

ACOUSTIC TRANSMITTER

ACTIVITY AND TILT



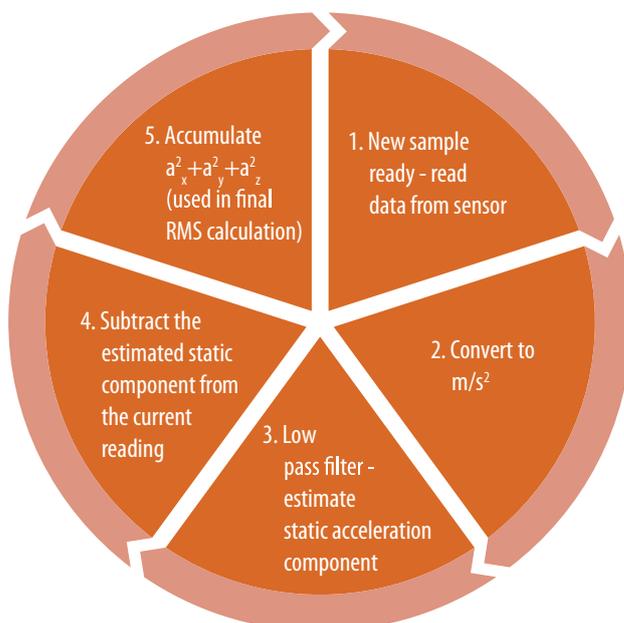
The embedded ultralow power 3-axis accelerometer registers both static and dynamic acceleration with 0.01 m/s² resolution. Common applications are measuring tilt angle of objects or animals, or level of activity. It may even be programmed to detect and report specific motion patterns.

ACTIVITY LEVEL

One central feature of the activity transmitter is its ability to register the level of activity to which it is exposed, like what is found in modern pace counters and activity trackers. This is accomplished by rapid sampling and monitoring the changes in acceleration on the transmitter over time.

On-board Processing Algorithm

Raw acceleration data is sampled from the accelerometer at the desired frequency, converted to m/s², and then passed through a low-pass filter to determine static components such as gravity or other offsets. This provides a static acceleration vector to which the current data sample is compared to extract the acceleration dynamics.



SPECIFICATIONS

Activity

Range activity:	0-3.465 m/s ²
Resolution:	0.01 m/s ²
Sampling frequency:	5 Hz
Max survival depth:	500 m

Tilt

Range tilt:	0-180°
Resolution:	1°
Max survival depth:	500 m

Sensor Combinations



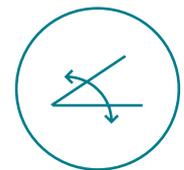
DEPTH



TEMPERATURE



ACTIVITY



TILT

Rotational movement causes changes in the static acceleration vector, and will as such be detected as activity along with linear accelerations. For persisting rotational movement, the influence will be less dominant over time as the low pass filter updates the static acceleration vector estimate. It is possible to tune the strength of the filter by adjusting the cut-off frequency. By default, this is set to 0.2 Hz.

The acceleration dynamics are accumulated over the desired sampling duration, and then a Root Mean Square (RMS) value of the acceleration is calculated. A_{RMS} is the value transmitted by the tag, and provides an estimate of total activity/movement during the sampling window.

$$A_{RMS} = \sqrt{\frac{\sum_{n=1}^N a_x^2 + a_y^2 + a_z^2}{N}}$$

As the characteristics of the activity may vary significantly between use cases the value transmitted by the tag can be programmed with user defined parameters:

- **Sample window duration:** The acceleration sample window is started right after the previous transmit has completed. To make sure the sampling has time to finish before the next transmit, the sampling window should be less than $t_{x_{min}}$.
- **Sample frequency:** Number of acceleration samples (each sample consists of 3 data points – a_x , a_y and a_z) collected in one second. Default sampling frequency is 5 Hz.
- **A_{RMS} acceleration range:** S256 transmits contains 1 byte of sensor data [0-255]. For example, a resolution of 0.013588 m/s² gives a range of 0 - 3.465 m/s². The range has proven useful for smaller and larger pelagic fish species as well as different species of crustaceans.

TILT ANGLE / INCLINATION

The sensor can measure tilt angle along the central axis (default) of the casing. This can be convenient for remote monitoring of tilt angle of any animal, equipment or any other object under water. The transmitted value ranges from 0° to 180°, with a 1° resolution and accuracy.

By using a magnet command the angular zero point may be set to change the default orientation or compensate for misalignment after mounting the tag.

BEHAVIOUR SIGNATURE RECOGNITION

Another key feature of the activity transmitter is the capability of detecting various motion signatures based on the raw data from the 3-axis accelerometer. Detection algorithms can be tailored to meet your specific needs and developed by Thelma Biotel. Ideally this is based on real data and video from controlled conditions where the relevant specimen is set up to log data directly from the desired motion pattern. After logging data on the specimen under controlled conditions, typically with video recording, the data can be analysed and used during programming.