



Expertise Applied | Answers Delivered

Battery Systems in Light Electric Vehicles (>60 V)



2/3-Wheeler & Recreational



Energy Storage

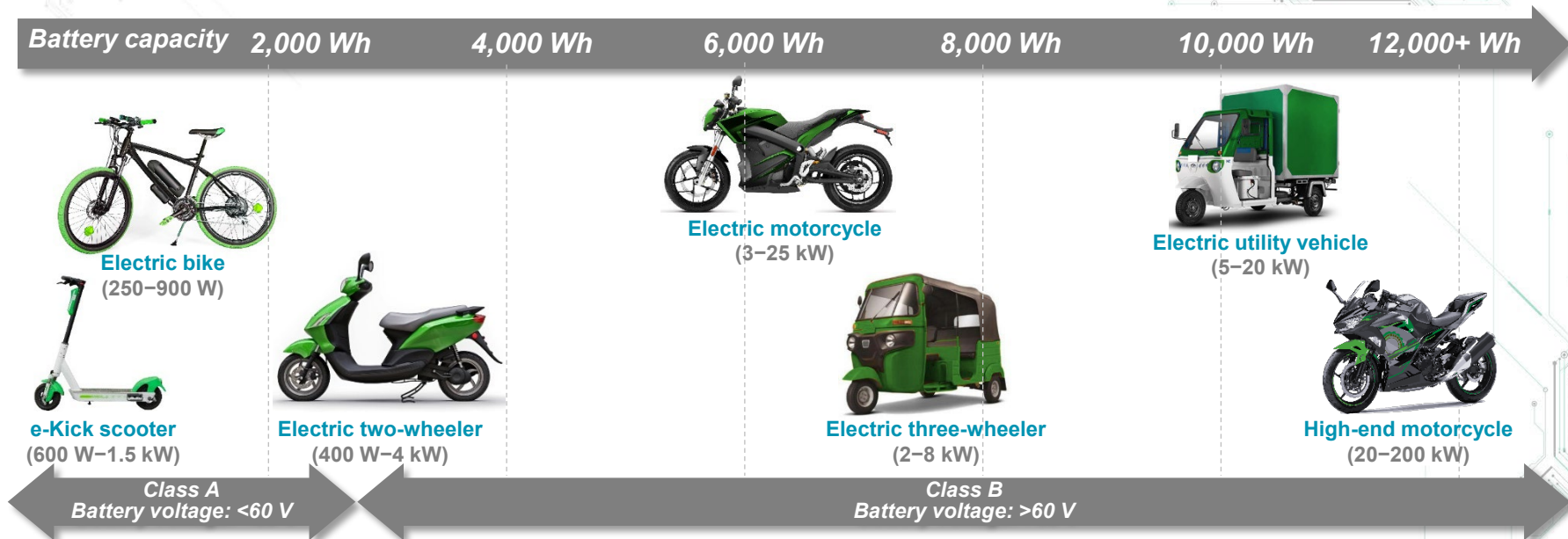
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What are Light Electric Vehicles (LEVs)?



LEVs are compact, battery-powered rides revolutionizing urban travel through clean, efficient, and agile mobility.

Battery voltage, current, and power ranges by LEV type

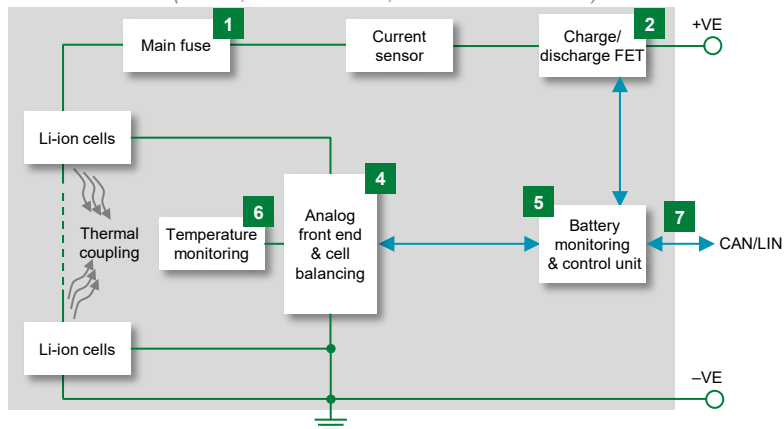


- **Electric bike:** 36–52 V → 48 V standard; 10–25 A → higher torque; used for city travel, by university students, etc.
- **e-Kick scooter:** 36–60 V → 48 V growing; 10–30 A; popular for urban commuting; moving to more power
- **Electric two-wheeler:** 48–72 V → 60 V+ popular; 20–50 A; used for city travel
- **Electric three-wheeler:** 48–96 V → 72 V+ rising; 30–100 A; cargo + passenger transit
- **Electric utility vehicle:** 72–120 V+ → 100 V+ common; 50–150 A; industrial and logistics
- **High-end motorcycle:** 72–120 V+ → 100 V+ high-end; 50–300 A; consumer and sports

Battery Management System (BMS) architecture: comparing between different LEVs

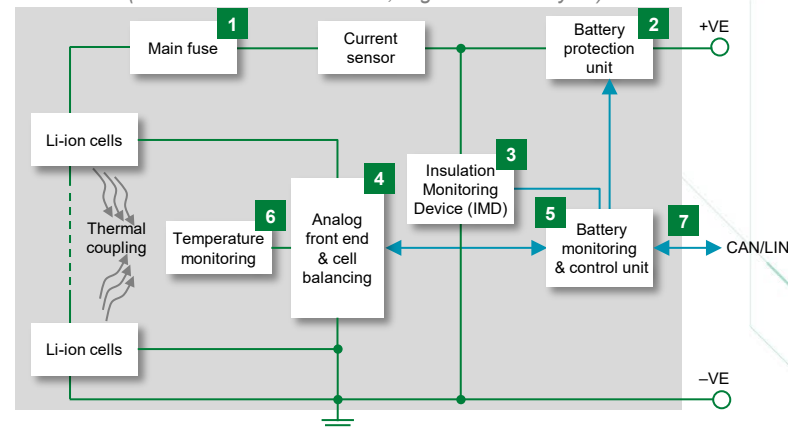
LEVs <60 V, Class A

(e-Bike, e-Kick scooter, Electric two-wheeler)



LEVs >60 V, Class B

(Electric two-/three-wheeler, High-end motorcycle)



	Protection node	Function	<60 V (Class A)	>60 V (Class B)
1	Main fuse	Clears hard shorts; protects pack, wiring, & controller	Voltage: ≤58.8 V; I_{cont}: ~20–60 A; Peaks: 2–3×; I_{SC}: ~0.4–0.9 kA	Voltage: 67–120 V; I_{cont}: 80–200 A+; Peaks: 2–3×; I_{SC}: ~1–5 kA
2	Battery protection unit	Connects/disconnects the pack from the vehicle	Usually performed by MOSFETs (often many in parallel)	MOSFETs rated up to 200 V + DC Contactor Relay rated for DC (up to 300 V) and high currents (up to 250 A)
3	IMD (isolation monitor) (to HV+, HV-, chassis)	Detects leakage to chassis; prevents contactor from closing; trips during operation	Not generally used	Solid State Relays used to switch safely, and reliably switch high-voltage, ultra-low-current measurement paths
4	Balancing circuit/AFE protection	Isolates a shorted/abused sense lead; protects AFE and harness	SMD fuse with high DC rating (commonly 125 VDC) and current rating (typically from 0.25–1 A)	Similar to <60 V
5	Secondary protection at battery pack level	Permanently opens the pack under unrecoverable faults (especially overvoltage/overcharge)	Three-terminal fuse rated up to 80 V and 60 A	SMD or Bolt-Down Three-Terminal Fuse rated up to 125 V and 150 A
6	Temperature monitoring	Cell temperature sensing	NTC + TTape™ Platform	NTC + TTape™ Platform
7	Communication line	I/O port, CAN/LIN protection against ESD	TVS Diode Array	TVS Diode Array

Battery protection & control solutions for LEVs <60 V

Electric bike, e-kick scooter, pedelec, and low-power electric two-wheeler such as moped and scooter



Scan to learn more about

Lithium Battery Pack (<60 V)
Protection and Control
Solutions from Littelfuse

Battery protection & control solutions for LEVs >60 V

High-power electric two-/three-wheelers, electric utility vehicles, high-end motorcycles, etc.

Main fuse + Battery disconnect unit

Fuse, DC Contactor Relay, MOSFET, TVS Diode, Current Sensing Resistor



Temperature monitoring

NTC, TTape™ Platform



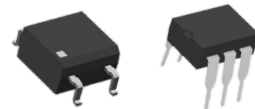
AFE and Cell balancing

Fuse, PolySwitch® Resettable Device, TVS Diode



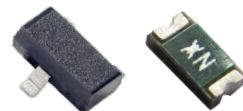
Insulation Monitoring Device (IMD)

Solid State Relay



Communication interface

TVS Diode Array, PolySwitch® Resettable Device



Battery swap/ Battery detection/Anti-tamper

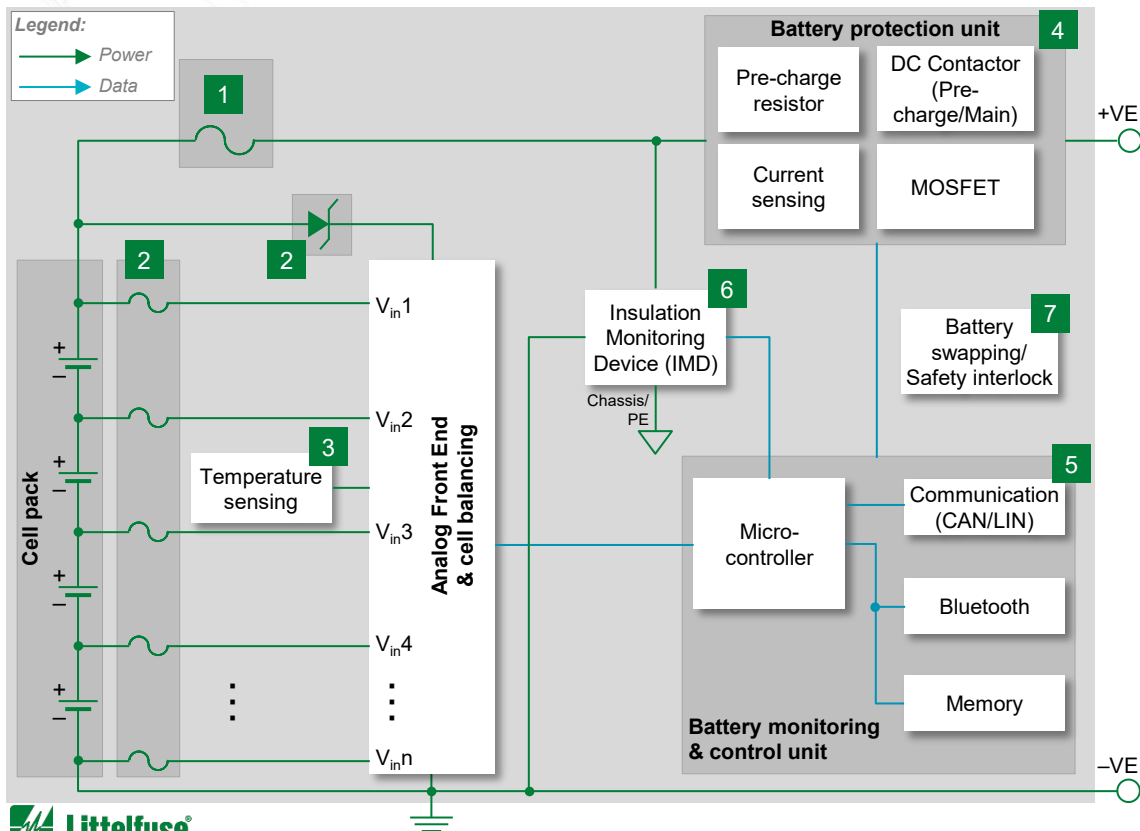
Reed Switch, Switch





Click the product series in the table below for more info

Functional block diagram of BMS used in LEVs >60 V



	Technology	Product series
1	Fuse, Fuseholder	MIDI 70V , Mega , MAXI 58V , 871 , 881 , LP Jcase , ATO
2	Fuse OR PolySwitch® Resettable Device	438A , 437A , MINI , 521
	TVS Diode	1812L
3	NTC	TPSMB-L
	TTape™ Platform	Leaded , Surface Mount
	DC Contactor Relay	TTP
4	MOSFET	DCNEV , DCNLEV , DCNLR
	TVS Diode	200V X4-Class , Trench (T, T2)
	Current Sensing Resistor	TPSMD , TP5.0SMDJ , SZ5KASMC
5	TVS Diode Array	WSTM-A , SSA
	PolySwitch® Resettable Device	AQ24COM-02 , AQ24COM-01
6	Solid State Relay	nanoASMD
7	Reed Switch	LAA110 , LCA701 , CPC1009N
	C&K® Switches	MDSR-10
		ZMS , ZMSM , LCS , KSC , ZMV , ZMW , ATS



Click the product series in the table below for more info

Benefits of recommended Littelfuse products

	Technology	Function in application	Product series	Benefits	Features
1	Fuse, Fuseholder	Clears hard shorts; protects pack, wiring, and controller	MIDI 70V , Mega , MAXI 58V , 871 , 881 , LP Jcase , ATO	Provides safety protection in low- and medium-voltage environments; full-range fuses	Bolt down, bladed, and SMD form factors; high breaking capacity; meets ISO 8820 standard or new AEC-Q specification
2	Fuse	Protect the balancing circuit/the AFE	438A , 437A , MINI , 521	Ensures excellent temperature stability and performance reliability; ceramic substrate ensures compatibility with high-temperature environment	Meets new AEC-Q specification; fast response to fault current; surface mount device
	OR PolySwitch® Resettable Device		1812L	Compact design saves board space; resettable protection	Low profile; fast response to fault currents; low resistance
	TVS Diode	Cell monitor IC sense line input overvoltage protection	TPSMB-L	Excellent clamping capability; meets automotive industry standards; fast response time; low reverse leakage current (I_R)	AEC-Q101 qualified; meets IEC standards for ESD protection and ISO standards for in-vehicle transient surges
3	NTC	Monitors analog temperature to facilitate functional control of batteries	Leaded , Surface Mount	Allows for high-precision temperature measurement in harsher environments	UL recognized with ring lug mounting; SMD NTCs in hermetically sealed MELF package suitable for operation up to 220 °C
	TTape™ Platform	Manages battery lifetime and helps identify hazardous temperature levels	TTP	Simple integration with existing BMS architectures + enables enhanced BMS control systems	Trip temperature of 58±3 °C, up to 50 sensing points on one string; enables BMS wakeup and single GPIO port usage
4	DC Contactor Relay	Connects and disconnects battery from main circuitry	DCNEV , DCNLEV , DCNLR	Allows a low-voltage signal to switch the contacts for a high-voltage signal	Wide range of capabilities: can switch up to thousands of amps and thousands of volts
	MOSFET	Battery protection (hybrid/solid-state)	200V X4-Class , Trench (T, T2)	Protects contactor from arcing, smoother pre-charge, lower EMI, programmable protection, enables rapid fault clearance	Low $R_{DS(on)}$, bidirectional current flow, strong SOA, gate-driver control, silent switching
	TVS Diode	Protects against voltage spikes and transients	TPSMD , TP5.0SMDJ , SZ5KASMC	Optimize board space; prevents nuisance trips/resets	Excellent clamping capability, high surge capability, low Zener impedance, and fast response time; SMD low profile surface mount package
	Current Sensing Resistor	Measures pack charge/discharge current	WSTM-A , SSA	High sensing accuracy; low thermal offset drift; low thermal sensitivity drift	Isolated from HV network; no additional power loss due to shunt resistor



Click the product series in
the table below for more info

Benefits of recommended Littelfuse products

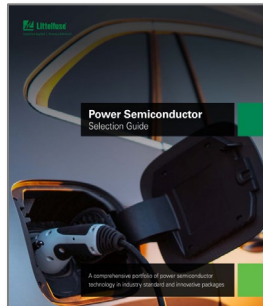
	Technology	Function in application	Product series	Benefits	Features
5	TVS Diode Array	Protects sensitive electronic ICs from ESD, EFT, and voltage spikes	AQ24COM-02 , AQ24COM-01	Ensures reliable equipment with no degradation in communication line performance	AEC-Q101 qualified; meets ESD protection levels specified under IEC 61000-4-2 and ISO 10605; low leakage current and clamping voltage
	PolySwitch® Resettable Device	Resettable overcurrent protection	nanoASMD	Reduce weight of wire harnesses; low the use of smaller wire sizes; solid state composition of PPTC devices helps provide reliability	Surface mount; rated up to 60 V; meets automotive industry standards
6	Solid State Relay	Monitors isolation	LAA110 , LCA701 , CPC1009N	Allows robust operation in a small four-pin package	1500 V I/O isolation; low drive requirements; no arching
7	Reed Switch	Provides the control signal for the battery pack	MDSR-10	Ensures contamination resistance and a compact design	Switches up to 200 VDC or 0.5 A at up to 10 W; 10 ¹² Ω insulation resistance
	C&K® Switches	Enables battery detection switching	ZMS , ZMSM , LCS , KSC , ZMV , ZMW	Confers long electrical and mechanical life; ideal when space is limited	IP65/IP67; SPST NO/SPST NC/SPDT; compact size
		Anti-tamper protection	ATS	Withstand harsh environments; long life; small footprint	IP54 sealed; vertical detect and a normally closed function

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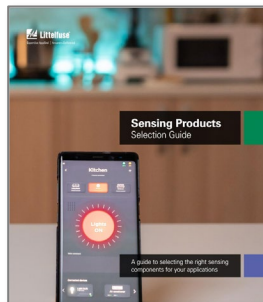
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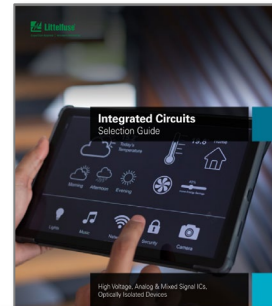
**Circuit Protection
Selection Guide**



**Power Semiconductor
Product Catalog**



**Sensing Products
Selection Guide**

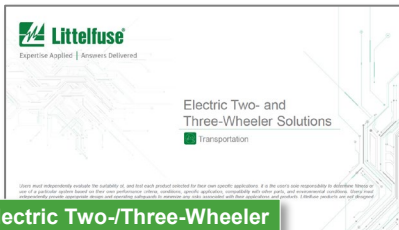


**Integrated Circuit
Selection Guide**

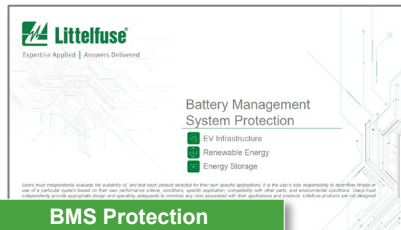


**C&K Switches
Selection Guide**

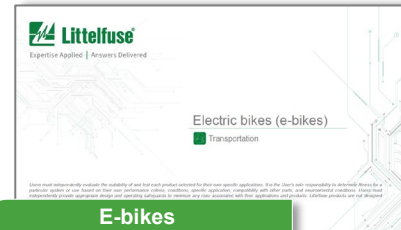
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**Electric Two-/Three-Wheeler
Solutions Spotlight**



**BMS Protection
Spotlight**



**E-bikes
Spotlight**



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