12V/24V BMS Protection Solution | 2025

Applications & Solutions

ALPINESEMI®

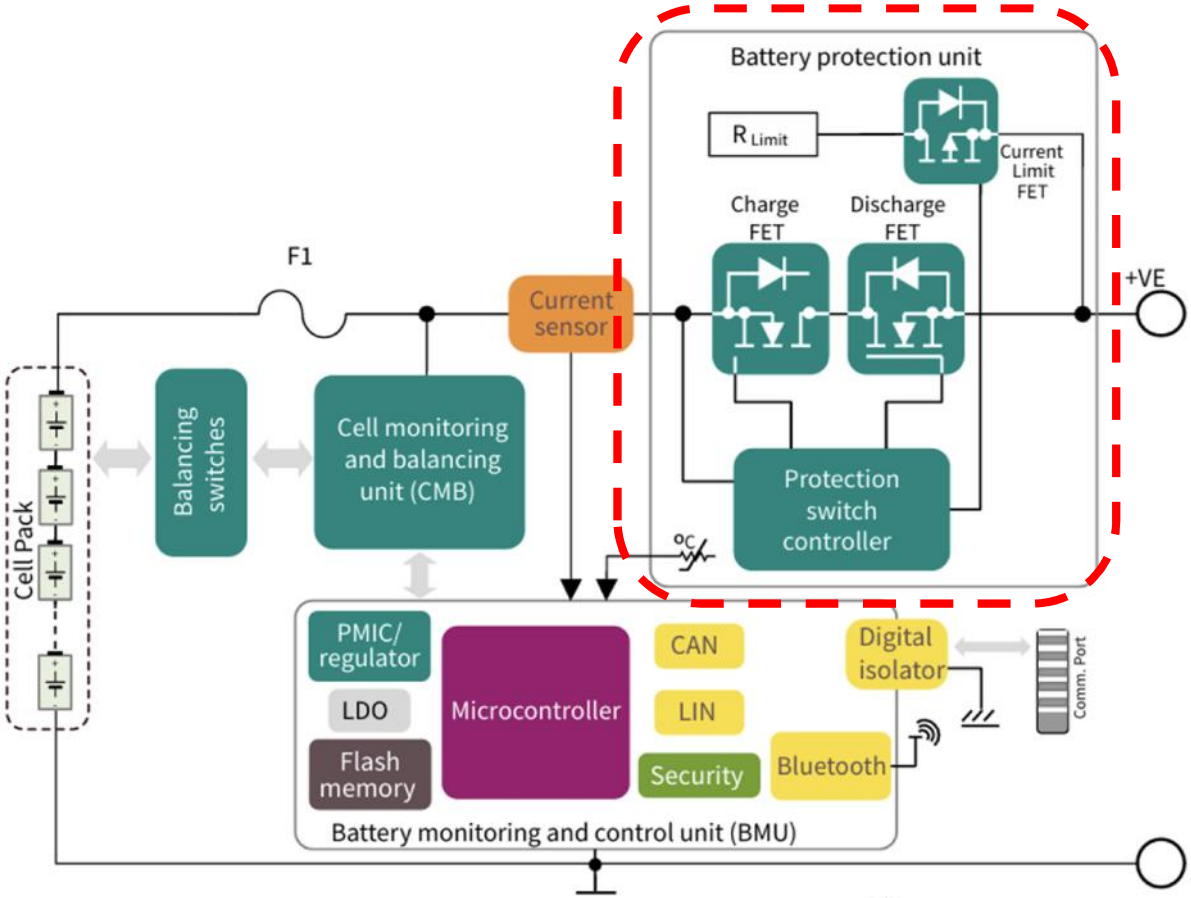
Background for BMS 12V/24V Failure Mode

The high-power density of lithium-ion batteries has made them very popular. However, the unstable behavior of lithium- ion cells under critical conditions requires them to be handled with care. That means a battery management system (BMS) is needed to monitor the battery state and ensure safe operation. BMS is typically equipped with an electronic switch that disconnects the battery from the charge or load under critical conditions that can lead to dangerous reactions. A battery protection unit (BPU) prevents possible damage to the battery cells and the failure of the battery.

Such critical conditions include:
- Over-charge that occurs when the battery is charged over the allowed maximum capacity
- High and low temperature when the internal temperature of the battery cells exceeds their safe operational temperature range
- Over-discharge when the battery is discharged under the allowed minimum capacity
- Overcurrent when the battery is exposed to a short circuit condition or a high inrush turn-on current
- Reverse polarity when the battery terminals are wrongly plugged into the device

Power Discrete Solution for BMS 12V/24V Protect System

In order to prevent these failures, ALPINESEMI offers a wide range of battery protection solutions that increase the lifetime and efficiency of lithium-ion batteries under stressful conditions.



Key Benefits

- Higher performance with lower RDS(on) and wider safe operating area (SOA)
- Cheaper solutions with a more compact bill of material and more effective parallelization solutions
- Short circuit protection with higher peak current rates to withstand higher current values
- Turn-on and turn-off solutions tailored to applications needs
- Up to 600 V MOSFET protection solutions (including single- and multi-module)

Power Discrete Solution Part Number Recommendation

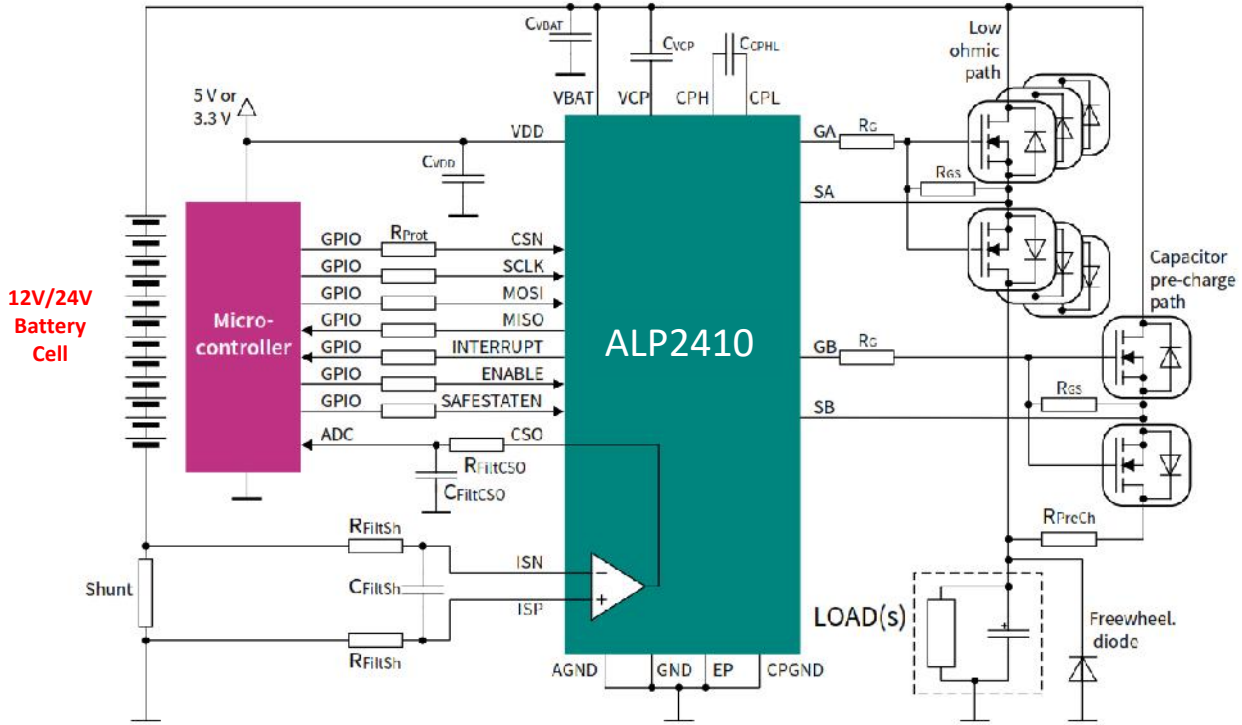
beyond boundaries…

Battery voltage	Application	Recommended Power MOSFETS				
18 V	Charge and discharge MOSFET	ALPG005N04LPR 40 V, 0.6 LFPAK56	ALPT010N04LPR 40 V, 1.0 mR LFPAK56	ALPT006N03LPR 30 V, 0.55 mR, LFPAK56	ALPG004N03LPR 30 V, 0.4 mR, LFPAK56	ALP016N03LSNT 30 V, 1.6 mR, TDFN 3.3x3.3
	Balancing MOSFET	ALPG004N03LPR 30 V, 0.4 mR, LFPAK56	ALP8969LSC 20 V, 16 mR, TSSOP8	ALP3406LXH 30 V, 38 mR, SOT-23	ALP3415H -20 V, 39 mR, SOT-23	ALP3010 -30 V, 17 mR, SOP-8
	Pre-charge MOSFET	ALP072P03LSU -30 V, 7.2 mR, PDFN56-8L	ALP058P03LMD -30 V, 5.8 mR, TO252	ALP026P04LSAU -40 V, 2.6 mR, PDFN56-8L	ALP40P40LSV -40 V, 13.5 mR, PDFN 3.3x3.3	ALP3010 -30 V, 17 mR, SOP-8
24 V	Charge and discharge MOSFET	ALPG005N04LPR 40 V, 0.6 LFPAK56	ALPT010N04LPR 40 V, 1.0 mR LFPAK56	ALPT005N03LPR 30 V, 0.55 mR, LFPAK56	ALP014N04LSU 40 V, 1.4 mR, PDFN56-8 Source-Down Center-Gate	ALP018N04LSNT 40 V, 1.8 mR, TDFN 3.3x3.3
	Balancing MOSFET	ALPG004N03LPR 30 V, 0.4 mR, LFPAK56	ALP8969LSC 20 V, 16 mR, TSSOP8	ALP3406LXH 30 V, 38 mR, SOT-23	ALP3415H -20 V, 39 mR, SOT-23	ALP3010 -30 V, 17 mR, SOP-8
	Pre-charge MOSFET	ALP6006SHT -60 V, 29 m2, SOT223	ALP065P06LSTP -60 V, 6.5 m2, AT PAK	ALP60P90LSAD -60 V, 12 m2, DPAK		
36 V	Charge and discharge MOSFET	ALPGT06N009 60 V, 0.75 mR, TOLL	ALP007N06N 60 V, 0.75 mR, TOLG	ALP007N06LPR 60 V, 0.7 mR, LFPAK56	ALP071N06LSU 60 V, 0.71 m2, PDFN56-8	ALP016N06HSE 60 V, 1.6 mR, D2PAK
	Balancing MOSFET	ALPG004N03LPR 30 V, 0.4 mR, LFPAK56	ALP8969LSC 20 V, 16 mR, TSSOP8	ALP3406LXH 30 V, 38 mR, SOT-23	ALP3415H -20 V, 39 mR, SOT-23	ALP3010 -30 V, 17 mR, SOP-8
	Pre-charge MOSFET	ALP6006SHT -60 V, 29 m2, SOT223	ALP065P06LSTP -60 V, 6.5 m2, AT PAK	ALP60P90LSAD -60 V, 12 m2, DPAK		
48 V	Charge and discharge MOSFET	ALPG009N08TR 80 V, 0.9 mR, TOLL	ALP011N08HLLD 80 V, 1.1 mQ, TOLT	ALPG015N08LPR 80 V, 1.5 mR, LFPAK56	ALPG007N08HRLD,80 V, 0.7 mR, TOLT	ALP020N08HSAUB 80 V, 2.0 mR, PDFN88
	Balancing MOSFET	ALPG004N03LPR 30 V, 0.4 mR, LFPAK56	ALP8969LSC 20 V, 16 mR, TSSOP8	ALP3406LXH 30 V, 38 mR, SOT-23	ALP3415H -20 V, 39 mR, SOT-23	ALP3010 -30 V, 17 mR, SOP-8
	Pre-charge MOSFET	ALP10P20LSD -100 V, 100 mR, TO252	ALP16P10LSHT -100 V, 160 mR, SOT-223			

Gate Driver Solution for BMS 12V/24V Protect System

ALP2410 is a one channel gate driver with two independent gate outputs for 12 / 24 V automotive applications. It offers several protection features for connecting/disconnecting loads or different power supplies.

- Faster reaction time (~ 10 us)
- Integrated bidirectional high or low side current sense amplifier
- High current source or sink support
- Robust against under-/overvoltage in the board-net - Flexible configuration of protection features plus the accessibility of diagnosis information via SPI



- One channel device with two high-side gate driver outputs
- 3Ωpull-down, 5Ω pull-up for fast switch on/off
- Support back-to-back MOSFET topologies (common drain and common source)
- Two bidirectional high-side analog current sense interfaces with externally adjustable gain
- Adjustable overcurrent/short-circuit protection
- Versatile comparator to implement: adjustable I-t wire protection, overvoltage/undervoltage or overtemperature protection