

## Level-Radar BM 70 M

Measurements with a system accuracy  
 $\pm 2$  mm and high repeatability,  
for use on different tank on board vessels



Variable area flowmeters

Vortex flowmeters

Flow controllers

Electromagnetic flowmeters

Ultrasonic flowmeters

Mass flowmeters

**Level measuring instruments**

Communications technology

Engineering systems & solutions

Switches, counters, displays and recorders

Heat metering

Pressure and temperature



**BM 70 M** is a liquid-level gauge designed to operate in extremely arduous conditions on ships. Measurement of liquids, pastes, oils and slurries contained in tanks is continuous and completely non-contacting. Primary head and signal converter form one compact unit.

**Variants and installation:**

Both variants (SA and V96) are easy to install on deck.

V96 Installation into a dome, also for retrofitting.

SA A mounting flange is mounted to the bottom edge of the cast antenna for bolting the BM 70 M to a dome

**Output of measured values:**

Local display and control elements, as well as long-distance transmission via current output (0/4 – 20 mA) and digital interfaces for connection to loading systems, recorders, controllers, limit switches, PC, etc.

## Level-Radar BM 70 M

**Non-contact level gauging  
using electromagnetic waves**

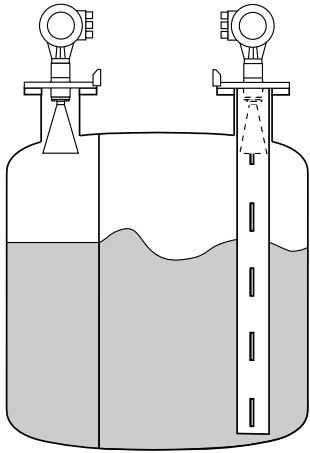
**Application conditions**

Liquids / liquid gases	✓
Pastes / sludges	✓
Solids / particulate materials	–
Measuring range ≤ 20 m	✓
Measuring range 20 – 35 m	✓
Measuring range 35 – 100 m	–
Storage tanks	✓
Still wells / reference vessels	K
Process tanks with slightly moving surface	K
Difficult process tanks (e.g. agitator)	–
Large or numerous internals in the tank	K
High accuracy (± 1 mm/0.04")	K
Excellent repeatability	✓
Current output 4 – 20 mA HART®	✓
Intrinsically safe outputs	✓
Bus connection (RS485, PROFIBUS-PA)	✓

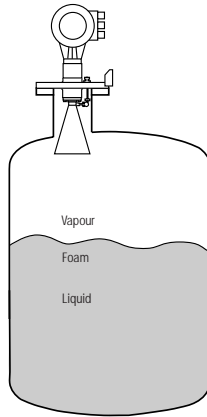
✓ suitable    – not suitable    K: contact KROHNE

**Typical applications**

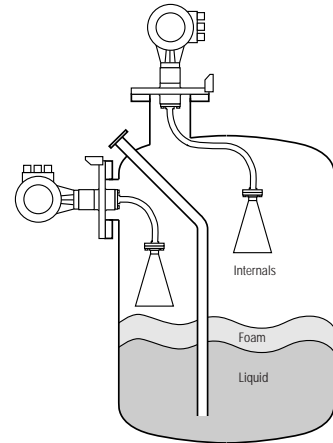
**BM 70 Horn antenna / BM 70 Still-Pipe**



**BM 70 Purging system**  
for cleaning, heating or cooling the antenna



**BM 70 with curved antenna extensions**  
for difficult applications



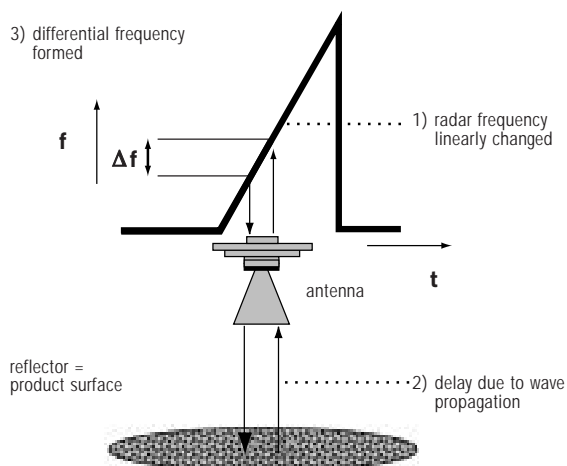
**Operating principle**

A radar signal is emitted via an antenna, reflected on the measuring surface and received after a delay time  $t$ .

**FMCW: Frequency Modulated Continuous Wave**

The FMCW-radar uses a high frequency signal sweep from 8.5–9.9 GHz (1). The signal is emitted, reflected from the product surface and received after a delay (2). For further signal processing the difference  $\Delta f$  is calculated from the actual transmit frequency and the receive frequency (3). The difference is directly proportional to the distance i.e. a large frequency difference corresponds to a large distance and vice versa.

The frequency difference is transformed via a Fourier transformation (FFT) into a frequency spectrum and then the distance is calculated from the spectrum.



**Linearity of frequency sweeps**

The measuring accuracy of a FMCW radar is determined from the linearity of the frequency sweep and its reproducibility. Linearity is corrected via a reference measurement of the oscillator characteristics.

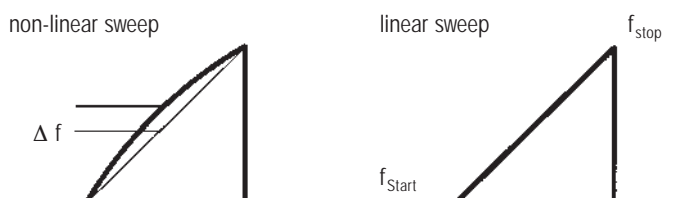
Non-linearity is corrected up to 98%

Direct frequency regulation is necessary with the BM 70 M device because of the higher demand on measuring accuracy. With the PLL technology (Phase Locked Loop) the signal frequency is directly recorded as digital data and the transmitter oscillator locks automatically on the right frequency.

**Advantages of FMCW**

Compared to the simple pulse radar technology, the use of FMCW radar offers the following advantages:

- Higher band-width of the microwave signal → better reflection separation → reliable reduction of noise
- Higher transmitting frequency → small angle → fewer interference reflections
- Higher transmitting frequency → smaller antenna diameter for same measuring range



**Technical data**

**1 Application range** distance, level, volume and reflection measurement of liquids, and liquefied gases in storage tanks of metal, and also on still wells

**2 Mode of operation and system structure** FMCW Radar in X-Band (8.5-9.9 GHz) with digital signal processing and quartz-controlled PLL frequency stabilization; compact instrument, modular construction

**3 Input**
**Measured quantities**

Primary quantities distance, reflection

Derived quantities level, volume

**Measuring range**

min. tank height: 0.5 m (1.6 ft)  
 max. measuring range: 35 m (115 ft) with still pipe 30 m (100 ft)  
 = antenna length + 10...20 cm for high accuracy: 1 m  
 ≤ 1 m/min (≤ 3.3 ft/min)

Block distance

Rate of change in level

**4 Output**

Variant	1 Ex-e current output HART®	2 Ex-i current output HART®	3 RS485 interface
Transmission rate	1200 Baud	1200 Baud	1200 – 38400 Baud
Address	0 – 15	0 – 15	0 – 255
Protocols	KROHNE-Protocol, HART®	KROHNE-Protocol, HART®	KROHNE-Protocol, HART®, Modbus-RTU
Type	active (current source); Ex-e	passive (current sink); Ex-i	active (current source); not-communicable; Ex-e
Current range	4 – 20 mA (error: 2 / 22 mA)	4 – 20 mA (error: 3.6 / 22 mA); 4 mA constant for HART®-Multidrop	4 – 20 mA (error: 2 / 22 mA)
Accuracy/Linearity	0.05 % (rel. 20 mA; 20°C/68°F)	0.05 % (rel. 20 mA; 20°C/68°F)	0.3 % (rel. 20 mA; 20°C/68°F)
Supply voltage		8 – 30 V (terminals 31+32)	
Temperature drift	≤ 100 ppm/K (typically 30 ppm/K)	≤ 100 ppm/K (typically 30 ppm/K)	≤ 200 ppm/K (typically 70 ppm/K)
Burden	≤ 500 Ω	≤ (U <sub>S</sub> – 8 V) / 22 mA, (U <sub>S</sub> = external supply voltage)	≤ 250 Ω
Switching output (optionally)	max. 100 mA / 30 V DC or 30 V AC; internal resistance ≤ 20 Ω	6 – 30 V; I <sub>Low</sub> ≤ 110 mA; U <sub>Low</sub> ≤ 2 V; I <sub>High</sub> ≤ 900 μA (U = 30 V), I <sub>High</sub> ≤ 200 μA (U = 8 V)	Low: I < 2 mA; High: I = 22 mA (R ≤ 250 Ω) or no-load voltage ≤ 18 V
Digital input (optionally)	to 'freeze' the measured value; voltage: 5 – 28 V DC; input resistance: ≥ 1 kΩ; floating		
Variant	4 PROFIBUS-PA (Ex-i)	5 Foundation Fieldbus	
Physical	to IEC 61 158-2 und FISCO model	to IEC 61 158-2 und FISCO model	
Bus characteristics	9 – 30 V; 0.3 mA max.; 4.2 W max.	9 – 30 V; 0.3 mA max.; 4.2 W max.	
Base current	10 mA	10 mA	
Fault current	6 mA	6 mA	
Failure signal	Current output: error signal 2/22 mA or 3.6 mA (Ex-i), plain text in local display Switching contact: contact opens or closes Digital interfaces: error flags		

**5 Measuring accuracy**

**Error of measurement** under reference conditions: up to 20 m ≤ 2 mm; 20 ... 35 m ± 0.01% of distance

**Repeatability** ≤ 0.5 x error of measurement

Measured-value resolution 0.1 mm (0.04")

**Ambient temperature effect** – 1 ppm/°C (influence of propagation way)

**6 Application conditions**

<b>6.1 Installation conditions</b>	avoid interference reflections and multiple reflections
<b>6.2 Ambient conditions</b>	
Hazardous locations	Zone 0,1,2; (PTB 02 ATEX 1078)
Ambient temperature of signal converter	Temperature classes: T6...T1; Explosion groups: IIA...IIC
Flange temperature	-40°C ... +60°C (depends on flange temperature) Horn antenna: -30°C ... +125°C (depends on T <sub>amb</sub> ); optional -60°C Solid antenna: -30°C ... +200°C (depends on T <sub>amb</sub> )
Ambient temperature limits of signal converter	measuring function OK, but LCD "freezes": min. -40°C functional upper limit, for max. 16 hours: max. +70°C
Storage temperature	-20°C ... +60°C
Environment class	environmental category F acc. GL damp heat 55°C RH = 95% for 96 hours salt mist (4 times) 5% NaCl spray periods 2 hours, storage 7 days at 40°C RH=93% acc. GL
Ingress protection of signal converter	IP 66 / IP 67 (equivalent to NEMA 6/6X)
Shock resistance	impact test in conformity with EN 61010, Section 8.2 with 0.5 J energy and drop test to prEN 50178:1994
Vibration resistance	2-13.2 Hz: ±1 mm; 13.2-100 Hz: 0.7g; 1 octave/min; 3 axes 90 min on each resonance (Q > 2) or at 30 Hz; 3 axes acc. GL
Insulation	HV test min. 1500 V eff. acc. GL Insul. resistance >10 MW@500V DC
EMC	EN 50081-1, EN 50082-2 acc. Ship approvals: discharge 6kV/8kV; field 10V/m 80MHz-1GHz AM; burst 1kV/2kV; conducted 3Veff. 10kHz-80MHz AM; surge 1kV/2kV; cond. emiss. 10kHz-30MHz; rad. emiss. 150kHz-2GHz

**6.3 Product conditions**

Physical properties	no effect on measurement results; for reliable measurements, the relative permittivity should have the following minimum values:
Relative permittivity	$\epsilon_r \geq 1.5$ ; $\epsilon_r < 2$ : still well recommended
Product limitations	liquid ammonia (NH <sub>3</sub> ); liquid hydrogen (H <sub>2</sub> ); liquid helium (He)
Process temperature	unrestricted (but be aware of ambient and flange temperatures!)
Operating pressure	dependent on flange size and pressure rating. Standard: max. 16 bar

**7 Design**

<b>Materials</b>	
Signal converter housing	stainless steel 1.4435 (or 1.4539) with blue powder coating
Signal converter sight window	borosilicate glass
Flange system / antenna	stainless steel 1.4435 (or 1.4539)
Gaskets	FPM (Viton), Kalrez 6375 (others optional) (PTFE is also in contact with product)
Process connection	DIN 2501 DN 200 / PN 16, Form C to DIN 2526; or ANSI B16.5 8", 150 lbs, RF
<b>Electrical connection</b>	
Cable entries	3 x M 25 x 1.5
Terminals	0.5 - 2.5 mm <sup>2</sup> (solid conductor: max. 4 mm <sup>2</sup> )
PE or FE and PA	U-clamp terminal (max. 4 mm <sup>2</sup> )
Shielding for RS 485 cable and when cable for current output is > 100 m (> 328 ft)	

**8 Local operator interface**

Key pad	3 keys
Magnetic sensors	for control through the closed housing
Local display	2-line illuminated LCD + 6 status markers
Operator interface language	English, German, French, Spanish, Portuguese, Swedish, Italian
Units of measurement	Lengths: m, cm, mm, inch, ft, % Volume: m <sup>3</sup> , Liter, US Gal, GB Gal, ft <sup>3</sup> , bbl, % Conversion unit: any text

**9 Power supply**

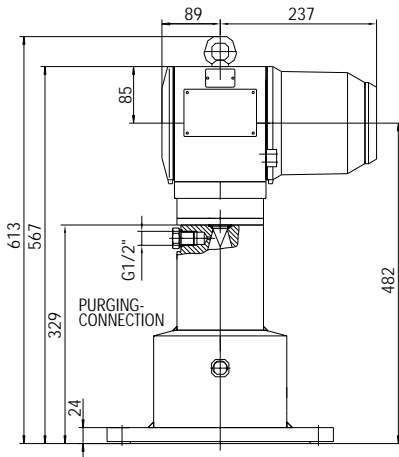
24 V DC/AC	18 - 31.2 V DC or 18 - 26.4 V AC (45 - 66 Hz)
115/230 V AC	optionally: 100 - 120 V AC (tolerance: 85 - 127 V), 200 - 240 V AC (tolerance: 170 - 254 V); 45 - 66 Hz
Power consumption	typically 7.5 W / 12 VA

**10 Certificates and approvals**

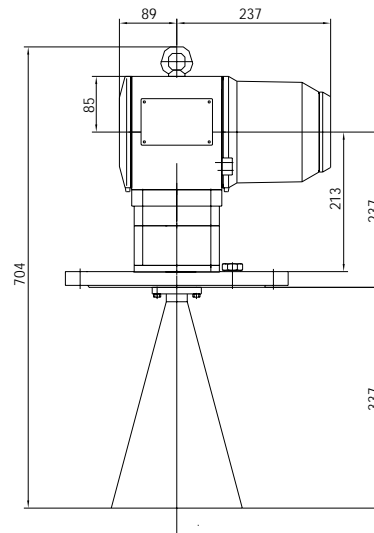
Ex approvals	According to ATEX, see 6.2
Radio approvals	R&TTE (Europe); FCC (USA) (based on general approvals for BM 70 A/P, BM 702)
Ship approvals	GL, ABS; In preparation: LR, DNV, CCS

**Dimensions and weights**

**Solid antenna (SA)**



**Horn antenna (V96)**



**Communication systems**

The BM 70 level radar systems can be operated with various communication interfaces.

**KROHNE SMART**

Standard interface for data transmission to a control unit.

**HART® protocol**

The HART® protocol transmits communication signals.

**PC-CAT for Windows**

User-friendly software package for setting and evaluation of BM 700 and BM 70 A/P data.

**Communications interfaces**

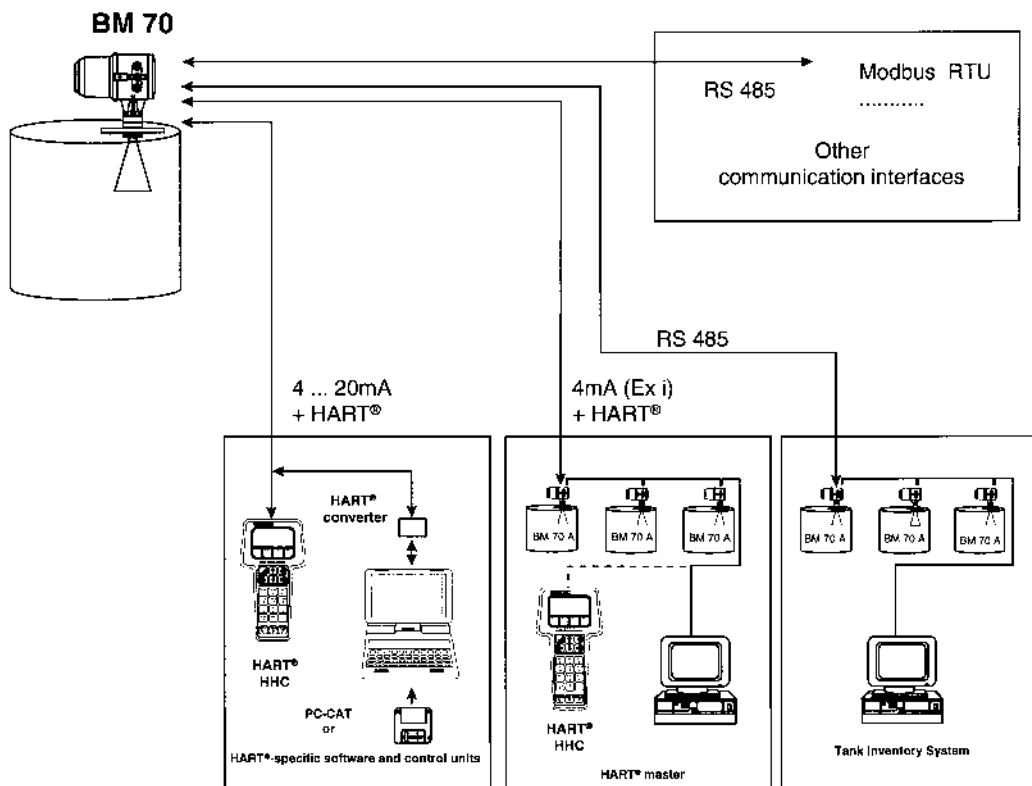
- PROFIBUS-PA protocol
- Fieldbus Foundation protocol

The following protocols are available for the RS 485 interface:

- KROHNE protocol
- Modbus protocol

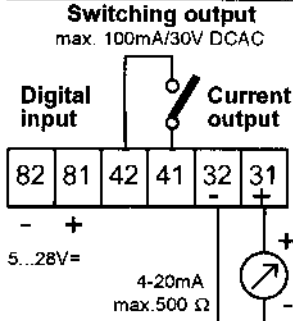
**KROHNE Tank Management System**

In addition to level gauging with the BM 70 A/P, KROHNE also supplies complete tank management systems.

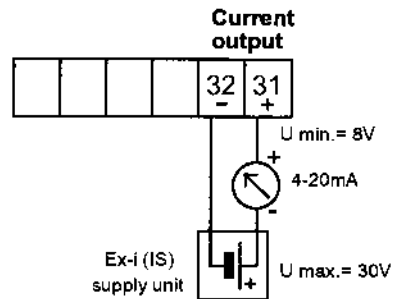


Electrical connections

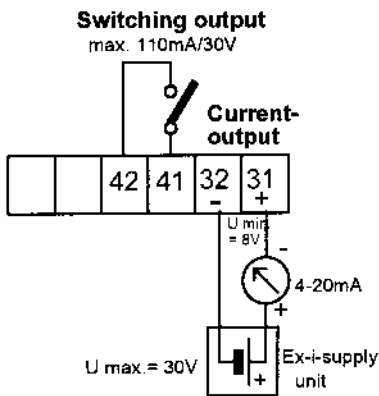
Current output HART®, Ex e:



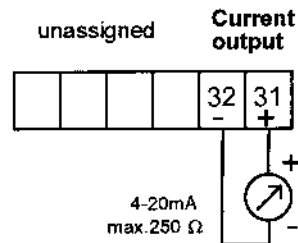
Ex-i current output HART®:



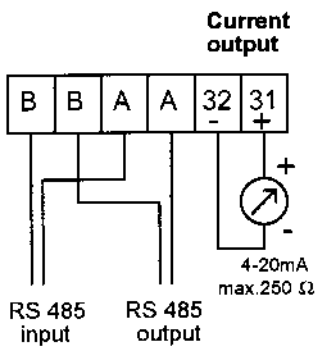
Ex-i Current output HART with switching output:



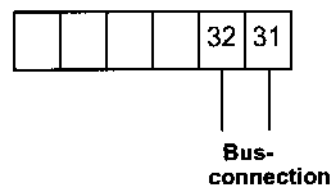
Current output (non-communicable):



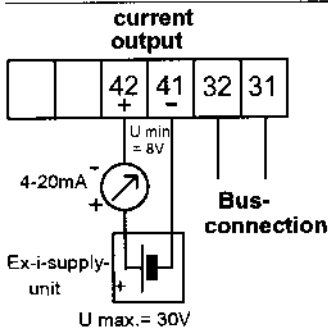
RS485 version:



Profibus PA or Foundation Fieldbus (FF)



Profibus PA / FF with current output:



Profibus PA / FF with switching output:

