Requirements Toolbox Report

Author(s):MAAM

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Chapter 1: Requirement Set: BMS_CYRS

Description

Customer Requirements Document "Battery Management System (BMS)"

1. Introduction
1.1 Purpose
This document outlines the high-level customer requirements for the Battery Management System (BMS). These requirements ensure the safe, efficient, and reliable operation of a battery module in automotive and energy storage applications.
1.2 Scope
The BMS shall manage, monitor, and optimize the performance of a battery module, interfacing seamlessly with the charger, inverter, and other connected systems. It shall prioritize safety, reliability, usability, and compliance with relevant industry standards.

Implementation Status

Total	Implemented	Justified	None
28	28	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
28	0	0	0	0	28

Change Information Change issue(s) found in 1 requirement(s).

1 Battery Management

Requirement Type Container

ID #1

Description

Change Information No change issue detected.

Implementation Status

Total	Implemented	Justified	None
2	2	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
2	0	0	0	0	2

1.1 Battery Module Operation

Requirement Type Functional

ID #2

Description

The **BMS** shall manage a **3-cell battery module** for automotive and energy storage applications.

Change Information No change issue detected.

Links

Artifact BMS_SRS.slreqx

- Battary_No (⇦Implemented by)
- Regulatory Compliance (⇦Related to)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

1.2 Charge and Discharge Regulation

Requirement Type Functional

ID #3

Description

The **BMS** shall regulate **charging** and **discharging processes** to maximize efficiency and extend battery life.

Change Information No change issue detected.

Links

Artifact BMS_SRS.slreqx

- Charging and Discharging (⇦Implemented by)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

2 Safety

Requirement Type Container

ID #4

Description

Change Information No change issue detected.

Implementation Status

Total	Implemented	Justified	None
3	3	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
3	0	0	0	0	3

2.1 Real-Time Monitoring

Requirement Type Functional

ID #5

Description

The **BMS** shall provide real-time monitoring of **cell voltages**, **temperatures**, **package voltage**, and **current**, with minimum sampling rate of **1 kHz**.

Change Information No change issue detected.

Links

Artifact BMS_SRS.slreqx

- Cell Voltages (⇦Implemented by)
- Cell Temperatures (⇦Implemented by)
- Pack Voltage (⇦Implemented by)
- Pack Current (⇦Implemented by)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

2.2 Fault Detection

Requirement Type Functional

ID #6

Description

The **BMS** shall detect any fault event (specifically **over-voltage**, **under-voltage**, **over-temperature**, and **short circuits**) and initiate a response within **50 milliseconds** of fault detection.

Change Information No change issue detected.

Links

Artifact BMS_SRS.slreqx

- Fault Detection (⇦Implemented by)
- Fault Response (⇦Implemented by)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

2.3 Fault Notifications

Requirement Type Functional

ID #7

Description

The **BMS** shall notify users of critical faults and provide **error codes** for troubleshooting.

Change Information No change issue detected.

Links

Artifact BMS_SRS.slreqx

- Fault Code (⇦Implemented by)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

3 Performance

Requirement Type Container

ID #8

Description

Change Information No change issue detected.

Implementation Status

Total	Implemented	Justified	None
3	3	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
3	0	0	0	0	3

3.1 Cell Balancing

Requirement Type Functional

ID #9

Description

The **BMS** shall **balance** the charge of cells to maximize battery life and stability.

Change Information No change issue detected.

Links

Artifact BMS_SRS.slreqx

Balancing Logic (Implemented by)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

3.2 Current Limit Enforcement

Requirement Type Functional

ID #10

Description

The **BMS** shall calculate and enforce **current limits** based on battery conditions.

Change Information No change issue detected.

Links

Artifact BMS_SRS.slreqx

Current Limits Calculation (Implemented by)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

3.3 SOC and SOH Estimation

Requirement Type Functional

ID #11

Description

The **BMS** shall **estimate** and display the following parameters:

- State of Charge (**SOC**).

- State of Health (**SOH**).

Change Information No change issue detected.

Links

Artifact BMS_SRS.slreqx

- SOC Estimation (⇦Implemented by)
- SOH Estimation (⇦Implemented by)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

4 Reliability and Maintainability

Requirement Type Container

ID #12

Description

Change Information No change issue detected.

Implementation Status

Total	Implemented	Justified	None
3	3	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
3	0	0	0	0	3

4.1 Data Logging

Requirement Type Functional

ID #13

Description

The **BMS** shall **log** and archive all operational data for a minimum retention period of **30 days** to support effective **diagnostics** and troubleshooting.

Change Information No change issue detected.

Links

Artifact BMS_SRS.slreqx

- Error Recording (⇦Implemented by)
- Operational Data Recording (⇦Implemented by)
- Recording Limit (⇦Implemented by)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

4.2 Fault Tolerance

Requirement Type Functional

ID #14

Description

The **BMS** shall remain operational during minor component failures by employing **fault-tolerant mechanisms**.

Change Information No change issue detected.

Links

Artifact BMS_SRS.slreqx

Fault Tolerance (⇦Implemented by)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

4.3 Self-Diagnostics

Requirement Type Functional

ID #15

Description

The **BMS** shall perform periodic **self-diagnostics** to detect and report any internal issues.

Change Information No change issue detected.

Links

Artifact BMS_SRS.slreqx

Self-Diagnostics (⇦Implemented by)

Self-Calibration (⇦Related to)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

5 Communication and Compatibility

Requirement Type Container

ID #16

Description

Change Information No change issue detected.

Implementation Status

Total	Implemented	Justified	None
2	2	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
2	0	0	0	0	2

5.1 External System Interface

Requirement Type Functional

ID #17

Description

The **BMS** shall provide robust **interfaces** to support integration with external systems, including but not limited to **chargers**, **inverters**, and **precharge circuits**.

Change Information No change issue detected.

Links

Artifact BMS_SRS.slreqx

System Interfaces (⇦Implemented by)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

5.2 Communication Protocols

Requirement Type Functional

ID #18

Description

The **BMS** shall support standard **MODBUS** communication protocols for interfacing with external devices (e.g., vehicle network, charger, inverter).

Change Information Change issue detected.

Links

Artifact BMS_SRS.slreqx

Communication Protocols (⇦Implemented by)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

6 Security

Requirement Type Container

ID #19

Description

Change Information No change issue detected.

Implementation Status

Total	Implemented	Justified	None
2	2	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
2	0	0	0	0	2

6.1 Data Security

Requirement Type Functional

ID #20

Description

The **BMS** shall secure communication and data using Advanced Encryption Standard (**AES**).

Change Information No change issue detected.

Links

Artifact BMS_SRS.slreqx

Data Security (⇦Implemented by)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

6.2 Access Control

Requirement Type Functional

ID #21

Description

The **BMS** shall incorporate robust **access control mechanisms** to prevent unauthorized access to its system functionalities and data.

Change Information No change issue detected.

Links

Artifact BMS_SRS.slreqx

Access Control (⇦Implemented by)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

7 User Interface and Alerts

Requirement Type Container

ID #22

Description

Change Information No change issue detected.

Implementation Status

Total	Implemented	Justified	None
2	2	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
2	0	0	0	0	2

7.1 User Monitoring Interface

Requirement Type Functional

ID #23

Description

The **BMS** shall provide a **user interface** that facilitates both monitoring of system status and configuration of operational parameters.

Change Information No change issue detected.

Links

Artifact BMS_SRS.slreqx

User Interface: Monitoring and Configuration (⇦Implemented by)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

7.2 Alerts and Notifications

Requirement Type Functional

ID #24

Description

The **BMS** shall provide **visual** and **audible alerts** to notify users of any critical alarms or warnings.

Change Information No change issue detected.

Links

Artifact BMS_SRS.slreqx

- User Interface: Alerts and Notifications (⇦Implemented by)
- Fault Notifications (⇦Related to)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

8 Software Updates

Requirement Type Container

ID #25

Description

Change Information No change issue detected.

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

8.1 OTA Updates

Requirement Type Functional

ID #26

Description

The **BMS** shall support secure over-the-air (**OTA**) software updates, ensuring that system downtime is minimized during the update process.

Change Information No change issue detected.

Links

Artifact BMS_SRS.slreqx

- Updates_Req (⇦Implemented by)
- Updates_Limit (⇦Implemented by)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

9 Compliance

Requirement Type Container

ID #27

Description

Change Information No change issue detected.

Implementation Status

Total	Implemented	Justified	None
2	2	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
2	0	0	0	0	2

9.1 Industry Standards

Requirement Type Functional

ID #28

Description

The **BMS** shall be designed, implemented, and validated to comply with the **ISO 26262** functional safety standard, ensuring adherence to all relevant safety measures and protocols.

Change Information No change issue detected.

Links

Artifact BMS_SRS.slreqx

Functional Safety (⇦Implemented by)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

9.2 Regulatory Compliance

Requirement Type Functional

ID #29

Description

The BMS shall meet all applicable regulatory requirements for automotive and energy storage applications, ensuring full compliance with industry standards and governmental regulations.

Change Information No change issue detected.

Links

Artifact BMS_SRS.slreqx

Regulatory Compliance (⇦Implemented by)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

10 Usability

Requirement Type Container

ID #30

Description

Change Information No change issue detected.

Implementation Status

Total	Implemented	Justified	None
2	2	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
2	0	0	0	0	2

10.1 Configurable Settings

Requirement Type Functional

ID #31

Description

The **BMS** shall allow users to **configure settings** including charging profiles and fault thresholds.

Change Information No change issue detected.

Links

Artifact BMS_SRS.slreqx

User Interface: Configuration (⇦Implemented by)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

10.2 Diagnostic Information

Requirement Type Functional

ID #32

Description

The **BMS** shall provide comprehensive **diagnostic information** to assist in maintenance and troubleshooting activities.

Change Information No change issue detected.

Links

Artifact BMS_SRS.slreqx

User Interface: Diagnostics (⇦Implemented by)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

11 Limitations

Requirement Type Container

ID #33

Description

Change Information No change issue detected.

Implementation Status

Total	Implemented	Justified	None
4	4	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
4	0	0	0	0	4

11.1 Environmental Limitations

Requirement Type Functional

ID #34

Description

The **BMS** shall operate reliably within an **ambient temperatures** between **-10°C and 60°C**.

Change Information No change issue detected.

Links

Artifact BMS_SRS.slreqx

Over-temperature (⇦Implemented by)

Under-temperature (⇦Implemented by)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

11.2 Voltage Thresholds

Requirement Type Functional

ID #35

Description

The **BMS** shall enforce an **over-voltage** threshold of **4.25V - 4.35V** per cell and an **underr-voltage** threshold of **2.50V - 2.70V** per cell, in accordance with the **safe operating** limits of **3.0V - 4.2V** lithium-ion battery cells.

Change Information No change issue detected.

Links

Artifact BMS_SRS.slreqx

- Over-voltage (⇦Implemented by)
- Under-voltage (⇦Implemented by)
- Battary_Limit (⇦Related to)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

11.3 Current Thresholds

Requirement Type Functional

ID #36

Description

The **BMS** shall limit the **maximum discharge current** to **30A** and the **maximum charge current** to **15A** to ensure safe battery operation.

Change Information No change issue detected.

Links

Artifact BMS_SRS.slreqx

- Charging Over-Current (⇦Implemented by)
- Discharging Over-Current (⇦Implemented by)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

11.4 Communication Latency

Requirement Type Functional

ID #37

Description

The **BMS** shall ensure that **communication latency** does not exceed **100 milliseconds**.

Change Information No change issue detected.

Links

Artifact BMS_SRS.slreqx

Communication Latency (⇦Implemented by)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

12 Acceptance Criteria

Requirement Type Container

ID #38

Description

Change Information No change issue detected.

Implementation Status

Total	Implemented	Justified	None
2	2	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
2	0	0	0	0	2

12.1 Functional Requirements Compliance

Requirement Type Functional

ID #39

Description

The **BMS** shall meet all specified functional and safety requirements as outlined in the system design and standards.

Change Information No change issue detected.

Links

Artifact BMS_SRS.slreqx

Documentation and Independent Verification (⇦Implemented by)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

12.2 Real-World Testing

Requirement Type Functional

ID #40

Description

The **BMS** shall undergo **rigorous testing** in real-world scenarios, including edge cases such as **high temperatures** and **sudden load changes**, to validate its reliability and performance.

Change Information No change issue detected.

Links

Artifact BMS_SRS.slreqx

Real-World Performance (Implemented by)

Implementation Status

Total	Implemented	Justified	None
1	1	0	0

Verification Status

Total	Passed	Justified	Failed	Unexecuted	None
1	0	0	0	0	1

Appendix

Artifact List

Requirement Set files:

#	Name	Folder	Revision
1	BMS_SRS.slreqx	H:\0\New MAAM\10 - MBD\Battary Management System\SWE.1 SRS	60

Change Issues

#	Link	Changed Target	Stored Information	Actual Information
1	Communication Protocols	BMS_CYRS:18 (Destination)	Revision: 11 (Timestamp: 21-Mar-2025 05:27:25)	Revision: 15 (Timestamp: 21-Mar-2025 06:48:09)