HYDAC ELECTRONIC

Oil Condition Sensor HYDACLAB® HLB 1400

User manual

(translation of original instructions)

CONTENTS

1 General

If you have any queries regarding technical details or the suitability of the instrument for your application, please contact our **Technical Sales department**. HYDACLAB® sensors have been individually calibrated on computer-aided test benches and subjected to a final test. They operate perfectly when used according to the specifications (see Technical Specifications).
However, if there is a cause for complaint, please contact **HYDAC Service**. Interference by anyone other than HYDAC personnel will invalidate all warranty claims.

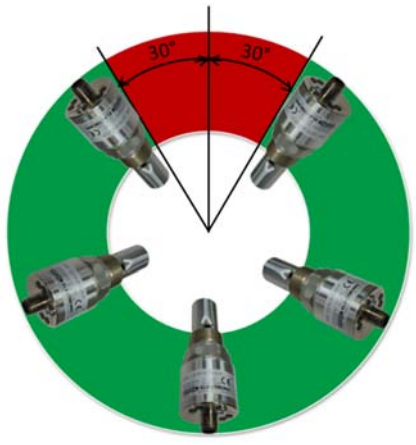
2 Safety Information

The Fluid Condition Sensor HYDACLAB® presents no safety concerns when operated in accordance with this user manual. However, in order to avoid any risk to the operator or any damage due to incorrect handling of the unit, please adhere strictly to the following safety instructions:

- Before commissioning, check that the unit is in perfect condition.
- Before commissioning, please read the operating instructions. Ensure that the unit is suitable for your application.
- During transportation, extra care must be taken to protect the unit from vibration and shock.
- The HYDACLAB® must not be put into service if any known technical defects are apparent.
- The unit must be installed according to the instructions.
- The information on the type code label must be noted.
- After an oil change, RESET must be carried out.
- The sensor should not be commissioned in old oil, as all relative data changes will be invalid.
- Troubleshooting and repair work may only be carried out at the HYDAC Service Department.
- All relevant and generally recognised safety requirements must be adhered to.
- If the instrument is not handled correctly, or if the operating instructions and specifications are not adhered to, damage to property or personal injury can result.

3 Installation

The sensor can be installed directly in the hydraulic system via the threaded G ¾ connection. Please ensure the sensor is not mounted in standing oil. It is recommended to fit the sensor in an inclined position, fitting angle ≥ 30°. Please avoid fitting the sensor vertically with the sensor element pointing downwards. When fitting, ensure that the sensor is completely submerged in the fluid and that the fluid can circulate freely through the sensor. The maximum max oil flow rate should not exceed 5 m/s.



Recommended mounting angle

For installation of the HYDACLAB®, HYDAC ELECTRONIC offers the appropriate mounting accessory (see sec. 12.1, Mechanical Accessories).
The electrical connection must be carried out by a qualified electrician according to the relevant regulations of the country, (VDE 0100 in Germany).
HYDACLAB® sensors carry the CE mark. A certificate of conformity is available on request. The relevant EMC standards EN 61000-6-1; EN 61000-6-2, EN 61000-6-3, EN 6100-6-4 are met. However, the stipulations of those standards are met only if the sensor's housing has been correctly earthed by a qualified electrician. When installed in a hydraulic block, earthing the block via the hydraulic system is sufficient.

Additional installation suggestions which, from experience, reduce the effect of electromagnetic interference:

- Cable connections to be kept as short as possible.
- Use shielded cable (e.g. LIYCY 5 x 0.5 mm²).
- The cable shielding must be fitted by qualified personnel, subject to the ambient conditions and with the aim of suppressing interference.
- Keep the unit well away from the electrical supply lines of power equipment, as well as from any electrical or electronic equipment that can cause interference.

4 Definition of the Terms

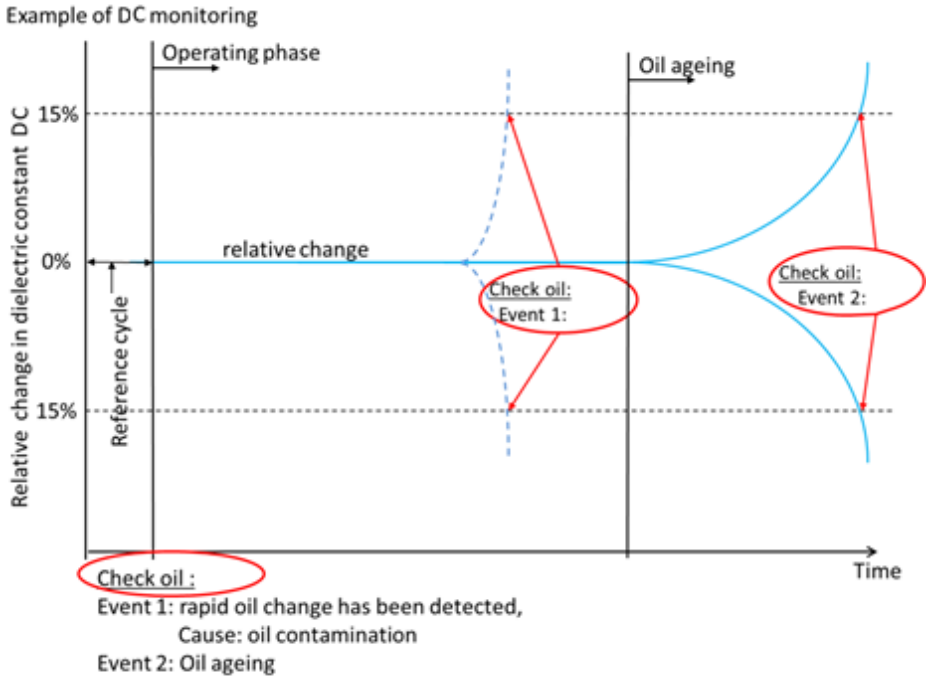
The term of relative dielectric constant $\varepsilon_r = \varepsilon/\varepsilon_0$, used in this operating manual is the parameter for the permeability of a substance to electrical fields with regard to the permeability of vacuum (ε_0). Other permitted definitions are "relative permitivity", "permitivity value" or "dielectric value". The relative dielectric constant will be referred to hereinafter as DC. A further term used in hereinafter is the relative change in the dielectric constant = relative change in DC.
The electrical conductivity of the oil is displayed in nS/m, the change in conductivity is displayed in %. The saturation level is a parameter for the concentration of water in oil: it is displayed relatively in %. Consequently, 100% corresponds to the point where the oil is fully saturated with water. No further water can be dissolved by the oil and there will be a presence of free water in the oil.

5 Function

HYDACLAB® is a compact, multi-functional sensor for determining the online condition of oil. The user is kept informed of changes in fluid condition as they occur and can take immediate action in the case of deteriorating operating conditions.

Changes in fluid condition that might occur due to ageing or mixing with other fluids, for example, are indicated by measuring the temperature, the saturation level, the relative change in electrical conductivity and the relative change in dielectric constant (also referred to as DC).

A change in conductivity or in the DC results in a deviation from the reference value in percent, determined during the reference phase.



The LEDs displayed by HYDACLAB® indicate information about the measured values of the analogue and the switching signals, (i.e. warning, alarm), as well as information about the sensor status and oil condition.

5.1 Switching output

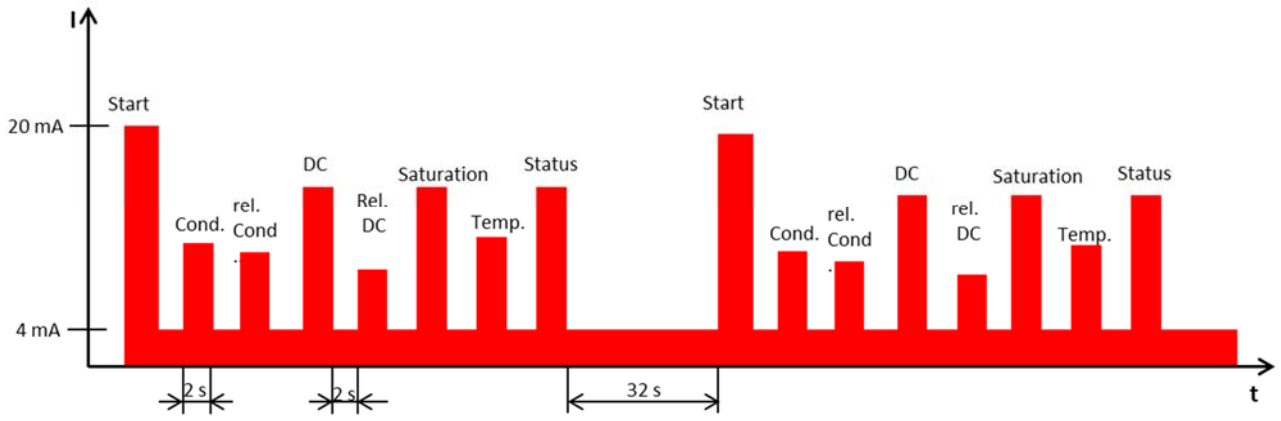
The switching output (normally closed function as standard version PIN 2), indicates an alarm function being initiated in the event of a change in the oil condition.
The output switches according to the following measured value changes (default settings):

Relative change in dielectric constant	± 15 %	(temperature compensated)
Relative change in conductivity	± 15 %	(temperature compensated)
Saturation level	≥ 85 %	
Temperature	≥ 80 °C	

5.2 Analogue output

Analogue output signals representing measured values are output sequentially on PIN 4, for connection to a non-HYDAC device.

The setup possibilities for the analogue sequence is described in sec. 5.4 Parameter settings.
The sequencing of the default pre-set signals is as shown in the diagram below:



All signals output to the sequential analogue output are default set as 4..20 mA current-loop signals (0 .. 10V is also possible), sequenced and spaced as follows:

		Output signal	Duration
Start signal:		20 mA	2 s
		Pause (4 mA)	2 s
Signal 1:	Absolute conductivity value	0 .. 100 nS/m	2 s
		Pause (4 mA)	2 s
Signal 2:	Change in electrical conductivity	-100 .. 200%	2 s
		Pause (4 mA)	2 s
Signal 3:	Absolute DC value	1 .. 10	2 s
		Pause (4 mA)	2 s
Signal 4:	Rel. Change in DC	-30% ... +30%	2 s
		Pause (4 mA)	2 s
Signal 5:	Saturation level	0% ... +100%	2 s
		Pause (4 mA)	2 s
Signal 6:	Temperature	-25°C... +100°C	2 s
		Pause (4 mA)	2 s
Signal 7:	Status signal	See table below for levels	2 s
Pause before next output cycle:		4 mA	32 s

Explanation of status signal:

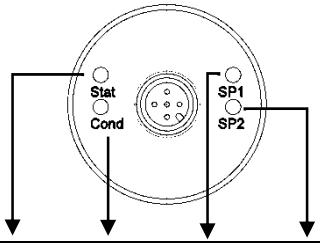
The information from the status signal is shown in the table.

mA	V	Status/Phase	Exceed operating temperature range	Switching status 1	Switching status 2
< 4.0	- - -	Error	irrelevant	irrelevant	irrelevant
4.0-4.5	0.00-0.31	Operating phase	No	No	No
4.5-5.0	0.31-0.62	Operating phase	No	No	Yes
5.0-5.5	0.62-0.94	Operating phase	No	Yes	No
5.5-6.0	0.94-1.25	Operating phase	No	Yes	Yes
6.0-6.5	1.25-1.56	Operating phase	Yes	No	No
6.5-7.0	1.56-1.87	Operating phase	Yes	No	Yes
7.0-7.5	1.87-2.19	Operating phase	Yes	Yes	No
7.5-8.0	2.19-2.50	Operating phase	Yes	Yes	Yes
8.0-8.5	2.50-2.81	Homogenisation phase	No	No	No
8.5-9.0	2.81-3.12	Homogenisation phase	No	No	Yes
9.0-9.5	3.12-3.44	Homogenisation phase	No	Yes	No
9.5-10.0	3.44-3.75	Homogenisation phase	No	Yes	Yes
10.0-10.5	3.75-4.06	Homogenisation phase	Yes	No	No
10.5-11.0	4.06-4.37	Homogenisation phase	Yes	No	Yes
11.0-11.5	4.37-4.69	Homogenisation phase	Yes	Yes	No
11.5-12.0	4.69-5.00	Homogenisation phase	Yes	Yes	Yes
12.0-12.5	5.00-5.31	Orientation phase	No	No	No
12.5-13.0	5.31-5.62	Orientation phase	No	No	Yes
13.0-13.5	5.62-5.94	Orientation phase	No	Yes	No
13.5-14.0	5.94-6.25	Orientation phase	No	Yes	Yes
14.0-14.5	6.25-6.56	Orientation phase	Yes	No	No
14.5-15.0	6.56-6.87	Orientation phase	Yes	No	Yes
15.0-15.5	6.87-7.19	Orientation phase	Yes	Yes	No
15.5-16.0	7.19-7.50	Orientation phase	Yes	Yes	Yes
16.0-16.5	7.50-7.81	Waiting phase	No	No	No
16.5-17.0	7.81-8.12	Waiting phase	No	No	Yes
17.0-17.5	8.12-8.44	Waiting phase	No	Yes	No
17.5-18.0	8.44-8.75	Waiting phase	No	Yes	Yes
18.0-18.5	8.75-9.06	Waiting phase	Yes	No	No
18.5-19.0	9.06-9.37	Waiting phase	Yes	No	Yes
19.0-19.5	9.37-9.69	Waiting phase	Yes	Yes	No
19.5-20.0	9.69-10.00	Waiting phase	Yes	Yes	Yes
- - -	> 10.00	Error	irrelevant	irrelevant	irrelevant

Note: Due to tolerance variations, we recommend setting the threshold in the evaluation electronics to approx. 0.25 mA or 0.15mA below the ideal value given in the table.

5.3 Overview of control LEDs

Parameters adjustable under menu point oil condition indication; warning threshold, chapter 5.4.5



Display		
	of	
	flashing	200ms on, 1300ms of
	blinking	500ms on, 500ms of
	constant	

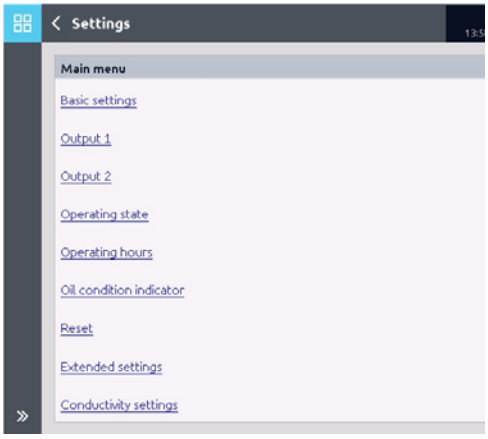
LED 1 Stat	LED 2 Cond	LED 3 SP 1	LED 4 SP 2	Note / Description	Note
				Waiting phase	For commissioning, the activation temperature of 40°C (default), must be exceeded.
				Orientation/ Homogenisation within the operation temperature range, fit table is being filled in	
				Orientation / Homogenisation outside the operating temperature range	
				Operating phase within the operating temperature range	
				Operating phase outside of the operating temperature range	
				Error	Perform a RESET
				Error	Please check ambient conditions and installation (can occur when measuring in air, for example)
				Device is not in the operating phase or an error has occurred	
				Saturation, dialectic or conductivity deviation within normal range	
				Warning: Saturation, dielectric or conductivity changes exceed the warning threshold	
				Alert: rapid oil change has been detected	Check the oil
				Alert: Saturation, dielectric or conductivity changes exceed the alarm threshold	Check the oil
				Error status	
				Switch output off	
				Switch output on	
				Critical sensor error	Please contact HYDAC Service.
				Firmware update	
				A reset is performed	

5.4 Parameter Setting via HMG/ CMWIN (For connection see chapter 13.2.1)

It is possible to adjust the sensor parameters to match the application requirements by means of the HMG 4000 (“Establish connection” see chapter 13.2) as well as by means of the PC software CMWIN, via the setting dialogue.

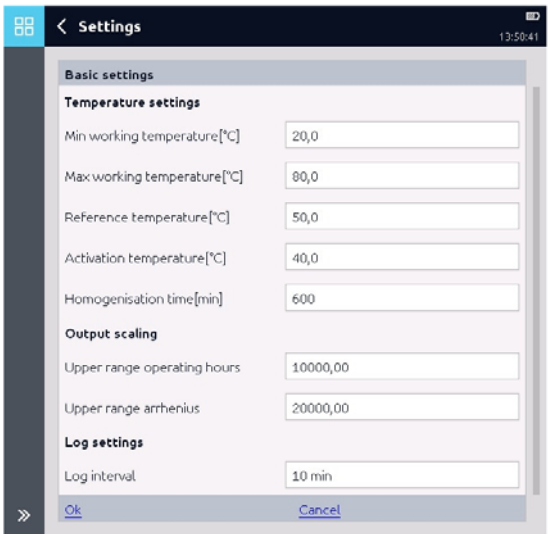
After connecting the sensor, chapter 13.2.1, you will be lead to the main menu, and presented with the windows described in detail as follows:

Select the sub menu to be changed via the navigation keys "↑" or "↓".



5.4.1 Basic Settings

In the basic settings menu, **temperature settings, output scaling** and **recording settings** can be changed. For this purpose, please select the value to be modified by means of the navigation keys. By pressing the OK button, the value is highlighted and then it is possible to enter a new value. Please press OK again to confirm the selected value. Default settings- see opposite.



5.4.1.1 Temperature Settings

Minimum operation temperature - The sensor is operational when the temperature is above this value.

Maximum operation temperature – The sensor is operational when the temperature is below this value

Reference temperature – The temperature compensated conductivity and DC values will be referenced to this temperature.

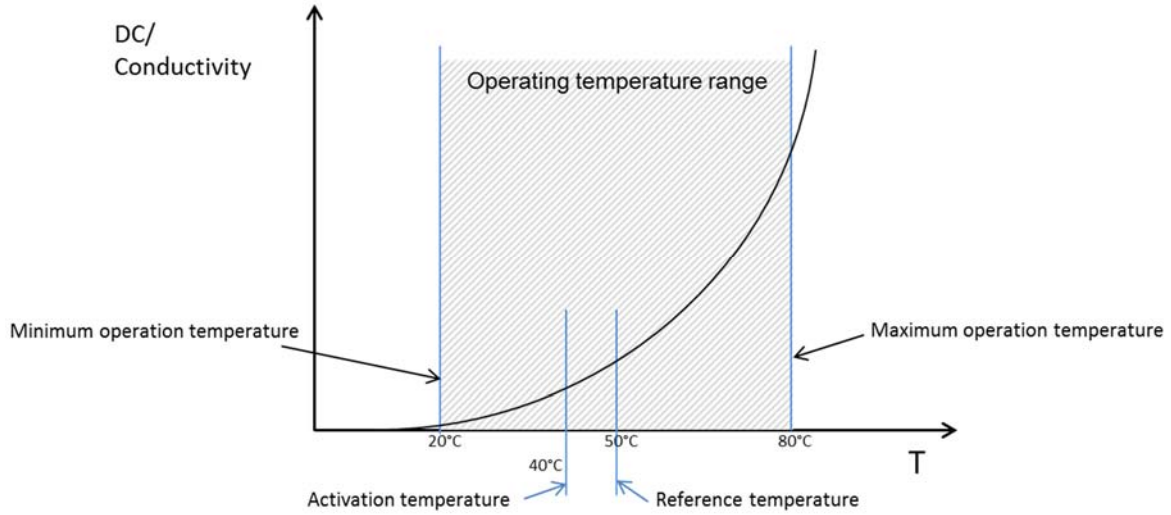
Activating temperature – This value must be exceeded in order for the sensor to start its referencing cycle.

Homogenisation period - The duration of the homogenisation phase will be defined by this period. The Homogenisation phase starts, once 50% of the working temperature range has been recorded. (see also graph chapter 6).

The time should be defined in order to ensure that the system carries out a complete circulation, a mixing of the oil and a complete temperature cycle.

	Factory settings	Description
Activation temperature	40°C	The value must be exceeded once to start the referencing phase.
Reference temperature	50°C	On completion of the orientation phase the values of the conductivity / DC will be referenced to this temperature.
Minimum operation temperature	20°C	Should the operating temperature lie below this value, the values for conductivity/DC will be frozen.
Maximum operation temperature	80°C	Should the operating temperature exceed this value, the values for conductivity/DC will be frozen.

5.4.1.2 Explanation of Terms regarding Temperature:



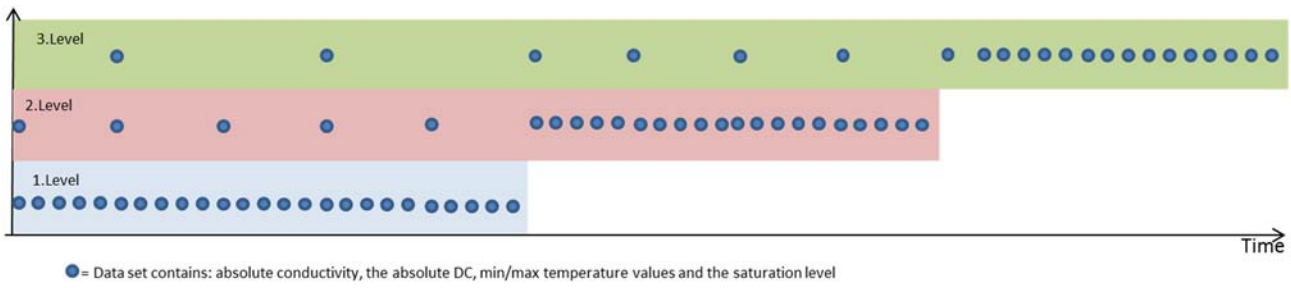
Notice: If the temperature range is changed during the reference cycle, NO reset needs to be performed, as HYDACLAB® automatically adapts to the new range.

5.4.1.3 Output Scaling

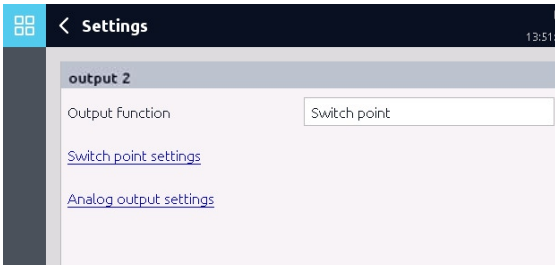
In the output scaling menu you can set the upper range of operating hours, the HYDACLAB® sensor thus counts the operating hours.
The output signal for the operating hours is scaled to a value set by the user, i.e. 4mA⇔ 0 operating hours and 20 mA ⇔10000 operating hours. This figure defines the maximum expected operating hours of the system since its last reset. Upper range Arrhenius: The Arrhenius rate defines the operating hours depending on temperature, the weighting is based on the Arrhenius equation.
For the Arrhenius value the output signal is scaled to an upper value by the user, i. e. 4 mA ⇔ 0 temperature dependent operating hours and 20 mA ⇔20000 temperature dependent operating hours, this value defines the maximum expected oil service life in the system.

5.4.1.4 Recording Settings

In the recording settings the recording interval can be adjusted. This setting defines the interval of the recorded values that are to be stored. The interval is adjustable in stages from 10 seconds to 2 hours by the user. Stored values are: the absolute conductivity, the absolute DC, the current temperature, min/max temperature values and the saturation level.
The log has a data storage with 3 storage levels. If the storage space is exhausted, a number of data sets will be compressed to one data set, marked with a time stamp and then moved to the next level. The values can be stored for up to 10 years.
Please confirm your changes by pressing **OK**.

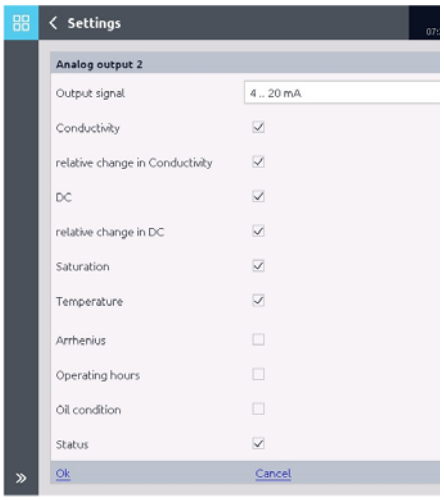


5.4.2 Output Functions



HYDACLAB® has 2 possible analogue outputs.
In the sub menu **Output 2** you can configure the analogue output in the output function.
The changes you perform here will also change the analogue sequence.

In the **analogue output** the user can select the parameters to be shown and set the analogue output signal to a 0 - 10 V signal or 4 - 20 mA.



The measured values for the sequence are frozen at its start-up in order to ensure that the measured values always refer to the condition during the start of the sequence.

For the Arrhenius value and the operating hours, the output signal is scaled to a maximum value which is set by the user, see 5.4.1.3. For all other parameters the measuring ranges are default settings.

If no parameter has been selected, the analogue output is switched off.

If only one parameter has been selected a pure analogue signal is output (no sequence).

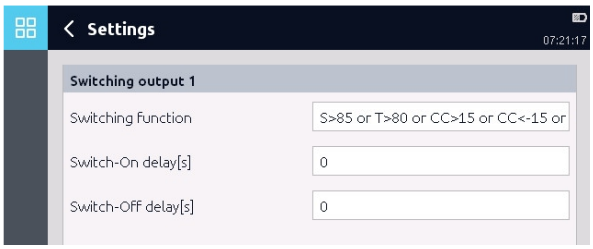
For each output, several parameters can be selected. In this case the values are shown as sequences, see 5.2 The parameters are shown one after another each 2 seconds. In between each shown parameter there is a pause of 2 seconds. The sequence starts with a 100% value representing the start value. The sequence is followed by a pause of 32 seconds. This means 7 values plus the start value have a sequence length of 30 seconds. The sequence starts every 62 seconds.

The output values of the oil condition represent:

Output value oil condition	
0%	No statement can be made
25%	OK
50%	Warning
75%	Quick oil change
100%	Alert

5.4.3 Switching outputs

HYDACLAB® has 2 possible switch points. They are bit coded to the device status and can also be issued via a physical switching output. They are displayed in the analogue sequence, see 5.2 For each switch point, a switching function as well as a switch-on and switch-off delay can be defined in seconds.



The switching function is defined by a logical expression. It is entered in the form of a text. The text can contain comparisons and logical combinations. Comparisons are always structured according to the following scheme <symbol> <comparative operator> <constant>.

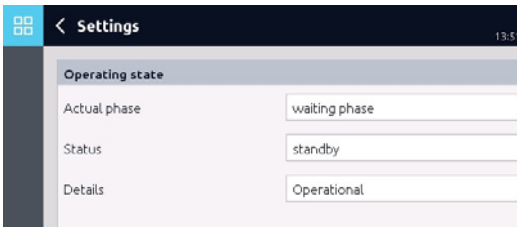
The following elements are possible:

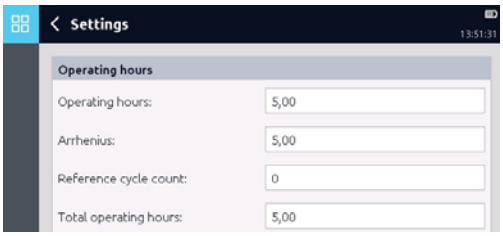
Symbol	Comparative operators	Logical operators	Constants
C for conductivity **CC** for % rel. change of electronic conductivity **P** for DC **PC** for % rel. change of DC **S** for saturation **T** for temperature **A** for Arrhenius value **H** for the number of operating hours **OC** for oil condition **Phase** for the current operating phase	**=** equal **>** greater than **>=** greater than or equal to **<** smaller than **<=** smaller than or equal to **<>** not equal	**and** a connection between 2 logical expressions **or** or-connection of 2 logical expressions (and) for putting expressions into parentheses. As the hiearchy of the **and** and the **or**-operator is not defined in mathematics, parentheses must be used if both operators are used on the same level. Example: " T > 30 and P > 5.3 or C > 2.6" is not allowed. Instead, please write: " T > 30 and (P > 5.3 or C > 2.6)" or "(T > 30 and P > 5.3) or C > 2.6"	Numeric values can be entered as a decimal number with a comma or a dot. The entered number must stay within the value range of the symbol. Uppercase and lowercase letters are ignored. Example: "Phase > 3 and T > 30 and T < 50 and (P > 5.3 or C > 2.6 or S > 45)"

Note: An empty text means that the switch point is always switched off.

5.4.4 Operating state and operating hours

The windows of the operating state and the operating hours serve as information only. No settings can be carried out from here.



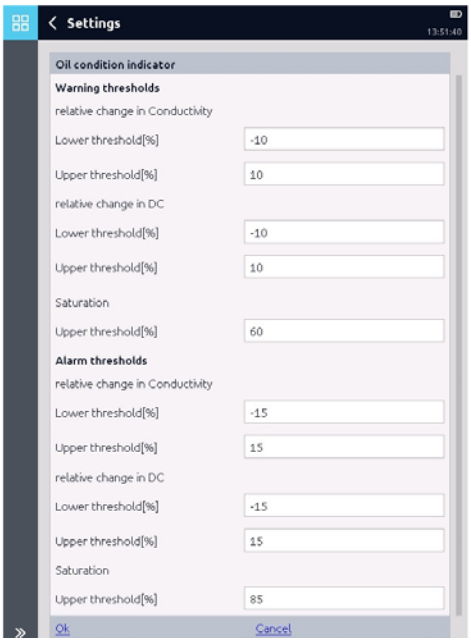


The HYDACLAB® sensor counts the operating hours**.** The operating hours indicate the maximum expected operating hours of the system since its last reset. The Arrhenius rate defines the operating hours depending on temperature. The weighting is based on an Arrhenius calculation. HYDACLAB® counts the amount of resets performed and is displayed as the number of reference cycles. The total number of operating hours describes the system's actual performed number of operating hours including the performed resets.

5.4.5 Oil condition display

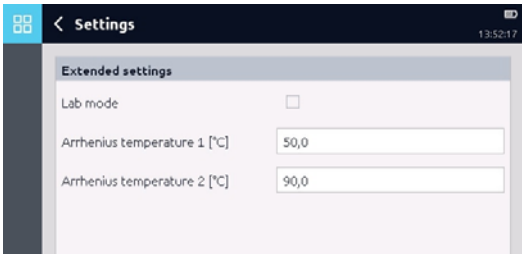
With the oil condition screen you have the opportunity to define the warning and alarm thresholds of the sensor, each of which are linked to a LED.

If the alarm threshold for conductivity change or DC change is set to +/- 0%, then they are not considered when displaying the oil condition.



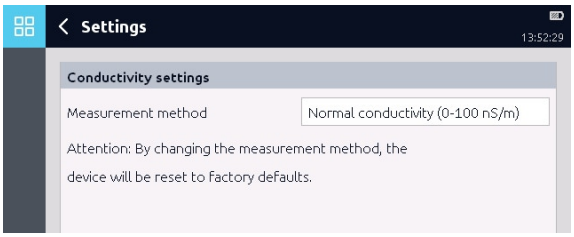
5.4.6 Extended settings “Lab mode”

"Lab Mode" switches off the referencing phase. The measured values DC and conductivity are recorded and output only as absolute values. There is no referencing phase and the “relative change in conductivity” and “relative change in DC” readings remain at 0%.



5.4.7 Conductivity settings

The default setting for conductivity is 0-100 nS / m. If the conductivity of the oil will never be more than 10 nS / m, then there is a possibility to set the conductivity scaling to 0-10 nS / m.

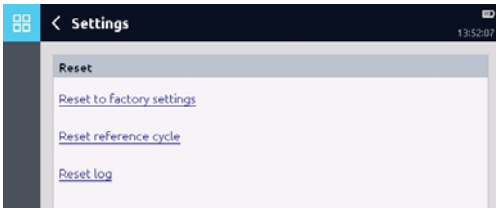


5.4.8 Reset

There are three different ways to perform a reset of the sensor.

Reset to default settings means that all settings in the device are set back to its delivered status.

Reset reference cycle (see 7.1) means that all settings will be kept, except for the reference cycle data. Therefore, the reference cycle must be performed again, i.e. after an oil change.



Reset log means that the fit table is kept but the data storage is cleared.

5.5 Interface Description HSP (HYDAC Simple Protocol)

The device has a serial interface. The user can communicate with the device via this interface. Data transmission at a baud rate of 9600 is possible via PIN 5 using the HSP protocol. The device supports the following functions:

HSP

Sensor Id
Command 000 is supported.

Device status
Commands 010 and 011 are supported.

Sensor Information
Commands 020 and 021 are supported.

Measured values
Commands 030, 031 and 032 are supported.

Read out Log
Commands 060, 061 , 070, 071 and 072 are supported.

Help
Command 999 is supported.
Detailed information can be found in the HSP protocol manual "HSP Specification".

6 Start-up

HYDACLAB® starts its data storage as soon as it is connected to a voltage supply and the fluid temperature exceeds its activating temperature of 40°C (factory settings) for the first time. The output signals for temperature and saturation are available immediately after sensor start-up. The signal for relative change in the DC and relative change in the conductivity is displayed after the homogenisation phase is completed. The conductivity and the dielectric change is indicated as a percentage deviation from the reference value determined during the referencing phase.

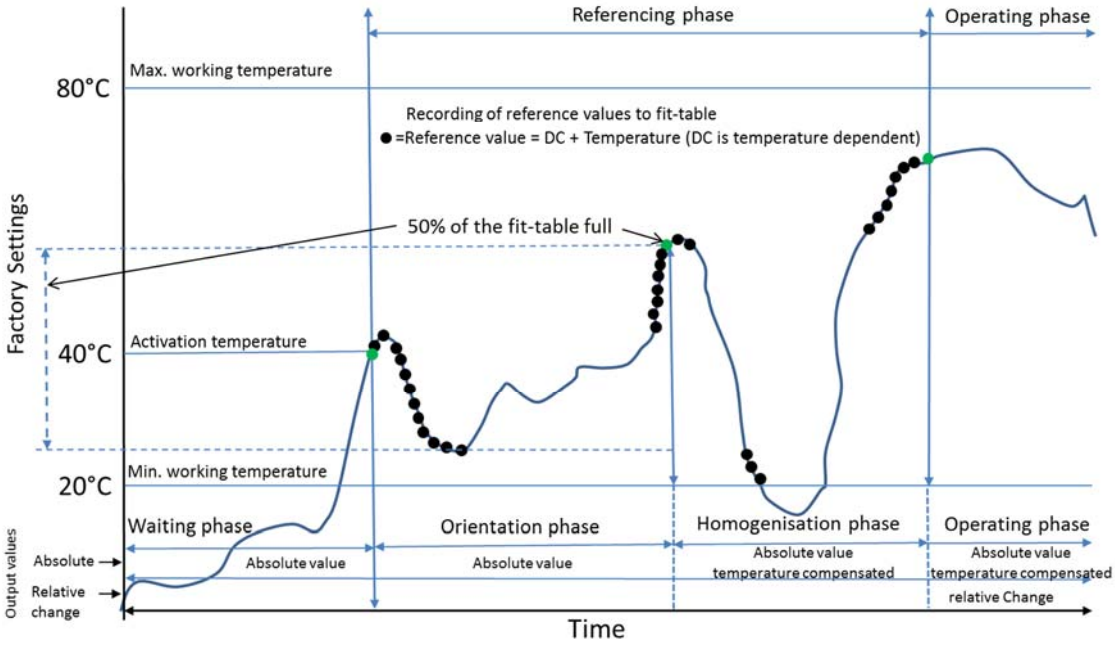
6.1 Fit Table

HYDACLAB® continuously writes to a fit table in which the respectively defined conductivity and dielectric values for each temperature are stored. By means of this table, the measured values can be linked to a reference temperature. The fit table will be frozen on completion of the homogenisation phase. The frozen fit table provides a reference framework for the calculation of the conductivity and dielectric change. On delivery of the HYDACLAB® the table is empty. The table is not written to until the activation temperature has been exceeded.

6.2 Reference Cycle

During the referencing cycle HYDACLAB® records the characteristics of the respective oil and adapts to the conditions of the relevant application. It is therefore essential that typical operating conditions, particularly all relevant operating temperature ranges, are run through during the reference phase. The end of the reference cycle is achieved when 50% of the working temperature is recorded and can be recognised from the LED as well as from the signal level of the status signal (see chapter 5.2).

Evaluation Cycle DC (Example)



During the referencing phase, the user must ensure that HYDACLAB® is only supplied with voltage if the operating conditions of the machine/system are normal.
(For example, the supply voltage of the sensor can be linked to the pump operation.)

The sensor should be reset if, after the machine/system is part-filled or re-filled the analogue values for the relative change in dielectric constant and the electric conductivity do not fall within a window of ± 5 %. This can be caused by variations in oil characteristics in different oil batches.

If only small temperature changes occur during the referencing phase, then it is possible that the "Fit Table" would never become 50% full, preventing the "Orientation Phase" from switching to the "Homogenisation Phase". Therefore the working temperature range should be set to accommodate this, otherwise HYDACLAB will never reach the Operating Phase, preventing the monitoring and alarming of changes in DC and Conductivity.

Alternatively, if due to limited temperature changes, the requirements of the "Referencing Phase" cannot be guaranteed, then only the absolute values need to be monitored (Lab Mode). Please note that if the temperature changes are only small, then the recording of the relationship between temperature and DC or the temperature and Conductivity becomes irrelevant anyway.

7 Reset functions

With reset, the entire contents of the memory including the reference phase is deleted. The sensor begins a new referencing phase once the voltage supply is re-connected and once the fluid temperature of 40°C (default setting) is exceeded for the first time. All parameter settings remain unchanged in the sensor.
A reset can be carried out in different ways:

7.1 Reset Button

Button on the device.
For this purpose, please loosen the screw (Torx T20) and press the button using a pointed object (pen or similar). Ensure the power supply is switched on. The button must be pressed for 2 seconds.

7.2 Reset using HMG 4000

A **reset** of the HYDACLAB® can be performed in the sensor dialogue of the HMG 4000. (Connection of the HYDACLAB® to a HMG 4000 see chapter13.2, HMG 4000).

7.3 Reset using PC software CMWIN

A **reset** of the HYDACLAB® can be performed in the sensor dialogue of the CMWIN software. CMWIN is special HYDAC PC software and is supplied with the HMG 510 and HMG 4000.

8 Electrical Connection

M 12x1,5 pole:

Pin	1	2	3	4	5
1C000	$+U_B$	SP1/AA1*	GND	SP2/AA2*	HSI
00S12	$+U_B$	RS485B	GND	RS485A	HSI

* Default settings: Pin 2:SP1 und Pin 4: AA2

M 12x1, 8 pole:

Pin	1	2	3	4	5	6	7	8
1CS12	$+U_B$	SP1/AA1	GND	PE	HSI	RS485A	RS485B	SP2/AA2

The following is applicable for the analogue output:

$R_{Lmin} \geq 1\ k\Omega$ for output 0..10V

$R_{Lmax} \leq 500\ \Omega$ for output 4..20mA

Note:

The load resistance R_L is the sum of the internal input resistance of the evaluation unit and the resistance of the connection line.

9 Standard Technical data

Input data	
Saturation level (relative humidity)	0 .. 100 % saturation
Temperature	-25 .. +100 °C
Dielectric constant (DC = εR)	1 .. 10
Change in the dielectric constant	-30 .. 30%
Electrical conductivity	0 .. 100 nS/m
Cange of electronic conductivity	-100 .. 200%
Operating pressure	< 50 bar
Pressure resistance	< 600 bar
Flow velocity	< 5 m/s
Parts in contact with fluid	Stainless steel / ceramic with vacuum-metallised seal Glass with thin-film metallic coating / FKM
Output variable saturation level	
Output signal (0 .. 100 %)	4 .. 20 mA / 0 .. 10 V
Calibration accuracy	≤ ± 2 % FS max.
Accuracy	± 3 % FS typ. *
Output variable temperature	
Output signal (-25 .. +100°C)	4 .. 20 mA / 0 .. 10 V
Accuracy	≤ ± 3 % FS max.
Output variable dielectric constant (ε_R)	
Output signal (1 .. 10)	4 .. 20 mA / 0 .. 10 V
Accuracy	≤ ± 5 % FS max.
Output variable change of dielectric constant	
Output signal (±30 % of IV)	4 .. 20 mA / 0 .. 10 V
Accuracy	see below **
Output variable electric conductivity (not for Mod 001)	
Output signal (0 .. 100 nS/m)	4 .. 20 mA / 0 .. 10 V
Accuracy	≤ ± 5 % FS max.
Output variable change of electric conductivity (not for Mod 001)	
Output signal (-100 .. 200 %)	4 .. 20 mA / 0 .. 10 V
Accuracy	see below **
Switching output (default settings)	
Signal 1 (N/C)	PNP Switching output 0.5 A max. Switching level ≥ U_B – 4 V
Default alert SP1 relative humidity	≥ 85 %
Default alert level SP1 temperature	≥ 80 °C
Default alert level SP1 rel. change in dielectric constant	± 15 %
Default alert SP1 rel. change in conductivity	± 15 % (not for Mod 001)
Environmental conditions	
Nominal temperature range	+20 .. +80 °C
Storage temperature	-30 .. +90 °C
Fluid compatibility	Suited for hydraulic and lubrication oils
CE - mark	EN 61000-6-1 / 2 / 3 / 4
Viscosity range	1 .. 5000 cSt
Shock resistance acc. to DIN EN 60068-2-27	50 g / 11 ms / half sine
Vibration resistance acc. to DIN EN 60068-2-6 at 5 .. 2000 Hz	10 g / sine
Protection class acc. To DIN EN 60529	IP 67 ***
Other data	
Supply voltage U_B	10 .. 36 V DC
Residual ripple of supply voltage	≤ 5 %
Current consumption without outputs	max. 100 mA
Mechanical connection	G ¾ A ISO 1179-2
Tightening torque, recommended	30 Nm
Electrical connection	M12x1, 5 pole / 8 pole
Housing	Stainless steel
Weight	approx. 215 g

Note: reverse polarity protection, short circuit protection provided. **FS** (**F**ull **S**cale) = relative to complete measuring range **IV** (**I**nitial **V**alue)

* The max. accuracy achievable when measuring relative humidity is heavily dependent on the type of fluid or fluid additive. More precise information on this is available on request.

** The accuracies when measuring the change of dielectric constant and the electric conductivity depend on the application, the oil type and the auto-calibration of the sensor. Detailed information available on request.

*** With mounted mating connector in corresponding protection class

10 Order details

Model code HYDACLAB 1400

H L B 1 4 J X - X X X X X - 000

Variables
4 = Measured variables:
- saturation (rel. humidity)
- temperature
- electric conductivity (not for Mod 001)
- dielectric constant (DC)

Mechanical connection
J = G ¾ A ISO 1179-2

Electrical Connection
8 = male connection M 12x1, 5 pole (mating connector not supplied)
P = male connection M 12x1, 8 pole (mating connector not supplied)

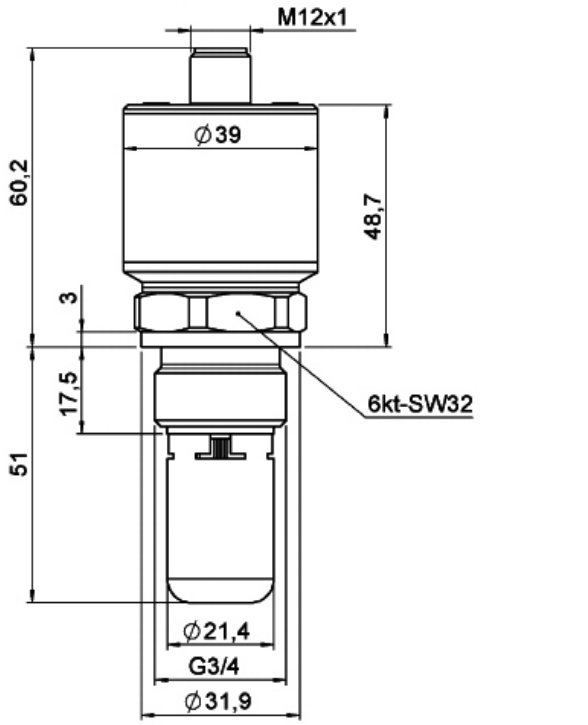
Signal / Interface
5 pole
1C000 = 1 switching output / analogue output
00S12 = RS 485
00F11 = CANopen (on request)
00F31 = IO-Link (on request)

8 pole
1CS12 = 1 switching output / analogue output / RS 485

Modification number
000 = standard
001 = Info *

* HLB 14J8-1C000-001 is a pure replacement for the HLB 1300. This device is preset on analog output 2 so that no conductivity values are output

11 Dimensions



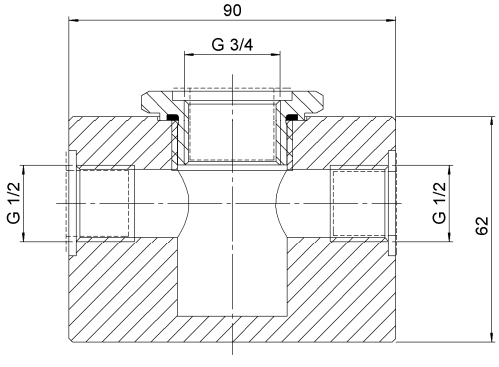
12 Accessories

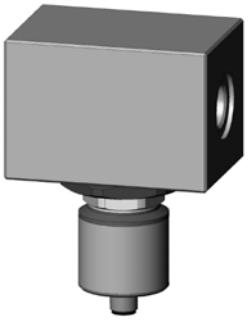
12.1 Mechanical

ZBM 21 (Flow)
Adapter to connect the HYDACLAB® fluid condition sensor in a G 1/2” line.

Note: suitable only for max. operating pressure < 50 bar and max oil flow rate < 5 m/s.

Order no.: 3244260

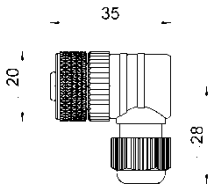




HYDACLAB®

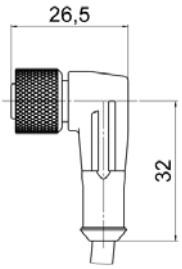
12.2 Electric

ZBE 08 (5 pole)
Connector M12x1, right-angled
Order no.:6006786



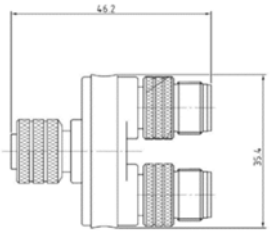
Colour recognition:
Pin 1: brown
Pin 2: white
Pin 3: blue
Pin 4: black
Pin5: grey

ZBE 08-02 (5 pole) with 2m cable
Order no.:6006792
ZBE 08S-02 (5 pole) with 2m screened cable
Order no.:6019455
ZBE 0P (8 pole)
Order no.:6055444
ZBE 0P-02 (8 pole) with 2m cable
Order no.:6052697

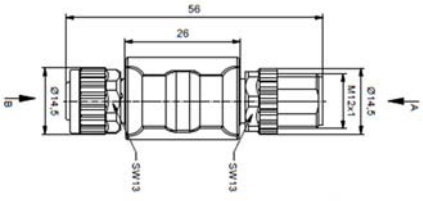


Colour recognition:
Pin 1: white
Pin 2: brown
Pin 3: green
Pin 4: yellow
Pin 5: greq
Pin 6: pink
Pin 7: blue
Pin 8: red

ZBE 26 (only required if HLB is to be supplied from an external supply to save HMG battery power)
Y-adapter (blue) for HLB
Order no.:3304374



ZBE 46
Adapter, HLB 1400 + AS1000
Order no.: 925725
ZBE 30-02
Sensor cable M12x1, 2m
Order no.:6040851
ZBE 30-05
Sensor cable M12x1, 5m
Order no.:6040852



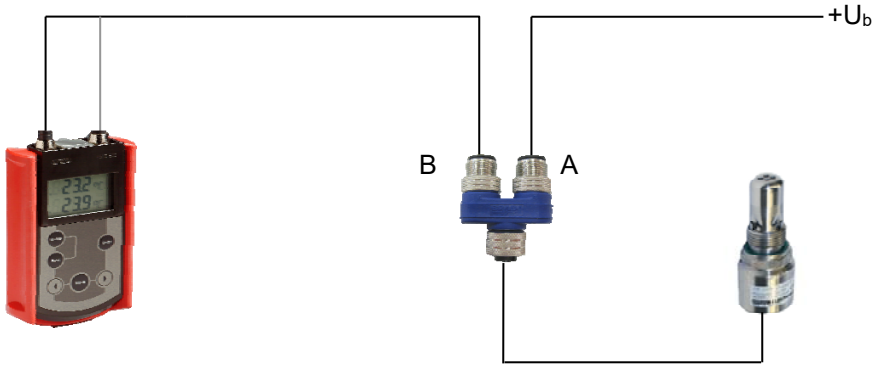
13 Displays

13.1 HMG 510

Portable 2-channel digital display, specially designed for use with HSI and SMART sensors. It is possible to display the actual measured values on the HMG 510 display.
Order No.: 909889 HMG 510-000

13.1.1 Connecting to a HMG 510

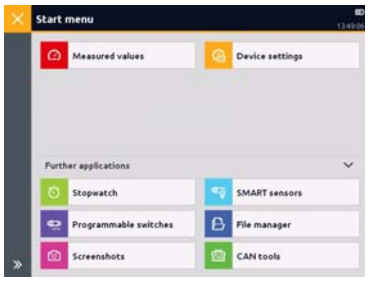
Remove the supply cable from the electrical connection of the HYDACLAB® and screw the blue Y-adapter HLB "ZBE 26" onto the sensor. Reconnect the supply cable to connection A of the Y-adapter and connect connection B using a sensor cable ZBE 30-xx to input A or B of the HMG 510.

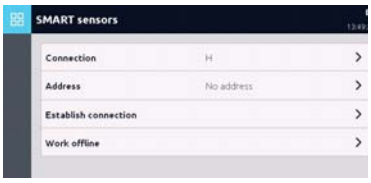


13.2 HMG 4000

Portable data recorder with a colour display with full graphics capability to display or record measured values from the HYDACLAB®. With the HMG 4000 the actual measured values and the stored measurement curves can be shown on the HMG 4000 display. The recordings can also be stored and processed on the HMG 4000. In addition, the HYDACLAB® can be reset using the HMG 4000.
(for a detailed description, see the operating manual for the HMG 4000).
Order no.: 925279 HMG 4000-000-E

To connect SMART sensors with the HMG 4000, select the **SMART Sensors** option in the **start menu**.
Then enter the **channel** to which the SMART sensor is connected.
You also have the option of entering a **sensor bus address.** The default setting is **No address.**





Bus addresses must be assigned when the SMART sensor is operated in a bus system.
After selecting **Establish connecting** information about the connected SMART sensor will be displayed above the function bar.

Main menu
SMART sensors
You are now in the SMART Sensor's menu and can enter settings to adapt the sensor to your requirements.
The items contained in the menu vary in accordance with the sensor type connected, i.e. not all of the menu items described below may be available.

Sensor Information
This menu provides the following information about the connected SMART sensor:

- Part number
- Serial number
- Information about the various measurement channels with regard to their type and measurement range.

Sensor Measured Values
The actual measured values along with the associated units of measurement of the connected SMART sensor are shown here.

Sensor Manage Recordings

In this menu you can transfer long-term recordings created by the SMART sensor to the HMG 4000, or delete them from the SMART sensor's memory. **Refresh** enables you to check whether new recordings are present. After having selected a recording and the option **transmission** you can determine whether you'd like to store it in the HMG 4000 under the earlier displayed combination of name and number, or whether you would like to assign a new designation.

Sensor Settings

In the sensor settings you can adjust the device parameters to suit your requirements, see chapter 5.4.

13.2.1 Connecting to a HMG 4000

Remove the supply cable from the electrical connection of the HYDACLAB® and screw the adapter "ZBE 46" onto the sensor.
Connect one of the inputs A to D of the HMG 4000 to the adapter "ZBE 46" using a sensor cable "ZBE 30-0z".

13.3 CMWIN

This is specially developed PC software, which communicates with the HYDACLAB® via a communication bridge (HMG 510 or HMG 4000). Using this software, measurement curves can be transferred to the PC, stored, displayed and processed or the actual measured values can be displayed.
CMWIN is supplied with the HMG 510 and HMG 4000. It is also available for download from our internet site.

13.4 CSI-B-2

By means of the condition monitoring interface module CSI-B-2 and the CMWIN software, it is also possible to read out the measured values directly from the sensor or to set the parameters.

Note

All HYDAC software products are available for download from our internet site.

14 Items supplied

1 HYDACLAB® - Sensor
1 Operating manual

15 Important tips at a glance

- The sensor once fitted must be completely immersed in the fluid and the fluid must be able to circulate freely through the sensor.
- When installing without the mounting block ZBM 21, make particularly sure that the flow of fluid is not impeded by the installation. There must be a minimum distance of 10 mm between the front end of the sensor head and the opposite wall of the pipe/housing.
- Ensure there is constant flow and prevent the formation of air bubbles. With standing oil, variations in measurement may increase.
- In principle the HYDACLAB® must only be supplied with voltage if normal flow is guaranteed. In other words, disconnect the HYDACLAB® from the supply voltage as soon as the system is switched off, stops operating or if the flow is interrupted for a significant period.
- Ensure that the operating conditions are typical during the reference cycle i.e. the whole range of conditions relevant to operation are included.
- The reference cycle starts as soon as HYDACLAB® is supplied with voltage **and** the fluid temperature exceeds the activation temperature of 40°C for the first time (default settings).
- During the reference cycle, please avoid mixing fluids and filling up with new oil.
- In the event of oil change or serious alteration in the ambient conditions, the unit should be reset.

16 Liability

This operating manual was made to the best of our knowledge. Nevertheless and despite the greatest care, it cannot be excluded that mistakes could have crept in. Therefore, please understand that in the absence of any provisions to the contrary hereinafter our warranty and liability – for any legal reasons whatsoever – are excluded in respect of the information in this operating manual. In particular, we shall not be liable for lost profit or other financial loss. This exclusion of liability does not apply in cases of intent and gross negligence. Moreover, it does not apply to defects which have been deceitfully concealed or in cases of culpable harm to life, physical injury and damage to health. In the event that we should negligently breach any material contractual obligation, our liability shall be limited to the foreseeable loss. Claims due to the Product Liability shall remain unaffected.
In cases where the translation is used, the text of the original German Assembly and Repair Instructions shall prevail.