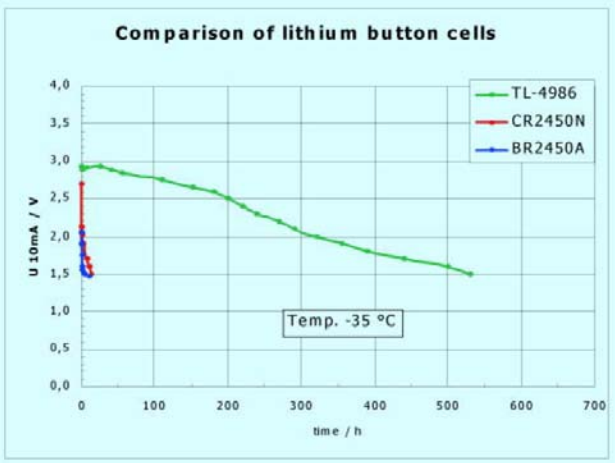
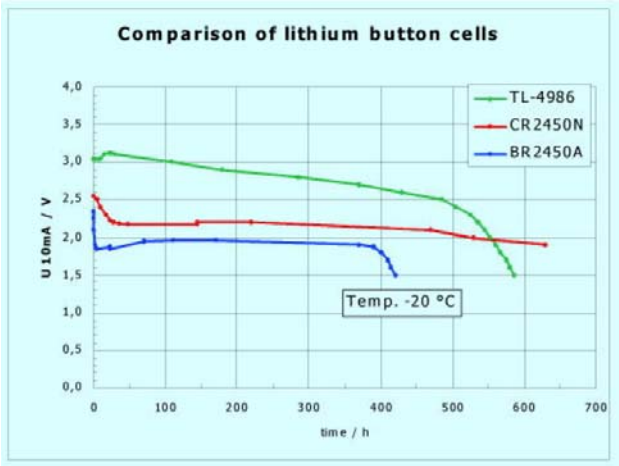
Implementing Lithium Batteries Into Automotive Applications

Depending on the application, the electrical and mechanical requirements differ widely from each other. A TPMS battery, for instance, should work for up to 10 years inside the wheel. The electrical load profile typically consists of a small (or no) background current and pulse currents in the vicinity up to 10 mA. Shock, vibration and centrifugal forces are very demanding. In the field of telematics, emergency, and safety devices, very high current pulses are drawn after a long standby time of up to 10 years. Very often, the suitability of lithium battery systems is limited by the temperature requirements. The standard temperature range for automotive applications is –40 °C to +85 °C. The TPMS profile specifies temperatures from –40 °C to peaks up to +150 °C (for three hours within the total operating time).

The lithium thionyl chloride ($Li/SOCl_2$) technology covers the widest temperature range of all available battery systems. Nevertheless there is also a discussion about the suitability of 3 V lithium cells, as these might be less expensive than the $Li/SOCl_2$ batteries. In the TPMS field low temperature is the limiting factor for electrical performance of Lithium batteries, whereas high temperatures and extreme temperature cycles represent the limiting factor for mechanical robustness and leak proof.

Sonnenschein Lithium GmbH (SOLi) conducted a comparative test program with the following battery types: 3 V button cells $LiMnO_2$ (CR2450N) and Li(CF)x (BR2450A), compared to the $Li/SOCl_2$ cell TL-4986/D, produced by Tadiran Batteries, the mother company of SOLi, optimised for the use in TPMS and used by the German car industry in all TPMS systems. As an example, Figures 1 and 2 show the electrical values of these three battery types at low temperatures of –20 °C and –25 °C respectively. The basis current for testing is 0 mA for 58 seconds, with pulses of 10 mA of 2 seconds.





As illustrated in figures 1 and 2, the low temperature performance is very poor for the CR and BR A cells. . At –20°C, the cells do not deliver the pulse currents at the required voltage. A further test with extreme temperature cycles shows that mechanically both CR and BR types are weak due to the crimp seal. The $Li/SOCl_2$ technology, due to its composition and construction, especially the hermetic sealing (steel can, steel cover, laser welding of cover to can and glass to metal seal) meets the extreme temperature cycling requirements.

Several long term and real time tests had been conducted in the 90's, before the battery was approved by the German car manufacturers. These include 100,000 km of real time testing in Arizona/USA (summer), and down hill driving in the Alps with a fully loaded car (the battery experiences temperatures up to +180 °C). Also, safety testing was carried out at 220 °C for three hours. The cell TL-4986/D was chosen by the German car industry and introduced to the market in 1997. Up to date well over a million units are working in the field. Due to its construction, the $Li/SOCl_2$ technology, delivered either in bobbin or wafer construction, is highly intrinsically safe. In case of a short circuit, currents do not reach strong values and the heat generated is easily channelled to the outside. The hermetically sealed case guarantees a long shelf life as well as a long operating life under extreme temperature profiles. Unlike crimp seals, the hermetic sealing prevents leakage and thus capacity loss over the life time and damage to the application.

Emergency systems as well as tracking and monitoring devices as a part of a telematics system in the car typically need a low or zero continuous current coupled with high pulse currents up to several Amperes for a period of seconds or even minutes. Some applications will rely on one pulse after a standby time of up to ten years inside the car. These applications exceed the power capability of the lithium thionyl chloride technology in bobbin-type construction. Spirally wound lithium cells are able to deliver high currents. However, they have significantly less energy, much higher self discharge, limited temperature ranges and thus are not suitable for long-term applications in an automotive environment. For these reasons, Tadiran Batteries has designed cells with a so-called Pulses Plus technology that combines the very high energy of the lithium thionyl chloride bobbin-type cell with a novel hermetically sealed rechargeable high-power element, the Hybrid Layer Capacitor (HLC). This new technology can be used to efficiently deliver current pulses of up to several Amperes with a minimum voltage of more than 3 V per cell. Moreover, the basic battery can be connected both in series and in parallel to battery packs for higher voltages, current pulses and capacities. The Pulses Plus series combines high energy with high power capability on a high safety level.

Sonnenschein Lithium GmbH

Industriestrasse 22
63654 Büdingen
Germany
tel: +49-6042 95 40
fax: +49-6042 95 41 90

from EPN 12/2004
http://www.epn-online.com/page/16414/implementing-lithium-batteries-into-automotive-applications-depending-on-the-application----.html#