AS 2000 Serie AquaSensor

Operating and maintenance instructions
Valid from firmware version 3.x up

English (translation of original instructions)

Document no.: 3114096d / 2008-10-23
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All details are subject to technical modifications.
Technical specifications are subject to change without notice.

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Preface

For you, as the owner of a product manufactured by us, we have produced this manual, comprising the most important instructions for its operation and maintenance.

It is intended to help you become acquainted with the ins and outs of the product and use it properly.

You should keep it in the vicinity of the product so it is always at your fingertips.

Sometimes the information contained in the documentation cannot always keep up with changes made to the product as we attach considerable importance to keeping our products cutting-edge. Consequently, there might be deviations in technical details, illustrations and dimensions.

If you discover errors while reading the documentation or have suggestions or other useful information, please don't hesitate to contact us:

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We look forward to receiving your input.

Our motto: “Putting experience into practice”
Customer Service

If you have any questions, suggestions, or encounter any problems of a technical nature, please don't hesitate to contact us. When contacting us, please always include the model/type designation and article no. of the product:

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Modifications to the Product

We would like to point out that changes to the product (e.g. purchasing options, etc.) may result in the information in the operating instructions no longer being completely accurate or sufficient.

When making modifications or performing repair work to components affecting the safety of the product, the product may not be put back into operation until it has been examined and released by a HYDAC representative.

Please notify us immediately of any modifications made to the product whether by you or a third party.

Warranty

For the warranty provided by us, please refer to the General Terms of Sale and Delivery of HYDAC Filtertechnik GmbH.

They are available at: www.hydac.com ⇒ Legal information.
Using the documentation

Please note that the method described above of locating specific information does not release you from your responsibility for carefully reading the entire manual prior to starting the unit up for the first time and carefully rereading the manual at regular intervals later on.

WHAT do I want to know?
I determine which topic I am looking for.

WHERE can I find the information I'm looking for?
The document has a table of contents at the beginning. I select the chapter I’m looking for and the corresponding page number.

The documentation number with its index enables you to order another copy of the operating and maintenance instructions. The index is incremented every time the manual is revised or changed.
Basic Safety Instructions

Installation, operation and maintenance tasks are only to be performed by competent personnel familiar with these operating and maintenance instructions.

The safe operation of the AS2000 can only be ensured if it is used for the purpose it was intended. If there is any question about the use, please contact the manufacturer. The manufacturer will not accept liability for damages resulting from misuse of the AS2000.

The following applies to all work performed using the unit: adherence to pertinent national regulations pertaining to accident prevention and safety at the workplace in addition to any applicable internal rules and regulations of the owner/operator, even though they are not specifically cited herein.

Whenever work is to be performed on one of the devices, it must first be separated from the voltage supply.

Do not measure on live parts!

Observe the measurement range of the device. The probes will be destroyed in the event of overheating.

The devices correspond to relevant requirements concerning electrical operating equipment. For this purpose, the following standards are complied with:

- Interference immunity factor to EN 61 326/A1: 1998
- Interference emission to EN 61 326 class B:1997

Abbreviations and symbols

The following symbols are used in these operating instructions to designate instructions of particular importance:

⚠️ This symbol denotes safety precautions, the non-observance of which can endanger persons and the environment

❗️ This symbol provides important instructions and tips for the proper handling and operation of the unit. Non-adherence to these instructions may result in damage to the immediate surroundings or cause the unit to malfunction or discontinue operation.

👉 This symbol designates tips for usage and other particularly useful information.
Proper/Designated Use

Use the device only for the following fields of application:

The display for the AquaSensor is a display and parametering unit for transducers. With this, one can:

- measure the relative humidity and temperature in mineral oils
- display measured values
- configure the transducer
- carry out a humidity adjustment.
- link several transducers together by means of an RS485 bus

Standards / Inspections

According to the Certificate of Conformance, this product fulfills the guidelines pursuant to 89 / 336 / EWG.

Checking the scope of delivery

Before commissioning the AquaSensor, check the contents of the package to make sure everything is present.

Included in the scope of delivery for the AquaSensor are the following:

- AquaSensor with probe
- Stainless steel screw connection ½” with cutting ring
- Ferrite sleeve (for utilization, see page 15)
- This manual
Technical Description

The AquaSensors AS 2000 series are stationary, microprocessor based measurement units for the continuous monitoring of the water saturation level and temperature in hydraulic and lubrication systems.

The saturation level indicates what percent of maximum possible water is dissolved in the oil. For this, 0% would mean water-free oil and 100% would mean oil that is completely saturated with water.

The AS measures the saturation level of oils independent of oil type, age or temperature.

It is designed for connection to low-pressure hydraulic lines of up to 10 bar (1MPa).

The saturation level and temperature are continuously outputted via various (in part optional) electric outputs (alarm relays, display, analogue electric output 4-20mA, RS485), and can thus be captured/read out via a PLC, analog ampere meter or a PC.

A saturation level of less than 50% should be maintained as a rule in order to ensure the safe operation of the lubrication and hydraulics systems.

Suitable Fluids

The AquaSensor should only be operated with the following fluids:

<table>
<thead>
<tr>
<th>Fluid Type</th>
<th>DIN Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mineral oils acc.</td>
<td>DIN 50524</td>
</tr>
<tr>
<td>Gear oils acc.</td>
<td>DIN 51517 and DIN 51524</td>
</tr>
<tr>
<td>Synthetic ester (HEES)</td>
<td>DIN 51524</td>
</tr>
</tbody>
</table>

Please contact us if you want to use other fluids.

The probe is not permitted to be immersed in water.
Installation

Wall mounting

The housing of the AquaSensor is designed to be wall-mounted. It should be placed in good position for reading and operating (at eye level if at all possible).

Ensure that sufficient space is available for the purpose of installing the cables.

Dimensions
Electrical Installation

It is not permitted to lengthen or shorten the sensor cable.

The casing of the AquaSensor features three heavy-gauge threaded cable fittings through which all the electrical supply and signal lines are routed into the casing. The lines are connected to the terminals inside the casing.

Depending upon the AquaSensor version ordered, there will be one or two modules in the housing:

- **Main module** that is supplied with all versions. This module has the terminals for the 4-20 mA analog outputs and the voltage supply for the main module plus three adjustment keys.

- Optional **Display Module** with terminals for the alarm relays, RS485 and voltage supply of the display module.

![Diagram](image)

(A) 4 … 20 analogue outlet + Main Module voltage supply
(B) RS 485 + Display Module voltage supply
(C) Alarm relays
(D) Display module (optional)
(E) Main board

Fig. 2-2
Main Module terminal assignment

The Main Module contains the 4 ... 20mA analogue outputs for the saturation level (\%S) and the temperature (°C). The main module is powered through the saturation level connections.

In addition, there are also three adjustment keys which are used to adjust the AquaSensor settings.

Actuate the adjustment keys only during an adjustment operation in order to prevent the loss of calibration values.

Adjustment keys

| + / - %S | • 4 ... 20 mA analogue output for saturation level  
| + / - °C | • Main Module voltage supply: 24°V°DC (10° ... 28°V°DC)  
|          | Analogue output temperature |

Voltage supply and analog outlets

The AquaSensor is supplied through the connections for the saturation level with 24 V DC (10 ... 28 V DC) versorgt.

The power consumption of the AquaSensor from the DC current source changes in the range from 4 ... 20 mA, depending on the parameter being measured.
The **ferrite sleeve** supplied is used for damping line-related interference signals and is clipped over the voltage supply cable in the vicinity of the connection terminals of the AS (outside the AS housing). This applies accordingly for the following connection descriptions.

**Display Module terminal assignment (optional)**

The display module (optional) contains terminals for the alarm relays, RS485 and the display power supply.

**B) Data interface RS485 and power supply display module**

<table>
<thead>
<tr>
<th>0 V</th>
<th>Ground display module</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATA - / DATA +</td>
<td>RS485 Bus</td>
</tr>
<tr>
<td>VCC</td>
<td>24VDC (10...28VDC)</td>
</tr>
</tbody>
</table>

**C) Switching outputs**

<table>
<thead>
<tr>
<th>+</th>
<th>Common +: max.: 28 V DC / 100 mA</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS2 / LS2</td>
<td>High / low limit value for temperature</td>
</tr>
<tr>
<td>HS1 / LS1</td>
<td>High / low limit value for saturation level</td>
</tr>
</tbody>
</table>

In order to ensure problem-free operation when using analog outputs, the voltage supply lines of the main and display module must be galvanically isolated from one another.

**Connection variant without utilization of the 4-20 mA analogue outputs**
Connection variant with utilization of the 4-20 mA analog outputs

Alarm relays

Two switching outlets each are available for the saturation level and the temperature:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>HS2 / LS2</td>
<td>High / low limit value for temperature</td>
</tr>
<tr>
<td>HS1 / LS1</td>
<td>High / low limit value for saturation level</td>
</tr>
<tr>
<td>Version</td>
<td>Transistors, switching via optical coupler towards +</td>
</tr>
<tr>
<td>Switching power</td>
<td>3 W max.</td>
</tr>
<tr>
<td>Switching voltage/current</td>
<td>max. 28 V DC, 100 mA</td>
</tr>
</tbody>
</table>

The switching behavior is displayed as follows:

Every switching output can be assigned a hysteresis.
This is positioned in the center between the limit values.

RS485

For the set up of the serial RS485 interface, please refer to page 37.
AquaSensor - AS 2000

Total length: max. 1200 m

PC

SPS

AS2000

AS2000

RS232

RS485

DATA -

DATA +

Vcc

0 V

DATA -

DATA +

Vcc
Hydraulic connection

When deciding on a location for the AquaSensor, consider the following points:

- The fluid should circulate freely around the probe
- Increased flow will improve the response speed of the AquaSensor (do not exceed the maximum flow rate (see below)).
- The probe must be able to be removed for checking and/or calibration. It is therefore advisable to place a shut-off valve both upstream and downstream from the probe.

Determine the system pressure and flow rate of the hydraulic facility and see whether it is within the permissible range for the AS.

<table>
<thead>
<tr>
<th>Maximum pressure</th>
<th>10 bar (1Mpa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum flow rate</td>
<td>4.5 m/s</td>
</tr>
</tbody>
</table>

Use the supplied cutting ring screw connection to install the probe in the system.

The probe, as shown in, should be installed at a right angle to the direction of flow and be immersed at least up to the marked line in the fluid to be measured.

In hydraulic tanks, the sensor should be installed where there is a high flow speed. Install it close to the return line.

Avoid places near claddings or other areas where oil circulation will be hindered. If the intent is to monitor a potential water leak source (such as a water cooler), then the AquaSensor should be placed immediately downstream of the potential water source.

Make sure that the protection cap is screwed on tightly for the installation of the probe.

The probe is not permitted to be immersed completely in the fluid, because the connection between the cable and the probe is only protected against spray water, which means that fluid could otherwise find its way into the probe.
Display and control elements

The moment the voltage supply reaches the AquaSensor, first the Firmware version (e.g. 3.00) and then the set device address (e.g. 001) are displayed. Once this has occurred, the device begins the measuring operation.

The unit is pre-set to display/output the saturation level in % in a range of 0 to 100% and the temperature in °C in a range of –20° to 120°C.

The current measured values are immediately outputted via the interfaces without having to adjust any settings in the user menu.

The menu is used to set the alarm relays, to select the output for the display (eg.

- There are some menu items (specially marked in these operating instructions) whose values may not be altered, because the calibration of the AquaSensor or other pre-set values might become lost.

![Diagram of AquaSensor display and control elements]
Operating buttons

**set** -button

- *When keeping this button pressed* -> to enter the Main Menu, to select a menu item, accept or save a displayed value or status or
- *Briefly press* -> in order to jump back to a menu one level back and to exit the Main Menu.

**UP** button to

- Scroll through menus
- Select a parameter
- Increase a displayed numerical value (digit)

**LEFT** button to

- Move from one display digit to another when changing a value

Main menu

Keep the **SET** button pressed to change to the Main Menu.

You can select from the following menu items:

<table>
<thead>
<tr>
<th>Menus</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit 1</td>
<td>Measurement unit for the saturation level (always %).</td>
</tr>
<tr>
<td>Unit 2</td>
<td>Select the output for temperature (°C or °F)</td>
</tr>
<tr>
<td>ProG*</td>
<td>Program the AS (instrument address, code, display brightness)</td>
</tr>
<tr>
<td>Code</td>
<td>Entering the code to enable additional menus</td>
</tr>
</tbody>
</table>

The following menus are enabled once the code is entered:

- SCAL  Scale outputs
- Adj   Calibration and adjustment of the AquaSensor
- ALar  Enter limit values for switching relays
- rSt   Resetting to the default settings

Change to the respective menu by selecting the required menu using the **UP** key and then confirm by keeping the **SET** key pressed.

Use **SET** key (press briefly) to go back one level.
Menu operation

Menu overview

The displays are operated via a Display menu, see below for description

- **SET** or **▲** means: Briefly press corresponding key
- **SET** means: Press and hold down "SET" key.

In the Main Menu:  Go to the next menu with **▲**. Select menu with **SET**. 

Inside the menu:

- White background: Select menu item with **▲** key, return to Main Menu with **SET**.
- Gray background: To the next menu item with **▲**, modifying the value as needed with **▲** (+1) and **▼** (next display digit).
- Confirm with **SET**.

---

![Diagram of menu operation](image-url)
Menus and their function

**CodE:** Enter User Code (0000 = without User Code)

**Unit 1:** Select measurement size and unit as well as scaling for Channel 1

**Unit 2:** Select measurement size and unit as well as scaling for Channel 2

**ProG:** Set characteristic values, display Min/Max values

**AdJ:** Carry out humidity adjustment and adjust offset for temperature and humidity

**ALAr:** Set limit values and the associated hysteresis for Channel 1 and Channel 2

**rST:** Reset device to original condition at time of delivery.

Switching display off

If the display is in measurement mode, then pressing the key will switch off the display (only one item will be displayed for checking).

Selection/Adjustment menus

There are two different types of menus: Unit 1, Unit 2 and rSt are selection menus in which specified measurement sizes and measurement units and/or specified responses can be selected.

The menus ProG, CodE, SCAL, AdJ and ALAr are adjustment menus in which characteristic values can be set as desired and/or saved measured values can be displayed.
Configuring

1. In the measurement mode (display of the measured values) press and hold down the SET button to open the Main Menu.

2. Press the Up button several times briefly, until the desired menu appears.

3. Press the SET button and hold it down in order to open the menu Selection menu (Unit 1, Unit 2, rSt)

4. Press the Up button several times briefly, until the desired measurement size and measurement unit or answer appears.

5. Press and hold down the SET button in order to confirm the selection.

- The selection is applied. The display jumps back to the Main Menu. Please be patient, the data transfer can take between 1 and 10 sec.!

Back into Measurement menu: press the SET button briefly.

Setting Menu (ProG, CodE, AdJ, ALAr)

4. Press the SET button briefly in order to switch to the next adjustable characteristic value without carrying out a modification

- change value if required

5. Press and hold down the SET button in order to be able to influence the characteristic value to be changed.

6. Press the Up button several times briefly in order to change the display digit that is flashing or to select between preset characteristic values.

7. Press the Down button briefly in order to switch to the next display digit.

8. Press and hold down the SET button in order to confirm the adjustment.

- The setting will be applied for what is shown in the display and for the calculation. The display then jumps to the next adjustable characteristic value (if available) or (by pressing the SET key briefly) back to the Measurement Menu.
Menu Code

Function: Enter User Code (factor setting: 0000)

The other menus are enabled with the correct User Code has been entered.

Enter the correct User Code (at the time of first use: 0000 or until a different code has been entered under PROG/UCod).

If no codes is selected (factory setting: 0000), then one uses the arrow keys to go directly to the Main Menu.

Press and hold down SET. The device releases the Menus for use and jumps to the UNIT 1 submenu.

One reaches the next submenu via ◄. This code will be left standing for ≈ 30 seconds and will not need to be reentered in the event of renewed activation during this time.
Menu Unit 1

Function: Selecting measurement size and measuring unit for Channel 1 outlet.

The measured value and the selected unit for Channel 1 will be displayed in the measurement mode in the left-hand side of the screen. Channel 1 is always the humidity output.

Selectable measurement sizes and units

<table>
<thead>
<tr>
<th>Measurement Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>rELH %</td>
<td>relative humidity in %</td>
</tr>
<tr>
<td>rELH rF</td>
<td>relative humidity in rF</td>
</tr>
<tr>
<td>rELH rH</td>
<td>relative humidity in rH</td>
</tr>
<tr>
<td>rELH Hr</td>
<td>relative humidity in Hr</td>
</tr>
<tr>
<td>dEPT td</td>
<td>Dew point in td*</td>
</tr>
<tr>
<td>dEPT °Cd</td>
<td>Dew point in °C*</td>
</tr>
<tr>
<td>dEPT °Fd</td>
<td>Dew point in °F*</td>
</tr>
</tbody>
</table>

* can only be disabled if UNIT 2 = °C or °F

Factory setting:

UNIT1 must always be set as follows:

Lo-1

Function: Setting lower scaling value for Channel 1 output.
As a rule, the Channel 1 output is the humidity output.

Specify a value between -199.9 and 999.9 that is suitable for the physical unit which you selected under UNIT 1.

Hi-1

Function: Setting upper scaling value for Channel 1 output.
As a rule, the Channel 1 output is the humidity output.

Specify a value between -199.9 and 999.9 that is suitable for the physical unit which you selected under UNIT 1.
Menu Unit 2

Function: Selecting measurement size and measuring unit for Channel 2 outlet.

The measured value and the selected unit for Channel 2 will be displayed in the measurement mode in the right-hand side of the screen. Channel 2 is always the temperature output.

After changing the measurement size/unit, always reset the scaling as well in accordance with your measurement task (e.g. 0...100°C = 32...212°F). If no new scaling is carried out, then an erroneous output value may result. The menu jumps back for this reason after the unit has been selected to Lo-2, the definition of the lower end of the scale, then to Hi-2.

Selectable measurement sizes and units

<table>
<thead>
<tr>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>tE °C: Temperature in °C</td>
</tr>
<tr>
<td>tE °F: Temperature in °F</td>
</tr>
<tr>
<td>dEPT td: Dew point in td*</td>
</tr>
<tr>
<td>dEPT °Cd: Dew point in °C*</td>
</tr>
<tr>
<td>dEPT °Fd: Dew point in °F</td>
</tr>
</tbody>
</table>

* can only be disabled if UNIT 2 = °C or °F

Factory setting:

<table>
<thead>
<tr>
<th>Unit 2</th>
<th>tE °C</th>
<th>Unit 2</th>
<th>tE °F</th>
</tr>
</thead>
</table>

Lo-2

Function: Setting lower scaling value for Channel 2 output. As a rule, the Channel 2 output is the temperature output.

► Specify a value between -199.9 and 999.9 that is suitable for the physical unit which you selected under UNIT 2.

Hi-2

Function: Setting upper scaling value for Channel 2 output. As a rule, the Channel 2 output is the temperature output.

► Specify a value between -199.9 and 999.9 that is suitable for the physical unit which you selected under UNIT 2.
Menu ProG

Function: Setting characteristic values, displaying saved Min/Max values, etc.

Menu Adr

Function: Modifying device address RS485.
Only in connection with an RS 485 - outlet.

► Enter a value between 001 und 255. Please note that each address may occur only once in an RS485 network.

Menu UCod

Function: Changing the User Code.
The operating menus will be blocked by the User Code if it is different from "0000" (default). This is to ensure that only authorized personnel are able to carry out modifications in these menus.

► Enter the valid User Code in the CodE Menu.
► Enter the new User Code in the PROG Menu under UCod and confirm the entry with SET.

Hi 1 / Lo 1

Function: Displaying the minimum value (Lo) and the maximum value (Hi) of Channel 1 (since the last voltage supply).

Press ▲ in order to switch between the displays Hi 1 and Lo 1.

Press and hold down SET in order to reset the minimum/maximum values.

Hi 2 / Lo 2

Function: Displaying the minimum value (Lo) and the maximum value (Hi) of Channel 2 (since the last voltage supply).

Press ▲ in order to switch between the displays Hi 2 and Lo 2.

Press and hold down SET in order to reset the minimum/maximum values.
disP

Function: Setting the brightness of the display screen and displaying/hiding measurement units in the Measurement menu.

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F100</td>
<td>Brightness 100%, measured values and measuring units displayed</td>
</tr>
<tr>
<td>F50</td>
<td>Brightness 50%, measured values and measuring units displayed</td>
</tr>
<tr>
<td>H100</td>
<td>Brightness 100%, measured values displayed, measuring units not displayed</td>
</tr>
<tr>
<td>H50</td>
<td>Brightness 50%, measured values displayed, measuring units not displayed</td>
</tr>
</tbody>
</table>

Pti

Function: Setting the time as to how long is to be pressed in order to change from the measurement view to the Main Menu.

In accordance with the value set, must be kept pressed down for different amounts of time before the device reacts to the entry.
This protects against unintended activation of the menu.
Select between the specified values 1, 3, 5 or 10 seconds.

Menu AdJ

In order to avoid losing the calibration values, this menu may only be selected in conjunction with adjustments that are to be carried out with a calibration and adjustment set.
Please refer to the Calibration and Adjustment set documentation for information concerning the performance of a calibration or an adjustment.

Detail see on page 43, chapter Calibration and Adjustment.

A-Lo

Function: Set and adjust and the lower point of the humidity curve.
The lower point is preset to 11.3% rF and ideal for HYDAC products. Before performing an adjustment, check whether an offset exists in menu item “OFF1” and “OFF2”. If one does, then set it to zero.
If an adjustment point other than 11.3% rF is desired (not recommended!):
  ► Specify a %rF value between 00.0 und 99.9.
    Now expose the probe for a sufficient amount of time to the humidity conditions that bouy have specified.
  ► Perform adjustment for the lower point: Press and hold down .
-HC- appears briefly in the display. The lower point of the humidity curve has been adjusted.

**OFF 1**

Function: Adjusting the offset for the Channel 1 characteristic curve.

An offset shifts the entire characteristic curve by the specified offset value.

The setting of an offset can be useful for compensating for a known deviation at a particular operating point. Greater errors can however occur as a result of the offset for measured values outside the working interval (see drawing).

► Specify a value between -99.9 and 99.9 that is suitable for the physical unit which you selected under **UNIT 1**.

**OFF 2**

Function: Adjusting the offset for the Channel 2 characteristic curve.

An offset shifts the entire characteristic curve by the specified offset value.

The setting of an offset can be useful for compensating for a known deviation at a particular operating point. Greater errors can however occur as a result of the offset for measured values outside the working interval (see drawing).

► Specify a value between -99.9 and 99.9 that is suitable for the physical unit which you selected under **UNIT 2**.
**A-Pr**

Function: Enter/correct absolute system pressure/air pressure in mbar (hPa). The value is required for calculating the degree of humidity. It is preset to 1013 mbar. Enter the prevailing absolute pressure.

**Menu ALAr**

Function: Setting the alarm values for the outputs.

**LS 1**

Function: Setting lower alarm value for Channel 1 output. Specify a value between -199.9 and 999.9.

**HS 1**

Function: Setting upper alarm value for Channel 1 output. Specify a value between -199.9 and 999.9.

**HY 1**

Function: Setting hysteresis for Channel 1 output.
The hysteresis lies to the left and to the right of the limit values (see drawing).

- Specify a value between 0.0 and 9.9.
  
  **Example:**
  
  - Alarm value: 40 %rF
  - Hysteresis: 8
  - Switching points at 48 %rF and 32 %rF

### LS 2

Function: Setting lower alarm value for Channel 2 output.

Specify a value between -199.9 and 999.9.

### HS 2

Function: Setting upper alarm value for Channel 2 output.

Specify a value between -199.9 and 999.9.

### HY 2

Function: Setting hysteresis for Channel 2 output.

The hysteresis lies to the left and to the right of the limit values (see drawing).

- Specify a value between 0.0 and 9.9.
  
  **Example:**
  
  - Alarm value: 40 °C
  - Hysteresis: 8
  - Switching points at 48°C and 32°C
**tESt**

Function: Setting switching outputs individually for test purposes.

Prerequisite: 10...28 V DC is present at the "+" terminal of the relay output terminal block.

- Take care to ensure that no sequences relevant to safety or processes are triggered during testing!
- Select between the specified values:

<table>
<thead>
<tr>
<th>No switching output set</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
</tbody>
</table>
Menu rST

Function: Resetting device settings back to the status at the time of delivery (Note: The temperature scaling is set to -20 to +70°C). The calibration data are not changed by the reset. The Code is reset to "0000".

► Select between the specified possibilities of rES no (perform no Reset) and rES YES (perform reset) using the key.

► Confirm your selection by pressing and holding down .

After the reset, the display will show:

rst 1, rst 2, rst 3, rst4, Segment test, Basic setting.
Retrofitting the display

Transducer board

The position of the sliding switch always under the plug-in socket, the alignment can vary (see page 15)

Note
The AquaSensor transducers without displays can be retrofitted with a display.

Perform the following steps to accomplish this:
1. Remove housing cover from the transducer.
2. Adjust the sliding switch (see Table, page 9 "Sliding switch positions").
3. Remove screws from the device board.
4. Screw in spacing bolts on the device board. Bend the two converters that are positioned a good distance to the top to the side.
5. Plug the flat ribbon cable plug strip of the display into the connection socket (guide pin on the right-hand side!).
6. Set up connections (analogue outputs, switching outputs, RS485 output), in each case in accordance with the display type (see Chapter 5).
7. Connect power supply (see Table "Power supply" in Chapter 5).
8. Mount the display board with the screws on the spacer bolts.
9. Screw on display housing cover.

- After it has been connected, the following appear on the display, one after the other: Firmware version, Bus address (if available), Segment test. The display of the measured values appears after these.
Connections Displays

Two power supply units that are galvanically disconnected from one another should be used to ensure problem-free operation (1x for the power supply to the AS2000, 1x for the power supply to the display).

This becomes mandatory as soon as the analogue outlets are used.

Technical Data

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data +</td>
<td>+ level of RS485 communications</td>
</tr>
<tr>
<td>Data -</td>
<td>- level of RS485 communications</td>
</tr>
<tr>
<td>+</td>
<td>10 ... 28 V DC for relay supply</td>
</tr>
<tr>
<td>Vcc</td>
<td>10 ... 28 V DC</td>
</tr>
<tr>
<td>0 V</td>
<td>Digital earth</td>
</tr>
</tbody>
</table>

Disconnected galvanically from the transducer:

Sliding switch positions (sw11 / sw12 on the transducer board)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ON</td>
</tr>
<tr>
<td>2</td>
<td>ON</td>
</tr>
</tbody>
</table>
AquaSensor - AS 2000  Retrofitting the display

2-wire connection 4 ... 20 mA)

Maximum load 500 Ohm
RS485 interface

The AquaSensor with RS485 is designed for a serial BUS communication, which is supervised by a master control system.

Up to 31 end units can be connected, whereby each unit is in possession of its own address.

The maximum cable length permissible is ≈ 400 m, whereby there should be a 120 Ohm termination resistor positioned at the beginning and at the end of the BUS. The need for this is to be verified in individual cases.

NOTE

Transference mistake

Data couldn't be correct transferred.

➢ Use shielded lines only!
➢ Set the screen down with large surface facing the protective ground.
➢ The screen may not be interrupted.

Report

Communication is carried out via interface characteristic values:

9600 Baud, 8 databits, 1 stop bit, no parity

The structure of the report is mixed, the data and characteristic values the transmission and output are binary (hexadecimal). The commands as such have to be transmitted in ASCII format.
A data frame has the following structure:

<table>
<thead>
<tr>
<th>Position</th>
<th>Contents</th>
<th>Range of values</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Instrument address</td>
<td>(1 to 255) default 0xFF or 0x00</td>
</tr>
<tr>
<td>1</td>
<td>MSB  frame number</td>
<td>At present generally &quot;0&quot;</td>
</tr>
<tr>
<td>2</td>
<td>LSB  frame number</td>
<td>At present generally &quot;0&quot;</td>
</tr>
<tr>
<td>3</td>
<td>MSB  number of frames</td>
<td>At present generally &quot;0&quot;</td>
</tr>
<tr>
<td>4</td>
<td>LSB  number of frames</td>
<td>At present generally &quot;0&quot;</td>
</tr>
<tr>
<td>5</td>
<td>No. of bytes of the command (in the range 6 to n)</td>
<td>1 to 118 Bytes</td>
</tr>
<tr>
<td>6 to n</td>
<td>Command (P6, PU)</td>
<td>2...10 Bytes</td>
</tr>
<tr>
<td>n + 1</td>
<td>Checksum via Position 0 to n</td>
<td>Binary complement</td>
</tr>
<tr>
<td>n + 2</td>
<td>Reserve</td>
<td>At present generally &quot;0&quot;</td>
</tr>
</tbody>
</table>

Frame

```
<table>
<thead>
<tr>
<th>n+2</th>
<th>n +1</th>
<th>6 to n</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Check sum</td>
<td>Command</td>
<td>Byte count</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Address</td>
</tr>
</tbody>
</table>
```

Each command starts with an ASCII "P", followed by another character in ASCII format, which identifies the command.

Generally the frame is part of all commands and requests within the protocol. The actual command lies within the frame, starts always from byte six.

### Description of the report

At present there are two operating modes:

1. Set instrument address
   - Command: P6 (ASCII)
2. Call up measured value
   - Command: PU (ASCII)

### Command structure

#### Request measured values

Command PU (10 Bytes) – with frame -:

```
<table>
<thead>
<tr>
<th>9</th>
<th>8</th>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x00</td>
<td>Check Sum</td>
<td>&quot;U&quot; (0x55)</td>
<td>WP (0x50)</td>
<td>Byte count PU command (0x02)</td>
<td>0x01</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>Address (0x01 to 0xFF)</td>
</tr>
</tbody>
</table>
```
### Answer: (25 Bytes) - with frame -:

<table>
<thead>
<tr>
<th>9</th>
<th>8</th>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit 1</td>
<td>Status 1</td>
<td>&quot;3&quot; (0x33)</td>
<td>&quot;&gt;&quot; (0x3E)</td>
<td>Byte count PU response (0x11)</td>
<td>0x01</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>address (0x01 to 0xFF)</td>
</tr>
<tr>
<td>Unit 3</td>
<td>Status 3</td>
<td>Exponent 2</td>
<td>Value 2 Low-byte</td>
<td>Value 2 High-byte</td>
<td>Unit 2</td>
<td>Status 2</td>
<td>Exponent 1</td>
<td>Value 1 Low-byte</td>
<td>Value 1 High-byte</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>18</td>
<td>17</td>
<td>16</td>
<td>15</td>
<td>14</td>
<td>13</td>
<td>12</td>
<td>11</td>
<td>10</td>
</tr>
</tbody>
</table>

#### Legend:
- **0x00**: Hexadecimal figure (here "0")
- **"3"**: Decimal figure as ASCII value
- **">"**: ASCII confirmation for successful transfer
- **"P"**: Alphabetic character ASCII value

#### Description status

In these bytes certain information for the following respective measured values is stored.

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Value is OK</td>
</tr>
<tr>
<td>1</td>
<td>Value too high</td>
</tr>
<tr>
<td>2</td>
<td>Value too low</td>
</tr>
<tr>
<td>3</td>
<td>Value undefined</td>
</tr>
</tbody>
</table>
Description unit:
These bytes show the physical unit of the following values.

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Temperature in °C</td>
</tr>
<tr>
<td>3</td>
<td>Degree of saturation in %</td>
</tr>
<tr>
<td>7</td>
<td>Temperature in °F</td>
</tr>
</tbody>
</table>

Description of value
The measurable is sent as an integer figure and divided into two bytes, whereby the high-byte is sent first and then the low-byte. The data format is stored as a binary complement, whereby negative figures can be recognised via the building of the binary complement. The digit sign is stored in the MSB of the high-byte with the following significance: 1 = "-"; 0 = "+". Is a "one" detected within the MSB of the high-byte, the negative figure has to be formed via the binary complement.

Description exponent
As the measured values are integers without decimal places, an exponent must be used in order to introduce numbers after the decimal point. Thus, for example, division by 10 is necessary when a measured value of 250 is received, in order to display this as its correct value of 25.0.

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x00</td>
<td>No exponent necessary</td>
</tr>
<tr>
<td>0xFF</td>
<td>Divide value by 10</td>
</tr>
<tr>
<td>0xFE</td>
<td>Divide value by 100</td>
</tr>
</tbody>
</table>

Set instrument address
Command P6: (18 Bytes) – with frame –

<table>
<thead>
<tr>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;6&quot;</td>
<td>&quot;P&quot;</td>
<td>Byte</td>
<td>0x01</td>
<td>0x00</td>
<td>0x00</td>
<td>address</td>
<td></td>
</tr>
<tr>
<td>0x36</td>
<td>0x50</td>
<td>count</td>
<td></td>
<td></td>
<td></td>
<td>(0x01 to 0xFF)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>P6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Command</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x01</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0x00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>14</td>
<td>13</td>
<td>12</td>
<td>11</td>
<td>10</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>Address assignment</td>
<td>S-Number Position 7</td>
<td>S-Number Position 6</td>
<td>S-Number Position 5</td>
<td>S-Number Position 4</td>
<td>S-Number Position 3</td>
<td>S-Number Position 2</td>
<td>S-Number Position 1</td>
</tr>
<tr>
<td>17</td>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Please note, that the set instrument address always has to be in byte "0" and the new allocated address in byte "15"!

At present the serial number is redundant and so far is not evaluated. Ideally these bytes are filled with "0x00". It is planned to mark them with the serial number of the display board, in order to enable a clear identification during BUS operation.

Answer: (1 Byte) – without frame -

0
">" (0x3E)

Exception:
Wird im Frame im Byte "0" If the device address "0" (0x00) is set in the frame in byte "0", then all of the devices will respond. This situation should be avoided at all times during BUS operation, as otherwise it will lead to a data crash, which could bring the system to a standstill.

The address "0" is used in order to be able to program a new address for a device in "stand-alone operation" that has an unknown address.

**Error messages**

An error message always starts with an ASCII "?" followed by an error code in binary format

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x00</td>
<td>Unknown command</td>
</tr>
<tr>
<td>0x01</td>
<td>Invalid command</td>
</tr>
<tr>
<td>0x02</td>
<td>Only internal, diagnosis</td>
</tr>
<tr>
<td>0x03</td>
<td>Only internal, diagnosis</td>
</tr>
<tr>
<td>0x04</td>
<td>Only internal, diagnosis</td>
</tr>
<tr>
<td>0x05</td>
<td>EPROM access (access refused)</td>
</tr>
</tbody>
</table>
Description check sum

The checksum is formed by adding one byte after another from byte "0" to byte "n". Afterwards the binary complement is formed from the number thus calculated (invert number and add one). The result is stored as a checksum in the next-to-last byte.

If the Master Controller once again executes a byte-by-byte addition of all bytes, then the result has to be "Zero" (carry-overs are to be ignored).

Example: PU command with address 2

<table>
<thead>
<tr>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;U&quot; (0x55)</td>
<td>&quot;P&quot; (0x50)</td>
<td>Byte count</td>
<td>0x01</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>Address (0x02)</td>
</tr>
<tr>
<td>9</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0x00</td>
<td>CS 0x56</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Addition value: 0xAA_____

Binary complement: 0x56 (0xAA + 0x01)

Result: 0xAA + 0x56 = 0x00 (carry-over 1 is ignored)

Recommended Hardware

We recommend the RS485/RS232 level convertor (Hydac Article No.: 6013281)

Hints

While drawing up the communication software, remember that a timeout of ≈ 200 ms per character transmitted has to be taken into account. If the time interval between transmitted bytes bigger, the internal counter is reset and the rest of the protocol will be ignored.

The driver module on the board requires ≈ 2 ms to carry out the procedure of switching between transmitting and receiving. The delay time of the master also has to be taken into account, therefore the FiFo, if available, should be switched on, to prevent losing any bytes on the hardware side.

The display itself requires ≈ 1 s per answer, which as well has to be taken into account with self-made software, set timeout accordingly.
Calibration and Adjustment

For the purposes of calibration, the AquaSensor is brought into contact with a defined saturation value and thus checked for accuracy (compared). If the resulting measurement deviates from the defined value by more than 5%, either upward or downward, then an adjustment should be carried out, during which the AquaSensor value will be made to conform with the defined value.

The AquaSensor should be calibrated at least once a year.

A suitable calibration and adjustment set is required for carrying out calibrations and/or adjustments. These kinds of sets can be ordered under the following part number:

| Calibration and adjustment set | HYDAC p/no: 3122629 |

Additional information is to be found in the operating instructions enclosed with the calibration and adjustment set.
## Eliminating malfunctions

<table>
<thead>
<tr>
<th>Malfunction</th>
<th>Possible causes</th>
<th>Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>---- ---- is illuminated in</td>
<td>Check data transfer to the connection</td>
<td>Transducer disrupted Check position of the sliding switch 11/12</td>
</tr>
<tr>
<td>the display</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Err is illuminated longer</td>
<td>Measured value of the transducer is faulty</td>
<td>Check transducer</td>
</tr>
<tr>
<td>than 5 sec in the display</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Display shows nothing</td>
<td>Separate power supply not connected</td>
<td>Connect display to voltage supply</td>
</tr>
<tr>
<td></td>
<td>-or- Voltage supply too low</td>
<td>Increase voltage supply to at least 10 V</td>
</tr>
<tr>
<td></td>
<td>-or- Sliding switch on the transducer</td>
<td>Set sliding switch 11/12 correctly.</td>
</tr>
<tr>
<td></td>
<td>board not in the correct position</td>
<td></td>
</tr>
</tbody>
</table>
### Technical data

<table>
<thead>
<tr>
<th>Measurement range (calibrated)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Saturation level:</td>
<td>0-100 %</td>
</tr>
<tr>
<td>Temperature:</td>
<td>-20 ... 120 °C</td>
</tr>
<tr>
<td><strong>Accuracy</strong></td>
<td></td>
</tr>
<tr>
<td>Saturation level:</td>
<td>+/- 2 %</td>
</tr>
<tr>
<td>Temperature:</td>
<td>+/- at 5 ... 50 °C</td>
</tr>
<tr>
<td><strong>Operating pressure</strong></td>
<td>-0.5 ... 10 bar / -0.05 ... 1 MPa</td>
</tr>
<tr>
<td><strong>Flow velocity</strong></td>
<td>max. 4.5 m/sec</td>
</tr>
<tr>
<td><strong>Fluid temperature range</strong></td>
<td>5 ... 90 °C</td>
</tr>
<tr>
<td><strong>Ambient temperature range</strong></td>
<td>-10 ... 70 °C</td>
</tr>
<tr>
<td><strong>Voltage supply</strong></td>
<td>24 V DC (10 ... 30 V DC) max. 100 mA residual ripple &lt;10%</td>
</tr>
<tr>
<td><strong>Analogue outputs:</strong></td>
<td></td>
</tr>
<tr>
<td>Saturation level</td>
<td>4 ... 20 mA, resolution 0.02 mA</td>
</tr>
<tr>
<td>Temperature</td>
<td>4 ... 20 mA, resolution 0.02 mA</td>
</tr>
<tr>
<td><strong>Max. load</strong></td>
<td>500 Ohm</td>
</tr>
<tr>
<td><strong>Interface</strong></td>
<td>RS485</td>
</tr>
<tr>
<td><strong>Alarm relays</strong></td>
<td>2 x saturation level (HS1/LS1) 2 x temperature (HS2/LS2) Switching transistors via optocoupler after +</td>
</tr>
<tr>
<td><strong>IP class</strong></td>
<td>IP 65</td>
</tr>
<tr>
<td><strong>Storage temperature range</strong></td>
<td>-40 ... 80 °C</td>
</tr>
<tr>
<td><strong>Weight sensor</strong></td>
<td>50 g</td>
</tr>
<tr>
<td><strong>Material of body</strong></td>
<td>Zinc diecasting GD-ZnAl4</td>
</tr>
<tr>
<td><strong>Dimensions (L x W x H)</strong></td>
<td>95 x 69 x 20 mm</td>
</tr>
</tbody>
</table>
Model Code

AquaSensor
AS 2000 series

Typenschlüssel / Model code / Code de commande

AS 2 3 3 0 -1 -U

Type / Type / Type
AS = AquaSensor

Messbereich / Measuring range / Plage de mesure
2 = Sättigungsgrad 0-100%, Temperatur -20...120 °C / Saturation level 0-100%, temperature -20...120 °C / Degré de saturation 0-100%, température-20...120 °C

Version / Version / Version
0 = 4 ... 20 mA Ausgang / 4 ... 20mA output / Sortie 4 ... 20 mA
3 = 4 ... 20 mA Ausgang = Display + RS485 Schnittstelle + Schaltausgänge / 4 ... 20 mA output = display + RS485 interface + switching outputs / Sortie 4 ... 20 mA = affichage + interface RS485 + relais

Gehäuse / Housing / Corps
3 = Für stationäre Einsatz / For static use / Pour utilisation stationnaire

Medien / Fluids / Fluides
0 = Für Standard - Mineralöle / For standard mineral oils / Pour huiles minérales standard

Kabellänge (bis Fühlerspitze) / Length of cable (to tip of probe) / Longueur du câble (jusqu’à l’extrémité de la sonde)
1 = 3000 mm

Versorgungsspannung / Supply voltage / Tension d’alimentation
U = 24 VDC

Lieferumfang / Items supplied / Fourniture
AS
– Edelstahlverschraubung 1/2" mit Schneidring (siehe Seite 2) / Stainless steel screw connection 1/2" with cutting ring (see page 2) / Raccord à visser inox 1/2" avec bague de serrage (voir page 2)
– Bedienungsanleitung / Manual / Manuel d'utilisation
Zubehör / Accessories / Accessoires
– Kalibrier- und Abgleichset Art.Nr.: 3122629 / Calibration and adjustment kit part no.: 3122629 / Set d’étalonnage et de calibration Code article : 3122629