



Expertise Applied | Answers Delivered



Application Handbook

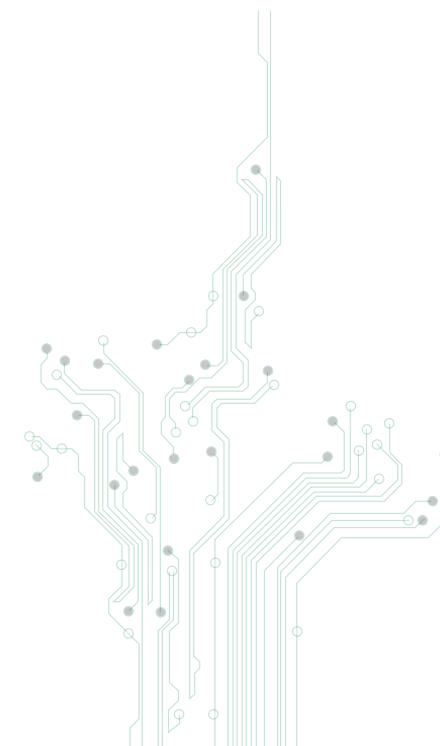
Design with Confidence

Supported by our deep application expertise and extensive portfolio

About This Application Handout

This application handout is designed to provide a concise overview of Littelfuse innovative technologies and solutions for applications such as eMobility, building solutions, health care, transportation, and renewable energy.

Topic	Page
Appliances	1–2
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Battery Powered Tools	5–6
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Data Center and Communication Infrastructure	11–12
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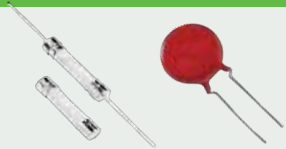


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Major Appliances

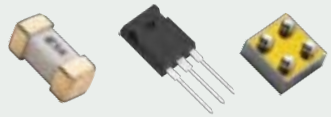
Input Protection

Fuse, MOV



Power Supply

Fuse, TVS Diode,
Load Switch



Control Board

PPTC, Current Sensing Resistor,
TRIAC



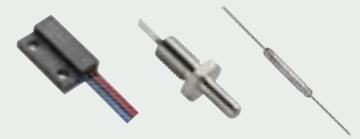
User Interface

TVS Diode Array,
Polymer ESD, Switch



Mechanical Subsystems

TMR Sensor, NTC,
Custom Reed Sensor, Reed Switch



Small Appliances



Scan to learn more!

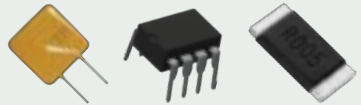
Power Supply Unit

Fuse, MOV, TVS Diode,
Schottky Diode, TRIAC



Motor Drive

PPTC, Gate Driver,
Current Sensing Resistor



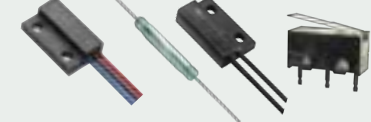
User Interface & Display

Load Switch, TVS Diode,
TVS Diode Array



Mechanical Sub-systems

TMR Sensor, Reed Switch,
Reed Sensor, Switch



Connectivity, ADAS, Safety, and Comfort System



Scan to learn more!

Infotainment

Fuse, PPTC, TVS Diode, Diode Array, MLV, Schottky Diode



Multi-purpose Camera

Fuse, PPTC, Diode Array, Polymer ESD, MLV, TVS Diode



V2X Communication

Fuse, PPTC, TVS Diode, Diode Array, Polymer ESD, Schottky Diode



Sensor Fusion

Fuse, Polymer ESD, TVS Diode, Diode Array, Schottky Diode



Switch Solutions

Tactile Switch, Keyswitch, Navigation Switch, Snap Switch



eCall System

Fuse, PPTC, Diode Array, Polymer ESD, MLV, TVS Diode



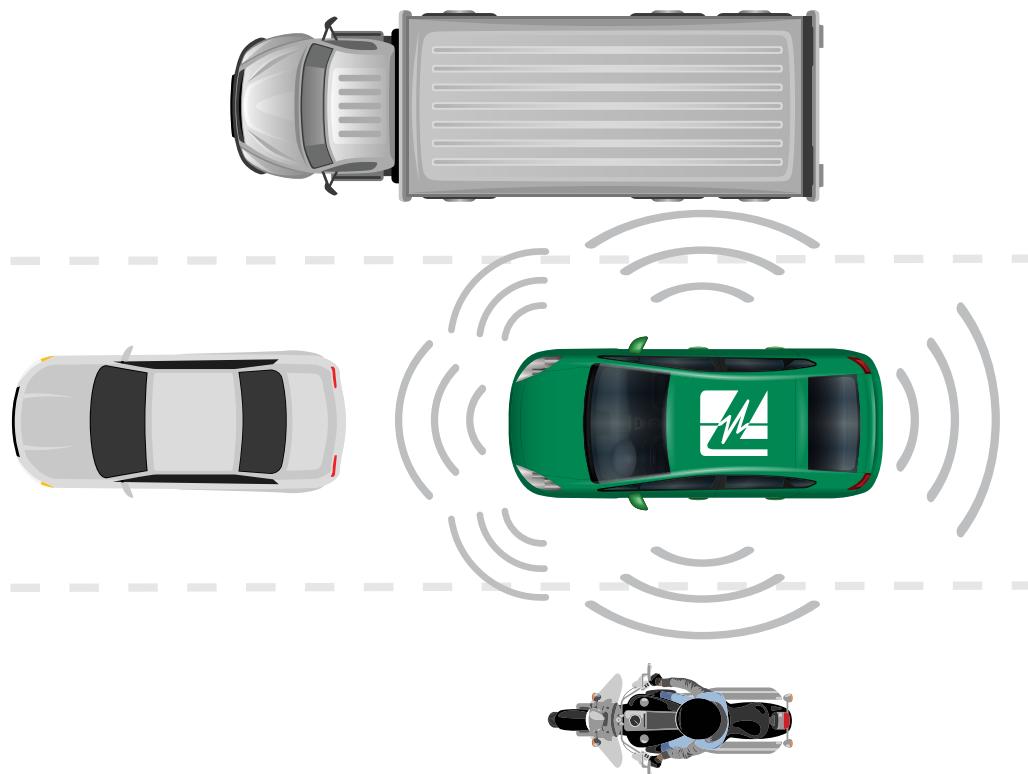
Radar System

Fuse, PPTC, TVS Diode, Schottky Diode, Diode Array, Polymer ESD



Domain & Zonal Controller

Fuse, PPTC, Diode Array, Polymer ESD, Schottky Diode, TVS Diode, MLV



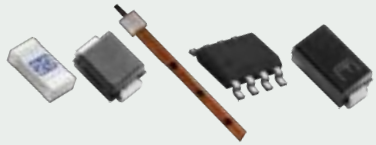
Powertrain for Electric Vehicles



Scan to learn more!

Battery Management System

Fuse, TVS Diode, TTape™,
Gate Driver, TVS Diode Array



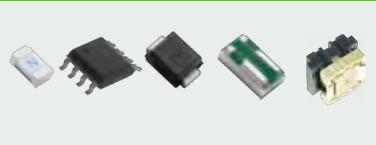
On-Board Charger

Switch, Fuse, MOV,
SIDACtor®, TVS Diode Array



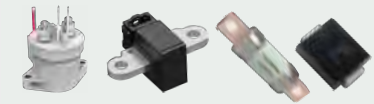
Traction Motor Inverter

Fuse, Gate Driver, TVS Diode,
Shunt Resistor, Thermal Protection



Battery Disconnect Unit

DC Contactor, Current Sensor,
High Voltage Fuses, TVS Diode



DC-DC Converter

Fuse, TVS Diode,
Diode Array, Gate Driver



Power Tools



Scan to learn more!

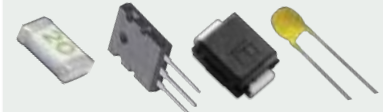
Power Charger

Fuse, MOV, TVS Diode,
MOSFET, Schottky Diode



Motor Control

Fuse, MOSFET,
TVS Diode, NTC



Battery Management

Fuse, PPTC, Battery Protector,
TVS Diode, eFuse



Switches

Tactile Switch



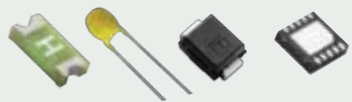
Robotic Appliances



Scan to learn more!

Docking Station

Fuse, NTC,
TVS Diode, eFuse



Battery Pack

TVS Diode, TVS Diode Array,
Battery Protector, PPTC



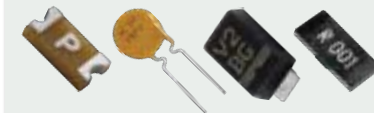
Power Management

TVS Diode, TVS Diode Array



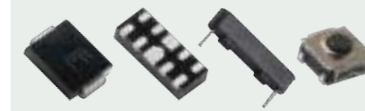
Motor Drive

Fuse, PPTC, TVS Diode,
Current Sensing Resistor



Display and Sensor

TVS Diode, TVS Diode Array,
Reed Switch, Switch



User Interface

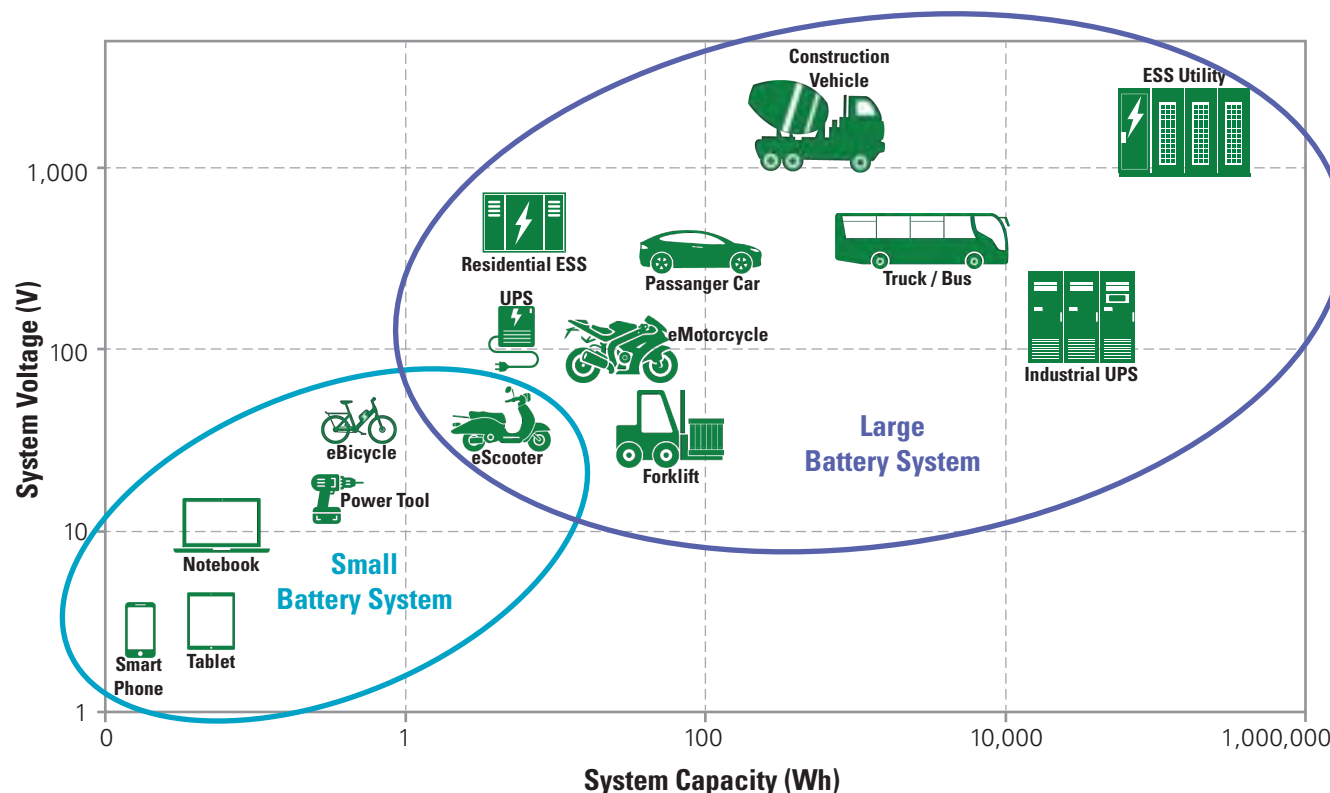
TVS Diode Array





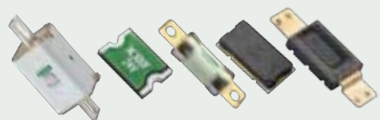
Scan to learn more!

Large Battery Systems



Overcurrent Protection

Fuse, PPTC, Battery Protector, Battery Mini-Breaker



Overvoltage Protection

MOV, SPD, SIDACTor®, TVS Diode



Sense Line Protection

Fuse, TVS Diode



Isolation Monitoring

Solid State Relay, Reed Relay



Battery Disconnect

DC Disconnect Switch, HVDC Contactor Relay



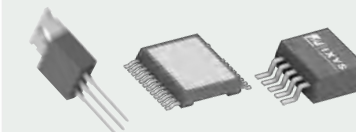
Ground Fault & Arch-Flash Protection

Ground Fault Relay, Arch-Flash Relay



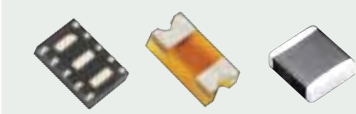
Power Control

MOSFET/IGBT, Power Module, Gate Driver



ESD Protection

TVS Diode Array, Polymer ESD, Multilayer Varistor



Sensing Solution

Magnetic Sensor, Temp Sensor, TTap



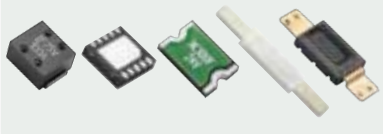
Small Battery System



Scan to learn more!

Cell Level Protection

Fuse, eFuse, PPTC, Battery Strap,
Battery Mini-breaker



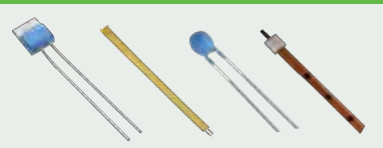
Battery Pack Protection

Fuse, Battery Protector,
TVS Diode



Temperature Sensing

NTC, RTD, TTape



Signal Line Protection

PPTC, TVS Diode Array



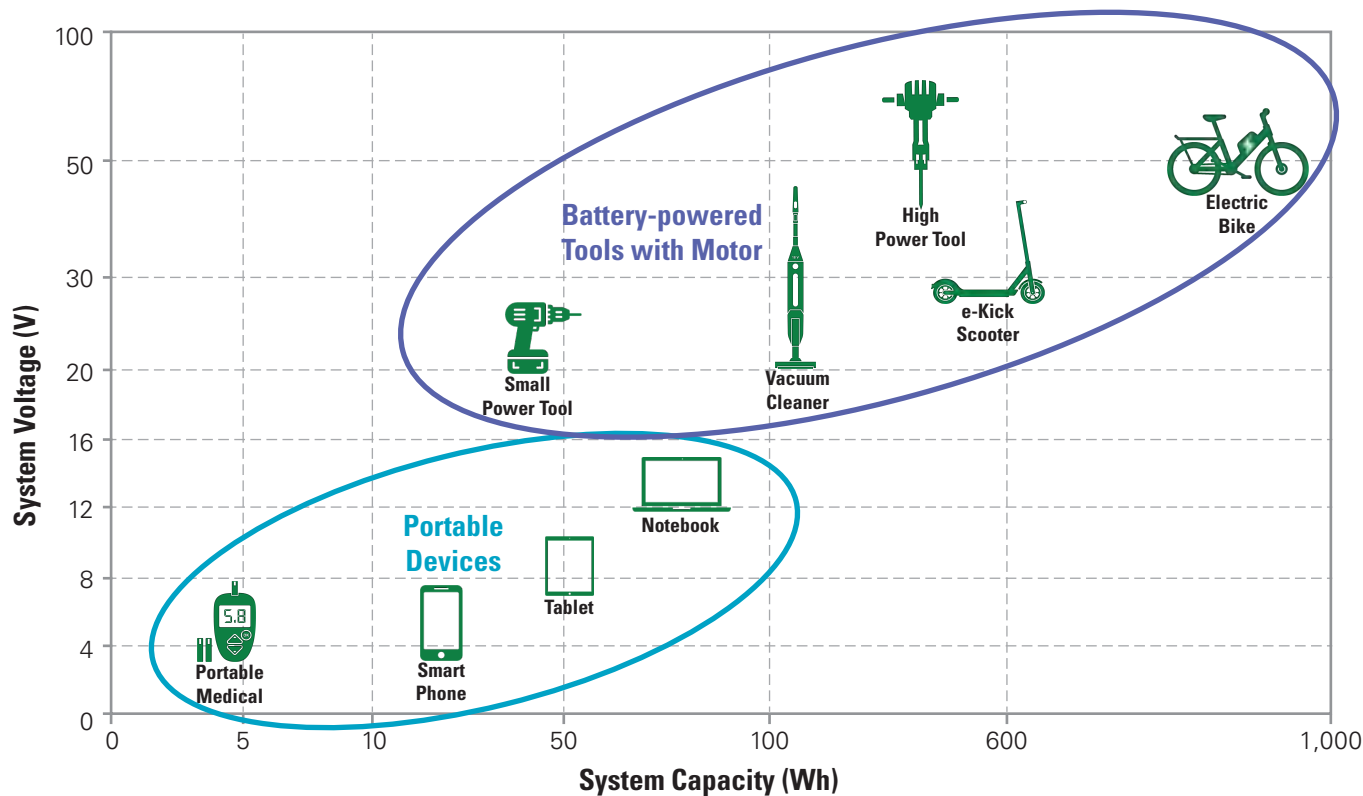
USB Port Protection

eFuse, Temperature Indicator,
PPTC, TVS Diode Array



Battery Status Indicator

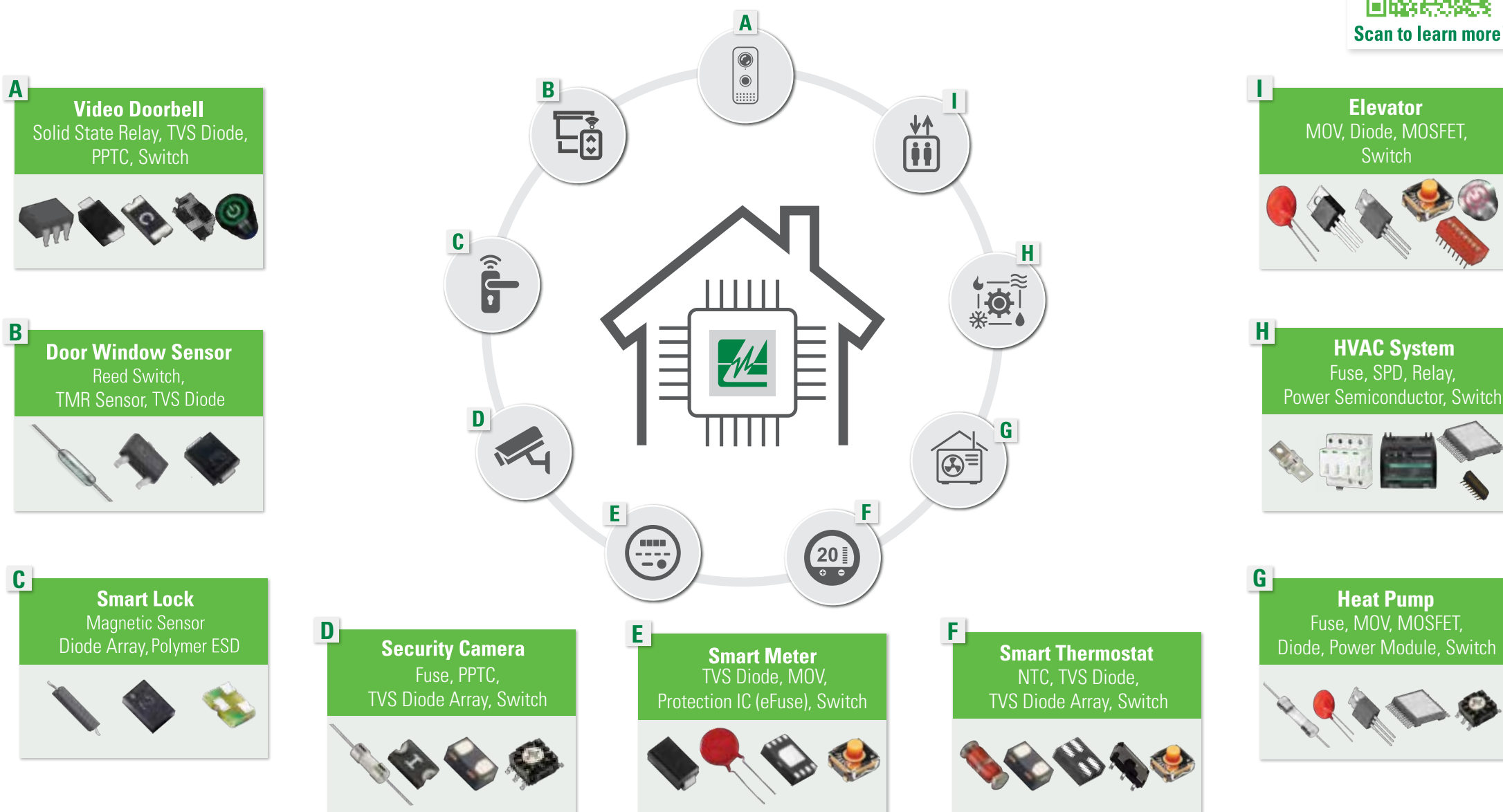
Tactile Switch





Scan to learn more!

Smart Home and Building Solutions



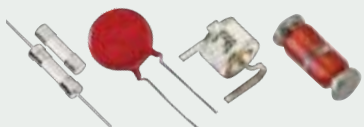
Residential Solar Solutions



Scan to learn more!

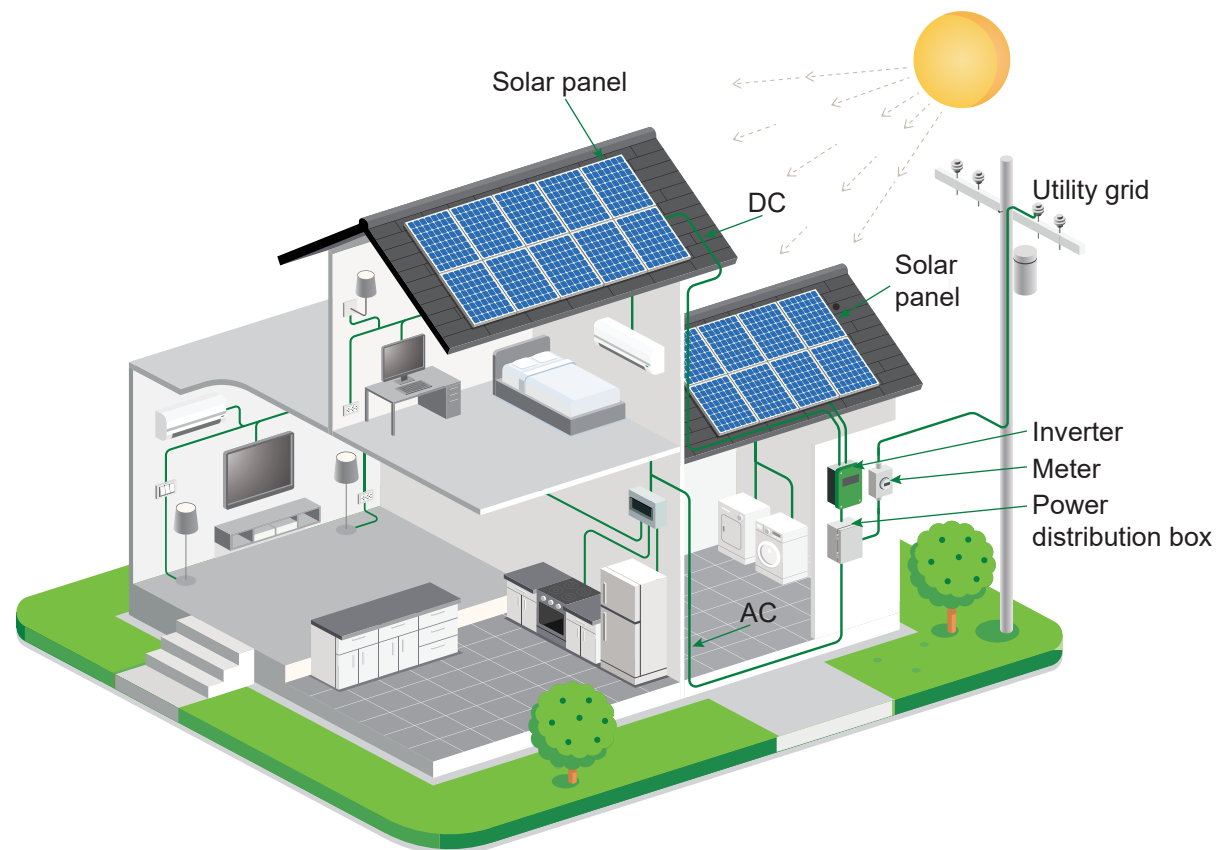
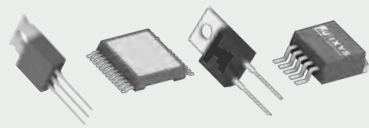
Input Protection

Fuse, MOV, GDT, NTC



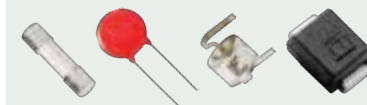
Power Conversion

MOSFET, IGBT, Power Module, Schottky Diode, Gate Driver



Output Protection

Fuse, MOV, GDT, TVS Diode



Communication and User Interface

TVS Diode Array, MLV, Switch



Enabling Data Center



Scan to learn more!

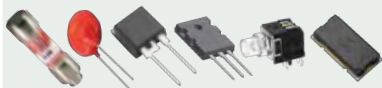
Power Distribution & Controls

Fuse, SPD, Protection Relay,
Contactor, Switch



UPS Power Shelf & Battery

Fuse, MOV, SIDACtor,
MOSFET, Switch, Battery Protector



Server Power Supply

Fuse, MOV, SiC MOSFET, Diode,
Thyristors, Thermistor



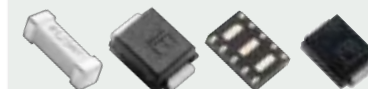
Computing/ Networking Equipment

Fuse, MOV, TVS Diode,
Reed Sensor, Switch



Ethernet Port Protection

Fuse, SIDACtor,
TVS Diode Array, TVS Diode



USB Port Protection

Temperature Indicator, PPTC
Diode Array, eFuse



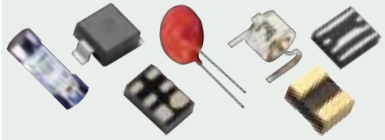
4G/5G Radio Access Network Equipment



Scan to learn more!

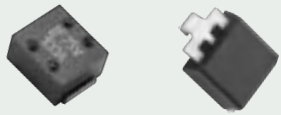
Advanced Antenna

Fuse, TVS Diode, MOV, GDT, SIDACTor®, TVS Diode Array, PPTC



Tower Mount Amplifier

Fuse,
TVS Diode



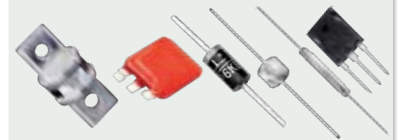
Baseband Unit

Fuse, MOV, SIDACTor®,
GDT, TVS Diode Array



Primary Protection

Fuse, MOV, TVS Diode, GDT,
Magnetic Sensor, Schottky Diode



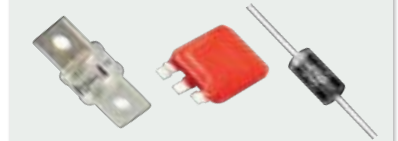
Battery Backup

TVS Diode, Fuse, TVS Diode Array
Polymer ESD, Battery Protector



Surge Protection Device

Fuse, MOV,
TVS Diode



AC Charging Station



Scan to learn more!

Power Board

Fuse, MOV, Circuit Breaker
Mechanical Relay



Charging Controller

Residual Current Monitoring,
EV Charging Controller Eval Board



Charging Gun

Reed Sensor,
Temperature Sensor, Snap Switch



Control Board

Reed Relay, TVS Diode,
Solid State Relay, Rotary Switch



Auxiliary Power Supply

Fuse, PPTC, MOV,
SIDACtor®, Schottky Diode



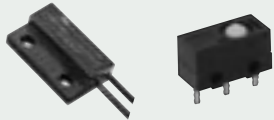
DC Charging Station



Scan to learn more!

Service Access Panel

Reed Sensor,
Snap Switch



User & Communication

TVS Diode Array,
Polymer ESD, Tactile Switch



Input Protection

Surge Protection Device



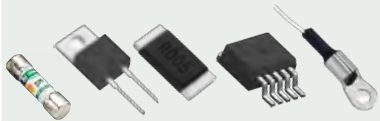
DC Output Protection

DC Fuse, HVDC Contactor
Earth Fault Relay, SPD



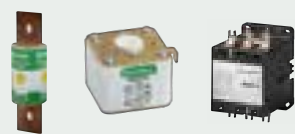
Power Conversion

Fuse, SiC/Si MOSFET, Current Sensor
Gate Driver, Temperature Sensor



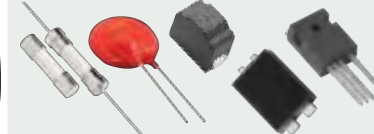
Power Distribution Unit

AC Fuse,
AC Contactor



Auxiliary Power Supply

Fuse, MOV,
Schottky Diode, Si MOSFET



Charging Plug

Temperature Sensor,
Reed Sensor, Snap Switch



Common Electrical Hazards For Power Input And High-speed Communication Ports



Scan to learn more!

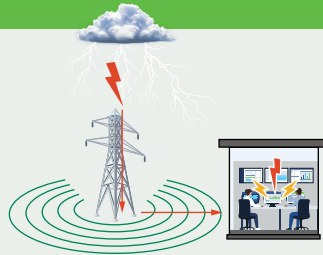
Lightning Surge

Induced lightning surges can be coupled to industrial data lines, causing damage to sensitive ICs.



Induced Power Surge

Lightning and power grid switching can induce power surges, causing damage.



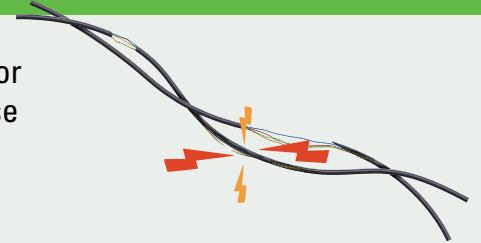
Electrostatic Discharge

ESD passing through connectors can cause damage to ICs.



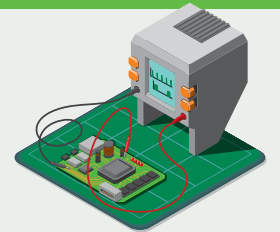
Power Cross

Miswiring during assembly or insulation damage can cause cables to be exposed to AC line voltage.



Electrical Fast Transient

An Electrical Fast Transient (EFT) can be a result of switching of inductive loads or relay contacts 'bouncing'.



Wire Aging And Installation Faults

RS-485 and Ethernet often share the same conduits with DC or AC gradually resulting in cracks in the insulation due to sharp bends and tight wiring ties.



General Port Protection



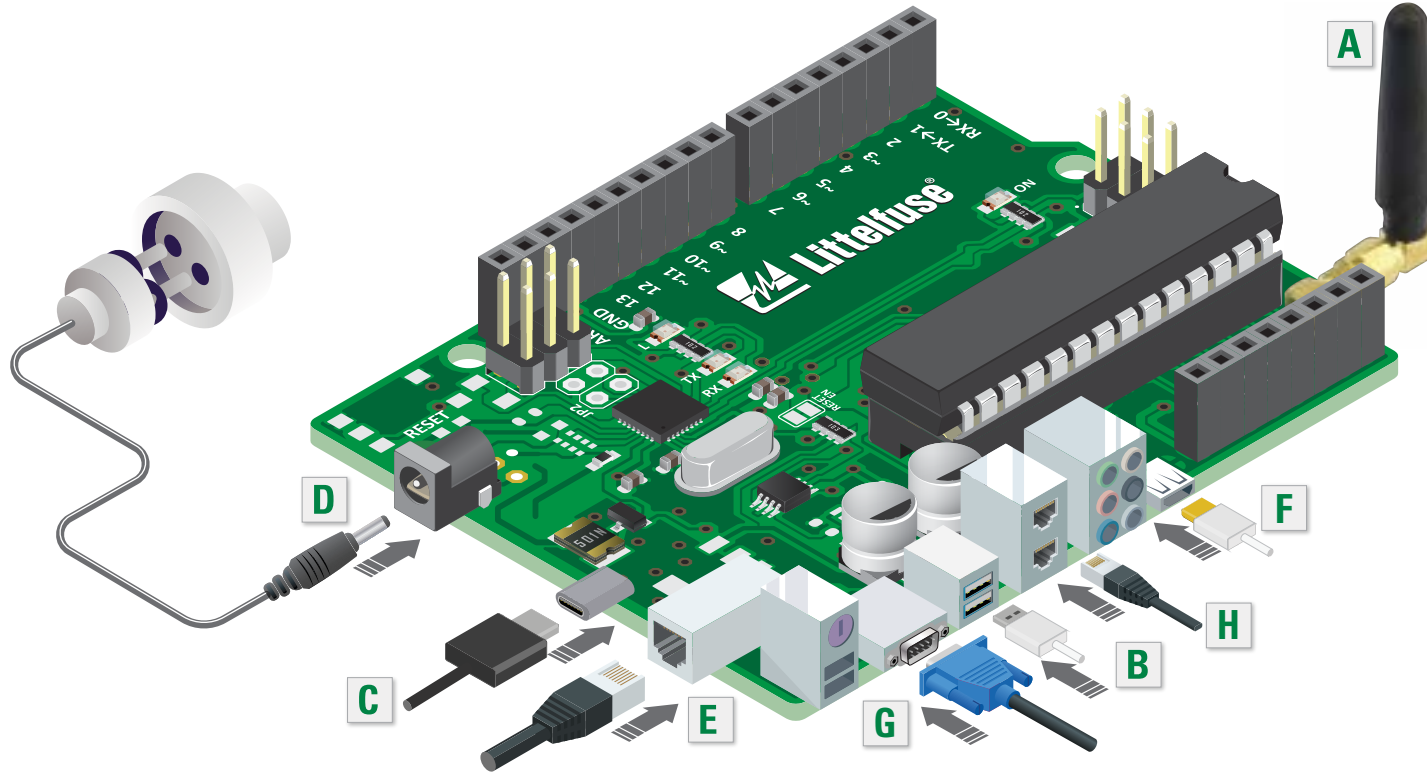
Scan to learn more!

A Antenna & Audio Line Protection
Polymer ESD, TVS Diode Array

B USB Type A & B
TVS Diode Array, PPTC, Common Mode Filter, Polymer ESD

C USB Type C
TVS Diode Array, setP™, eFuse, Common Mode Filter

D DC Input Protection
TVS Diode, MOV, GDT



E SATA 3.0
TVS Diode Array, Polymer ESD

F HDMI/Display
TVS Diode Array, Common Mode Filter, Polymer ESD

G RS-485
TVS Diode Array, PPTC, Polymer ESD

H Ethernet
TVS Diode, Fuse, GDT, Polymer ESD

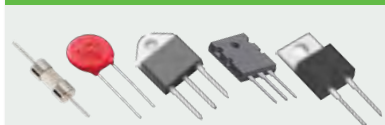


Scan to learn more!

Industrial Controller (PLC) and Communication Infrastructure

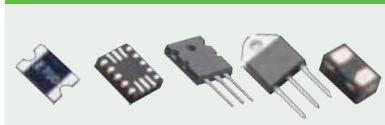
Programmable Logic Controller

Fuse, MOV, SIDACTor®,
MOSFET, Diode



Industrial IoT Gateway

PPTC, eFuse, SIDACTor®,
TVS Diode, TVS Diode Array



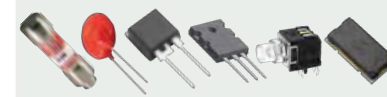
Power Distribution & Controls

Fuse, SPD, Protection Relay,
Contactor, Switch



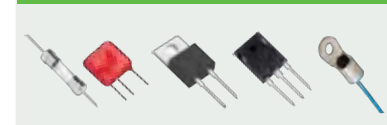
UPS Power Shelf & Battery

Fuse, MOV, SIDACTor®,
MOSFET, Switch, Battery Protector



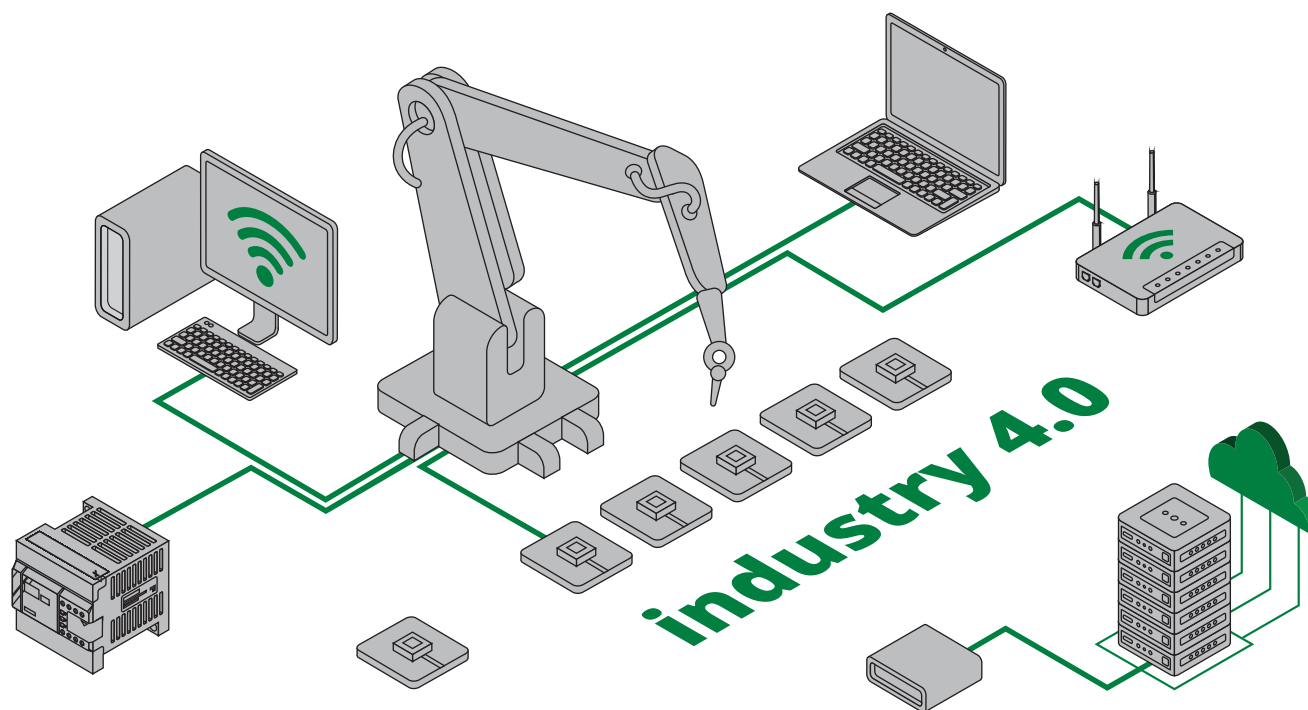
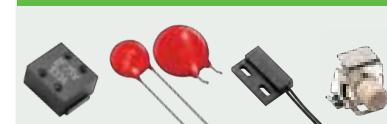
Server Power Supply

Fuse, MOV, SiC MOSFET, Diode,
Thyristors, Thermistor



Computing/ Networking Equipment

Fuse, MOV, TVS Diode,
Reed Sensor, Switch



Industrial IoT Gateway



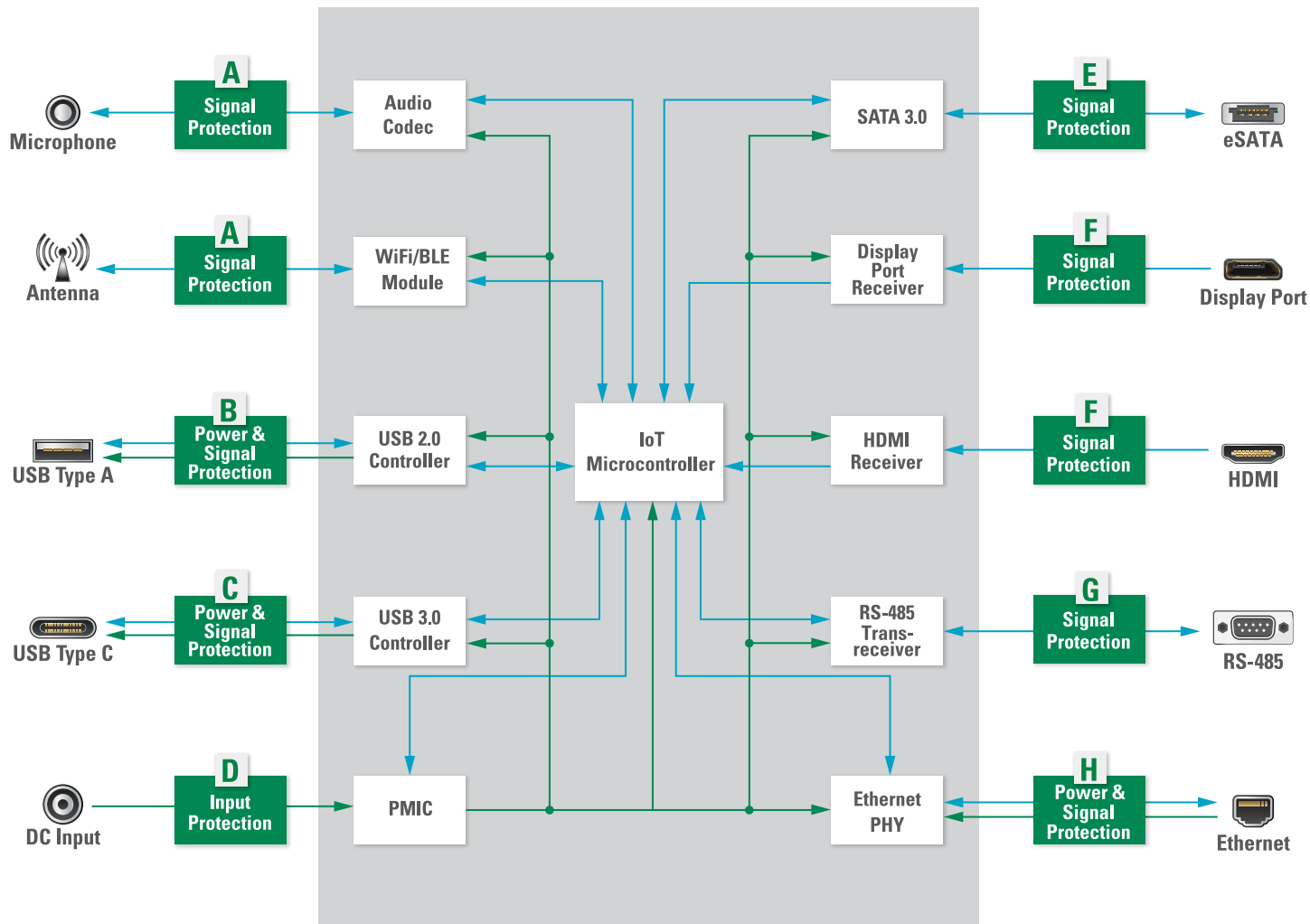
Scan to learn more!

A Antenna & Audio Line Protection
Polymer ESD, TVS Diode Array

B USB Type A & B
TVS Diode Array, PPTC, Common Mode Filter, Polymer ESD

C USB Type C
TVS Diode Array, setP™, eFuse, Common Mode Filter

D DC Input Protection
TVS Diode, MOV, GDT



Legend:



E SATA 3.0
TVS Diode Array, Polymer ESD

F HDMI/Display Port
TVS Diode Array, Common Mode Filter, Polymer ESD

G RS-485
TVS Diode Array, PPTC, Polymer ESD

H Ethernet
TVS Diode, Fuse, GDT, Polymer ESD

Emergency Medical Equipment



Scan to learn more!

Power Supply

Fuse, MOV,
TVS Diode, Switch



Battery Management

PPTC, TVS Diode Array,
Switch



Power Semiconductor

MOSFET,
TVS Diode, Gate Driver



Communication

TVS Diode Array,
Polymer ESD



Switching & Sensing

Reed Sensor,
Switch



USB Protection

eFuse, Temperature Indicator,
PPTC, TVS Diode Array



Portable Medical & Connected Drug Delivery System



Scan to learn more!

Power management

eFuse, PPTC



USB Protection

eFuse, Temperature Indicator,
PPTC, TVS Diode Array



Wireless Communication

TVS Diode Array



Keypad

Tactile Switch, Detect Switch



Dose Dialing & Activity Detection

Tactile Switch, Detect Switch,
Reed Switch, TMR Switch



MCU & Motor Control

Microcontroller,
TVS Diode, Gate Driver



Smart Wearables & Gaming Controllers



Scan to learn more!

Battery Pack

Battery Strap,
Battery Mini-Breaker



USB Protection

Digital Temp Indicator, PPTC,
TVS Diode Array, eFuse



Load Switching

Load Switch IC



UI Buttons

Tactile Switch



Controller Switches

Tactile Switch,
Thumbstick Switch



Joy Stick

Thumbstick Switch





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USB Type-C Chargers



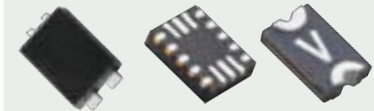
**AC Input
Primary Protection**
Fuse



**High-frequency
Converter And Clamp**
TVS Diode, Optocoupler,
Bridge Diode



Output Protection
Schottky Diode, eFuse,
Digital Temperature Indicator



Solar Inverter & Battery Energy Storage System (BESS)



Scan to learn more!

Input Protection

In-line Fuse, SPD,
Ground Fault Relay, DC Disconnect



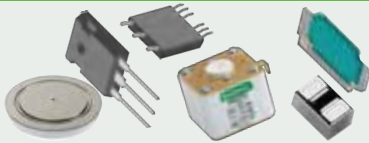
Output Protection

AC Ground Fault Relay,
Fuse, SPD



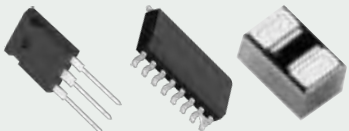
Power Conversion

Diode, MOSFET, IGBT,
Power Module, Fuse, TVS Diode



Auxiliary Power Supply

Si/SiC MOSFET, Gate Driver,
TVS Diode



Communication

TVS Diode Array



BESS

Fuse, MOV, SPD, Arc Flash Relay,
Ground Fault Relay, IGBT



Green Hydrogen



Scan to learn more!

Input Protection

Fuse, SPD



Arc Flash Protection

Arc Flash Relay



Ground Fault Monitoring

Ground Fault Relay



Power Conversion (Using Discrete Solutions)

High Power Thyristor, Diode, IGBT



Power Conversion (Using Stacks & Assemblies)

Power Stack



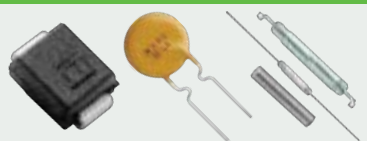
Electric Two-Wheelers and Three-Wheelers



Scan to learn more!

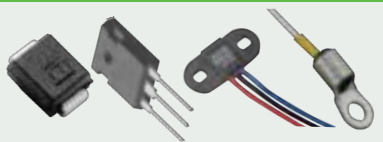
Comfort Unit

(USB/Charging Port, Cluster, Side Stand)
TVS Diode, PPTC, Reed Switch



ECU/Motor Drive

TVS Diode Array, Si MOSFET
Hall Effect Sensor, NTC



Safety Unit

(Lighting, PDU, Handle Grip Control)
Fuse, TVS Diode, MOV, Switch



Battery Management System

Fuse, TVS Diode, TVS Diode Array,
NTC, Reed Switch, Switch



On-Board Charger

Fuse, MOV,
TVS Diode, SiC Diode, NTC



EV Charging

Fuse, MOV, GDT,
Diode, MOSFET, Gate Driver



Electric Bikes (eBikes)



Scan to learn more!

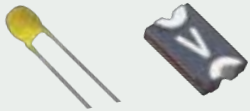
DC Input Protection

Fuse, TVS Diode



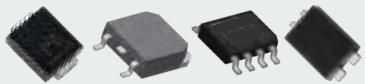
Power Bridge Protection And Temperature Sensing

NTC, Temperature Indicator



Power Bridge

TVS Diode, MOSFET,
Gate Driver, Schottky Diode



USB, I/O, & Charging Port

Temperature Indicator, PPTC,
TVS Diode Array, eFuse, Fuse



Side Stand And Handle Grip Control

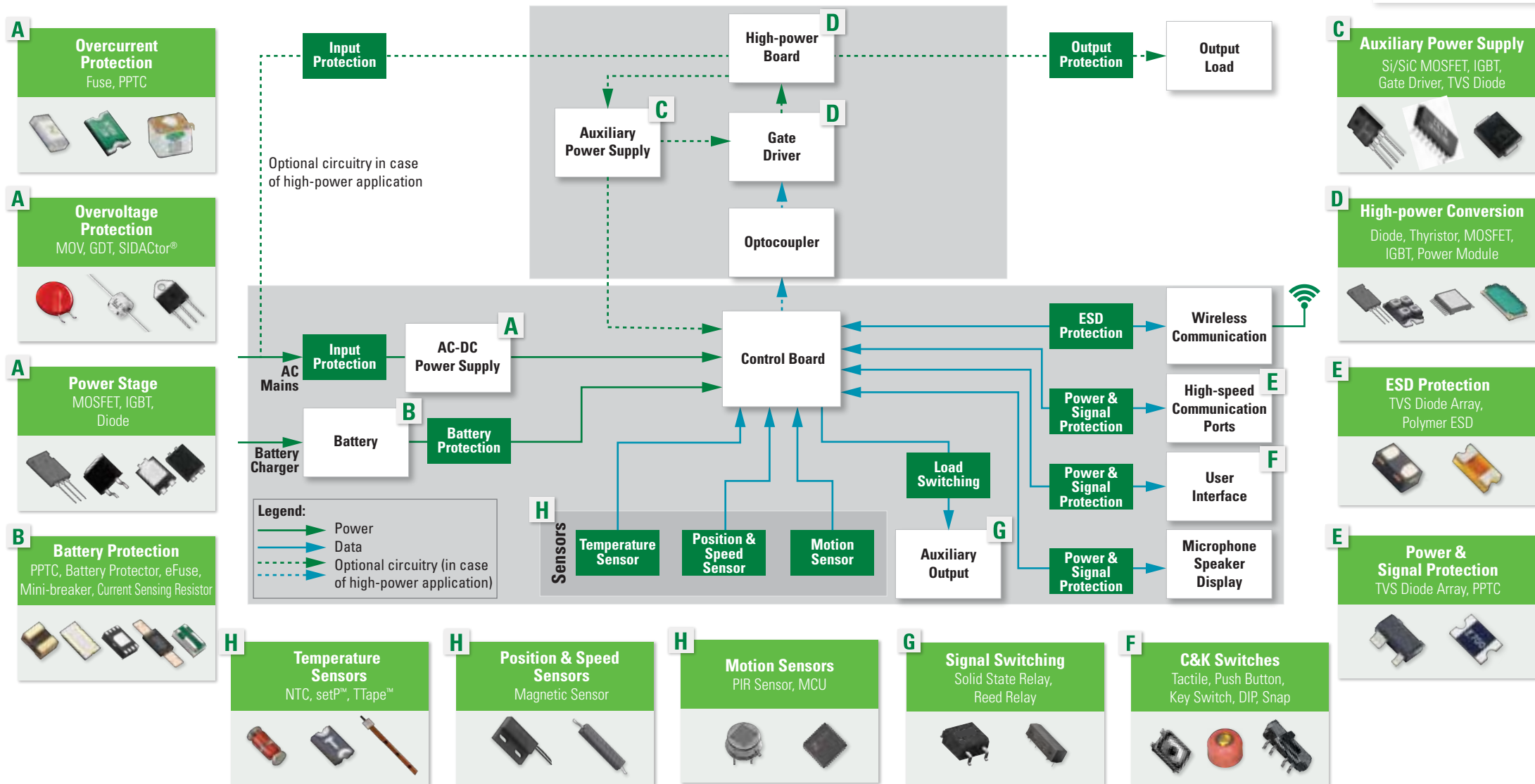
Reed Switch, Tactile Switch



Common Building Blocks in an Electronic System Design



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Littelfuse Multi-technology Portfolio Overview



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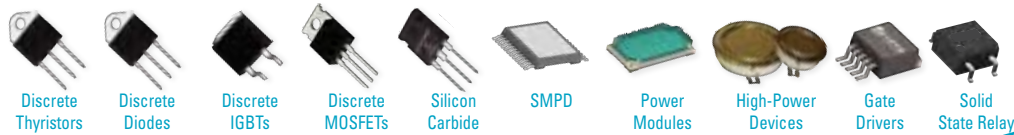
CIRCUIT PROTECTION SOLUTIONS



SENSING SOLUTIONS



POWER SEMICONDUCTOR SOLUTIONS



C&K® SWITCHES



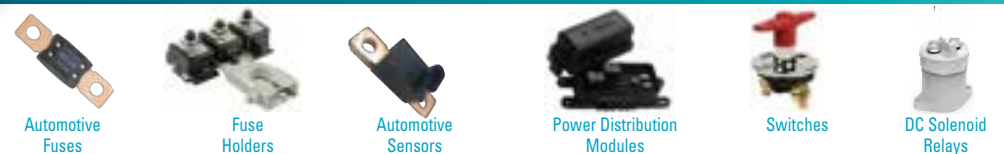
AVIATION, DEFENSE, AND SPACE



INDUSTRIAL CONTROL SOLUTIONS



TRANSPORTATION SOLUTIONS



Global Lab Capabilities



You need to be certain that your products live up to the highest standards for performance, reliability, safety, and regulatory compliance. Working with Littelfuse, you have access to dedicated application engineers who partner with you to provide expert design consultation, perform comprehensive tests simulating the harshest environments, and confidentially evaluate the results in consultation with you.

TESTING CAPABILITIES

Environmental

- Autoclave
- Dust
- H3TRB
- HAST
- High- and Low-Temperature Storage
- High-Temperature Loading
- Ingress Protection (IP)
- HTGB
- HTRB
- Temperature and Humidity
- Temperature Cycling
- Thermal Shock
- Salt Fog

Physical-Mechanical Characteristics

- Acceleration
- Die Shear
- Leak Detection
- Mechanical Shock
- Resistance to Soldering Heat (Dip, Reflow, Wave)
- Resistance to Solvents
- Solderability
- Terminal Strength (Push, Pull, Bend)
- Vibration
- Wetting Balance
- Wire Pull

Electrical

- BCI
- Capacitance
- EFT
- ESD
- Impedance
- Insulation Resistance
- I-V
- Life
- Lightning Surge
- Overload
- Parametric Tests
- Power-Cross
- Power Cycling
- Ring Wave
- R-T
- S-Parameter Measurements (Insertion Loss, Isolation, Reflection)
- Short Circuit
- Step Current
- Surface Resistivity
- Surge
- TDR (Eye Diagram)
- Telecom
- Thermal Cut-Off
- Time-to-Trip
- TLP
- Transient
- Trip Cycle
- Trip Endurance
- Voltage Drop



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Littelfuse Overview

About Littelfuse

Littelfuse is a trusted partner to engineers worldwide who seek our technical expertise to accurately conduct and analyze test results. Our global vision, team, and leadership collectively provide the strategic foundation to deliver innovations that help bolster businesses and align with global megatrends.

Littelfuse offers leading technologies in circuit protection, power control, and sensing. We continue to expand our broad and diverse portfolio of products into adjacent markets, including power semiconductors, heavy-duty switches, and magnetic, optical, electromechanical, and temperature sensors, as well as other products that provide safe control and distribution of electrical power.

Littelfuse offers a wide variety of product technologies.

Overcurrent Protection

- Fuses
- Protection ICs
- PolySwitch® Resettable PPTC

Overvoltage Suppression

- Gas Discharge Tubes (GDTs)
- Open LED Protectors
- PulseGuard® ESD Suppressors
- SIDACTor® Protection Thyristors
- TVS Diodes
- TVS Diode Arrays
- Varistors
- Wafer and Bare Die

Power Semiconductors

- Bare Die Devices
- Bipolar Devices
- Discrete and Module Solutions
- Fully Engineered Subsystems
- IGBTs
- MOSFETs
- Power Semiconductors and ICs
- Power Control
- Switching Thyristors
- Silicon Carbide Technology
- TRIAC Thyristors

Integrated Circuits and Solid-State Relays

- Gate Drivers
- High-Voltage ICs
- Solid-State Relays

Electromechanical Switches

- Dip Switches
- Detect Switches
- Keyswitch Switches
- Navigation Switches
- Pushbutton Switches
- Rocker Switches
- Rotary Switches
- Snap-Acting Switches
- Slide Switches
- Switchlock Switches
- Tactile Switches
- Toggle Switches

High Reliability Connectors

- D-Sub Connectors
- Harness Solutions
- Micro-D Connectors
- Wire to Wire connectors

Magnetic Sensing

- Hall Effect Sensors
- Magnetic Actuators
- Reed Switches
- Reed Sensors
- Reed Relays

Temperature Sensing

- Digital Temperature Indicators
- RTDs
- Thermistors
- TTape™ Temperature Indicators

Industrial & Transportation

- Arch-Flash Relay
- Automotive Sensor
- Contactor
- DC Solenoid Relays
- Ground-Fault Relay
- Motor & Pump Protection
- Power Distribution Module
- Residual Current Monitor

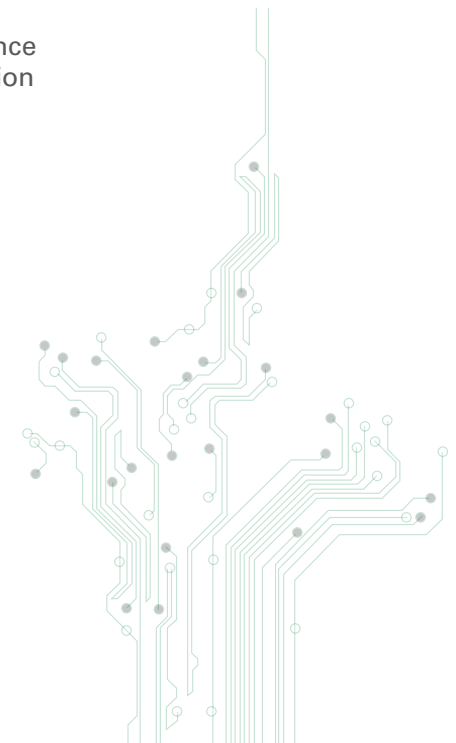
Global Footprint

At Littelfuse, our mission is to develop innovative circuit protection, power control, and sensing solutions that meet our customers' unique needs. This customer-focused philosophy has helped us become the top circuit protection brand in the world.

Our industry-leading product portfolio includes reliable circuit protection, power control, and sensing products that are designed for a variety of markets and applications. We have assembled unparalleled expertise and developed a global footprint that puts our facilities close to our customers and target markets. As our global manufacturing and R&D teams objectively recommend the best circuit protection, power control, or sensing solution for each customer application, they form partnerships that will lead to the development of the next generation of advanced products.

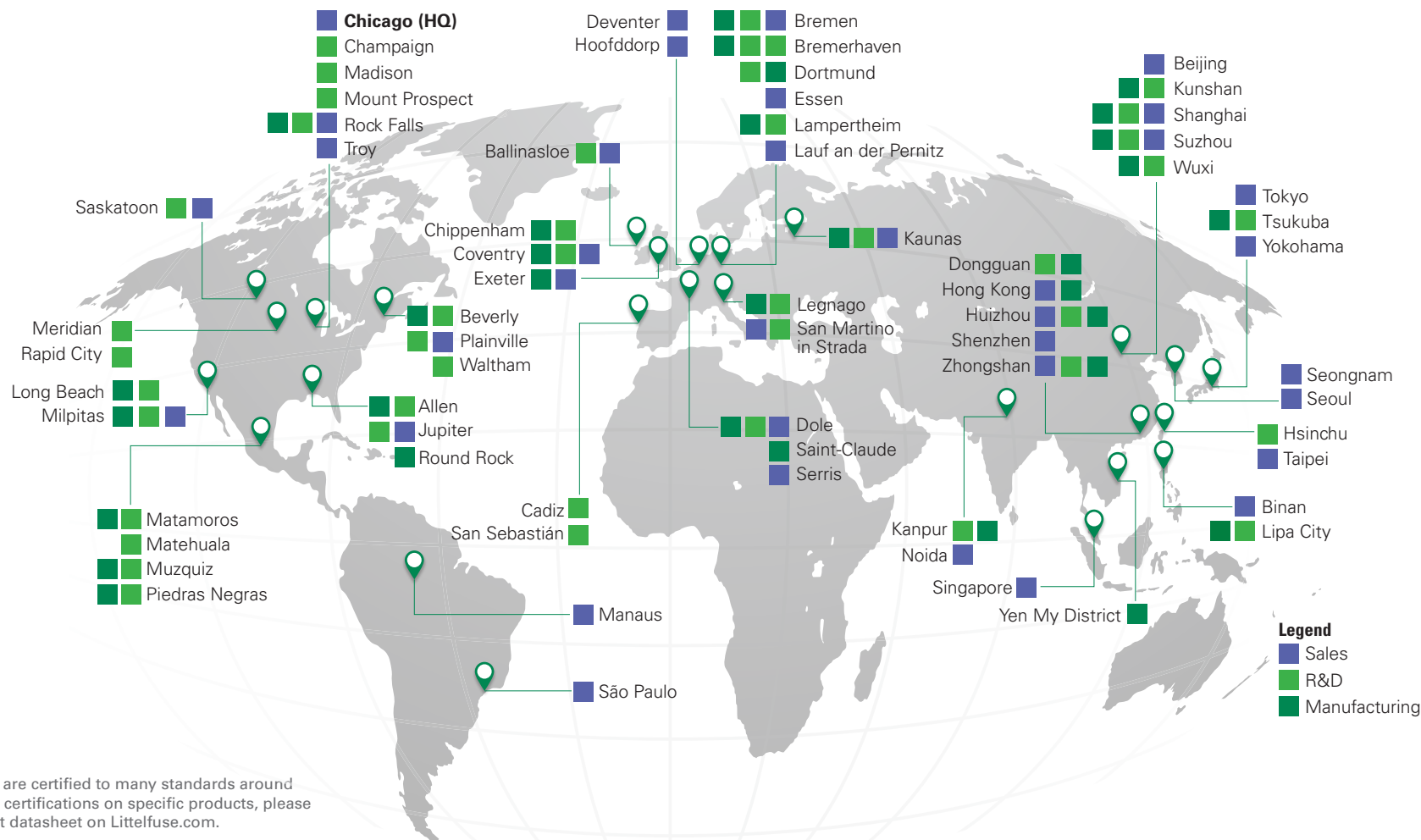
Littelfuse provides:

- Application Expertise
- Global Support
- Operational Excellence
- Technology Innovation
- Collaboration
- Customer Focus





LOCAL RESOURCES FOR A GLOBAL MARKET



Littelfuse products are certified to many standards around the world. To check certifications on specific products, please refer to the product datasheet on Littelfuse.com.



Expertise Applied | Answers Delivered

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