Manual OPCom II

V1.06.13

Read the safety instructions and operating instructions prior to commissioning!

Note: Illustrations do not always precisely correspond to the original. No legal claim can be derived due to incorrect information. Product design is subject to change without notice.

For any questions please contact:

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The device complies with CE requirements

ARGO-HYTOS GmbH (AHDE) warrants that this device is free from material and manufacturing defects for a period of two years from the date of delivery. If a defect should emerge on the device during this period, AHDE will either repair the device free of charge or provide an equivalent replacement for the defective product, at its discretion.

In order to be able to utilize customer service in the framework of this warranty, customers must inform their local AHDE customer service centers of any defects prior to the expiry of the warranty period and submit the defective device for inspection. Costs associated with packing and transport to the customer service center are to be borne by the customer, and the shipment must be prepaid freight. AHDE assumes the cost for returning the device to the customer, as long as the delivery location is in the same country as the customer service center.

This warranty does not cover defects or damages caused by improper use, improper servicing or improper maintenance. This warranty does not cover damages as a result of attempted repairs by technicians other than those authorized and trained by the plant to install, repair or maintain these devices, or damages as a result of improper use or connection of unsuitable accessories, or cases where devices have been reconfigured or integrated into other products in such a way that customer service work on the device would entail an unreasonable expenditure in terms of time or difficulty.

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DAMAGES, EVEN IN THE EVENT THAT THEY HAVE ANNOUNCED THE POSSIBILITY OF SUCH DAMAGES IN ADVANCE.

Safety

This manual makes use of warning symbols and caution symbols, which appear prior to the procedure or step to which they pertain. Please be especially careful when performing procedures preceded by or including such a symbol. A triangle with an exclamation mark refers to a generalized risk, whereas a triangle with a lightning bolt refers to an electrical hazard.

WARNING

A warning refers to potential health risks. Such symbols refer to the need to exercise caution; failure to perform procedures properly or to take these warnings into account may lead to injuries or fatalities. When you see a warning, do not continue before you completely understand the risks, and have established the conditions required to proceed safely.

Caution

A CAUTION symbol indicates a risk of damage to OPCom II. This symbol refers to the need to exercise caution; failure to adhere to proper procedures may lead to damages on the monitor. When you see a warning, do not continue before you completely understand the risks.

Note

A note refers to an important operating procedure or other important information which has no bearing on the safety of people or equipment.

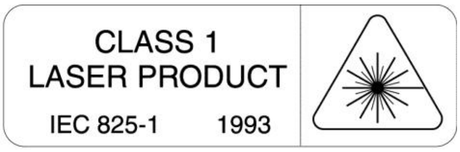
Laser safety information

Never remove the coverings. The device uses a laser with the potential to harm users.

OPCom II contains a laser sensor classified as a Class 1 product during normal use (pursuant to 21 CFR, subchapter J of the Health and Safety Act of 1968). This manual does not contain any service information regarding installed parts. Service should only be performed by trained service personnel.

OPCom II has been evaluated and tested in accordance with EN61010-1:1993, "Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use," IEC 825-1:1993, "Safety of Laser Products," and other relevant industry norms (e.g. ISO 4406, ISO 6149-2).

A sticker indicating the laser class pursuant to 21CFR has been applied to the device. A copy of this sticker can be seen in Image 1 below.



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1. Quick start

The steps that must be executed for commissioning the particle monitor **OPCOM II** are described below. The following components are necessary for this:

1. PC/laptop with RS232 connection, or alternatively a USB connection, that serves as the measurement computer.
2. Particle monitor **OPCOM II** (order number: SPCO 300-1000)
3. Sensor cable to RS232 (order number: SCSO 100-5030)
4. Power supply unit incl. rubber connector (order no. SCSO 100-5080)
5. Software LubMon**PC**$_{light}$ (www.argo-hytos.com)
6. In addition for connection via USB: USB to RS232 converter with associated driver software (order no: SCSO 100-5040)

The **LubMonPC**$_{light}$ software can be downloaded from the web site **www.argo-hytos.com**.

The components must be prepared as follows:

A) Software installation LubMonPC$_{light}$

1. Unpack the **LubMonPClight.zip** file on your computer.
2. Prior to starting **LubMonPClight.exe** installation of the LabVIEW Runtime Engine (V8.5) is required. This engine can also be downloaded from the download area of ARGO-HYTOS (www.argo-hytos.com).

B) Software installation of the driver for the USB to RS232 converter for data acquisition via USB (if you are not using a converter please continue with point D)

3. Now connect your USB to RS232 converter to your PC/laptop.
4. If the USB to RS232 converter is not known to the PC, the appropriate driver must be installed. To do this follow the installation instructions provided by the operating system or on the supplied driver CD.

C) **Sensor connection for data acquisition via USB**

5. Connect the sensor cable to the sensor with the M12 connector.
6. Connect the 9-pin D-sub connector of the cable to the appropriate serial interface of the USB to RS232 converter.
7. Connect the power supply unit and the sensor cable.
8. Now properly connect your power supply unit to the line voltage via the rubber connector. Your sensor is now ready for operation.

D) Sensor connection for data acquisition via RS232

9. Connect the sensor cable to the sensor with the M12 connector.
10. Connect the 9-pin D-sub connector of the cable to the appropriate serial interface of your PC/laptop.
11. Connect the power supply unit and the sensor cable.
12. Now properly connect your power supply unit to the line voltage via the rubber connector. Your sensor is now ready for operation.

E) Start the software

13. LubMon**PC***light* can be started by double clicking on the **LubMonPClight.exe** file.
14. Select the serial interface (COM) to which you have connected the sensor on the computer. If you are not using a USB to RS232 converter, this is usually COM 1.
15. If you are using a USB to RS232 converter a new virtual COM port will be created. Select this COM port. If necessary you can check the allocation of the virtual COM port in the Windows Device Manager.
16. The incoming data as well as the identification of the sensor are displayed on the left side of the window. The data can be visualized on the right side of the window in a diagram.

2. Technical description

2.1. Measurement principles

OPCom II is an optical particle monitor whose functionality is based on the light extinction principle (see Figure 2.1)

It consists of a measurement cell (A), a laser (B) and a photo diode (C). The laser beams through the measurement cell to the opposite photo diode. If a particle passes through the laser beam, the light intensity detected by the photo diode is reduced. The reduction in intensity corresponds to the sice of the particle.

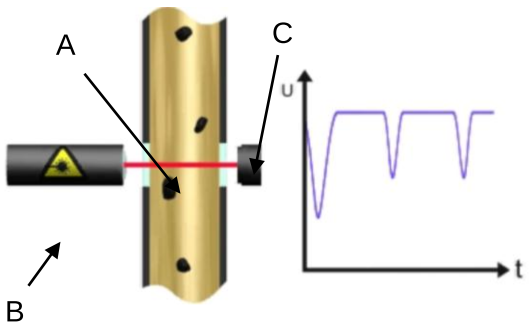

Figure 2.1: Design and measurement principle of the particle monitor

OPCom II lets users monitor the contamination level and the purity trend of fluids. Differences in absolute precision may arise compared to particle counters calibrated according to ISO 11171:99. However, the deviation is less than a scale number. Changes are shown with great precision.

Continuous monitoring of purity allows changes in the machine to be detected very quickly. Prompt warning allows measures to be taken before the contamination increases to the point of damaging the entire system.

2.2. Calibration

The instrument is calibrated following procedures described in ISO 11943.

The equipment used in the calibration is primary calibrated in accordance with ISO 11171 and therefore traceable to NIST SRM 2806A.

Note:

The symbol µm (c) indicates particle size calibration using ISOMTD test dust.

2.3. Technical data

Sensor data		Size	Unit
Max. operating pressure		420 (dynamic) 600 (static)	bar bar
Operating temperature range fluid		-10 ... 60	°C
Operating temperature range environment		-10 ... 60	°C
Storage temperature range		-20 ... 80	°C
Ambient humidity		0 … 95 (noncondensing)	% r.H.
Resistance hydraulic fluid		Mineral and ester liquids, polyalphaolefins, diesel fuel	
Moistened, sealing materials		Stainless steel, sapphire, chrom, NBR	
Power supply		9 … 33	VDC
Max. power consumption		2	W
Outputs:	Current output Interfaces Alarm contact	4 ... 20 RS232, CANopen Open collector	mA - -
Connecting dimension:	Fluid Electrical	¼“, Minimess 16x1,5 M12x1 (8-pole)	
Permissible flow		50 … 400	ml/min
Measurement range according to ISO 4406:99 Degree of purity (measurement range) Degree of purity (calibrated range) Accuracy of measurement		 0 … 24 10…22 ± 1	 Scale number Scale number Scale number

Table 2.1: Technical data

2.4. Dimensional drawing

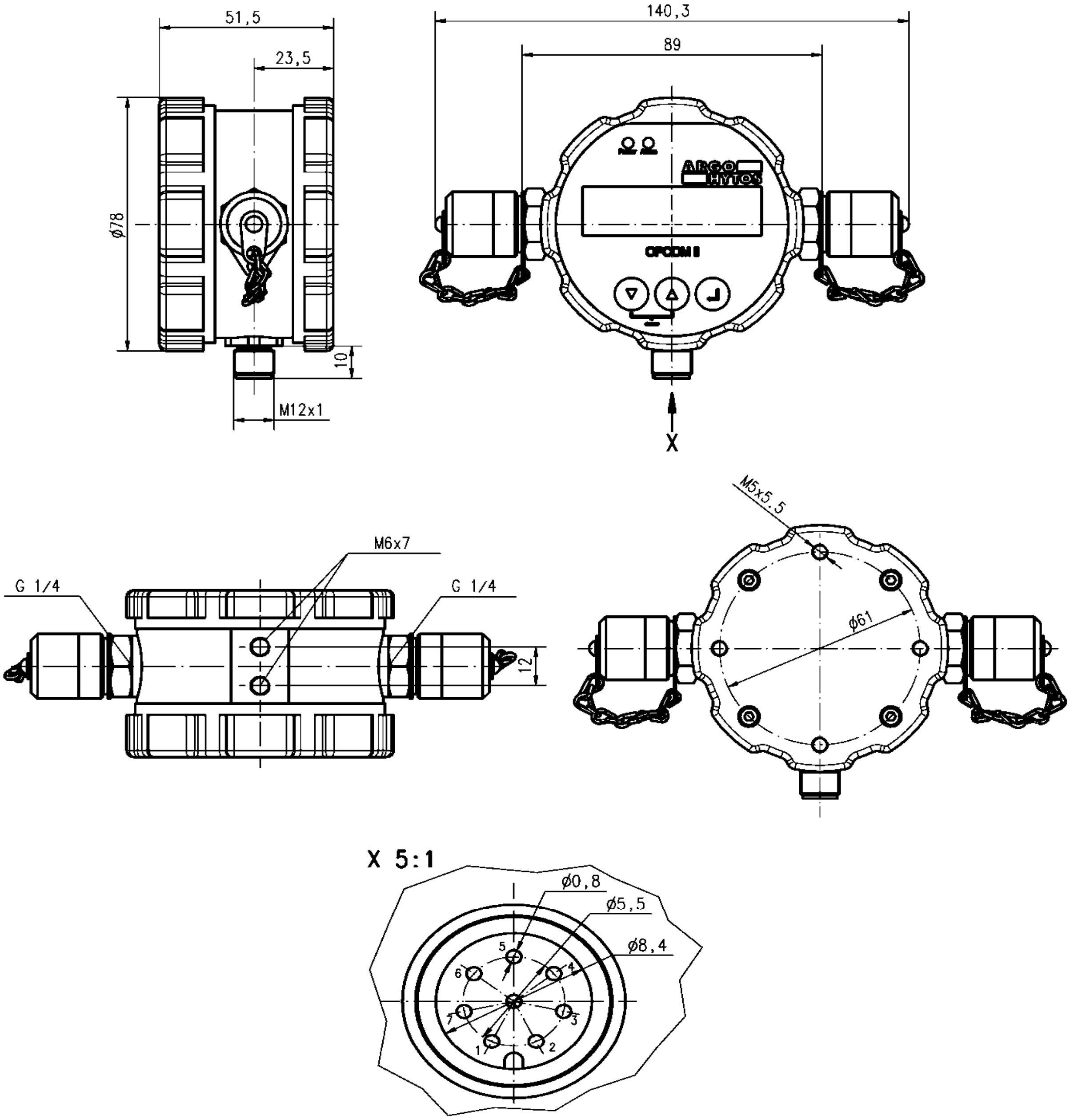

Figure 2.2: Dimensional drawing OPCOM II

3. Installation

3.1. Installation location

OPCom II should be connected to a pressure line using a T-junction in a bypass flow. The sensor has two ¼”ports and is equipped with two Minimess test ports at the factory. The system pressure needs to provide the required flow between 50 and 400 ml/min. Please use short lines to connect the OPCom II to minimize the risk that large particles deposit in the measurement line. The flow direction can be chosen freely.

3.2. Boundary conditions

The device should be installed at a relevant measurement location in the hydraulic circuit where constant pressure conditions predominate. The pressure may vary, but it may not exhibit any peaks or strong fluctuations during the measurement.

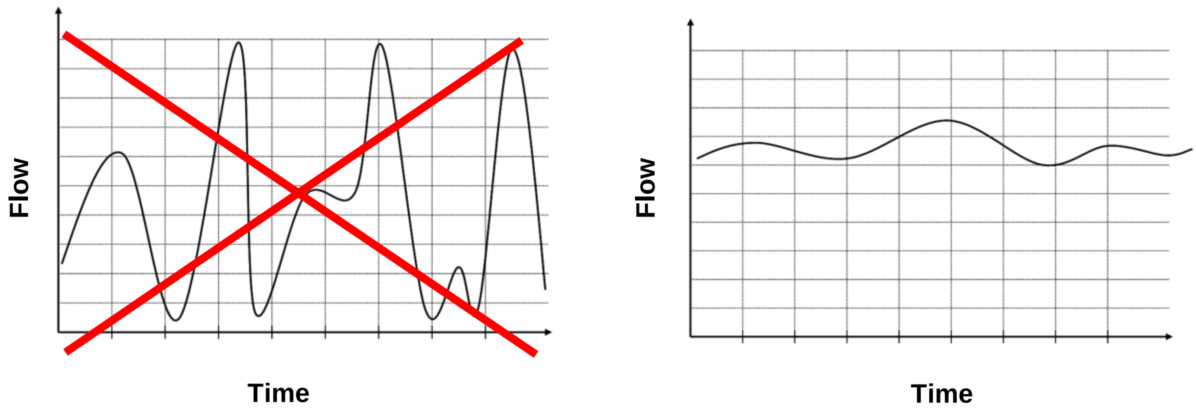

Figure 3.1: Boundary condition flow rate

For an accurate measurement please ensure that a constant volume flow between 50 and 400 ml/min is present. Figure 3.2: illustrates the pressure difference for different viscosities as a function of volume flow. The required pressure can be estimated with reference to the required volume flow.

Flow regulation or pressure reduction should always be performed after (downstream of) the particle monitor, since control devices generate particles (or air bubbles) that may influence the measurement results. If a pump is needed to generate a flow, its design should limit pulsation as much as possible, and the OPCom II has to be in the pressure line, since negative pressure on the suction side can lead to air bubbles.

As mentioned above, the particle recognition procedure is optically. Anything that differs visually from the oil will be detected. In addition to solid particles, this includes bubbles and droplets. Therefore it must be ensured that the fluid is free of bubbles and droplets at all time. A typical sign that the oil contains bubbles and droplets is a very high scale number and in some cases matching scale numbers in different size channels.

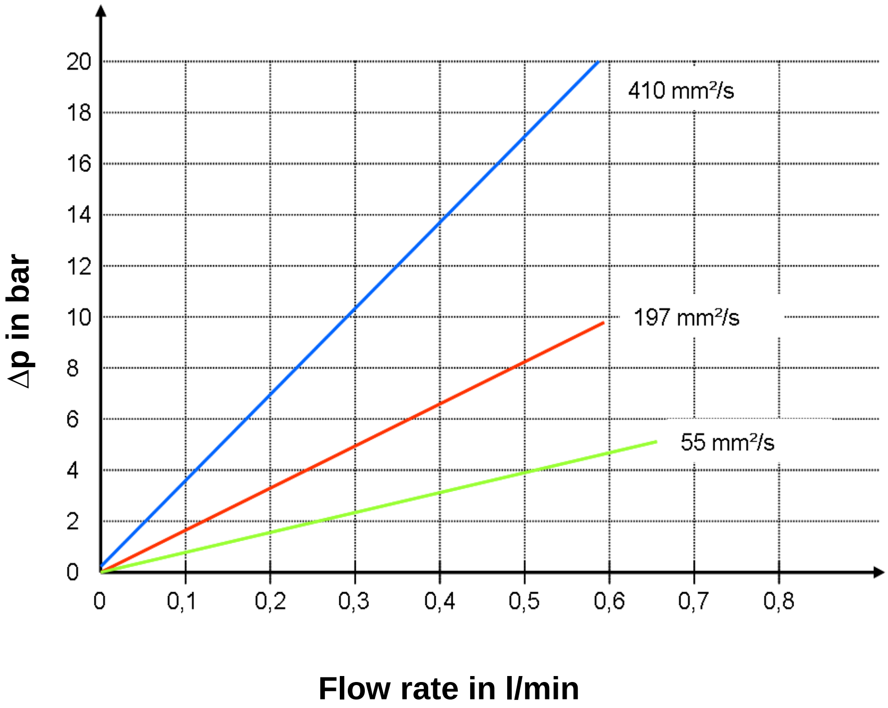

Figure 3.2: Δp-Q characteristics for varying viscosities

4. Electrical connection

Only a qualified electrician should install the device. Comply with national and international guidelines for setting up electrical equipment.

Power supply in accordance with EN50178, SELV, PELV, VDE0100-410/A1.

De-energize the system for the installation and connect the device as follows:

4.1. Pin assignment

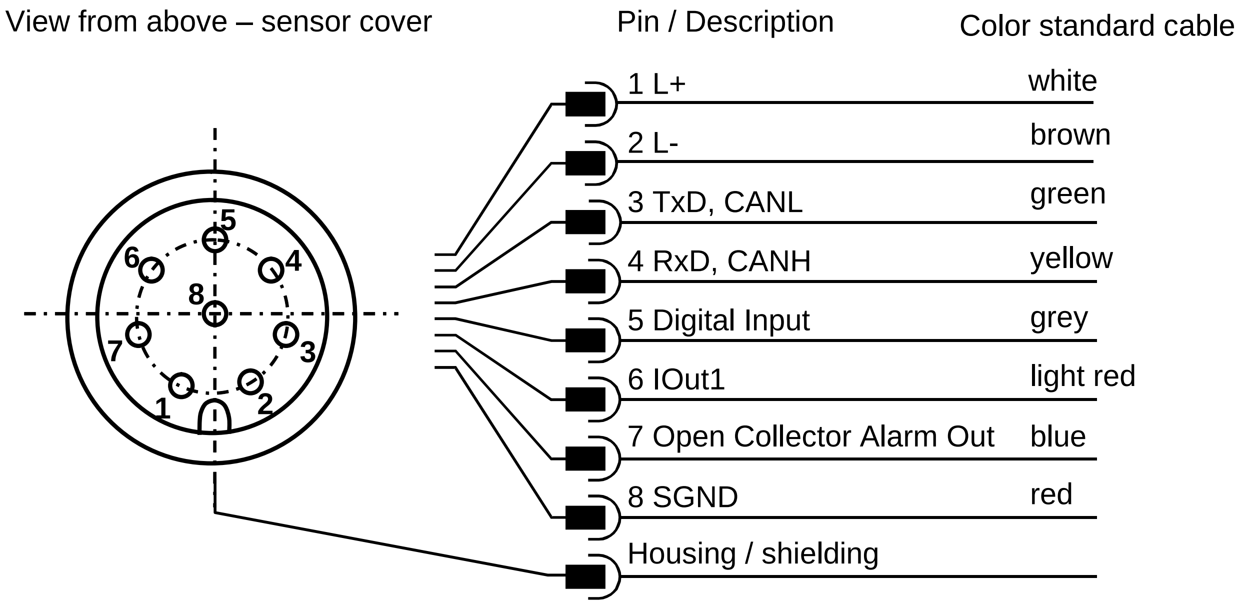

Figure 4.1: Pin assignment of the connector

The sensor cable must be shielded. To achieve IP67 degree of protection, only use suitable connectors and cable. The tightening torque for the connector is 0.1 Nm.

4.2. Analogue current output (4...20 mA) – Measurement without load resistor

Current should be measured with a suitable current measurement device, in accordance with Figure 4.2.

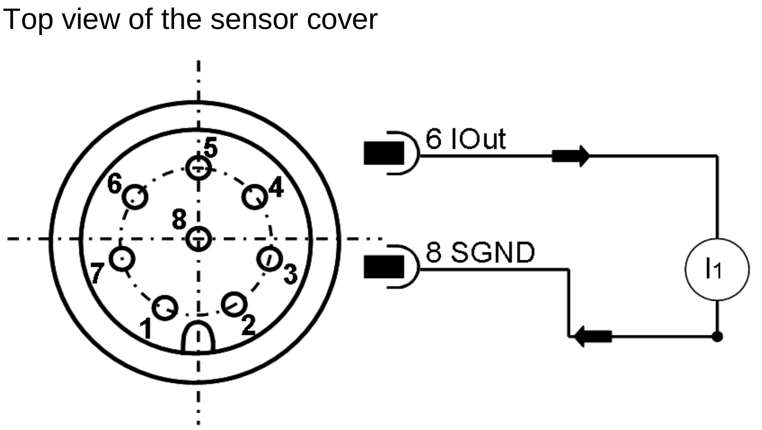

Figure 4.2: Measuring the analog 4..20 mA outputs without load resistor

The scale number can be calculated from the current I1 and the formula *(4-2)*

4.3. Analog current output (4...20 mA) – Measurement with load resistor

In order to measure the currents of the analog current output, a load resistor must be connected to the output as shown in Figure 4.3. The load resistance is defined in section 4.4. Use a voltmeter to measure the voltage that drops out via the resistor.

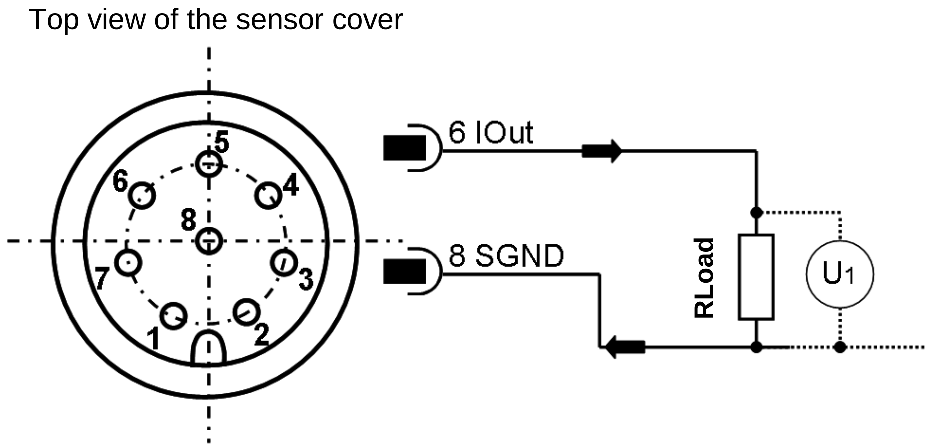

Figure 4.3: Connection of the load resistor for measuring the analogue 4..20 mA output

The scale number can be calculated from the voltage U1 and the formula *(4-2)*

4.4. Load resistor

The load resistor cannot be selected as desired. It must be adapted according to the supply voltage of the sensor. The maximum load resistance can be calculated with the formula *(4-1)*. Alternatively, Table 4.1 is available.

Output quantity	Size equation	Formula
Load resistor	$R_{Max} = \frac{U - 2V}{20mA} - 100\Omega$	*(4-1)*

R_{max} in Ω	U_{Supply} in Volt
250	9
400	12
1000	24

Table 4.1: Determination of the load resistance as a function of supply voltage

4.5. Analog output calibration (reference value for current output)

Output quantity	Size equation	Formula
Scale number / purity class	$OZ = \frac{26}{16mA} \cdot I / mA - \frac{26}{4}$	*(4-2)*

Pursuant to ISO 4406:99, the current range covers scale numbers from 0 to 26. A current value of 4 mA would correspond to a scale number of 0, whereas 20 mA would correspond to a scale number of 26.

Scale number	0	13	26
Iout in mA	4	12	20

Table 4.3: Calibrating current outputs

4.6. Sequential data output

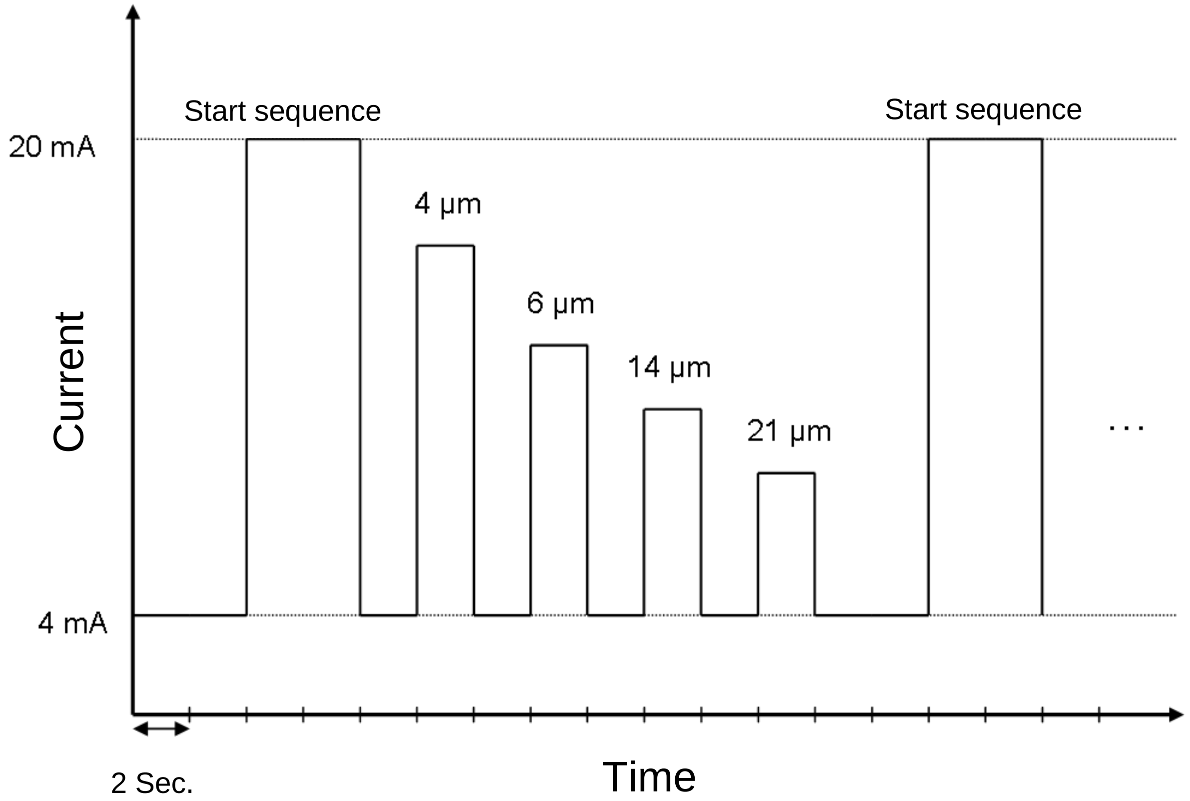

Figure 4.4: Output sequence of all parameters sequentially

4.7. Digital output

The digital output is not short-circuit proof, has no overvoltage protection, no current limitation and no overvoltage protection. The maximum voltage is 36 VDC.

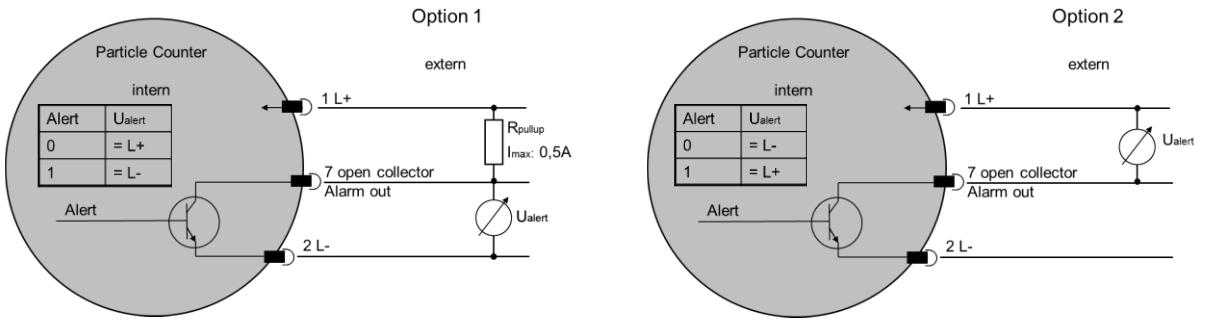

Figure 4.5: Digital output

5. Menu and operation

The ▲ or▼ buttons are used to navigate in the menu and to page through entries. Press the select button ↵ to jump to the next level. Go back by pressing the ▲ and▼ buttons simultaneously. If you need to make adjustments to values, you can jump to the next location by pressing the ↵ button. Select the number to change, and change it using the arrow keys ▲▼. The changes are only accepted once you confirm using ↵ after the last position. If you jump to a higher level before final confirmation, the changes will be rejected. The menu is shown in Figure 5.1.

5.1. OperationModes

There are four operation modes that you can be chosen in the menu:

1. **Time-controlled**: OPCom II works with a sample time and delay time between measurements. A 60 second measurement time and a delay time of 10 seconds, would delivers a measurement result every 70 seconds. In fact, the real time interval will slightly differ as the laser is adjusted at the beginning of each measurement.

2. **Digital I/O**: The measurement continues for as long as there is a signal at the input. However, the minimum measurement duration is 30 seconds. The cleaner the oil, the longer the measurement. ISO 4406:99 degrees of purity of 15 and better should be subjected to at least 120 seconds of measurement.

   The digital input is active when the input connection is connected to ground. The following current is then configured: I = (U-1,1V) / 5600Ohm, where U is the supply voltage.

3. **Manual**: A measurement can be started and stopped manually by using the ↵button.

4. **Automatic**: The measurement time will be chosen automatically according to flow and concentration. This mode can be used to check the recommended minimum measurement time.

5.2. Menu structure

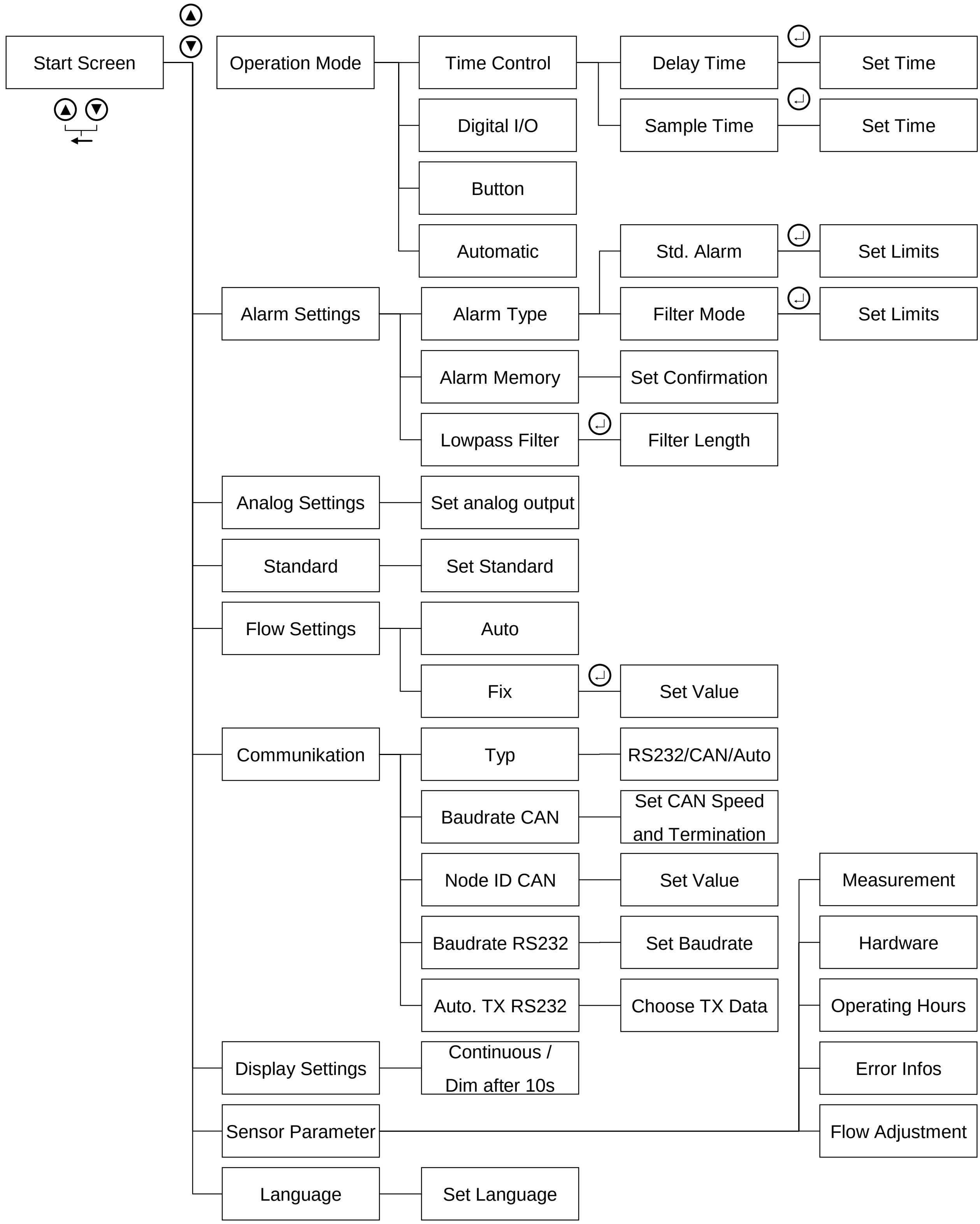

Figure 5.1: Menu structure

5.3. Alarm Settings

There are two different alarm modes that can be chosen in the menu:

1. **Standard mode**: The alarm is activated once a threshold is crossed. Activation occurs as soon as a channel crosses the threshold.

2. **Filter mode**: This setting is used to monitor a purification process. The alarm is activated once the set purity has been reached. Activation occurs once all the selected channels have fallen below the threshold.

Alarm thresholds can be configured separately for each variable by pressing the ↵ button after choosing a mode. In order to neglect a size class, the value should be set to 0.

OPCOM II's digital alarm output connects to ground (open collector). The maximum voltage is 36 V, and the maximum switching current is 0.5A. When switched on, the resistance is approximately 500 mOhm. The current limitation has to be realized externally.

5.4. Analog output settings

Here you select which size channel to place on the 4...20 mA output. This setting can be made in the menu. The output is linear and is expressed in whole scale numbers (4 mA corresponds to scale number 0 and 20 mA to scale number 26). The maximum load depends on the supply voltage (the rule: Rmax = ((U - 2V)/20mA) - 100Ohm).

If sequential output is selected, the scale numbers are output sequentially.

5.5. Standard

You can select whether to display the purity level according to ISO 4406:99 or SAE AS4059E. Note that for SAE AS4059, the sizes 38 and 70µm are not evaluated in separate channels.

5.6. Display Settings

The display can be set to be on permanently or to turn off after ten seconds (default).

5.7. Flow Settings

In addition to particle size and number, OPCom II also records the flow, in order to be able to calculate the concentration. Every measurement is associated with a certain imprecision. For this reason it is possible to set the flow on the device if it is known. The concentration is then calculated based on the set volume flow.

5.8. Communication settings

Here you can select how to configure the digital interface. The following options are possible:

1. Serial RS-232: See chapter on configuring the serial interface and command list
2. CAN: See chapter CAN-BUS

5.9. Sensor Parameter

This menu shows various information like measurements results, hardware status, operation hours, error information or the flow adjustment. The flow adjustment bar gives an indication if the calculated flow through the instrument is in the needed range between 50 ml/min and 400ml/min. If the flow is to low (L) or to high (H) the corresponding letter is flashing.

5.10. Flow adjustment

The bar graph reflects whether the flow is in the optimum range. If this is not the case, the accuracy decreases.

6. Communication

6.1. Serial interface

The OPCom II has a serial interface through which the sensor can be read out and configured. For this a PC and an appropriate terminal program or readout software are required. Both of these components are described in more detail in the chapters below.

The sensor must be connected to an available COM port on a computer. A suitable communication cable for the serial connection between sensor and computer/controller is described in the Accessories chapter. If the computer does not have a factory-installed COM port then it is possible to use serial interface cards or USB to serial converters.

6.2. Interface parameters

- Baud rate: 9600 (Standard) / 19200 / 57600 / 115200
- Data bits: 8
- Parity: None
- Stop bits: 1
- Flow control: None

6.3. Command list: Read commands

#	Command	Meaning	Return format
1	RVal[CR]	Reading all measured values with subsequent check sum (CRC)	$Time:%.4f[h];ISO4um:%i[-];ISO6um:%i[-];ISO14um:%i[-];ISO21um:%i[-];SAE4um:%i[-];SAE6um:%i[-];SAE14um:%i[-];SAE21um:%i[-];Conc4um:%.2f[p/ml]; Conc6um: %.2f [p/ml]; Conc14um: %.2f [p/ml];Conc21um: %.2f [p/ml]; FIndex:%i[-] ;MTime:%i[s];ERC1: 0x0000;ERC2 :0x0000;ERC3:0x0000; ERC4:0x0300; CRC:x[CR][LF]
2	RID[CR]	Read the identification with subsequent check sum (CRC)	$Argo-Hytos;OPComII;SN:xxxxxx; SW:xx.xx.xx;CRC:x[CR][LF]
3	RCon[CR]	Read the current configuration with subsequent check sum (CRC)	$Std:%i;StartMode:%i;Flow:%i;AO1:%i;Amode:%i;Mean:%i;Alarm4:%i;Alarm6:%i;Alarm14:%i;Alarm21:%i;Mtime:%i[s];Htime:%i[s];CRC:x[CR][LF]

4	RMemS[CR]	Read number of storable datasets	MemS:%i[-][CR][LF]
5	RMemU[CR]	Read number of stored datasets	MemU:%i[-][CR][LF]
6	RMemO[CR]	Read the buffer organisation, data parameters and unit are output	Time;ISO4um;ISO6um;ISO14um;ISO21um;SAE4um;SAE6um;SAE14um;SAE21um;Conc4um;Conc6um;Conc14um;Conc21um;FIndex;MTime;ERC1;ERC2;ERC3;ERC4
7	RMem[CR]	Read entire buffer, including organisation, datasets are separated	See answer on command “RVal”
8	RMem-n[CR]	Read the last *n* datasets in the buffer with subsequent checksum (CRC) per data set, data separated by semicolon, datasets separated by [CR][LF], starting with the oldest dataset, interrupt by pressing any button	$x.xxx;x.xxxx;x.xxxx;x.xxxx; x.xxxx;... ;CRC:x[CR][LF] … $x.xxx;x.xxxx;x.xxxx;x.xxxx; x.xxxx;... ;CRC:x[CR][LF]
9	RMem-n;i[CR]	Read *i* datasets in the buffer, beginning with the (current dataset)-(*n* datasets) with subsequent checksum (CRC) per dataset, data separated by semicolon, datasets separated by [CR][LF], starting with the oldest dataset, interrupt by pressing any button	$x.xxx;x.xxxx;x.xxxx;x.xxxx; x.xxxx;... ;CRC:x[CR][LF] … $x.xxx;x.xxxx;x.xxxx;x.xxxx; x.xxxx;... ;CRC:x[CR][LF]
10	RMemH-n[CR]	Read datasets from the last *n* hours in the buffer with subsequent checksum (CRC) per dataset, data separated by semicolon, datasets separated by [CR][LF], starting with the oldest dataset, interrupt by pressing any button	$x.xxx;x.xxxx;x.xxxx;x.xxxx; x.xxxx;... ;CRC:x[CR][LF] … $x.xxx;x.xxxx;x.xxxx;x.xxxx; x.xxxx;... ;CRC:x[CR][LF]

Table 6.1: RS232 Read commands

6.4. Command list: Write commands

#	Command	Meaning	Return format
1	WMtime:x[CR]	Specify measurement time in seconds	Mtime:x[s];CRC:z[CR][LF]
2	WHtime:x[CR]	Specify waiting period between two measurements in seconds	Htime:x[s];CRC:z[CR][LF]
3	SAlarm4x[CR]	Set alarm value for the 4µm channel	Alarm4:x[-];CRC:z[CR][LF]
4	SAlarm6x[CR]	Set alarm value (y) for the 6 µm channel	Alarm6:x[-];CRC:z[CR][LF]
5	SAlarm14x[CR]	Set alarm value (y) for the 14 µm channel	Alarm14:x[-];CRC:z[CR][LF]
6	SAlarm21x[CR]	Set alarm value (y) for the 21 µm channel	Alarm21:x[-];CRC:z[CR][LF]
7	SAO1x[CR]	Allocate suitable measurement value to the current output. x=0: disabled x=1: ISO 4µm x=2: ISO 6µm x=3: ISO 14µm x=4: ISO 21µm x=5: sequential	AO1:x; CRC:z[CR][LF]
8	SRSBRx[CR]	Set RS232 baud rate x=0: 9600 x=1: 19200 x=2: 57200 x=3: 115200	RSBR:x;CRX:z[CR][LF] (for CAN-Modus: See chapter CAN-BUS)
9	SCTRMx[CR]	CAN open termination x=0: off x=1: on	CTRM:x;CRC:z[CR][LF]

10	SAutoTx[CR]	Data transfer x=0: on request x=1: automatic	AutoT:x;CRC:z[CR][LF]
11	SComModex[CR]	Communication type x=0: RS232 x=1: CANopen x=2: Autodetect	ComMode:x;CRC:z[CR][LF]
12	SAlarmDx[CR]	Alarm type x=0: Standard Alarm x=1: Filter Mode	AlarmD:x;CRC:z[CR][LF]
13	SStartModex[CR]	Start mode x=0: Time-controlled (starts automatically after power-on) x=1: Digital I/O x=2: Manual / RS232 x=3: Automatic	StartMode:x[CR][LF]
14	SStdx[CR]	Standard x=0: ISO 4406:99 x=1: SAE AS4059	Std:x;CRC:z[CR][LF]
15	Start[CR]	Start a measurement in Manual mode	Measuring[CR][LF]
16	Stop[CR]	End measurement and output results	See answer on command “RVal”

Table 6.2: RS232 Write commands

[CR] = Carriage Return　　*[LF] = Line Feed*

6.5. CRC calculation

Each character that is sent in the string (incl. line feed and carriage return), must be added up, and a value range of 8 bit (0→255) serves as the basis. If the result equals ZERO, a fault is not present.

Example of a sent string: $Code4µm:21[-];CRC:%[CR][LN]

Character	Value of some of the film in
$	36
C	67
o	111
d	100
e	101
4	52
µ	181
m	109
:	58
2	50
1	49
[	91
-	45
]	93
;	59
C	67
R	82
C	67
:	58
%	37
[CR]	13
[LN]	10
Sum:	**0 = OK**

Table 6.3: Example CRC calculation

6.6. ERC Description

ERC 1															
Oil specific bits								**reserved**							
MSB Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	LSB Bit 0
0	0	0	0	ISO(i+1)>= ISO(i)	flow low	flow high	concentration>= ISO 23	0	0	0	0	0	0	0	0

ERC 2															
reserved								**reserved**							
MSB Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	LSB Bit 0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

ERC 3															
reserved								reserved							
MSB Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	LSB Bit 0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

ERC 4															
measurement Info								**sensor alarm**							
MSB Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	LSB Bit 0
0	concentration alarm	power up, true before first measurement	alarm mode 1=Filter 0=Standard	mode: manuell	mode: I/O	mode: automatic	measurement ist running	0	0	temperature < -20°C	temperature > 80°C	photo voltage high	photo voltage low	laser curren low	laser current hight

Table 6.4: ERC description

6.7. Terminal program (example: Microsoft Windows Hyper Terminal)

If the sensor is connected to a PC and is supplied with power, it can communicate with the PC, using any terminal program desired. Different terminal programs are offered as freeware on the Internet. The easiest possibility is to use "Hyper Terminal" that is included with Microsoft Windows. This program is found under ***Start/Programs/Accessories/Communication***. If you have started the program three windows will appear in succession, in these first a name for the connection must be specified, a COM port must be specified, and the correct communication parameters must be specified. The three windows are shown in Fig. 7.1 to Fig. 7.4.

Figure 6.1: Microsoft Windows Hyper Terminal

Figure 6.2: Microsoft Windows Hyper Terminal - Choice of interface for communication.

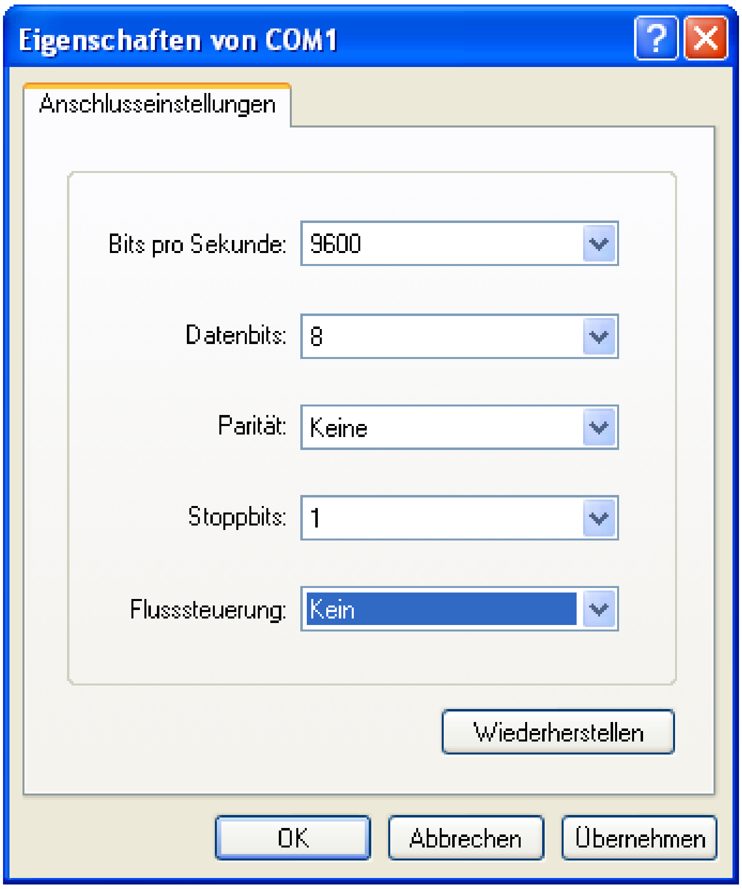

Figure 6.3: Microsoft Windows Hyper Terminal - Choice of the communication parameters.

In the following entry window you can enter the appropriate commands for read-out or configuring. The command list is specified under chapter 7.1.

Note in this regard that by default all characters that are entered in the terminal program via the keyboard do not appear on the screen. This can be changed via the option "Enable Local Echo".

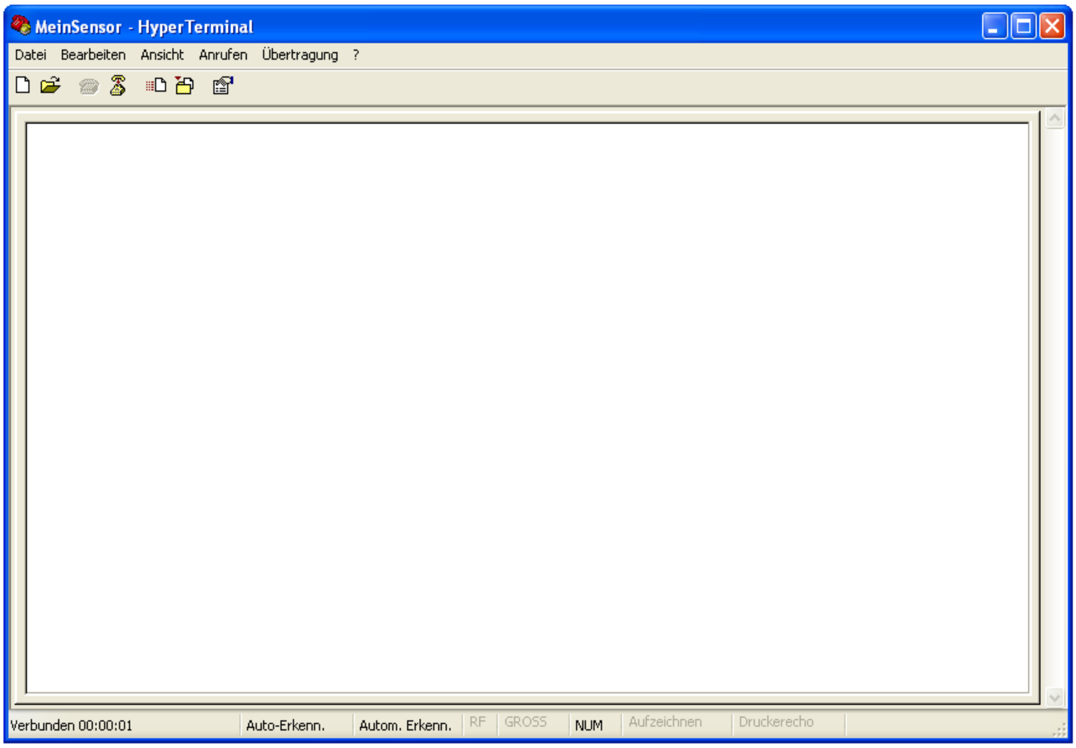

Figure 6.4: Windows Hyper Terminal – Entry window

6.8. TCP/IP connection

Hyper Terminal alternatively also offers the possibility of establishing a TCP/IP connection. If sensors are remotely queried via this protocol, then conversion of the RS232 signal with the aid of an Ethernet gateway is required. Suitable gateways can be requested from ARGO-HYTOS.

6.9. Software

ARGO-HYTOS makes different programs (drivers, LabVIEW tools and auxiliary programs) available for the sensor technology area. These programs can be downloaded at www.argo-hytos.com.

7. CAN

CANopen is a network protocol based on the CAN field bus and which implements layer 1 (Physical Layer), layer 2 (Datalink Layer) and layer 7 (Application Layer) together from the perspective of the OSI layer model. The layers located in between are not needed, since a fieldbus generally only consists of one segment (no need for the "Transport and Network Layer“, layer 3 and 4) and does not know any sessions (layer 5).

CAN (Controller Area Network) only describes layers 1 and 2 (ISO11898); in practice, these are completely implemented within the device hardware.

However, in order to ensure the cooperation of CAN devices, a protocol is needed to standardize the use of the 11-bit CAN-ID signal and the 8 byte user data. For example, this can be done using the CANopen protocol, which represents application layer 7 in the OSIS layer model and enables system administration in addition to the standardized profiles.

- The Application Layer (CAN Application Layer = CAL) provides a set of rules and protocols for communication that can be used by any device connected to the bus.
- The communication profile describes the procedure for device configuration, including how data is exchanged between the devices.
- The device profiles describe class-specific procedures for communication, e.g. with I/O modules, sensors, etc.

The following chapters describe the CAN Application Layer on which CANopen is based in further detail, and also describe CANopen as such, with its sensor-specific profiles.

7.1. CAN communication

The CAN interface corresponds to the "CAN 2.0B Active Specification". The data packets correspond to the format shown in Figure7.1. The figure is for illustration purposes only; implementation corresponds to the CAN 2.0B specification.

The sensor supports a limited number of transfer speeds on the CAN bus (see Table 7.1).

Data rates recommended by CiA and supported by the sensor			
Data rate	**Supported**	**CiA Draft 301**	**Bus length (pursuant to CiA Draft Standard 301)**
1 Mbit/s	No	yes	25 m
800 kbit/s	No	yes	50 m
500 kbit/s	Yes	yes	100 m
250 kbit/s	Yes	yes	250 m
125 kbit/s	Yes	yes	500 m
100 kbit/s	Yes	no	750 m
50 kbit/s	Yes	yes	1000 m
20 kbit/s	Yes	yes	2500 m
10 kbit/s	Yes	yes	5000 m

Table 7.1: Supported bus speeds for CANopen communication and associated cable lengths

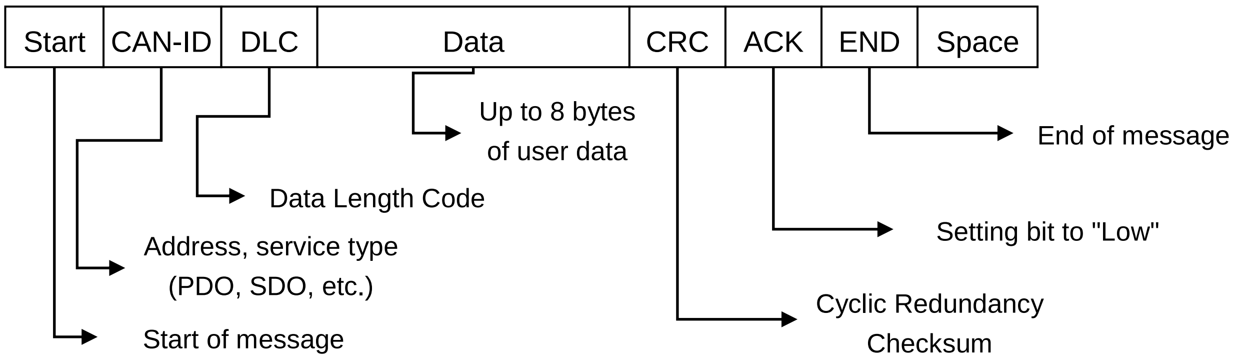

Figure7.1: CAN message format

7.2. CANopen

CAL provides all message protocols and management functions, but does not describe the contents of the CMS objects (it only describes the how, not the what). This is where CANopen takes over, which is based on CAL. The implemented procedure is used to realize a distributed control network, which can interconnect anything from very simple subscribers to highly complex controls without leading to communication problems between the subscribers.

The central concept behind CANopen is called the Device Object Dictionary (OD); it is also used in other fieldbus systems.

The chapters below will first address the Object Dictionary, then the Communication Profile Area (CPA), and finally the CANopen communication procedure as such.

7.2.1. "CANopen Object Dictionary" in general

The CANopenObject Dictionary (OD) is an object directory in which each object can be addressed with a 16-bit index. Each object may consist of several data elements that can be addressed by means of an 8-bit subindex.

The basic layout of a CANopen object dictionary is portrayed in Table 7.2.

CANopen Object Dictionary	
Index (hex)	**Object**
0000	-
0001 - 001F	Static data types (Boolean, integer)
0020 - 003F	Complex data types (consisting of standard data types)
0040 - 005F	Complex data types, manufacturer-specific
0060 - 007F	Static data types (device profile-specific)
0080 - 009F	Complex data types (device profile-specific)
00A0 - 0FFF	reserved
1000 - 1FFF	Communication Profile Area (e.g. device type, error register, supported PDOs etc.)
2000 - 5FFF	Communication Profile Area (manufacturer-specific
6000 - 9FFF	Device profile-specific Device Profile Area (e.g. “DSP-401 Device Profile for I/O Modules”)

A000 - FFFF	reserved

Table 7.2: General CANopen Object Dictionary structure

7.2.2. CANopen Communication Objects

Communication objects transferred when using CANopen are described by services and protocols and are classified as follows:

- Network Management (NMT) provides services and is used for bus initialization, error handling and node control
- Process Data Objects (PDOs) are used to transfer process data in real-time
- Service Data Objects (SDOs) enable read and write access to a node's object dictionary
- Special Function Object protocol enables application-specific network synchronization, timestamp transfer and emergency notifications

An example of network initialization using a CANopen Master and a sensor is described below.

After applying a current, the sensor sends a Boot-Up message within approximately five seconds once the preoperational status has been achieved. In this status, the sensor only sends heartbeat messages if configured accordingly (paragraph A in Figure 7.2).

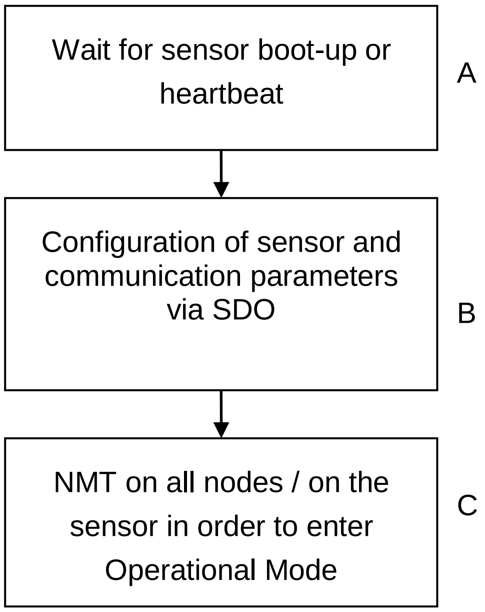

Figure 7.2: CANopen bus initialization process

After that the sensor can be configured using SDOs; this is not necessary in most cases since the communications parameters are automatically saved by the censor once set (see Paragraph B in Figure 7.2).

In order to set the sensor to the operational state, you can either send a message to this effect to all CANopen subscribers, or send a message especially to the sensor. In the operational state, the sensor will send the supported PDOs either at periodic intervals or as triggered by synch messages, depending on its configuration (see Paragraph C in Figure 7.2). Depending on the sensor state, various CANopen services are available.

Availability of services depending on the sensor status				
Com. Object	**Initializing**	**Pre-operational**	**Operational**	**Stopped**
PDO			X	

SDO		X	X	
Synch		X	X	
BootUp	X			
NMT		X	X	X

Table 7.3: Available CANopen services in various sensor states

7.2.3. Service Data Object (SDO)

Service Data Objects facilitate read and write access to the sensor's object dictionary. The SDOs are acknowledged; transfer is always performed between two subscribers, i.e. a client/server model.

The sensor can only function as a server, i.e. it only responds to SDO notifications, and does not send any queries to other subscribers independently. The ID of the SDO notifications from the sensor to the client is NodeID+0x580. The expected ID for requests from the client to the sensor (server) in the case of SDO messages is NodeID+0x600. The entries in the object dictionary are transferred using these relatively high (and therefore low priority) IDs.

The standard protocol for SDO transfer requires 4 bytes in order to encode the sender direction, datatype, index and subindex. That leaves only 4 bytes out of the 8 bytes of a CAN data field available for the content. For objects whose data content is greater than 4 bytes, there are two additional protocols for performing what is referred to as fragmented SDO transfer.

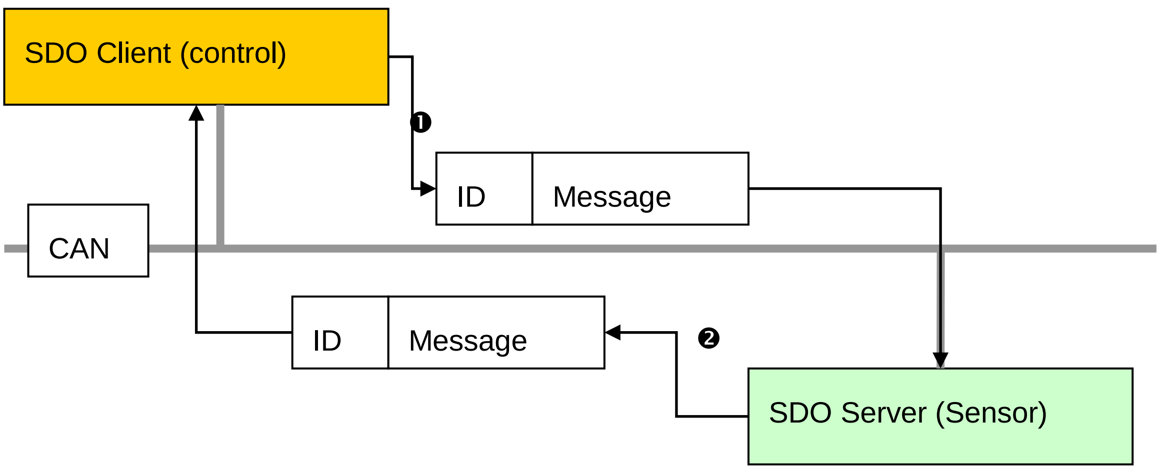

Figure 7.3: SDO Client/Server relationship

SDOs are meant for use in configuring the sensor through access to the object dictionary, to query seldom needed data or configuration values, or to download large data volumes. A summary of SDO properties:

- All data in the object dictionary can be accessed
- Confirmed transfer
- Client/Server relationship during communication

The control and user data of a non-segmented SDO standard message is distributed across the CAN message as depicted in Table 7.4. The user data in an SDO message usually consists of up to 4 bytes. The control data in an SDO message (Cmd, Index, Subindex) is used to determine the direction of access to the object dictionary and the transferred data type if applicable. Please consult "CiA Draft Standard 301" for the exact specifications of the SDO protocol.

Below you will find an example of an SDO query of the sensor serial number from the object dictionary as sent to Index 0x1018, Subindex 4, with a 32 bit data length. The client (control) sends a read request to the sensor with ID "NodeID" to this end (see Table 7.4).

CAN	CAN-ID	DLC	CAN Message user data							
			0	1	2	3	4	5	6	7
CANopen	**COB-ID 11 Bit**	**DLC**	**Cmd**	**Index**		**Subidx**	**SDO user data**			
				1	**0**	**0**	**3**	**2**	**1**	**0**
Message from client to sensor	0x600+ NodeID	0x08	0x40	0x18	0x10	0x01	dont care	dont care	dont care	dont care

Table 7.4: SDO download request from the client to the server

The sensor responds with a corresponding SDO message (see Table 7.5) encoding the datatype, index, sub-index and serial number of the sensor, in this case using sample serial number 200123 (0x30E15).

CAN	CAN-ID	DLC	CAN Message user data							
			0	1	2	3	4	5	6	7
CANopen	**COB-ID 11 Bit**	**DLC**	**Cmd**	**Index**		**Subidx**	**SDO user data**			
				1	**0**	**0**	**3**	**2**	**1**	**0**
Message from sensor to client	0x580+ NodeID	0x08	0x43	0x18	0x10	0x01	0x15	0x0E	0x03	0x00

Table 7.5: SDO download response from the server to the client

Below you will find a sample data upload (heartbeat time) using SDO to the sensor object dictionary at index 0x1017 with a data length of 16 bits. To do this, the client (control) sends a write request to the sensor using ID “NodeID” (see Table 7.6) in order to set the heartbeat time to 1000 ms (0x03E8).

CAN	CAN-ID	DLC	CAN Message user data							
			0	1	2	3	4	5	6	7
CANopen	**COB-ID 11 Bit**	**DLC**	**Cmd**	**Index**		**Subidx**	**SDO user data**			
				1	**0**	**0**	**3**	**2**	**1**	**0**
Message from client to sensor	0x600+ NodeID	0x08	0x2B	0x17	0x10	0x00	0xE8	0x03	0	0

Table 7.6: SDO upload request from the client to the server

The sensor responds with a corresponding SDO message (see Table 7.7) confirming that the access attempt was successful and that the index and subindex on which access occurred have been encoded.

CAN	CAN-ID	DLC	CAN Message user data							
			0	1	2	3	4	5	6	7
CANopen	**COB-ID 11 Bit**	**DLC**	**Cmd**	**Index**		**Subidx**	**SDO user data**			
				1	**0**	**0**	**3**	**2**	**1**	**0**
Message from sensor to client	0x580+ NodeID	0x08	0x60	0x17	0x10	0x00	0x00	0x00	0x00	0x00

Table 7.7: SDO upload response from the server to the client

7.2.4. Process Data Object (PDO)

PDOs are one or more datasets mirroring up to 8 bytes of data in a CAN message from the object dictionary for the purpose of transferring data quickly from a "producer" to one or more "consumers" (see: Figure 7.4). Every PDO has a unique COB-ID (Communication Object Identifier), and is only sent from a single node; it can be received by several nodes, and does not need to be acknowledged/confirmed.

PDOs are ideally suited to the transfer of data from sensors for control purposes, or to transfer data from the control system to actuators. An overview of sensor PDO attributes:

- Sensor supports three TPDOs, but no RPDOs
- Data mapping in PDOs is fixed and cannot be changed
- COB-IDs for TPDO1 and TPDO2 can be selected freely, whereas TPDO3 always has COB-ID 0x380+NodeID
- TPDO1 and TPDO2 can be transferred as triggered by an Event/Timer, or transferred cyclically on SYNCH, and can be configured individually for both TPDOs; TPDO3 takes on the settings of TPDO2

The sensor supports two different PDO transfer methods.

1. When using the event or timer-trigger method, transfer is triggered by an internal timer or event in the sensor.
2. In the SYNCH-triggered method, transfer is performed in response to a SYNCH message (CAN message from a SYNCH producer without user data). The answer using PDO is either sent on each received Synch, or after every 'n' SYNCH message received.

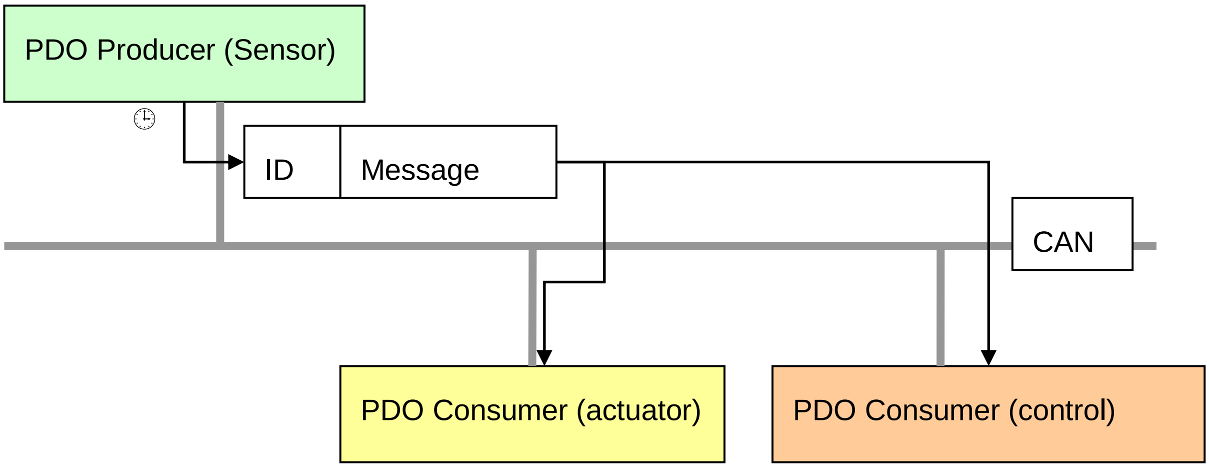

Figure 7.4: PDO Consumer/Producer relationship

7.2.5. "CANopen Object Dictionary" in detail

The communication-based part of the object dictionary is represented inTable 7.8. With few exceptions, the settings that can be made here correspond to the CANopen Standard as described in DS-301.

Communication Profile Area						
Idx	**SIdx**	**Name**	**Type**	**Attr.**	**Default**	**Notes**
1000h	0	device type	unsigned 32	ro	194h	Sensor, see DS404
1001h	0	error register	unsigned 8	ro	00h	mandatory, see DS301
1017h	0	producer heartbeat time	unsigned 16	rw	1388h	heartbit time in ms, range: 0..65535
1018h		identity object	record	ro		
	0	Number of entries	unsigned 8	ro	04h	largest sub index
	1	Vendor ID	unsigned 32	ro	000000E6h	Argo Hytos
	2	Product Code	unsigned 32	ro	00004F4Ch	OpCom II
	3	Revision Number	unsigned 32	ro	1000	Device dependant
	4	Serial Number	unsigned 32	ro		Device dependant
1800h		Transmit PDO1 Parameter	record			
	0	Number of entries	unsigned 8	ro	05h	largest sub index
	1	COB-ID	unsigned 32	rw	180h+NodeID	COB-ID used by PDO, range: 181h..1FFh, can be changed while not operational
	2	transmission type	unsigned 8	rw	FFh	cyclic+synchronous, asynchronous values: 1-240, 254, 255
	5	event timer	unsigned 16	rw	1F4h	event timer in ms for asynchronous TPDO1, value has to be a multiple of 50 and max 12700
1801h		Transmit PDO2 Parameter	record			
	0	Number of entries	unsigned 8	ro	05h	largest sub index
	1	COB-ID	unsigned 32	rw	280h+NodeID	COB-ID used by PDO, range: 281h..2FFh, can be changed while not operational
	2	transmission type	unsigned 8	rw	FFh	cyclic+synchronous, asynchronous values: 1-240, 254, 255
	5	event timer	unsigned 16	rw	1F4h	event timer in ms for asynchronous TPDO2 range: 0..65000
1802h		Transmit PDO3	record			

		Parameter				
	0	Number of entries	unsigned 8	ro	05h	largest sub index
	1	COB-ID	unsigned 32	rw	380h+NodeID	COB-ID used by PDO, range: 381h..3FFh, can be changed while not operational
	2	transmission type	unsigned 8	rw	FFh	cyclic+synchronous, asynchronous values: 1-240, 254, 255
	5	event timer	unsigned 16	rw	1F4h	event timer in ms for asynchronous TPDO3 range: 0..65000
1A00h		TPDO1 Mapping Parameter	record			
	0	Number of entries	unsigned 8	ro	05h	largest sub index
	1	PDO Mapping for 1st app obj. to be mapped	unsigned 32	co	20000220h	Runtime stamp of measurement, 4 bytes
	2	PDO Mapping for 2nd app obj. to be mapped	unsigned 32	co	20010108h	ISO4µm, 1 Byte in 2001h, sub 01
	3	PDO Mapping for 3rd app obj. to be mapped	unsigned 32	co	20010208h	ISO6µm, 1 Byte in 2001h, sub 02
	4	PDO Mapping for 4th app obj. to be mapped	unsigned 33	co	20010308h	ISO14µm, 1 Byte in 2001h, sub 03
	5	PDO Mapping for 5th app obj. to be mapped	unsigned 32	co	20010408h	ISO21µm, 1 Byte in 2001h, sub 04
1A01h		TPDO2 Mapping Parameter	record			
	0	Number of entries	unsigned 8	ro	05h	largest sub index
	1	PDO Mapping for 1st app obj. to be mapped	unsigned 32	co	20000220h	Runtime stamp of measurement, 4 bytes
	2	PDO Mapping for 2nd app obj. to be mapped	unsigned 32	co	20020108h	SAE4µm, 1 Byte in 2002h, sub 01
	3	PDO Mapping for 3rd app obj. to be mapped	unsigned 32	co	20020208h	SAE6µm, 1 Byte in 2002h, sub 02
	4	PDO Mapping for 4th app obj. to be mapped	unsigned 33	co	20020308h	SAE14µm, 1 Byte in 2002h, sub 03
	5	PDO Mapping for 5th app obj. to be mapped	unsigned 32	co	20020408h	SAE21µm, 1 Byte in 2002h, sub 04
1A02h		TPDO3 Mapping Parameter	record			
	0	Number of entries	unsigned 8	ro	05h	largest sub index

	1	PDO Mapping for 1st app obj. to be mapped	unsigned 32	co	20000120h	Runtime meter, 4 bytes
	2	PDO Mapping for 2nd app obj. to be mapped	unsigned 32	co	20030108h	Oil status bits bits, 1 Byte
	3	PDO Mapping for 3rd app obj. to be mapped	unsigned 32	co	20030708h	Measurement bits, 1 Byte
	4	PDO Mapping for 4th app obj. to be mapped	unsigned 32	co	20030808h	Sensor status bits, 1 Byte
	5	PDO Mapping for 5th app obj. to be mapped	unsigned 32	co	20040008h	Temperature 1 Byte
2000h		Time related parameters of the sensor	record			
	0	Number of entries	unsigned 8	ro	02h	largest sub index
	1	Runtime meter	unsigned 32	ro		Sensor up time in seconds
	2	Runtime stamp of measurement	unsigned 32	ro		Timestamp of last measurement
2001h		ISO measurement	record			
	0	Number of entries	unsigned 8	ro	04h	largest sub index
	1	ISO4µm	unsigned 8	ro		
	2	ISO6µm	unsigned 8	ro		
	3	ISO14µm	unsigned 8	ro		
	4	ISO21µm	unsigned 8	ro		
2002h		SAE measurement	record			
	0	Number of entries	unsigned 8	ro	04h	largest sub index
	1	SAE4µm	unsigned 8	ro		
	2	SAE6µm	unsigned 8	ro		
	3	SAE14µm	unsigned 8	ro		
	4	SAE21µm	unsigned 8	ro		
2003h		Condition Monitoring Bitfield	array			
	0	Number of entries	unsigned 8	ro	08h	largest sub index

	1	Oil specific bits	unsigned 8	ro		0 concentration limit exceeded 1 high flow 2 low flow
	2	reserved	unsigned 8	ro		
	3	reserved	unsigned 8	ro		
	4	reserved	unsigned 8	ro		
	5	reserved	unsigned 8	ro		
	6	reserved	unsigned 8	ro		
	7	Measurement info	unsigned 8	ro		0 Measurement ongoing 1 Measurement mode automatic 2 Measurement mode I/O 3 Measurement mode manual 4 Alarm mode filter / standard
	8	Sensor alarm	unsigned 8	ro		0 Laser current high 1 Laser current low 2 Photo voltage high 3 Photo voltage low 4 Temperature high 5 Temperature low
2004h	0	Sensor Temperature	signed 8	ro		Oil temperature in °C
2020h		Commando	unsigned 8	wo		1 = Start measurement 2 = Stop measurement
2030h		Measurement related settings	record			
	0	Number of entries	unsigned 8	ro	08h	largest sub index
	1	Measurement Time	unsigned 32	rw		Measurement Time in s
	2	Hold Time	unsigned 32	rw		Time between Measurements
	3	Operation Mode	unsigned 16	rw		0 = Time Control 1 = Digital I/O 2 = Button 3 = Automatic
	4	History disable	unsigned 16	rw	0	0 = History enabled 1 = History disabled
2031h		Startup Settings	record			
	0	Number of entries	unsigned 8	ro	01h	largest sub index
	1	Startmode	unsigned 16	rw	0h	0 = Network with NMT Master (Init→PreOp→Start_Remote_Node→ Operational) >0 = Network without NMT Master

						(Init→ Operational)
2100h		Readmem control functions	record			
	0	Number of entries	unsigned 8	ro	04h	largest sub index
	1	Size of history memory	unsigned 32	ro	device dependand	size of memory in datasets
	2	Used history mem	unsigned 32	ro		used datasets within memory (corresponds internaly to write pointer)
	3	Reading pointer, dataset	unsigned 32	ro		autoincrementing read pointer to a dataset for history memory reading; can be between 0 and current write pointer
	4	Clear history memory	unsigned 16	wo		1 = clear memory
2101h	0	Readmem Initiate segmented SDO data Upload	unsigned 16	ro		Appropriate Pointer has to be set (with 2100sub3) before start reading, Size of the record will be sent back on reading

Table 7.8: Communication Profile Area

8. Commissioning

The following sections present instructions on how to check device functionality.

8.1. Verification via a PC

Connect the sensor to a PC via the serial interface (RS232) and start the Microsoft Windows Hyper Terminal (see chapter 6.7).

Now have a specialized person with electrical training connect the sensor to the power supply. If the serial interface is correctly connected and parameters are correctly assigned, the serial number ("300-1000-5xxxxx") is displayed on the entry window of the terminal program.

In addition, when receiving a carriage return, which corresponds to activation of the enter key or sending the value 0xD, the sensor have to send "?" as response.

8.2. Verification via the analog current outputs

Have a specialized person with electrical training connect the sensor to the power supply. Now check the analog current outputs (see chapter 4).

The current value should not be under 4mA and it should not be over 20mA. Pay attention to the relationship between supply voltage and load resistance (see 4.4 Load resistor).

9. Troubleshooting

__Error:__ No communication (ComPort) or current outputs < 4mA	
Cause	***Measure***
▪ Cable is not correctly connected	▪ First ensure that the electrical connections of the sensor, i.e. the data cable and power cable, have been properly executed. Ensure that the connection is configured as prescribed.
▪ Operating voltage is outside of the prescribed range	▪ Operate the sensor in the range between 9 V and 33 VDC.
__Error:__ No serial communication	
Cause	***Measure***
▪ Interface configuration is defective	▪ Check and correct the interface parameter settings as needed (9600, 8,1, N, N). Test communication using a terminal program, and with an interface tester as needed.
▪ Wrong communication port selected	▪ Check and correct the selection of the communication port (e.g. COM1)
▪ Incorrect syntax of the sensor commands	▪ Check the syntax of the sensor commands. Pay particular attention to upper case and lower case
▪ NumLock key is off	▪ Activate the NumLock key
▪ Caps lock key is activated (upper case)	▪ Deactivate the Caps Lock
▪ Wrong cable or cable is defective	▪ If possible use the ARGO-HYTOS data cable
__Error:__ The same purity was indicated for all sizes	
Cause	***Measure***
▪ Air in the oil	▪ Connect OPCom II on pressure side

	▪ Increase distance from the pump
Error: *Incorrect measurement of the analog current outputs*	
Cause	***Measure***
▪ A wrong parameter is output	▪ Correct the assignment of the measured values to the current outputs
Error: *Laser current high/photo voltage low*	
▪ Air in the oil	▪ Connect OPCom II on pressure side ▪ Increase distance from the pump
▪ Contaminated cell	▪ Clean OPCom II using clean oil or a solvent such as isopropanol

Table 9.1: Error description

10. Accessories

Power supply unit

Description: 24V power supply for connecting to prefabricated data cable SCSO 100-5030

Order number: SCSO 100-5080

Line socket

Description: 8-pin, shielded M12 cable socket suitable for cable diameters of 6..8 mm, degree of protection IP67, temperature range -40 °C to 85 °C

Order number: SCSO 100-5010

Prefabricated data cable with open ends

Description: Shielded sensor cable, degree of protection IP67, temperature range -20 °C to 85 °C, oil-resistant, page 1 - extrusion die sensor plug, page 2 - 8 single-strand

Order number: SCSO 100-5020

Pre-assembled data cable for computer connection / D-Sub connector 9-pole

Description: Shielded sensor cable, degree of protection IP67, temperature range -20°C to 85°C, oil-resistant, page 1 -extrusion die sensor plug, page 2 -9-pin D-sub socket / hollow connector for power supply (power supply unit must be ordered separately!)

Order number: SCSO 100-5030

USB/serial adapter

Description: Adapter for conversion of serial RS232 interface to "Universal Serial Bus" (USB). Several sensors can be addressed simultaneously via USB.

Order number: SCSO 100-5040

11. Contact address

ARGO-HYTOS GMBH

Sensors & Measurement division

Industriestraße 9

76703 Kraichtal-Menzingen

Tel. +49-7250-76-0

Fax +49-7250-76-575

E-Mail: info.de@argo-hytos.com

12. EC Declaration of conformity

The manufacturer

ARGO-HYTOS GMBH
Industriestrasse 9
D-76703 Kraichtal

herewith declares that the sensor described below

Particle Monitor, OPCom II, SAP-Nr. 2739540X

satisfies the following EC directive:

EMC Directive 2004/108/EC

Harmonized standards:

EN 61000-6-2:2005 – Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments

EN 61000-6-4:2007 – Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission for industrial environments

The evaluation and testing of the device was made by the EMC testing laboratory:

TÜV SÜD SENTON GmbH
Äußere Frühlingstraße 15
D-94315 Straubing

A labeling requirement under the **Pressure Equipment Directive 97/23/EC** does **not** exist. The assessment to this directive was made by the ARGO-HYTOS GmbH

The declaration applies for all identical copies of the product that are manufactured according to the included development, design, and manufacturing drawings and descriptions, which are a component of this declaration.

Kraichtal, 02/07/2012

Dr. Marcus Fischer
Technical Director

13. **Change log**

10/30/2012: Correction of formula *(4-2)* in chapter 4.5 - RCK

11/13/2012: Updated the CANopen object dictionary and version updated to 1.04.12 - HD

11/15/2012: Correction of formula *(4-2)* - KN

11/30/2012: Chapter 2.2 Calibration added – KN

11/03/2013: Technical data corrected, layout fixed, ERC table added, general revision – KN