

Continuous level

Non-contacting measurement



Non-contacting measurement technology by Berthold

The level measurement technology by Berthold is used in a variety of industrial sectors – ranging from the chemical to the waste water industry. It is suitable for measuring ranges of just a few millimetres up to several metres.

Applications are particularly successful when facing extreme measurement conditions:

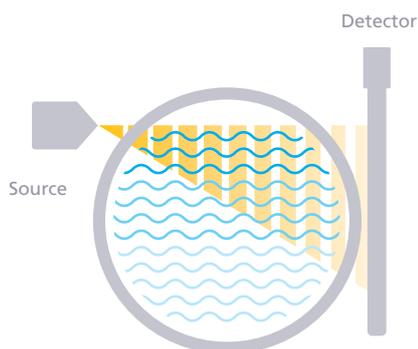
- Extreme temperatures
- High pressure
- Excessive foam formation
- Dust
- Acid or abrasive media

Our level measurement technology is suitable for any kind of vessel or bunker, e.g. storage tanks, hot storage tanks, vessels with agitators, cyclones, high-pressure reactors or autoclaves.



Non-contacting perfection

- Easy mounting, on the outside of the vessel
- No contact with measured material
- Free of wear and maintenance
- Subsequent installation on existing systems possible



Measuring principle & function

Gamma radiation is attenuated when it passes through the vessel. This attenuation is measured by a detector. The extent to which the radiation is attenuated is dependent on the level. The higher the level, the less radiation will reach the detector. In this manner, the level can be reliably monitored - irrespective of pressure, temperature, viscosity, colour and all chemical properties.

Consequently, this results in the high reliability and low maintenance of the radiometric measurement systems, even under harsh operating and environmental conditions.

Continuous level measurement

Customized solutions which ideally comply with the existing requirements may be achieved by using various detectors and sources. They can be combined in various ways and may also be inserted in dip pipes.

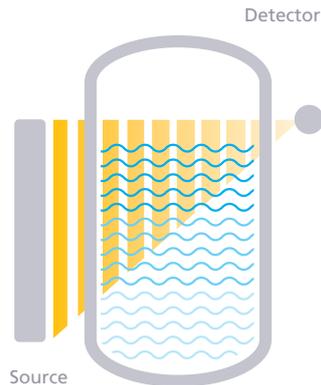
Which of these possibilities is selected depends on the:

- Measurement geometry
- Accuracy requirements
- Economic aspects

Our experienced application engineers will support you to find the optimum system configuration.

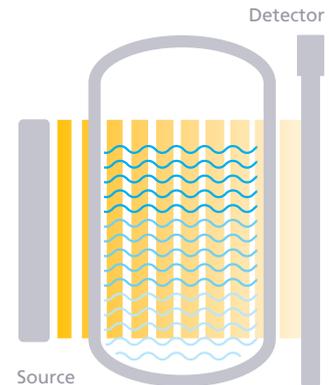
Rod source / Point detector

- Best accuracy over the entire measuring range
- Not affected by interfering radiation
- Can be optimally adjusted to the measurement geometry



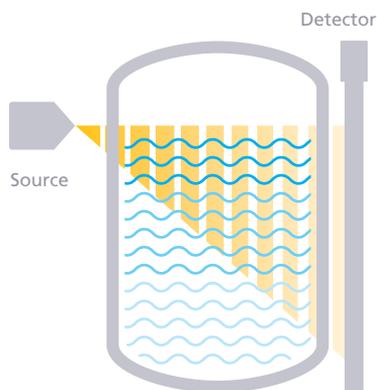
Rod source / Rod detector

- Can also be used in dip pipes
- Ideal for high pressures
- Highest sensitivity at minimum source activity



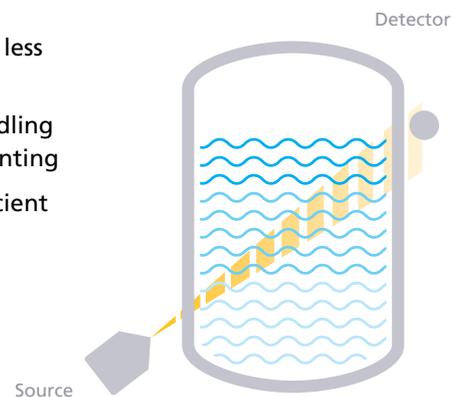
Point source / Rod detector

- Very cost-efficient
- Large measuring ranges can easily be measured



Point source / Point detector

- Short measuring ranges
- Takes up less space
- Easy handling and mounting
- Cost-efficient



Using variety and experience to achieve a custom-made solution

Due to its unique and comprehensive range of „modular systems“, Berthold is unparalleled when it comes to developing custom-made solutions that exactly meet the requirements of your measurement task. The Berthold experts can choose from a variety of proven solutions in order to provide you with the optimum system configuration that best fulfills your requirements and offer even further benefits that are not listed in your specifications.

By using different source geometries and isotopes, we are able to install superior systems that are perfectly tailored to your application and operating conditions. In combination with the highly sensitive detectors, extremely precise measurements are achieved while source activities are kept to a minimum.

The great variety of communication standards and certificates or the availability of 2-wire systems with separate evaluation units and compact probes complete the „Berthold offer of modular systems“.

Excellent application engineers, a development department that has invested more than 800 man-years into the development of our systems and more than 30 patents

ensure the function and precision that you have come to expect. The more than 20,000 measurement systems reliably operating worldwide are a proof of that every day.

No matter which measurement task you are facing – we can offer you the right solution.

Varied technological leadership

- Large selection of detectors
- 2-wire systems with separate evaluation units or compact probes
- In-house production of various source types and shapes with different isotopes
- Communication via HART, 4-20 mA, Profibus PA, Foundation Fieldbus
- Comprehensive safety features
- Robust design
- Comfortable software solutions
- Regular quality and stress tests



The detectors offer the following benefits

Highest sensitivity

The high sensitivity offers many advantages:

- Increased accuracy and faster reaction times
- Reduced source activity ensuring a longer service life and less effort regarding radiation protection
- Use of smaller shieldings resulting in lower acquisition and transportation costs for source and shielding
- Dose rate of less than 1 $\mu\text{Sv/h}$

Very good long-term stability

A patented procedure for automatic drift compensation compensates temperature influences and ensures a high sensitivity as well as a constant measurement accuracy over the entire lifetime of the system.

For example, the stability of the CrystalSENS is $\leq 0.002\%$ per $^{\circ}\text{C}$, tested over a temperature range of $-40\dots+60^{\circ}\text{C}$.



CrystalSENS

Point detector with high-quality scintillation crystal made of sodium iodide which achieves a particularly high sensitivity despite its small volume. Due to its compact design, it is ideally suited for applications with limited space requirements.



SuperSENS

Point detector with extraordinarily high sensitivity and measurement accuracy. Ideally suited for applications that could only be solved by using very high source activities until now. It is perfect for thick-walled pipes and vessels or for large vessel diameters because measurements can be carried out using smallest source activities. The extremely large scintillation volume is many times bigger than that of traditional detectors resulting in a threefold to fourfold increase of the sensitivity. By using the SuperSENS, an imminent source replacement can be delayed by several years.



UniSENS

Rod detector with a sensitive length of 0.5 to 2 m. Multiple UniSENS detectors can be cascaded in order to cover larger measuring ranges.



TowerSENS

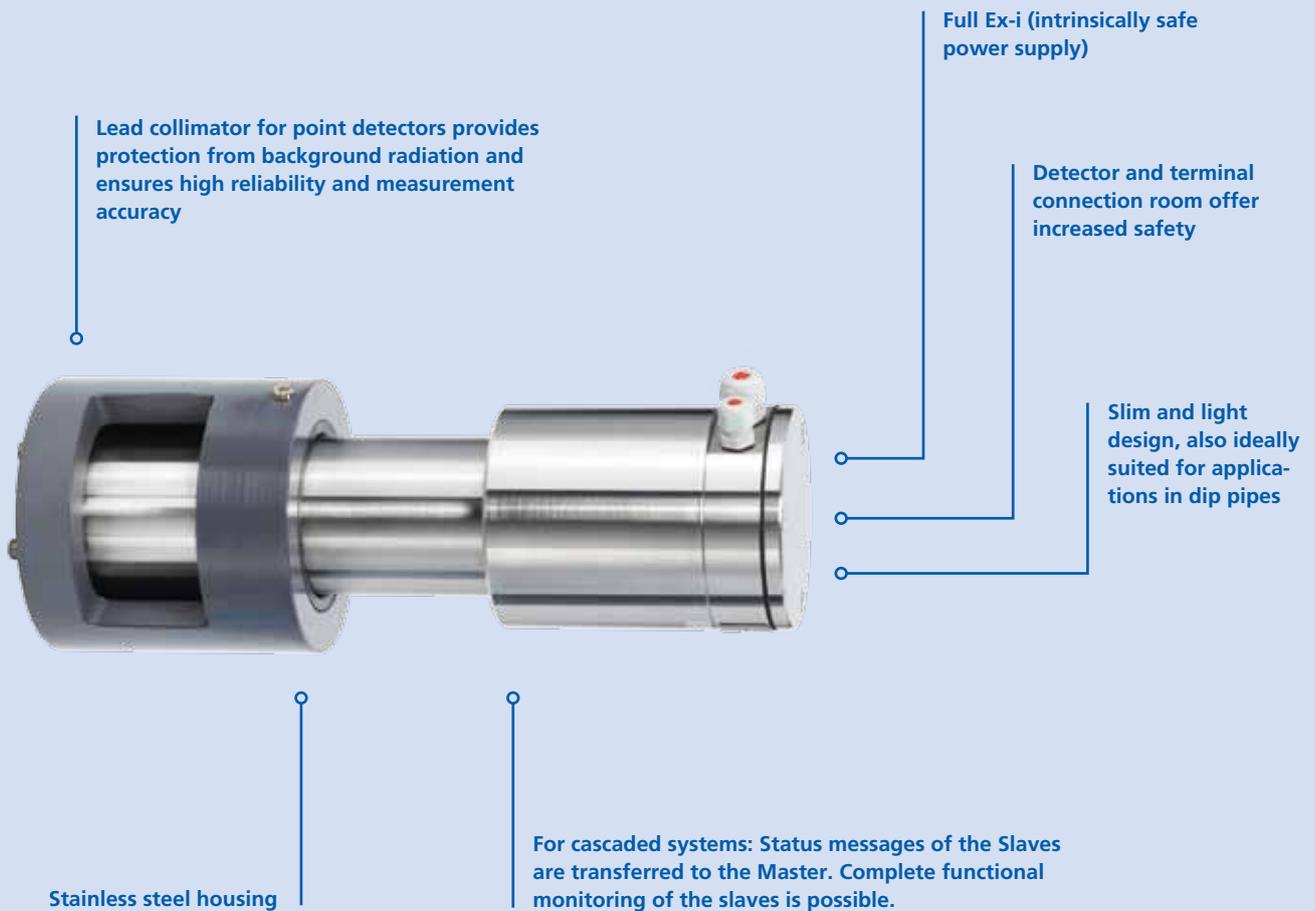
This rod detector is the most economical solution for extremely long measuring ranges. A single detector is able to cover measuring ranges of up to 8 m. Thanks to the solid scintillator rod it comprises a high level of sensitivity and good light conducting characteristics.

LB 440

The right choice for standard applications

Using proven 2-wire technology

- The most commonly used radiometric detector worldwide
- Ideal for standard applications
- Proven 2-wire technology with separate evaluation unit and intrinsically safe power supply
- Very easy to use
- Radiation interference discrimination
- Highest reliability



Proven in thousands of applications – LB 440

The LB 440 offers proven 2-wire technology with a separate evaluation unit of the best quality. During the decades of its successful use, it has received many system optimisations. The more than 15,000 systems that are in operation today are an impressive proof of its high industrial standard. LB 440 has successful applications in SIL2 plants as well. The detector is slim and light, easy to mount and can be used for dip pipes. It is a system that provides unique versatility and reliability.

Separate evaluation unit with display



Radiation Interference Discrimination

The patented method for suppressing interference radiation makes this system especially reliable. The measurement continues without being interrupted even if interference radiation is present. The interference radiation is recognised due to its different kind of energy. The detector then switches to a second measurement channel and continues the measurement in an error-free manner. This patented method makes the LB 440 especially reliable and safe.

Calibration using UNIBERT

UNIBERT makes calibration very convenient. All calibrating functions can be activated using a PC or laptop connected to the RS 232 interface. The results can be graphically displayed.

LB 440

Evaluation unit

Power supply	115/230 VAC, ±10 %, 50 ... 60 Hz, 30 VA 24 VDC (18 ... 32 VDC), 30 W; 24 VAC, +10 %/-15 %, 50 ... 60 Hz, 30 VA
Ambient temperature	Operation: 0 ... +50°C (-40 ... +122°F), no condensation Storage: 0 ... +70°C (-40 ... +158°F), no condensation
Design	19" module 3 HE, 21 TE, protection class IP 20
Installation	19" frame (max. 4 modules), wall housing (max. 2 modules) or switch-board

Detector operating data

Power supply	Supplied by evaluation unit via a 2-wire signal cable
Cable connections	1x M16 for cable 4 ... 9 mm 1x M12 for cable 3 ... 6 mm
Maximum cable length	with Berthold cable ID no. 32024, LiYCY-OZ 2 x 1 mm ² : 1000 m other cables: max. 40 Ω, for intrinsically safe installations: L & C to be considered according to certificate.
Wire cross-section	0.5 ... 1.5 mm ²
Housing material	Stainless steel ISO 1.4301 / AISI 304
Water cooling	Option (can also be retrofitted), max. 6 bar
Cascading	up to 9 detectors

	Scintillator size Ø x length [mm]	Weight [kg]	Weight with cooling system [kg]	Collimator
CrystalSENS (point detectors)	25 x 25 (NaI/Tl)	6	8	Option
	40 x 35 (NaI/Tl)	6	8	Option
	50 x 50 (NaI/Tl)	18	20	Standard
UniSENS (rod detectors)	50 x 500 (polymer)	9	11,5	Option
	50 x 750 (polymer)	10,5	14	Option
	50 x 1000 (polymer)	12	17	Option
	50 x 1250 (polymer)	13,5	19,5	Option
	50 x 1500 (polymer)	15	22	Option
50 x 2000 (polymer)	16,5	25	Option	
SuperSENS	150 x 150 (polymer)	45	54	Standard
Ambient temperature Operation and storage	-40 ... +60 °C (-40 ... +140 °F) for NaI/Tl and/or -40 ... +55 °C (-40 ... +131 °F) for polymer Observe possible temp. restrictions for Ex-protection!			
Temperature stability	≤0.002 %/°C (-20 ... +50 °C) for NaI/Tl and/or ≤0.01 %/°C (-20 ... +50 °C) for polymer			

Detector certificates & tests

IP protection	IP65
Explosion protection	ATEX: II 2 G EEx de IIC T6 II 2 D EEx de IIC T6 IP65 T80 II 2 G EEx ib IIC T6 FM/CSA: Class I Division 1 Group A, B, C, D FM: Class II Division 1 Group E, F, G -40 ... +73 °C -40 ... +73 °C -20 ... +60 °C -20 ... +50 °C -20 ... +50 °C
Other certificates	Nepsi, TIIS, Kosha, others upon request

Signal inputs and outputs

Signal output	0/4 ... 20 mA potential-free / max. impedance 500 Ω
Digital inputs	Hold input
Digital outputs	1 relay for collective fault message 2 relays for min. / max. Alarm or detector temperature Permissible load at ohmic load: AC: max. 250 V, max. 1 A, max. 200 VA DC: max. 300 V, max. 1 A, max. 60 W
Interfaces	RS 232 for parameter export or PC operation using UNIBERT
Data backup	in non-volatile memory
Menu languages	English, German, French

Uni-Probe LB 490

A universal field device for various applications

A versatile compact device

- Versatile detector for various applications
- Compact field device with integrated evaluation unit
- Communication via HART, Foundation Fieldbus or Profibus PA
- Communication can be switched from Bus to HART at any time
- High operational safety, FMEDA with SFF 96 %
- Inexpensive and solid system for standard applications.

For cascaded systems: Status messages of the Slaves are transferred to the Master. Complete functional monitoring of the slaves is possible.

CPU monitoring through Watch Dog Timer

3 relays can be freely configured

Stainless steel housing

Current output active or passive

Digital input for empty adjustment

The 4...20 mA current output is always available (e. g. for on-site display)

Intrinsically safe signal output (optional)

Monitored current output

Robust compact device for high demands

The level measurement system LB 490 Uni-Probe is a proven compact device provided with a robust stainless steel housing. It comes at a reasonable price, is reliable and precise and only requires very little source activity. It features all common communication capabilities such as

HART, Profibus PA and Foundation Fieldbus. A FMEDA study revealed a SFF (Safe Failure Fraction) of 96 %. This is an excellent result and an impressive testimony of the high reliability and operational safety provided by these systems.



LB 490

Detector operating data

Power supply	100 ... 240 VAC, ±10 %, 50 ... 60 Hz, 15 VA 24 VDC (18 ... 32 VDC), 15 W; 24 VAC +10 %/-15 %, 50 ... 60 Hz, 15 VA
Cable connections	4 cable entries, 3/4 inch, NPT, closed with blind plug Option: metric adapters and cable glands upon request
maximum cable length	3300 m (120 Ω), 1600 m (250 Ω), 800 m (500 Ω)
Wire cross-section	0.5 ... 1.5 mm ²
Housing material	Stainless steel ISO 1.4301 / AISI 304
Water cooling	Option, max. 6 bar
Cascading	up to 8 detectors

	Scintillator size Ø x length [mm]	Weight [kg]	Weight with cooling system [kg]	Collimator
CrystalSENS (point detectors)	50 x 50 (NaI/Tl)	22,5	24	Standard
UniSENS (rod detectors)	50 x 500 (polymer)	14	18,5	Option
	50 x 1000 (polymer)	17	25	Option
	50 x 1500 (polymer)	19	30,5	Option
	50 x 2000 (polymer)	21	36	Option
TowerSENS	50 x 1000 basic module (polymer)	20	27	-
	50 x 2000 basic module (polymer)	26	41	-
	50 x 2000 extension module (polymer)	17	32	-
	up to 3 extension modules			
SuperSENS	150 x 150 (polymer)	52	62	Standard
Ambient temperature Operation and storage	-40 ... +60 °C (-40 ... +140 °F) for NaI/Tl and/or -40 ... +55 °C (-40 ... +131 °F) for polymer Observe possible temp. restrictions for Ex-protection! for 100...240 VAC version, operation only up to max. 50 °C			
Temperature stability	≤0.002 %/°C (-40 ... +50 °C) for NaI/Tl and/or ≤0.01 %/°C (-40 ... +50 °C) for polymer			

Detector certificates & tests

IP protection	IP65 / IP66 + Nema 4X		
Explosion protection	ATEX:	II 2 GD EEx d IIB T5 IP66 T80 °C II 2 GD EEx d IIC T6 IP66 T80 °C (...+50°C for LB 490 TowerSENS and SuperSENS) II 2 GD EEx d [ia] IIC T6 IP66 T80 °C	-40 ... +80 °C -40 ... +60 °C -20 ... +50 °C
	FM/CSA:	Class I Division 1 Group A, B, C, D Class II Division 1, Group E, F, G	-40 ... +50 °C
Other certificates	Nepsi, IECEx, Kosha, CCOE, others upon request		

Signal inputs and outputs

Signal output	HART 4 ... 20 mA potential-free, active or passive max. impedance: 500 Ω (active) Voltage supply: 12 V ... 24 V (passive) max. impedance at 12 V: 250 Ω and/or 24 V: 500 Ω (passive) Option: intrinsically safe HART current output 4 ... 20 mA, potential-free, passive Voltage supply: 12 ... 30 V, voltage drop <3.5 V, 20 m signal cable (blue), pre-assembled Exi IIB: Lo=14.78 mH; Co=679 nF / Exi IIC: Lo=2.18 mH; Co=84 nF
Bus output - Option	Bus interface: Profibus PA or Foundation Fieldbus Bus powered, typical 13 mA with 2xAI function blocks Option: intrinsically safe Bus interface, 20 m signal cable (blue), pre-assembled Approval according to ATEX and FISCO
Digital inputs	Dig In 1: Hold input, Dig In 2: Empty adjustment
Digital outputs	1 relay (SPDT) for collective fault message 3 relays (SPDT) alternatively for: Hold signal, min. / max. alarm, detector temperature, radiation interference detection Permissible load at ohmic load: max. 5 A at 250 VAC or 30 VDC
Interfaces	RS 232 for software update
Data backup	in non-volatile memory

Monitored current output

By monitoring the current output, it is ensured that the correct measurement values are displayed. The device constantly compares the actual flowing current with the target value. In the event of deviations, a failure current is generated. A Watch Dog Timer monitors the functioning of the CPU simultaneously.

Communication

The following user interfaces are available for communication and parameter settings:

HART

- HART communicator
- DTM for FDT
- Siemens Simatic PDM

Profibus PA

- Siemens Simatic PDM
- Alternatively also via HART

Foundation Fieldbus (FF)

- HART communicator
- Process control system
- Alternatively also via HART

SENSseries LB 480

The best choice for high demands

The best choice for high demands

- Compact field device with integrated evaluation unit
- Process connection via HART
- SILready developed according to IEC 61508 and FMEDA with SFF 96 %
- Quick Start menu for effective and fast start-up
- Daily functional check and continuous self-monitoring
- High interference immunity (SIL standard)
- Gas-density compensation

Monitoring of detector temperature with adjustable max./min. threshold for cooling control

Monitored current output

CPU monitoring through Watch Dog Timer

Cable chamber offering increased safety, easy and safe connection in the field for all four wires

Excellent IP protection: IP 65, 66, 67, 68, 69K

Current output active or passive

Extremely robust design

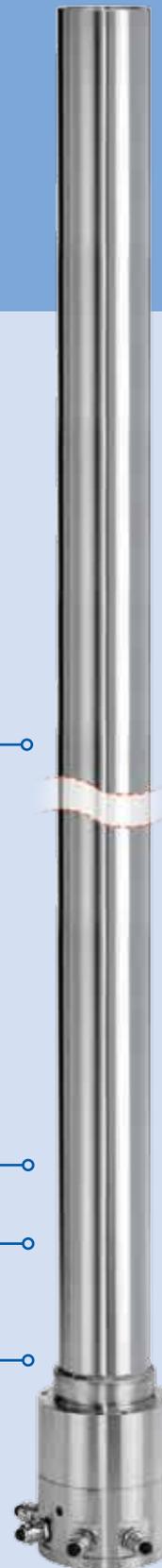
Continuous water cooling for the entire detector (can also be retro-fitted)

Stainless steel housing

Operation via HART communicator, Siemens Simatic PDM or AMS/DeltaV

High durability confirmed in various temperature, shock and vibration tests.

For cascaded systems: Status messages of the Slaves are transferred to the Master. Complete functional monitoring of the slaves is possible.



SENSseries LB 480 for critical processes

The SENSseries LB 480 measurement system is especially suited for challenging applications. It was developed according to IEC 61508 and features many maintenance-oriented diagnosis functions. For instance, the performance of the detector is continuously monitored by using cosmic radiation as a reference measurement. SENSseries LB 480 is SILready. The system offers an excellent operational safety and system stability as well as a high interference immunity that complies with the SIL standard. In short: It is the best choice for your critical processes.

Automatic gas-density compensation

The automatic gas-density compensation ensures an extremely precise measurement during applications with a extremely fluctuating gas pressure. The influence of the gas density is determined via a pressure sensor, or if necessary by a radiometric detector, and is entered into the level measurement.



LB 480

Detector operating data

Power supply	100 ... 240 VAC, $\pm 10\%$, 50 ... 60 Hz, 8 VA 24 VDC (18 ... 32 VDC), 8 W
Cable connections	4 cable entries M20 closed with blind plug Option: Cable glands M20
Maximum cable length	3300 m (120 Ω), 1600 m (250 Ω), 800 m (500 Ω)
Wire cross-section	0.5 ... 1.5 mm ² (up to 2.5 mm ² without wire-end sleeve)
Housing material	Stainless steel ISO 1.4301 / AISI 304 (others upon request)
Water cooling	Option (can also be retrofitted), max. 6 bar
Cascading	up to 17 detectors

	Scintillator size \varnothing x length [mm]	Weight [kg]	Weight with cooling system [kg]	Collimator
CrystalSENS (point detectors)	50 x 50 (NaI/Tl)	11	14,5	Option
UniSENS (rod detectors)	50 x 500 (polymer)	14	21	Option
	50 x 1000 (polymer)	18	28	Option
	50 x 1500 (polymer)	22	35,5	Option
	50 x 2000 (polymer)	27	44	Option
Ambient temperature Operation and storage	-40 ... +60 °C (-40 ... +140 °F) for NaI/Tl and/or -40 ... +55 °C (-40 ... +131 °F) for polymer Observe possible temp. restrictions for Ex-protection!			
Temperature stability	$\leq 0.002\%$ /°C (-40 ... +60°C) for NaI/Tl and/or $\leq 0.01\%$ /°C (-40 ... +55°C) for polymer			

Detector certificates & tests

IP protection	IP65 / IP66 / IP67 / IP68 / IP69K		
Explosion protection	ATEX: II 2 G Ex db eb IIC T5 / Ex tb IIIC T95 °C II 2 G Ex db eb IIC T6 / Ex tb IIIC T80 °C		-40 °C ... 80 °C -40 °C ... 65 °C
Vibration / Shock	Vibration: 1.9 g / mechanical Shock: 30 g according to DIN EN 60068-6 and 60068-2-27		

Signal inputs and outputs

Signal output	HART 4 ... 20 mA potential-free, active or passive max. impedance: 500 Ω (active) Resolution better than 0.006 mA Stability $\pm 0.001\%$ /°C (-40 ... 60 °C) Voltage supply: 12 V ... 24 V (passive) max. impedance at 12 V: 250 Ω (passive) max. impedance at 24 V: 500 Ω (passive)
Digital outputs	Open Collector alternatively for: Max. alarm, min. alarm, warning messages + error messages, hold signal, interference radiation detection, detector temperature Permissible load at ohmic load: max. 100 mA at 5 ... 36 VDC
Interfaces	RS 485 for software update, cascading, gas-density compensation
Data backup	in non-volatile memory

Unique technology

Making special solutions the new standard

Berthold is the only radiometry supplier worldwide with an in-house source production. This opens up unique possibilities for us and our customers. The sources are manufactured customer-specifically and can therefore be optimally adjusted to the respective application requirements. Our standard range includes:

- Point and rod sources
- Dip pipe sources for installation in a vessel
- Various isotopes such as Cs-137 or Co-60
- Shieldings with different exit angles for radiation beam
- Various shielding materials such as lead, wolfram or stainless steel

This variety enables us to always select the isotopes and shieldings that represent the most cost-efficient solution for the respective application while ensuring the best measurement result at minimum radiation exposure. We will be happy to develop special solutions for special applications as well. **Please contact us.**



Rod source innovation

Rod sources with continuous activity distribution achieve the highest measurement accuracy. This is why they are often used for critical processes. Thanks to the unique Berthold manufacturing method, the activity is distributed along the source length in such a way that the radiation passes through the vessel in an optimal manner – which applies to each individual vessel. This means that it does not matter whether the level has changed in the upper or lower part of the measuring range since the sensitivity of the measurement is equally high over the entire measuring range.

Maximum safety

The SSC source capsules made by Berthold have been tested according to ISO 2919 and exceed even the highest classification C66646. They are extremely robust and can withstand temperatures of up to 1200 °C. The three-fold encapsulation of the isotope ensures maximum safety even in extreme measurement environments. Our shieldings comply with the following international standards:

- ANSI 43.8
- ISO 7205
- IEC 62598

Tailor-made – the best solution for you

For every measurement, our project engineers recalculate the required source activity while strictly adhering to the ALARA principle (As Low As Reasonably Achievable). This means that the sources are designed in such a way that only the absolutely necessary source activity is used. Thanks to the high sensitivity of our detectors, the source activity in systems made by Berthold is the lowest of all systems currently available on the market. A dose rate of less than 0.001 mSv/h is already sufficient in order to realise a reliable level measurement. In order to provide you with a short overview of the radiations you may be exposed to, we have listed some examples in the table „How high is the radiation?“.

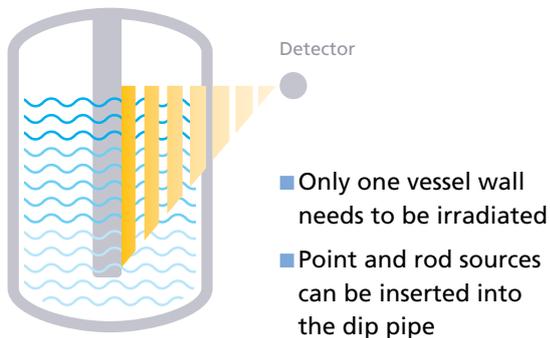
Competence in radiation protection

Whoever conducts radiometric measurements automatically has to deal with the issue of radiation protection. So it is good that we have a team of in-house experts on this matter. In the radiation protection business unit, experts deal with the tasks related to dose rate measurement. The transfer of knowledge is direct and synergies are to your advantage. Berthold takes a special responsibility when it comes to the training of its customers. We offer trainings for radiation protection officers.

How high is the radiation?

Radiation	
Flight over the Atlantic	0.06 mSv
Chest x-ray	0.1 mSv
Living at 1600 metres above sea level	1.2 mSv/a
Berthold measurement (vessel is empty)	0.001 mSv/h

Arrangement with source in dip pipe



Various variants (point and rod sources) and isotopes (Co-60, Cs-137) available

Maximum safety due to the use of extremely temperature and corrosion resistant source capsules

Use of various shielding materials such as lead, wolfram or stainless steel

Project-specific design of the source activity according to the ALARA principle

Small in size and with best shielding effect



In-house production plant for sources enables customer-specific production and individual designs

Other applications



Our detectors are also ideally suited for the following applications:

- **Density and concentration**
- **Point level switch**
- **Bulk flow / mass flow**

Technical support – a matter of course

Our sales engineers and application experts will gladly assist you in choosing the detector that is best suited for your measurement task. They will determine the right solution according to your needs and specifications and provide you with individual advice, free of charge.

LB 440**Uni-Probe LB 490****SENSseries LB 480****Communication standards**

4-20 mA	•	•	•
HART		•	•
Foundation Fieldbus		•	
Profibus PA		•	

Explosion protection

ATEX	•	•	•
Intrinsically safe signal output	•	•	•
Intrinsically safe power supply	•		
FM	•	•	
CSA	•	•	
IECEX		•	

Versions

CrystalSENS	•	•	•
UniSENS	•	•	•
TowerSENS		•	
SuperSENS	•	•	

Software

Radiation Interference Detection	•	•	•
Radiation Interference Discrimination	•		
Monitored current output		•	•
Gas-density compensation			•
Quick Start			•

Operation and parameter settings

Separate evaluation unit	•		
HART communicator		•	•
DeltaV AMS / Simatic PDM		•	•
FDT/DTM		•	



We are there for you! Worldwide.

Our sales engineers look forward to your request. Regardless of what you want to measure and no matter where. We will provide you with the right system for each measurement task and we do know how to configure it so that it perfectly suits your needs. From a wide variety of possible variants, our application engineers will choose the right one for your.

Benefit from our know-how, our experience and our engineering spirit – especially in the early project phases. **Please contact us.**

All components required for this purposes are developed and manufactured in Germany entirely. At Berthold, you will always receive „made in Germany“ quality products.

BERTHOLD TECHNOLOGIES perfect solutions from a single source.

The engineers and service technicians of Berthold Technologies are always there when they are needed. Thanks to our worldwide network of branch offices we are able to provide you with quick and competent support if necessary. Our qualified personnel will be at your site in no time at all.

You can take our word for it.



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