# Electronic level switch
# ENS 3000

## User manual

(Translation of original instruction)

# Contents

# Preface

This manual provides you, as user of our product, with key information on the operation and maintenance of the equipment.

It will acquaint you with the product and assist you in obtaining maximum benefit in the applications for which it is designed.

The assembly instructions must always be kept accessible at the place of use of the measuring system for immediate reference.
Please note: the specifications outlined in this documentation for the instrument technology are correct at the time of publishing. Deviations in technical specifications, illustrations and dimensions are therefore possible.

If you find any errors while reading the documentation or have additional comments or suggestions, please contact us at:

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We look forward to receiving your input.

**“Putting experience into practice”**

# 1 Safety Information

Before commissioning, check the instrument and any accessories supplied. Before commissioning, please read the operating instructions. Ensure that the instrument is suitable for your application

Incorrect handling and/or failure to comply with the operating instructions or technical specifications can result in damage to property and/or persons.

# 2 Functions of the ENS 3000

Depending on the model, the instrument has the following functions:

- Display of the actual fluid level in inch or cm (depending on version).
- Display of the actual temperature in °F or °C.
- Display of the minimum and maximum value of fluid level or temperature or of a pre-set switching point
- Switching of the switch outputs based on the fluid level or temperature and the pre-set switch parameters
- Analogue output
- Menu for the basic settings (ENS 3000 is adjustable to the particular application)
- Programming Enables

# 3 Installation

## 3.1 GENERAL INSTALLATION NOTES

The electronic level switch ENS 3000 should be fastened at the metal collar of the adaptor using a mounting device which grips as much of the metal collar as possible. Any device large enough to hold a metal collar of 0.866 inch diameter can be used.

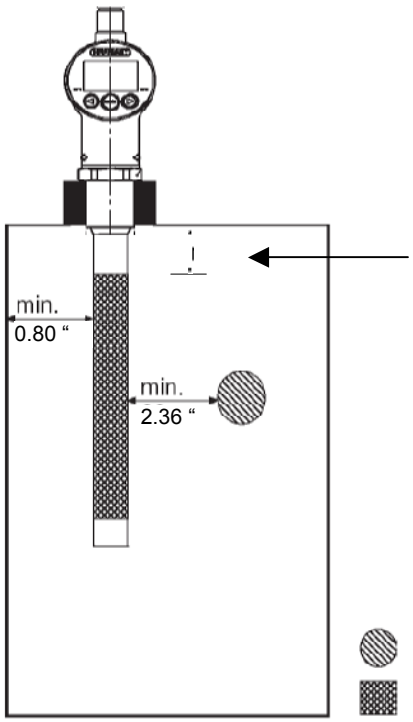
For simple and reliable installation, we recommend using the mounting accessory from HYDAC ELECTRONIC (see Section 15.2 Accessories, Mechanical Connection).

To ensure safe operation of the ENS 3000 the following conditions must be met:

- The active range of the probe must extend down into the tank and must be clear of the tank walls.
- When installing in small plastic tanks, the unit must be installed as near as possible to the centre of the tank.
- When installing in metallic rising pipes (e.g. mounted on the side of the tank) the sensor must be mounted in the centre of the tube. We recommend that the internal diameter of the tube is $\geq$ 2.36 inch
- Any metallic objects (e.g. metallic pipes or baffles) inside the tank must be at least 2.36 inch away from the active zone of the sensor. Otherwise they will be recognised as mounting devices and the measurements will be distorted.
- When mounting in tanks, the distance between the sensor and the walls of the tank must be at least 0.79 inch.

- In order to prevent the material of the tank cover from affecting the measurement results, the active zone must be a minimum distance below the tank cover.

  The required minimum distances are dependent on the probe length.
  The necessary minimum distances are given in Section 3.2 (Installation using HYDAC Accessories).



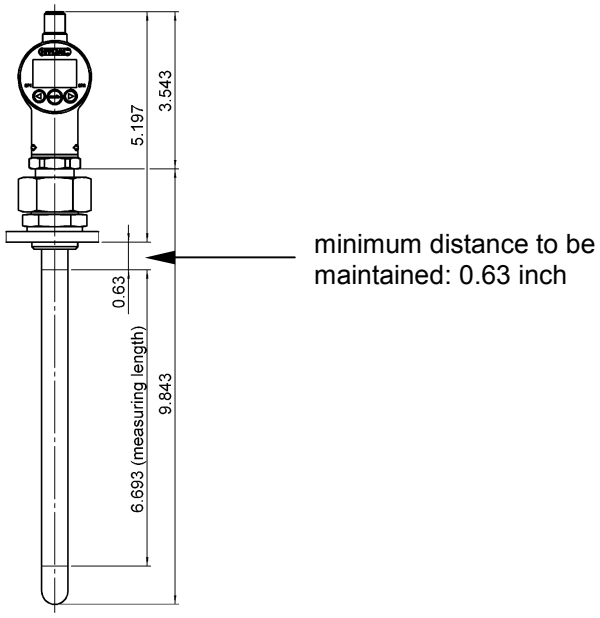

| Minimum distance | Probe length |
|---|---|
| 0.65 inch | 9.80 inch |
| 1.35 inch | 16.20 inch |
| 1.50 inch | 20.50 inch |
| 1.30 inch | 28.70 inch |

**metallic component**

**active zone**

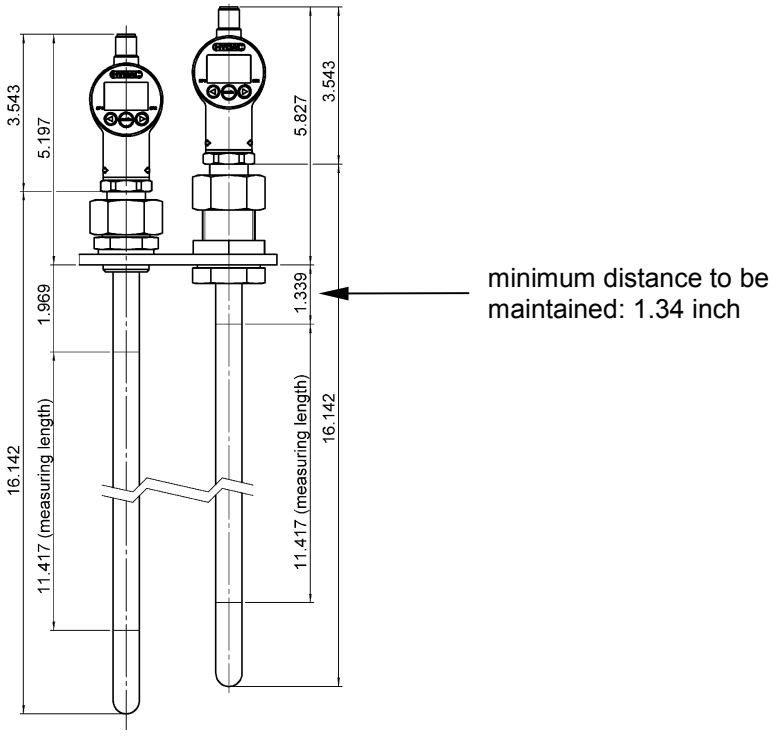
## 3.2 INSTALLATION USING HYDAC ACCESSORIES

### 3.2.1 Installation ENS 3000, probe length 9.80 inch (permitted accessory ZBM 20)



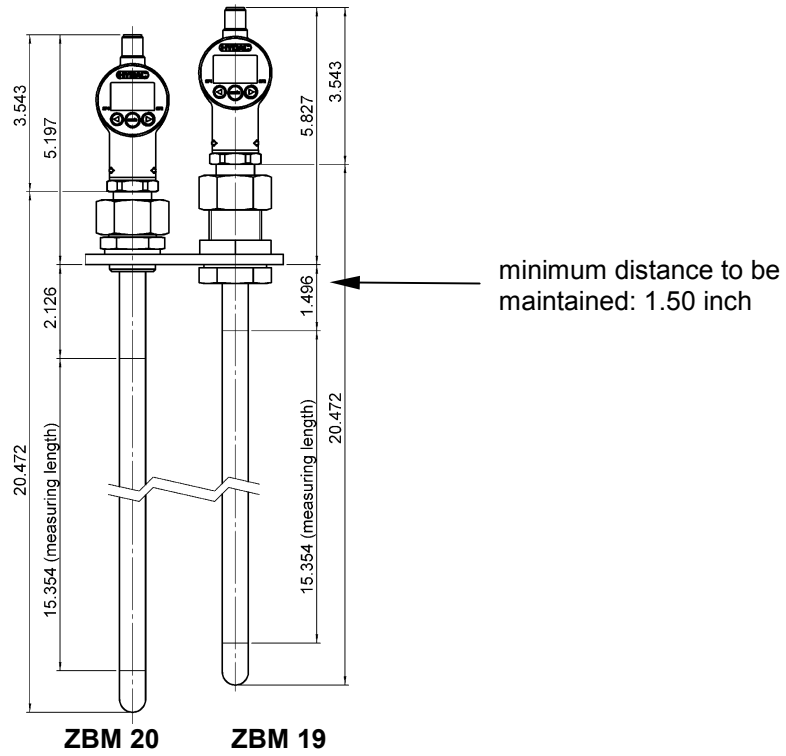

**ZBM 20**

### 3.2.2 Installation ENS 3000, probe length 16.20 inch (permitted accessories ZBM 19 and ZBM 20)

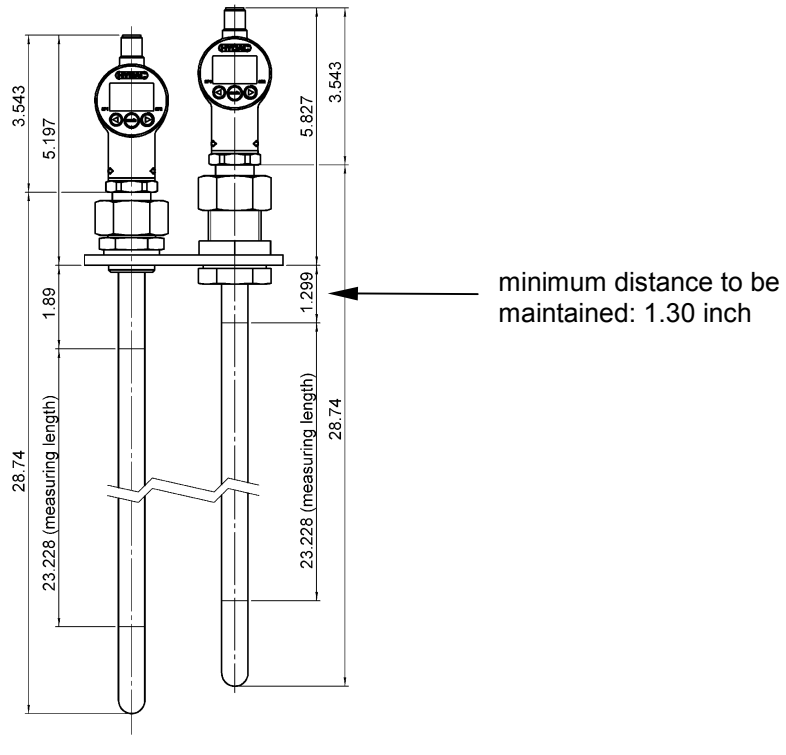



**ZBM 20** **ZBM 19**

### 3.2.3 Installation ENS 3000, probe length 20.50 inch (permitted accessories ZBM 19 and ZBM 20 )



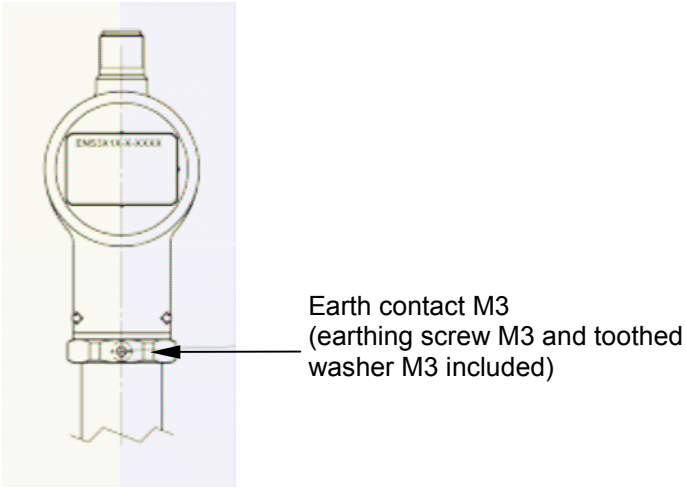

### 3.2.4 Installation ENS 3000, probe length 28.70 inch (permitted accessories ZBM 19 and ZBM 20)



## 3.3 IMPORTANT SAFETY NOTES

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

- Make line connections as short as possible
- Use shielded lines
- The cable shielding must be fitted by qualified personnel, subject to the ambient conditions and with the aim of suppressing interference.
- Keep the unit well away from the electrical supply lines of power equipment, as well as from any electrical or electronic equipment causing interference.
- **Always** connect the **earthing screw** of the ENS 3000 to the earthing rail (e.g. in the control cabinet). We recommend using a 16 AWG cable and as short a line length as possible.




The level switch ENS 3000 must be installed in the tank as near to vertically as possible. If the ENS 3000 is not mounted vertically, then the accuracy of the ENS deteriorates with increasing angle of incline. (Additional inaccuracy if ENS is at an angle of 5°: approx. ±0.5% ; additional inaccuracy if at an angle of 10°: approx. ±1.5%).

**CAUTION:**
The electronic level switch ENS 3000 must not be used at positive pressure. Short-term pressure of up to 40 psi for no longer than 1 minute is possible without causing damage.

# 4 Starting up

**CAUTION:**
Before commissioning select the type of fluid to be measured (default setting: Oil), procedure see chap. 8.2.

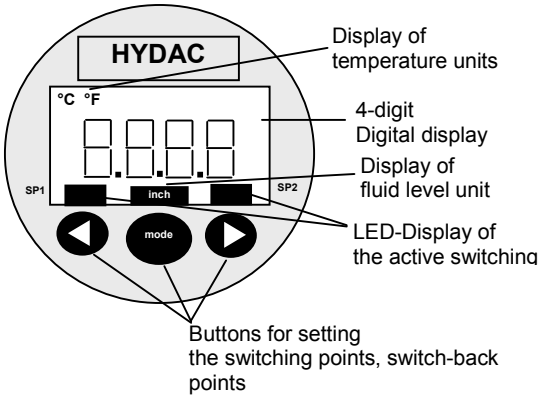
**NOTE**:
After recognizing a valid measurement value, the ENS 3000 (version with 4 switch points), checks for diversion points within the active zone beyond the recognized measuring value. These will be corrected immediately. After approx. 15 minutes, the corrections will be stored permantently, but only if the set fluid to be measured is oil.
Menu point FcAL is used to reset faulty corrections and the learning phase re-starts (see Chapter 8.2 Summary of the basic settings).

Method of determining the offset value:
We suggest the following procedure for determining the value of the fluid level offset:

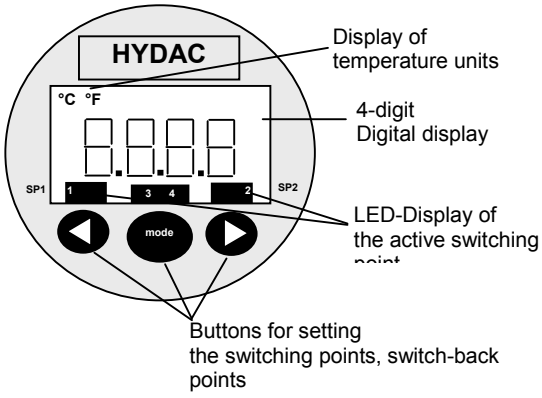
- Installation resp. mounting of ENS 3000 inside the tank
- Check: is the display flashing or does it show a value greater than zero.
- If the display flashes, the level lies outside the active measuring zone (level too high, resp. level too low).
  If the system reports low level, the fluid level will gradually be filled up by until 0 is displayed. Then, the ENS 3000 is removed from the tank and the fluid level inside the tank is determined by a measuring unit. Depending on the model, this value is displayed in the menu noFS in " inch " or " cm " after having been determined.
- If the display shows value 0 or if high level is reported, the level is gradually reduced by draining the fluid until the value 0 appears in the display. After removing the ENS 3000 from the tank the process is as described above.

## 5 Operating keys of the ENS 3000

1 or 2 Switching points



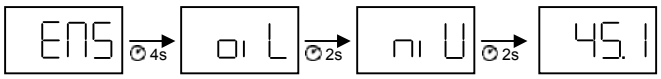

4 Switching points




## 6 Digital display

After switching on the supply voltage “ENS" appears for about 2 seconds in the display, followed by the actual set fluid, level or temperature and then begins to show the actual value (basic setting).

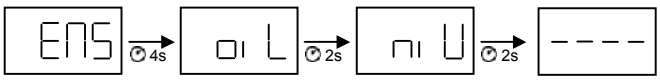
1 or 2 Switching points




4 Switching points

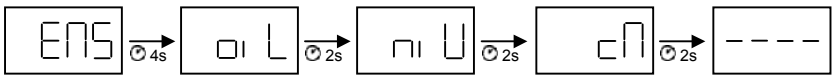

If the level exceeds or falls below the measuring zone of the electronic level sensor, the following sequence is displayed:

1 or 2 Switching points




flashing display

4 Switching points




flashing display

**NOTE**:

- If level is too low: top up the fluid until a valid measurement is detected.
- If level is too high: drain the fluid until a valid measurement is detected.

In the basic settings, the display can be changed as follows:

- Display of the maximum value "**n.TOP**"
  The highest level measured in the system since the unit was last switched on or since last reset is displayed permanently.
- Display of the minimum value "**n.MIN**"
  The lowest level measured in the system since the unit was last switched on or since last reset is displayed permanently.
- Display of the actual temperature "**TEMP**"
- Display of the maximum temperature value "**T.TOP**"
  The highest level measured in the system since the unit was last switched on or since last reset is displayed permanently.
- Display of the minimum value "**T.MIN**"
  The lowest temperature measured in the system since the unit was last switched on or since last reset is displayed permanently.
- Display of the set switchpoint "**S.P. 1**", "**S.P. 2**", "**S.P. 3**" or "**S.P. 4**" Depending on the model, one of the switch points 1 to 4 can be permanently displayed.
- Display dark "**oFF**".
  The display is switched off.

Depending on the setting, "**n.TOP**", "**n.MIN**", "**TEMP**", "**T.TOP**", "**T.MIN**", "**S.P. 1**", "**S.P. 2**", "**S.P. 3**" , "**S.P. 4**" or "**oFF**" briefly appear in the display following the switch-on message. The ; ◂ or ▸ key may be used to scroll through the above fluid levels and temperatures. If neither of these keys is pressed within approx. 5 seconds, the value of the parameter pre-set to appear in the display will be shown.

**NOTE**:

- If the actual fluid level exceeds the upper limit of the unit's nominal range, it can no longer be measured and the display starts to flash.
  The values of the switching outputs and analogue outputs are maintained.
  The maximum resp. minimum value plus the set offset are shown in the display.
- If, after a voltage breakdown, the display shows ---- (flashing centre LEDs), it should be checked whether the tank level is too high or too low.
  The analogue output provides 4 mA resp. 0 V depending on the setting of the analogue input.
- If the actual fluid level falls below the lower limit of the unit's nominal range, it can no longer be displayed and the display will start to flash.
  The values of the switching outputs and analogue outputs are maintained. In the display, 0.00 resp. the set offset appears.
- If the actual level "niv" has been chosen as a primary setting (displayed value shown permanently), press key ▸ repeatedly to show
  - maximum level value "**n.TOP**"
  - minimum level value "**n.MIN**"
  - actual temperature "**TEMP**"
  - maximum temperature "**T.TOP**"
  - minimum temperature "**T.MIN**"

  Pressing key ◂ reverses the order of the displayed values.

# 7 Output function

## 7.1 SWITCHING OUTPUTS

The EDS 3000 has either 1, 2 or 4 switching outputs.
The following output signals can be set in the basic settings:

### 7.1.1 Switch point setting (SP)

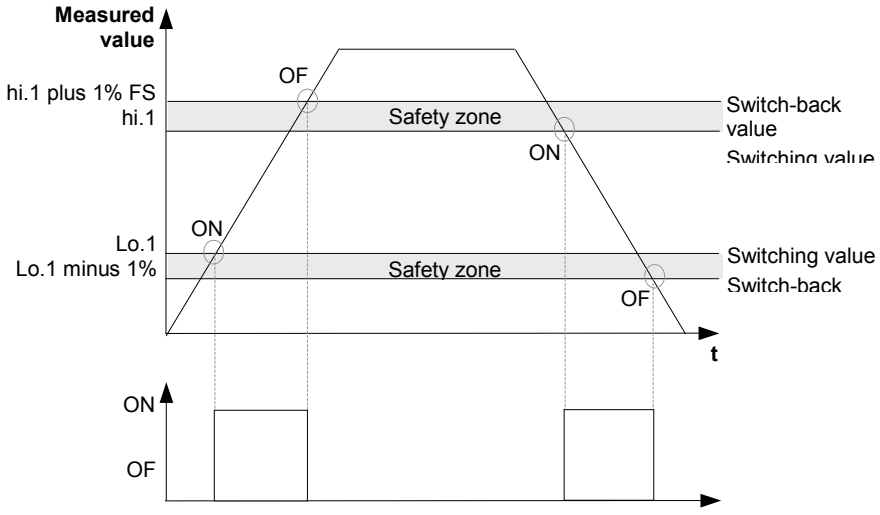
One switchpoint and one hysteresis can be set for every switching output. The particular output will switch when the set switch point is reached and switch back when the measurements drop below the switch-back point. The switch-back point is always determined by the set hysteresis.
(switching point minus switching hysteresis = switch-back point)

Abbreviations: "**S.P.1**", "**S.P.2**", "**S.P.3**" , "**S.P.4**" = switching point 1 to 4
"**HyS.1**", "**HyS.2**", "**HyS.3**" , "**HyS.4**" = hysteresis 1 to 4

### 7.1.2 Window mode (WIN)

Operating in window mode allows the unit to monitor a range. An upper and a lower switching point which defines the range can be assigned to each switching output. The particular output is switched when the level or temperature enters this range. The output switches back when leaving the range. The lower switch-back value is just below the lower switching value (lower switching value minus 1% FS, see section 7.4). The upper switch-back value is just above the upper switching value (upper switching value plus 1% FS, see section 7.4). The range between the switch value and the switch-back value forms a safety margin which prevents unwanted switching operations from being triggered.

Example for switching output 1 (normally open):




Abbreviations: "**HI 1**" to "**HI 4**" = High level 1 to 4 = upper switching point 1 to 4
"**Lo 1**" to "**Lo 4**" = Low level 1 to 4 = lower switching point 1 to 4
**FS** (**f**ull **s**cale) = relative to the complete measuring range

**NOTE:**
The window function will only operate properly (switch on and off), if all switching values (including the safety zone) are greater than 0 inch or –9.4 °F (model with temperature sensor), and are within the unit's **nominal** measuring range.

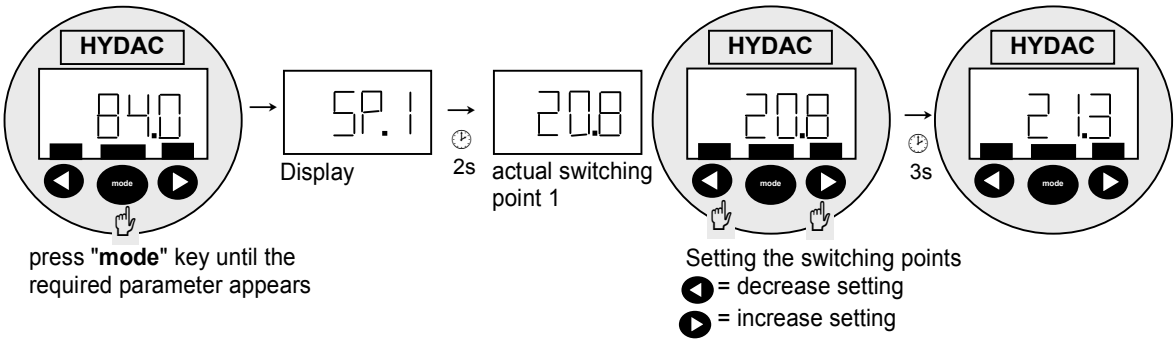
## 7.2 ANALOGUE OUTPUT

The versions with 1 or 2 switching points can have an analogue output as an option.
The output can be switched to either 4 .. 20 mA or 0 .. 10 V (corresponding to measuring range) via the basic menu and can be assigned to fluid level or to temperature (optional).

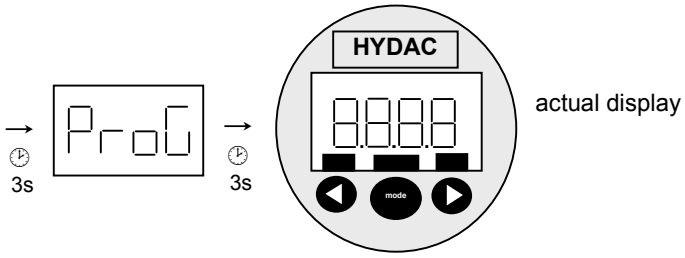
The versions with 4 switching points have two 0 .. 10 V analogue outputs.
In this case fluid level and temperature are permanently assigned to an output.

## 7.3 SETTING THE SWITCHING POINTS AND HYSTERESES OR SWITCHING RANGES FOR WINDOW MODE

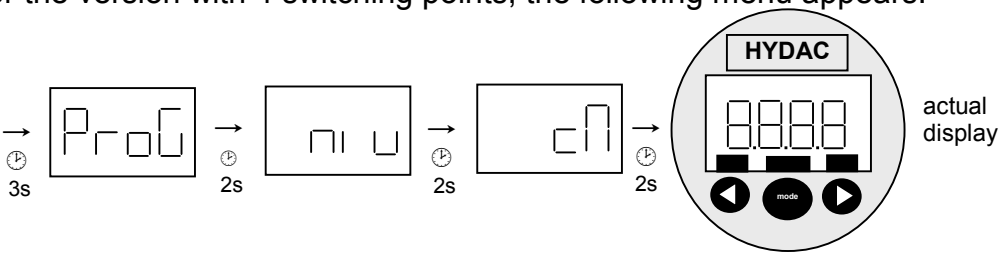
- Press the "**mode**" key.
- Either "**S.P.1**" or "**Hi.1**" will appear in the display.
- Keep pressing the mode key repeatedly to scroll through to the required parameter. (S.P.1, hYS.1, S.P.4 or hYS.4 appears when switching point mode is set; Hi.1, Lo.1, Hi.4 or Lo.4 appears when window mode is set)
- After 2 seconds have elapsed, the actual setting will flash.
- Use the ◂ and ▸ keys to alter the settings.
- If necessary, use the "**mode**" key to select further parameters and the ◂ and ▸ keys to alter the settings.
- If no key has been pressed for 3 seconds, the display will revert to displaying the primary display and the settings will be saved to the unit.




For the version with 1 or 2 switching points, the following menu point appears:



For the version with 4 switching points, the following menu appears:




**NOTE**:

- If "LOC" appears in the display when attempting to change a setting, programming is disabled.
  Action: Set the programming enable(s) to "**free**". (see section 10 Programming Enables)
- If the ; key ◂ or key ▸ is held down while changing a setting, the value will advance automatically.
- Whenever any settings have been altered, "**PROG**" appears briefly in the display when the display switches over. The new setting is then saved in the unit.

## 7.4 SETTING RANGES FOR THE SWITCHING OUTPUTS

(switching point minus switching hysteresis = switch-back point)

| Probe length in inch | Measuring range in inch | Switching point in inch * | Switching hysteresis in inch * |
|---|---|---|---|
| 9.80 | 6.70 | 0.10 .. 6.70 | 0.05 .. 6.60 |
| 16.20 | 11.40 | 0.20 .. 11.40 | 0.05 .. 11.25 |
| 20.50 | 15.35 | 0.25 .. 15.35 | 0.05 .. 15.15 |
| 28.70 | 23.20 | 0.35 .. 23.20 | 0.15 .. 22.85 |

The increment for all units is 0.05 inch.

| Probe length in cm | Measuring range in cm | Switching point in cm * | Switching hysteresis in cm * |
|---|---|---|---|
| 25.0 | 17.0 | 0.3 .. 17.0 | 0.1 .. 16.8 |
| 41.0 | 29.0 | 0.5 .. 29.0 | 0.2 .. 28.7 |
| 52.0 | 39.0 | 0.6 .. 39.0 | 0.2 .. 38.6 |
| 73.0 | 59.0 | 0.9 .. 59.0 | 0.3 .. 58.4 |

The increment for all units is 0.1 cm.

| Switching point in °F * | Switching hysteresis in °F * | Increment in °F |
|---|---|---|
| -9 .. 212 | 2 .. 222 | 1 |

| Switching point in °C * | Switching hysteresis in °C * | Increment in °C * |
|---|---|---|
| -23.0 .. 100.0 | 1 .. 123.5 | 0.5 |

* All ranges given in the table can be adjusted by the increments shown and apply when the offset is zero.

## 7.5 SETTING RANGES FOR THE WINDOW FUNCTION

| Probe length in inch * | Lower switch value in inch * | Upper switch value in inch * |
|---|---|---|
| 9.80 | 0.10 .. 6.55 | 0.20 .. 6.60 |
| 16.20 | 0.20 .. 11.15 | 0.30 .. 11.25 |
| 20.50 | 0.25 . 15.05 | 0.35 .. 15.15 |
| 28.70 | 0.40 .. 22.80 | 0.60 .. 23.00 |

The increment for all units is 0.05 inch

| Probe length in cm | Lower switch value in cm * | Upper switch value in cm* |
|---|---|---|
| 25.0 | 0.3 .. 16.7 | 0.4.. 16.8 |
| 41.0 | 0.5 .. 28.4 | 0.7 .. 28.7 |
| 52.0 | 0.6 . 38.3 | 0.9 .. 38.6 |
| 73.0 | 0.9 .. 57.9 | 1.4 .. 58.4 |

The increment for all units is 0.1 cm.

## 7.6 SETTING RANGES FOR THE OFFSET

| Probe length in inch | Measuring range in inch | Setting range for Offset in inch* |
|---|---|---|
| 9.8 | 6.7 | 0 .. 26.8 |
| 16.2 | 11.4 | 0 .. 45.6 |
| 20.5 | 15.35 | 0 .. 61.4 |
| 28.7 | 23.2 | 0 .. 69.6 |

The increment for all units is 0.05 inch.

| Probe length in cm | Measuring range in cm | Setting range for Offset in cm * |
|---|---|---|
| 25 | 17 | 0 .. 68 |
| 41 | 29 | 0 .. 116 |
| 52 | 39 | 0 .. 156 |
| 73 | 59 | 0 .. 177 |

The increment for all units is 0.1 cm.

* All ranges given in the table can be adjusted by the increments shown

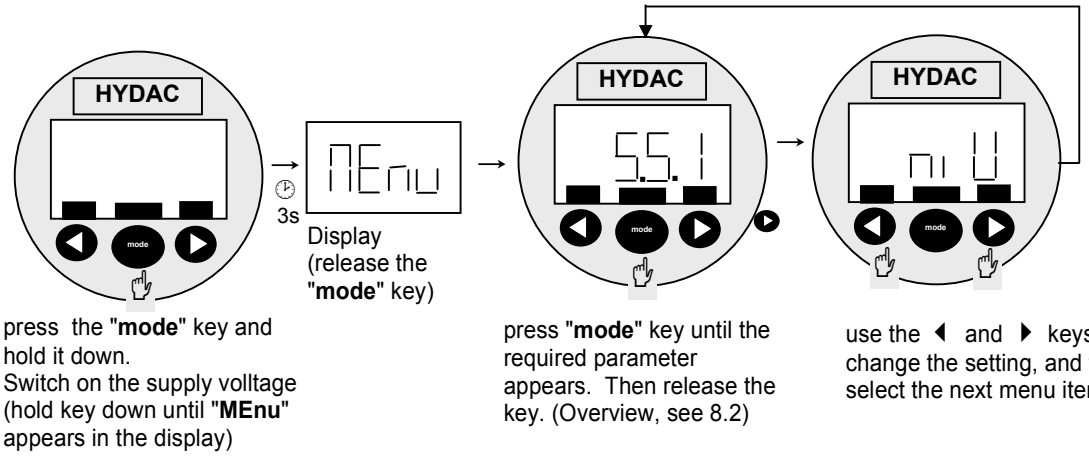
# 8 Basic settings

The function of the ENS 3000 can be adapted to suit the particular application by altering several basic settings. These settings are combined in a single menu.

## 8.1 CHANGING THE BASIC SETTINGS

**NOTE**:
- When the menu is activated, no switching operations are carried out!

Activating the Basic Settings menu:




To close the Basic Settings menu:
Select the "END" menu item, set to "YES": the ENS 3000 returns to normal display mode after 2 s.

**NOTE:**
- If there is no activity in this menu for approx. 25 seconds, the menu will automatically close and any changes you have made will not be applied.

## 8.2 SUMMARY OF THE BASIC SETTINGS

| Setting | Display | Setting range | Default setting |
|---|---|---|---|
| **Switching output 1 assignment (S.S.1)** | | | |
| niU Switching output 1 to switch at the pre-set fluid level<br>TEMP Switching output 1 to switch at the pre-set temperature | S.S.1 | niv / TEMP | niv |
| **Switching mode, switching output 1 (S.m.1)** | | | |
| SP Switching output 1 is operating in switching point hysteresis mode<br>Win Switching output 1 is operating in window mode | S.m.1 | SP / Win | SP |
| **Switching direction, switching output 1 (S.d.1)** | | | |
| on Normally open<br>oFF Normally closed | S.d.1 | ON / OFF | ON |
| **Switch-on delay, switching output 1 ($T_{ON}$ 1)**<br>Time in seconds which must elapse once the particular switch point has been reached or exceeded before switching will occur.<br>Increment: 1s | t.on.1 | 0 .. 9999s | 1 |
| **Switch-off delay, switching output 1 ($T_{OFF}$ 1)**<br>Time, in seconds, which must elapse once the value has dropped below the switch back point before a switching operation will occur.<br>Increment: 1s | t.oF.1 | 0 .. 9999s | 1 |
| **Settings for switching output 2, 3 or 4 are carried out as discribed above** | | | |
| **Primary display (Primary)**<br>Value to be continually displayed:<br>Anzeige stehen soll:<br>niU Actual fluid level<br>n.toP Peak fluid level<br>n.miN Lowest fluid level<br>TEMP Actual temperature<br>t.toP Peak temperature<br>t.miN Lowest temperature<br>SP.1 up to SP.4 Switch point 1 to 4 | Pri.n | niv/ n.Top/ n.Min/ Temp/ T.Top/ T.Min/ S.P.1/ S.P.2/ S.P.3/ S.P.4/ OFF | niv |

| Setting | | Display | Setting range | Default setting |
|---|---|---|---|---|
| oFF | Display off | | | |
| (For function, see Section 6. "Digital display") | | | | |

| Setting | | Display | Setting range | Default setting |
|---|---|---|---|---|
| **Setting the indication range of the fluid level (FLUID LEVEL RANGE)** | | | | |
| inch | The fluid level is indicated in inch | rAn | inch/ cm | inch (depending on the model) |
| cm | The fluid level is indicated in cm | | | |
| **Setting the level offset (NIVEAU OFFSET) while the fluid level is displayed** | | | | |
| The distance between the base of the tank and the start of the active zone of the fluid level sensor is regarded as the "offset". Inputting this distance will generate a reference to actual fluid level. | | oFS | | 0 |
| **Setting the indication range of the temperature (TEMPERATURE RANGE)** | | | | |
| FAHr | The temperature is shown in °F. °F angezeigt | rAn | Fahr/ celc | Fahr (depending on version) |
| cELc | The temperature is shown in °C. °C angezeigt | | | |
| **Setting the type of fluid** | | | | |
| oiL | Fluid level sensor calibrated to oil parameters | SELn | oil/ AcL | oil |
| AcL | Fluid level sensor calibrated to cooling lubricants parameters (Aqueous cooling Lubricants = AcL) | | | |
| When the new selection is saved, the change is active. On the version with 4 SP the message neU is also displayed. | | | | |
| **Assigning the analogue output (Select Output)*** | | | | |
| niU | The analogue output is assigned to the fluid level | Sour | niv/ TEMP | niv |
| TEMP | Assigns the analogue output to temperature. | | | |

| Setting | Display | Setting range | Default setting |
|---|---|---|---|
| **Analogue output (Output)** | | | |
| nAnP The analogue output provides a 4 .. 20 mA signal for the active measuring range | ouTP | MAMP/ VOLT/ | MAMP |
| UoLT The analogue output provides a 0 .. 10 V signal for the active measuring range | | | |
| **NOTE: relevant for replacement of "previous" devices only** | | | |
| In addition to the probe lengths 410 mm and 520 mm, when the analogue output has been assigned to the fluid level. | | MA.Sr/ VO.Sr | |
| nA.Sr The analogue output provides a 4 .. 20 mA signal for a active measuring range reduced by 30 mm | | | |
| Uo.Sr The analogue output provides a 0 .. 10 mA signal for a active measuring range reduced by 30 mm | | | |
| **Particular in the variant with 4 SP:** | | | |
| UoLT The analogue output provides a 0 .. 10 V signal for the active measuring range of the fluid level | ouTP | VOLT/ VO.Sr | VOLTS |
| Uo.Sr The analogue output provides a 0 .. 10 mA signal for a active measuring range reduced by 30 mm | | | |
| **Re-setting the measuring probe to factory settings**** | | | |
| no The factory settings are not active | FcAL | YES/ NO | NO |
| YES The factory settings are active | | | |

When the new selection is saved, the message nEU is displayed and the change is active.

| Setting | Display | Setting range | Default setting |
|---|---|---|---|
| **Version number (Version)**<br>Displays the current software version.<br>(view only) | UEr5 | | |
| **Close the basic settings menu (End)**<br>YES The basic settings menu is closed.<br>no Further changes can be made to the basic settings. | End | YES/ NO | NO |

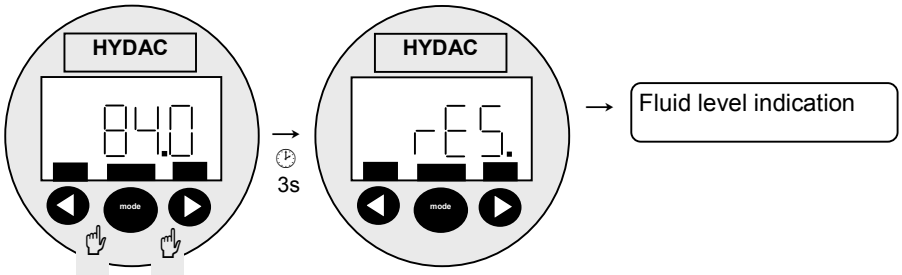
If any basic settings have been altered, "**ProG**" appears briefly in the display as soon as the basic settings menu is closed and then the value selected for primary display is shown.

* This menu point appears only on versions with 1 or 2 SP.

** This menu point appears only on versions with 4 SP.

## 9 Resetting the peak values

There is an option for resetting the peak values of the fluid level and of the temperature (depending on the model)

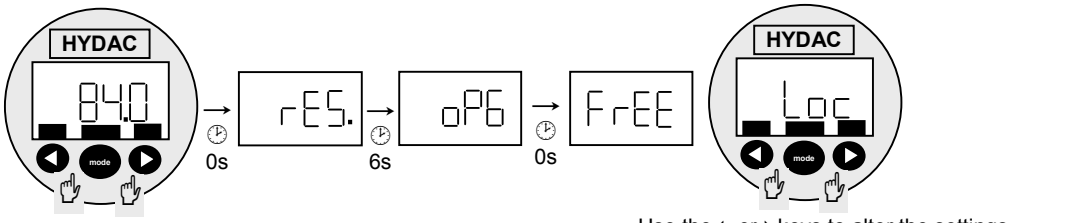



Press both arrow keys simultaneously and hold them down for 3 s.

## 10 Programming Enables

The unit has 2 program enables which must both be enabled in order to modify the settings.
The operating program enable can be set or cancelled during operation. It provides protection against unintentional alterations of settings.
A programming disable via the main programming enable prevents any changes from being made to the settings during operation. This serves, for example, as a safety function or as protection against unauthorised alterations.

### 10.1 ALTERING THE OPERATING PROGRAMMING ENABLE

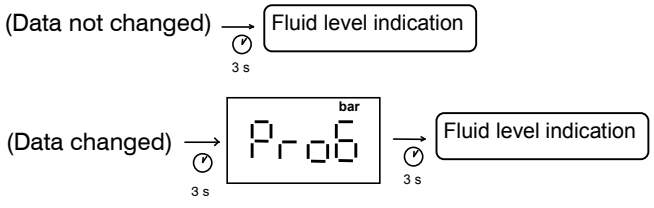



Press both arrow keys simultaneously

Display (release arrow keys)

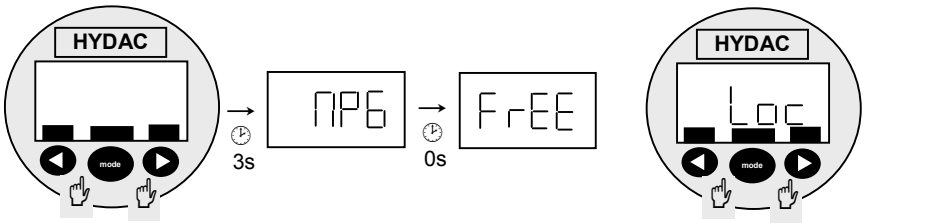
Use the ◂ or ▸ keys to alter the settings

FrEE = programming enabled
Loc = programming disabled



## 10.2 CHANGING THE MAIN PROGRAMMING ENABLE

**NOTE:**
Switch off the supply voltage or disconnect the instrument from the supply voltage.

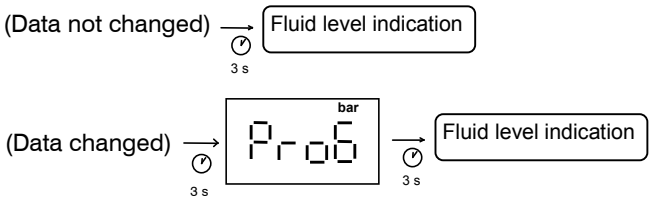



Press both arrow keys simultaneously and hold them down. Switch on supply voltage. (hold the keys down for 3 s)

Display (release arrow keys)

Use the ◂ or ▸ keys to alter the settings

FrEE = programming enabled
Loc = programming disabled




**NOTE**:
- Whenever any settings have been altered, "ProG" appears briefly in the display when the display switches over. The new setting is then saved in the unit.

# 11 Messages

## 11.1 ERROR MESSAGES

If an error is detected, a corresponding error message appears that must be acknowledged by pressing any key.
Possible error messages:

**E.01** The switch points and hysteresis values have been set in such a way that the resulting switch-back point is no longer within the permitted setting range.
Example:
Switching point has been set to 8.20 inch, the hysteresis to 9.05 inch.
**Action:** Correct the settings.

**E.10** A data error was detected in the saved settings. This could be due to strong electromagnetic interference or a component fault.
**Action:** Check all settings (programming enable, switch points, switch-back points and basic settings) and correct them, if necessary. If the error occurs frequently, please contact the HYDAC Service Department.

**E.20** Implausible measuring values have been reported from the level sensor for a long period.
**Action:** Acknowledge the error message by pressing any key. If the error message continues to be displayed, please contact our service department.

**E.21** A communication error was detected within the level sensor.
**Action:** Acknowledge the error message by pressing any key. If the error message continues to be displayed, please contact our service department.

**E.22** An internal communication error to the temperature sensor (optional) was detected.
**Action:** Acknowledge the error message by pressing any key. If the error message continues to be displayed, please contact our service department.

## 11.2 OTHER MESSAGES

Other messages that cannot be acknowledged by pressing any key may also appear on the display.

Possible message, if the ENS has not yet been used:

– – – – Flashing display of all centre LEDs.

The ENS detects an undefined condition, i.e. the level of the fluid is outside the active zone. Therefore the level is either too low or too high.

**Action**: If level is too low: top up the fluid until a valid measurement is detected.
If level is too high: drain the fluid until a valid measurement is detected.

Possible message, if ENS has already been in use:

**0.0 resp. flashing offset** A flashing zero value in the display

The ENS detected a change in fluid level which is below the active zone. The last reliable fluid level measured is less than the average value of the unit's effective range.

**xx.x** A flashing non-zero value in the display

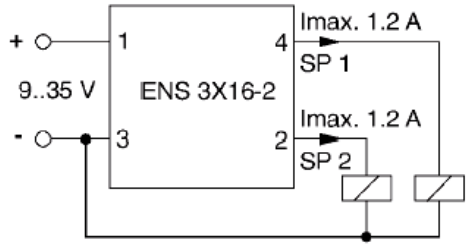
The ENS detected a change in the fluid level which is higher than the active zone. The last reliable fluid level measured is greater than the average value of the unit's effective range. Possible values for x.xx: 6.70, 11.40, 15.35, 23.20 (without offset values)

– – Flashing left and right centre LED.
The ENS has detected a fault and the distance between the imperfection and the measurement signal is so small that no clear measurement signal can be identified. The last valid status of the switching output and the analogue output remain maintained.

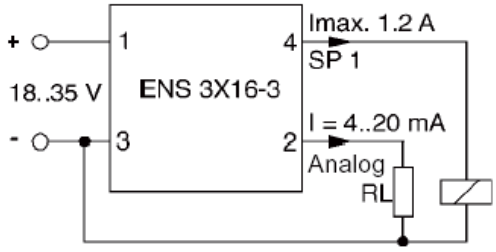
# 12 Pin assignment

## 12.1 PIN CONNECTIONS WITH 1 OR 2 SWITCHING OUTPUTS

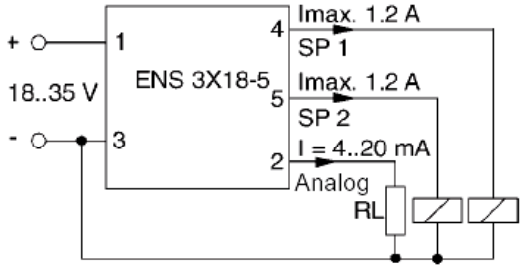
Model with 2 switching outputs
Connector 4 pole M12x1




Model with 1 switching output and 1 analogue outputs
Connector 4 pole M12x1

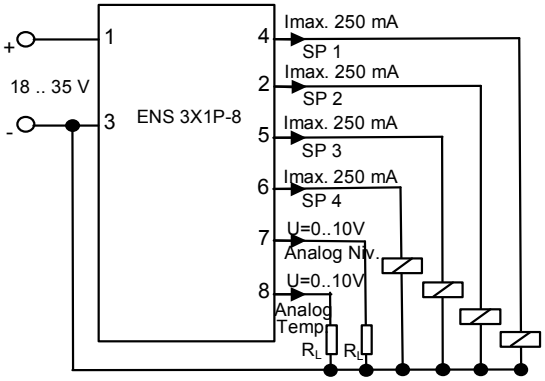



Model with 2 switching outputs and 1 analogue outputs
Connector 5 pole M12x1




## 12.2 PIN CONNECTIONS WITH 4 SWITCHING OUTPUTS

Model with 4 switching outputs and 2 analogue outputs
Connector 8 pole M12x1



## 13 Technical specifications

| | |
|---|---|
| **Input data** | |
| Sensor type | Capacitive Level Sensor |
| Probe length | 9.80; 13.20; 20.50; 28.70 inch |
| Measuring range | 6.70; 11.40; 15.35; 23.20 inch |
| Max. speed of change of the fluid level | 1.75; 2.36; 3.15; 3.94 inch/s |
| Repeatability | ≤ ± 2 % FS * |
| Switching point accuracy | ≤ ± 2 % FS |
| **Temperature (optional)** | |
| Sensor type | Semi-conductor sensor |
| Measuring range | -13 .. +212 °F |
| Accuracy | ± 34.7 °F |
| Reaction time ($t_{90}$) | 180 s |
| **Output data** | |
| **Analogue output (optional)** | |
| With 1 or 2 SP selectable | 4 .. 20 mA ohmic resistance ≤ 500 Ω<br>0 .. 10 V ohmic resistance ≥ 1 kΩ<br>corresponds to measuring range selected |
| With 4 SP (only with temperature sensor) | 0 .. 10 V ohmic resistance ≥ 1 kΩ<br>corresponds to measuring range selected |
| **Switching outputs** | |
| Type | Transistor output PNP<br>Programmable as N/O or N/C |
| Assignment | On version with temperature measurement<br>user-selectable temperature or fluid level |
| Switch current | 1 or 2 SP: max. 1.2 A per output<br>4 SP: max. 0.25 A per output |
| Switch cycles | > 100 million |
| **Environmental conditions** | |
| Compensated temperature range | 32 .. +140 °F |
| Operating temperature range | 32 .. +140 °F |
| Storage temperature range | -40 .. +176 °F |
| Fluid temperature range: | 32 .. +140 °F |
| CE - mark | EN 61000-6-1 / 2 / 3 / 4 |
| cULus-mark** | Certificate No.: E318391 |
| Vibration resistance according to DIN EN 60068-2-6 (0 .. 500 Hz) | ≤ 5 g |
| Shock resistance according to DIN EN 60068-2-29 (1 ms) | 25 g |
| Protection class to DIN 40050 | IP 67 |

| **Other data** | |
|---|---|
| Max. tank pressure | 7 psi (short-term 40 psi t < 1 min) |
| supply voltage | 9 .. 35 V DC without analogue output<br>18 .. 35 V DC with analogue output |
| when applied according to UL specifications | - limited energy –<br>according to<br>9.3 UL 61010; Class 2;<br>UL 1310 / 1585; LPS UL 60950 |
| Current consumption | max. 2,470 A total<br>max. 90 mA inactive<br>switching outputs and<br>2 analogue outputs |
| Residual ripple of supply voltage | ≤ 5 % |
| Fluids | Hydraulic oils (mineral based), synth. oils,<br>fluids containing water *** |
| Parts in contact with fluid | Ceramic |
| Display | 4-digit, LED, 7 segment, red,<br>height of digits 7 mm |
| Weight | 180 .. 300 g, according to probe length |

Note: Reverse polarity protection of the supply voltage, excess voltage, override and short circuit protection are provided.
**FS** (**f**ull **s**cale) = regarding the complete measuring range
* specifies (at constant level)
** environmental conditions according to 1.4.2 UL 61010-1; C22.2 No. 61010-1
*** further fluids on request

## 14 Order details

**ENS 3 X 1 X – X –XXXX – 000 – K**

**Serial-no.**
(determined by manufacturer)

**Temperature sensor**
1 =with temperature sensor
2 =without temperature sensor
Only possible with output options "2", "3" and "5"

**Mechanical connection**
1 =22 mm diameter collar to fit
cuttting ring coupling G22L

**Electrical connection**
6 = M12x1, 4 pole
only possible with output options “2“ und “3“
(connector not supplied)
8 = M12x1, 5 pole
only possible with output options “5“
(connector not supplied)
P = M12x1, 8 pole
only possible with output options “8“
(connector not supplied)

**Output**
2 =2 switching outputs
(in conjunction with electrical connector type “6“ only)
3 =1 switching output and 1 analogue output
(in conjunction with electrical connector type “6“ only)
5 =2 switching outputs and 1 analogue output
(in conjunction with electrical connector type “8“ only)
8 =4 switching outputs and 2 analogue outputs
(in conjunction with electrical connector type “P“ only)

**Probe length**
0100 = 9.80 inch, 0162 = 16.20 inch
0205 = 20.50 inch, 0287 = 28.70 inch

**Modification number**
400= US-standard (determined by manufacturer)

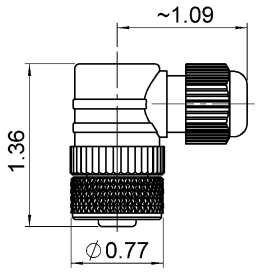
**Material of probe**
K =ceramic

# 15 Accessories

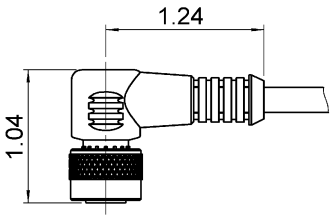
## 15.1 FOR ELECTRICAL CONNECTION

15.1.1 For use with ouput options "2" and "3"

**ZBE 06 (4 pole)**
Connector, female M12x1, right-angle
Part No.: 6006788




**ZBE 06-02 (4 pole)**
Female connector M12x1, right-angle with 2m (78.7 inch) cable,
Part No.: 6006790

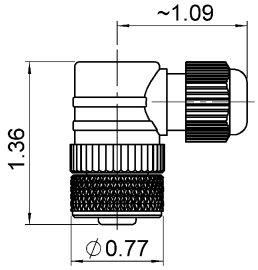



**ZBE 06-05 (4 pole)**
Female connector M12x1, right-angle with 5m (197 inch) cable,
Part No.: 6006789

Colour code:
Pin 1: brown
Pin 2: white
Pin 3: blue
Pin 4: black

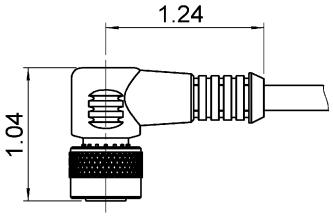
15.1.2 For use with ouput options "2", "3" and "5"

**ZBE 08 (5 pole)**
Female connector M12x1, right-angle
Part No.: 6006786



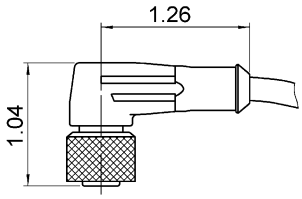

**ZBE 08-02 (5 pole)**
Female connector M12x1, right-angle with 2m (78.7 inch) cable,
Part No.: 6006792

**ZBE 08-05 (5 pole)**
Female connector M12x1, right-angle with 5m (197 inch) cable
Part No.: 6006791




Colour code: Pin 1: brown
Pin 2: white
Pin 3: blue
Pin 4: black
Pin 5: grey

**ZBE 08S-02 (5-pole)**
Female connector M12x1, right-angle with 2m (78.7 inch) cable, screened
Part No.: 6019455



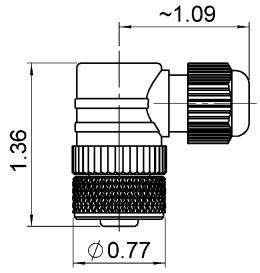

**ZBE 08S-05 (5-pole)**
Female connector M12x1, right-angle with 5m (197 inch) cable, screened
Part No.: 6019456

**ZBE 08S-10 (5-pole)**
Female connector M12x1, right-angle with 10m (394 inch) cable, screened
Part No.: 6023102

Colour code: Pin 1: brown
Pin 2: white
Pin 3: blue
Pin 4: black
Pin 5: grey

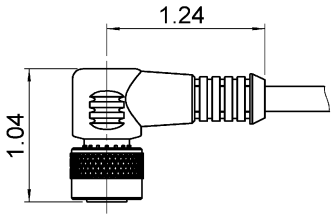
15.1.3 For use with ouput options "8"

**ZBE 0P (8 pole)**
Female connector M12x1, right-angle
Part No.: 6055444




**ZBE 0P-02 (8 pole)**
Female connector M12x1, right-angle with 2m (78.7 inch) cable,
Part No.: 6052697

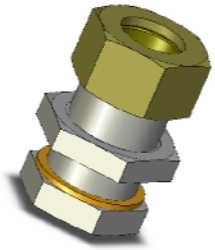
**ZBE 0P-05 (8 pole),**
Female connector M12x1, right-angle with 5m (197 inch) cable
Part No.: 6052698

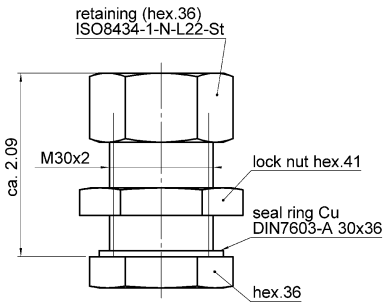



Colour code:
Pin 1: white
Pin 2: brown
Pin 3: green
Pin 4: yellow
Pin 5: grey
Pin 6: pink
Pin 7: blue
Pin 8: red

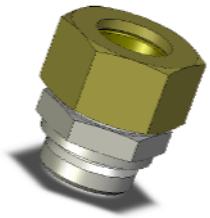
## 15.2 FOR MECHANICAL CONNECTION

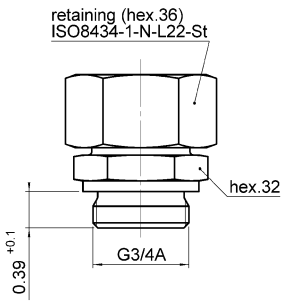
**ZBM 19**
**(permitted use with probe lengths13.20; 20.50; 28.70 inch)**
Straight bulkhead fitting
Part No.: 908738



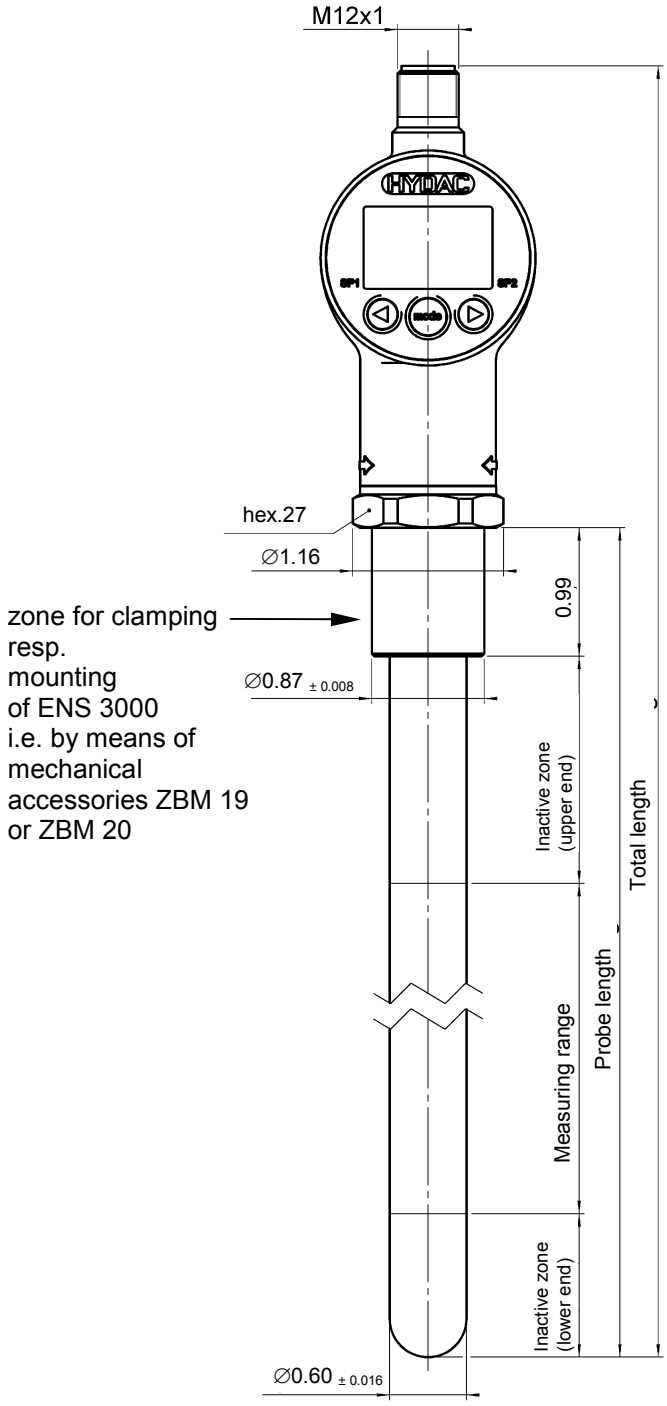



**ZBM 20**
**(permitted use with probe lengths 9.80; 13.20; 20.50; 28.70 inch)**
Straight connecting piece
Part No.: 908739

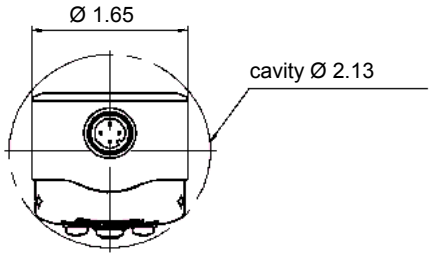




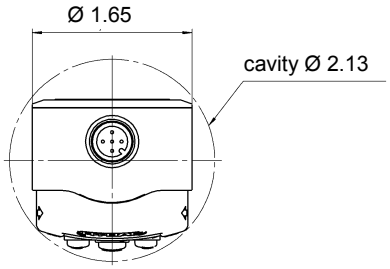
## 16 Dimensions



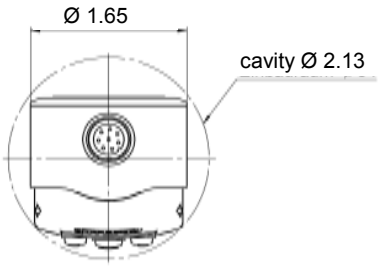

4 pole




5 pole




8 pole




| Code | (inch) | (inch) | (inch) | (inch) |
|---|---|---|---|---|
| Inactive zone (lower end) | approx. 0.87 | approx. 1.10 | approx. 1.34 | approx. 1.95 |
| Measuring range | 6.70 | 11.40 | 15.35 | 23.20 |
| Probe length | 9.80 | 16.20 | 20.50 | 28.70 |
| Total length | 13.40 | 19.70 | 24.00 | 32.30 |
| Inactive zone (upper end) | approx. 1.30 | approx. 2.65 | approx. 2.80 | approx. 2.55 |

# 17 Application examples

## 17.1 HYDRAULIC POWER UNIT: TO MONITOR MINIMUM FLUID LEVEL WITH ADVANCE WARNING AND ALARM

In this example application, an advance warning should be given when the fluid level reaches 30 cm and tank refilling should be started. An alarm should be triggered if the fluid level drops below 10 cm and reset once the fluid level has reached 15 cm again.

For realization of this function as described in the example,

the following settings in the menu and on the switching points of ENS 3000 must be effected:

| Menu item | Selection | Numerical value |
|---|---|---|
| Switching output S.S.1 assignment | niv | |
| Switching mode S.m. 1 | SP | |
| Switching direction S.d. 1 | off | |
| Switch-on delay Ton 1 | | 1 |
| Switch-off delay Toff 1 | | 1 |
| Switching output S.S.2 assignment | niv | |
| Switching mode S.m. 2 | SP | |
| Switching direction S.d. 2 | on | |
| Switch-on delay Ton 2 | | 1 |
| Switch-off delay Toff 2 | | 1 |

| Switching point settings | Numerical value |
|---|---|
| Switching output S.P.1 | 30.5 |
| Hysteresis switching output Hi.1 | 0.5 |
| Switching output S.P.2 | 15 |
| Hysteresis switching output Hi.2 | 5 |

## 17.2 HYDRAULIC POWER UNIT: MINIMUM FLUID LEVEL MONITORING WITH ADVANCE WARNING AND MINIMUM TEMPERATURE MONITORING

In this example application, an advance warning should be given when the fluid level reaches 30 cm and tank refilling should be started. The temperature also must not fall below a certain limit. If, for example, a temperature of

20°C is reached, a "stop" signal will appear. Furthermore, the temperature will be transferred to an SPS card as a 4 .. 20 mA signal.

For realization of this function as described in the example,

the following settings in the menu and on the switching points of ENS 3000 must be effected:

| Menu item | Selection | Numerical value |
|---|---|---|
| Switching output S.S.1 assignment | niv | |
| Switching mode S.m. 1 | SP | |
| Switching direction S.d. 1 | off | |
| Switch-on delay Ton 1 | | 1 |
| Switch-off delay Toff 1 | | 1 |
| Switching output S.S.2 assignment | TEMP | |
| Switching mode S.m. 2 | SP | |
| Switching direction S.d. 2 | on | |
| Switch-on delay Ton 2 | | 1 |
| Switch-off delay Toff 2 | | 1 |
| Analogue output S.ouT assignment | TEMP | |
| Analogue output ouTP | MAMP | |

| Switching point settings | Numerical value |
|---|---|
| Switching output S.P.1 | 30.5 |
| Hysteresis switching output Hi.1 | 0.5 |
| Switching output S.P.2 | 20.5 |
| Hysteresis switching output Hi.2 | 0.5 |

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**HYDAC Service**
For enquiries on repairs or alterations, please contact HYDAC Service.

**HYDAC SERVICE GMBH**
Hauptstr. 27
D-66128 Saarbrücken
Germany

Phone: +49 (0) 6897 509-1936
Fax.: +49 (0) 6897 509-1933

**Note**

The information in this manual relates to the operating conditions and applications described. For applications and operating conditions not described, please contact the relevant technical department.

If you have any questions, suggestions, or encounter any problems of a technical nature, please contact your Hydac representative.

All technical details are subject to change without notice.