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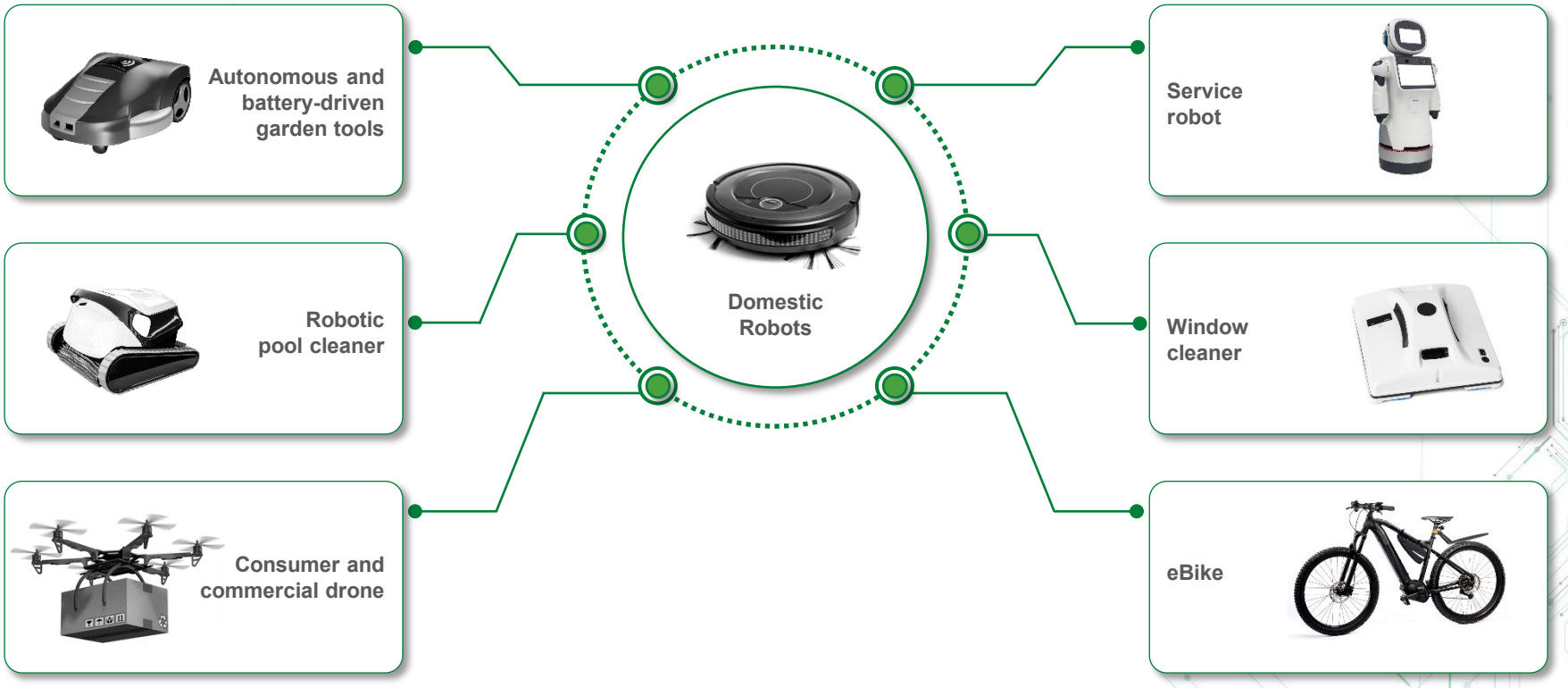
Robotic Appliances

Appliances

REV0823

Many battery powered devices in very different applications share similar safety and control elements



Domestic robotics market is growing at 18% CAGR

Market Trends and Drivers

Global domestic robotics unit shipments are expected to increase from ~18.3 million in 2022 to ~29.6 million units in 2025 at a CAGR of 18%.

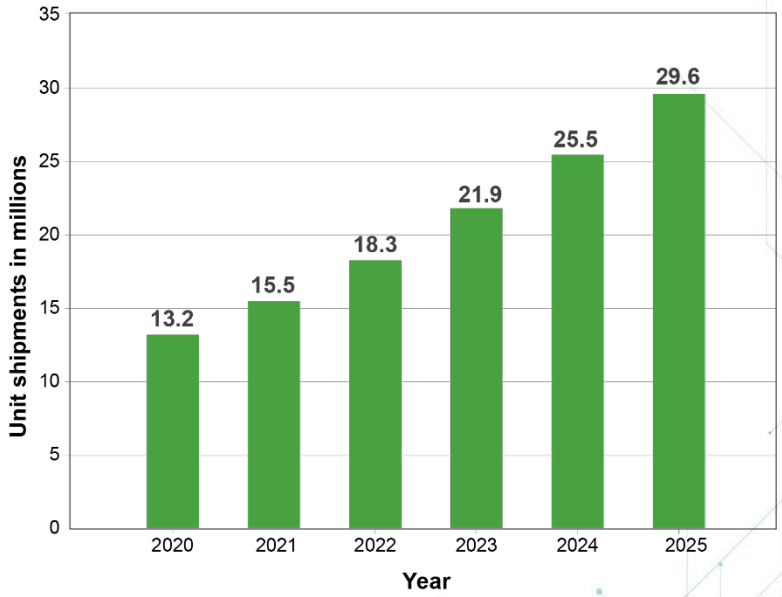
Developments in artificial intelligence (AI), machine learning, and sensor technologies are enabling more sophisticated domestic robots. These robots can navigate complex environments, recognize objects, and respond to voice commands.

As homes become more interconnected through the Internet of Things (IoT), there is an increasing trend toward automation. Domestic robots that can integrate into smart home systems are seeing growing demand.

Robots contain complex electrical systems that require protection from power surges, overcurrent, overvoltage, and other electrical issues.

Ensuring safe, reliable power sources (Li-ion battery) in domestic robots can prevent overheating, short circuits, and fires, which promotes user trust and regulatory compliance.

Domestic robotics strong growth at 18% CAGR



Source: https://www.statista.com/statistics/730884/domestic-service-robots-shipments-worldwide/

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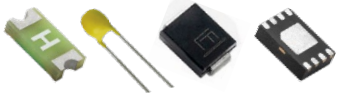
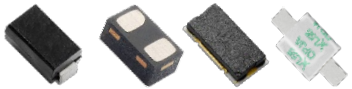
Recommended Littelfuse solutions for the most popular domestic robot–vacuum cleaner

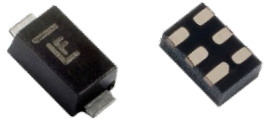
1 Docking station
Fuse, NTC,
TVS Diode, eFuse

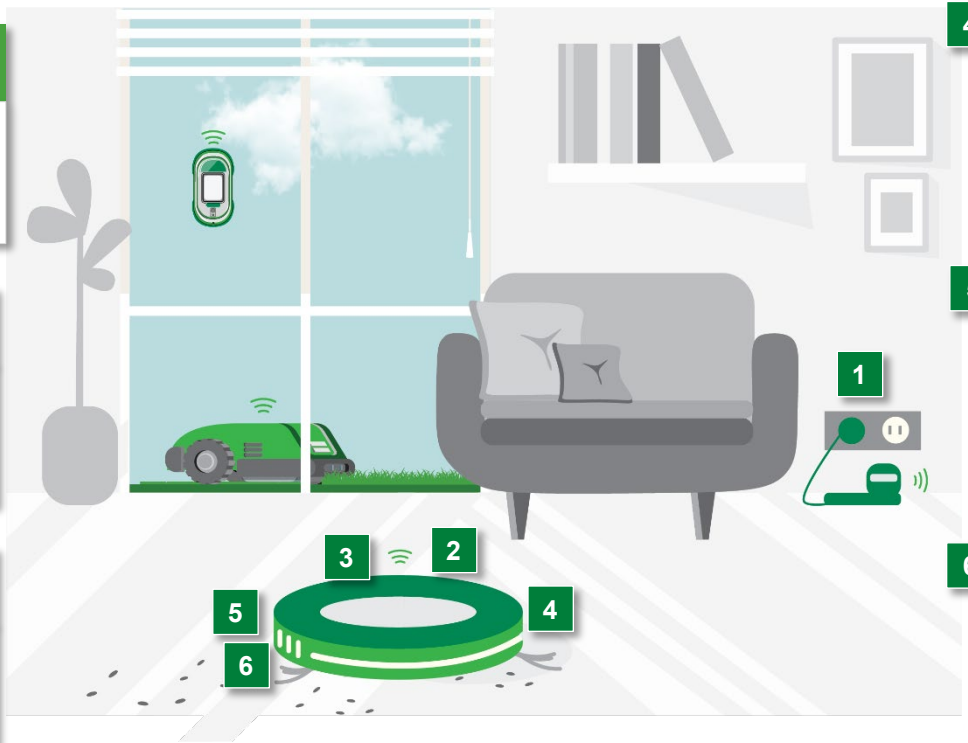


2 Battery pack
TVS Diode, NTC,
Battery Protector, PPTC

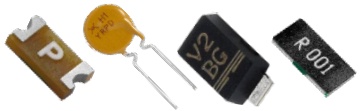


3 Power management
TVS Diode, TVS Diode Array





4 Motor drive
Fuse, PPTC
TVS Diode, Current Sensing Resistor



5 Display and sensor
TVS Diode, TVS Diode Array,
Reed Switch, Switch

6 User Interface
TVS Diode Array

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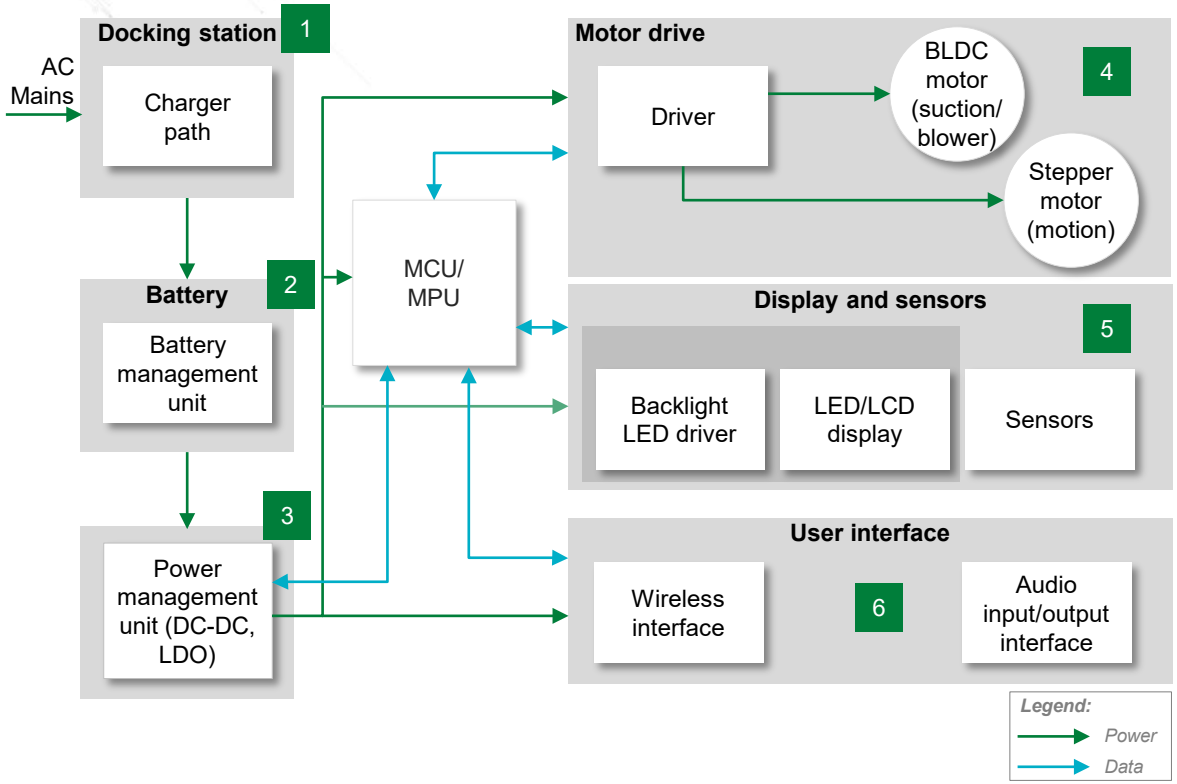
Click the product series in the table below for more info

Robotic appliance system architecture



	Technology	Product series
1	Docking station	
2	Battery	
3	Fuse	466, 467
	PPTC	2920L
	TVS Diode	SMAJ, SMBJ
	Protection IC (eFuse)	LS24
4	NTC	Leadedthermistor
	Current Sensing Resistor	WSTC
	PPTC	16R, RGEF
	Gate Driver	LF2136BTR
5	TVS Diode	SMF4L
	TVS Diode Array	SP3423, SP1064
	Reed Switch	59050
	Switch	KSE
6	TVS Diode Array	SP1064

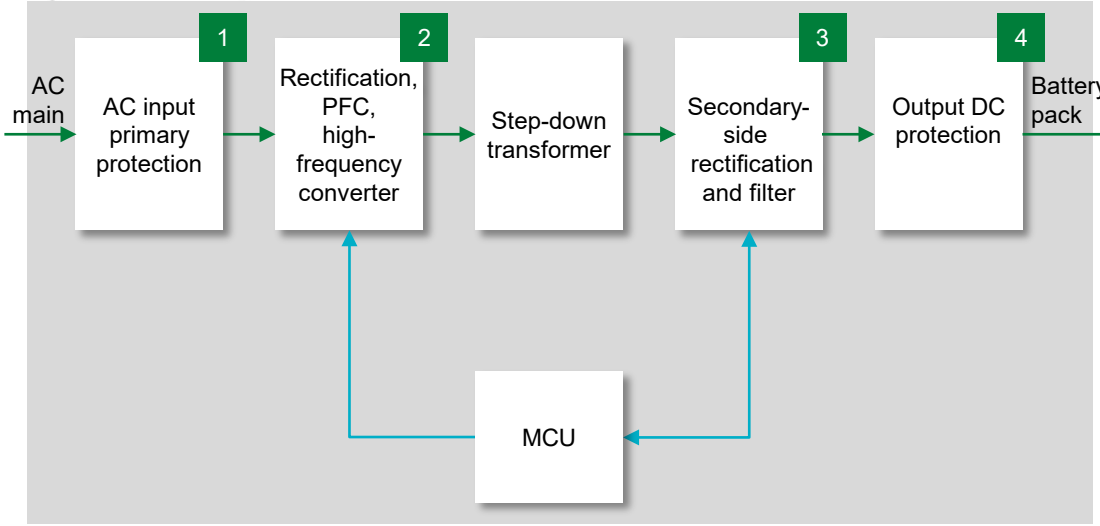
Click the product series in the table below for more info

Use cases and benefits of components for motor drive

	Technology	Function in application	Series	Benefits	Features
3	Chip fuse	Protects battery and downstream controller from inrush current due to motor shorting or external shorts at contacts	466, 467	Reduces customer qualification time by complying with third party safety standards such as UL/IEC; SMD form-factor allows for compact design	Third-party compliance UL/IEC; low internal resistance; shock safe; vibration resistant
	PPTC	Protects from overtemperature and overcurrent events	2920L	Prevents nuisance fuse opening; third-party agency certification at component level reduces OEM qualification time/effort at device level	Resettable; surface mountable; compact design with wide range of form factors
	TVS Diode	Protects power unit from voltage transients	SMAJ, SMBJ	Improves system reliability by protecting down-stream components from transients on power lines	Excellent clamping capability
	Protection IC (eFuse)	Provides both overcurrent and overvoltage protection	LS24	Programmable; replaces a Power Schottky Diode with an integrated 35 mΩ N-Channel MOSFET	2.7~24 V operation voltage; surge up to 28 V and 6 A continuous current; eight-lead 2 mm x 3 mm DFN packages
4	NTC	Temperature sensing	Leadedthermistor	Accurate temperature (component/ ambient) for enabling safe device operation	High reliability; small form factor; fast thermal response
	Current Sensing Resistor	Part of current measurement circuitry	WSTC	Cost-effective solution for current sensing	Power rating up to 2~3 W; high precision and stability
	PPTC	Protects motor from overtemperature	16R, RGEF	Reduces customer qualification time by complying with third-party safety standards such as UL/IEC; enables safe device operation	Resettable; surface mountable; compact design with wide range of form factors
	Gate Driver	Controls the switching MOSFETs	LF2136BTR	Comprehensive protection features: shoot-through protection logic	200 mA source/350 mA sink output current capability; outputs tolerant to negative transients; dv/dt immune
5	TVS Diode	Protects ICs from ESD through display	SMF4L	Improves system reliability by protecting down-stream components from transients on power lines	Low profile: maximum height of 1mm; low leakage of 1.0 µA
	TVS Diode Array	Protects ICs from ESD through display	SP3423, SP1064	Smaller form-factor and multi-line protection enables ease of design	Low capacitance of 1.0 pF per I/O
	Reed Switch	Provides an interlock by shutting off power when lid is open	59050	Protects end user from electrical shocks and physical harm	Hermetically sealed, magnetically operated contact; certified tor use in NA and Europe
	Switch	Tactile switch for on/off operations	KSE	Cost-efficient; low-profile	IP67, 300000 cycles
6	TVS Diode Array	Protects ICs from ESD through audio interface	SP1064	Smaller form-factor and multi-line protection enables ease of design	Low leakage current of 0.5µA (MAX) at 5V

Click the product series in the table below for more info

Docking station/charger protection architecture



	Technology	Series
1	Fuse	5X20mm Fuse, TR, TE
	MOV	LA, CIII, TMOV
2	MOSFET	X2-class
	TVS Diode	P6SMB
3	Schottky Diode	MBR, DST
4	TVS Diode	SMBJ

Legend:
Power
Data

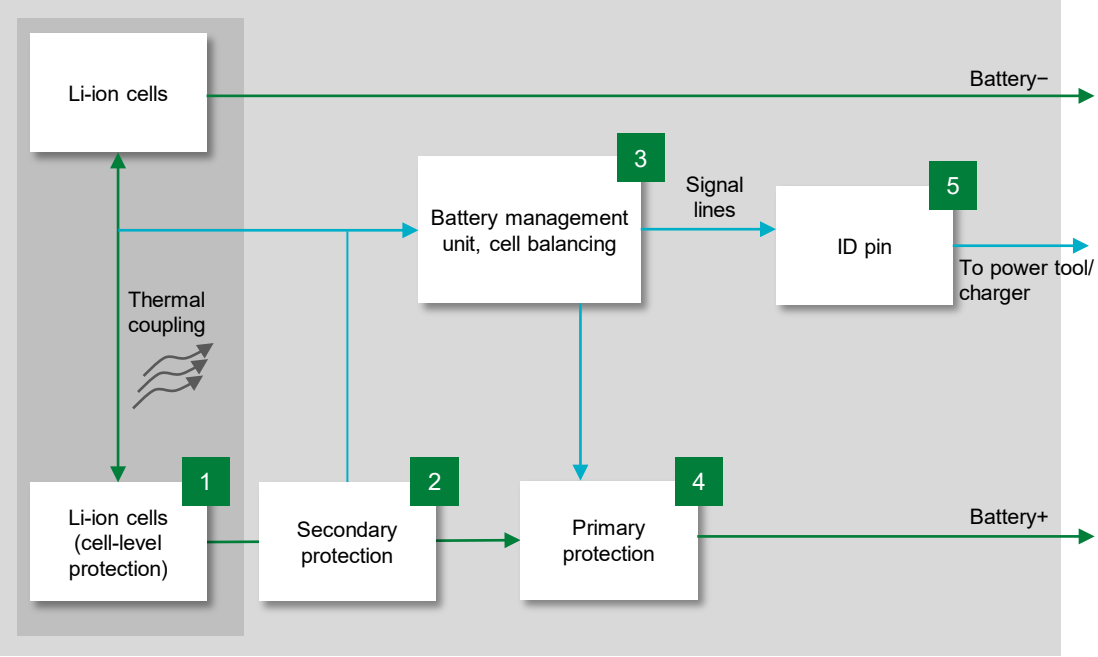
Click the product series in the table below for more info

Potential Littelfuse products for docking station

	Technology	Function in Application	Series	Benefits	Features
1	Fuse	Protects the power stage from overcurrent	5X20mm Fuse, TR, TE	Reduces customer qualification time by complying with third-party safety standards such as UL/IEC	Third-party compliance with UL/IEC; low internal resistance; shock-safe; vibration-resistant
	MOV	Protects power unit from voltage surges such as lighting and transients	LA, CIII, TMOV	Reduces customer qualification time by complying with third-party safety standards such as UL/IEC	High energy absorption capability: 40–530 J (2 ms)
2	MOSFET	Offers high switching speed in power supply units	X2-class	Offers fast response time and lower heat signature	Low $R_{ds(on)}$, dv / dt ruggedness
	TVS Diode	Protects the power unit from voltage transients	P6SMB	Improves system reliability by protecting downstream components from transients on power lines	Excellent clamping capability
3	Schottky Diode	Performs rectification and blocking in power supply units	MBR, DST	Enables the design of high efficiency power supplies	Ultra-low forward voltage drop; high-frequency operation
4	TVS Diode	Offers surge protection	SMBJ	Improves system reliability by protecting downstream components from transients on power lines	Excellent clamping capability

Click the product series in the table below for more info

Battery pack block diagram



	Technology	Product series
1	NTC	KC
2	Fuse ***OR*** Battery Protector	881, 688 ***OR*** ITV
3	PPTC ***OR*** Fuse	0805L ***OR*** 458
	TVS Diode Array	SP1003, SC1006
	Current Sensing Resistor	L4CL
4	TVS Diode Array	SMF, SMF4L
5	TVS Diode Array	SP3021, SP1007
	PPTC	zeptoSMDC

Legend:
Power
Data

- ***Secondary protection*** *– Protects cells if the primary safety circuit fails*
- ***Primary protection*** *– Handles all the basic safety functions: overvoltage, undervoltage, overcurrent, under-temperature, and overtemperature*

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Click the product series in the table below for more info

Products for battery packs

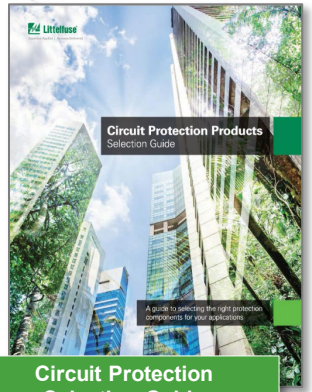
	Technology	Function in application	Product series	Benefits	Features
1	NTC	Monitors analog temperature of battery packs during charging and discharging cycles	KC	Provides accurate temperature readings for enabling safe device operation	Insulated lead wires, small form factor, fast thermal response
2	Fuse ***OR*** Battery Protector	Non-resettable overcurrent protection	881, 688 ***OR*** ITV	Reduces customer qualification time by complying with third-party safety standards such as UL/IEC	Third-party compliance UL/IEC, low internal resistance, shock safe, vibration resistant
		Offers non-resettable overcurrent and overcharge protection (on demand activated)		Offers overcurrent and overcharge protection and controlled disconnection; can be activated by BMS	Surface mountable; UL and TUV certified, three-pin device, controlled fusible element
3	Fuse ***OR*** PPTC	Offers non-resettable protection for BMS MOSFET from high currents due to external shorts	0805L ***OR*** 458	Saves space with smaller footprint	Surface mountable, UL and TUV certified, three-pin device, controlled fusible element
				Reduces customer qualification time by complying with third-party safety standards such as UL/IEC; allows for compact design with SMD form factor	Surface mountable, compatible with lead-free solder processes per IEC standards; PPTC is only for single-cell applications
	TVS Diode Array	Protects control devices from voltage transients	SP1003, SC1006	Protects ICs and other sensitive components	Excellent clamping capability
	Current Sensing Resistor	Part of current measurement circuitry	L4CL	Excellent performance in accuracy, noise performance, surface heat distribution and have a lower surface temperature	Tolerance down to 0.3%, Separate voltage sensing terminals
4	TVS Diode Array	Protects battery packs from over-voltage conditions due to abnormal charging conditions	SMF, SMF4L	Improves system reliability by protecting downstream components from transients on power lines	Low profile: maximum height of 1mm. Low leakage of 1.0 µA
5	PPTC	Offers overcurrent protection for TVS or Zener diode	SP3021, SP1007	Resets to normal operation after fault is cleared; saves space with smaller footprint	Maximum electrical rating: 13 VDC; short circuit current: 82~200 mA; small footprint 0201 size
	TVS Diode Array	Offers ESD protection of I2C input	zeptoSMDC	Offers a small, space-saving design; prevents signal disruption with low capacitance	µDFN-2 (0201) footprint; ±30 kV ESD withstand voltage

Select applicable safety and compliance standards

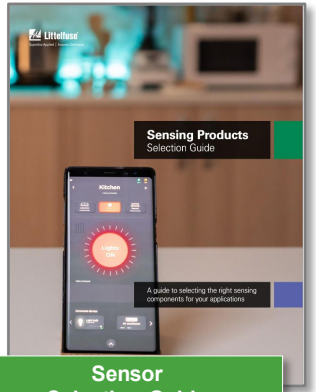
Standard	Sub-section requirement	Components supporting standard	How Littelfuse benefits OEMs
UL 1017, IEC 62784, GB4706.7	4.17: Any protective component must be evaluated to it's basic component standard	All safety critical components (Fuse, MOV, PPTC, NTC)	Approved by third party safety certification agencies: UL, IEC, and CSA
	4.15.3: Clearance requirement in accordance with UL 840	MOV	Use of MOV allows for reduction in spacing requirements
	5.8: Limit temperature to acceptable levels	NTC	Prevent appliances from reaching temperatures that constitute risk of fire or material damage
	Section D8.3: Limited circuits	PPTC	Maximum available current in secondary circuit inherently current limited
UL 2595, IEC 62133-2	7: Rechargeable battery-powered appliances	PPTC, NTC	Meet the general requirements of battery-operated appliances UL 2595
UL 1310, UL 1012 IEC/EN 61000	Section D2: Class 2 circuits	PPTC, Fuses	Docking station: charging station shall meet requirements of UL 1310
UL 1434; UL 248	4.9.3: Motor overload protection	SMD PPTC, SMD Fuse	PPTC approved to UL-1434 spec, UL60730-1 for motor overload protection; Fuses approved to UL- 248
	5.26: Abnormal overload test	Fuses approved to UL 248	Product will withstand overload conditions at 110%, 135%, 200%
UL 1017	Section D8.3: Limited circuits	PPTC	Maximum available current in secondary circuit inherently current limited

Additional information can be found on Littelfuse.com

Explore the world of Littelfuse with the electronics eCatalogs (ecatalogs.littelfuse.com)



Circuit Protection Selection Guide

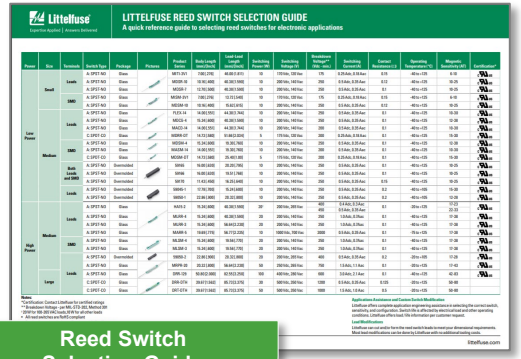


Sensor Selection Guide

ESD Suppression Selection Guide

ESD Protection Design Guide

Click images for more information



Reed Switch Selection Guide

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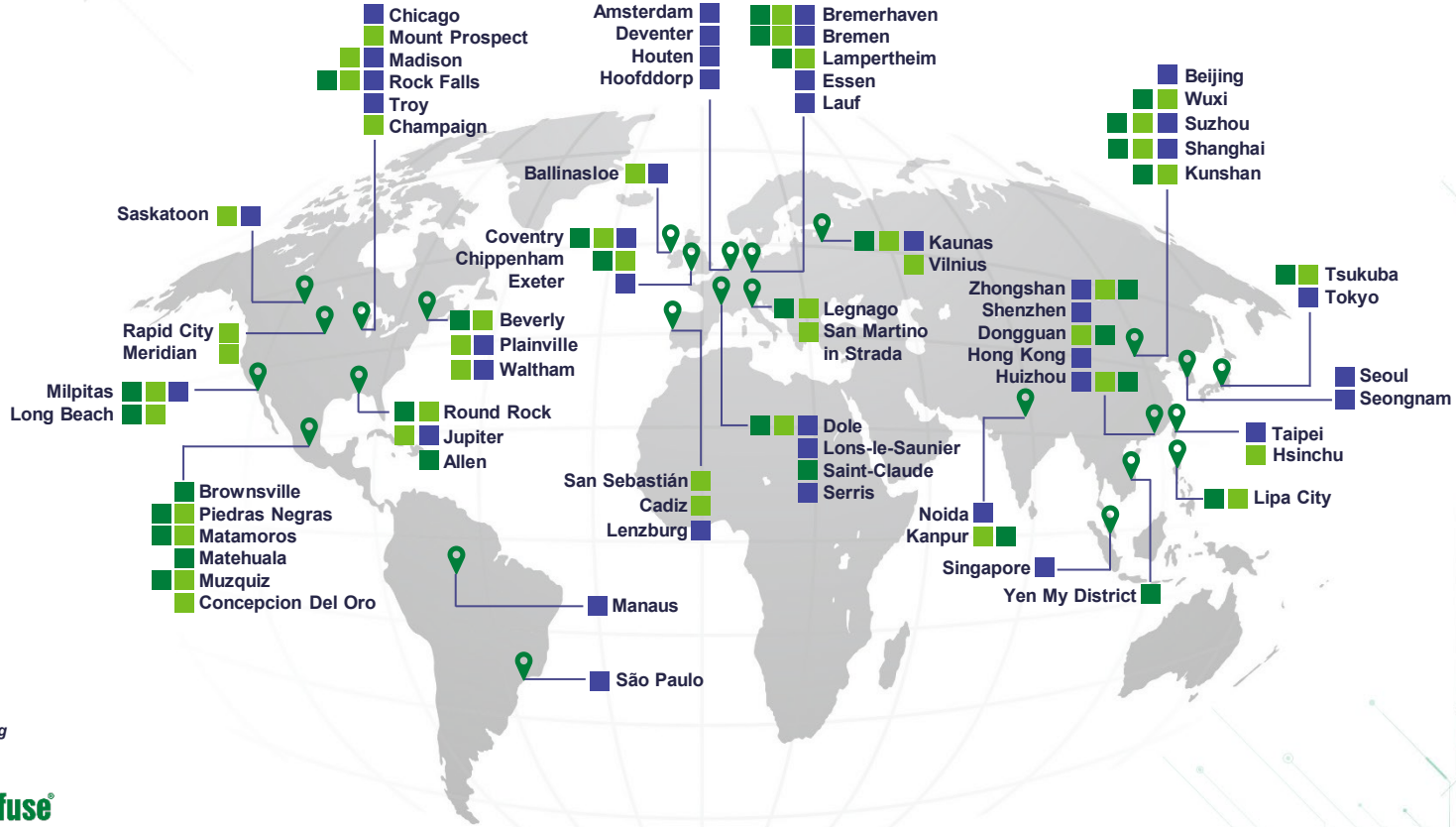
Local resources supporting our global customers



Legend

- *Sales*
- *R&D*
- *Manufacturing*

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Partner for tomorrow’s electronic systems

Broad product portfolio

We are an industrial technology manufacturing company empowering a sustainable, connected, and safer world

Application expertise

Our engineers partner directly with customers to help speed up product design and meet unique needs

Global customer service

Our global customer service team will work with you to anticipate your needs and ensure a seamless experience

Compliance and regulatory expertise

We help customers in the design process to account for requirements set by global regulatory authorities

Testing capabilities

We help customers get products to market faster and offer certification testing to global regulatory standards

Global manufacturing

We offer high-quality manufacturing that is committed to the highest quality standards

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