

Battery management system module based on L9963E



Features

- Hosts the L9963E AEC-Q100 qualified automotive multicell battery monitoring and balancing IC
- Voltage monitoring of every single cell and of the entire battery node
- Voltage, current, and temperature sensing of each cell
- 5 GPIOs to connect temperature sensors as NTCs
- An NTC hosted on the L9963E to sense the chip temperature
- Passive balancing
- Compact size: 100 mm x 76 mm
- Included in the AutoDevKit ecosystem

Description

The **AEK-POW-BMS63EN** is a battery management system (BMS) evaluation board that can handle from 1 to 31 Li-ion battery nodes. Each battery node manages from 4 to 14 battery cells, for a voltage range between 48 V and 800 V.

The board is based on the **L9963E**, which is designed for operation in both hybrid (HE) and full electric (BE) vehicles using lithium battery packs, but its use can be extended to other Transportation and Industrial applications.

The main activity of the **L9963E** is monitoring cells and battery node status through stack voltage measurement, cell voltage measurement, temperature measurement, and coulomb counting. Measurement and diagnostic tasks can be executed either on demand or periodically, with a programmable cycle interval. Measurement data are available for an external microcontroller to perform charge balancing and to compute the state of charge (SOC) and the state of health (SOH).

The main functions of a standard BMS are monitoring and protecting the battery pack.

The monitoring function is related to the measurement of the battery current, voltage, and temperature. The protection function brings the system to a safety state in case of under or overvoltage and overheating.

The **AEK-POW-BMS63EN** provides an elaborate monitoring network to sense the voltage, current, and temperature of each cell. This sensing allows elaborating the SOC of each battery cell and, consequently, the state of charge of all battery packs. The SOC allows assessing the remaining battery capacity, which equates to the remaining driving range.

For maintenance reasons, it is important to monitor the SOC estimation over time. According to our algorithm for the SOC calculation, the more the SOC differs from its nominal value (that is, its value when the batteries are new), the more a cell of the battery pack risks over-discharge. Thus, the SOC evolution over time allows asserting the state of health (SOH) of a cell or a battery pack to spot early indications that a cell is at risk of over-discharge or overcharging.

The SOC of a battery cell is required to maintain its safe operation and duration during charge, discharge, and storage. However, SOC cannot be measured directly and is estimated from other measurements and known parameters (such as characterization curves or look-up tables). This information on the battery cells is necessary to determine how the voltage varies according to the current, the temperature, etc., on the basis of the battery chemical composition and production lot used.

The **AEK-POW-BMS63EN** can work in two different daisy chain topologies: centralized and dual access ring.

Product summary	
Battery management system module based on L9963E	AEK-POW-BMS63EN
Automotive chip for battery management applications with daisy chain up to 31 devices	L9963E
Applications	Battery Management Systems E-mobility Home battery accumulators

In a centralized daisy chain configuration, a series of BMS is connected to an MCU board through a single transceiver connected to the [AEK-POW-BMS63EN](#) isolated ISOLport. The BMS are connected to each other through the isolated ISOH port.

The MCU communicates with the [AEK-COM-ISOSPI1](#) hosted [L9963T](#) transceiver through the SPI protocol. The transceiver converts these signals into ISO SPI signals to communicate with the BMS.

The [AEK-COM-ISOSPI1](#) allows converting SPI signals in isolated SPI signals, thereby reducing the number of necessary wires from 4 to 2 and implementing differential communication for higher noise immunity.

A dual access ring configuration is also possible by adding another transceiver that makes the communication bidirectional. The secondary ring is used as a backup in case the primary ring fails. Data moves in opposite directions around the rings, and each ring remains independent of the other unless the primary ring fails. The two rings are connected to continue the flow of data traffic.

In AutoDevKit ecosystem software package, we created two example demos (one for centralized and one for dual access ring configuration) to elaborate SOC and SOH, using Li-ion batteries. Battery packs may have different SOC, and balancing is necessary to bring them all to the same charge level. After detecting the lowest charge in the battery pack, all the other battery nodes are discharged to reach its level. The demos explain how to activate the internal MOSFETs of the [L9963E](#), which short-circuit the cell on an external dissipation resistor to discharge it. Passive cell balancing can be performed either via the [L9963E](#) internal MOSFETs or via external MOSFETs/resistors. The controller can either manually control the balancing drivers or start a balancing task with a fixed duration. In the second case called silent mode, the balancing may be programmed to continue even when the IC enters a low power mode, to avoid unnecessary current absorption from the battery pack. The balancing function is necessary to lengthen the battery capacity and its duration.

Different MCUs can be used. In our demos we used the [AEK-MCU-C4MLIT1](#), while other ASIL-B and ASIL-D microcontrollers of the SPC58 Chorus family are supported.

1 Block diagram

Figure 1. Block diagram

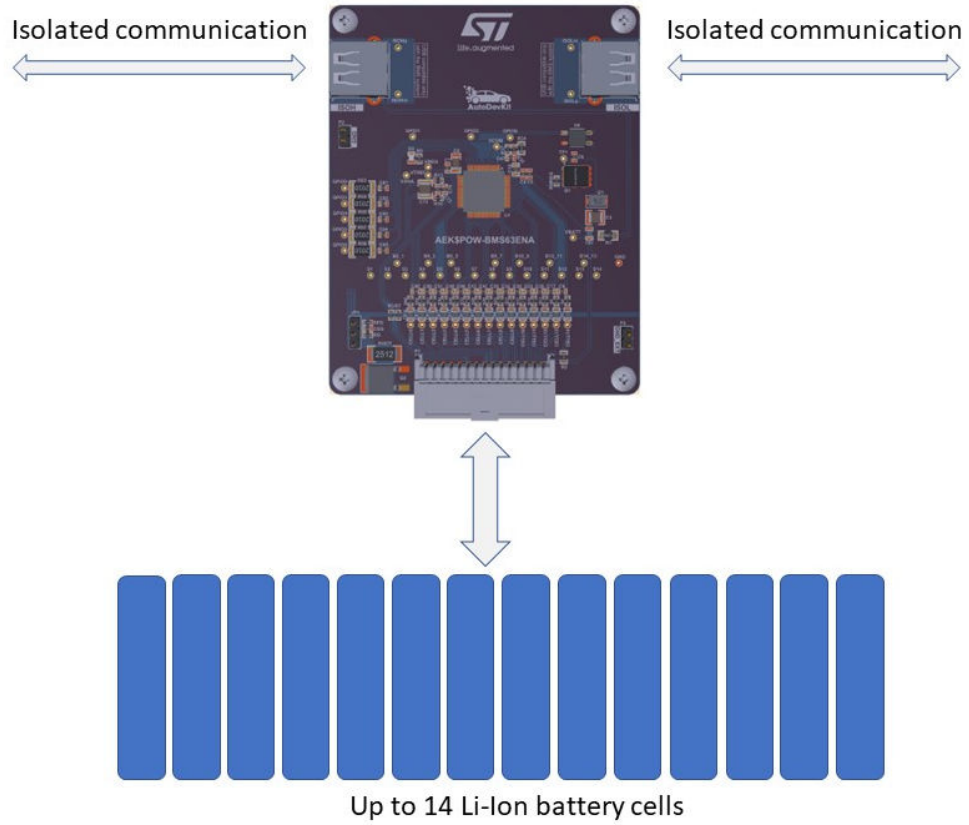


Figure 2. Centralized BMS without node-to-node isolation

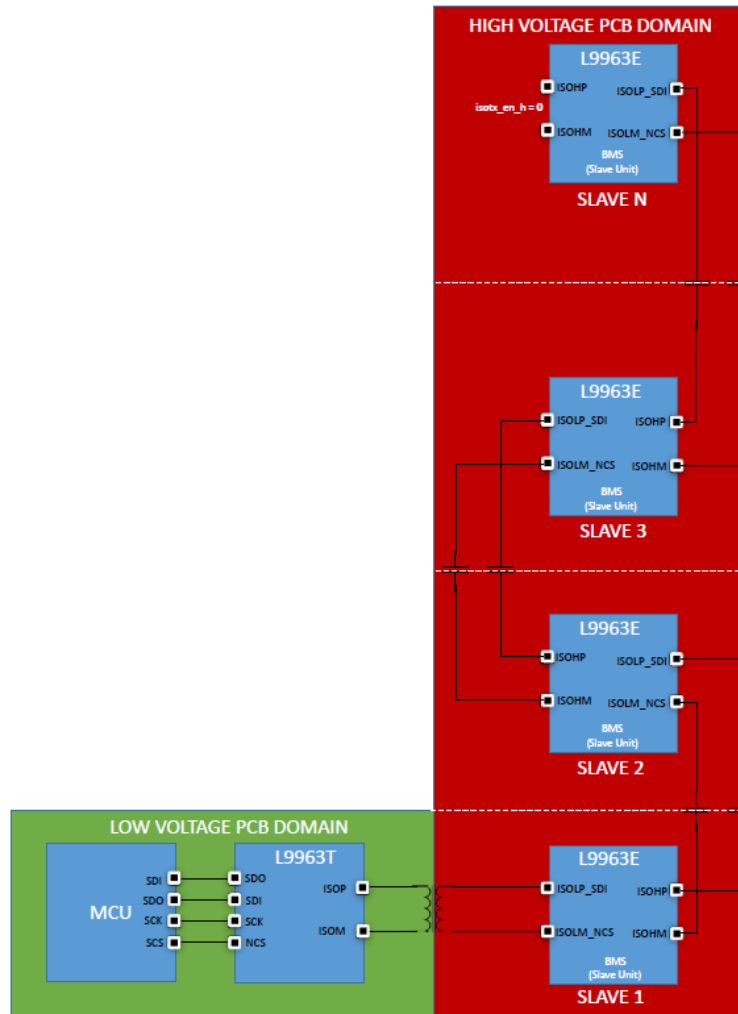
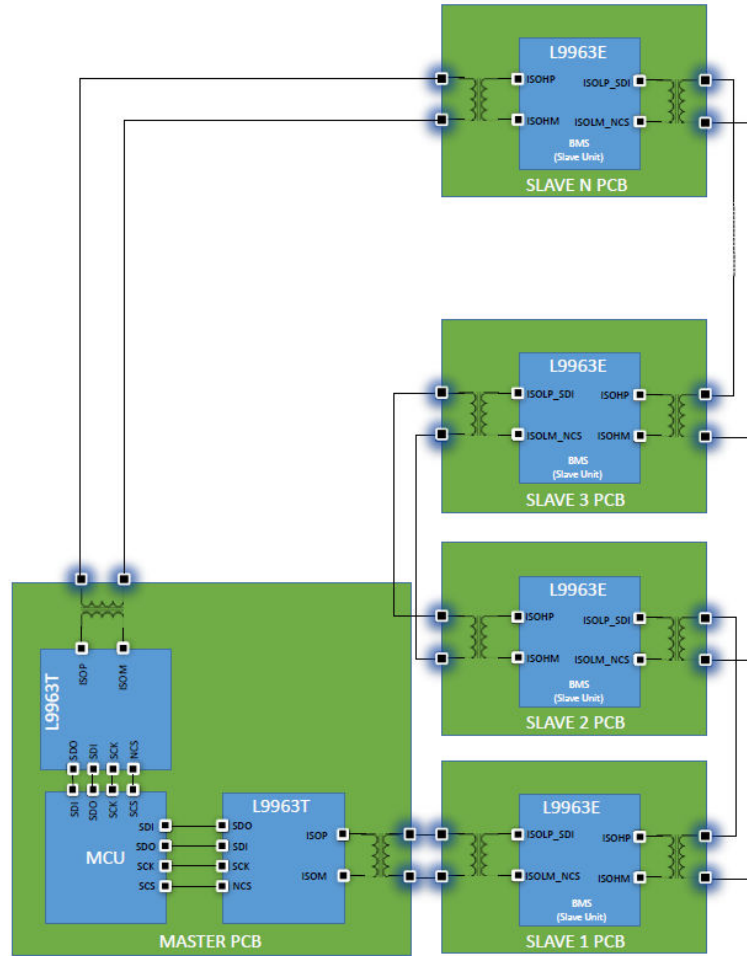
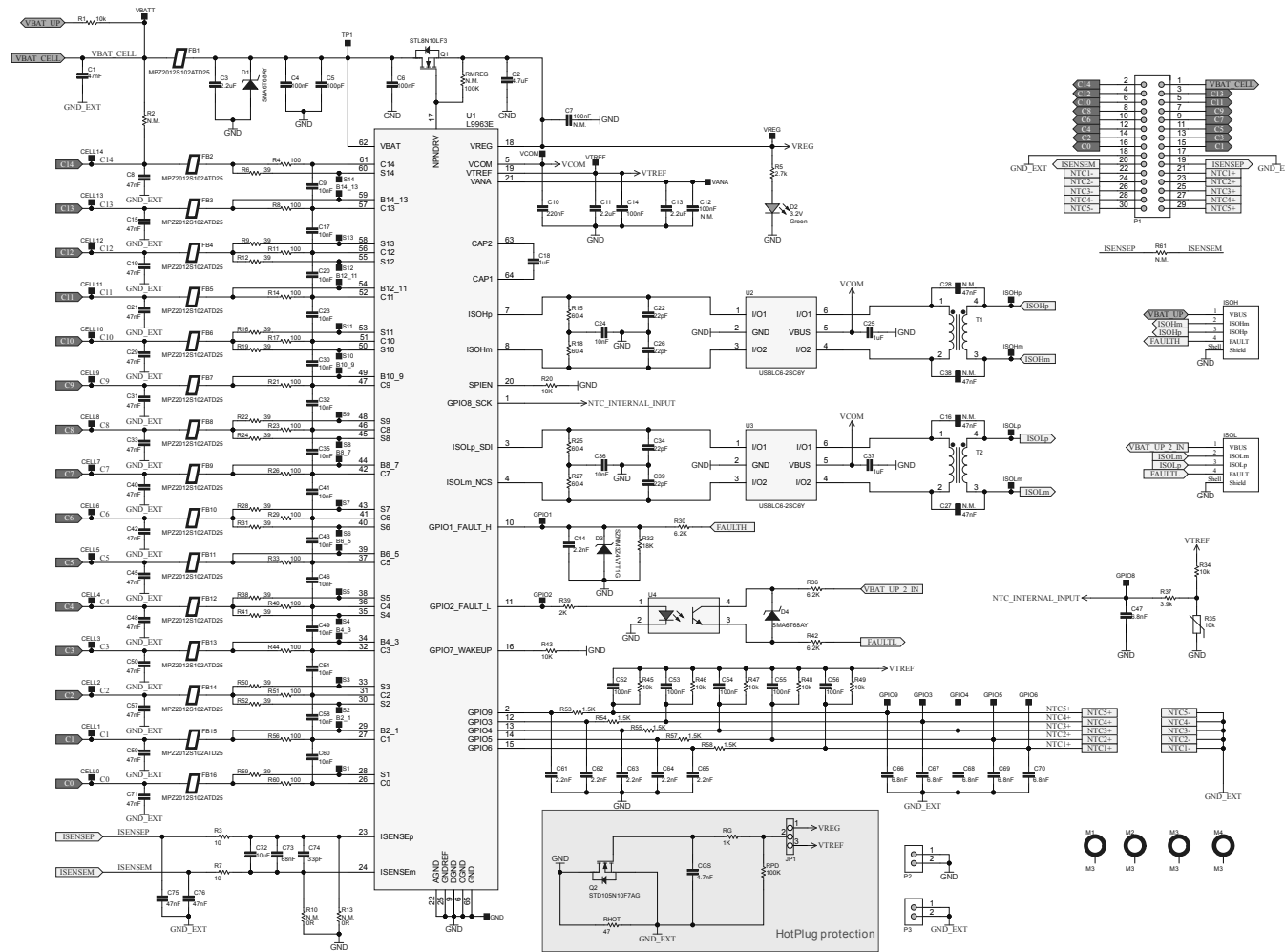


Figure 3. Dual access ring BMS with isolated nodes



2 Schematic diagrams

Figure 4. AEK-POW-BMS63EN schematic diagram



3 Board versions

Table 1. AEK-POW-BMS63EN versions

Finished good	Schematic diagrams	Bill of materials
AEK\$POW-BMS63ENA ⁽¹⁾	AEK-POW-BMS63EN schematic diagrams	AEK-POW-BMS63EN bill of materials

1. This code identifies the AEK-POW-BMS63EN evaluation board first version. It is printed on the board PCB.

Revision history

Table 2. Document revision history

Date	Version	Changes
02-May-2023	1	Initial release.

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