Battery Management System

Assume any missing data

1. OVERVIEW

This specification document outlines the Battery Management System (BMS) for a battery module comprised of three cells, designed in compliance with. The BMS manages the efficient operation and safety of the battery module, which interfaces with a charger, an inverter, and includes a precharge circuit.

2. BMS INTERFACES

2.1. BMS INPUTS

Port Interface	Data Element	Type	Units	Description
VfbStateRequest	StateRequest	Enum	-	Request from vehicle network
VfbCellVoltages	CellVoltage	Float32	V	Voltage of each cell
VfbCellTemperatures	CellTemperature	Float32	°C	Temperature of each cell
VfbPackVoltage	TotalPackVoltage	Float32	V	Total voltage of battery pack
VfbPackCurrent	PackCurrent	Float32	A	Current flowing through pack
VfbChargerVoltageOutput	ChargerOutputVoltage	Float32	V	Output voltage from charger
VfbInverterVoltageOutput	InverterOutputVoltage	Float32	V	Output voltage to inverter

2.2. BMS OUTPUTS

Port Interface	Data Element	Type	Units	Description
VfbStateOfCharge	StateOfCharge	Float32	%	Calculated state of charge
VfbBmsOperationalState	OperationalState	Enum	-	Current operational state
VfbCurrentLimits	CurrentLimits	Float32	A	Computed current limitations
VfbBalanceCommands	BalanceCommand	Boolean[]	-	Commands to balance cell charge

VfbChargeCurrentCmd	ChargeCurrentCommand	Float32	A	Command current for charging
VfbContactorCmds	ContactorCommand	Boolean	-	Commands to manage contactors

3. BMS SOFTWARE ARCHITECTURE

The BMS software is structured into modules, executed within a Stateflow operating system. Each module is triggered at specified time intervals:

MainStateMachine (50 ms) – Manages the BMS states, including charging and fault conditions.

CurrentLimitsCalculation (100 ms) – Calculates the allowable current ranges based on cell voltages.

StateOfChargeEstimation (200 ms) – Estimates the charge state using inputs like current and voltage.

BalancingLogic (250 ms) – Adjusts the charge levels across the cells to ensure longevity and stability.

3.1 MainStateMachine

This runnable manages the state transitions based on inputs like StateRequest and CellVoltage, updating the BMS's operational state and controlling the charging commands.

3.2 CurrentLimitsCalculation

This runnable computes the permissible current limits using the input from CellVoltage, ensuring safe operation under varying conditions.

3.3 StateOfChargeEstimation

Utilizing methods like Coulomb Counting and voltage-based estimation, this runnable calculates the battery's state of charge, essential for effective energy management.

3.4 BalancingLogic

Executes the cell balancing commands based on the differences in cell voltages, ensuring all cells maintain similar charge levels and prolong the battery's operational life.

This design ensures the BMS operates efficiently within the automotive environment, effectively managing a battery module with three cells, and interfacing seamlessly with the charger, inverter, and precharge circuits.