



NOSHOK Series 755 / 756 Digital Pressure Transmitter Operating Manual

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1 General Safety Instructions

Observe the national safety and accident prevention regulations, as well as the following safety instructions in this operating manual when working with the hydrostatic pressure transducer.

Any operation not described in the following instructions should not be used.

If a fault cannot be corrected, the device should be removed from operation and disposed of to prevent its reinstallation.

Repairs should only be performed by the manufacturer. All other repairs or device modifications are unauthorized.

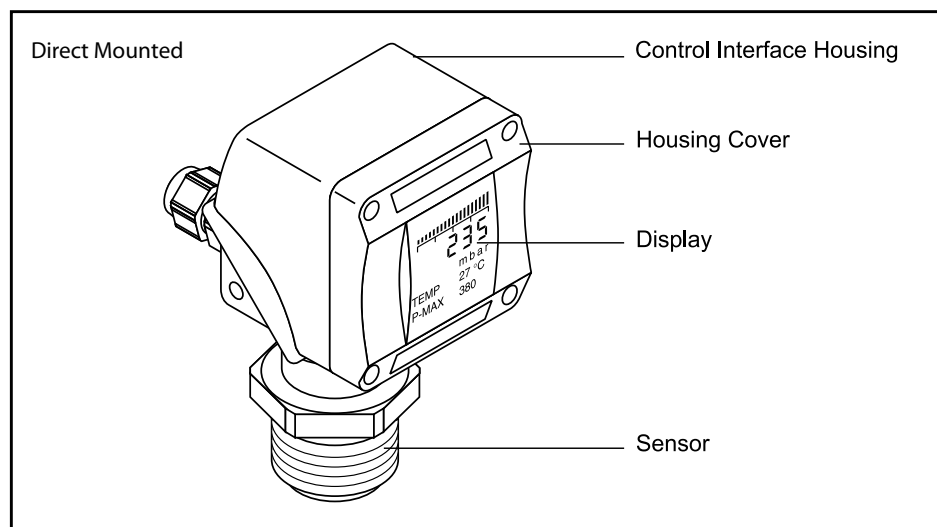
Other important safety guidelines are located in the individual sections of this instruction manual.

2 Product Description

The pressure transmitter can be used in level control as well as pressure measurement in process applications. A variety of process connections, measurement ranges, electronic interfaces and display options offer a product for a wide range of applications.

2.1 Construction

The Digitrans consists of a pressure sensor, a control interface unit and a housing cover with optional display. Different modular configurations are available allowing a variety of designs.



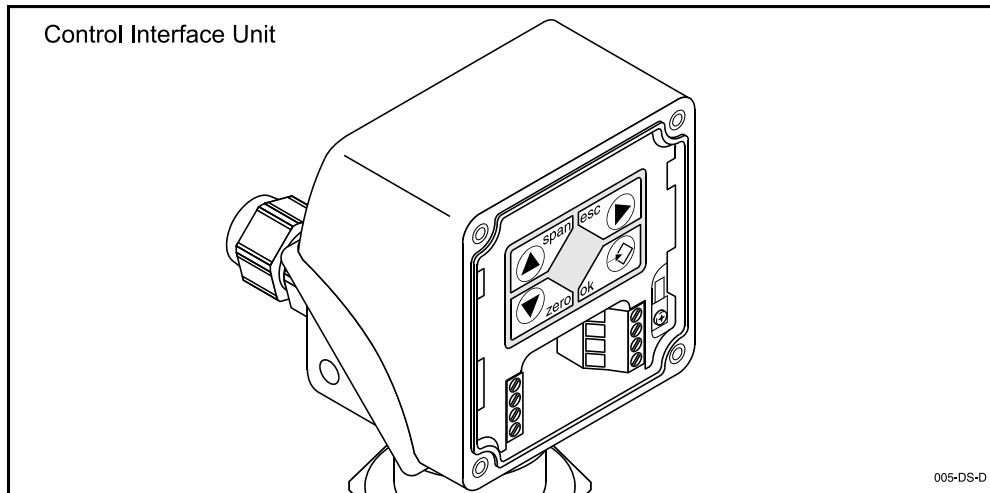
2.1.1 Pressure Transducer

The pressure transducer has a piezo-resistive or thinfilm measurement cell depending on the pressure range. The sensors are temperature compensated, and have a fully welded membrane which is "helium" leak-tested. Pressure transducers do not have internal seals.

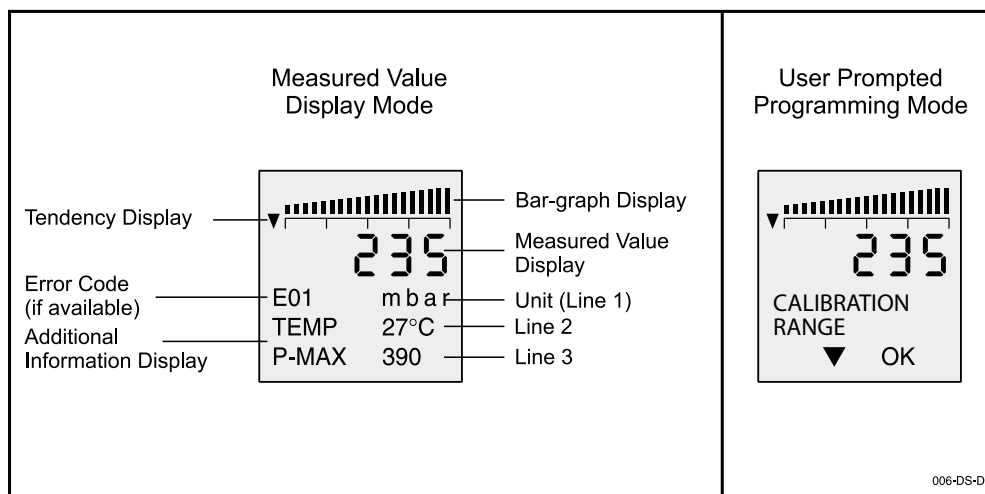
Pressure transducers further distinguish themselves from one another based on their ranges and the types of media-touching materials. Different versions of process connections can be selected for a wide range of application conditions.

2.1.2 Control Interface Unit

The control interface unit contains the terminal compartment and the keypad used in programming the device. The four keys must be active (unlocked) before use. The keypad is locked during normal operation to protect data and functions previously entered. The keypad automatically locks after 10 minutes of disuse. The control interface converts the sensor's digital signal into a standard 4-20 mA current signal.



2.1.3 Display Unit



The measured-value indicator has four digits (in a 7-segment display) + symbols. Below it, is line 1 (16-segment display) used to display error codes and the signal's unit of measure. The unit of measure can be selected by the operator.

Additional information is displayed in lines 2 and 3 (16-segment display). The operator can enter commands in the programming mode on the display unit by means of menu driven, clear-text prompts.

Devices with displays clearly offer a higher number of programming and control interface options. These options include alarm status, dampening, signal inversion, tank linearization and diagnostic messages.



Display units can be easily upgraded (see Section 4.2).

2.2 Function

The mode of operation for signal conversion is the same for all versions. The pressure transducer converts the existing pressure into an electrical signal. Microelectronics further process the input signal and produce a proportional 4-20 mA standard signal.

The display-version allows programming (parameterization) and the display of expanded functions such as inversion, dampening, alarm status and linearization.

2.2.1 Functions of Devices without Displays

- Calibration of zero and span with pressure (see 5.3)
- Calibration of zero and span without pressure (dry adjustment) (see 5.4)
- Setting the dampening / integrating the output signal 0-40 s (see 5.5)
- Reset to manufacturer's default values (see 5.6)

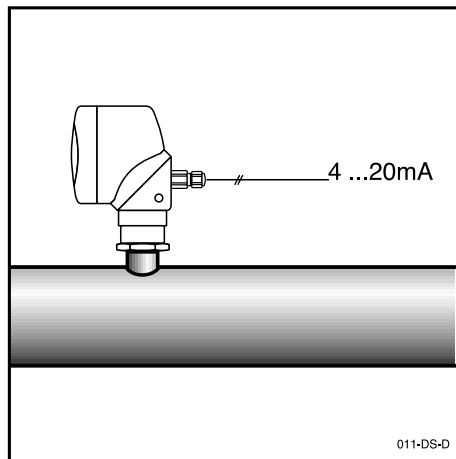
2.2.2 Functions of Devices with Displays

- Optional units of measure for measured-values (mbar, bar, psi, mA, %, m, mm WS) (see 6.5.1)
- Temperature and Min/Max values shown in display (see 6.5.1)
- Nominal pressure range of the sensor shown in display (see 6.5.1)
- Zero and span calibration (with/without pressure) (see 6.5.2)
- Dampening setting / integration of output signal 0-40 s (see 6.5.3)
- Inversion of the output current signal (see 6.5.3)
- Alarm output current value setting (3.6 mA or 21 mA) (see 6.5.3)
- Setting the limits of the output signal (see 6.5.3)
- Offset of the output signal (see 6.5.3)
- Mounting correction of the sensor
- Measuring circuit test function (see 6.5.4)
- Reset functions (see 6.5.4)
- Password activation (see 6.5.4)
- Selecting the language of the display (see 6.5.5)
- Entry of a table function for the linearization of the output signal (see 6.5.6)
- Entry of medium consistency (see 6.5.6)

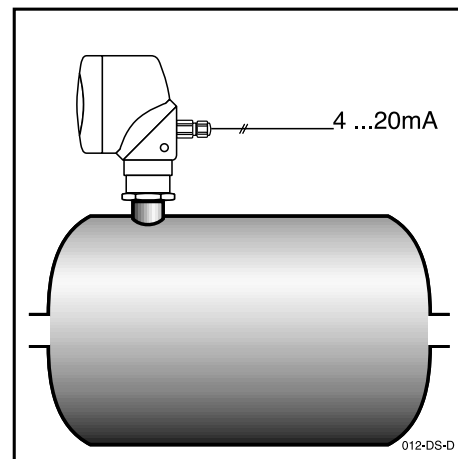
2.3 Installation Examples

The Digitrans is primarily used to detect the pressure in pipes, plants and tanks. The pressure is measured using absolute (against a vacuum) or relative (against external or air pressure) measurement depending on the type of sensor selected.

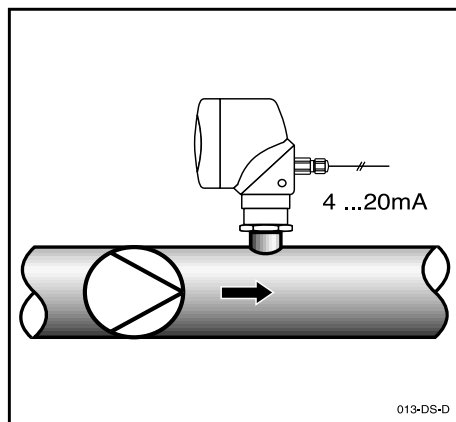
The Digitrans is also used for hydrostatic pressure measurement of liquids in tanks.



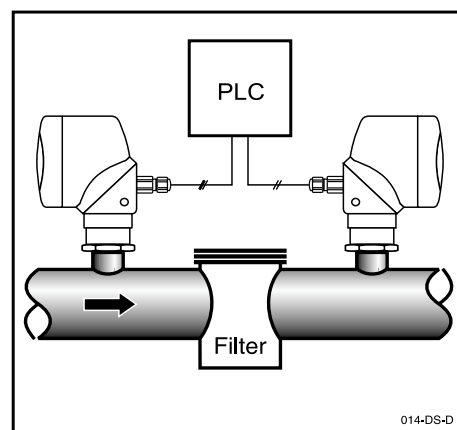
*Process Pressure Measurement:
Used to measure pressure of liquids
or gases in pipelines.*



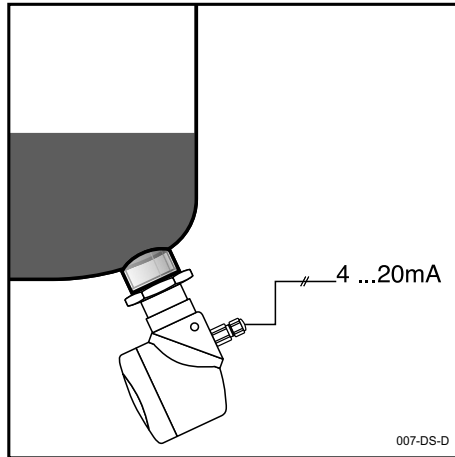
*Process Pressure Measurement:
Used to measure container pressure.*



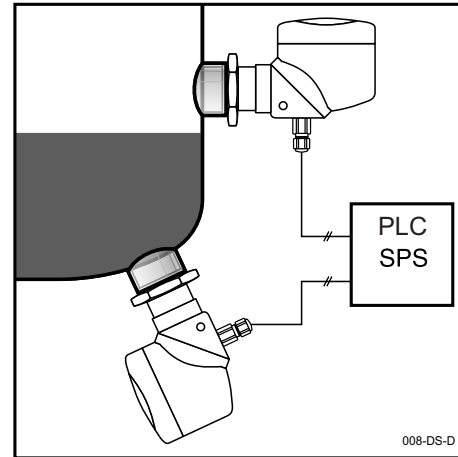
*Process Pressure Measurement:
Installed behind feed pumps for
process control or monitoring pump
functions.*



*Process Pressure Measurement:
Installed in front of and behind the filter.
Uses the pressure differential for moni-
toring the function or accumulation of dirt
in the filter. Both output signals are pro-
cessed by a PLC or signal converter.*



*Level Control:
Externally mounted
(with front flush diaphragm)*



*Level Control:
Combined pressure and head pressure
are measured by two externally mounted
pressure transducers. The two signals
are analyzed and the differential is cal-
culated by a PLC or suitable signal con-
verter.*

3 Technical Data

3.1 Input-values

Pressure Range (Absolute pressure upon request)	0 - 5 psi	<i>overload limit</i> 30 psi
	0 - 25 psi	150 psi
	0 - 100 psi	500 psi
	0 - 250 psi	1200 psi
	0 - 500 psi	1200 psi
	0 - 1500 psi	3000 psi
	0 - 3000 psi	7500 psi
	0 - 7500 psi	18000 psi
	0 - 15000 psi	22000 psi

3.2 Output-values

Output signal	4 ... 20 mA
Characteristic deviation [% of span] (linearity, hysteresis, repeatability)	≤ 0.10 at ranges of ≥ 600 psi ≤ 0.15 at ranges of ≥ 600 psi
Turn down behavior: up to 1 : 5 1 : 5 to 1 : 20	no characteristic deviation characteristic deviation * (turn down / 5)
Total error (between 50 ... 104°F)	better than 0,15 % of full scale for ranges > 600 psi better than 0,20 % of full scale for ranges < 600 psi
Load	$R_A \leq (U_B - 12 \text{ V}) / 23 \text{ mA}$ (R_A in Ohms & U_B in volts)
Fault signal	3.6 mA or 21 mA, programmable
Integration time	0 s, 1 s, 5 s, 20 s, 40 s, programmable
Adjustment of the span	1 : 20
Integrated lightning protection	optional
Zero point adjustment	2.5 ... 99 %

3.3 Construction

Process connections Series 755		1/2" NPT Male
Series 756	Front Flush	G1B Ranges: 0 psi to 25 psi G 1/2 B Ranges: 100 psi to 7500 psi
Materials Housings Series 755 Series 756		Durable, fiberglass plastic (PBT) CrNi-steel 1.4571 and 1.4542 CrNi-steel 1.4571 and O-Ring: NBR {Viton or EPDM}; {Hastelloy C4}
Internal transmission fluid		Standard {Halocarbon oil for oxygen- based designs}; {FDA-approved}
Electrical connection and protection method per EN 60 529/ IEC529		M 20 x 1.5 cable gland with internal ter- minal block (see 4.4)
Electronic protection methods		Reverse polarity, overload and short cir- cuit protection

3.4 Auxilliary Power

Power supply	12 ... 36 V DC
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3.5 Ambient Conditions

Ambient temperature	- 4 °F ... 158 °F (- 20 °C ... 70 °C)
Storage temperature	- 31 °F ... 176 °F (- 35 °C ... 80 °C)
Climate class	D per DIN IEC 654-1
Environmental protection	IP 65 (IP 67 upon request)
EMC per	EN 61326, NAMUR NE 21

3.6 Process Conditions

Medium temperatures	– 22 °F ... 212 °F (– 30 °C ... 100 °C)
Max. wash-down temperatures	248 °F (120 °C)



Attention

The device should not be subjected to the wash-down temperature for more than 10 minutes at a time!

4 Installation

The device should be installed/operated in accordance with the provisions of ElexV, the Device Safety Regulation, this operating manual and generally recognized industry standards.

4.1 Pressure Transmitter Installation



Attention

The pressure transmitter's diaphragm should not come into contact with hard or sharp objects.

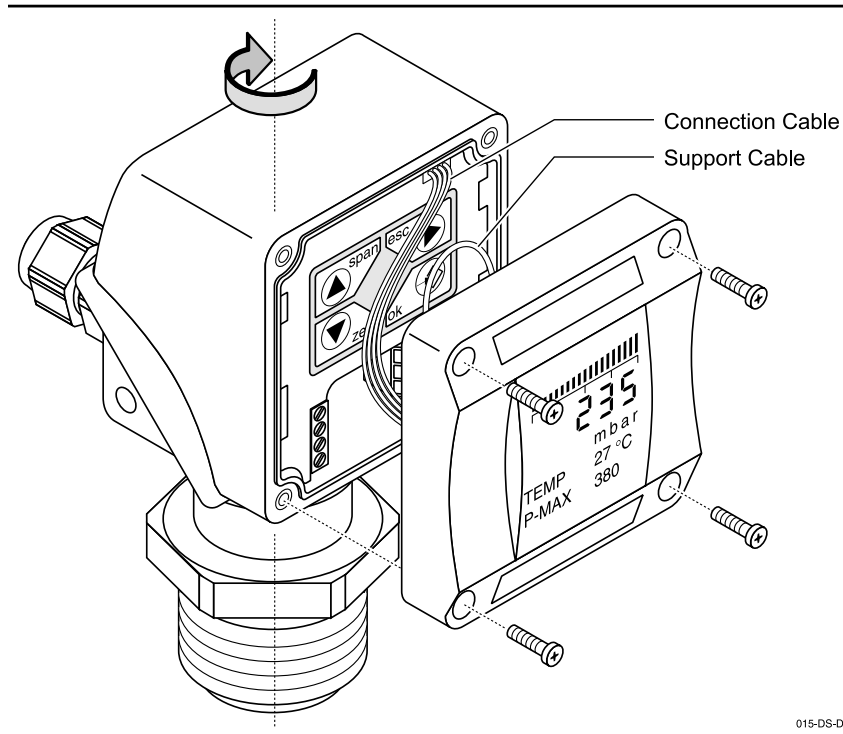
Installation Using Welding Support:

- Insert a filler piece (a pressure transmitter dummy) into the welding support.
- Weld the support into the container/pipe wall (section-weld process).
- Remove the filler piece.
- Install the pressure transmitter in the welding support.

4.2 Display Unit Upgrades

The display unit can be easily upgraded at any time.

- Remove the housing cover and the support cable.
- Attach the display unit's support cable to the same site.
- Plug the display unit's connector into the appropriate jack.
The display unit can be mounted at 90° angles.
- Fasten the display unit with screws.



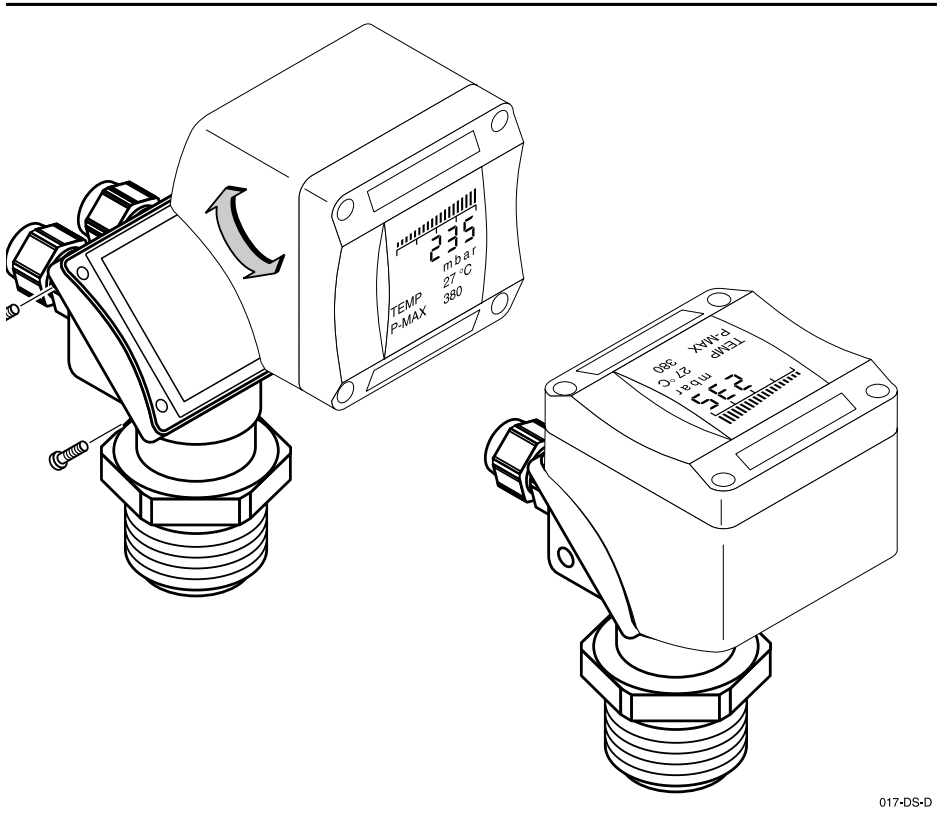
All functions are programmable once the pressure transmitter has been upgraded with a display unit. The adjusted parameters are stored after the display unit is removed.

The display unit can be rotated about 300°, so that it can be read under various installation conditions. The housing cover with built-in display can be fastened to the housing at all four side positions.

4.3 Housing Reconfiguration

Rotate the housing of the display unit in order to be able to read the display from above when the pressure transmitter is installed in an upright position.

- Loosen the 4 internal hexagonal screws.
- Lightly lift off the housing with the display unit.
- Carefully turn the housing 180°.
- Re-tighten the screws.



4.4 Electrical Connection



Attention

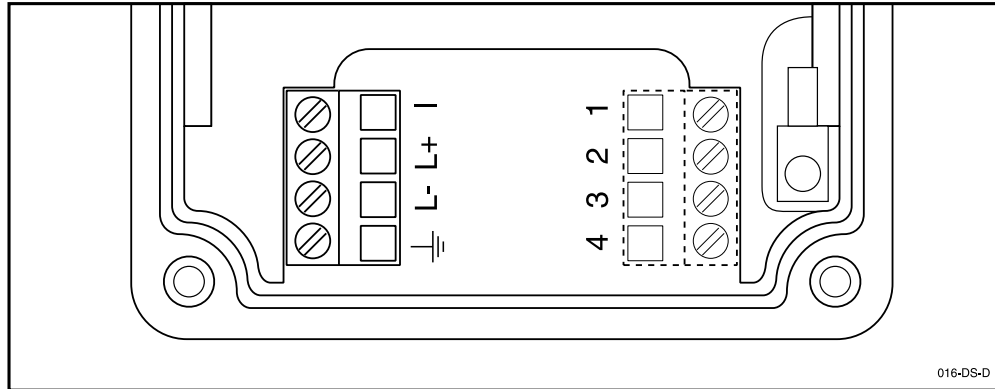
*Please observe local installation regulations (Germany: VDE-Standard).
The terminal voltage should not exceed 36 V.*

The supply voltage is between 12 and 36 V DC (12 and 30 V for intrinsic safety devices). The power supply and the output signal are conducted across a two-wire cable (max. 12 mm outer diameter, max. 14 AWG) and connected in accordance with the pin configuration.

Auxiliary power can be supplied by a power unit, a transmitter power supply or by means of a PLC connection.

It is suggested to use a design with integrated lightning protection for preventing damage due to voltage spikes.

Terminal Configuration



 Ground

L- Positive Output

L+ Positive Supply

I Test circuit; connect the ampere meter between terminals L+ and I

The unit must be properly grounded in order to guarantee EMC resistance.

4.5 Pressure Compensation when using a Relative Pressure Sensor

A Gortex diaphragm is used to compensate for the atmospheric pressure under the IP 65 Protection Method.

A special cable with capillaries for relative pressurization is used for Protection Method IP 67.

5 Operation of Devices without Displays

5.1 Preparation

This unit can be programmed before or after installation.

- Connect an ampere meter to the device's output (between terminals I and L+).
- Note that after each action, a brief oscillation/deflection of 20 mA occurs (verification of a successful action).

The following device functions can be programmed without a display unit:

- Zero point adjustment with a full or empty container (with/without pressure)
- Span adjustment with a full or empty container (with/without pressure)
- Integration time
- Reset to manufacturer's defaults



An error signal is caused by a current surge (21 mA or 3.6 mA; 5 sec) when the zero point or span setting fall outside of the sensor's nominal pressure range during adjustments with existing pressure. No values are stored.



The keypad becomes inactive after 10 min. of disuse. All settings will default to previously stored values. Only settings that have been confirmed with the "OK" function are stored.

5.2 Key Functions

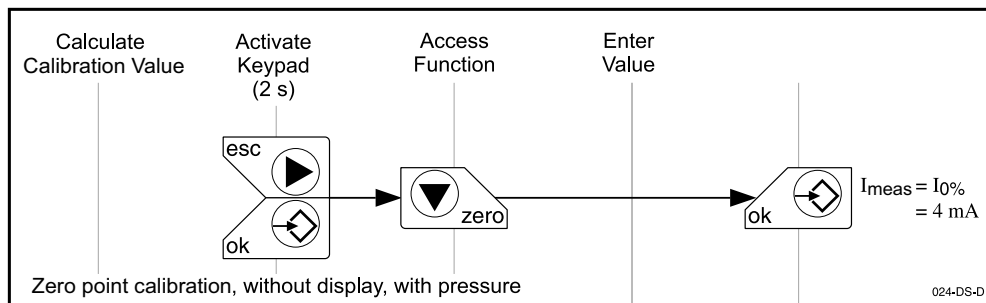
Function 1		Function 2	
	Basic setting, store span		Action: upward, increase value
	Basic setting, store zero point		Action: downward, decrease value
	Exit key or pro- gramming mode	 	Activate keys (push simulta- neously for 2 sec.)
	Verification (store)		
 	Basic setting Integration time/ dampening (push simultaneously for 2 sec.)	 	Reset to default (push simulta- neously for 2 sec.)

5.3 Calibration with Pressure

5.3.1 Zero Point Calibration



Determine if the pressure to be used as the zero point ($P 0\%$), is present at the transmitter diaphragm before calibration.

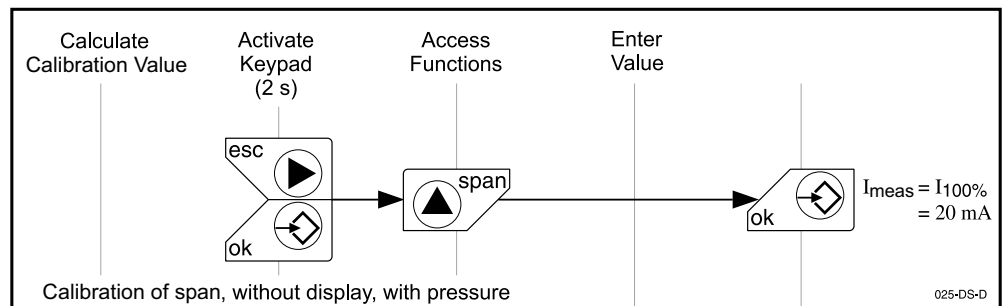


5.3.2 Span Calibration

Calibration of the measurement range (span).



Ensure that the pressure to be used as the span end-point ($P 100\%$) is present at the transmitter diaphragm.



A change in the zero point has no effect on the calibrated span. However, if the span end-point is higher than the peak value of the sensor's nominal pressure range, then span end-point is fixed at this peak value and the span is reduced accordingly. A change in the span setting has no effect on the zero point. The zero point and span end-point must fall within the sensor's nominal pressure range.

5.4 Calibration without Pressure

Determine the current reference values for the zero point and the span to be entered in the transmitter before calibration. This is done as follows:

5.4.1 Zero Point Calibration

- Determine the hydrostatic pressure of the liquid's surface that meets the zero point.
- Adjust this pressure in proportion to the sensor's nominal pressure range.
- Multiply this proportion by 16 mA and add 4 mA to the result.

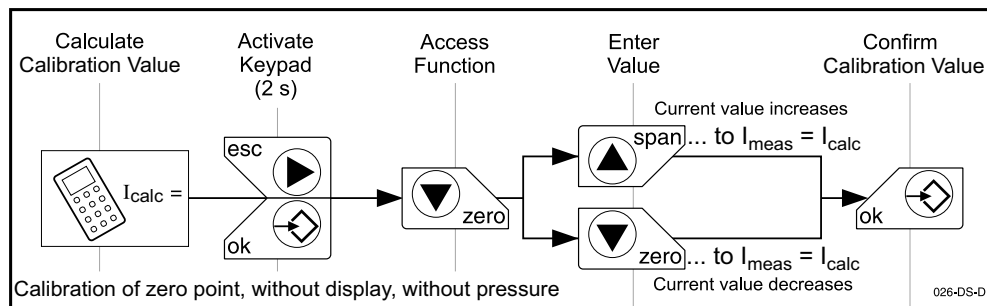
This produces the calculated current (value I_{calc}), which is entered in the transmitter and used to program the zero point (0%).

Example:

A pressure transducer with 0 ... 400 mbar (nominal pressure) needs to be programmed. The liquid's surface (with a density of 1) is 1 m above the diaphragm at the zero point producing a pressure of 100 mbar.

$$I_{calc} = \frac{\text{Zero point pressure (0\%)} \ 100 \text{ mbar}}{\text{Sensors nominal pressure } 400 \text{ mbar}} \times 16 \text{ mA} + 4 \text{ mA} = 8 \text{ mA}$$

This means that the device's current value must be set to 8 mA when performing a dry (empty) calibration.



5.4.2 Span Calibration

- Determine the hydrostatic pressure of the liquid's surface, which corresponds to the span end-point.
- Calculate the difference of the pressure value between span end-point and zero point and divide this difference by the nominal pressure range of the sensor.
- Multiply this proportion by 16 mA and add 4 mA to the result.

This produces the calculated current (value I_{calc}), which is entered in the transmitter and used to program the span end-point (100%).

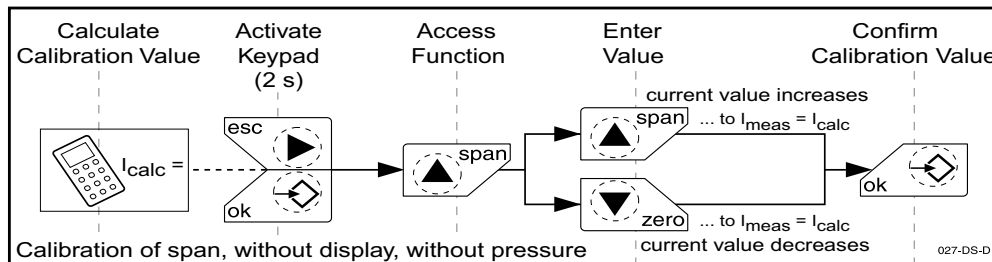
The measurement range between zero point and span end-point will be stored as span.

Example:

A pressure transducer with 0 ... 400 mbar (nominal pressure) is to be programmed.
The liquid's surface (with a density of 1) is 1 m above the diaphragm at the zero point.
The maximum (span end-point) should be 3 m.

$$I_{calc} = \frac{\text{pressure difference (span) (300 mbar - 100 mbar)}}{\text{Sensors nominal pressure 400 mbar}} \times 16 \text{ mA} + 4 \text{ mA} = 12 \text{ mA}$$

This means that the output must be set to 12 mA during programming.



*A change in the zero point has no effect on the adjusted span.
However, if the span end-point is higher than the peak value of the sensor's nominal pressure range, then the span end-point is fixed at this peak value and the span is reduced accordingly.
A change in the span setting has no effect on the zero point. The zero point and span end-point must fall within the sensor's nominal pressure range.*



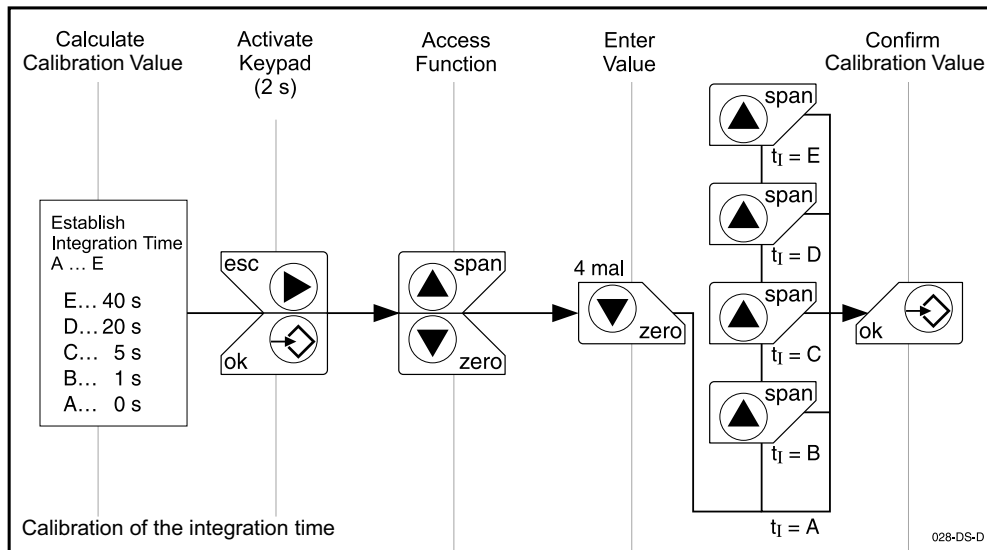
Important

A test / correction of the zero point is suggested after adjusting the span in order to maintain optimum accuracy.

5.5 Integration Time (Dampening) Adjustment

The following integration time settings can be used: 0, 1, 5, 20 and 40 s.

The sensor's measured values can then be averaged using the adjusted integration time.



5.6 Reset to Default

All default data settings are restored by simultaneously pressing the "zero", "esc" and the "ok" buttons for 2 seconds (see Para. 6.4).



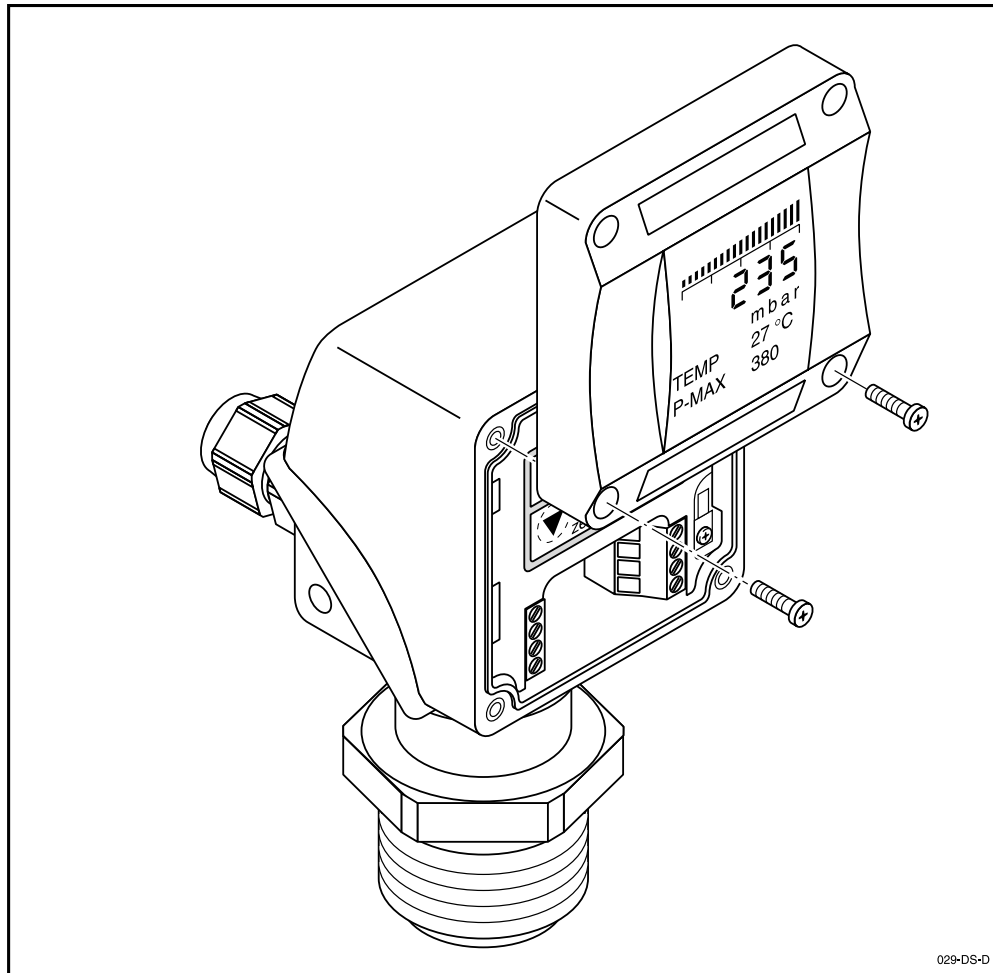
Important

Calibrated special measurement ranges i. e. 4 bar on a 6 bar transmitter can be adjusted by factory pre-setting. A reset to default will reset the sensor back to its nominal range (i. e. 6 bar). The factory pre-setting gets lost.




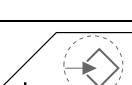


6 Operation of Devices with Displays

6.1 The Display

In order to program the device, remove the display with a screwdriver and re-attach it to the housing as shown in the diagram below.



6.2 Key Functions

Button	Functions		
	Main Menu	Sub-menu	Edit Functions
	back to the previous menu option	back to the previous menu option	increase value
	forward to next menu option	forward to next menu option	decrease value
	back to value display without saving	back to main menu without saving	back to the sub-menu without saving
	to the sub-menu	to the edit functions	save value
 	activate keypad (push simultaneously; 2 s)		

6.3 The Programming Mode

The device can be programmed before or after installation.

The keypad is activated and the device can be programmed by simultaneously pressing the "esc" and "ok" keys (for 2 sec.). This method is used to access the main menus. Each main menu has one or more sub-menus and each sub-menu, may have its own sub-menus.



The keypad becomes inactive after 10 min. of disuse. All settings will default to previously stored values. Only settings that have been confirmed with the "OK" function are stored.



A change in the starting measurement (zero point) has no effect on the measurement span. Likewise, a change in the span has no effect on the starting measurement.



An error signal occurs when the zero point or span settings fall outside of the sensor's nominal pressure range during calibration with pressure. Nothing is saved.

6.4 Default Data (factory setting)

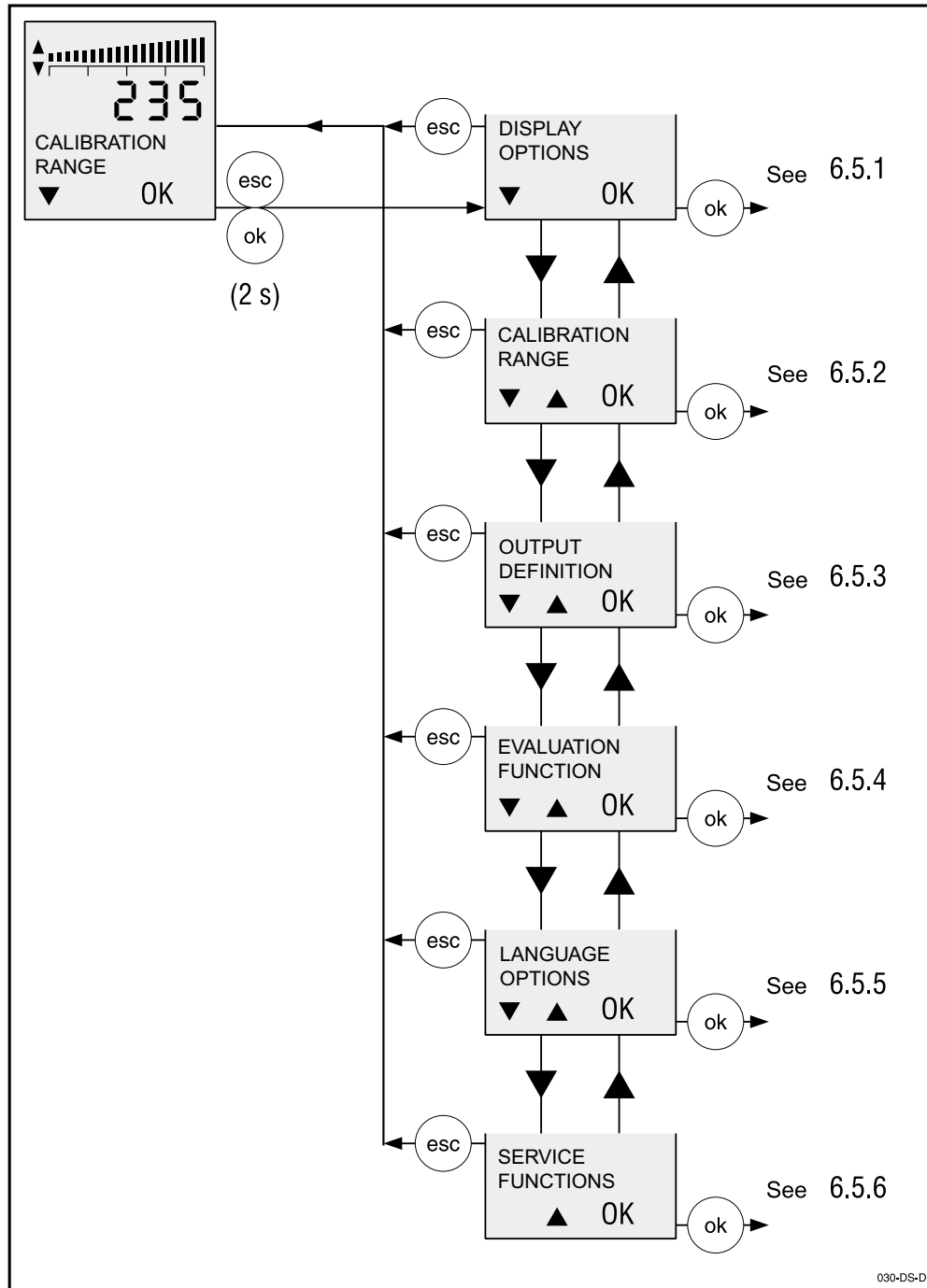
Function		Defaults
Display	Unit of measurement (Line 1) Line 2 Line 3	Pressure display (in bar) Temperature display (in °C) Sensor's nominal pressure range (in bar)
Calibration		zero 4 mA = nom. pressure range start span 20 mA = nom. pressure range end
Output	Damping Inversion Fault Limits I-offset	0 s no 21 mA (upscale) 3.8 ... 20.5 mA 0 mA
Service password		no active password
Service mounting correction		not activated
Language		English
Evaluation	linear density	yes 1 g/cm ³



Important

Calibrated special measurement ranges i. e. 60 psi on a 100 psi transmitter can be adjusted by factory pre-setting. A reset to default will reset the sensor back to its nominal range (i. e. 100 psi). The factory pre-setting gets lost.

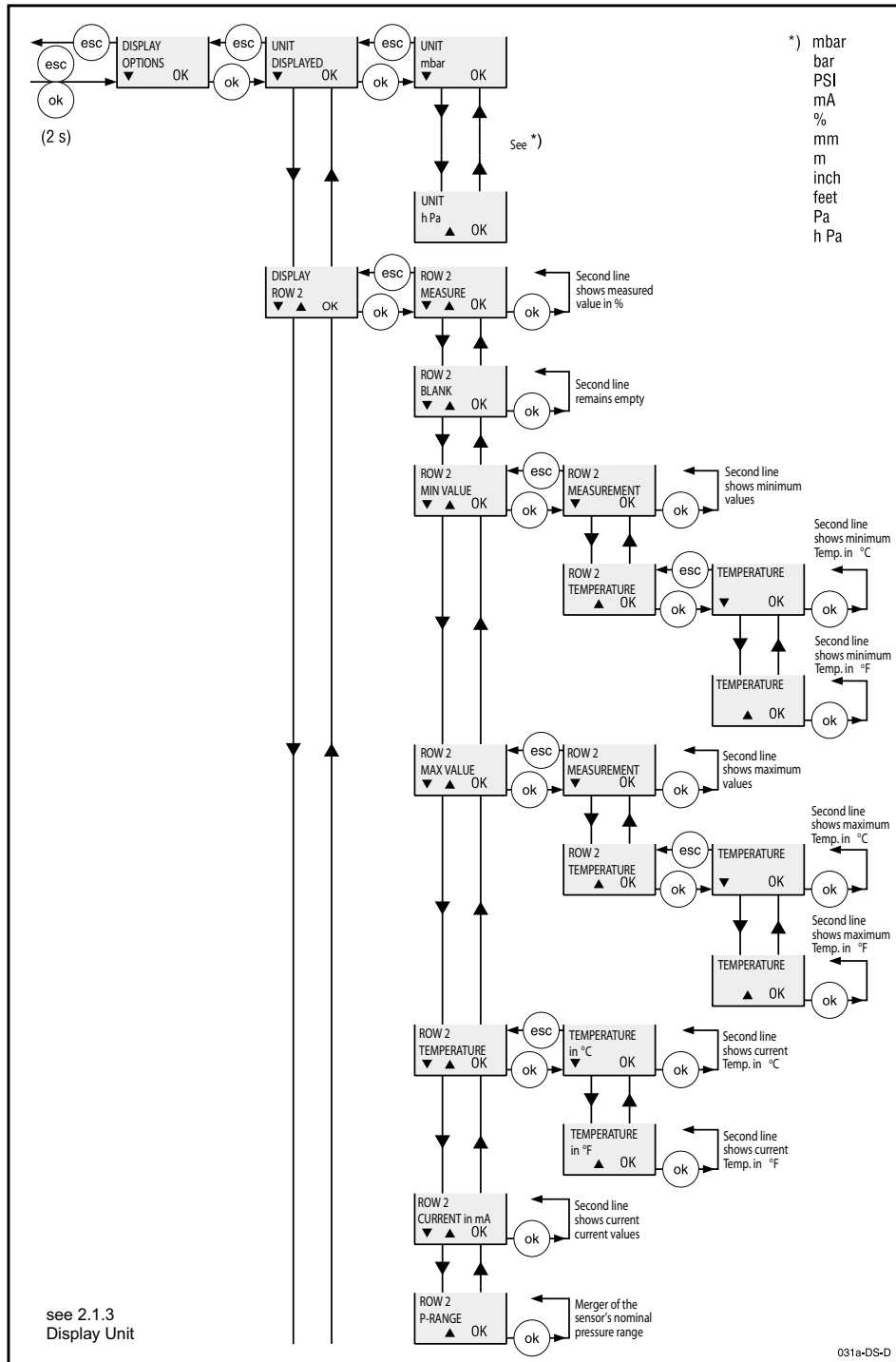
6.5 Main Menu

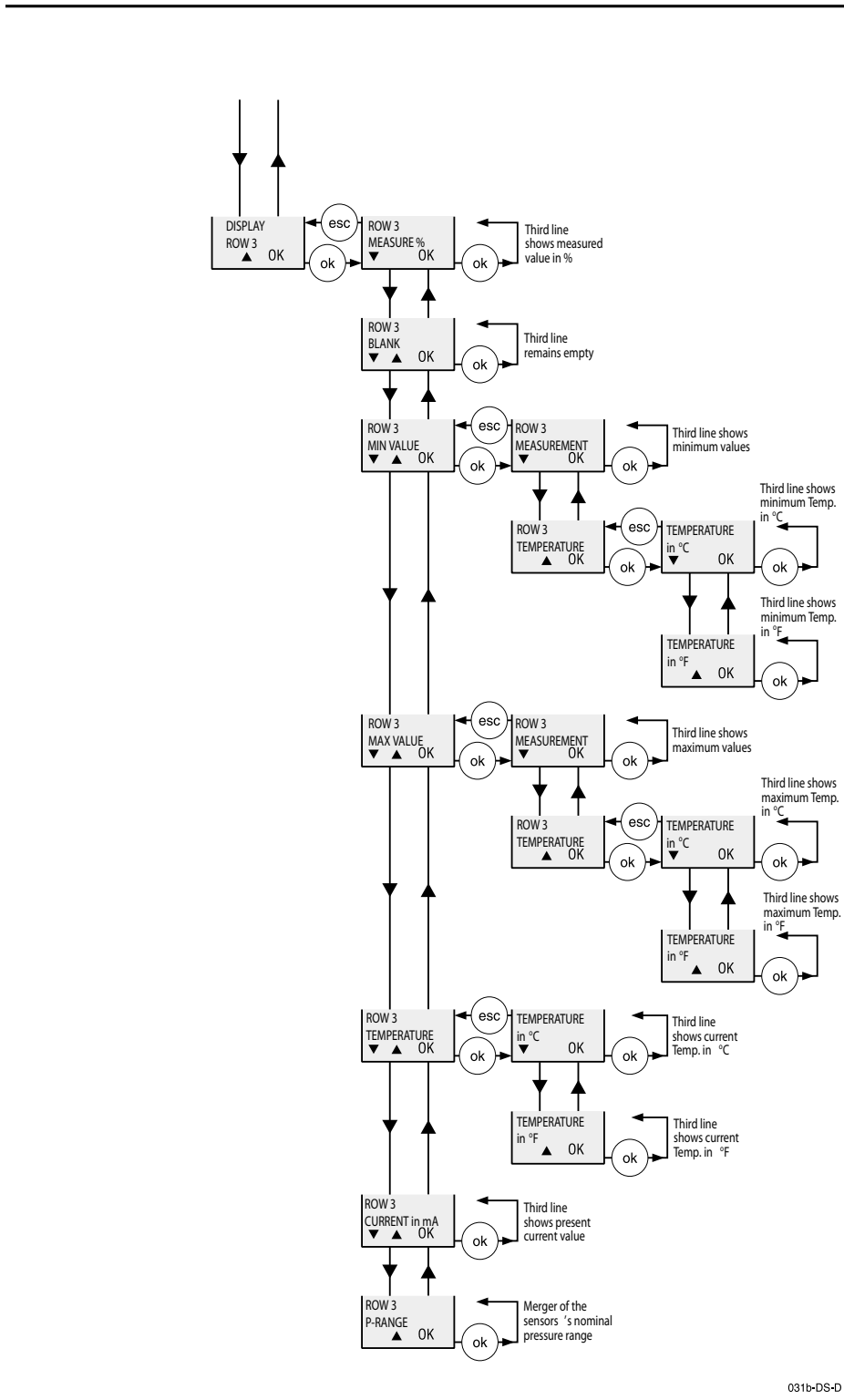


6.5.1 Main Menu: Display

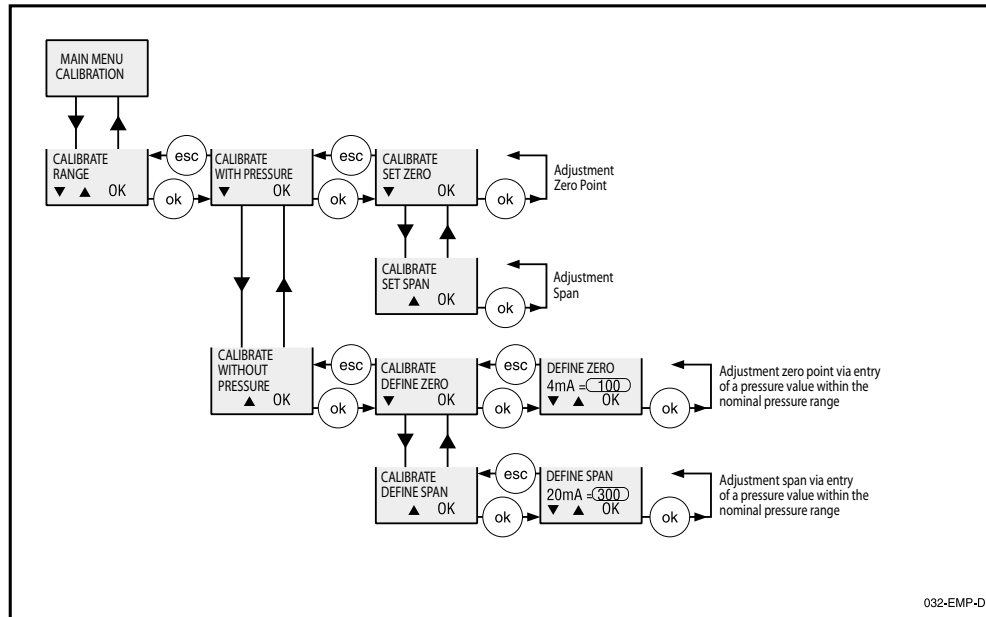


The density of a medium must be entered to calculate the correct fill-level when displaying or adjusting the level in high units (e.g. mm, m, feet, inch)(see 6.5.6).





6.5.2 Main Menu: Calibration of zero and span



A single pressure value is set for the zero point or the span end-point within the sensor's nominal pressure range, and assigned to the associated output current signal when making adjustments with existing pressure. An error signal occurs when the existing pressure lies outside of the sensor's nominal pressure range. The value is not saved in this case.



Important

A mounting correction should be performed before or after making an adjustment without pressure (dry adjustment) (see 6.5.4). The sensor must therefore be placed in the reference position for the measurement (installation site) without pressure on the diaphragm.



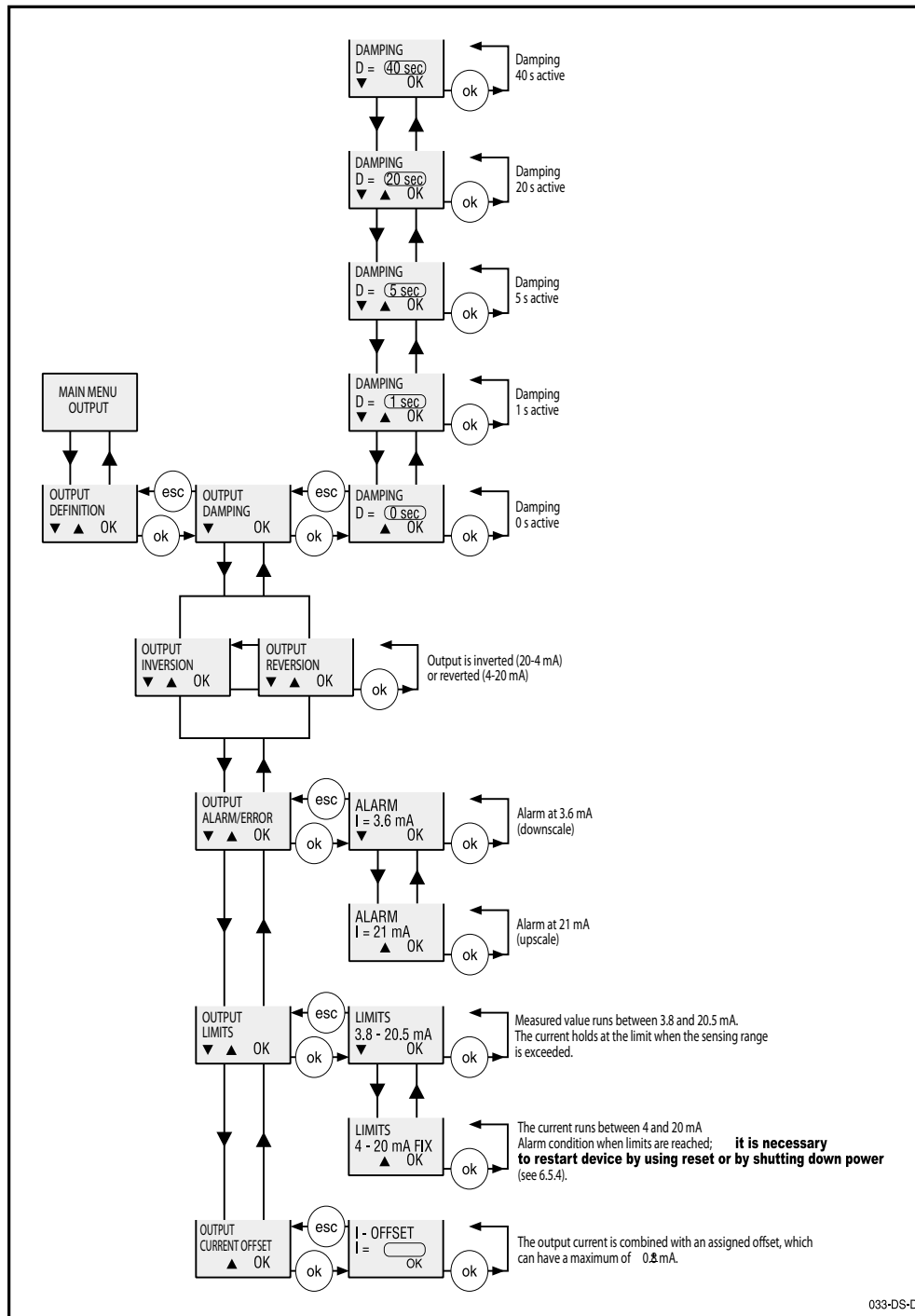
A mounting correction is unnecessary when making an adjustment with pressure (wet adjustment). Otherwise, the mounting correction must be performed before saving the zero point and span end-point.



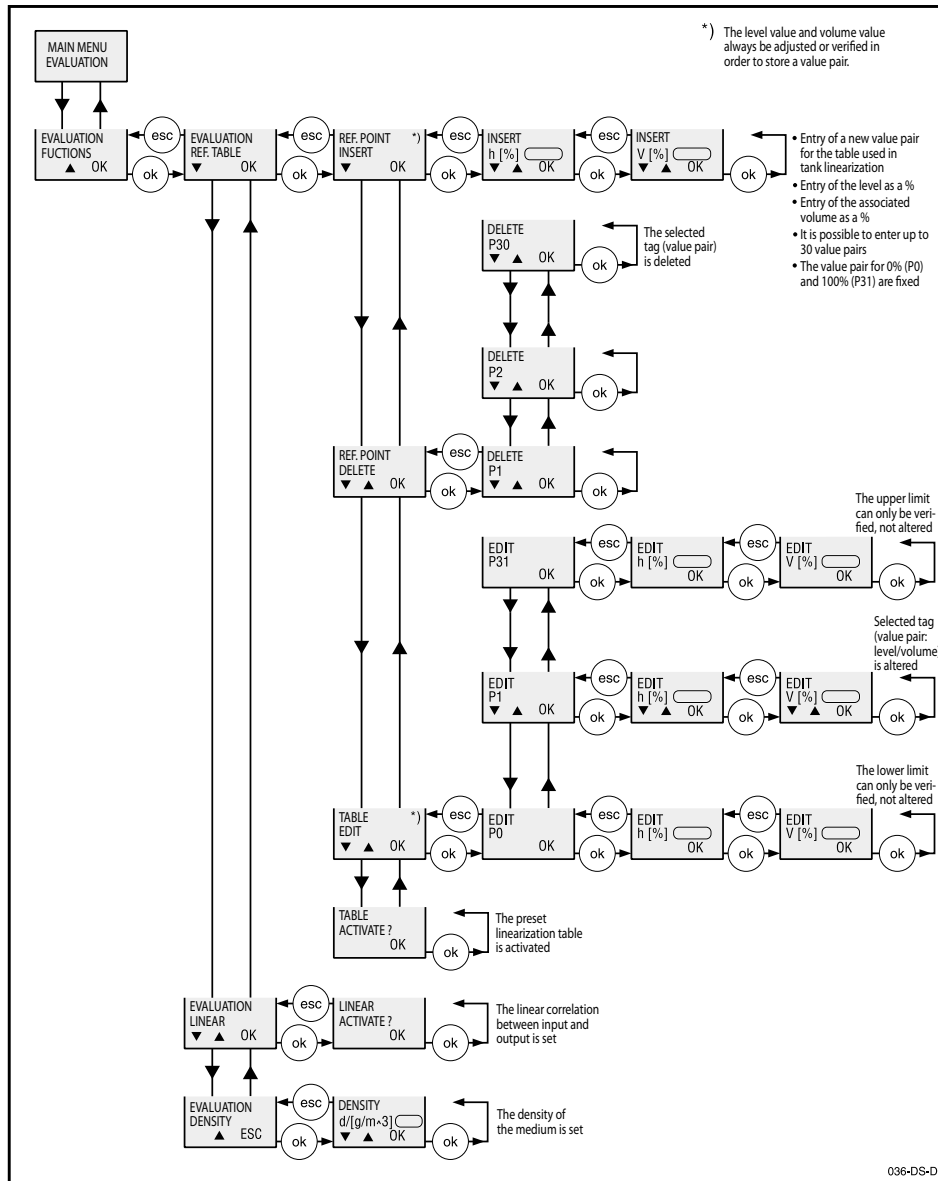
Important

A test / correction of the zero point is suggested after adjusting the span in order to maintain optimum accuracy.

6.5.3 Main Menu: Output



6.5.4 Main Menu: Evaluation



Enter eight values, which are each assigned a volumetric value of measure for tank linearization. The linearization and the assignment of the 4 ... 20 mA output signal are converted into tank volumes using this value pair.



Please check the following if "Wrong Entry" appears in the Evaluation menu:

- whether or not more than 32 value pairs are entered in the table for tank linearization (please note: P 0 and P 31 are fixed at 0% and 100% respectively)
- whether or not an existing hight value was tried to be stored again
Please enter correct values.

Example:

Level 100 %: 4000 mm

Density: 1 g/cm³

Density correction: 0.9 g/cm³

Span end point: $\frac{4000 \text{ mm} \times \text{g/cm}^3}{0.9 \text{ g/cm}^3} = 4444 \text{ mm}$

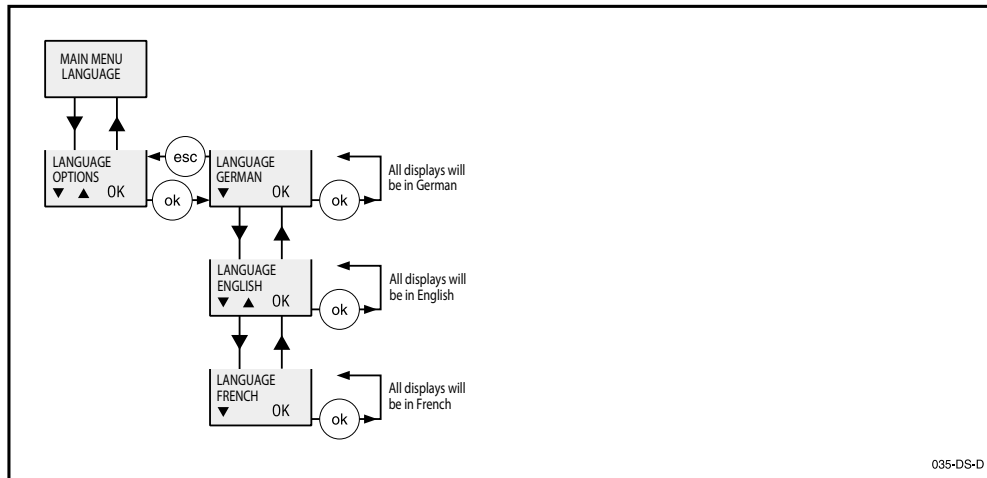
The span (end-point) must be re-calibrated (with or without pressure) to 4000 mm in order to prevent a 4000 mm level tank from being overfilled.



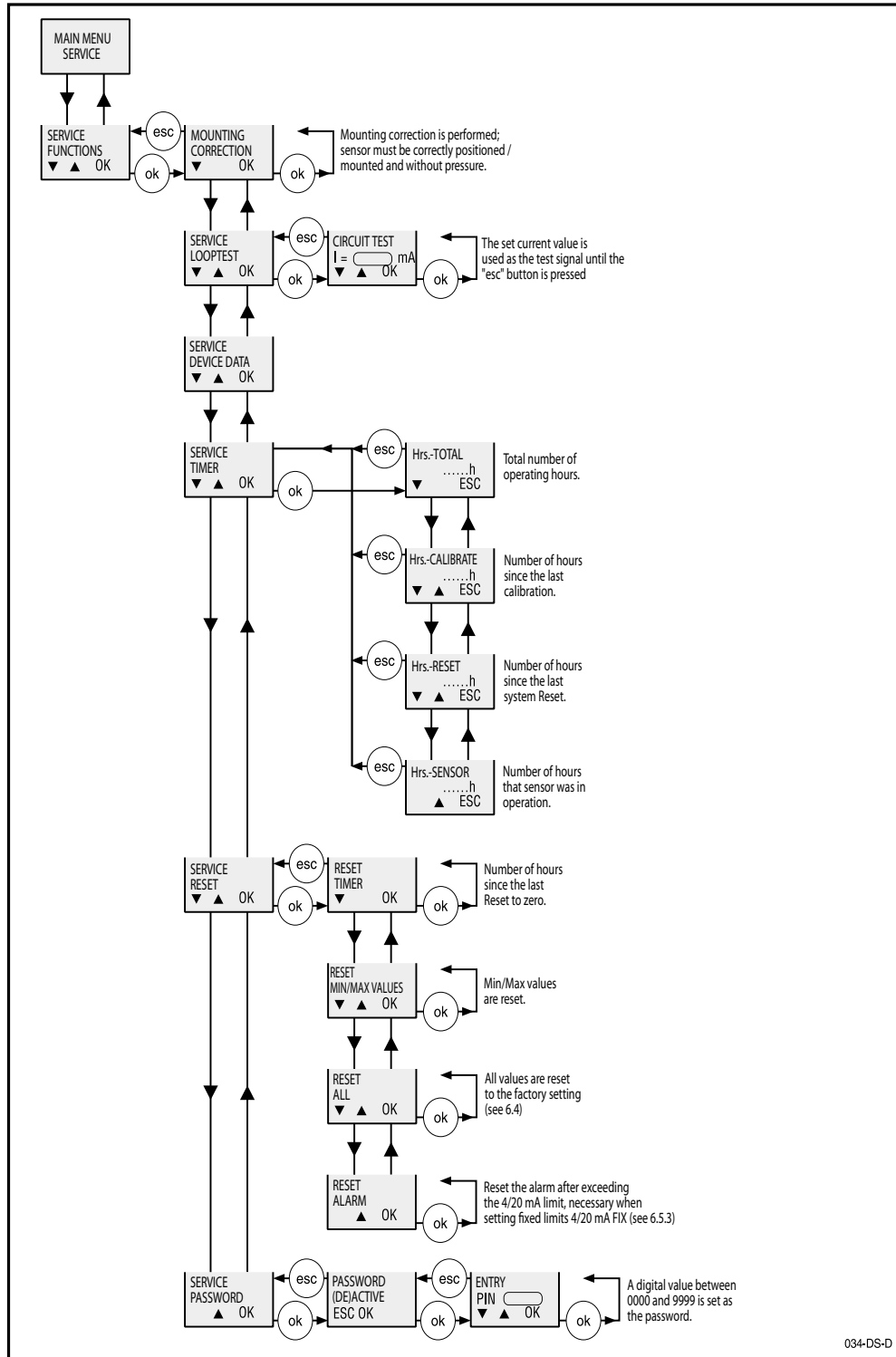
Important

A change or correction in the density causes a change in the span end-point's unit of measure (mm, m, inch, feet). The span end-point must be re-calibrated when changing the medium to be measured (due to a change in density).

6.5.5 Main Menu: Language



6.5.6 Main Menu: Service



7 Diagnostics and Service



Attention

If the fault cannot be corrected, the device should be taken out of operation and stored to prevent re-installation.



Attention

Repairs should only be performed by the manufacturer. All other repairs or alterations are unauthorized.

The following error messages can appear on devices with displays (see also para. 2.1.3):

Error Code	Error	Error Correction Measures
E00	ROM-error	Return device to manufacturer
E01	Power supply error	Test power supply
E03	EEPROM communications error	Disconnect and reconnect power supply
E04	Sensor's temperature range was exceeded	Return sensor's temperature to specified limits
E06	Sensor recognition	Disconnect and reconnect power supply
E07	General communications error between the sensor and the control interface unit	Check the connection between the sensor and the control interface unit

8 Disposal



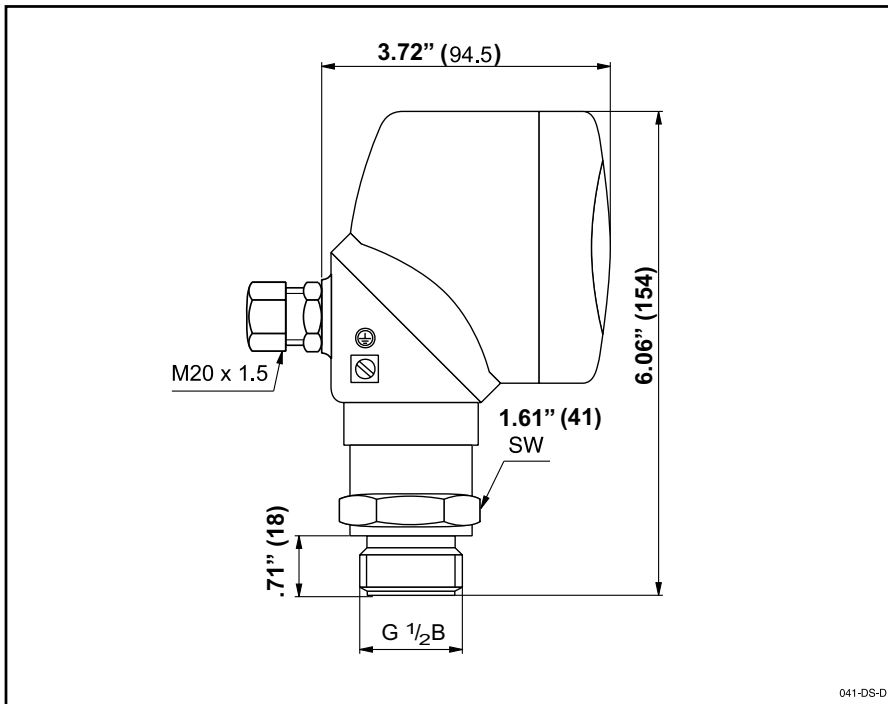
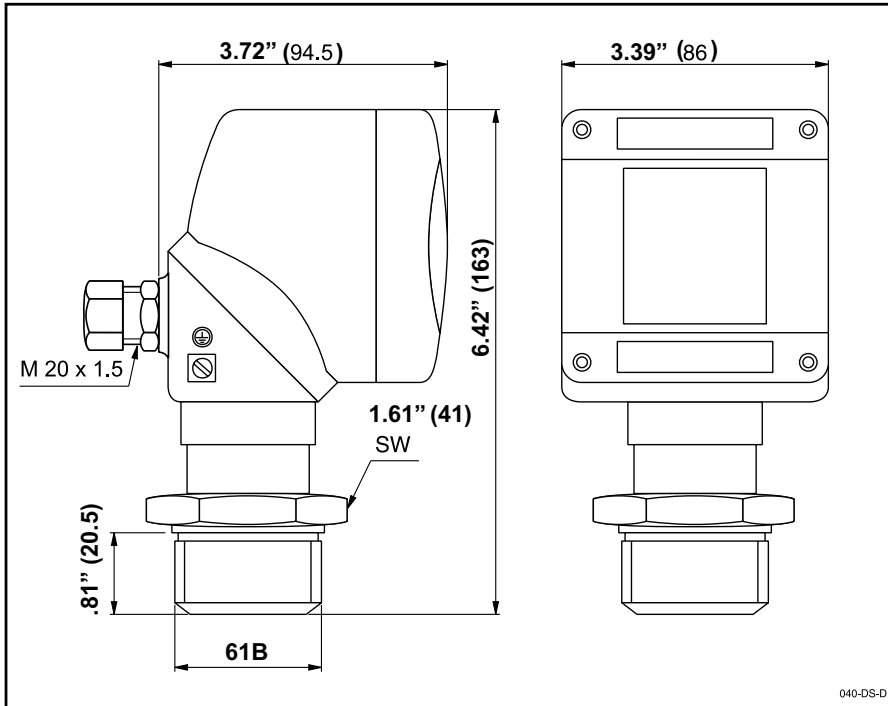
Important

Please observe local guidelines and regulations when disposing of devices that are no longer serviceable.

Please turn any recyclable components in to the appropriate local organizations.

9 Appendix

9.1 Dimension Diagrams



(mm)

9.2 Warranty Conditions

The pressure transmitter has a 3 year warranty.



Attention

Repairs may only be performed by the manufacturer. All other repairs and device alterations are unauthorized and will void the warranty.

9.3 Glossary

Adjustment	Allocation of the signal output range (4 ... 20 mA) to the desired pressure measurement range or level measurement range.
Integration	Also dampening: timely communication of the measurement signal; rise time of the current output signal after a signal surge
Inversion	Conversion of the output signal from 4 ... 20 mA to 20 ... 4 mA
Nom. pressure range	The operating pressure range for which the sensor was designed
Zero point	Start of the pressure measurement range
Parameterization	Also configuration: programming of the relevant parameters and the pressure measurement range specific to the application and measurement location.
Span	The programmed pressure measurement range
Span end point	The highest pressure value of the programmed measurement span (end-point of the span)
Tank linearization	Determination of approximate volume/pressure ratio values with non-linear correlations based on varying container designs For example, a non-linear correlation exists between the fill level and the volume in spherical containers. During linearization, the non-linear volume is assigned the 4 ... 20 mA output signal from a table of values (proximity process by means of up to 32 support points).
Defaults	The sensor parameters are pre-programmed by the manufacturer

9.4 Units of Pressure Measurement

1 atm (atmospheres)	= 760 mm Hg = 760 Torr = 1.033 kp/cm ² = 0.1013 MPa
1 Torr	= 133.3 Pa
1 kp/mm ²	= 9.81 N/mm ² = 9.81 MPa
1 bar	= 0.1 MPa
1 mbar	= 1 hPa (Hektopascal)
1 psi (pound per square inch)	= 6.895 · 10 ³ Pa
1 bar	= 33.5 feet of water

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Notes:

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