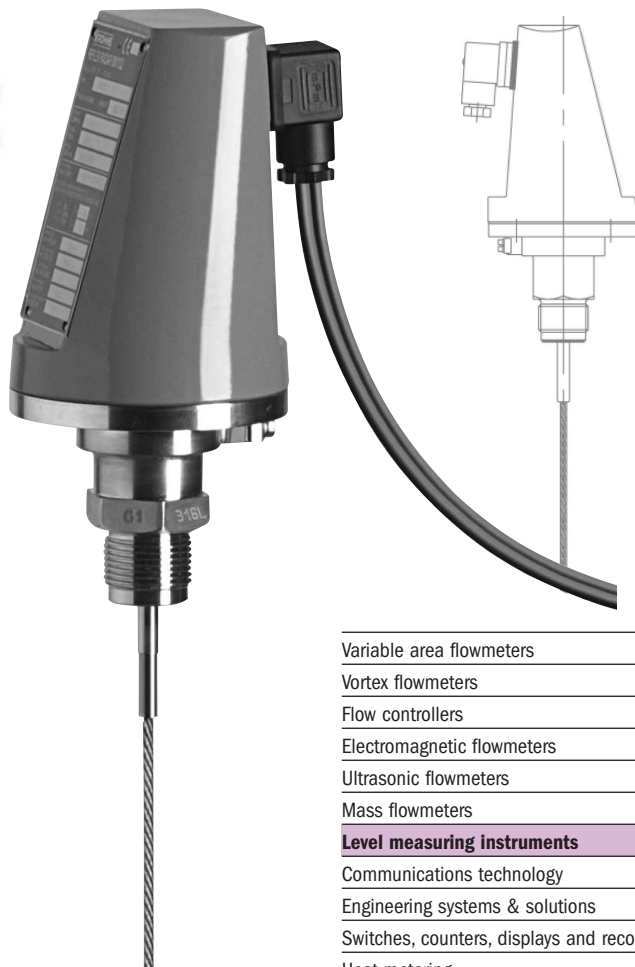
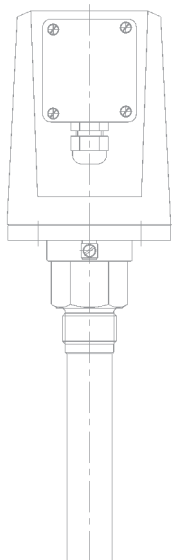


Handbook

BM 102 MICROFLEX

T D R Level gauge

2-WIRE



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

Table of contents

Device description and range of applications	4
Principal gauge components	4
Items included with supply	6
Documentation supplied	6
Product liability and warranty	6
1 Mechanical installation	7
1.1 Handling and storage	7
1.2 Installation restrictions	8
1.3 Mounting on the tank	8
1.3.1 Installation instructions: general notes	8
1.3.2 Installation instructions: nozzle	9
1.3.3 Installation instructions: Gauge - all applications	11
1.3.4 Specific installation instructions: gauge - liquid applications	14
1.3.5 Specific installation instructions: gauge - solid applications	16
2 Electrical connections	18
2.1 Electrical installation instructions	18
2.1.1 Wiring general notes	18
2.1.2 Wiring connections: DIN connector	18
2.1.3 Wiring connections: M16 terminal box	19
2.1.4 'Ex' equalizing conductor	19
2.2 Power Supply	20
2.2.1 Non-hazardous-duty version	20
2.2.2 Hazardous-duty version	21
2.3 Electrical output	22
2.3.1 Network options	22
2.3.2 HART® communication protocol	22
3 User interface	23
3.1 Power-on and start-up	23
3.2 Available user interfaces	23
3.3 Operator control	23
3.3.1 PCSTAR 2 for Windows : basic installation & operating instructions	23
3.3.2 Summary of User Functions in PCSTAR 2 (F2 – Configuration)	27
3.3.3 Quick Configuration: configuration examples	33
3.3.4 HART® Communicator: installation & operating instructions	38
3.3.5 Characters available for alpha-numerical data functions in PC STAR 2 and on the HART® console	46
3.3.6 Local user display (instruments equipped with DIN connectors only)	47
3.4 BM 102 MICROFLEX T.D.R. meter characteristics	48
3.4.1 Gauge operating logic when the reflection is lost	49
3.4.2 Gain and voltage amplitude	50
3.4.3 Level measurement when more than one phase or layer in the tank	56
4 Service / Maintenance	57
4.1 Replacement of the signal converter	57
4.2 Fault clearing	59

5	Technical data	63
5.1	Technical data	63
5.1.1	Accuracy	65
5.1.2	Start-up characteristics	66
5.2	BM 102 equipment architecture	67
5.2.1	BM 102 mechanical options (by probe type)	67
5.2.2	Definition of terms	69
5.2.3	Probe measurement limits	70
5.3	Gauge dimensions	71
6	Measuring principle	72
6.1	General principle.....	72
6.1.1	Level measurement of one product.....	73
7	Certificates and Approvals	74
8	PCSTAR 2 software user's guide	75
8.1	Software installation.....	75
8.2	PCSTAR 2 software history	75
8.3	Supported networks.....	75
8.4	PCSTAR 2 functions	75
8.4.1	F1 Help	76
8.4.2	F2-Connection: on-line functions	76
8.4.3	F3 Exit:.....	84
8.4.4	F4 Serial (parameters):.....	84
8.4.5	F5 Record (Reading):	84
8.4.6	F9 Colors	87
8.4.7	Other important PCSTAR 2 functions	87
8.5	Fault Clearing PCSTAR 2	88
	Appendix A: BM 102 Level Gauge Configuration Record	89
	Appendix B: BM 102 – CE Declaration of Conformity	90
	Appendix C: Returning a device for testing or repair to KROHNE	91

Device description and range of applications

The BM 102 MICROFLEX level gauge uses the Time Domain Reflectometry (TDR) measuring principle and two-wire technology for level measurement. It is designed solely for measuring the distance, level, volume and ullage of liquids, pastes, slurries and powder products. It can continue to measure the level or distance and total volume in applications with two products.

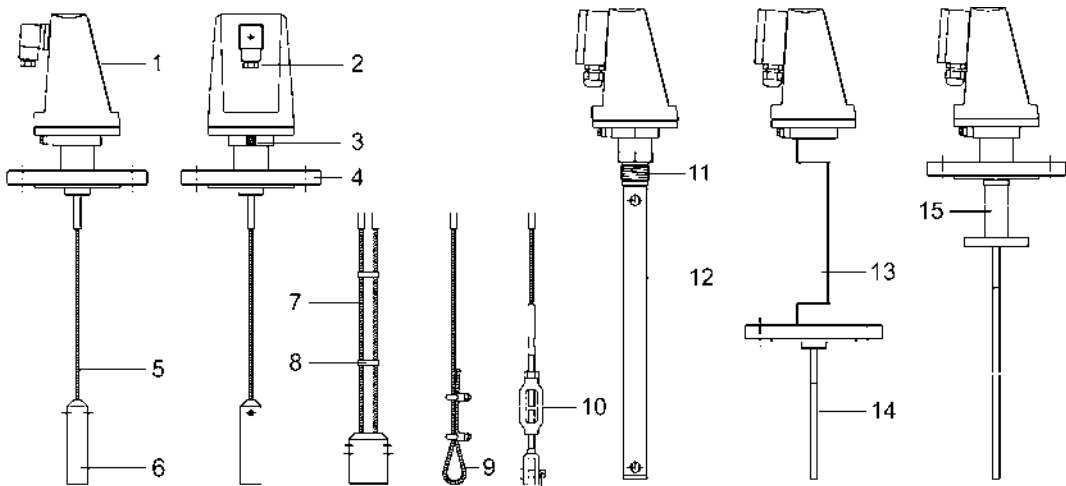
The level measurement data can be displayed and the gauge configured using either a HART Handheld Communicator console (HHC) or a PC work station equipped with PCSTAR2 software supplied as standard with the gauge.

Principal gauge components

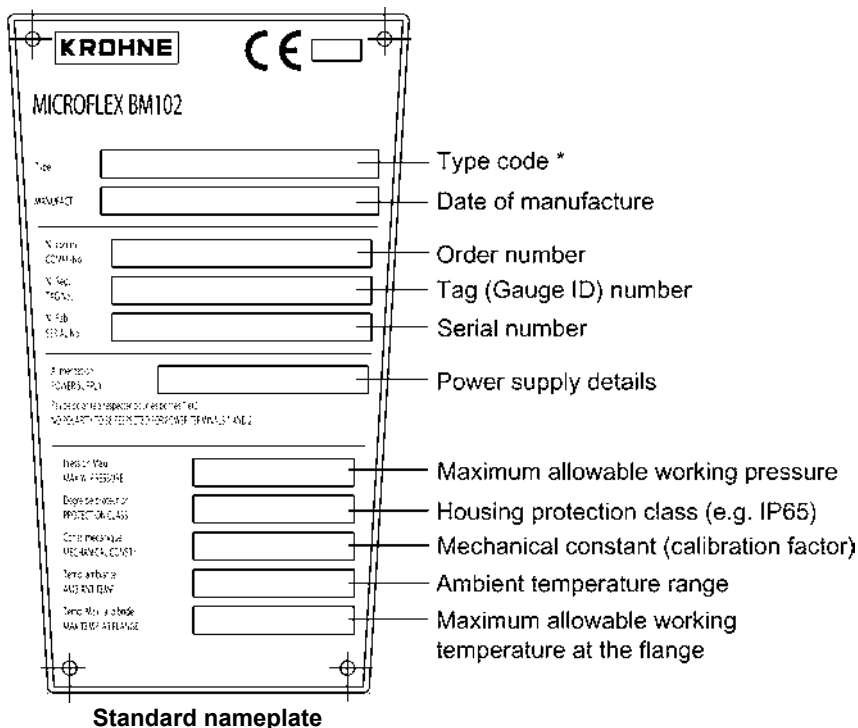
BM 102 housing and probes (non-Ex and Ex versions)

with high-temperature option

with inactive length option



- 1 Nameplate (see next page for details)
- 2 Cable entry (output and power supply) to wiring compartment
- 3 Equi-potential bonding system connection (Ex – see section 2.1.4)
- 4 Flange (process connection onto tank or other suitable mounting)
- 5 Single cable probe
- 6 Counterweight (with threaded hole in base for anchoring)
- 7 Twin cable probe
- 8 Spacer
- 9 Chuck / ring (for single cable probes)
- 10 Turnbuckle (for twin or single cable probes)
- 11 Threaded process connection (e.g. 1" G, 1" NPT, ...)
- 12 Coaxial probe
- 13 Extension tube for high temperature applications
- 14 Single rod probe
- 15 Inactive length: coaxial tube under the process connection (i.e. an inactive length of the probe) for installations with long nozzles or concrete roofs – for single rod and single cable probe versions only



*eg. VF030415B0112110110100000. The “type code” gives the options chosen for this unit and is defined in the BM 102 Data Sheet. This document is available from your local KROHNE Sales office or on the “Download Centre” on KROHNE’s website <http://www.krohne.com/>.

Items included with supply:

The scope of supply encompasses:

- Signal converter with probe in the version ordered. The version is stated on the nameplate.
- PCSTAR 2 computer software for data display and gauge configuration.

Documentation supplied:

Installation & Operating instructions:

Installation, connection, start-up and safety advice in condensed form, but sufficient for most applications. This is supplied as a printed document with the device delivered.

Handbook (this manual):

Detailed user manual and reference book, including how to configure meter parameters available in the user menu and how to perform basic maintenance. This is not shipped with the level meter ordered.

Supplementary Installation and Operating Instructions BM 102 KEMA 00 ATEX 1101X:

Supplementary instructions covering devices to be installed and used in hazardous areas. This document is only supplied with specially approved instruments. This document is available from your local KROHNE Sales office or on the "Download Centre" on KROHNE's website <http://www.krohne.com/>.

Product liability and warranty:

The BM 102 TDR level gauge is designed for measuring the distance, level, and volume of liquids, pastes, slurries and powders. It may equally measure level, distance, total volume and ullage in applications where two or more products are present.

Special codes and regulations apply to its use in hazardous areas. Please refer to the BM 102 MICROFLEX KEMA 00 ATEX 1101X Supplementary Installation and Operating Instructions for further information. This document is available from your local KROHNE Sales office or on the "Download Centre" on KROHNE's website <http://www.krohne.com/>.

Responsibility as to suitability and intended use of these level gauges rests solely with the user. Improper installation and operation of our level gauges may lead to loss of warranty. In addition, the "General conditions of sale", forming the basis of the purchasing contract, are applicable.

If you need to return measuring instruments to KROHNE, please note the information given in Appendix C. KROHNE regrets that they cannot repair or check your device unless it is accompanied by the completed form.

The level gauge does not form part of an overfill protection system (as defined for example in WHG: German water resources act) nor is it concerned by the Pressure Equipment Directive (PED) 97/23/EC.

1 Mechanical installation

1.1 Handling and storage



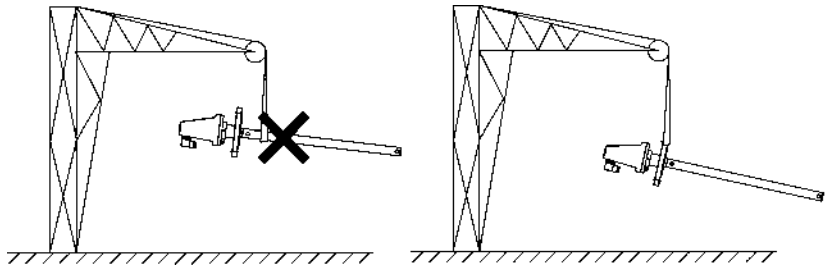
To carry: the device will weigh between 3 kg or 7 lb and 12 kg or 25 lb. Carry using both hands to lift the device carefully by the converter housing. If necessary, use lifting gear.

No attempt should be made to lift the instrument by its probe.

Caution:

The probe is a critical gauge component.

Do not damage– Handle with care!!!

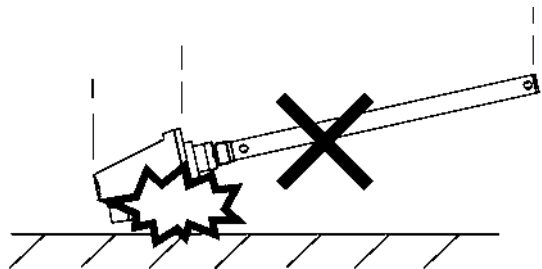


Avoiding blows

When handling the BM 102, avoid hard blows, jolts, impacts, etc.

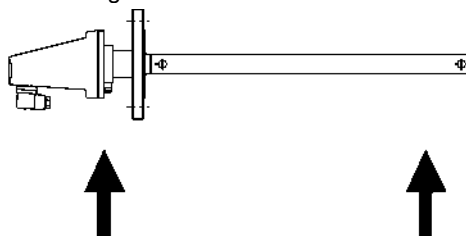


Caution:
Fragile electronics



Avoid bending (single rod and coaxial probes)

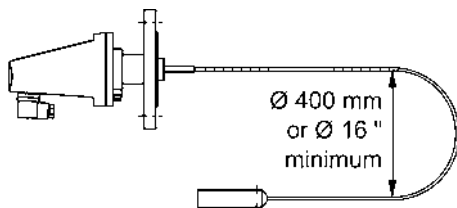
Support the probe to avoid bending.



Support probe here

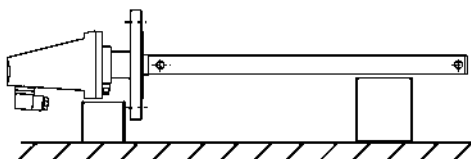
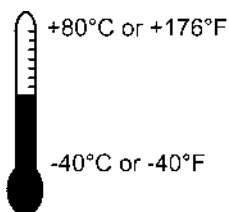
Avoid cable kinks and fraying

Do not coil the cable less than 400 mm or 16 " in diameter. Cable kinks or fraying will cause measurement errors.



Storage temperature

Store within the given storage temperature limits.



1.2 Installation restrictions

Hazardous-duty systems (Ex, FM,...)

- Refer to the BM 102 MICROFLEX KEMA 00 ATEX 1101X Supplementary Installation and Operating Instructions for further information on installing gauges approved for use in hazardous locations. This document is available from your local KROHNE Sales office or on the "Download Centre" on KROHNE's website <http://www.krohne.com/>.
- Check that the flange, gasket and probe materials are compatible with the product. Read the information given on the converter nameplate, the flange markings and specifications in the approval certificates.

1.3 Mounting on the tank

1.3.1 Installation instructions: general notes

The fitter should give some thought to tank fittings and tank shape.

- Nozzle position in relation to the tank walls and other objects inside the tanks (Warning : this free area will depend on the probe type selected: refer to later on in this section)
- Type of tank roof, i.e. floating, concrete, integral, etc; and base, i.e. conical, etc.

Whenever working on an installation, remember to:

- Disconnect the power supply before starting work.

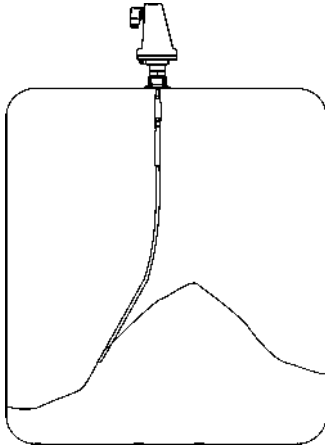
However,

- The gauge may be installed when the tank contains product.

1.3.2 Installation instructions: nozzle

Threaded process connections

The simplest and most economic way is to mount the BM 102 directly on the tank with a GAS or NPT threaded connection.

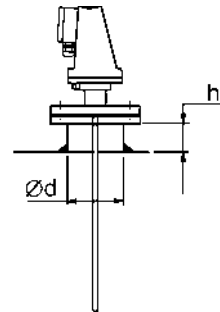


Nozzle height



Recommendation

Do not fit a nozzle longer than its diameter, especially for single probes and powder applications



$$h \leq \text{Ø}d$$

, where h = nozzle height and
d = nozzle diameter

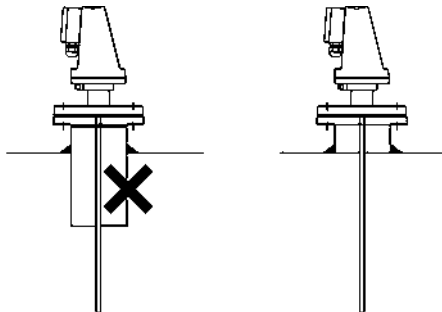
Contact KROHNE if this relationship cannot be respected.

Nozzles extending into tank



Caution:

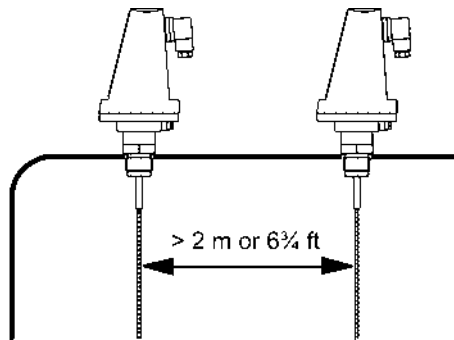
Do not use nozzles that extend into the tank. This will disturb the electromagnetic emitted pulse and the measurement.



Installation of two devices

If two devices are to be used on the same tank, these should be mounted at a distance of at least 2 m or 6 ¾ ft away from each other. If not, interferences from the electromagnetic (EM) fields generated by both instruments may cause measurement errors.

Not applicable to coaxial probes - the outer shell of the probe contains the EM field: no minimum distance required.



Process connection

For the gauge to make accurate measurements:

- The tank process connection must be level.
- Ensure a good fit with the gauge process connection
- The tank roof should not deform under the weight of the gauge

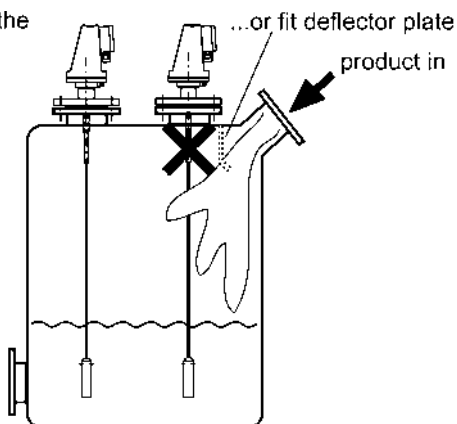
Process connection and entry pipe



Caution:

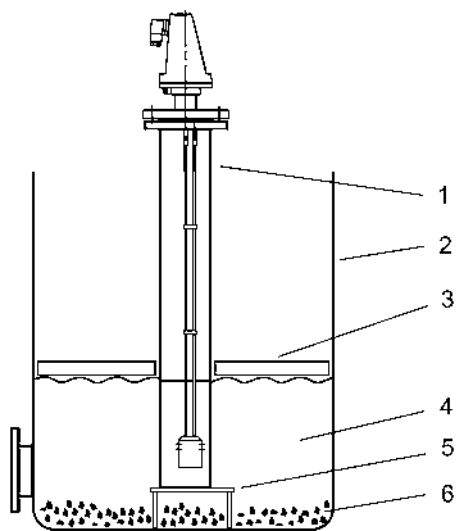
Do not put the nozzle close to the entry pipe. Pouring the product directly onto the probe will give false readings. Install deflector plate if impossible to distance gauge from entry pipe.

Install far from the entry pipe...



Stilling wells

Tanks with floating roofs for petro-chemical applications: use a stilling well.



- 1 Stilling well
- 2 Tank
- 3 Floating roof
- 4 Product (petroleum applications)
- 5 Well fixed to tank base (no roof deformation)
- 6 Sediment

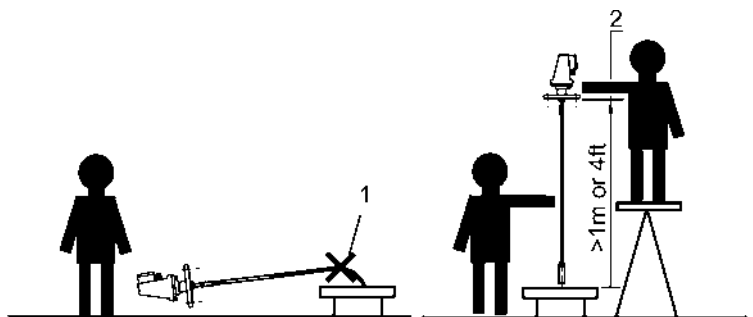
1.3.3 Installation instructions: Gauge - all applications

BM102 gauges are designed to be mounted on a suitable process connection on a tank or sump. Install the gauge using two people to avoid damaging the probe. Support the housing and the probe.

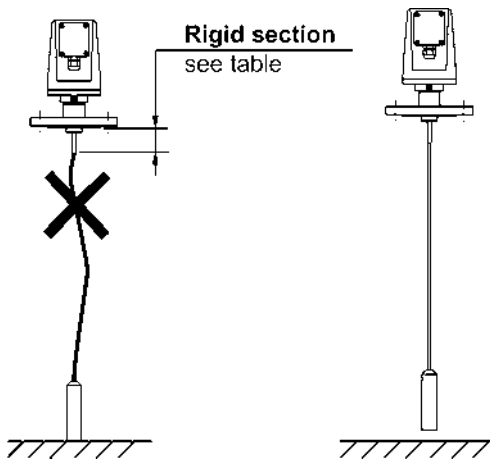
Installation of single and twin cable probe level meters



- 1 **Caution :**
Do not over-bend probe!
- 2 **Inserting the probe:**
hold more than one metre above the opening to avoid cable bending.



Probes: entanglement, straightness and tank bottom clearance



Rigid section length of single and twin cable probes

Cable diameter	Rigid section length
Single cable	
Ø4mm or 0.15"	40mm or 1½"
Ø8mm or 0.15"	200mm or 8"
Twin cable	
Ø4mm or 0.15"	40mm or 1½"

- Cable probes must be straight once inserted into the tank. They must also be far from other objects (e.g. mixers) to avoid entanglement.
- In order to maintain the gauge's operating characteristics, it is recommended to avoid touching the tank bottom with the counterweights (for cable probes) or probe end (other types).

Objects (discontinuities) inside the tank that influence the probe's EM (electromagnetic) field

Install the gauge far from protruding objects such as:

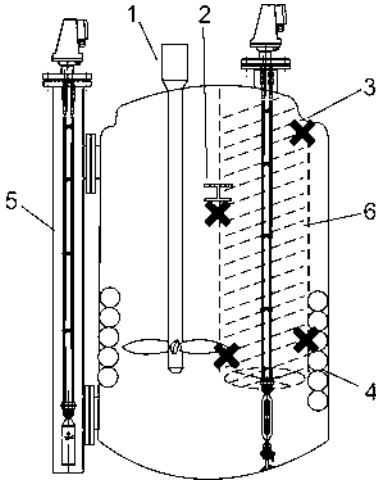
- Heating tubes,
- Sudden changes in tank cross-section,
- Tank wall reinforcements and beams,
- Weld lines and dip-stick pipes, etc...

TDR gauges generate electromagnetic (EM) fields when a measurement pulse is emitted. This field is affected by any nearby discontinuities and these will weaken and potentially block the emitted pulse. A minimum distance is recommended depending on the probe type to be installed. See the table on the next page for recommended free space dimensions.

Alternatively, the fitter may use a reference chamber or stilling well. However, the chamber walls must be smooth (i.e. no visible weld lines), straight and vertical to maintain the pulse strength and gauge accuracy.

For clean applications only :

Coaxial (type 3) probes may be used close to or touching objects or walls as the EM field generated by the probe is contained within the probe's outer sheath (refer also to the EM field sizes/free area given in the figures on the next page).



- 1 Agitator
- 2 Support beam perpendicular to the pulse direction
- 3 Abrupt changes in tank cross section
- 4 Heating tubes
- 5 Alternative solution: reference chamber
-electromagnetic field is contained within chamber
- 6 Gauge electromagnetic field:
Any intruding metallic object will be detected in this zone if perpendicular to the emitted pulse direction.

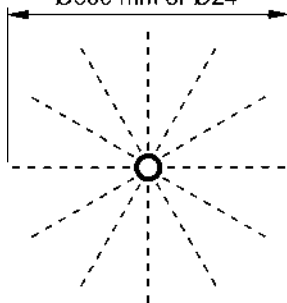
✘ = Do not fit the gauge near to these objects.

Recommended minimum distance of probe from objects inside the tank

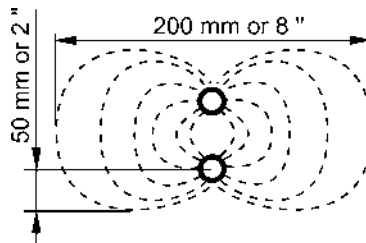
Probe Type	Minimum free space
Single (types 1,2 and 6)	300 mm or 12"
Twin (type 4)	100 mm or 4"
Coaxial (type 3)	0 mm or 0"

Electromagnetic field shape around probe, by type (not to scale)

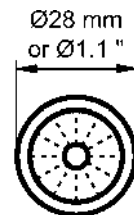
Single (types 1,2 and 6)
Ø600 mm or Ø24"



Twin (type 4)



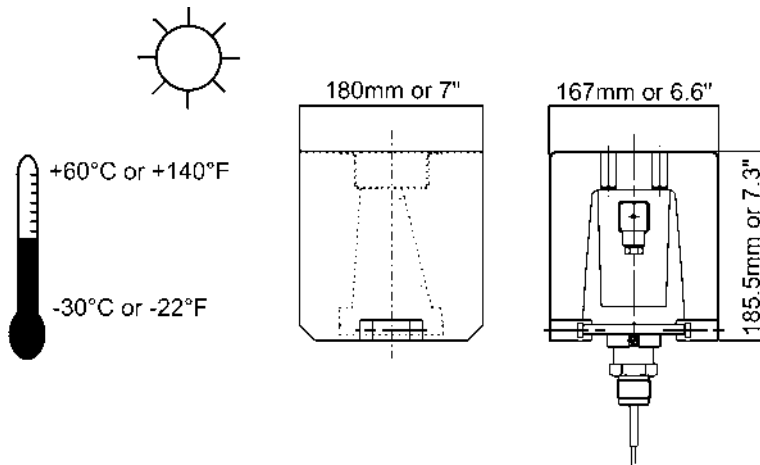
Coaxial (type 3)



No beam angle for any probe type.

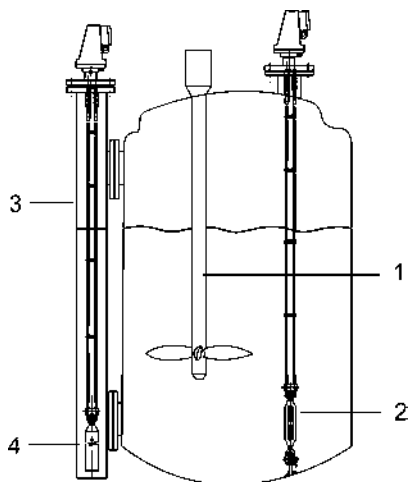
Avoid direct solar radiation

Fit a sunshade on the gauge for open-air installations: this is either supplied on demand by KROHNE or provided by the customer. The ambient temperature limits of the gauge are given below.



1.3.4 Specific installation instructions: gauge - liquid applications

Probe bending in agitated products: recommended solutions

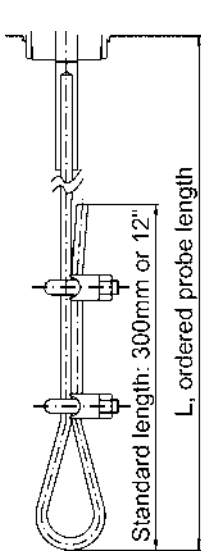


- 1 Agitator
- 2 Turnbuckle for anchoring probe to tank bottom
- 3 Bypass chamber
- 4 Probe and counterweight (centred on request)

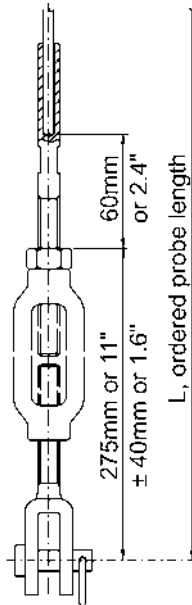
Mounting on a reference vessel or still well is ideal. To ensure that the probe does not come into contact with the tank wall, the probe should be fixed to the bottom of the chamber or centred.

Fastening the probe to the tank bottom

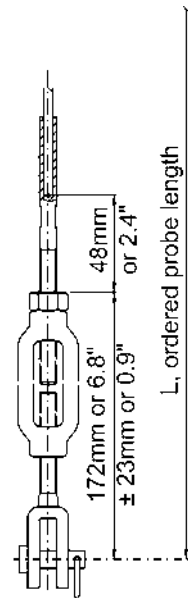
Flexible probes can be fastened with a chuck (ring), turnbuckle or similar fastening device to the tank bottom:



Chuck (ring)



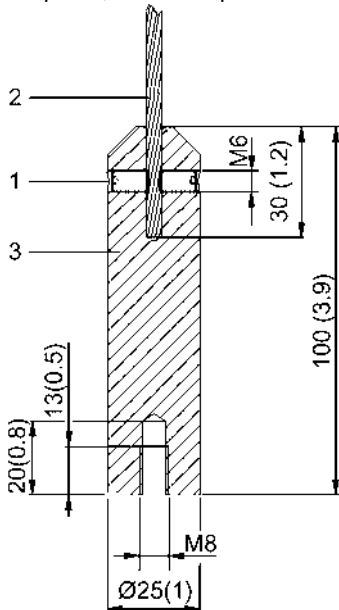
Turnbuckle for Ø8 mm cable probes



Turnbuckle for Ø4 mm cable probes

Shortening cable probes

If required, the cable probe can be shortened, but this applies only when used in liquids.



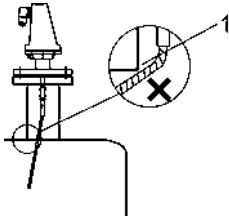
Procedure

Step	Action
1	Detach socket set screw M6x10 (ISO 4026) with a 3mm Allen (hexagon) key (ISO 2936).
2	Pull cable (2) out of counterweight (3) and shorten to required length using cable cutters to prevent the cable wires and strands from splaying out.
3	Insert cable back into counterweight and tighten down screws
4	Change configuration parameters to new probe length; the reference point is the top edge of the weight (user menu function 1.1.6)

Dimensions in mm (inches).

1.3.5 Specific installation instructions: gauge - solid applications

False readings:

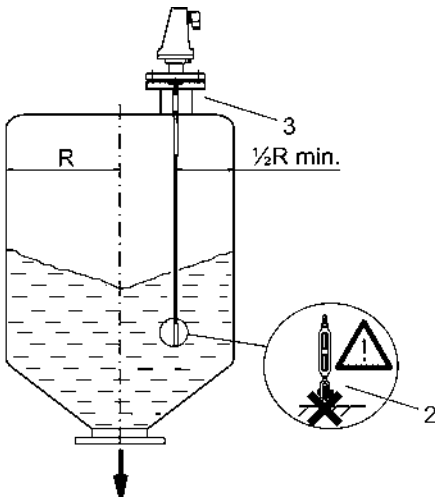


- 1 Do not let probe touch the side of the nozzle

Conical silo nozzles, false readings and traction on the cable probes



Caution



- 2 **High traction forces :**
We recommend that the probe should not be anchored to avoid excessive traction loads on the cable.
- 3 **Bending and traction:**
Position the connection on the roof at $\frac{1}{2}$ radius of the tank and with minimum nozzle height. This will avoid damage due to bending and traction during emptying.

Traction forces during emptying cycles for powder applications

Traction load is dependent upon the height and shape of the tank, product particle size & density, and the rate at which the tank is emptied. The table below gives the load up to which cable probes will hold.

Cable maximum design load, traction

Probe	Maximum Load
Single cable Ø8 mm or Ø0.3"	3.5 T or 7700 lb

Traction on cable according to product (approximate value in metric tons)

Probe used	Material	Probe Length / m (ft)		
		10 (33)	20 (65.5)	24 (79)
Single cable Ø8mm or Ø0.3"	Cement	1.0 T or 2200 lb	2.0 T or 4410 lb	2.4 T or 5290 lb
	Flyash	0.5 T or 1100 lb	1.0 T or 2200 lb	1.2 T or 2650 lb

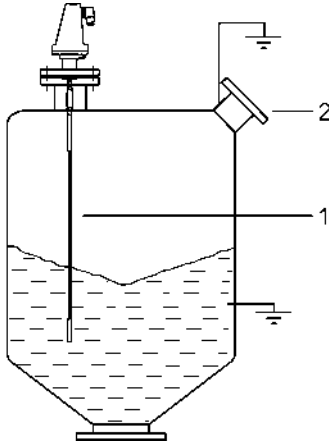
Electro static discharge (E.S.D.)

BM 102 non-Ex and Ex gauge electronics are shielded up to 4kV against E.S.D..



Note:

E.S.D. cannot be solved by BM102 E.S.D. protection. It is the customer's responsibility to avoid E.S.D. by grounding the tank, product and probe installation.



1



Danger of injury

The probe may receive an electrostatic discharge during operation; earth the probe by pushing it against tank wall with a suitably isolated tool just before touching it to avoid receiving a shock.

2

Earth the entry pipe and product.

Product deposits on the nozzle and probe

Product build-up can occur under the nozzle: this may weaken the pulse. Avoid cavities that permit the build-up of deposits.

Tank roof deformation

Tank roofs should support loads of at least 3.5 tonnes or 7700lb for gauge installations using Ø8mm or 0.3" (type 6) single cable probes.

2 Electrical connections

2.1 Electrical installation instructions

2.1.1 Wiring general notes

Connection to power is effected at the plug connector in the signal converter. Two wiring compartments are available: DIN connector or M16 terminal box. Observe applicable rules and regulations for cable connection: VDE 165 or equivalent national regulations.

Always disconnect from power supply before opening wiring compartment. This is not mandatory for Exi applications.

Hazardous-duty systems



Only certified intrinsically safe equipment may be connected to the BM 102 in hazardous areas. Please refer to the BM 102 MICROFLEX KEMA 00 ATEX 1101X Supplementary Installation and Operating Instructions for further information. This document is available from your local KROHNE Sales office or on the "Download Centre" on KROHNE's website <http://www.krohne.com/>.

2.1.2 Wiring connections: DIN connector

Terminals:

3 poles and 1 x ground. Wire cross-section: max. 1.5 mm² (AWG 16)

Cable entry:

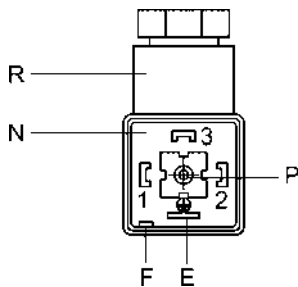
1 x PG11, cable diameter: 8 ... 10 mm (0.31 ... 0.39"), IP 65

Shielding:

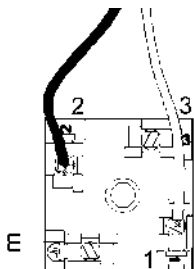
do not connect to the DIN connector.

Signal cable:

no shielding required



- 1 Detach screw P and remove plug from signal converter.
- 2 Separate part N from part R by inserting the flat tip of a screwdriver into gap F.
- 3 Connect current loop to terminals 1 and 2 (any polarity). Use ferrules to protect cable ends. Terminals 3 and E are not connected.
- 4 Fit parts N and R together again.
- 5 Fit gasket, re-insert connector plug R on the signal converter, and replace screw P.



Caution

Grounding terminal E is not connected to the housing of the signal converter or to the device flange. To avoid ground current loops, the cable shielding may not be connected at both ends.



Hazardous-duty systems

When used in hazardous areas, only one intrinsically safe power supply may be connected to terminals 1 and 2. Ground terminal E and terminal 3 are not connected.

2.1.3 Wiring connections: M16 terminal box

Power terminals: Wire cross-section: max. 1.5 mm² (AWG 16)
Cable entry: 1 x M16 x 1.5, cable diameter: 3.5 ... 8 mm (0.14 ... 0.31"), IP 65
for USA: ½" NPT conduit connection
Shielding: Do not connect shielding to the terminal compartment.



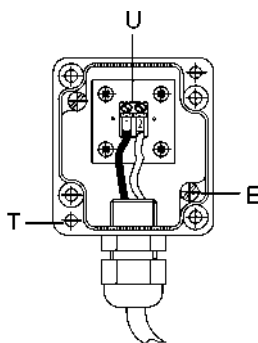
Hazardous-duty systems

When used in hazardous areas, only one intrinsically safe power supply may be connected to terminals 1 and 2. Ground terminal E is not connected.



Caution

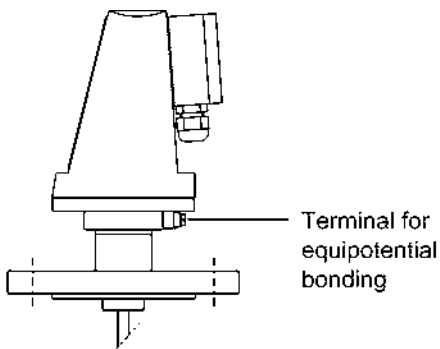
Ground terminal, E, is not connected to the signal converter housing or to the device flange. To avoid ground current loops, the cable shielding may not be connected at both ends.



- 1 Detach the 4 screws, T, and remove cover from terminal compartment.
- 2 Connect the cable ends, fitted with ferrules, to the power terminal, U (not polarity sensitive).
- 3 Shut the terminal compartment.

2.1.4 'Ex' equalizing conductor

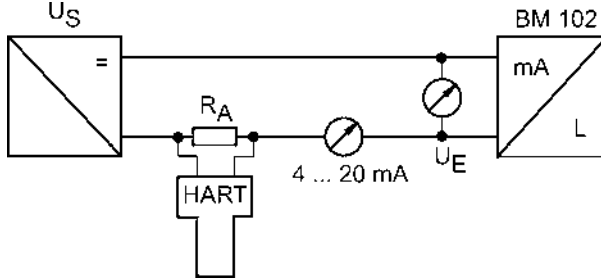
Refer to the BM 102 MICROFLEX KEMA 00 ATEX 1101X Supplementary Installation and Operating Instructions for further information.



Terminal for equipotential bonding
U-clamp terminal,
max. conductor cross-section:
4 mm²/6.2 • 10-3 sq.in. on 'neck' of signal
converter

2.2 Power Supply

2.2.1 Non-hazardous-duty version



Power supply
 Rated voltage
 Max. voltage
 (U_{input}):
 Min. voltage
 (U_{input}):

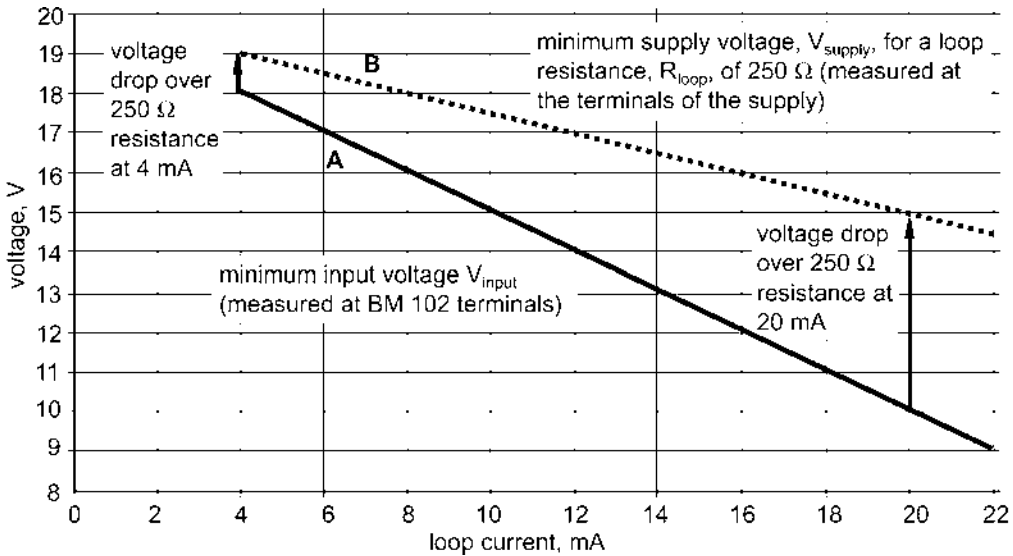
24 V DC
 35 V DC
 'Ex' = 28 V DC
 dependent on
 load impedance,
 see graph below



A supply voltage above 35 V DC can cause irreparable damage to the signal converter. Also, power supply voltages above the specified max. values and below the specified min. values can lead to faulty measurements or to a device reset.

Load impedance R_{loop}

Loop resistance, R_{loop}	$R_{HART} + R_{cable} + R_{ammeter}$
Min. R_{loop}	0 ohms
Max. R_{loop}	750 ohms
R_{HART} resistance for HART® communication	250 ohms (recommended)



Line A = minimum voltage at the BM 102 terminals
 Line B = voltage drop caused by a 250 ohm loop resistance

Example for calculating the power supply:

The voltage drop is tested at 22 mA.

$$U_{\text{power min. 22}} = 22 \text{ mA} \times \text{load impedance} + U_{\text{input min. 22}}$$

$$U_{\text{power min. 22}} = 22 \text{ mA} \times 250 \text{ ohms} + 10 \text{ V} = 5.5 \text{ V} + 10 \text{ V} = 15.5 \text{ V}$$

In order to cover the whole current range, the voltage drop must also be tested at 4 mA.

By analogy, the following applies:

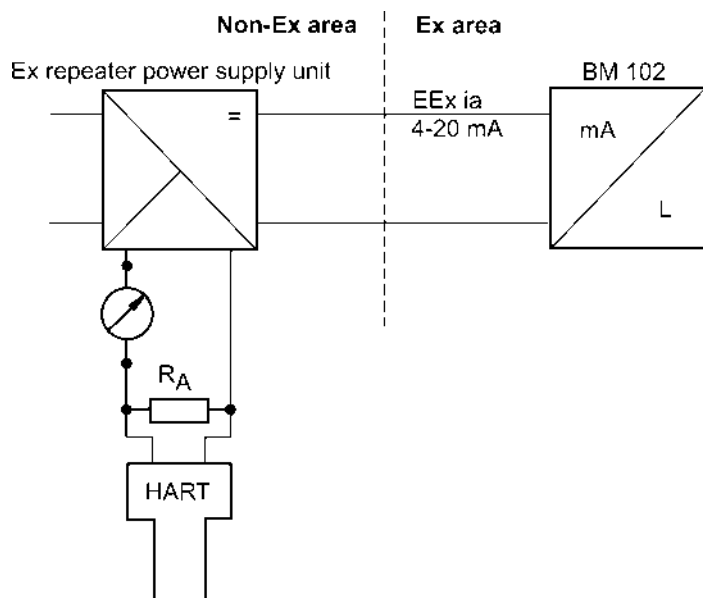
$$U_{\text{power min. 4}} = 4 \text{ mA} \times \text{load impedance} + U_{\text{input min. 4}}$$

$$U_{\text{power min. 4}} = 4 \text{ mA} \times 250 \text{ ohms} + 18 \text{ V} = 1 \text{ V} + 18 \text{ V} = 19 \text{ V}$$

At a load impedance of 250 ohms, a power supply voltage of 19 V is sufficient to energize the current device range of 4 to 20 mA.

2.2.2 Hazardous-duty version

The certified device may only be used with other 'Ex' certified equipment. The minimum electrical safety data indicated on the nameplate must be observed. To ensure proper operation, the minimum parameters specified above in section 2.2.1 for the power supply must be observed to ensure that a given 4 to 20 mA converter is adequate for use with the BM 102. Refer to the BM 102 MICROFLEX KEMA 00 ATEX 1101X Supplementary Installation and Operating Instructions for further information. This document is available from the "Download Centre" on KROHNE's website [http:// www.krohne.com/](http://www.krohne.com/).



In addition, the connected equipment must be HART®-compatible so that it can be operated with the communication software or the HART® communicator.

An 'Ex' repeater power supply unit must be used. For calculation of the supply voltage the same applies as for the non-'Ex' version.

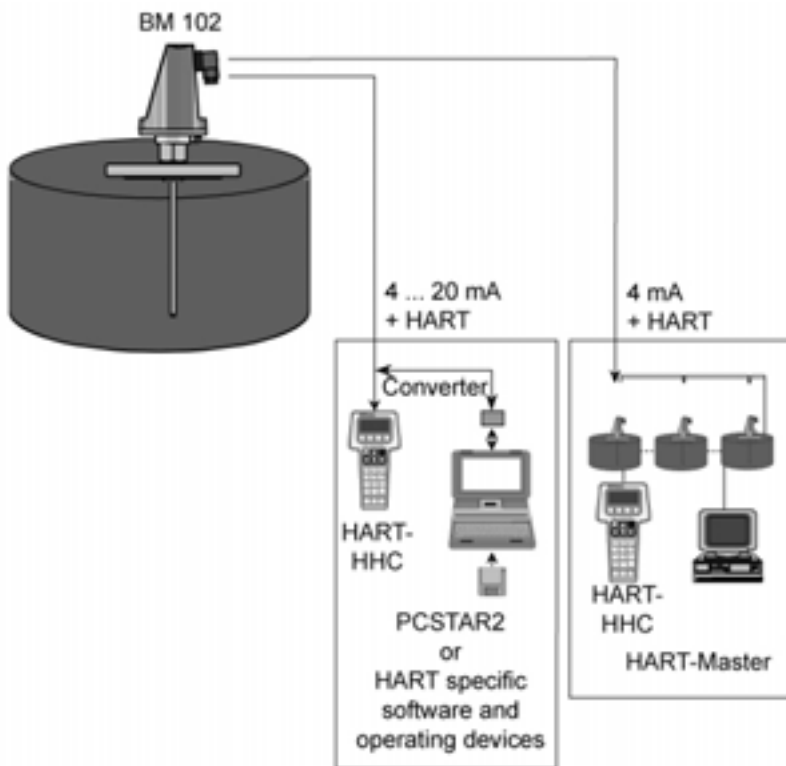
2.3 Electrical output

2.3.1 Network options

The output is available in 2 versions:

1. Current output HART[®], passive, HART[®] protocol
2. Current output Ex-ia HART[®], intrinsically safe; passive, HART[®] protocol

All versions with HART[®] protocol can be operated with the PC-STAR 2 program.



2.3.2 HART[®] communication protocol

In accordance with the Rosemount Standard, HART[®] communication can be used with a BM 102. It is used as a point-to-point connection between the BM 102 as slave and the HART[®] master.

Additional information

The following can be called up via the following interfaces:

- Current output: 22 mA for error signal.
- Digital HART[®] interfaces: scanning of error flags and error messages.

3 User interface

3.1 Power-on and start-up

The BM 102 is pre-configured in accordance to customer order specifications and measurements can be made immediately. A start-up time of less than 23 seconds should be allowed for once connected and the power is switched on.

If the probe length has been shortened since delivery, please refer to section 3.3.1: Summary of User Functions, user function 1.1.6: Probe length to modify configured probe length.

3.2 Available user interfaces

Measurements may be taken using either:

- PC STAR 2 software
Included as standard with the instrument. The basic installation & operating instructions are presented in section 3.3.1 (requires PC workstation).
- HART[®] Handheld Communicator (HHC)
Sold separately. Automatic recognition of the instrument when connected. A list of HHC-accessible parameters is given in section 3.3.4.
- DA 06 local indicator
Sold as an option for devices equipped with DIN connectors. For displaying readings only. Refer to section 3.3.6 for technical data.

3.3 Operator control

You can configure the device by way of the HHC or the PC-STAR 2 software. This is explained further in sections 3.3.1 and 3.3.2. Operator control via the separate HHC is described in the operating instructions supplied with the communicator.

3.3.1 PCSTAR 2 for Windows : basic installation & operating instructions

Software description

PC STAR 2 is a Windows program that permits clear and concise display of data and configuration of the BM 102 from a remote location. The program is available in English, German or French.

PC-STAR 2 system requirements

- PC with at least 486 processor 75 MHz, recommended: Pentium 120 MHz or higher
- Microsoft Windows 9x, Me, 2000, NT and XP*
- min. 16 MB main memory (RAM)
- min. 3 MB available hard disk storage
- 3 ½ " Floppy disk drive
- Mouse or other pointing device
- Serial RS 232 port

* XP may not be automatically recognized by PCSTAR 2 in versions prior to V2.01. Refer to Section 8.5 for the corrective procedure.

Installing and connecting PCSTAR 2 to the gauge

1. Connect the HART® adapter (not included in supply) through a load impedance of 350 ohms maximum (for hazardous-duty purposes, fix to the non-intrinsically safe side of the repeater power supply unit) and plug it into a serial interface on your PC. The repeater power supply unit must have HART® capability.
2. Installing the program: Access the files on the floppy disk supplied with the instrument and execute the file "setup.exe" and follow the instructions on the screen.
3. Running the program: once the program is installed, execute the program. The screen shown below will be displayed.



F1-Help	F2-Connection	F3-Exit	F4-Serial	F5-Record reading
			F9-Colors	

- Define device interface: type F4 or left-click on “F4-Serial” at the bottom of the screen - to define the interface to which the device is to be connected.



- | | |
|-------------------|--|
| Serial Port | The serial port allows the user to select a free serial port (COM 1 to 4) on the computer. |
| BM102 Address | Type the “Address” that you have given a gauge (a value between 0 and 15) and press ENTER or OK. This will select the required device. If you are in a point to point network leave the box at its default value (-1). |
| Device Identifier | Device Identifier refers to the “Device number” given in User Function No. 1.4.4. |
| Initial baud rate | Transmission rate of data. Has a default value of 1200 bd. |
| RTS state | The RTS state depends on the type of RS232 converter used. For RS232<->HARTTM(i.e. VIATOR from MACTEK) use inversed RTS state. |

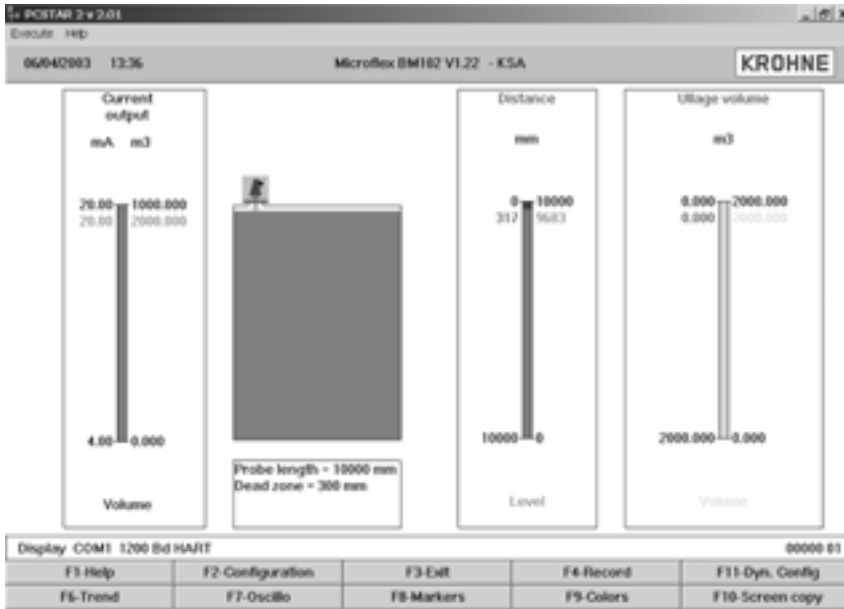
- On-line connection with the gauge: Press F2 or left-click on “F2-Connection” to set up the connection with the device - the configuration parameters are automatically loaded into the computer.



then ...



6. After the connection has been established, the following screen is shown. This will show the current status of the tank. No further configuration should be necessary. The following functions are available on the screen and will be discussed further in section 8.4:
- F2 – Device configuration: a summary of the parameters are given on the next page,
 - F7 – Oscilloscope function: have all reflections occurring at the probe displayed,
 - F11 – Dynamic/on-line device configuration,
 - F4 – View and record all information during operation,
 - F6 – Trend: observe the level trend since start of the program,
 - F8 – Marker: read the status of the device
 - and F10 – make printouts (screen shots).



3.3.2 Summary of User Functions in PCSTAR 2 (F2 – Configuration)

The table below provides an overview of all parameters that can be set in the configuration menu using F2 in PCSTAR2. Reset default values are in bold type in the “Input Range” column.

Function	Input Range	Description
1.0.0 Operation		
1.1.0 Basic parameters		
1.1.1 Tank height	Enter 0 ... 60 m or 0 ... 197 ft. As per order	The tank height forms the basis for calculating level measurements and for the relevant current output. It is defined as the distance between the lower flange surface and the reference point at the bottom of the tank. The output unit is determined via Fct. 1.2.4.: Length Unit The set tank height is the upper limit for Fct. 1.3.4: Scale I1 max (if Fct. 1.3.1 is set to “Level” or “Distance”). Note: the device will not measure beyond the programmed probe length if the current output is configured to measure distance or level .
1.1.2 Dead zone Warning : Critical Parameter	Enter a value Fct.1.5.1(Detection delay) ... probe length. <ul style="list-style-type: none"> • Twin probe with probe length < 1m or 3.3 ft 0.2 m or 8 in • Single probe or twin probe with probe length > 1m or 3.3 ft 0.4 m or 16 in • Coaxial probe 0 m or 0 in 	The dead zone is the minimum measuring distance from the process connection (reference point) to the surface of the product. So as not to impair measurement accuracy, the minimum values given in Section 5.2.3 should be adhered to. The BM 102 will ignore signals in the dead zone and display the last reading taken. The output unit is set via Fct. 1.2.4: Length Unit
1.1.3 Time constant	1 ... 100 seconds 5 seconds	This function filters possible signal fluctuations when the liquid is turbulent.

Function	Input Range	Description
1.1.6 Probe length	Enter 0.1 m or 3.9" ... probe length (max.: 24000 mm or 78¾ ft.) As per order	This value must be equal to the exact length of the probe. This value should be modified when the probe has been replaced or shortened (cable probes). The output unit is set via Fct. 1.2.4 Length Unit. An automatic search for the probe tip can be carried out when the tank is empty to update the parameter using the function F11 in the "Dynamic Configuration" menu. Probe length may be set greater than tank height but less than 24 m or 78¾ ft. for special installations.

Function	Input Range	Description
1.2.0 Display		To display readings in the form and units required
1.2.4 Length unit	Select m, cm, mm, inch, ft or optional unit* mm	Unit for display of level and distance. *When "optional unit" selected, you get to the menu item Fct. 1.2.6: New unit and can there define user-defined units. The unit selected here is used in the following functions:; Fct. 1.1.1 Tank height, Fct. 1.1.2 Dead zone, Fct. 1.1.6 Probe length, Fct. 1.5.1 Detection delay and Fct. 1.7.2 Input table*. If "Level" or "Distance" is selected in fct. 1.3.1, then the units selected will also be used in these functions: Fct. 1.3.3 Scale l1 min. and Fct. 1.3.4 Scale l1max.. In addition the displayed value will use the selected unit.
1.2.5 Volume unit	Select m ³ , l, US Gal, ft ³ , bbl, m ³ /h, ft ³ /h, kg, metric tonnes or tons US m³	Unit of displayed volume / conversion value. Conversion means converting a level value into a "conversion value" (usually volume) in order e.g. to realize a non-linear function as a factor of the level. The unit selected here is also valid for the following function: Fct. 1.7.2 Input table. If "Volume" or "Ullage volume" is selected in fct. 1.3.1, then the units selected will also be used in these functions: Fct. 1.3.3 Scale l1 min. Fct. 1.3.4 Scale l1 max.
1.2.6 New unit (length)		Appears only when "Optional unit" is selected in Fct. 1.2.4: Length unit.
1.2.6.1 Unit name	4 ASCII characters Unit	Name of the new unit (max. 4 characters)
1.2.6.2 Unit fact.	Min.: > 0.0 Max.: 100 000 1.0	Reference for the conversion factor is the millimetre. At a conversion factor of 10, the new unit is equivalent to 10 mm. At a conversion factor of 0.1, the new unit is equivalent to 0.1 mm.

* This list is not exhaustive and also includes the Dynamic configuration menu functions in PCSTAR 2.

Function	Input Range	Description
1.3.0 Current output I		This configures the current output. These functions are independent from what is displayed.
1.3.1 Current 1 item	Select Off, Level, Distance, Volume* or Ullage volume* Level	Selection of the required function for the current output.
1.3.2 Current 1 range	Select 4-20mA or 4-20mA + 22 mA on error. 4-20mA	This parameter defines the status which the current output assumes in the event of a fault: 4-20 mA (last measured value held in the event of a fault) 4-20 mA / E = 22 mA (is set to 22 mA in the event of a fault).
1.3.3 Scale I1 min.	Enter a value from 0 mm** to a value lower than that entered for Fct. 1.3.4 Scale I max. As per order	This function defines the lower limit of the analog measuring range. It is 4 mA. The value of this parameter always has to be lower than the value selected for Fct. 1.3.4: Scale I1 max.
1.3.4 Scale I1 max.	Enter value higher than the value selected under Fct. 1.3.3. "Scale I min." up to tank height or the maximum volume table value*** As per order	This function defines the upper limit of the analog measuring range. It is 20 mA. The value of this parameter must always be: - lower than or equal to the value selected under Fct. 1.1.1: Tank height or the maximum volume table value, - higher than the value selected under Fct. 1.3.3: Scale I1 min., otherwise an error message will appear during parameter check.
1.3.5 Error delay	Select No delay, 10 sec., 20 sec., 30 sec., 1 min., 2 min., 5 min. or 15 min. No delay	This menu is only available when (4-20 mA / E = 22 mA) has been selected under Fct. 1.3.2: Current 1 range. With this parameter, a time delay can be defined for transition of the current output to 22 mA after an error has been noted. During the delay, measurement and the analog output are held. When the error disappears, the delay also serves to return to the measuring mode.

* complete fct. 1.7.2 "Input table" before selecting "volume " or "ullage volume".

** or other unit selected in fct. 1.2.4 Length Unit, 1.2.5 Volume Unit depending on the item selected in fct. 1.3.1 Current 1 Item.

*** depends on the value selected in fct. 1.3.1 Current 1 Item.

Function	Input Range	Description
1.4.0 User data		
1.4.3 Checksum	Read only	This value is used for identification of the device software version. The checksum is tested when starting. This helps to detect any problems with the microcontroller.
1.4.4 Device number** (Tag number)	00000 01	This parameter assigns an identification number to the device. A text consisting of max. 8 ASCII characters can be entered.
1.4.5 Serial number	Read only	This parameter serves to identify the respective measuring device. This number cannot be changed and sets the address for use with HART® interfaces.
1.4.6 French command number	Read only	Factory-programmed number, to be quoted in case of warranty and service claims.
1.4.7 German command number	Read only	Factory-programmed number, to be quoted in case of warranty and service claims.
1.4.8 Option** (Descriptor)		This function can be used for entering text of max. 15 ASCII characters (customer information only)
1.4.9 Probe type	Single rod, Twin rod, Single cable, Single cable + counterweight, Single cable without counterweight, Twin cable, Twin cable + counterweight, Coaxial, Special 1, Special 2 or Special 3 As per order	Information on probe type supplied with signal converter. This is a read-only parameter.

** Refer to section 3.3.5: Characters available for alpha-numerical data functions in PC STAR 2 and on the HART® console.

Function	Input Range	Description
1.5.0 Application		For difficult applications
1.5.1 Detection delay	Enter a value 0 mm / 0 in. to Fct. 1.1.2 Dead zone As per order	This function can be used to define an area directly below the flange in which interference reflections (e.g. from the tank nozzle) are masked. This value has to be smaller than or equal to the dead zone (Fct. 1.1.2.).
1.6.0 Serial I/O (serial input/output)		For integrating into a signal network. Standard hardware platform for HART® is the current loop with superposed FSK signals. For a multidrop application the current output is set to "OFF" and consequently to a constant 4 mA. With a multidrop bus, up to 15 HART® devices can be operated.
1.6.2 Address	Addresses from 0 to 15 0	With this function, every device connected to a bus is assigned an address between 0 and 15 (HART® protocol). If several devices are connected to a digital bus, each device must be assigned a unique address under which it can then be identified in the bus. 0 = Analogue output active 1 - 15 = Multi-drop mode active, analogue output inactive
1.7.0 Volume table		For calibrating the gauge for volume measurement.
1.7.2. Input table	Select point 01 to 20, enter level and then volume values respectively. 0 (conversion table not created, volume measurement not possible)	This function is used for setting up the strapping table (level/volume). Up to 20 points can be assigned. Every new point must be larger than the preceding one. The units of length and volume can be changed later without affecting the settings in the table. The units selected for length and volume in fct.s 1.2.4 and 1.2.5 will be used here.

3.3.3 Quick Configuration: configuration examples

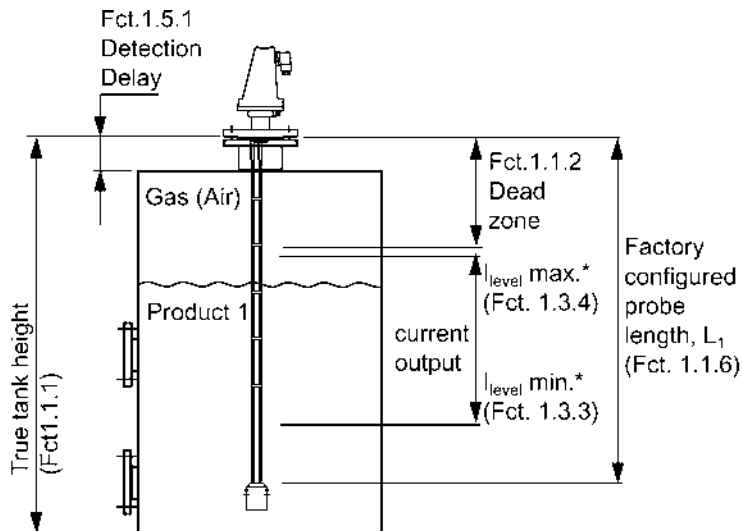
The minimum functions (fct.) to be configured for a simple measurement are listed below:

Functions		Definition
PCSTAR 2	HART®	
1.1.1	2.1.1.1	Tank Height
1.1.2	2.1.1.4	Dead zone
1.3.1 ... 4	2.1.3.1 ... 4	Current Output
1.7.0	2.1.7.0	Volume table*

*For volume measurements

Example procedures for each set of functions are given on the following pages. Each procedure is given in a series of steps in table form and is according to the PCSTAR 2 F2-Configuration parameter list. Please refer to section 3.3.4 for the equivalent parameters available on the HART® Communicator.

Definitions for quick configuration



* where PCSTAR 2 Fct. 1.3.1 (HART® Fct. 2.1.3.1) Current I1 Item is configured to "Level"

Typical gauge used for quick configuration examples:

Probe type:	twin Ø4 mm or 0.15" cable probe (type 4)
Product measured:	Water (dielectric constant, $\epsilon_r = 80$)
Tank height:	10000.00 mm or 33 ft.
(PCSTAR 2: Fct. 1.1.1, HART®: Fct. 2.1.1.1)	
Dead zone:	0.15 m or ½ ft. (see "probe measurement limits" in section 5.2.3 for the Ø4 mm or 0.15" twin cable probe, type 4)
(PCSTAR 2: Fct. 1.1.2, HART®: Fct. 2.1.1.4)	
Probe length, L_1 :	9.00 m or 29.5 ft. (do not modify unless advised to)
(PCSTAR 2: Fct. 1.1.6 HART®: Fct. 2.1.1.2)	

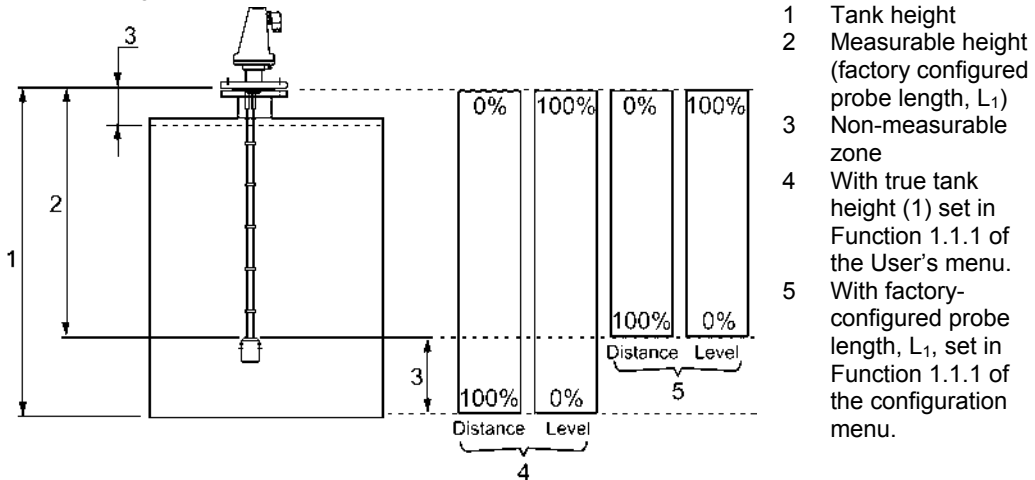
Tank height: configuration of user menu PCSTAR 2 function 1.1.1 (HART® Fct. 2.1.1.1)

This function is usually either defined as true tank height or as factory configured probe length, L_1 (see diagram on preceding page) if the former is not supplied by the customer in the order.

Why change the tank height?

- setting the distance in PCSTAR 2 Fct 1.1.1 (HART® Fct. 2.1.1.1) to L_1 avoids having a non-measurable zone underneath the probe where the measurement on the display freezes.
- when setting up a measurement scale as explained on the following pages, this means that the level at the end of the probe will be taken as zero instead of the tank bottom.

How tank height affects measurement when either Level or Distance is measured



Example procedure 1 (using PCSTAR 2):

- to change true tank height (10000mm or 33 ft) to factory configured probe length, L_1 (9000mm or 29½ ft), and then save the new parameter. Refer to item 5 in the diagram above.

Step	Action	Data entered / value set
1	Press F2 to connect to the device	Tank status screen displayed (level reads 6750 mm)
2	Press F2 to enter configuration menu	Configuration menu displayed
3	Click on the data set field for Fct. 1.1.1 Tank height	This field currently reads 10000.00 (mm)
4	Type in the new value	9000.00
5	Press the button "F6-Send to BM102" for the BM 102 to immediately accept the new value.	n/a
6	Press "F3-Exit" to quit the configuration menu.	Tank status screen displayed (level now reads 5750 mm)

Dead zone: configuration of user menu PCSTAR 2 function 1.1.2 (HART® Fct. 2.1.1.4)

The top dead zone is the minimum measuring distance between the gauge flange facing (the reference point) and the product. The various probes for the BM 102 have differing top dead zones and these are given in section 5.2.3: Probe measurement limits.

Why is configuration of the dead zone important?

The gauge will not display measurements taken here – the reading is blocked on reaching this zone. This will avoid the gauge confusing the true level with a parasite (i.e. flange) as the product nears the tank fitting and thereby displaying a false reading. It should be noted that although the reading is frozen, the gauge will continue to follow the reflection. The PCSTAR 2 F8-marker menu will display “Tank full” in this zone.

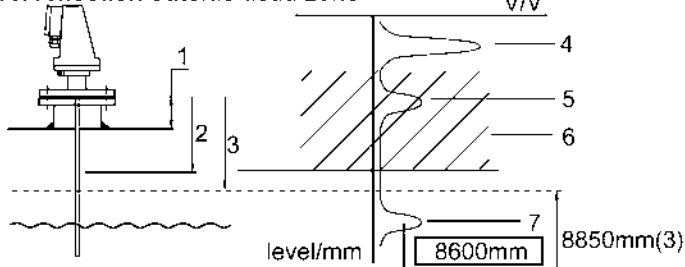
What is the difference between these functions:

PCSTAR 2 Fct 1.1.2/ HART® Fct. 2.1.1.4: Dead zone

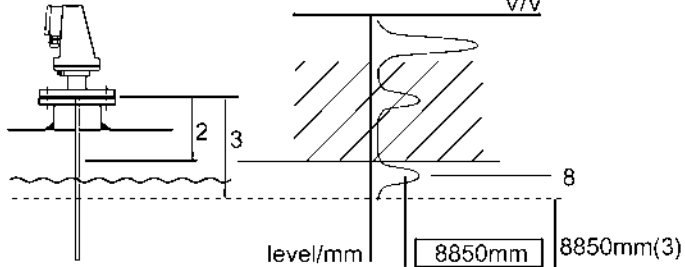
PCSTAR 2 Fct 1.5.1/ HART® Fct. 2.1.5.3: Detection delay?

The “detection delay” function masks all signals (i.e. none are detected by the gauge) up to a defined distance from the flange facing. The detection delay zone size is never greater than the dead zone size. The PCSTAR 2 F8-marker menu will display “Tank full” and “Level lost” in this zone. This is illustrated below – the value in the box is the displayed value:

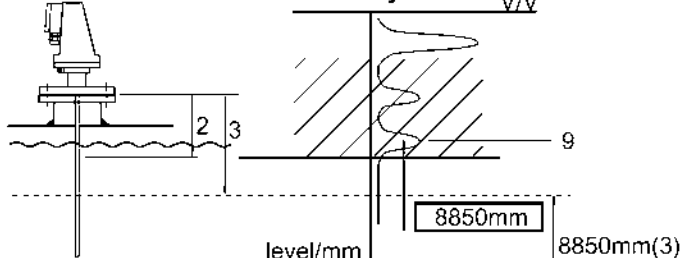
Level reflection outside dead zone



Level reflection inside dead zone



Level reflection inside detection delay zone



- 1 Height of tank fitting
- 2 Detection delay (Fct.1.5.1=120mm)
- 3 Dead zone limit (Fct.1.1.2=150mm)
- 4 Emitted signal
- 5 Flange reflection (masked)
- 6 Masked zone (all signals here are ignored)
- 7 Level reflection outside dead zone – true level displayed
- 8 Level reflection inside dead zone – level at dead zone limit displayed (frozen)
- 9 Level reflection inside detection delay zone – not detected by gauge and level at dead zone limit displayed (frozen)

*(3) = 8850 mm - dead zone configured limit in terms of level

How to set an analogue current output scale

User menu functions 1.3.1 to 1.3.4

This set of functions allows users to set up a scale. The minimum (4mA) and maximum (20mA) values of an analogue current output should ideally lie within the device's active measuring zone, as the device will freeze when the signal is lost.

Refer to the measurement limits table for each probe type in the introduction. Refer also to the start of section 3.3.3 for the advantages of changing tank height.

Example procedure 2 (using PCSTAR 2):

To personalise a measurement scale

- select "Level" as the current output parameter for the scale to be set up from the tank bottom
- select 4 ... 20 mA current range with an error output at 22 mA
- choose suitable minimum and maximum values for the scale.

Step	Action	Data entered / value set
1	Press F2 to connect to the device	Tank status screen displayed (level reads 5650 mm)
2	Press F2 to enter configuration menu	Configuration menu displayed
3	Scroll down the screen and click on the data set field for Fct. 1.3.1: Current 1 item. This will reveal a scroll menu.	This field currently reads "distance"
4	Use mouse to scroll down data set field. Click on the new value.	This field now reads "level"
5	Scroll down to Fct. 1.3.2: Current 1 range and click on data set field. This reveal a scroll menu.	This field currently reads "4-20 mA"
6	Use mouse to scroll down data set field. Click on the new value.	This field now reads "4-20 mA / E = 22 mA"
7	Scroll down to Fct. 1.3.3: Scale I1 min and click on data set field.	This field currently reads "0000 mm"
8	Enter the new value. This will give the level that corresponds to the minimum output of 4 mA.	This field now reads "1000 mm"
9	Scroll down to Fct. 1.3.4: Scale I1 max and click on data set field.	This field currently reads "6000 mm" (std. default: 6000 mm)
10	Change to 8850 mm. This will give the level that corresponds to the maximum output of 20 mA. (and sets max. output at the top dead zone limit)	This field now reads "8850 mm"
11	Press F6-Send to BM102 to immediately update the device configuration.	n/a
12	Press F3-Exit to quit the configuration menu screen.	Tank status screen displayed (level reads 5650 mm)

Setting up a volume table

Refer to procedure 3.

How to configure the gauge to give volume readings
User menu PCSTAR 2 function 1.7.2 (HART® submenu 2.1.7)

- To be able to measure the volume, a conversion table (strapping table) will need to be created using the PCSTAR 2 program or the HART® communicator.
- The strapping table assigns defined volumes to the various levels.
- In the case of non-symmetrical tanks, e.g. tanks with dished bottom, the accuracy of volumetric measurement will depend on the number of entered “level/volume pairs”. The maximum number of pairs (points) that can be set is 20. The volume is linearly determined (interpolated) between 2 points.
- The conversion table is generally used for volume, but can also be used for mass and flow. Five points have been set in the following example.

Procedure 3: creating a strap table the probe by assigning a volume to a user-defined level (using PCSTAR 2)

Step	Action	Data entered/value selected
1	Connect to the gauge as described in section 3.3.1.	n/a
2	Press function key F2 or left click on F2-connection at the bottom of the window. This will open the user configuration menu.	n/a
3	Go to user function 1.1.1: Tank height to enter value (click on field and type in value)	6.00 m or 19.69 ft*
4	Go to user function 1.1.2: Dead zone to enter blocking distance value.	0.40 m or 1.31 ft*
5	Go to user function 1.1.6: Probe length to enter value	5.80 m or 19.03 ft*
6	Go to user function 1.2.4: Length Unit to select length units.	m or ft
7	Go to user function 1.2.5: Volume unit to select volume units	m ³ or ft ³
8	Go to user function 1.7.2: Input table. A maximum of 20 points can be entered. For each point a level and a volume must be entered. Each point should have a value higher than preceding one.	See table below

Input table

Point	Level	Volume
1	0.0 m or 0.0 ft	0.0 m ³ or 0.0 ft ³
2	0.20 m or 0.66ft	0.5 m ³ or 17.66 ft ³
3	0.75 m or 2.46ft	1.0 m ³ or 35.31 ft ³
4	1.00 m or 3.28ft	1.5 m ³ or 52.97 ft ³
5	5.60 m or 18.37ft	16.8 m ³ or 593.3 ft ³

*Max. level = tank height – dead zone
 = 6.00 m – 0.40 m or 19.69 ft – 1.31 ft
 = 5.60 m or 18.37 ft, equivalent to a volume of 16.80 m³ or 593.3 ft³

Note:

The level can effectively be measured between 0.20 m or 8” and 5.60 m or 18½ ft. When the product level drops below the tip of the probe, the BM 102 will indicate that there is still remains of 0.20 m or 8”. Accordingly, the BM 102 can only indicate a level between 0.20 m or 8” and 5.60 m or 18½ ft, since it only measures along the probes. The size of the dead zone depends on the installation and on the probe type.

Supplementary procedure for setting the 4 ... 20 mA current to output volume readings (using PCSTAR 2)

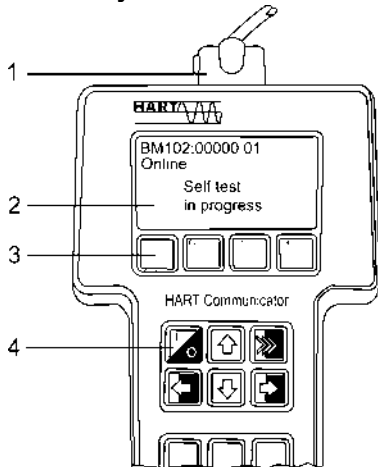
Step	Action	Data entered/value selected
1	Go to user function 1.3.1 "Current 1 item" to select measurement function.	Volume
2	Go to user function 1.3.2 "Current 1 range" to set fault status	4 ... 20 mA
3	Go to user function 1.3.3 "Scale I1 min" to enter volume value for the minimum output (4 mA)	0.50 m ³ or 17.66 ft ³
4	Go to user function 1.3.3 "Scale I1 max" to enter volume value for the maximum output (20 mA)	16.80 m ³ or 52.97 ft ³
5	Either save the new configuration to disk by left-clicking on F5-Save to disk and download it onto the BM 102 using the F6-Send to BM102 key.	n/a
6	Press F3 to exit the configuration menu.	n/a

3.3.4 HART® Communicator: installation & operating instructions

Display and configuration can also be carried out with a HART® communicator. Operator control via the separate HHC is described in detail in the operating instructions supplied with the HHC.

Basic instructions for taking measurements

Communicator layout



- 1 Two-pin jack for loop connectors
- 2 LCD
- 3 Function keys (F1 ... F4)
- 4 Action keys

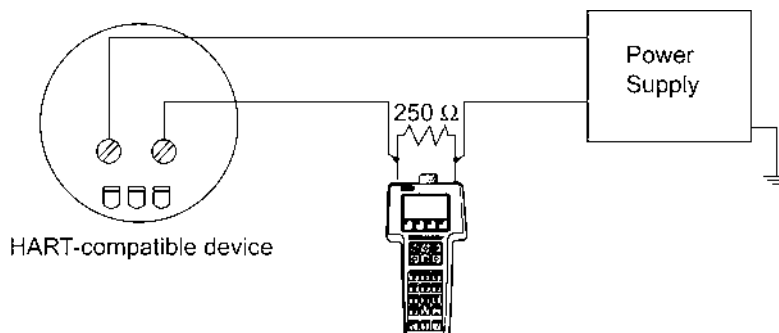
On/off	UP Arrow	n/a
LEFT Arrow	DOWN Arrow	RIGHT Arrow

Other functions:-

LEFT Arrow: Previous menu key

RIGHT Arrow: Select key

Wiring, standard (non-Ex)



Caution

Refer to the HHC manual for wiring instructions when in an explosive atmosphere.

Displaying readings

Use the UP and DOWN arrows to move to the correct line and then select with the RIGHT Arrow.

1	HART Communicator				
1	Offline				
2 →	Online				
3	Frequency Device				
4	Utility				
<table border="1"> <tr> <td>F1</td> <td>F2</td> <td>F3</td> <td>F4</td> </tr> </table>		F1	F2	F3	F4
F1	F2	F3	F4		

Main menu

2	BM102:00000 01								
	Online								
1 →	<Process Var.>								
2	<Config./Test>								
3	<Access/Rights>								
4	<Watch status>								
5	<HART Variables>								
<table border="1"> <tr> <td colspan="4">SAVE</td> </tr> <tr> <td>F1</td> <td>F2</td> <td>F3</td> <td>F4</td> </tr> </table>		SAVE				F1	F2	F3	F4
SAVE									
F1	F2	F3	F4						

Online menu

3	BM102:00000 01								
	<Process Var.>								
1 →	<Measurements>								
2	<Input/Outputs>								
<table border="1"> <tr> <td colspan="2">SAVE</td> <td colspan="2">HOME</td> </tr> <tr> <td>F1</td> <td>F2</td> <td>F3</td> <td>F4</td> </tr> </table>		SAVE		HOME		F1	F2	F3	F4
SAVE		HOME							
F1	F2	F3	F4						

Measurement & input and output functions menu

4	BM102:00000 01								
	<Measurements>								
1 →	Lvl 878.00 mm								
2	Dist 121.00 mm								
<table border="1"> <tr> <td>HELP</td> <td>SAVE</td> <td>HOME</td> <td></td> </tr> <tr> <td>F1</td> <td>F2</td> <td>F3</td> <td>F4</td> </tr> </table>		HELP	SAVE	HOME		F1	F2	F3	F4
HELP	SAVE	HOME							
F1	F2	F3	F4						

Measurement display function

Configuration: summary of user functions via HART® Communicator HC 275

Reset default values are in bold type in the “Input Range” column. Refer to the HART® HC275 Communicator operating instructions for further operating details.

Function (Fct.)	Input Range	Description
1.0 PROCESS VAR.		
1.1.0 MEASUREMENTS		
1.1.1 LEVEL		Level value.
1.1.2 DISTANCE		Distance value.
1.1.3 VOLUME		Volume value if a strapping table is programmed.
1.1.4 ULLAGE VOLUME		Ullage Volume value if a strapping table is programmed.
1.2.0 INPUTS/OUTPUTS		
1.2.1 FUNCTION I		Function associated to the current output (Primary Variable).
1.2.2 I		Current output value (mA)
1.2.3 %		Percentage of PV range.

Function (Fct.)	Input Range	Description
2.0 CONFIG./TEST		
2.1.0 OPERATION		
2.1.1.0 BASIS PARAMETER		
2.1.1.1 TANK HEIGHT	Enter 0 up to 60000 mm or 2362" As per order	Tank height. The tank height is defined as the distance between the bottom of the tank and the lower flange surface.
2.1.1.2 PROBE LENGTH	Enter 0 mm up to < 24000 mm or 1063" As per order	This value has to be equal to the exact length of the probe. The only situation for changing this value is if the probe length has been changed.
2.1.1.3 TIME CONSTANT	Enter to 100 seconds 5 seconds	The time constant allows filtering of possible signal fluctuations when the product surface is turbulent.
2.1.1.4 DEAD ZONE	Enter a value Fct.1.5.1(Detection delay) ... probe length. <ul style="list-style-type: none"> • Twin probe with Probe length <1 m or 3.3 ft 0.2 m or 8 in • Single probe or twin probe with probe length >1m or 3.3 ft 0.4 m or 16 in • Coaxial probe 0 m or 0 in 	Measurements near the flange may not be precise or reliable. Measurement may not be precise in an area less than this recommended value, depending on the probe type.
Warning : Critical Parameter		
2.1.1.5 SENSOR INFO		
2.1.1.5.1 Sensor upper limit	= Probe length	Read only Menu. Upper sensor limit.
2.1.1.5.2 Sensor lower limit	= 0	Read only Menu. Lower sensor limit.
2.1.1.5.3 Sensor min. span	= 1 mm or 0.04"	Read only Menu. Sensor minimum span.
2.1.2.0 DISPLAY		
2.1.2.1 LENGTH		
2.1.2.1.1 LENGTH UNIT	Select m, cm, mm, inch, Ft, optional unit mm	Length unit of displayed value (level / distance). The optional unit allows the user to define a new unit (name and factor) see menu 2.1.2.1.3
2.1.2.1.2 DISPLAY FORMAT	0, 1, 2, 3, 4, 5, exponential format, auto 2	Number of decimal places. Defines the displayed length values format (option of the HART® communicator H275).

Function (Fct.)	Input Range	Description
2.1.2.1.3.0 DEFINE NEW UNIT		
2.1.2.1.3.1 UNIT NAME	4 ASCII characters "unit"	Optional unit name. User has to enter the unit name before using it in the menu "LENGTH UNIT".
2.1.2.1.3.2 UNIT FACTOR	Enter 0.0 to 100000 1.0	Optional unit factor. User has to enter the Unit Factor before using it in the menu "LENGTH UNIT". With a factor 1.0, the unit is equivalent to one millimeter. With a factor 1000.0, the unit is equivalent to one meter.
2.1.2.2.0 VOLUME		
2.1.2.2.1 VOLUME UNIT	Select m3, l, US Gal, Ft3, bbl, M3/h, Ft3/h, kg, Metric Tons, US Tons m³	Unit for conversion values ("volume table"). The selected unit is only used to display the conversion value from the strapping table.
2.1.2.2.2 DISPLAY FORMAT	0, 1, 2, 3, 4, 5, exponential format, auto 2	Number of decimal places. Defines the displayed volume value format. (Option of the HART [®] communicator H275).
2.1.3.0 ANALOG OUTPUT		
2.1.3.1 FUNCTION I	Select Level, Distance, Volume, Ullage Volume Level	Current output function (measured value to be displayed). Volume functions will appear if a volume table exists in menu 2.1.7.0
2.1.3.2 RANGE I	Select 4-20 mA or 4-20 mA + 22 mA if error 4-20 mA	Current output range 4 ... 20 mA (1st choice). When the BM 102 is in error mode, the current output is frozen except if the second choice is selected and then the current output is fixed at 22 mA.
2.1.3.3 ERROR DELAY	Select No delay, 10 s, 20 s, 30 s, 1 mn, 2 mn, 5 mn, 15 mn No delay	This menu is available in case the range I menu is set to 4-20 mA with error 22 mA. This parameter sets the delay before the current output goes to 22 mA after the error mode occurred.
2.1.3.4 SCALE I min. 4 mA	Enter 0 to Scale I max. As per order	Input the lower range value (corresponding to 4 mA) depending of the parameter 2.1.3.1 chosen.
2.1.3.5 SCALE I max. 20 mA	Enter Scale I min to tank height As per order	Input the upper range value (corresponding to 20 mA) depending of the parameter 2.1.3.1 chosen.

Function (Fct.)	Input Range	Description
2.1.4.0 USER DATA		
2.1.4.1 TAG	00000 01	Tag number of device.
2.1.4.2 SERIAL NUMBER		Read only menu. Each device has its own serial number.
2.1.4.3 FRENCH COMMISSION NUMBER		Read only menu. This number is factory set. Refer to this number in case of warranty or service claims.
2.1.4.4 GERMAN COMMISSION NUMBER		Read only menu. This number is factory set. Refer to this number in case of warranty or service claims.
2.1.4.5 RELEASE NUMBER		Read only menu. Release number of the device (Software and Hardware version).
2.1.4.5 PROBE TYPE	Rod, Twin Rod, Cable, Cable +counterweight, Cable without counterweight, Twin Cable, Twin Cable + counterweight, Coax, Special 1, Special 2, Special 3 As per order	Read only menu. Probe type attached to the flange.
2.1.4.5 CHECKSUM		Read Only menu. Similar to the release number. This parameter allows to identify the software version of device.

Function (Fct.)	Input Range	Description
2.1.5.0 APPLICATION		
2.1.5.1.0 THRESHOLD		
2.1.5.1.1 LEV. PULSE AMP.	Read only value.	Dynamic value. Amplitude of level pulse in millivolts.
2.1.5.1.2 LEV. PULSE GAIN	Read only value.	Dynamic value. Amplification of level pulse (gain 0, 1, 2, or 3).
2.1.5.1. THRESHOLD	Enter a value from 50mV to 25000mV 500 mV G3 at 1 m	Threshold of the level pulse (in millivolts). The threshold evolves in terms of gain amplification factor changing by the electronic converter.
2.1.5.2 DISTANCE INPUT	Enter a value from Fct. 2.1.1.4: Dead zone to fct. 2.1.1.2: Probe length	This function forces the BM 102 to search for the product surface in a zone other than the actual measuring zone. If there is no level signal, you can enter an estimated value.
2.1.5.3 DETECTION DELAY	Enter a value 0mm or 0in to Fct. 2.1.1.4: Dead zone As per order	This function forces the instrument not to analyse reflections in a zone directly below the flange. The entered value of the detection delay must be smaller than the "dead zone" value.
2.1.5.4 SEARCH PROBE END	The search zone for the probe end is from Fct 2.1.5.3 Detection delay up to Fct. 2.1.1.1 Tank height.	Automatically measures the probe length. The tank must be empty. Tank height must be configured to a value greater than the estimated probe length. Measured in the units configured in fct. 2.1.2.1.1.
2.1.5.5 RESET BM 102		Restarts the BM 102.
2.1.6.0 SERIAL I/O		
2.1.6.1 ADDRESS	Enter 0 to 15 0	Sets the address of the device for connection to a HART multidrop network. The current output switches to 4 mA. 0 = 4 ... 20 mA output current active 1 – 15 = in multidrop mode (4 mA)
2.1.7.0 STRAP TABLE		
2.1.7.1 VOLUME UNIT	Select m3, l, US Gal, Ft3, bbl, M3/h, Ft3/h, kg, Metric Tons, US Tons Liter [l]	Unit for conversion values ("volume table"). The selected unit is used to define the strapping table values.
2.1.7.2 INPUT TABLE	0 to 20 points 0 (i.e. no volume table)	This function defines the strapping table. The maximum number of points is 20. Each subsequent value must be greater than the previous one. The length and volume units can be changed later without affecting the settings in the table. Calculations are done automatically in the instrument.
2.1.7.3 DELETE TABLE		This function deletes the strapping table.

Function (Fct.)	Input Range	Description
2.2.0 TESTS		
2.2.1 TEST OUTPUT	Select 4 mA, 20 mA, Other	This function allows the current output to be tested. The output can be set to one of the listed values. With a reference ammeter, the calibration of the current output can be verified.
2.3.0 SERVICE		
		Restricted access factory configuration menu. These parameters may be accessed via Fct. 3.2 "Specialist PSW (password).

3.0 ACCESS RIGHTS		
3.1 MAINTENANCE PSW	Yes or no. Enter 9-character code if "Yes". No	Disables the access lock on the configuration menu. The password must contain exactly 9 characters. E, R or U are used only. The password is displayed in a scrambled format. It allows KROHNE to decode the password in case it was forgotten.
3.2 SPECIALIST PSW	See KROHNE Service centre or BM 102 Service Manual for code.	Specialist access to the Service Parameters.

4.0 WATCH STATUS		Displays the status of the device.
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5.0 HART® VARIABLES		
5.1 MANUFACTURER	KROHNE	Read only menu.
5.2 MODEL	BM 102	Read only menu.
5.3 FLD DEV REV	1.0	Field device revision. Read only menu.
5.4 SOFTWARE REV	1.0	Software revision. Read only menu.
5.5 HARDWARE REV	1.0	Hardware revision. Read only menu.
5.6 DEVICE ID		Read only menu. The device ID is also the serial number of the device.
5.7 MESSAGE		32 bytes of ASCII characters
5.8 DESCRIPTOR		16 bytes of ASCII characters. Equivalent to PCSTAR2 Fct. 1.4.8
5.9 DATE		Month Day Year (xx / xx / xx).
5.10 NUM RESP PREAM		Number of preamble in the response frame of the device.
5.11 TAG		Tag name of the BM 102.
5.12 POLL ADDRESS		Address of the device.

3.3.5 Characters available for alpha-numerical data functions in PC STAR 2 and on the HART® console

This concerns the following functions:

PCSTAR 2 fct. 12.6.1: Unit name, fct. 1.4.4: Device number, fct. 1.4.8: Option

HART® console (HHC) fct. 5.7 Message, fct. 5.8 Descriptor, fct. 5.11 Tag

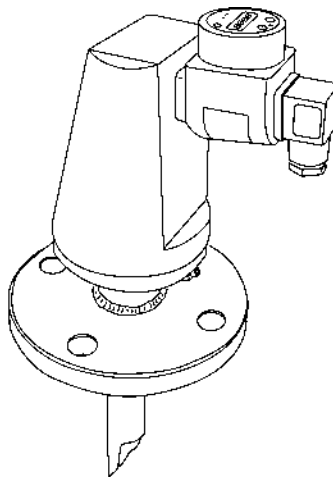
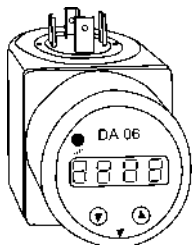
@	H	P	X	Space	(0	8
A	I	Q	Y	!)	1	9
B	J	R	Z	"	*	2	:
C	K	S	[#	+	3	;
D	L	T	\	\$	'	4	<
E	M	U]	%	-	5	=
F	N	V	^	&	.	6	>
G	O	W	_	'	/	7	?

3.3.6 Local user display (instruments equipped with DIN connectors only)

The BM 102 local indicator is available as an option. This fits onto the BM 102's standard DIN connector. Data can be read from an LED display. The gauge configuration menu cannot be accessed with this option. For non-Ex applications only. Please refer to the DA 06 Supplementary instruction manual for further information.

Technical data: DA 06 Plug-in Display (non-Ex)

DA 06 Plug-in display (supplied separately) DA 06 Plug-in display mounted on BM 102 gauge



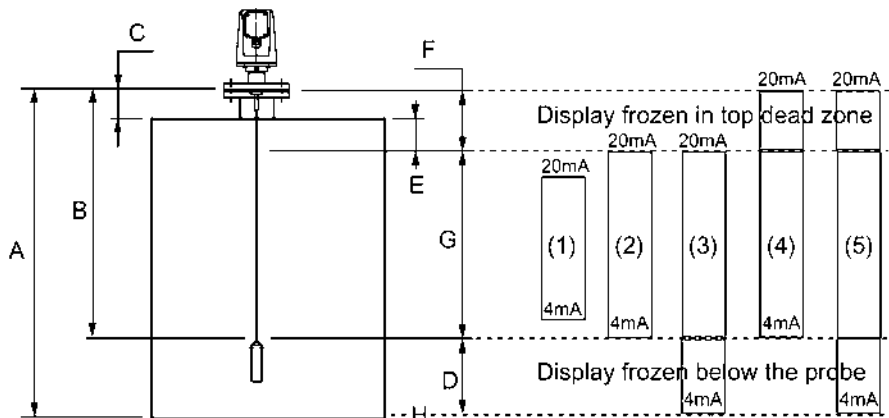
Measuring range:	-1999 to 9999 digits (min. and max. values user defined)
Display:	4-digit, 7.6 mm or 0.3" high, red LED display, display housing can be turned through 330°
Accuracy:	0.1 % +/- 1 digit
Adjustable parameters:	Scaling, decimal point, attenuation, switching point, delay
Min. / max. value memory:	Displays the minimum and maximum values recorded during operation.
Housing:	Plastic, PA 6.6 / polycarbonate 47mm X 47mm x 68 mm or 1.9" x 1.9" x 2.7" (h x w x d), housing can be turned by 300°
Protection:	IP 65 (EN 60529)
Temperature range (ambient)	
Electronic system:	0°C ... +60°C or 32°F ... 140°F
Storage:	-30°C ... +80°C or -22°F ... 176°F
Electrical connection:	Adapter for plug as per DIN 43650
Input signal	4...20 mA / 2-wire
Max. voltage drop over unit	Approximately 6 V DC
Switching output1	open collector (PNP), max. 125 mA, on and off delay: 0 to 100 seconds, temperature influence: 0.1% / 10 K
CE conformity	EN 50081-1 and EN 50082-2

3.4 BM 102 MICROFLEX T.D.R. meter characteristics

This subsection explains:

- the four principle configurations for setting up a measurement scale and what the user should be aware of in each case;
- what happens when the tank is full or empty;
- what is the level threshold and how to modify it and
- what happens when level is measured when more than one product in the tank;

The measurement scale: five possible configurations for analogue current output – with “Level” selected in PCSTAR 2 function 1.3.1: Current 1 Item



- | | |
|---|---|
| A Tank height (Fct. 1.1.1) | F Upper dead zone (Fct. 1.1.2) |
| B Probe length (Fct. 1.1.6) | G Optimal measuring range |
| C Detection delay (Fct. 1.5.1) | H Reference point at tank bottom |
| D Non-measurable zone | |
| E Minimum distance between non-measurable zone and dead zone (Fct.: 1.1.2 – Fct.: 1.5.1) | Fct.: 1.3.1 = Level |

The configurations described below are illustrated in the above diagram:

- (1) The “current output” range is smaller than the optimal measuring range.
Scale min.: 4 mA (Fct. 1.3.3) = tank height – probe length
Scale max.: 20 mA (Fct. 1.3.4) = tank height – dead zone
- (2) The “current output” range is equal to the optimal measuring range:
Scale min.: 4 mA (Fct. 1.3.3) = tank height – probe length
Scale max.: 20 mA (Fct. 1.3.4) = tank height – dead zone
- (3) The “current output” range is greater than the optimal measuring range:
Scale min.: 4 mA (Fct. 1.3.3) = 0.0
Scale max.: 20 mA (Fct. 1.3.4) = tank height – dead zone
- (4) The “current output” range is greater than the optimal measuring range:
Scale min.: 4 mA (Fct. 1.3.3) = tank height – probe length
Scale max.: 20 mA (Fct. 1.3.4) = tank height
- (5) The “current output” range is greater than the optimal measuring range:
Scale min.: 4 mA (Fct. 1.3.3) = 0.0
Scale max.: 20 mA (Fct. 1.3.4) = tank height

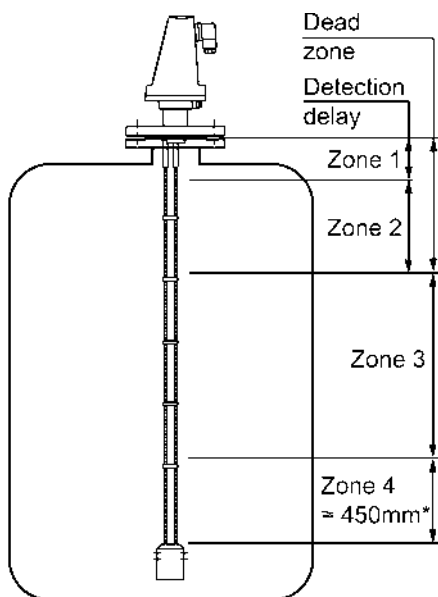


NOTE:

The reference point for distance measurements is the bottom of the flange face.

3.4.1 Gauge operating logic when the reflection is lost

The product reflection pulse is usually lost when the level is in the top dead zone or near the bottom of the tank. The diagram below shows the action taken by the gauge depending on where the last reflection was lost. Use PCSTAR2 F8-Marker display function or HART[®] HHC Fct. 4.0 Watch Status to follow the measurement status of the gauge.



* if L > 2 m or 6 ¾ ft

Zone 1 : Dead and detection delay zones

Marker "Tank full" and "Level lost" is displayed when the product enters the dead zone and no reflection is found. This will also occur once the level reflection is within the detection delay zone.

The gauge assumes the tank is full and displays the maximum level value.

The gauge searches for a reflection along the entire length of the probe.

Zone 2 : Full zone (& dead zone)

Marker "Tank full" is displayed in this zone.

If the gauge loses the signal in this zone, it reacts as in zone 1: the tank is assumed to be full.

The gauge searches for a reflection along the length of the probe.

Zone 3 : Central measurement zone

The gauge searches along the length of the probe for the largest pulse reflection.

If the pulse is lost the reading freezes at the last value.

Marker "Level lost" will be displayed. The probe will search for a reflection along the length of the probe.

Zone 4 : Empty zone

If the reflection is lost here then the gauge assumes the tank is empty and marker "tank empty" is displayed. The gauge searches for a reflection in this zone but makes a search along the entire length of the probe once every minute.

The reading will remain frozen during this time.

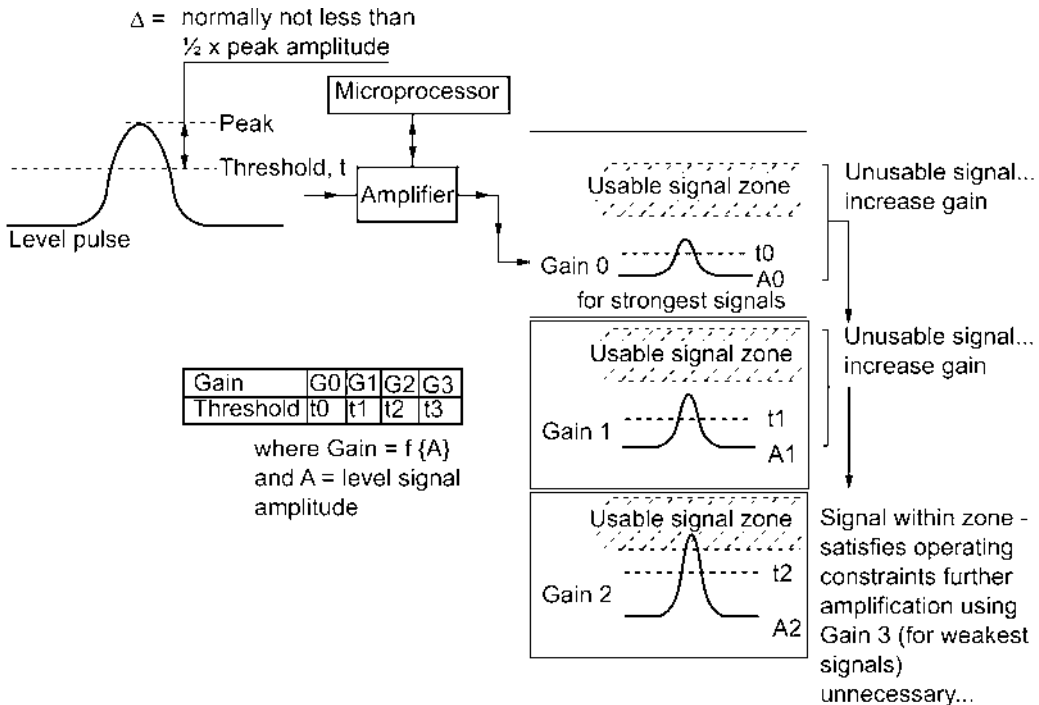
3.4.2 Gain and voltage amplitude

As explained in the measuring principle in section 6, the level of a product is converted from a return signal (the product reflection) received by the gauge: this signal has taken a certain amount of time to return to the gauge and it has a certain strength / size measured in milli-volts (dependant on the dielectric constant of the product).

All pulse signals returning to the gauge electronics block (including flange, obstruction and the product surface reflections) are converted to voltage amplitudes. The gauge's microprocessor looks for part of the largest signal that is over a set voltage amplitude, called the "threshold", and identifies this as the product being measured. For this signal to be usable by the gauge, the microprocessor will amplify the signal by increasing the gain. Once the signal is within a set "working" range, the gauge follows this signal. The gauge registers any changes in time for this part of the signal to return to the converter and translate this into a displayed level or volume.

Gain is a function of voltage amplitude. This defines the default threshold value when the gauge is searching for the product level. A strong return signal will be given a low gain (i.e. Gain 0 or a small amplification). However, if the signal is very weak, then a Gain of 3 (i.e. high signal amplification) is given.

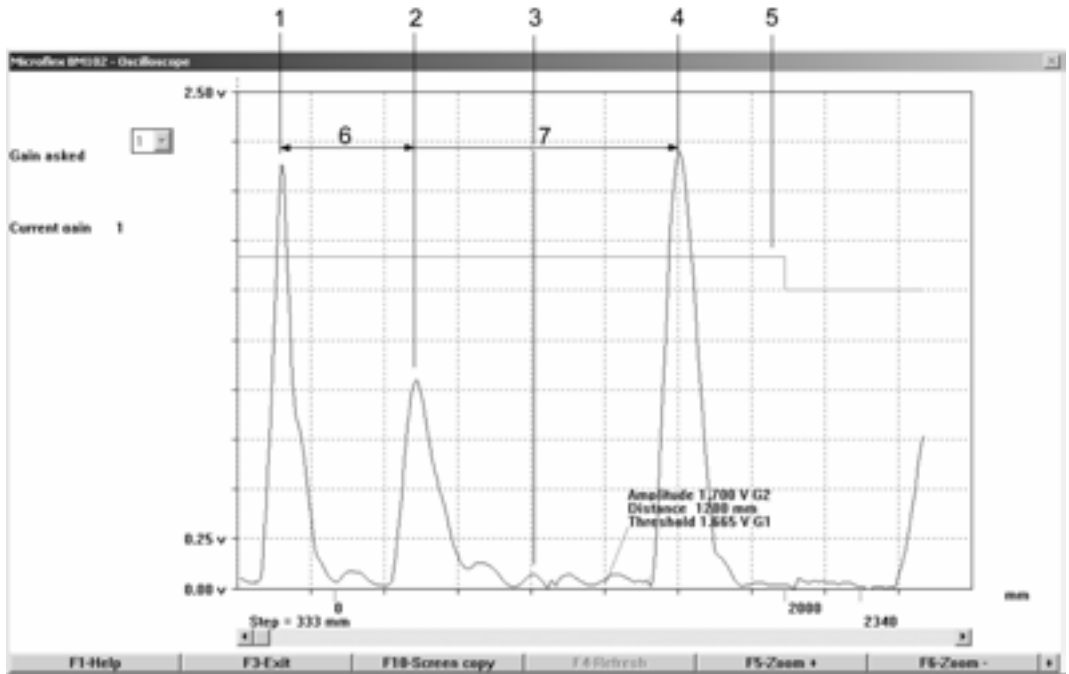
Example of signal amplification:



Level measurement: Level pulse amplitude and threshold

After connection to a power supply, the BM102 will:

1. Measure reflection pulses in terms of voltage amplitude by cycling through a set of gains.
2. Identify the highest amplitude as being the product level.



This screenshot of the PCSTAR 2 F7-Oscilloscope function while measuring a typical one product application identifies:

- 1 Emitted pulse
- 2 Flange reflection (except coaxial probe)
- 3 Non-product reflection (e.g. parasite: agitator)
- 4 Product level reflection
- 5 Level threshold (with two-metre steps). Set in F11-Dynamic configuration menu
- 6 Offset (see below for definition)
- 7 Distance measured as a function of time

Offset is the distance for the signal to travel from the converter to the flange. (the gauge's reference point).

The level signal can be optimized by way of two factors:

Amplification factor

The amplitude of the signals is proportional to the dielectric constant of the product. At low amplitudes the signal should be amplified. The amplification factor is dependent on the dielectric constant and on the probe type. The device sets the gain automatically.

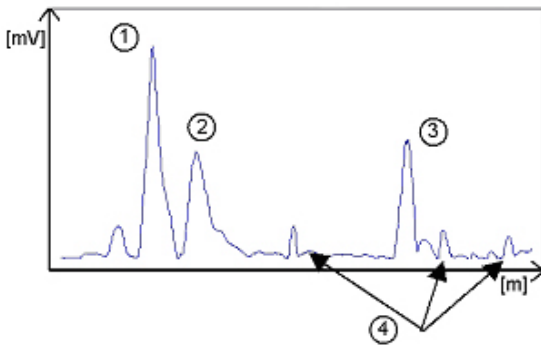
The following factors apply to the set gain:

Gain	Amplification factor
0	1.05
1	2.10
2	4.37
3	8.93

Level threshold

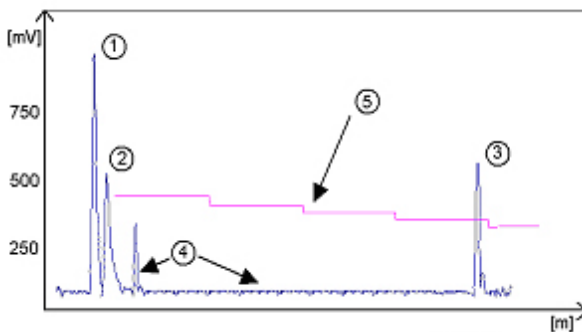
The level threshold suppresses interference signals so that only the reflections from the product surface (level signal) are shown. The factory setting of the level threshold is suitable for standard applications. The threshold will need to be adjusted in the case of very low dielectric constants, multiple interference reflections or unfavourable installation conditions.

The illustrations below show interference signals when the oscilloscope function is used. These reflections can be due to various causes, e.g. tank internals or multiple reflections within the measuring range.



Even though the interference signals are very weak, the threshold should nevertheless be set to a value above these signals.

- 1 Emitted pulse
- 2 Flange reflection
- 3 Level signal
- 4 Interference signal



- 1 Emitted pulse
- 2 Flange reflection
- 3 Level signal
- 4 Interference signal
- 5 Threshold

In the diagram above it can be seen that the level of the threshold is not constant: 400 mV at 1 m or 3.3 ft, and only 250 mV at 10 m or 33 ft.

No attenuation is required at a probe length ≤ 3 m or 10 ft. The form of the threshold is dependent on attenuation and is automatically adjusted by the device over the measured length.

Setting the level threshold

If the level threshold is set too high, i.e. it is greater than the amplitude of the level reflection, the device will not find any level even with maximum amplification.

If the level threshold is set too low, i.e. it is below the amplitude of some of the interference signals, the device will identify and indicate one of these interference signals as a level reflection only if the tank is empty.

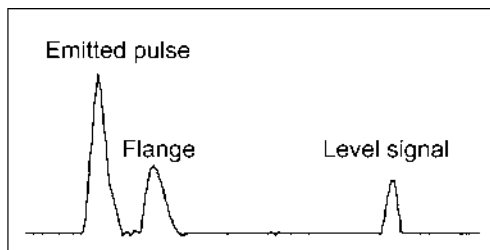
Precise setting of the level threshold is especially important when the dielectric constant is low.

- To set, the level (amplitude of the reflection) must be known.
- The level threshold should be half-way between the invalid interference signals and the level reflection signal.
- The reflection from the probe tip, which is clearly identifiable at a low ϵ_r value, does not need to lie below the level threshold.

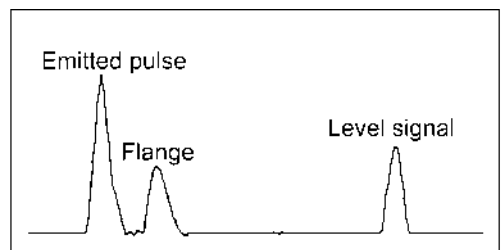
Take a look at all the reflections over the entire probe length and then change the level threshold and/or the amplification factor in the “Dynamic configuration (F11)” menu.

Typical signal trends

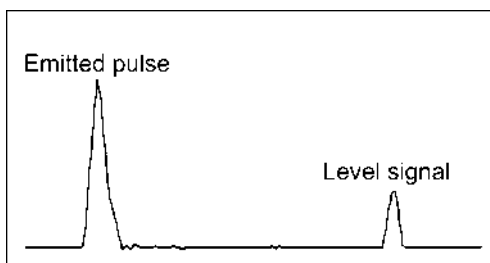
The following diagrams show characteristic signals that have been recorded with the oscilloscope function.



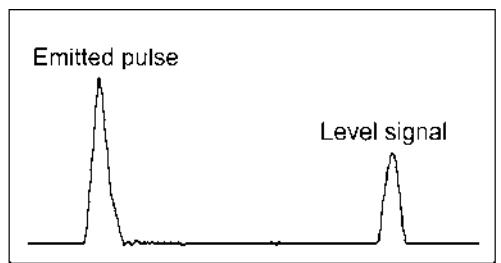
Rod or cable probe with gain 1



Rod or cable probe with gain 2



Coaxial probe with gain 1



Coaxial probe with gain 2

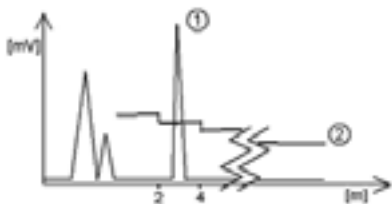
The signal from coaxial probes does not include the flange reflection, due to the mechanical setup which does not produce any change in impedance at the flange.

The amplitude of reflection from the product surface increases as the level rises and decreases as the level falls.

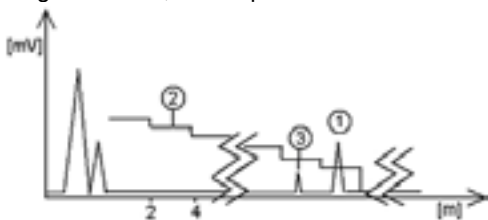
Automatic adjustment:

To maintain a sufficiently strong reflection signal, the gain is adjusted automatically. When the amplitude of the level reflection decreases, the gain will increase to compensate for the loss in signal amplitude. Gain and level threshold thus maintain the same proportion.

At gain 3, the level signal (1) is located between a distance of 2 and 4 metres or 6.5 and 13 ft. (2) is the level threshold. This is shown below:



The level has dropped, increasing the distance between the product and the flange. The reflection signals for level (1) and interference signals (3) have become weaker (smaller amplitude). The interference signals are now below the level threshold (2), whose lower limit is 50 mV. As in the diagram above, the amplification factor is 3. Refer to the graph below:



In both cases, the automatically adjusted gain of the threshold indicates all signals located above one-half of the amplitude of the level signal.

In the event of operational or installation faults, you can frequently identify the cause of the fault by means of this function and normally eliminate it yourself. Should the fault persist, please send a copy of the screen (screen shots with F10) to your KROHNE Service Centre. A list of service centres for each country is supplied on the back page of this handbook.

Procedure (example where the level measured is too low compared to true level)

- read off displayed peak amplitude using the oscilloscope function – F7
- modify level threshold value

Step	Action	Data entered/ value displayed
1	Execute PCSTAR 2. Press F2 to connect to gauge.	n/a
2	Press F11 to open F11-Dynamic configuration window.	n/a
3	The top of the window gives the distance, peak amplitude in volts and gain.	21000 mm 650 mV Gain 3
4	The configured level threshold is listed under peak amplitude in mV. Click on the "Modify" box to activate the "Threshold" field.	n/a
5	Click on the "Threshold" field and enter the new value.	500 mV
6	If the approximate level is known, click on the "Distance" field and then click on the "Search" button	-
7	If the value is still too low, try reducing threshold again by small amounts. If this does not resolve the problem, contact the KROHNE Service Centre. . A list of service centres for each country is supplied on the back page of this handbook.	n/a

Note that the threshold drops every 2 metres or 6.5 feet.

Solid application notes

Most dry solid applications except powder or flakes with high dielectric constants, such as coal powder, are measured with a Gain of 3. If it is difficult to measure level at a certain point with the gauge using a Gain from 0 to 2, then an internal tank structure (exposed girder, etc.) is most likely to be within the electromagnetic pulse field area: the gauge will detect the largest signal and assume this is the product level.

3.4.3 Level measurement when more than one phase or layer in the tank

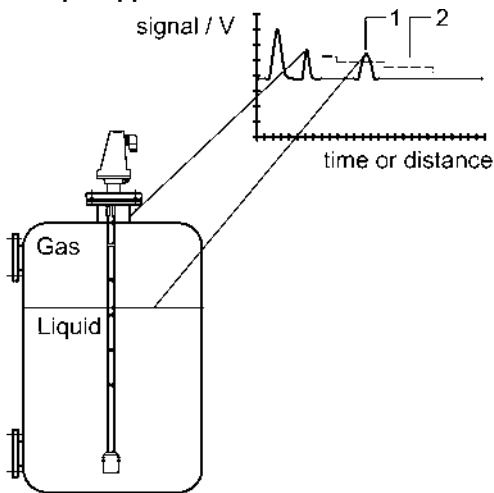
Level can be measured with more than one phase in the tank. This requires setting a parameter in the factory menu (Fct. 1.1.3: Application Type) to the following measurement mode:

- 2 liquids, 1 level for measuring level with two or more phases
- 1 liquid, 1 level for measuring one phase or liquid

Characteristics

- The level of the top product can be detected if it has a minimum layer of approximately 100 mm – when measuring a top product with a dielectric constant of 2.4.
- The mode “2 liquids, 1 level” permits level to be measured even when more than 2 liquids are present in the tank.
- The first return signal is identified as being level and the second is ignored.
- This mode may be used with all probe types.

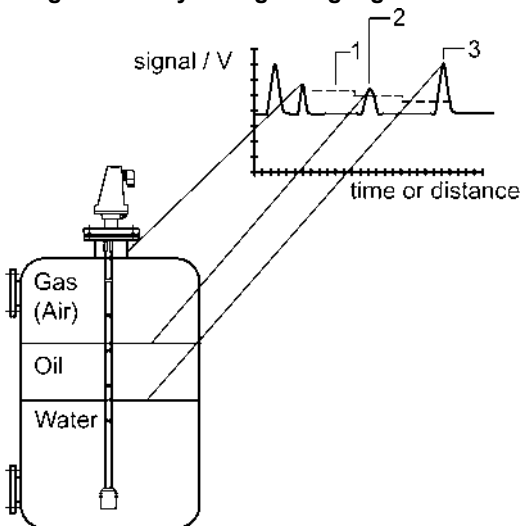
Example application 1: level measurement of oil (1 liquid in the tank)



With Factory Menu Fct. 1.1.3: Application Type set to 1 liquid, 1 level, the BM 102 will search for the return signal with the highest amplitude (i.e. higher than the threshold). It will measure the oil level.

- 1 Level measurement signal
- 2 Threshold

Example application 2: level measurement when there are 2 liquids (oil/water) in the tank – using a correctly configured gauge



With Factory Menu Fct. 1.1.3: Application Type set to 2 liquids, 1 level, the BM 102 will search for the first return signal higher than the control threshold. It will correctly measure the oil level (i.e. “level”).

- 1 Level signal
- 2 Threshold - finds first signal
- 3 Oil-water interface signal

For further information, please contact your local KROHNE Service Centre. Contact details are supplied on the last page of this manual.

4 Service / Maintenance

Maintenance is normally not required in standard applications. However, heavy deposits on the probe can cause measurement deviations or faulty operation. The measuring system is comprised of:

- a signal converter,
- a probe,
- seals and
- a process connection.

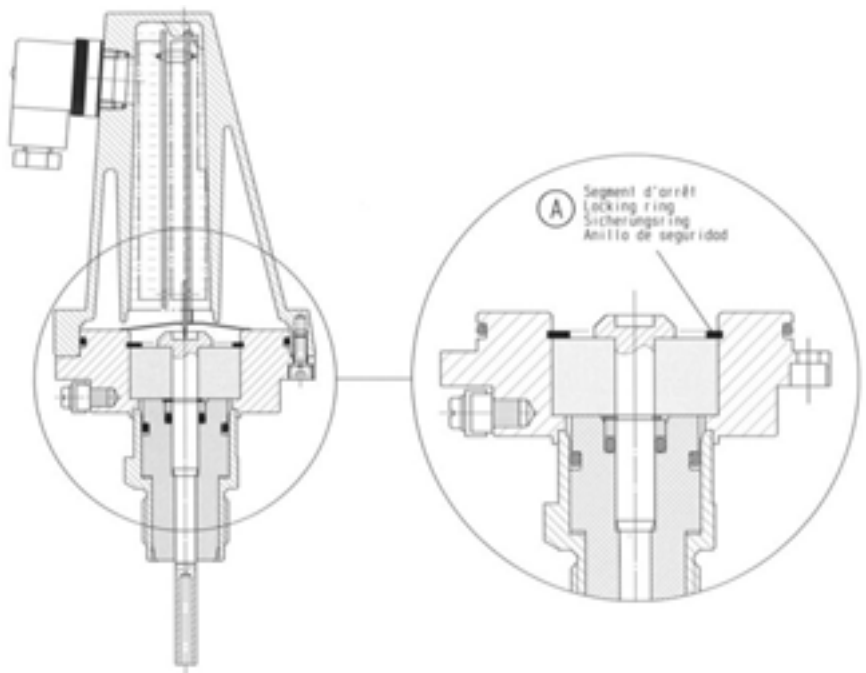
4.1 Replacement of the signal converter

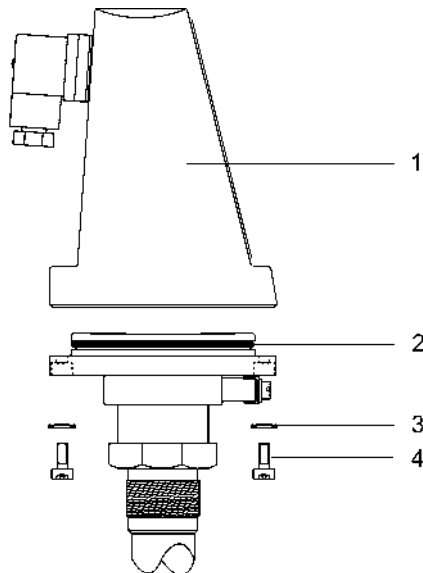
BM 102 servicing by the customer is limited by warranty to the removal and replacement of the housing containing the potted signal converter. Other repairs must be done by KROHNE-authorized service staff. For safety reasons, the signal converter must be detached from the flange system under atmospheric conditions.



Before changing the converter and its housing:

- Disconnect gauge from the power supply before servicing.
- Ensure that the tank is at atmospheric pressure before servicing.
- Do not, under any circumstances, remove the locking ring (circlips), item A, shown below – this is a critical pressure-bearing component:





- 1 Signal converter housing
- 2 O-ring, grease well before fitting
- 3 Lock washer
- 4 Housing (socket head cap) screw x 4 (M5 x 12), non-pressure-bearing

Procedure to replace the signal converter (refer to diagram above)

Step	Action
1	Disconnect all wires (see sections 2.1.2 or 2.1.3)
2	Unscrew the 4 socket head cap screws M5x12 (ISO 4762), item 4, using a 4 mm Allen/hexagon key) and remove the signal converter.
3	The gasket between signal converter and flange must be well greased.
4	Install the new signal converter and making sure that the signal pin in the housing is not damaged.
5	Reinsert and tighten up the 4 socket head cap screws M5x12, item 4.
6	Reconnect all wires as described in sections 2.1.2 or 2.1.3.



Hazardous-duty systems

Before replacing the signal converter in hazardous locations, make absolutely sure that there is no risk of explosion (gas-free certificate). For further information refer to the BM 102 MICROFLEX KEMA 00 ATEX 1101X Supplementary Installation and Operating Instructions. This document is available from the "Download Centre" on KROHNE's website <http://www.krohne.com/>.



For pressurized tanks with a flange connection between the tank and the device, do not undo the 4 flange bolts - these are used for fastening the complete sealing system.

4.2 Fault clearing

Event	Fault	Action
Error messages		
“Tank full” status marker on*, reading frozen at max. or min. value	No fault. The level has reached (and possibly risen above) the top configured measurement limit and is either displaying the maximum (when measuring level) or minimum (when measuring distance) output.	None. Measurements should be normal once the level is in the configured measurement range.
“Tank empty” status marker on*, reading frozen at max. or min. value	No fault. The level has entered the gauge’s bottom dead zone and can no longer detect a return signal. Either the maximum (when measuring distance) or minimum (when measuring level) output is displayed.	None. Measurements should be normal once the level is in the configured measurement range.
“Tank full” and “Level lost” status marker on*, reading frozen at max. or min. value	No fault. The level has entered the gauge’s top dead zone and can no longer detect a return signal.	Empty the tank below the top measurement range limit and check the measurement.
“Level lost” status marker on*, reading is frozen	The instrument has lost the level signal, has searched but not yet found the return pulse. This may occur if the pulse has dropped below the threshold. Parasite signals from the flange or obstructions in the tank may render the gauge unable to identify the correct signal.	Ensure that tank is emptied below maximum level and check the measurement. If the signal is not detected then modify the control threshold manually as shown in sections 3.5.2 and 8.4.2 using the oscilloscope (F7) and dynamic configuration (F11) windows in PCSTAR 2.
“Reference not found” status marker on*	Occurs when there is a problem with the time base on the HF board.	Please contact your local KROHNE Service Centre**.
“Level lost” and “Reference not found” status markers on*, reading frozen	The probe has received an electrostatic discharge.	The gauge will search for the level again and resume readings. If the reading remains frozen then the signal converter may have been damaged by ESD and may need replacing. Please contact your local KROHNE Service Centre**.

* Gauge connected to PC-STAR 2 software or HART Handheld Controller (HHC) with Marker status window (F8) or list displayed

** KROHNE service centre contact details are supplied on the last page of this handbook.

Event	Fault	Action
"Flange not found" status marker on*	The signal converter has been incorrectly configured to measure with a cable or rod probe when it is equipped with a coaxial probe. This may also be due to installation on a long nozzle which has the effect of attenuating the flange pulse.	Contact your local KROHNE Service Centre for the corrective procedure**.
"Delay out of limits" status marker on*, reading is frozen.	The emitted pulse has not been detected. The gauge will not work until it has been found.	The signal converter may need replacing. Please contact your local KROHNE Service Centre**.
"Negative voltage error" status marker on*	Occurs when there is a problem with the time base on the HF board.	Please contact your local KROHNE Service Centre**.
"VC01 voltage error" status marker on*		
"VC02 voltage error" status marker on*		
"Reprogramming FPGA" status marker on*		

* Gauge connected to PC-STAR 2 software or HART Handheld Controller (HHC) with Marker status window (F8) or list displayed

** KROHNE service centre contact details are supplied on the last page of this handbook.

Event	Fault	Action
General operation		
Instrument is not accurate with a product that has a high dielectric. A constant offset is observed when taking measurements.	Tank height is not correct.	Check current output and tank height parameters. If the signal converter has been replaced, verify that factory calibration parameters are still the same. Ask KROHNE** for the factory calibration sheet (if not supplied) and the password for access to the factory menu.
The BM 102 indicates an incorrect level value.	The BM 102 measures a non-valid reflection.	Check the tank for obstructions and verify that the probe is clean. In the case the indicated level is close to the nozzle, increase the detection delay and the dead zone with the same ratio or increase the threshold level if the full measurement range is essential. In any case use the PC STAR 2 oscilloscope function to visualise and to analyse the application. The threshold level must be adjusted so that it masks the disturbances. It also gives enough margin for detection of the level pulse. Very large pulses along the measurement signal (same amplitude as the initial pulse) can be caused by a probe which is touching the nozzle or the tank side (see section 1.3.5). Ensure that no contact is possible.
Instrument is not accurate when there are two or more phases in the tank.	The instrument may be incorrectly configured for this type of application i.e. it is measuring the interface instead of the level.	Contact KROHNE** for the corrective procedure or refer to the Service Manual. Check that Factory Menu function 1.1.3: Application Type is set to "2 liquids, 1 level". Check also that there is a layer of more than 100 mm of top product above the bottom product.

** KROHNE service centre contact details are supplied on the last page of this handbook.

Event	Fault	Action
Electrical Connections and Communication Output		
Current Output value < 4 mA.	No power supply.	Check the power supply
	Connection of the device is incorrect.	Check the connection between the device and the power supply.
	The calibration of the current output is incorrect.	Execute the calibration if you have authorized access or contact KROHNE Service centre**.
Reads 22 mA.	An error has occurred.	This happens in case the range 4-20 mA / error 22 mA is selected. Check the status of the device by selecting the marker window (F8) or enter the status (4.0) menu of the HART® communicator.
	The device is in its start-up phase.	Wait 50 seconds. If the current value drops to a value between 4 and 20 mA, and goes immediately back to 22 mA, contact your KROHNE Service Centre**.
The value at the current output does not correspond to the value at the display (PC STAR 2 or HART® communicator).	The current output settings are incorrect.	Check the current loop and the connections. Configure the output as described in Sect. 3.3.3 (user sub-menu 1.3) of the BM 102 Handbook – also try adjusting the threshold using F11-Dynamic Configuration function (PCSTAR 2) or menu 2.1.5.1.0 (HHC).
Data communication via the digital interface is not working. The BM 102 is in its start up phase, wait 50 seconds and try again.	The communication parameters of the computer are set incorrectly.	Check computer setting (address/device number).
	Bad connection to the interface.	Check connection.
	Current output value is < 4 mA.	Contact your KROHNE Service Centre**.
	Current output value is = 22 mA	If problem persists then contact your KROHNE Service Centre**.

* This document is available from your local KROHNE Sales office or on the "Download Centre" on KROHNE's website <http://www.krohne.com/>.

** KROHNE service centre contact details are supplied on the last page of this handbook.

Repeatability	± 2 mm or 0.08 “
Hysteresis	none
Resolution	± 1 mm or 0.04 “
Transient recovery time	The transient recovery time to 1% deviation from the final value amounts to approx. 4.6 times the programmed time constant. However, the transient recovery time may differ if changes in level are very rapid.
Start-up time	≤ 23 seconds
Long term drift	The long term drift is within the specified error of measurement. Allow for the thermal expansion coefficient in the case of liquids (organic liquids: ~0.15%/K)
Influence of ambient temperature	
current output	HART®: typically 70 ppm/K
measured value	Approx.25 ppm (max. deviation over whole measurement range).
atmosphere	-1 ppm/K (above the liquid product).
digital	No influence on measured value due to regular self-calibration.

Environment

Ambient temperature	-30°C ... +60°C or -20°F ... +140°F***
Storage temperature	-40°C ... +80°C or -40°F ... +176°F
Environment class	Locations exposed direct to open-air climate, D1
Protection	IP 65 / NEMA 4 – 4X
Shock resistance	The device withstands the impact test in conformity with EN 61010, Section 8.2 with 0.5 J energy.
Vibration endurance limit	IEC 68-2-6 and prEN 50178 (10-57Hz: 0.075 mm / 57-150 Hz: 1 G).

Power supply

Standard	24 V DC,
Hazardous-duty (Ex, FM, ...)	≤ 28 V DC
Range	18 ... 35 V DC

Process

Process temperature, product	-30°C ... +200°C or -22°F ... +392°F * **
Process temperature, flange	-30°C ... +90°C or -22°F ... +194°F, option +200°C or 390°F**
Process pressure, standard	-1 ... 16 bar or -14.5 ... 232 psig; max. 40 bar or 580 psig at 20°C or 45°F***

Minimum dielectric constant ϵ_r of product measured: probe type limits

Coaxial (type 3)	$\epsilon_r \geq 1.4$
Twin probe (type 4)	$\epsilon_r \geq 1.8$
Single probes (types 1, 2 & 6)	$\epsilon_r \geq 2.1$

Human interface

Communication, standard	Operator control and data display via PC using PCSTAR 2 software or HART® handheld communicator
	Point-to-point 1 gauge connected to a PC or HHC
	Multi-drop Up to 5 gauges connected to a PC or HHC

* see BM 102 MICROFLEX KEMA 00ATEX1101X Supplementary Installation and Operating Instructions for Ex values

** higher or lower temperatures on request (non-Ex)

*** Subject to the process temperature and the mechanical properties of the process connection

Construction materials

Housing	Aluminium with epoxy coating
Probe	Refer to section 5.2.1: BM 102 mechanical options
Gasket	Viton, optionally Kalrez 6375
Spacers (on twin probes)	Refer to section 5.2.1: BM 102 mechanical options

Weight

Housing	2 kg or 4.4 lb
Single rod Ø 8 mm	0.41 kg/m or 0.28 lb/ft
Single cable Ø 4 mm	0.12 kg/m or 0.08 lb/ft
Twin cable Ø 4 mm	0.24 kg/m or 0.16 lb/ft
Single cable Ø 8 mm	0.41 kg/m or 0.28 lb/ft
Coaxial	1.3 kg/m or 0.87 lb/ft

Standards

Electromagnetic compatibility directives followed for EU countries

The level gauge satisfies the protection requirements of :

Electromagnetic compatibility

Directive 89/336/EEC in conjunction with EN 61326-1(A1&A2) and EN 61000-6-2 standards. It also respects the NAMUR NE 21/98 standard. Protection against EMC emissions is only guaranteed when the device is used in metal tanks (except when the device is equipped with coaxial probes).

Other EU directives

Low voltage electrical equipment

Directive 73/23/EEC modified by Directive 93/68/EEC (art.13) in conjunction with the EN 61010-1 standard.

ATEX*

Directive 94/9/EC in conjunction with EN 50014, EN 50020 and EN 50284 standards.

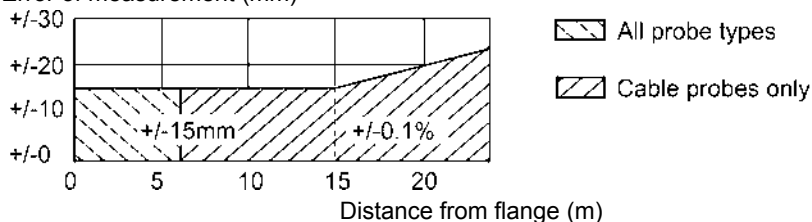
Refer to the BM 102 MICROFLEX KEMA 00 ATEX 1101X Supplementary Installation and Operating Instructions for further information.

5.1.1 Accuracy

Due to the method of measurement, which primarily determines distance, the measuring accuracy is specified only as a factor of distance. For that reason, all data in this section refers to the measured distance.

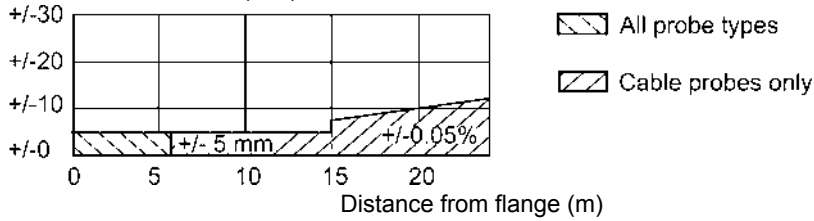
Standard calibration

Error of measurement (mm)



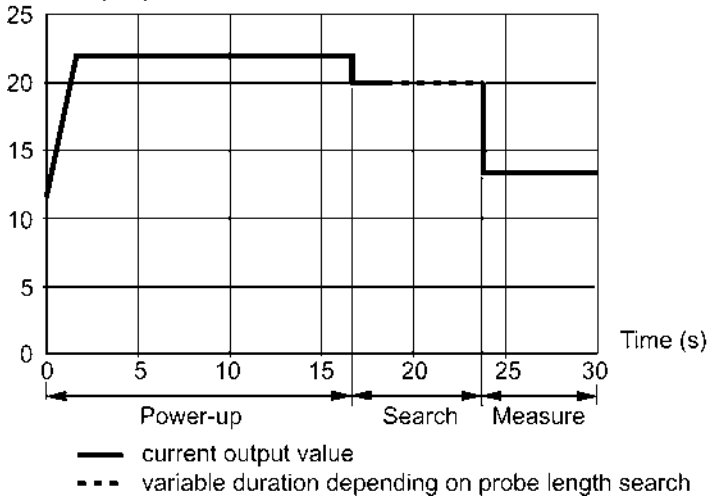
Special calibration

Error of measurement (mm)



5.1.2 Start-up characteristics

Current (mA)



The current output stays at 22 mA for 15 seconds once switched on.

The analogue output subsequently indicates a value between 4 and 20 mA until the level has been found.

After a maximum of 23 seconds, the current output indicates the measured level and follows it.

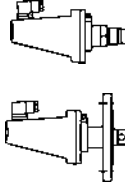
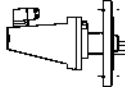
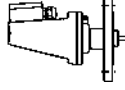
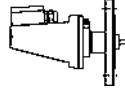
5.2 BM 102 equipment architecture

5.2.1 BM 102 mechanical options (by probe type)

		Liquid / Liquid Gas applications				
Probe (Type code)	Coaxial Øext. 28 mm or 1.1" (Type 3)	Twin cable Ø4 mm or 0.15" (Type 4)	Single cable Ø4 mm or 0.15" (Type 2)	Single rod Ø8 mm or 0.3" (Type 1)	Single cable Ø8 mm or 0.3" (Type 6)	
Description	Single inner conductor with protective tube.	Two flexible SS316 cables with spacers interspersed along its length, with short circuit and counterweight.	Single flexible cable with counterweight.	Single rigid rod.	Single flexible cable with counterweight.	
Level						
Range, max.	≤ 6 m or 20 ft.	≤ 24 m or 79 ft.	≤ 24 m or 79 ft.	≤ 3 m or 10 ft.**	≤ 24 m or 79 ft.	
Free area (no obstructions or discontinuities)	Ø0 mm or Ø0 "	Ø200 mm or Ø8 "	Ø600 mm or Ø24 "	Ø600 mm or Ø24 "	Ø600 mm or Ø4 "	
Minimum dielectric constant, εr	1.4	1.8	2.1	2.1	2.1	
Minimum process connection	DN50 PN 25/40 2" ANSI 150 lbs 1" G / 1" NPT	DN50 PN 25/40 2" ANSI 150 lbs 2" G / 2" NPT***	DN50 PN 25/40 2" ANSI 150 lbs 1" G / 1" NPT	DN50 PN 25/40 2" ANSI 150 lbs 1" G / 1" NPT	DN50 PN 25/40 2" ANSI 150 lbs 1½" G / 1½" NPT	
Probe material	SS 316L Hastelloy C276	SS 316 / 316L	SS 316 / 316L Hastelloy C22 SS 316 FEP coated	SS 316L Hastelloy C276 PVDF coated (non-Ex)* PVC coated (non-Ex)*	SS 316 / 316L	
					Powder	

Liquid * gauge with flange connection ** higher on request *** on request

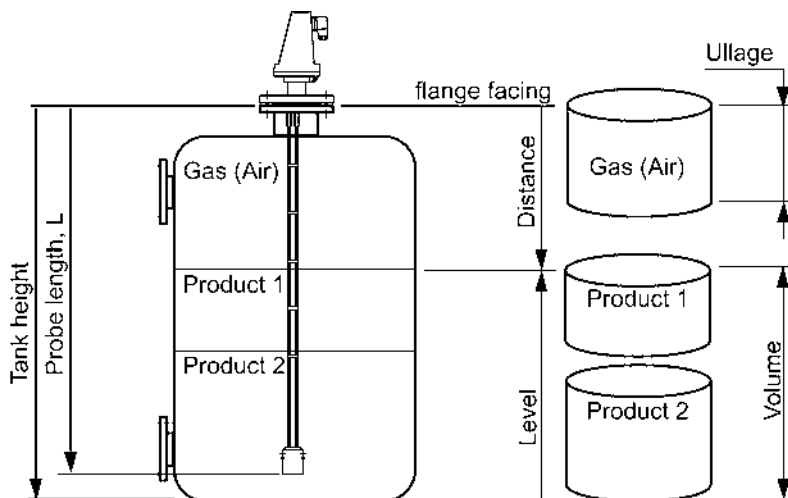
*** on request

Liquid / Liquid Gas applications				
Probe (Type code)	Coaxial Øext. 28 mm or 1.1" (Type 3)	Twin cable Ø4 mm or 0.15" (Type 4)	Single cable Ø4 mm or 0.15" (Type 2)	Single rod Ø8 mm or 0.3" (Type 1)
Spacer material	PTFE (if length > 1.5 m or 5 ft).	FEP moulded onto the cable.	No spacer.	No spacer.
Counterweight (dimensions in mm)	None	Ø45 x 60 (316L) Turnbuckle (316L)	Ø25 x 100 (316L) Ø25 x 100 (HC22) Ø25 x 100 (HC276) Chuck (316L) Turnbuckle (316L)	Ø12 x 100 (316L), where L > 10 m Ø45 x 245 (316L), where L < 10 m Turnbuckle (316L)** Without**
Gauge illustration				
				Powder

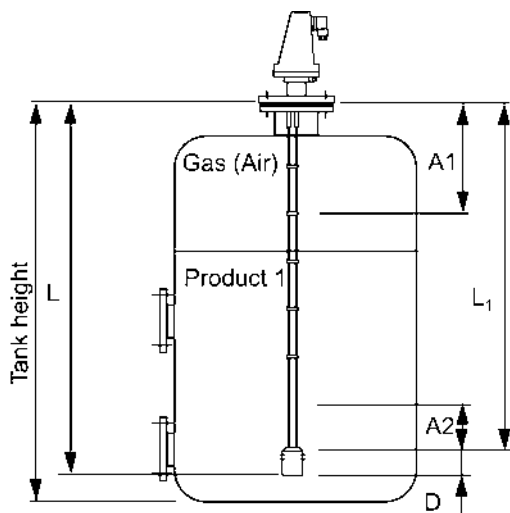
** on request

5.2.2 Definition of terms

Distance	Distance from the face of flange to the level (1 product) or the surface of the top product (2 products).
Level:	Height from the bottom of the of the tank to the surface of the top product (Tank height – distance).
Probe Length:	Ordered length of probe, L1, from face of flange to end of probe (including short circuit and counterweight).
Tank Height:	Distance from the face of the flange to the bottom of the tank.
Ullage (volume):	Unfilled volume.
Volume:	Total volume filled.



5.2.3 Probe measurement limits



A1, the top dead zone,

The minimum distance from the flange to the top limit of the measuring range. The measurement displayed on the gauge will freeze below this distance and status markers will indicate that the reflection has been lost.

A2, the bottom dead zone,

A length at the end of the probe where measurement is not possible. For products with very low dielectric constants ($\epsilon_r < 5$), accuracy may be affected in a non-linear zone up to 150 mm or 6" above the bottom dead zone, A2

D, the non measurement zone,

A zone where measurements cannot be taken (i.e. the counterweight, turnbuckle, etc.*). The measurement displayed on the gauge will freeze to L_2 .

L₁, factory configured probe length

Length to the end of the probe (excluding short circuit or counterweight*). This parameter is given in User Function 1.1.6: Probe length in the User Configuration Mode.

L, with probe length

The length specified by the customer in the order (including the counterweight).

Note : dead zone = blocking distance

*except the $\varnothing 12$ mm x 100 mm or $\varnothing 1/2$ " x 4" counterweight for the $\varnothing 8$ mm or 0.3 " single cable probe



Warning:

Set PCSTAR 2 User Function 1.1.2 "Dead zone" in the gauge's configuration mode to at least top dead zone size as specified per probe type in the table below, so that the gauge never displays product level within this zone. Refer to user function 1.1.2 in section 4.2 for more information.

Probe measurement limits

Probe type	Top dead zone, A1 $\epsilon_r = 80^*$	Bottom dead zone, A2 $\epsilon_r = 80^*$	Top dead zone, A1 $\epsilon_r = 2.4^*$	Bottom dead zone, A2 $\epsilon_r = 2.4^*$
Twin cable $\varnothing 4$ mm (4)	150mm or 6"	20mm or 0.8"	300 mm or 12"	100mm or 4"
Single cable $\varnothing 4$ mm (2)	300mm or 12"	20mm or 0.8"	400mm or 15 $\frac{3}{4}$ "	100mm or 4"
Single rod (1)	300mm or 12"	20mm or 0.8"	400mm or 15 $\frac{3}{4}$ "	100mm or 4"
Single cable $\varnothing 8$ mm (6)	300mm or 12"	20mm or 0.8"	400mm or 15 $\frac{3}{4}$ "	100mm or 4"
Coaxial (3)	0mm or 0"	10mm or 0.4"	0mm or 0"	100mm or 4"

*The dielectric constant ϵ_r of water is 80. The dielectric constant ϵ_r of oil is 2.4



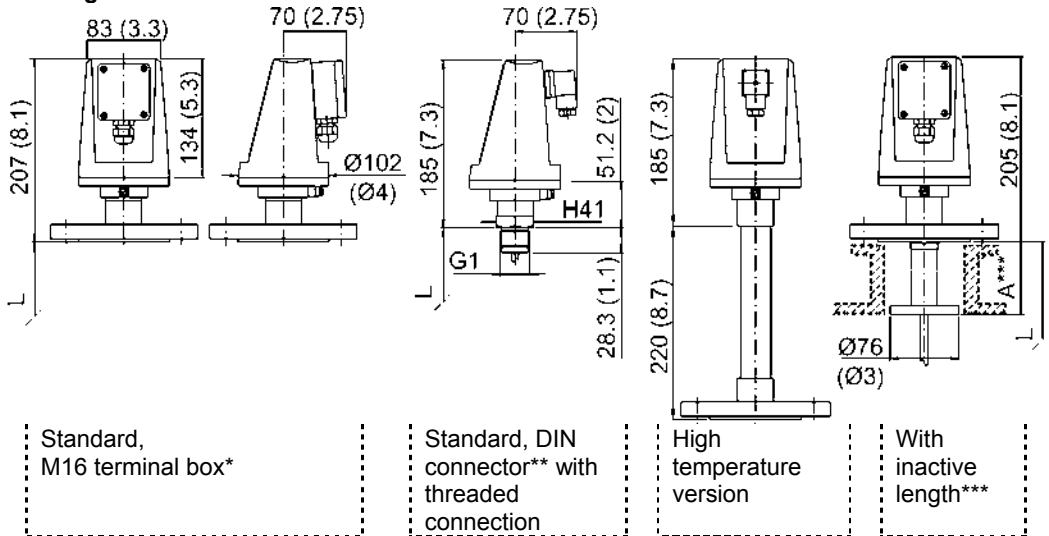
Note:

If the device is mounted on a tank fitting (e.g. a nozzle), include the height of the tank fitting in the programmed dead zone.

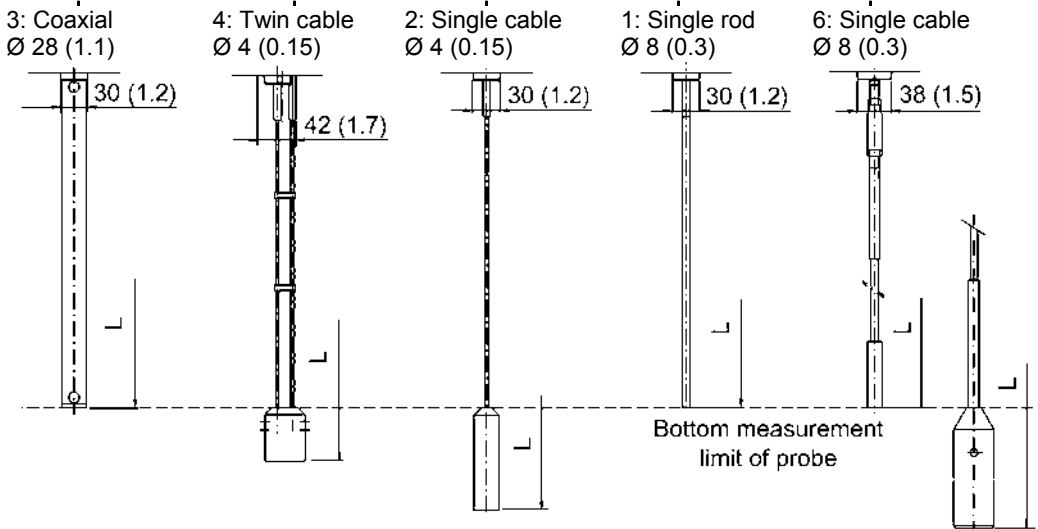
5.3 Gauge dimensions

This diagram illustrates standard gauge configurations and overall dimensions.

Housing



Probe



Standard counterweight

None	Ø45x60 (Ø1½x2½)	Ø25x100 (Ø1x4)	None	Ø12x100 (Ø½x4)**** or Ø45x245 (Ø½x9¼)*****
------	--------------------	-------------------	------	---

Size of threaded hole in base of counterweight for anchoring

None	M8	M8	None	M8
------	----	----	------	----

Dimensions in mm (inches)

* with a cable fitting M16X1.5 Ø3.5-Ø8 ** with a cable fitting PG11 Ø8-Ø10 DIN43650-A
 *** the inactive length (i.e. a non-active extension at the top of the probe) may be supplied with the following standard lengths : 100 mm or 4", 200 mm or 8", 300 mm or 12", 400 mm or 16", 500 mm or 20" and 1 m or 40" – for single rod and single cable probe versions only.
 **** where L > 10m or > 33ft ***** where L < 10m or < 33ft L = ordered probe length

6 Measuring principle

6.1 General principle

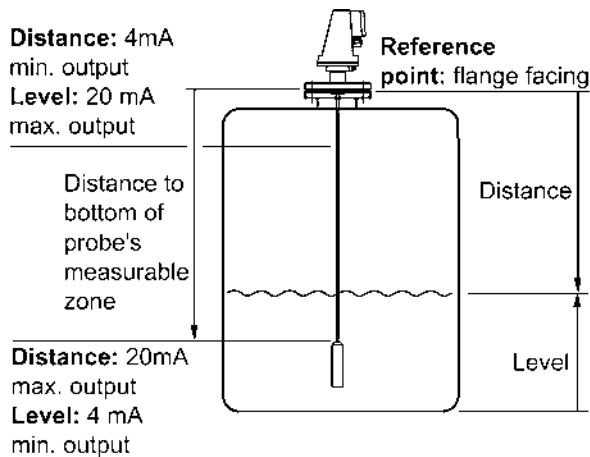
The BM102 MICROFLEX has been developed from a tried and tested technology called "Time Domain Reflectometry" (T.D.R.). Other modern applications include checking for and locating damage along telecommunication cable lines.

The BM 102 sends low-power electromagnetic pulses of one nanosecond width along a rod or cable conductor. This pulse travels at a known speed: the speed of light. Upon reaching the surface of the product to be measured, the pulses are reflected back with a signal strength that is dependent on the dielectric constant, ϵ_r , of the product (e.g. up to 80% of the pulse strength is reflected from the surface of water).

A product's dielectric constant, ϵ_r , is an electrical property. The strength of pulse reflection from the surface of the product being measured is registered by the instrument as signal amplitude in volts.

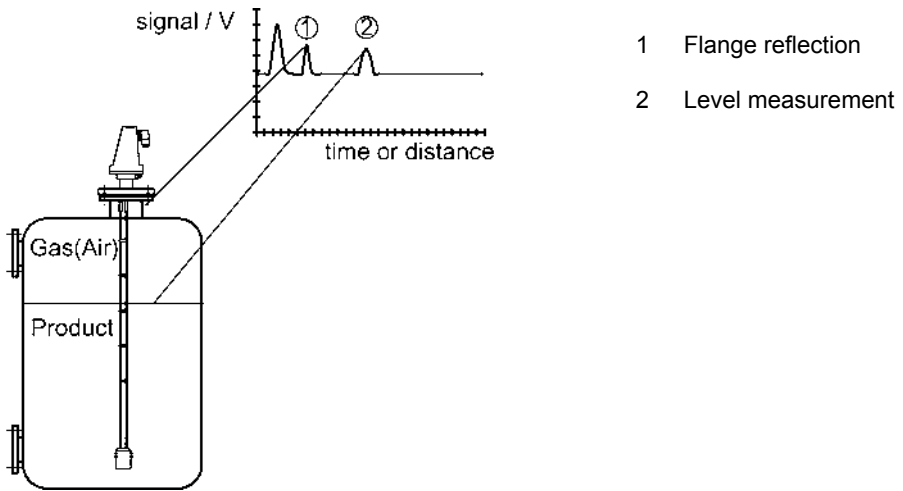
The instrument measures the time between the emission and the reception of the signal: half of this time corresponds to the distance from the instrument reference point (the flange facing) to the product surface. This value of time is converted into an analogue output current between 4 and 20mA or a digital signal corresponding to a calibrated distance which can then be displayed digitally in a variety of forms from a list of choices available in the gauge's user menu.

Readings taken using this technology have the advantage of being uninfluenced by dust, foam, vapour, agitated and boiling surfaces. Pressure, temperature and density variations also have no effect.



The BM 102 determines level using a "direct" measurement method, explained below.

Level measurement as signal amplitude over time since signal was emitted



6.1.1 Level measurement of one product


The pulse is emitted by the instrument and guided along the probe. It reflects off the first product surface it meets and returns to the instrument.

The distance from the gauge flange to the product is proportional to the time taken:

$$\text{Distance} = \frac{c_0 \cdot \text{time taken}}{2}, \text{ where } c_0 \text{ is the speed of light in air.}$$

Level is determined by subtracting the distance to the product from the tank height. Note that the instrument is normally delivered with level being measured from the end of the probe, where the tank is taken to be empty once the product falls below this point.

7 Certificates and Approvals

Approval and project code	Approved classes and groups
ATEX* KEMA 00 ATEX 1101 X	 II 1 G or II 1/2 D T 100 °C EEx ia IIC T6 ... T3 or EEx ia IIB T6 ... T3
Factory Mutual Research* Project ID 3009543	Intrinsically Safe apparatus for use in Class I, II and III, Division 1, Groups A, B, C, D, E, F and G and Class I Zone 0 Group IIC hazardous (classified) locations in accordance with Entity requirements and Control drawing F0820860412.
CSA* Project 1183965 (Edition 1) (KEMA: 2007223.00)	Class: 2258 04 – Process Control Equipment – Intrinsically Safe, Entity – For Hazardous Locations Products: Class I, Groups A, B, C and D; Class II, Groups E, F and G; Class III.

Symbols used for the identification of approved equipment



Conformity to E.U. directives and norms



Ex-approved
**



FM-approved
**



CSA-approved
**

* Refer to BM 102 MICROFLEX KEMA 00 ATEX 1101 X Supplementary Installation and Operating Instructions for further information. The certificates are available on KROHNE's download centre webpage on <http://www.krohne.com/>.

**The above symbols, with the exception of the "CE" symbol, will not appear on gauge nameplates or supplied paperwork unless the approvals are specified in the order by the customer.

8 PCSTAR 2 software user's guide

This section is a complete guide to the functions available in PC STAR 2 V2.01, a software program developed in-house to optimise remote configuration and data display on a PC (Personal Computer) work station. It is supplied as standard with the instrument.

8.1 Software installation

Refer to section 3.3.1.

8.2 PCSTAR 2 software history

Date of introduction	PC user software (PCSTAR 2) details		
	Software release	Compatible operating system (PC)	Compatible BM 102 firmware
04/2000	V0.42a	Win 3.x, Win 9.x	Ver. 1.00
07/2000	V0.43a	Win 9x	Ver. 1.10 to 1.11
01/2001	1.00	Win 9x	Ver. 1.20 to 1.22
10/2002	2.00	Win 9x, 2000, Me, NT	Ver. 1.22 to 1.23
06/2003	2.01	Win 9x, 2000, Me, NT, XP	Ver. 1.20 to 1.23

8.3 Supported networks

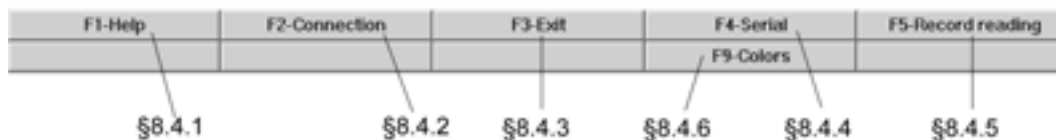
- Point-to-point
- Multi-drop

Refer to section 5.5.1.

8.4 PCSTAR 2 functions

Check that the correct hardware has been installed to allow communication between the gauge and the work station. Once the software is running, the basic functions (and the associated function keys) will be shown at the foot of the first page.

Open the PCSTAR 2 software. The operator will see the PCSTAR 2 main title window:



To enter the functions displayed in the diagram above, move the cursor to the bar concerned and left-click to open or use the keyboard function key (F1 – F10) indicated. The functions and sub-functions available are discussed in sections 8.4.1 to 8.4.7 below.

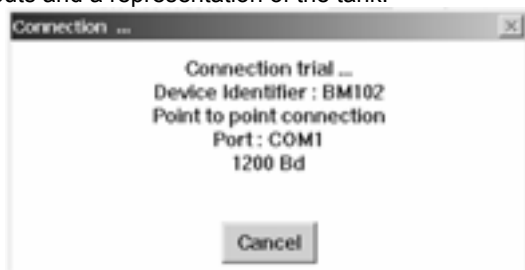
8.4.1 F1 Help

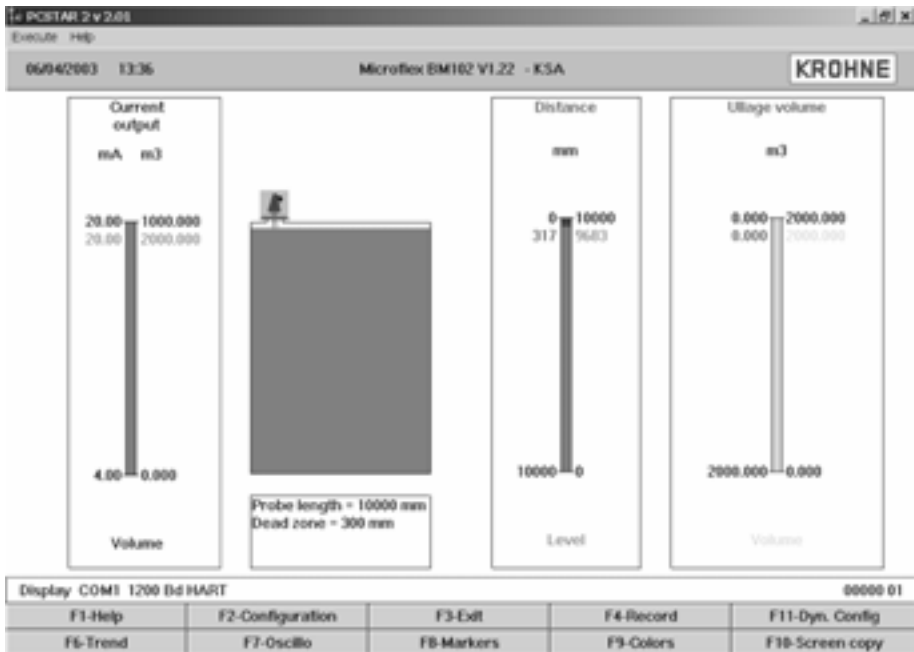
PCSTAR 2 Off- and On-line Help file for a summary of PCSTAR 2 functions.

8.4.2 F2-Connection: on-line functions

F2-Connection opens a real-time connection between PCSTAR 2 and the gauge.

This establishes a connection with the gauge(s). A small window will open either confirming the connection or advising the user otherwise. This will open a window which displays graphics of the current status of outputs and a representation of the tank.





This shows the real-time tank status. This screen is divided into three parts. In default layout for a single output, this will show a bar with Current output and level graduations on the left hand side, a representation of the tank with its contents in the middle (the top dead zone will be indicated as a grey dotted line) and a bar with distance and level graduations on the right.

Functions available on this screen are:

F1-Help	On-line help (presents information given in this guide)
F2-Configuration	BM 102 user parameters.
F3-Exit	Disconnect from gauge
F4-Record	Configure PCSTAR to record data from the gauge over a given time period
F6-Trend	level against recording time graph
F7-Oscillo(scope)	Voltage amplitude against distance from flange graph displaying all reflections registered along the probe.
F8-Markers	Status markers on/off graph
F9-Colors	For modifying the colour of display screen elements
F10-Screen copy	Saving for printing this screen in bitmap format
F11-Dyn. Config (dynamic configuration)	For changing the control threshold for detecting reflections manually. Useful when there are obstructions causing parasite signals in the tank.

These functions are described on the following pages.

F1 – Help Menu:

On-line help file.

F2 – Configuration Menu:

For creating and modifying gauge settings while PCSTAR 2 is connected to the gauge. The configuration may also be created, modified or saved without sending the new settings to the gauge in this window. The User configuration menu will be listed as shown in Section 3.3.1 of this manual. The values displayed will be either default or customer-order specified values. Follow the instructions in this section to configure the gauge.

1.0.0. Operation	
1.1.0. Basis parameters	
1.1.1. Tank height (0.60000 mm)	10000 mm
1.1.2. Dead zone (0.10000 mm)	300 mm
1.1.3. Time constant (1 - 100 s)	5 s
1.1.6. Probe length (0.27000 mm)	10000 mm
1.2.0. Display	
1.2.4. Length unit	mm

F1-Help	F2-Load from disk	F3-Exit
F4-Load from BM102	F5-Save to disk	F6-Send to BM102

Functions available on this page (use scroll slider on the right hand side to show all):-

User functions 1.1.1, 1.1.2, 1.1.3 & 1.1.6 : Basis Parameters

User functions 1.2.4, 1.2.5 & 1.2.6 : Display Parameters

User functions 1.3.1 to 1.3.5 : Current Output I Parameters

User functions 1.4.3 to 1.4.9 : User Data Parameters

User function 1.5.1 : Application Parameter

User function 1.6.2 : Serial Input/Output Parameter

User function 1.7.0 : Volume Table Parameters and...

F1 – Help :

On-line help file

F2 – Load from disk :

This loads old settings from the hard disk onto PCSTAR 2 (but not to gauge).

F3 – Exit:

Exit configuration page to real-time measurement main window.

F4 – Load from BM102:

This loads the configuration used by the gauge into PCSTAR 2.

F5 – Save to disk:

Press to save a configuration onto disk in *.KRF format. This allows the user to load configurations later and also facilitates analysis of the gauge by KROHNE personnel if a problem is encountered.

F6 – Send to BM102:

Press this once all configuration parameters have been entered. This will load the new configuration into the gauge.

F3 – Exit

Quit to main title window.

F4 – Record Menu

The software will temporarily record the last two hours of operation without using the record menu. This information will be displayed on the “Trend” and “Markers” windows. However, if the user wishes to make a permanent record of measurement data then it is necessary to set and confirm a measurement record period in this menu. It is also recommended to activate the “Oscilloscope” option in order to have information on pulse reflection times.

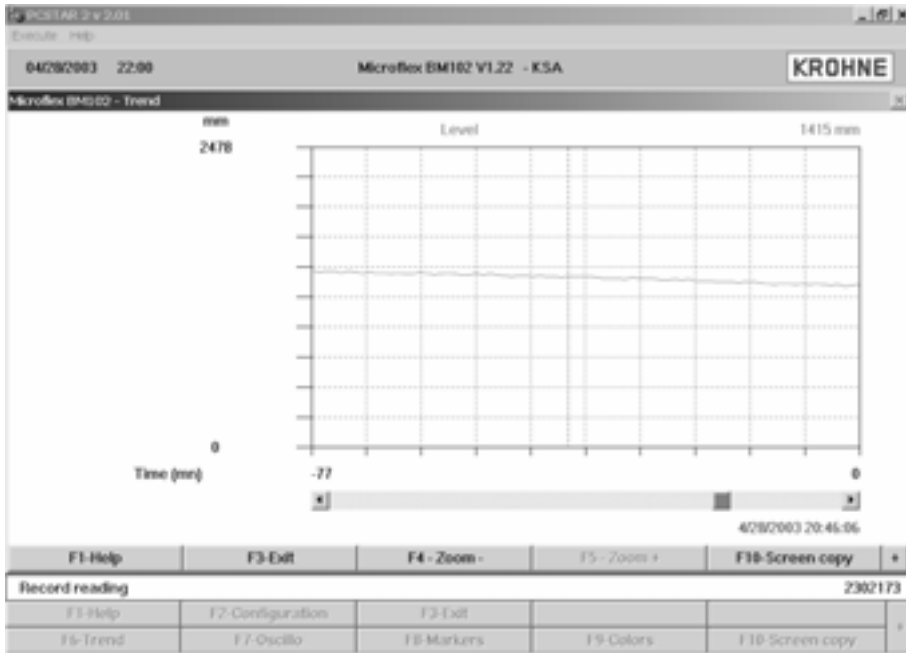
This is set in the window below:

Functions available on this page:-

F1 – Help:	On-line help file
F2 – Start:	Start Record
F3 – Exit:	Exit to real-time measurement main window
Browse:	Find directory and create record file (*.dat)
Recording Options:	Start of Recording- Either from now or a delayed start (date and time)
	End of Recording- Either in a given number of hours or a given date and time.
	Signal/ Oscilloscope- Activate these zones to record these types of data.
	Time slice- Time spacing between each recorded reading. Range: 1 to 30 minutes.
	Comments- Complementary information concerning the record (50 characters maximum)

F6 – Trend Menu

Displays a real-time graph of level against time since the gauge started recording.

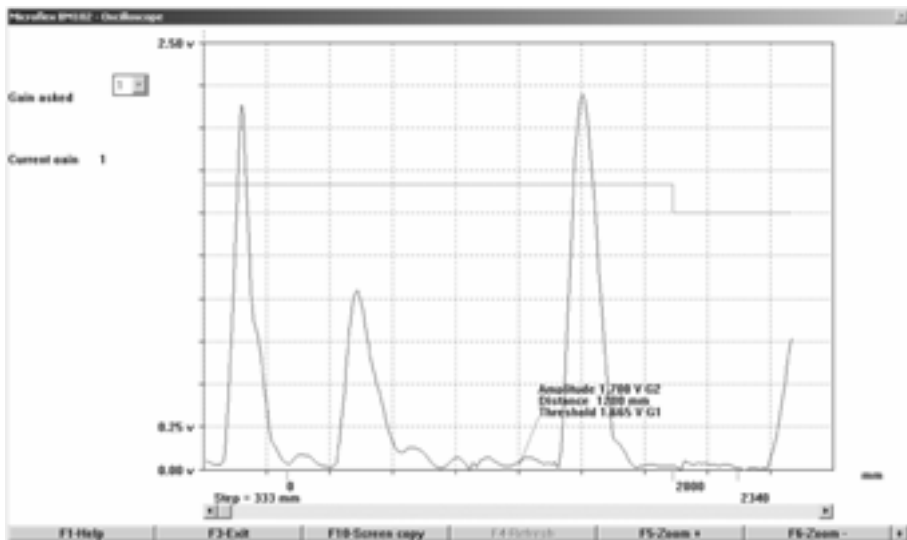


Functions:-

- F1 – Help:** On-line help file
- F3 – Exit:** Exit to real-time measurement main window
- F4 – Zoom -:** Reduces the time scale
- F5 – Zoom +:** Increases the time scale
- F10 – Screen copy** To select a directory and save the current screen as a bitmap file.

F7 – Oscilloscope function

Using the F7 – Oscilloscope function (Oscillo.), all reflections occurring at the probe can be displayed. This is a help for optimum setting of the dead zone, the non-measurable zone, and the threshold under Function F11. It provides details on the position and strength (amplitude) of every signal between the initial pulse and the tip of the probe.



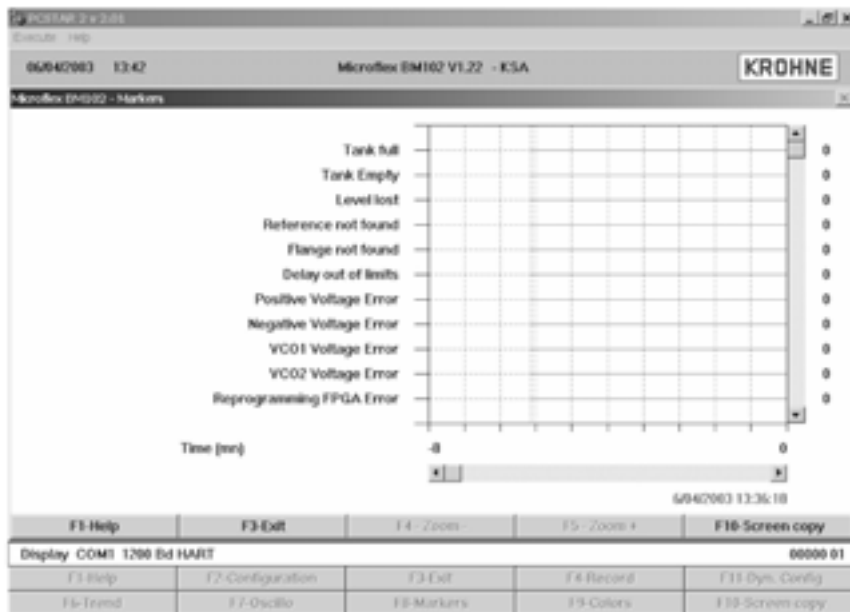
Refer to section 3.4.2: Gain and signal amplitude for information on how to use F7-Oscilloscope and F11-Dynamic Configuration windows to modify Gain and level threshold manually to assist detection of the product surface in unfavourable installation conditions.

Other functions available on the Oscilloscope window:

- | | |
|--------------------------|---|
| F1 – Help | On-line help file |
| F3 – Exit | Exit to real-time measurement main window |
| F4 – Zoom - | Reduces the time slice scale |
| F5 – Zoom + | Increases the time slice scale |
| F10 – Screen copy | To select a directory and save the current screen as a bitmap file. |

F8 – Markers Menu

Displays a real-time evolving graph of error markers which are either displayed as active (value 1) or inactive (value 0).



Refer to section 4.2 “Fault clearing” for corrective procedures when the markers shown above are active.

Other functions available on the Markers window:

- F1 – Help** On-line help file
- F3 – Exit** Exit to real-time measurement main window
- F4 – Zoom -** Reduces the time slice scale
- F5 – Zoom +** Increases the time slice scale
- F10 – Screen copy** To select a directory and save the current screen as a bitmap file.

F9 – Colors Menu

Refer to section 8.4.7 for all information concerning this set of functions.

F10 – Screen copy Menu

To save a bitmap image of the active window.

F11 – Dynamic configuration

Use F11-Dyn. Config. to get into the “Dynamic Configuration” menu.

Microflex BM600 - Dynamic User Configuration

Threshold 317 mm
Distance Amplitude Gain 1.296 V 0

Threshold 50 mV Modify

Distance Input Distance mm Search

Search End of Probe Search

Value to test 4 mA Current output tests Test

F1-Help F3-Exit F10-Screen copy

Display COM1 1200 Bd HALF 00000 81

F1-Help F2-Configuration F3-Exit F4-Record F11-Dyn. Config
F6-Trend F7-Oscillo F8-Markers F9-Colors F10-Screen copy

Here, you can:

- read the distance to the product surface, the amplitude and the amplification factor,
- change the level threshold
- specify the distance to the product surface,
- initiate automatic search of the probe tip,
- test the current output.

Fct. Threshold

The level threshold must be adjusted according to the amplitude and the amplification factor of the level reflection signal. The factory-set threshold is suitable for most applications.

Factory-set threshold	500V, gain 3 when distance < 2 m or < 6½ ft
Min. threshold	50 mV, gain 3
Max. threshold	2500 mV, gain 0

Where interference reflections are caused by tank fittings/nozzles or other internals, which can lead to faulty measurements, the level threshold must be adjusted. The interference signals are suppressed and only the signals are indicated whose amplitude lies above the threshold.



NOTE:

The level threshold may not be set when the tank is full; rather, it should ideally lie halfway between the level and interference reflections.

To set the level threshold, we recommend the following filling height:

- Minimum height: 300 mm or 12 " above the probe tip or the upper weight,
- Maximum height: distance to flange at least 500 mm or 20 "

Fct. Input distance

This function is used to search for the level signal at a pre-configured distance. The current output is set to the appropriate value directly after the distance has been input.



Note:

If the function is executed during normal operation, this may possibly have consequences on downstream systems.

Fct. Search end of probe

This function automatically defines the probe length. It is used, for example, after the probe has been shortened. The tank needs to be empty when this function is executed. If the probe tip is not found, possibly a level threshold has been set that is too high. Set the threshold to a lower value so that the reflection signal from the probe tip can be identified.

Fct. Current output tests

This function is used to check the accuracy of the analog output by means of a milliammeter. For this test a milliammeter must be connected into the loop. The following current values to be generated can be selected: 4/8/12/20/22 mA.

Other functions:-

F1 – Help

On-line help file,

F3 – Exit

Exit to real-time measurement main window,

F10 – Screen copy

To select a directory and save the current screen as a bitmap file.

8.4.3 F3 Exit:

To quit PCSTAR.

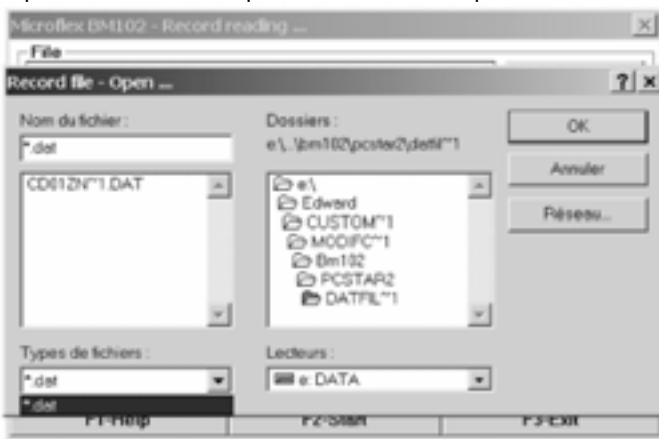
8.4.4 F4 Serial (parameters):

For configuring the gauge for networks. Refer to section 3.3.1 for a list of available parameters.

8.4.5 F5 Record (Reading):

Play back recording functions (offline).

1. The function will display a window: Record file – Open.... Browse for the DAT file required. Press OK to open file or Cancel to quit.



2. When OK is pressed, the DAT file details are displayed.



Functions:

F1 – Help

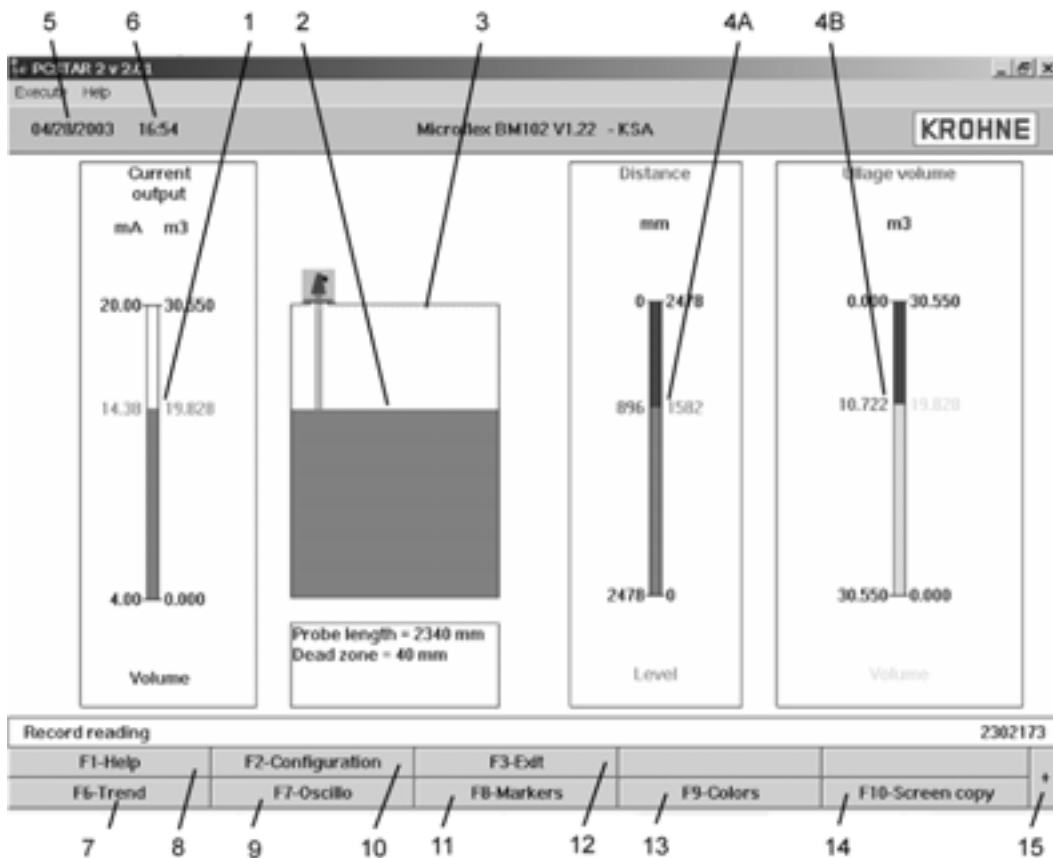
On-line help file.

F2 – Start

Start reading the file data. Goes to record reading main window – see below.

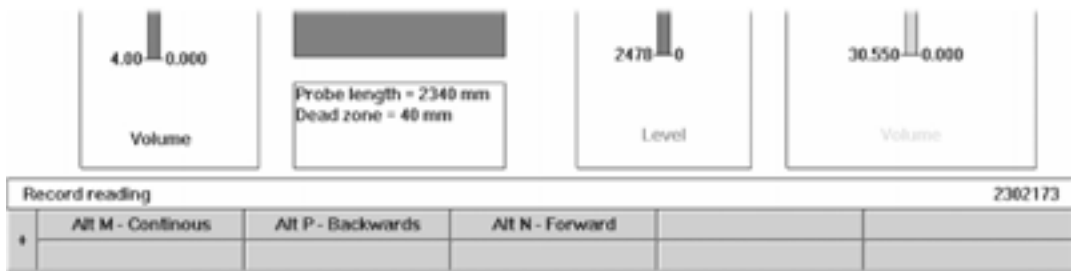
F3 – Exit

Exit to main title window.



Item	Item Description
1	Current output 1/ level in mA/mm
2	Tank diagram showing current position of level
3	Dead zone limit (configured)
4A & B	(A) Distance/ level of top product in mm & (B) Ullage volume/ volume in liters* (*configurable display).
5	Date of time slice
6	Time of time slice
7	F6: Trend function – shows level and interface over time recorded
8	F1: Help – on-line help function
9	F7: Oscilloscope – to display signal amplitude/return signal time at a given day and time
10	F2 : Configuration – access to user menu. The settings here are read-only. This list will also show modifications to the gauge settings over the time measurement data is recorded
11	F8 : Markers – Error indicators activated at a given time and date
12	F3 : Exit Record Reading window
13	F9 : Colors – change screen component colours as shown in Section 8.4.3
14	F10 : Screen copy – function for saving bitmaps of the current screen.
15	+ : playback functions – see screenshot below

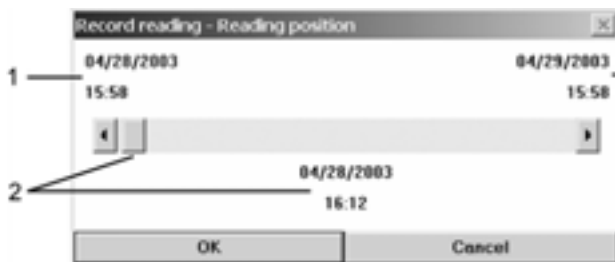
The Signal, Trend, Markers, Configuration function windows given in the list on the preceding page correspond to those found in the real-time display windows with the exception that the real-time functions are suppressed, i.e. F6 Numerize in the Alt F1 Oscilloscope window.



Bottom of Record Reading main screen when the “+” sign is pressed

“+” sign ...at the bottom right hand side of the window. This will access the viewing features in the Record Display Window (item 15).

- Alt M to view either the data in Continuous mode or in Step by step mode.
- Alt N to view “Forward” (Continuous mode) or “Next (step)” (Step by step mode).
- Alt P to view “Backwards” (Continuous mode) or “Previous (step)” (Step by step mode).
- Alt B Reading Position - A slider control appears to permit the user to browse quickly through the time slices recorded, as shown below. Either click on the arrows at the end of the bar to move back or forward one time slice, or hold the left mouse button down and pull the slider along to the required time slice.



- 1 Record start time slice
- 2 Currently displayed time slice
- 3 Record stop time slice

8.4.6 F9 Colors

Change colours used on PCSTAR display board. 16 are available.



- F1 – Help** On-line PCSTAR Help
- F2 – Exit and save** Saves new settings for the screen elements concerned
- F3 – Exit** Exit to main title window without saving modified elements.
- F4 – Default colors** Reset to original colour scheme

Modifiable color parameters

Screen elements	Chosen component
Select display window from the drop-down menu	Selected by scrolling through a drop-down menu or by clicking on the element concerned. Click on colour palette to select colour and press F2 to save modified settings and exit.
Tank	Background, tank, text, level, interface level, shadow, information background, information text and light.
Current outputs	Background, current outputs text, current output 2, current output 1, shadow and light.
Measurement bar graphs	Background, level, text, distance, interface level, volume, ullage volume, shadow and light.
Signal	Background, dead zone, frame, grid, signal, position arrow, actual gain, other gains, shadow and light.
Trend/Markers	Background, markers, frame, grid and position cursor

8.4.7 Other important PCSTAR 2 functions

Ctrl Alt R: BM 102 MICROFLEX – Reset

This resets the gauge from the main screen. This should be done before operating with a new configuration. It empties the old data temporarily stored in the gauge memory and permits the gauge to go through a series of checks to accept and operate with a new configuration.

Changing languages

Close PCSTAR 2. Go to “Start up” at the bottom of the desktop screen. Select menu “Programs” then “KROHNE MICROFLEX BM102” from the options given and finally select “Change PCSTAR 2 language” from this submenu. A choice of three languages (English, French and German) is given. Select the one required and confirm “OK” then re-open PCSTAR 2.

8.5 Fault Clearing PCSTAR 2

Event	Fault	Action
PCSTAR 2 is unable to connect to the gauge	The RTS Shutdown parameter is unable to assign a value to the PC operating system (XP for PCSTAR 2 versions prior to 2.01) When at default value 0, PCSTAR 2 tests the O.S. to identify which one is installed. An RTS Shutdown timing value is assigned depending on the results. However, this test may not recognize Windows XP, so PCSTAR will not work.	Please follow the corrective procedure below:

Corrective procedure to permit gauge to connect to PCSTAR 2 using OS WINDOWS XP

Step	Action	Data entered/value set
1	Go to PcSt2NT.ini file in the Windows directory on the hard disk under the PC STAR 2 sub-directory.	n/a
2	Find RTSShutdown in the list of parameters. The default value is 0.	n/a
3	Modify the line.	RTSShutdown = 150
4	Save file.	n/a
5	Close the file and run PCSTAR 2. No further software configuration problems should be encountered.	n/a

Appendix A: BM 102 Level Gauge Configuration Record

Please enter the data that has been set in the signal converter.

BM 102 Parameters Checklist	Firmware-Vers.:	Date:	
Device:	Comm. No.:		
Location:			
Contact person:	Telephone:		
Remarks:			

Menu item changed, date: .../.../..... .../.../..... .../.../.....

Fct.	User configuration parameters		
1.1.1	Tank height		
1.1.2	Dead zone		
1.1.3	Time constant		
1.1.6	Probe length		
1.2.4	Length unit		
1.2.5	Volume unit		
1.2.6.1	(new) unit name		
1.2.6.2	(new) unit factor		
1.3.1	Current output 1, item		
1.3.2	Current output 1, range		
1.3.3	Scale I1 min (4mA)		
1.3.4	Scale I1 max (20mA)		
1.3.5	Error delay		
1.4.4	Device number		
1.5.1	Detection delay		
1.6.2	Address		
	Threshold		

Strapping (volume) table values (please specify units)

Point	Level	Volume	Point	Level	Volume
0			10		
1			11		
2			12		
3			13		
4			14		
5			15		
6			16		
7			17		
8			18		
9			19		

Menu item changed, date: .../.../..... .../.../..... .../.../.....

Fct.	Factory configuration parameters (KROHNE SERVICE TECHNICIANS ONLY)		
1.1.1	Probe type		
1.1.2	Offset		
1.1.3	Application type		
1.1.4	Epsilon R		
2.1	Electronic offset		
2.4	Electronic Calspeed		
2.5	Mechanical Calspeed		
2.6	Reference frequency		

Appendix B: BM 102 – CE Declaration of Conformity

Konformitätserklärung	Declaration of Conformity	Déclaration de conformité																		
<p>Wir: KROHNE SA Usine des Ors 26103 ROMANS France</p>	<p>We: KROHNE SA Usine des Ors 26103 ROMANS France</p>	<p>Nous: KROHNE SA Usine des Ors 26103 ROMANS France</p>																		
<p>erklären in alleiniger Verantwortung, daß das Produkt:</p>	<p>declare under our sole responsibility that the product:</p>	<p>déclarons sous notre seule responsabilité que le produit:</p>																		
<p>Füllstandmesser BM102</p>	<p>Level Measuring Instrument BM102</p>	<p>Transmetteur de niveau BM102</p>																		
<p>auf die sich diese Erklärung bezieht, mit den folgenden Normen oder normativen Dokumenten übereinstimmt:</p>	<p>to which this declaration relates, is in conformity with the following standards or other normative documents:</p>	<p>auquel se réfère cette déclaration, est conforme aux normes ou autres documents consultés:</p>																		
<table border="0"> <tr> <td>Niedrigspannung</td> <td>NF EN 61010-1</td> </tr> <tr> <td>EMV</td> <td>EN 50081-1 EN 50082-2</td> </tr> <tr> <td>ATEX*</td> <td>EN 50014 EN 50020 EN 50284</td> </tr> </table>	Niedrigspannung	NF EN 61010-1	EMV	EN 50081-1 EN 50082-2	ATEX*	EN 50014 EN 50020 EN 50284	<table border="0"> <tr> <td>Low tension</td> <td>NF EN 61010-1</td> </tr> <tr> <td>EMC</td> <td>EN 50081-1 EN 50082-2</td> </tr> <tr> <td>ATEX*</td> <td>EN 50014 EN 50020 EN 50284</td> </tr> </table>	Low tension	NF EN 61010-1	EMC	EN 50081-1 EN 50082-2	ATEX*	EN 50014 EN 50020 EN 50284	<table border="0"> <tr> <td>Basse tension</td> <td>NF EN 61010-1</td> </tr> <tr> <td>CEM</td> <td>EN 50081-1 EN 50082-2</td> </tr> <tr> <td>ATEX*</td> <td>EN 50014 EN 50020 EN 50284</td> </tr> </table>	Basse tension	NF EN 61010-1	CEM	EN 50081-1 EN 50082-2	ATEX*	EN 50014 EN 50020 EN 50284
Niedrigspannung	NF EN 61010-1																			
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<p>*Nur für Ex Geräte gemäß den Bestimmungen der Richtlinien 89/336/EWG (Elektromagnetische Verträglichkeit), 73/23/EWG (Niederspannungsrichtlinie) und 94/9/EG (ATEX)</p>	<p>*For Ex devices only according to the provisions of Directives 89/336/EEC (Electromagnetic Compatibility), 73/23/EEC (Low Voltage Directive) and 94/9/EC (ATEX)</p>	<p>*Seulement pour les appareils EX conformément aux dispositions des directives 89/336/CEE (Compatibilité Electromagnétique), 73/23/CEE (Basse Tension) et 94/9/CE (ATEX)</p>																		
<p>Romans, den 29 Oktober 2001</p>	<p>Romans, October 29th, 2001</p>	<p>Romans, le 29 octobre 2001</p>																		
 Christian Savary Geschäftsführer	 Christian Savary General Manager	 Christian Savary Directeur Général																		

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Appendix C: Returning a device for testing or repair to KROHNE

Your instrument has been carefully manufactured and tested. If installed and operated in accordance with these operating instructions, it will rarely present any problems. Should you nevertheless need to return an instrument for inspection or repair, please pay strict attention to the following points.

Due to statutory regulations on environmental protection and safeguarding the health and safety of our personnel, KROHNE may only handle, test and repair returned devices that have been in contact with products without risk to personnel and environment.

This means that KROHNE can only service your instrument if it is accompanied by the following certificate confirming that the instrument is safe to handle. If the instrument has been operated with toxic, caustic, flammable or water-endangering products, you are kindly requested:

- to check and ensure, if necessary by rinsing or neutralizing, that all cavities are free from such dangerous substances,
- to enclose a certificate with the level gauge conforming that it is safe to handle and stating the product used.

We cannot service your instrument unless accompanied by such a certificate.

Specimen certificate

Company: _____ Address: _____

Department: _____ Name: _____

Tel. No.: _____ Fax No.: _____

The enclosed level gauge _____

Type: _____

KROHNE Order No. or Serial No.: _____

has been operated with the following process
liquid: _____

Because this liquid is

<input type="checkbox"/>	water-hazardous
<input type="checkbox"/>	toxic
<input type="checkbox"/>	caustic
<input type="checkbox"/>	flammable

we have

<input type="checkbox"/>	checked that all cavities in the instrument are free from such substances
<input type="checkbox"/>	flushed out and neutralized all cavities in the device

We confirm that there is no risk to humans or environment through any residual liquid contained in the instrument.

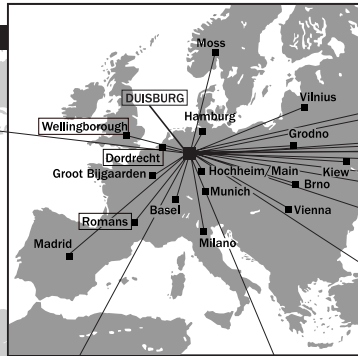
Date: _____ Signature: _____

Company stamp:

<http://www.krohne.com>

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Denmark	Poland
Ecuador	Portugal
Egypt	Saudi Arabia
Finland	Senegal
French Antilles	Singapore
Greece	Slovakia
Guinea	Slovenia
Hong Kong	Sweden
Hungary	Taiwan
Indonesia	Thailand
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