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Specialists in Animal Radio Monitoring

## ACTIVITY & POSTURE SENSING

Activity-sensing circuits can be added to all but the very smallest radio tags to provide information about what an animal is doing. The principle component in the circuit is a mercury tilt-switch which switches between two distinctly different pulse rates (fast and slow). The pulse rates can be set to any reasonable values, but typically the slow pulse would be about 50 pulses per minute, and the fast pulse 70 - 80 pulses per minute. The tilt-switch is an hermetically-sealed short metal tube, with two contact wires at one end. Inside the tube is a small drop of mercury which can move freely from end to end. When the mercury is at the end with the wire contacts, it bridges them and closes the switch (switch on). In this position the pulse rate is slow. When the mercury moves away from the contacts the switch becomes open-circuit (off), and the pulse rate is fast.

### Activity-sensing

The angle and position of the switch determines what information it provides about the animal's activities. At the most basic level, a tilt-switch can indicate simply whether or not an animal is active. For this, the tilt-switch is usually fitted in a side-to-side orientation, and slightly biased towards the 'on' position, such that the mercury inside the switch is likely to slide from end to end of the switch when the animal moves. The reason for the bias towards 'on', is to try to ensure that slow is the dominant pulse rate, particularly when the animal is inactive. This is because pulse rate affects battery life (fast pulses deplete the battery quicker), and there is little benefit in a tag pulsing fast on an animal that is not moving. When the animal is active, the slow pulse rate should be dominant, but irregular fast pulses should be heard as the mercury moves about in its tube. When the animal is inactive the pulse rate may be either fast or slow, but will be constant.

### Posture-sensing

On some species it is possible to position the switch such that the different pulse rates indicate particular postures. For example, if a tilt-switch is fitted in a front-to-back position, and at an appropriate angle in a collar tag, it should be possible to determine either head-up (e.g. vigilant) or head-down (grazing) postures in its wearer (though it is not usually possible to identify both postures in one animal, since one or the other head position will give the same pulse rate as an intermediate posture). Similarly, a posture-sensing tag on the tail of a bird can distinguish between flying (tail nearly horizontal) from when it is sat in a tree (tail roughly vertical).

### Behaviour-sensing

The use of tilt-switches to monitor particular behaviours is really an extension of posture-sensing. It often relies on other characteristics of the signal from the tag, as well as the pulse rate. The technique is only suitable for certain species, although it is often not apparent which species and which behaviours will give sufficiently distinct pulse characteristics, until the tags are in use. The principle is best illustrated by an example. Radio-tags containing tilt-switches on the tails of Nightjars (*Caprimulgus*

europaeus) can be used to identify a particular type of feeding behaviour (fly-catching). During this behaviour, a Nightjar flies from a perch to catch a moth in the air up to about 10 m above, then returns to the perch to eat it. The characteristic signal from the radio is a short period of irregular pulses when the bird is in flight, followed by a constant signal when the bird is on the perch. Accompanying the irregular pulse rate, there is also a sudden increase and a noticeable pulse-to-pulse variation in the strength of the signal (because signals get stronger with increased transmitter height).

Tilt-switches can also be used to detect mortality, using the simple principle that an animal that is active as still alive, while one that has been inactive when checked on several separate occasions may be dead !

### **Activity-sensing (using mortality-sensing circuits)**

Mortality-sensing circuits are a further development of activity-sensing circuits. They contain a timer which quickens tag pulse rate if the animal has not moved during a predefined period. Their function is fully explained elsewhere in this document. The reason for introducing them here is because they can also be used for activity-sensing applications, and are particularly useful if a data logger is being used. For further details see the section on mortality-sensing.

### **Specification of tilt-switch parameters**

If you order tilt-switches for your radio tags, Biotrack will normally choose what we consider are the most appropriate pulse rates and switch positions/angles. However, we are very happy to modify any of these parameters to your specification, or to discuss what angles might be appropriate and what behaviours could be identified (or need to be identified as part of the research). If you have any doubts or questions, please discuss it with us. There is no extra charge for setting non-standard switch parameters.

### **Tilt-switches: Benefits and Costs.**

Benefits:

- Permit remote behavioural monitoring.
- Can be used for mortality sensing.

Costs

- Extra weight (0.5 - 1g) and bulk (the two types of switches we use are 3 x 5 mm or 5 x 9 mm).
- Extra cost (see price list).
- Reduces tag battery life in proportion to how long the transmitter is in fast pulse mode.