User Manual

OilQSens® OQ 3000

Constantly redefining the difference.™

User manual

OilQSens® OQ 3000

cmc Instruments GmbH
Meß-, Regel- und Analysentechnik
Rudolf Diesel Strasse 12 A
D-65760 Eschborn

E-Mail : info@cmc-instruments.de

Tel.: + 49 6173 320078
Fax.: + 49 6173 65050

Table of contents

1. ABOUT THIS MANUAL 5
2. WARRANTY, SERVICE POLICY, REPAIR SERVICE 7
    2.1 SERVICE POLICY 8
    2.2 PROPRIETARY RIGHTS 8
3. SPECIFICATIONS 9
4. DESCRIPTION 11
    4.1 PRINCIPLE OF OPERATION 11
    4.2 SAFETY INSTRUCTIONS 12
    4.3 POWER SUPPLY 12
    4.4 ELECTROSTATIC ELECTRICITY 12
5. INSTALLATION OF THE SENSOR 13
6. INSTALLATION OF COMMUNICATION UNIT 14
7. COMMUNICATION 15
    7.1 POSSIBILITIES OF COMMUNICATION 15
    7.2 CAN BUS INTERFACE (optional) 18
    7.2 PROFIBUS/PROFINET/MODBUS INTERFACE (optional) 19
    7.5 INSTALLATION ON A NETWORK 20
8. WSENS SOFTWARE 22
    8.1 INSTALLATION 22
    8.2 OPERATION & FUNCTION 23
    8.3 CALCULATIONS 30
9. DRAWINGS 31
    9.1 OILQSENS® SENSOR 31
    9.2 OILQSENS® COMMUNICATION UNIT 31
    9.3 OILQSENS® COMMUNICATION MODULE (optional) 32
    9.4 OILQSENS® – HIGH TEMPERATURE UNIT (HT, optional) 32
10. MAINTENANCE 33
11. CODES 33
    11.2 PROFIBUS/PROFINET/MODBUS (optional) 34
12. DECLARATION OF CONFORMITY 35

1. ABOUT THIS MANUAL

OilQSens® was designed for simple use, according to the „Plug and Play“ principle and so was this manual. For the benefit of clarity, all electronics, software and physical details not necessary for the operation of the unit are omitted. It is the way we want it.

We understand that you want to put your **OilQSens®** to use as soon as possible. To achieve this goal, take the time to **read all the manual in its entirety**. Every section is based on the assumption that you have read and understood the preceding one. Every section has important comments for the user. This analyzer is very simple to install and to use; also, it is maintenance-free. No special technical knowledge is required to operate the unit.

We hope that you will enjoy working with **OilQSens®**. In the spirit of progress and continuous improvement, we would appreciate any comments you may have, negative or positive, as long they are constructive.

cmc Instruments GmbH believes that the information in this manual is accurate. The document has been carefully reviewed for technical accuracy. If there should be any error, **cmc Instruments GmbH** reserves the right to make changes to subsequent editions of this document without prior notice to holders of this edition. The reader should contact **cmc Instruments GmbH** if errors are suspected. In no event shall **cmc Instruments GmbH** be liable for any damages arising out of, or related to, this document or the information contained in it.

THANK YOU FOR BUYING CMC INSTRUMENTS!

Unpacking the instrument

To provide appropriate protection during shipping the OilQSens® comes in a sturdy packaging.

IMPORTANT:

Should the packaging show visible signs of abuse or external damage the analyzer is to be unpacked immediately with extra care to check for actual damage. If any indication of a defective instrument is given it should under no circumstance be placed into service. Immediately contact your sales representative or cmc Instruments GmbH directly for further advice.

After the instrument is unpacked make sure to check the packaging for additional parts and manuals.

Should the analyzer be stored again before being placed into service it should be done in the original shipping container.

2. WARRANTY, SERVICE POLICY, REPAIR SERVICE

Goods and part(s) (excluding consumable) manufactured by Seller are warranted to be free from defects in workmanship and material under normal use and service for a period of twelve (12) months from the date of shipment by Seller. Consumable, glassholder, O-rings, etc. are warranted to be free from defects in workmanship and material under normal use and service for a period of twelve (12) months from date of shipment by Seller. Goods, part(s) and consumable proven by Seller to be defective in workmanship and /or material shall be replaced or repaired, free of charge, F.O.B. Seller's factory provided that the goods, part(s) or consumable are returned to Seller's designated factory, transportation charges prepaid, within the twelve (12) months period of warranty in the case of goods and part(s), and in the case of consumable, within the twelve (12) months period of warranty. This warranty shall be in effect for replacement or repaired goods, part(s) and the remaining portion of the twelve (12) months warranty in the case of consumable. A defect in goods, part(s) and consumable of the commercial unit shall not operate to condemn such commercial unit when such goods, part(s) and consumable are capable of being renewed, repaired or replaced.

The Seller shall not be liable to the Buyer, or to any other person, for the loss or damage directly or indirectly, arising from the use of the equipment of goods, from breach of any warranty, or from any other cause.

All other warranties, expressed or implied are hereby excluded.

In consideration of the herein stated purchase price of the goods, seller grants only the above stated express warranty. No other warranties are granted including, but not limited, express and implied warranties of merchantability and fitness for a particular purpose.

This warranty is the only warranty made by cmc instruments GmbH with respect to the goods delivered hereunder, and no employee, representative or other person or entity is authorized to assume for cmc instruments GmbH any obligation or liability beyond or at variance with this warranty in connection with the sale of cmc instruments products:

Limitations of Remedy:

Seller shall not be liable for damages caused by delay in performance. The sole and exclusive remedy for breach of warranty shall be limited to repair or replacement under the standard warranty clause. In no case, regardless of the form of the cause of action, shall seller's liability exceed the price to buyer of the specific goods manufactured by seller giving rise to the cause of action. Buyer agrees that in no event shall seller's liability extend to include incidental or consequential damages. Consequential damages shall include but are not limited to, loss of anticipated profits, loss of use, loss of revenue, cost of capital and damage or loss of other property or equipment. In no event shall seller be liable for property damage and/or third party claims covered by umbrella insurance and/or indemnity coverage provided to buyer, first assignees, and each successor interest to the goods provided here under.

Force majeure

Seller not be liable for failure to perform due to labor strikes or acts beyond Seller's direct control.

2.1 SERVICE POLICY

1. If a product should fail during the warranty period, it will be repaired free of charge. For out of warranty repairs, the customer will be invoiced for repair charges at current standard labor and materials rate.

2. Customers who return products for repairs, within the warranty period, and the product is found to be free of defect, may be liable for the minimum current repair charge.

3. For parts replacement, the original part must be returned within serial and model numbers of the analyzer. No part will be shipped if the original is not sent back to **cmc Instruments GmbH**.

2.2 PROPRIETARY RIGHTS

Buyer agrees that any cmc Instruments software, firmware and hardware products ordered or included in the goods ordered are proprietary to cmc Instruments GmbH. No change, modification, defacement, alteration, reverse engineering, software decompilations nor reproduction of such software or hardware products or disclosures of programming content to other parties is authorized without the express written consent of cmc Instruments GmbH. To maintain cmc Instruments GmbH trade secret and other proprietary protection of such software and firmware, such items are not sold hereunder but are licensed to buyer.

3. SPECIFICATIONS

Ranges:

Conductivity:	0.1 to 20,000 pS/m
Relative permittivity:	1 to 5

Measuring values are independent of viscosity of the oil.

Sensitivity:

Conductivity:	0.01 pS/m
Relative permittivity:	$1*10^{-6}$
Temperature:	0.1 K
Response time:	< 45 sec

Accuracy:

Conductivity:	±1% of value ±0.5 pS/m
Relative permittivity:	±1.5% of value ±0.0001
Maximum oil pressure:	60 barg / 870 psig at 20°C
Oil temperature:	-10 °C to +75°C
Sensor-cable:	3 m, shielded cable (other lengths on request), water-proof LEMO connectors
Supply:	115-230 V/ 50-60 Hz
Power consumption:	0.2 W
Dimensions (sensor):	ø 70 mm x 103 mm
Dimensions (communication unit):	210 mm x 250 mm x 165 mm
Dimensions (communication module):	87 mm x 110 mm x 30 mm
Dimensions (HT module, opt.):	150 mm x 120 mm x 60 mm
Weight (sensor)	2.70 kg
Weight (sensor, HT option)	3.35 kg
Weight (communication unit)	4.45 kg
Weight (communication module)	0.25 kg
Max pressure, measurement chamber:	60 barg / 870 psig
Connections:	¼” Swagelok® connector for tube with outer diameter of 6 mm, other on request

Resistance to all species of oil.

O-ring:	Viton®
Operating temperature:	-10°C to +75°C
Storage temperature:	-20°C to +85°C

Ports/interface:

Serial (RS232):	9-pin SUB-D- female connector
Network (LAN):	LAN (twisted pair-cable Cat.5 or better)
Network wireless (WLAN):	IEEE 802.11 b/g with IEEE 802.11i encryption
Optional communication:	RS232/RS485 RS232/USB RS232/Profibus RS232/Profinet RS232/Modbus RS232/CAN Analog Output (0..10V, 0/4..20mA)

Web based decentralized condition monitoring system:

Measuring signal transmission to web server,
Data query and presentation of existing Web browser

Software:	WSens®/SW

<u>Sensor body:</u>

Sensor bowl:	Stainless steel
Sensor carrier:	Stainless steel
Sensor head:	Stainless steel or Aluminium dep. on model

4. DESCRIPTION

OilQSens® is an instrument for measuring conductivity, relative permittivity and temperature of oils and other fluids.

The OilQSens® consists out of two basic modules, sensor and communication unit with communication module.

PLEASE READ THE ENTIRE MANUAL BEFORE OPERATING THE ANALYZER!

OilQSens® is fully microprocessor controlled and is designed to operate in rough field service. The amplifier is a high technology, solid state unit.

The measuring signals of the sensor are transferred via special high quality water proof connectors (IP68) to the communication unit.

4.1 PRINCIPLE OF OPERATION

The OilQSens® sensor measures the electrical conductivity, relative permittivity and the temperature of the fluid.

The sensor consists of three plates which are arranged parallel to each other. These form a capacitor. The fluid flows between the capacitor plates and forms the dielectric between the plates.

Thus, it is possible that the capacity of this capacitor can be measured. On the basis of capacity, the relative permittivity is defined. The dielectric properties of the oils are especially determined by the water content, which, in the case of products that are not enriched with additives, becomes accessible via the accurate measurement of the relative permittivity. Pure water has a relative permittivity of 80, oil has a relative permittivity of 2 to 5. In the case of oils enriched with additives, statements on the degradation of additives can also be derived from changes in the relative permittivity.

Furthermore, the resistance between the plates can be measured. For instance, metal abrasion, broken oil molecules, acids or oil soap all bring about an increase in electric conductivity, which, on account of the low conductivity value of oil as compared to all these contamination products, directly correlates to the degree of pollution. Since oil is an excellent insulator, it has conductivities between 1.0 to 90000pS/m. Opposite is the conductivity of pure water which is a few µS/m and metals which are some MS/m. This means with water is more conductive than oil by a factor of 300 to 10^5 or metals than oil by a factor of 10^{16}.

The temperature is measured to allow comparison of permittivity and conductivity values at different temperatures. The electrical parameters of relative permittivity and conductivity are temperature dependent. A self-learning, adaptive temperature compensation algorithm allows accurate comparison of data taken at different temperature.

4.2 SAFETY INSTRUCTIONS

Do comply with these safety precautions under all circumstances. Failure to comply with these regulations may be hazardous to the health of the operating personnel and/or cause damage to the instrument!
OilQSens® is not to be operated in an explosive environment without additional protective measures!
OilQSens® has to be operated in a dry and frost-free environment. Avoid exposure to direct sun-light and other sources of extensive heat. The OilQSens® is only to be operated between -20°C and +85°C ambient temperature. If the instrument is operated outside it is recommended to install it in a weather-proof enclosure.

4.3 POWER SUPPLY

Before placing the unit into service do always cross-check the required voltage given on the data-plate with your local mains power voltage!
The power-plug is only to be connected to a grounded receptacle. The protective measures are not to be by-passed by using an ungrounded extension cord!
Every interruption or disconnection of the protective grounding inside or outside of the instrument can cause the instrument to become a safety hazard. Deliberate disruptions are not tolerable!
Before any attempt to open, service or repair the analyzer, the instrument is to be disconnected from any power source!
If working on an open and fully connected instrument is unavoidable it is only to be done by authorized and trained personnel who are fully aware of all eventual hazards that are associated with this kind of work!

4.4 ELECTROSTATIC ELECTRICITY

Handling electronic components is a relatively easy task but the electronic components used in this instrument might be permanently damaged by electrostatic discharge (ESD). These discharges can be avoided by following these precautions:
Electricity should be discharged prior to opening the instrument. Make sure that there is no charge build-up while working on the open instrument. The best possible protection is achieved if all work on the instrument is done at an ESD-safe work place and an antistatic wristband is worn.
If such a workplace is not available the following guidelines should be strictly followed. Any electrostatic electricity is to be discharged by touching the metal case of a protected instrument, which is connected to an appropriate power receptacle.

Do not plug in the instrument you are working on to provide discharge capability!

This procedure is to be repeated several times during working on the instrument.

5. INSTALLATION OF THE SENSOR

The sensor can be mounted inline by screwing the sensor into the line.

Generally the connection of the sensor cable to the sensor should be on the side and the flow across the sensor, vertical. If you choose vertical flow the input should be from the bottom. You should install the sensor direct at the output of your machine and before a pump or installed filter. You have also to guarantee that the sensor is fully filled with oil during the whole measurement process.

Figure 1 shows the installation of the OilQSens® basic sensor in bypass line.

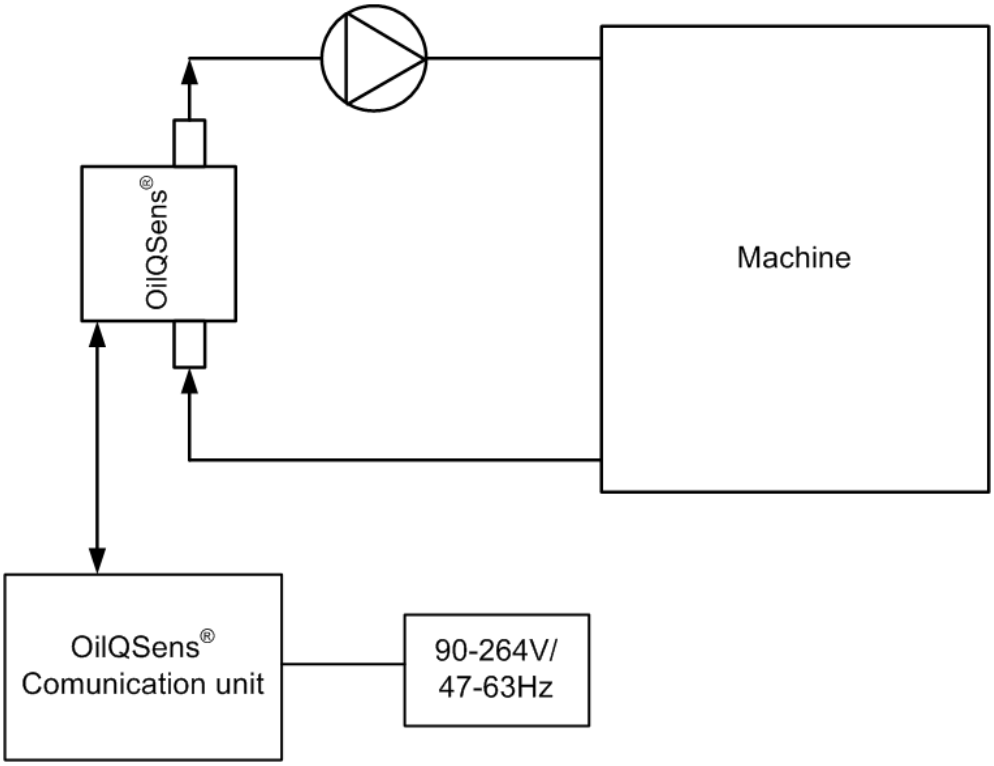


Fig. 1: Installation of the OilQSens® basic sensor in a bypass line.

If the OilQSens® is operated in bypass line, then a pump may be required to provide the necessary flow.

Flow rate is not critical but should be as constant as possible and optimally between 100 ml/min – 140 ml/min.

During installation, care should be taken that no air bubbles can form or become trapped in the chamber. For example, a poor choice of pump could cause this. Any bubbles will affect the results.

It is important to ensure that the communication unit and sensor must be grounded.

6. INSTALLATION OF COMMUNICATION UNIT

Install the sensor.

Connect the cable from the communication unit / module to the sensor (or in case of the High Temperature Option, to the separated high temperature box).

Finally, connect the power adapter, first with the communication unit and then the power supply.

Please note that the supply voltage match the specifications on the nameplate of the power supply!

OilQSens® is now ready to measure.

3 green LED's are mounted on the communication unit. The top LED indicates whether WLAN activity is present (optional feature). The middle LED lights up when operation of the communication unit is established. It flashes briefly when something is sent over the serial RS232 interface. When it is permanently on, the communication unit is not ready for use. The lower LED blinks at different time intervals and indicates the sensor is measuring. If this LED lights permanently, or is permanently out, there is a problem with the measurement. Please contact the manufacturer.

7. COMMUNICATION

7.1 POSSIBILITIES OF COMMUNICATION

The following modes are possible:

- RS232 or Profibus/Profinet/Modbus/CAN,
- RS232/Profibus/Profinet/Modbus/CAN and LAN **or** RS232/Profibus/Profinet/Modbus/CAN and WLAN,
- 8-channel Analog Output (0-10 V) with USB-Output module (requires PC or Laptop, Windows version 7 or higher),
- 2-channel Analog Output (0-10 V, requires LAN interface),
- GSM module.

The simultaneous operation of LAN and WLAN is not possible.
The simultaneous operation of RS232 and Profibus/Modbus/CAN is not possible.

Furthermore, it is possible to use a converter RS232/RS485 or RS232/USB the serial port to establish connectivity to a PC or notebook.

The next figure show the possibilities of communication of the OilQSens®.

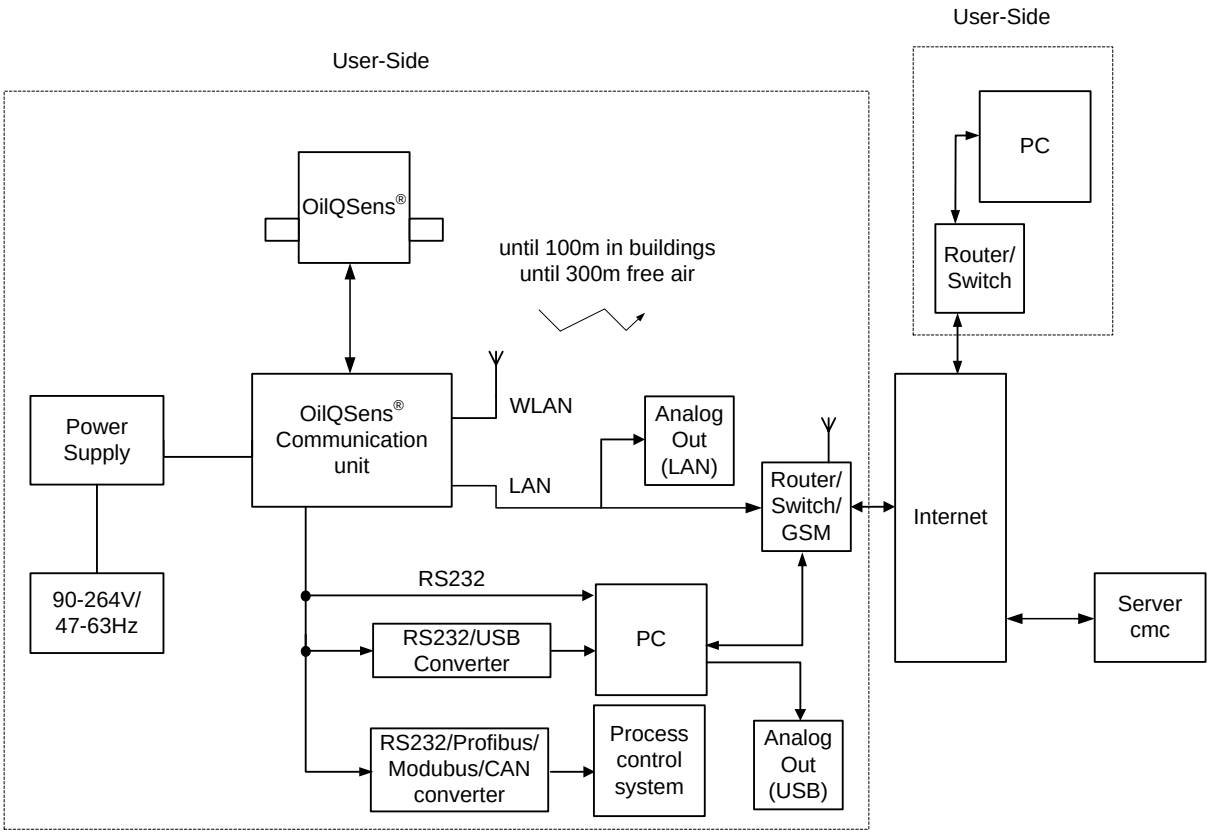


Fig. 2: Communication of the OilQSens®.

RS232 / RS232-USB:

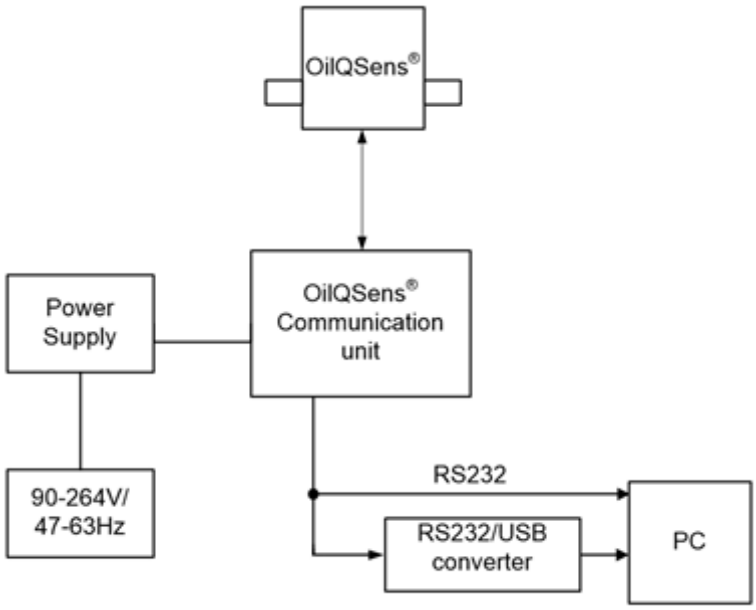


Fig. 3a: RS232 / RS232-USB Communication of the OilQSens®.

Profibus:

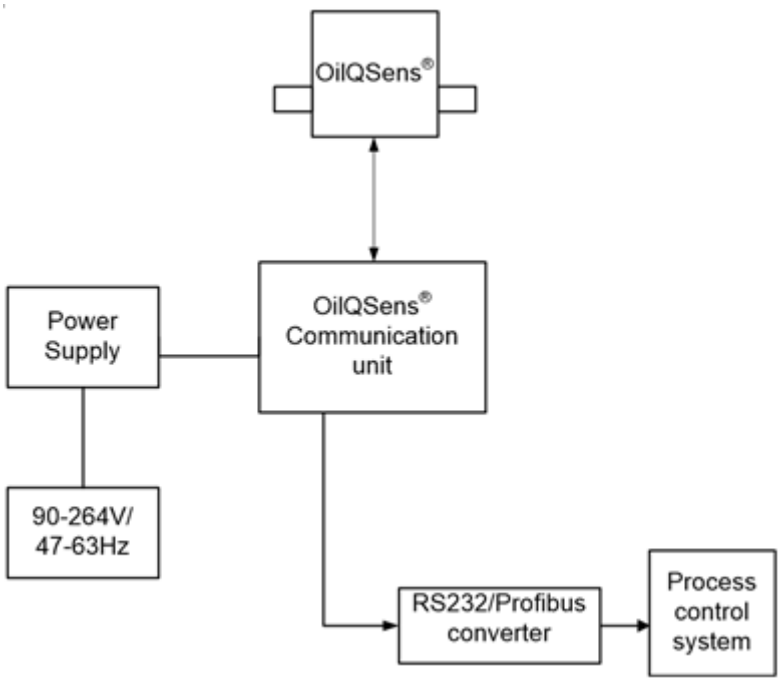


Fig. 3b: PROFIBUS communication of the OilQSens®.

Network (LAN):

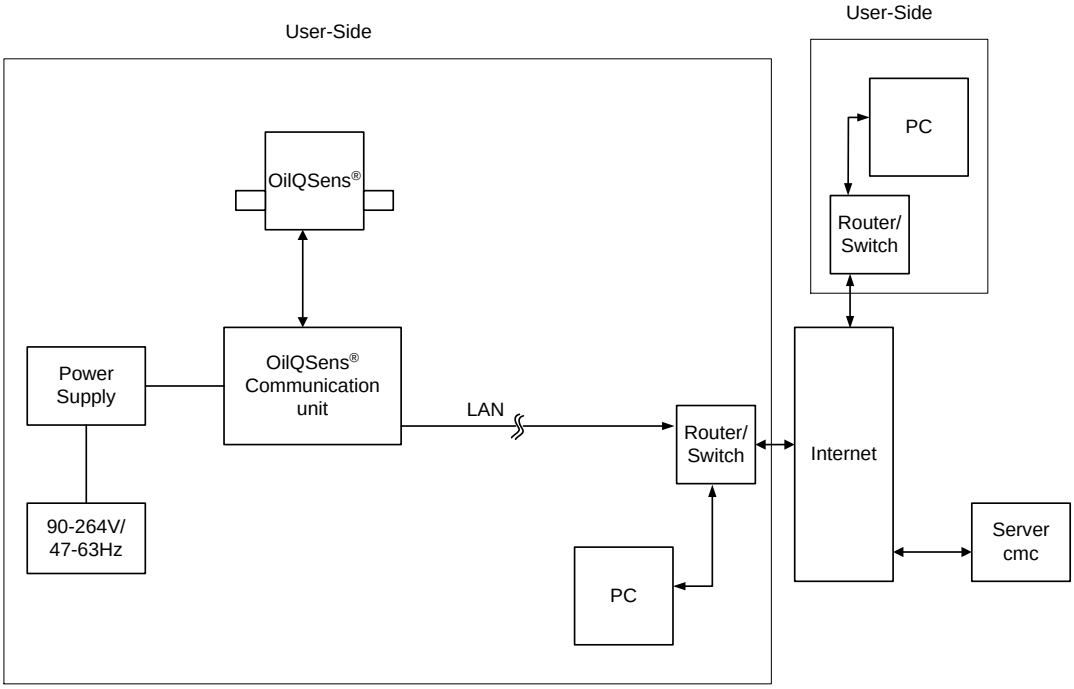


Fig. 4: Network (LAN) communication of the OilQSens®.

Network wireless (WLAN)

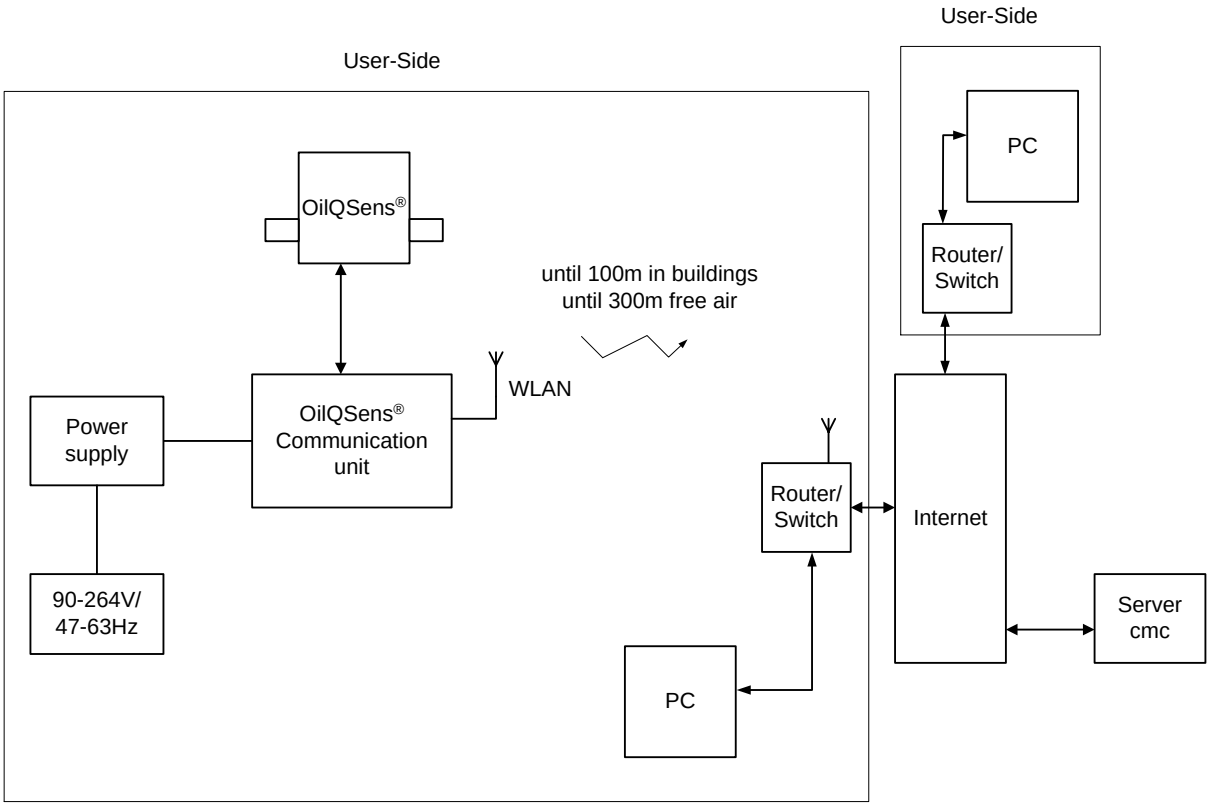


Fig. 5: Network wireless (WLAN) communication of the OilQSens®.

7.2 CAN BUS INTERFACE (optional)

The standard setting for the CAN Bus speed is 1Mbit.

The standard CAN address registers are ID 200, ID 201 as shown in table 1.

Reg.	Parameter	# Bytes	Scaling factor	Example	Value
200	Temperature [°C]	2 Bytes	1/2.55	0040	25.098
200	Rel. permittivity	3 Bytes	0.000001	31e6bd	3.270333
200	Elec. conductivity [pS/m]	3 Bytes	0.1	000071	11.3
201	Compens. rel. permittivity	3 Bytes	0.000001	32220b	3.285515
201	Compens. elec. conductivity [pS/m]	3 Bytes	0.1	0000d8	21.6

Tab. 1: CAN bus data transmission format.

For the correct connection of the CAN module please refer to the information below:

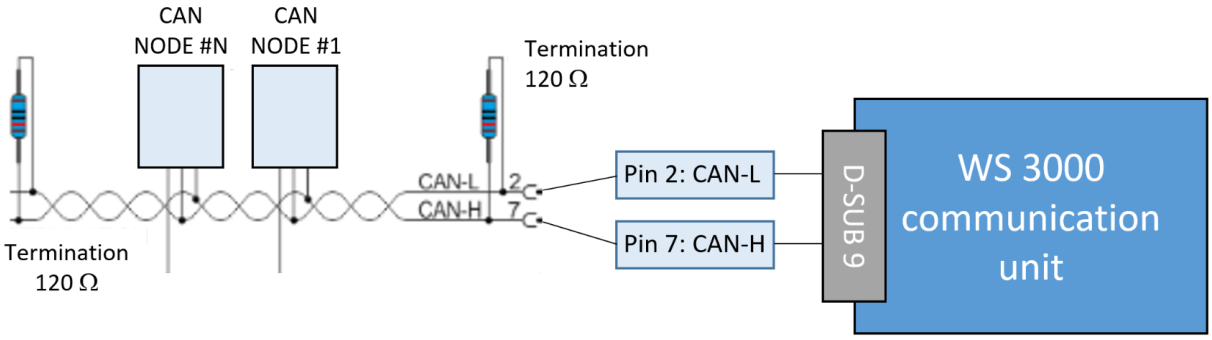


Fig. 6: CAN bus connection scheme, pin 2 CAN-Low and pin 7 CAN-High.

7.2 PROFIBUS/PROFINET/MODBUS INTERFACE (optional)

The following table shows the contents of a Profibus/Profinet/Modbus telegram in detail. The positions are fixed for a simple conversion of the string value. The corresponding GSD file is provided by Download-Link (Profibus/Profinet only). The length of the datagram is 224 characters; the Profibus/Profinet master can be configured as follows: INPUT: 128 Byte (64 word), 64 Byte (32 word), 32 Byte (16 word).

Bit Position	Content	Designation
1	0	Counter
2-14	SNX01-OQ-1234	Serial Number
15	/	Separator
16-18	O	Hardware
19	/	Separator
20-46	FW|CMCWARE V4.0 2016-02-12|	Firmware-Version
47	/	Separator
48	[LF]	Line Feed
49-62	t000000.000000	Temperature
63	[LF]	Line Feed
64-77	e000000.000000	ε_r
78	[LF]	Line Feed
79-92	r000000.000000	ε_{r40}
93	[LF]	Line Feed
94-107	k00000.0000000	κ
108	[LF]	Line Feed
109-122	j00000.0000000	κ_{40}
123	[LF]	Line Feed
124-137	d000000.000000	tan δ
138	[LF]	Line Feed
139-152	g000000.000000	tan δ_{40}
153	[LF]	Line Feed
154-157	w100	Water Activity
158	[LF]	Line Feed
159-162	b100	Breakdown Voltage
163	[LF]	Line Feed
164-167	c100	Code
168	[LF]	Line Feed
169-224	…	Service Information

Tab. 1: Bit positon of data transmission.

The command for *temperature reset* can be send to the oil sensor system via the Profibus/Profinet/Modbus interface: STKRESETF [LF]

The *reference temperature* can be set to 40°C for example by the following command: STC40000000F [LF]

7.4 RS232 INTERFACE

For connection to a PC / laptop, a 9-pin cable (9-pin D-SUB jack) is necessary.
Communication settings:

Baud rate:	9600 Baud
Parity Bits:	none
Data Bits:	8
Stop Bits:	1
Flow control:	no

7.5 INSTALLATION ON A NETWORK

Installation of OilQSens® in customer network

Depending on the selected mode, LAN or WLAN, it is pre-configured by the manufacturer.

Installation with a fixed IP address

Prior to delivery the manufacturer assigns a free fixed IP address on its network. OilQSens® then seeks this address.

Installation with DHCP

After connection to the network by the customer, OilQSens® is automatically assigned a free IP address by the DHCP server on the router.

Registration on the website

Each OilQSens® has a unique serial number in a database.

Username, password and website access are sent separately from the manufacturer. Press Enter to proceed to the sensor data. Fig. 7 shows the login page of the website.

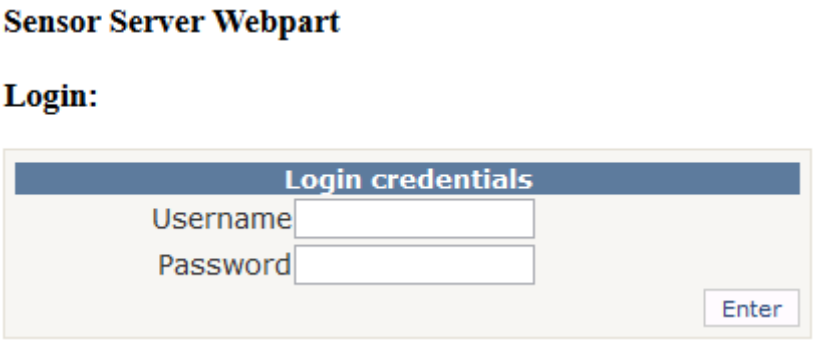


Fig. 7: Login mask of the cmc Server.

Login to local Website

Please enter the IP address of the communication unit into your Web Browser adding /sensor.html, to get access onto the local generated Website

Example: http://100.200.100.200/sensor.html

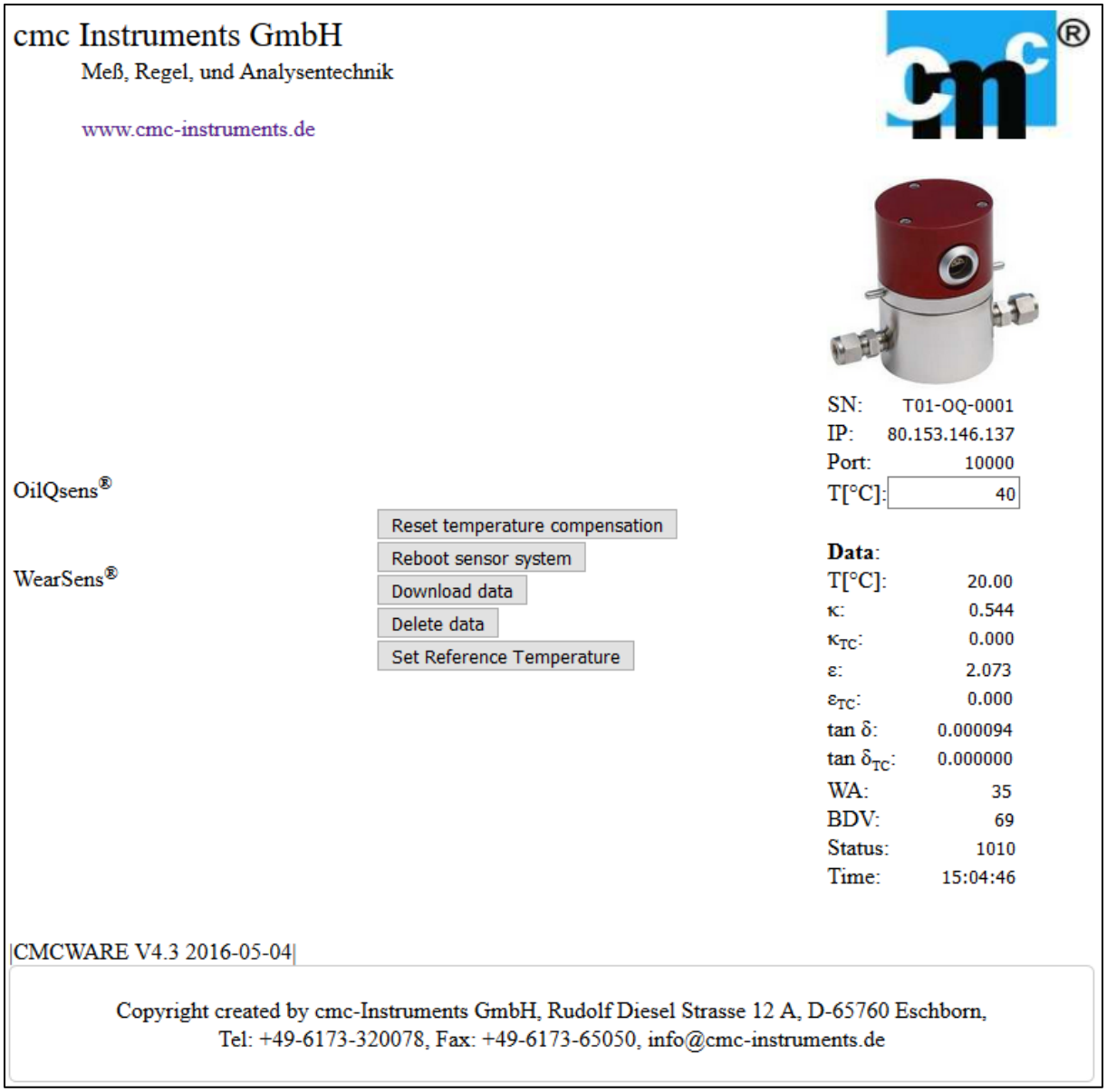


Fig. 8: Locally generated site to reset the temperature compensation or to reboot of the communication unit

On the local website, you can perform a temperature reset or a reboot of the communication unit. Furthermore, you can set the reference temperature for the temperature compensation. By the button „Download data“ all locally stored data can be copied to your PC/Laptop.

8. WSENS SOFTWARE

8.1 INSTALLATION

PC - software installation

1. DVD-Drive: execute *\LabViewRuntimeEngine2015-32bit\ LVRTE2015SP1_f3Patchstd.exe*
2. Restart PC
3. DVD-Drive: execute *\LabViewRuntimeEngineVISA-RS232\NIVISA1550full.exe*
4. Restart PC
5. DVD-drive: copy folder *"WSensSoftware"* to local hard disk
6. Execute **WSens_vX.X.exe** at *WSensSoftware\WSensX_vX.X.exe on* local hard disk

RS 232 connection (not available with Profibus/Profinet/CAN/Modbus option)

To establish the connection of the communication unit with a PC use the provided RS232 serial cable included in the accessories, if necessary use the RS232/USB adapter if there is no direct RS232 connection available at the computer. Make sure all cables are connected as described. The WSens software is not available for the Profibus communication.

System requirements

Processor	Pentium® III/Celeron® 866 MHz or faster (32 Bit) , Pentium® 4 G1 or faster (64 Bit)
Memory	256 MB RAM
Display	1024 x 768 screen resolution
Operating System	Windows 8.1/8/7/Vista (32 Bit, 64 Bit) , Windows XP SP3 (32 Bit), Windows Server 2012 R2 (64 Bit), Windows Server 2008 R2 (64 Bit) Windows Server 2003 R2 (32 Bit)
Disk Space	620 MB

Tab. 3: System requirements of the WSens Software.

8.2 OPERATION & FUNCTION

On the next eight pages the operation and function of the WSens Software is described in detail.
The graphical user interface of WSens is divided in two parts: the following parameters are displayed on the left hand side of the GUI: conductivity κ, dielectric constant ε_r, temperature-compensated values of the conductivity κ_{TC}, relative permittivity ε_{rTC} and temperature. On the right hand side you will find more trending graphs and settings. The x-axis of the graphs shows the time after the measurement start in minutes. The maximum time window of each graph is 24 hours. After 24 hours the time windows shifts correspondingly.

The software starts with the tab ***settings*** as shown in figure 9. Here you can:

- change, open and close the COM Port, serial RS232 connection
- start and stop the recording of a measurement
- reboot the communication unit / module
- reset the temperature compensation algorithm
- change the reference temperature for the temperature compensation algorithm
- adjust the email notification settings
- adjust the limit settings of the temperature compensated data
- change the language
- close the software.

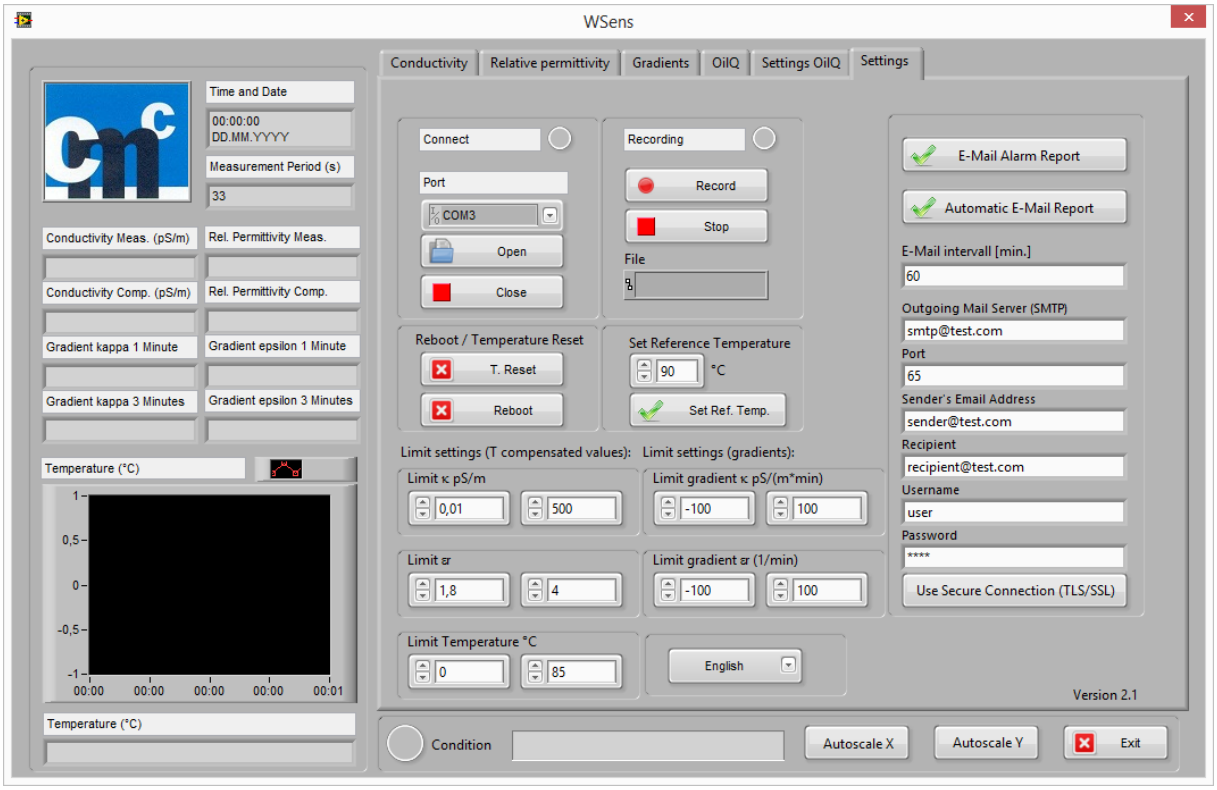


Fig. 9: WSens Software – Settings.

Change, open and close the COM Port

- Choose COM Port
    - With USB-Serial Adapter
        - Properties of Computer (right mouse computer→Properties)
        - Hardware → Device-manager
        - Search USB-serial Adapter, which COM Port # is in brackets
- Choose Button „OPEN“
- to close the COM-PORT click on the Button „CLOSE“.

Start and stop the recording of a measurement

- Start the recording of a measurement:
    - Choose Button „RECORD“
    - Select the appropriate location and name on your PC / Notebook
    - Ending of the name should be **.csv**, e.g. test.csv and click OK
- Stop the recording of a measurement:
    - Choose Button „STOP“.

Reboot the communication unit / module

- Reboot the communication unit / module: click Button Reboot, soft re-start.

Reset the temperature compensation algorithm

By pressing the button “T.Reset” the temperature compensation algorithm will be restarted and enters a new learning cycle. You have to reset the temperature compensation algorithm after changing the oil. Before you restart the temperature compensation algorithm, make sure the sensor is completely filled with oil and no air bubbles are inside.

ONLY AFTER THE FIRST INSTALLATION OF THE SENSOR, or **AN EXCHANGE OF THE OIL MEDIUM, IT IS IMPORTANT TO PERFORM A TEMPERATURE RESET.**

After that and after changing the reference temperature (see next page) the sensor should measure at least 10 values for the conductivity and dielectric constant, with a minimum temperature difference of 1°C without load of the monitored system. Readings of the temperature-compensated values are displayed, if the algorithm has gathered sufficient data to start its compensation correctly.

Change the reference temperature for the temperature compensation algorithm

Note: This feature is only available in communication firmware version > 3.0!

- Change the reference temperature:
  - Type in the new reference temperature
  - Click on Button “Set. Ref. Temp.” to set the new reference temperature, the communication unit will be restarted and an automatic T-Reset is performed at the same time. So the temperature algorithm need new learning data (i.e. performing a measurement as noted on the previous page).

Adjust the email notification settings

- Fill in your email settings to enable automatic email notification
- Alarm Report notification is enabled by click on Button “ E-Mail Alarm Report”
- Cyclic automatic email notification is enabled by click on Button “ Automatic E-Mail Report”
- The interval of email notifications can be modified by the field “E-Mail interval [min]”. The unit is minutes.

Adjust the limit settings of the temperature compensated data

The limit values of the temperature compensated values of κ_{TC}, ε_{rTC}, T, gradients of κ_{TC} & ε_{rTC} can be set individually. Please note that this feature will be available after the temperature compensation has been initialized properly as described on the previous page. These limit values can vary on the different oil types used in the monitored system and have to be adjusted on the specific application.

Change the language

Two languages are supported: German, English.

- Choose the language by click on the Button “Language”.

Close the software

Exit the software by click on the button “Exit”. A window will open: “Overwrite limit settings?” You can choose “Yes!” or “No!” to save the last used settings to the Computer. At the next program start the last saved settings are reloaded.

Conductivity, Relative Permittivity, Gradients

In the tabs ***Conductivity, Relative Permittivity, Gradients*** (see fig. 10 - 12) the measured data is visualized in graphs over the time.

In the tab ***Gradients*** the slopes of the temperature-compensated dielectric constant and conductivity over a time interval of 1 minute are displayed.

Application: Oil regeneration unit:

The conductivity and the relative permittivity will decrease during an oil regeneration cycle due to filtering of the contamination products and drying of the insulating oil.

Application High voltage transformer:

Contamination products, such as particles, cellulose fibres, moisture and their contaminating effects, such as acid and oil soaps cause a change in the electrical properties of oil: the conductivity will increase over time; the relative permittivity will vary due to the change of the polar elements in the oil: e.g. consumption of polar inhibitor components, humidity in the oil, formed acids.

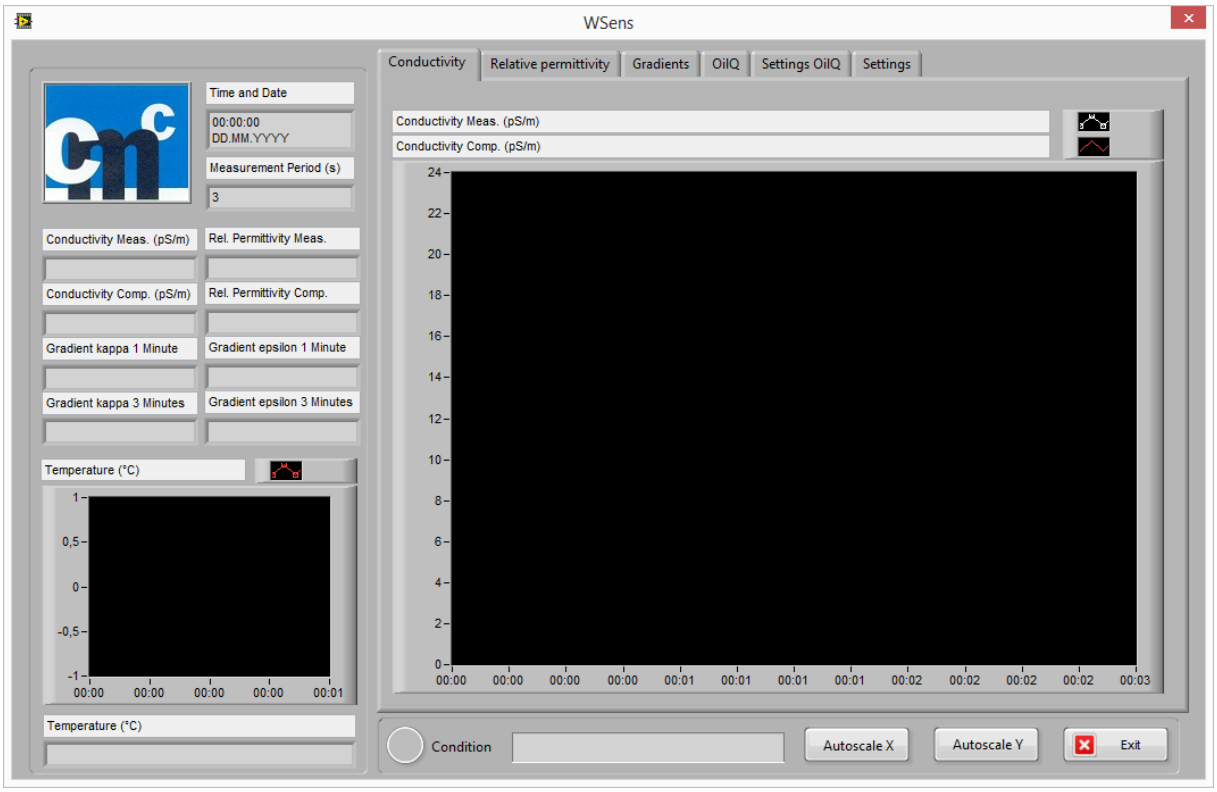


Fig. 10: WSens Software – Conductivity.

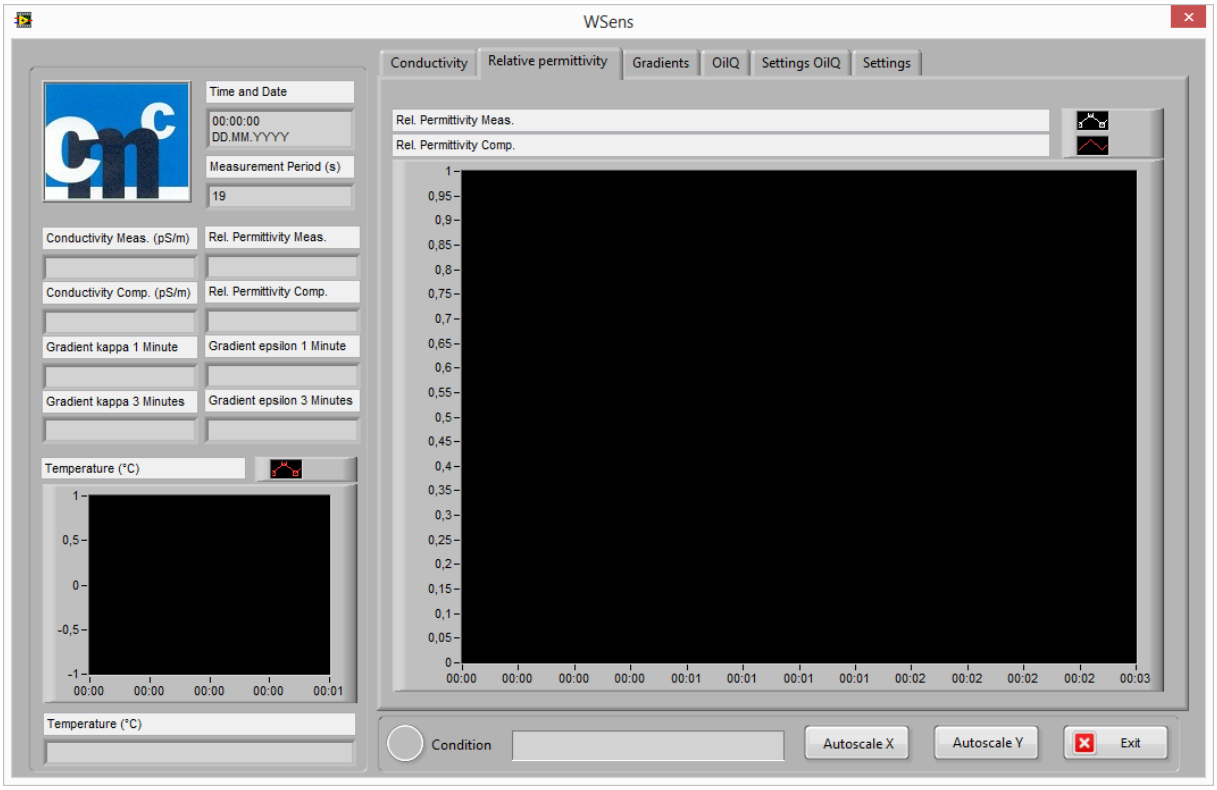


Fig. 11: WSens Software – Relative Permittivity.

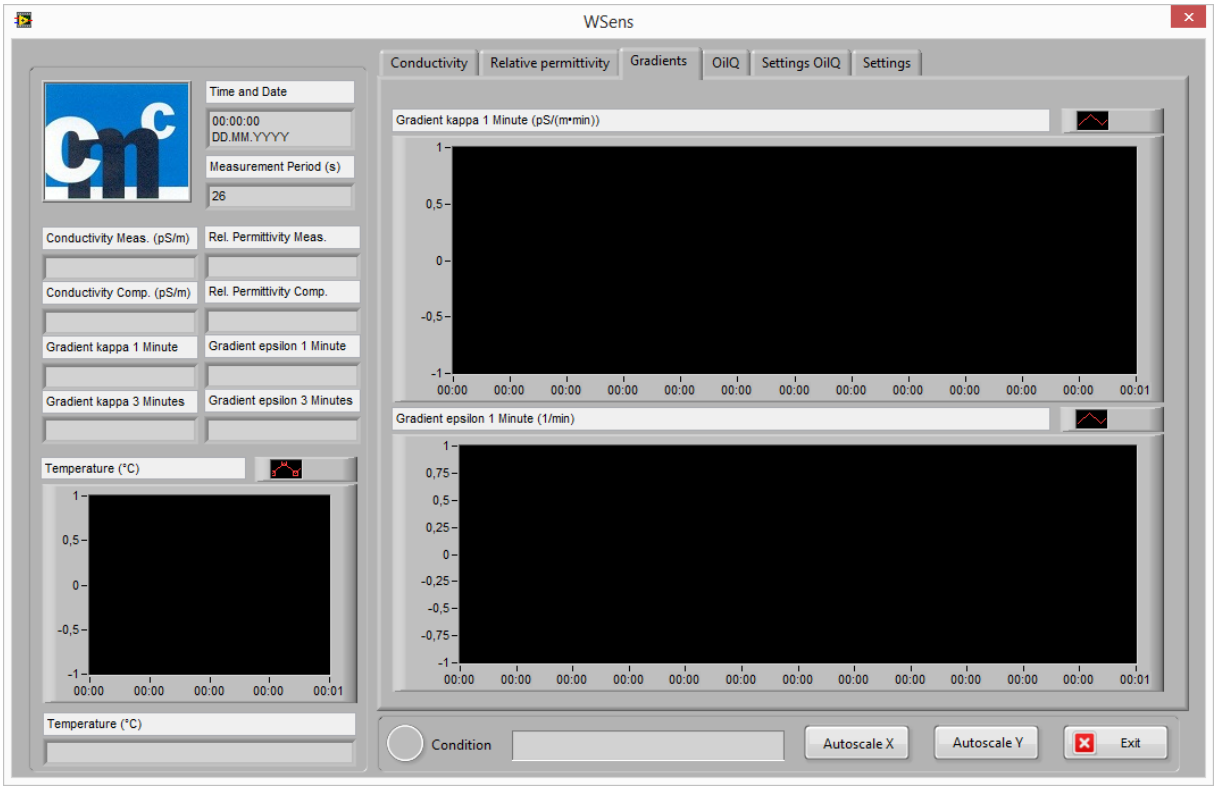


Fig. 12: WSens Software – Gradients.

Breakdown Voltage, Loss Factor tan δ, Humidity

The tab ***OilQ*** contains graphs for the Breakdown Voltage, estimated Humidity and the Loss Factor tan δ and their temperature compensated values (see fig. 13).

Please find details on the calculation and procedures on the loss factor tan δ, breakdown voltage and humidity in the next section 8.3.

Application oil regeneration unit:

The breakdown voltage will increase during an oil regeneration cycle due to filtering of the contamination products insulating oil, while the humidity and the loss factor tan δ will decrease due to cleaning and drying of the transformer oil.

Application high voltage transformer:

The breakdown voltage will decrease, the loss factor tan δ will increase over time based on oil aging, acidification and contamination. The humidity will also vary due to temperature changes in the oil.

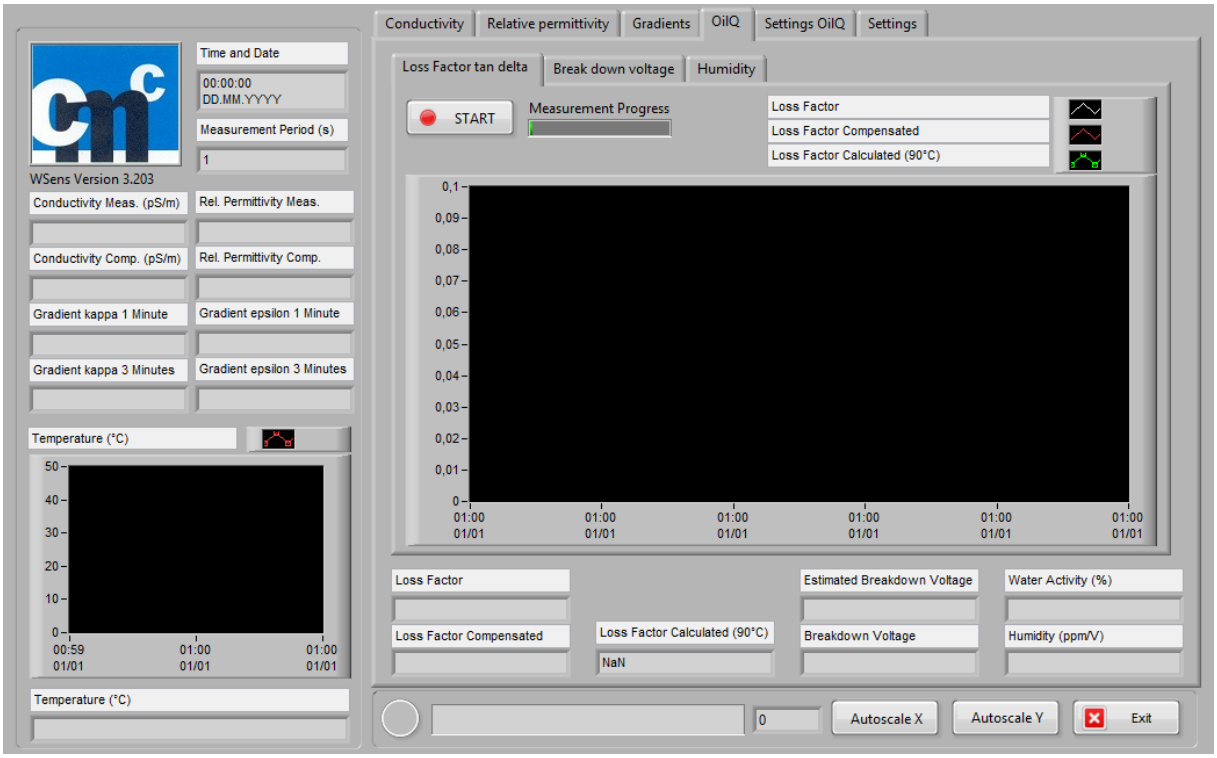


Fig. 13: WSens Software – OilQ.

Settings OilQ

Via the tab “Settings OilQ” the oil specific parameters can be modified.

By clicking on the oil selector different defined oil types can be chosen to estimate the breakdown voltage and humidity for this specific oil (see fig. 14).

The limit values of the temperature compensated values of loss factor tan δ_{TC}, humidity and breakdown voltage can be set individually. Please note that this feature will be available after the temperature compensation has been initialized properly as described on the page 20. These limit values can vary on the different country standards depending on your localization. Please refer to your local standards.

The oil parameters (= coefficients) can be modified manually by clicking on the Button “Change Oil Parameters”. A new window will open (see fig. 15,16):

- the name of the oil can be changed in the first line.
- a0 and b0 are the coefficients of the linear fit of a multiple point calibration (minimum number of point = 2) to estimate the humidity.
- c0, d0, e0, f0 are the coefficients of the second order equation to estimate the breakdown voltage.

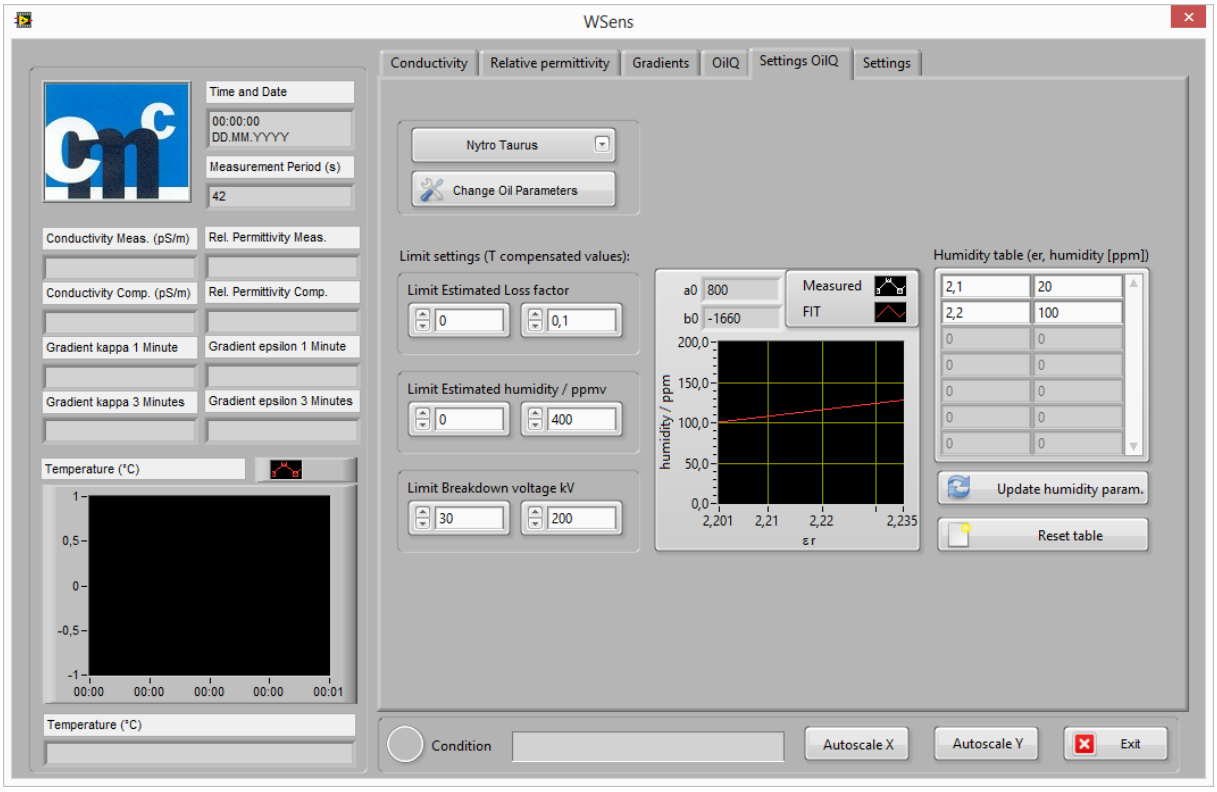


Fig. 14: WSens Software – Settings OilQ.

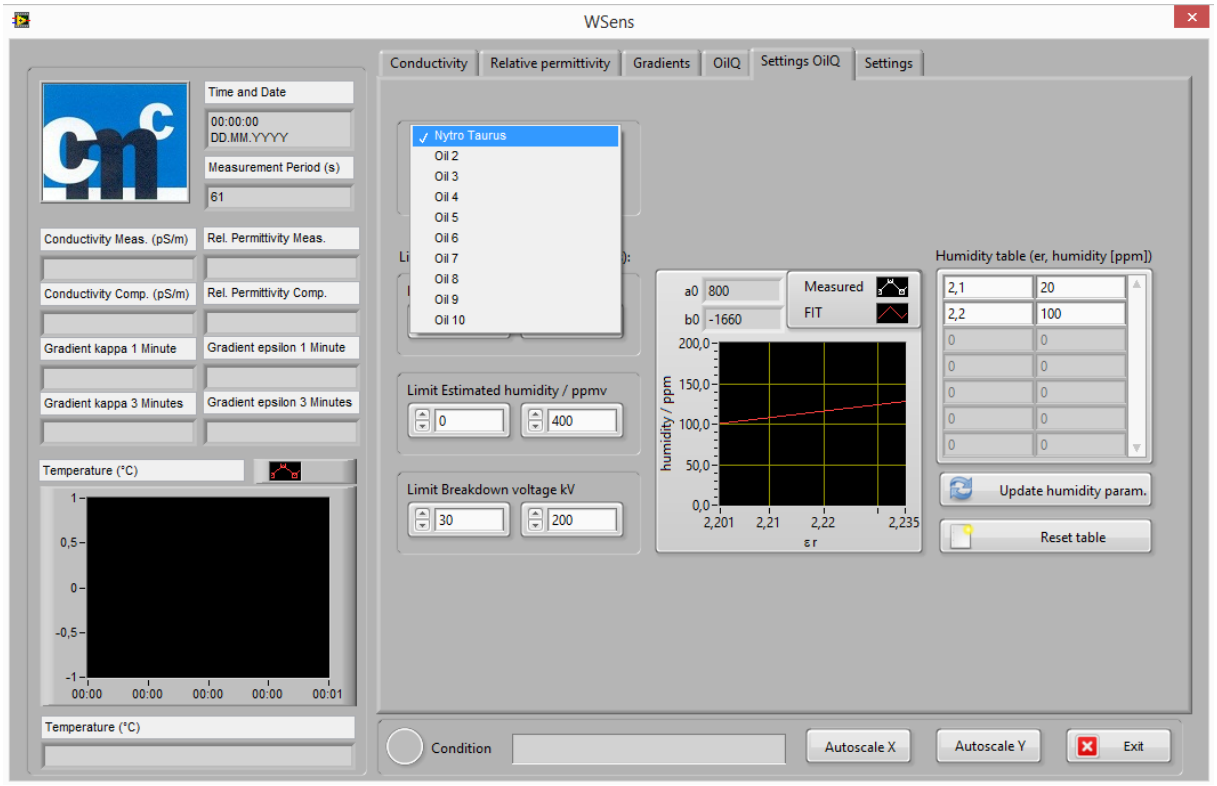
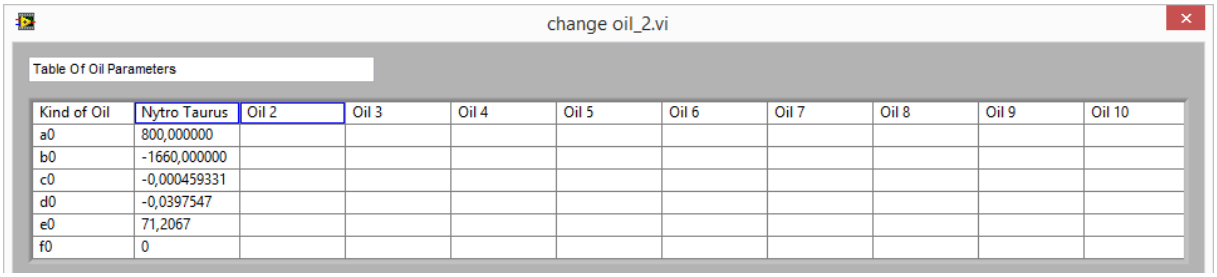


Fig. 15: WSens Software – Settings OilQ.



Kind of Oil	Nytro Taurus	Oil 2	Oil 3	Oil 4	Oil 5	Oil 6	Oil 7	Oil 8	Oil 9	Oil 10
a0	800,000000									
b0	-1660,000000									
c0	-0,000459331									
d0	-0,0397547									
e0	71,2067									
f0	0									

Fig. 16: WSens Software – Change oil parameters.

8.3 CALCULATIONS

Loss factor

The calculation of $\tan\delta$ or the temperature compensated loss factor $\tan\delta_{40}$ is done via the following formula:

$$\tan\delta = \frac{\kappa}{\varepsilon_r \cdot \varepsilon_0 \cdot \omega}$$

$$\tan\delta_{40} = \frac{\kappa_{40}}{\varepsilon_{r40} \cdot \varepsilon_0 \cdot \omega}$$

with $\varepsilon_0 = 8{,}85418781762 \cdot 10^{-12} \frac{As}{Vm}$ and $\omega = 2\pi \cdot f$, f =50Hz.

9. DRAWINGS

9.1 OILQSENS® SENSOR

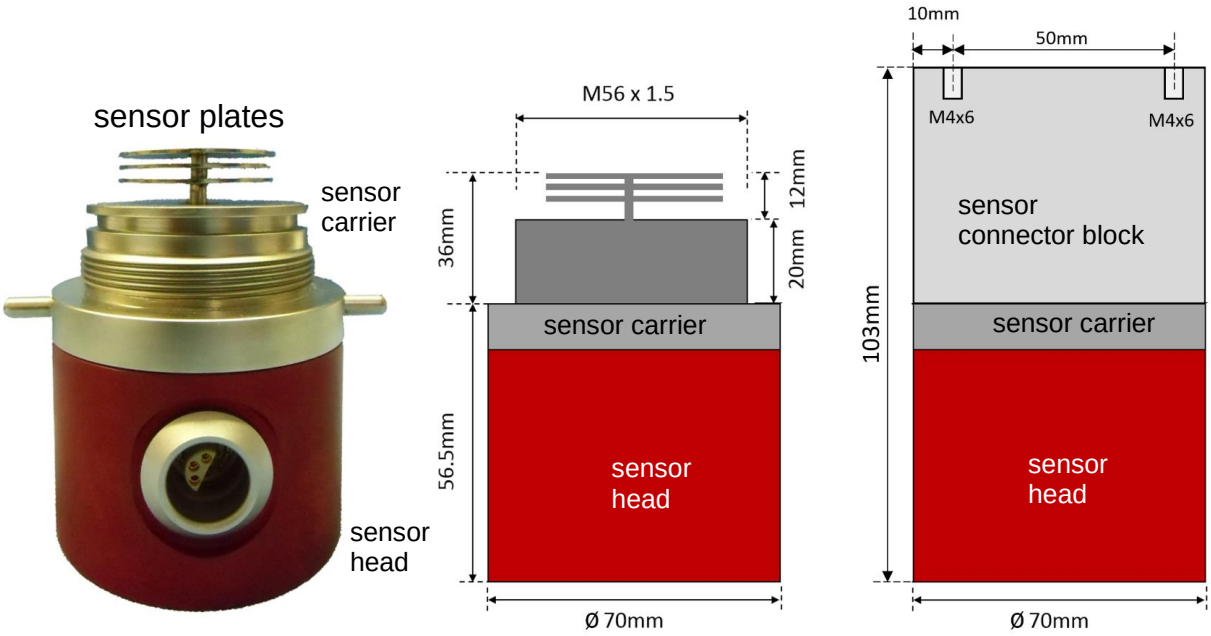


Fig. 17: Dimensions of the OilQSens® base sensor.

9.2 OILQSENS® COMMUNICATION UNIT

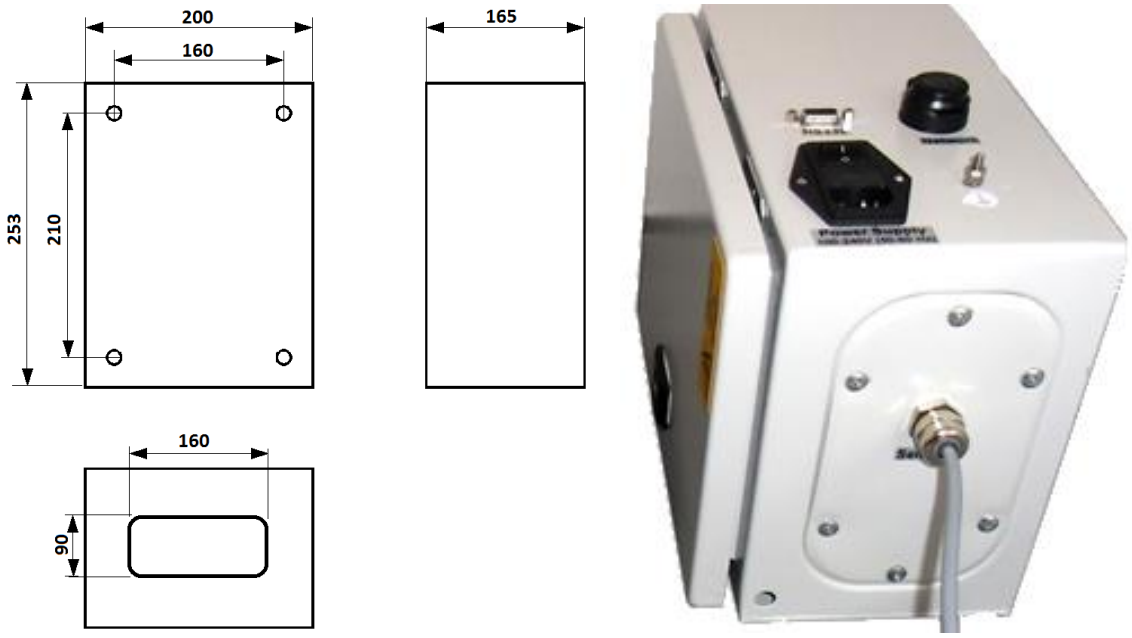


Fig. 18: Dimensions and picture of the OilQSens® communication unit.

9.3 OILQSENS® COMMUNICATION MODULE (optional)

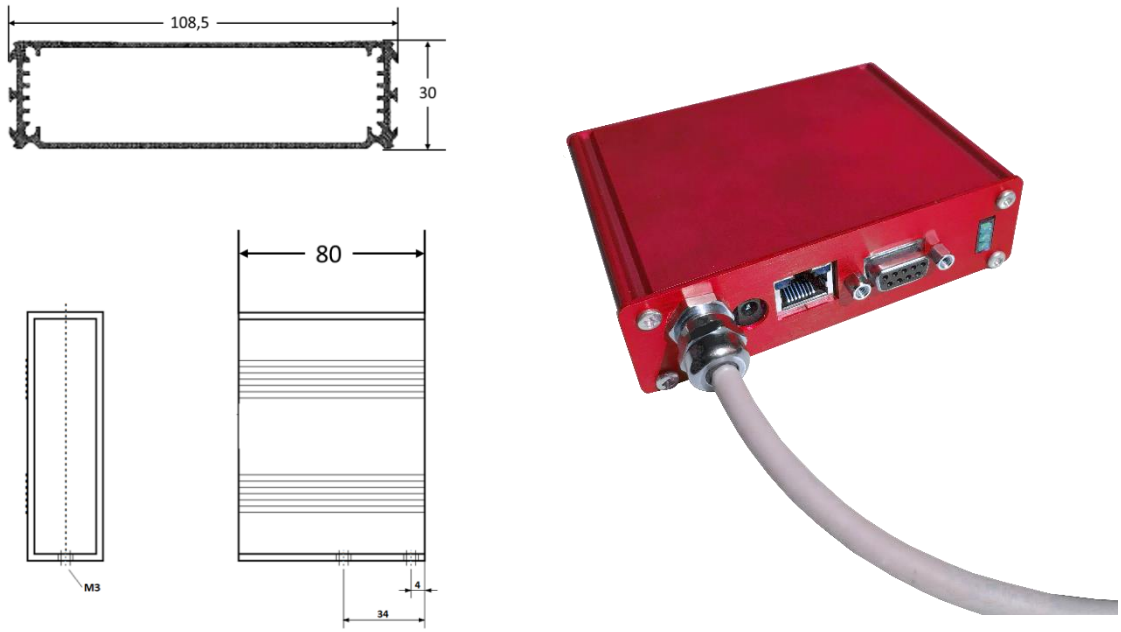


Fig. 19: Dimensions and picture of the OilQSens® communication module.

9.4 OILQSENS® – HIGH TEMPERATURE UNIT (HT, optional)

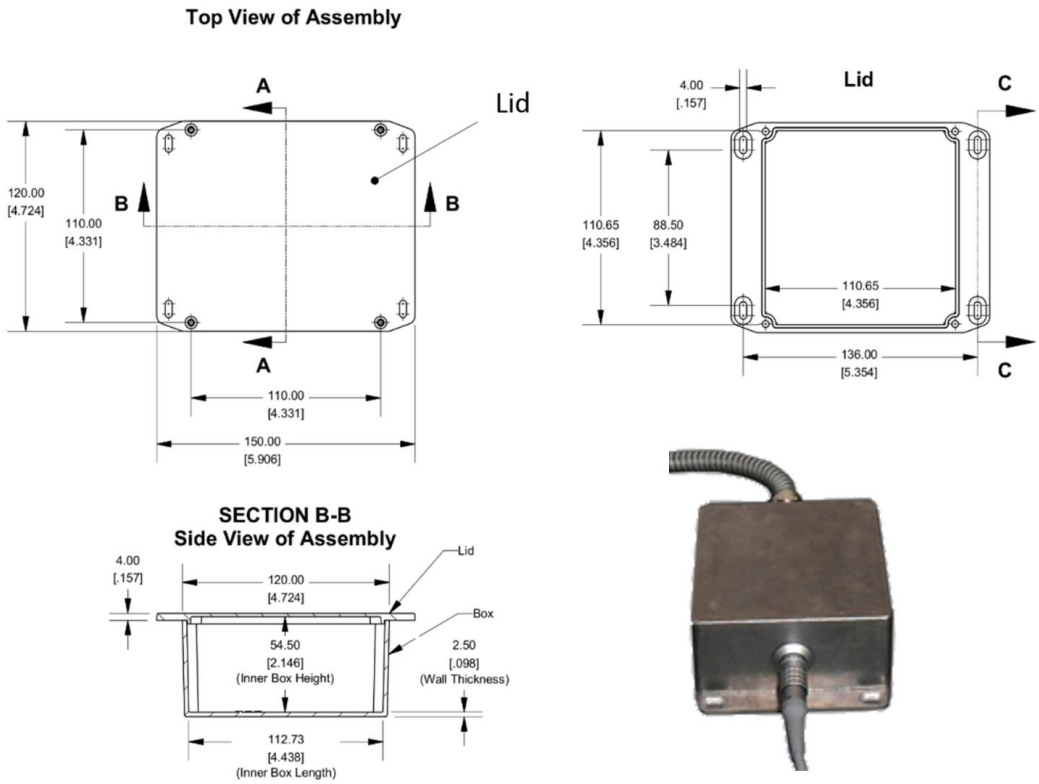


Fig. 20: Dimensions and picture of the OilQSens® high temperature unit, optional.

10. MAINTENANCE

Due to its special design the sensor system doesn't need specific maintenance. The cleaning of the sensor bowl and the sensor plates should only be performed, when all parts of the sensor have ambient room temperature, else the threads can be damaged! Unscrew the sensor bowl from the sensor carrier carefully. After cleaning the sensor bowl and sensor plates (Xylol, Isopropanol) grease has to be applied to both threads (inner and outer thread of the bowl and carrier), else threads can be damaged! Damage of the sensor due to incorrect treatment is not covered by warranty!

11. CODES

11.1 RS232 (WSens-Software)

Bit 1: Sensor is in the calibration mode.
Bit 2: Sensor has not completed the learning phase of the temperature compensation algorithm.
Bit 3: The value of ε_r is <1.8. Is there air in the measuring chamber?
Bit 4: The temperature compensation for ε_r is incorrect.
Bit 5: The temperature compensation for κ_r is incorrect.
Bit 6: Maximum measuring range exceeded.

Example 1:

Code = 110

Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1
0	0	0	1	1	0

Bit 2 = 1: Sensor is still in the temp. learning phase.
Bit 3 = 1: ε_r is <1,8. Are there air inclusions in the measuring chamber?

Example 2:

Code = 0

Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1
0	0	0	0	0	0

No error.

11.2 PROFIBUS/PROFINET/MODBUS (optional)

First of all, 100 (decimal value) has to be subtracted from selected code at position 164-167. After conversion into binary notation, the sensor can be easily identified:

Bit 1: Sensor is in the calibration mode.
Bit 2: Sensor has not completed the learning phase of the temperature compensation algorithm.
Bit 3: The value of ε_r is <1.8. Is there air in the measuring chamber?
Bit 4: The temperature compensation for ε_r is incorrect.
Bit 5: The temperature compensation for κ_r is incorrect.
Bit 6: Maximum measuring range exceeded.

Example 1:

Selected Value = „c106“
Code = 106 - 100 = 6 → Conversion in binary representation: 110

Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1
0	0	0	1	1	0

Bit 2 = 1: Sensor is still in the temperature-learning phase.
Bit 3 = 1: ε_r is <1.8. Are there air inclusions in the measuring chamber?

Example 2:

Selected Value = „c100“
Code = 100 - 100 = 0 → Conversion in binary representation: 0

Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1
0	0	0	0	0	0

No error.

12. DECLARATION OF CONFORMITY

EG Konformitätserklärung
Declaration of Conformity
Declaration de Conformite

cmc Instruments GmbH
Meß-, Regel- und Analysentechnik
Rudolf Diesel Strasse 12A
65760 Eschborn

Erklärt in alleiniger Verantwortung, dass das Produkt / declare under our sole responsibilty, that the product /declarons sous notre responsabilité, que le produit:

Typ, Modell / Type, Model / Type, Modele: **Ölqualitätssensor OilQSens®**
Oil Quality Sensor OilQSens®
Sensor qualité pétrole OilQSens®

mit den Anforderungen der Normen und Richtlinien / fulfills the requirements of the standards and regulations of the Directive / satisfait aux exigences des normes et directives:

2011/65/EU:	Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment Text with EEA relevance
2014/35/EU:	Directive on the harmonisation of electrical equipment designed for use within certain voltage limits
2014/30/EU:	on the harmonisation relating to electromagnetic compatibility
DIN EN 55022:	Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement
DIN EN 61000-6-1:	Electromagnetic compatibility (EMC) - Part 6-1: Generic standards - Immunity for residential, commercial and light-industrial environments
DIN EN 61000-6-3:	Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments
DIN EN 61000-6-4:	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
DIN EN 61010-1:	Safety requirements for electrical equipment for measurement, control and laboratory use - Part 1: General requirements

CE

übereinstimmt und damit den Bedingungen entspricht / and therefore corresponds to the regulations of Directive /correspond aux reglement de la Directive.

Ort und Datum der Ausstellung / place and date of issue /lieu et date d'etablissement:

Eschborn, 30. Juni 2017

Die Erklärung entspricht EN 45 014 /
This Declaration corresponds to EN 45 014 /
Cette Declaration correspond a EN 45 014.

cmc Instruments GmbH
Mess-/ Regel- und Analysentechnik
Rudolf-Diesel-Strasse 12A
D-65760 Eschborn
Phone +49-(0)6173-320078
Fax +49-(0)6173-65050

cmc Instruments GmbH
Meß-, Regel und Analysentechnik

Rudolf Diesel Strasse 12 A
D – 65760 Eschborn

Tel.: +49 (0) 6173/32 00 78
Fax: +49 (0) 6173/6 50 50
E-Mail: info@cmc-instruments.de

Constantly redefining the difference.™