

### Radar level meters with guided wave (principle TDR)

- Suited to continuous level measurement of various liquid, bulk solids, mush and pasty materials.
- Quick view measured values on the OLED or LCD display
- Universal use, direct mounting into hoppers, silos, tanks, sumps etc.
- Variants with stainless steel rod or rope electrode
- Measuring range up to 40m
- Possibility of using in explosive areas (version Xi, XiT), or in flammable dust areas (Xd, XdT)
- Current output (4 ... 20 mA), HART® protocol, or output RS-485 with protocol Modbus® RTU



The GRLM® radar level meters are compact measuring devices consisting of two main parts – a level meter (housing) and a display module (display). The electronics transmits very short electrical pulses (0.5 ns), which are linked to a one-wire transmission line (measuring electrode). Measuring electrode can be created of rod or rope. The pulse propagates along the electrode in the form of electromagnetic wave toward the level surface, where it is partly reflected and the reflected component is returned to the receiving module of the electronics. The electronics measures the time of flight of electromagnetic wave and the instant distance to the surface level is calculated. Then based on the height of the level, the level meter current output 4 .. 20 mA is set with the HART communications or an industrial RS-485 line with Modbus RTU communications and the measured value is shown on the display.

Radar level meters with guided wave are suited to continuous level measurement of various liquid, mush and bulk-solid materials. Level meters are resistant against changes in the atmosphere (pressure, temperature, dust, steam) and to changes in medium parameters (change in dielectric constant, conductivity)

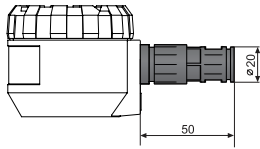


### VARIANTS OF SENSORS

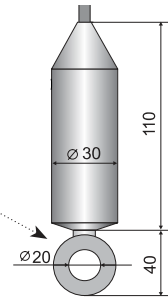
- **GRLM-70\_-00** **Without electrode**, the electrode is made by customer (only variant 10 or 30) and connected to the electrode junction by M8 thread.
- **GRLM-70\_-10** **Uncoated stainless steel rod electrode**, for level measurement liquids and bulk solid materials (water solutions, emulsion, oils, diesel, flour, sand, granulates, etc.). Maximum electrode length 8 m.
- **GRLM-70\_-11** **Fully coated stainless steel rod electrode (PFA Teflon®)**, for level measurement of aggressive liquids and very pure liquids. Maximum electrode length 2 m.
- **GRLM-70\_-12** **Fully coated stainless steel rod electrode (FEP Teflon®)**, for level measurement of aggressive liquids and drinks. Maximum electrode length 2 m.
- **GRLM-70\_-13** **Semi-coated stainless steel rod electrode (FEP Teflon®)**, for level measurement of liquids in area, where it could condense steam on the electrode. Maximum electrode length 8 m.
- **GRLM-70\_-20** **Uncoated stainless steel rod electrode with reference tube**, for accurate level measurement of liquids in cramped spaces. Maximum electrode length 3 m.



variant GRLM-70 with protective conductor



Anchoring eye for variant GRLM-70 -33 (35)



## TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS– LEVEL METER		
Supply voltage	GRLM-70N(T)-__ GRLM-70Xi(T)-__ GRLM-70Xd(T)-__	18 ... 36 V DC 18 ... 30 V DC 18 ... 33 V DC
Output	GRLM-70__-_-I GRLM-70__-_-M	4 ... 20 mA with HART® route RS-485 with Modbus RTU
Current consumption	GRLM-70__-_-I GRLM-70__-_-M	4 ... 20 mA / max. 22 mA typ. 10 mA / max. 30 mA
Basic error <sup>1)</sup> (for reference reflector <sup>7)</sup> ) - GRLM-70_-20 in area 0,1 – 0,2 m / 0,2 – 2,0 m / 2,0 – 3,0 m - other types in area 0,1 – 0,2 m / 0,2 – 2,0 m / 2,0 – 40 m		± 5 mm / ± 3 mm / ± 2 mm ± 10 mm / ± 4 mm / ± 2 mm
Error of current output <sup>6)</sup>		max. 80 µA
Resolution		0,1 mm
Maximal length of measuring electrode	GRLM-70_-10, 13 GRLM-70_-11 (12) GRLM-70_-20 GRLM-70_-30 (33,34,35) GRLM-70_-32	8 m 2 m 3 m 40 m 12 m
Dead zone <sup>2)</sup>	- measur. sensitivity: low, medium, user (1 - 4) - measur. sensitivity: high, user (5) - measur. sensitivity: user (6, 7) - measur. sensitivity: user (8)	100 mm / 0 mm <sup>3)</sup> 150 mm / 50 mm <sup>3)</sup> 200 mm / 50 mm <sup>3)</sup> 250 mm / 50 mm <sup>3)</sup>
Adjustable measuring range (SPAN)		min. 200 mm
Electrical parameters for variants Xi (XiT) – max. internal values		U <sub>i</sub> =30 V DC; I <sub>i</sub> =132 mA; P <sub>i</sub> =0,99W; C <sub>i</sub> =370 nF; L <sub>i</sub> =0,9 mH
Measurement sensitivity (8 degrees)		low (1) - medium (3) - high (5) - user (1 - 8)
Failure indication (echo loss) adjustable in modes:		3,75 mA, 4 mA, 20 mA, 22 mA, LAST <sup>4)</sup>
Damping		1 .. 99 s
Rise time		cca 60 s
Leakage resistance electrode - housing		10 kΩ
Coupling capacity (housing - power) / dielectric strength		5 nF / 500 V AC
Maximal resistance of current output load R <sub>max</sub> for voltage - 24V DC / 22V DC / 20V DC		270 Ω / 180 Ω / 90 Ω <sup>5)</sup>
Maximum tensile strength of the rope electrode		1400 kg
Tightening torque of cable gland	GRLM-70N(NT,Xi,XiT) GRLM-70Xd(XdT)	3 Nm (plastic) 7 Nm (steel)
Protection class		IP67
Recommended cable	GRLM-70__-_-I GRLM-70__-_-M	PVC 2 x 0,75 mm <sup>2</sup> PVC 2 x 2 x 0,25 mm <sup>2</sup> (twisted pair, shielded)
Weight (without electrode)		cca 0,5 kg (1 kg variant T)

1) Error is +/- 6 mm in the area 200 mm from the end of the rod electrode or from the end of the rope electrode without ballast.

2) Dead zone = blind zone = blocking distance from the start and at the end of the electrode.

3) Size of the dead zone at the start / end of the rod electrode. The size of the dead zone at the end of the rope electrode is always 110 mm (area of the ballast).

4) Upon outage of the echo, the display shows the last measured value and current is maintained at the last valid value.

5) Including resistor 250R with connection with HART.

6) This error can only be utilised in the current output configuration. Data outputs (HART, MODBUS) are not affected by this error.

7) Metal round plate 0,5 m<sup>2</sup>

## TECHNICAL SPECIFICATIONS – DISPLAY MODULE

Type of display	matrix OLED, LCD <sup>1)</sup>	
Resolution	128 x 64 pixels	
Height of digits / Number of display digits of measured values	9 mm / 5 digits	
Colour of display	OLED	yellow
	LCD	black with white background light
Type of buttons	membrane	
Ambient temperature range	OLED	-30 ... +70 °C
	LCD	-20 ... +70 °C
Weight	46 g	

1) OLED- suitable for indoor and low-light applications. LCD – suitable for outdoor applications particularly with direct sunlight.

## USED MATERIALS

Sensor part	Variants	Standard material
Lid	All types	aluminium alloy with powder coating
Glass	All types	polycarbonate
Body	All types	aluminium alloy with powder coating
Housing with thread	All types	St. Steel W. Nr. 1.4571 (AISI 316 Ti)
Electrode	GRLM-70_-10(11,12,13,20) GRLM-70_-30(32,33,34,35)	St. Steel W. Nr. 1.4404 (AISI 316 L) St. Steel W. Nr. 1.4401 (AISI 316 )
Electrode coating	GRLM-70_-11 GRLM-70_-12, 13 GRLM-70_-32 GRLM-70_-34, 35	PFA FEP FEP PA
Reference tube	GRLM-70_-20	St. Steel W. Nr. 1.4301 (AISI 304)
Weight	GRLM-70_-30	St. Steel W. Nr. 1.4301 (AISI 304)
Weight coating	GRLM-70_-32	PTFE
Anchorage	GRLM-70_-33	St. Steel W. Nr. 1.4401 (AISI 316)
Display module	All types	plastic material POM
Cable gland	GRLM-70N(NT, Xi, XiT) GRLM-70Xd(XdT)	plastic - polyamide metal - nickel-plated brass

## DEVICE CLASSIFICATION (according to EN60079-10-1 and EN 60079-10-2)

Level meter performance	Type of electrode	Device classification
GRLM-70N	All types	Basic performance for non-explosive atmospheres.
GRLM-70NT	All types	High-temperature basic performance for non-explosive atmospheres (max. 200°C).
GRLM-70Xi(XiT)	00,10,11,12,13 20,30,32,33	Intrinsically safe performance (high-temperature) for use in hazardous areas (explosive gas atmospheres), Ⓔ II 1/2 G Ex ia IIB T5 Ga/Gb with intrinsically safe supply units, electrode part zone 0, housing with electronics zone 1, see Fig. 1.
GRLM-70Xd(XdT)	00,10,30,33,34,35	Performance (high-temperature) is protected by "Ex t" lock for hazardous areas (flammable dust areas), Ⓔ II 1/2 D Ex ta/tb IIIC T75°C...T300°C Da/Db, electrode part zone 20, housing with electronics zone 21 see Fig. 1.

## PROCESS CONNECTION

Pipe thread	G 1"	G
Pressure thread	NPT 1"	NPT
Jointless connection (Tri-Clamp)	ø 50,5 mm	CI50

## TEMPERATURE AND PRESSURE RESISTIVITY

Variant performance	temperature tm	temperature tp	temperature ta	Max. operation pressure for temp. tp	
				to 30°C	to 85°C
GRLM-70N(Xi,Xd)-10	-40°C ... +300°C	-40°C ... +85°C	-30°C ... +70°C	15 MPa	10 MPa
GRLM-70N(Xi,Xd)-20	-40°C ... +200°C	-40°C ... +85°C	-30°C ... +70°C	15 MPa	10 MPa
GRIM-70N(Xi)-11(12,13)	-40°C ... +200°C	-40°C ... +85°C	-30°C ... +70°C	4 MPa	2,5 MPa
GRLM-70N(Xi,Xd)-30(33)	-40°C ... +200°C	-40°C ... +85°C	-30°C ... +70°C	15 MPa	10 MPa
GRLM-70N(Xi)-32	-40°C ... +130°C	-40°C ... +85°C	-30°C ... +70°C	1 MPa	0,5 MPa
GRLM-70N(Xd)-34(35)	-40°C ... +95°C	-40°C ... +85°C	-30°C ... +70°C	15 MPa	10 MPa

## TEMPERATURE RESISTIVITY (high-temperature performance)

Variant performance	temperature $t_m$	temperature $t_p$	temperature $t_a$
GRLM-70NT(XiT,XdT)-10	-40°C ... +300°C	-40°C ... +200°C	-30°C ... +70°C
GRLM-70NT(XiT,XdT)-20	-40°C ... +200°C	-40°C ... +200°C	-30°C ... +70°C
GRIM-70NT(XiT)-11(12,13)	-40°C ... +200°C	-40°C ... +200°C	-30°C ... +70°C
GRLM-70NT(XiT,XdT)-30(33)	-40°C ... +200°C	-40°C ... +130°C	-30°C ... +70°C
GRLM-70NT(XiT)-32	-40°C ... +130°C	-40°C ... +130°C	-30°C ... +70°C
GRLM-70NT(XdT)-34(35)	-40°C ... +95°C	-40°C ... +130°C	-30°C ... +70°C

Note.: For correct function of the level meter must not be exceeded any of the temperature range ( $t_p$ ,  $t_m$  or  $t_a$ ).

## MAXIMAL TEMPERATURES FOR PERFORMANCE Xi(XiT) CATEGORY 1/2G

temp. class (El. device of the group II)	temperature $t_m$	temperature $t_p$	temperature $t_a$
T5 (100 °C)	-40°C ... +98°C	-40°C ... +90°C	-30°C ... +70°C
T4 (135 °C)	-40°C ... +133°C	-40°C ... +125°C	-30°C ... +70°C
T3 (200°C)	-40°C ... +198°C	-40°C ... +190°C	-30°C ... +70°C
T2 (300°C)	-40°C ... +298°C	-40°C ... +200°C	-30°C ... +70°C
T1 (450°C)	-40°C ... +300°C	-40°C ... +200°C	-30°C ... +70°C

## MAXIMUM SURFACE TEMPERATURE OF THE DEVICE CONFIGURATION Xd(XdT) CATEGORY 1/2D

variant	device surface temperature	
All variants	in the place of the housing with electronics: in process connection: on the electrode:	ambient temperature $t_a$ +5°C max. equal to temperature $t_p$ max. equal to temperature $t_m$

## PRESSURE RESISTIVITY (high-temperature performance)

Variant performance	Max. operation pressure for temp. $t_p$				
	to 30°C	to 85°C	to 130°C	to 160°C	to 200°C
GRLM-70NT(XiT,XdT)-10(20,30,33)	15 MPa	10 MPa	3 MPa <sup>1)</sup>	2 MPa <sup>1)</sup>	1 MPa <sup>1)</sup>
GRIM-70NT(XiT)-11(12,13)	4 MPa	2,5 MPa	2 MPa	1,5 MPa	0,3 MPa
GRLM-70NT(XiT,XdT)-34(35)	15 MPa	10 MPa	3 MPa <sup>1)</sup>	-	-
GRLM-70NT(XiT)-32	1 MPa	0,5 MPa	0,1 MPa	-	-

1). The mentioned values are not valid for hot water, water solution and steam, in such cases it is necessary to consult with the manufacturer.

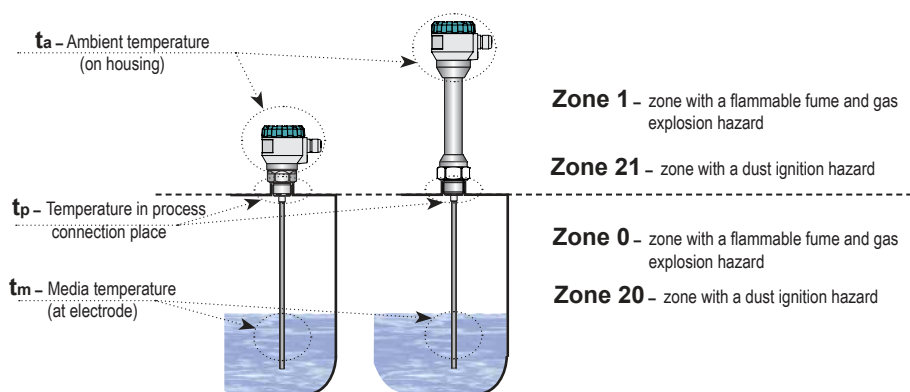


Fig. 1: Places for measurement of temperature and explosive areas

The maximum allowable temperature of the medium, process connection and ambient temperature depends in GRLM-70Xi (XiT) at the desired temperature class (see tab. Maximum temperatures for the performance Xi (XiT) category 1/2G and tab.). Maximal surface temperature at GRLM-70Xd(XdT) depends on ambient temperature, medium operating temperature and own warming device (see tab. Device surface temperature for performance Xd(XdT) category 1/2 D). The temperature value can not be exceeded, because the hot surface of the device could cause ignition of an explosive or flammable atmosphere. At the same time can not exceed the maximum temperature for the different variants of the electrodes (Table of temperature durability).

## INSTALLATION INSTRUCTIONS

The level meter is connected to consequential (evaluating) device with a suitable cable with the outer diameter of 6 to 8 mm using screw terminals located under the display module. The recommended cross section of cores for the current version  $2 \times 0,5 \pm 0,75 \text{ mm}^2$  and for the version with Modbus communication  $2 \times 2 \times 0,25 \text{ mm}^2$  (twisted pair, shielded). Plus pole (+U) is connected to the terminal (+), minus pole (0V) to the terminal (-) and the shielding (only for shielded cables) to the terminal ( $\perp$ ). Communication wires A and B of the line RS-485 (for version "M" - Modbus) are connected to the terminals A and B.

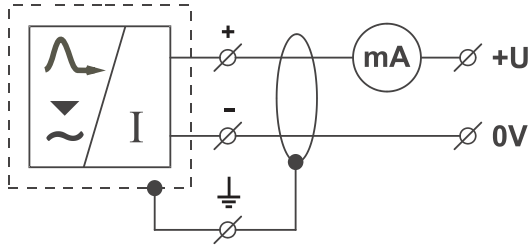


Fig. 19: Wiring diagram of the level meter with current output GRLM-70\_--\_-I

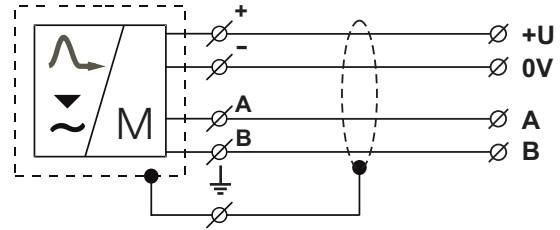


Fig. 21: Wiring diagram of the level meter with Modbus GRLM-70\_--\_-M

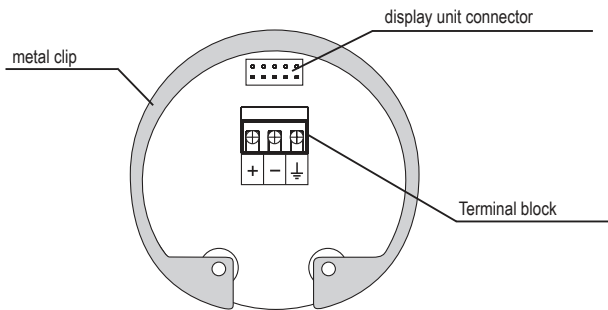


Fig. 20: Inside view of screw terminals of the level meter with current output GRLM-70\_--\_-I

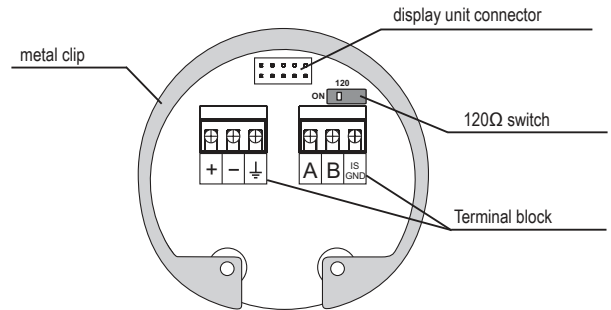


Fig. 22: Inside view of screw terminals of the level meter with Modbus GRLM-70\_--\_-M

## SETTING ELEMENTS

Settings are performed using 3 buttons located on the display module DM-70. All the settings are available in the menu of the level meter.

### button

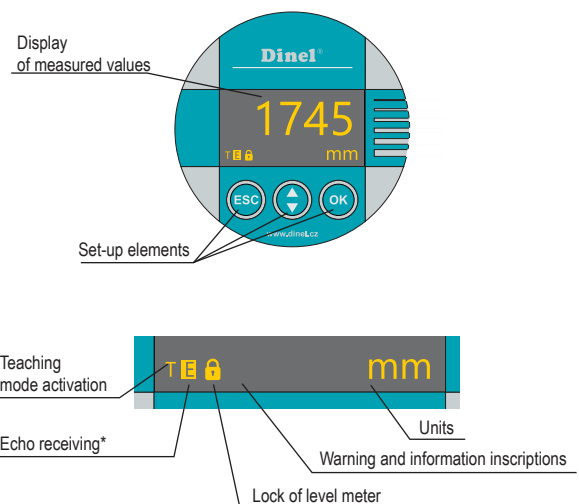
- Set-up mode access
- Confirmation of selected item in the menu
- Move the cursor in the line
- Saving of set-up data

### button


- Move in the menu
- Change of values

### button



- Cancelling of carried out changes
- Shift one level up



\* Slow flashing while the reflected signal (echo) is received from the measured level.

 Level meter GRLM-70\_--\_-L is supplied without the display module (display) DM-70. To setup the level meter, it is necessary to connect a display module to it (or it can be configured via HART or MODBUS). When the settings are completed, the display module may be disconnected and the level meter then measures without it.

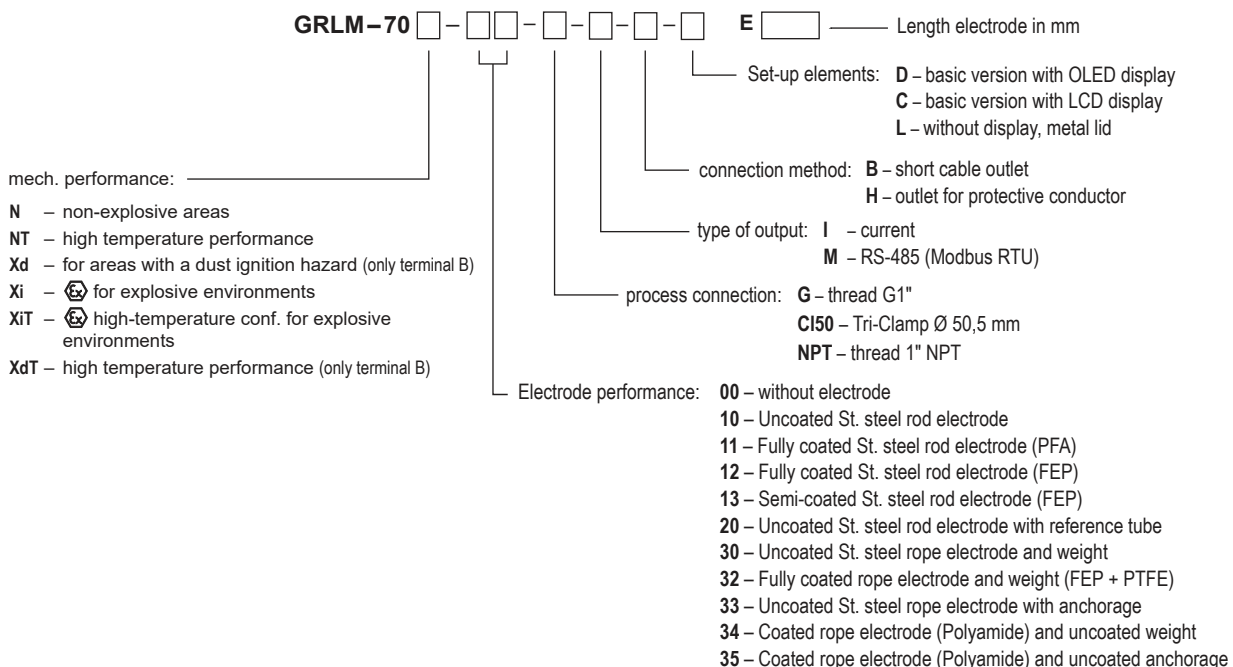
## FUNCTION AND STATUS INDICATION

- **Status indication (left lower corner of the display):**
  - symbol „E“ - **alternating flashing** - correct reception of the reflected wave indicating the level
  - symbol „T“ - **permanent shine** - "LEARNING" mode is activated
  - symbol  - **inverse shine** - activation of the "LEARNING" mode
  - symbol  - **permanent shine** - the level meter is locked against unauthorized setting using a password, enter password to unlock (see MENU - PASSWORD)
- **Warning inscriptions:**
  - NO ECHO** - when empty tank, after you perform the procedure **TEACHING**
    - level meter is not able to measure (check the media or change the sensitivity)
  - FIXED OUTPUT** - the output stream is fixed to a constant value (see DIAGNOSTIC - CURRENT)
  - LOW POWER** - low supply voltage (must be in the range - see Technical specifications)
  - NO PASSWORD** - the level meter is protected using a password against unauthorized setting
- **Information inscriptions:**
  - DISTANCE TO LEVEL** - the display shows the current distance (see DIAGNOSTIC - DISTANCE)
  - CURRENT** - the display shows the current proud (see DIAGNOSTIC - CURRENT)

### Status and failure signalization, using:

- display module (see chapter 8)
- setting of the failure mode to the level selected in MENU - SERVICE - ERROR MODE (applies to current version with HART communication- I)
- status messages in HART communication (applies to current version with HART communication - I)
- status registers: STATUS 1 and STATUS 2 in MODBUS communication (applies to the version with MODBUS communication - M)

## ORDER CODE





## CORRECT SPECIFICATION EXAMPLES

GRLM-70N-10-G-I-B-D E1000

(N) Performance for non-explosive areas; (10) Uncoated St. steel rod electrode; (G) Output type thread G1"; (I) Type of output current; (B) Connection method short cable outlet; (D) Set-up elements basic version with display; Length electrode 1 000 m.

GRLM-70Xi-12-G-I-H-L E1000

(Xi) Explosive environments performance; (12) Fully coated St. steel rod electrode (FEP); (G) Output type thread G1"; (I) Type of output current; (H) Connection method outlet for protective conductor; (L) Set-up elements without display, metal lid; Length electrode; Length electrode 1 000 m.

## ACCESSORIES

**standard** - included in the level meter price

- 1x of seal (asbestos free), other seals (PTFE, Al, etc.)\*

\* Pressure resistance - see the table in the accessories datasheet in the "seals and gaskets".

**optional – for a surcharge** - (see catalogue sheet of accessories)

- Fixing stainless steel nuts G1"
- steel welding flange ON-G1"
- stainless steel welding flange NN-G1"
- extension cable for PK-70-1 display

## SAFETY, PROTECTION, COMPATIBILITY AND EXPLOSION PROOF

The level meter is equipped with protection against electric shock on the electrode, reverse polarity, output current overload, short circuit and against current overload on output.

Protection against dangerous contact is provided by low safety voltage according to EN 33 2000- 4-41 (SELV). Electromagnetic compatibility is provided by conformity with standards EN 5501 (B), EN 61326- 1, EN 61000-4-2 (A, 30kV), EN 61000-4-3 (A, 10kV), EN 61000-4-4 (A, 2kV), EN 61000-4-5 (A, 2kV), EN 61000-4-6 (A, 10kV).

Explosion proof GRLM-70Xi(XiT) is provided by conformity with standards EN 60079-0:2013; EN 60079-11:2012 and EN 60079-26:2007. Explosion proof GRLM-70Xi(XiT) is verified FTZÚ – AO 210 Ostrava – Radvanice: FTZÚ 13 ATEX 0212X.

Explosion proof GRLM-70Xd(XdT) is provided by conformity with standards EN 60079- 0:2013; EN 60079-31:2014. Explosion proof GRLM-70Xd(XdT) is verified FTZÚ – AO 210 Ostrava – Radvanice: FTZÚ 15 ATEX 0207X.

A declaration of conformity was issued for this device in the wording of Act No. 90/2016 Coll., as amended. Supplied electrical equipment matches the requirements of valid European directives for safety and electromagnetic compatibility.

### **Special conditions for safe use of variants GRLM-70Xi(XiT)**

Level meters GRLM-70Xi (XiT) are designed for connection to intrinsically safe circuits with galvanic isolation. If you use the device without galvanic isolation (Zener barriers) it is necessary to offset a potential between the sensor and the grounding point of the barriers.

Maximum output parameters of intrinsically safe units must correspond with limit input parameters of the level meter. In the evaluation of intrinsic safety of the circuit must be taken into account the parameters of the connected cable (especially its inductance and capacitance).

The electrode part of the GRLM-70Xi (XiT) can be placed in zone 0, the body with electronics can be placed in zone 1.

### **Special conditions for safe use of variants GRLM-70Xd(XdT)**

Ambient temperature of housing Ta: -30°C to +70°C. Maximum surface temperature. When is used variant with sight glass cover, the housing shall be protected against direct sunlight. The electrode part of the GRLM-70Xd(XdT) can be placed in zone 20, the body with electronics can be placed in zone 21.

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