



## **Patrick in the Box** **Portable particle monitor**

Operating Manual

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# 1. Safety

## 1.1 General safety instructions

- Heed the valid regulations for accident protection and environmental protection.
- Observe the safety instruction and regulations of the country in which the product is used and applied.
- Use HYDROTECHNIK GmbH products only if they are in technically perfect condition.
- Heed all instructions on the product.
- People who install, operate, uninstall or maintain HYDROTECHNIK GmbH products may not be under the influence of alcohol or other drugs or medications that influence the ability to react.
- Use only accessory and spare parts approved by the manufacturer in order to exclude danger to people due to unsuitable spare parts.
- Adhere to the technical data and environmental conditions specified in the product documentation.
- If in safety-relevant applications unsuitable products are installed or use, unintended operating conditions can arise in the application, which can cause personal injury or property damage. Therefore, only use a product in safety-relevant applications if these are explicitly specified and permitted in the product documentation.
- You may only start the product up if it has been determined that the end product (for example, a machine or system) in which the HYDROTECHNIK GmbH products are installed complies with the country-specific provisions, safety regulations, and standards of the application.

**⚠ Caution****Dangerous electrical voltage**

- Never cut, damage or modify the connector cables or place things on them.
- Never touch the instrument with wet or moist hands.
- Only connect the instrument to power supplies for which it is suited (see technical data).
- Unplug the power cable from the outlet during a thunderstorm.
- Unplug the power cable if you detect smoke or there is an odor, or if the power cable is damaged.
- Ensure sufficient grounding of your system. Inadequate grounding may cause incorrect measurements.

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**⚠ Caution****Laser**

The particle counter contains a laser, which with proper use is classified as a Class 1 laser according to DIN EN 60825-1:2001-11. The accessible laser beam is not dangerous under reasonably foreseeable conditions.

- For Class 1 laser equipment, in the upper performance range, blinding, compromising of color vision, and disruptions cannot be excluded.
- Do not remove any covers or panels.

**⚠ Warning****Risk of burns**

When connecting to hot oil, be aware that skin contact with hot oil can cause burns.

## 1.2 Notes on handling with the measuring system

- For pressures greater than 2.5 bar, close the pressure reducing valve (order no. 5117-06-20.00) in front of the inlet.
- Do not discharge pressures above 2.5 bar into the device. This would damage the integrated pump.
- Avoid skin contact with hot oil. It could burn your skin.
- The measuring system should be placed in a suitable place so that it does not fall or damage the device.
- Maintain proper handling of the device and accessories.
- If hydraulic fluid leaks or spills, pollution of the environment and groundwater must be avoided. Use oil binding agents to bind oil that has leaked out.
- Make sure that the measuring set-up is clean to prevent contamination with e.g. metal shavings or fibers from cleaning rags into the hydraulic lines. It could lead to wear and malfunctions in the product.
- Before commissioning, check that all hydraulic and mechanical connections are connected and tight, and that all seals and closures of the plug connections are correctly installed and undamaged.
- Do not use hemp as a sealant.

ENG

## 1.3 Notes on handling with cables and hoses

- Protect the device from exceeding the permissible voltage supply range, mechanical overload and incorrect pin assignment.
- Never expose the device to excessive heat or moisture, observe the technical data.
- Never let water or other liquids get inside the device.
- Never open the devices.
- Avoid strong magnetic fields. Keep the device away from electric motors or other devices that generate electromagnetic fields. Strong magnetic fields can cause malfunctions and affect measured values.
- Avoid condensation. If condensation has formed, allow the device to acclimatize before you switch it on. Otherwise it can be damaged.

## 2. INTRODUCTION

### 2.1 Scope

This manual is valid for instruments designated „Patrick in the Box“. It is intended for the operator of the instrument, that means the person who works with the instrument. This is not a technical manual. Please contact our customer service in case you have questions that go beyond the contents of this manual.

### 2.2 Copyright

The instrument and this manual are protected by copyright. Reproduction without license will be prosecuted. All rights reserved to this manual; this includes the reproduction and/or duplication in any conceivable form, e.g. by photocopying, printing, on any data recording media or in translated form. Reproduction of this manual is only permitted with written approval from HYDROTECHNIK GmbH.

The technical state at the time of delivery of the instrument and the manual is decisive if no other information is given. We reserve the right to make technical changes without special announcement. Earlier manuals are no longer valid. The general conditions of sale and delivery of HYDROTECHNIK GmbH apply.

### 2.3 Limitation of liability

We guarantee the faultless functioning of our product in accordance with our advertising, the product information we publish and this manual. Additional product properties are not assured. We assume no liability for the economy and faultless function if the product is used for a different purpose than the one described in the chapter **Intended use** (chap. 2.4).

Compensation claims are generally excluded, except if intention or culpable negligence by HYDROTECHNIK GmbH is proved, or if product features promised are not provided.

If the product is used in environments for which it is not suited or that do not represent the technical standard, we shall not be responsible for the consequences. We assume no liability for damage to installations and systems in the surroundings of the product that is caused by a fault of the product or an error in this manual. We are not responsible for the violation of patents and/or other rights of third persons outside the Federal Republic of Germany.

We are not liable for damage that results from improper operation and non-compliance with the instructions in this manual. We are not liable for lost profits

and for consequential damages that arise from non-compliance with safety and warning information. We assume no liability for damage that results from the use of accessories and wearing parts that were not delivered and/or approved by HYDROTECHNIK GmbH.

The products of HYDROTECHNIK GmbH are designed for a long life. They represent the state of the art and their functions have been individually checked before delivery. The electrical and mechanical design corresponds to current standards and regulations. HYDROTECHNIK GmbH conducts ongoing product and market research for the further development and continuous improvement of its products.

In case of faults and/or technical trouble, please contact HYDROTECHNIK GmbH customer service. We can assure you that we will take immediate measures. The guarantee conditions of HYDROTECHNIK GmbH apply; if desired, we will gladly send you these.

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## 2.4 Intended use

The instrument „Patrick in the Box“ is used for measuring and monitoring the particle contamination in hydraulic systems and bottle samples. Use only in fluids of group 2 according to the classification of the pressure equipment directive 2014/68/EU (non dangerous fluids).

## 2.5 Warranty

In accordance with our warranty conditions, we guarantee the condition without defects of this instrument „Patrick in the Box“ for a duration of twelve months. Wearing parts and storage batteries are excluded from this warranty. The warranty becomes void if repair work or interventions are executed by unauthorized persons.

Within the warranty period we will repair damage or defects that are caused by a manufacturing fault. We only accept warranty claims if they are reported to us immediately after their discovery, but no later than twelve months after delivery. The warranty benefit is by our choice through free repair of defective parts or replacement with sound parts.

Please send the instruments for which you have made a warranty claim postage-paid and with a copy of the invoice or the delivery slip to HYDROTECHNIK GmbH customer service. You can find the address at the end of this manual.



## 2.6 Customer obligations

The operator of this product must ensure that only persons who

- know the regulations concerning occupational safety and accident prevention,
- have been instructed in the operation of this product,
- have read and understood this manual

are permitted to operate this instrument.

Persons who operate this instrument are obliged to

- obey all regulations on occupational safety and accident prevention,
- read this manual completely, especially the safety instructions in the first chapter.

ENG

## 2.7 Authorized personnel

Persons are considered to be authorized if they have a professional education, technical experience, knowledge of the relevant standards and regulations and if they are able to estimate their duties and recognize possible danger at an early time.

### **Operator of the instrument „Patrick in the Box“**

Persons are considered to be authorized if they have been instructed in the operation of the instrument and have read and understood this manual completely.

### **Personnel for installation and maintenance**

Persons are considered to be authorized if they have been trained in all aspects of the instrument and have read and understood this manual completely.

## 2.8 Disposal

Do not dispose of this product with your household waste.  
You can find more detailed information on disposal on our website at:  
[www.hydrotechnik.com](http://www.hydrotechnik.com).

## 3. DESCRIPTION OF THE PORTABLE PARTICLE MONITOR

### 3.1 Properties

The portable particle monitor "Patrick in the Box" consists of a suitcase in which the particle monitor "Patrick" is installed. An integrated pump and an accumulator are also included in the case. The two minimess® test points connect the inlet and outlet lines in accordance with the labeling. Suitable cables from the accessories list in chapter 7.2 must be used for the electrical connections.

The device has an operating time of approx. 3 hours in battery mode. The charge status is shown on the display on the connection plate in the case.

Together with the HYDROTECHNIK measuring systems MultiSystem 5060 Plus / MultiSystem 5070 or the HYDROTECHNIK software "HydroCom", the automatically saved measurement data can be displayed and evaluated.

Bottle sample or samples from oil tanks can be analysed immediately for their contamination status. This will protect your hydraulic system from failure and adapt maintenance work individually. This proactive maintenance approach is ideal for locations with multiple storage tanks/systems and makes the analyser to the ultimate solution for controlling and diagnosis.

A measuring cycle can also be operated over a longer period of time, for example to measure a cleaning phase. For this purpose, an integrated data logger enables measured values to be stored in a ring buffer with over 3000 measurements. Data can be transferred and evaluated using a MultiSystem measuring device (MS5060Plus or MS5070) or the "HydroCom" software.

Real-time monitoring can be carried out by the electrical interfaces RS232, Can or by the analog 4-20mA signal. A filter unit can also be controlled by configuring an alarm output.

### 3.2 Dimensions of the instrument

The dimensions of the measuring case can be seen on the following technical drawing:

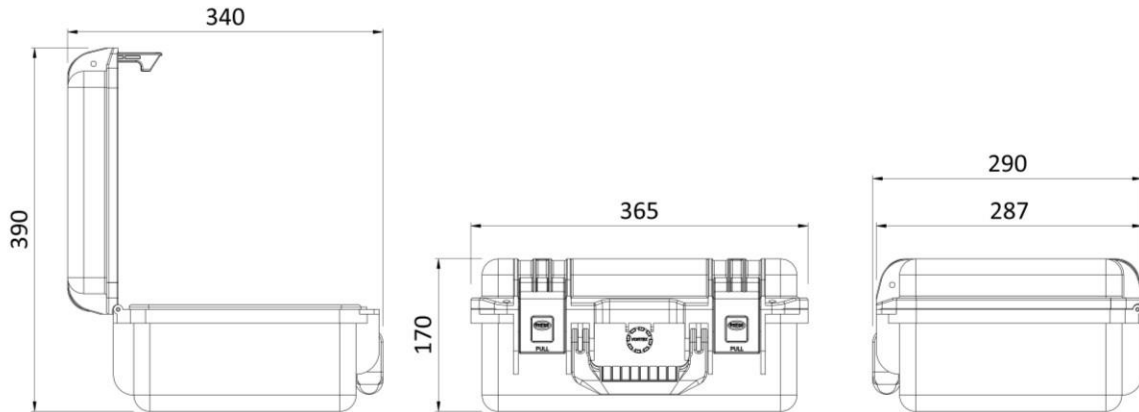


Figure 1: Dimension of the instrument

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### 3.3 Specifications

Specification	Detail
Dimensions	(w)365 mm x (d)290 mm x (h)170 mm
Weight	5.5 kg
Finish	Black HPX resin
Nominal Battery Voltage	15.0 VDC
Charge Voltage	16.8 VDC
Capacity	5.2 Ah
Charge time	2 h (80%) 5 h (100%)
Run time	3 h
Modes of operation	Tank sampling Bottle sampling (1000ml minimum sample bottle recommended)
Cleanliness standards	ISO 4406, NAS 1638, SAE AS4059, GOST 17216
Accuracy	±1 ordinal number
Measuring range	10 – 22 calibrated range; 6 – 10; 22 - 24 non-calibrated range
Viscosity range	1-190 cSt
Fluid compatibility	Diesel & oil (hydraulic, lubrication, mineral, synthetic)
Fluid temperature	-10 to 55°C (oils)
Operating temperature	0°C to +50°C
Connections	1604 minimess test points, with 0.6m long 8mm tubing
Pressure	2.5 bar max (up to 350 bar with optional High Pressure device)
Environment	Lid closed – IP 67 Lid open – IP 54
Maximum humidity	97% relative humidity, non-condensing

### 3.4 Description of the instrument

This chapter describes the user interface and the connections of the portable particle monitor:



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Figure 2: User interface of the instrument

<b>A</b>	<b>Inlet line</b>	<b>E</b>	<b>Digital Output (CAN/RS232)</b>
<b>B</b>	<b>Outlet line</b>	<b>F</b>	<b>Switch for Sensor / Pump</b>
<b>C</b>	<b>Analog Output</b>	<b>G</b>	<b>Connector for power supply</b>
<b>D</b>	<b>Battery indicator</b>	<b>H</b>	<b>Particle monitor</b>

The foam insert in which the accessories are placed is located on the user interface. Figure 3 describes the accessories.



Figure 3: Foam insert for the accessories

<b>A</b>	<b>Power adapter</b>	<b>C</b>	<b>Inlet hose</b>
<b>B</b>	<b>Cable for power adapter</b>	<b>D</b>	<b>Outlet hose</b>

## 4. INSTALLATION AND START-UP

Commissioning is described in this chapter.

### **⚠ Caution**

#### **Observe the technical specification**

Observe the limits of the technical specification in chapter 3.3. If damage occurs due to non-observance of the device, the liability expires.

ENG

If the battery is sufficiently charged or the system is connected to the power supply, an analysis can be carried out using two variants:

### **4.1 *Measurement via bottle samples / direct withdrawal from the tank***

The hose with the integrated suction filter is connected to the supply line of the portable particle monitor, as shown in Figure 4. The open end is immersed in the bottle sample or tank.

The simple hose line serves as a tank line, via which the oil is returned.

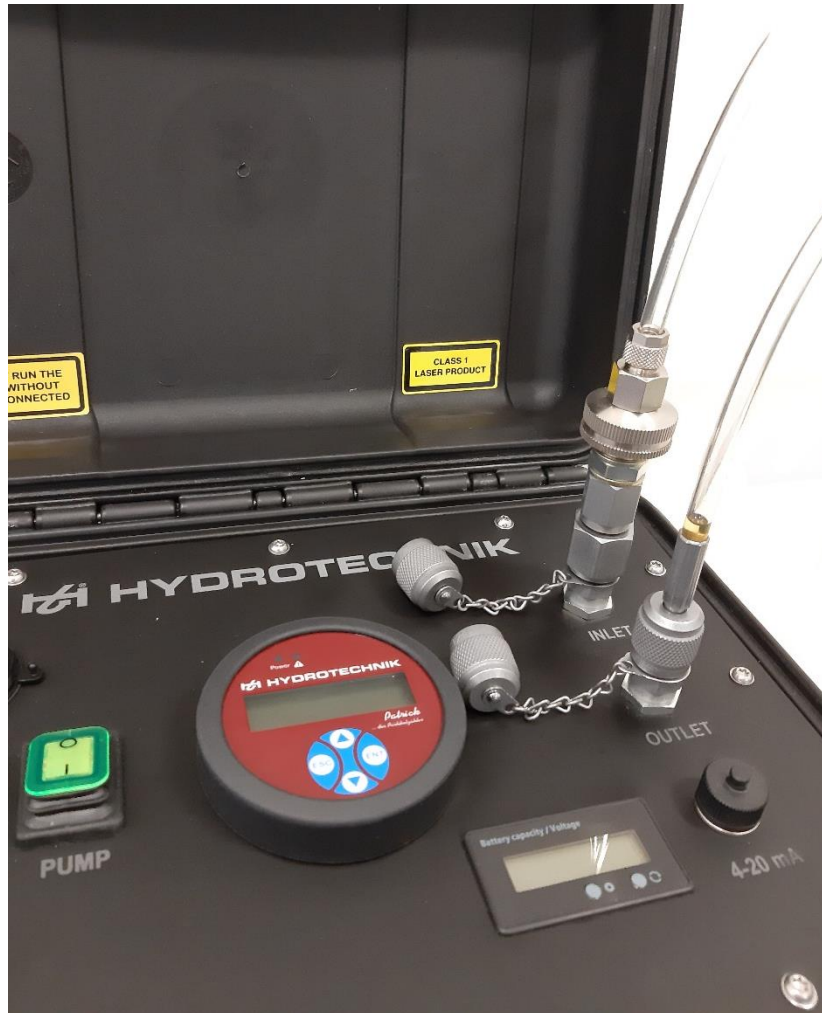


Figure 4: Connection of the hose to the user interface

It is recommended to use at least one sample of 1 liter oil. Make sure that there is no air left in the system. Introduce the oil flowing back through an immersed hose to avoid bubbles.

**Suction strainer**

The suction filter can be dismantled for cleaning. The components are shown in Figure 5.

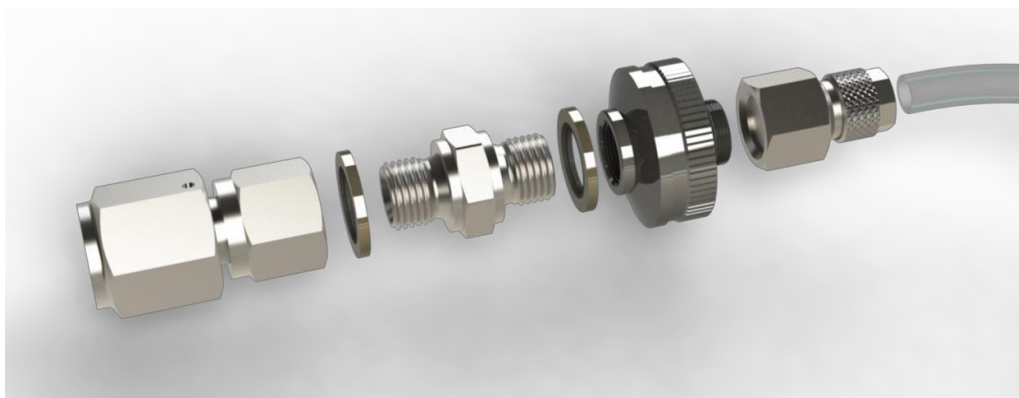


Figure 5: Disassembly of the suction strainer

The inline strainer has a 270 µm mesh and is used for keeping accidental debris from damaging the pump gears or clogging other components.

The strainer must be used always, otherwise the units warranty will become void.



Figure 6: Strainer

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## 4.2 Direct connection to the hydraulic line

Alternatively, it is also possible to connect the "Patrick in the Box" device to a pressure line via Minimess® test points

### Warning

#### Connection to pressure line

Always use the pressure reducing valve by pressures greater than 2.5 bar. If pressure surges above 2.5 bar are passed into the device, this will damage the pump!

Figure 7 shows the connection to a pressure line via the pressure reducing valve. The pressure reducing valve can be connected to a pressure line using a standard Minimess® hose (e.g. 1m hose with Minimess® 1620 test points: Order no.: S110-AC-AC-01.00N).





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Figure 7: Connection to the pressure line via the pressure reducing valve

### 4.3 Deaerate the device and the hose lines

A plausible measurement is only possible when all the air has been displaced and there are no more air bubbles. Proceed as follows:

- Connect the measuring instrument as described in chapter 4.1 / 4.2.
- Start the pump. Wait until no more air bubbles can be seen on the transparent hose on the discharge line.
- Then you can start the measurement process.

**⚠ Caution**

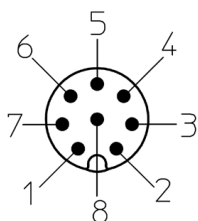
**Risk of contamination with incompatible oil**

Since the portable particle monitor could still be filled with incompatible oil from the last measurement, let the flow separate into an extra bottle.

**4.4 Electrical connections**

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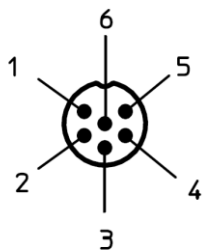
The following illustration shows the pin assignment of the electrical connections for the digital Interface:



Circular connector M12 x 1;  
8-pin connector

Pin	
1	Stromversorgung
2	GND
3	TxD, CAN-L
4	RxD, CAN-H
5	-
6	-
7	-
8	-

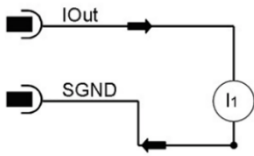
The analog interfaces are on the M16 x 0.75; 6-pin connector with the following pin assignment:



Circular connector M16 x 0.75;  
6-pin connector

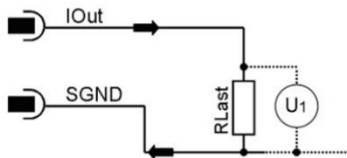
Pin	
1	Signal
2	GND
3	-
4	-
5	-
6	-

### Current measurement



Carry out the current measurement with a suitable measuring device. The current measurement does not require a load resistor. Here you measure the current directly between 4 mA and 20 mA.

### Voltage measurement



In order to be able to measure the currents of the two analog current outputs, a load resistor must be connected to each output. Depending on the supply voltage, the load resistance should be between 250 and 2,600 ohms. With a voltmeter you can measure the voltage that drops across the respective resistor.

ENG

## 4.5 Evaluation

The measurement result can be read directly on the particle monitor. The precise operation and menu navigation are described in the operating instructions of the particle monitor "Patrick". These operating instructions can be found on the homepage of [www.hydrotechnik.com](http://www.hydrotechnik.com).

Furthermore, the portable particle monitor can be connected directly to the measuring device using a suitable hydrotechnik measuring device (e.g. MultiSystem 5070). This makes it possible to read the history memory and display it graphically.

A connection to a PC is possible using the USB-CAN adapter (order no.: 8824-T4-02.00). With the HydroCom software it is also possible to read out the memory and display the measured values.

### ***Conversion of analog output to ordinal number***

The analog current output provides a signal from 4 ... 20 mA. The conversions for the respective ordinal numbers are described below.

I/mA	ISO 4406:99	SAE AS4059E
4	0	000
12	13	5
20	26	12

Table: Comparison table current output to atomic number ISO and SAE.

I/mA	NAS 1638	GOST 17216
4	00	00
12	7	15
13	8	17
14	9	-
15	10	-
16	11	-
17	12	-
20	-	-

Table: Comparison table current output to atomic number NAS and GOST

Standard	Atomic number formula
ISO 4406:99	$1.625 * I/mA - 6.5$
SAE AS4059E	$0.875 * I/mA - 5.5$
NAS 1638	$I/mA - 5$
GOST 17216	$2 * I/mA - 9$

Table: Conversion of atomic numbers

## 4.6 Sequential data output

For the standards ISO 4406:99 and SAE AS4059E, you can select a sequential data output.

There are two modes for the sequential data output:

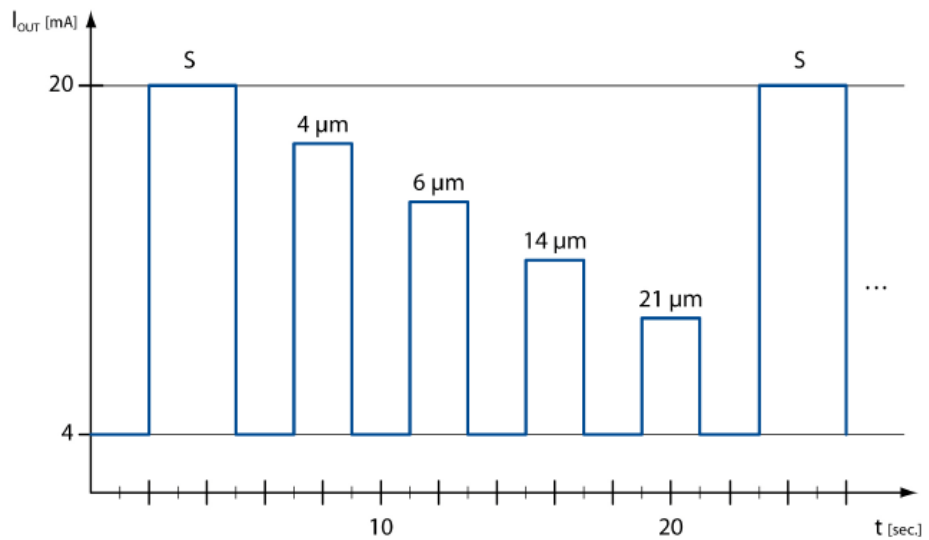
- Sequential
- Sequential 2

**Sequential**

After a start sequence (S), the measurement values for the different size classes are transmitted one after another. After a pause, the next cycle begins with the transmission of the start sequence.

For NAS and GOST, no sequential output is available.

**Sequence 1 - 5**



Picture: Sequence for the output of all parameters one after another

ENG

**Sequential2**

The Sequenziell2 mode is an expansion of the Sequenziell mode. The expansion consists of the three following sequences:

**Sequence 6**

Meaning	I/mA							
	5	7	9	11	13	15	17	19
Flow too low ERC 1, Bit 10	1	1	1	1	0	0	0	0
Flow too high ERC 1, Bit 9	1	1	0	0	1	1	0	0
Error in measurement cell ERC 4, Bit 0, 1, 2 or 3	1	0	1	0	1	0	1	0

**Sequence 6**

Meaning	I/mA							
	5	7	9	11	13	15	17	19
Flow too low ERC 1, Bit 10	1	1	1	1	0	0	0	0
Flow too high ERC 1, Bit 9	1	1	0	0	1	1	0	0
Error in measurement cell ERC 4, Bit 0, 1, 2 or 3	1	0	1	0	1	0	1	0

**Sequence 7**

Meaning	I/mA							
	5	7	9	11	13	15	17	19
Concentration too low ERC 1, Bit 14	1	1	1	1	0	0	0	0
Concentration too high ERC 1, Bit 8	1	1	0	0	1	1	0	0
Measurement result not plausible ERC 1, Bit 13	1	0	1	0	1	0	1	0

**Sequence 8**

Meaning	I/mA							
	5	7	9	11	13	15	17	19
Alarm concentration ERC 4, Bit 14	1	1	1	1	0	0	0	0
Alarm temperature ERC 4, Bit 15	1	1	0	0	1	1	0	0
ISO(i+1) ≥ ISO(i) ERC 1, Bit 11	1	0	1	0	1	0	1	0

Table: Sequence for the second sequential mode

ENG

## 5. DESCRIPTION OF THE PATRICK

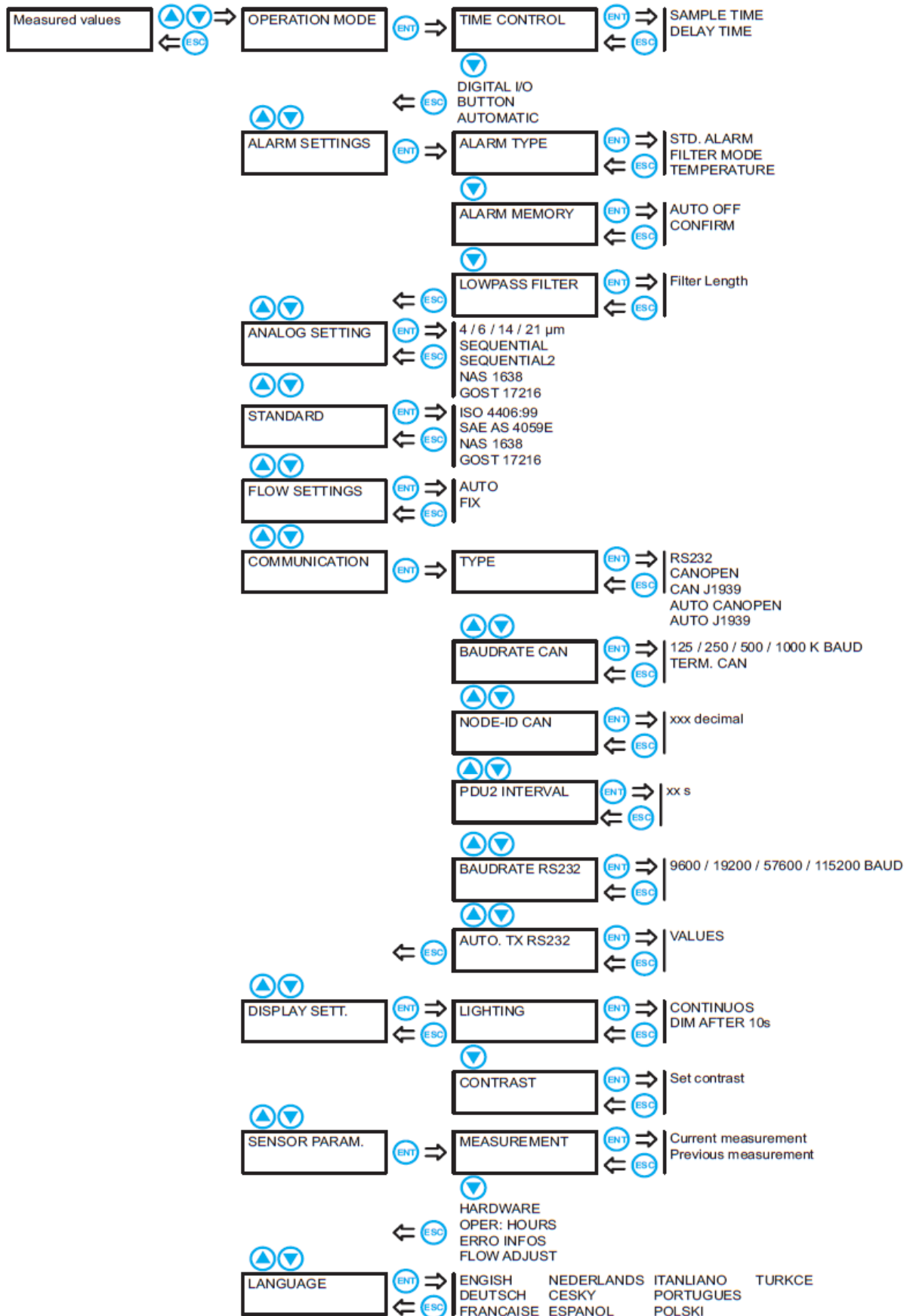


A	Fluid supply
B	Pivoting instrument front
C	Power light
D	Alarm light
E	Display
F	Fluid drain
G	Enter key
H	Page up key
I	Page down key

ENG

	<p>Calls up the main menu from the measurement value display</p> <p>Moves the highlighting up</p> <p>Increases a number in an input field</p>
	<p>Calls up the main menu from the measurement value display</p> <p>Moves the highlighting down</p> <p>Reduces a number in an input field</p>
	<p>Selects menu entries from and open submenus</p> <p>Confirms the entries</p> <p>Jumps to the next number in an input field</p>
	<p>Jumps one menu level up</p> <p>Exits the main menu</p> <p> Cancels entries</p>

**5.1 Menu tree**



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The individual submenus and functions are described chronologically below.

## Selecting the operating mode

<b>⚠ Note</b>
<p><b>Heed minimum measurement duration</b></p> <p>The measurement duration should always be at least 30 seconds; otherwise, under some circumstances, the particle count cannot be recorded completely. The cleaner the oil is, the longer it should be measured. Purity grades according to ISO 4406:99 of 15 and better should be re-measured at least every 120 seconds.</p>

ENG

**Patrick** can be used in three operating modes:

<b>Timer</b>	<p><b>Patrick</b> works with the set measurement duration and wait time between the measurements.</p> <p>Example: one minute measurement duration and four minutes wait time produces a result every five minutes. In fact, it takes two to three seconds longer since the laser is regulated at the beginning of each measurement.</p> <p>With activated and marked Timer option, press <b>ENT</b> again to set the measurement duration and wait time:</p> <ul style="list-style-type: none"> <li>• Measurement duration:                     <ul style="list-style-type: none"> <li>Press <b>ENT</b> to start the entry.</li> <li>Arrows appear next to the first digit.</li> <li>Press <b>▲ ▼</b> to set the first digit.</li> <li>Press <b>ENT</b> to change to the next digit.</li> <li>Set all of the digits of the measurement duration this way, confirm with <b>ENT</b> and press <b>ESC</b>.</li> </ul> </li> <li>• Wait time:                     <ul style="list-style-type: none"> <li>Set the desired wait time as described for the measurement duration</li> </ul> </li> </ul>
<b>Digital I/O</b>	<p>The measurement lasts as long as there is a signal on the input. The digital input is active if it is connected to a ground. Then there is a current of</p> $I = (U - 1.1 \text{ V}) / 5600 \ \Omega$ <p>With U = supply voltage.</p>
<b>Key</b>	<p>Press the <b>ENT</b> key to start and end a measurement.</p>
<b>Automatic</b>	<p>In automatic mode, the measurement time is determined dynamically, depending on the flow and the particle concentration.</p> <p>The measurement can last between 45 and 300 seconds. A measurement value should be awaited at the earliest after 45 seconds if in this time the defined number of particles was detected. If the defined number of particles has also not been detected after 300 seconds, the measurement is cancelled and the result displayed. The result is then not backed up statistically.</p>

## Configuring alarms

**Alarm type** First you select the alarm type here:

<b>Std. Alarm</b>	As soon as a channel exceeds a set threshold, the alarm is triggered.
<b>Filter mode</b>	Serves to monitor a cleaning: As soon as all activated channels have dropped below a threshold, the alarm is triggered.
<b>Temperature</b>	As soon as the temperature exceeds the set threshold, the alarm is triggered. In order to deactivate the alarm, the limit value must be <b>00</b> . The measured temperature does not correspond directly to the temperature of the oil.

ENG

Activate the desired alarm type with and then press again to display the alarm thresholds:

STD. ALARM			
0/	0/	0/	0

Press “ENT” to start the entry. Arrows appear next to the first “zero”. Press “up/down” to set the first alarm threshold. Press “ENT” to change to the next size class. Set the alarm thresholds this way for all size classes. If one should not be considered, set its value to 0.

The thresholds set for the standard alarm also apply for the filter mode, and vice-versa.

**Alarm memory** Here you select the behavior of Patrick when an alarm is present. This can either be switched off automatically (Autom. off), or it can remain active up to an acknowledgement by keypress (Confirm).

**Deep-Pass filter** In a hydraulic system, short-term concentration increases (peaks) can occur, which are not representative for the overall system. The particle counter detects this change and displays these correctly.

The deep-pass filter ensures that for a set alarm threshold, an alarm is not triggered for each peak. The particle concentrations relevant for the alarm are smoothed internally and an alarm is only output in case of a long-lasting measurement change. The measurement value output and display are not affected by the filtering.

- With a volumetric flow of 0 ml/min or an ISO class of 0 to 4 µm, the filter function is deactivated automatically.

- Adjustment range: 1 ... 255 (1 = deactivated)
- Factory setting: 2
- Recommended value: ≤10k

## Configuring analog output

Here you select which data should be output via the analog output

4 μm 6 μm 14 μm 21 μm	Select a size class whose measurement value should be output via the analog output.  The output is done in whole atomic numbers (4 mA corresponds to the atomic number "zero", 20 mA to the atomic number "26").  The output depends on the set standard, ISO or SAE. The maximum working resistance depends on the supply voltage:  $R_{max} = \frac{U - 2V}{20mA} - 100\Omega$
<b>Sequential</b>	The measurement values of all size classes are output one after another. ⇒ <b>Sequential</b> on page 26
<b>Sequenziell2</b>	The measurement values of all size classes are output one after another. Alarms are also output. ⇒ <b>Sequenziell2</b> on page 27
<b>NAS 1638</b>	Output regardless of set standard. On the LCD, ISO, SAE or GOST can be displayed; however, via the analog output, NAS is output.
<b>GOST 17216</b>	Output regardless of set standard. On the LCD, ISO, SAE or NAS can be displayed; however, via the analog output, GOST is output.

ENG

## Selecting a standard

The display of the purity can be selected according to one of the following standards:

- ISO 4406:99
- SAE AS4059E
- NAS 1638
- GOST 17216

For the display according to SAE, ensure that the size classes 38 and 70 μm are not evaluated on separate channels, but together with the size class 21.

The setting refers only to the display on the start screen. In the internal memory and for the output via the digital interface (CAN or RS232), all standards are visible.

You can tell which standard is selected in the bottom left of the start screen.

## Configuring flow rate

Patrick in addition to the particle size and number, also records the flow rate in order to calculate the concentration from this. This happens if the Auto option is set (recommended flow rate: 100 ... 400 ml/min).

ENG

However, since each measurement is afflicted with imprecision, you can permanently set a known flow rate. The concentration is then calculated from this. Set the "Fix" option and then press "ENT" again:

FIX
050 ml/min

Press "ENT" to start the entry. Arrows appear next to the first digit. Press "up/down" to set the first digit. Press "ENT" to change to the next digit. Set the flow rate this way.

Select a flow rate that is similar to the actual flow rate. In case of a larger deviation, the calculated concentration is falsified.

## Selecting communication

Here you define the configuration of the digital interface.

Select type of the interface:

<b>RS 232</b>	Output of the data via the RS232 interface.
<b>CANopen</b>	Output of the data via CAN bus in the CANopen protocol.
<b>CAN J1939</b>	Output of the data via CAN bus in the J1939 protocol.
<b>Auto CANOPEN<sup>(a)</sup></b>	The connected interfaces are detected automatically. If the CAN type is detected, the CANopen protocol is used.
<b>Auto J1939<sup>(a)</sup></b>	The connected interfaces are detected automatically. If the CAN type is detected, the CAN J1939 protocol is used.

**CAN baud rate**

Select the speed of the data transmission via the CAN interface. The selected speed must match that of your CAN bus; otherwise communication is not possible.

50 / 125 / ...	Select the speed in kBaud.
Term. CAN	Switches on a 120 Ω resistance for termination of the CAN line. This option should always be activated.

**Node-ID**

Here you can display the set Node-ID of the particle counter. You need this in order to correctly address CAN commands or to assign CAN signals correctly.

ENG

**PDU2 Interval**

You can set the interval with which the PDU2 is sent here. PDU2 is only used with CAN J1939.

**Baud rate RS 232**

Select the speed of the data transmission via the RS 232 interface. The selected speed must match that of your system; otherwise communication is not possible.

**Automatic send**

Here, you can set whether the measurement values are sent automatically via the RS232 interface.






## Configuring the display

A variety of display styles are available for the display.

- **Lighting:**  
Selection whether the background lighting should be permanently active or whether it should be deactivated automatically after 10 seconds.
- **Contrast:**  
Adjustment of the contrast via a bar display

## Sensor parameters

With this menu element, you can display various parameters of the particle counter:

<b>Measurement results</b>	<p>Displays the last measurement results of the size glasses and the index of the volumetric flow.</p> <p>Press  to switch the display between the size classes.</p> <p>Press  to display the previous measurement result.</p>
<b>Electronics</b>	<p>Displays various measurement values of the electronics.</p> <p>Press  to display additional parameters.</p>
<b>Operating hours</b>	<p>Displays the number of operating hours of sensor and laser.</p>
<b>Error info</b>	<p>Displays a list of the error messages and alarms that have occurred.</p> <p>Press   to page through the available messages.</p>
<b>Set flow</b>	<p>Here the level of the volumetric flow is displayed.</p> <ul style="list-style-type: none"> <li>• If the bar is between <b>L</b> and <b>H</b>, the volumetric flow is OK.</li> <li>• If the bar fills the entire diagram or if no bar is visible and <b>H/L</b> is flashing, the volumetric flow is too high or too low and it must be adjusted.</li> </ul> <p>The limits of the display (bar diagram) are between L = 50 ml/min and H = 400 ml/min.</p> <p>The display is updated every 10 seconds.</p> <p>If the <b>FIX</b> flow is set to a static value, this is also displayed. However, the bar will not change.</p>

ENG

## Setting the language

Select one of the available languages for the display of the operating menu.

## Calibration

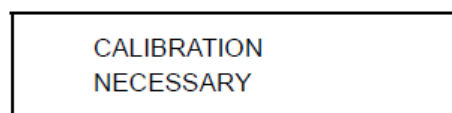
The particle counter is calibrated relying on ISO 11943.

The equipment that is used for the calibration is calibrated first according to ISO 11171 and can thus be traced back to NIST SRM 2806A.

The calibration certificate of the particle counter has an initial validity of 18 months. Subsequent certificates will be issued with a validity of 12 months.

### Calibration note

The particle counter indicates the need for calibration with a message on the display.



Have the particle counter calibrated by the manufacturer.

- Press the “ENT” input key for 2 seconds to acknowledge the message.
- The message appears again after 500, 800 and 900 hours.
- After 1000 hours, the message flashes at a 2-second interval.
- However, the particle counter can be operated completely and provides measurement results at all times.

You can see the remaining hours up to the appearance of the first message (HOURSCAL) on the particle counter’s menu under SENSORPARAM > OPERATING HOURS.

ENG

## 6. COMMUNICATION SETTING

### 6.1 Configuration of the serial interface

Patrick can be read out and configured using a serial interface. For this you need a PC with the installed terminal software.

Connect Patrick to a free COM port on the computer. A suitable communication cable for the serial connection between sensor and PC/controller is available as an accessory. If the computer has no standard COM port, it is possible to use a serial interface card or a USB-serial converter.

ENG

#### 6.1.1 Interface parameters

- Baud rate: 9600 / 57600
- Data bits: 8
- Parity: none
- Stop bits: 1
- Flow control: None

#### 6.1.2 Interface parameters

Command	Meaning	Return format
RVal[←]	Reading of the current measurement value with subsequent checksum (CRC)	\$Time:%.4f[h];ISO4µm:%i[-];ISO6µm:%i[-];ISO14µm:%i[-];ISO21µm:%i[-];SAE4µm:%i[-];SAE6µm:%i[-];SAE14µm:%i[-];SAE21µm:%i[-];Conc4µm:%.2f[p/ml];Conc6µm:%.2f[p/ml];Conc14µm:%.2f[p/ml];Conc21µm:%.2f[p/ml];FIndex:%i[-];Mtime:%i[s];Status:0x0000; 0x0000;0x0000;0x0000;CRC:x
RMemS[CR]	Reading of the storage-capable data records	MemS: xxxx[CR][LF]
RMemU[CR]	Reading of the number of stored data records	MemU: xxxx[CR][LF]
RMem[←]	Reading of all saved measurement values	Time [h]; T [°C]; P [-];P40 [-];PTG [1/K];... [CR][LF] x.xxx;x.xxx;x.xxx;x.xxx; x.xxx;... [CR][LF]
RID[←]	Reading of the identification with subsequent checksum (CRC)	Hydrotechnik;Patrick;SN:xxxxxx-xxx; SW:xx.xx.xx;CRC:x 1)
RCon[←]	Reading of the current configuration	Smode:%i;Fmode:%i;Analog:%i; Amode:%i;Alarm4:%i;Alarm6:%i; Alarm14:%i;Alarm21:%i;(Mtime:%i[s];Htime:%i[s])

Table: Command list: Read commands

Please contact our customer service if you need a complete list of all the commands



## 6.2 Communication via USB

Patrick can be read out using a USB interface. For this you need a PC with the installed software HYDROcom 6. Connect Patrick to a USB port on the computer. A suitable RS 232 - USB converter cable is available as an accessory. Heed the notes in the online help for the HYDROcom 6 software for additional information.

## 6.3 CANopen

The particle counter can be incorporated into bus systems that correspond to the CANopen standard. For a detailed description of CANopen and the underlying architecture, see the relevant specialized books and textbooks.

### CANopen Object Dictionary

The table contains the communication-related part of the particle counter's object directory. The possible settings correspond, but for a few exceptions, to the CANopen standard as described in "DS-301".

Idx	SIdx	Name	Type	Attr.	Standard	Notes
1000h	0	Instrument type	unsigned 32	ro	194h	Sensor, see DS404
1001h	0	Error list	unsigned 8	ro	00h	Obligatory, see DS301
1017h	0	Heartbeat time	unsigned 16	rw	1388h	Heartbeat time in ms, range: 0 ... 65535
1018h		Identity object	record	ro		
	0	Number of entries	unsigned 8	ro	04h	Largest sub-index
	1	Manufacturer ID	unsigned 32	ro	000001C0h	HYDROTECHNIK
	2	Product code	unsigned 32	ro	12D5C74Ch	12D5C74Ch
	3	Version number	unsigned 32	ro	1000	Instrument-dependent
	4	Serial number	unsigned 32	ro		Instrument-dependent
1800h		Transmissions PDO1 parameter	record			
	0	Number of entries	unsigned 8	ro	05h	Largest sub-index
	1	COB-ID	unsigned 32	rw	180h +NodeID	COB-ID of PDO used, range: 181h ... 1FFh, can be changed if switched off (bit 30 must always be set, means no triggered TPDO on RTR)
	2	Transmission type	unsigned 8	rw	FFh	Cyclical + synchronous, asynchronous Values: 1 ... 240, 254, 255
	5	Event time	unsigned 16	rw	1F4h	Event time in ms for asynchronous TPDO1, value must be a multiple of 50 and max 12700

Table: Communication profile

(a) Mapped to PDO

Idx	SIdx	Name	Type	Attr.	Standard	Notes
1801h		Transmissions PDO2 parameter	record			
	0	Number of entries	unsigned 8	ro	05h	Largest sub-index
	1	COB-ID	unsigned 32	rw	280h +NodeID	COB-ID uses from PDO, range: 281H .. 2FFh, can be changed if switched off (bit 30 must always be set, means no triggered TPDO on RTR)
	2	Transmission type	unsigned 8	rw	FFh	Cyclical + synchronous, asynchronous Values: 1 ... 240, 254, 255
	5	Event time	unsigned 16	rw	1F4h	Event time in ms for asynchronous TPDO2 range: 0 ... 65000
1802h		Transmissions PDO3 parameter	record			
				ro		
	0	Number of entries	unsigned 8	ro	05h	Largest sub-index
	1	COB-ID	unsigned 32	rw	380h+NodeID	COB-ID uses from PDO, range: 381H .. 3FFh, can be changed if switched off (bit 30 must always be set, means no triggered TPDO on RTR)
	2	Transmission type	unsigned 8	rw	FFh	Cyclical + synchronous, asynchronous Values: 1 ... 240, 254, 255
	5	Event time	unsigned 16	rw	1F4h	Event time 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 first application object to be mapped	unsigned 32	co	20000220h	Operating hours stamp for the measurement, 4 bytes
	2	PDO mapping for second application object to be mapped	unsigned 32	co	20010108h	ISO4µm, 1 Byte in 2001h, sub 01
	3	PDO mapping for third application object to be mapped	unsigned 32	co	20010208h	ISO6µm, 1 Byte in 2001h, sub 02
	4	PDO mapping for fourth application object to be mapped	unsigned 33	co	20010308h	ISO14µm, 1 Byte in 2001h, sub 03
	5	PDO mapping for fifth application object to be mapped	unsigned 32	co	20010408h	ISO21µm, 1 Byte in 2001h, sub 04

Table: Communication profile

(a) Mapped to PDO

Idx	SIdx	Name	Type	Attr.	Standard	Notes
1A01h		TPDO2 Mapping Parameter	record			
	0	Number of entries	unsigned 8	ro	05h	Largest sub-index
	1	PDO mapping for first application object to be mapped	unsigned 32	co	20000220h	Operating hours stamp for the measurement, 4 bytes
	2	PDO mapping for second application object to be mapped	unsigned 32	co	20020108h	SAE4 $\mu$ m, 1 Byte in 2002h, sub 01
	3	PDO mapping for third application object to be mapped	unsigned 33	co	20020208h	SAE6 $\mu$ m, 1 Byte in 2002h, sub 02
	4	PDO mapping for fourth application object to be mapped	unsigned 32	co	20020308h	SAE14 $\mu$ m, 1 Byte in 2002h, sub 03
	5	PDO mapping for fifth application object to be mapped	unsigned 32	co	20020408h	SAE21 $\mu$ m, 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 first application object to be mapped	unsigned 32	co	20000120h	Operating hours counter, 4 bytes
	2	PDO mapping for second application object to be mapped	unsigned 32	co	20030108h	Operating hours counter, 1 byte
	3	PDO mapping for third application object to be mapped	unsigned 32	co	20030708h	Measurement bits, 1 byte
	4	PDO mapping for fourth application object to be mapped	unsigned 32	co	20030808h	Sensor status bits, 1 byte
	5	PDO mapping for fifth application object to be mapped	unsigned 32	co	20040008h	Temperature, 1 byte
2000h		Time-related sensor parameter	record			
	0	Number of entries	unsigned 8	ro	02h	Largest sub-index
	1	Operating hours counter <sup>1</sup>	unsigned 32	ro		Sensor operating time in seconds
	2	Operating hours stamp for the measurement <sup>1</sup>	unsigned 32	ro		Time stamp for the last measurement

Table: Communication profile

(a) Mapped to PDO

ENG

Idx	SIdx	Name	Type	Attr.	Standard	Notes
2001h		ISO measurement	record			
	0	Number of entries	unsigned 8	ro	04h	Largest sub-index
	1	ISO4 $\mu\text{m}^1$	unsigned 8	ro		
	2	ISO6 $\mu\text{m}^1$	unsigned 8	ro		
	3	ISO14 $\mu\text{m}^1$	unsigned 8	ro		
	4	ISO21 $\mu\text{m}^1$	unsigned 8	ro		
2002h		SAE measurement	record			
	0	Number of entries	unsigned 8	ro	04h	Largest sub-index
	1	SAE4 $\mu\text{m}^1$	unsigned 8	ro		Offset of two to be depicted by 000 00 and 0, Applies for all classes: 0 = SAE 000 1 = SAE 00 2 = SAE 0 3 = SAE 1 4 = SAE 2 ...
	2	SAE6 $\mu\text{m}^1$	unsigned 8	ro		
	3	SAE14 $\mu\text{m}^1$	unsigned 8	ro		
	4	SAE21 $\mu\text{m}^1$	unsigned 8	ro		

Table: Communication profile

(a) Mapped to PDO

ENG

Idx	SIdx	Name	Type	Attr.	Standard	Notes
2003h		Condition monitoring bit field	array			
	0	Number of entries	unsigned 8	ro	08h	Largest sub-index
	1	Oil-specific bits <sup>1</sup>	unsigned 8	ro		0 = Conc. Limit exceeded (C >= ISO 23) 1 = Flow rate high (F > 400) 2 = Flow rate low (F < 50) 3 = Measurement values not plausible (air...), ISO (i+1) >= ISO(i) 4 = AutoMode: MessZeit reached 5 = Autoparts not reached 6 = Concentration too low
	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 information <sup>1</sup>	unsigned 8	ro		0 = measurement running 1 = measurement mode auto 2 = measurement mode I/O 3 = measurement mode manual 4 = alarm mode filter / standard
	8	Sensor alarm <sup>1</sup>	unsigned 8	ro		0 = laser current high (I > 2.8 mA) 1 = laser current low (I < 1 mA) 2 = Photo voltage high (U > 4V) 3 = Photo voltage low (U < 4V) 4 = Temperature high (T > 80°C) 5 = Temperature low (T < -20°C)
2004h	0	Sensor temperature <sup>(a)</sup>	signed 8	ro		Oil temperature in °C
2005h	0	Flow index	unsigned 16	ro		Flow index (0 ... 400)

Table: Communication profile

(a) Mapped to PDO

Idx	SIdx	Name	Type	Attr.	Standard	Notes
2020h		Command	unsigned 8	wo		1 = measurement start 2 = measurement stop
2030h		Measurement settings	record			
	0	Number of entries	unsigned 8	ro	2h	Largest sub-index
	1	Meas. period	unsigned 32	rw		Measurement time in s
	2	Wait time	unsigned 32	rw		Time between two measurements
2031h		Start settings	record			
	0	Number of entries	unsigned 8	ro	1h	Largest sub-index
	1	Start mode	unsigned 16	rw	0h	0 = network with NMT master (Init => PreOp => Start_Remote_Node => Operational) >0 = network without NMT master (Init => Operational)
2100h		Control functions read memory	record			
	0	Number of entries	unsigned 8	ro	3h	Largest sub-index
	1	Size of the history memory	unsigned 32	ro	Instrument-dependent	Memory size in data records
	2	History memory used	unsigned 32	ro		Occupied data records in the memory (corresponds internally to the write pointer)
	3	Read pointer, data record	unsigned 32	rw		Auto incremental read pointer to a data record to read the history memory Between 0 and the current write pointer
2101h	0	Memory reading begins segmented SDO data uploading	unsigned 16	ro		Before reading, a suitable pointer must be set (with 2100sub3), data record size is sent back after reading Thus a standardized "segmented SDO Upload" is initiated To be noted: for each data record change a toggle bit and set the appropriate bit at the end of the complete transmission

Table: Communication profile

(a) Mapped to PDO

ENG

## 7. SERVICE AND ACCESSORIES

### 7.1 Cleaning and maintenance

The portable particle monitor "Patrick in the Box" can be cleaned on the outside with a soft, slightly damp cloth. If the device was previously used with a contaminated or other incompatible oil type, the oil in the device and in the pipes must be replaced by a flushing process. To do this, separate the flow in the vent.

#### **Caution**

##### **Damage to the measuring device possible!**

Switch off the instrument and disconnect it from the power supply before you start cleaning. Otherwise there may be a short circuit, which can damage the measuring device considerably.

#### **Vorsicht**

##### **Damage to the measuring device possible!**

Never use aggressive cleaning agents, solvents or similar chemicals to clean the measuring section or the sensors. The result could be damage to the sensor elements and thus an impact on the measurement results.

The portable particle monitor "Patrick in the Box" works largely maintenance-free. However, it is necessary to have the particle monitor calibrated regularly. We recommend calibration every 12 months if used frequently. Have the portable particle monitor calibrated by the manufacturer. HYDROTECHNIK maintains an efficient calibration laboratory. Please contact our service at:

Tel.: +49 6431 4004-555  
Email: [service@hydrotechnik.com](mailto:service@hydrotechnik.com)

ENG

## 7.2 Accessories and spare parts

Order number	Description	Note
5117-06-20.00	Pressure reducing valve	When connecting to pressure lines greater than 2.5 bar
S150-AD-AD-0050N	Minimess® hose DN4-315 bar; 0,5m	Connection of pressure reducing valve and instrument
S100-AC-AC-0100N	Minimess® Messschlauch DN2-400 bar; 1m	Connection of the pressure reducing valve to pressure lines
3160-00-82.00	MultiSystem 5070	
8824-T4-02.00	USB - CAN Adapter mit 2m Kabel zum Anschluss an PC	When used with the "HydroCom" software

ENG



## 8. APPENDIX

### 8.1 Troubleshooting

#### No communication on the COM port or power failures < 4 mA

Cable not connected correctly	Connect the power and communication cables correctly.
Operating voltage outside the prescribed range	Operate the sensor in the range between 9 and 36 VDC.
Communication bus incorrectly configured	Check the settings on the <b>Communication</b> menu.

ENG

#### No serial communication

Interface configuration incorrect	Check whether the interface parameters (9600, 8, 1, N, N) in <b>Patrick</b> and PC are set correctly.
Wrong COM port	Check and correct the COM port
Incorrect spelling of the sensor commands	Check the spelling of the sensor commands, heed upper and lower-case letter.
NumLock key deactivated	Activate the NumLock key.
Shift key is on (Upper case letters)	Deactivate the upper case letters by pressing the Shift key.
Cable incorrect or defective	Use only cables from HYDROTECHNIK GmbH.

#### Identical measurement values in all size classes

Air in the oil	Connect the particle counter to the pressure side. Increase the distance from the pump. Increase the operating pressure within the specified range.
----------------	---

#### All size channels display the value 0/0/0/0

No volumetric flow	Check the supply and return lines for correct installation. Increase the operating pressure within the specified range.
There is no valid measurement result	Check the configuration and the measurement mode. Make sure that a measurement begins and is completed.
Measurement cell soiled The symbol flashes on the display ►	Clean the particle counter with clean oil or solvent such as Isopropanol. Flush with clean oil in the opposite direction.
Measurement cell defective The symbol flashes on the display ►	Contact HYDROTECHNIK GmbH.

**Incorrect measurement of the analog current outputs**

<b>Incorrect parameter is output</b>	Correct the assignment of the measurement values to the current outputs.
--------------------------------------	--

**no valid application appears constantly on the display  
The device keeps restarting**

<b>The basic system has a fault. All communication lines are deactivated automatically.</b>	Contact HYDROTECHNIK GmbH.
---	----------------------------

ENG

**Laser current high / photo voltage low**

<b>Air in the oil</b>	Connect the particle counter to the pressure side. Increase the distance from the pump. Increase the operating pressure within the specified range.
<b>Measurement cell soiled</b>	Clean the particle counter with clean oil or solvent such as Isopropanol. Flush with clean oil in the opposite direction.

**8.2 Error Code**

Patrick Collects various errors, information and operating states and combines these into four 16-bit values, the ERC (error code).

Bit	ECR 1	ECR 2	ECR 3	ECR 4
0		First limit value calibration (S1) reached		Laser current too large
1		Last limit value calibration (S5) reached		Laser current too small
2				Detector voltage too small
3				Detector voltage too large
4				Temperature >80°C
5				Temperature <-20°C
6				
7				Measurement mode = Automatic
8	Concentration ≥ ISO 23			Measurement running
9	Flow too high (Flow < 50)			Measurement mode = timed

Bit	ECR 1	ECR 2	ECR 3	ECR 4
10	Flow too low (Flow > 400)			Measurement mode = Digital I/O
11	ISO(i+1) ≥ ISO(i)			Measurement mode = Key
12				Alarm mode: 0= Standard 1= Filter
13	Autoparts not reached			Power Up = 1 before first measure- ment
14	Concentration ≤ ISO 9			Alarm concentration
15				Alarm temperature

Table: *ERC*

ENG

### 8.3 Errors on the display

After each measurement, Patrick checks various conditions. If the check produces errors during measurement or on the instrument, then these are output on the display.

The errors are output on the left of the display. The error text flashes. If more than one error is displayed, then the error texts are output so that they alternate.

Error text	Meaning	Error Code
FL LO	Flow too low	ECR 1, Bit 10
FL HI	Flow too high	ECR 1, Bit 9
CELL	Error in measurement cell	ERC 4, Bit 0, 1, 2 or 3
C LO	Concentration too low	ERC 1, Bit 14
C HI	Concentration too high	ERC 1, Bit 8
2 CLN	Measurement result not plausible	ERC 1, Bit 13

Table: *Error texts*

Email: [info@hydrotechnik.com](mailto:info@hydrotechnik.com)  
[www.hydrotechnik.com](http://www.hydrotechnik.com)

**Hydrotechnik GmbH**  
D-65549 Limburg  
Tel.: +49 6432 4004-0

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