Application Note

Safety features in SI-9300R and SI-9300R-SA Battery Analysis System

Application Note: 2025/07

Introduction

Battery testing and analysis involve inherent risks. The SI-9300R and SI-9300R-SA systems are designed with comprehensive safety features to minimize hazards and ensure secure operation throughout testing procedures.

SI-9300R and SI-9300R-SA Hardware Safety Features

Emergency Stop (STOP) Button

Each SI-9300R module includes a front-panel STOP button that immediately halts all active experiments across all channels within the module. For complete shutdown, the system power switch on the cabinet can be turned off, and the power plug disconnected from the mains.



Figure 1. Experiment Stop Button on the front panel of SI-9300R and SI-9300R-SA module

Temperature Monitoring

Monitoring the temperature of the device under test is critical for both performance evaluation and safety. A rise in temperature may indicate a thermal

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runaway, signaling the need to stop the experiment. The SI-9300R and SI-9300R-SA systems provide temperature monitoring via

- VTI data logger (up to 16 channels, compatible with all common thermocouples)
- Built-in auxiliary channels (up to two temperature measurements per channel using NTC thermistors)

Emergency Stop (ESTOP) System



Figure 2. SI-9300R ESTOP Enclosure

As an additional layer of protection, ESTOP provides a method of safe disconnection of the three-phase mains to battery analyzer system. In the event of an emergency, swiftly depressing the emergency stop button mounted to the front of the ESTOP enclosure will turn off the power supply to the SI-9300R cabinet and the SI-9300R-SA module.

The built-in volt-free relays, accessible via the auxiliary contacts, enable remote shutdown of other emergency stop (ESTOP) equipment within the customer's setup—such as environmental control systems and fire suppression systems

The emergency stop can also be activated via the REMOTE OFF function on the Auxiliary connector. The SI-9300R system can be switched off when the interconnected fire suppression system or the gas detection system identifies an emergency stop.

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Integration and interaction

By combining the hardware and software capabilities of the SI-9300R and SI-9300R-SA systems, seamless integration with external emergency stop mechanisms and interaction with thermal chambers, environmental monitoring systems, and fire suppression systems is enabled.

As illustrated in the system schematic, the VTI data logger continuously monitors the voltage and temperature of all cells—even when no test procedure is actively running. If any cell's voltage falls outside the user-defined limits, a normally closed relay will open, signaling a potential battery fault to the fire suppression system and other emergency response mechanisms. Similarly, if a cell exceeds the user-defined temperature threshold, another normally closed relay will open to lock the chamber door, preventing access until the cell has cooled to a safe level.

Table 1. Example Traffic Light Color for SI-9300R Status Reporting

Color*	Status*	Description
Green	Ready	All channels on the instrument are idle, faulty-free and ready to start tests.
Yellow	Running	One or more channels is running a test.
Red	Fault	One or more channels have stopped due to a fault condition.

*The traffic lights are not provided with SI-9300 system. The color for the status is based on actual application and customizable

The light tower (traffic light indicator) provides clear visual representation of the overall status of the SI-9300R system. As outlined in Table 1:

- **Green** indicates a "Ready" state, meaning all channels are idle, fault-free, and prepared to begin testing.
- **Yellow** signifies a "Running" state, where one or more channels are actively executing a test.
- **Red** denotes a "Fault" state, triggered when one or more channels have stopped due to a detected fault condition.

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By leveraging the status reporting capabilities of the Aspire Energy software, the digital outputs from the VTI data logger, and the Relay Driver, this system offers flexible integration. It can directly control external light towers—such as those on thermal chambers—ensuring synchronized and centralized status indication across multiple instruments.

Aspire Software

Cell Library

Safety limits are required for each cell type in the Cell Library to prevent overdriving the cells. The available safety limits are Min and Max cell voltage, Max current for charge and discharge, max capacity, max and min temperature, and max humidity. Both the auxiliary channels are capable to monitor the cell voltage up on the set range.

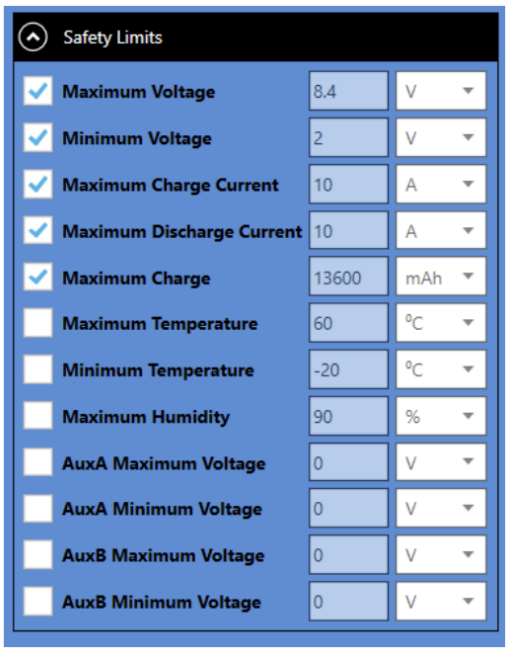


Figure 4. Safety limitations of a cell in the Aspire Energy Software

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Power Management

The SI-9300R system includes built-in power management capabilities, allowing users to define maximum voltage and charge/discharge current limits for the entire cabinet. This ensures safe and controlled operation tailored to specific testing requirements.

Test step and sequence

Each test step in the SI-9300R system can be configured with individual termination conditions that act as safety limits. For instance, during a Charge CC-CV (Constant Current–Constant Voltage) step, users can set maximum voltage and charge capacity thresholds to ensure safe and controlled operation.

Furthermore, the system supports Advanced Step Termination logic using “AND” and “OR” operators, allowing multiple conditions to be combined. This enables more precise and flexible safety configurations tailored to specific testing requirements.

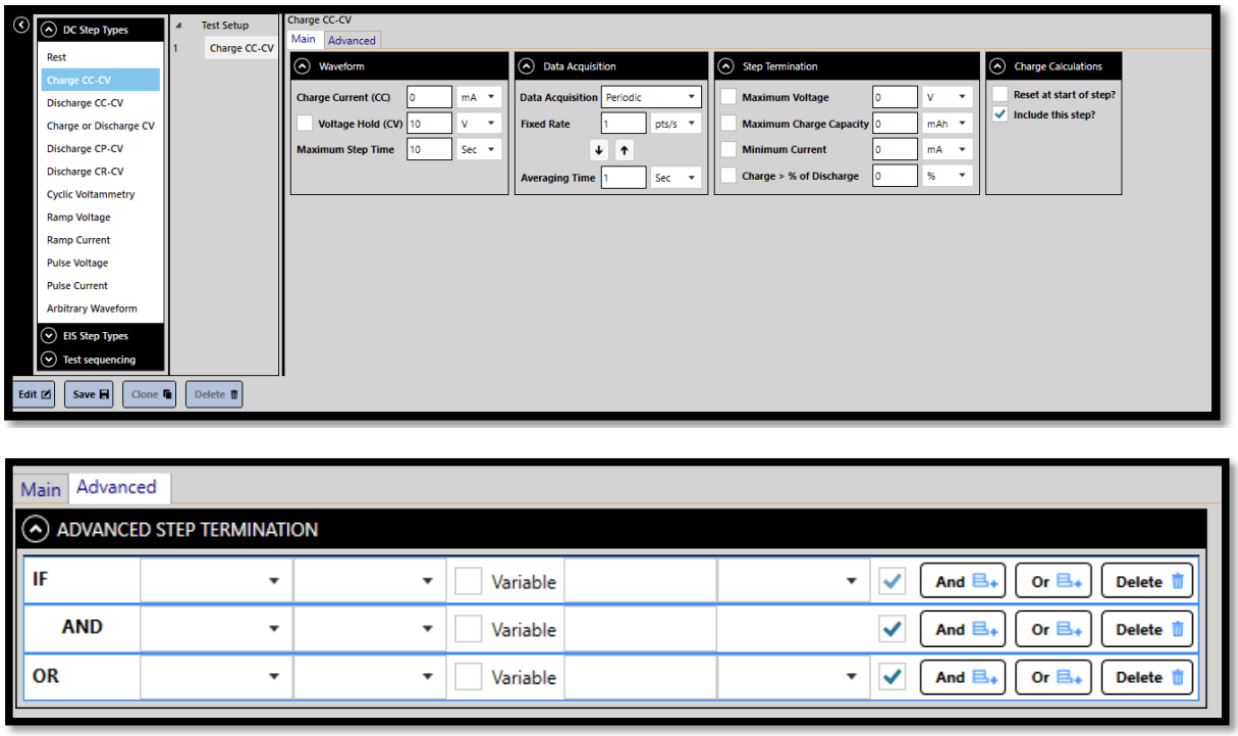


Figure 6. General and advanced step termination conditions in test sequence settings.

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Thermal Chamber control

The Aspire Energy software natively supports ESPEC environmental control thermal chambers equipped with P-200, P-300, and Watlow F4T controllers. Additionally, it can interface with other common thermal controllers—such as Eurotherm (2xxx and 3xxx series) and Lakeshore models (331, 332, and 335)—via the Modbus protocol.

Through direct integration, Aspire Energy enables not only precise monitoring and control of temperature and humidity but also provides the ability to safely pause or stop the thermal chamber when necessary, enhancing operational safety and flexibility.

Summary

The SI-9300R and SI-9300R-SA systems are equipped with comprehensive safety features at both the hardware and software levels. These built-in protections ensure reliable and secure operation across a wide range of use cases. Additionally, the systems offer flexible integration and interaction options with external instruments, making them well-suited for both scientific research and industrial applications in diverse environments.

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