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Advanced Lithium Battery Technology Key to AMR Market

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One of the first frontiers of automated remote monitoring technology, the Automatic Meter Reader (AMR) market is finally coming of age. From one million units shipped in 1994, the market has grown steadily, with approximately 7 million units expected to be installed in 2002, for a total of approximately 40 million units in the field.

Understanding the AMR Market

Several forces are working together to revolutionize utility meter technology: Utility market deregulation; and rapid advances in wireless technology. Deregulation has brought new players into the marketplace, companies willing to make substantial investments in expanding product capabilities and services through drive-by and fixed network AMR systems. Utilities are increasingly looking to AMR devices as a means of recruiting new customers, retaining old customers, providing better service at lower cost, as well as supplying a variety of value added services to their commercial customers.

Battery manufacturers, under continual pressure to respond to the changing needs of AMR manufacturers, are currently adapting lithium battery technology to deliver longer life through lower self-discharge as well as expanding temperature ranges. At the same time, battery manufacturers must find new ways to increase capacity to handle the unique demands of high current pulse AMR devices.

Matching the Right Battery to the Application

Of the approximately 40 million AMR units currently installed, the majority utilize lithium thionyl chloride batteries. Lithium batteries are typically preferred for utility AMT applications due to their inherent long life, high energy density and extended temperature ranges. Long life is critical — as battery failure leads to additional service calls, which can negatively impact utility profitability. Also, in remote applications, including in-ground pits and other hard-to-reach places where battery replacement is difficult or impossible, longer life lithium technologies are essential.

In reality, each application is different in terms of energy usage, size and environmental considerations. The following product illustrates typical performance requirement issues for AMT devices.

Hexagram STAR Meter Transmitter Units

In 1997, Hexagram introduced the STAR Fixed Network Automatic Meter Reading System, which employs sophisticated RF technology to eliminate the need for meter readers and site visits. STAR fixed network Meter Transmitter Units (MTUs) work with gas, electric and water meters mounted outdoors, in basements, as well as in pits. The MTU contains a narrow band UHF transmitter with a range of several miles. Each day the MTU transmits the meter-reading data which is collected by an inexpensive network of receivers and forwarded to the utility.

Lithium thionyl chloride battery technology is well suited for this application. Hexagram has used over two million lithium thionyl chloride batteries in its utility products. Many of these devices have been operating for over 15 years without a battery change. This attests to the excellent reliability and service life provided by these batteries, as the service life offered by lithium thionyl chloride can last up to 20 years. Reliability is another major advantage, as lithium thionyl chloride batteries can operate in severe environmental conditions (-40°C to 85°C).

Pushing Current Technology to the Limit

In instances where the AMR device generates high current pulses at periodic intervals, with little or no background current between signal transmissions, standard lithium batteries may not be able to deliver higher performance without sacrificing product life — as battery failure can disrupt the billing process, resulting in expensive service calls.

Of all the available lithium batteries chemistries, bobbin-type Li/SOCL2 cells offer the advantages of higher energy density and voltage, excellent temperature characteristics and low self-discharge rates. However, bobbin-type cells have two major obstacles with regard to high pulse applications: passivation after storage at elevated temperatures, and low current due to its low rate design.

To address these problems, engineers at Tadiran began experimenting with a hybrid battery, which utilizes lithium thionyl chloride chemistry in tandem with a hybrid layer capacitor (HLC). Now marketed as PulsesPlus batteries, these hybrid cells can supply pulses measured in AMPs, whereas standard lithium thionyl chloride cells can only supply mili-amps. This hybrid cell offers all the major benefits associated with thionyl chloride bobbin cells as compared to other lithium technologies. These benefits include higher capacity, lower

self-discharge (less than 2 percent per year), lower ESR (equivalent serial resistance), no passivation effect and a broader temperature range of (-40°C to 85°C).

The Hybrid Layer Capacitor is charged by the battery and powers the pulses via its very low output impedance. The HLC is recharged by the battery in advance of the next pulse to eliminate passivation effects. Combining the HLC with a lithium battery also allows end-of-life measurements. Monitoring the battery + HLC's open circuit voltage allows available capacity to be accurately measured, since capacitance of the battery pack is a function of the open circuit voltage.

Neptune R900 Meter Interface Units

Several AMR manufacturers have adapted this new hybrid lithium battery technology, including Neptune Technology Group, Inc. The company manufactures the R900 meter interface unit (MIU), a compact electronic device that collects data from networked encoded registers, then transmits that data using frequency-hopping spread-spectrum technology to ensure data security as well as reading accuracy and reliability.

Unique to the Neptune R900 MIU is its ability to read both Neptune's ProRead or ARB encoder registers and the Invensys ECR II encoder registers without the need for programming. The R900 is available in single or dual port options. The data transmitted by the R900 is captured by either a DAP handheld computer for walk-by meter reading or by Neptune's EZDrive Drive-By Data Collector for drive-by meter reading. The meter reading data is transferred from the field to the utility's billing system via Neptune's EZRouteMAPS route management software.

In designing a system capable of multiple data transmissions per day, Neptune required a battery that wouldn't compromise battery life expectancy for increased power. Extending the time between battery replacements was critical to Neptune, since longer life translates into reduced field service.

According to Kent Murray, vice president of marketing at Neptune, "For our future higher powered RF MIUs, Neptune has selected the Tadiran PulsesPlus hybrid lithium battery because of the increased available capacity to handle multiple high powered daily transmissions. According to our design engineers an operating life of approximately 15 years should be feasible using the PulsesPlus in our newest high powered units. Competing battery technologies only permitted a 5-7 year lifespan."

The concept of combining lithium batteries with hybrid layer capacitors is rapidly gaining acceptance in other high current pulse applications as well, including GPS tracking devices, automotive emergency roadside assistance systems, oceanographic and deep-sea devices, security systems, as well as military and aerospace equipment.

As the current wave of deregulation continues and AMR/utility meter device manufacturers strive to make their technologies increasingly feature-rich, they must work closely with battery manufacturers to ensure that emerging battery technologies can keep pace with rapid product advancements.

Sol Jacobs is vice president and general manager of Tadiran Batteries, a leading manufacturer of Lithium Thionyl Chloride cells, including PulsesPlus batteries. Tadiran also manufactures primary batteries in a variety of configurations, including cylindrical, coin-sized cells and packs.