

IVS 01

Inline multifunction sensor

Viscosity + Temperature + rel. dielectric constant



Instruction manual Version 1.3

Serial-No. IVS 01:

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Index

	Page
1. SAFETY INFORMATION	4
1.1. Signal glossary.....	4
1.2. Dangers of misuse	4
1.3. Intended applications	5
2. APPLICATIONS AND INSTALLATION	6
2.1. Setup.....	6
2.2. Block diagram	6
2.3. General Information	6
2.4. Preparation for operation	7
2.4.1. Sensor Installation	7
2.4.2. Installation of the evaluation electronics.....	7
2.4.3. Electrical Connections	8
2.5. Operation of the IVS 01	8
2.5.1. Choose of the system function.....	8
2.5.2. Action for the function „Monitoring of the oil quality“	9
2.5.2.1. Key Operation	9
2.5.2.2. Function	10
2.5.2.3. Fresh oil calibration	10
2.5.2.4. Adjustment / Alteration displayed evaluated oil quality	11
2.6. System start at first time – Initializations of the IVS 01	11
2.7. Measurement.....	12
2.7.1. Continuous measurement.....	12
2.7.2. Use of the current outputs.....	12
2.7.2.1. Temperature	13
2.7.2.2. Viscosity.....	13
2.7.2.3. Relative dielectric constant.....	14
2.7.2.4. Traffic light colour scheme	14
2.7.3. Oil quality monitoring	15
2.7.3.1. Temperature compensation „OFF“	16
2.7.3.2. Temperature compensation „ON“	17
2.8. Default settings (parameters) at delivery	17
2.9. LED – Indication	18
3. CONFIGURATION AND SOFTWARE	20
3.1. Service functions	20
3.2. Installation of the driver.....	20
3.3. Data Manager.....	20
3.3.1. Installation of the data manager.....	21
3.3.2. DATA MANAGER.....	21
3.3.2.1. Settings.....	21
3.3.2.1.1. System information.....	23
3.3.2.1.2. Scaling (Scaling of the analogue outputs).....	23
3.3.2.1.3. Oil quality monitoring	24
3.3.2.1.4. REFRESH	24
3.3.2.1.5. EEPROM.....	25
3.3.2.1.6. Menu - File	25
3.3.2.1.6.1. Refresh	25
3.3.2.1.6.2. Backup.....	25
3.3.2.1.6.3. Restore	26

3.3.2.1.6.4.	EXIT.....	26
3.3.2.2.	Terminal.....	26
3.3.2.2.1.	Transfer of measured values	27
3.3.2.2.2.	Saving measured values	27
3.3.2.2.3.	Convert the TXT file into an EXCEL file	28
4.	<u>ANNEXE</u>	29
4.1.	Technical data	29
4.1.1.	IVS 01 – Sensor	29
4.1.2.	Operating Parameters	29
4.1.3.	Measurement Parameters	30
4.1.4.	IVS 01 – Evaluation electronic	30
4.2.	Pin outs.....	30
4.2.1.	Female-jack “Sensor” on the housing	30
4.2.2.	Counterpart female-Jack for power supply and the current output	31
	(External configurable female-jack in delivery: view at the solder side).....	31
4.2.3.	Traffic light colour functions	31
4.3.	Assembly instructions.....	32
4.4.	Measuring principle	33
4.4.1.	Multifunction sensor – IVS 01	33
4.4.2.	Evaluation electronic.....	33
4.5.	Application areas – compatibility.....	33
4.6.	Troubleshooting.....	34
4.7.	Cleaning the sensor	34
4.8.	Calibration	34
4.9.	Scope of delivery	35

1. Safety information

1.1. Signal glossary

- Any nonobservance of the safety information in this manual implies risk and endangerment of life and the physical condition of the operator. The notes are marked with the following signal words:

 **DANGER** induces a dangerous situation which **causes dead or bad injuries** in case of nonobservance

 **WARNING** induces a dangerous situation which can **cause dead or bad injuries** in case of nonobservance.

 **CAUTION** induces, together with the danger symbol, a dangerous situation which can **cause light or medium heavy injuries** in case of nonobservance.

- Any nonobservance of safety instructions in this manual, which does not cause injuries but destruction of the system and its operability are marked with the following signal word:

 **NOTICE** describes the correct way of handling the device.

- The above signal words can be combined with the safety symbols or the warning symbols.



General danger



Danger caused by electricity



Dangerous for the environment

1.2. Dangers of misuse

The IVS 01 has undergone a safety inspection. The integrated electric and hydraulic safety elements ensure safe operation if the device is used as it is intended to.

WARNING

In cases of maloperation or misuse, as well as in cases of ignoring the application limits and safety regulations, the following threats can occur regarding the:

- Life or physical condition of the operator; 
- The **IVS 01** device, as well as the connected machines and systems; 
- The accuracy of the **IVS 01**; 
- The environment 

WARNING

It is therefore necessary that all persons involved in the operation, maintenance and repair of the device, observe the instruction manual strictly.

1.3. Intended applications

The inline multifunction sensor IVS 01 is used to determine the oil condition in hydraulic and lubrication systems.

The user can be accurately informed in time about the absolute parameters “viscosity, temperature and relative dielectric constant” as well as their significant changes.

With the determination of the important parameters of oil condition, the user can accurately assess the plant status and initiate necessary measures in time and cost-efficiently before major damage occurs.

Operation Limits

The device is exclusively suitable for on-line applications in hydraulic and lubricating systems within the given limits of use:

Max. operation pressure:	$p = 25 \text{ bar}$	(362 PSI)
Viscosity range:	$\mu = 5 \dots 1000 \text{ mPa}\cdot\text{s}$	(6...1200 mm ² /s)
Oil temperature range:	-40 ... 130 °C	(-22...266°F)
Ambient temperature range::	0 ... 70 °C	(32...158°F)

The regular function of the IVS 01 and the warranty of safety are guaranteed only if it is used with by **INTERNORMEN Technology GmbH** provided and allowed accessories.

The sensor has to be inserted into the hydraulic system and connected to the evaluation system.



No unauthorized modifications or changes are allowed at the IVS 01!



The information about operation, maintenance and repair of the device contained in the manual has to be followed strictly!

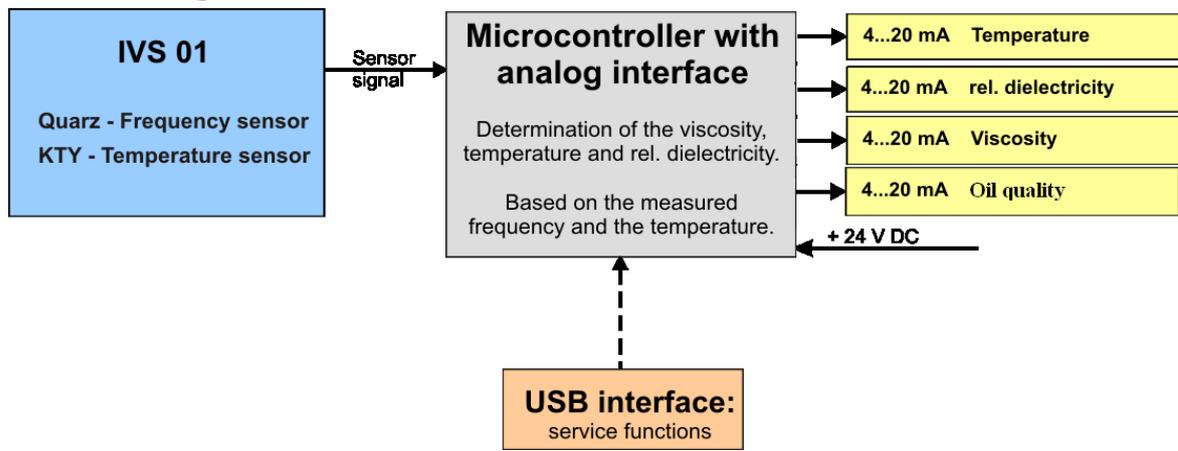
2. Applications and installation

2.1. Setup

The IVS 01 consists of the sensor (1) and the evaluation system (2).



2.2. Block diagram



2.3. General Information

During the operation, the influences of external factors on the lubricant are very extensive. The external influences are e.g. the crafts, energies and interactions with other materials. The force effects include pressure and shear stress; energy influences are heat dissipations (strong temperature fluctuations contribute); The interaction with other materials happens for example a lubricant comes into contact with gases (air, nitrous gases, or sulfur dioxide,) with liquids (water, unknown liquids such as detergents, solvents, etc.) and solids (metals, ceramics, plastic particles and sealing materials. The results of the pollution effects on the hydraulic and lubrication systems are very various, e.g. higher wear, a drastic increase in breakdown of components, also malfunctions.

The IVS 01 has been designed for continuous condition monitoring and condition analysis of hydraulic and lubrication systems, such as an assessment of the aging condition of oil, the detection of mixing of oils and the avoidance of unnecessary oil changes.

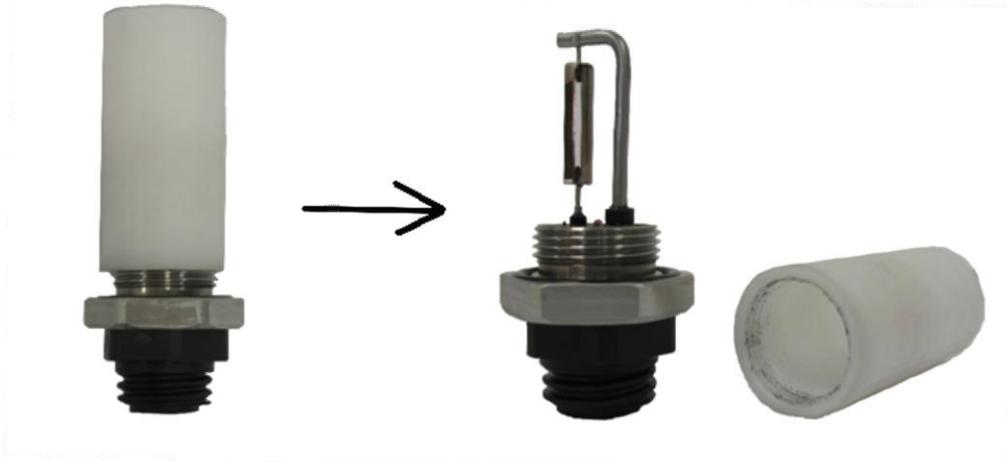
The following parameters can be measured:

- Viscosity 5...1000 mPas
(Other viscosity ranges on request)
- Temperature -40...130 °C
- Relative dielectric constant 1...10.
- Output of the present measurement values as current signals (4~20 mA) via the analog interface [OUT] and the indication of oil quality as traffic-light function (ok, limit, alarm) on the evaluation unit.

2.4. Preparation for operation

2.4.1. Sensor Installation

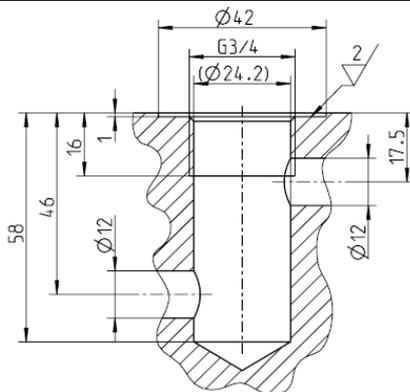
- The sensor head is fitted with a protective cover in the supply.
- Remove the cover before you install the sensor



- Installation of the multifunction sensor in the hydraulic circuit with G 3/4 " thread in compliance with the maximum limits. (See technical data, chapter 4.1)

NOTICE While installing the sensor, hard knocks, tilting or bending of the bow at the sensor head is to be avoided. Excessive vibration and shock effects should take place only in the built-in, oil-filled state. During transport, the vibration and shock resistance of the sensor is significantly limited.

Example of the sensor installation place:



2.4.2. Installation of the evaluation electronics

- Place the evaluation electronics at a convenient spot close to the system using the clips for wall or top-hat rail fastening. (See also chapter 4.3).

NOTICE Make sure that the evaluation system is protected from excessive ambient temperatures (>70°C).

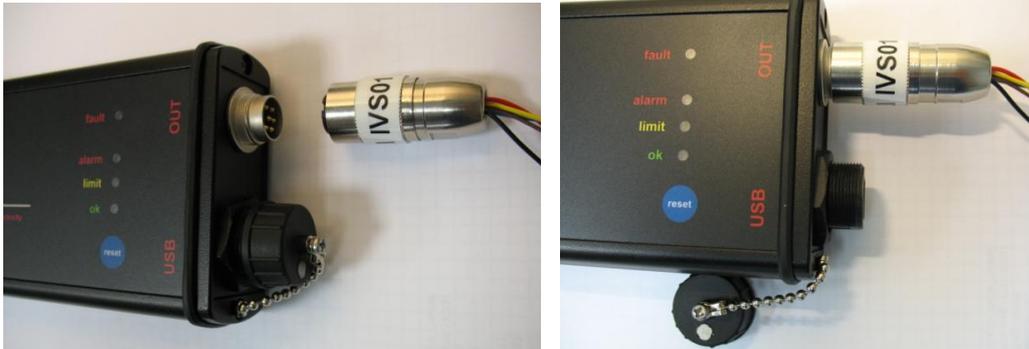
2.4.3. Electrical Connections

- The connection between the evaluation electronics and the multifunction sensor is established with a 7 m standard sensor cable. (Max. length: 20 m).

NOTICE Please do not modify the sensor cable, because the calibration of the sensor is based on the length of the sensor cable.



- The connection between the current output of the IVS 01 (evaluation electronics [OUT]) and an external control or evaluation system is established by cable. (See chapter 4.2)



- The operating voltage of the IVS 01 is 24 volts DC. In order to generate the necessary voltage, make sure that the required voltage is provided on the IVS 01 system and the connected cable is available. (See also the PIN assignment in chapter 4.2).

After inserting the sensor into the system, the IVS 01 is ready to be operated - if it is in compliance with the specified limits and if the evaluation electronics is connected with the sensor and the external control and evaluation system.

2.5. Operation of the IVS 01

2.5.1. Choose of the system function

- The measurement system fulfills three basic functions, that can be changed by the delivered software:
 - **Continuous measurements** of the oil, output of measured values through current signal (4-20mA). This continuous measurement will be operated within every system function. If this system function is chosen, the oil quality will not be evaluated.

Additionally, the monitoring of the oil quality can be enabled. This function is distinguished into two different modes.

- **Monitoring of the oil quality without Temperature-compensation:** the signal outputs (4...20 mA) include the current measured results, and the oil quality as well. The oil quality is evaluated according to the user-programmed specifications, without the influence of the temperature.
- **Monitoring of the oil quality with Temperature-compensation:** the signal outputs (4...20 mA) include the current measured results, and the oil quality as well. The oil quality is evaluated according to the user-programmed limit-parameters, and the influence of the temperature change.

NOTICE the factory setting of system function is “*continuous measurements*”, it can / should be changed by the software, before the sensor is applied with the other system functions, e.g. “*monitoring of the oil quality*”. Chapter 3.3.2.1. (If the „*Monitoring of the oil quality*“ ist not required, the system function should not be changed by the software!)

2.5.2. Action for the function „Monitoring of the oil quality“

NOTICE These actions are just available and required, if the function “Monitoring of the quality” is enabled by the software.

2.5.2.1. Key Operation



- A **magnet** is integrated into the protection cap of the USB port, with which the device can be operated through contact with the blue area [RESET].
- The order to **execute** individual **actions** is carried out by the “**contact time**” of the **magnet** on the blue [RESET] area.

NOTICE Make sure that the magnet is properly put on the field.



- The **action performed** is indicated by **changing of the LEDs**
- The **RESET** function is used for calibrating the sensor with the using oil

2.5.2.2. Function

- (1) For a “contact time” of the magnet under **0.2 second**, the operation will be ignored (suppression of interference). There is no action taking place.
- (2) In the case of a longer operation (approx. **1 - 2 seconds**) the current LEDs-display **disappears, and the red (fault) LED flashes while the other three LEDs remain extinguished.**
 - a) Shortly later the green (**ok**) LED lightens for about **three seconds** and goes out again. Then it happens with the **yellow (limit)** and the **red (alarm) LED** in the same way.
 - b) If a “contact time” has been accomplished again, **while one of the LEDs is on**, the LED will flash **for about 5 seconds** to indicate that a **function has been selected.**

NOTICE If the action isn't confirmed with another “contact time” during this phase, the device will return to the normal operating mode after the red (alarm) LED goes out, which means none of the three possible functions is selected.

- c) If any further action happens on the **[RESET]** area during the 5-second flashing phase, the function that the flashing LED is assigned to is going to be selected and (If there is no action during those 5 seconds, the oil sensor will return into the normal operating mode. This makes it possible to cancel a wrong selection.)
- (3) Subsequently the oil sensor will perform the selected functions. The three functions are coded as follows:

LED-colour	Function
green	trigger fresh oil calibration
yellow	adjustment / alteration displayed evaluated oil quality
red	currently without function

Depending on the chosen function the corresponding display by LEDs will appear. (Note: currently no function for the LED red).

2.5.2.3. Fresh oil calibration

- The command fresh oil calibration signals the system that the oil monitoring has to be carried out.
- This command should only be performed if the system was previously filled with fresh oil and if a new monitoring cycle should be started.
- All **previously saved monitoring data of the reference values** will be **deleted** and the reference values of the **new (fresh) oil** will be newly determined when the necessary conditions are met.

NOTICE If the system is set with temperature compensation (see chapter 2.7.3.2) the command for fresh oil calibration may only be triggered when the oil operating temperature reaches the preset reference temperature!

2.5.2.4. Adjustment / Alteration displayed evaluated oil quality

- This feature can cause a change of the displayed value regarding the oil quality in terms of oil improvement.
- If in a comparatively short time after the fresh oil calibration has been performed, the displayed oil quality goes from the condition “green” (meaning: very good or good oil quality) to the condition “yellow” (medium oil quality) and if the change is not plausible, an “adjustment / alteration displayed evaluated oil quality” can be performed.
- This will be done by the “contact time” of the magnet on the [RESET] area (see chapter 2.5.2.1)
- The readjustment can be triggered while the LED is yellow. That is how the displayed oil quality can be changed towards a better oil quality, i.e. the display will be changed from status “yellow” to “green” or from status “red” to “yellow”.

2.6. System start at first time – Initializations of the IVS 01

NOTICE Before starting with measurements make sure that fresh oil is in the hydraulic system.

- The evaluation system is initialized, after the insertion of the sensor into the system, and connection of the evaluation electronics to the sensor and an external control or evaluation system.
- Notice the four LEDs on the evaluation electronics. (See chapter 0)
 - Immediately after connecting the power supply, all 4 LEDs will light up for a few seconds. (**State M**)
 - After that the appropriate version will be identified by a short flash of the green LED.
 - Depending on the operating state the indication of the LEDs could be various.
- The displayed value is based on the default of the variable “MK” for the appropriate operating mode (see chapters 2.8 and 0)
 - If **MK = 1** has been selected (no oil quality can be indicated, measurement without temperature compensation) the operation is error-free and the sensor has been connected accurately, the **green LED flashes briefly at each measurement**.
 - **MK = 1** is set by default upon delivery
 - If **MK = 7 or MK = 8** have been selected the operation is error-free and the sensor has been connected accurately, the **green (ok), yellow (Limit), red (Alarm)** LEDs flash and the **condition A** is indicated (the red (**fault**) – LED isn’t flashing).
 - ⇒ The device is sending a signal: “**Waiting for the command fresh oil calibration**”
- Activating the command for fresh oil calibration with [RESET] (MK = 7 or 8 see chapter 2.5.2.3)
 - If the command has been properly activated, the LEDs will change to **condition E** and as a confirmation the **yellow (Limit)** LED will **go off**.
Depending on applications, the calibration can last for several hours!
 - In **MK=7** the fresh oil calibration duration depends on the time necessary for the operating temperature to reach the preset reference temperature value. The

calibration will take place after the operating temperature exceeds and then falls below the reference temperature for 4 times.

- In MK=8 the duration of the fresh oil calibration depends on the adjustable “evaluation time interval” (see chapter 3.3.2.1.3). The standard time is 30 hours and 10 minutes.

10 Min + 3 x “evaluation time interval” = the duration of the fresh oil calibration

- The calibration is finished when the red (**Alarm**) LED is off and the system is then activated for oil monitoring.

NOTICE A proper monitoring is not possible if the red LED doesn't go out! A changing of the evaluation electronics or of the sensor might be necessary.

2.7. Measurement

The measurement system has two functions:

1. Continuous oil measurements and indication of measured values (temperature, viscosity, relative dielectric constant) as current signals.

NOTICE In case of error, all three analogue outputs have a current of 2mA!

2. Monitoring of the oil quality according to user-programmed instructions or set limit values.

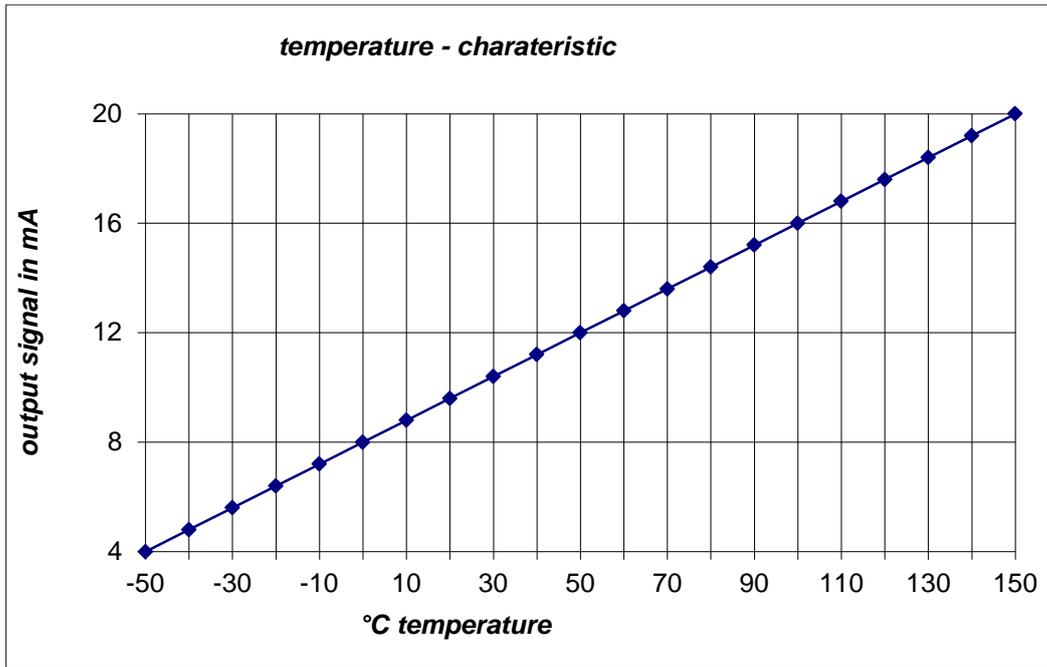
2.7.1. Continuous measurement

- Generally, continuous measurement always takes three oil variables (oil temperature, viscosity, relative dielectric constant) into account.
- The outputs of the measured values at the port [**OUT**] are current signals in every 30 seconds (**Response Time**).

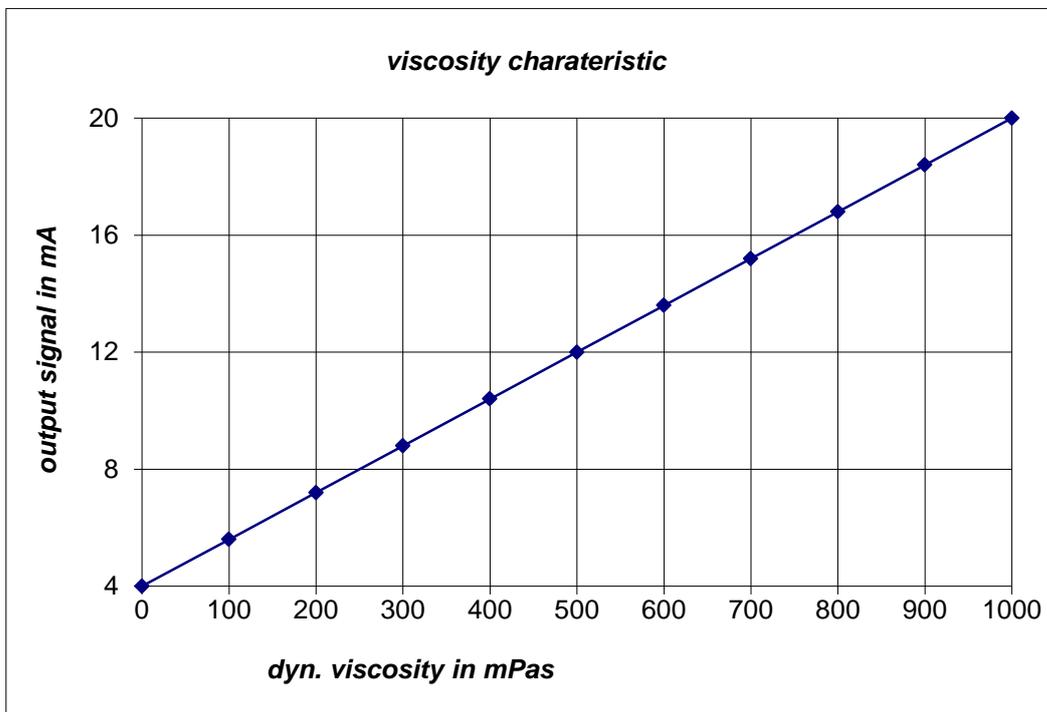
2.7.2. Use of the current outputs

- To use the current signals at the port [**OUT**] with an existing external control or evaluation system (e.g.: PLC), the IVS 01 - evaluation system has to be connected with the external system by cable. (Pay attention to the PIN assignment of power supply of the OUTPUT connection on the electronic evaluation system!)
- The conversion of the current signals is based on the following diagrams.

2.7.2.1. Temperature

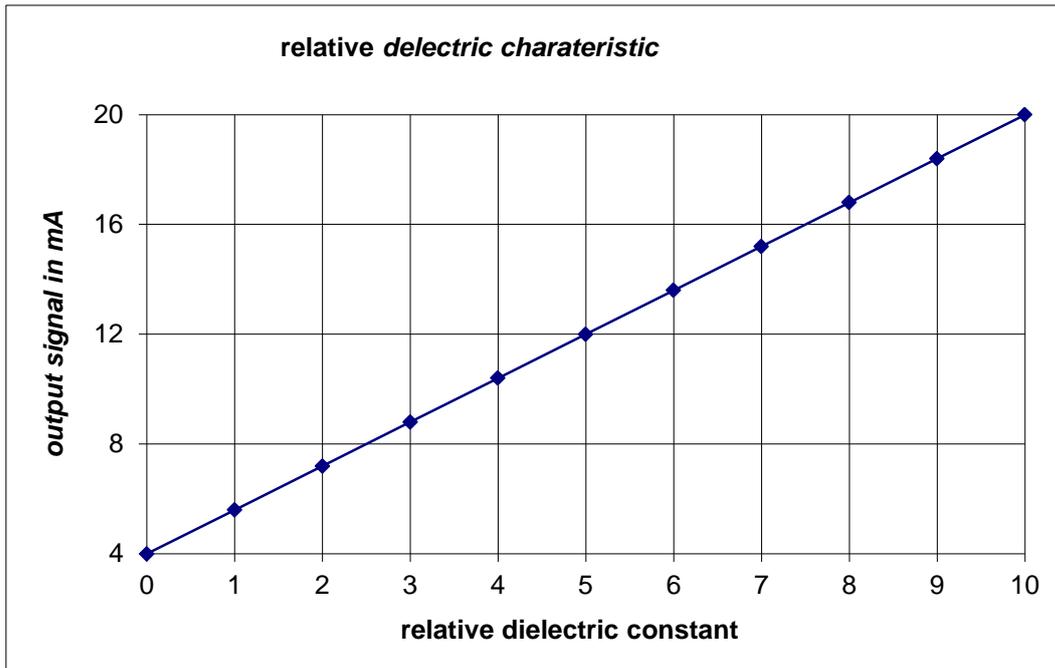


2.7.2.2. Viscosity



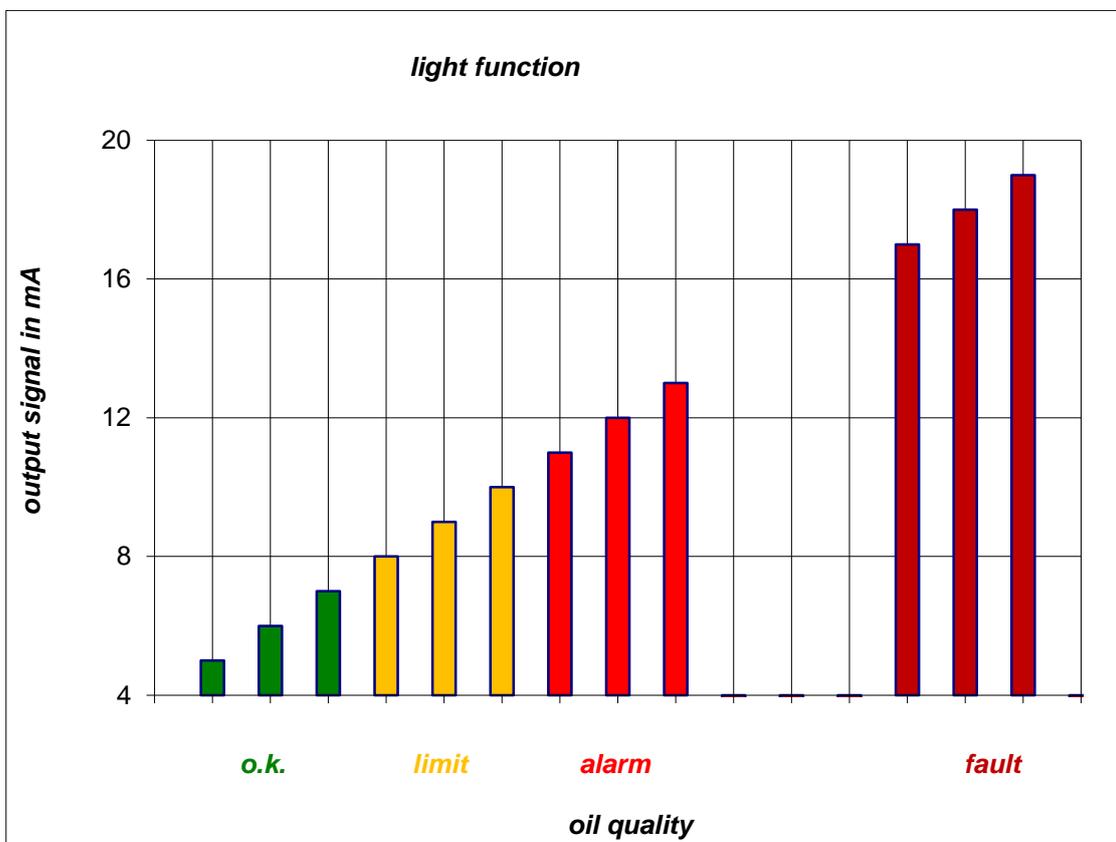
- The IVS 01 default settings, upon delivery, are: viscosity range 0 ... 1000 mPas
- **NOTICE** Other viscosity ranges on request.

2.7.2.3. Relative dielectric constant



- The default setting of the rel. dielectric constant is on delivery defaults: 0...10

2.7.2.4. Traffic light colour scheme



- The traffic light colour function shows the oil quality depending on the fresh oil condition – the output will be shown as a colour code.

NOTICE Make sure that the fresh oil calibration doesn't start before the operating temperature is reached to the reference temperature.

- The color-coded output corresponds to the defined fresh oil condition depending on the operating temperature and the defined limits for viscosity and dielectricity (see chapter 3.3.2.1.3)

Current signals in mA	Output traffic light colour scheme
5 - 7	Green
8 - 10	Yellow
11 - 13	Red
17 - 19	Error

NOTICE If the fresh oil calibration wasn't carried out completely, the current output of the "traffic light colour system" will be 6 mA.

2.7.3. Oil quality monitoring

- In addition to the continuous measurement of relevant oil data, the IVS 01 is able to monitor the oil quality by means of traffic lights and display functions on the evaluation system.
- The basis for oil quality monitoring:
 - Defining the fresh oil condition by performing fresh oil calibration
 - Specification of limit values (warning, alarm) of viscosity and rel. dielectric constant for an oil quality assessment.

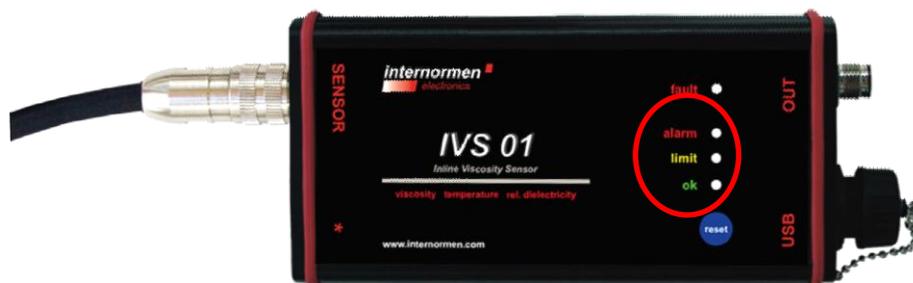
NOTICE the parameters can be changed by the software Data Manager.

- To assess the oil quality, the fresh oil condition under the operating temperature should be taken as the reference. The system will determine the current oil data and note changes comparing to the initial state of fresh oil.

Three states of the oil quality as bellow:

Very good/ good oil quality (green LED on = ok)
 Medium oil quality (yellow LED on = Limit)
 Bad oil quality (red LED on = Alarm)

- This oil quality will be displayed on the LEDs of the evaluation system after the fresh oil calibration has been completed.



- The prerequisite for this function is the default setting of viscosity and/or rel. dielectric constant limit values (see chapter 2.8)

- The limit values are percentage changes based on the measurement values of the fresh oil condition of the oil that is being used.
 - The standard default settings are saved ex-factory. They are 15% for the warning and 30% for the alarm in case of viscosity changes, or 25% for the warning and 50% for the alarm in case of the change of rel. dielectric constant.
 - This means that a viscosity discrepancy of $\pm 15\%$ or a rel. dielectric constant discrepancy of $\pm 25\%$, corresponding to the fresh oil condition, will cause a warning message on the evaluation system (**yellow LED on**). At a viscosity discrepancy of $\pm 30\%$ or a rel. dielectric constant discrepancy of 50% the display of the evaluation system will show the alarm message (**red LED on**).
- When the oil quality deteriorates the colour change on the display will be immediate, i.e. the colour change will take place even if only one of the two limits is reached or exceeded.
- In the previous oil quality assessments it was assumed (in order to keep things simple) that the current oil parameters can be directly compared to the fresh oil parameters (which were considered to be reference parameters). That is usually not possible because of the varying oil temperatures.
- **At different oil temperatures** between the calibration and measurements the following approaches are possible:
 - Monitoring of the oil quality by **measuring at a defined reference temperature** (temperature compensation OFF)
 - Monitoring of the oil quality by means of **conversion the current measured oil data to the defined reference temperature** (temperature compensation ON)

2.7.3.1. Temperature compensation „OFF“

- Monitoring of the oil quality by **measuring at a defined reference temperature while the temperature compensation is off**.
- In this case, the **operating mode** has to be set up to “without T-compensation ” (see chapter 2.8 & 3.3.2.1) \Rightarrow the measurements will be evaluated **without** temperature compensation.
- The oil quality will be only evaluated at the **defined reference temperature of the oil** (i.e. the temperature during the fresh oil calibration and measurements must be same)
- **Preset reference temperature: 50 °C**
- The advantage of this approach is the **direct compare of oil data**, for both the fresh oil data and the current oil data are always determined at the **same temperature!**

NOTICE For continuous operated machines, whose operating temperatures are below the defined reference, this approach is not applicable!!

2.7.3.2. Temperature compensation „ON“

- Monitoring of the oil quality by means of **conversion the current measured oil data to the defined reference temperature** while the **temperature compensation is on**.
- In this case, the “**operating mode**” in Data Manager has to be set up to “with T-compensation” (see chapter 2.8) ⇒ the measurements will be evaluated **with** temperature compensation.
- For machines, of which oil circuits do not have a cooling curve, the appropriate **temperature compensation has to be calculated** before the current oil data and the appropriate fresh oil measurement data are compared.
- However, this is necessary **only for the viscosity**, because the relative dielectric constant doesn't depend on the temperature very much.
- For the temperature compensation of the viscosity it is necessary to know the value for the so-called **slope of viscosity-temperature „m“** according to the equation of Ubbelohde-Walther – beside the fresh oil viscosity values and the corresponding temperature.
- The directional characteristic „m“ is a variable saved in the system and can be altered at any time as soon as the system gets connected to a computer (see chapter 2.8)

2.8. Default settings (parameters) at delivery

Parameters and meanings	Default sett. (Standard)
Measurement mode MK = 1 ⇒ no display of the oil quality ⇒ Temperature compensation OFF ⇒ Current output of the oil quality = 18mA MK = 7 ⇒ display of the oil quality ⇒ Temperature compensation OFF MK = 8 ⇒ display of the oil quality ⇒ Temperature compensation ON	1
Reference temperature [°C] (see chapter 0) a) Fixed temperature for oil quality respectively b) Reference temperature for temperature compensation	50.0
Slope of viscosity-temperature m Variable for temperature compensation	3.5
Limit value-oil quality Viscosity = yellow [%]	15.0
Limit value-oil quality Viscosity = red [%]	30.0
Limit value-oil quality rel. DC = yellow [%]	25.0
Limit value-oil quality rel. DC = red [%]	50.0
Scale Viscosity-Analogue output	1000.0
Evaluation time of the oil quality	10 Std.

NOTICE the parameters can be changed by the software (see chapter 3.3.2.1 Fehler! erweisquelle konnte nicht gefunden werden.)

2.9. LED – Indication

- The LEDs on the front side of the evaluation system are meant to inform about the oil condition or possible errors.
- The combinations A...E will only be indicated in the modes MK = 7 or MK = 8.

	Fault(red)	OK(green)	(yellow)	(red)	Meaning
A	off	on	on	on	Waiting for command of fresh oil calibration
B	off	on	off	off	Oil ok (very good / good oil quality)
C	off	off	on	off	Warning (medium oil quality)
D	off	off	off	on	Alarm (bad oil quality, requires oil change)
E	off	on	off	on	Waiting for fresh oil calibration
F	flashing	off	off	off	Error, generally searching
G	flashing	on	off	off	Error, temperature sensor
H	flashing	off	on	off	Error, quartz sensor
I	flashing	on	on	off	Error, cable
J	flashing	off	off	on	Error, searching for the frequency
K	flashing	on	off	on	Error, electric conductive fluid
M	on	on	on	on	Program start

- Immediately after connecting the power supply for a few seconds all four LEDs will be on (condition M). After this, depending on the operating condition another indication will appear.
- In errorless operation is the red LED (**fault**) off.
- In cases of new installations and when the sensor is correctly connected in modes MK = 7 or 8, the state A will be displayed: “Waiting for command of fresh oil calibration”. The command is triggered by contact of the magnet with the [RESET] area.
- After implementation of the fresh oil calibration the display changes to green and red (state E) thereby indicating “Waiting for fresh oil calibration”. Until now the fresh oil calibration is not yet accomplished ⇒ it is waiting for certain conditions to be fulfilled.
 - The fresh oil calibration depends on whether the system
 - a) works with a fixed reference temperature or
 - b) has to perform a temperature compensation of the viscosity measurement.
 - For the version a) the calibration happens only when the operating temperature reaches or exceeds the reference temperature that is saved as default in the system (standard 50 °C). Then the display changes to green which means “Oil ok, very good / good oil quality” (state B)
 - For the version b) the calibration will happen only if a reasonably constant operating temperature is set in the process; the viscosity will in that case be based on the reference temperature set as default (standard 50 °C). Afterwards the display changes to green showing “Oil ok, very good / good oil quality” (state B)
- After a longer operating time the display can change into yellow (state C) or red (state D), which indicates warning or alarm of the oil quality.

- If an error occurs, the **red LED [fault]** will flash. The device detects possible errors and indicates the errors by the combinations of the switched-on LEDs
- **A brief flashing of the error LED can happen and should be tolerated.**
- **The flashing of the error LED for longer than 2 minutes indicates a permanent system failure.**

NOTICE In this mode, oil monitoring isn't possible anymore!

3. Configuration and Software

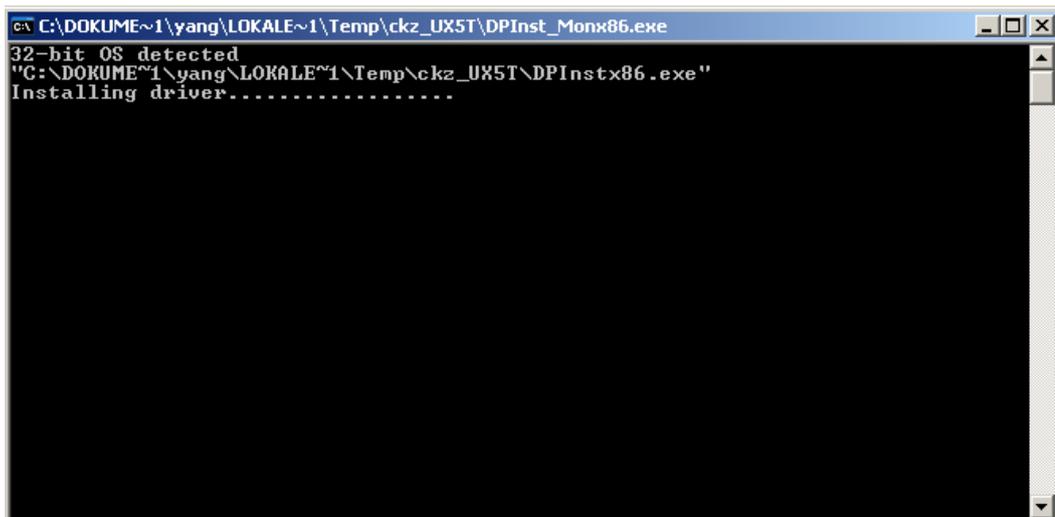
- By default, the configuration and operation of the IVS 01 can be done by using the included software “data manager”.

3.1. Service functions

- The service functions are:
 - Defining the limit values for viscosity and rel. dielectric constant;
 - Scale of the measurands: temperature, viscosity and rel. dielectric constant;
 - Calibration values of fresh oil or the reference temperature and operating modes
- All service functions are to be carried out by using the software “data manager”.

3.2. Installation of the driver

- Connect an external computer to the IVS 01 with USB cable.
- A new hardware will be detected when the IVS 01 connected to the PC at the first time.
- The program “CDM20824_Setup.exe”, included on the supplied CD-ROM, has to be installed once.
⇒ Then the following window will appear while the installation, and disappear after a successful installation:



```
C:\DOKUME~1\yang\LOKALE~1\Temp\ckz_UX5T\DPInst_Monx86.exe
32-bit OS detected
"C:\DOKUME~1\yang\LOKALE~1\Temp\ckz_UX5T\DPInstx86.exe"
Installing driver.....
```

- The installation of the drivers has been completed then.

3.3. Data Manager

- After the installation of the driver, the software “**IVS 01 DATA MANAGER - Vers. 2.0**”, which was specially developed for the IVS has to be installed on the external PC.
- The data manager enables the configuration and operation of the IVS 01, as well as the data transfer of stored measurement data into an Excel sheet.

3.3.1. Installation of the data manager

- Start the CD-ROM “**DATA MANAGER Vers. 2.0**” and run the IVS 01 installation with **setup.exe** (confirm the Windows security query so that the program can be installed).
- After a successful installation, the data manager “**IVS 01 Data Manager**” on the external computer can be started.

3.3.2. DATA MANAGER

- After starting the **IVS 01 Data Manager** program, the main menu of the data manager will appear.
- The small light symbol will flash in colours between yellow and dark green during the search for the connected IVS 01.



- The colour of the light changes to bright green as soon as the IVS 01 is found.

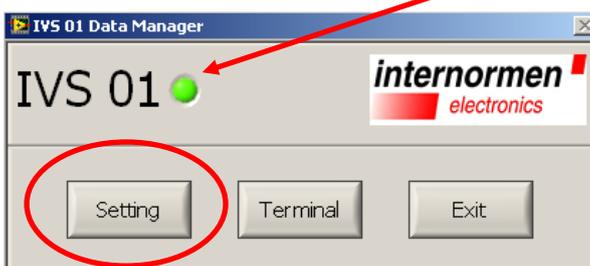


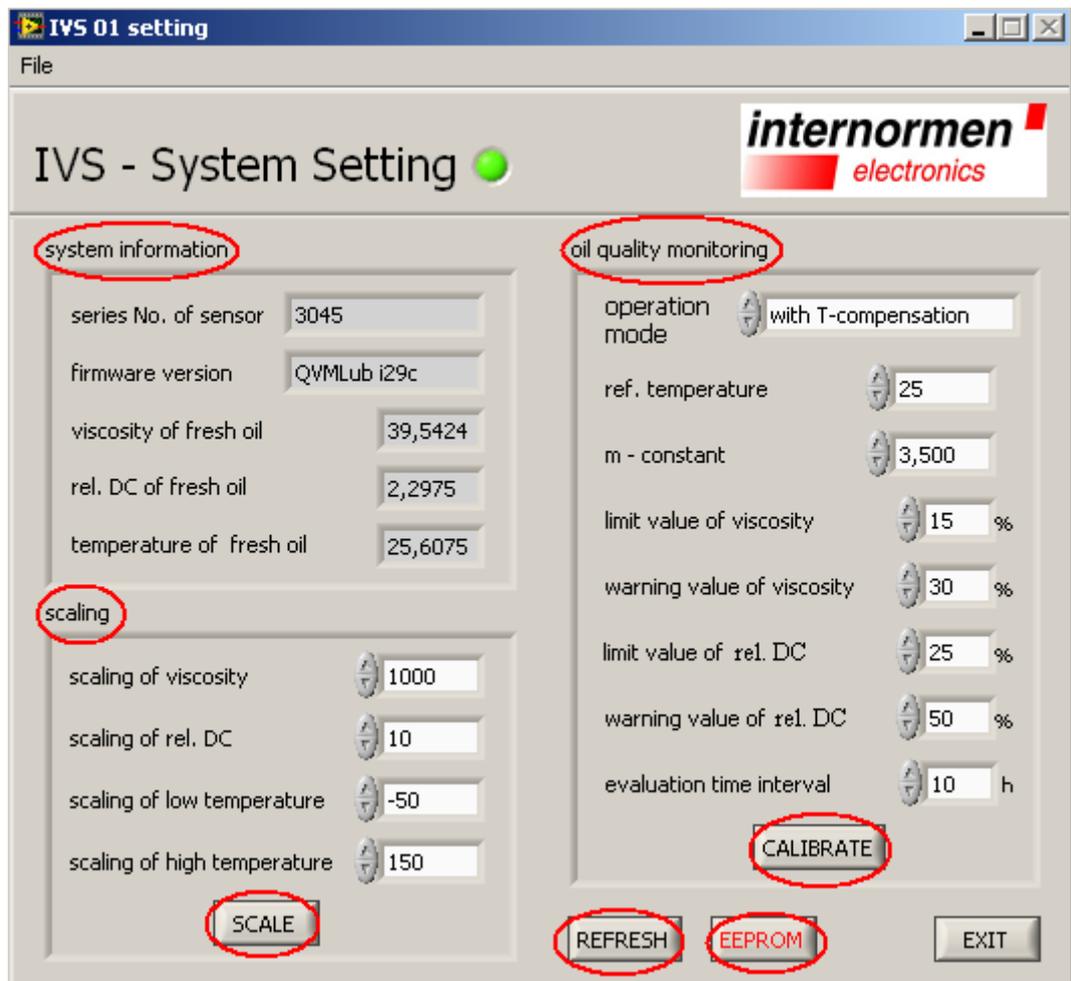
⇒ Selection of functions:

- Setting
- Terminal

3.3.2.1. Settings

- A click on the button “**Setting**” enables the access to service data.
- The service data will be automatically read from the device and displayed in the software.
- During the reading of data the light is going to flash.

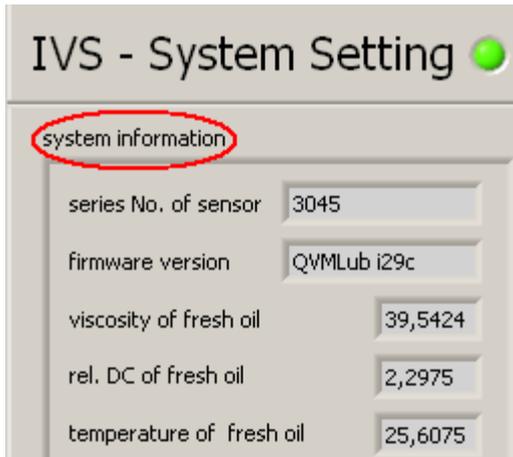




- Display of system information
 - Display and the possibility to change the scaling of analogue outputs (Scaling – “SCALE”)
 - Display and the possibility to change the displayed parameters showing the oil quality (oil quality monitoring – “CALIBRATE”)
 - Re-reading the current data. (“REFRESH”)
 - Save the current system data in the device. (“EEPROM”)
 - Usage of submenu functions “File”
- Back to the main menu with button “EXIT”.



3.3.2.1.1. System information

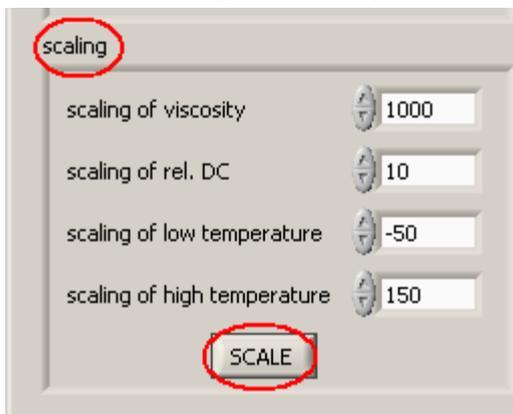


- Device information is displayed like
 - Serial number of the sensor (3045)
 - Firmware version (QVMLub i29c)
 - Reference values of the fresh oil

Parameter	values	Display
viscosity of fresh oil	39.5424	Fresh oil viscosity in mPas.
rel. DC of fresh oil	2.2975	The rel. dielectric constant of the fresh oil
temperature of fresh oil	25.6075	the temperature, at which the measurement for reference values has been carried out

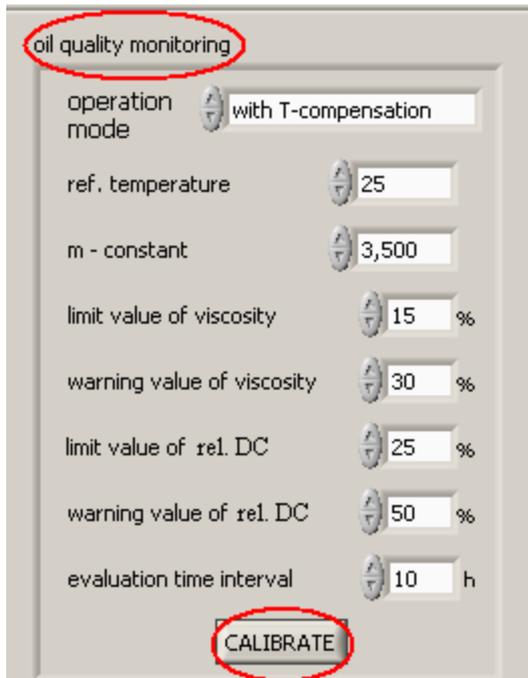
NOTICE A change of the above mentioned reference values using the software are not possible!

3.3.2.1.2. Scaling (Scaling of the analogue outputs)



- Scaling of the analogue outputs (viscosity, rel. dielectric constant and temperature). (see chapter 2.7.2.1)
- Perform changes with the button “SCALE”.

3.3.2.1.3. Oil quality monitoring



- Parameter display for oil quality:
 - Reference temperature,
 - Direction constant-m
 - Viscosity and dielectricity limit values
- Perform changes by using the button „**CALIBRATE**“.
 - Operation Mode
 - MK value. 1, 7, 8 (see chapter 2.7.3.1 and 2.8)
 - 1: no oil quality monitoring: no oil quality monitoring possible
 - 7: without T-compensation: with monitoring of the oil quality at a reference temperature, **no** temperature compensation
 - 8: with T-compensation: with continuous monitoring of the oil quality, **with** temperature compensation
 - Ref. temperature
 - Reference temperature respectively operating temperature
 - Only at MK = 7 and 8.
 - M-constant
 - slope of viscosity-temperature as constant
 - Necessary only in mode MK = 8 according to the Ubbelohde-Walther equation **NOTICE** Changes by qualified personnel only!
 - Evaluation time interval
 - The time needed for an oil quality evaluation and its display through the current output and “the traffic light function” on the evaluation unit of IVS01
 - Default: 10 hours.

3.3.2.1.4. REFRESH



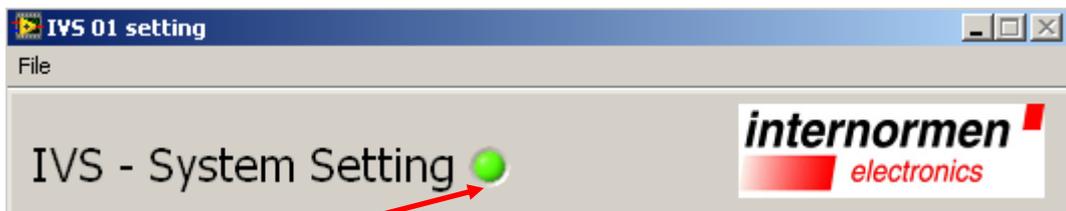
- The current, in the device used data will be read and displayed again.

3.3.2.1.5. EEPROM



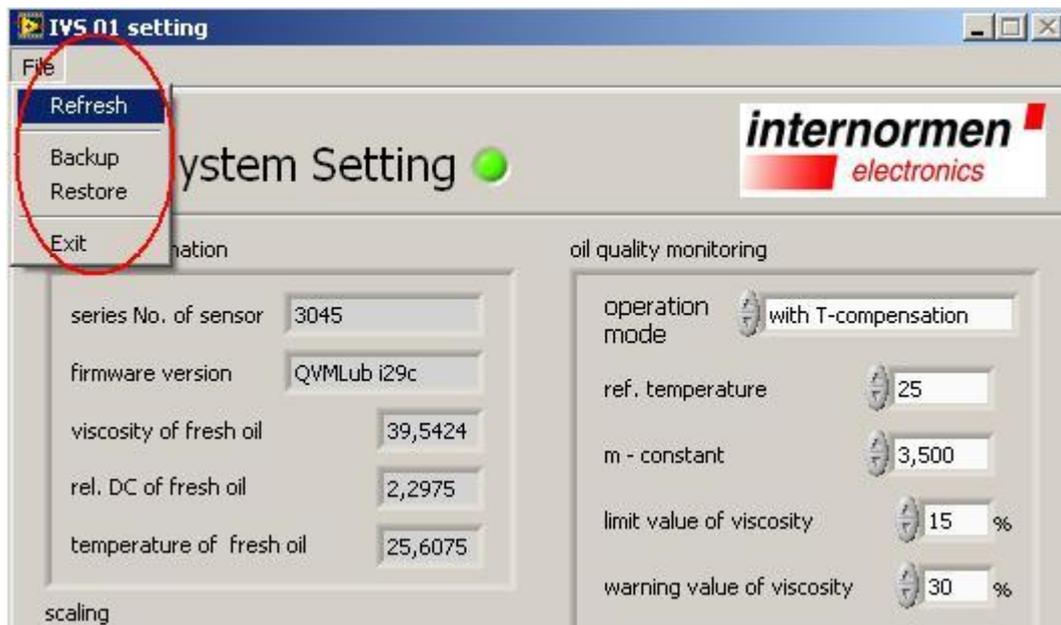
- The data temporary used in the device will be saved in EEPROM.

NOTICE It is recommended to save all the changes of system data in the device with „EEPROM“, because after re-start all existing data will be deleted and overwritten with old data!



- The light flashes while the data communication between the external PC and the IVS01.
NOTICE Make no further actions until this process is completed!

3.3.2.1.6. Menu - File

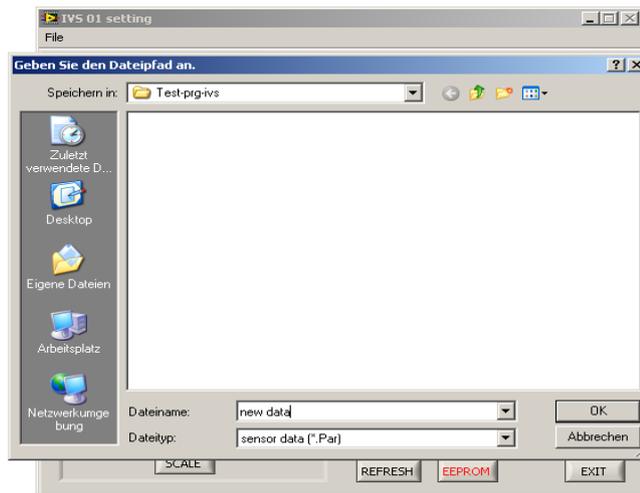


3.3.2.1.6.1. Refresh

- The current, in the device used data will be read and displayed again.

3.3.2.1.6.2. Backup

- All currently used data will be read out and stored as a text-file on the PC.
- Data reading and data transfer using „Backup“.
 - Select a data path and file name to store the data and confirm with „OK“
 - A file of the form „KNxxxx.Par“ will be saved on the external PC.



- Then the data in the specified path is saved

3.3.2.1.6.3. Restore

- The data saved in a text-file can be re-transferred to the IVS 01.
 - The file “KNxxxx.Par” containing all important sensor data is also on the CD-ROM.
 - This file is needed to restore the factory settings.
 - To restore the factory settings:
 - Select “Restore” in the menu “File”
 - Select the „.Par“ file on PC
 - Data saved in the “.Par” file will be transferred to the device
- NOTICE** Make no further actions until this process (light flash) is completed!
- It is suggested to save the data from IVS01 as a “KNxxxx.Par” file onto an external PC, before the IVS01 is used for the first time.

3.3.2.1.6.4. EXIT

- By using “EXIT” back to the main menu.

3.3.2.2. Terminal



- By clicking the button “Terminal” the current measured values can be read out and presented tabularly and graphically.
- The oil condition can be illustrated continuously and quantitative by continuous reading of measurement values.

3.3.2.2.1. Transfer of measured values

Table

No.	date	time	Temperature (°C)	Eta (mPas)	Freq. (Hz)	rel. DC
84	14.07.2010	16:28	25,8	23,9	78830,1	0,7
85	14.07.2010	16:28	25,8	23,2	78830,3	0,7
86	14.07.2010	16:28	25,8	22,7	78830,1	0,7
87	14.07.2010	16:29	25,8	22,4	78829,7	0,7
88	14.07.2010	16:29	25,8	22,2	78829,5	0,7
89	14.07.2010	16:29	25,8	22,3	78828,7	0,7
90	14.07.2010	16:29	25,8	22,3	78828,3	0,7
91	14.07.2010	16:29	25,8	22,3	78828,3	0,7
92	14.07.2010	16:29	25,8	22,4	78828,0	0,7
93	14.07.2010	16:29	25,8	22,5	78828,0	0,7
94	14.07.2010	16:29	25,8	22,5	78828,0	0,7
95	14.07.2010	16:30	25,8	22,6	78827,7	0,7
96	14.07.2010	16:30	25,8	22,7	78827,5	0,7
97	14.07.2010	16:30	25,8	22,7	78827,5	0,7
98	14.07.2010	16:30	25,8	22,8	78827,5	0,7
99	14.07.2010	16:30	25,8	22,8	78827,3	0,7
100	14.07.2010	16:30	25,8	22,8	78827,3	0,7

read
0; 0.257999954E2; 0.228499943E2; 0.853519915E3; 0.788273332E5;
0.706666645E0; 0.363107976E2; 0.229842121E2; 0.259135719E1; 0.181148047E2;
5

start

close

- Start transferring of the measurement values by using „start“.
 - The current measurement data will be transferred and tabularly presented within 20 seconds
 - In addition, the dynamic viscosity and rel. dielectric constant will be presented graphically.
 - A maximum of 100 values can be transferred and displayed.
 - After clicking button “start”, the transferring will be started in 100 seconds.
- To end the data transferring also use the button “start”.
- To leave this submenu use the button “close” ⇒ back to the main menu.

3.3.2.2.2. Saving measured values

- The current measurement data can be saved in a “.txt” file within a specified time interval.
- The time interval and the file path can be set after clicking the button “start”.

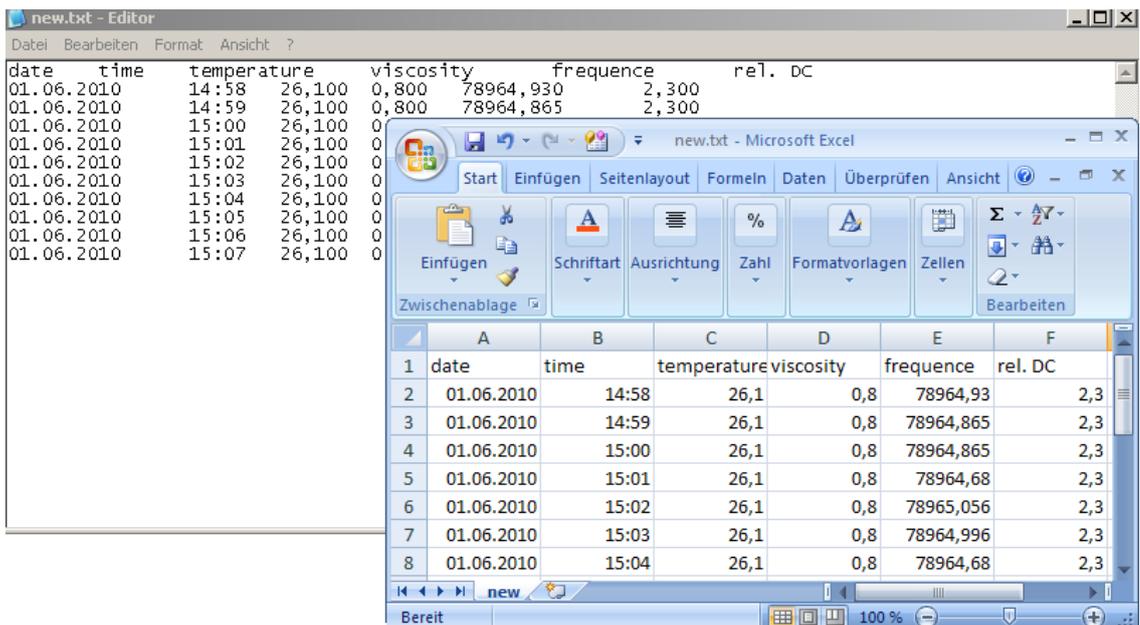




- Define the path and name of the txt-file by clicking the button “file...”
- Define the storage interval by using .
 - Possible storage intervals: from 0 to 6000 minutes.
 - If the interval isn't selected, no measurement values will be saved.
- Confirm the selection with “OK”.

3.3.2.2.3. Convert the TXT file into an EXCEL file

- The measurement values are saved in a .txt file.
- This file can be opened and directly imported into an “.xls” file.

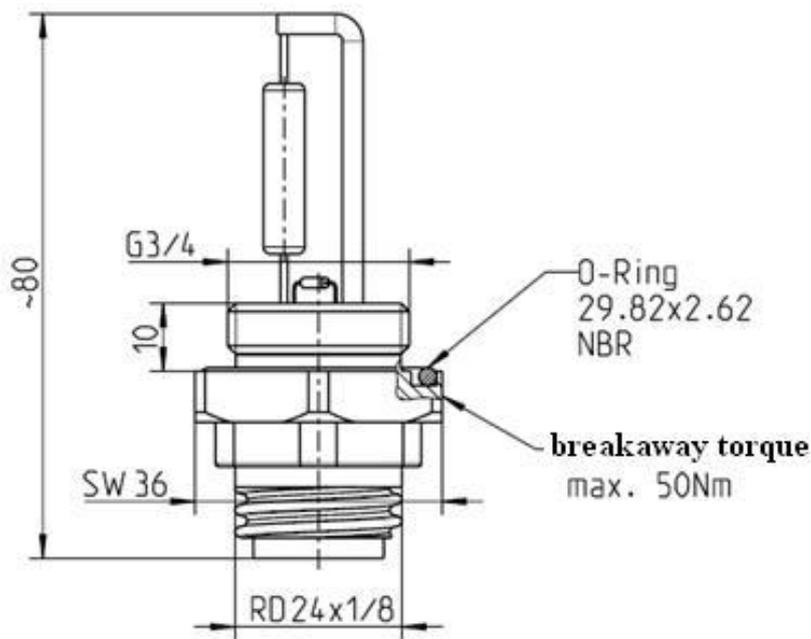


4. Annexe

4.1. Technical data

4.1.1. IVS 01 – Sensor

Fluid sensor:	Torsion quartz
Temperature sensor:	Silicon-planar sensor KTY
Calibration:	Pre-calibrated at the factory in reference fluids
Material:	PA 66-GF30, 1.4301, 1.4310 and german silver
Connection:	Connector with screw locking system RD24x1/8, 6-pin, according to Hirschmann® connector CA6GS
Sensor cable:	Special cable LIYY-LIYCY 6 x 0.5 with safety ring, Quartz lines in cable individually shielded
Threaded connection:	G 3/4"
Dimensions:	length approx. 150 mm
Weight:	Approx. 70 g



4.1.2. Operating Parameters



Power supply:	24 V DC
Pressure operating range:	≤ 25 bar
Standard viscosity range:	5...1000 mPa·s (Other ranges on request)
Max. permitted oil temperature:	-40...130 °C
Ambient temperature:	0...70 °C
Protection class:	IP 67
Operating fluids:	all non-conductive hydraulic and lubricating fluids based on mineral oil

4.1.3. Measurement Parameters



Temperature:	-40...130°C
Dynamic viscosity:	5...1000 mPa·s
Relative dielectric constant:	1...10

4.1.4. IVS 01 – Evaluation electronic

Measurement parameter: dynamic viscosity, temperature and relative dielectric constant

Indicators: 3 LED (green, yellow, red)
Oil quality (good / medium / bad)

Error indicator: 1 LED (red) for errors (fault)

Operating temperature: 0...70°C

Operating voltage: 24 ± 6 V DC

Operating current: approx. 100 mA (version analogue)

Material: Aluminum

Protection class: IP 67

Connectors: M12 (male-plug) 6-pin **OUT** (current output)

M12 (female-jack) 7-pin **Sensor** (sensor input)

Interface: USB (for setting the service functions)

Dimensions: 165 x 85 x 35 mm (only box without connectors)

L x B x H in mm

Weight: 370 g

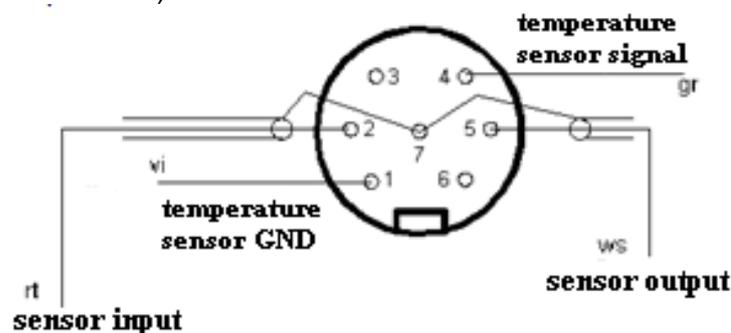
4.2. Pin outs

The basic unit of the IVS 01 system has the following connections:

- Built-in female-jack for “Sensor” (7-pin)
- Male-plug for “Power supply” and “current output” (6-pin)
- The sensor cable has an appropriate counterpart to the 7-pin female-jack of the evaluation electronics: male-plug “cable” (7-pin)

4.2.1. Female-jack “Sensor” on the housing

(View on the solder side)



Markings:	Pin-No.:
Temperature sensor GND	1
Quartz sensor-input (shielded)	2
memory-Chip	3
Temperature sensor signal	4
Quartz sensor-output (shielded)	5
memory-Chip	6
shield	7

4.2.2. Counterpart female-Jack for power supply and the current output

(External configurable female-jack in delivery: view at the solder side)

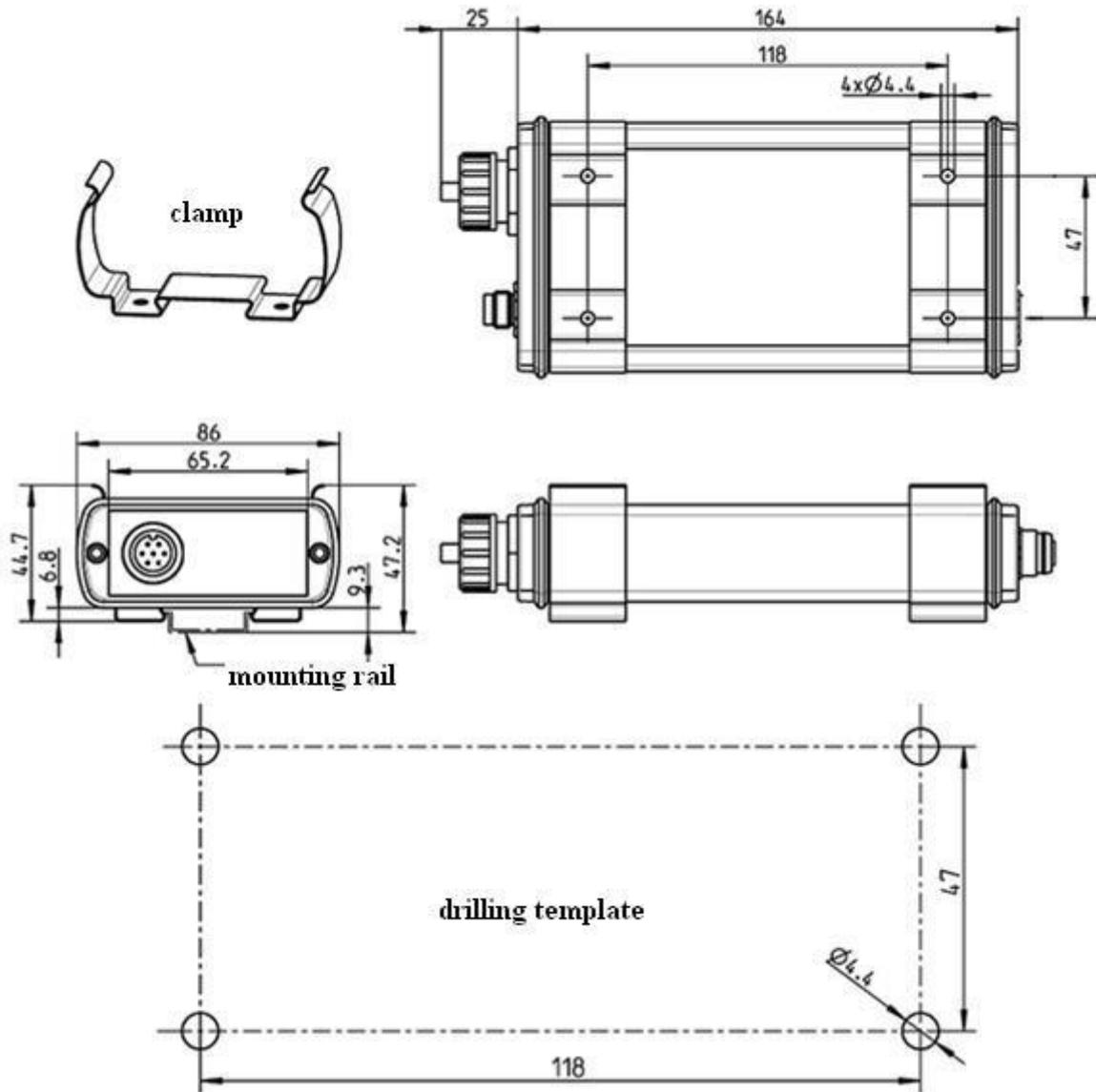
	Markings:	Pin-No.:
		+VDC (Power Supply) +24 VDC (± 6 V)
	Output 4...20 mA viscosity	2
	Output 4...20 mA temperature	3
	GND (Power Supply)	4
	Output 4...20 mA rel. dielectric constant	5
	Output 4...20 mA traffic light function (display of the oil quality)	6

4.2.3. Traffic light colour functions

Output in mA	Traffic light colour
5 - 7	Green
8 - 10	Yellow
11 - 13	Red
17 - 19	Fault

4.3. Assembly instructions

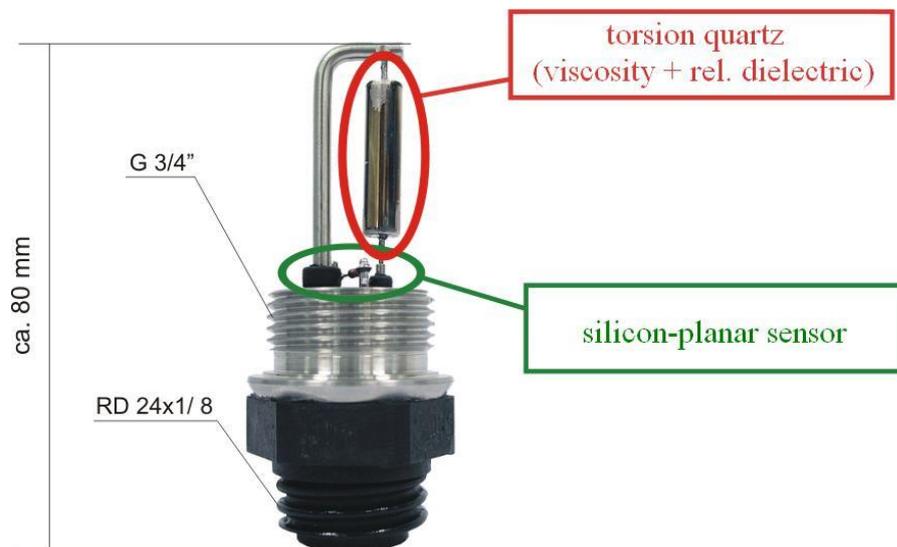
dimensioning in mm



4.4. Measuring principle

4.4.1. Multifunction sensor – IVS 01

- The multifunction sensor IVS 01 is designed to measure:
 - The dynamic viscosity
 - The relative dielectric constant
 - The temperature in °C or °F.
- It is based on the use of a **piezoelectric crystal** in the form of a **torsion oscillator** for measuring the viscosity.
- **The electric alternating field** applied to the **oscillator** (78 KHz) causes a movement of the sensor, so that the **surrounding oil is sheared**.
- On the other hand, the movement is prevented by the external force (**shear stress**) of the fluid.
- This determines the electrical response of the sensor. **The dynamic viscosity** is determined by the **changes of the resonance frequency and the signal amplitude** to the resonance frequency in air.
- The measured viscosity will be presented in **mPa·s**.



4.4.2. Evaluation electronic

- The viscosity, temperature and relative dielectric constant will be determined by evaluating the signals, which come from the multifunction sensor.
- The output of each parameter has the form of 4 current signals at the analogue interface [OUT].

4.5. Application areas – compatibility

NOTICE ⚠️ ⚡️

Lubricating oil	
DIN 51517 T1...T3	ISO 3498
C	C
CL	CB
CLP	CC

Hydraulic oil	
DIN 51524 T1...T2	ISO 11158
H	H
HL	HL
HLP	HM

- Other media on request.

NOTICE The sensor head is designed for use in oils and not in electrically-conductive fluids, such as Water, aqueous solutions, etc.

4.6. Troubleshooting

- The IVS 01 user is not permitted to do any modification on the device. Malfunctions, which could be solved by user, are therefore limited to a check of the cables, e.g.

sensor cable break. 

NOTICE Otherwise, the IVS 01 has to be sent back to *INTERNORMEN Technology GmbH* where the device will be checked over and calibrated.

- A brief description of the error can help us during troubleshooting and repair. In case of telephone inquiries, or to clarify the warranty claims, the serial number of the device and the date of purchase are needed.

4.7. Cleaning the sensor

The cleaning of the sensor head is carried out by immersing the sensor into a solvent, preferably in wash benzene, in stubborn case in acetone.

If the sensor head stays connected to the evaluation unit during the cleaning process, the cleaning efficiency can be improved by the vibrating sensor.

Make sure that during the cleaning process

- **The measurement head is treated with utmost care!**
- **Mechanical force effects, touching the sensor surface with tools or hard objects has to be implicitly avoided!**
- **The sensor head is exposed to any abrupt changes in temperature (>100°C)!**

Notes:

- In particularly difficult cases, the sensor head can be cleaned by using a soft brush.
- A short blow-drying to the sensor head under a hot air blower leads to rapid drying.
- Always use the provided protective tube for transporting the sensor head!!

4.8. Calibration

-  **CAUTION**    *INTERNORMEN Technology GmbH* recommends a calibration interval of one year. For secondary calibration, the IVS 01 has to be sent to the *INTERNORMEN Technology GmbH* in Altlussheim.
- The calibration and maintenance service package for the IVS 01 includes:
 - maintenance of the device
 - check of the consumable materials
 - sensor function test
 - calibration
 - 24 hours function test

4.9. Scope of delivery



- (1) Sensor complete
- (2) 2x Mounting clamps
- (3) Connector plug current output
- (4) USB-A zu USB-B Kabel
- (5) Datenmanager-CD
- (6) Instruction manual

Article No.:

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