APPLICATION NOTE

Maintenance Watchdog™ Battery Life

One of the most important questions concerning wireless sensors is: How long will the batteries last? It is difficult to provide an easy answer because the battery life depends upon how much the battery is used and its environment. Because the Maintenance Watchdog™ system allows the user a great deal of flexibility, the battery life answer becomes even more difficult to evaluate. It is important to understand the factors that affect the battery life and to configure the system to optimize the battery life of the monitoring system.

Factors that affect battery life

- **Frequency of Records** – The criticality of an asset and the time to failure should be considered when scheduling a wireless sensor. The least amount of data records that will provide a high level of surveillance should be selected. After the sensor is installed, the cost of monitoring is the $15 for a replacement battery and the cost to physically replace the battery.

- **Length of Record** – The minimum sampling resolution required to detect possible faults should be selected so that the wireless transfer of data is minimized. A longer data record uses more battery capacity. The following are data record transport times under ideal conditions (data rate 3500bps):

    - 800-line FFT = 10 seconds
    - 1600-line FFT = 20 seconds
    - 3200-line FFT = 40 seconds

- **Weak Radio Link** – When a sensor does not receive a handshake from the Network Access Point, it relies on packet retries to transfer data. A sensor with a weak radio link might be able to transfer data successfully, but it will use many retries to complete the message. The radio transfer for each data record is timed and recorded to provide an indication of the quality of radio link. With a weak radio link, a repeater might have to be added to optimize the radio network.

- **Repeater Usage** – Using a repeater roughly doubles the time a wireless sensor is transferring data. The sensor is awake longer because the repeater relays every data packet to the Network Access Point. Finding an optimal location for the Network Access Point radio pod is important so that a minimal amount of repeaters are required.

- **Exposure to Temperature** (above 122 degrees F) – In higher temperatures, the batteries passivate (build up an internal resistance). The wireless sensors monitor the temperature and battery voltage and regulate passivation by using battery current to break down the internal resistance. For higher temperature applications, a high temperature battery is recommended. Insulation blocks can also be used in mounting the sensor.

- **Shelf Life and Storage –** Lithium batteries have shelf lives in excess of 10 years when properly stored. The Lithium battery will discharge its electrical capacity slowly over this period. For this reason it is not practical to have Lithium products operate longer than 10 years. Any battery not used for a period of several weeks should be stored in a refrigerated environment (35F – 40F) for maximum shelf life.

Accelerated Life Tests

Accelerated life tests, ALT, have been performed on the Maintenance Watchdog™ system to determine the number of data records that a standard battery will transmit. The following parameters were used:

- Frequency of readings – every 2 minutes
- Length of record – 800-line FFT, 60kFMax
- Radio link – 3500bps
- Temperature – 70 degrees F

1. Direct connection of accelerometer to Network Access Point (no repeater)

   RESULT: 15,914 data records

2. Repeater connection for accelerometer to Network Access Point

   RESULTS: 7578 data records

Life Estimates

The data from the accelerated life tests can be used to estimate the upper limit for battery life. These estimates assume 800line FFT, good radio link (3500bps), no repeater, and moderate temperatures (70F). The following life estimates are predicted for various periodic settings:

Periodic Mode (Event every so many minutes)	Life Estimate (Days)
2	22
5	55
10	111
60	663

The following life estimates are predicted for various schedule settings:

Schedule Mode (Events per day)	Life Estimate (Years)
12	3.6
8	5.5
4	10.9*
3	14.5*

* The shelf life of the Lithium battery will limit the life under these conditions

Under actual conditions, the battery life may be less than ideal. Predicting this life is sometimes difficult in advance, but once the product is deployed this prediction becomes possible. While operating, the wireless sensors log their actual air times, and temperatures. An Excel spreadsheet is available to predict the battery life based on these measured conditions.

Summary

The Maintenance Watchdog™ System requires careful configuration to insure that proper surveillance is achieved for an asset while the optimal battery life is achieved. Like most engineering efforts, understanding all of the system parameters is critical to properly specifying a solution.

More information on the Maintenance Watchdog™ wireless condition monitoring system is available at:

http://www.techkor.com/industrial/wireless.htm

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