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S Y S T E M O V E R V I E W

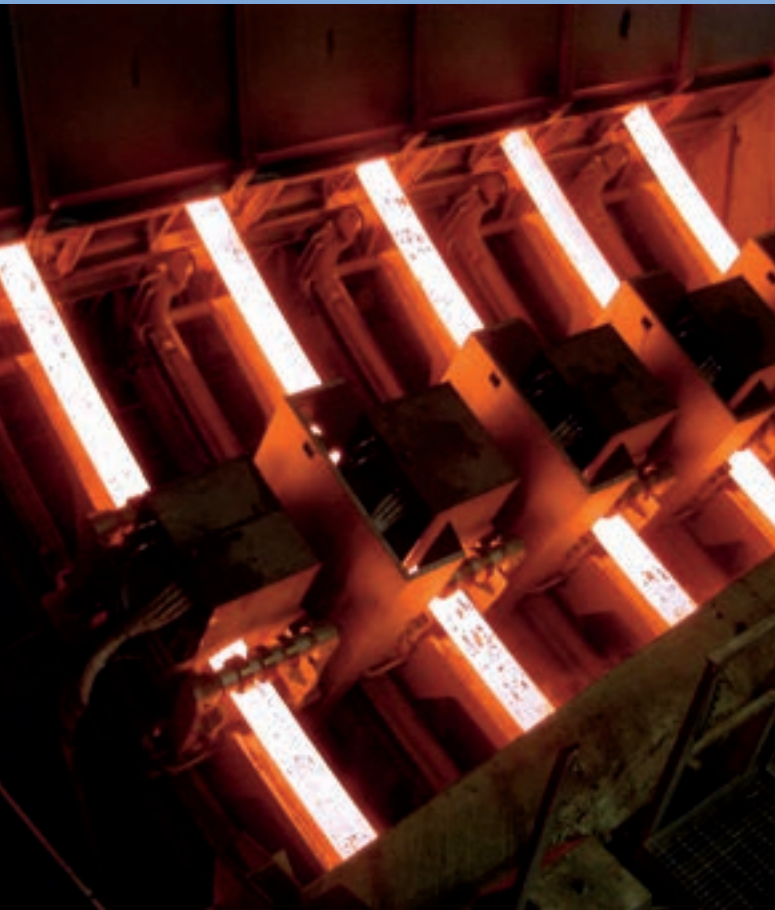
# Mold Level Measurement

non-contacting – quick – reliable



**BERTHOLD**  
TECHNOLOGIES

# Berthold Technologies – mold level measurement



## Quick and precise mold level measurement in continuous casting applications

A precise and quick measurement of mold level lays the foundation for the production of high quality steel and the reliable prevention of steel overflows and breakouts. The Berthold mold level systems fulfill this role reliably and accurately.

Several thousand strands throughout the world are equipped with Berthold systems.

The level of liquid metal in the mold is measured reliably and precisely. The extremely short cycle time of 5 ms allows for an optimum control of the casting process – both in automatic start-up and in normal operation.

Berthold Technologies is the only supplier providing both radiometric and electromagnetic measuring systems to solve this challenging measurement application. Depending on the requirements and measurement conditions, the optimum technology is selected. A combination of both technologies is also possible and advisable in demanding applications.

## Radiometric measurement

Gamma radiation is attenuated as it passes through the mold. This attenuation is measured by a detector. The extent to which the radiation is attenuated depends on the mold level. The higher the level of molten metal in the mold, the less radiation will reach the detector. In this manner, the mold level can be reliably monitored - irrespective of dust, temperature and vibrations.

The radiometric measurement is maintenance-free and applicable for all mold types and sizes. Beside the typical installation on slab and billet casters it is also successfully applied on beam-blank and round casters.

## Electromagnetic measurement

A coil inside the sensor generates an electromagnetic field, penetrating deep into the mold. As a result an eddy current is induced in the top layer of the molten metal. This eddy current generates a counteracting electromagnetic field – its strength being proportional to the distance between sensor and molten metal inside the mold. In this way the mold level is determined very precisely – irrespective of casting powder or slag.

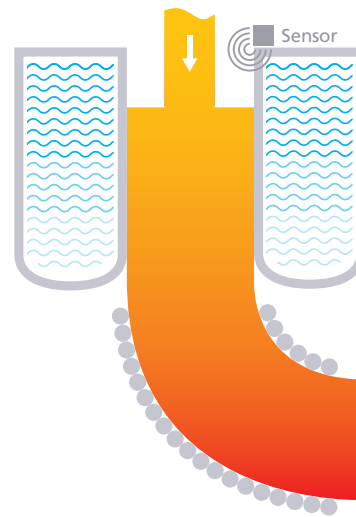
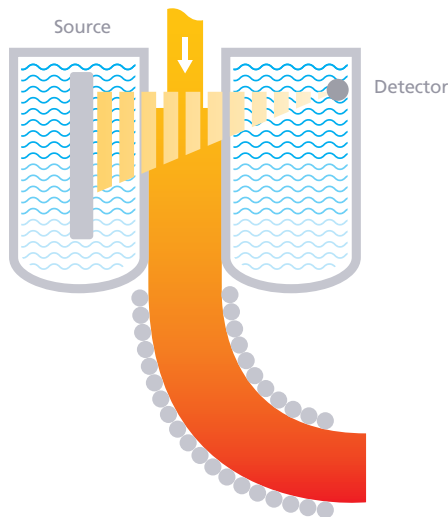
## Systems characteristics

### GAMMAcast Radiometric measurement

- Highest reliability
- Virtually unlimited measuring range
- Very robust
- Applicable for all mold types
- Easy calibration
- Minimum source activity due to high-sensitive detectors
- Maintenance-free
- Constantly high accuracy over the whole measurement range

### ECcast Electromagnetic measurement

- Best accuracy
- High resolution <0.1 mm
- Quick response time
- Not affected by casting powder or slag
- No radioactive source required
- Easy retrofit of existing casters
- Available with a suspended sensor type or with a edge mounted sensor type



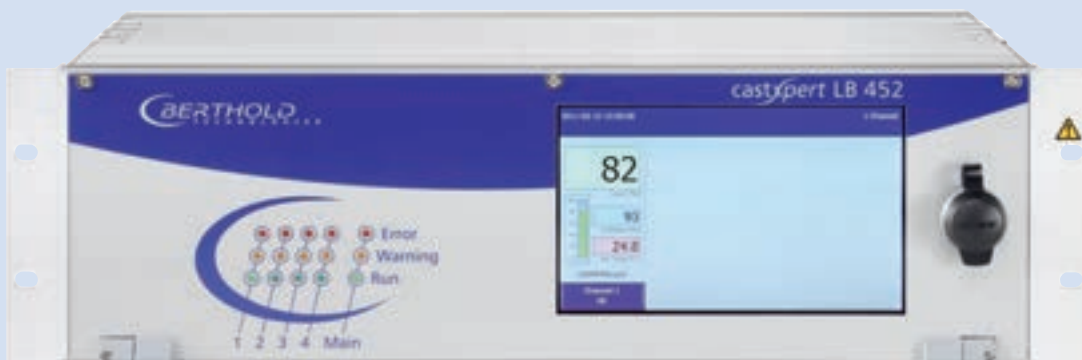
### Combination: ECcast plus GAMMAcast

**Two technologies complement each other providing the optimum system for highest demands.**

- Large measuring range
- Perfect for automatic start-up
- Highest safety due to redundancy
- Determination of casting powder/slag thickness is possible

# castXpert LB 452

## The universal evaluation unit



The castXpert LB 452 is the mold level measuring system that has been setting standards for years. It provides accurate and reliable measurements, and ensures optimal control of the continuous casting process due to the short cycle time of 5 ms. This evaluation unit is used in both radiometric and electromagnetic systems, without any need of modification. This saves time and enables safe operation.

## Evaluation unit with touchscreen

### ■ Extremely fast

The unique short cycle time of 5 ms provides the ideal basis for reliable control.

### ■ Information Plus+

Detector temperature and status are continuously monitored and displayed.

### ■ Safety

Comprehensive self-diagnostics and plausibility checks of measurement and calibration ensure the highest process reliability.

### ■ Highest accuracy

By using several calibration points, non-linearities of the calibration curve are perfectly eliminated, and high accuracy can be achieved over the entire measuring range.

### ■ Designed according to IEC 61508 (SIL Standard)

### ■ Easy to use

The large colour touchscreen makes operation and calibration particularly easy. The ability to select from different operating languages facilitates ease of operation. Regardless of where the system is installed.

### ■ Automatic start-up

Benefit from faster response times during start-up of casting, by the ability to set a smaller time constant in the low measuring range.

### ■ 4 measuring channels

Up to four strands can be measured simultaneously. Each measurement channel is equipped with its own power supply and CPU. Therefore, the channels are independent of each other and high process reliability is guaranteed.

### ■ Monitored current output

Continuous monitoring of the current output ensures highest reliability and signal stability. This plausibility test is patented.

# Our rod sources

## Unique Berthold Technology

Co-60 rod sources are used as a standard in mold level measurements. The special feature: The rod sources are characterized by a continuous distribution of activity, which can only be realized through the unique manufacturing process from Berthold.

The best measurement accuracy is achieved with these rod sources from Berthold because the accuracy over the entire measuring range is consistently high.

## AOS - Activity Optimized Source

In this particular type of rod source the accuracy in the upper part of the measuring range can be increased significantly by optimizing the distribution of activity. Especially for small formats the statistical noise is minimized, without increasing the overall activity of the source.

Or do you already have a satisfying accuracy? In this case AOS can be used to reduce the source activity while maintaining the same accuracy. Depending on the application, the use of smaller shieldings is possible. In many cases the more cost-efficient lead may be used instead of tungsten.

### AOS at a glance

- Highest precision in the important part of the measuring range
- Small and cost-effective shieldings
- Low source activity



Robust external housing from stainless steel

Highest mechanical resistance according to ISO 2919, ISO/C 66646

Inner core to carry the activity

Activity distribution over the whole source length by customer-specific winding of the special wire

Special wire containing Co-60

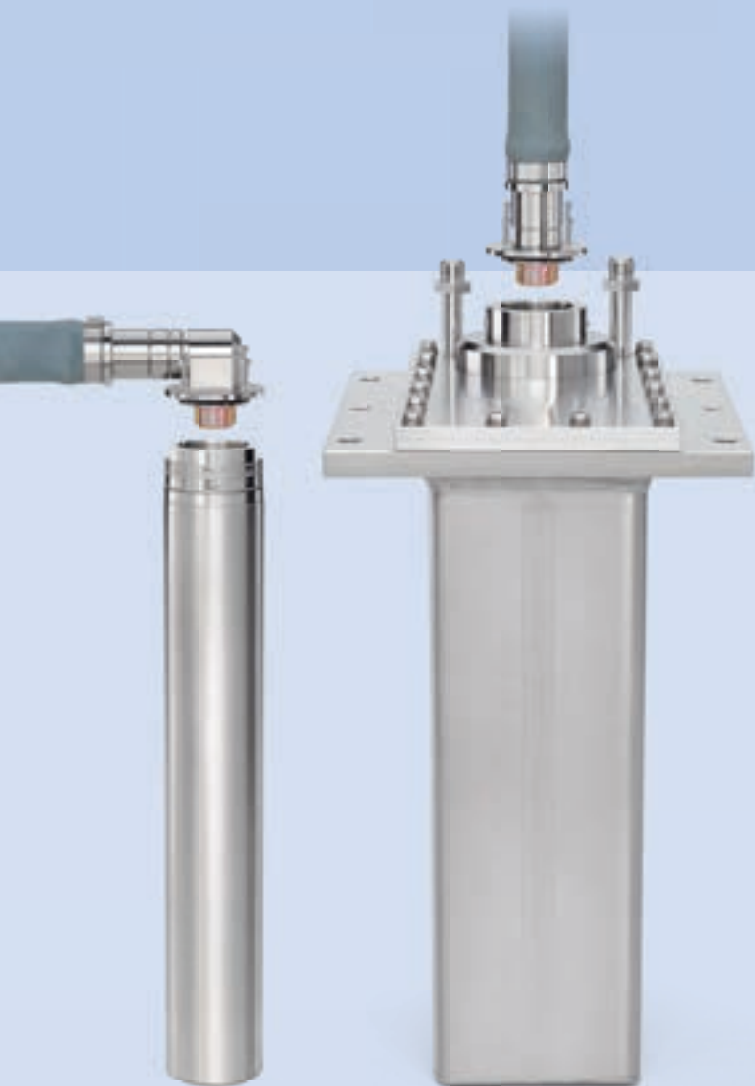
Integrity guaranteed by individual source tests

# GAMMAcast detectors

Berthold detectors are characterized by their excellent sensitivity for gamma radiation, their robust design and the PlugProtect connection technology. The high measurement accuracy achieved combined with the outstanding mechanical stability guarantees for high reliability and a long detector life – perfect for the use in continuous casting.

## At a glance

- High mechanical stability (verified by Fraunhofer Institute)
- Absolutely secure through high IP protection class IP 66/67
- PlugProtect protected and separate terminal connection zone allows for a safe and easy replacement of cable or detector
- Micro-Controller inside the detector communicates state and temperature
- Heavy duty cable available in various lengths, extremely heat resistant and robust – splash resistant
- Various types of plugs and terminal connections (straight and 90°-angled)
- Water cooling available for all detector types



## LB 6739 Perfect for standard applications

- Slim design, low space requirements
- CsI crystal with high sensitivity for gamma radiation
- Highly durable against mechanical shock and vibrations due to elastic bedding of crystal and PMT.

## LB 6752 For demanding applications

- Large polymer scintillator for increased sensitivity and precision
- Lower source activities
- Smaller and cost-efficient shields sufficient

## LB 6760 With Solid State Silicon Photomultiplier

- No electromagnetic disturbance through breaks or stirrers
- High sensitivity (similar LB 6739)
- Unbreakable detector due to innovative Silicon Solid State Photomultiplier technology

## castXpert LB 452

### General Arrangement

Rack	19", 3 HU Control unit with 7" color display and touch screen
Max. Load	4 measuring channels
Weight	approx. 4-6 kg depending on equipment
IP code	IP 20
Power Supply	100 ...240 VAC +/-10%, 50...60Hz Control unit including one measuring channel: approx. 30 W Every further measuring channel: approx. 15 W
Ambient temperature	Operation: 0 ... +50°C (+32 ...+122°F), no condensation Storage: -20... +70°C (-4 ... +158°F), no condensation

### Each Measuring Channel

Basic Module (mandatory)	Independent power supply (100 ...240 VAC +/-10%, 50...60Hz) Current output 4...20 mA floating Switchable source- (max. impedance 500 Ω) or sink- (max. 24 VDC, 500 Ω; min. 12 VDC, 250 Ω) mode 2 digital inputs: floating, for external empty and full adjust Relay output (SPDT) for error signal max. 33 VAC, 46 VDC, 5 A, non-inductive
Extension Module (option)	Current output 4...20 mA floating Switchable source- (max. impedance 500 Ω) or sink- (max. 24 VDC, 500 Ω; min. 12 VDC, 250 Ω) mode Possible configurations: Level, detector temperature, detector count rate 2 digital Inputs: floating, for external selection of up to 4 calibration curves 2 relay outputs (SPDT, SPST NO) for configurable alarm signal max. 33 VAC, 46 VDC, 5 A, non-inductive
Bus Module (Profibus DP or Profinet)	Output of cyclic data: Level, detector count rate (CPS), detector temperature, actual calibration index, system status, error number Input of cyclic data: Calibration index, empty and full adjust, acknowledge errors

### Overall System

Software	Cycle time: 5 ms Data log on internal memory card or via Ethernet Data export to USB flash drive
Operating languages	Bulgarian, Chinese, Czech, English, French, German, Hungarian, Italian, Korean, Portuguese, Rumanian, Russian, Spanish

## Detector Service Modem

The modem is used to operate the GAMMAcast detectors with a PC via USB connection. Thus, the functional testing of the detector, software updates and parameter settings can be easily performed in the workshop.

### Features

- Functional testing
- Recording of the plateau curve
- Automatic or manual adjustment of the operating point and high voltage settings
- Error diagnostics
- Set and access parameters
- Temperature control
- Software updates



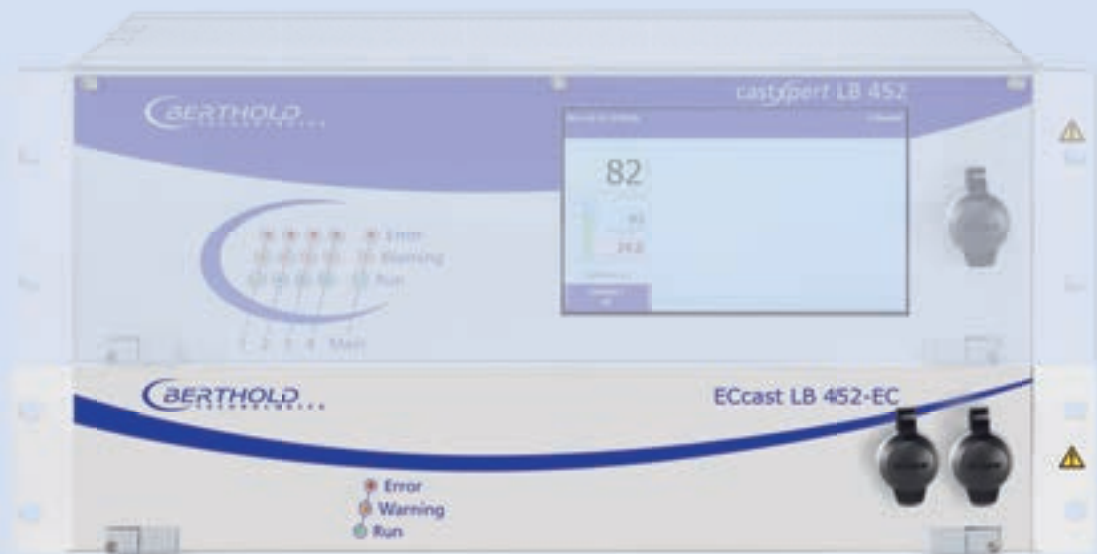
## GAMMAcast LB 6739, LB 6760 and LB 6752

### Mechanics

Material	Stainless steel
Scintillator	LB 6739: CsI-crystal; Ø 40 mm or Ø 25 mm, H: 50 mm LB 6760: NaI-crystal; Ø 40 mm, H: 50 mm LB 6752: Organic polymer scintillator, 150x100x50 mm <sup>3</sup> or 150x100x25 mm <sup>3</sup>
Ambient Temperatures	Operation: -20 ... +50°C (-4 ... +122°F) Cooling water required at higher temperatures
Power	15...32 VDC, approx. 1.2 W
Output signal	Pulses, max. 10 V
Water cooling	Optional for LB 6739 and LB 6760, Standard for LB 6752 Connection: R <sup>1</sup> / <sub>4</sub> , max. 6 bar Drinking water quality (or filtered process water without suspended particles)
IP class	IP 66 / IP 67
Connections	Detector – terminal box resp. detector – castXpert LB 452: Special cable with PlugProtect connector; straight or 90°-angled connector plus open ends or HeavyCon plug Terminal box – castXpert LB 452: 6-wired, screened (6 x 1.5 mm <sup>2</sup> ) max. length 500 m
Weight	LB 6739 / LB 6760: approx. 2 kg, with water cooling approx. 3 kg LB 6752: approx. 24 kg
Vibration / Shock	Vibration: 0.2 g / mechanical shock: 100 g according to DIN EN 60086-2-6 and 60068-2-27

# ECcast LB 452-EC

## The completion to castXpert LB 452



ECcast – Berthold’s electromagnetic measurement systems – measure the mold level reliably and extremely accurately, and is not affected by casting powder or slag. ECcast can be used as a stand-alone system or for even higher process reliability can be combined with the radiometric GAMMAcast systems.

### ■ Accurate and reliable

The measured signal is very smooth and not affected by casting powder or slag

### ■ Excellent measurement performance

With a resolution smaller 0.1 mm and a fast response time of approx. 50 ms, the system offers best conditions for optimum mold level control.

### ■ Easy System Integration

The ECcast LB 452-EC unit is installed as an add-on module to the castXpert LB 452 evaluation unit. It is responsible for signal generation and primary signal processing.

### ■ Known operating concept

The unit is operated using the castXpert LB 452 evaluation unit.

### ■ Compensation of mold oscillation

The ECcast add-on module has the ability to compensate for mold oscillation. The output signal is then corrected for the oscillation.



# ECcast Sensors



## Suspended Sensor

- Air cooling
- Measuring range: 150 mm from sensor bottom edge
- For virtually all formats
- Installation on manipulator, above the mold
- Only one system per strand required
- Integrated pre-amplifier – no additional electronics in the field
- Optimum heat protection through changeable sensor cover
- Not affected by electromagnetic brakes or stirrers and mold coatings

## Edge-Type Sensor

- Water cooling
- Measuring range: 200-250 mm from edge of the mold
- For slab and thin-slab formats
- Easy mechanical installation at the mold
- Preparation of the system in the workshop possible
- No mechanically interfering parts above the mold
- Wide area is measured
- Integrated acceleration sensor for oscillation compensation

# ECcast Accessories

## Calibration rig

The calibration rig ensures easy and quick set-up and commissioning of the electromagnetic measurement. A plate representing the level of hot metal is moved up and down the mold stepwise by an electrical mechanism. The measured response is recorded for each step, resulting in a representative calibration curve.

- Fully automatic recording of calibration points
- Easy calibration during set-up and commissioning
- Maximum safety through verification of the measuring points



## ECcast LB 452-EC

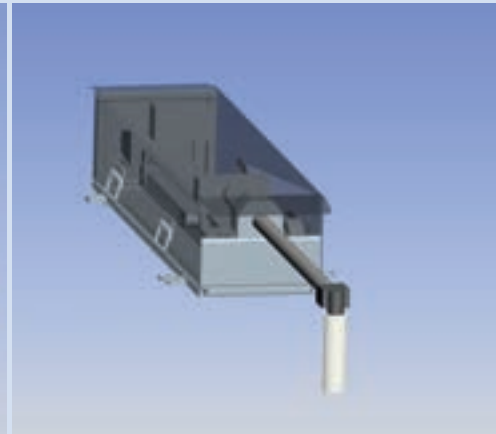
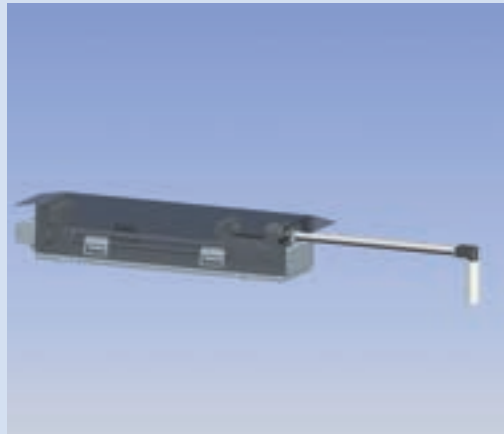
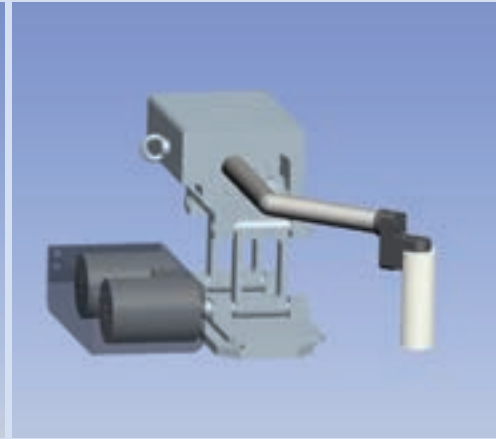
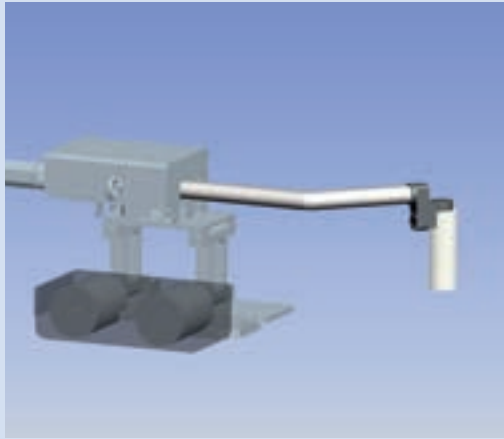
Rack	19", 2 HU, depth=423 mm
Weight	approx. 5 kg
IP code	IP 20
Power Supply	100 ...240 VAC +/-10%, 50...60 Hz
Ambient temperature	Operation: 0 ... +40°C (+32 ...+104°F), no condensation Storage: -20... +70°C (-4 ... +158°F), no condensation
Reaction time	max. 50 ms



## Manipulator

The manipulator incorporates the suspended sensor. It ensures accurate and automatic positioning of the sensor over the mold. In the event of problems (e.g. overflow, break-through etc.) the sensor is quickly brought to safety, thus creating free space above the mold. Signal cables and the influx for the cooling air are guided via the manipulator.

Different versions of manipulators can be realized, depending on the space requirements and the desired directions of movement. Two examples are shown here. We will gladly inform you or others!



### Edge-Type Sensor

### Suspended Sensor

Outer dimensions	Width: 500 mm	Ø: 40 mm, height: 222 mm
Weight	approx. 5 kg	approx. 1 kg
Ambient temperature	Operation: 0 ... +50°C (+32 ... +122°F) Storage: -20... +70°C (-4 ... +158°F)	Operation: 0 ... +50°C (+32 ... +122°F) (inside air-cooled sensor) Storage: -20... +50°C (-4 ... +122°F)
Cooling	Water, approx. 4-6 l/min, max. 15 bar, max. 30°C Drinking water quality (or filtered process water without suspended particles)	Air, approx. 500 l/min at 2 bar, max 30°C, max. 4 bar Quality: clean, oil-free
Assembly	On edge of mold	On manipulator arm
Cables	Sensor – Pre-amplifier max. length 15m, special cable connected to sensor Pre-amplifier – ECcast LB 452-EC max. length 150 m, according to specification	Sensor – ECcast LB 452-EC max. length 150 m, according to specification



## We are here for you! Worldwide

Berthold Technologies, your partners in mold level measurement with unparalleled expertise. Thousands of Berthold systems are worldwide in operation. We produce the most reliable and finest instruments to optimally support your continuous casting process. Our systems combine modern technology with over 60 years experience. Together we will find the optimum solution for your system. Our sales engineers are looking forward to your inquiry.

**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. Site visits are promptly organized to ensure minimum downtime.

**You can take our word for it.**

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