

Data_Link 2000

APPLICATION NOTE AN019 **Monitoring Rotating Filter Beds**

Summary

European legislation specifies that all waste water treatment plants are monitored to minimise pollution due to equipment failures. Many small unmanned sites use rotating filter beds to treat the water. These rely on a rotating arm to distribute the water evenly over a circular bed. The arm is usually powered by the water pressure. If it stops rotating for any reason the filtering will become ineffective so there is a risk of polluting the watercourse into which the plant discharges.

There is thus a need to monitor the arm to confirm that it is rotating. This can be achieved easily by installing a battery-powered *Nano_Link*, fitted with a rotation sensor, on the arm. No other installation work is required. The *Nano_Link* constantly monitors the sensor and will radio an alarm if it stops rotating. It also counts the total number of revolutions of the arm, and measures the rotation speed. Both of these parameters can also be transmitted by radio if required.

The rotation sensor uses one analogue input and two totalised counts within *Nano_Link*. The remaining I/O capacity is available for any other use that may be required.

Method of Operation

The rotation sensor incorporates an extremely sensitive magnetic sensor that acts as an electronic compass. To conserve power, *Nano_Link* samples the sensor at regular intervals. Each time *Nano_Link* senses that it has passed North or South it calculates the total number of revolutions, the time per half-revolution and derives an alarm flag to indicate if it stops rotating. The alarm is generated in any of the following cases:

1. It has slowed to less than one quarter of the previous speed, and the user has not downloaded a time-out to it. This ensures that an alarm will be generated within a time period that is dynamically adjusted according to the rotation speed. The calculation is made each time the arm passes North or South. This is appropriate for arms with a rotation period of up to 20 minutes. For example, if the normal rotation speed is one revolution per minute an alarm will be generated within 2 minutes. If the normal rotation speed is one revolution every 20 minutes an alarm will be generated within 40 minutes.
2. More than 45 minutes have elapsed since it last passed North or South, and the user has not downloaded a time-out to it. This is appropriate to arms with a rotation period of between 20 minutes and one hour. For example, if the normal rotation speed is one revolution an hour minutes an alarm will be generated within 45 minutes.

3. The user has downloaded to it a time-out and no movement has been detected for that time (if a time-out has been downloaded then mechanisms (1) and (2) are disabled). This is appropriate to arms that may stop for extended periods. For example, an arm may rotate at one revolution per minute during the day, but stop for up to 8 hours overnight. The user could download a time-out of 10 hours. An alarm would then only be generated if no movement was detected for a continuous period of 10 hours.

When movement resumes the alarm is cleared.

Installation

The Rotation Sensor is mounted in the same enclosure as the *Nano_Link* and is polarised such that its direction of maximum sensitivity is when the cable from the sensor is horizontal, which means the enclosure can be either attached to a vertical surface with the aerial socket at the top or mounted on a horizontal surface.

Internally the sensor is connected to analogue input 2 which is obviously not available for normal use.

The configuration switches S2 poles 6, 7 and 8 should be set to 111 (i.e. all ON). This will configure *Nano_Link* to operate as a low power outstation, and to process analogue input 2 as a rotation sensor. The remaining configuration switches should be set as required.

Base-station Configuration

An outstation equipped with a rotation sensor generates a rotation alarm flag in the location allocated for the *Bus_Link* alarm flag. Since *Nano_Link* doesn't have a *Bus_Link* port this alarm flag was not previously used.

Count 1 from the *Nano_Link* records the total number of revolutions completed by the rotation sensor. Count 2 registers the time per revolution, in seconds. If the unit stops rotating Count 2 is forced to 0xFFFF (65535).

The base-station can be configured to read whichever of these flags and registers it needs. No special configuration is needed in the base-station if alarm mechanisms (1) or (2) are used. However, to use mechanism (3) the base-station must be configured to instruct the outstation to exception report. For example, if the outstation is set to station address 10 the following could be included in the base-station data routing configuration:

Exception Analogue = 600 -> Outstation 10 Analogue Input 2

The value set determines the period in minutes that can elapse since the arm last passed North or South before an alarm is generated. Therefore this example will generate an alarm if the arm has not moved for 10 hours.

Since count 1 and count 2 are used by the rotation sensor when configured in this mode, digital inputs 1 & 2 cannot be used to count pulses, but can still monitor status conditions. Analogue Input 2 is used by the rotation sensor so cannot be used as a normal analogue. Digital inputs 3 & 4 and analogue input 1 operate as normal.

Specifications

Minimum rotation period:	1 minute
Maximum rotation period:	8 hours
Maximum rotation period change without generating alarm:	Period increases 4x within half revolution