]	Degassing valve	Valve V1	(NC)
[3]	Oil pump	Pump P1	-
[4]	Bypass valve oil pump	Valve V5	(NO)
[5]	Extraction chamber	-	-
[6]	Measurement cell insulation valve	Valve V2	(NC)
[7]	Ventilation valve	Valve V4	(NC)
[8]	Measurement cell	-	-
[9]	Depression valve	Valve V3	(NC)
[10]	Depression compressor	Compressor K1	-

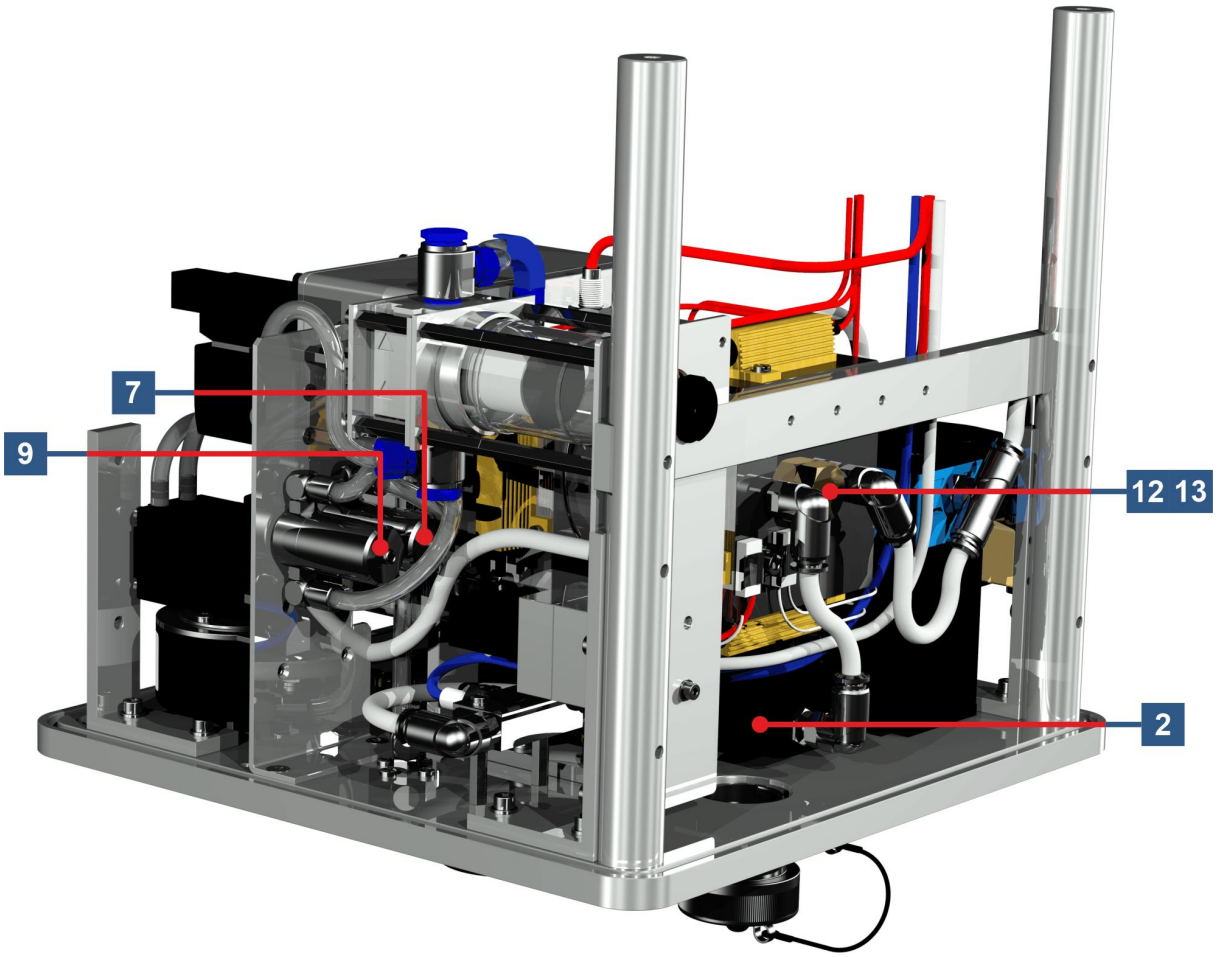
(NC): Valve currentless closed (Normally Closed)
(NO): Valve currentless open (Normally Open)



Legend	Name	Short name	(Valve function)
[11]	Oil flow meter	Flow F1	
[12]	Moisture in oil sensor extraction chamber	Moisture M1	
[13]	Oil temperature sensor extraction chamber	Temperature T2	
[14]	Level sensor zero detection	Level L0	
[15]	Temperature sensor heating extraction chamber	-	
[16]	Level sensor low extraction chamber	Level L1	
[17]	Level sensor high extraction chamber	Level L2	
[18]	Gas temperature sensor measurement cell	Temperature T1	
[19]	Moisture in gas sensor measurement cell	-	
[20]	Pressure sensor measurement cell	-	
[21]	Temperature sensor heating measurement cell	-	
[22]	Oil separator	-	







4. Firmware

4.1 General information

The gas-in-oil analyzer SITRAM® Multisense 5 is based on a microprocessor controlled measurement system. A 32 Bit „Coldfire“ processor with a clock frequency of 240 MHz is used. The software has been developed with the language „C“. The system has a static memory of 128 Mbyte for measurement data. This offers approx. 16 years time storage capacity for the measurement data.

After this period, the oldest data will be overwritten by the latest values. When using additional external sensors, the storage capacity depends from the number of sensors and the time interval selected for storage. The following formula can be used to determine the storage capacity:

$$Memorydepth[days] \approx \frac{128 \cdot 2^{20}[Byte]}{23000[Byte/day] + \sum_{n=1}^{12} 288[Byte/day] \cdot Sensorstorages_n[1/Std]}$$

With one additional sensor with a time interval of 5 minutes the following calculation results:

$$Memorydepth[days] \approx \frac{128 \cdot 2^{20}[Byte]}{23000[Byte/day] + 3456[Byte/day]} \approx \frac{128 \cdot 2^{20}[Byte]}{26456[Byte/day]} \approx 5000[days]$$

Also an additional reduction of the storage time takes place by the definition of alarms. Each change of alarm status requires 12 Bytes of storage.

Attention !!!

To avoid any loss of data, it is proposed to read out regularly the measurement data by the Windows based software SITRAM® Multisense Software.

4.2 Process sequence

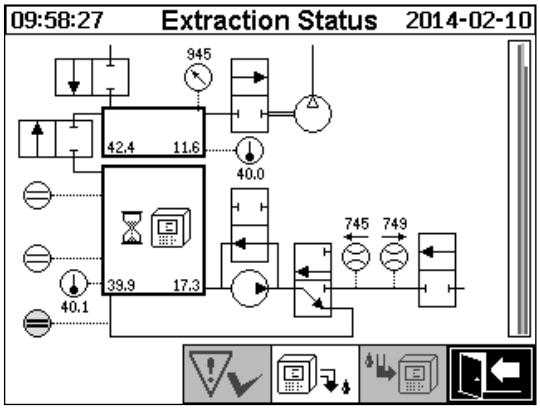
This chapter contains the description of the individual process steps and the information regarding the safety and its functions. If an error occurs, the process is interrupted and the system is set into a defined condition (pump and compressor off, all valves closed).

Color	Component	Status
White	Pump: Compressor: Level: Flow:	Off Off Not reached Not present
Green	Pump: Compressor: Level: Flow: 2/2 way valve: 3/2 way valve:	On On Reached Present A-P open A-R closed / A-P open
Yellow	2/2 way valve: 3/2 way valve:	A-P closed A-R open / A-P closed

4.2.1 Zero measurement

In this process step the zero measurement is performed.

Legend	Status of the component
[1]	**Level L0** “not reached”
[2]	**Level L1** “not reached”
[3]	**Level L2** “not reached”
[4]	**Valve V6** “closed”
[5]	**Flow F1** “not present”
[6]	**Valve V1** “degassing”
[7]	**Valve V3** “closed”
[8]	**Compressor K1** “off”
[9]	**Valve V4** “closed”
[10]	**Valve V2** “closed”
[11]	**Pump P1** “off”
[12]	**Valve V5** “open”



Safety functions and error detection for zero measurement

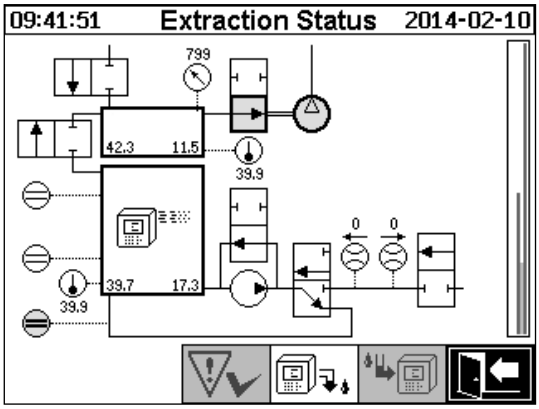
Monitored components	Detectable errors
Level sensors zero detection, low and high	Level L0, L1 or L2 reached

Measurement cell	Measurement cell offline
Pressure sensor	Pressure unstable

4.2.2 Depression generation

In this process step a depression in the measurement cell is generated.

Legend	Status of the component
[1]	**Level L0** “not reached”
[2]	**Level L1** “not reached”
[3]	**Level L2** “not reached”
[4]	**Valve V6** “closed”
[5]	**Flow F1** “not present”
[6]	**Valve V1** “degassing”
[7]	**Valve V3** “open”
[8]	**Compressor K1** “on”
[9]	**Valve V4** “closed”
[10]	**Valve V2** “closed”
[11]	**Pump P1** “off”
[12]	**Valve V5** “open”



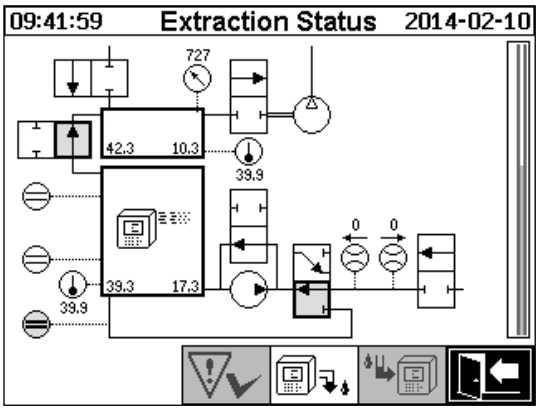
Safety functions and detection for depression generation

Monitored components	Detectable errors
Level sensors zero detection, low and high	Level L0, L1 or L2 reached
Measurement cell	Measurement cell offline
Pressure sensor	No depression

4.2.3 Leak check

This process step checks the pressure stability of the complete system.

Legend	Status of the component
[1]	**Level L0** “not reached”
[2]	**Level L1** “not reached”
[3]	**Level L2** “not reached”
[4]	**Valve V6** “closed”
[5]	**Flow F1** “not present”
[6]	**Valve V1** “filling - draining”
[7]	**Valve V3** “closed”
[8]	**Compressor K1** “off”
[9]	**Valve V4** “closed”
[10]	**Valve V2** “open”
[11]	**Pump P1** “off”
[12]	**Valve V5** “open”



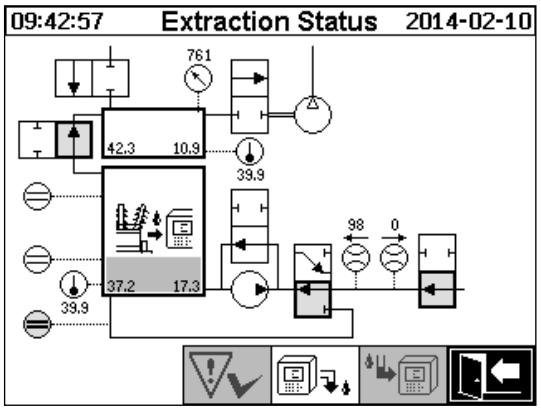
Safety functions and error detection for leak check

Monitored components	Detectable errors
Level sensors zero detection, low and high	Level L0, L1 or L2 reached
Measurement cell	Measurement cell offline
Pressure sensor	Pressure loss
Flow meter	Valve V6 not closed properly

4.2.4 Filling to level L1

In this process step the extraction chamber is filled with oil up to level L1.

Legend	Status of the component
[1]	**Level L0** “reached”
[2]	**Level L1** “reached”
[3]	**Level L2** “not reached”
[4]	**Valve V6** “open”
[5]	**Flow F1** “present - filling”
[6]	**Valve V1** “filling - draining”
[7]	**Valve V3** “closed”
[8]	**Compressor K1** “off”
[9]	**Valve V4** “closed”
[10]	**Valve V2** “open”
[11]	**Pump P1** “off”
[12]	**Valve V5** “open”



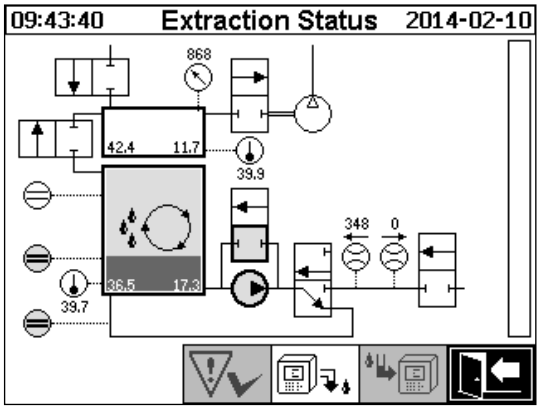
Safety functions and error detection for filling to level L1

Monitored components	Detectable errors
Level sensors zero detection, low and high	Level L0 or L1 not reached Level L2 reached
Level sensors zero detection, low and high Flow meter Time monitoring	• Level drop • Filling stuck • Filling timeout
Measurement cell	Measurement cell offline
Pressure sensor	• Pressure loss • Flow stuck

4.2.5 Degassing

During the process step degassing the oil in the extraction chamber is circulated with the oil pump to get a quasi equilibrium between gas-in-oil and gas-in-air (Headspace principal).

Legend	Status of the component
[1]	**Level L0** "reached"
[2]	**Level L1** "reached"
[3]	**Level L2** "not reached"
[4]	**Valve V6** "closed"
[5]	**Flow F1** "not present"
[6]	**Valve V1** "degassing"
[7]	**Valve V3** "closed"
[8]	**Compressor K1** "off"
[9]	**Valve V4** "closed"
[10]	**Valve V2** "closed"
[11]	**Pump P1** "on"
[12]	**Valve V5** "closed"



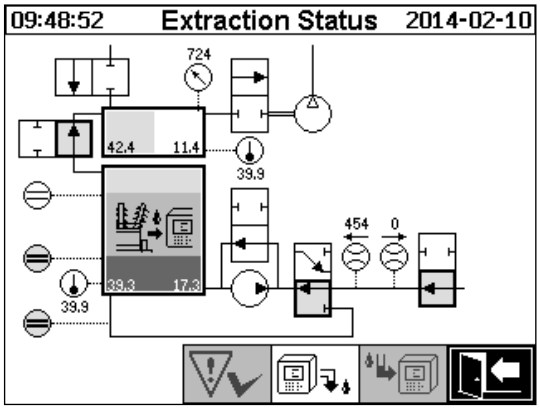
Safety functions and error detection for degassing

Monitored components	Detectable errors
Level sensors zero detection, low and high	Level L0 or L1 not reached Level L2 reached
Level sensors zero detection, low and high	Level drop
Measurement cell	Measurement cell offline
Pressure sensor	• Pressure loss • Valve V4 not closed properly
Flow meter	Valve V6 not closed properly

4.2.6 Filling to level L2

During this process step the extraction chamber is filled up with oil up to level L2. The existing gas/air mixture will be pressed into the measurement cell

Legend	Status of the component
[1]	**Level L0** "reached"
[2]	**Level L1** "reached"
[3]	**Level L2** "reached"
[4]	**Valve V6** "open"
[5]	**Flow F1** "present - filling"
[6]	**Valve V1** "filling - draining"
[7]	**Valve V3** "closed"
[8]	**Compressor K1** "off"
[9]	**Valve V4** "closed"
[10]	**Valve V2** "open"
[11]	**Pump P1** "off"
[12]	**Valve V5** "open"



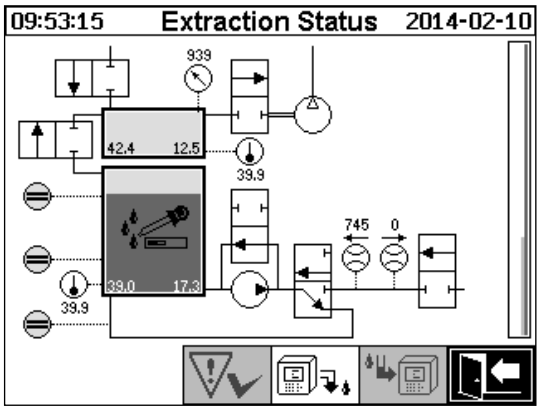
Safety functions and error detection for filling to level L2

Monitored components	Detectable errors
Level sensors zero detection, low and high	Level L0, L1 or L2 not reached
Level sensors zero detection, low and high Flow meter Time monitoring	• Flow stuck • Flow draining • Level timeout (prevents flooding of the measurement cell)
Measurement cell	Measurement cell offline
Pressure sensor	No pressure increase

4.2.7 Measurement

During this process step the amount of gas-in-air will be measured.

Legend	Status of the component
[1]	**Level L0** “reached”
[2]	**Level L1** “reached”
[3]	**Level L2** “reached”
[4]	**Valve V6** “closed”
[5]	**Flow F1** “not present”
[6]	**Valve V1** “degassing”
[7]	**Valve V3** “closed”
[8]	**Compressor K1** “off”
[9]	**Valve V4** “closed”
[10]	**Valve V2** “closed”
[11]	**Pump P1** “off”
[12]	**Valve V5** “open”



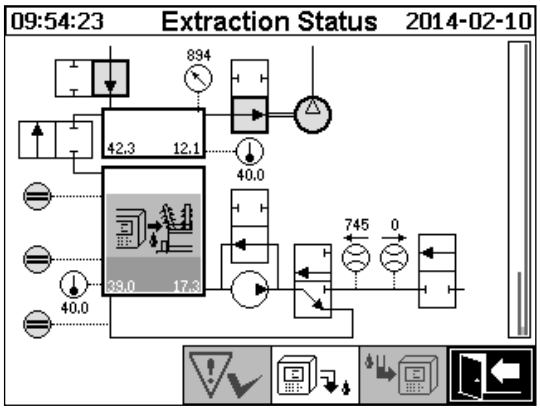
Safety functions and error detection for measurement

Monitored components	Detectable errors
Level sensors zero detection, low and high	Level L0, L1 or L2 not reached
Measurement cell	Measurement cell offline

4.2.8 Ventilation

This process cycle is used for ventilate the measurement cell with fresh air.

Legend	Status of the component
[1]	**Level L0** “reached”
[2]	**Level L1** “reached”
[3]	**Level L2** “reached”
[4]	**Valve V6** “closed”
[5]	**Flow F1** “not present”
[6]	**Valve V1** “degassing”
[7]	**Valve V3** “open”
[8]	**Compressor K1** “on”
[9]	**Valve V4** “open”
[10]	**Valve V2** “closed”
[11]	**Pump P1** “off”
[12]	**Valve V5** “open”



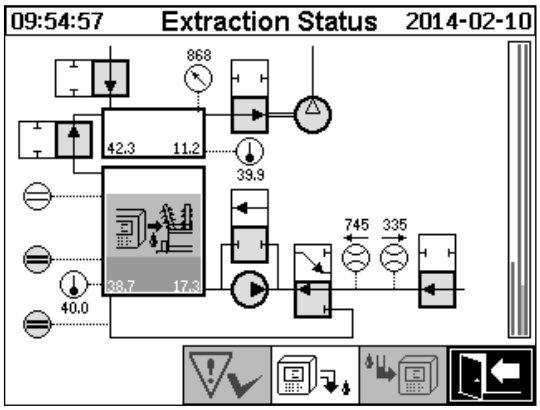
Safety functions and error detection for ventilation

Monitored components	Detectable errors
Level sensors zero detection, low and high	Level L0, L1 or L2 not reached
Measurement cell	Measurement cell offline
Pressure sensor	No depression

4.2.9 Draining

This process step will empty the extraction chamber. The oil is pumped back into the transformer.

Legend	Status of the component
[1]	**Level L0** “reached”
[2]	**Level L1** “reached”
[3]	**Level L2** “reached”
[4]	**Valve V6** “open”
[5]	**Flow F1** “present - draining”
[6]	**Valve V1** “filling - draining”
[7]	**Valve V3** “open”
[8]	**Compressor K1** “on”
[9]	**Valve V4** “open”
[10]	**Valve V2** “open”
[11]	**Pump P1** “on”
[12]	**Valve V5** “closed”



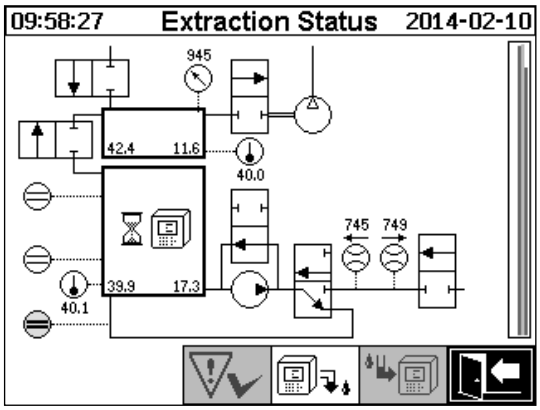
Safety functions and error detection for draining

Monitored components	Detectable errors
Level sensors zero detection, low and high	Level L0, L1 or L2 reached
Level sensors zero detection, low and high Flow meter Time monitoring	• Flow stuck • Flow filling • Level timeout (prevents to pump air into the transformer)
Measurement cell	Measurement cell offline
Pressure sensor	No depression

4.2.10 Wait

This process step set the unit into synch-wait status until the next measurement cycle.

Legend	Status of the component
[1]	**Level L0** “not reached”
[2]	**Level L1** “not reached”
[3]	**Level L2** “not reached”
[4]	**Valve V6** “closed”
[5]	**Flow F1** “not present”
[6]	**Valve V1** “degassing”
[7]	**Valve V3** “closed”
[8]	**Compressor K1** “off”
[9]	**Valve V4** “closed”
[10]	**Valve V2** “closed”
[11]	**Pump P1** “off”
[12]	**Valve V5** “open”

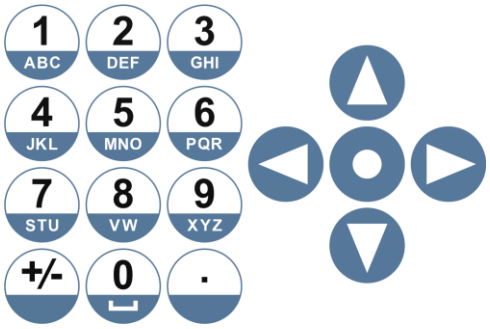


Safety functions and error detection for wait

Monitored components	Detectable errors
Level sensors zero detection, low and high	Level L0, L1 or L2 not reached
Measurement cell	Measurement cell offline

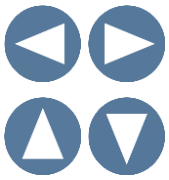
4.3 Operation with the keypad

The SITRAM® Multisense unit, when in use, can be operated by its built-in alphanumeric keypad, the cursor keys and the enter key. For this the protection cover must be removed. Loosen the knurled thumb screws on the front side and remove the protection cover carefully



4.3.1 Cursor keys

Functions of the cursor keys:



Use the left / right cursor keys to move the cursor horizontally. Entries can be deleted using the left cursor key.

Use the up / down cursor keys to move the cursor vertically or to adjust the contrast of the LCD display while the main menu is active.

4.3.2 Enter key

Functions of the enter key:

By pressing the Enter key the selected function is activated or terminated or entered a submenu.

4.3.3 Alphanumeric keypad

Functions of the alphanumeric keypad:

Alphanumeric input of customer specific data.

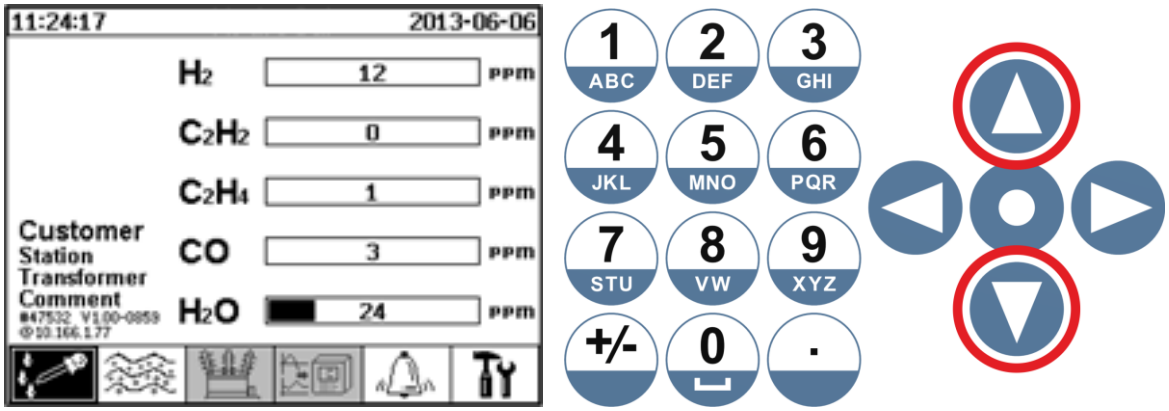
The input is based on the same principle as in mobile phones (not smart phone). By continuously pressing the appropriate alphanumeric key, the corresponding digits or characters can be entered. The following table shows which key can be entered for digits and characters in the appropriate input format:

Key	+/- - Selection of **input format**		
	Capital letter	**Small letter**	**Number**
1 ABC	ABC1	abc1	1
2 DEF	DEF2	def2	2
3 GHI	GHI3	ghi3	3
4 JKL	JKL4	jkl4	4
5 MNO	MNO5	mno5	5
6 PQR	PQR6	pqr6	6
7 STU	STU7	stu7	7
8 VW	VW8	vw8	8
9 XYZ	XYZ9	xyz9	9
0 ␣	␣0@{}()<>[]	␣0@{}()<>[]	0
.	.+-*/_#,:;	.+-*/_#,:;	.

Note: After a capital letter has been entered, the firmware format will automatically switch to small letter.

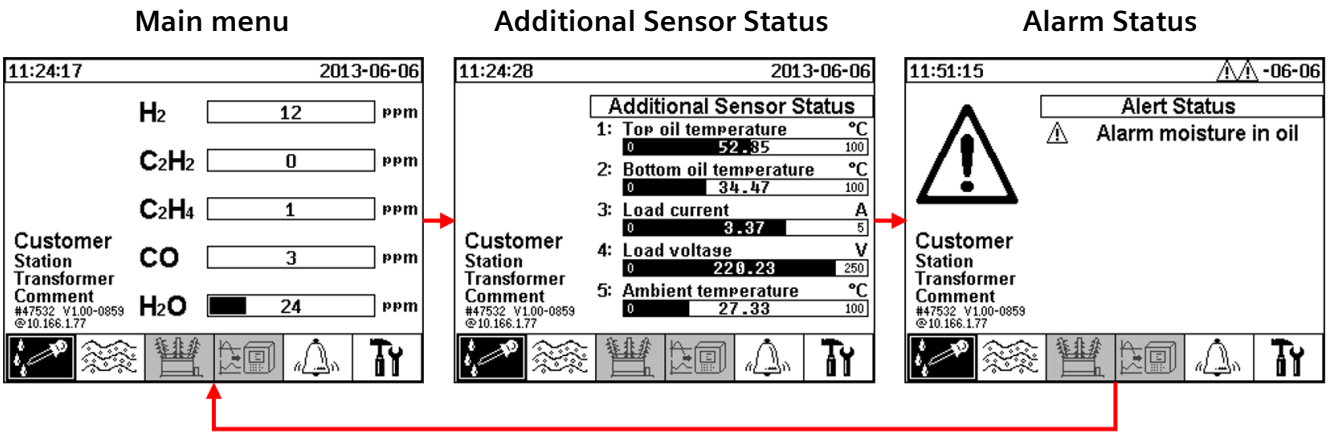
4.3.4 Contrast set up

The contrast of the SITRAM® Multisense display can be changed by pressing the up / down cursor keys while the main menu is displayed.

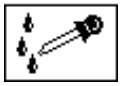


4.4 Main menu

After the supply voltage for the SITRAM® Multisense unit is switched on a short beep sound is hearable and after a short time the main menu appears on the display. The actual measured values of the corresponding gas concentrations and moisture in oil is shown. If other additional sensors are connected or not acknowledged alarms are present, the display will change periodically every 5 seconds (4.8.5.3) to the additional sensor status or to the alert status menu.



Following submenus can be selected from the main menu:



Extraction status (4.5)

Gas-in-oil measurement (4.6)

Transformer specific measurements (not implemented yet)

Additional sensor measurements (not implemented yet)

Alarm overview / alarm history (4.7)

Device setup (4.8)

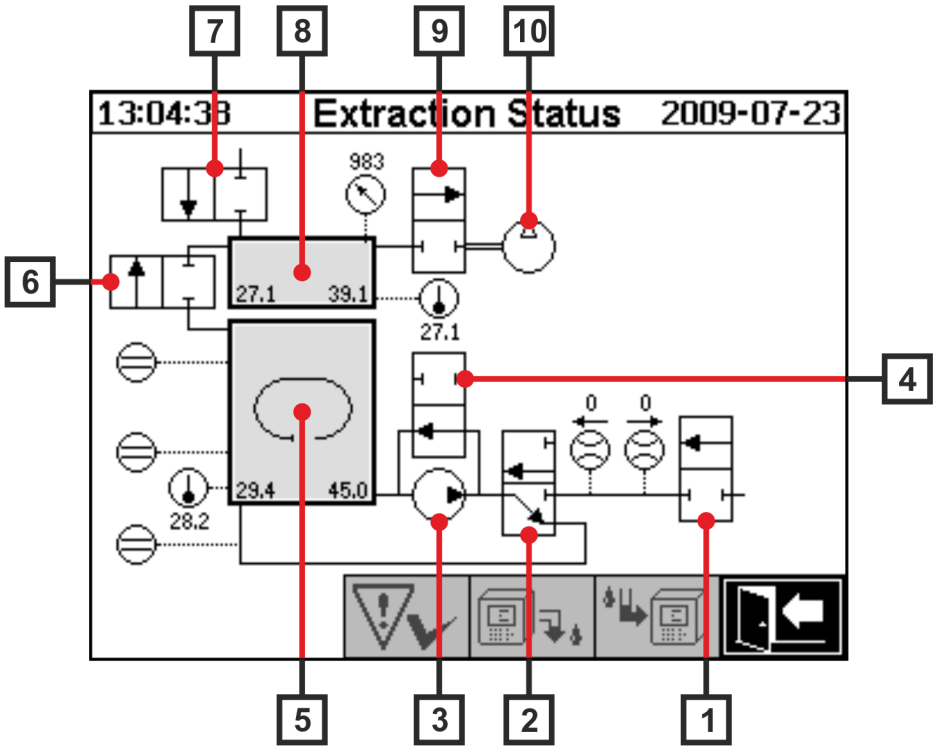
Note:

- In the main menu below the customer specific information (customer, station, transformer and comment) you can find the serial number (e.g. #47532), the installed firmware version (e.g. V 1.00-0859) and with active Ethernet connection as well the IP number (e.g. @10.166.1.77) of the SITRAM® Multisense unit.
- To enter directly the “Main menu” press the 1 ABC key.
- To enter directly the „Additional sensor status“ menu press the 2 DEF key.
- To enter directly the „Alarm status“ menu press the 3 GHI key.

4.5 Extraction status

In the extraction status menu the measurement- and extraction components of the SITRAM® Multisense unit are pictured as a hydraulic functional diagram. The components are active and change their status according the actual process step (4.2):

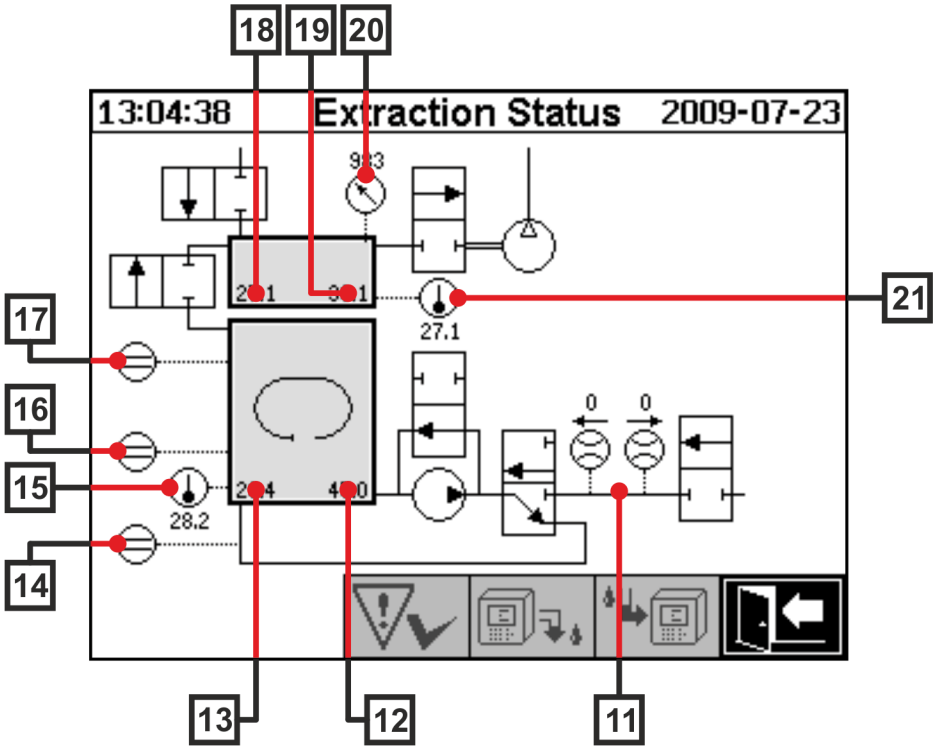
Extraction components:



Legend	Name	Short term	(Valve function)
[1]	In - / outlet valve	Valve V6	(NC)
[2]	Degassing valve	Valve V1	(NC)
[3]	Oil pump	Pump P1	-
[4]	Bypass valve oil pump	Valve V5	(NO)
[5]	Extraction chamber	-	-
[6]	Measurement cell insulation valve	Valve V2	(NC)
[7]	Ventilation valve	Valve V4	(NC)
[8]	Measurement cell	-	-
[9]	Depression valve	Valve V3	(NC)
[10]	Depression compressor	Compressor K1	-

(NC): Valve without supply closed (Normally Closed)
(NO): Valve without supply open (Normally Open)

Measurement components:

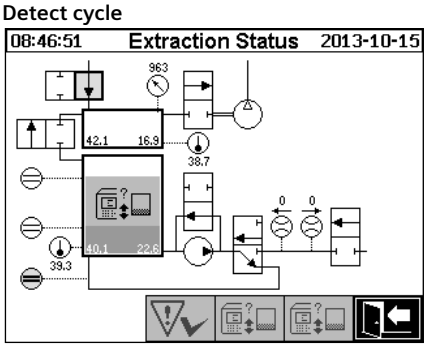


Legend	Name	Short term	(Valve function)
[11]	Oil flow meter	Flow F1	
[12]	Moisture in oil sensor extraction chamber	Moisture in oil H_2O	
[13]	Oil temperature sensor extraction chamber	Temperature T2	
[14]	Level sensor zero detection	Level L0	
[15]	Temperature heating extraction chamber	-	
[16]	Level sensor low extraction chamber	Level L1	
[17]	Level sensor high extraction chamber	Level L2	
[18]	Gas temperature measurement cell	Temperature T1	
[19]	Moisture in gas measurement cell	-	
[20]	Pressure sensor measurement cell	-	
[21]	Temperature heating measurement cell	-	

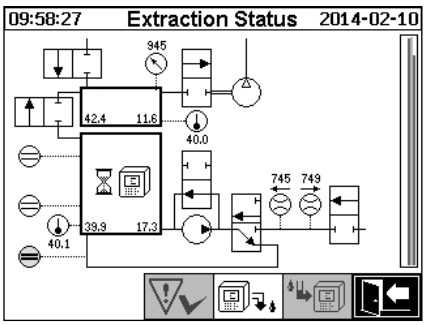
Overview of all visualized process steps:

SITRAM® Multisense inactive (un-mounted)

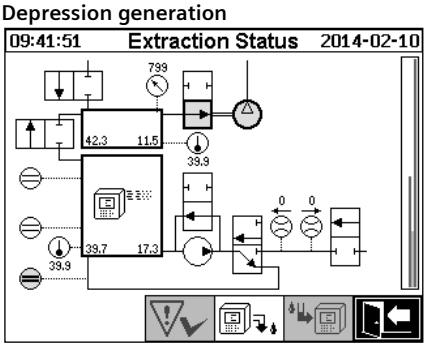
Detect cycle



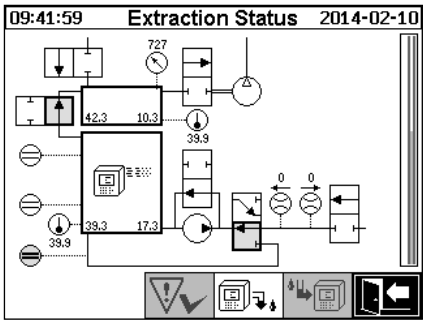
Zero measurement



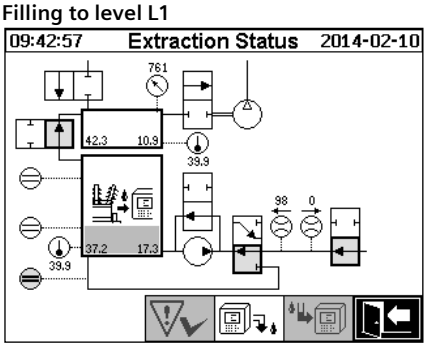
Depression generation



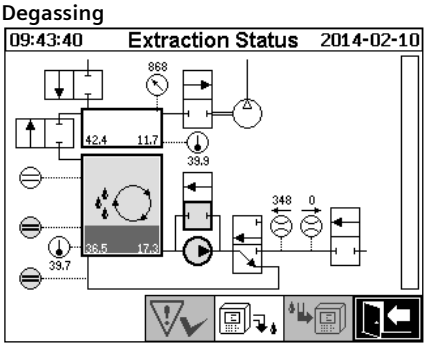
Leak check



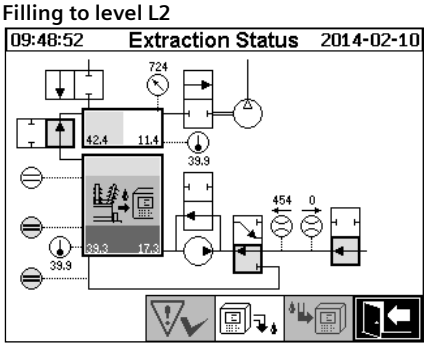
Filling to level L1



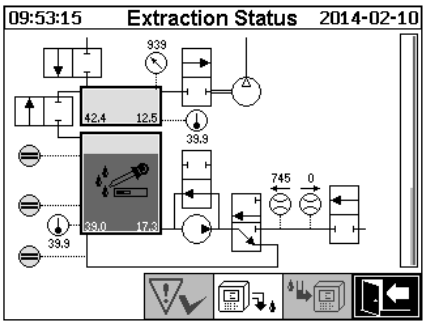
Degassing



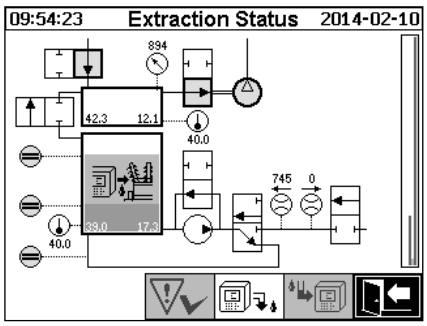
Filling to level L2



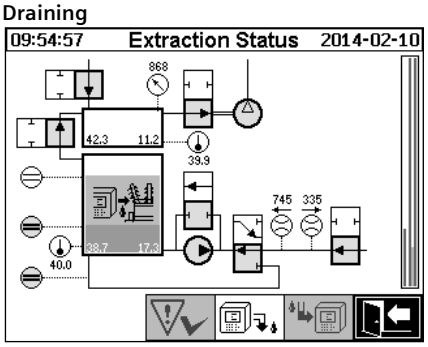
Measurement



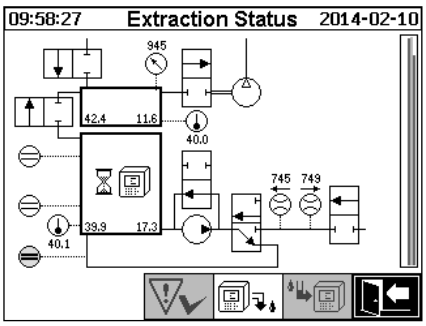
Ventilation



Draining



Wait



Following functions can be selected in the extraction status menu:

Extraction error acknowledgement (4.5.1)

Unmount - Deactivating the unit (4.5.2)

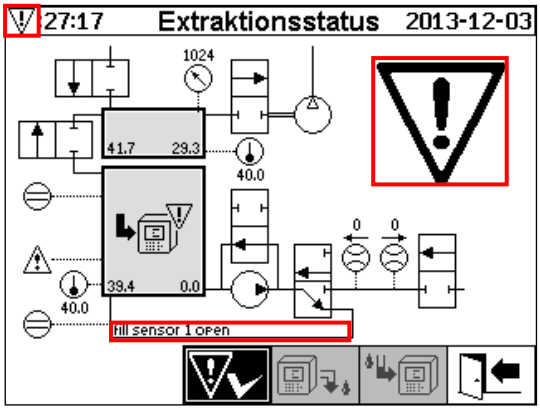
Mount - Activating the unit (4.5.3)

Exit menu

4.5.1 Extraction error acknowledgement

After an extraction error has occurred and it was resolved, the error can be acknowledged with the key.

The extraction error is visualized with an additional information line (below the extraction chamber) and warning icons (header and right of the compressor).



Note: The big warning icon is also visualized in the main menu. The little warning icon is visualized in each menu.

Additional information about individual extraction errors can be found in the chapter „Extraction error – Extraction status menu“ (7.1.6.4).

4.5.2 Unmount – Deactivating the unit

With the key the unit is deactivated (often the term „unmount“ is used). Afterwards switch off the supply voltage and remove the unit from the transformer valve.

How to deactivate the SITRAM® Multisense unit see chapter ”Putting into operation” (2.4.3).

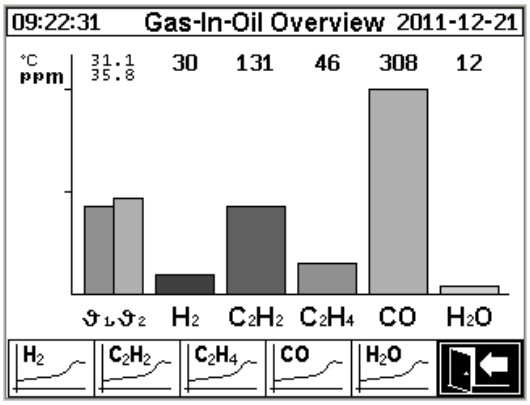
4.5.3 Mount – Activating the unit

With the key the unit is activated (often the term „mount“ is used). The detect cycle is started. It recognizes the current status of the unit and establishes a defined status of the system.

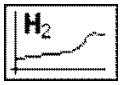
How to activate the SITRAM® Multisense unit see chapter ”Putting into operation” (2.4.3).

4.6 Gas-in-oil measurement

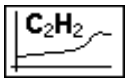
In the menu “Gas-in-oil measurement” an overview of the measured gases in form of a bar graph is displayed. The measured values of H_2, C_2H_2, C_2H_4, CO and H_2O show the current gas content in oil. In the pictures below the contents are displayed as follow: H_2 30ppm, C_2H_2 131ppm, C_2H_4 46ppm, CO 308ppm and H_2O 12ppm. The double bar graph on the left side shows the temperatures ϑ1 with 31.1°C (gas temperature measurement cell T1) and ϑ2 with 35.8°C (oil temperature extraction chamber T2).



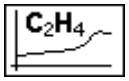
The following values are available on this SITRAM® Multisense unit:



Hydrogen

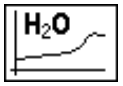


Acetylene



Ethylene

Carbon monoxide

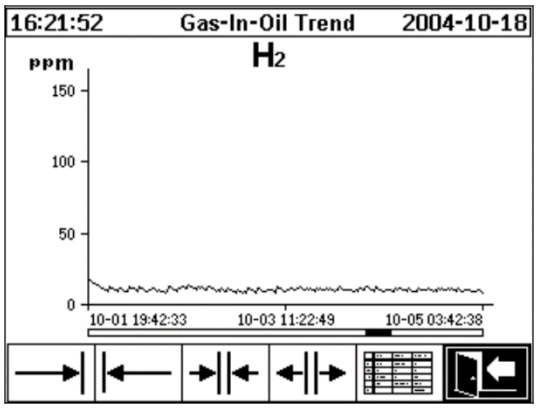


Moisture in oil

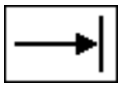
Temperatures:
- ϑ1 Gas temperature measurement cell (T1)
- ϑ2 Oil temperature extraction chamber (T2)

4.6.1  Graph view

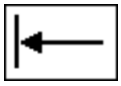
After selection of the appropriate measurement whose graphical trend is displayed.



Following functions can be selected in the graph view:

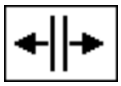


Scroll to the right on the time axis (future)



Scroll to the left on the time axis (past)

Zoom out. The minimum resolution is 3 day / page



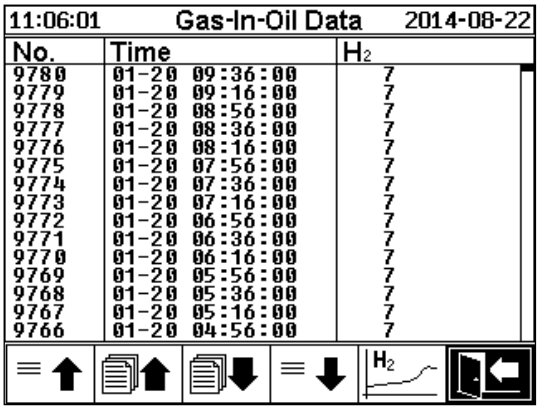
Zoom in. The maximum resolution is 8 hours / page

Table view

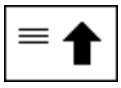
Exit menu

4.6.2  Table view

The table view displays each measured value with record number, date and time. The order is chronological und the last measurement is always on top of the table.



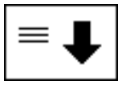
Following functions can be selected in the table view:



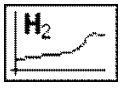
Scroll up one line

Scroll up one page

Scroll down one page



Scroll down one line

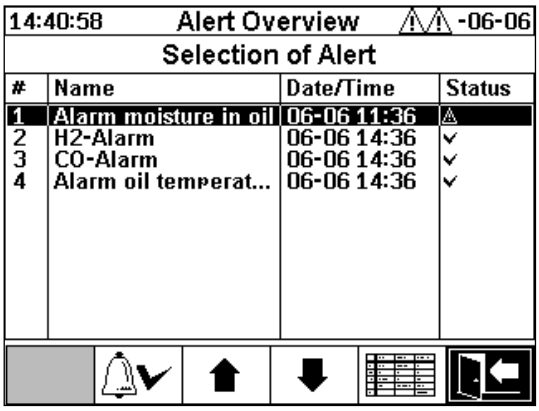


Graph view

Exit menu

4.7 Alarm overview / alarm history

In the menu „Alarm overview / alarm history“ all configured alarms are displayed as a table.



All configured alarms are shown together with their status information. In the column „Date / Time“ the time of status change is shown.

The icons in the column “status” have the following meaning:

- ✓ **Icon - OK:** No active alarm present for this measurement.
  - Time entry present: There was an alarm present in the past, which has been acknowledged at the time illustrated.
  - No time entry present: No alarm was present in the past.
- ⚠ **Icon - Single-stage limit exceedance present:** The defined threshold value „Level 1“ is currently exceeded. The threshold value „Level 1“ was exceeded at the time shown.
- 🖹 **Icon - Single-stage limit exceedance not present:** The defined threshold value „Level 1“ was exceeded in the past. The threshold value „Level 1“ was underrun at the time shown.
- **Double-stage limit exceedance present:**
  - ⚠⚠ **Icon:** The defined threshold values „Level 1“ and „Level 2“ are currently exceeded. The threshold value „Level 2“ was exceeded at the time shown.
  - ⚠🖹 **Icon:** The defined threshold values „Level 1“ and „Level 2“ were exceeded in the past. The threshold value „Level 2“ was underrun at the time shown, the threshold value „Level 1“ is still exceeded.
- 🖹🖹 **Icon - Double-stage limit exceedance not present:** The defined threshold values „Level 1“ and „Level 2“ were exceeded in the past. The threshold value „Level 1“ was underrun at the time shown.

In the menu „Alarm overview / alarm history“ following functions can be selected:

 Alarm acknowledge of the selected alarm (4.7.1)

 Scroll up one line

 Scroll down one line

 Alarm settings of the selected alarm (4.7.2)

 Exit menu

4.7.1 Alarm acknowledgement

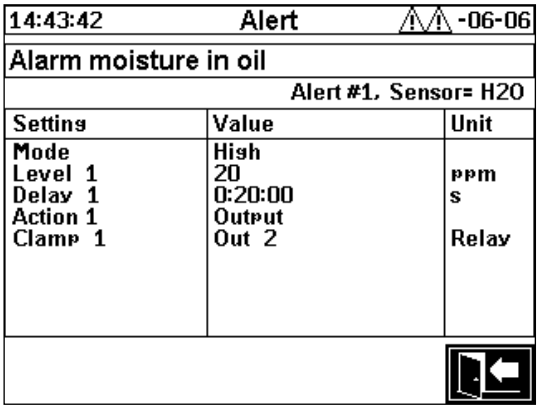
To acknowledge the selected alarm, a password entry is required (default password 9999).

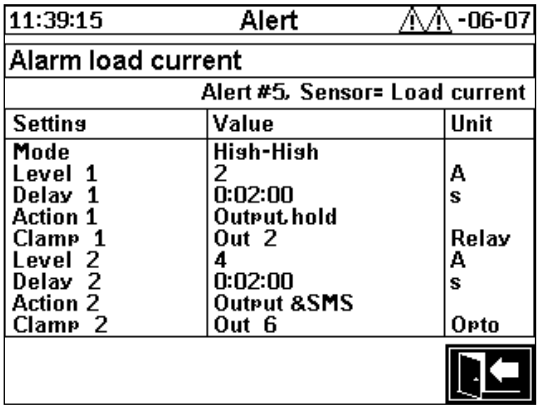
After entering the appropriate password using the alphanumeric keypad and confirm with the Enter key, the alarm is acknowledged.

Note: Each alarm has to be acknowledged individually in the firmware.

4.7.2 Alarm settings of the selected alarm

In the submenu „Alarm settings" the detailed information of the selected alarm is displayed.





Details of the corresponding alarm settings see chapter (4.8.4).

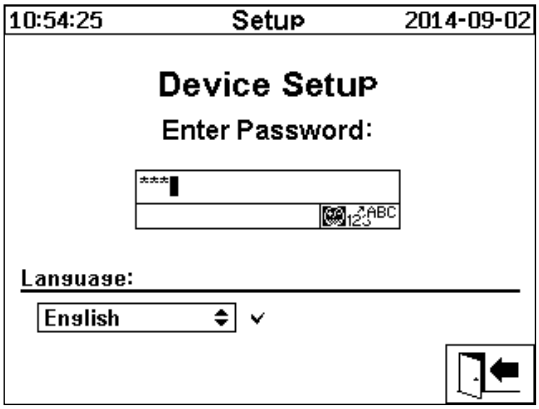
4.8 Device setup

The user language can be selected on the SITRAM® Multisense unit. The following languages are available: English, German, French, Russian, Turkish, Spanish and Polish.

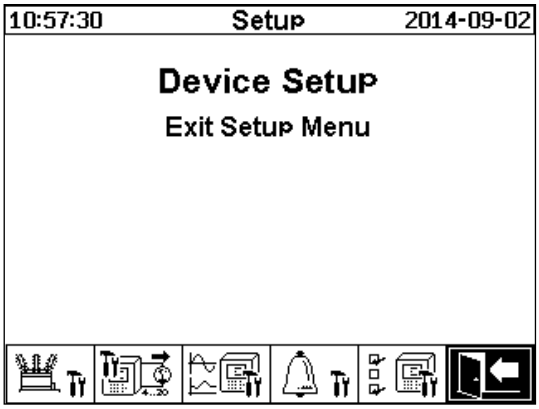
Select the language selection field with the cursor key. Choose the needed language by repressing the Enter key.

If the language has changed, the icon appears right to the language selection field. It must be selected with the cursor key and confirmed by the Enter key. The icon indicates the selected language.

Before changes can be entered into the device setup, a password is required (default password 9999).



After entering the appropriate password using the alphanumeric keypad and confirm with the Enter key, the „device setup" menu will be opened.



Following submenus are selectable in the „device setup" menu:


Transformer related setup (4.8.1)


Analog output setup (4.8.2)


Additional sensors (4.8.3)

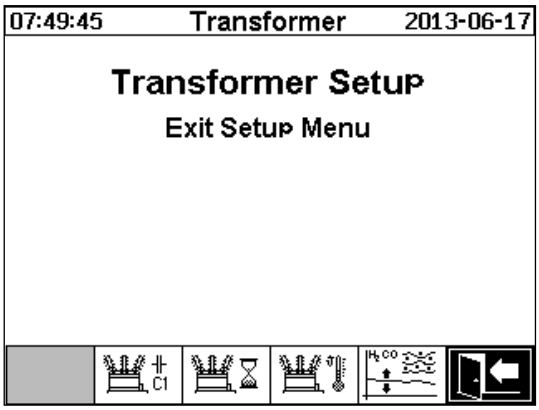

Alarm setup (Alarm level and alarm sources) (4.8.4)


SITRAM® Multisense setup (4.8.5)

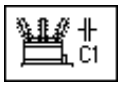
Exit menu

4.8.1  Transformer related setup

Transformer specific information can be entered and managed only with SITRAM® Multisense Software. However, these data are not necessary to operate the unit.

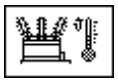


Following submenus are selectable in the „Transformer related setup“ menu:

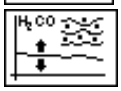


Bushing Monitoring (4.8.1.1)

Ageing rate / Loss of life (4.8.1.2)



Hotspot calculation (4.8.1.3)

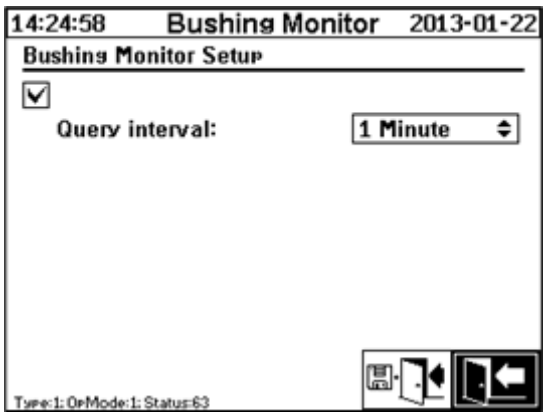


DGA adjustment (4.8.1.4)

Exit menu

4.8.1.1  Bushing Monitoring

In the menu „Bushing Monitoring“ (Bushing Monitor Siemens Energy Bushing Monitoring) following settings can be made:



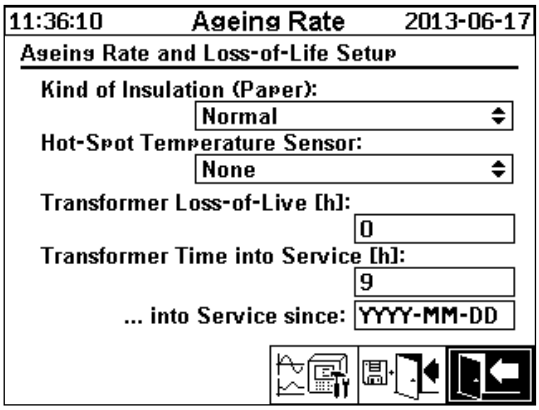
- Siemens Energy Bushing Monitoring: Activation „Off“ ☐ or „On“ ☑
- Query interval: 1 Minute / 3 Minutes / 15 Minutes / 1 Hour

Note: The activation should be made only with connected Siemens Energy Bushing Monitoring!

In the status line at the left bottom end the following information appears:
<Bushing Monitoring serial number> <Bushing Monitoring firmware version>
<Bushing Monitoring status message>
<Type:t> <OpMode:o> <Status:s> (for internal use only)
Note: The two upper status lines appear only when the communication between SITRAM® Multisense and Siemens Energy Bushing Monitoring is established.

4.8.1.2  Ageing rate / Loss of life

After selecting the submenu “Ageing rate / Loss of life” the following screen appears on the display:



Each field must contain the required information:

- Kind of Insulation (Paper): Selection between “Normal” and “Thermally upgraded”
- Hotspot temperature sensor: Selection between „None“ and all available temperature sensors
- Transformer loss of life: [h]
- Transformer time into service: [h]
- ... into service since: [YYYY-MM-DD]

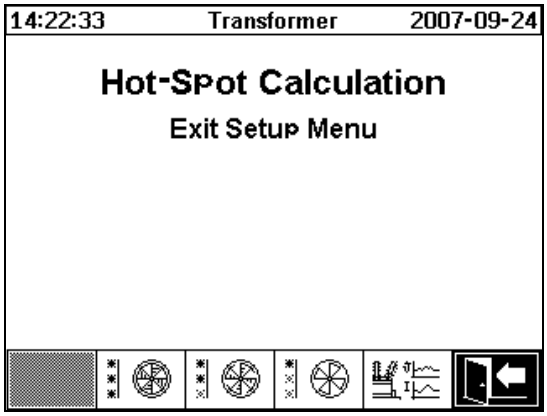
If necessary you must previously define the additional hotspot temperature sensor as an analog input by selecting the  key. See needed settings on chapter (4.8.3).

At the end, all entered values are saved and activated by pressing the  key "Save and exit menu".

4.8.1.3  Hot spot calculation

The SITRAM® Multisense unit can calculate the hot spot temperature of a transformer. For this calculation the SITRAM® Multisense unit requires additional sensors for following measurements:

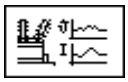
- Load current (at least one phase)
- Top oil temperature (Transformer)
- Condition cooling stage (not necessary required, improves the calculation model significantly)



 Cooling stage #3 condition (4.8.1.3.1)

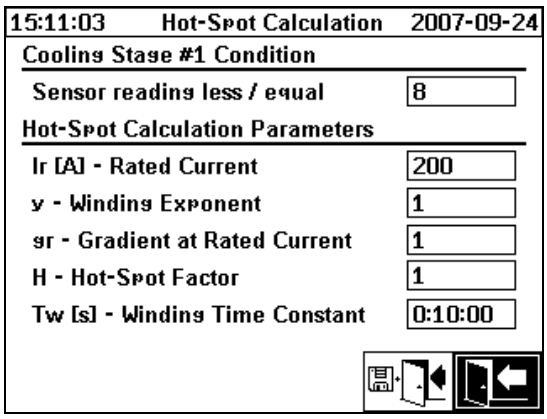
 Cooling stage #2 condition (4.8.1.3.1)

 Cooling stage #1 condition (4.8.1.3.1)

 Additional sensor references (4.8.1.3.2)

 Exit menu

4.8.1.3.1  Cooling stage #1 condition



Each field must contain the required information:

- Cooling stage #1, #2 or #3 condition
  - Is active, when the current at the sensor input is less or equal than x: [mA]
- Hot spot calculation parameters
  - Rated current: Ir [A]
  - Winding exponent: y
  - Gradient at rated current: gr
  - Hot spot factor: H
  - Winding time constant: Tw [s]

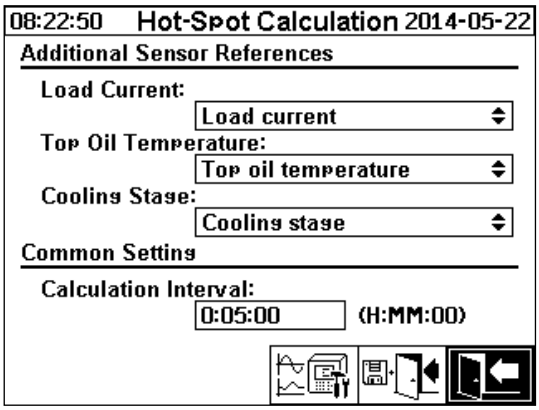
All required information is usually taken from the technical specification of the transformer manufacturer.

At the end, all entered values are saved and activated by pressing the key "Save and exit menu".

To enter the parameters for cooling stage #2 condition and cooling stage #3 condition the above procedure applies.

4.8.1.3.2 Additional sensor references

After selecting the submenu “Additional sensor references” the following screen appears on the display:



Each field must contain the required information:

- Load current: Selection between „None“ and load current sensor.
  Note: An additional load current sensor must be existent! See chapter (4.8.3)
- Top oil temperature (Transformer): Selection between „None“ and all available temperature sensors.
  Note: An additional top oil temperature sensor must be existent!
- Cooling stage: Selection between „None“ and all available unitless sensors.
  Note: An additional sensor for detecting the cooling stage condition must be existent!

If necessary, you need to configure the additional reference sensors as analog input in advance, by pressing the key. See chapter (4.8.3) for the settings.

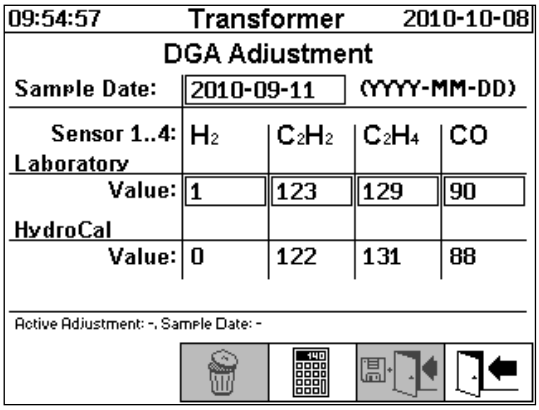
Then you must define the calculation interval. It is edited using the cursor keys and confirmed by alphanumeric keypad. The calculation interval is entered in seconds or in hours, minutes and seconds. As a colon, use the key. After confirming the entry with the Enter key, the calculation interval appears in h: mm: 00 on the display.

Note: The calculation interval must be smaller than the storage interval of the hot spot temperature sensor! We recommend defining the calculation interval to 0:01:00 (1 minute).

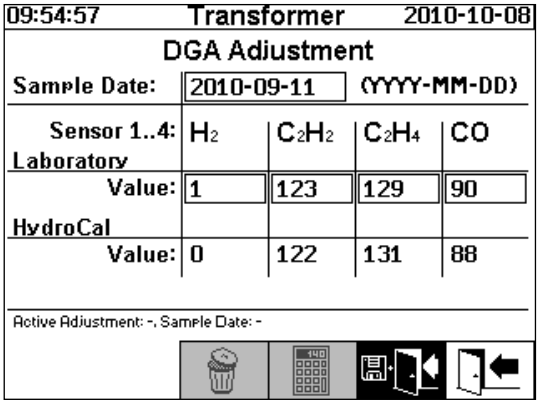
At the end, all entered values are saved and activated by pressing the key "Save and exit menu".

4.8.1.4  DGA Adjustment

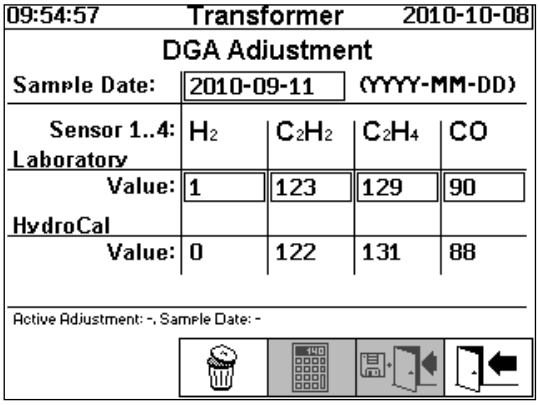
In the menu DGA adjustment the results from the laboratory analysis can be entered. These can be used for calculation of correction factors, which are applied for determination of the gas content.



To enter the results of the laboratory analysis, the date of the analysis should be entered into the field „sample date“ first. Then, the daily mean value of gas concentrations of the SITRAM® Multisense unit is calculated and display in the fields „SITRAM® Multisense value”. After the results H_2, C_2H_2, C_2H_4, und CO of the laboratory analysis have been entered into the fields "Laboratory value", the  key becomes active. The new correction factors are calculated by pressing the  key. After a short calculation time, indicated by the hourglass icon, the following message appears on the display: "DGA adjustment calculation successful.".



The new values are saved and activated by pressing the  key "Save and exit menu". The new correction factors are now applied to the future measurement values.



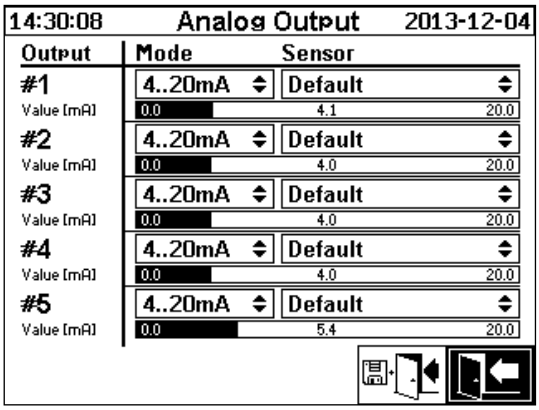
4.8.2 Analog output setup

This SITRAM® Multisense unit contains 5 analog current outputs which can be operated with 0 ... 20 mA or 4 ... 20 mA. These can be used as outputs for gas-in-oil concentration, moisture in oil, temperatures or all additional sensors.

The factory standard setup / -assignment comes as follow:

Output #1:	Mode: 4 ... 20 mA	Sensor: H_2 concentration
Output #2:	Mode: 4 ... 20 mA	Sensor: C_2H_2 concentration
Output #3:	Mode: 4 ... 20 mA	Sensor: C_2H_4 concentration
Output #4:	Mode: 4 ... 20 mA	Sensor: CO concentration
Output #5:	Mode: 4 ... 20 mA	Sensor: H_2O concentration

Test currents can be set in the menu, which overrides the current values. These are used to check the installation. When exit the analog setup menu the current values are outputted again.



Analog output 1 - X301:1(+) & 2(-)

Analog output 2 - X301:3(+) & 4(-)

Analog output 3 - X301:5(+) & 6(-)

Analog output 4 - X301:7(+) & 8(-)

Analog output 5 - X301:9(+) & 10(-)

In the sensor column following selections can be made:

- Default
- H_2 - C_2H_2 - C_2H_4 - CO - H_2O concentration
- H_2 - C_2H_2 - C_2H_4 - CO - H_2O daily trend
- H_2 - C_2H_2 - C_2H_4 - CO - H_2O weekly trend
- Temperature $\vartheta 1$ (T1 gas temperature measurement cell)
- Temperature $\vartheta 2$ (T2 oil temperature extraction chamber)
- All additional sensors defined measurements

In the mode column following selections can be made:

- Off
- 0...20 mA
- 4...20 mA
- Test

For simulation and testing purposes, a current between 0 and 20 mA can be generated at the outputs. For the corresponding analog output the mode column must be set to “Test” and the cursor must be located in the sensor column. By repressing the Enter key the current toggles between the following values: 0, 1, 3, 4, 5, 10, 15, 19 and 20 mA.

Note: When exit the menu the test currents are switched of automatically and the corresponding sensor is assigned to the output again.

At the end, all entered values are saved and activated by pressing the key "Save and exit menu".

If you don`t want to save the values exit the menu with the key.

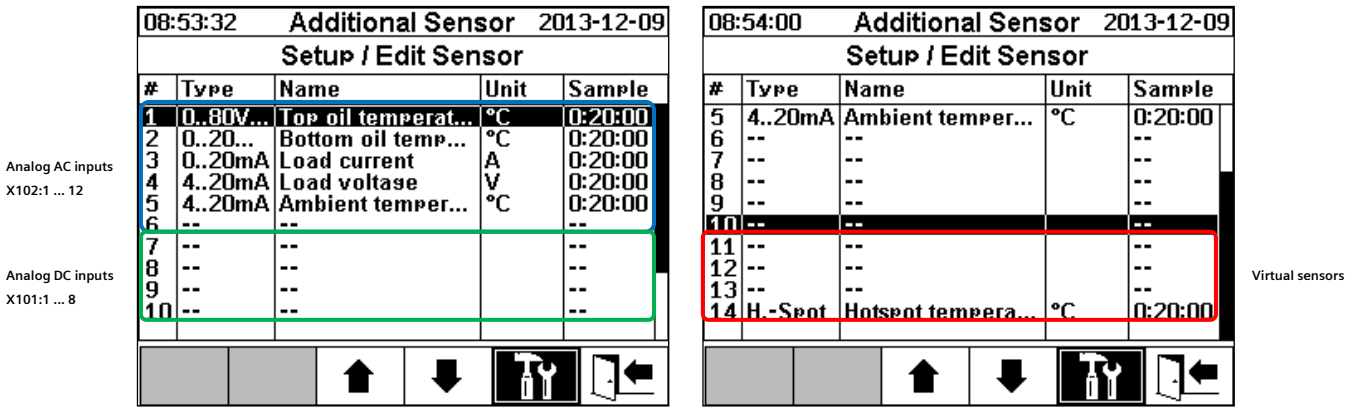
4.8.3 Additional sensors

The SITRAM® Multisense 5 unit features 10 analog inputs in the corresponding completion (optional measurement input- and Optocoupler output card). The first six (connection terminal X102:1 ... 12) are for AC current signals of either 0 ... 20 mA AC or 0 ... 80 V AC (configurable by jumpers), the next four (connection terminal X101:1 ... 8) are for DC current signals of 0/4 ... 20 mA DC.

In addition to the analog inputs there are so called virtual sensors. These four virtual sensors are configured in the same way as the analog inputs and are explained in this chapter as well.

Additional sensors with standard output signals of 0/4...20 mA can be directly connected to the analog inputs of the SITRAM® Multisense unit.

Note: The power supply for the additional sensors can not be generated from the SITRAM® Multisense unit!



First an input number must be selected. The first 10 input numbers are assigned to the analog inputs (#1 ... 6 additional sensors [AC] – connection terminal X102:1 ... 12 / #7 ... 10 additional sensors [DC] – connection terminal X101:1 ... 8). The last 4 input numbers (11 ... 14) are assigned to the virtual sensors.

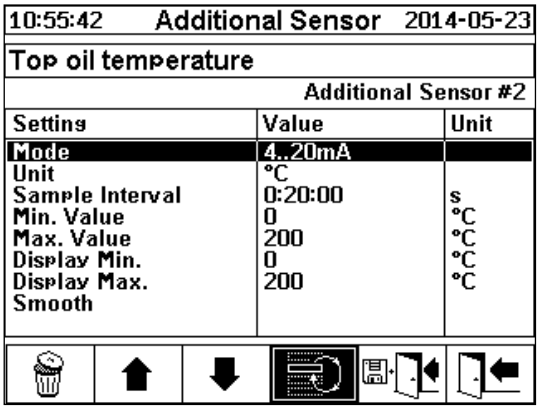
Following functions are available:


Scroll up one line


Scroll down one line


Exit menu

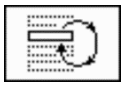
After pressing the  key following functions are available:



 Delete additional sensor configuration

 Scroll up one line

 Scroll down one line

 Cycles through the available selection in the following lines:
Mode, Unit and Smooth

 Save and exit menu

 Exit menu (without save)

By repressing the  key in the “Mode” line following selection can be made:

Input 1...6 (additional sensors) – connection terminal X102:1 ... 12

- 0 ... 20mA (DC)
- 4 ... 20mA (DC)
- 0 ... 80V AC
- 0 ... 20mA AC

Note: It`s possible to connect DC current signals to the first six additional sensor inputs. But only a limited part of the input range (approx. 71%) will be used in this case!

Input 7...10 (additional sensors) – connection terminal X101:1 ... 8

- 0 ... 20mA (DC)
- 4 ... 20mA (DC)

By repressing the  key in the “Unit” line following selection can be made:

-- (no unit)

- °C
- ppm
- %
- V
- kV
- mA
- A
- kA
- ppm/Day
- ppm/Week
- #

The name of the “additional sensors #” can be edited with the cursor keys, the  key and the alphanumeric keypad.

The "sample interval" can be edited with the cursor keys, the  key and the alphanumeric keypad. It can be entered either in seconds or in hours, minutes and seconds. As a colon, use the  key. After confirming the entry with the Enter key, the sample interval appears in [hours]:[minutes]:[seconds] on the display.

The range is entered as followed:
The „minimum value“ corresponds to the input value of either 0V, 0 mA or 4 mA.
The „maximum value“ corresponds to the input value of either 10V or 20mA.
The range of the sensor values can be limited on the display, while setting „Display Minimum“ and „Display Maximum“ accordingly.

The virtual inputs #11 ... 14 are treated like analog inputs. These are displayed on the screen as additional sensors. See chapter (4.8.1.3.2).

By repressing the  key in the “Mode” line following selection can be made:

- H.-Spot Hot spot temperature [°C]
- Ag.Rate Ageing rate [%]
- L.o.life Loss of life [h]
- Avg.r.Ar Average ageing rate [%]

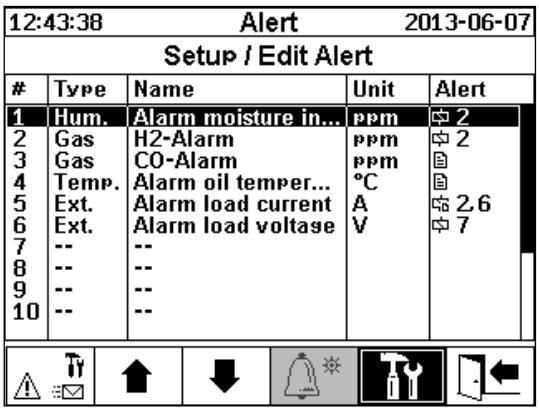
By repressing the  key in the “Unit” line following selection can be made:

- -- No unit
- °C Hot spot temperature
- % Ageing rate / average ageing rate
- h Loss of life

4.8.4 Alarm level and alarm sources

With this SITRAM® Multisense unit you have the possibility to configure up to 16 alarms. The alarms can be applied either on internal or external measurements and can be outputted in different ways. To route the alarms to the digital outputs is one of these ways. The SITRAM® Multisense unit contains 10 digital alarm outputs. The first five (Output Out 1...5 Relay – Terminal X402:1 ... 10) are relay outputs. If the status is „on" the contact is closed and if the status is „off" the contact is open (on output #1 you have the possibility to invert the function via jumper on the measurement- and controller card (3.3)). The next five (Output Out 6..10 Opto – Terminal X103:1 ... 10) are optional Optocoupler outputs. If the status is „on" the output circuit is connected through and if the status is „off" the output circuit is open.

Note: The system fault (4.8.5.2) can be individually routed to one of the digital outputs (Standard assignment: Out 1 Relay) via firmware. Do not assign any other of the 16 alarms to this output!



In the alarm overview following information column are available:

#	Number:	1 ... 16
Type	Type:	Gas / Temp. / Hum. / Trend / Ext.
Name	Name:	Free naming – e.g. oil temperature high
Unit	Unit:	Depending on the measurement – e.g. ppm / °C / A / mA / V / kV etc.
Alert	Routing:	LOG entry / output with number / SMS – e.g. 🗎, 2, 2,6 etc.

Following functions / submenus are available:


Alarm SMS setup (4.8.5.5.2)


Scroll up one line


Scroll down one line

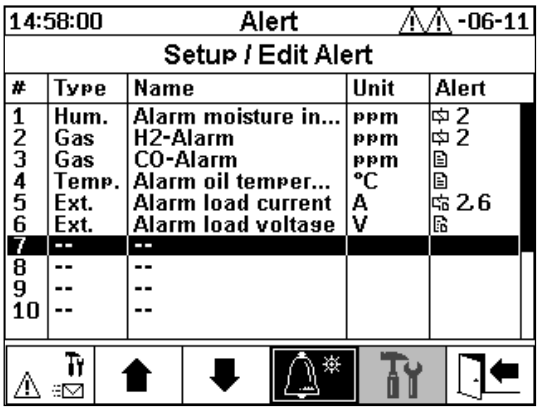

Create new alarm (4.8.4.1)


Alarm setup (4.8.4.2)

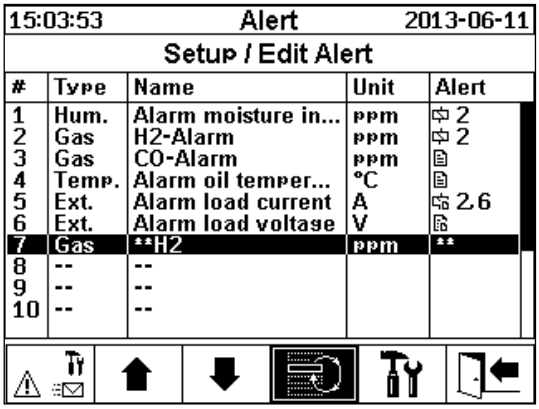

Exit menu (without save)

4.8.4.1  Create new alarm

To create a new alarm, select a free alarm number using the cursor keys:



Once the  key has been selected the key icon change to  and by repressing this key you can select the needed measurement.



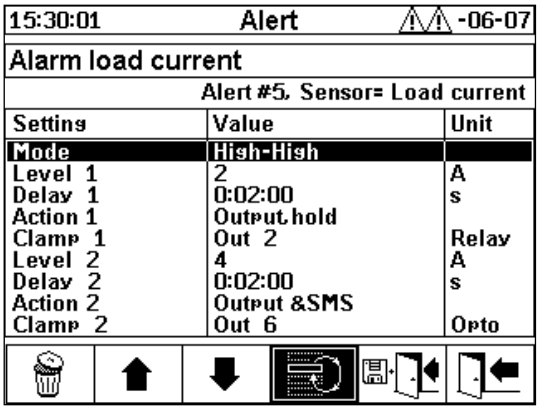
Following measurements are available by repressing the  key:

- Gas H_2 - C_2H_2 - C_2H_4 - CO - concentration
- Temp. T1 ($\vartheta 1$ gas temperature measurement cell)
  T2 ($\vartheta 2$ oil temperature extraction chamber)
- Hum. H_2O - concentration
- Trend H_2 - C_2H_2 - C_2H_4 - CO – daily trend
- Trend H_2 - C_2H_2 - C_2H_4 - CO – weekly trend
- Ext. All additional sensors defined measurements

After selection of the needed measurement, select the  key (4.8.4.2).

4.8.4.2  Alarm setup

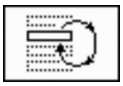
After a new alarm has been created and selected with the  key, the following functions are available:



 Delete alarm configuration

 Scroll up one line

 Scroll down one line

 Cycles through the available selection in the following lines:
Mode, Action 1/2 and Clamp 1/2 (if an output was selected under action)

 Activates the entry of alphanumeric key pad for the lines:
Level 1/2 and Delay 1/2

 Save and exit menu

 Exit menu

4.8.4.2.1 Alarm setup - Mode

In the Mode line by pressing the  key, following selection can be made:

- **High:** A single-stage alarm is triggered when the threshold value “Level 1” is exceeded.
- **High- High**: A double-stage alarm is triggered. The first stage of the alarm is triggered when the threshold value “Level 1” is exceeded. The second stage of the alarm is triggered when the threshold value “Level 2” is exceeded.
- **Low:** A single-stage alarm is triggered when the threshold value “Level 1” is underruned.
- **Low - Low:** A double-stage alarm is triggered. The first stage of the alarm is triggered when the threshold value “Level 1” is underruned. The second stage of the alarm is triggered when the threshold value “Level 2” is underruned.
- **Low - High:** A double-stage alarm is triggered when the measurement value is outside of the range. The first stage of the alarm is triggered when the threshold value “Level 1” is underruned. The second stage of the alarm is triggered when the threshold value “Level 2” is exceeded.
- **Range:** A single-stage alarm is triggered when the measurement value is inside the range, which is defined by the threshold values “Level 1” and “Level 2”.

4.8.4.2.2 Alarm setup - Level

The alarm setup can be edited with the  key, the cursor keys and the alphanumeric keypad. The unit is defined by the measurement:

- ppm Gas Gas concentration H_2 - C_2H_2 - C_2H_4 - CO
- °C Temp. Temperature T1 - T2
- ppm Hum. Concentration H_2O
- ppm/d Trend Gas concentration – Daily trend H_2, C_2H_2, C_2H_4, CO
- ppm/w Trend Gas concentration – Weekly trend H_2, C_2H_2, C_2H_4, CO

With additional sensors the unit is defined by the measured value (e.g.: Volt, Ampere, etc.).
The threshold values (Level 1/2) has to be within the measurement ranges, which are:

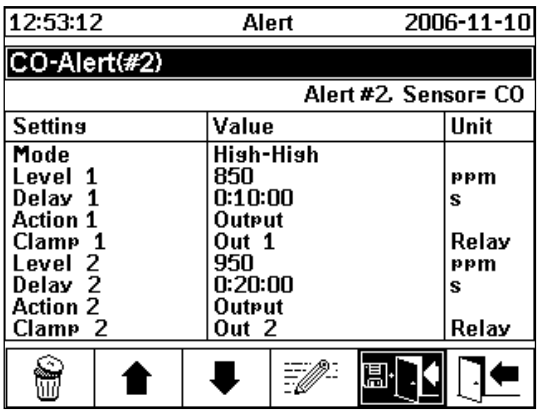
- 0 ... 2000 ppm Gas concentration H_2, C_2H_2, C_2H_4
- 0 ... 5000 ppm Gas concentration CO
- 0 ... 100 ppm Moisture in oil H_2O
- -20 ... 100 °C Temperatures T1, T2
- For additional sensors the measurement range is defined by “Min. Value” and “Max. Value”.

4.8.4.2.3 Alarm setup - Delay

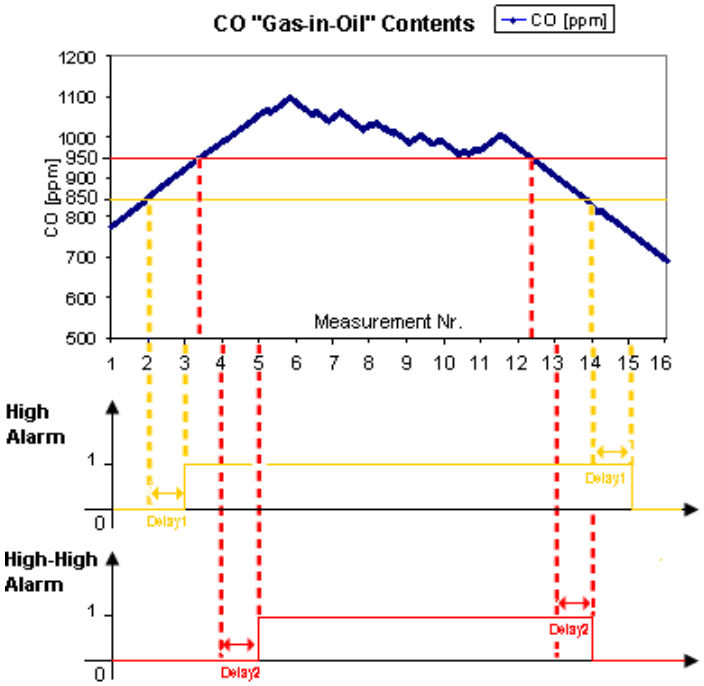
The delays are used to suppress the alarm release for short periods exceedances or underrunances of the threshold value.

The delay can be entered either in seconds or in hours, minutes and seconds. As a colon, use the  key. After confirming the entry with the Enter key, the delay appears in [hours]:[minutes]:[seconds] on the display.

Example: CO alarm is set as followed:



In case the threshold value is exceeded the following time sequence results:



Note: The measurement interval for the „Gas-in-oil" measurement takes 20 minutes.

4.8.4.2.4 Alarm setup - Action

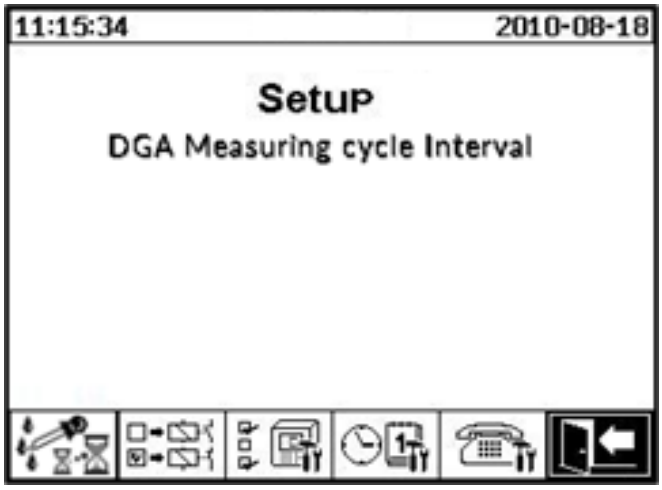
In the Action line by pressing the  key, following selection can be made:

- **Log entry** 🗎**:** A status change is stored into the alarm history, this must be acknowledged.
- **Output** 🔌2**:** A status change is stored into the alarm history, this must be acknowledged. In addition, depending on the selected mode, if the measurement value has exceeded or underruned the threshold value, an output is set. The output is reset as soon the alarm in no longer present.
- **Output, hold** 🔌2**:** A status change is stored into the alarm history, this must be acknowledged. In addition, depending on the selected mode, if the measurement value has exceeded or underruned the threshold value, an output is set. When the alarm is no longer present, the output remains switched on until it is acknowledged by hand.
- **Log & SMS** 🗎**:** A status change is stored into the alarm history, this must be acknowledged. In addition a SMS is sent to the specified recipients.
- **Output & SMS** 🔌2**:** A status change is stored into the alarm history, this must be acknowledged. In addition, depending on the selected mode, if the measurement value has exceeded or underruned the threshold value, an output is set and a SMS to the specified recipients is sent.
- **Output, hold & SMS** 🔌2**:** A status change is stored into the alarm history, this must be acknowledged. In addition, depending on the selected mode, if the measurement value has exceeded or underruned the threshold value, an output is set. When the alarm is no longer present, the output remains switched on until it is acknowledged by hand. A SMS to the specified recipients is sent too.

Note: The entry into the alarm history is always active, as soon an alarm is defined!!!

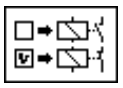
It`s possible to assign different alarms to the same output. This is used to create a collective alarm.

4.8.5 SITRAM® Multisense setup



Following submenus are available in SITRAM® Multisense setup:


DGA Measurement-Cycle Interval (4.8.5.1)


Digital output test (4.8.5.2)


Device options (4.8.5.3)

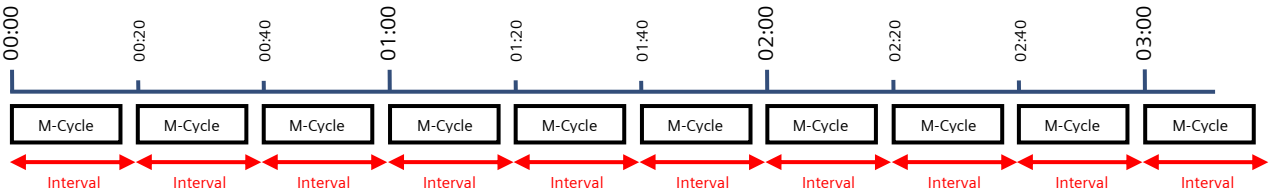

Date, time & clock settings (4.8.5.4)


Communication / Connection (4.8.5.5)

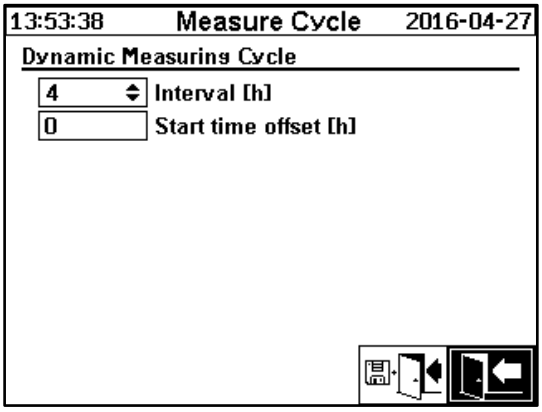

Exit menu

4.8.5.1 DGA Measurement-Cycle Interval

The DGA measurement cycle interval defines the time period between the start of a measurement until the next start of the next measurement. As default, the SITRAM® Multisense unit works with a standard measurement cycle interval of four hours. In case of increasing (fluctuating) measurement results, the measurement cycle interval automatically change to a 20-minute interval. In this case the measurement cycle starts synchronously with the time at each xx:00, xx:20 and xx:40 and takes at least 16 ... 19 minutes. The duration of the measurement cycle cannot be changed.



Instead of the standard interval of four hours the DGA measurement cycle interval can be changed to 2, 8, 12 or 24 hours in case of stable measurement results. The measurement cycle starts synchronously with the time (clock hour). 00:00 o`clock is the start reference.



Interval [h]

Following values can be selected in selection field Interval [h]:

- -- (*Disabled*) – Standard interval every 20 minutes
- 2, 4(default), 8, 12 or 24

Start time offset [h]

The start of the interval can be shifted by full hours with the start time offset [h].

- Input range: 0 ... (Interval - 1) [h]

Examples:

Interval [h]	Start time offset [h]	Start of the measurement at
--	(not selectable)	00:00 / 00:20 / 00:40 / 01:00 / 01:20 / 01:40 / 02:00 / ....
2	0	00:00 / 02:00 / 04:00 / 06:00 / 08:00 / 10:00 / 11:00 / ....
2	1	01:00 / 03:00 / 05:00 / 07:00 / 09:00 / 11:00 / 13:00 / ....
4	2	02:00 / 06:00 / 10:00 / 14:00 / 18:00 / 22:00 / 02:00 / ....
8	0	00:00 / 08:00 / 16:00 / 00:00 / 08:00 / 16:00 / 00:00 / ....
8	3	03:00 / 11:00 / 19:00 / 03:00 / 11:00 / 19:00 / 03:00 / ....

Start reference

Note: The measured values are available within maximum 20 minutes after the start of the measurement.

4.8.5.1.1 Dynamic DGA measuring cycle interval

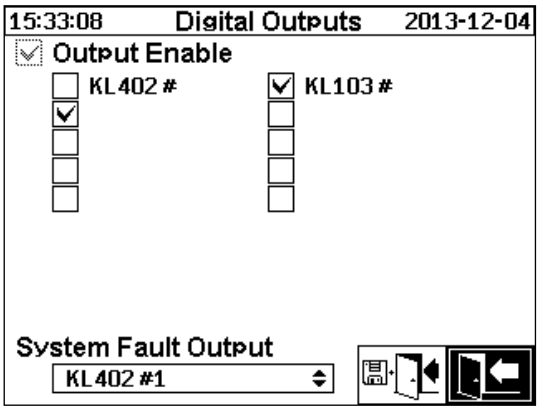
Up to version V1.50-B0001, the measuring cycle was set to 20 minutes. Since then, switching to a slower measuring cycle can take place. The desired time can be set by the user (default 4 hours). Switching to the slow measuring cycle is performed automatically when a stable measurement is detected. The slow measurement cycle is also automatically switched over to the fast / normal measurement if a strong change in the measurements is detected.

4.8.5.2 Digital output test

To test the digital outputs and its peripherals, the alarm outputs can be switched by hand in this menu. Select the output with the cursor keys and switch the output on and off by repressing the Enter key.

The five relay outputs are labeled with KL402# (see chapter (3.3) [9] - X402:1 ... 10).

The five optional Optocoupler outputs are labeled with KL103# (see chapter (3.3) [12] - X103:1 ... 10).



4.8.5.2.1 System fault output

The SITRAM® Multisense unit contains an internal system monitoring which can be assigned to a digital output. The following internal error sources are monitored:

- Loss of time
- Data memory not ready
- RTC not ready (buffer capacitor empty)

The system fault can be assigned to one of the 10 digital outputs. Following selection can be made in the field “System fault output”:

- KL402 #1 X402:1&2 (Relay output 1)
- KL402 #2 X402:3&4 (Relay output 2)
- KL402 #3 X402:5&6 (Relay output 3)
- KL402 #4 X402:7&8 (Relay output 4)
- KL402 #5 X402:9&10 (Relay output 5)
- KL103 #1 X103:1&2 (Optocoupler output 1)
- KL103 #2 X103:3&4 (Optocoupler output 2)
- KL103 #3 X103:5&6 (Optocoupler output 3)
- KL103 #4 X103:7&8 (Optocoupler output 4)
- KL103 #5 X103:9&10 (Optocoupler output 5)
- -- (No assignment of the system fault to an output)

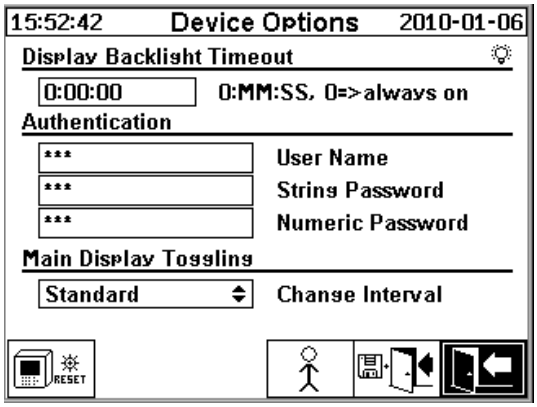
If the output is already occupied by another alarm assignment, the terminal number is show with an previously exclamation mark (e.g. ! KL402 #2).

In error-free status the relay contact is closed or the optocoupler output circuit is connected through.

Note: The function of the relay output 1 (KL402 #1) can be inverted, configurable via jumper on the measurement- and controller card (3.3).

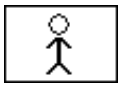
4.8.5.3 Device options

In this menu the display backlight timeout, the authentication and the change interval of the main menu can be set:



Following submenus are available in device options:

By pressing the reset key a software reset is performed in the unit.



Customer data setup (4.8.5.3.1)

Save and exit menu

Exit menu

Display backlight timeout

The switch-off delay of the display illumination after active operation, can be entered either in seconds or in hours, minutes and seconds. As a colon, use the  key. After confirming the entry with the Enter key  , the delay appears in [hours]:[minutes]:[seconds] on the display.

Note: With the setting 0:00:00 the display illumination is always on. To switch-off the display illumination manually, select the  icon and confirm with the Enter key.

Note: The display illumination turns on as well, when the communication to the SITRAM® Multisense unit via serial interface RS232 is active (only for service purposes).

Authentication

Some settings and operations of the SITRAM® Multisense unit are protected by user name and password:

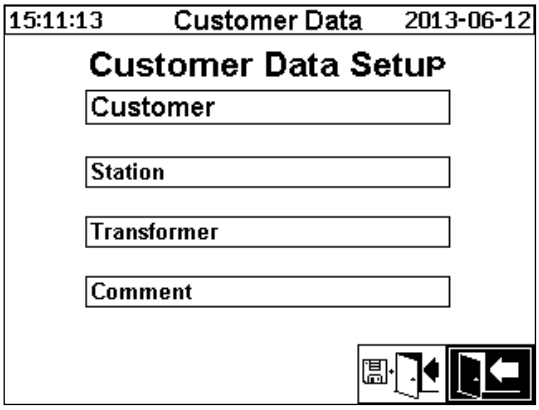
- User name (Default user name: Siemens Energy)
  - Modem Login
- String password (Default string password: KWA)
  - Modem Login
- Numeric password (Default numeric password: 9999)
  - Device setup
  - Customer data setup
  - Alarm acknowledgement

Main display toggling – Main menu

The content of the main screen changes in a defined cycle. By repressing the Enter key the following selection can be made:

- Standard Changes every 5 seconds
- Slow Changes every 15 seconds
- Very slow Changes every 25 seconds

4.8.5.3.1 Customer data setup



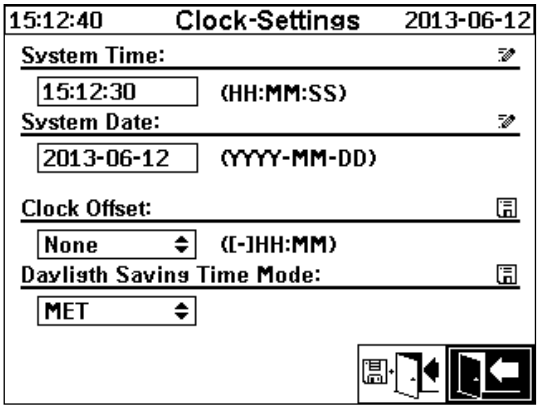
The selection of the field is made with the cursor keys and the enter key. The input is made with the alphanumeric keypad and the cursor keys and will be confirmed by pressing the enter key. Up to 26 characters can be entered, but only the first 10 characters will be displayed in the main menu.


Save and exit menu


Save and exit

4.8.5.4 Date, time & clock settings

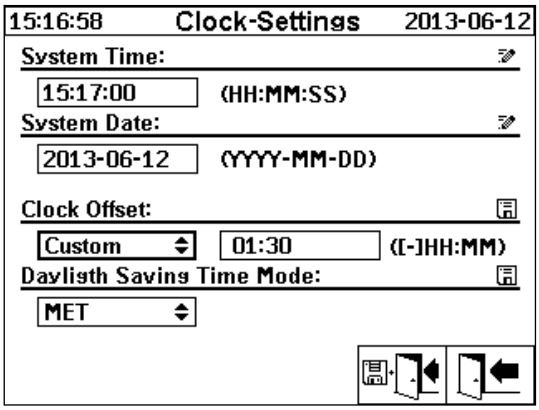
The SITRAM® Multisense unit has a submenu to setup the system time, system date, clock offset and the daylight-saving time mode.



Following input formats has to be considered for the system time and system date:

System Time: [hours]:[minutes]:[seconds] (Input of the double point with the . key)

System Date: [year]-[month]-[day] (Input of the minus with the +/- key)



Clock offset

With the clock offset the time shift to GMT time (Greenwich Mean Time) can be set. By repressing the Enter key the following selection can be made:

- None
- +01:00 to +06:00
- Custom
- -06:00 to -01:00

In the setting custom the needed time shift can be entered in [hours]:[minutes] into the right field. Input of the double point with the . key.

Note: "None“ means that the synchronization to GMT time is not active. This setting is recommended.

DST, Daylight saving time mode

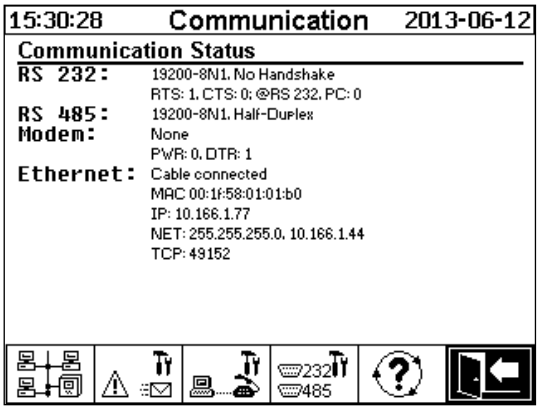
For the DST mode following selections are possible by button:

- MET (Middle European Time): The summer and winter time is switched automatically.
- No: The function is deactivated.

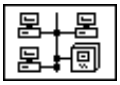
Note: The daylight-saving time refers to the time zone MET
(Last Sunday in March to last Sunday in October)!

4.8.5.5  Communication / Connection

In the communication / connection menu the configuration of the communication interfaces are made and the status of the corresponding interface (RS232, RS485, Modem and Ethernet) is displayed.

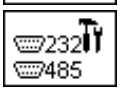


Following submenus are available in the communication / connection menu:


Network setup (4.8.5.5.1)


Alarm SMS setup (4.8.5.5.2)


Modem setup (4.8.5.5.3)



RS232 / 485 setup (4.8.5.5.4)


Refresh status information


Exit menu

4.8.5.5.1  Network setup

The unit is equipped with an Ethernet interface. It allows the integration into a TCP/IP local area network and supports static and dynamic integration. How the unit has to be incorporated into the network (on site) has to be defined by the network administrator.

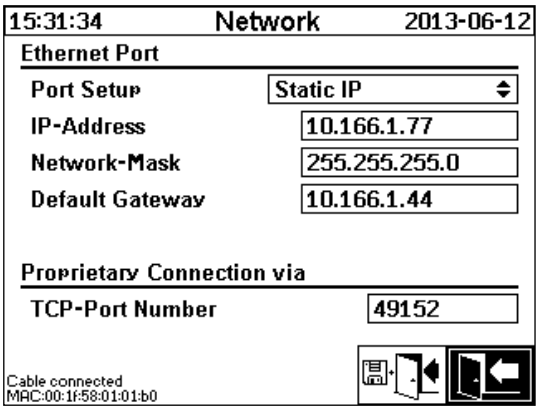
4.8.5.5.1.1 Static IP

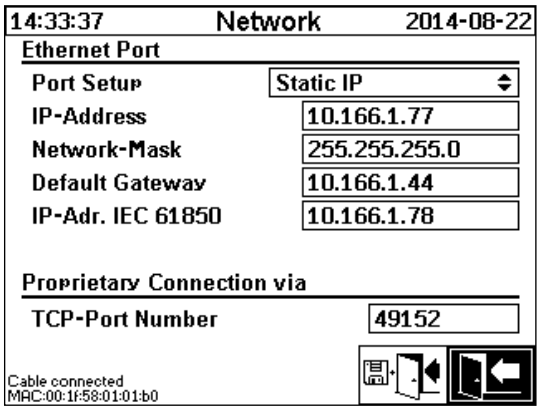
The network administrator has to deliver the following information, which has to be entered into the corresponding fields of the network submenu:

- IP Address
- Network mask
- Default gateway

With selected IEC 61850 modem in addition:

- IP Address IEC 61850

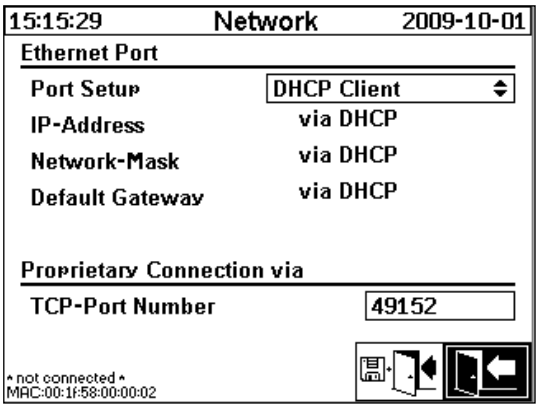




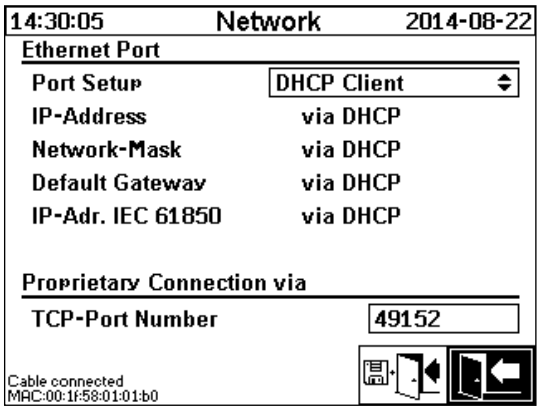
4.8.5.5.1.2 DHCP Client

The network administrator must allow the automatic TCP/IP address assignment for the SITRAM® Multisense unit in the network.

Normal screen:



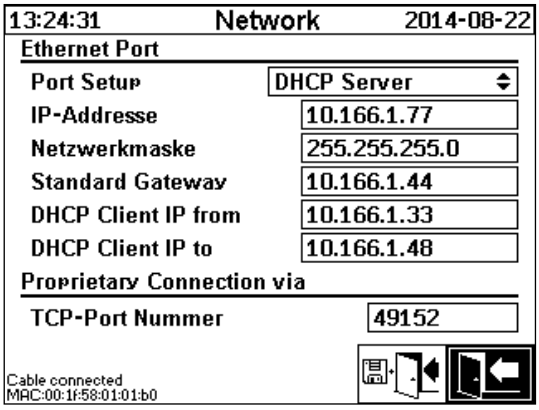
With selected IEC 61850 modem in addition:



4.8.5.5.1.3 DHCP Server

For test purposes a DHCP server can be activated on the unit. This feature is only implemented to allow the connection of a laptop / portable computer with Windows standard network configuration during installation.

Note: The unit is not designed to serve as a real DHCP server in a real network environment.



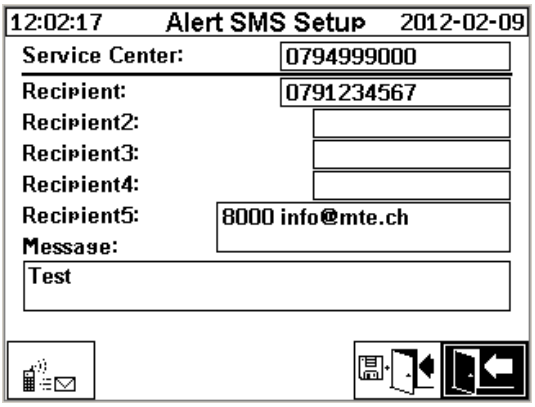
4.8.5.5.1.4 TCP-Port Number

The TCP Port Number should also be defined by the network administrator. The free range for TCP port number is: 49152 ... 65535. Default factory setting is 49152.

Possible range is 1 ... 65535, but some of these numbers are reserved for other applications e.g. by HTTP, FTP, E-Mail etc.

4.8.5.5.2 Alarm SMS setup

If the SITRAM® Multisense unit is equipped with an on-board GSM modem, the sending of short messages for incoming alarms can be configured in the alarm SMS menu. See chapter alarm level and alarm sources (4.8.4).



The number of the service center is entered in the top field, if this number is not already included on the SIM card.

The phone numbers of the alarm recipients are entered into the fields recipient - recipient 5.

At the receiver, 5 it is possible to enter either a phone number or an e-mail address. Here, however, a code number must be entered in front of the e-mail address. To get this code number, please contact the provider of the inserted SIM card.

For Swisscom Switzerland the following provider code number input has to be done:

"555<space>e-mail address<space>"

For Vodafone Germany the following provider code number input has to be done:

"3400<space>e-mail address<space>"

For T1 Germany the following provider code number input has to be done:

"8000<space>e-mail address<space>"

An alarm message (text message with max. 63 characters, which is sent by SMS or e-mail) is de-fined in the field "Message". The content of the alarm message can be entered directly and/or by us-ing a wild-card with the alphanumeric keypad.

Wild-card definition:

- {#} - Serial number
- {1} - Customer data line 1
- {2} - Customer data line 2
- {3} - Customer data line 3
- {4} - Customer data line 4
- {T} - System time long: “hh:mm:ss”
- {t} - System time short: “hh:mm”
- {D} - System date long: “YYYY:MM:DD”
- {d} - System date short: “YY:MM:DD”

Input examples:

"Alarm on Transformer 1!"

"{A} Alarm on SITRAM® Multisense {#}!"

"{#}{D}{T}{A}"

- {A} - Alarm name
- {a} - Alarm number
- {l} - Alarm level

Value of the alarm level {l}

Mode	Condition	Value
„All“	No Alarm	0
High	> High	1
High-High	> High	1
	> High-High	2
Low	< Low	1
Low-Low	< Low	1
	< Low-Low	2
Low-High	< Low	1
	> High	2
Range	> Low	1
	< High	1

Note: In the menu “Alert-Level and Alert-Sources” (4.8.4) the field action has to be selected to “log & SMS”, “Output & SMS” or “Output hold & SMS” to use this function. Moreover, the on-board GSM modem (4.8.5.5.3.2) must be installed and configured correctly.

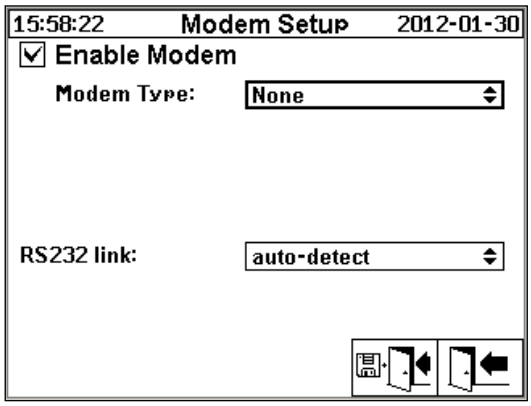

Send test SMS


Save and exit menu


Exit menu

4.8.5.5.3  Modem setup

If an on-board GSM-, GPRS, Analog- or DNP3 modem is installed in the SITRAM® Multisense unit, the modem settings are performed here:



Following functions are available:

Save and exit menu

Exit menu

In the field modem type following selection can be made by repressing the Enter key:

- **No Modem**
- **Analog (internal)** (4.8.5.5.3.1)
- **GSM (internal)** (4.8.5.5.3.2)
- **DNP3-GW (internal)** (4.8.5.5.3.3)
- **IEC61850-GW (int.**) (4.8.5.5.3.4)
- **GPRS** (4.8.5.5.3.5)

In the field RS232 link following selection can be made by repressing the Enter key:

- **auto-detect**
- **RS232 connector**
- **Modem socket**

The function RS232 link is used for internal switching of the RS232 interface:

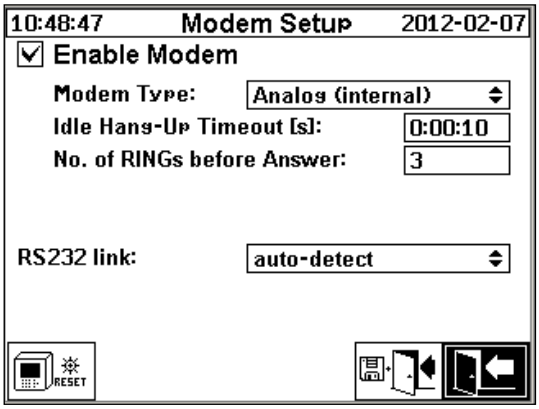
RS232 connector: Real RS232 interface on ST4 of the measurement and controller card. This in-terface is rarely used because SITRAM® Multisense 5 is equipped with an Ethernet interface.

Modem socket: On-board modem (BU4 and ST6). The connector ST6 on the measurement and controller card is only used for Siemens Energy service purposes!

Note: Standard setting is on auto-detect!

4.8.5.5.3.1 Analog modem

For the selection Analog (internal) the following screen will be displayed:



Idle Hang-Up Timeout [s]
If no data communication is detected, the call will be terminated after this time (10 ... 2550)

No. of rings before answer
Number of rings before the modem answers the call (2 ... 12).

Following functions are available:

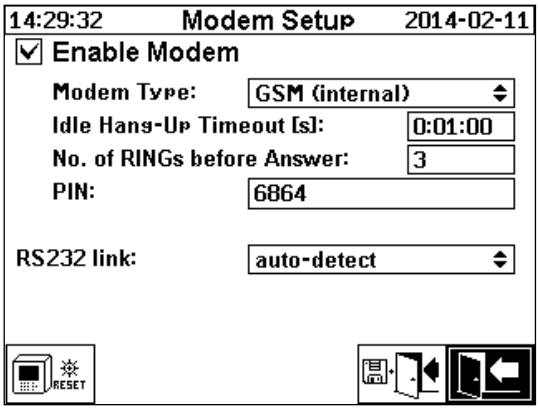
Modem reset (interrupts temporary the supply voltage of the modem)

Save and exit menu

Exit menu

4.8.5.5.3.2 GSM modem

For the selection GSM (internal) the following screen will be displayed:



Idle Hang-Up Timeout [s]
If no data communication is detected, the call will be terminated after this time (10 ... 2550)

Note: The value should be set to 1 minute (0:01:00)

No. of rings before answer
Number of rings before the modem answers the call (2 ... 12).

PIN
Enter the PIN code for the used SIM card here. If the SIM card does not require a PIN code, the field can be left empty.

Following functions are available:

Modem reset (interrupts temporary the supply voltage of the modem)

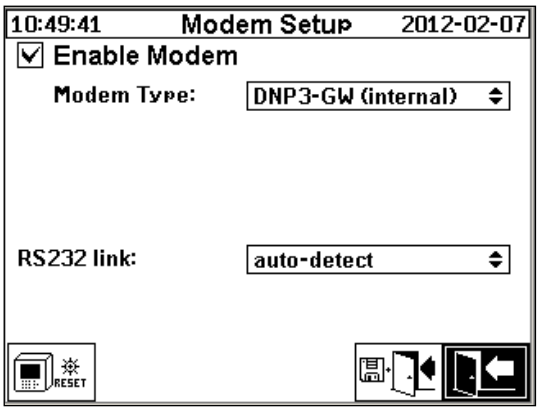
Save and exit menu

Exit menu

Note: Using a GSM modem the RS232 interface should be configured as follow:
Baud rate: 19200
Handshake: RTS/CTS (is detected automatically if GSM modem is plugged in)

4.8.5.5.3.3 DNP3 modem

For the selection DNP3-GW (internal) the following screen will be displayed:



No additional settings are available for this modem type.

Following functions are available:

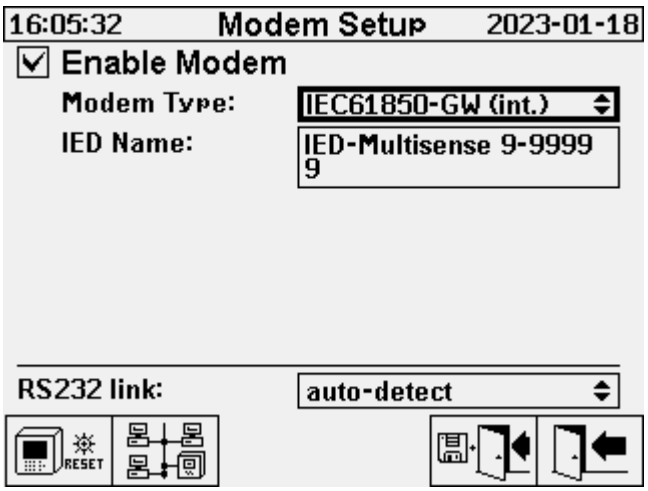
Modem reset (interrupts temporary the supply voltage of the modem)

Save and exit menu

Exit menu

4.8.5.5.3.4 IEC 61850 modem

For the selection IEC61850-GW (int.) the following screen will be displayed:

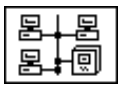


IED Name

This input field is used for naming the SITRAM® Multisense unit in the IEC 61850 namespace. The alphanumeric key pad is used to enter the name, same procedure as on other input fields. Without entering, the name will be automatically generated:
„IED-MS“ <number of SITRAM® Multisense type> „-“ <serial number> e.g.: IED-MS9-99999

Following functions are available:

Modem reset (interrupts temporary the supply voltage of the modem)



Network setup (4.8.5.5.1) / (0)

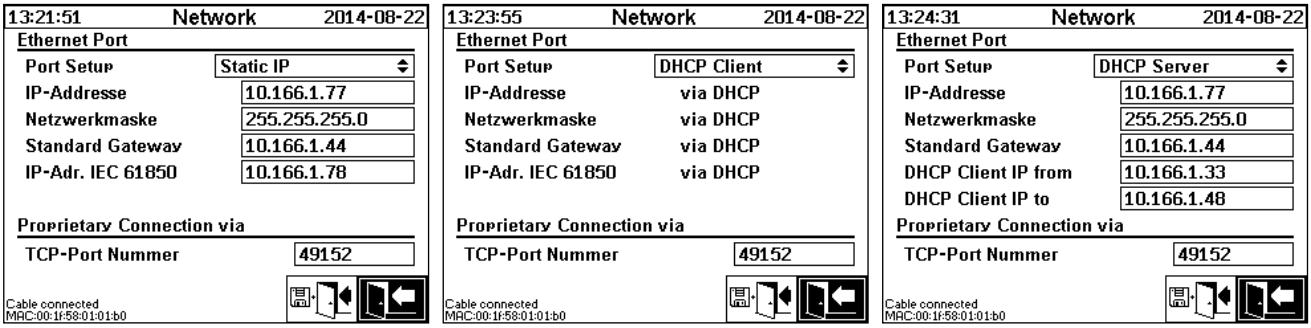
Save and exit menu

Exit menu

Note: Using an IEC 61850 modem the RS232 interface should be configured as follow:
Baud rate: 57600

Network setup with IEC 61850

The general network settings are expanded by the input field (IP-Adr. IEC 61850). There may be entered in the case of IP Static selection, the IEC 61850 network address. When selecting DHCP client the address assignment is automatically generated. The selection DHCP server is only used for test purposes.



Note: The unit is not designed to serve as a real DHCP server in a real network environment.

4.8.5.5.3.5 GPRS modem

The status or the settings for GPRS modem can be found in three screens

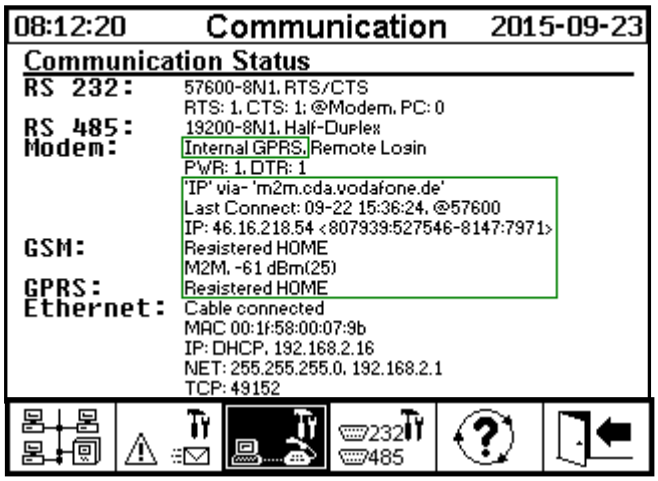
- Communication status
- Modem Setup settings
- Main screen IP-address

GPRS Modem Status

Device Setup -> SITRAM® Multisense Setup

SITRAM® Multisense Setup: Communication/Connection.

Expanded screen: *Communication*



Expanded information:

- **Modem:**
  Protocol and server information, the start of the connectionan the assigned IP-address. In the angle brackets counters for transmitted / received bytes and PPP packets are displayed
- **GSM:**
  Registration status, network operator and signal strength
- **GPRS:**
  Registration status

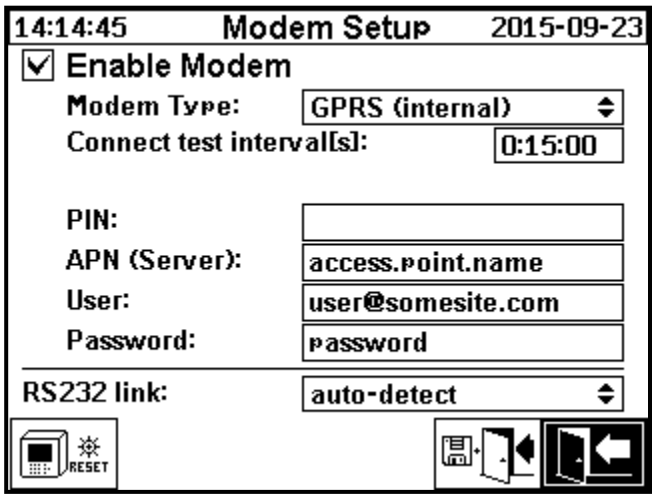
GPRS Modem setting

Device Setup -> SITRAM® Multisense Setup

SITRAM® Multisense Setup: Communication/Connection.

Communication -> Modem Setup

Expanded screen: *Modem Setup*

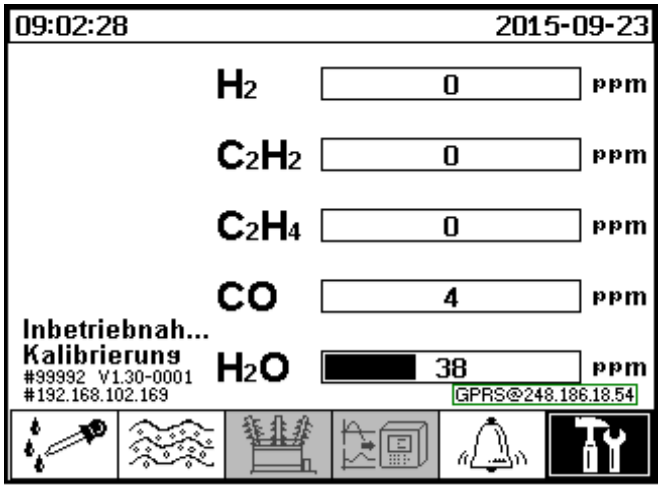


- GPRS (internal)
  If GPRS – Modem is selected, there are fife elements:
  - Connect test interval[s]
  - PIN
  - APN (Server):
  - User:
  - Password:
- Connect test interval[s]
  Here, the time will be entered, which is used to determine whether the connection is still active. If there is no data traffic for the specified time, the other party (the server, which is the radio network operator) is called. In response the connection is OK. Otherwise a modem restart sequence is executed (DTR off/on, to login), restore the connection.
  Note: Prefer here shorter time settings (less than 15 minutes). The connection is constantly and generates only then costs, when data is transmitted. A short test interval generates unnecessary data volume that has to be paid. There must be a balance between early detection of an interrupted connection and the costs.
- PIN
  The GPRS-Modem registered themselves in GSM network. Here is a pin is necessary.
  Note: This is a current option (not tested), because no PIN entry was necessary in the previously available SIM cards, to start a GPRS-connection.
- APN (Server)
  APN (Access Point Name) is a String, indicating the name of the server, in which to log the modem. The input is required for operation of the GPRS connection.
  Examples for valid APN settings: 'internet.t-mobile', 'web.vodafone.de'.
- User and
- Password
  To log on to the Server can be used UPAP (User Password Authentication Protocol). The two fields User and Password must be set with the corresponding data.

Note: UPAP is possible even with empty User and Password.

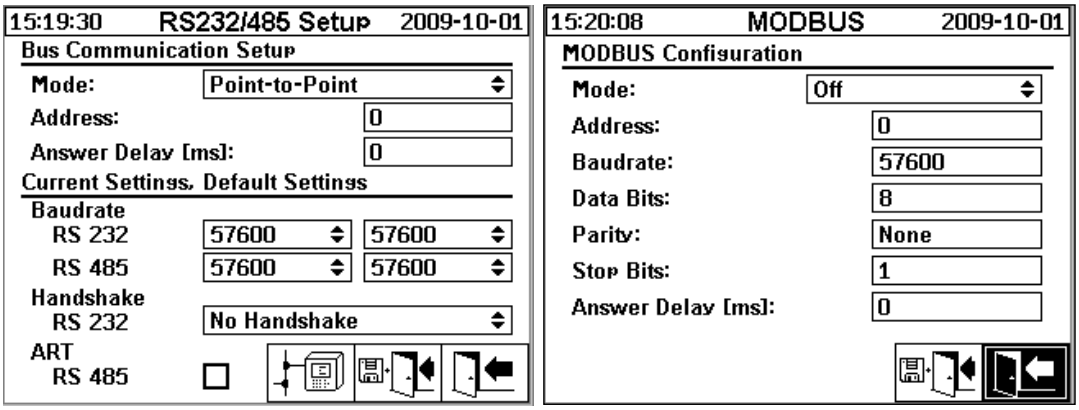
4.8.5.5.3.6 Main screen

During a GPRS connection, the IP address is displayed at the bottom right.



4.8.5.5.4 RS232 / RS485 setup

The settings for the serial interface must be entered in the following menus:



This section shows various ways in order to communicate with the SITRAM® Multisense unit.

- **Point-to-Point** (0)

Direct connection between Host (PC) and one SITRAM® Multisense unit via RS232, RS485 or Modem.

- **Bus-Node** (4.8.5.5.4.3)

Connection between Host (PC) and several SITRAM® Multisense units via RS485 bus.

- **Bus-Bridge** (4.8.5.5.4.4)

Connection between Host (PC) and several SITRAM® Multisense units via RS485 bus. A SITRAM® Multisense unit is used as gateway, i.e. it has a modem- or a RS232 connection with the Host (PC).

- **MODBUS** (4.8.5.5.4.5)

Connection between a SCADA System and one or several SITRAM® Multisense units.

4.8.5.5.4.1 General

The RS232 interface is only available for service purposes and a special connection cable is necessary. The following sections describe how to configure the SITRAM® Multisense units and the SITRAM® Multisense Software software. After a short description screen shots of SITRAM® Multisense and SITRAM® Multisense Software illustrate the setup. Some comments and notes may follow the screen shots.

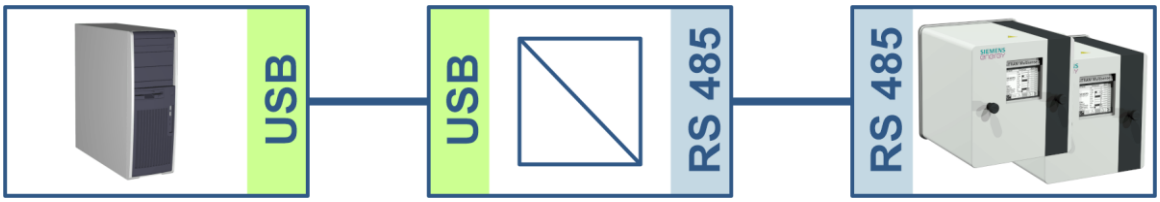
Note: SITRAM® Multisense Software is described in detail in its own separate operation manual.

4.8.5.5.4.2 Point to point

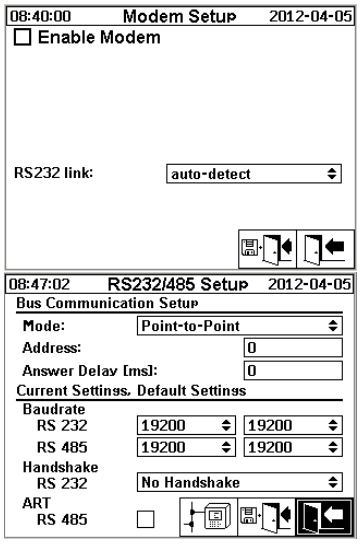
The point-to-point connection has the simplest setup. The host (PC) is connected directly to one SITRAM® Multisense unit. For this connection the RS232 interface (service purpose only), the RS485 interface or the modem can be used. The point-to-point connection is the default setting in the SITRAM® Multisense unit and SITRAM® Multisense Software.

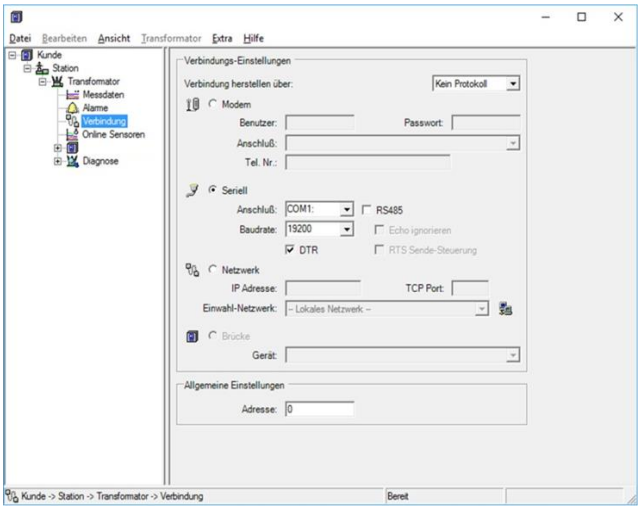
Point to point - RS485

The RS485 interface can be used for long distance connections (up to 1000 m). This consists of a two-wire interface with half-duplex and software-handshake.



SITRAM® Multisense **SITRAM® Multisense Software**





Make sure that the baud rate and COM port are set correctly in SITRAM® Multisense Software and that the checkbox ART RS485 is selected (default: ART not selected) in the firmware menu. An RS485 adapter may require additional settings in SITRAM® Multisense Software connection settings (ignore echo, RTS send control).

ART

SITRAM® Multisense 5 hardware supports ART (Automatic Receive Transmit Control). ART is a special RS485 protocol which simply sends the data and switches off the transmission mode immediately after the last character has been sent. For this type of protocol the RS485 communication bus must be equipped with special terminating resistors.

RS485 PC-Adapter

To connect a Host (PC) to the SITRAM® Multisense RS485 interface, usually an adapter (interface converter) is required. Depending on the properties of the adapter in use, the RS485 related checkboxes in SITRAM® Multisense Software must be set accordingly.

For communication with a SITRAM® Multisense unit only the two-wire half-duplex mode is of interest. This mode requires a kind of send/receive-control which is either ART (Automatic Receive Transmit control) or a manual control (e.g. via the RTS signal). Further the adapter may echo the sent data.

The two checkboxes in the SITRAM® Multisense Software connection settings must mirror the properties of the adapter:

- Ignore echo
  Must be selected, if the adapter sends a response (echo).
- RTS send control
  Must be selected, if the adapter needs a manual send-/receive control via RTS signal.

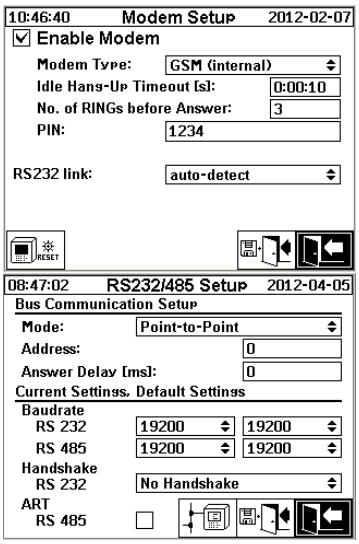
Answer delay

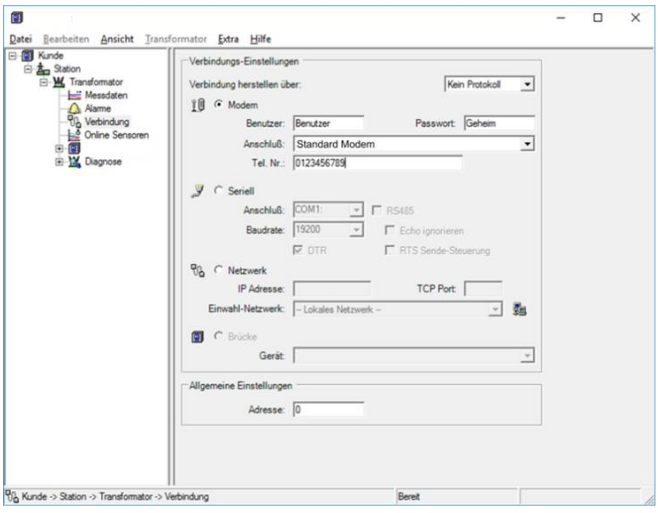
If an adapter with RTS send control is used, everything is configured right and the communication still does not work, this may be due to the send-/receive control. If the adapter does not release the transmitter quick enough, the answer of the SITRAM® Multisense unit is recognized only partially or not at all. Therefore, in SITRAM® Multisense an answer delay should be entered (0 ... 2550 ms) to conteract this problem.

Point to point - Modem

The modem allows a remote access to the unit using a telephone line. The connection via modem is very similar to the point-to-point connection via RS232. The connection supports full-duplex, but may be limited in speed.

SITRAM® Multisense **SITRAM® Multisense Software**



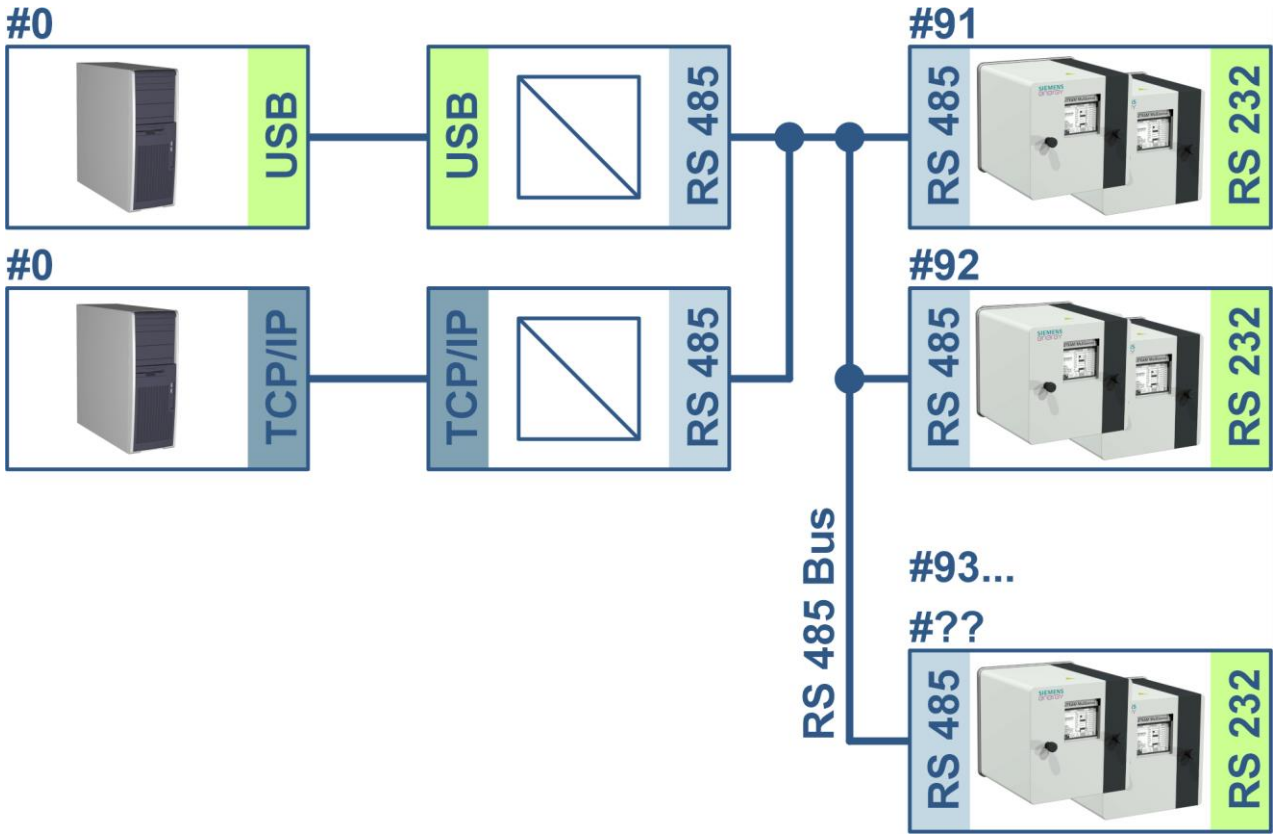


The configuration of the SITRAM® Multisense modem is already performed at the factory before delivery. In SITRAM® Multisense Software “Connect via: Modem” should be selected and the corresponding fields (Login, Password, Device, Tel. Nr.) filled out correctly (4.8.5.5.3.2).

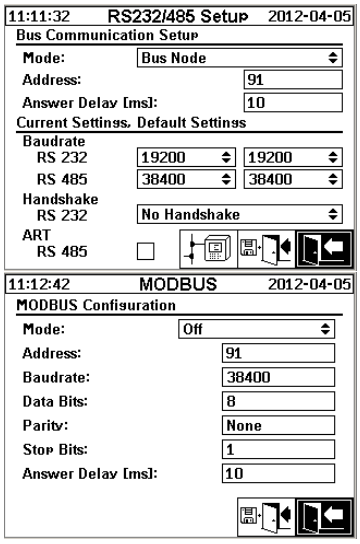
4.8.5.5.4.3 RS485 Bus-Node

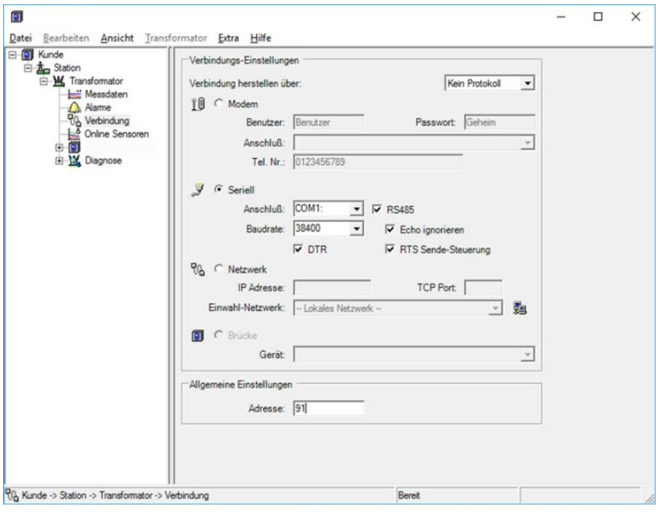
Using the RS485 interface it is possible to connect several SITRAM® Multisense units to a host (PC). However, it is possible to communicate with one unit at a time. The following figure shows the schematic topology.

Note: Of course, there must be only one host (PC)! The host (PC) with the TCP/IP connection is showed as an alternative way how the connection to the RS485 bus could look like. Various third-party suppliers have such af network-to-serial-adapter in their assortment.



SITRAM® Multisense **SITRAM® Multisense Software**





Bus communication setup in the SITRAM® Multisense unit:

- Select Mode to "Bus Node"
- Enter unique address (1...254) for each unit in the RS485 bus

Note: There can be up to 32 units in the RS485 bus currently.

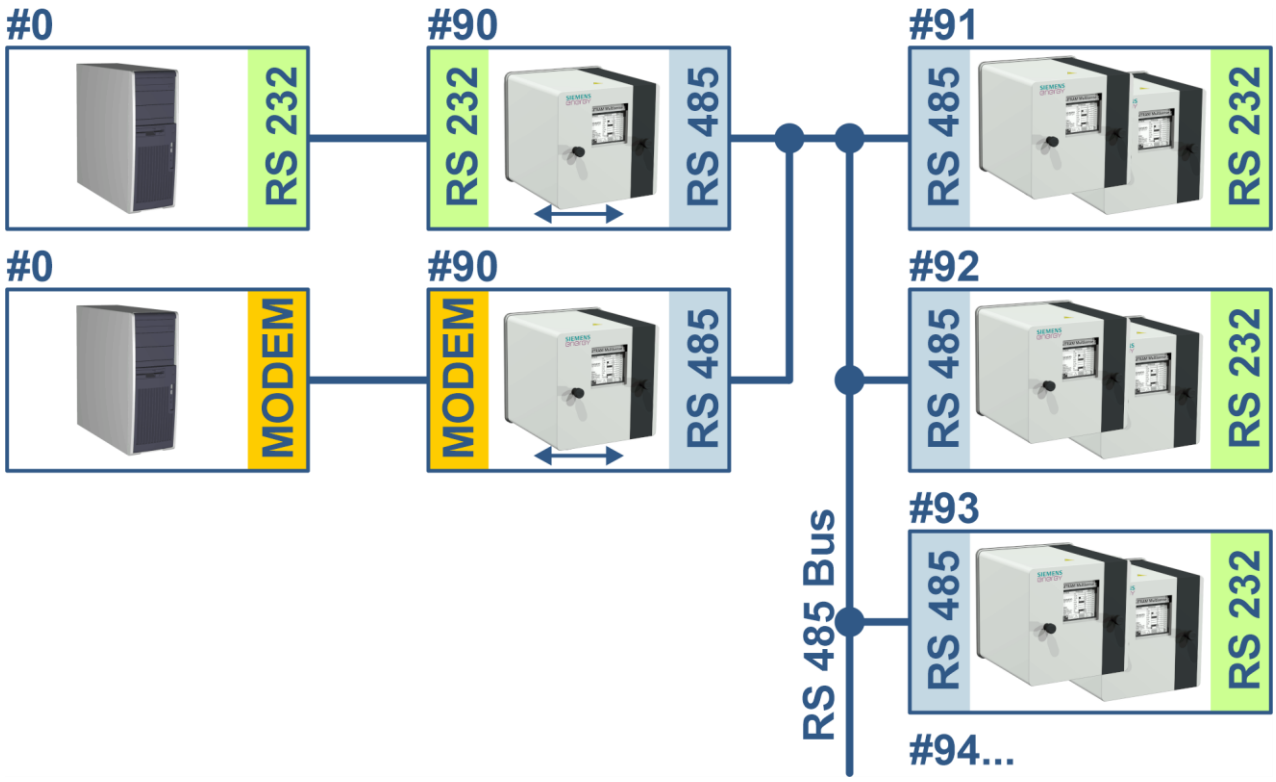
- Enter "Answer delay" (0 ... 2550 ms), based on the adapter in use
- Select baud rate (300 ... 115200) for RS485 current settings
- Select MODBUS Mode to “Off”

Connection settings in SITRAM® Multisense Software:

- Select COM-Port in Connect via:
- Select correct Device
- Select checkbox RS485
- Select baud rate (300 ... 115200) for RS485 (same setting as unit)
- Select checkboxes Ignore Echo & RTS Send control according to adapter specification
- Common settings: Enter correct address (own bus address)

4.8.5.5.4.4 RS485 Bus-Bridge

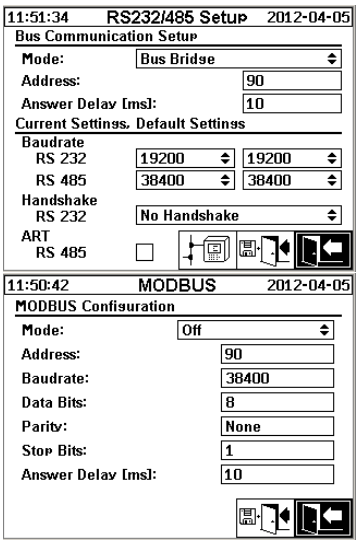
The RS485 bus bridge is an extension to access several SITRAM® Multisense units in a RS485 network. In this configuration the host (PC) is connected to a SITRAM® Multisense unit, which serves as a gateway, using either the RS232 interface or a modem.

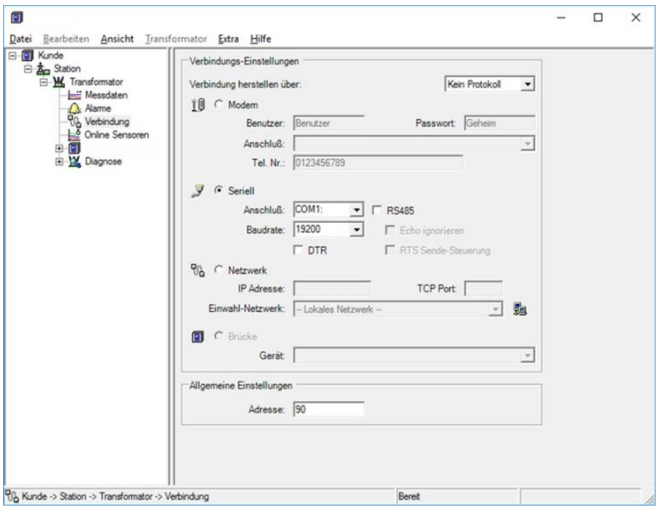


The setup of all SITRAM® Multisense units must be according to the RS485 bus node setup, with one ex-ception. The SITRAM® Multisense that serves as a communication gateway must be selected as a “Bus Bridge” in the bus communication setup field Mode.

Bus-Bridge - Gateway unit setup

SITRAM® Multisense	SITRAM® Multisense Software





Bus communication setup in the SITRAM® Multisense unit:

- Select Mode to "Bus Bridge"
- Enter unique address (1...254) for each unit in the RS485 bus

Note: There can be up to 32 units in the RS485 bus currently.

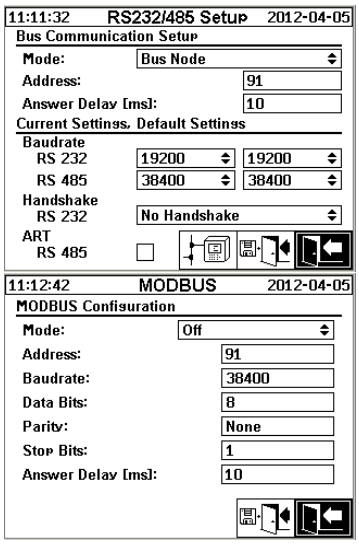
- Enter "Answer delay" (0 ... 2550 ms) (suggested value: 0)
- Select baud rate (300 ... 115200) for RS485 current settings
- Select baud rate (300 ... 115200) for RS232 current settings
- Select MODBUS Mode to “Off”

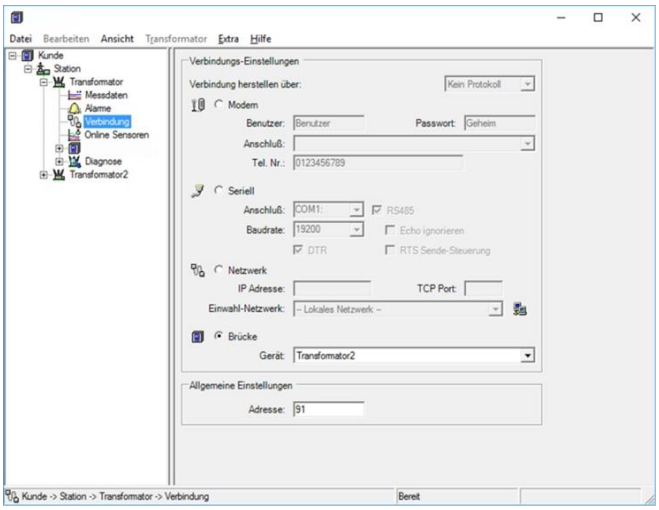
Connection settings in SITRAM® Multisense Software:

- Select COM-Port in Connect via:
- Select correct Device
- Checkbox RS485 not selected!
- Select baud rate (300 ... 115200) for RS232 (same setting as gateway unit)
- Common settings: Enter correct address (own bus address)

Bus-Bridge - Bus unit setup

SITRAM® Multisense	SITRAM® Multisense Software





Bus communication setup in the SITRAM® Multisense unit:

- Select Mode to "Bus Node"
- Enter unique address (1…254) for each unit in the RS485 bus

Note: There can be up to 32 units in the RS485 bus currently.

- Enter "Answer delay" (0 … 2550 ms) (suggested value: 0)
- Select baud rate (300 … 115200) for RS485 current settings
- Select MODBUS Mode to “Off”

Connection settings in SITRAM® Multisense Software:

- Select Bridge in Connect via:
- Device: Select the SITRAM® Multisense unit which serves as gateway
- Common settings: Enter correct address (own bus address)

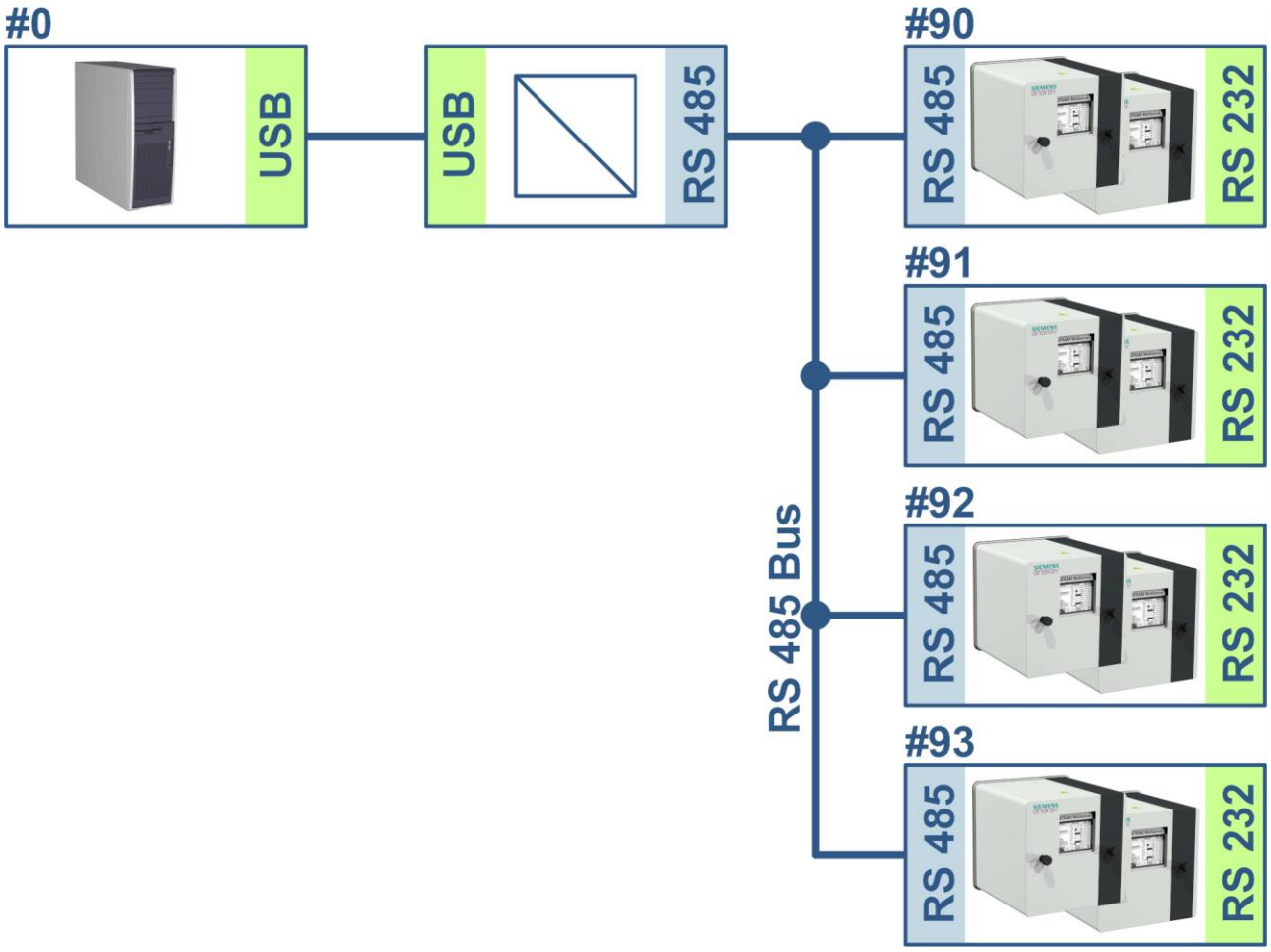
Bus-Bridge – Gateway unit modem setup

The bus bridge function can also be realized with a modem connection on the primary side. The settings for SITRAM® Multisense and SITRAM® Multisense Software are the same like in the point-to-point configuration which are explained in (0).

4.8.5.5.4.5 MODBUS

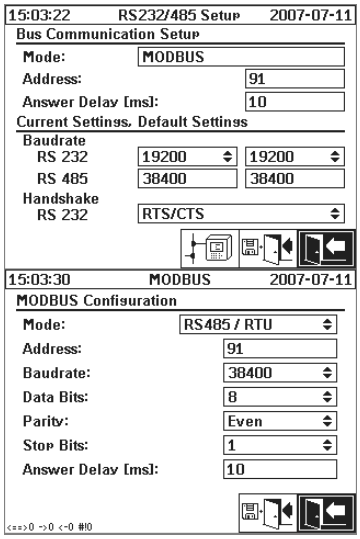
MODBUS via USB

The connection of multiple SITRAM® Multisense units to a control system can be done via the MODBUS. At this time Modbus is not realized in SITRAM® Multisense Software but for the sake of completeness it is listed here.



As an example the connection from “ADAM-4572 1-port Modbus® to Ethernet Data Gateway” from Advantech (www.advantech.com) is presented here.

SITRAM® Multisense



Settings MODBUS configuration in SITRAM® Multisense 5:

- Selection of the required mode:
  - RS485 RTU
  - RS485 ASCII
  - RS232 RTU
  - RS232 ASCII
- Distinct address (1...254) assigned to each unit in the RS485 bus.

Note: Actually up to 32 units can be present in the same RS485 bus.

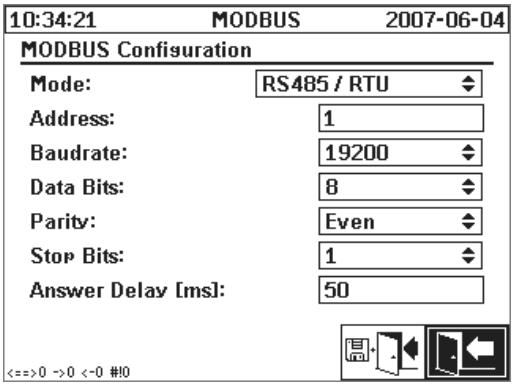
- Set baud rate (2400, 4800, 9600, 19200, 38400, 57600 or 115200)
- Set data (7 or 8)
- Set parity (none, odd or even)
- Set stop bits (1 or 2)
- Set response delay if necessary (0 ... 2550 ms)

Note: In case the MODBUS protocol via RS232 interface is active and:

- if no data flow control (RTS / CTS) is available
- if the internal modem is not available

4.8.5.5.4.6 MODBUS Configuration

With the Enter key in the mode field the following selection can be done:



- **Mode**

Off / RS485 RTU / RS485 ASCII / RS232 RTU / RS232 ASCII (Service purpose only)

- **Address**
- The unit address is to be entered in the address field. The address range from 1 ... 247 is approved for the MODBUS communication. Addresses from 1...254 can be assigned for the SITRAM® Multisense proprietary protocol.

Note: Actually up to 32 units can be present in the same RS485 bus.

- **Baud rate, data bits, parity und stop bits**

The format coding of the serial MODBUS protocol can be set with these input fields.

Note:

- The format coding will not be adapted automatically by changing the mode. Related to the mode the format coding has to be entered manually.
- Only the adjustment of the baud rate is used for the SITRAM® Multisense proprietary protocol. The remaining settings will be ignored and the fixed values (8 data bits/ no parity / 1 stop bit) will be adopted.

- **Answer delay**

In case problems occur with the communication an answer delay (0 ... 2550 ms) mostly solves the problem.

Test options for SITRAM® Multisense 5

An image of the MODBUS statistics can be found in the lower left corner of the LCD display:

<==> 0 ; Counter of all MODBUS messages
-> 0 ; Counter of all received MODBUS messages
<- 0 ; Counter of all transmitted MODBUS messages
#! 0 ; Counter of all parity- and framing errors in the interface

4.8.5.5.4.7 MODBUS/TCP via Network

The MODBUS communication can be implemented into a network. MODBUS/TCP is available on the unit and uses the standard port number 502. It is independent from the serial MODBUS configuration. The functions register- and address display are identical to the serial port realization. Two MODBUS/TCP connections are possible simultaneously. MODBUS/TCP is always on.

5. Modbus: Function, Register und Address Mapping

The following MODBUS functions, register- and address ranges are used:

Modbus Function Code	Modbus Address Dec / Hex	Register Address [1] (5 Digits Dec)	SITRAM® Multisense
0x02 Read Discrete Input	 1000 / 3E8 ... 1015 / 3F7	 11001 ... 11016	**Alarm status** Alarm #1 ... Alarm #16 Only the information whether an alarm condition is pending is returned. The level of the alarm (e.g. Hi or Hi-Hi) is not transmitted.
0x04 Read Input Register	 1000 / 3E8 ... 1029 / 405	 31001 ... 31030	**Sensor value** Sensor #1 ... Sensor #30 The sensor assignment is given by the proprietary command SNSR (see below the mapping table). The sensor value is transmitted as a signed integer. Prior to transmission the real reading is multiplied by 10 (to have a 1-digit precision). So to get the 'real' measurement the returned value must be divided by 10. An open sensor input (NAN-value) is returned as value -32768 (0x8000). **When real values are greater than 15,000 ppm, this function will not properly perform. Utilize then the floating point addresses (see next line)**
0x04 Read Input Register	 2000 / 7D0 2002 / 7D2 2004 / 7D4 ... 2059 / 80B	 32001 32003 32005 ... 32060	**Sensor value** Sensor #1 Sensor #2 Sensor #3 ... Sensor #30 The sensor assignment is given by the proprietary command SNSR (see below the mapping table). The sensor value is transmitted as a floating point value (32 bit, big-endian). An open sensor input is returned as value NAN (0x7FFFFFFF).

Modbus Function Code	Modbus Address Dec / Hex	Register Address [1] (5 Digits Dec)	SITRAM® Multisense
0x04 Read Input Register	 3000 / BB8 ... 3015 / BC7	 33001 ... 33016	**Alarm status** Alarm #1 ... Alarm #16 The full alarm status information is returned. 0 No alarm 1 Level 1 alarm (not active) 2 Level 2 alarm (not active) 3 Level 1 alarm (active) 4 Level 2 alarm (active)
0x04 Read Input Register	 4000 / FA0 ... 4001 / FA1 4002 / FA2 ... 4003 / FA3	 34001 ... 34002 34003 ... 34004	**Request Aging Rate** Loss of life [s] Operation time [s] The values are transferred as unsigned 32 bit integer values each into two MODBUS register addresses
0x04 Read Input Registers	 5000 / 1388- 5001 / 1389 .. 5002 / 138A- 5003 / 138B	 35001 - 35002 .. 35003 - 35004	**Query System Status Registers** System Error Extraction Chamber Two freely configurable registers are available for testing the write function. A value of 0 (zero) indicates correct operation.
0x06 Write Single Register	 0 / 0 ... 1 / 1	 40001 ... 40002	**Holding Register** Test register #1, #2 To test the write functionality there are 2 registers that may be modified freely. (The reset initialization values of the two registers are 0xA5A5 and 0x5A5A.)

Modbus Function Code	Modbus Address Dec / Hex	Register Address [1] (5 Digits Dec)	SITRAM® Multisense
0x06 Write Single Register	1000 / 3E8	41001	**Alarm Confirmation** Alarm status #16 .. #1 The alarms are coded as a bit field and are presented as a single MODBUS register (Alarm #16 -> 0x8000, alarm #1 -> 0x0001). By writing a '0'-Bit at the corresponding position a probably active alarm can be reset. Writing '0000' resets all alarms.
0x06 Write Single Register	2000 / 7D0	42001	**Switch MODBUS protocol off** MODBUS off It is now possible to switch the MODBUS protocol off via MODBUS. This is done by writing 0x00FF (like OFF).
0x03 Read Holding Register	 0 / 0 ... 1 / 1 1000 / 3E8 2000 / 7D0	 40001 ... 40002 41001 42001	**Holding Registers** 16-Bit test register #1, #2 Alarm status bit pattern #16 ... #1 MODBUS protocol status **Note:** The reading is always 0x0000. If the MODBUS status is OFF, it is not possible to read this status via MODBUS.

[1] Modicon® PLC address schematic

Currently the following assignment of sensor numbers (SNSR) applies:

1	Gas sensor H_2	
2	Gas sensor C_2H_2	
3	Gas sensor C_2H_4	
4	Gas sensor CO	
5	Temperature sensor $\vartheta 1$	(T1 Gas temperature measurement cell)
6	Temperature sensor $\vartheta 2$	(T2 Oil temperature extraction chamber)
7	Oil moisture sensor	
8	- reserved -	
9	Daily trend gas sensor H_2	
10	Daily trend gas sensor C_2H_2	
11	Daily trend gas sensor C_2H_4	
12	Daily trend gas sensor CO	
13	Weekly trend gas sensor H_2	
14	Weekly trend gas sensor C_2H_2	
15	Weekly trend gas sensor C_2H_4	
16	Weekly trend gas sensor CO	
17 ... 22	Additional sensors 1 ... 6	(Analog sensors AC)
23 ... 26	Additional sensors 7 ... 10	(Analog sensors DC)
27 ... 30	Virtual sensors 11 ... 14	(Hotspot, aging rate, etc.)

5.1 Serial MODBUS Communication Examples

The following hard- and software was used to test the MODBUS communication together with SITRAM® Multisense. Both programs are available for download free of charge. The two hardware adapters are not the only applications that operate together with SITRAM® Multisense. They are only two tested examples.

Programs (for Microsoft® Windows):

- QuickMod Modbus® scanning tool (Windows based)
  AzeoTech, Inc. (www.azeotech.com)
- Modpoll Modbus® Polling Tool (command line Tool)
  FOCUS Software Engineering (www.focus-sw.com)

Hardware:

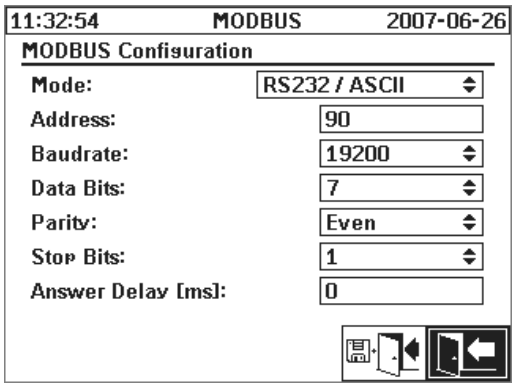
- Roline RS232C / RS485 Converter
  Roline IC-485S (12.02.1028), IC-485SI (12.02.1029), (www.rotronic.ch)
- ADAM-4572 1-port Modbus® to Ethernet Data Gateway
  Advantech (www.advantech.com)

5.1.1 MODBUS RS232 ASCII with Modpoll (RS232 Service purpose only)

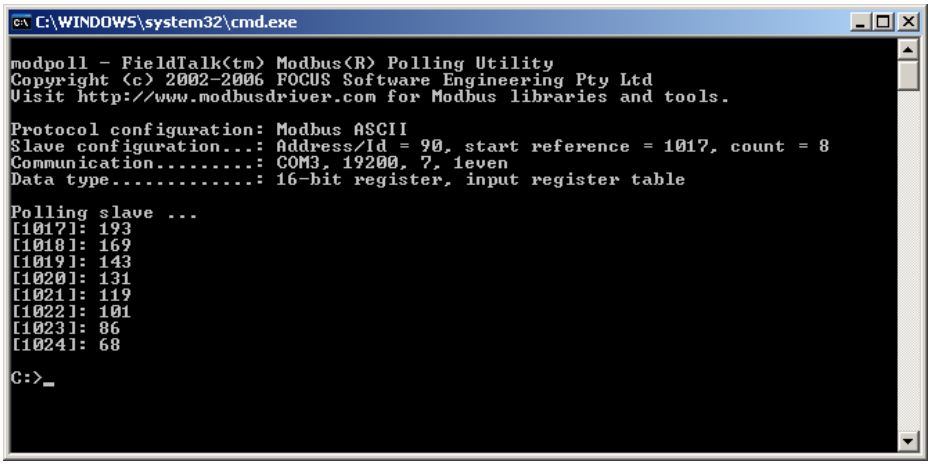
Connection, settings and results are as follows:

- Physical connection

- SITRAM® Multisense settings and screenshot



- SITRAM® Multisense can be operated without answer delay for this application, because it supports full duplex mode via RS232 interface (RS232 service purpose only).
- Modpoll result screenshot



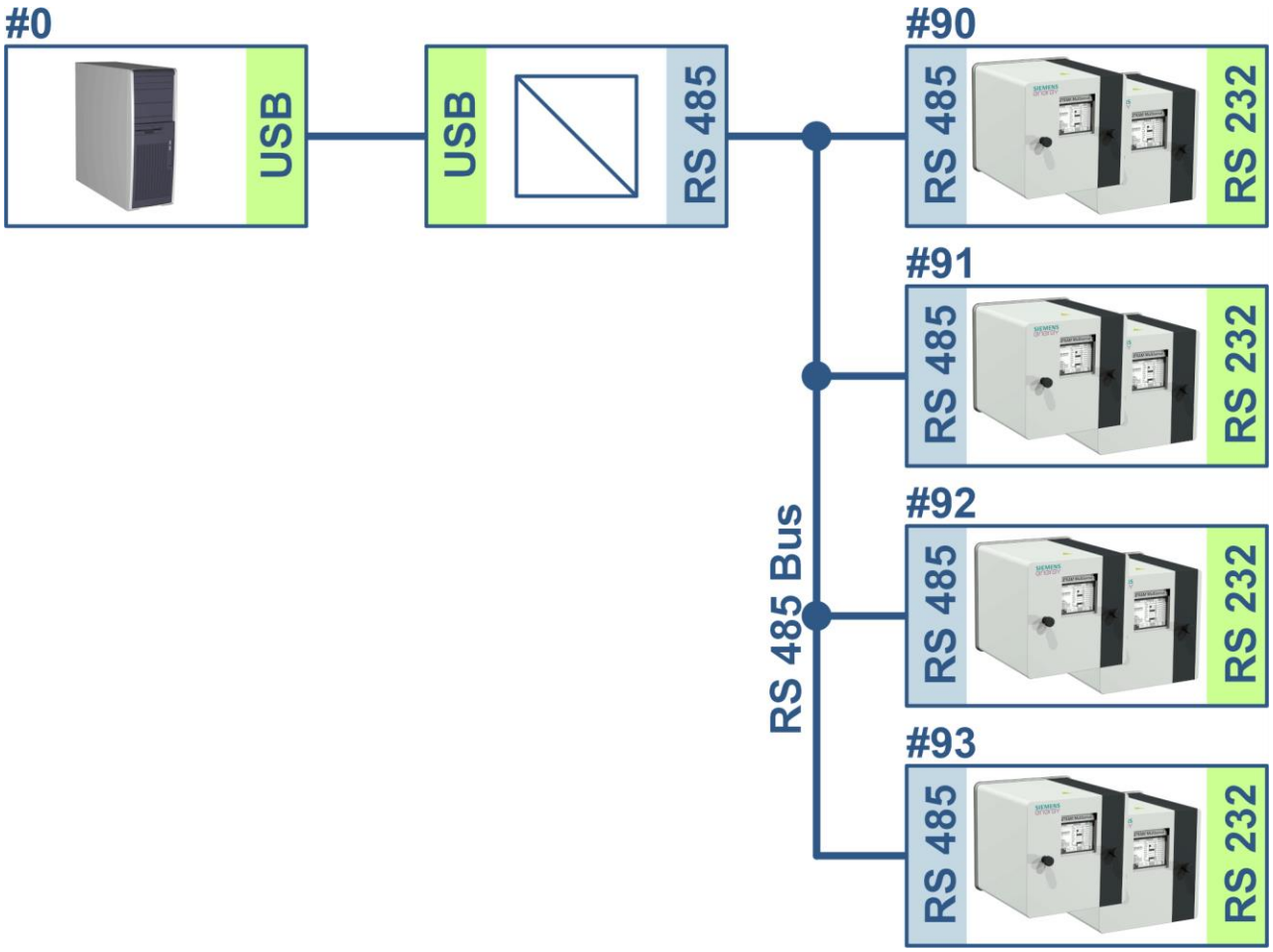
- To scan the additional sensors 1 ... 8, Modpoll needs the start register address 1017 (Address = 1016 ... 1023, Register = 1017 ... 1024).

5.1.2 MODBUS RS485 RTU with Modpoll

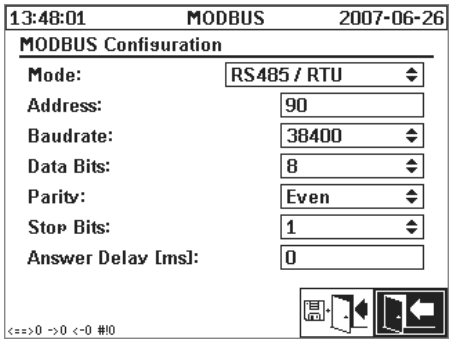
This RTU MODBUS connection was realized with Modpoll and the ADAM-4572 Ethernet-Gateway. It includes the possibility to connect multiple SITRAM® Multisense units to the RS485 bus.

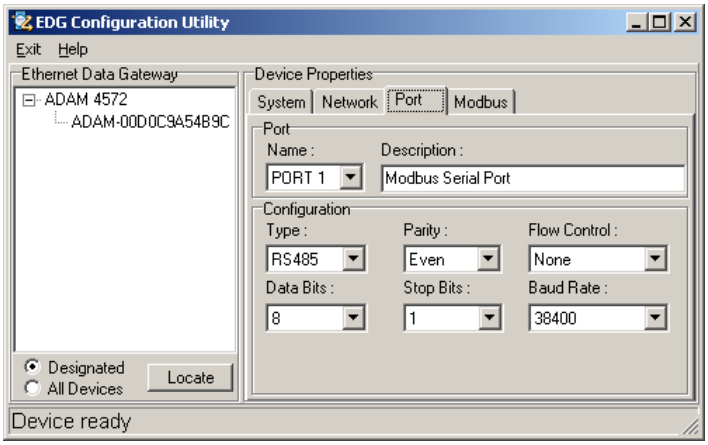
Connection, settings and results are as follows:

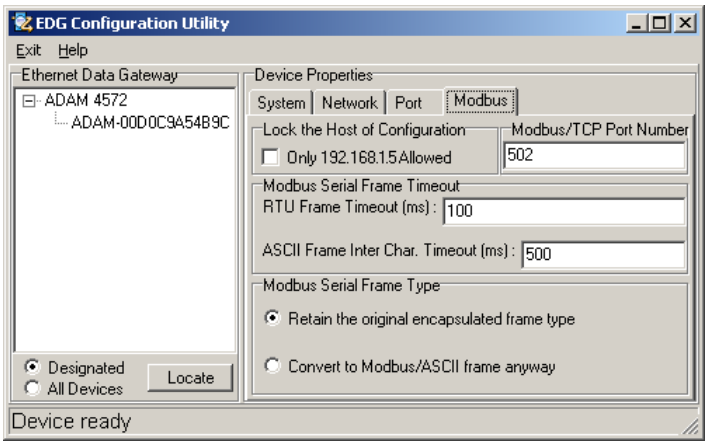
- Physical connection



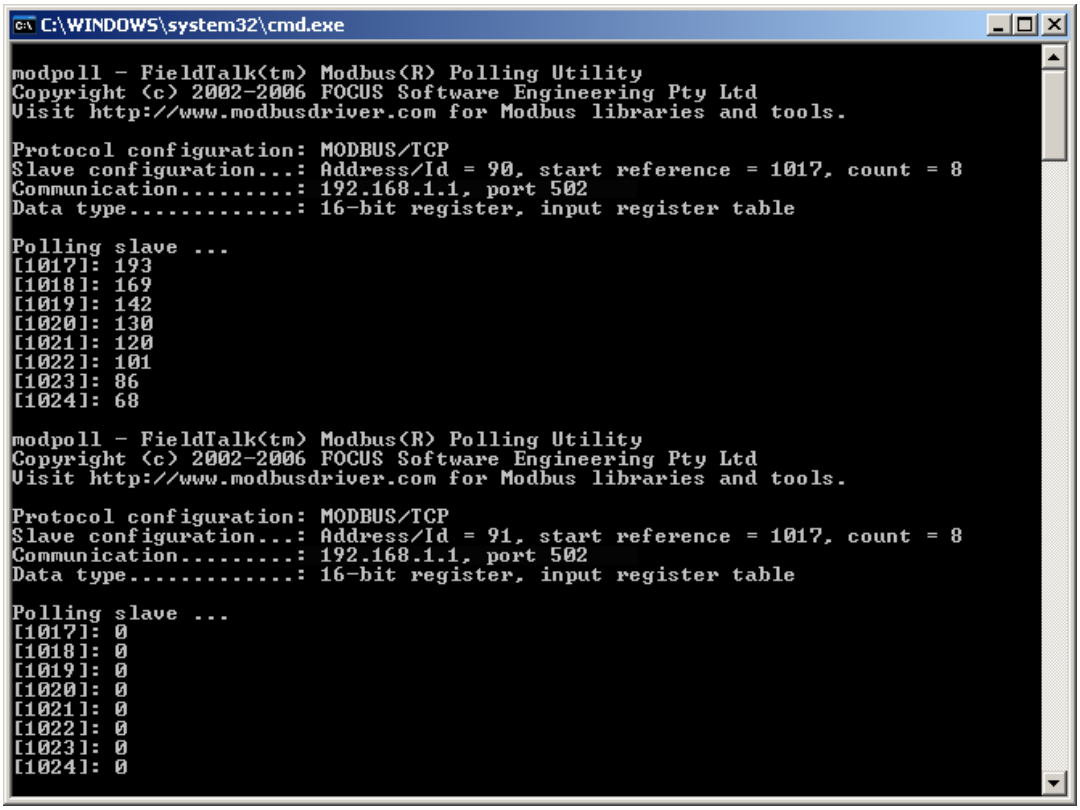
SITRAM® Multisense (only unit #90) and ADAM-4572 settings:







- In this case SITRAM® MULTISENSE does not need an answer delay. Each SITRAM® Multisense unit that is connected to the bus has its unique address (#90 ... #93, #0 reserved for host PC).
- The ADAM-4572 answer delay (Timeout) can be small. The SITRAM® Multisense answers within 100 ms and ADAM-4572 uses ART which does not generate an additional delay.
- Modpoll screenshot



6. RS485 Wiring

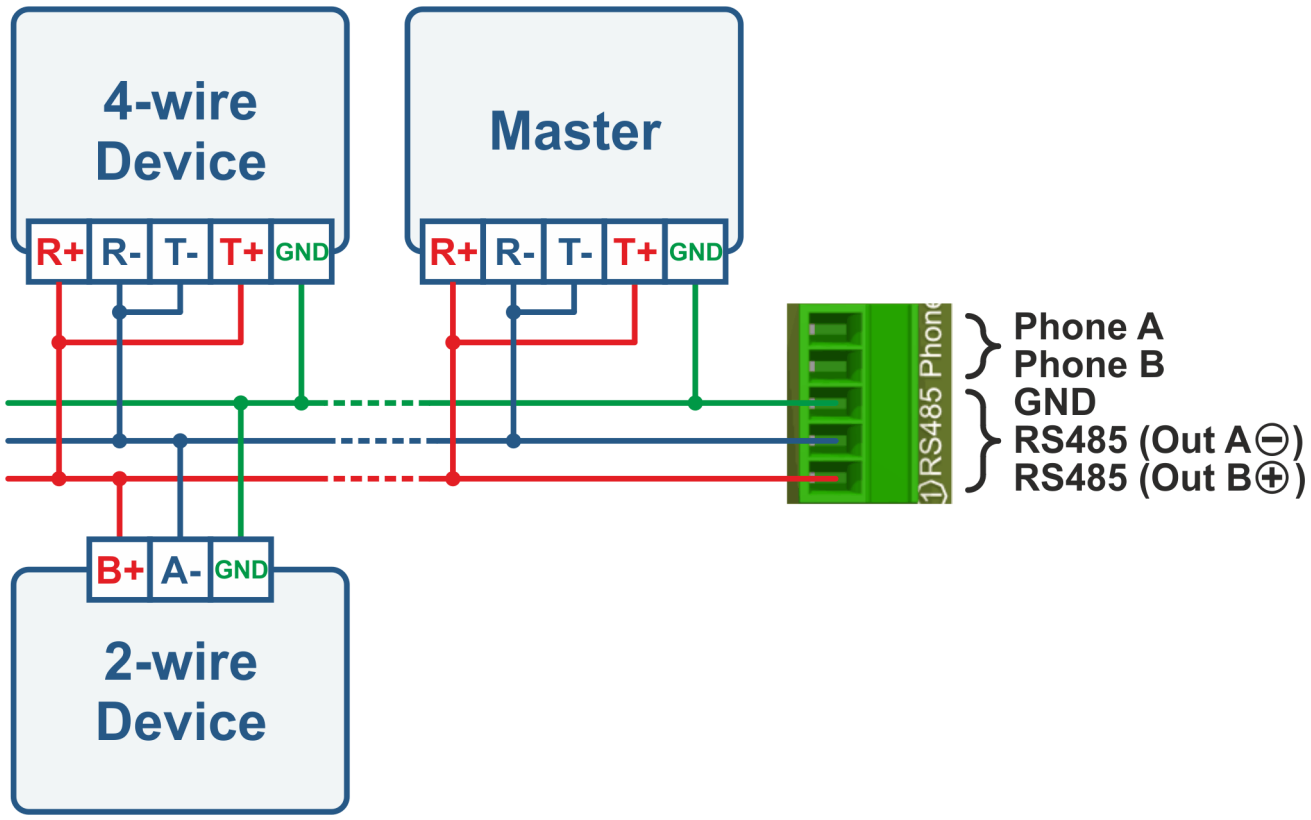
This chapter contains the wiring of the RS485 connection.

6.1 RS485

The RS485 interface, which is integrated into the SITRAM® Multisense unit, is designed as a 3 wire interface. The 3 wires are screwed to the connection terminal KL302 (RS485 Phone) on pin 1, 2 and 3, which can be found on the measurement- and controller card inside of the SITRAM® Multisense unit.

Note: Pay attention to polarity!!

1) OUT B ⊕ RS485
2) OUT A ⊖ RS485
3) GNDIO Ground without shielding



Termination, Biasing, Grounding and Protection of the RS485 Bus

The description about termination, biasing, grounding and protection of the RS485 bus is very complex and would be clearly out of the scope of this manual.

7. Trouble shooting

7.1 Extraction Chamber Error

This chapter describes the error analysis and troubleshooting of the extraction chamber. The following short description guide describes the process in short form. The following chapters describe the extraction chamber process with detailed background information to the short description guide.

7.1.1 Short description on Site

Step by step procedure:

- **Never** switch **off** and **on** the **supply voltage** of a **faulty unit** to bring it back into function!
- Ensure that the „Mount - Activating the unit" key is active () .
- Make sure that the external gate- / ball valve was not accidentally closed.
- Check the extraction error status icon on the main menu.
- Use the SITRAM® Multisense service tool to read out the service data.
- Carefully remove the protection cover.
- Check the extraction chamber by visual inspection.
- Check for oil leakage in the protection cover or inside of the unit.
- Check if any loose pneumatic connections (air white / oil yellow) can be found.
- Check if any loose electric connections can be found.
- If necessary repair or exchange defect components.
- If no errors can be found in the unit, open the extraction status menu.
- Acknowledge the extraction error in the extraction status menu via the  key.
- Observe the unit during the initialization cycle is being executed.
- Wait for the next measurement cycle and observe the process.
- In case a new error occurs, read out the service data again.
- Send the service data (ZIP file) to the Siemens Energy Service Department (support@siemens-energy.com) and wait for an answer.

7.1.2 Short description via Remote Access

Step by step procedure:

- **Never** switch **off** and **on** the **supply voltage** of a **faulty unit** to bring it back into function!
- Use the SITRAM® Multisense service tool to read out the service data.
- Send the service data (ZIP file) to the Siemens Energy Service Department (support@siemens-energy.com) and wait for an answer.
- In case the Siemens Energy Service Department recognizes the problem as a hardware error, an onsite service is necessary.
- The Siemens Energy Service Department will send a command file that resets the unit.
- For transfering the command file to the unit use the SITRAM® Multisense service tool.
- **Never transfer** an **old command file,** which you received at an earlier time for a different unit, to the actual unit.
- Check the operating status after some time.
- In case the unit does not work, an onsite service is necessary.

7.1.3 Gas-Extraction Principle

The „gas-in-oil" analysis system SITRAM® Multisense 5 is based on the so called „Headspace" principle, which extracts the error gas out of the transformer oil. The complete extraction- and measurement unit consists of the following components: connection unit, valves, pneumatic tubes, oil pump, depression compressor, flow meter, level sensors, pressure sensor, oil separator, extraction unit (extraction chamber with moisture in oil- and temperature sensor and heating), measurement cell with heating and front plate complete (measurement- and controller card with alphanumeric keypad and display).

7.1.3.1 Extraction cycle

During the extraction cycle the extraction chamber is partially filled with oil. To extract the error gas out of the oil, it is warmed up and circulated. Afterwards the air, accumulated with gas, is pressed into the measurement cell by completely filling the extraction chamber with oil. After the measurement cycle the oil is pumped back into the transformer.

7.1.3.2 Unit Activation

The extraction can only work if the device on the transformer or a test facility has been activated. After the unit was installed correctly, the user has to set the unit into operation by pressing the key „Mount - Activating the unit". The initialization cycle starts and must be successful completed so that the unit is ready for operation.

The unit status is visible in the extraction status menu. The keys „Unmount" and „Mount" can be found in the footer. Only one key can be selected at one time.

The following illustration shows the status „Unmounted". The key „Unmount" (gray background) can not be selected – the key „Mount" (white background) can be selected in this case.

Unmount - Deactivating the unit / Mount - Activating the unit

After the key „Mount" was pressed the unit changes into the initialization cycle. The two keys thereby change as follows:

7.1.4 Extraction Error

With every complex unit there is a risk of failure. The same applies to the units from the SITRAM® Multisense family.

In case of a failure the following dangers have to be avoided:

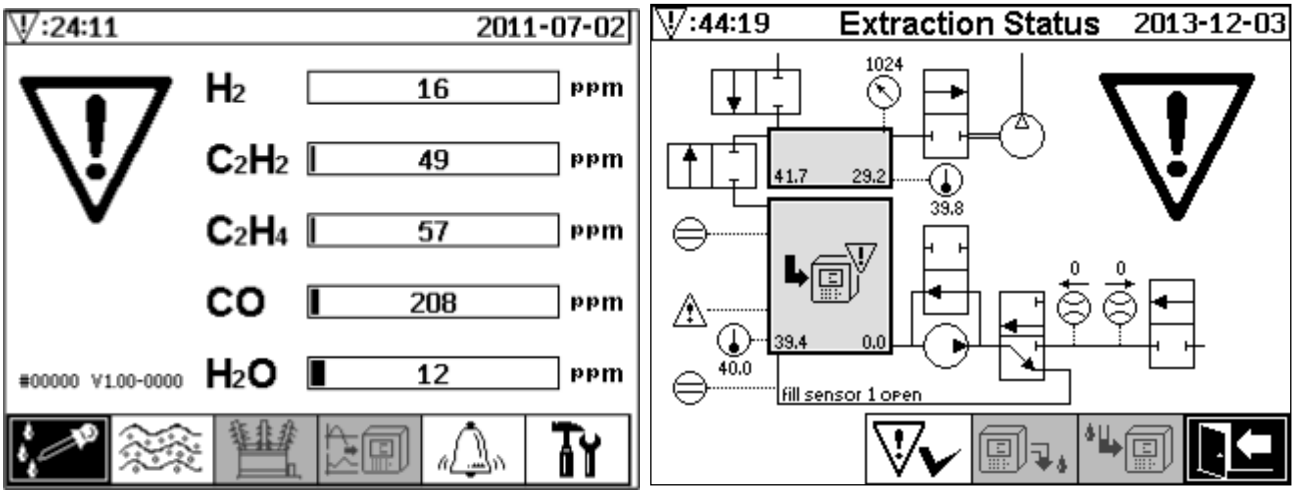
- Pollution
- Oil leakage
- Penetration of air into the transformer (Buchholz Relay)

The control software of the unit (firmware) is trying to avoid these dangers with different control- and test algorithms. However if the firmware still discovers a status of abnormal or unusual behavior the extraction cycle will be stopped (pump and compressor „off", all valves „closed") and the system set into error status. This error status can only be left by human intervention.

Important: An **electrical power outage** will **not reset this error!**

7.1.5 Extraction Error – Indication

An error status is indicated in the main menu and extraction status menu by means of a big, flashing warning icon or by a small, flashing warning icon in the status list (upper left).



7.1.6 Extraction Error – Analysis- and Acknowledgement Possibilities

An extraction error can only be set back by human intervention. This can be done manually on site or by remote access via firmware command.

The following chapters describe the analysis- and acknowledgement possibilities in case of an error. Therewith the differences between on site and remote access will be shown. A remote analysis is only possible when a remote access is available on the unit.

It is not allowed to **switch off and on the unit** or to perform a software reset in any case! The unit firmware has a big internal cache memory in which the activities of the extraction system are stored. The internal cache memory resides in the not remanent part (RAM) and therefore the activities will be lost in case of a reset (hardware/software). Thus, all activities, which are also used for troubleshooting, would be lost in the event of a reset.

The cache memory is read by using the SITRAM® Multisense service tool.

7.1.6.1 Service-Data Read Out

In case of an error all data should be read out via the SITRAM® Multisense service tool, before further intervention. The cache memory data of the error cycle contains potentially valuable information which should therefore be stored. This data is needed by the Siemens Energy service technician to localize the problem. If the SITRAM® Multisense service tool is used for troubleshooting, also do not perform a download in the meantime, because this would restart the unit as well. The update request which the SITRAM® Multisense service tool proposes when a unit is detected must be terminated. The last DGA analysis data (Service Data Read) will not be used and therefore can be marked (date and gases) as unknown.

7.1.6.2 Short Instruction Service Data Read Out

This short instruction should help to read out the service data with the SITRAM® Multisense service tool.
Please use the detailed description in case you need detailed information

- Unpack the SITRAM® Multisense service tool into the desired folder (Zip file)
- Connect unit
- Start SITRAM® Multisense service tool
- Select interface  (serial/network)
- Enter COM port and baud rate for the serial interface
- Enter IP address and port number for the network interface
- Press the  key
- Terminate and skip boot loader-, firmware- and parameter update
- Read out service data only (service data read)
- Insert last DGA analysis data or mark as unknown (date and gases)
- Select storage location
- Assign a file name or accept automatic file name assignment
- Start service data read out (service data read)
- Wait for completion

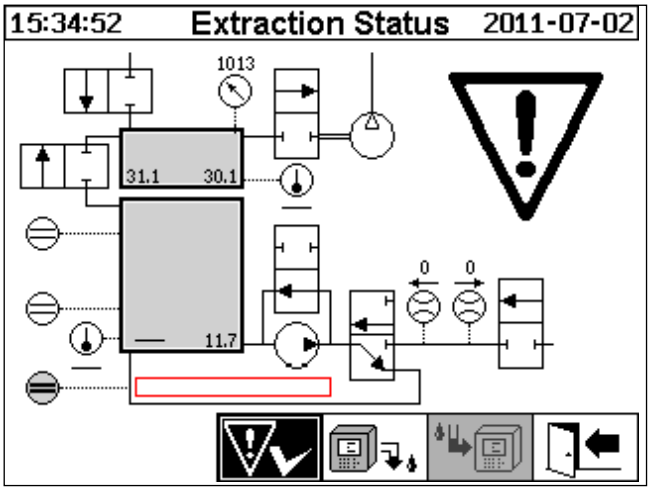
7.1.6.3 Extraction Error – On site Analysis

To confirm an extraction error, the unit protection cover has to be removed. It should be checked if the unit protection cover is contaminated with oil. Also the unit should be checked by visual control to ensure that it is intact.

If damages are recognized on the unit the related parts have to be repaired or must be exchanged. Ensure yourself that the gate- / ball valve is completely open and that the unit is in status „Mounted“.

7.1.6.4 Extraction Error – Extraction Status Menu

The error is also indicated in the extraction status menu. There could be a problem within the oil- (foreign bodies or dirt) or air tube system (leakage), which is not recognizable as oil pollution in the device or the protection cover. The red mark in the following illustration indicates the area in which the error messages will be displayed in case of an error.

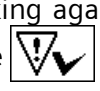


Extraction error status menu with error message mark

The area for the error message is to narrow to show the possible error reason. The error message is displayed in short form. The following table shows possible reasons that can occur if the extraction fails. As many components are involved in the extraction cycle, the analysis of the error cycle cache memory data is essential for the troubleshooting.

Error Message	Possible Reason
fill sensor *x* short	Hardware-Error
fill sensor *x* open	Hardware-Error
fill level cascade	Hardware-Error
fill level *x* bad	Hardware-Error
flow stuck	Pump P1, oil tubes, valves, flow meter
flow leak	Oil tubes and valves
m-chamber offline	Measurement cell hardware-error
no depression (drain/flush)	Air tubes, valves and compressor
level timeout (drain/flush)	Whole system
depress. timeout (fill)	All tubes, valves and compressor
depress. pressure stuck (fill)	All tubes and compressor
depress. timeout (circ)	All tubes, valves and compressor
depress. pressure stuck (circ)	All tubes, valves and compressor
depress. lost (circ)	All tubes and valves
depress. change	All tubes and valves
no pressure rise (fill #*x*)	All tubes and valves
timeout (fill #*x*)	All tubes and valves
detect overall timeout	All tubes and valves
detect amb. pres. timeout	Air tubes, valves and measurement cell
detect depres. pres. stuck	Air tubes and valves
fill level #x lost	Oil tubes and valves
leak check failure	All tubes and valves

7.1.6.5 Extraction Error – Acknowledgement by Hand

As soon the system is working again, the error can be acknowledged. This is done in the extraction status menu by pressing the  key.

After the  key was pressed the initialization cycle starts. This cycle should be observed. The protection cover is not remounted yet. When the initialization cycle is finished the unit, until the next measurement cycle (every 20 minutes), goes into the status wait. The measurement cycle should be observed without the protection cover as well, because not all components are used in the initialization cycle.

In case an error occurs again, the service data must be read out again from the unit via the SITRAM® Multisense service tool. For analysis the read out service data has to be sent to the Siemens Energy service department (support@siemens-energy.com). Before taking any more steps, wait for the answer of the Siemens Energy service department.

7.1.6.6 Extraction Error – Acknowledgement via command file

The acknowledgement via command file requires a communication connection to the unit. The service data has to be read out and sent to the Siemens Energy service department.

Different answers of the Siemens Energy service department are possible. A hardware problem can indicate that an onsite visit is necessary or maybe the problem can be solved with a so called unit command file.

To transfer this file to your unit, only use the SITRAM® Multisense service tool. **NEVER transfer** an **old command file**, which you have received in the past for a different unit onto the actual unit without contacting the Siemens Energy service department.

The extraction unit is very complex. To confirm an error without a detailed analysis and to act accordingly can result in different dangers (7.1.4).

7.1.7 SITRAM® Multisense Service Tool

SITRAM® Multisense Service Tool is a helper software for the units of the SITRAM® Multisense family.

The software is mainly used for:

- Update the firmware and parameterization of SITRAM® Multisense units
- Read out service data (configuration, parameterization, diagnostic- and measurement data)

7.1.7.1 Distribution / Installation

The SITRAM® Multisense service tool is distributed as a compressed file (zip-file). An installation is not necessary. Just unpack the compressed file into the desired folder.

7.1.7.2 System – Requirements

The following system requirements must be fulfilled for the SITRAM® Multisense service tool:

- Personal Computer (PC) with Microsoft® Windows operating system like Windows XP, Vista, Windows 7 or Windows 8.
- Ethernet interface
- Option: RS232 communication interface (internal RS232 or USB-to-RS232 adapter)

7.1.7.3 Diagnosis Cycle – Data Read Out

Proceed as follows to read out service data with the SITRAM® Multisense service tool.

7.1.7.3.1 Connection and Start

The unit of the SITRAM® Multisense family has to be connected to the PC by network cable to the network interface or by serial cable to a free COM port. Next the SITRAM® Multisense service tool can be started via the start file:

7.1.7.3.2 Interface Selection

SITRAM® Multisense units can be connected via Ethernet- or serial interface. The key in the upper left corner functions as a switch for the following two interface selections:

- When Ethernet is active, *IP Address:* and *Port Number:* must be entered.
- The IP address depends on the network settings (fixed IP / DHCP).
- The port number is defined by the SITRAM® Multisense unit Ethernet settings.

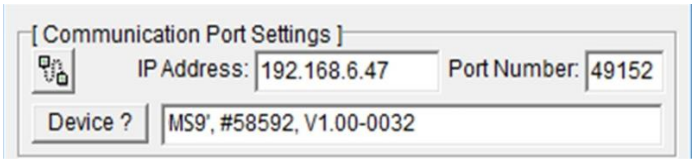


Figure: Ethernet Interface Selection

- When serial connection is active, COM port and baud rate will be set via the selection fields.

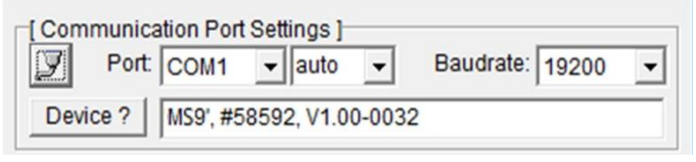


Figure: Serial Interface Selection (COM Port)

7.1.7.3.3 Device Detection

The connected unit must be detected before you can work with it.

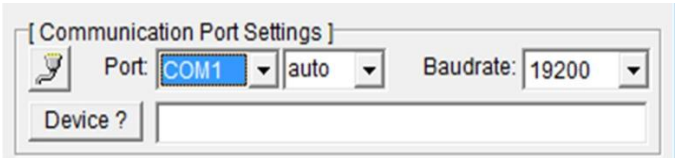
The following screenshots show the connection detection. The handling with Ethernet is similar.

To start the device detection the PC COM port (*Communication Port Settings*) has to be chosen to whom the unit is connected.

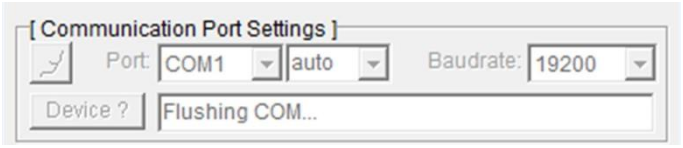
Note: The standard baud rate of 19200 must only be changed if a different baud rate is set on the unit.

When the Device? key is pressed, the detection cycle starts.

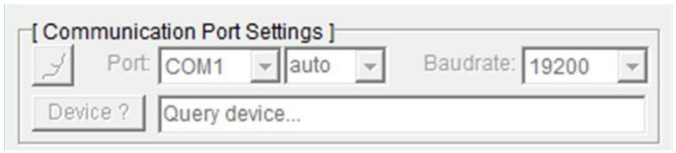
- Choose COM port and baud rate



- Start the device detection



- Device detection is being performed



- The device was recognized

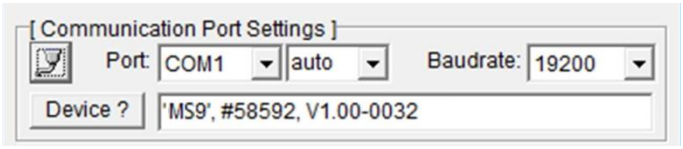


Figure: Sequence of the device detection

- After successful device detection the text field Device? is displayed with the following contend:
- Device name: '*SITRAM® Multisense*'
- Serial number: *#99999*
- Firmware version: *V1.00-B0000*

In case the unit was not recognized, ensure that the settings for port number and baud rate are correct and repeat the process. When using Ethernet the connection to the device can be checked with the PING command. Ensure that IP address and port number are set correctly.

7.1.7.3.4 Firmware- and Parameter Update

In case of an extraction error, this step must be skipped.

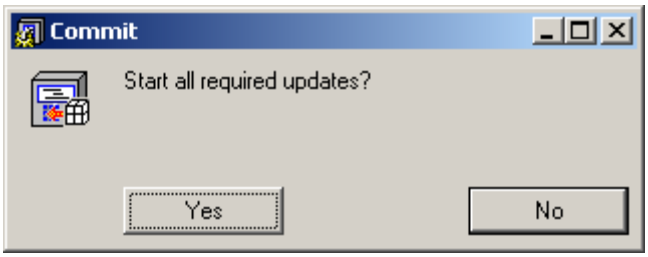


Figure: Update Request

Close the dialogue window by pressing the No-key (No) and thus skip the update cycle.

7.1.7.3.5 Service data Read Out (Service Data Read)

In case of an error of SITRAM® Multisense the SITRAM® Multisense service tool may **only be used for** service data (configuration, parameterization, diagnosis- and measurement data) **read out**.

7.1.7.3.6 Latest DGA Analysis Data - Latest DGA Results

To read out the service data with the SITRAM® Multisense service tool, the results of the recent DGA analysis (Dissolved Gas Analysis), which you received from the laboratory, must be entered. Depending on the used SITRAM® Multisense type different amounts of reference gas values are required.

If available, the values (date & reference gas values) must be entered in the related fields. Otherwise the fields „?", which stands for not available (unknown), must be checked.

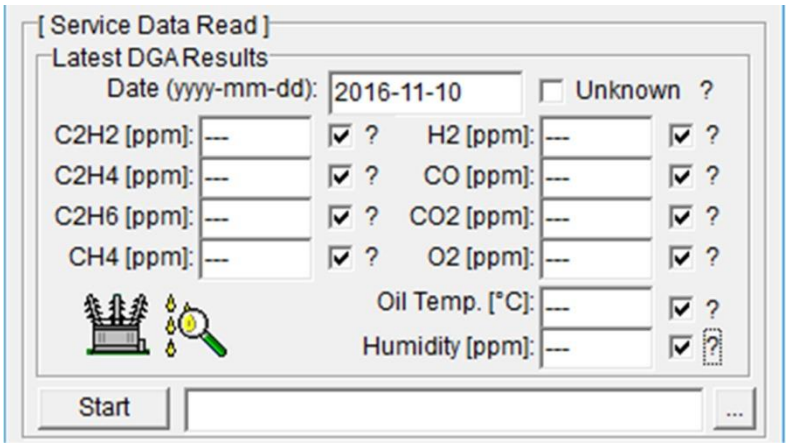


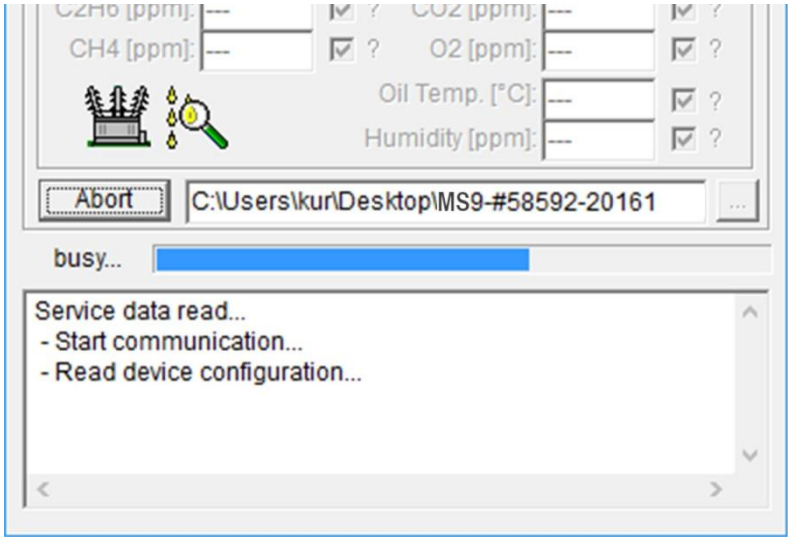
Figure: Latest DGA analysis data

Next location and file name, where the diagnosis date should be placed, must be selected. Therefore, press the '...'-key. By default, a file name, which consists of unit name, serial number, read out date (YYYYMMDD) and read out time (hhmmss), will be offered (i.e. SITRAM® Multisense-#28822-20090918-120202.dat). The default location for the service data file is the "Personal data storage" directory of the user.

7.1.7.3.7 Execute the Service data Read Out

By pressing the Start key, the data read out will be started. The following steps will be executed:

- Read out the device configuration



- Read out service data

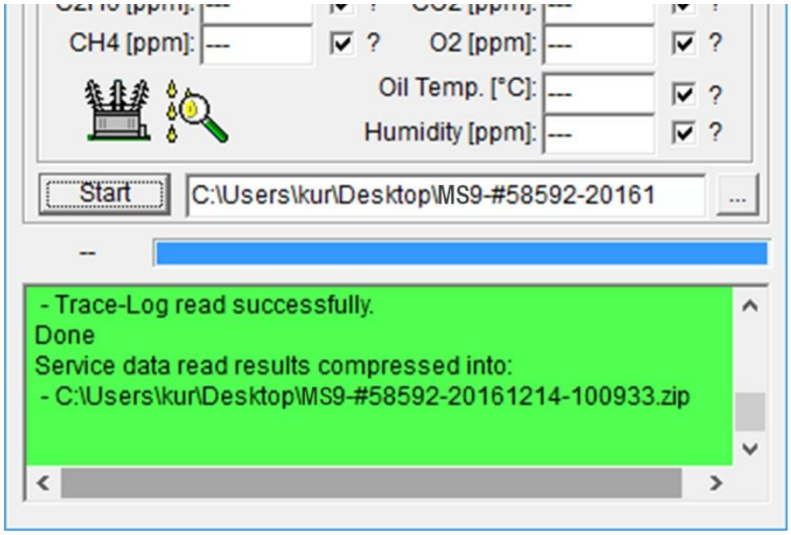


Figure: Read out service data

At the end, the read-out data (.dat) are compressed and stored into a zip (.zip) file with the same name. The uncompressed file (.dat) will be removed.

For error analysis please send the compressed file to the Siemens Energy service department.

8. Technical Data

General

Optional nominal voltages of auxiliary supply:	120 V -20% +15% AC 50/60 Hz [1] or 230 V -20% +15% AC 50/60 Hz [1] or 120 V -20% +15% DC [1] or 230 V -20% +15% DC [1] Other nominal voltages on request!
Power consumption:	max. 400 VA
Housing:	Aluminum
Dimensions:	W 263 x H 274 x D 331 mm
Weight:	Approx. 13.5 kg
Operation temperature: (ambient)	-55°C ... +55°C (below -10°C display function locked)
Oil temperature: (inside transformer)	-20°C ... +90°C
Storage temperature: (ambient)	-20°C ... +65°C
Oil Pressure:	up to 800 kpa (negative pressure allowed)
Supported Fluids:	mineral Oil synthetic Ester on request
Connection to valve:	G 1½" DIN ISO 228-1 or 1½" NPT ANSI B 1.20.1
Safety	CE certified
Insulation protection:	IEC 61010-1:2001
Degree of protection:	IP-55

Measurements

Gas/Moisture in oil measurement				
Measurement	Range	Accuracy[2] and LDL[3]	Expected Accuracy and LDL in the field[4]	Repeatability
Hydrogen H_2	5 ... 2,000 ppm	±5% ±5ppm	±15% ±25ppm	±1% ±2ppm
Carbon Monoxide CO	20 ... 5,000 ppm	±5% ±20ppm	±20% ±25ppm	±1% ±2ppm
Acetylene C_2H_2	1 ... 2,000 ppm	±5% ±1ppm	±20% ±5ppm	±1% ±2ppm
Ethylene C_2H_4	1 ... 2,000 ppm	±5% ±1ppm	±20% ±10ppm	±1% ±2ppm
Moisture H_2O	1 ... 100 %	±3% ±1ppm	±3% ±3ppm	±3% ±3ppm

LDL = „Lowest detectable Limits“

Operation principle

- Miniaturized gas sample production based on headspace principle (no membrane, negative pressure proofed)
- Patent-pending oil sampling system (EP 1 950 560 A1)
- Near-infrared gas sensor unit for CO, C_2H_2 and C_2H_4
- Micro-electronic gas sensor for H_2
- Thin-film capacitive moisture sensor H_2O

■ Temperature sensors (for oil and gas temperature)

Analog and digital outputs

5 x Analog DC Outputs		Default concentration (Free assignment)
Type	Range	
1 x Current DC	0/4 ... 20 mADC	Hydrogen H_2
1 x Current DC	0/4 ... 20 mADC	Acetylene C_2H_2
1 x Current DC	0/4 ... 20 mADC	Ethylene C_2H_4
1 x Current DC	0/4 ... 20 mADC	Carbon Monoxide CO
1 x Current DC	0/4 ... 20 mADC	Moisture in Oil H_2O

5 x Digital outputs		Max. Switching capacity (Free assignment)
Type	Control Voltage	
5 x Relay	12 VDC	220 VDC/VAC / 2 A / 60 W

Analog inputs and digital outputs (option)

6 x Analog AC inputs		Accuracy of the	Remarks
Type	Range	**measuring value**	
6 x Current AC **or** **6 x Voltage AC**	0/4 ... 20 mAAC +20% or 0 ... 80 VAC +20%	≤ 1.0 %	Configurable by jumpers[5)]

4 x Analog DC inputs		Accuracy of the	Remarks
Type	Range	**measuring value**	
4 x Current DC	0/4 ... 20 mADC	≤ 0.5 %	

5 x Digital outputs		Max. Switching capacity (Free assignment)
Type	Control voltage	
5 x Optocoupler	5 VDC	U_{CE}: 24 V rated / 35 V max. U_{EC}: 7 V max. I_{CE}: 40 mA max.

Communication

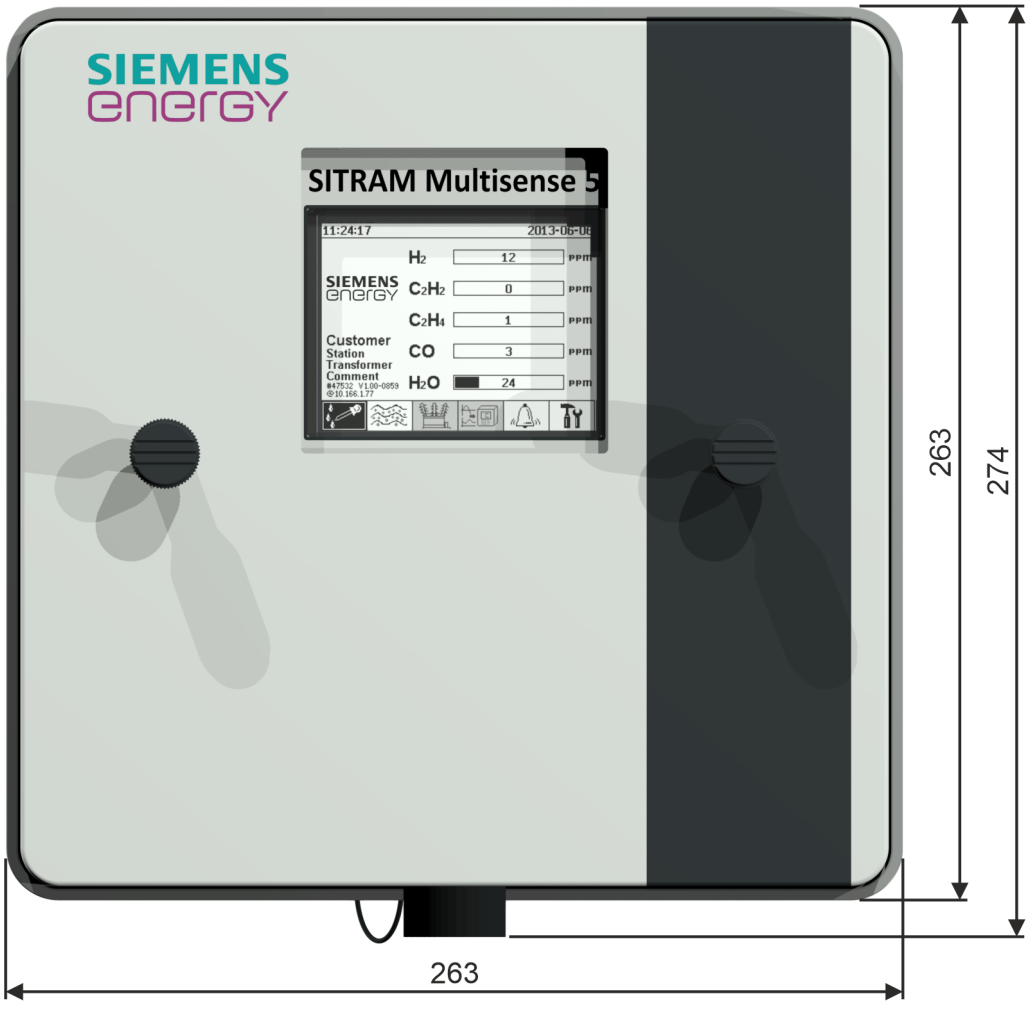
■ RS 485 (proprietary or MODBUS® RTU/ASCII protocol)
■ ETHERNET 10/100 Mbit/s – copper-wired / RJ 45 or fiber-optical / SC Duplex (proprietary or MODBUS® TCP protocol)
■ 2G/3G modem with external adhesive antenna (optional) (proprietary protocol)
■ DNP3 serial modem (option) (DNP3 protocol)
■ IEC 61850 modem – copper-wired / RJ45 or fiber-optical / SC Duplex (option) (IEC 61850 protocol)

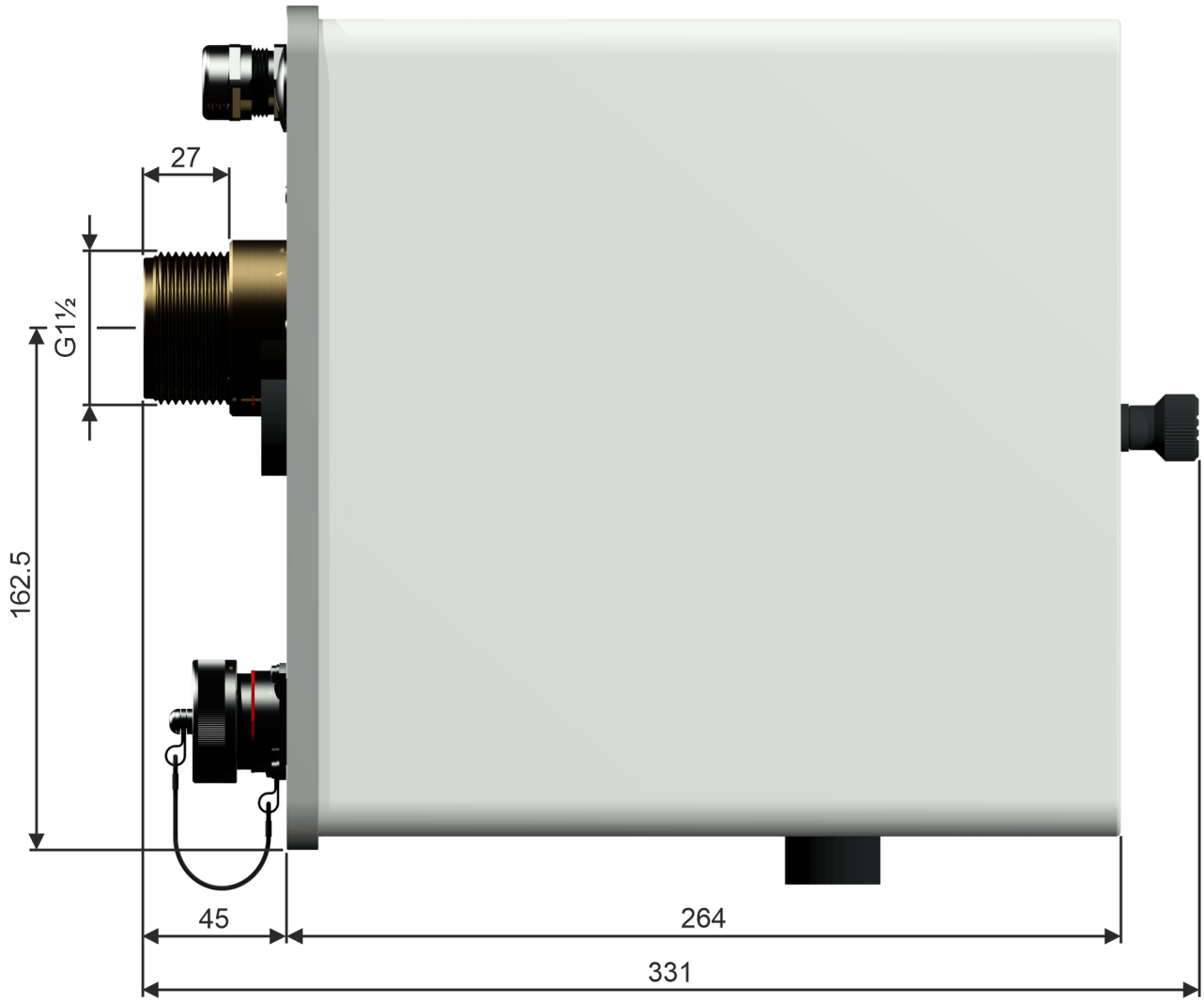
Notes

[1)]By the nominal voltages the following nominal voltage ranges result:
120 V ⇨ 120 V -20% = **96 V_{min}** 120 V +15% = **138 V_{max}**
230 V ⇨ 230 V -20% = **184 V_{min}** 230 V +15% = **264 V_{max}**

[2)] Accuracy of the detector during calibration process under controlled laboratory conditions
[3)] According to headspace method described in IEC60567:2011
[4)] Related to temperatures, ambient +20°C and oil +55°C**,** Accuracy for moisture in oil H_2O only valid for mineral transformer oil types
[5)] Default jumper configuration: Current

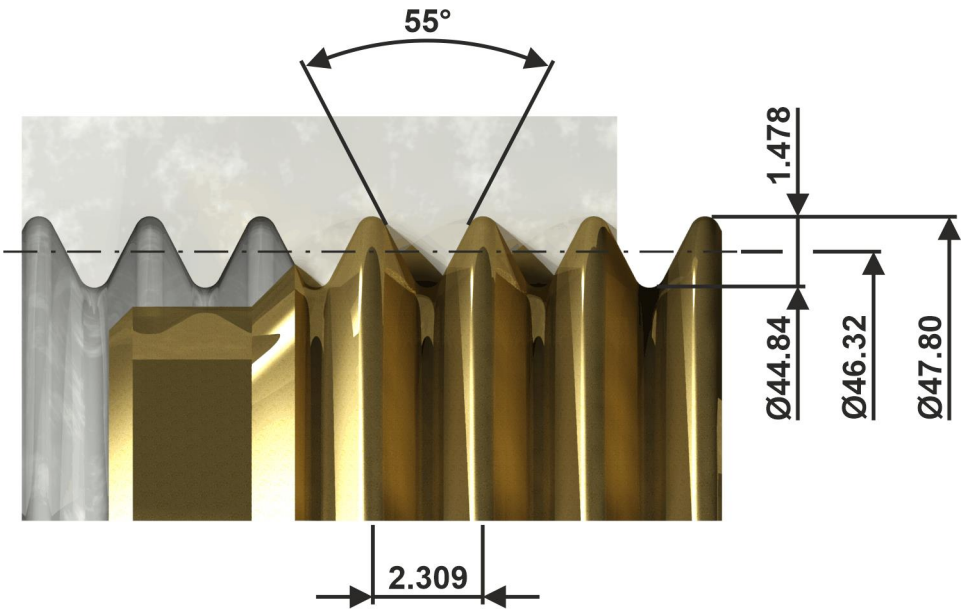
9. Dimensional Drawings



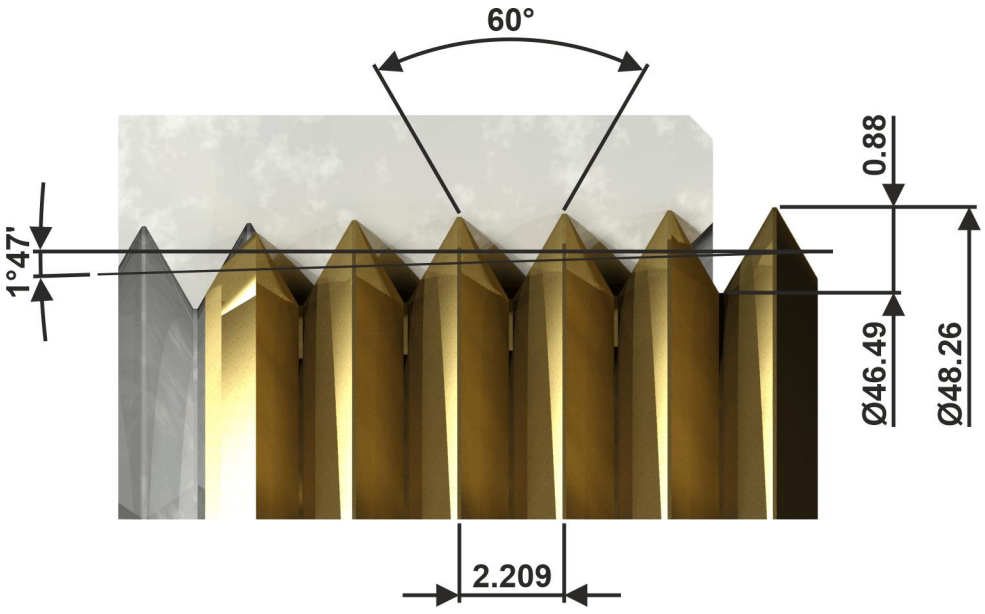


9.1 Dimensions of valve connection

9.1.1 Connection thread G 1½" DIN ISO 228-1



9.1.2 Connection thread 1½" NPT ANSI B 1.20.1



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Multisense 5		
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