Sensor Transmitter

DEPTH

The Thelma Biotel depth sensor transmitter is a versatile tool for wireless depth and pressure measurements under different conditions. The standard sensor offers high - resolution data down to either a standard of 290 meters water depth or a deep water version down to 1000 meters water depth.

HIGHLIGHTS

- Available in all transmitter sizes 6, 7, 9, 13 and 16
- Long operational lifetime ~ 3 months - > 10 years

The Thelma Biotel depth sensor transmitter measures the pressure of the liquid above the sensor and the atmospheric pressure to achieve depth values. The pressure sensor is located at the face of the transmitter, and measurements are taken through a small hole that transfers the pressure through the casting and onto the pressure sensor membrane.

Thelma Biotel offers the smallest depth sensor acoustic transmitters on the market. It can be delivered down to 6.3 mm in combination with other sensors, such as temperature and acceleration, with several months of operational lifetime.

APPLICATIONS

Versatile & suitable for tracking & observation of:

- Fish & other aquatic species
- Fishing gear and nets
- Water depth measurements
- Oceanographic instruments

Wireless measurement of infrastructure such as:

- Mooring lines & anchoring
- Cage weights in aquaculture
- Net pens

SPECIFICATIONS

Standard sensor

Max measured depth:	290 m
Max survival depth:	500 m
Max resolution:	0.01 m

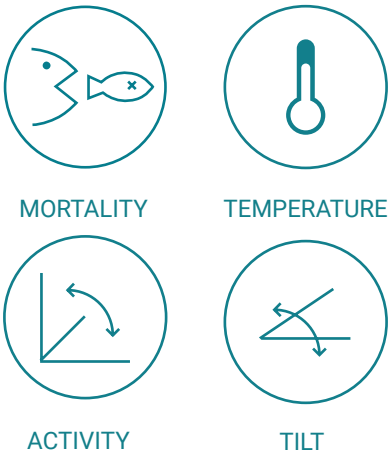
1K sensor

Only available in sizes 13 & 16

Max measured depth:	1000 m
Max survival depth:	2000 m
Max resolution:	0.25 m

Further specification options available on request

COMBINATIONS



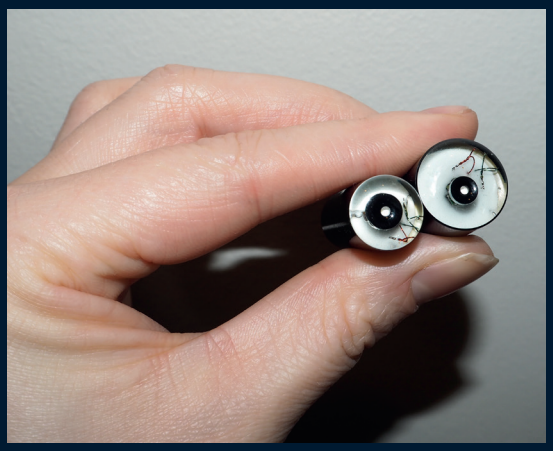
To explore the transmitter and sensor options, use the tag builder on our website:

THELMABIOTEL
www.thelmabiotel.com

PRESSURE

Measurements

The Standard measurement for pressure is a point measurement taken right before the data is transmitted. This means that the measurement frequency will be linked to the transmit interval. Always check your delivery note to ensure you apply the correct calculation when converting measurement data to the unit of choice. The method may vary due to different data ranges and setups.



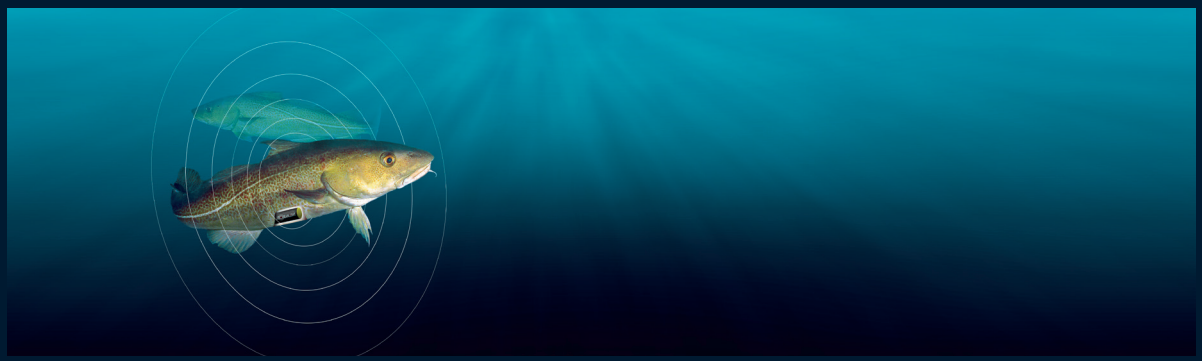
Measurement modes

There is a variation of measurement modes available upon request. Some of these include higher resolution down to cm in water depth, average depth measurements to remove bias from wave disturbance, proportion of last day the measurements have been more shallow or deep than a baseline, or Max / Min / average for last day.

Do not hesitate to contact us for more information regarding your project.

COMPATIBILITY

Thelma Biotel transmitters are compatible with the Open Protocol system to enable efficient research cooperation across borders and among different projects and universities. The Open Protocol allows users to freely choose equipment from different manufacturers and run open tenders competitions for equipment in follow-up orders of future equipment.



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Sensor Transmitter

TEMPERATURE

The Thelma Biotel temperature sensor transmitter deliver wireless, high-resolution data in the temperature range - 20 to 50 °C.

HIGHLIGHTS

- Available in all transmitter sizes 6, 7, 9, 13 and 16
- Long operational lifetime ~ 3 months - > 10 years

The transmitter measures the temperature using an embedded, high - precision digital sensor. When the transmitter is implanted, the animal's experienced temperature is measured.

Thelma Biotel offers the smallest temperature sensor acoustic transmitters on the market. It can be delivered down to 6.3 mm in combination with other sensors, such as depth and acceleration, with several months of operational lifetime.

APPLICATIONS

Highly applicable alone or combined to investigate:

- Experienced temperature
- Mammal predation
- Water layer differences

Day degrees measurements:

- Accumulation of day - degrees over time as direct output

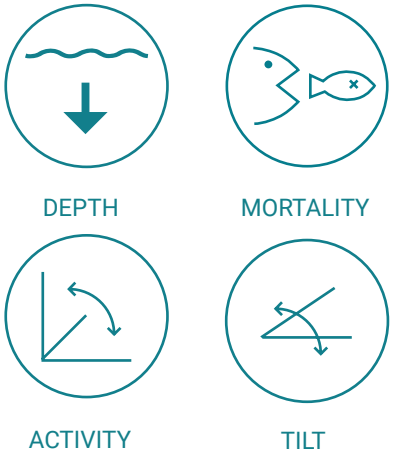
SPECIFICATIONS

Standard sensor

Min temperature:	- 20 °C
Max temperature:	50 °C
Accuracy:	0.1 °C
Resolution:	0.1 °C
Max survival depth:	500 m

Further specification options available on request

COMBINATIONS



To explore the transmitter and sensor options, use the tag builder on our website:

THELMABIOTEL
www.thelmabiotel.com

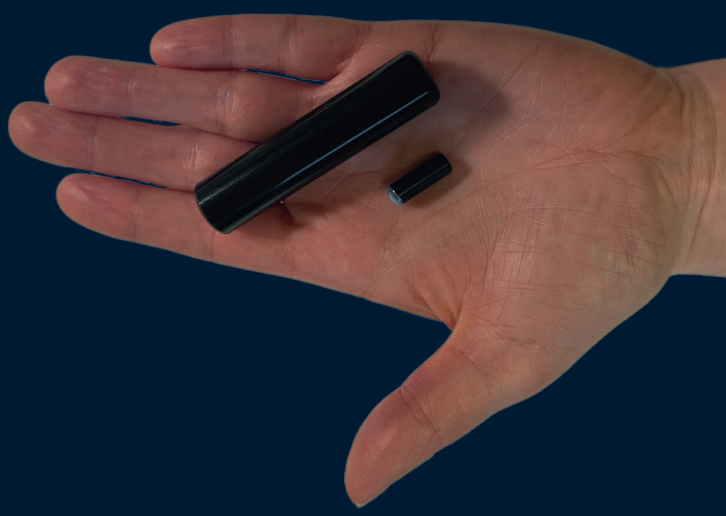
TEMPERATURE

Measurements

Standard measurement for temperature is a point measurement taken right before the data is transmitted. This means that the measurement frequency will be linked to the transmit interval. Always check your delivery note to ensure you apply the correct calculation when converting measurement data to the unit of choice. The method may vary due to different data ranges and setups.

Measurement modes

There is a variation of measurement modes available upon request. For example, a trigger at specific temperatures for a change in ID when exposed to temperatures above/below a baseline for mammal predation tracking.



The transmitter can also be made to measure day - degrees as a direct output in addition to the temperature values. In the latter instance, the measurement mode will be an accumulation of temperature above zero °C over time rather than a point measurement.

Do not hesitate to contact us for more information regarding your project.

COMPATIBILITY

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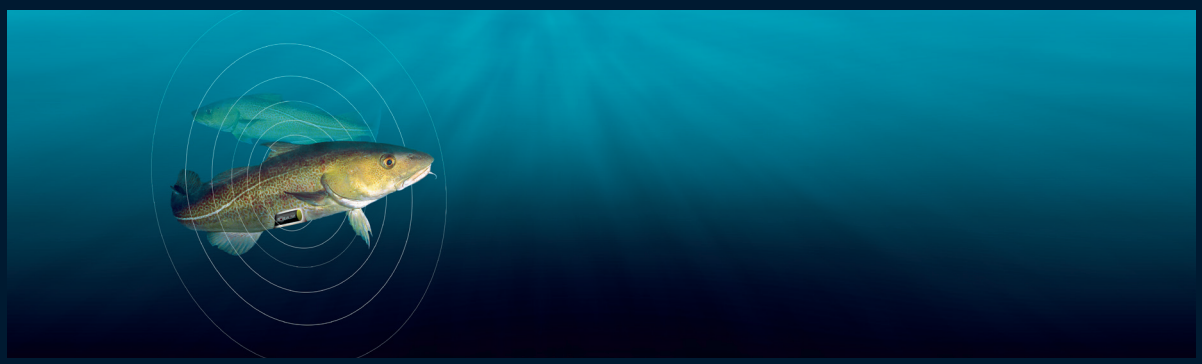

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Sensor Transmitter

ACTIVITY

The Thelma Biotel activity sensor transmitter delivers high-resolution data, felxible and applicable from small to large animals.

HIGHLIGHTS

- Available in all transmitter sizes 6, 7, 9, 13 and 16
- Long operational lifetime ~ 3 months - > 10 years

The activity sensor is fully embedded in the transmitter with no external ports. It uses a 3-axis accelerometer for rapid sampling to document any activity and movement over a chosen sampling duration.

Thelma Biotel offers the smallest activity sensor acoustic transmitters on the market. It can be delivered down to 6.3 mm in combination with other sensors, such as temperature and depth, with several months of operational lifetime.

APPLICATIONS

Studying animal behaviour in regards to:

- Energy expenditure
- Workload in river rapids
- Spawning/feeding/activity
- Response to habitat changes

Two calculation options available:

- Root mean square (**RMS**)
- Overall dynamic body acceleration (**ODBA**)

SPECIFICATIONS

Standard sensor

Activity range:	0 - 3.465 m/s^2
Resolution:	0.013588 m/s^2
Max survival depth:	500 m

Sampling frequency:

RMS:	5 Hz
ODBA:	25 Hz

Further specification options available on request

COMBINATIONS

DEPTH

TEMPERATURE

MORTALITY

TILT

To explore the transmitter and sensor options, use the tag builder on our website:

THELMABIOTEL
www.thelmabiotel.com

ACTIVITY

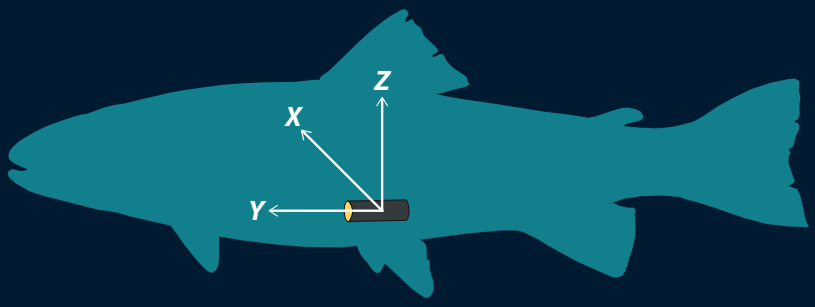
Measurements

The total acceleration in the activity sensor transmitter is measured in three axes (X, Y and Z) and consists of two components, static and dynamic acceleration. The tag runs the raw acceleration data through a low-pass filter where the static component, with gravity and sensor offset, is subtracted from the acceleration reading. The remaining part of the reading is the dynamic part with information about the animals movement.

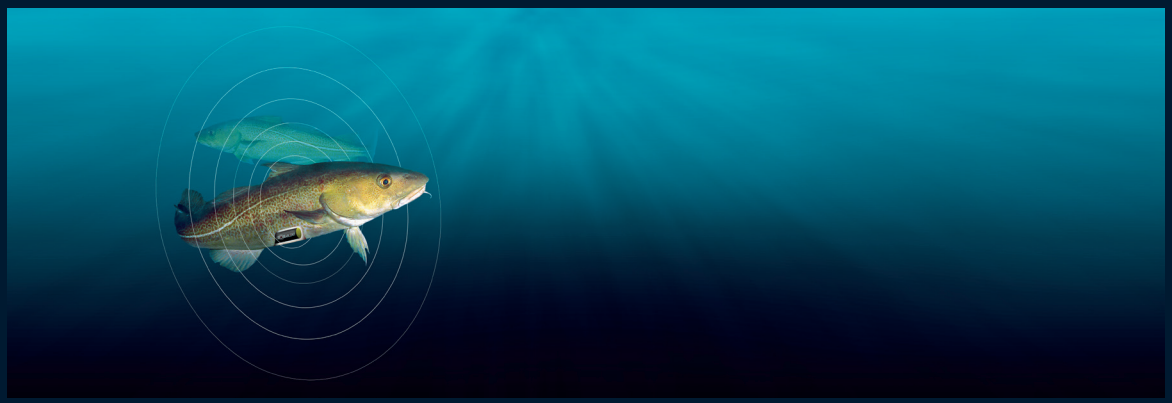
The measurement output transmitted can be calculated using the equation for **ODBA** (overall dynamic body acceleration) or **RMS** (root mean square). We propose to chose RMS or ODBA based upon the studies your work refernce to, aligning your results for comparison.

"A number of studies have demonstrated a clear individual-specific relationship between oxygen consumption (VO2) and ODBA, showing that ODBA can be used as a proxy for energy expenditure during the tested activities on the tested species" (Wilson et al., 2020). "An important caveat is that acceleration-based proxies only quantify mechanical energy use and cannot account directly for metabolic energy consumed by physiological processes such as thermoregulation" (Gleiss, Wilson, et al., 2011).

Martin Lopez, L. M., Aguilar de Soto, N., Madsen, P. T., & Johnson, M. (2022). Overall dynamic body acceleration measures activity differently on large versus small aquatic animals. Methods in Ecology and Evolution, 13(2), 447-458.



The activity sensor cannot function with standard point measurement, and it must log continuously over a period to catch the activity from the tagged animal. The default setting lets the sensor record acceleration data for 1/3 of the average transmit interval. The measurement starts right after the previous transmit.



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Sensor Transmitter

INCLINATION

The Thelma Biotel inclination sensor transmitter deliver high-resolution data in the tilt range 0 - 180° along the central axis as a default.

HIGHLIGHTS

- Available in all transmitter sizes 6, 7, 9, 13 and 16
- Long operational lifetime ~ 3 months - > 10 years

The inclination sensor is embedded into the transmitter and measures the tilt angle along the central axis of the casing.

Thelma Biotel offers the smallest inclination sensor acoustic transmitters on the market. It can be delivered down to 6.3 mm in combination with other sensors, such as temperature and depth, with several months of operational lifetime.

APPLICATIONS

Equipment and infrastructure control:

- Pressure distribution and angular measurements of anchor lines
- Volume measurements of net bags in fish farming facilities
- Angle of deployed equipment on lake - or seabed

Animal behaviour

- Angle of individuals
- Resting or diurnal migration

SPECIFICATIONS

Standard sensor

Tilt range:	0 - 180 °
Resolution:	1 °
Max survival depth:	500 m

Further specification options available on request

COMBINATIONS

DEPTH

TEMPERATURE

MORTALITY

ACTIVITY

To explore the transmitter and sensor options, use the tag builder on our website:

THELMABIOTEL
www.thelmabiotel.com

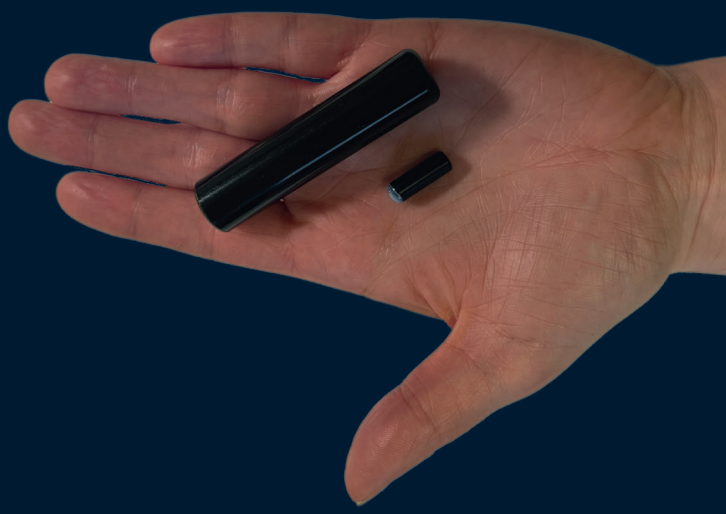
TILT

Measurements

Standard measurement for tilt is a point measurement taken right before the data is transmitted. This means that the measurement frequency will be linked to the transmit interval. Always check your delivery note to ensure you apply the correct calculation when converting measurement data to unit of choice. The method may vary due to different data ranges and set-ups.

Measurement modes

There is a variation of measurement modes available upon request. Some modes can include longer or shorter measurement intervals, proportion of last day the measurements have been more or less tilted than a baseline, or Max / Min / average. Using a magnet command, the angular zero point may be set to change the default orientation or compensate for misalignment after mounting the tag.
Do not hesitate to contact us for more information regarding your project.



COMPATIBILITY

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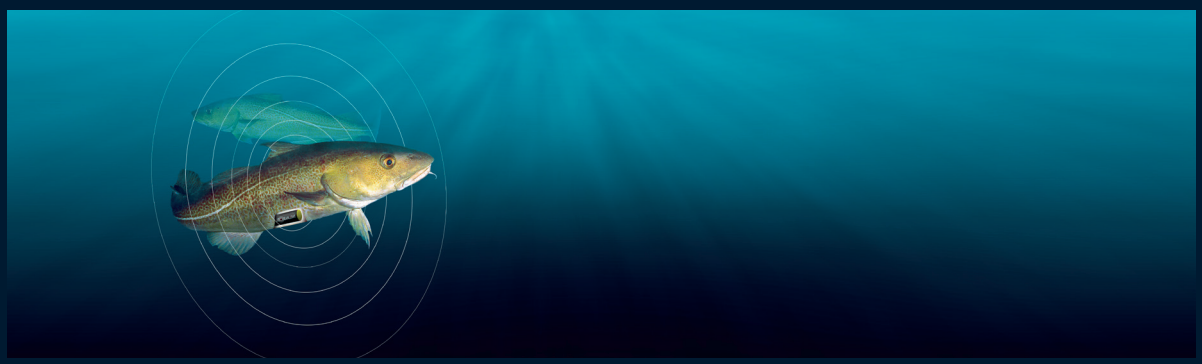

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Sensor Transmitter

MORTALITY

The Thelma Biotel mortality sensor transmitter measures mortality events in tagged animals using orientation technology. The sensor triggers as the animal loses the ability to maintain proper orientation.

HIGHLIGHTS

- Available in all transmitter sizes 6, 7, 9, 13 and 16
- Long operational lifetime ~ 3 months - > 10 years

The mortality sensor transmitter records mortality events using an embedded accelerometer which tracks the orientation, thus tilt values over time.

Thelma Biotel offers the smallest mortality sensor acoustic transmitters on the market. It can be delivered down to 6.3 mm in combination with other sensors, such as depth and acceleration, with several months of operational lifetime.

APPLICATIONS

Recording mortality events in regards to:

- Predation vs. natural mortality
- Anthropogenic influence
- Barriers
- Behavioural ecology

Highly applicable in the study of migratory species:

- Salmon smolts
- Trout

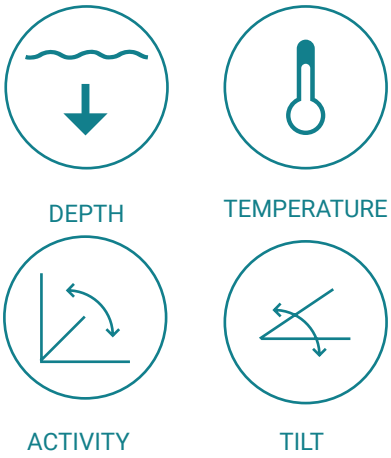
SPECIFICATIONS

Standard sensor

Alive/Dead:	ID shift
Orientation range:	0-180°
Resolution:	1°
Accuracy:	1°
Max survival depth:	500 m

Further specification options available on request

COMBINATIONS



To explore the transmitter and sensor options, use the tag builder on our website:

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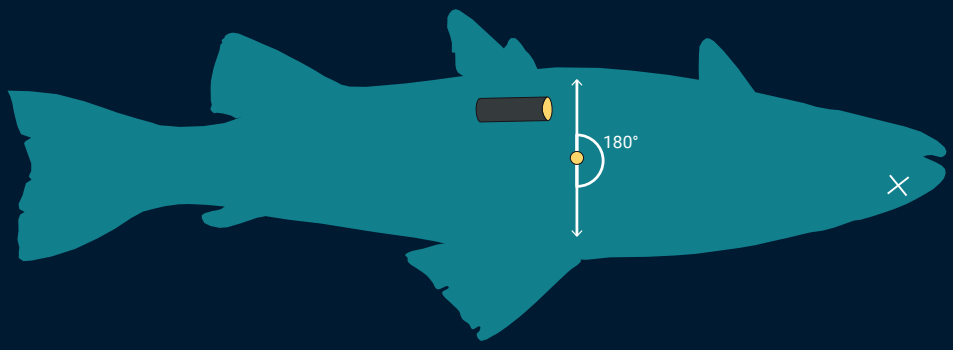
www.thelmabiotel.com

MORTALITY

Measurements

The mortality sensor is based on orientation technology and records the tilt values randomly at every interval to create an average baseline orientation, which is constantly updated. Larger deviations from the baseline over a certain time period results in the triggering of the mortality sensor and a change in the status (or ID) from alive to dead. To avoid sudden orientation changes at a few time points resulting in the triggering of the sensor, the average tilt value from the past hour is compared to the baseline. This means that the sensor spends some time comparing the baseline to the average before triggering the ID switch. For example, tests have shown that a 180° sudden change in orientation will switch the mortality trigger after around 21 minutes. The sensor also accounts for larger deviations in orientation during surgery with a delayed reset. The reset functionality assures that the tag does not switch during surgery resulting in biased data.



COMPATIBILITY

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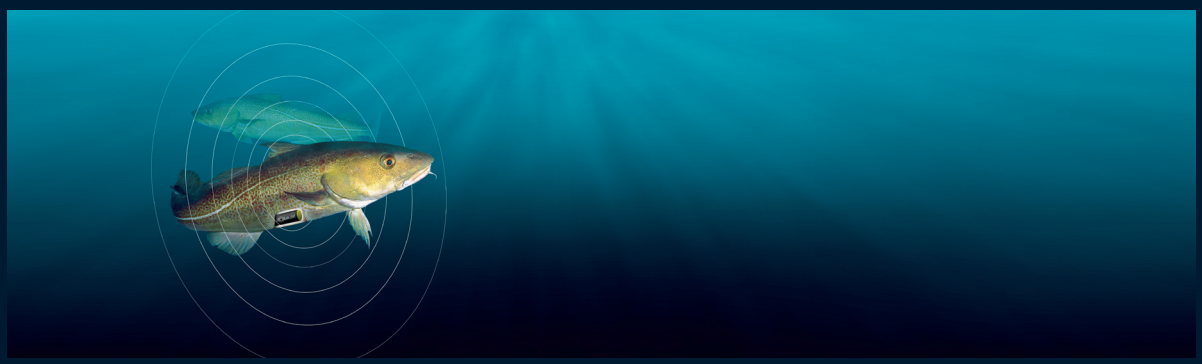

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Sensor Transmitter

CONDUCTIVITY/SALINITY

The Thelma Biotel conductivity or salinity sensor transmitter deliver conductivity + temperature data or salinity data for either fresh water - or brackish/salt water use.

HIGHLIGHTS

- Available in transmitter sizes 9, 13 and 16
- Operational lifetime 3+ months

The Thelma Biotel conductivity/salinity sensor is located on the face of the transmitter, and the measurements is taken through the four electrodes for wide measuring ranges.

The sensor transmitter should be attached externally to a fish, other species, or object to be in direct contact with the water. Available sensors include one version for use in fresh water and one version to measure salinity in brackish and salt water.

APPLICATIONS

Conductivity:

- Ground- vs. surface water
- Water quality
- Mining runoff
- Freshwater use

Salinity:

- Salt and brackish water use
- Halocline differences
- Estuary studies

SPECIFICATIONS

Conductivity

Cond. range:	0-2500 µS/cm
Temperature range:	0 - 25.5 °C
Resolution:	10 µS/cm
Max survival depth:	500 m

Salinity

Salinity range:	0-40 ppt
Resolution:	1 ppt
Max survival depth:	500 m

Further specification options available on request

COMBINATIONS

TEMPERATURE

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