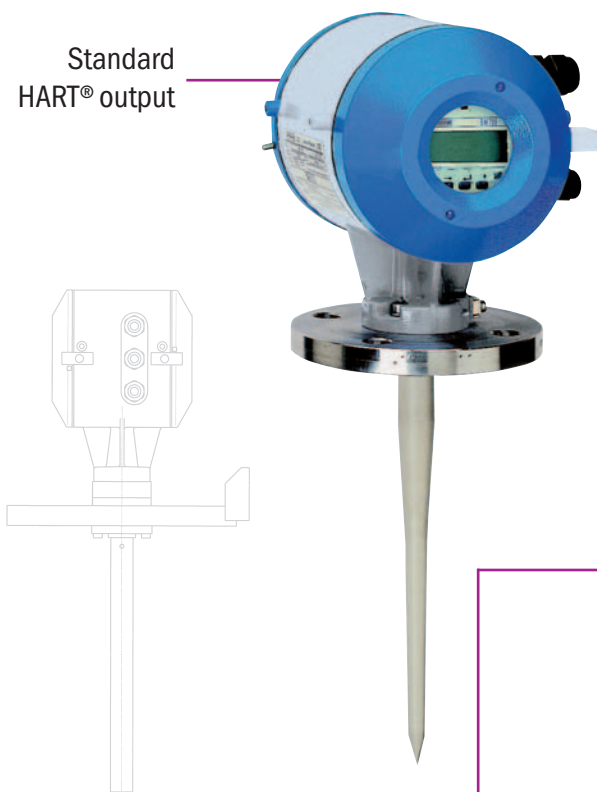


Level-Radar BM 700, BM 70 A, BM 70 P

Non-contact level gauging
using electromagnetic waves

Standard
HART® output

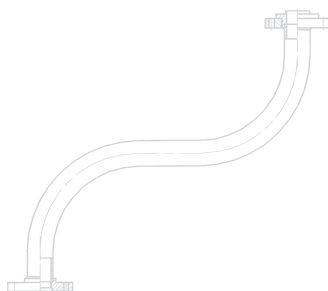


Easy to program
in the field or via PC



Microwave frequency
~ 10 GHz

For use in
process tanks



Electromagnetic flowmeters

Variable area flowmeters

Mass flowmeters

Ultrasonic flowmeters

Vortex flowmeters

Flow controllers

Level measuring instruments

Pressure and temperature

Heat metering

Communications technology

Switches, counters, displays and recorders

Engineering systems & solutions

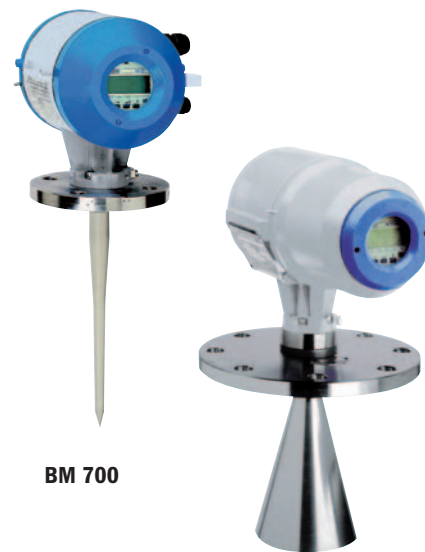


Level-Radar BM 700, BM 70 A, BM 70 P

Non-contact level gauging
using electromagnetic waves

The BM 70 line comprises high-quality measuring instruments to perform a wide range of measuring tasks.

- The **low-cost BM 700** is ideal for storage tanks, still wells and reference vessels.
- The **BM 70 A** supplies **reliable measurements** in tanks with agitators or other internals.
- The **BM 70 P** is the **high-precision** version with a measuring accuracy of ± 1 mm.



BM 700

BM 70 A / BM 70 P

Contents

Product selection	2
Modularity	3
Applications	4
Operating principle	6
Quality of measurement	7
Technical data BM 700	10
Technical data BM 70 A	14
Technical data BM 70 P	18
Communications systems	22
Approvals	24

Selection Sheet

Application condition	BM 700	BM 70 A	BM 70 P
Liquids / liquid gases	✓	✓	✓
Pastes / sludges	✓	✓	✓
Solids / particulate materials	–	K	–
Measuring range ≤ 20 m	✓	✓	✓
Measuring range 20 - 35 m	–	✓	✓
Measuring range 35 - 100 m	–	K	–
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")	–	–	✓
Excellent repeatability	–	–	✓
Current output 4 - 20 mA HART®	✓	✓	✓
Intrinsically safe outputs	–	✓	✓
Bus connection (RS485, PROFIBUS-PA)	–	✓	✓

✓ suitable – not suitable K: contact KROHNE

Flexible through modularity

Level-Radar measuring system

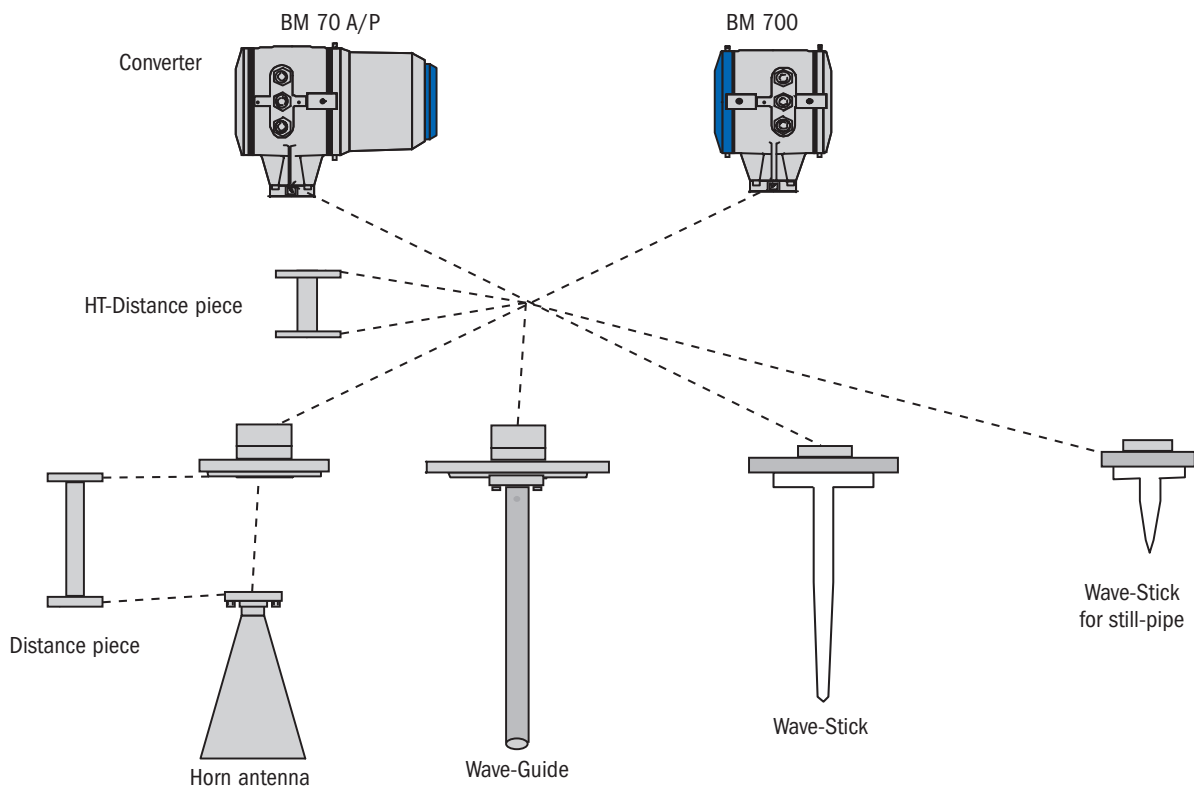
The modular design allows us to provide the optimum solution for your measuring problem. The system consists of

- converter,
- flange,
- antenna.

Flange and antenna are available in various versions, sizes and materials.

Converter for BM 70 A/P

The modularity makes it possible to retrofit the converter to a communication system (e.g. PROFIBUS-PA) in place of a 4 – 20 mA current output. The process need not be interrupted.



Horn antenna

Most frequently used antenna, available in different metals.

Application in reactors, process and storage vessels as well as waste water tanks and still wells.

Wave-Guide

A tubular antenna extension is passed through the product and down to the tank bottom. The antenna extension interconnects with the tank, and for this purpose a vent hole is featured in the top part of the extension. Suitable for spherical tanks, horizontal and vertical vessels containing relatively clean products, or liquefied gases.

Wave-Stick

The dielectric rod antenna and the sealing face of the connecting flange are made of PTFE. Resistant to high-temperature steam, CIP/SIP capability up to 160°C (320°F).

Particularly suitable for applications in the food and beverage, waste water, chemical and pharmaceutical industries.

High-temperature (HT) distance piece

Is mounted between flange and converter to protect the electronics of the converter against high temperature.

Antenna extension

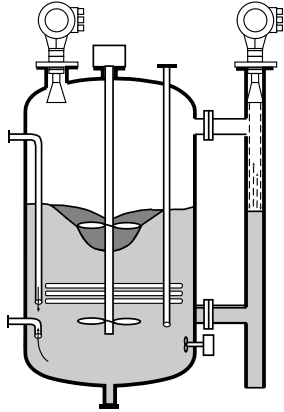
Straight, rectangular or S-shaped extensions are available for specific and particularly difficult application conditions. Such extensions are used in cases where the antenna is exposed to particularly high temperatures and where there are problems of space.

Antenna purging system (w/o figure)

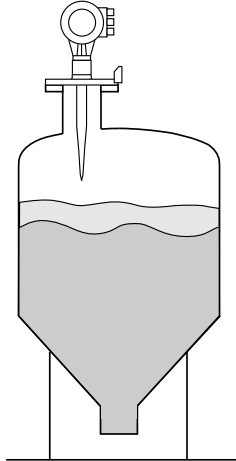
The purging system is used for cleaning, heating and cooling the antenna. The purging medium is introduced through the connecting flange. Application in the petrochemical, chemical and pharmaceutical industries under conditions of very low and very high temperatures and with products tending to form deposits and incrustations.

Typical applications

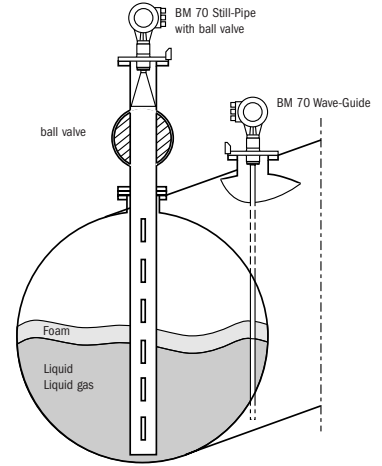
BM 70 Horn antenna mounted on a process tank and on a side vessel



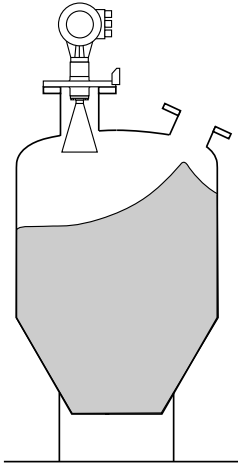
BM 70 Wave-Stick mounted on a process tank for the food and beverage industry



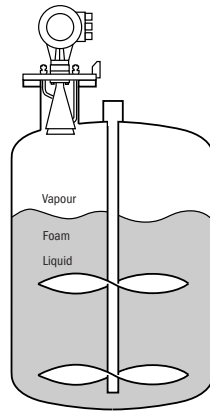
BM 70 Still-Pipe / BM 70 Wave-Guide on a liquefied-gas tank



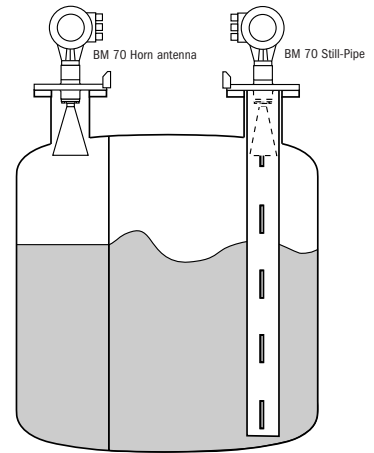
BM 70 Horn antenna for particulate materials



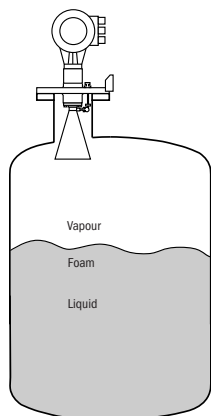
BM 70 Heating system for condensing products



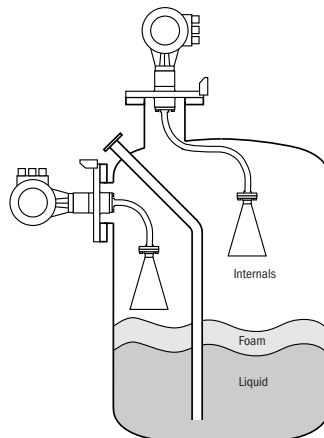
BM 70 Horn antenna / BM 70 Still-Pipe on a storage tank



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



BM 70 with curved antenna extensions for difficult applications



BM 700, 70 A, 70 P

Use in storage tanks

Product	paraffin
Tank atmosphere	condensation
Product surface	smooth
Temperature	70°C (158°F)
Pressure	atmospheric



Use in process tanks

Product	alcohol
Tank atmosphere	condensation
Product surface	turbulent
Temperature	90°C (194°F)
Pressure	2 bar (29 psig)

Encrustations on the antenna

Product	caustic soda with bauxite sludge
Tank atmosphere	dust, condensation
Product surface	foam
Temperature	50°C (122°F)
Pressure	atmospheric



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 Δf 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.

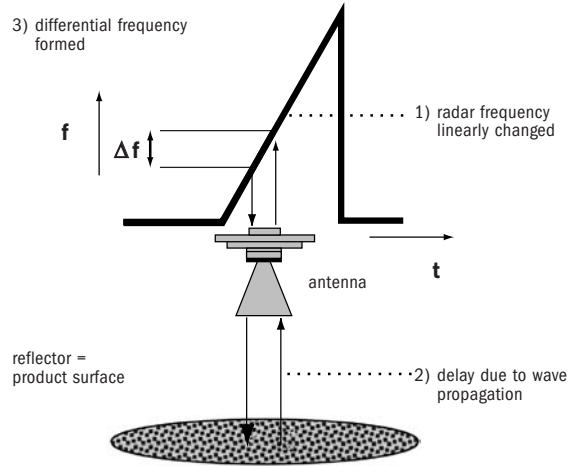
Non-linearity is corrected up to 98% (BM 700/BM 70 A)

Direct frequency regulation is necessary with the BM 70 P 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.

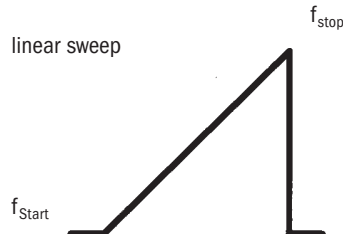
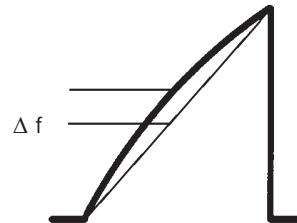
Advantages of FMCW

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



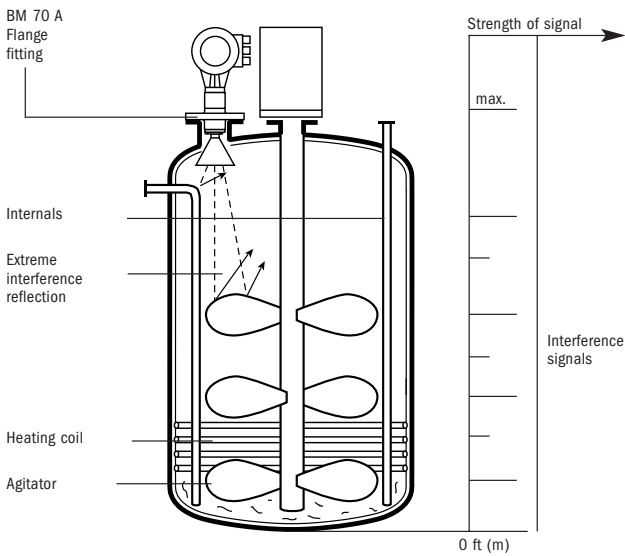
non-linear sweep



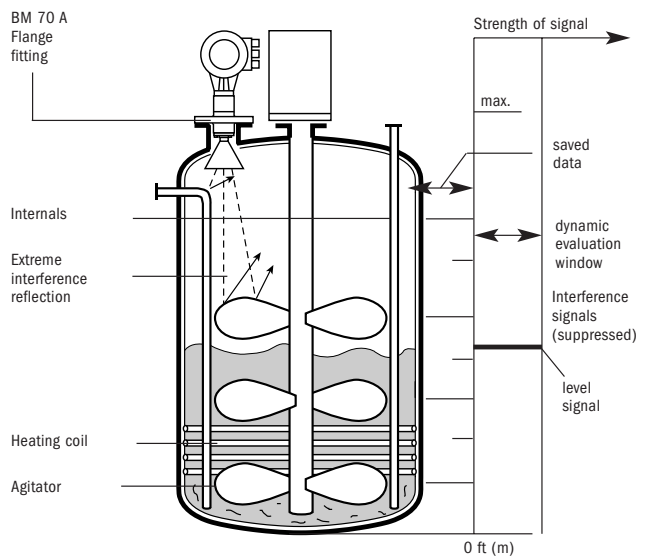
Quality of measurement

Reflections caused by struts, weld seams and tank internals are identified as “fixed targets” and can be blanked out, provided the useful signal reflected from the product surface is greater than the interference reflection. Sporadic interference signals caused by agitator blades, falling deposits or sidestreams of the main filling flow are blanked out by the microprocessor-controlled signal evaluation.

Empty-tank spectrum of a process tank with agitators

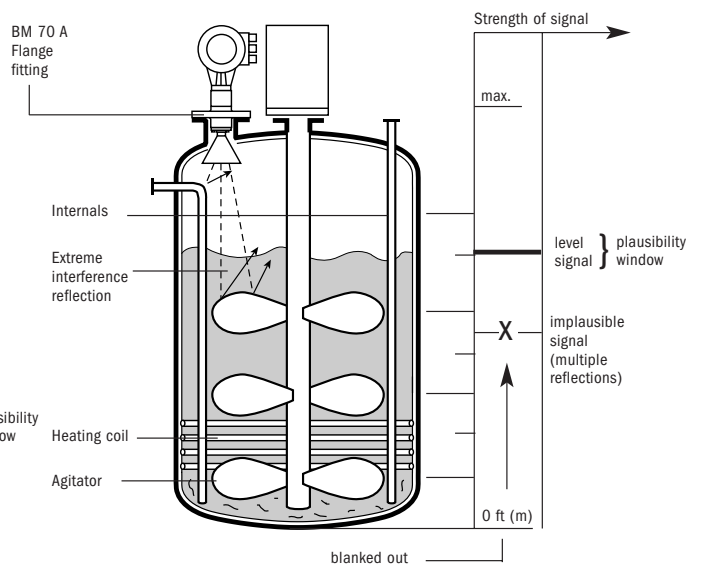
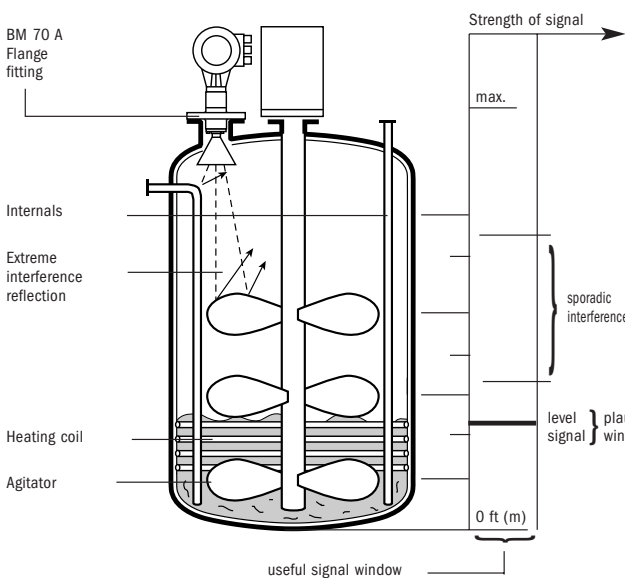


Interference signals and fixed targets blanked out



Software is provided for tracking measured values. A “plausibility window” in which the next measured value is expected is defined by the preceding measurements in conjunction with the programmed tracking speed. Measured values not located in this “distance window” are blanked out.

Measured-value plausibility check

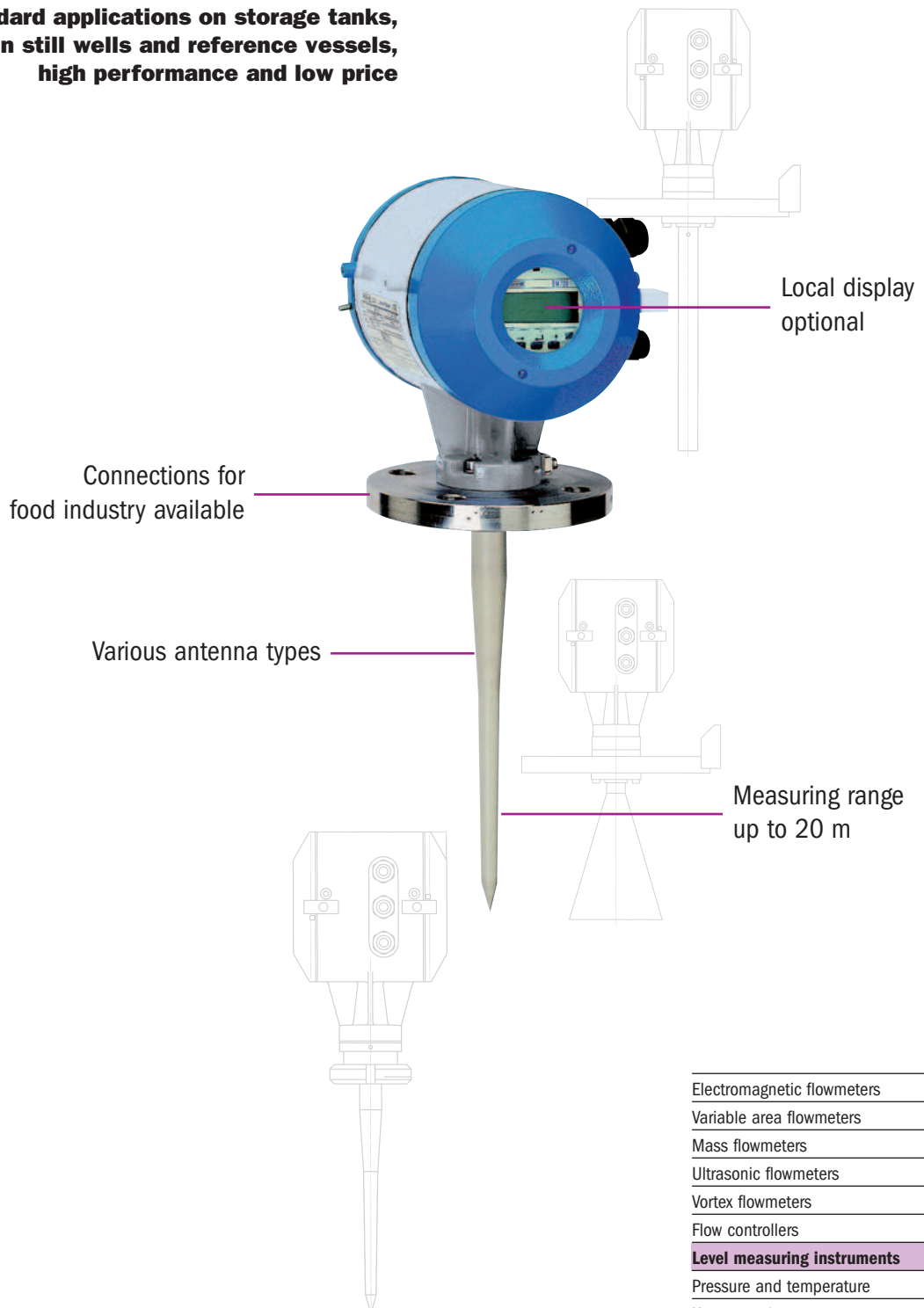




Notes

Level-Radar BM 700

For standard applications on storage tanks,
in still wells and reference vessels,
high performance and low price



Local display
optional

Connections for
food industry available

Various antenna types

Measuring range
up to 20 m

Electromagnetic flowmeters

Variable area flowmeters

Mass flowmeters

Ultrasonic flowmeters

Vortex flowmeters

Flow controllers

Level measuring instruments

Pressure and temperature

Heat metering

Communications technology

Switches, counters, displays and recorders

Engineering systems & solutions

Technical data

1 Application range distance, level, volume measurement of liquids, pastes, slurries, in storage tanks, still wells or reference vessels

2 Operating mode/system structure FMCW radar in the X band (8.5-9.9 GHz) with digital signal processing; compact device, modular design

3 Input

Measured quantities
 Primary quantity distance
 Derived quantities level, volume

Measuring range
 Min. tank height 0.5 m (1.6 ft)
 Max. measuring range 20 m (65.6 ft)

Block distance min. 0.2 - 0.5 m (0.7 - 1.6 ft)
 Rate of change in level ≤ 10 m/min (≤ 33 ft/min)

4 Output

Ex-e current output HART®
 Type active (current source); Ex-e
 Current range 4 - 20 mA (error: 22 mA)
 Accuracy/linearity 0.15 % (rel. 20 mA; 20°C/68°F)
 Temperature drift ≤ 100 ppm/K (typically 50 ppm/K)
 Load ≤ 350 Ω

Failure signal Current output: error signal 22 mA, plain text in local display

5 Measuring accuracy

Error of measurement min. ±1 cm (0.4") or ±0.3%

Repeatability ≤ 0.5 x error of measurement
 Measured-value resolution 1 mm (0.04")

Ambient temperature effect no temperature effect on measured value (see output)

6 Field service conditions

6.1 Installation conditions avoid interference reflections and multiple reflections

6.2 Ambient conditions
 Hazardous locations Zone 0, 1, 2; IIC/IIB, T1 -T6
 Ambient temperature at signal converter -20 ... +55°C (-4 ... +131°F); functional range: -40 ... +70°C (-40 ... +158°F)

Flange temperature

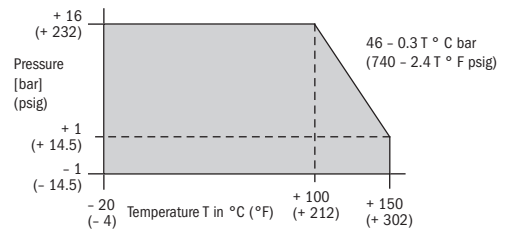
Version	Min. flange temperature		Max. flange temperature	
	Standard version	Special version	w/o HT-distance piece	with HT-distance piece
V96 with horn antenna / Wave-guide with				
Gasket K4079	-20°C (-5°F)	-	+130°C (+266°F)	+250°C (+482°F)*
Gasket K2035	-20°C (-5°F)	-	+130°C (+266°F)	+210°C (+410°F)
Gasket K6375 / K1091	-20°C (-5°F)	-	+130°C (+266°F)	+250°C (+482°F)
Gasket Viton / FEP	-15°C (+5°F)	-	+130°C (+266°F)	+200°C (+392°F)
Gasket Silicone / FEP	-30°C (-20°F)	-60°C (-76°F) on request	+130°C (+266°F)	+200°C (+392°F)
LP Flange system with horn antenna / Wave-Guide	-20°C (-4°F)	-	+130°C (+266°F)	-
Wave-Stick				
PTFE with flange plate	-40°C (-40°F)	-	+130°C (+266°F)**	+150°C (+302°F)**
PTFE w/o flange plate	-20°C (-4°F)	-	+130°C (+266°F)	+150°C (+302°F)**
PP w/o flange plate	-20°C (-4°F)	-	+100°C (+212°F)	-
	* Safety limit 280°C (536°F)		** pressure dependant, see below	

Environment class Locations exposed direct to open-air climate, D1 Severity in conformity with EN 60654-1
 Protection category EN 60529/IEC 529 (signal converter) IP 66 / IP 67
 Shock resistance Impact test to EN 61010, Sect. 8.2 with 0.5 J energy; drop test to prEN 50178
 Vibration endurance limit IEC 68-2-6 and prEN 50178 (10-57 Hz: 0.075 mm / 57-150 Hz: 1 g)
 EMC EN 50081-1, EN 50082-2; NAMUR Recommendation

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	$\epsilon_r \geq 1.5$; $\epsilon_r < 3$: still well recommended; Wave-Stick immersed: $\epsilon_r \geq 4$
Product limitations	liquid ammonia (NH ₃); liquid hydrogen (H ₂); liquid helium (He)
Process temperature	Unrestricted (but be aware of ambient and flange temperatures!)
Operating pressure	dependent on flange size and pressure rating (see table)
Horn antennae/Wave-Guide	Standard: up to 40 bar (580 psig) (higher on request)

Wave-Stick
 w/o flange plate: ≤ 2 bar/29 psig
 with flange plate: see diagram



7 Component parts

Dimensions and weights see “Dimensions and weights”

Materials

Signal converter housing	Aluminium with electrostatic powder coating; sight window (optional): glass
Flange system, antenna, antenna extension	Stainless steel 1.4571 (316 Ti) or 1.4435 (316 L), Hastelloy C4 or B2, titanium, tantalum (information on other materials available on request)
Gaskets	Kalrez 4079, 2035, 6375; Viton (FPM); FEP-coated (basically, in all versions, PTFE is also in contact with the product)
Wave-Stick	only PP or PTFE in contact with the product; flanges made of stainless steel 1.4571 (316 Ti)

Process connection

Horn antenna/Wave-Guide	DIN 2501/DIN 2526, Form C	DN 50 – DN 200, PN 6 – PN 64
	ASME B 16.5	2” – 8”, 150/300 lb/RF
Wave-Stick	DIN 2501/DIN 2526, Form C	DN 50 – 150
	ASME B 16.5	G 1½, 2” – 6”
Dairy screw connection	DIN 11851	DN 50, DN 65, DN 80
	SMS 1145	51 mm, 63 mm, 76 mm
Tri-Clamp connection	ISO 2852	2” – 4”

Electrical connection

Cable entries	3 x M 25 x 1.5
Terminals	0.5 – 2.5 mm ² (solid conductor: max. 4 mm ²)
PE or FE and PA	U-clamp terminal (max. 4 mm ²)
Shielding when cable for current output is > 100 m (> 328 ft)	

8 Local operator interface

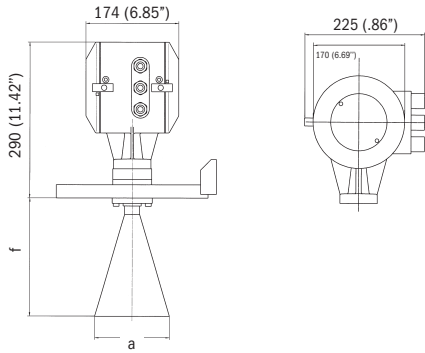
Key pad	3 keys
Magnetic sensors	Operation with bar magnet without opening the housing
Local display	2-line illuminated LCD + 6 status markers
Operator interface language	English, German, French, Spanish, Portuguese, Swedish, Italian
Units of measurement	Lengths: m, cm, mm, inch, ft, %, Volume: m ³ , Liter, US Gal, GB Gal, ft ³ , bbl, % Conversion unit: any text

9 Power supply

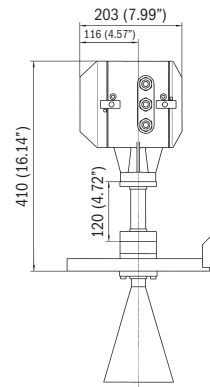
24 V DC/AC	19.2 – 28.8 V DC or 20.4 – 26.4 V AC (45 – 66 Hz)
115/230 V AC	(external power supply unit)
Power consumption	typically 6 W / 10 VA

Dimensions and weights

BM 700 Horn antenna



High-temperature version



Flange connections to:

DIN 2501 (= BS 4504) DN 50 - DN 200 / PN 6 - PN 64

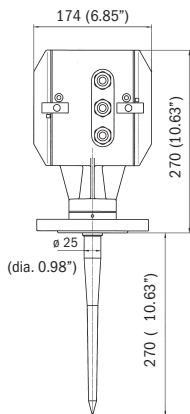
ASME B 16.5 / 2" - 8" / Class 150/300 lb/RF

Nominal size to		Antenna	Dimensions in mm (inches)				approx. weight
DN	ASME	Type	dia. a	SS 1.4571 or SS 316 Ti f	Hastelloy C4 f	Titanium, tantalum f	kg (lb)
80	3"	1	80 (3.15)	110 (4.33)	145 (5.71)	110 (4.33)	17 (37.48)
100	4"	2	100 (3.94)	148 (5.83)	177 (6.97)	146 (5.75)	18 (39.68)
150	6"	3	140 (5.51)	223 (8.78)	250 (9.84)	220 (8.66)	23 (50.71)
200	8"	4	200 (7.87)	335 (13.19)	360 (14.17)	332 (13.07)	30 (66.14)

Subject to change without notice

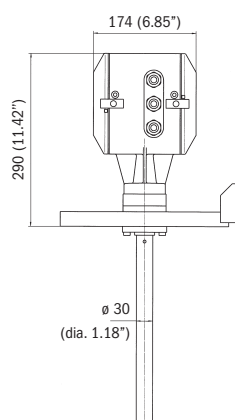
BM 700 Wave-Stick

Weight DN 50: approx. 12.5 kg (27.56 lb)



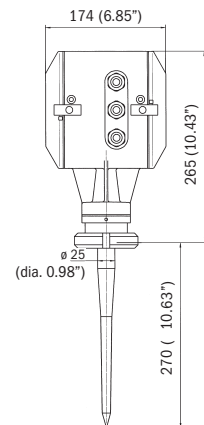
BM 700 Wave-Guide

Weight DN 50; 1 m: approx.: 13.5 kg (29.76 lb)



BM 700 Wave-Stick

(Dairy screw connection to DIN 11851)



Dimensions in mm (inches)

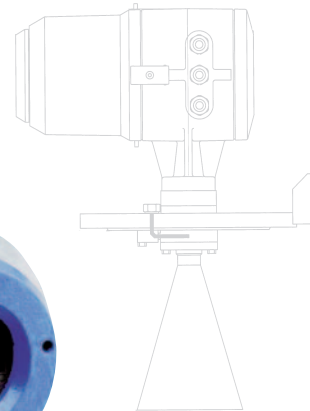
Level-Radar BM 70 A

Reliable measurement on tanks with agitators or other internals, also in extreme process conditions

Further interfaces:
RS 485, PROFIBUS-PA,
Fieldbus Foundation

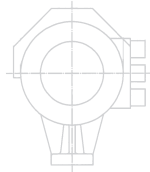
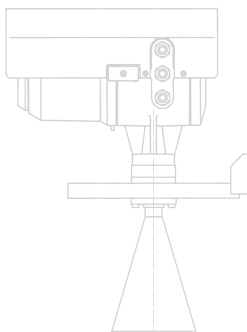
Max. allowable operating
pressure up to
400 bar (5800 psig)

Measuring range
up to 100 m (330 ft)



Rectangular and S-shaped
antenna extensions

A variety of
antennas available



Electromagnetic flowmeters

Variable area flowmeters

Mass flowmeters

Ultrasonic flowmeters

Vortex flowmeters

Flow controllers

Level measuring instruments

Pressure and temperature

Heat metering

Communications technology

Switches, counters, displays and recorders

Engineering systems & solutions

Instrument versions

	BM 70 A Standard	BM 70 A Precision	BM 70 A Wave-Guide	BM 70 A Still well	BM 70 A Antenna purging system	BM 70 A Wave-Stick	BM 70 A Wave-Stick w/o flange plate
Measuring range	40 m (131 ft)	40 m (131 ft)	10 m ² (32.8 ft) ²	40 m (131 ft)	40 m (131 ft)	20 m (65.6 ft)	20 m (65.6 ft)
Block distance (min. measuring distance from flange)	0.4 m (1.31 ft)	1 m (3.28 ft)	0.3 m (0.98 ft)	0.5 m (1.64 ft)	0.4 m (1.31 ft)	0.2 m (0.66 ft)	0.2 m (0.7 ft)
Application range¹⁾	F, S	F	F, FG	F, FG	F, S	F, S	F, S
Accuracies	see accuracy graph						
Max. allowable operating pressure (dependent on flange type)	-1-64 bar ³⁾ -14.5-928 psig ³⁾	-1-64 bar -14.5-928 psig	-1-64 bar ³⁾ -14.5-928 psig ³⁾	-1-64 bar ³⁾ -14.5-928 psig ³⁾	-1-64 bar -14.5-928 psig	-1-16 bar -14.5-232 psig	-1-2 bar -14-5 psig
Operating temperature at flange	250°C 482°F	250°C 482°F	250°C 482°F	250°C 482°F	250°C 482°F	100 ... 150°C ⁴⁾ 212 ... 302°F ⁴⁾	100 ... 150°C 212 ... 302°F
Hazardous-duty version (Ex)	Zone 0	Zone 0	Zone 0	Zone 0	Zone 0	Zone 0	Zone 1
Angle of radiation	± 8°	± 6°	± 0°	± 0°	-	± 9°	± 9°
Connection flange DIN 2501: PN 6 - PN 64 ASME B 16.5: Class 150, 300, 600 lb/RF	DN 150/200 6"/8"	DN 200 8"	DN 50 - 200 2" - 8"	DN 50 - 200 2" - 8"	DN 100 - 200 4" - 8"	DN 50 - 150 2" - 6"	DN 50 - 150 2" - 6"

¹⁾ F = liquids, slurries, pastes; S = particulate materials; FG = liquefied gases ²⁾ Ex version 0 - 3 m (0 - 9.8 ft) ³⁾ higher pressures on request ⁴⁾ dependent on pressure

Technical data

1 Application range

Distance, level, volume and reflection measurement of liquids, pastes, slurries, solids and particulate materials in storage and process tanks, in containers of metal or concrete and in still wells

2 Operating mode/system

FMCW radar in the X band (8.5-9.9 GHz) with digital signal processing; compact device, modular design

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: 40 m (131 ft) (optionally also larger); Wave-Stick: 20 m (65.6 ft)

Block distance

min. 0.2 - 1.0 m (0.7 - 3.3 ft); see table "Instrument versions"

Rate of change in level

≤ 10 m/min (≤ 32.8 ft/min)

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)
Load	≤ 500 Ω	≤ (U _S - 8 V) / 22 mA, (U _S = external supply voltage)	≤ 250 Ω
Switching output (optionally)	max. 100 mA / 30 V DC or 30 V AC; internal resistance ≤ 20 Ω; floating	6 - 30 V; I _{Low} ≤ 110 mA; U _{Low} ≤ 2 V; I _{High} ≤ 900 μA (U = 30 V), I _{High} ≤ 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 and FISCO model	to IEC 61 158-2 and 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 and reference conditions	see "Accuracy graph"
Repeatability	≤ 0.5 error of measurement
Messwertauflösung	1 mm (0.039")
Umgebungstemperatureinfluss	no temperature effect on measured value; (see output)

6 Field service conditions

6.1 Installation conditions	Avoid interference reflections and multiple reflections
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6.2 Ambient conditions	
Hazardous locations	Zone 0, 1, 2; IIC/IIB, T1 -T6
Ambient temperature at signal converter	-20 ... +55°C (-24 ... +131°F); Functional range: -40 ... +70°C (-40 ... +158°F)

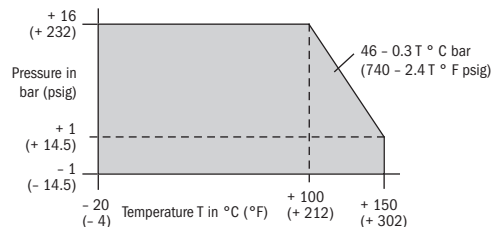
Version	Min. flange temperature		Max. flange temperature	
	Standard version	Special version	w/o HT-distance piece	with HT-distance piece
V96 with horn antenna / Wave-guide with Gasket K4079	-20°C (-5°F)	-	+130°C (+260°F)	+250°C (+480°F)*
Gasket K2035	-20°C (-5°F)	-	+130°C (+260°F)	+210°C (+410°F)
Gasket K6375 / K1091	-20°C (-5°F)	-	+130°C (+260°F)	+250°C (+480°F)
Gasket Viton / FEP	-15°C (+5°F)	-	+130°C (+260°F)	+200°C (+390°F)
Gasket Silicone / FEP	-30°C (-20°F)	-60°C (-75°F) on request	+130°C (+260°F)	+200°C (+390°F)
Wave-Stick				
PTFE with flange plate	-20°C (-5°F)	-	+130°C (+260°F)**	+150°C (+300°F)**
PTFE w/o flange plate	-20°C (-5°F)	-	+130°C (+260°F)	+150°C (+300°F)**
PP w/o flange plate	-20°C (-5°F)	-	+100°C (+210°F)	-
	* Safety limit 280°C (536°F)		** pressure dependant, see below	

Environment class	Locations exposed direct to open-air climate, D1 Severity in conformity with EN 60654-1
Protection category EN 60529/IEC 529	(signal converter) IP 66 / IP 67
Shock resistance	Impact test to EN 61010, Sect. 8.2 with 0.5 J energy; drop test to prEN 50178
Vibration endurance limit	IEC 68-2-6 and prEN 50178 (10-57 Hz: 0.075 mm / 57-150 Hz: 1 g)
EMC	EN 50081-1, EN 50082-2; NAMUR Recommendation

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	$\epsilon_r \geq 1.5$; $\epsilon_r < 3$: still well recommended; Wave-Stick immersed: $\epsilon_r \geq 4$
Product limitations	liquid ammonia (NH ₃); liquid hydrogen (H ₂); liquid helium (He)
Process temperature	unrestricted (but be aware of ambient and flange temperatures!)
Operating pressure	
Horn antenna/Wave-Guide	dependent on flange size and pressure rating (see "Instrument versions") Standard: max. 40 bar/580 psig (higher on request)

Wave-Stick
w/o flange plate: ≤ 2 bar/29 psig
with flange plate: see diagram



7 Component parts

Dimensions and weights	See "Dimensions and weights"	
Materials		
Signal converter housing	Aluminium with electrostatic powder coating; sight window: glass	
Flange system, antenna, antenna extension	Stainless steel 1.4571 (316 Ti) or 1.4435 (316 L), Hastelloy C4 or B2, titanium, tantalum (information on other materials available on request)	
Gaskets	Kalrez 4079, 2035, 6375; Viton (FPM); FEP-coated (basically, in all versions, PTFE is also in contact with the product)	
Wave-Stick	only PTFE in contact with the product; flanges made of stainless steel 1.4571 (316 Ti)	
Process connection		
Horn antenna/Wave-Guide	DIN 2501/DIN 2526, Form C ASME B 16.5	DN 50 - DN 200 / PN 6 - PN 64 2" - 8", Class 150/300 lb/RF
Wave-Stick	DIN 2501/DIN 2526, Form C ASME B 16.5	DN 50 - DN 150 2" - 6"
Dairy screw connection	DIN 11851 SMS 1145	DN 50, DN 65, DN 80 51 mm, 63 mm, 76 mm
Tri-Clamp connection	ISO 2852	2" - 4"
Electrical connection		
Cable entries	3 x M 25 x 1.5	
Terminals	0.5 - 2.5 mm ² (solid conductor: max. 4 mm ²)	
PE or FE and PA	U-clamp terminal (max. 4 mm ²)	
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	Operation with bar magnet without opening the 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 ³ , Liter, US Gal, GB Gal, ft ³ , 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

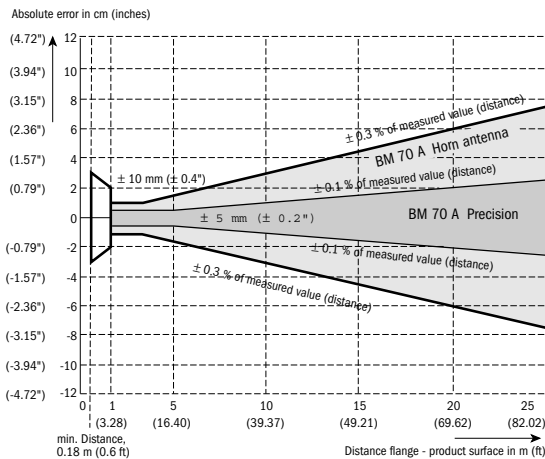
Accuracy graph

Reference conditions

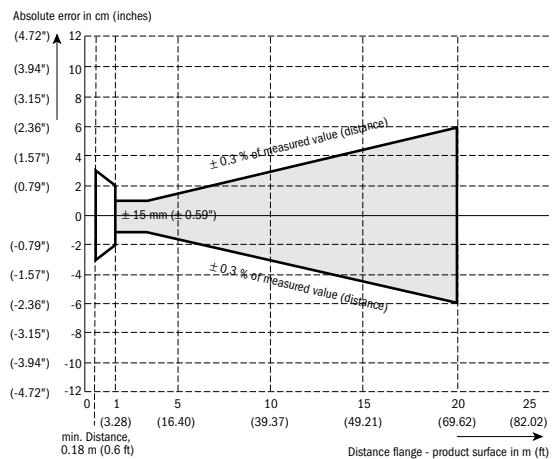
Ambient temperature: 20°C (68°F)	Rel. humidity 65%	No interference reflections
Pressure: 1013 mbar abs. (14.69 psia)	Product: water, still surface	min. distance from flange face: 1/7 x tank height

BM 70 A Horn antenna

BM 70 A Precision



BM 70 A Wave-Stick



Level-Radar BM 70 P

**Measurements with a system accuracy
± 1 mm (0.04") and high repeatability,
for use in storage tanks**

Further interfaces: RS 485,
PROFIBUS-PA, Fieldbus Foundation

The first radar level
measurement system with
dynamic PLL frequency
stabilization

System accuracy
± 1 mm (0.04"),
repeatability
better than
0.5 mm (0.02")

Thermal endurance
up to 250°C (482°F)

Measuring range
up to 35 m (115 ft)



Electromagnetic flowmeters

Variable area flowmeters

Mass flowmeters

Ultrasonic flowmeters

Vortex flowmeters

Flow controllers

Level measuring instruments

Pressure and temperature

Heat metering

Communications technology

Switches, counters, displays and recorders

Engineering systems & solutions

Technical data

1 Application range	distance, level, volume and reflection measurement of liquids, and liquefied gases in storage tanks, generally in containers of metal or concrete, and in still wells
2 Operating mode/ system structure	Quartz-controlled PLL-stabilized FMCW radar in the X band (8.5 – 9.9 GHz) with digital signal processing; compact device, modular design
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)
Block distance	min. 0.5 m (1.6 ft)
Rate of change in level	≤ 1 m/min (≤ 3.3 ft/min)

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-Protokol, 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)
Bürde	≤ 500 Ω	≤ (U _s – 8 V) / 22 mA, (U _s = 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 _{Low} ≤ 110 mA; U _{Low} ≤ 2 V; I _{High} ≤ 900 µA (U = 30 V), I _{High} ≤ 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	min. ± 1 mm (0.04") or ± 0.01% [T = 20°C (68°F); p = 1 bar abs. (14.7 psia)]
Repeatability	≤ 0.5 x error of measurement
Measured-value resolution	0.1 mm (0.04")
Ambient temperature effect	- 1 ppm/°C

6 Field service conditions

6.1 Installation conditions	avoid interference reflections and multiple reflections
Angle of radiation	Horn antenna type 4: $\pm 6^\circ$ Still well: $\pm 0^\circ$

6.2 Ambient conditions

Hazardous locations	Zone 0, 1, 2; IIC/IIB, T1 – T6
Ambient temperature at signal converter	-20 ... +55°C (-24 ... +131°F); functional range: -40 ... +70°C (-40 ... +158°F)

Flange temperature

Version	Min. flange temperature		Max. flange temperature	
	Standard version	Special version	w/o HT-distance piece	with HT-distance piece
V96 with horn antenna / Wave-guide with				
Gasket K4079	-20°C (-5°F)	-	+130°C (+260°F)	+250°C (+480°F)*
Gasket K2035	-20°C (-5°F)	-	+130°C (+260°F)	+210°C (+410°F)
Gasket K6375 / K1091	-20°C (-5°F)	-	+130°C (+260°F)	+250°C (+480°F)
Gasket Viton / FEP	-15°C (+5°F)	-	+130°C (+260°F)	+200°C (+390°F)
Gasket Silicone / FEP	-30°C (-20°F)	-60°C (-76°F) on request	+130°C (+260°F)	+200°C (+390°F)

* Safety limit 280°C (536°F)

Environment class	locations exposed direct to open-air climate, D1 Severity in conformity with EN 60654-1
Protection category EN 60529/IEC 529	(signal converter) IP 66 / IP 67
Shock resistance	impact test to EN 61010, Sect. 8.2 with 0.5 J energy; drop test to prEN 50178
Vibration endurance limit	IEC 68-2-6 and prEN 50178 (10-57 Hz: 0.075 mm / 57-150 Hz: 1 g)
EMC	EN 50081-1, EN 50082-2; NAMUR Recommendation

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	$\epsilon_r \geq 1.5$; $\epsilon_r < 3$: still well recommended
Product limitations	liquid ammonia (NH ₃); liquid hydrogen (H ₂); liquid helium (He)
Process temperature	unrestricted (but be aware of ambient and flange temperatures!)
Operating pressure	
Horn antenna/Wave-Guide	dependent on flange size and pressure rating. Standard: max. 10 bar (145 psig) (higher on request);

7 Component parts

Dimensions and weights	see "Dimensions and weights"
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Materials

Signal converter housing	aluminium with electrostatic powder coating; sight window: glass
Flange system, antenna, antenna extension	Stainless steel 1.4571 (316 Ti) or 1.4435 (316 L), Hastelloy C4 or B2, titanium, tantalum (information on other materials available on request)
Gaskets	Kalrez 4079, 2035, 6375; Viton (FPM); FEP-coated (basically, in all versions, PTFE is also in contact with the product)

Process connection

Horn antenna		DN 200, PN 10 or 8", 150 lb/RF
Wave-Guide	DIN 2501/DIN 2526, Form C ASME B 16.5	DN 50 – DN 200 / PN 6 – PN 64 2" – 8", Class 150/300 lb/RF

Electrical connection

Cable entries	3 x M 25 x 1.5
Terminals	0.5 – 2.5 mm ² (solid conductor: max. 4 mm ²)
PE or FE and PA	U-clamp terminal (max. 4 mm ²)
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	operation with bar magnet without opening the 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 ³ , Liter, US Gal, GB Gal, ft ³ , 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

BM 70 A, BM 70 P

Dimensions and weights

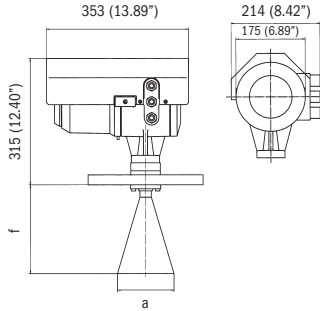
Dimensions in mm (inches)

Flange connections to:

DIN 2501 (= BS 4504) DN 50 - DN 200 / PN 6 - PN 64

ASME B 16.5 / 2" - 8" / Class 150/300 lb, RF

BM 70 Horn antenna

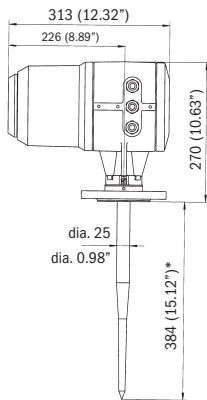


Nominal size to		Antenna	Dimensions (mm/inches)				Weight (kg/lb)
DN	ASME		Ø a	f (SS)	f (HC)	f (Titanium/Tantalum)	
80	3"	1	80 (3.15)	110 (4.33)	145 (5.71)	110 (4.33)	17 (37.5)
100	4"	2	100 (3.94)	148 (5.83)	177 (6.97)	146 (5.75)	18 (39.7)
150	6"	3	140 (5.51)	223 (8.78)	250 (9.84)	220 (8.66)	23 (50.7)
200	8"	4	200 (7.78)	335 (13.19)	360 (14.17)	332 (13.07)	30 (66.1)
80	3"	1S*	76 (2.98)	420 (16.54)	-	-	18 (39.7)
100	4"	2S*	100 (3.94)	620 (24.41)	-	-	19 (41.9)
150	6"	3S*	152 (5.98)	820 (32.28)	-	-	25 (55.1)
200	8"	4S*	200 (7.78)	820 (32.28)	-	-	32 (70.5)

* Only for BM 70 P for use in still wells

BM 70 Wave-Stick

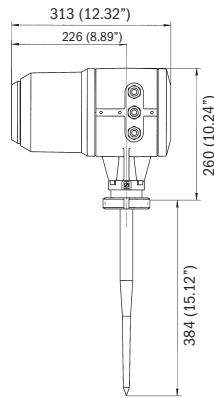
Weight DN 50: approx. 12.5 kg (27.6 lb)



* other lengths on request

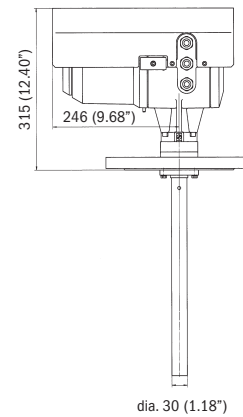
BM 70 Wave-Stick

(Dairy screw connection to DIN 11 851)

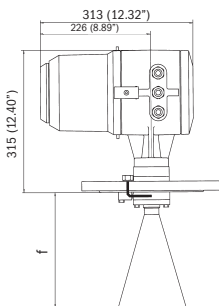


BM 70 Wave-Guide

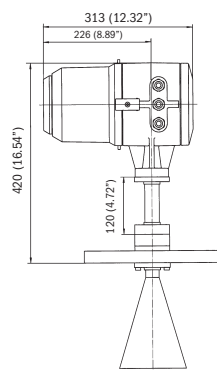
Weight DN 50; 1 m: approx.: 13.5 kg (29.8 lb)



BM 70 Antenna purging system

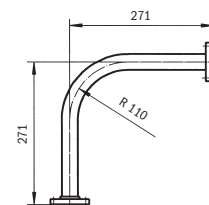


BM 70 High-temperature version

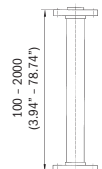


BM 70 Antenna extensions

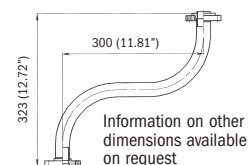
Rectangular extension



Straight extension

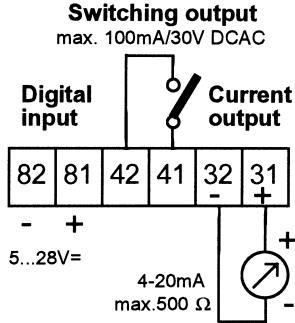


S-shaped extension

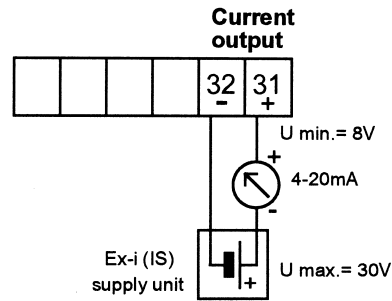


Electrical connections

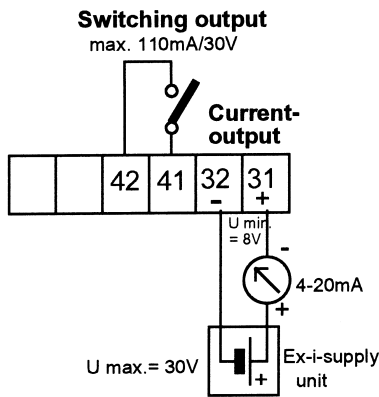
Current output HART®, Ex e:



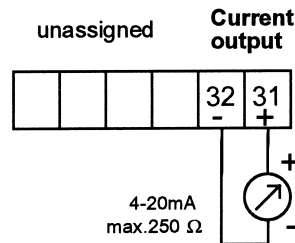
Ex-i current output HART®:



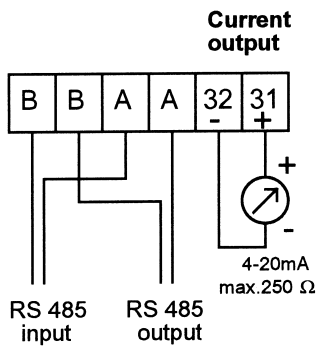
Ex-i Current output HART with switching output:



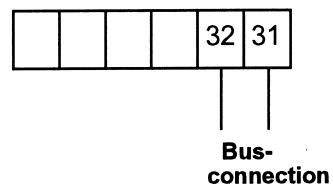
Current output (non-communicable):



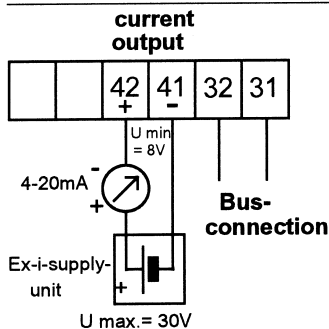
RS485 version:



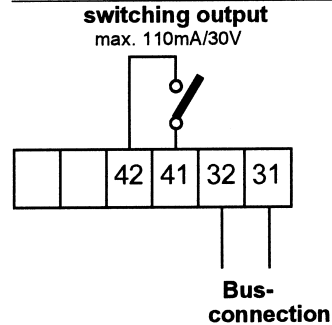
Profibus PA or Foundation Fieldbus (FF)



Profibus PA / FF with current output:



Profibus PA / FF with switching output:



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

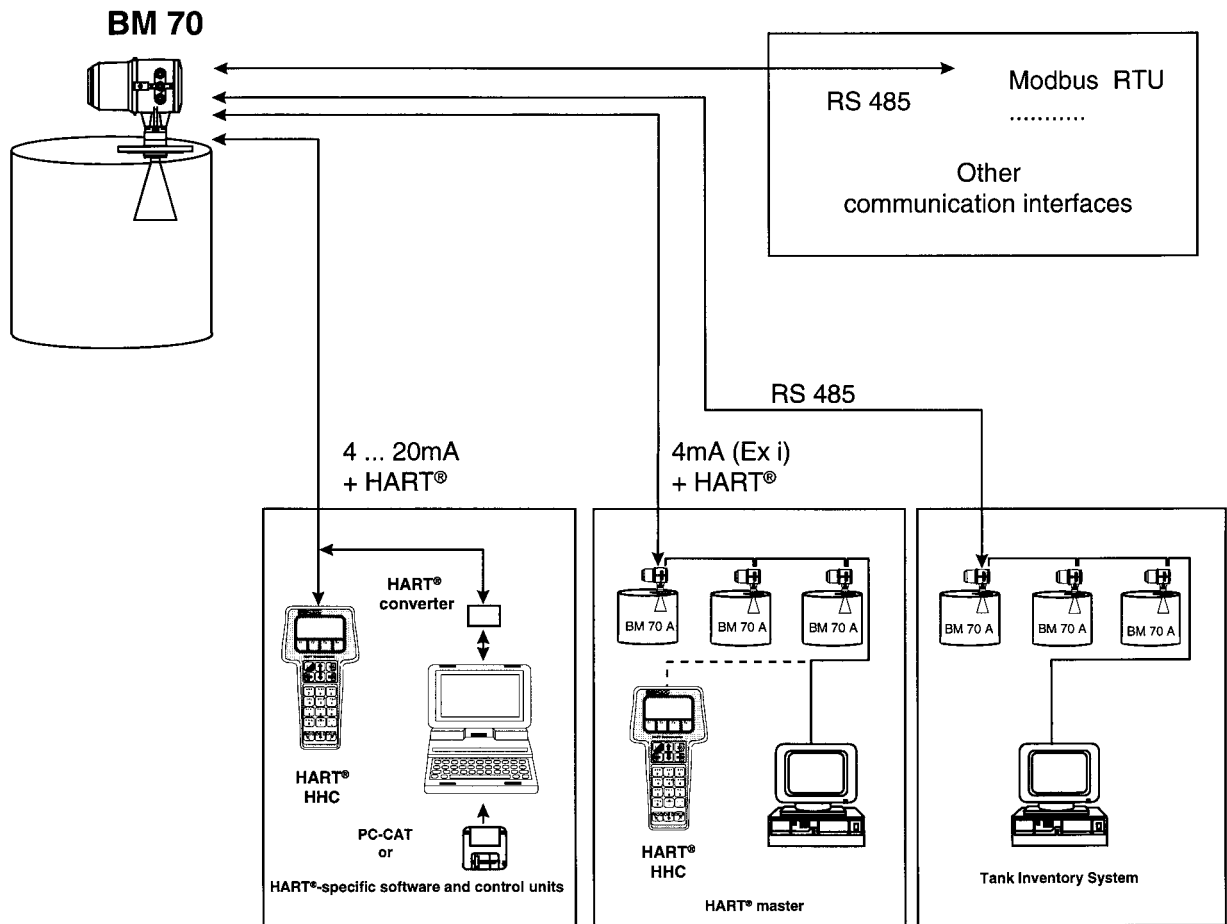
- PROFIBUS-PA protocol
- Fieldbus Foundation protocol

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.



User program PC-CAT for Windows

Our BM 70 is easy to install. To facilitate configuration, each unit is supplied with the intuitive and time-tried software, PC-CAT for Windows. PC-CAT provides a number of useful features including:

- Quick on-site configuration
- Print-out of configuration protocol
- Simple conversion, volume or correction tables
- Check routine to monitor functionality of the BM 70
- Monitoring and recording of the radar signal during operation
- Trend and evaluation of the signal during operation

PC-CAT works on all IBM-compatible PC's using Windows 9x or NT.

PC-CAT Version 4.00 and higher can communicate with all current KROHNE level radar gauges including BM 70 A/P, BM 700, BM 702 versions, also with HART® protocol and RS 485.

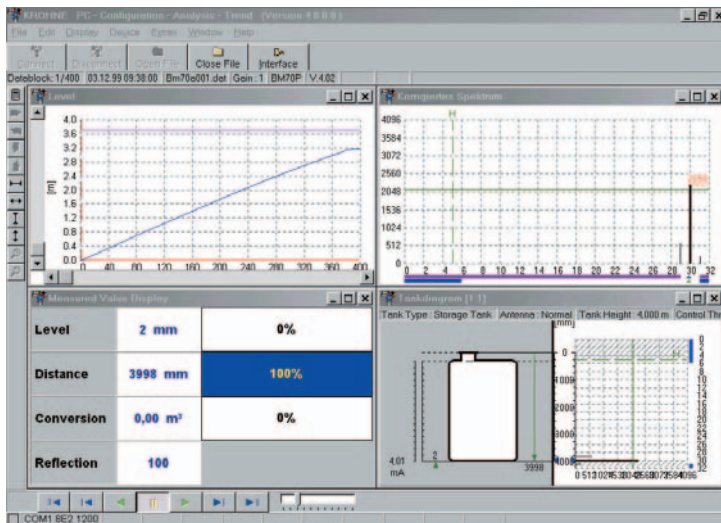
The PC-CAT kit includes a PC adapter for current output. The adapter can be connected to the PC's standard RS 232 interface.

PC-CAT allows convenient remote control of all functions of the signal converter. The vessel can be shown in schematic form together with the associated measured values and the measured spectrum. A trend graph of the output signal and threshold signal strength is also provided. All relevant instrument data can be recorded in the form of a data set small enough to be stored on a floppy disk or transferred electronically. Stored data can also be used for configuring other units of the BM 70 product line.

PC-CAT files can later be used to analyse the performance of the level gauge. All graphs and screens can be exported to word processing systems or other programs.

The customer's PC containing PC-CAT is connected to the current output via the supplied PC adapter, max. distance from the level gauge: 1000 m or 3300 ft. The PC adapter has no effect on in-line instruments such as milliammeters, recorders, etc., connected to the current output.

With every BM 70 delivery you get the freeware program PC-CAT for Windows Lite (Vers. 4.01 / Order No.: V 5001 00 506). Herewith you can perform the normal configuration, simple analyses and record PC-CAT files - all you need is a regular HART®-adapter.



Approvals

Application	Approved by	Instrument version	Certification mark
With Explosion protection In stationary storage tanks for flammable, water pollutants liquids, classes AI, All and B	PTB (II 1/2 G EEx de IIC T1 - T6, Zone 0) (EEx de (ia)/(ib) IIC/IIB T1 - T6, Zone 0)	BM 70 Ex BM 70 A i, BM 70 P i	PTB 99 ATEX 2061 X
	FM / USA (I Div. 1 Gr. B/C/D, II/III Div. 1 Gr. E/F/G)	BM 70 Ex	J. I. 3000 813
	FM / USA (I Div. 2 Gr. B/C/D, II/III Div. 2 Gr. E/F/G)	BM 70 Wave-Stick	
	FM / USA (I Div. 1 Gr. B/C/D; II Div. 1 Gr. E/F/G; III I Div. 2 Gr. B/C/D; II Div. 2 Gr. F/G; III)	BM 70 i	J. I. 3006 165
	CSA / Canada (I Gr. B/C/D; II Gr. E/F/G, III)	BM 70 Ex	LR 105802-5
	RIIS / Japan (T6)	BM 70 Ex	pending
Quality assurance	TÜV/CERT KWU		DIN ISO 9001/EN 29001 KTA 1401 QSP 4A
Druckbehälterverordnung (German pressure vessel code)	RW TÜV	BM 70	5636602