

## SmartBox 1 / SmartBox 2 / SmartBox 3



### Electronic Content Indicator - Optionally with additional functions



CONTENT	Page:
GENERAL	1
DESIGN	1
OPERATING MEDIA	1
IDENTIFICATION	2
INSTALLATION	2
START-UP	5
EXAMPLES FOR PROGRAMMING	6
OPERATION	10
PERFORMANCE CHECK	10
MAINTENANCE	10
REPAIR	10
ADDITIONAL TECHNICAL DATA	11
LIST OF ACCESSORIES	11

## GENERAL

The electronic tank management system SmartBox 1, SmartBox 2 and SmartBox 3 can be used for monitoring of the liquids contained in unpressurized liquids tanks.

In addition to the registration of tank content, other functions can be implemented by system enhancements, e.g. temperature measurement, data telecommunication, or connection to master control systems of the building.

The SmartBox 2 has additional relay control functions, e.g. for activating external alarm devices, solenoid valves, or the dry-run protection function of pumps.

The SmartBox 3 has relay control functions and an audible alarm for minimum level Indication. When the acoustic alarm sounds, it can be switched off by pressing the 'Quit' key.

Thanks to its modular design, the system can be equipped with additional modules, e.g. with an analog interface or a GSM module for telecommunication.

The indicated measurements are not gaged for invoicing.

The measuring probe is not a safety device, not even in connection with an electronic indicator. Accordingly, it will not replace a limit monitoring indicator at the tank.

To operate the device as intended and to observe the warranty conditions, it is imperative that you adhere to this Installation and Operating Manual and hand it over to the user.

## DESIGN

The SmartBox 1 has an 8-digit LCD display and a measuring input for connecting the probe. The SmartBox 2 has additionally 2 programmable relays with make and break switching output. The SmartBox 3 has a programmable relay with make and break switching output and an acoustic alarm for minimum level Indication. As a standard, the measuring probe can be installed with tank connecting thread G1, G1½ or G2.

## OPERATING MEDIA

Fuel oil EL	acc. to DIN 51603-1	petroleum	fire point > 55°C
Diesel fuel DK	acc. to DIN EN 590	alcohol	fire point > 55°C
FAME (Biodiesel)	acc. to DIN EN 14214	glycerin	
Hydraulic oil		glycol	
Motor oil		brake fluid	
Vegetable oil		water	
Urea solution	e.g. AdBlue acc. to DIN 70700	Otto fuel with fire point < 55°C	only with SmartBox in EX version

**IDENTIFICATION**

Label	Explanation
<b>CE</b>	Pursuant to EN 50081-1, EN 50082-1 and EN 61010-1 / A2

**INSTALLATION**

Check the indicator and the probe element for transport damages before start of the installation. Indicator and measuring probe must only be installed and commissioned by qualified personnel. This requirement also applies to maintenance and repairs. In case of improper installation, any warranty claims will be forfeited.

- The device must only be installed into tanks which are not operated under pressure. This is to say that the tanks must be equipped with a tank ventilation according to the regulations. Additionally, heating oil and fuel tanks must have a functioning limit monitoring indicator as overflow protection.
- The inlet of the probe cable at the tank must be sealed in such a way that no smell will permeate or water will penetrate under operating conditions.

**Notes on installation**

Expert installation under observation of the technical regulations for planning, construction and operation of the system as a whole is the precondition for faultless functioning of the contents indicator. These regulations also include the accident prevention regulations of the employers' liability insurance associations, the VDE regulations, and the installation and operating instructions for the fluid tank. The housing of the indicator is suitable for wall mounting and is connected to the 230 V mains supply. Under normal circumstances, the indicator must be operated with the housing cover closed. It is installed and commissioned by the qualified technician while the unit is open.

► Warning: Keep away from the area of the 230V terminal.

**Installation of the indicator**

Mount the indicator to the wall in a suitable position. After loosening the four screws, open the indicator by removing the cover. Mount the unit to a smooth vertical wall by means of four dowels. Mount the housing of the indicator by the four fixing holes by means of the enclosed screws. Take care not to damage the housing! After connecting the terminals and setting the unit up, rescrew the cover.

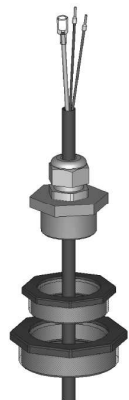
**The indicator must not be installed in areas subject to explosion hazards!**

**Installation of the probe element**

- For welded basement steel tanks and buried tanks, the probe is installed by means of the enclosed screw fitting with cable bushing.
- In most cases of installation to basement tanks, the fuel gauge with float used before is dismantled so that its opening can be used to screw in the probe unit.
- With buried tanks, there usually is a free opening to screw in the probe element; it will be closed with a removable filler plug.

Installation of the probe into the tank by means of the enclosed screw fitting (see illustration on the right):

- If applicable, switch the oil burner off and lock the take-off pipe of the tank.
- Clear the opening at the tank.
- Push the screw fitting, if applicable with reduction bush(es), over the probe cable and insert the probe into the tank.
- Seal the screw fitting smell-tight (e.g. with PTFE tape) and screw it into the tank cover.
- Lower the probe into the tank until the probe head touches the tank floor (you will feel that through the cable). Then, screw down the cable gland to fix the floor. Optionally, the probe can also be fixed in a lying position on the tank floor.
- Usually, it is not necessary to perform a probe zero adjustment (step 9. Offset calibration).



Re-open the take-off line of the tank and reactivate the oil burner if applicable. Check the function of the oil burner.

## Electrical Installation

### Connection line between indicator and probe unit:

Voltage: Probe element 20 V DC

Connection: Probe connection cable to terminals **1 + 2** (see Fig. on the right)

Air capillaries: The cable must be installed in such a way that pressure equalization with the ambient air is ensured but no moisture can penetrate into the cable end.

Extension: The probe cable can be extended by max. 200 m - e.g. with cable type NYM or YR (moisture-proof) or NYY (ground) and with min. cable cross-section 2 x 0.4 mm<sup>2</sup>. **For cable extension in the dome** or outdoors, a **watertight connection socket** with special pressure equalization filter must be **used** (accessory).

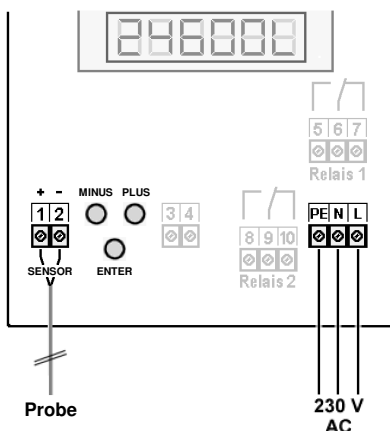
Shield: If the probe cable (or extension) runs close to power lines, a shielded signal line should be used (connect shield to **PE** terminal).

### Connection of supply voltage:

Voltage: 230 V AC 50 Hz

Connection: Terminals **PE, N + L** to the indicator (cable not comprised in the delivery )

## Indicator without cover lid



### Connection probe cable

<b>1</b>	<b>+</b>	<b>=</b>	<b>red</b>
<b>2</b>	<b>-</b>	<b>=</b>	<b>black</b>

## Connection of the relay contacts at the indicator SmartBox 2 und SmartBox 3

The indicator SmartBox 2 has two relay contact pairs (SmartBox 3 → one) for the connection of external control circuits or for activating external alarm or signal devices.

In case of failure of the unit and if the fill level (and optionally the temperature) is above the selected limit, the contact of relay terminals **6 + 7** and **9 + 10** are closed, or **5 + 6** and **8 + 9** are open - see the legend on the PCB in the unit.

Switching voltage max. 250 V AC

Switching current max. 3.5 A

Connection closed in case of alarm open in case of alarm

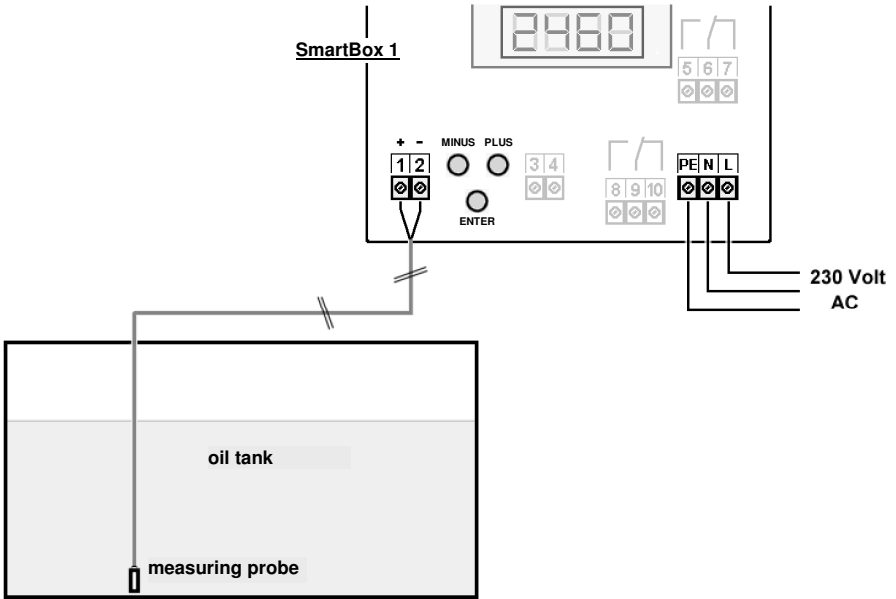
Relay 1 terminals **5 + 6** terminals **6 + 7** only SmartBox 2

Relay 2 terminals **8 + 9** terminals **9 + 10** SmartBox 2 + 3

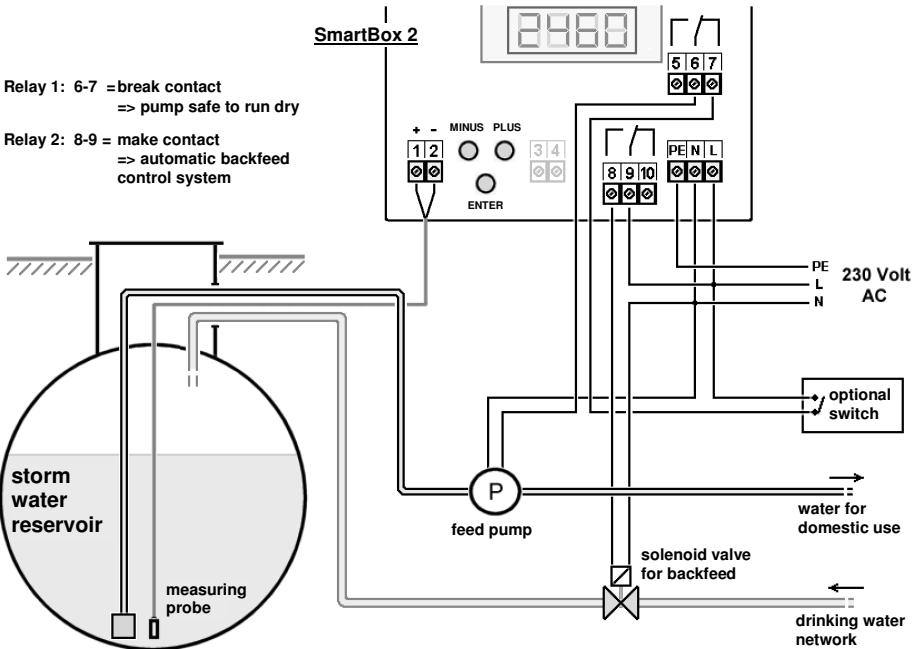
## Connection of interface to SmartBox 4, SmartBox 5 or PC set

The measured values can be transmitted to the SmartBox 4, SmartBox 5 or the PC set via the integrated interface "SERIAL LINK OUTPUT" terminals **3 + 4**.

## Fuel oil tank - wiring example SmartBox 1



## Rain water reservoir - wiring example SmartBox 2



## START-UP

After the contents indicator has been installed, it can be started up.

Before programming, you need to ascertain the tank data and enter the values into the right column **Input value** of the following table. Then, enter the values for the individual entry steps.

Optionally, the device can also be programmed as explained in the enclosed Quick Guide.

<b>Setting a parameter:</b>	Press <b>ENTER</b> to call the setup mode. Select the desired setting parameter via <b>PLUS</b> . Press <b>ENTER</b> to call up the value selection for the parameter. Set the value with <b>PLUS/MINUS</b> , press <b>ENTER</b> to save.	
<b>Quitting the setup mode:</b>	You can quit the setup mode at any time. Select "8.Exit" and press <b>ENTER</b> → to go back to the standard display mode.	
Step	Input function	Input value
<b>1. Probe</b>	Select probe measuring range (see type label of the probe) - default value is 250 mbar	_____ <b>mbar</b>
<b>2. Fluid (medium)</b>	Select the <u>medium</u> (also refer to p. 7), e.g.: - <b>heating oil</b> (default): <b>Heat.oil</b> - <b>Diesel</b> : <b>Diesel</b> - select other stored media with + / - - or enter density value <b>... kg/m3</b> For unknown density values, see the Notes on Programming - p. 7	_____
<b>3. Tank (tank shape)</b>	Select the <u>tank shape</u> (also refer to p. 7+8), e.g.: - <b>linear</b> (default): <b>Linear</b> - <b>cylindrical</b> horizontal: <b>Cyl.</b> - <b>cyl.</b> horizontal 50 to 100 m <sup>3</sup> : <b>Cyl.&gt;50m3</b>	_____
<b>4. Volume (tank volume)</b>	Enter tank volume (or maximum fill level): e. g.: 20.000L <u>Important:</u> Please see a volume table for the highest value, if available. For a 100 m <sup>3</sup> cyl. buried tank, this may for example be the value <i>100 600 liters</i> .	_____ <b>L</b>
<b>5. Height (tank height or max. filling height)</b>	Enter inner tank height in millimeters: e. g.: 2.500 mm (max. value = 9.999 mm) (height without dome) <u>Important:</u> Please see a volume table for the highest value, if available. For a 100 m <sup>3</sup> cyl. buried tank, this may for example be the value <i>288 cm = 2,880 mm</i> .	_____ <b>mm</b>
<b>Steps 6 + 7 are only required for SmartBox 2 and SmartBox 3</b>		
→ <b>SmartBox 2:</b> <b>6. Relay1</b> <u>or</u> → <b>SmartBox 3:</b> <b>6. Beeper (Acoustic alarm)</b>	Enter switchpoints as percentage from 01 to 99 (and/or as °C value from -99 to +99) - <u>only for a probe with temperature measuring function</u> deactivate → activate with + / - to active → press <b>Enter</b> to confirm → On: 10% → ON: set with + / - → <b>Enter</b> Off: 12% → OFF: set with + / - → <b>Enter</b>	<b>On</b> _____ % <b>Off</b> _____ %

	On: +0°C → ON: set with +/- → Enter Off: +0°C → OFF: set with +/- → Enter <b>Deactivate</b> the relay or beeper via <i>deactive</i> or input of 0% or 0°C (for On and Off).	On _____ °C  Off _____ °C
<b>7. Relay2</b>	See <b>6. Relay 1</b> for the data for Relay 2	
<b>8. Exit (quit)</b>	Press Enter to return to display mode	

After performing entry steps 1 - 7, the programming process is completed. After confirmation of step 8 "Exit", the device automatically returns to standard display mode; the current tank content is shown in the display.

**Special functions are available under entry steps 9 to 13 (see page 9).**

After the end of setup, do not forget to re-screw the housing cover!

## Examples for programming

### Example 1 Basement tank for 6000 liters heating oil, liter indication, linear steel tank

Inner height 165 cm, (fill level 125 cm)  
Standard probe TDS-6023 0 – 250 mbar

<u>Step</u>	<u>Entries/selection</u>
1. Probe 250 mbar	250mbar
2. Medium: heating oil	Heat.oil
3. Tank shape: linear	Linear
4. Tank volume: 6000 liters	6000L (set with +/- keys)
5. Inner tank height: 165 cm	1,650mm (set with +/- keys)
6. Relay 1 – no function	deactive
7. Relay 2 – no function	deactive
8. Exit → press ENTER to see the indication → e.g. 4550L	

### Example 2 Buried tank, cylindrical, horizontal, for 100,600 liters Diesel oil

Inner height 2.886 m, (fill level 54 cm)  
Standard probe TDS-6023 0 – 250 mbar

<u>Step</u>	<u>Entries</u>
1. Probe 250 mbar	250mbar
2. Medium: Diesel	Diesel
3. Tank shape cyl. horizontal >50m <sup>3</sup>	Cyl.>50m3
4. Tank volume: 100,600 liters	100,600L ( <u>exact value from volume table</u> )
5. Inner tank height: 288 cm	2,886mm ( <u>exact value from volume table</u> )
6. Relay 1 – no function	deactive
7. Relay 2 - no function	deactive
8. Exit → press ENTER to see the indication → e.g. 12800L	

### Tank with inner casing

For tanks with inner casing (e.g. cyl. horizontal or basement-welded tanks), the entries for inner height and volume should be adjusted.

Examples:

→ Wall thickness of inner casing 0.5 cm → reduce value for inner height by approx. 1 cm, reduce volume for 10 m<sup>3</sup> by 1.3%, for 20 m<sup>3</sup> by 1%, for 50 m<sup>3</sup> by 0.8% and for 100 m<sup>3</sup> by 0.7%.

→ Wall thickness of inner casing 2 cm → reduce value for inner height by approx. 4 cm, reduce volume for 10 m<sup>3</sup> by 5%, for 20 m<sup>3</sup> by 4%, for 50 m<sup>3</sup> by 3% and for 100 m<sup>3</sup> by 2.5%.

**Example 3 Well, 7.50 m maximum water level from ground of the well**  
(fill level 4.20 m), **relay switching function** is desired.  
Probe TDS-6029 (measuring range 0 – 1000 mbar), indication in m water column.


Step	Entries
1. Probe 1000 mbar	1000mbar
2. Medium: water	H2O
3. Tank shape (well shape): linear	Linear
4. Max. value 7500 (indicated in m)	7,500L (set with +/- keys)
5. Inner tank height 7.50m	7,500mm (set with +/- keys)
6. Relay1 – ON at <05% - OFF at >10%	active → On: 05% → Off:10%
7. Relay2 – no function	
8. Exit → press PLUS key to go to	
12. Unit – indicated unit: m	Unit: m
13. Rounding: auto	auto (just confirm with ENTER)
14. Exit → press ENTER to see the indication → e.g. 4.20m	







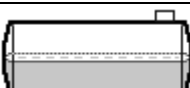
## Notes on programming

Menu item	Setting	Description
0.Exit		Back to display mode
1.Probe	100mbar 150mbar 250mbar 500mbar 1000mbar 2000mbar 3000mbar 5000mbar Set mbar Cal mode	Tank height heating oil up to 1.2 m – water up to 1 m Tank height heating oil up to 1.8 m – water up to 1.5 m Standard probe - tank height heating oil up to 3 m – water up to 2.5 m Tank height heating oil up to 6 m – water up to 5 m Tank height heating oil up to 12 m – water up to 10 m Tank height heating oil up to 24 m – water up to 20 m Tank height heating oil up to 36 m – water up to 30 m Tank height heating oil up to 60 m – water up to 50 m Entry of a specific probe with different measuring range Is only indicated if item 10. Set h or 11. Set V has been activated
2.Fluid Medium	Heat.oil H2O Diesel BioD RME,FAME Rapsol Palmoil Motoroil AdBlue Normal-B Super-B Set kg/m3 Cal mode	845 kg/m3 - default setting 999 830 880 880 (rapeseed, methyl ester, fatty acid methyl ester) 915 910 865 1.090 743 750 Entry of a specific density value Is only indicated if item 10. Set h or 11. Set V has been activated

If the density of the stored medium is unknown, the reference height can be entered in menu item 10. Set h. To this end, determine the current fill level in mm, deduct 10 mm from it and enter the resulting value - click YES to confirm the entry.

Should the current fill level be smaller 75%, we urgently recommend to adjust the value after the next refueling to achieve a good measuring accuracy.

3. tank tank shape	Linear	Default setting <u>linear</u> tank, rectangular tanks, vertical cylinders, basement-welded steel tanks.	
--------------------------	--------	--	--

	Cyl.	<u>cylindrical</u> tank ( <u>optionally</u> , see Cyl.>50m <sup>3</sup> ), horizontal cylinders; tubular tanks, max. 45 m <sup>3</sup> ; typical shape for steel outdoor or buried tanks.	
	Ball	<u>spherical</u> tank; buried tanks with spherical basic shape; frequently plastic buried tank (GRP).	
	Oval	<u>oval</u> basement tanks; typical shape of GRP tanks and single-walled sheet metal tanks	
	Convex	Plastic battery tanks, <u>convex</u> , slightly bellied shape, alternative to linear	
	Concave	Plastic battery tanks, <u>concave</u> , slightly caved in shape, alternative to linear	
	Plastic	Plastic tank with recess Plastic tank with a large recess (hollow) in the center (without tape bindings)	
	Cyl.>50m <sup>3</sup>	large <u>cylindrical</u> outdoor tank <u>50.000 liters to 100.000 liters</u> ; a special bearing chart conversion table can be ordered specifically for large cylindrical tanks of 50 m <sup>3</sup> to 100 m <sup>3</sup> .	
4. Volume tank volume	xxx.xxxL	Default setting is 0 L. 0L is an invalid value. This parameter must be set in all cases.	
5. Height Inner tank height	x.xxx mm (or cm)	Default setting is 2,000 mm (Maximum value is 9,999 mm) - for probes from 1,000 mbar, the height is indicated/set in cm, not in mm.	
6. Relay1 (SBox 2) <u>or</u>	deactive active	Default setting (enter on deactive → go to next entry step) Enter on active results in the next 'On' step	
6. Beeper (SBox 3)	On: 10%	10% is the default setting, range is 0..99 Relay or acoustic alarm switches ON when the content of the tank falls below a limit of e.g. 10%.	
	Off: 12%	12% is the default setting (hysteresis) Relay or acoustic alarm switches OFF again when the content of the tank rises above a limit of e.g. 12%. When On=0% and Off=0%, no fill level switching function is active.	
	On: +0C	Only if a <u>temperature adapter</u> is available; range is -99C .. +99C When On=0C and Off=0C, no temperature switching function is active Relay or acoustic alarm switches ON when the temperature falls below a limit of e.g. 15°C.	
	Off: +0C	Relay or acoustic alarm switches OFF again when the temperature rises above a limit of e.g. 17°C (hysteresis).	
7. Relay2		For entries for Relay2, refer to 6. Relay1	
8. Exit		Back to display mode	



9.Offset	ESC Calibrat Default	Zero point adjustment (probe offset) is indicated only after a calibration has been performed
10.Set h	xxxx mm	Possibility to enter reference height for 2-point-measurement, for a different probe measuring range, or if density is unknown. Deduct 10 mm from the current fill level as measured*, and enter the resulting value. If tank height "5.Height" has been indicated in cm (e.g. for probe measuring range from 1,000 mbar), the value will be indicated in cm here!
	Cal: No Cal: Yes	If activated (Yes), a confirmation dialog follows because from now on, the system will not calculate with the density as entered but with a special factor. Then, "Cal Mode" is indicated in step 1+2.  If this entry is made while the tank is almost empty, it is advisable to perform a readjustment later on, see 11.Set V.
11.Set V	xxx.xxxL	Readjustment of the fill level indication with +/- key.
	Cal: No Cal: Yes	See 10.Set h
12.Unit	Unit: L Unit: m <sup>3</sup> Unit: % Unit: m	Default setting  (3 decimal points: 999,900L) (2 decimal points: 75.50 m <sup>3</sup> ) (2 decimal points: 99.50 %) (2 decimal points: 2.50 m)
13.Round Rounding	auto off 2 5 10 20 50 100	Default setting (increments of 1)  In dependence on the preset volume, one or two zeros are added. This is to say that a selected rounding value 2..100 refers to the 4 <sup>th</sup> indicated position (e.g. for a 100,000L tank, 10= stands for 1,000L rounding)
14. – 19. Exit		Back to display mode
20. LCD	Contr 60	Set the contrast of the LCD display
21. Info		Shows the following: Software version                   V1.00 Serial number                       SN1234 X0                                       xxxx B   xxxx
22.TestI		Indication of the current mA measured value and the hex value for the AD converter
23.TestR	Rel1 ON Rel1 OFF Rel2 ON Rel2 OFF	Relay test
24.Init	Sure:No Sure:Yes	Clear all settings (factory settings)
26. Exit		Back to display mode

**Error messages**

<b>Error code</b>	<b>Significance</b>
Error E1	The set value is invalid
Error E2	Measured value too small (<3mA => probe defective)
Error E3	Measured value too great for zero point calibration (probe must not be immersed)
Error E4	Not defined
Error E5	Not defined
Error E6	Set height is too great (measured value is too small - the probe must be immersed)
Error E7	Set volume is too great (measured value is too small - the probe must be immersed)
Error E8	Measured value is too great (probe short-circuited, defective, or incorrectly connected)
Error E9	Measured value is 0 (no probe connected, or wire breakage, or reversed polarity)
ErrorE10	Calibration error
ErrorE11	Warning 'Tank empty' (tank content is actually too small for calibration) Press OK to continue nevertheless)

**Checking the level probe signal:** At 0 cm fill level → approx. 3.5 – 4.5 mA  
Can be checked through menu item 22. For 1 m water column → approx. 9 - 11 mA (for standard probe with measuring range of 250 mbar)

**OPERATION**

The contents indicator does not require any attention during ongoing operation.

**PERFORMANCE CHECK**

After refueling the tanks or once per year, check whether the indicated value corresponds to the fill level.

**MAINTENANCE****SAFETY INFORMATION for water-polluting operating media:**

**Any material leakage occurring during maintenance must be collected.**

**Observe the respective legal regulations!**

With correct installation and operation, the contents indicator is free of maintenance. The indicator and the probe element must be checked annually, as described under PERFORMANCE CHECK.

**REPAIR**

In case of repeated error or alarm message (relay output) while the tank content does not reach / remains under the set fill level alarm threshold at the probe element, check the connection line of the signal and probe element for breakage or short-circuit, re-install if necessary.

If the measures explained under the headings START-UP, OPERATION and MAINTENANCE fail to achieve regular re-START, and unless the instructions have been misunderstood, the device must be removed and sent to the manufacturer's for a check-up. Any unauthorized handling will result in loss of any warranty claims.

**ADDITIONAL TECHNICAL DATA****Indicator**

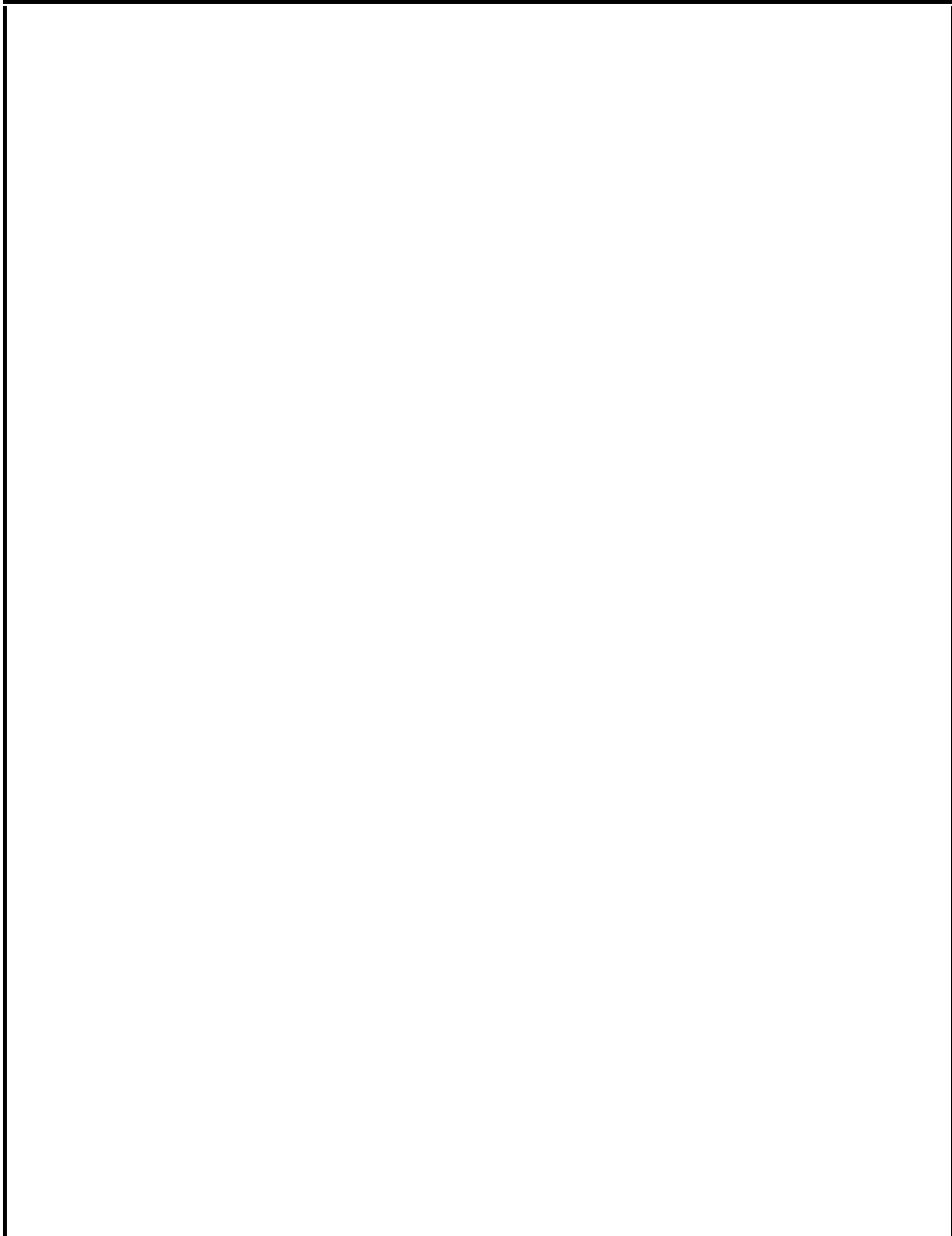
Supply voltage	230 V AC 50 Hz	Degree of protection:	IP 30 or IP 65 acc. to IEC 529
Power input:	max. 2 VA		
Measuring input:	4 - 20mA ; U <sub>0</sub> = 20V ;	Resolution:	10 Bit
		Accuracy:	± 1 %
Relay output:		Optional (see accessories)	
Switching voltage:	max. 250 V AC	Analog output:	0 - 5 V DC
Switching current	max. 3.5 A		4-20 mA
Dimensions W x H x D: in [mm]	120x120x49 (IP30) or 130x130x60 (IP65)	Housing:	Polystyrene (IP30) or Polycarbonate (IP65)

**Probe element (relative pressure probe for level detection)**

Operating voltage:	20 V DC	Degree of protection:	IP 68 acc. to IEC 529
Material:	V4A ; POM; FPM; HD-PE	Length of probe (without cable)	90 mm
Standard version:	250 mbar	Length of probe connection cable	6 m
Installation position:	vertically suspended, or horizontally supine		
Temperature range:	Ambience	0 °C to 80 °C	
	Operating media		

**LIST OF ACCESSORIES**

Order no.	Product description	Information on application
28 851-00	DTM-1 data transmission module 0-5 V	Retrofittable module as interface to data transmission, e.g. for the master control system of the building
28 853-00	DTM-3 data transmission module 4-20 mA	Retrofittable module as interface to data transmission, e.g. for the master control system of the building
28 856-00	PC set	Retrofit kit for data transmission to a PC – incl. software for indication/evaluation and for sending messages via e-mail
28 857-00	Cable junction box IP 66, water-tight, with pressure equalization	To extend the probe cable - e.g. in the dome
28 500-00	SmartBox 5 - data transmitter	GSM telecommunication system for SmartBox 1, 2 or 3 and event messages (e.g. burner malfunction)
28 858-00	Additional antenna	Additional antenna for reception amplification at the SmartBox 5 - data transmitter



**GOK Regler- und Armaturen-Gesellschaft mbH & Co. KG**

Oberbreiter Straße 2-16, D-97 340 Marktbreit ☎ +49 9332 404-0 Fax +49 9332 404-43

E-Mail: [info@gok-online.de](mailto:info@gok-online.de) Internet: [www.gok-online.de](http://www.gok-online.de)