

## Oil Condition Sensors - LubCos H<sub>2</sub>O

SCSO 300-1000



### Safety and operating instructions

**Read safety and operating instructions before use**

**Note:** Representations do not always exactly correspond to the original. No legal claims arise from information provided by us in error. Subject to change.

**The sensor complies with the CE requirements**

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## 1. Quick Start

The following section describes the steps for initial commissioning of the Water Sensor LubCos H<sub>2</sub>O to be carried out at the PC. For this purpose, the following components are required:

1. PC / Laptop with RS232 connection, or alternatively, with a USB port, which serves as a measuring computer
2. Water Sensor LubCos H<sub>2</sub>O (order number: SCSO 300-1000)
3. Sensor cable (order number: SCSO 100-5030)
4. Power supply incl. cold device plug (order number: SCSO 100-5080)
5. Software LubMon PClight [www.argo-hytos.com](http://www.argo-hytos.com)
6. In addition, when connected via USB: USB-RS232 converter with associated driver software (order number: SCSO 100-5040)

The software **LubMon PClight** can be downloaded from the website [www.argo-hytos.com](http://www.argo-hytos.com).

### The components are to be prepared as follows:

#### A) Software Installation LubMon PClight

1. Extract the file LubMon PClight.zip on your computer.

#### B) Software installation of the driver for the USB-RS232 converter with data acquisition via USB

(If you do not use a converter, please continue with point D)

2. Now connect your USB-RS232 converter to your PC / laptop.
3. If the USB-RS232 converter is not known by the PC, the corresponding driver must be installed.  
For this purpose, follow the installation instructions of the operating system or the supplied driver CD.

#### C) Sensor connection with data acquisition via USB

4. Connect the sensor cable to the M12 connector at the sensor.
5. Connect the 9-pin D-Sub connector of the cable to the appropriate serial port of the USB-RS232 converter.
6. Connect the power supply and the sensor cable.
7. Now properly connect your power supply via the cold device plug to the mains voltage.  
Your sensor is now ready for operation.

#### D) Sensor connection with data acquisition via RS232

8. Connect the sensor cable to the M12 connector at the sensor.
9. Connect the 9-pin D-Sub connector of the cable to the appropriate serial port of your PC / laptop.
10. Connect the power supply and the sensor cable.
11. Now properly connect your power supply via the cold device plug to the mains voltage.  
Your sensor is now ready for operation.

#### E) Starting the software

12. LubMon PClight or LubMon Config can be started by double click onto the file LubMon PClight.exe or LubMon Config.exe.
13. Select the serial port (COM), at which you have connected the sensor to the computer. If you do not use a USB-RS232 converter, this is usually COM 1.
14. When using a USB-RS232 converter, a new virtual COM port is created. Then choose this port.  
If necessary, you can check the assignment of the virtual COM port in the Windows Device Manager.
15. The incoming data and the identification of the sensor appear on the left side of the window.  
On the right side of the window, the data can be visualized in a graph.

### 2.1 General

The LubCos H<sub>2</sub>O serves to measure changes in the properties of hydraulic and lubricating media. The corresponding measured values are continuously recorded and can be issued via a serial interface or via two 4..20 mA current outputs.

The sensor detects the following two physical characteristics

- › temperature
- › relative humidity

### 2.2 Temperature measurement

For measuring the oil temperature, a PT1000 platinum resistance sensor is used. The measuring range extends from -20 °C to +120 °C. Since the resistance sensor is directly in the oil, the conductivity of the surrounding medium may not exceed a value of 3 mSm<sup>-1</sup>.

### 2.3 Humidity measurement

The measurement of relative humidity  $\varphi$  is effected by using a capacitive transducer. The capacitive humidity sensor detects the relative humidity in the range between 0% and 100%. In case of free water or emulsions, the sensor indicates 100%.

#### 2.3.1 Relative humidity

Relative humidity  $\varphi$  is understood to be the ratio of the actually in the oil contained ( $\rho_w$ ) to the maximum possible amount of dissolved water at the saturation limit ( $\rho_{w,max}$ ).

$$\varphi = \frac{\rho_w}{\rho_{w,max}} \cdot 100 \quad (2-1)$$

Since the saturation limit, i.e. the maximum absorbable absolute humidity  $\rho_{w,max}$ , is strongly temperature dependent, the relative humidity varies with the temperature, even when the absolute humidity remains constant. Usually, oils absorb more water with increasing temperature.

#### 2.3.2 Absolute humidity

The absolute humidity is no physically measured value. It is determined by the relative humidity  $\varphi$  and the saturation limit  $\rho_{w,max}$  according to the following formula (2-2).

$$\rho_w = \frac{\varphi \cdot \rho_{w,max}}{100} \quad (2-2)$$

The saturation limit  $\rho_{w,max}$  depends on the oil type and temperature and must be determined in the laboratory. For more information, please contact the ARGO-HYTOS service team.

### 2.4 Operating hours counter

The sensor has an integrated operating hours counter whose values are still present even after power failure. After interruption, the counter restarts counting at the last recorded (stored) value before the interruption.

### 3. Technical specifications

#### 3.1 General data

Sensor data	Size	Unit
<b>Max. operating pressure</b>	50	bar
<b>Operating conditions</b>		
Temperature <sup>1</sup>	-40 ... 105	°C
Rel. humidity <sup>1</sup>	0 ... 100	% r.H. (non-condensing)
<b>Compatible liquids</b>	mineral oils (H, HL, HLP, HLPD, HVLP) synthetic esters (HETG, HEPG, HEES, HEPR), polyalkyleneglycols (PAG) zinc and ash-free oils (ZAF) polyalphaolefins (PAO)	
<b>Wetted Materials</b>	aluminum, HNBR, polyurethane resin, epoxy resin, chemical nickel / gold (ENIG) soldering tin (Sn60Pb40, Sn96,5Ag3Cu0,5NiGe), aluminum oxide, glass (DuPont QQ550)	
<b>Protection class <sup>2</sup></b>	IP67	
<b>Power supply <sup>3</sup></b>	9 ...33	V
<b>Current consumption</b>	max. 60	mA
<b>Output</b>		
Current output (2x) <sup>4</sup>	4...20	mA
Accuracy current output <sup>5</sup>	±2	%
Interfaces	RS232	-
<b>Connecting dimensions</b>		
Threaded connection	G $\frac{3}{4}$	inch
Tightening torque connection thread	45 ±4,5	Nm
Electrical connection	M12x1, 8-pole	-
Tightening torque M12 connector	0,1	Nm
<b>Measuring range</b>		
Rel. humidity	0...100	% r.H.
Temperature	-20...120	°C
<b>Measuring resolution</b>		
Rel. humidity	1	% r.H.
Temperature	0,1	K
<b>Measuring accuracy <sup>6</sup></b>		
Rel. humidity (10...90 %) <sup>7</sup>	±3	% r.H.
Rel. humidity (<10 %, >90 %) <sup>7</sup>	±5	% r.H.
Temperature	±2	K
<b>Response time (T90 <sup>8</sup>) humidity measurement</b>	<1 (air) <5 (oil)	min
<b>Weight</b>	115	g

<sup>1</sup> Outside the specified measuring range, there are possibly no plausible measuring values to be expected

<sup>2</sup> With screwed on connector

<sup>3</sup> Automatic switch off at U <8 V and U >36 V, with load-dump impulses over 50V an external protection must be provided

<sup>4</sup> Outputs IOut1 and IOut2 are freely configurable (see interfaces and communication commands)

<sup>5</sup> In relation to the analogue current signal (4 ... 20 mA)

<sup>6</sup> Works calibration

<sup>7</sup> Calibrated to air at room temperature

<sup>8</sup> Time required for a sensor to reach 90% of the final value at the output in the event of an abrupt change

#### 3.2 Dimensions

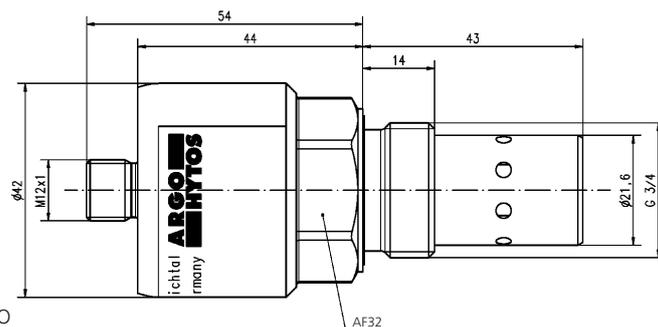


Figure 1: Dimension drawing LubCos H<sub>2</sub>O

## 4. Mounting

The sensor is designed as a screw-in sensor with a  $\frac{3}{4}$ " thread. Ideally, the sensor is installed in hydraulic circuits in the tank or in the return line. With gear units with forced flushing, the sensor can also be arranged in the purge line. In general, when placing the sensor, the maximum allowable pressures and temperatures are to be considered (see Chapter 3).

Screw the sensor into a prepared position in the tank or in the return line. For installation in the return line also the return line adapter (order no. SCSO 100-5070) can be used. The sealing to the oil side is provided by a profile sealing ring. In order to ensure a proper sealing, the sealing surface for inserting the sensor should be specially prepared and the maximum roughness should be  $R_{\max} = 16$ . The tightening torque of the sensor is  $45 \text{ Nm} \pm 4.5 \text{ Nm}$ .

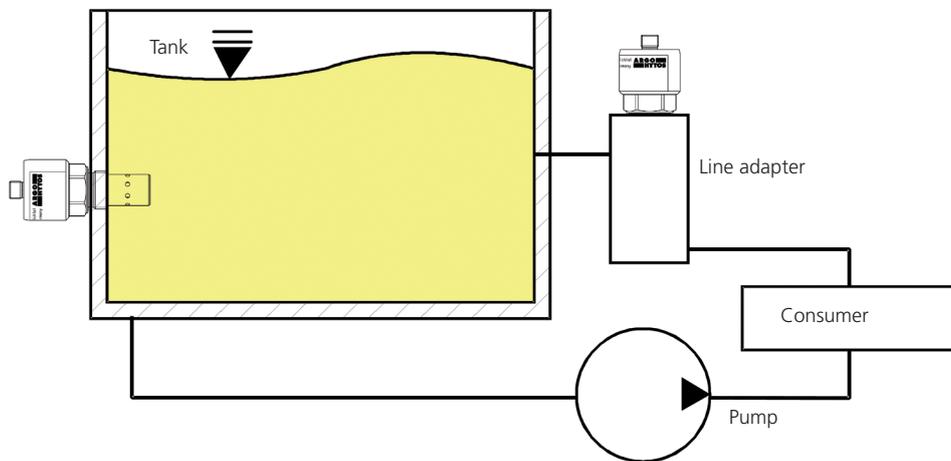


Figure 2: Mounting of a sensor in an oil tank or a line adapter

To ensure proper operation, please respect the following guidelines and the mounting position and location of the sensor:

- › Generally, the measurement should be carried out at a location which is characteristic for the system to be monitored.
- › The sensor should be installed at a location at which the medium is sufficiently mixed.
- › Ideally, with tank mounting, the sensor should be placed in the vicinity of the return or flushing line.
- › Ensure that the sensor is completely covered with oil in all operating conditions of the system. Especially note the pendulum volume of the tank and a possible inclined position. Foaming in the tank should be avoided.
- › When installed in the return line or flushing line, it must be ensured that the flushing line is not running empty in any operating situation.
- › To avoid thermal influences as far as possible, the sensor should not be installed in the immediate vicinity of hot parts and components (e.g. motor).
- › When the oil is insufficiently mixed in the tank, free water may deposit at the bottom. The sensor at position 1 would therefore not detect the free water. In this special case, mounting position 2 is recommended.

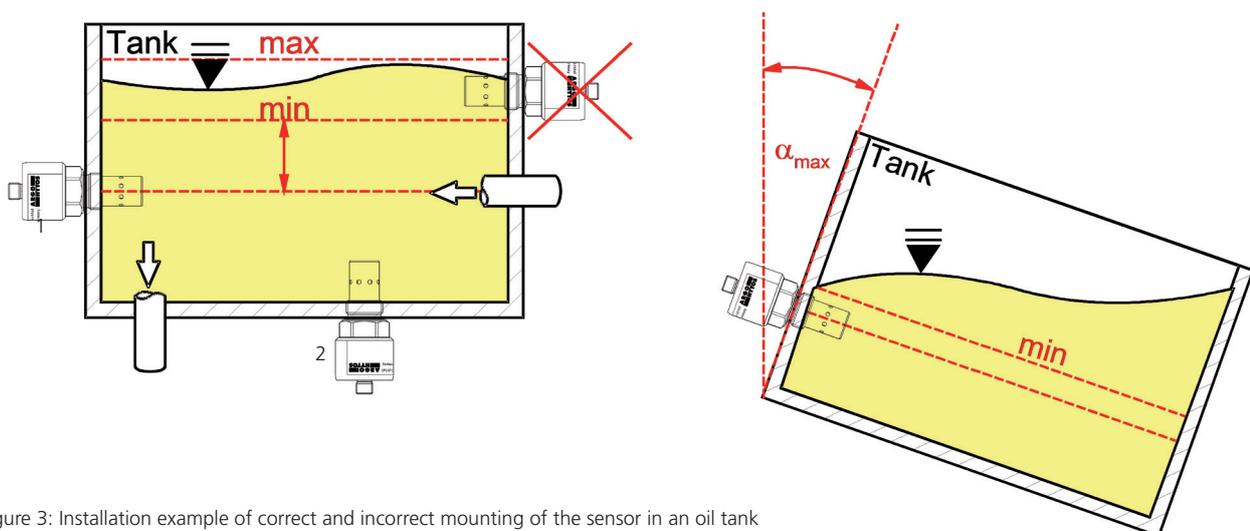


Figure 3: Installation example of correct and incorrect mounting of the sensor in an oil tank

## 5. Electrical connection

The device must be installed by a qualified electrician. Follow the national and international regulations for the installation of electrical equipment.

Voltage supply according to EN 50178, SELV, PELV, VDE 0100-410 / A1.

For installation, disconnect the device from the power and connect the device as follows:

### 5.1 Pin assignment

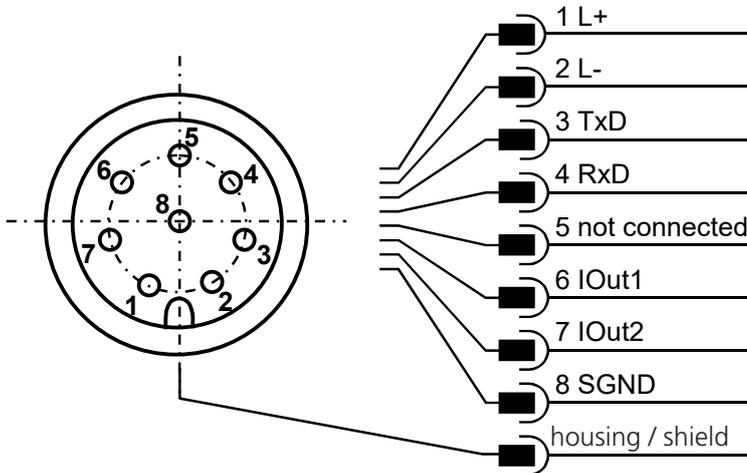


Figure 4: Pin assignment with plan view of the sensor cover

The permissible operating voltage is between 9V and 33V DC. The sensor cable is to be shielded. Potential difference between SGND, L- and housing/shield signals may lead to device failure.

In order to achieve the protection class IP67, only suitable plugs and cables may be used. The tightening torque for the plug is 0.1 Nm.

### 5.2 Analog current outputs (4..20 mA) - measurement without load resistance

The current measurement should be carried out with a suitable ammeter according to the next figure.

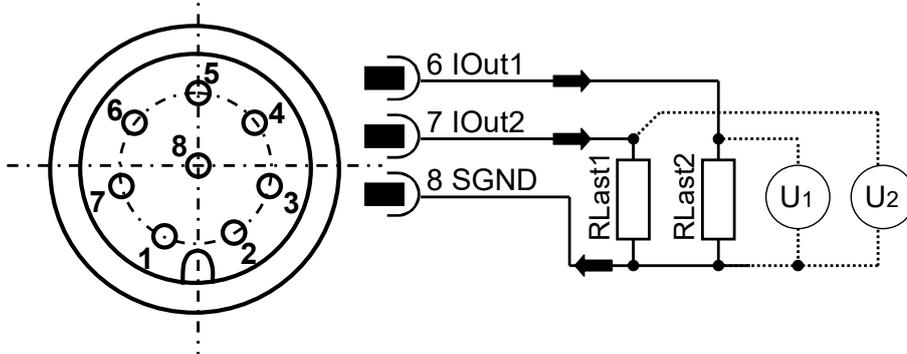


Figure 5: Measurement of the analog outputs 4..20 mA without load resistance

The assignment of the measured current value to the parameter (temperature and humidity) can be found in Chapter 5.3.2.

### 5.3 Analog current outputs (4..20 mA) - measurement with load resistance

In order to measure the currents of both analog current outputs, a load resistance must be connected to each output as shown in Figure 6. The load resistance should be, depending on the supply voltage, between 25 Ohm and 200 Ohm. With the use of a voltmeter, the voltage at each resistor can now be measured.

Top view sensor cover

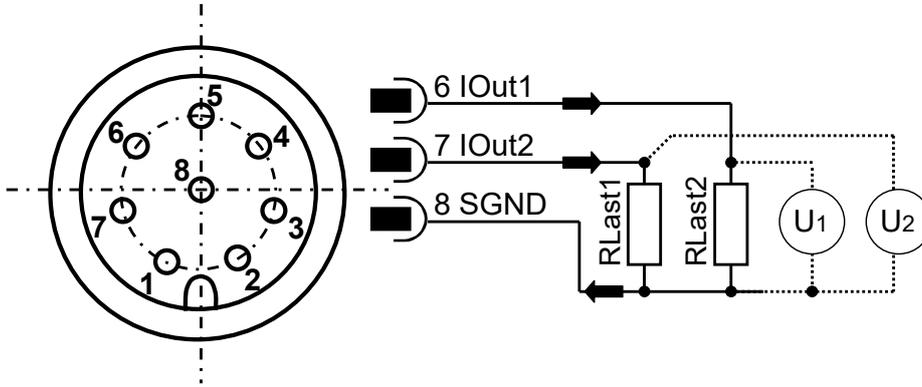


Figure 6: Connection of the load resistances for measuring the analog 4..20 mA outputs

In order to determine the corresponding parameters (temperature, humidity, etc.) from the present voltages, the voltages with the formulas from Table 2 must be converted accordingly.

The default configuration provides the oil temperature on channel 1 and the relative humidity on channel 2. A change in the channel assignment is possible and is described in Chapter 7.1.

#### 5.3.1 Load resistance

The load resistance cannot be chosen arbitrarily. It must be adjusted according to the supply voltage of the sensor. The maximum load resistance can be calculated with the formula (5 -1). In Table 1, the load resistances for different voltages are listed.

$$R_{max} / \Omega = U_{supply} / V \cdot 25 (\Omega / V) - 200 \Omega \quad (5-1)$$

$R_{max}$ in $\Omega$	$U_{supply}$ in V
25	9
100	12
200	16
400	24
625	33

Table 1: Determination of the load resistance as a function of the supply voltage

### 5.3.2 Calibration

Output size	Equation	Formula
T in °C	$T / ^\circ\text{C} = \frac{U/V}{R/\Omega} \cdot 8750 (^\circ\text{C} / \text{A}) - 55^\circ\text{C}$	(5-2)
RH in %	$\text{RH} / \% = \frac{U/V}{R/\Omega} \cdot 6250 (\% / \text{A}) - 25 \%$	(5-3)
AH in ppm	$\text{RH} / \% = \frac{U/V}{R/\Omega} \cdot \frac{\text{AHScal} / \text{ppm}}{16 \cdot 10^{-3} \text{A}} \cdot \frac{\text{AHScal} / \text{ppm}}{4}$	(5-4)

Table 2: Calculation of the output parameters of the analog current outputs

By default, the temperature is displayed at the current outputs in a range between -20 °C and 120 °C and the relative humidity between 0 and 100 %. These limits are fixed and cannot be changed. The upper limit for the absolute humidity (AHScal) is necessary for the scaling of the analog current outputs. This limit can be freely adjusted (see Table 3). The threshold value however is oil-specific and must be determined in the laboratory together with the other parameters that are necessary for the measurement of the absolute humidity. For more information, please contact the ARGO-HYTOS service team. The scaling of the current output is linear.

Iout in mA	4	12	20
T in °C	-20	50	120
RH in %	0	50	100
AH in ppm	0	0,5*AHScal	AHScal

Table 3: Scaling of the analog current outputs

### 6.1 Serial interface (RS232)

The sensor LubCos H<sub>2</sub>O is provided with a serial interface, via which it can be read and configured. For this purpose, a PC and an appropriate terminal program or a readout software is required. Both are described in more detail in the following chapters.

First, you need to select an existing, free COM port at you computer to which you connect your sensor.

An appropriate communication cable for the serial connection between sensor and computer / controller is available under order no. SCSO 100-5020 or SCSO 100-5030.

In case the computer should not be provided with a standard COM port, it is possible to use serial interface cards or USB-to-serial converters.

#### 6.1.1 Interface parameters

- › Baud rate: 9600
- › Data bits: 8
- › Parity: none
- › Stop bits: 1
- › Flow control: none

### 6.2 Command list

Below, all interface commands for communication with the sensor are listed. These can be transferred to the sensor by using a serial terminal program.

#### 6.2.1 Read commands

#	Instruction format	Meaning	Return format
1	RVal[CR]	Reading all measurements with subsequent checksum (CRC)	\$RH:xx[%];AH:xxx[pp]; T:xx.x[C]; ...;CRC:x[CR][LF]
2	RID[CR]	Reading the identification and subsequent checksum (CRC)	\$ARGO-HYTOS;LubCosH2O; SN:xxxxxx; ...;CRC:x[CR][LF]
3	RCon[CR]	Reading the configuration parameters with subsequent checksum (CRC)	\$AO1:x;AO2:x;AHScal:xxx; CRC:x[CR][LF]

Table 4: Serial communication: read commands

#### 6.2.2 Write commands

#	Instruction format	Meaning	Return format
1	WAHScalxxxx[CR]	Sets the limit of the absolute humidity. This value is critical for scaling with output via the 4..20 mA interface.	AHScal:xxxx[CR][LF]
2	SAO1x[CR]	Assignment of the first current output with a corresponding measured value. Standard: Temperature (see Chapter 7)	AO1:x[CR][LF]
3	SAO2x[CR]	Assignment of the second current output with a corresponding measured value. Standard: Relative humidity (see Chapter 7)	AO2:x[CR][LF]
4	CTime[CR]	Deletes the operating hours counter	OK[CR][LF]

Table 5: Serial communication - write commands

Note:

[CR] = [Carriage Return (0xD)]      [LF] = [Linefeed (0xA)]

### 6.2.3 CRC calculation

Each character sent in the string (incl. Line Feed and Carriage Return) must be added up, based on a range of 8 bits (0→255). If the result is zero, there is no error. When calculating the checksum, pay attention to using the correct code page (ASCII).

**Example of a sent string: RH:31[%];CRC:Ú[CR][LF]**

Character	Value
R	82
H	72
:	58
3	51
1	49
[	91
%	37
]	93
;	59
C	67
R	82
C	67
:	58
Ú	217
[CR]	13
[LF]	10
Sum	0→OK

Table 6: Example of a checksum calculation (CRC)

### **6.3 Terminal program**

If the sensor is connected to a computer and is powered, communication with the sensor is possible using any program that supports serial communication. Various serial terminal programs are available on the Internet. The communication configuration should be in accordance with section 6.1.1.

Communication with the sensor can also be integrated into programs created in most programming languages using standard libraries. The sensor response is based on ASCII table characters, so appropriate encoding or conversion must be used to interpret the data correctly.

### **6.4 TCP / IP connection**

The Hyper Terminal alternatively offers the possibility to establish a TCP / IP connection. If sensors are remotely interrogated via this protocol, the conversion of the RS232 signal, using an Ethernet Gateway, is required. Matching gateways can be requested at ARGO-HYTOS.

### **6.5 Software**

ARGO-HYTOS offers various programs (drivers, LabVIEW tools and utilities) for the field of sensor technology. These can be downloaded from [www.argo-hytos.com](http://www.argo-hytos.com).

### 7.1 Setting the analog current outputs

The two analog current outputs are factory-set. On channel 1 the temperature and on channel 2 the relative humidity is issued. However, the sensor makes it possible to change the default output parameters. The command for this is: "SAO1x[CR]" and "SOA2x[CR]" with the corresponding numerical code x.

Numerical code x	Parameter
0	Temperature (T)
1	Relative humidity (RH)
2	Absolute humidity (AH)
100	Output fixed at 4 mA
101	Output fixed at 12 mA
102	Output fixed at 20 mA

Table 7: Numerical code for the output parameters of the analog current outputs

To check whether the sensor is working properly.

### 8.1 Function test using a PC

Connect the sensor via the serial interface (RS232) with a PC and start serial terminal program (see Chapter 6.3)

Now have the sensor connected to the power supply by an electrically trained specialist. With correct connection and parameterization of the serial interface, the identification of the device will appear on the input window of the terminal program.

When receiving a Carriage Return, the sensor must furthermore send a "?" in response, this is equivalent to pressing the Enter key or sending the value 0xD.

Alternatively, you can use Argo-Hytos software (such as LubMon PClight) available on the website.

### 8.2 Function test via the analog current outputs

Have the sensor connected to the power supply by an electrically trained specialist.

Now check the analog current outputs (see Chapter 5).

The current value should not be under  $4 \text{ mA} \pm 0,2 \text{ mA}$  and not over  $20 \text{ mA} \pm 0,2 \text{ mA}$ . The relation between supply voltage and load resistance must be observed (see Chapter 5.3.1).

<b>Error: No serial communication - and analog current outputs &lt; 4mA</b>	
<b>Reason</b>	<b>Measure</b>
› Cable is not properly connected	› First, please check the correct electrical connection of the sensor or the data and power cable. Please be aware of the prescribed connection assignment.
› Operating voltage is outside the prescribed range	› Please operate the sensor in the range between 9 V und 33 V DC.
<b>Error: No serial communication</b>	
<b>Reason</b>	<b>Measure</b>
› Interface configuration is faulty	› Check and possibly correct the settings of the interface parameters (9600, 8,1, N, N). Test the communication using a terminal program, if necessary by using an interface tester.
› Wrong communication port selected	› Check and correct the choice of the communication port (e.g. COM1)
› Incorrect spelling of sensor commands	› Check the spelling of the sensor commands. Note in particular the capitalization and lowercase
› NumLock key is not activated	› Activate the NumLock key
› Caps lock is engaged (capitalization)	› Deactivate the capitalization
› Cable wrong or defective	› If possible, use ARGO-HYTOS data cables
<b>Error: Incorrect measurement of the absolute humidity</b>	
<b>Reason</b>	<b>Measure</b>
› Calibration parameter is set incorrectly	› The calibration parameters are oil-specific and must be programmed. Contact the ARGO-HYTOS service team.
› Measuring range is set incorrectly	› The measuring range is oil-specific and must be programmed. Contact the ARGO-HYTOS service team.
<b>Error: Incorrect measurement of the analog current outputs</b>	
<b>Reason</b>	<b>Measure</b>
› A wrong parameter is output	› Correct the assignment of the measured values to the current outputs.

Table 8: Reasons for errors and countermeasures

## 10. Accessories

Description	Order No.
<b>Angle block for pipe installation - adapter</b> <ul style="list-style-type: none"> <li>› Sensor adapter block for pipe installation</li> <li>› Line connectors ¾"</li> <li>› Material: Aluminum</li> </ul>	SCSO 100-5070
<b>Universal power supply</b> <ul style="list-style-type: none"> <li>› Input range: 100...240VAC 50/60Hz</li> <li>› Output voltage: 24VDC / max. 0,63A / 15W</li> <li>› Temperature range in operation: 0...40°C</li> <li>› Compatible with data cable SCSO 100-5030</li> <li>› Supply line: Euro power cord 2-pole, 1.5m</li> </ul>	SCSO 100-5080
<b>Sensor connector</b> <ul style="list-style-type: none"> <li>› M12 8-pole, straight, IP67</li> <li>› Suitable for cable diameter 6...8 mm</li> <li>› Temperature range -20°C ... 85°C</li> </ul>	SCSO 100-5010
<b>Data cable with open ends</b> <ul style="list-style-type: none"> <li>› Side 1: M12 8-pole, 90° angled, IP67</li> <li>› Side 2: open</li> <li>› Length: 5m, shielded</li> <li>› Temperature range -25°C...90°C</li> <li>› Oil-resistant</li> </ul>	SCSO 100-5020
<b>Data cable for computer connection</b> <ul style="list-style-type: none"> <li>› Side 1: M12 8-pole, 90° angled, IP67</li> <li>› Side 2: D-Sub connector 9-pole with separate DC Plug for power supply</li> <li>› Length: 5m, shielded</li> <li>› Temperature range -25°C...90°C</li> <li>› Oil-resistant</li> </ul>	SCSO 100-5030
<b>Adapter USB - RS232 serial</b> <ul style="list-style-type: none"> <li>› Side 1 (PC): USB A plug</li> <li>› Side 2 (periphery): D-Sub connector 9-pole</li> <li>› Length: 1.8m</li> </ul>	PPCO 100-5420

Table 9: Accessories

## 11. Contact address

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**ARGO-HYTOS Polska sp. z o.o.**  
**Grabskiego 27**  
**32-640 Zator**  
**Poland**

**Phone: +48 33 873 16 52**  
**Email: [info.pl@argo-hytos.com](mailto:info.pl@argo-hytos.com)**

International

## ARGO-HYTOS worldwide

<b>Benelux</b>	ARGO-HYTOS B.V.	info.benelux@argo-hytos.com
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<b>China</b>	ARGO-HYTOS Fluid Power Systems	info.cn@argo-hytos.com
<b>Czech Republic</b>	ARGO-HYTOS s.r.o	info.cz@argo-hytos.com
	ARGO-HYTOS Protech s.r.o	info.protech@argo-hytos.com
<b>France</b>	ARGO-HYTOS SAS	info.fr@argo-hytos.com
<b>Germany</b>	ARGO-HYTOS GMBH	info.de@argo-hytos.com
<b>Great Britain</b>	ARGO-HYTOS Ltd.	info.uk@argo-hytos.com
<b>Hong Kong</b>	ARGO-HYTOS Hong Kong Ltd.	info.hk@argo-hytos.com
<b>India</b>	ARGO-HYTOS PVT. LTD.	info.in@argo-hytos.com
<b>Italy</b>	ARGO-HYTOS S.r.l.	info.it@argo-hytos.com
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