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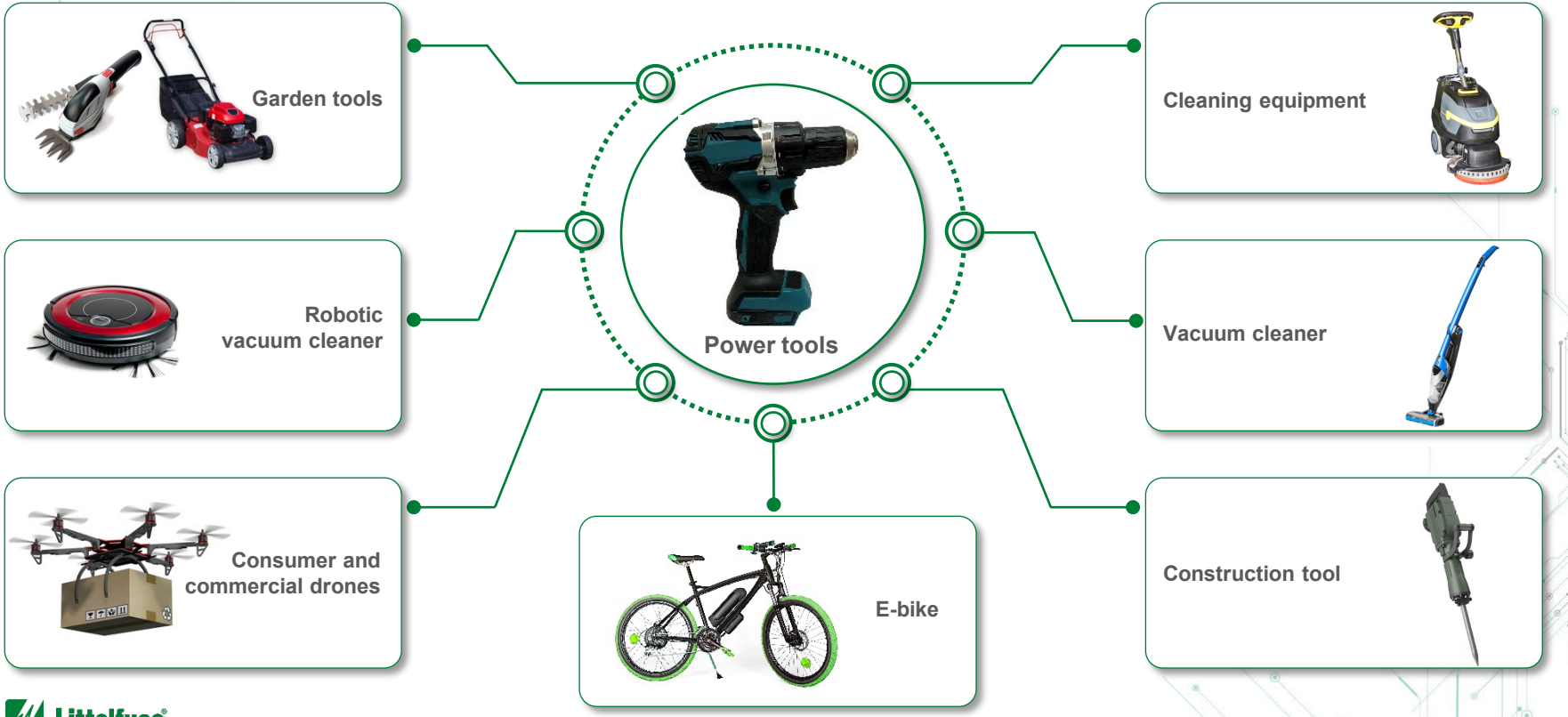
Cordless Power Tools


Appliances


General Industrial & Electrical Equipment

REV0125

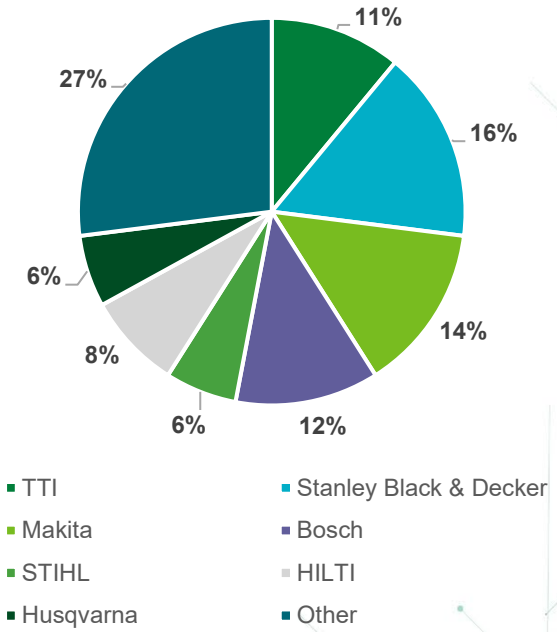
Many battery-powered devices in very different applications share similar safety and control elements



Global power tool market statistics and drivers

Market Trends and Drivers
The global cordless power tools market is projected to grow at a compound annual growth rate (CAGR) of 7.5% from 2024 to 2028.
Cordless power tools dominate the market, accounting for more than half of total power tool sales in 2024.
The cordless power tool architecture (that is, control, battery management, and safety) is very similar across all battery-run devices.
Portable tools are adopting more powerful cells or different form factors. This evolution highlights the importance of electronic design and safety in both chargers and battery packs.
Brushless DC motors are preferred for power tools due to better reliability/longevity, smaller size, and improved output performance.

The power tool market is growing at a ~7.5% CAGR



Source: Littelfuse Estimates, Statista, alliedmarketresearch

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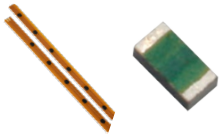
Battery

Battery packs used in power tools and appliances

1 Thermal cell protection
TTape™, NTC

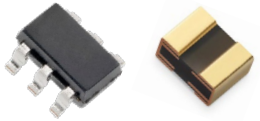


2 Secondary protection
Fuse, Battery Protector

3 Battery management unit
Fuse, PolySwitch® PPTC,
Current Sensing Resistors

4 Primary protection
TVS Diode

5 ID communication
TVS Diode Array, PPTC



6 Switch
Tactile, Detect

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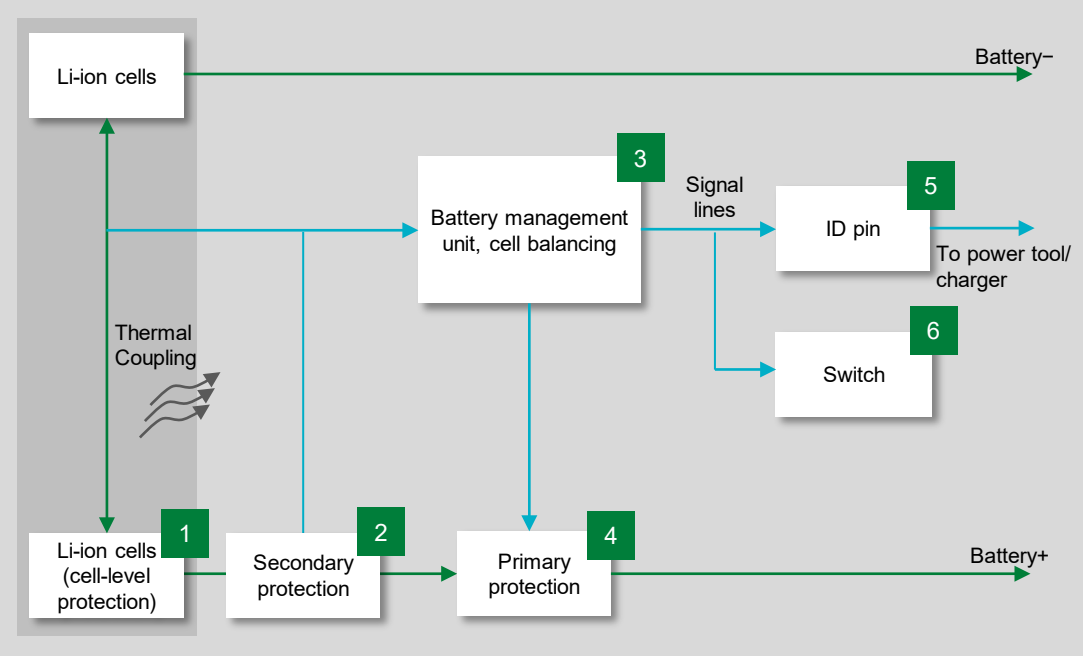
Click the product series in the table below for more info

Cordless tool battery pack block diagram



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

	Technology	Product series
1	TTape™ Platform	TTP
	NTC	KC
2	Fuse ***OR*** Battery Protector	BF1, 871 ***OR*** ITV
3	PolySwitch® PPTC ***OR*** Fuse	0805L ***OR*** 438
	Current Sensing Resistor	SSA
4	TVS Diode	SMF, SMF4L
5	PolySwitch® PPTC	zeptoSMDC
	TVS Diode Array	SP3021, SP1007
6	Tactile Switch	KSC441J, PTS645V, KSC2, KSC DCT

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Click the product series in the table below for more info

Typical products for tools & appliances battery packs

	Technology	Function in application	Product series	Benefits	Features
1	TTape™ Platform	Managing battery lifetime and helping 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; enable BMS wakeup and single GPIO port usage
	NTC	Analog temperature monitoring 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	BF1, 871 ***OR*** ITV	Space-saving solutions; SMD-type fuses improve reliability in environments with significant mechanical vibrations	supports higher power requirements with a single fuse design; current ratings up to 200 A
		Non-resettable overcurrent and overcharge protection (on-demand activation)		Overcurrent and overcharge protection; controlled disconnection; can be activated by BMS	Surface mountable; UL and TUV certified; 3-pin device; controlled fusible element
3	Fuse ***OR*** PolySwitch® PPTC	Non-resettable protection for BMS from high currents due to external shorts	438 ***OR*** 0805L	Saves board space; excellent temperature stability and performance reliability; high I^2t value ensures high inrush current withstand capability	Operating temperature from -55 °C to +150 °C
		Resettable protection for BMS from high currents due to external shorts		SMD form-factor allows for compact design; resets after short-circuit clearance	Surface mountable; compatible with lead-free solder processes per IEC standards
	Current Sensing Resistor	Part of current measurement circuitry	SSA	Cost-effective solution compared to competing technologies; compact size;	Tolerance down to 1%; high power ratings, up to 15 W
4	TVS Diode	Protects battery packs from overvoltage conditions due to abnormal charging conditions	SMF, SMF4L	Improves system reliability by protecting downstream components from transients on power lines	Excellent clamping capability
5	PolySwitch® PPTC	Overcurrent protection for TVS or Zener Diode	zeptoSMDC	Resets to normal operation after short-circuit is cleared; smaller footprint saves space	Maximum electrical rating: 13 VDC; short circuit current: 82~200 mA; small footprint 0201 size
	TVS Diode Array	ESD protection of I^2C input	SP3021, SP1007	Small, space-saving design; low capacitance to prevent signal disruption	µDFN-2 (0201) footprint; ±30 kV ESD withstand voltage
6	Tactile switch	Indication of battery status	KSC441J, PTS645V, KSC2, KSC DCT	Saves space; reliable and repeatable haptic performance elevates end users' experience	Microminiature, short travel, PCB mount tactile with a minimum of 100K operations

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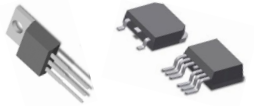
Cordless tool

Key elements of cordless power tool

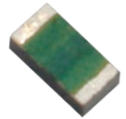
1 DC input protection
Fuse, TVS Diode, Reed Switch

2 Power bridge protection
NTC, setP™

3 Power Bridge and Gate Driver
MOSFET



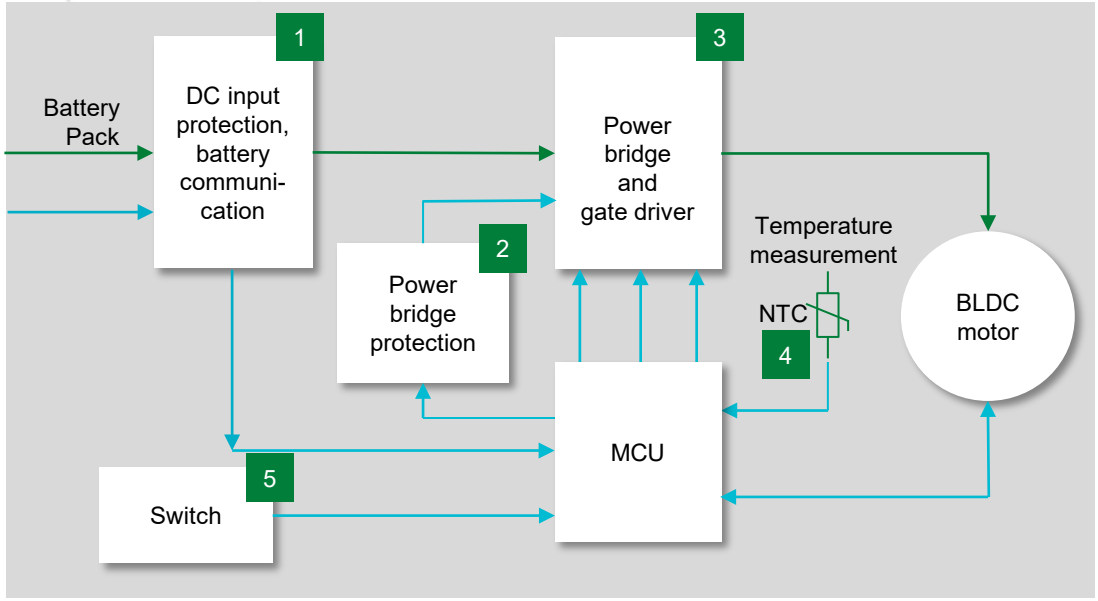
4 Temperature protection
NTC



5 Switch
Tactile, Snap-Acting, Slide

Click the product series in the table below for more info

BLDC motor protection architecture



	Technology	Product series
1	Fuse	501
	TVS Diode	SMAJ, SMBJ, 5KP
	Reed Switch	MDSR-10, 59166
2	NTC	KC
	Digital Temperature Indicator	setP™
3	MOSFET	Gen2 / Gen4
4	NTC	RB
5	Snap Acting	LCS, TF, TM, ZMS, ZMA
	Tactile Switch	KSC OF, KSC2, KSC3, KSC4, KSC7
	Slide Switch	OS, JS, L, AYZ

Click the product series in the table below for more info

Select Littelfuse products for BLDC motor protection

	Technology	Function in application	Product series	Benefits	Features
1	Fuse	Protects the battery and downstream controller from damage due to inrush current, motor shorting, or external shorts at contacts	501	Provides quick protection for circuits with minimal space requirements and reduces risk of damage from short circuits	Third-party compliance with UL/IEC; low internal resistance; shock safe; vibration-resistant
	TVS Diode	Protects battery pack from voltage transients	SMAJ, SMBJ, 5KP	Improves system reliability by protecting downstream components from transients on power lines	Excellent clamping capability
	Reed Switch	Provides control signal to turn the motor on or off	MDSR-10, 59166	Contamination resistant, compact design	Switch up to 200 VDC or 0.5 A at up to 10 W; 10^{12} Ohms insulation resistance
2	NTC	Provides temperature sensing of power MOSFET	KC	Provides accurate temperature (part/ambient) for enabling safe device operation	High reliability; small form factor; fast thermal response
	Digital Temperature Indicator	Indicates FET overheating	setP™	Provides reliable overheating indication regardless of power being delivered	Compact footprint 0805; multipoint measurement (device configuration in series)
3	MOSFET	Part of the inverter of brushless DC motor for high-frequency switching	Gen2 / Gen4 (from 36 V)	Improves system efficiency and enables compact design	Low $R_{ds(on)}$; high current capability
4	NTC	Provides temperature sensing to prevent motor damage due to overheating	RB	Provides accurate temperature (part/ambient) for enabling safe device operation	High reliability; small form factor; fast thermal response
5	Snap Acting ***OR*** Tactile Switch	Provides device actuation (on/off control)	LCS, TF, TM, ZMS, ZMA	Reliable snap-acting mechanism ensures consistent performance; wide variety of rocker and terminal styles available	Reliable snap-acting mechanism; compact size; IP67 rating (ZMS)
			KSC OF, KSC2, KSC3, KSC4, KSC7	Long electrical and mechanical life; reliable snap-acting mechanism ensures consistent performance, making these switches suitable for critical applications	IP67 rated; protection against dust and water; wide variety of actuator and terminal styles
	Slide Switch	Provides mode control	OS, JS, L, AYZ	Reliable performance in high-vibration and high-load scenarios	Miniature and compact designs for space-saving applications; surface-mount options for modern PCB integration

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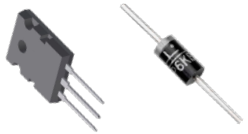
Charger

Functional elements in power tool charger

1 AC input primary protection
Fuse, MOV, NTC

2 Rectification, high-frequency converter
MOSFET, TVS Diode



3 Secondary-side rectification
Schottky Diode

4 DC output protection
TVS Diode

5 Wireless communication
TVS Diode Array

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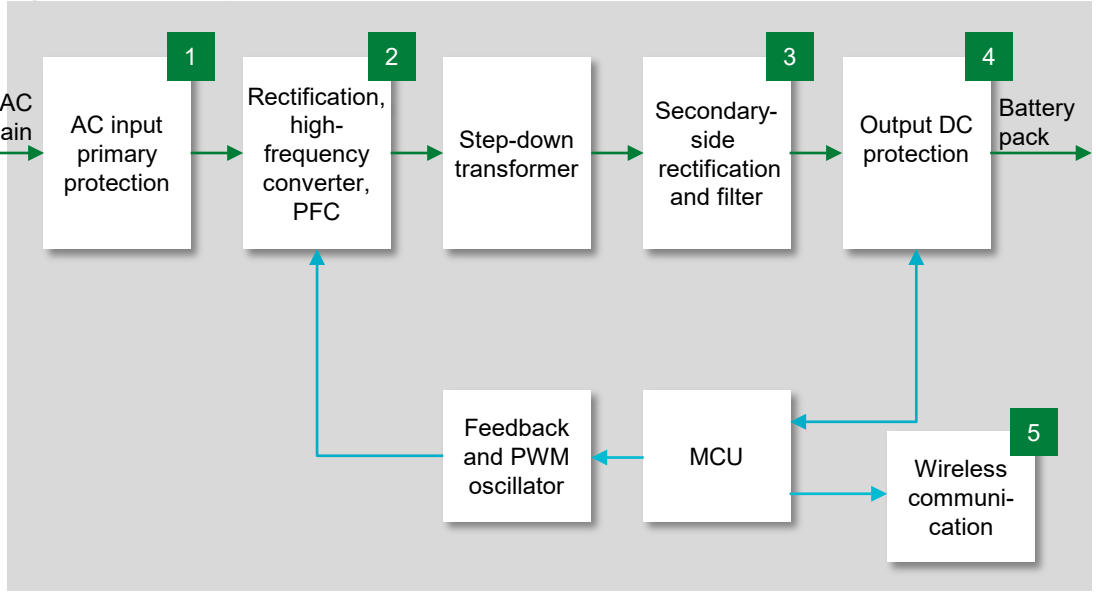
Click the product series in the table below for more info

Power tool charger protection architecture



Legend:
Power
Data

	Technology	Product series
1	Fuse	5X20mm Fuse, TR, TE
	MOV	Xtreme, TMOV
2	MOSFET	X2-class
	TVS Diode	P6KE, P6SMB
3	Schottky Diode	MBR, DST
4	TVS Diode	SMBJ
5	TVS Diode Array	SP3021, SP1007

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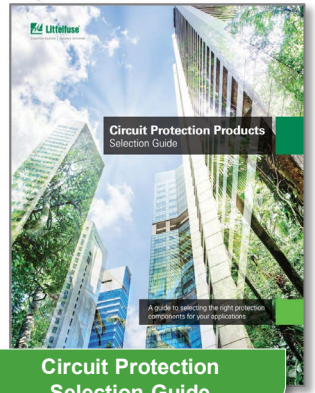
Click the product series in the table below for more info

Potential Littelfuse products for power tool charger

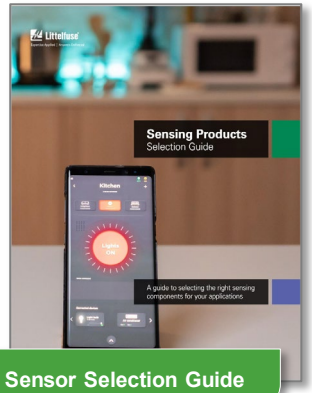
	Technology	Function in application	Product series	Benefits	Features
1	Fuse	Protects the power stage from overcurrent	5X20mm Fuse, TR, TE	Offers durability; saves space; ensures safety from high short-circuit currents	Third-party compliance with UL/IEC; low internal resistance; shock-safe; vibration-resistant
	MOV	Protects the power unit from voltage surges such as lighting and transients	Xtreme, TMOV	Provides quick protection against voltage spikes; handles high energy surges; easy to install in various designs	Thermally protected (TMOV); best-in-class high-energy absorption with compact size
2	MOSFET	High switching speed in power supply units	X2-class	Fast response time and lower heat signature	Low $R_{ds(on)}$, dv/dt ruggedness
	TVS Diode	Protects the power unit from voltage transients	P6KE, P6SMB	Improves system reliability by protecting downstream components from transients on power lines	Excellent clamping capability
3	Schottky Diode	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	Surge protection	SMBJ	Improves system reliability by protecting downstream components from transients on power lines	Excellent clamping capability
5	TVS Diode Array	ESD protection of wireless communication	SP3021, SP1007	Small, space-saving design; low capacitance to prevent signal disruption	µDFN-2 (0201) footprint; ±30 kV ESD withstand voltage

Additional information can be found at Littelfuse.com

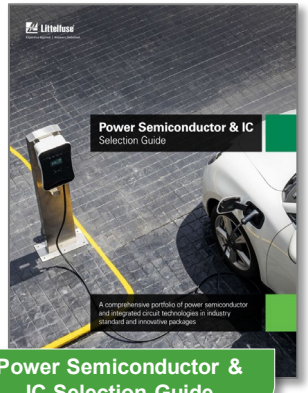
Explore the world of Littelfuse products and applications with eCatalogs (ecatalogs.littelfuse.com)



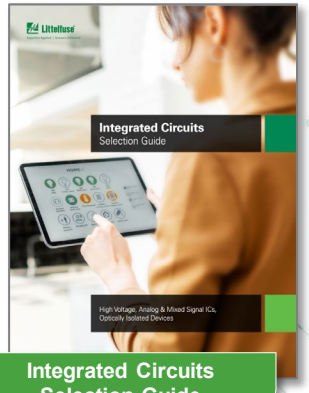
Circuit Protection Selection Guide



Sensor Selection Guide



Power Semiconductor & IC Selection Guide



Integrated Circuits Selection Guide

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Small Appliances Spotlight

Scan the code to learn more!

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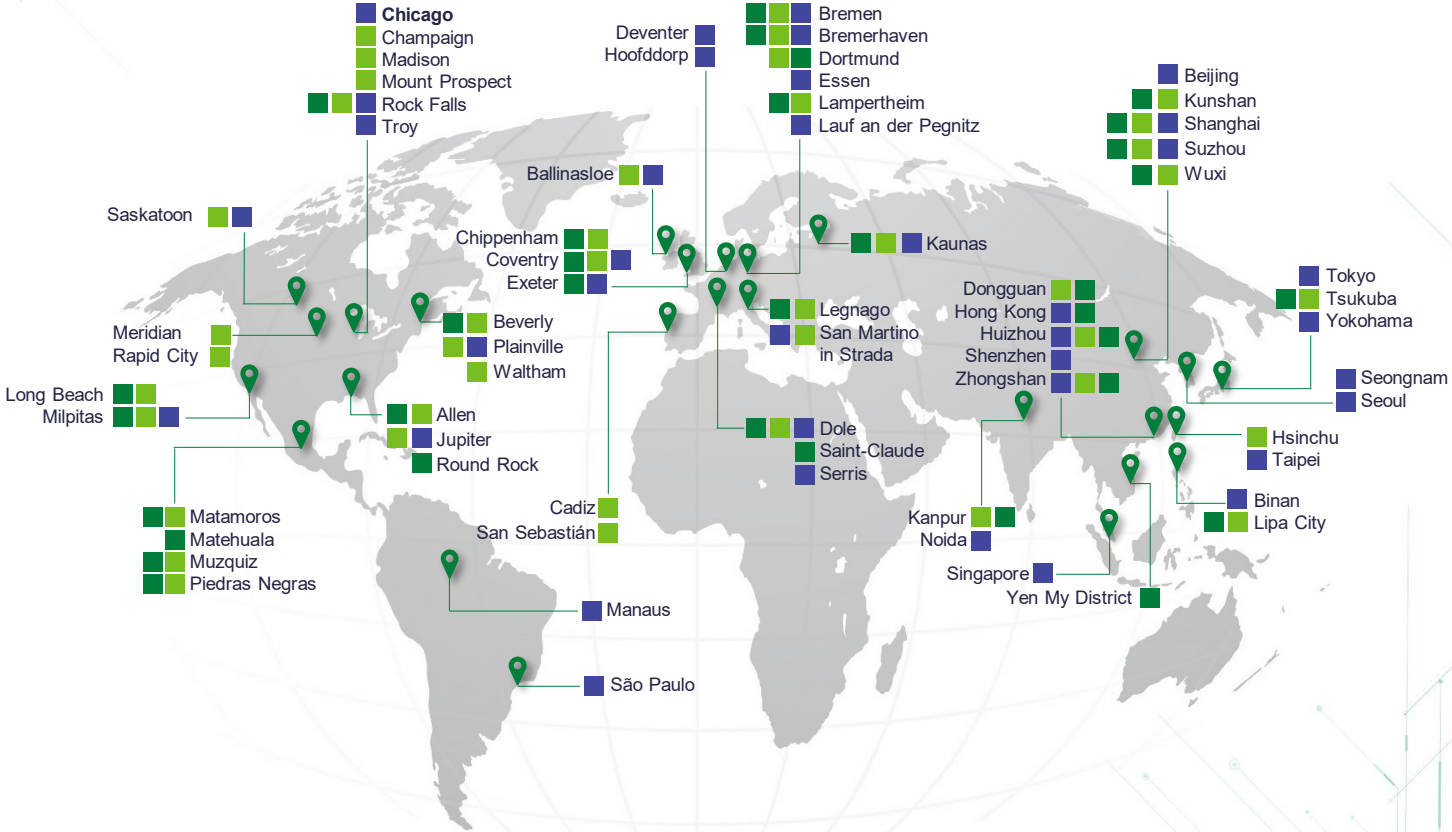
Local resources supporting our global customers



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