



QUALLION LLC PRODUCT & TECHNOLOGY FACT SHEET

Quallion LLC is largest manufacturer of customized lithium ion batteries in the United States. The company designs, fabricates and manufactures state-of-the-art lithium ion cells and battery packs, and develops new battery chemistries for the military, aerospace, medical and automotive industries. Building on its legacy leadership position in the medical device industry, the company has developed a range of novel enabling technologies that include the world's smallest implantable secondary battery and the proprietary Zero-Volt™ and SaFE-LYTE™ technologies.

Products

Primary Batteries

- **Lithium/Carbon Monofluoride (CFx)** – These batteries were among the first commercially successful lithium battery systems. The chemistry delivers very high energy density, long storage life, very good safety record, wide temperature, and very low self-discharge. These batteries are found in a wide range of low-to-medium current applications for military, aerospace, electronics, and medical customers.
- **High Rate Vanadium Chemistry** – These batteries have been designed for use in cardiac defibrillators and other biomedical applications. They offer excellent durability and high specific energy, power, and energy density for these products.
- **Lithium/Manganese Dioxide (Li/MnO₂)** – These are used in many applications due to their high voltage, long shelf life, relatively low cost, excellent safety record, and wide temperature range. These batteries are found in many consumer electronic devices, memory backup applications, and specialized military products.

Secondary Batteries

- **5A2 Lithium Ion battery** technology delivers all the benefits of traditional Li-ion chemistries with unique enhancements customized for the medical, military and aerospace industries. Quallion's engineers have developed a robust chemistry capable of delivering extended performance and long life under the most extreme conditions. In addition to eliminated self discharge and calendar fade, Quallion's cells are designed for up to 25 years of cycle life under varied conditions. This technology is ideally suited for long life applications such as 20 year medical implants, 15-20 year LEO missions, deep discharge GEO missions and high fidelity military applications.

Technology

Due to an unmatched expertise in lithium ion chemistry, Quallion has built an intellectual portfolio of patented technologies that give its batteries a competitive advantage. These enabling enhancements give Quallion's lithium ion batteries unrivaled safety and performance.

- **Zero-Volt™** - This technology allows long storage periods in a deep discharged state with no permanent capacity loss due to low voltage. The ability to discharge a battery to zero volts offers a number of important advantages in many vehicle, medical, space, and military applications. It can be stored for long periods of time without maintenance and the charge can be completely removed when connecting batteries to volatile systems or implanting cells inside the human body.
- **SaFE-LYTE™** - With this technology, Quallion has successfully found a way to enhance battery safety without any compromise in electrochemical performance. SaFE-LYTE™ technology integrates into the battery a liquid halogen compound that is flame-retardant and immiscible in the electrolyte. This solution significantly lowers the risk of combustion, and allows Quallion to produce batteries that are far safer than conventional Li-ion options.
- **Calendar Fade/Self Discharge** – These are two critical performance criteria for lithium ion cells. Quallion's 5A2 chemistry has demonstrated unrivaled performance in both circumstances. Quallion's 15 Ahr LEO and GEO satellite cells have demonstrated 95% calendar life retention capacity after 500 days at room temperature storage. Notably, these cells were charged to 4.1V each time they were returned to storage.
 - Under more rigorous testing conditions, Quallion is conducting ongoing evaluations of its 5A2 Chemistry. After charging the test cells to 4.1V, they were placed at 37C and stored without interruptions for 3.5 years. The results revealed less than 12% discharge loss and less than 4% calendar fade loss.
- **Li-Polymer** – Quallion's lithium polymer batteries can be safer, smaller, lighter, and especially thinner than lithium ion alternatives. Unlike lithium ion batteries, in which the electrolyte is held in an organic solvent, the lithium electrolyte is held within a solid polymer composite in Li-Poly batteries. This means a metal casing is not necessary in a Li-Poly cell, a distinction that allows more flexibility in size and shape, as well as a slightly higher energy density. This technology holds great promise for development of innovative implantable medical devices that require a power source that is very small, oddly shaped, thermally stable, and highly conductive.
- **Matrix Battery (MBD)** – Quallion's proprietary Matrix technology holds great promise for manufacturers seeking to reduce reliability issues and long-term costs. This highly scaleable system simultaneously links mass numbers of small cells in parallel and series, an approach that eliminates the need for control electronics without any compromises in reliability and redundancy.
 - This low-cost modular system allows prequalified cells to be repackaged to suit new specifications without substantial time, cost, or headache.