hohner

Test Report

Battery Life Validation for Hohner Wireless Shaft Encoders

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Introduction

The Hohner series of wireless encoders have been designed for very low power consumption in order to achieve a useful battery lifetime. Of course, the battery lifetime of any device/system depends on the capacity of the battery used and the demands placed on it by the powered system.

The battery used in the Hohner wireless encoders has been certified as intrinsically safe and therefore it will be the only battery to be tested for lifetime.

The encoder used for this test is a standard catalog wireless encoder but which has had certain firmware modifications in order to accelerate the demands on the battery and provide a baseline *worst-case* lifetime result. Details and rationale for the firmware modifications are described later.

While this test was carried out on a specific model of encoder, this test report is applicable to all Hohner wireless encoders. This is because all our wireless encoders employ the exact same counting/processing/transmitting circuits regardless of the housing or enclosure that contains them. Any signal output differences are all generated at the receiver end, and therefore will not affect battery life in any manner. (e.g. incremental, 4-20mA, RS232, RS485, MODBUS)

Test Set-Up & Results

As previously stated the test encoder had some firmware modifications. Since the intent was not to test(or destroy) any mechanical components, by testing at high speed for a long duration, such as bearings or the driving motor, firmware modifications were made to exercise the encoder as it would be if it were actually turning.
To achieve this, an internal 32bit counter was continuously incremented at a rate of about 1800 counts/second. This rate of counting is equivalent to a 200 PPR encoder turning at about 500 rpm. Additionally, about every 12.7mS or almost 80 times /second, the instantaneous count was captured and the 16 MSBits of the count were transmitted. These 16 MSBits were monitored on a receiver and when the received 16bit count rolled-over about every 28 days(which actually represented a 32bit count roll-over) the battery voltage was then measured. This process continued for 392 days until the encoder would no longer transmit.

Test Apparatus:

Tektronix 2246 Oscilloscope
Fluke 99B Scopemeter
Fluke 8050A DMM
Hohner Wireless Encoder P/N 3AM1-06WR-0200
Hohner RS232 Receiver - Series 08
Encoder Battery P/N WiFi Bat

Test Parameters:

Ambient temperature:	approx. 20C (68F)
Test Duration:	392 days
Data Logging:	28 day increments
Start Battery Voltage:	3.65V
Average Continuous Battery Current:	2.29mA
Counting Current:	1.6mA
Transmitting Current:	15mA

Subject Test Battery Basic Specs:

Nominal capacity	19000 mAh
Open circuit voltage	3.66V
Nominal voltage	3.6V
Maximum continuous current	200mA

Figure 1 below shows the battery current drawn during the operation of the encoder over the duration of this test. It illustrates the current varies according to the two operating states that the encoder is in, counting & transmitting. While just counting, 1.6mA of current is drawn for 12.05mS & when transmitting 15mA is drawn for 650uS. This cycle was repeated continuously every 12.7mS which yielded a transmission rate of almost 80 transmissions/second. As indicated earlier, this operating profile is equivalent to a 200 ppr encoder turning at about 500 rpm and is near the maximum practical transmission rate due to the simultaneous demands on the processor of counting & transmitting.

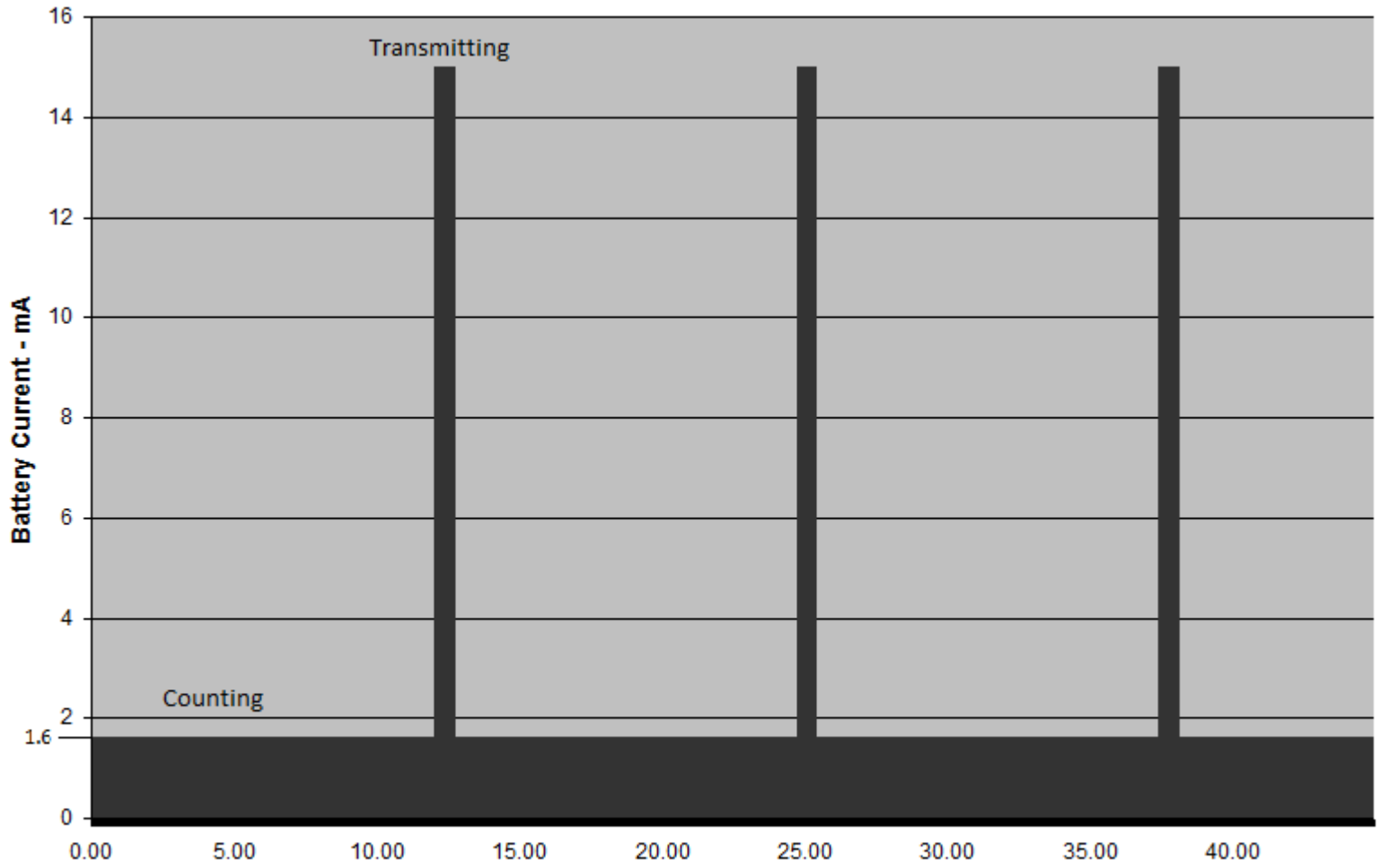

Figure 1 - Battery Current vs. Time (mS)

Figure 2 below shows the battery voltage at the sampling points approximately every 28 days until the encoder ceased to transmit at day 392. Although the encoder was counting and transmitting until the battery level reached 2.37 volts on day 392, the operating range of the system when the battery is that low is reduced since the transmitter RF signal output power is proportional to the input voltage.

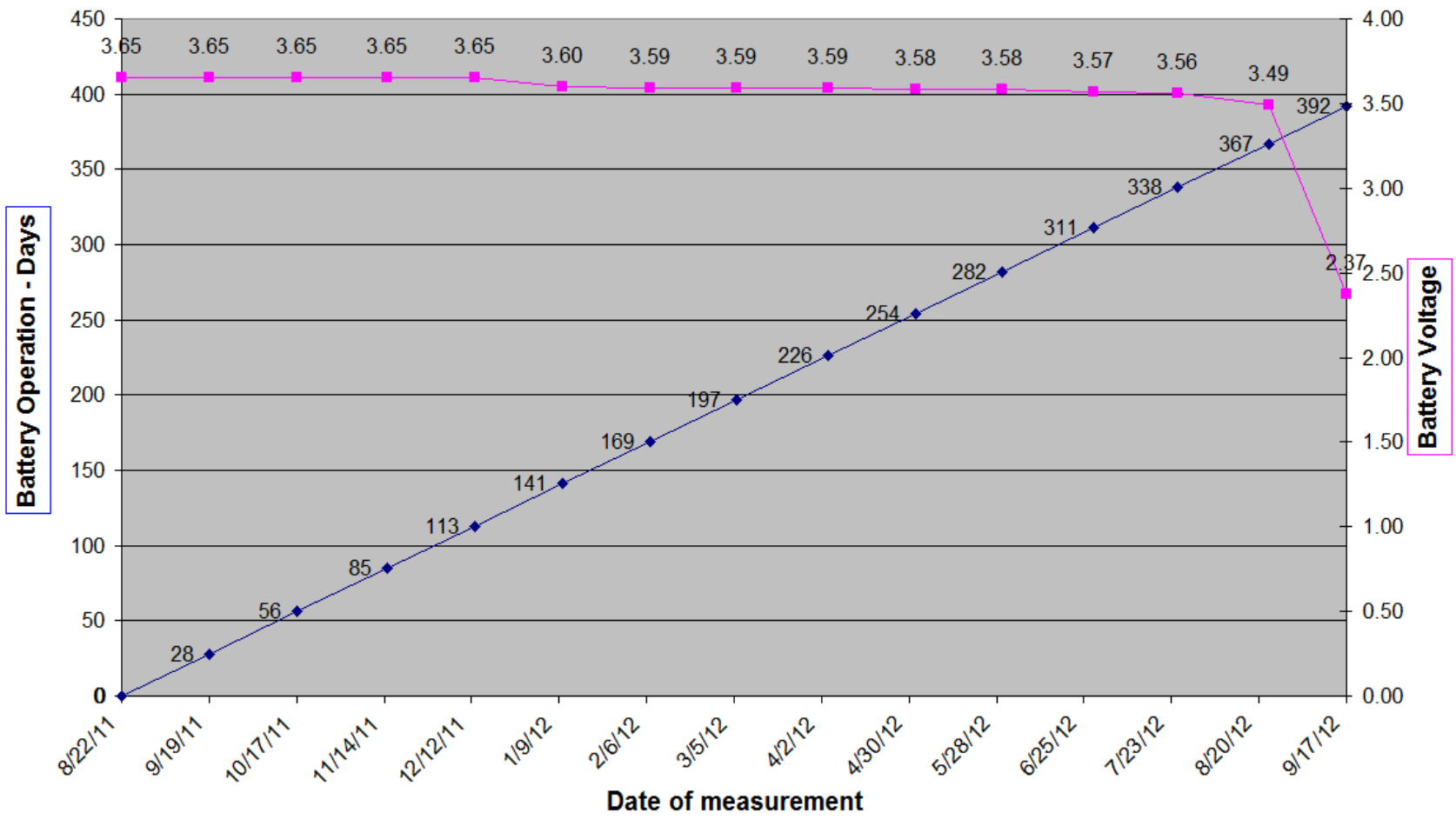

Figure 2 - Battery Voltage vs. Days

Conclusions

This test has shown that the battery used with the Hohner wireless encoders can enable them to continually & reliably transmit their position data for at least a year. This test has also shown that the test profile was very near to a worst case example of battery life.

Another metric could be to say that this encoder system has transmitted over 8 Gigabytes of data over a span of 13 months, transmitting this data 24hr. / day, 7 days a week.
i.e. 3 bytes/transmission X 80 transmissions/sec. x 86400 sec./day x 392 days = 8.1 x10^9 bytes

It would also be useful to compare these results with the battery manufacturer claims of capacity.
According to the battery cell datasheet this battery has a 19000 milli-amp-hr. capacity.
The average current drawn by the encoder can be determined from the given data.
So, (1.6mA x 12.05mS) + (15mA x 0.65mS) / 12.7mS = 2.29mA
And dividing this into the stated capacity of 19000 mAh
Yields, 19000mAh / 2.29mA = 8297 hrs. = 346 days
This value is close to our actual test results.

A reasonable question at this point may be, 'If this test profile was near to a worst case scenario then under what conditions could we see an improvement in battery lifetime?'

To answer that question I refer you back to ***Figure 1 – Battery Current vs. Time (ms).***
Here we can see that the minimum current drawn at any time is about 1.6mA. This is the minimum current drawn over the life of the test. Because this test profile simulated a continuously turning & transmitting encoder it put the greatest demand on the battery.

For any operation running less than continuously, then the power consumption would be reduced accordingly. When Hohner wireless encoders are not actually turning, after a brief delay, they will go into a *sleep* mode, where the current is reduced to about 0.1 mA. At this power demand rate the battery life would theoretically be close to the battery shelf-life.

So, as has been demonstrated, any practical application of the Hohner wireless encoders will result in a battery life of at least a year and most probably longer for most real-world applications.