A drop-in solution for lithium-ion battery safety sensing systems

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As the demand for energy-dense, rechargeable power grows across industries, lithium-ion batteries have become the backbone of modern technology. From EVs and drones to residential energy storage and critical infrastructure, these batteries power the systems that power the world. But with this progress comes risk.

Figure 1: The BES LITE series. Source: Honeywell

BES LITE, a lithium-ion battery safety sensor developed by Honeywell, offers a new standard in early warning capabilities.

The potential for thermal runaway, a chain reaction that can lead to fires or explosions, has made battery safety not just an engineering consideration but also a business imperative. Traditional battery safety solutions used in stationary battery energy storage systems often utilize sensors placed at the container level, detecting issues late. While these methods provide some level of safety, they are limited by their detection time and prone to false alarms.

BES LITE, a lithium-ion battery safety sensor developed by Honeywell, offers a new standard in early warning capabilities. BES LITE is an advanced solution that offers significant improvements in battery safety. By detecting electrolyte vapor at the battery module level, it empowers battery designers and safety engineers to prevent failures before they escalate.

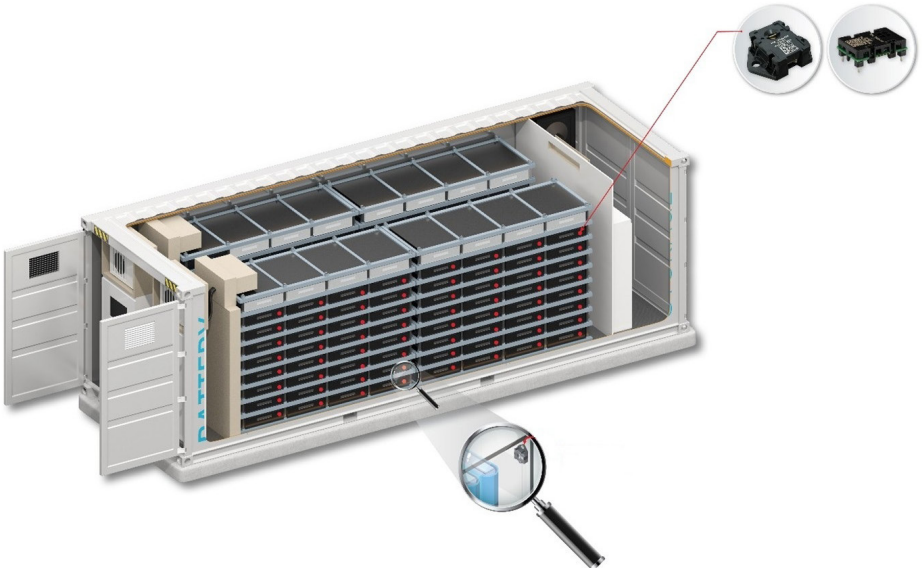

Figure 2. One BES LITE sensor is mounted inside each battery module. Source: Honeywell

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BES LITE sensor technology integrates reliable and efficient detection mechanisms, crucial for preventing thermal runaway in a variety of different platforms and applications. Understanding the technical factors contributing to thermal runaway hazards, why current detection methods fall short and exploring innovative solutions designed to mitigate these risks will empower users to make the right decisions for their applications. BES LITE technology enables safer operation of lithium-ion batteries, broader compatibility and seamless integration into modern battery systems.

Understanding thermal runaway

Thermal runaway is a self-reinforcing chain reaction. It begins when a battery is subjected to electrical abuse (overcharging), thermal abuse (exposure to high temperatures) or mechanical damage (puncture or vibration). These stressors degrade the internal separator, often a polymer membrane that keeps the anode and cathode electrically isolated. If the separator fails, it can result in internal short circuits that quickly heat the cell.

This increase in temperature causes the electrolyte to vaporize, which subsequently raises both pressure and temperature within the battery cell. Once the pressure within the cell reaches a critical threshold, it has the potential to vent out toxic gases, ignite or explode, setting off a chain reaction of failures in neighboring cells. These events pose extreme risks in high-capacity battery systems from EVs to stationary energy storage. Failure in just a single cell can cascade, causing a major issue.

Figure 3: Battery safety sensors and are vital in monitoring and maintaining lithium-ion battery health and detecting abnormal conditions like over-charging or overheating. Source: Tony Baggett/Adobe stock

Limitations of traditional sensing systems

Historically, battery safety systems have relied on container-level gas detection. These systems often monitor carbon monoxide or hydrogen levels to determine if a thermal runaway event has occurred. These sensors are installed outside the battery packs, only alerting operators after vapors escape the battery module. This delayed response can lead to slow or inadequate reactions to potential hazards. These container-level systems pose an issue as the levels of these gases must reach a certain threshold level within the container before mitigation efforts can be activated. By the time these container-level systems register these levels, an individual battery module may already be severely compromised.

Figure 4. BESS containers can be cumbersome and difficult to accurately monitor without the right safety parameters. Source: Honeywell

This late-stage detection leaves little time to act, particularly in mission-critical environments. In some cases, these container-level systems trigger false alarms due to environmental contaminants or cross-gas interference within the container, causing unnecessary shutdowns and reducing trust in safety systems.

BES LITE: Inside-the-pack detection

Innovative solutions are being created to mitigate the risks associated with lithium-ion batteries. BES LITE is one such product, designed to enhance asset protection and user safety in high-risk industries. BES LITE addresses the shortcomings of container-level systems by moving detection to inside the battery module. Instead of waiting for gases to vent out of the battery module, BES LITE senses electrolyte vapor the moment it begins to form within the battery module, providing battery management systems (BMS) with a critical window of early action.

With a straightforward three-state analog output, BES LITE easily integrates into BMS architectures, enabling automated thermal runaway mitigation responses like halting charging or initiating system cooldowns. It's chemistry-agnostic, working across lithium iron phosphate (LFP), lithium nickel manganese cobalt (NMC), lithium titanate (LTO) and more. Partnerships with companies like Honeywell facilitate the integration of BES LITE into battery designs, leveraging their expertise and resources.

The importance of sensors in battery safety is paramount. Battery safety sensors and current sensors are vital in monitoring and maintaining the health of lithium-ion batteries and detecting abnormal conditions like overcharging or overheating. This early, direct sensing provides engineers with a faster and more reliable safety trigger than any container-level system.

High-capacity battery applications

The risk of thermal runaway grows with battery size and energy density. Batteries over 1 kilowatt-hour (kWh) are particularly vulnerable, especially in environments with demanding performance requirements and space constraints. Key applications include:

- Battery energy storage systems (BESS)
- Drones and UAVs
- Residential energy storage systems
- Portable power generators and campsite batteries
- Electric scooters and two-wheelers

These use cases demand a compact, lightweight and accurate sensor that doesn't compromise reliability. BES LITE was purpose-built to meet these needs.

High-capacity battery applications

Traditional CO/H2 sensors typically detect cell failure later in the thermal runaway process. BES LITE detects problems at first vent, providing valuable time to take action. This difference in timing can be the difference between a manageable anomaly and a catastrophic event. BES LITE gives operators significant amounts of additional response time compared to container-based systems. When it comes to stopping charging and preventing a fire, this time can feel like an eternity. This protection is vital for maintaining the integrity of mission-critical applications.

Additional advantages include:

- No internal heating element, reducing energy use and improving safety
- Resistant to cross-gas interference and siloxane poisoning, ensuring reliable performance even in challenging environments
- Consistent detection across chemistries, eliminating sensor mismatch risks

BES LITE was designed with safety and reliability in mind. This innovative product not only integrates quickly into existing products, but is designed for the future and the enhanced reliability needs that might come with it.

Designed for engineers: Easy integration and versatility

Engineers need more than sensitivity — they need practical integration options. The BES LITE's small form factor, lightweight design and low power consumption make it ideal for integration into various devices. Its resistance to cross-gas interferences and siloxane poisoning ensures reliability in demanding environments, making it a versatile and dependable choice for engineers and customers. BES LITE is sold in two forms for easy integration: Flange mount (with M3-compatible holes for surface installation) and board mount (for direct PCB integration).

The BES LITE is also designed with size and weight in mind. The ultra-compact design weighs less than 9 grams with less than 10 mm in height and a 31 mm max dimension. The simple output interface is also easily read by most BMS control architectures. Whether users are designing a drone or a modular BESS cabinet, it was designed to provide a drop-in solution for battery health visibility.

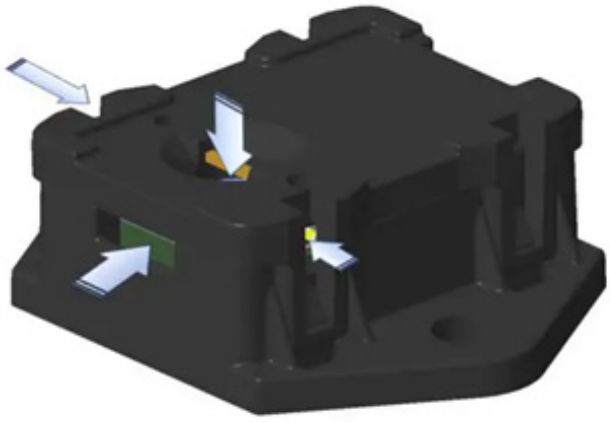

Figure 5: Honeywell BES LITE battery safety electrolyte detector. Source: Mouser

The value of early action

When it comes to battery safety, timing is everything. By the time gases reach a container-level sensor, an explosion risk is imminent. BES LITE empowers systems to act when

there's still time to prevent damage. That means:

- Preventing thermal runaway
- Preserving expensive asset
- Reducing downtime and reputational risk

It's not just about meeting standards. It's about owning the moment before a crisis.

BES LITE for lithium-ion applications

As lithium-ion batteries grow in size, density and ubiquity, so too do the consequences of safety failures. Industries need a better solution than waiting for the smell, view of smoke or the sound of a venting cell. Damage should be detected right at the source, making BES LITE a strong contender for every lithium-ion battery application.

BES LITE, developed by Honeywell, provides very early and reliable warning system. Designed for seamless integration and chemistry-agnostic deployment, it redefines what battery safety can look like. To learn more about integrating BES LITE into safety architecture, contact the battery safety experts at Powell.

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