Application note

Eaton 9PX lithium-ion UPS

UPS systems with lithium-ion batteries help IT professionals protect both their equipment and their time efficiency. Eaton's 9PX lithium-ion UPS batteries have a service life of 8 to 10 years, making them a "set it and forget it" power protection solution. These lightweight batteries provide longer UPS runtime and allow smaller external battery modules compared to lead-acid batteries with similar power ratings, saving valuable rack space while boosting uptime for connected devices.

Lithium-ion batteries have less environmental impact than VRLA batteries

What is a lithium-ion battery?

Lithium-ion batteries are gaining in popularity for applications such as electric vehicles, portable electronics and renewable energy systems. One reason for this is the low total cost of ownership (TCO) over the lifecycle of the battery, which takes into account their minimal maintenance, long lifespan and high efficiency.

More than one lithium-ion battery chemistry is available in the market. Eaton uses a Lithium-ion Phosphate (LiFePO4 or simply "LFP") chemistry that creates a stable and safe battery for UPS applications. Here are some LFP basics:

Chemistry

LFP is a cathode material used in lithium-ion batteries. It is known for its safety and high thermal stability. LFP's unique crystal structure allows for efficient intercalation and deintercalation of lithium ions during the charging and discharging processes that does not create oxygen as an off-put should there be a thermal event (i.e., battery overheating, also known as "thermal runaway"), reducing the battery's igniting potential.

- **Anode Material:** The anode of a lithium-ion battery is typically made of graphite, which can also intercalate lithium ions during operation.
- **Electrolyte:** A lithium-ion battery's electrolyte is typically a lithium salt dissolved in a solvent, which allows the transport of lithium ions between the cathode and anode during charging and discharging.
- **Operation:** During discharge, lithium ions move from the anode to the cathode through the electrolyte, and electrons flow through the external circuit, creating an electric current. In the charging process, the lithium ions move from the cathode back to the anode.

Because LFP is less prone to thermal runaway reactions and has a high thermal stability, it is considered a safer cathode material than other lithium-ion chemistries like cobalt oxide.

LFP batteries are tolerant to voltage variation and can be more cost-effective than some other lithium-ion batteries because they use less expensive materials.

LFP vs other lithium-ion chemistries:

While other lithium-ion compounds excel in specific energy, they lack the safety and longevity of LFP, making LFP the optimal choice for critical IT power protection. See diagrams to the right.

Source: Battery University

Temperatures at which thermal runaway becomes a risk:

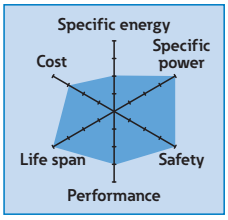
Lithium Nickel Manganese Cobalt Oxide (LiNiMnCoO2) — NMC: **210°C (410°F)**

Lithium Manganese Oxide (LiMn2O4) — LMO: **250°C (482°F)**

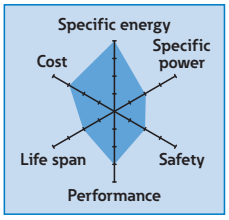
Lithium Iron Phosphate (LiFePO4) — LFPC: **270°C (518°F)**

Lithium Titanate (Li2TiO3) — LTO: ***Not available***

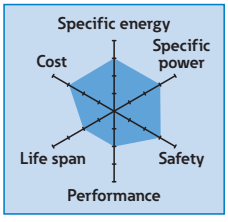
UN38.3 safety standards limit lithium battery temperatures to 170°C (338°F), far below the LFP thermal runaway risk temperature.



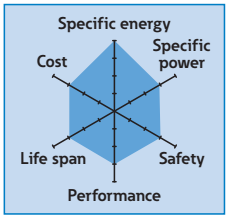
Lithium Iron Phospate (LiFePO4) – LFP



Lithium Cobalt Oxide (LiCoO2) – LCO



Lithium Manganese Oxide (LiMn2O4) – LMO



Lithium Nickel Manganese Cobalt Oxide (LiNiMnCoO2) – NMC

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VRLA vs Lithium-ion

Valve regulated lead–acid (VRLA) batteries, also known as a sealed lead–acid (SLA) batteries, have been used in UPS systems for years and are still a common choice. Lithium-ion batteries, especially LFP batteries, however, are lighter and longer lasting and are gaining ground in the UPS market. Here are some advantages lithium-ion batteries hold over comparable lead-acid batteries:

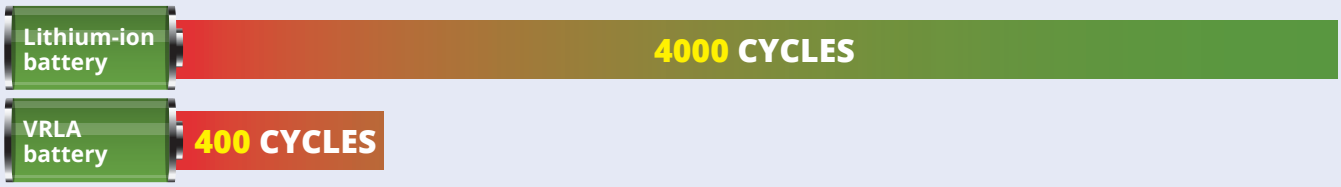
Battery size

- Up to 40% lighter, making transportation, installation and on-going management easier
- Typically a smaller footprint, saving space for revenue generating equipment in high-density IT environments

Performance

- Up to 10x more discharge cycles and 2-3x longer overall battery life—ideal for remote/difficult-to-access installations where battery replacements are especially inconvenient
- Less performance degradation in high-temperature environments
- Up to 3x faster charge time improves recovery

Comparing sample battery discharge cycles with 50% load in comparable UPS systems*



**Discharge cycles for lithium-ion battery and VRLA batteries in Eaton 9PX UPS systems @ 25°C (77°F)*

Eaton's 9PX lithium-ion UPS

Eaton's 9-series UPS includes ten LFP-battery models boasting all the lithium-ion power protection benefits described in this piece. This single-phase, double-conversion UPS offers 1-6 kVA battery backup that IT professionals can rely on to keep mission-critical infrastructure operational—all within a safe, lightweight, easy-to-manage UPS.

The 9PX UPS offers a **battery management system (BMS)** that works in tandem with lithium-ion's strengths for optimal safety and peace of mind:

- Monitoring every cell for improved cell-balancing efficiency
- Actively tracking temperature and charge voltage variation, min./max. voltages, multiple temperatures, state of charge, cycling and other battery health data to detect potential issues early
- Preventing battery safety issues, such as dendrite growth and thermal runaway
- Providing a precise state of charge and accurate state of health

The 9PX lithium-ion UPS battery management system is designed in-house by Eaton engineers to ensure seamless integration between battery and UPS. Additionally, the 9PX lithium-ion UPS offers:

- Up to 4 external battery modules (EBMs) for added runtime
- Load segmenting to shed non-critical devices during a power outage
- Remote power on (RPO) remote on/off (ROO) for fast, efficient management
- Compatibility with the Gigabit Network Card for enhanced control, security and power data
- 5-year all-inclusive (electronics and battery) warranty with premium support from Eaton

For more information, visit
Eaton.com/9PX

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