



# **Building and Home Automation** Application Guide



Today's **buildings and homes** are equipped with **intelligent technologies** for **safer, more convenient, and energy-efficient living.**



**Intelligent Appliances**



**Smart Lock**



**Garage Door**



**Elevator**



**HVAC**



**Security Camera**



**Smart Thermostat**



**Intelligent Outlet**



**Fire and Smoke Alarm**



**Electronic Dimmer**



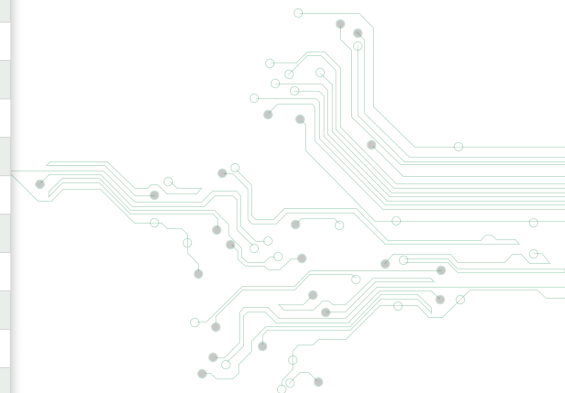
**Smart Meter**



## About this guide

This guide provides an overview of the Littelfuse technologies used in various building and home automation applications. It is designed to help you quickly find circuit protection, power control, and sensing solutions appropriate to your application.

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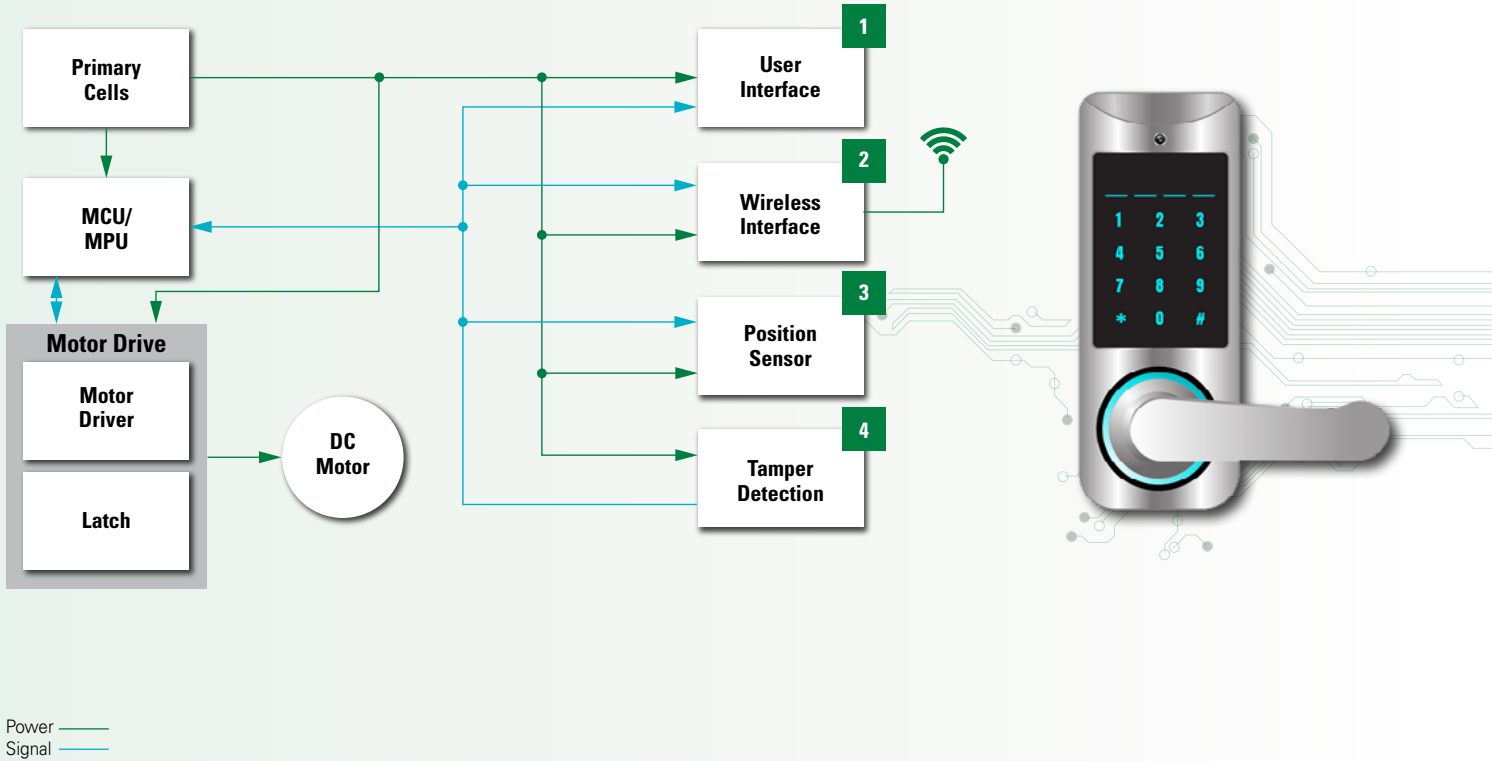


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# Smart Lock

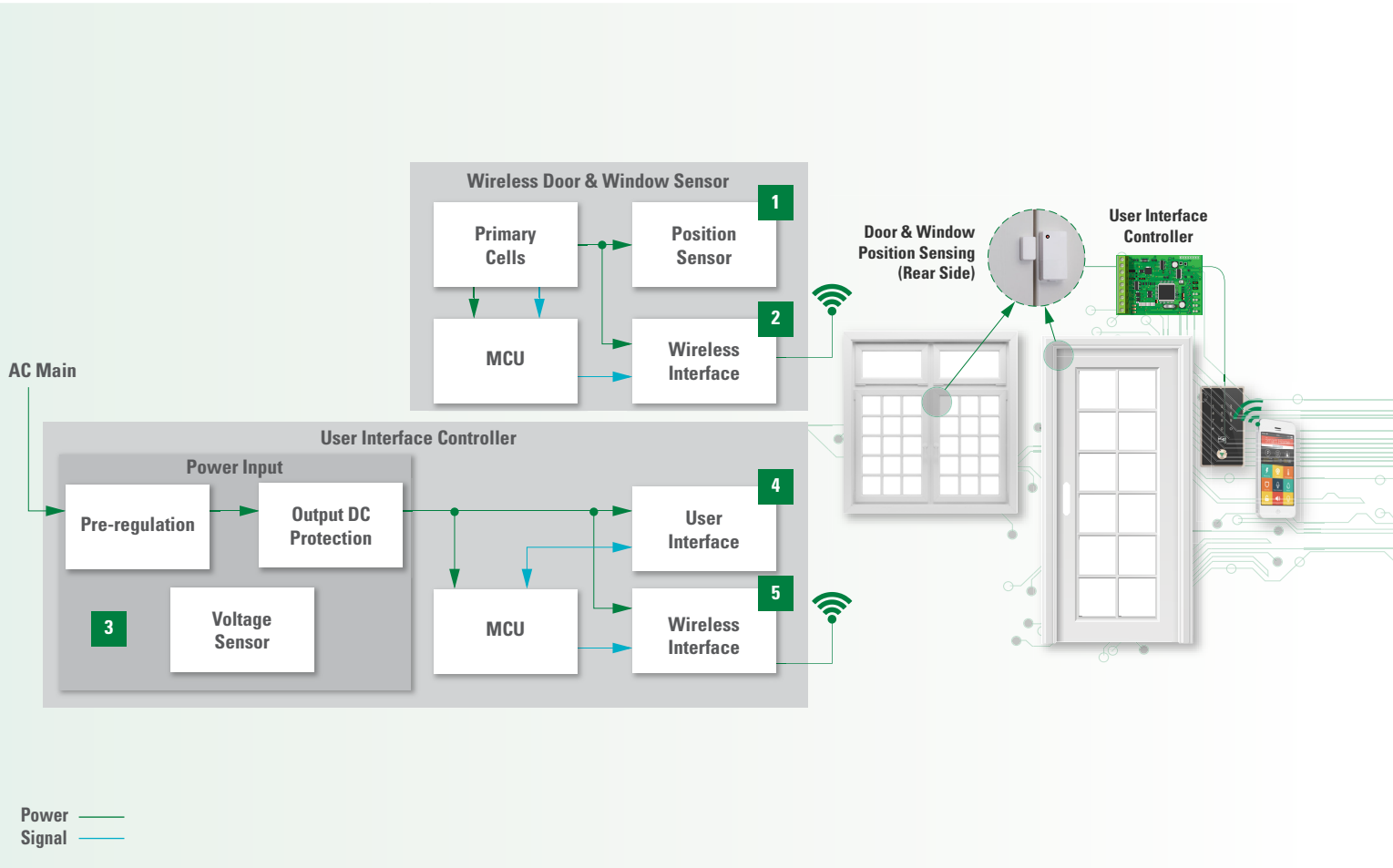
A smart lock on a door is more than a simple lock; it is a system that includes a user interface, position sensors, battery, processor, and DC motor that moves the latch. Smart locks use a wireless interface, allowing local control through a smartphone and remote control via a PC connected to a communications network.



	Technology	Function in Application	Product Series	Features
1	TVS Diode Array	Protects touchscreen ICs from user-induced ESD events	<a href="#">SP1012</a> <a href="#">SP1003</a>	Low dynamic resistance; five-channel protection in a small 0402 footprint; maintains high signal integrity
2	Polymer ESD Suppressor	Protects the Wi-Fi chipset from user-induced ESD events	<a href="#">PGB10603</a> <a href="#">PGB10402</a>	Ultra-low capacitance; compact form factor; low leakage current; fast response time
3	Reed Switch and Magnetic Actuator	Proximity detection of the door to verify full closure before engaging deadbolt	<a href="#">MDSM-4</a> <a href="#">MDSR-10, H-36</a>	Hermetically sealed; magnetically operated contacts
4	Reed Switch	Alerts user if someone is tampering with the lock	<a href="#">59166</a>	Hermetically sealed; magnetically operated contacts

# Door and Window Sensing

In an access control system, windows and doors are wirelessly networked to a central control panel. Position sensors on the doors and windows communicate their status to the control panel, and user input on the panel is able to control door latches via small DC motors and associated processors. Batteries and antennas complete the system.

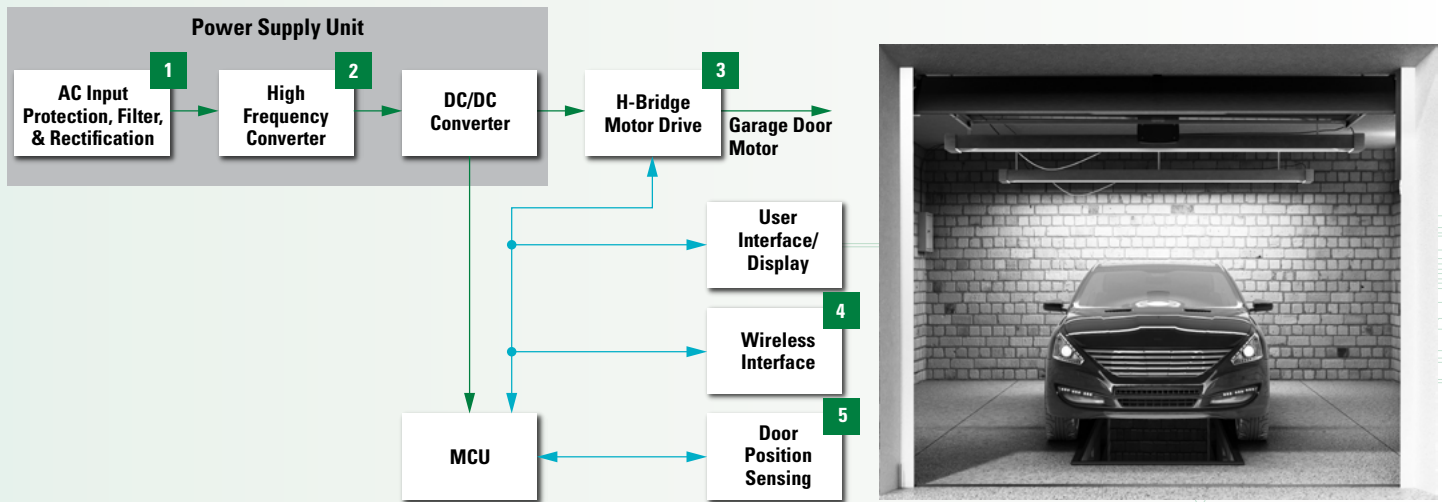


	Technology	Function in Application	Product Series	Features
1	Reed Switch and Magnetic Actuator	Open/closed proximity detection of the window or door	<a href="#">MDSM-4</a> <a href="#">MDSR-10, H-36</a>	Hermetically sealed; magnetically operated contacts
2	Polymer ESD Suppressor	Protects the Wi-Fi chipset from user-induced ESD events	<a href="#">PGB10603</a> <a href="#">PGB10402</a>	Ultra-low capacitance; compact form factor; low leakage current; fast response time
3	Fuse	Protects equipment and personnel from overcurrent faults	<a href="#">215</a> <a href="#">875</a> <a href="#">877</a>	Compliant with UL/IEC standards; low internal resistance; shock safe; vibration resistant
	MOV	Protects the power unit from lightning and other voltage transients on the AC line	<a href="#">LA</a> <a href="#">C-III</a>	Can meet wide-set surge withstanding specifications: 40 – 530 J (2 mS)
	TVS Diode	Protects sensitive electronic components from voltage transients	<a href="#">SMCJ</a>	1500 W peak pulse capability; low, dynamic resistance; 0402 footprint
4	TVS Diode Array	Protects touchscreen ICs from user-induced ESD events	<a href="#">SP1012</a> <a href="#">SP1003</a>	Ultra-low capacitance; compact form factor; low leakage current
5	Polymer ESD Suppressor	Protects the Wi-Fi chipset from user-induced ESD events	<a href="#">PGB10603</a> <a href="#">PGB10402</a>	Ultra-low capacitance; compact form factor; low leakage current; fast response time



# Automatic Garage Door

Automatic garage doors can be monitored by wireless security camera systems, allowing users to remotely control the door and observe the space through the camera's feed. Door position sensing technologies ensure that the door is fully opened or closed to help prevent theft or injury.



Power ———  
Signal ———

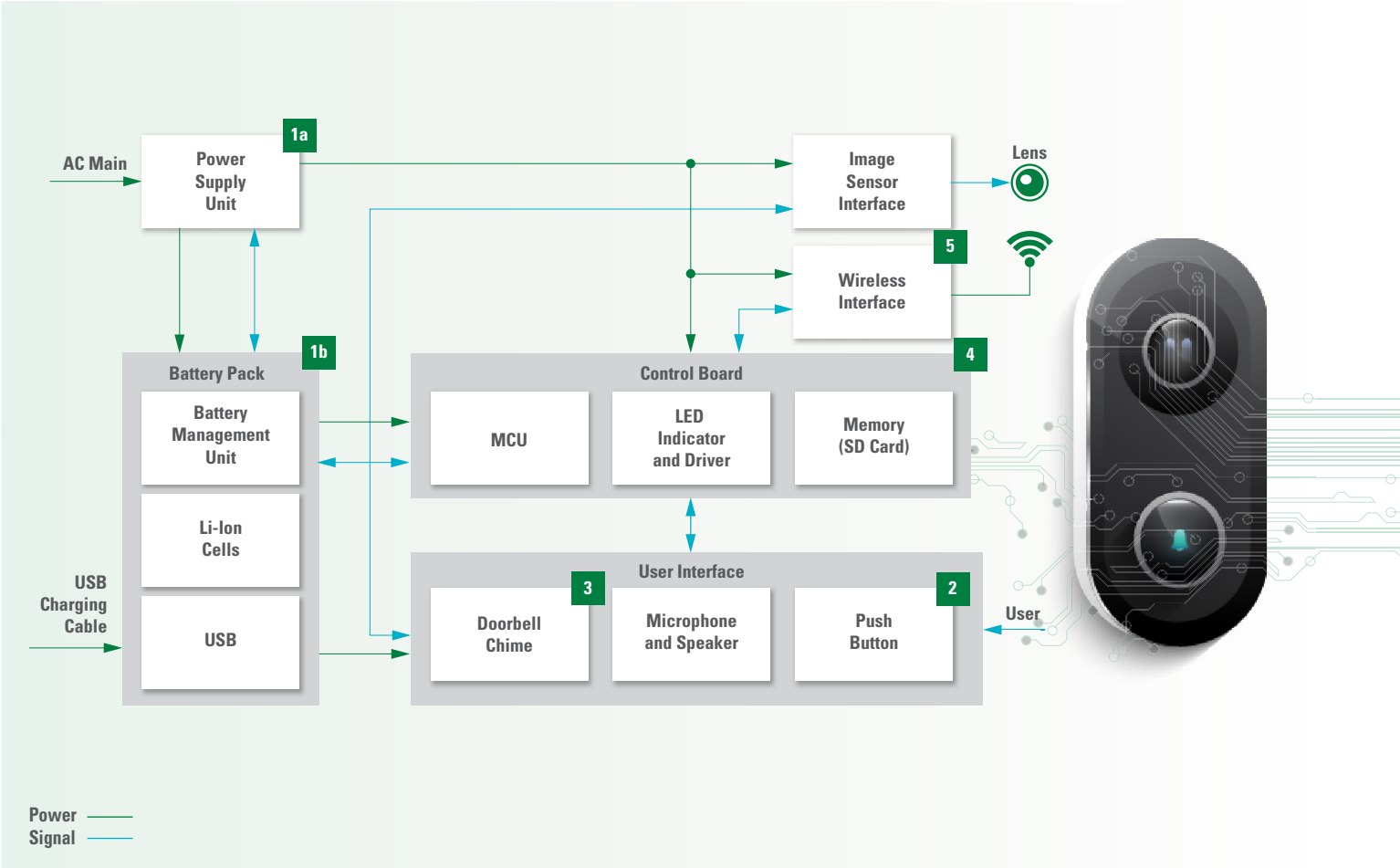
	Technology	Function in Application	Product Series	Features
1	Fuse	Protects power stage from overcurrent events	<a href="#">835</a> <a href="#">215</a>	Third-party compliance (UL/IEC); low internal resistance; shock safe; vibration resistant
	MOV	Protects power supply from line voltage surges and meets regulatory requirements	<a href="#">UltraMOV</a> <a href="#">TMOV</a>	High peak surge current rating up to 10 kA; high operating temperature range up to 125° C
2	MOSFET	Turns power supply units on and off	<a href="#">X2 Class</a>	Low Rds(on), dv/dt ruggedness
3	Hall Effect Sensor	Position and speed sensing of the motor	<a href="#">55140</a> <a href="#">55100</a>	Magnetically operated position sensing; built-in temperature compensation; high switching speed up to 10 kHz
	NTC	Temperature sensing of the door motor	<a href="#">USUR1000</a> <a href="#">SM</a>	UL Recognized with ring lug mounting; SM NTCs is in hermetically sealed MELF package suitable for operation up to 220° C
4	TVS Diode Array *	Protects wireless chipsets from ESD induced by user	<a href="#">SP3213</a>	Space efficient, 0201 form factor; third-party compliance; low capacitance
5	Reed Switch	Proximity detection of the door to verify if fully open/closed	<a href="#">59166</a> <a href="#">MDSM-4</a> , <a href="#">MDSM-10</a>	Hermetically sealed; magnetically operated contacts

\* This is recommended for compact designs where clearance between the antenna and the casing is < 2 mm.



# Video Doorbell

Depending on the model, some smart doorbells are battery powered and rechargeable through USBs, some include local memory for video storage, and some have microphones and speakers. All smart doorbells share basic functions: power input or battery pack, image sensor, control board, user interface, and wireless interface.

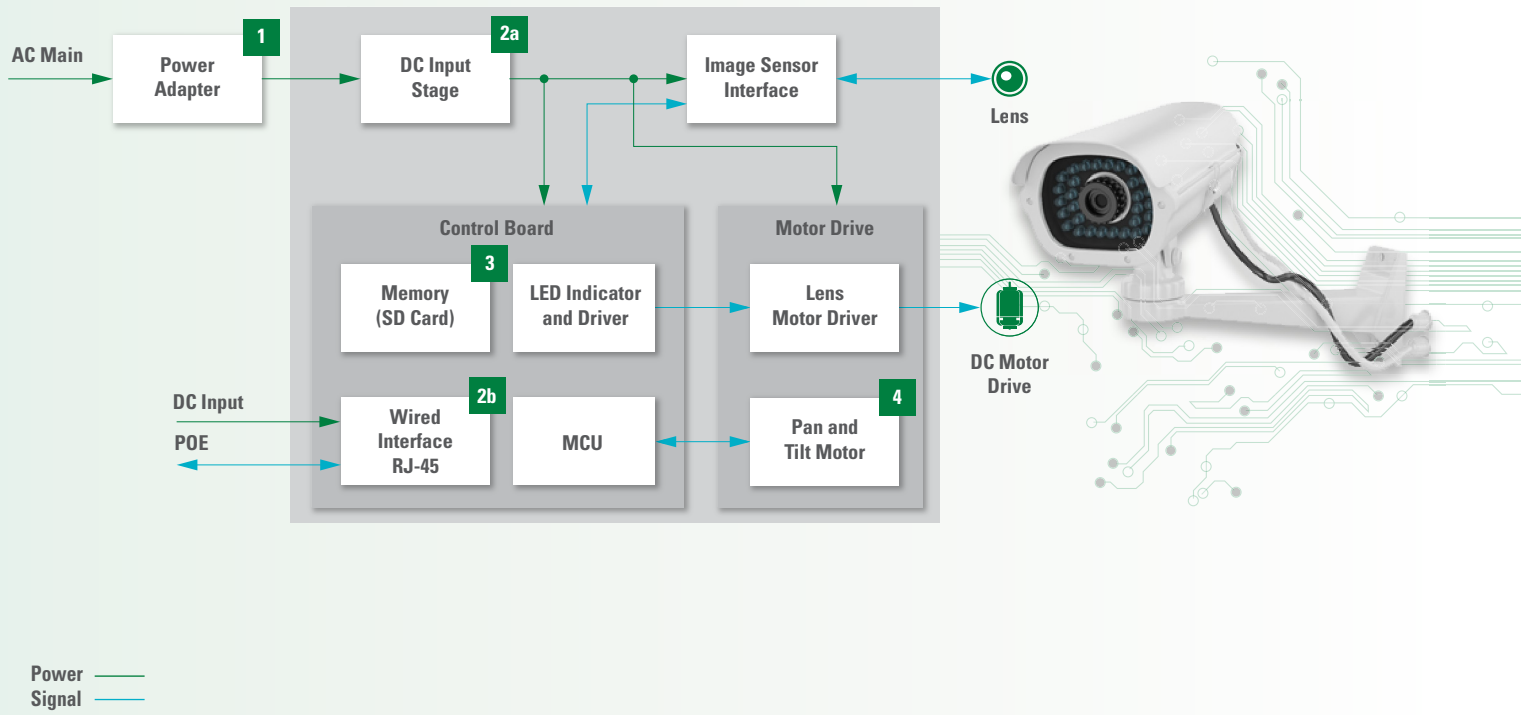


	Technology	Function in Application	Product Series	Features
1a	Fuse	Protects the power stage from overcurrent events	<a href="#">443</a> <a href="#">449</a>	Surface mountable; wide range of current ratings, time lag
	Solid State Relay	Optically isolated switch	<a href="#">PLB190</a>	5000 V <sub>RMS</sub> input/output isolation; no EMI/RFI generation; arc-free with no snubbing circuits
	TVS Diode	Protects sensitive electronic components from voltage transients	<a href="#">4.0SMDJ24A</a>	4000 W peak pulse capability; compatible with the lead-free solder reflow temperature profile
1b	Fuse	Protects from high discharge currents due to external shorts	<a href="#">469</a> <a href="#">449</a>	Surface mountable; wide range of current ratings available
	TVS Diode	Protects sensitive electronic components from voltage transients	<a href="#">SMBJ</a>	600 W peak pulse power capability; fast response time (<1.0 ps)
	MLV	ESD protection for data lines	<a href="#">MLA</a>	Bidirectional clamping, low form factor; wide operational temperature range
2	TVS Diode Array	Protects memory card from user-induced ESD event	<a href="#">SP1006</a>	Industry smallest footprint available (0201); low leakage current
3	Solid State Relay	Optically isolated switch functions as a dual-purpose switch between chime and camera	<a href="#">LCB710</a>	Normally closed switch; no EMI/RFI generation arc-free with no snubbing circuits with an ability to handle high pulse current
4	TVS Diode Array	Protects memory card from user-induced ESD event	<a href="#">SP1006</a>	Industry-smallest footprint available (0201); low leakage current
5	Polymer ESD Suppressor	Protects the Wi-Fi chipset from user-induced ESD events	<a href="#">PGB10603</a> <a href="#">PGB10402</a>	Ultra-low capacitance; compact form factor; low leakage current; fast response time



# Outdoor Security Camera

At its heart, a security camera is an image sensor integrated with a processor and memory. It communicates with a central computer through Ethernet, sending video images and receiving commands. Often, the system includes the motor that drives a zoom lens and a second motor that drives the camera pan/tilt position. An AC-to-DC power adapter powers the motor drivers and the rest of the system.



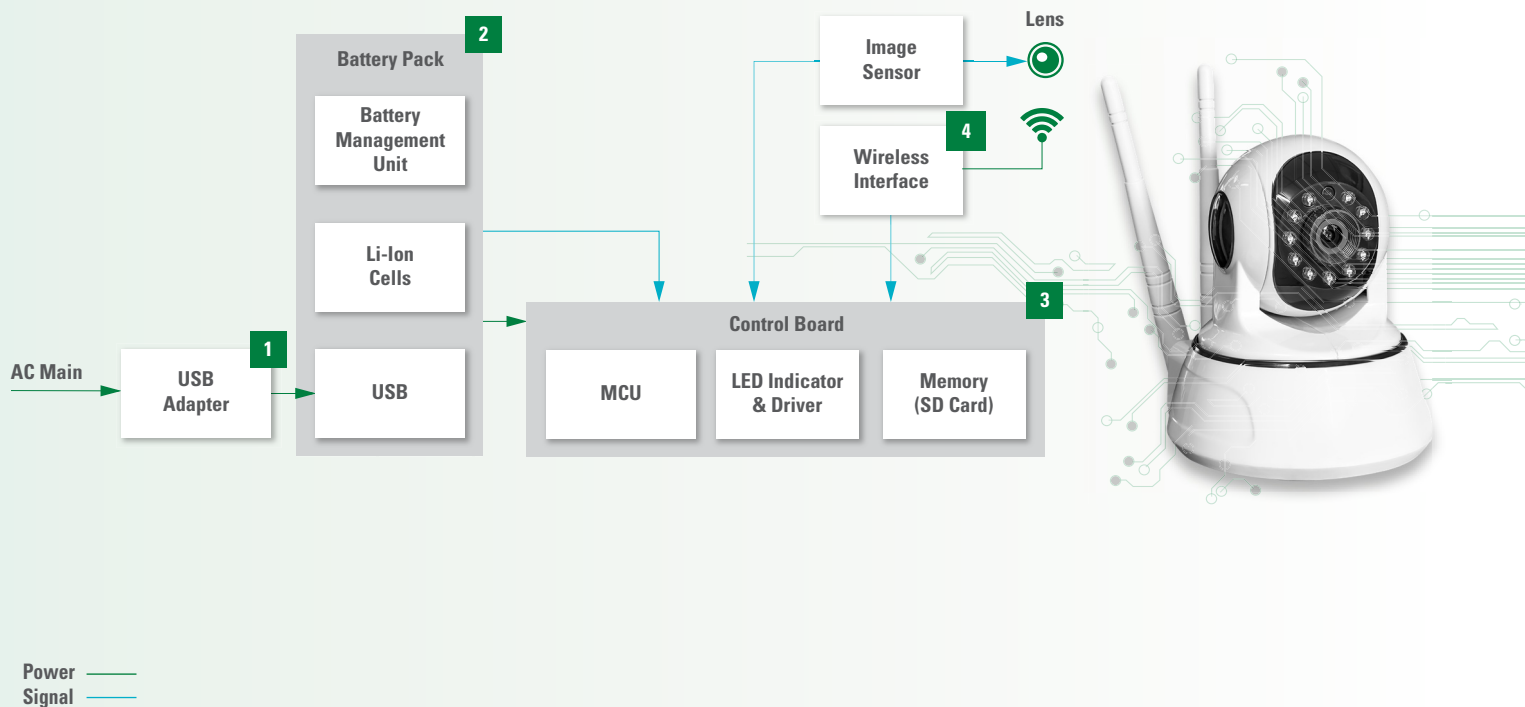
	Technology	Function in Application	Product Series	Features
1	Fuse	Protects power stage from overcurrent events	<a href="#">875</a> <a href="#">807, 373</a>	Third-party compliance (UL/IEC); low internal resistance; shock safe; vibration resistant
	MOV	Protects power unit from voltage transients and lightning	<a href="#">C-III, LA</a> <a href="#">UltraMOV</a>	High energy absorption capability - 40–530 J (2 ms)
	TVS Diode	Protects power unit from voltage transients	<a href="#">P6KE</a> <a href="#">P6SMB</a>	600 W peak pulse capability; glass passivated chip junction
2a	Fuse	Protects the power stage from overcurrent events	<a href="#">461, 449</a> <a href="#">picoSMD</a>	Surface mountable; resettable option
	TVS Diode	Protects sensitive electronic parts in the power stage from voltage transients	<a href="#">5.0SMDJ</a>	5000 W peak pulse capability
2b	Fuse, PPTC	Protects power stage from overcurrent events	<a href="#">461, 449</a> <a href="#">picoSMD</a>	Surface mountable; resettable option
	TVS Diode Array	Protects the sensitive electronic parts from voltage transients	<a href="#">SRV05-4HTG</a> <a href="#">SP0504SHTG</a>	Multiple rail-to-rail protections; low leakage current; low capacitance of 1 pF (TYP) per I/O
3	TVS Diode Array	Protects memory card from user-induced ESD event	<a href="#">SP1006</a>	Industry's smallest footprint available (0201); low leakage current
4	Solid State Relay	Optically isolated switch to drive motor	<a href="#">CPC1651</a>	Higher current rating; 1 A versus 0.5 A load current



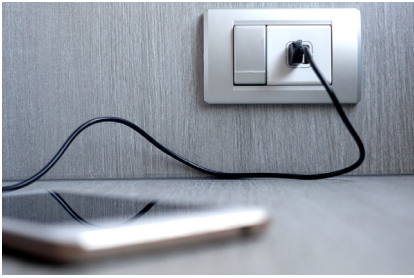


# Wireless Security Camera

Wireless security cameras are portable devices that transmit a video and audio signal through Wi-Fi or a radio band to a wireless receiver. The control board includes a microprocessor, driver, and often a memory card. The control board communicates with the camera image sensor and wireless interface. Usually the battery pack is powered by a USB power adapter.

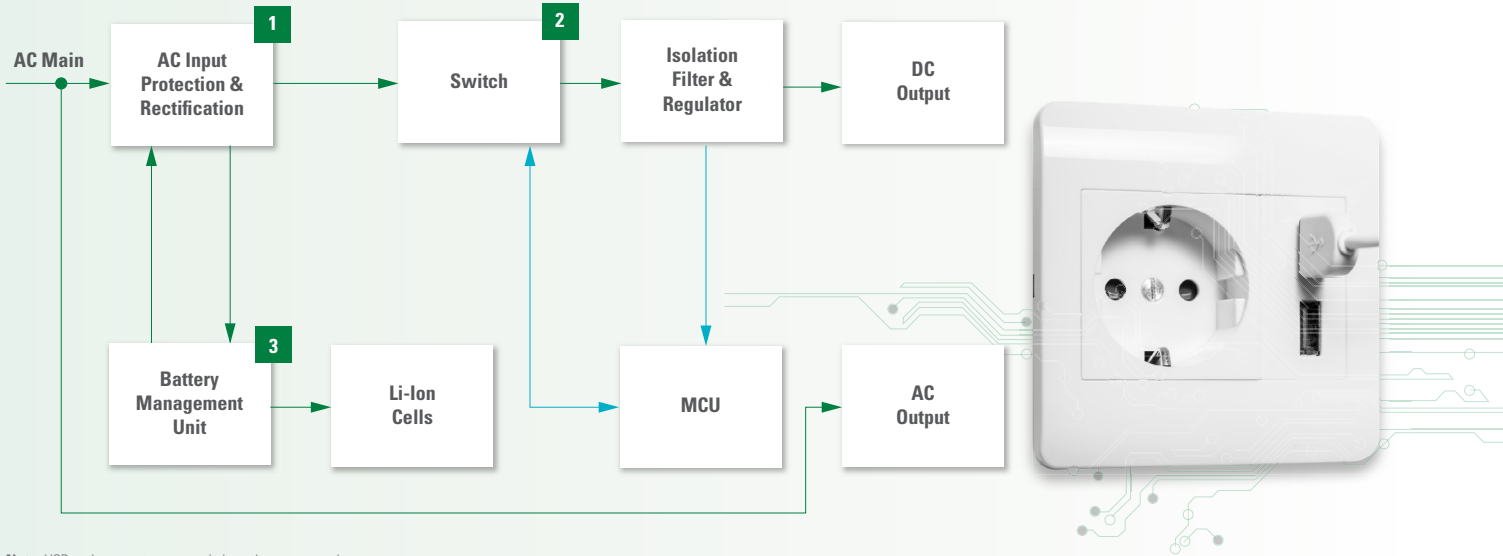


	Technology	Function in Application	Product Series	Features
1	Fuse	Protects power stage from overcurrent events	875 807, 373	Third-party compliance (UL/IEC); low internal resistance; shock safe; vibration resistant
	MOV	Protects power unit from voltage transients and lightning	C-III, LA UltraMOV	High energy absorption capability: 40–530 J (2 ms)
	TVS Diode	Protects power unit from voltage transients	P6KE P6SMB	600 W peak pulse capability; glass passivated chip junction
	Temperature Indicator	Protects USB-C plugs and receptacles from overheating	setP™	Resettable; low resistance; compact design
2	PPTC	Protects the power stage from overcurrent events	0805L, Nano Pico	Resettable; low resistance; compact design
	MLV	ESD protection for data lines	MLA	Bidirectional clamping; low form factor; wide operational temperature range
	Temperature Indicator	Protects USB-C plugs and receptacles from overheating	setP™	Resettable; low resistance; compact design
3	TVS Diode Array	Protects memory card from user-induced ESD events	SP1006	Industry's smallest footprint available (0201); low leakage current
4	Polymer ESD Suppressor	Protects the Wi-Fi chipset from user-induced ESD events	PGB10603 PGB10402	Ultra-low capacitance; compact form factor; low leakage current; fast response time



# USB Outlet

A USB outlet is a combination of USB charging ports and traditional AC wall outlets. It functions as a switched-mode power supply, and therefore, its design is more complex than a traditional outlet. After AC power is rectified, it passes through a switch and microprocessor-controlled regulator before being made available at the USB port. Some USB outlets also offer battery backup.



Note: USB outlet operates as a switch mode power supply

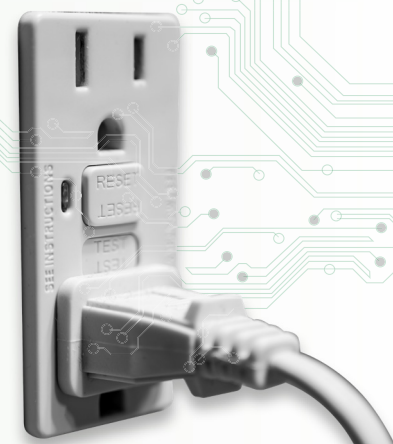
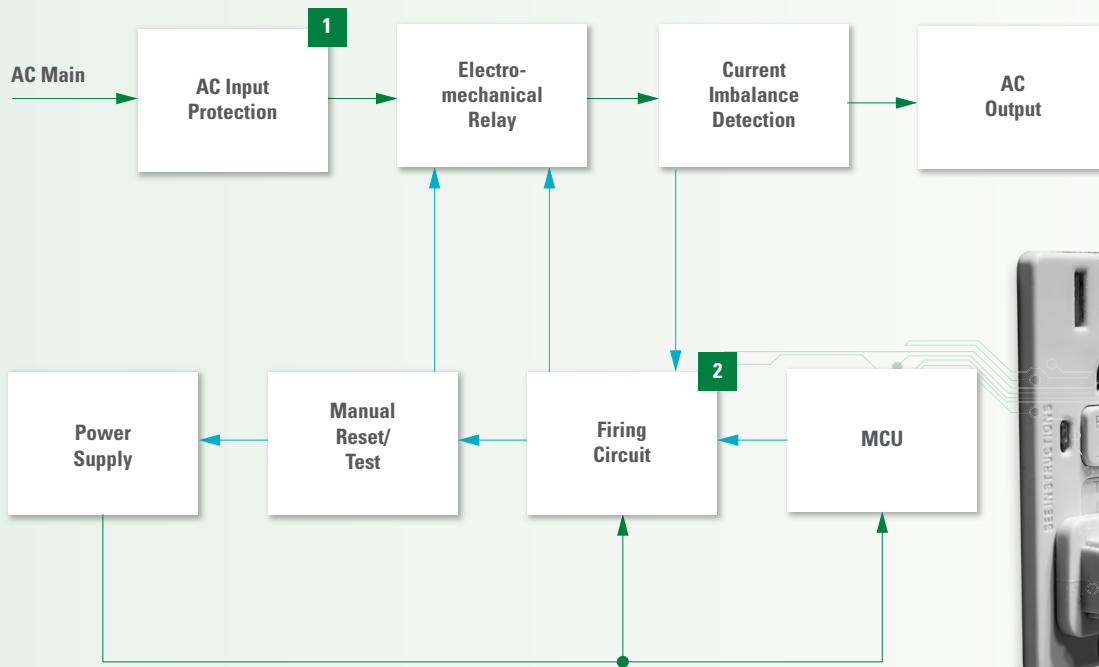
Power —  
Signal —

	Technology	Function in Application	Product Series	Features
1	Fuse	Protects input power stage and downstream components from faults due to overcurrent	<a href="#">Nano Pico</a>	Third-party compliance UL/IEC, low internal resistance; shock safe; vibration resistant
	MOV	Protects power unit from voltage surges, such as lightning and transients	<a href="#">UltraMOV</a>	High peak surge current rating up to 10 kA; high operating temperature range up to 125° C
	TVS Diode	Protects sensitive electronic components from voltage transients	<a href="#">SMCJ</a>	1500 W peak pulse capability; low, dynamic resistance; 0402 footprint
2	Schottky Diode	Rectification and blocking in power supply units	<a href="#">MBR DST</a>	Ultra-low forward voltage drop; high-frequency operation
	Gate Driver	High side and low side gate driver for Power MOSFETs	<a href="#">IX4340</a>	Capable of sourcing and sinking up to 5 A
	MOSFET	High switching speed in power supply units	<a href="#">X2 Class</a>	Low $R_{ds(on)}$ , dv/dt ruggedness
3	NTC	Temperature sensing	<a href="#">UPS16673</a>	Tight tolerance; ultra thin; customizable



# GFCI/AFCI Receptacle

A ground fault circuit interrupter and arc flash circuit interrupter (GFCI/AFCI) receptacle is a wall outlet that interrupts power when a suspected ground fault or arc is detected. AC power passes through a relay and current transformer (sensor) before arriving at the outlet. The sensor and relay communicate with a firing circuit, which is supported by a microprocessor, power supply, and manual reset button.

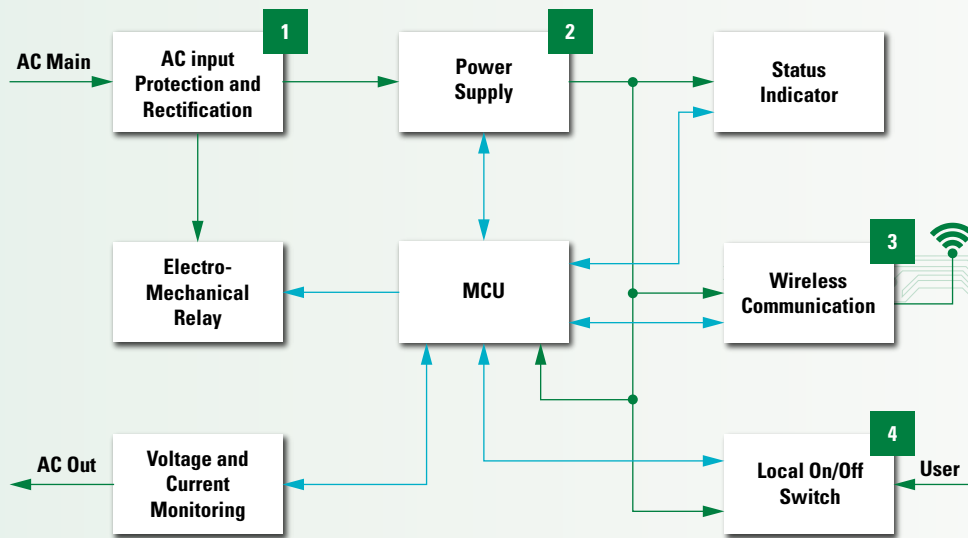


	Technology	Function in Application	Product Series	Features
1	Fuse	Protects input power stage and downstream components from faults due to overcurrent	<a href="#">Nano</a> <a href="#">Pico</a>	Third-party compliance UL/IEC; low internal resistance; shock safe; vibration resistant
	MOV	Protects power unit from voltage surges, such as lightning and transients	<a href="#">UltraMOV</a>	High peak surge current rating up to 10 kA; high operating temperature range up to 125° C
2	TVS Diode	Protects sensitive electronic components from voltage transients	<a href="#">SMCJ</a>	1500 W peak pulse capability; low, dynamic resistance; 0402 footprint
	SCR	Triggers electro-mechanical relay to disengage electrical contacts during fault	<a href="#">Sjxx08xSx</a> / <a href="#">Sjxx08xx</a>	Up to 600 V capability; high surge capability up to 100 A



# Intelligent Outlet

By communicating with a smart home network, an intelligent outlet allows users to turn power on and off devices plugged into the outlet using a smart phone. The heart of the outlet is a microprocessor with wireless communication. It is supported by AC power and rectification, a power supply, and electro-mechanical relay.



Power ———  
Signal ———

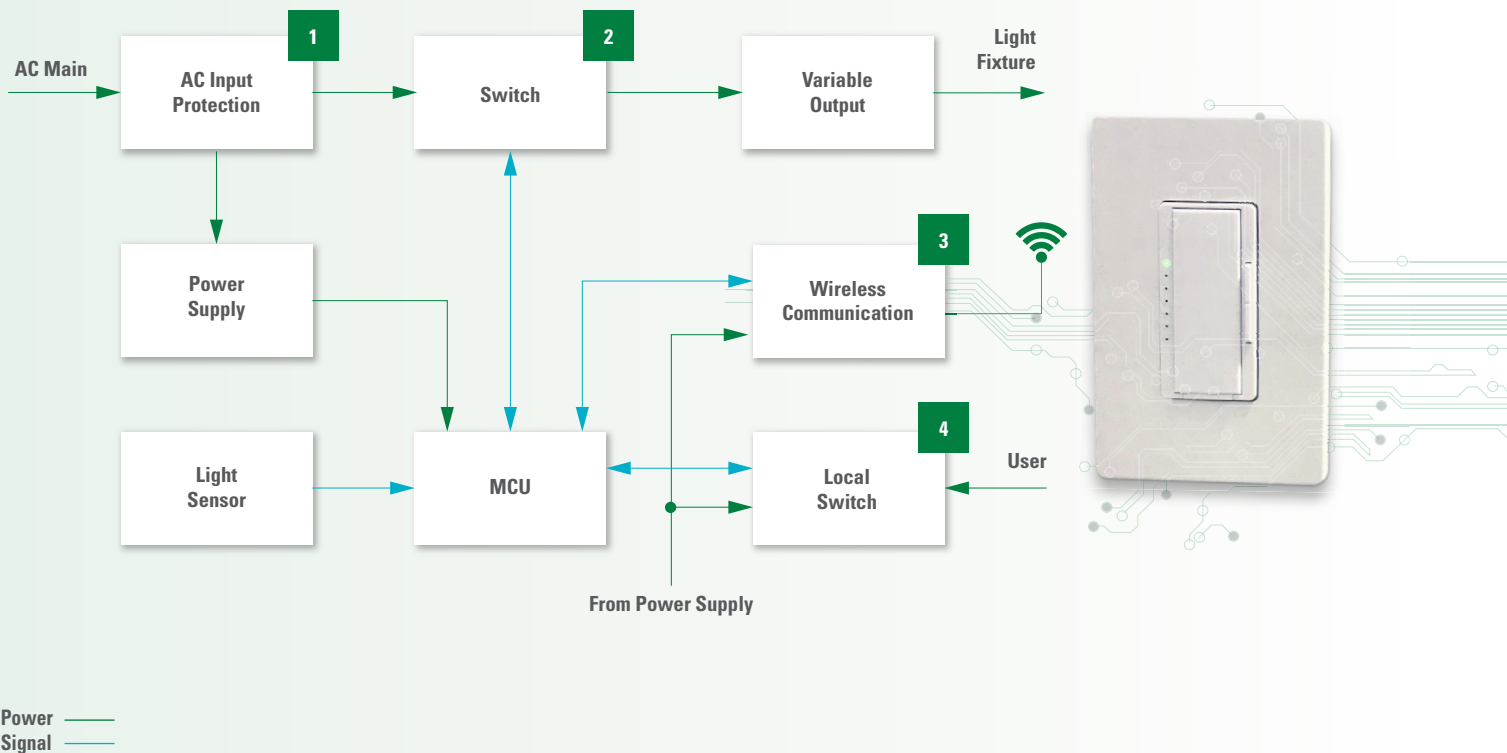


	Technology	Function in Application	Product Series	Features
1	Fuse	Protects input power stage and downstream components from faults due to overcurrent	<a href="#">Nano Pico</a>	Third-party compliance UL/IEC; low internal resistance; shock safe; vibration resistant
	MOV	Protects power unit from voltage surges, such as lightning and transients	<a href="#">UltraMOV</a>	High peak surge current rating up to 10 kA; high operating temperature range up to 125° C
	TVS Diode	Protects sensitive electronic components from voltage transients	<a href="#">SMCJ</a>	1500 W peak pulse capability; low, dynamic resistance; 0402 footprint
2	Schottky Diode	Rectification and blocking in power supply units	<a href="#">DST</a>	Ultra low forward voltage drop; high frequency operation
3	TVS Diode Array	Protects wireless chipsets from ESD induced by user	<a href="#">SP3213</a>	Space-efficient 0201 form factor; third-party compliance; low capacitance
	Polymer ESD Suppressor	Protects wireless chipsets from ESD induced by user	<a href="#">PESD</a>	Fast response (<1 nS); low leakage current; very low capacitance of 0.25 pF per I/O
4	TVS Diode Array Polymer ESD	Protects IC from ESD induced by user	<a href="#">SP3213</a> <a href="#">PESD</a>	Low capacitance of 1.0 pF per I/O



# Electronic Dimmer

More complex than a rheostat-controlled light switch, an electronic dimmer controls light levels using a solid-state MOSFET. The MOSFET and associated processor require DC power from a power supply. Often, electronic dimmers are internet enabled. Signal lines connect the antenna, light sensor, and manual switch to the processor.

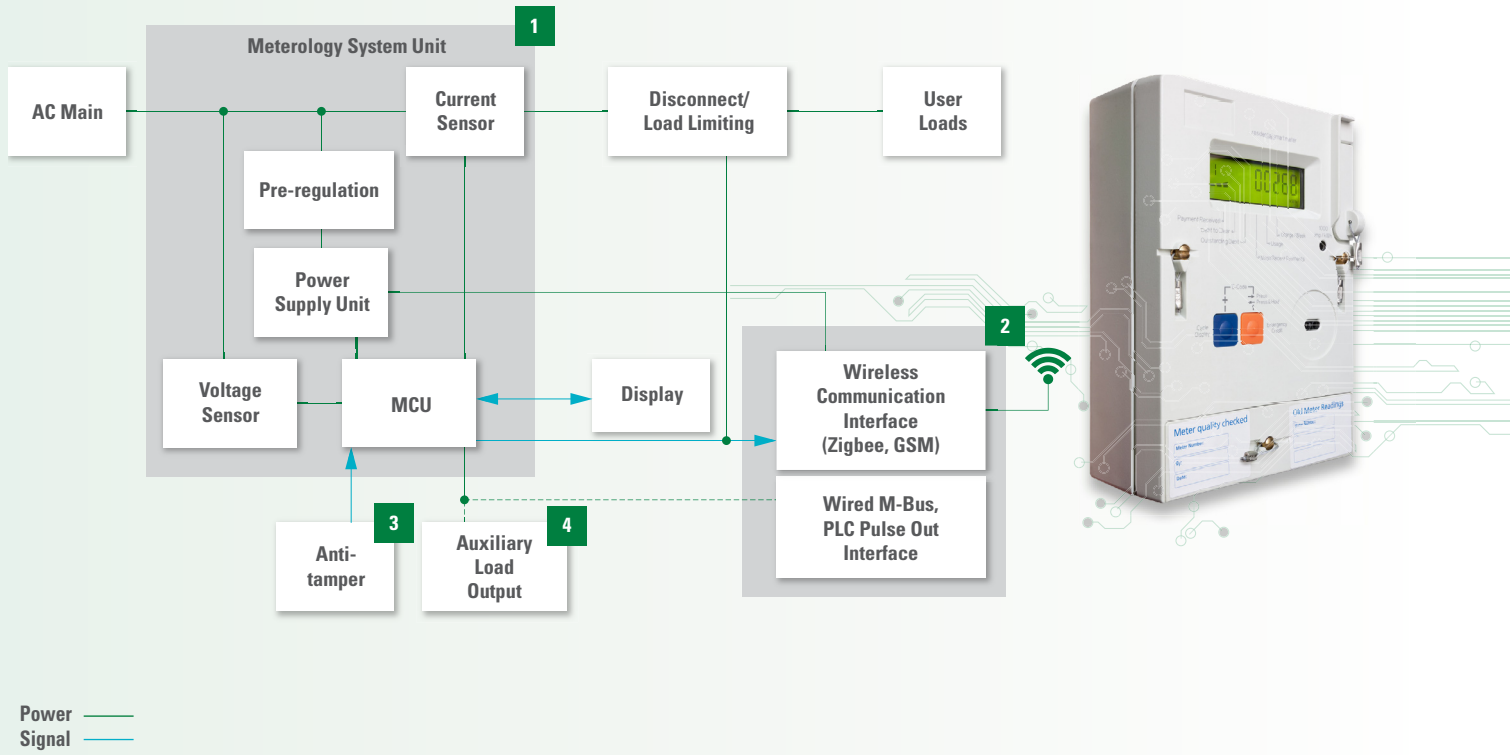


	Technology	Function in Application	Product Series	Features
1	Fuse	Protects input power stage and downstream components from faults due to overcurrent	<a href="#">Nano</a> <a href="#">Pico</a>	Third party compliance UL/IEC; low internal resistance; shock safe; vibration resistant
	MOV	Protects power supply from line voltage surges and meets regulatory requirements	<a href="#">UltraMOV</a>	High peak surge current rating up to 10 kA; high operating temperature range up to 125° C
	TVS Diode	Protects sensitive electronic components from voltage transients	<a href="#">SMCJ</a>	1500 W peak pulse capability; low, dynamic resistance; 0402 footprint
2	Triac	AC switching for dimming light	<a href="#">Q6008xH1LED</a>	UL 1557 recognized; full control of light output at low end of load conditions; high Tj (110° C)
	Gate Driver	High-side and low-side gate driver for Power MOSFETs	<a href="#">IX4340</a>	Capable of sourcing and sinking up to 5 A
	MOSFET	Turns power supply units on and off	<a href="#">X2 Class</a>	Low Rds(on), dv/dt ruggedness
	MOV	Protects power supply from line voltage surges and meets regulatory requirements	<a href="#">TMOV</a>	Integrated thermal protection device; high peak surge current rating up to 10 kA
3	TVS Diode Array	Protects wireless chipsets from ESD induced by user	<a href="#">SP3213</a>	Space-efficient 0201 form factor; third-party compliance; low capacitance
	Polymer ESD Suppressor	Protects wireless chipsets from ESD induced by user	<a href="#">PESD</a>	Fast response (<1 nS); low leakage current; very low capacitance of 0.25 pF per I/O
4	TVS Diode Array Polymer ESD	Protects IC from ESD induced by user	<a href="#">SP3213</a> <a href="#">PESD</a>	Low capacitance of 1.0 pF per I/O



# Electric Meter

Smart electric meters are key to advanced energy management. They send meter readings to the power utility through a wireless network similar to a mobile phone network. Their design follows their purpose: metrology unit, wireless interface, anti-tampering components, and an auxiliary load output for extensions into individual units in a building.

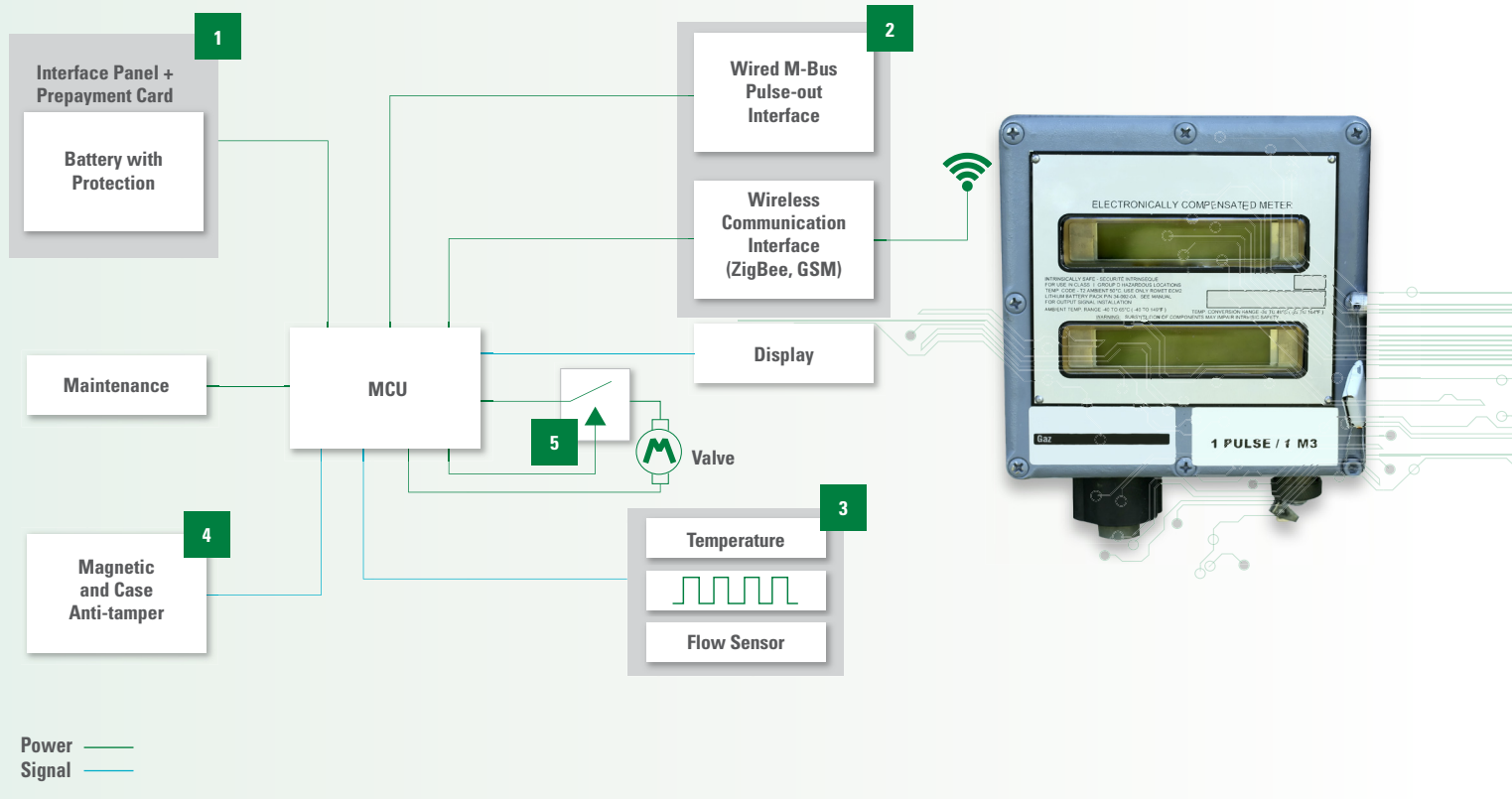


	Technology	Function in Application	Product Series	Features
1	MOV	Protects power unit from voltage transients and lightning	<a href="#">UltraMOV, C-III, TMOV</a>	High energy absorption capability: 40–530 J (2 ms)
	Cartridge Fuse	Protects power stage from overcurrent events	<a href="#">215, 514, 835</a>	Third-party compliance (UL/IEC); low internal resistance; shock safe
	TVS Diode	Protects electronic components from voltage transients	<a href="#">SMAJ, SMBJ</a>	1500 W peak pulse capability
	NTC	Protects power stage from high inrush current	<a href="#">ST, End-banded Chip</a>	Unique design enables them to handle extremely high current and voltage levels
	MOSFET/SiC MOSFET	Provides high-frequency load switching	<a href="#">Polar™, X2 Class, LSICM0170E1000</a>	Dynamic dv/dt rating; low R <sub>DS(ON)</sub> and Qg avalanche rated low package inductance
	PPTC	Protects power stage from overcurrent events	<a href="#">TRF600-150</a>	Resettable overcurrent protection; fast time-to-trip resistance sorted and matched devices available
	MOSFET	Provides switching function in pre-regulation circuit for charging capacitor	<a href="#">X2 Class</a>	Ultra-low on-resistance R <sub>DS(ON)</sub> and gate charge Qg; dv/dt ruggedness; low package inductance
2	TVS Diode Array	Protects wired communication interface from user-induced ESD events	<a href="#">AQxx-02HTG, LC03-3.3</a>	Absorbs repetitive ESD strikes (+/- 30 kV contact and air discharge)
	SIDACtor®	Protects sensitive electronic components from damage due to lightning surges	<a href="#">SEP0xx</a>	Low insertion loss; log-linear capacitance; low clamping voltage
	Solid State Relay	Provides isolation of pulse-out signal between MCU and MBus	<a href="#">PLA192, CPC1394, PLA193, PLA194</a>	Up to 3750 V <sub>RMS</sub> input/output isolation; UL/IEC certified; low drive power
3	Reed Switch	Prevents magnetically induced tampering	<a href="#">MDSR-10</a>	Hermetically sealed; magnetically operated contacts
4	Solid State Relay	Provides isolation from MCU for pulse-out signal	<a href="#">PLA192, CPC1394, CPC1983YE, PLA193</a>	Up to 3750 V <sub>RMS</sub> input/output isolation; UL/IEC certified; low drive power
	TVS, MOV	Protects auxiliary I/O from voltage transients due to overload	<a href="#">SMCJ, SMZ</a>	Excellent clamping-capability; low incremental surge resistance



# Gas and Water Meter

A smart gas meter or smart water meter sends readings to the utility via a wireless link. It is usually battery powered, so it must be designed for low power consumption. Temperature and flow sensors send signals to the microcontroller, which sends readings to the wireless interface. Other signal lines connect to anti-tamper components and a display. Some meters read payment cards and have a user interface panel.

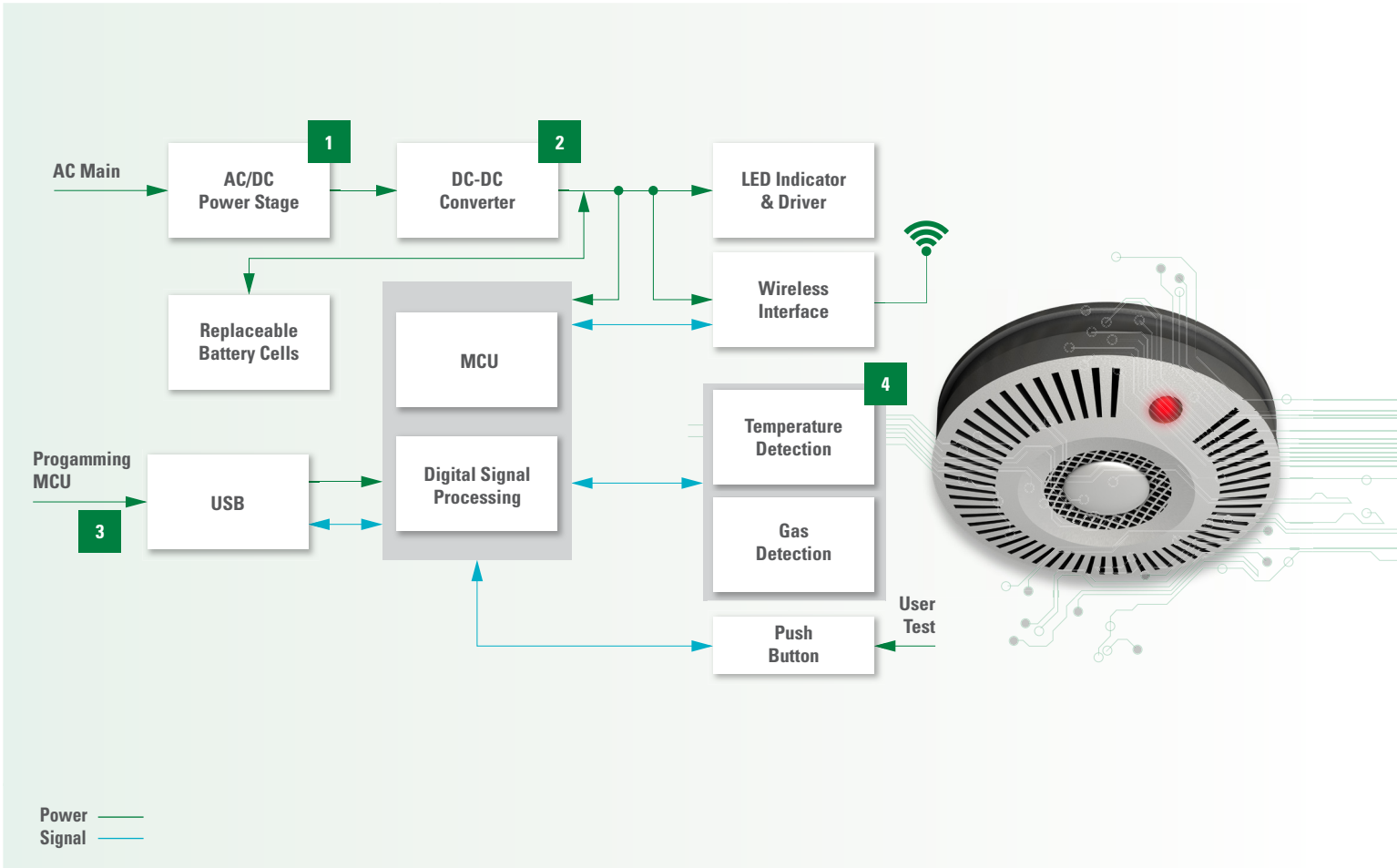


	Technology	Function in Application	Product Series	Features
1	Fuse PPTC	Protects power stage from overcurrent events	<a href="#">Atex 259 / 304, 437</a> <a href="#">Femto, Nano</a>	Resettable; third-party compliance (UL/IEC); low internal resistance
	TVS Diode	Protects sensitive electronic components from voltage transients	<a href="#">SMBJ, SMCJ</a>	1500 W peak pulse capability; low and dynamic resistance; 0402 footprint
2	TVS Diode Array	Protects wired communication interface from user induced ESD events	<a href="#">AQxx-02HTG</a>	ESD: IEC 61000-4-2, ±30 kV contact, ±30 kV air; EFT: IEC 61000-4-4, 50 A (5/50 ns); low clamping voltage
	SIDACTor®	Protects sensitive electronic component damage due to lightning surges	<a href="#">SEP0xx</a>	Low insertion loss; log-linear capacitance; combined longitudinal and metallic protection
3	Solid State Relay	Provides isolation of pulse-out signal between MCU and MBus	<a href="#">PLA192, CPC1394</a> <a href="#">PLA193, PLA194</a>	Up to 3750 V <sub>RMS</sub> input/output isolation; UL/IEC certified; low drive power
	NTC	Sensing temperature of gas or water in specific meters	<a href="#">MELF style, End-banded Chip, Thermistor assembly</a>	Surface mountable; fast thermal response
4	Reed Switch	Sensing flow of gas or water in specific meters	<a href="#">MDSR-10</a>	Hermetically sealed; magnetically operated contacts
	Reed Switch	Prevents magnetically induced tampering	<a href="#">59166</a> <a href="#">MDSM-4</a>	Hermetically sealed; magnetically operated contacts
5	Solid State Relay	Provides isolation from MCU for pulse-out signal	<a href="#">PLA192, CPC1394</a> <a href="#">CPC1983YE, PLA193, PLA194</a>	Up to 3750 V <sub>RMS</sub> input/output isolation; UL/IEC certified; low drive power



# Fire and Smoke Alarm

Smart fire and smoke alarms send a message to a mobile phone when they detect heat or smoke. Inside the alarm, signal lines link the MCU and digital signal processing to the wireless interface, temperature and gas detectors, test push button, and USB port (used for programming). Designs that receive power from AC mains rather than from batteries must convert the power to DC at the proper voltage.



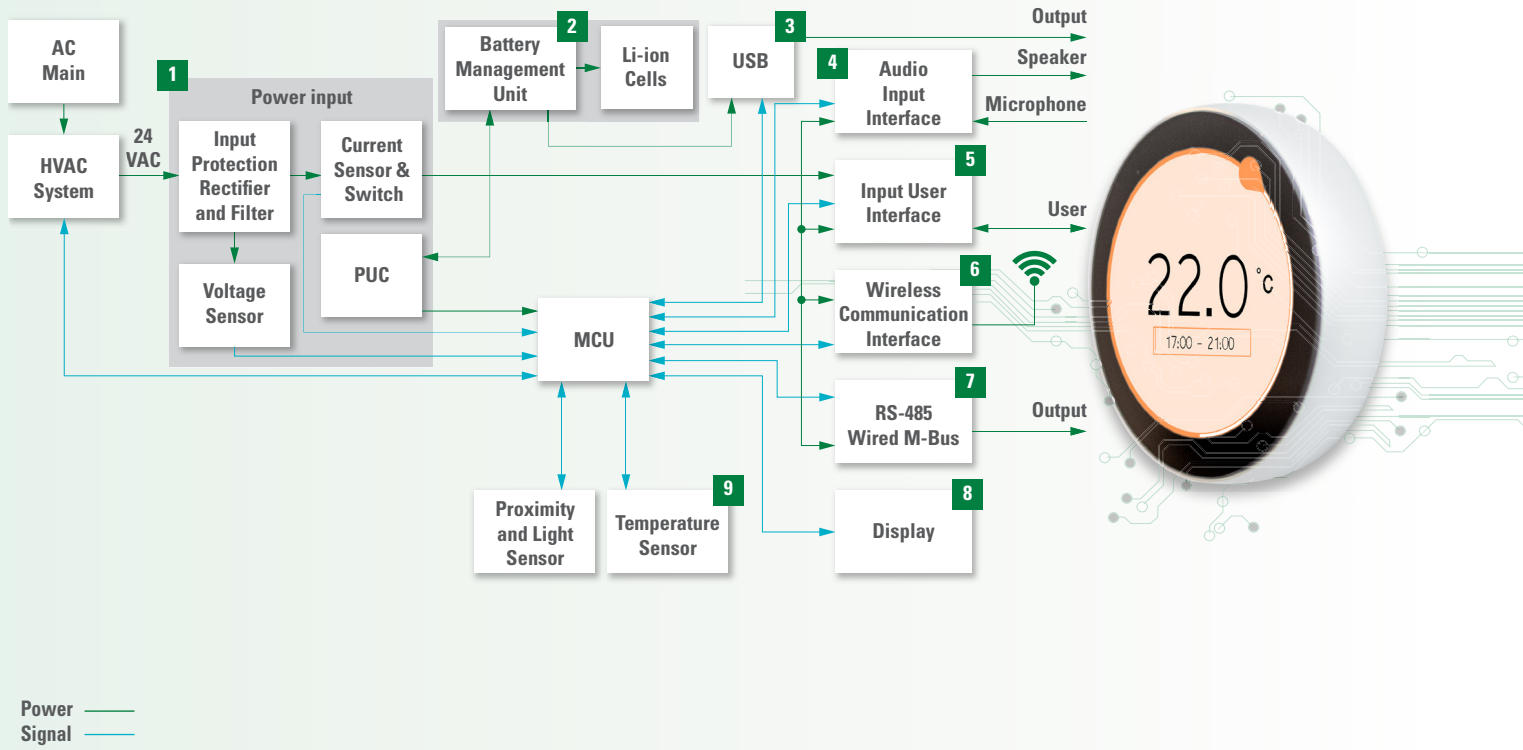
	Technology	Function in Application	Product Series	Features
1	Fuse	Protects power stage from overcurrent events	<a href="#">875</a> <a href="#">807, 373</a>	Third-party compliance (UL/IEC); low internal resistance; shock safe; vibration resistant
	MOV	Helps protect power unit from voltage surges and lightning events on AC line	<a href="#">C-III</a> <a href="#">LA</a>	Can meet wide-set surge withstand specifications: 40–530 J (2 mS)
	MOSFET	Main switching transistor in SMPS	<a href="#">X2 Class</a>	Low $R_{ds(on)}$ ; low gate charge and dv/dt ruggedness
2	TVS Diode	Protects sensitive electronic components from voltage transients	<a href="#">SMCJ</a>	1500 W peak pulse capability; low, dynamic resistance; 0402 footprint
3	PPTC	Protection against front-end short circuit and overload current conditions	<a href="#">Nano</a> <a href="#">Pico</a>	Ultra-low internal resistance; higher current holding in smallest SMD package
	MLV	ESD protection for data lines	<a href="#">MLA</a>	Bidirectional clamping; low form factor; wide operational temperature range
4	NTC	Temperature sensing	<a href="#">KC</a>	High reliability; small form factor; fast thermal response





# Smart Thermostat

Smart thermostats are programmable thermostats that are internet capable, allowing remote control through Wi-Fi and smart phones. Additional functions in design include wireless communication (antenna) and an audio interface (speaker and microphone). Other function blocks include the temperature sensor, local user interface and display, processor, power input, and USB port.

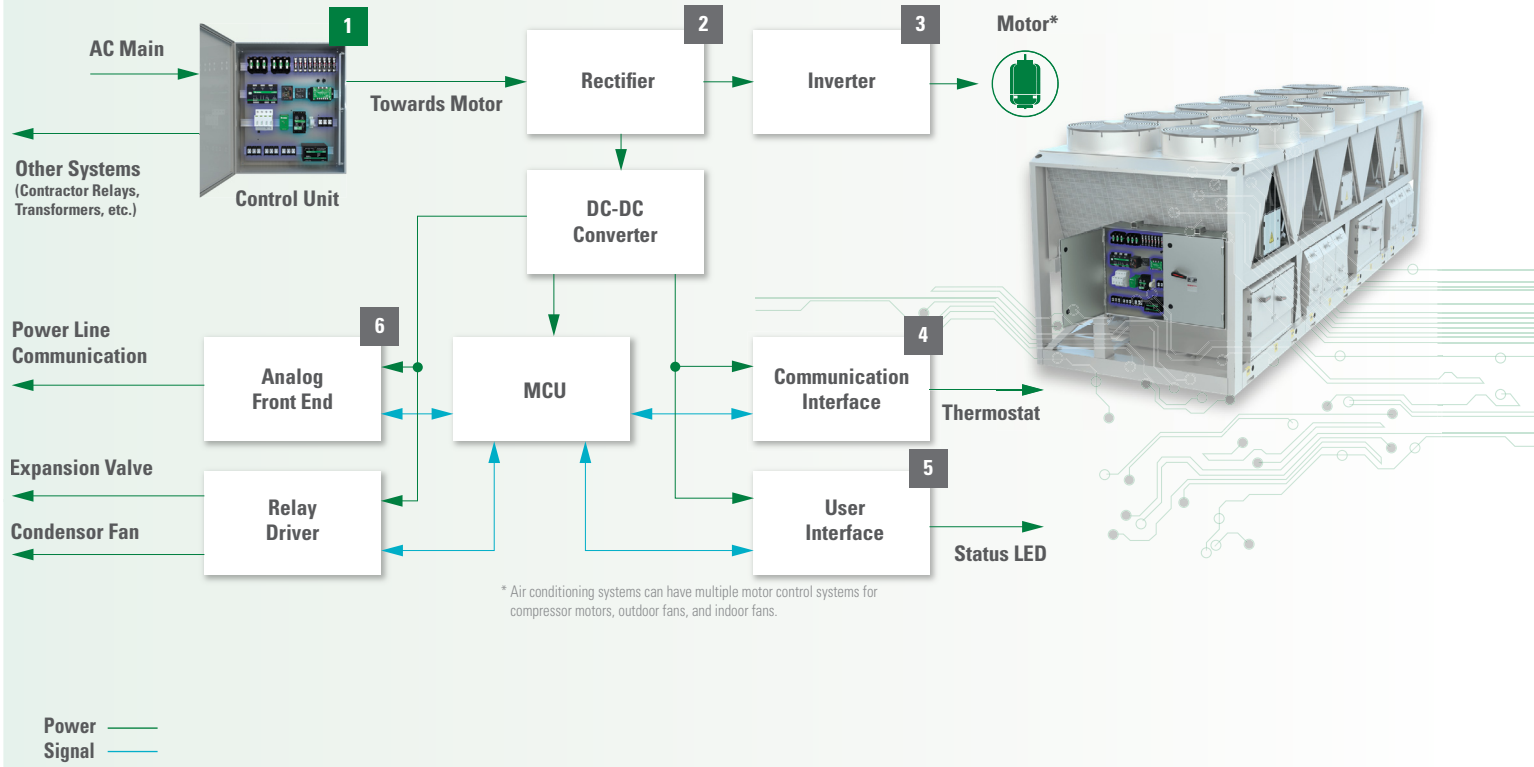


	Technology	Function in Application	Product Series	Features
1	Chip Fuse 24 VAC	Power unit protection from overcurrent	<a href="#">437, 468</a>	-55° C - 150° C operating temperature
	PPTC	Power unit protection from OC or OT	<a href="#">2920L, SMDC</a>	Low profile
	TVS Diode	Power unit protection from voltage transients	<a href="#">SACB, SMAJ, SMF3.3</a>	Excellent clamping capability
	Relay Driver	Latching relay driver	<a href="#">CPC1601, CPC1001</a>	No EMI/RFI generation
2	TVS Diode, MLV	Protects IC from transient voltage surge	<a href="#">MLA, SMF</a>	Meets IEC global standards
	PPTC	Protects thermostat from OT and OC	<a href="#">femto, Nano, Pico</a>	Compact design with many options
3	Strap PPTC	Rechargeable battery cell protection	<a href="#">MXP, SL</a>	Installs directly on battery
	TVS Array	USB - Protects ICs from ESD	<a href="#">SESD, SPXX</a>	Low capacitance of 1.0 pF per I/O
4	PPTC	USB - Protects electronics from OC	<a href="#">0402L, femto</a>	Compact design
	TVS Array	Audio interface - Protects ICs from ESD	<a href="#">SACB, SMAJ, SMBJ</a>	Excellent clamping capability
5	TVS Array	User interface - Protects ICs from ESD	<a href="#">PESD, SP3213-01UTG</a>	Low capacitance of 1.0 pF per I/O
6	TVS Array	Wireless interface - Protects ICs from ESD	<a href="#">SP3213-01UTG</a>	Low capacitance of 1.0 pF per I/O
	Polymer ESD	Wireless interface - Protects ICs from ESD	<a href="#">PESD</a>	Low leakage current
7	TVS Array	RS-485 - Protects ICs from ESD	<a href="#">SM712</a>	+12 V/-7 V Standoff
8	TVS Diode, MLV	Display - Protects ICs from ESD	<a href="#">MLA, PLED, SMF</a>	Low capacitance of 1.0 pF per I/O
			<a href="#">SM, DO-35</a>	Glass encapsulated thermistors
9	NTC	Temperature sensing	<a href="#">RB</a>	Used in hybrid substrates and integrated circuits



# HVAC – Control Unit

Motor control systems control the heating and cooling of the HVAC unit by monitoring environmental temperatures and adjusting blower performance to reach desired temperatures. The control cabinet houses circuit protection devices that protect AC lines, control circuitry, power semiconductors, and compressor and blower motors.

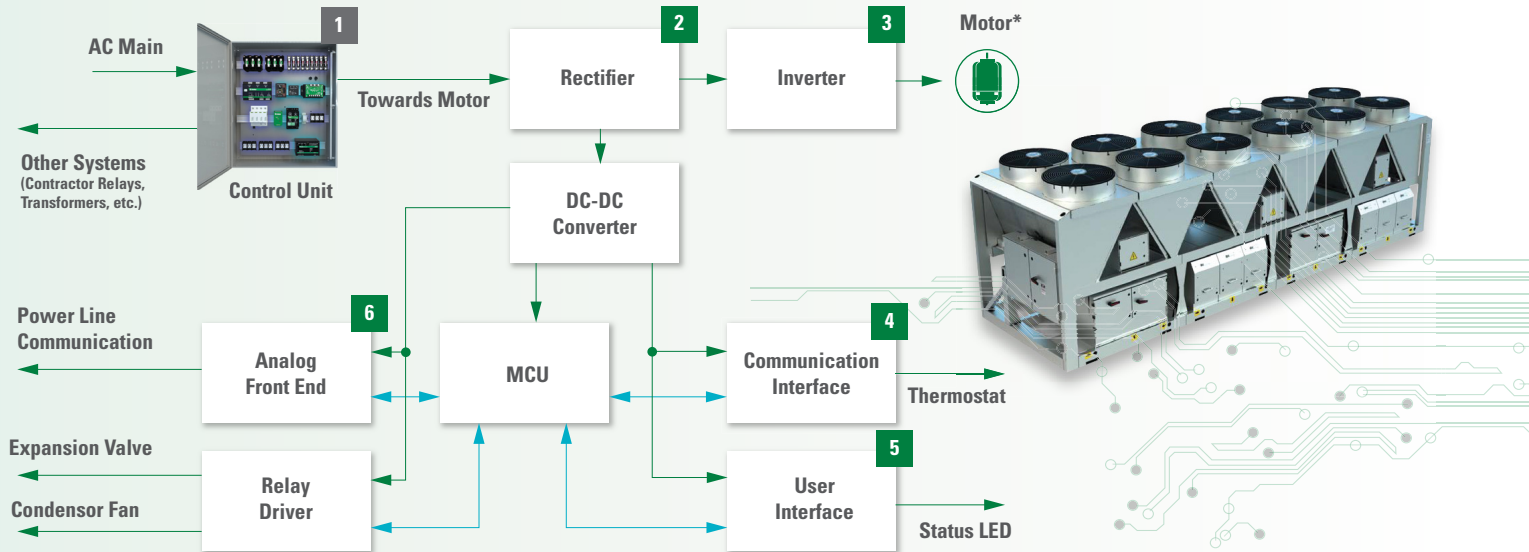


Technology	Function in Application	Product Series	Features
UL Class Fuses	Protects HVAC system from overload and short circuits	<a href="#">CCMR, KLDB, KLKR, KLKD, FLNR, FLSR, JLLN, JLLS, JTD</a>	Voltage range 0–600 V and current ratings from 0.1–1200 A
Type 2 Surge Protection Devices	Protects from power fluctuations or surges	<a href="#">SPD2</a>	20 kA nominal interrupting rating and 50 kA maximum interrupting rating
SIDACTor® + MOV	Low clamp protection for AC power line	<a href="#">Pxxx0FNL</a> <a href="#">Pxxx0ME + UltraMOV</a>	Lower clamping voltage, lower leakage current (NA level)
TVS Diode	Protects power line from transient surges	<a href="#">High Voltage AK</a> <a href="#">LTKAK</a>	High-power TVS 8/20 μs rating from 1 to 20 kA in axial lead or SMT form factor
Three-Phase Voltage Monitors	Protects compressors and blower motors	<a href="#">460, 201A</a> <a href="#">250A, 455</a>	Universal range from 190 to 480 VAC or 475 to 600 VAC and 50/60 Hz
AC Current Transducers and Sensors	Used as an AC current-proof relay to indicate if a motor is operating	<a href="#">TCSA20,</a> <a href="#">LSRX-C, LSRX</a>	Monitors 0–20 A (TCSA20) Energizes the output contact whenever 4.5 A or greater is present (LSRX-C, LSRX)
Time Delay Relays	Delays the blower from turning on or off after the demand has been met	<a href="#">TMV, CT1, TRU1,</a> <a href="#">TS1, TH1, TDUH, TDUB</a>	Universal AC/DC operating voltage; solid-state output and total encapsulation for protection against shock, vibration, and humidity
Solid State Relay	Isolation switch	<a href="#">CPC40055ST</a> <a href="#">CPC1998J</a>	Blocking voltage up to 800 V and load current up to 20 A <sub>RMS</sub> ; input-to-output isolation - 2500 V <sub>RMS</sub>
Reed Sensor	Provides open/close detection to protect from physical harm or equipment damage	<a href="#">59140</a> <a href="#">57140</a>	Application-specific customization available, wide range of sensitivity available



# HVAC – Drive System

HVAC systems have several functional sections. AC power is rectified to drive the DC motor. Control is provided through high-speed switching of the IGBT module. The system depends on communication between its subcomponents, including microcontroller, motor speed and temperature sensors, thermostat, and user controls.



\* Air conditioning systems can have multiple motor control systems for compressor motors, outdoor fans, and indoor fans.

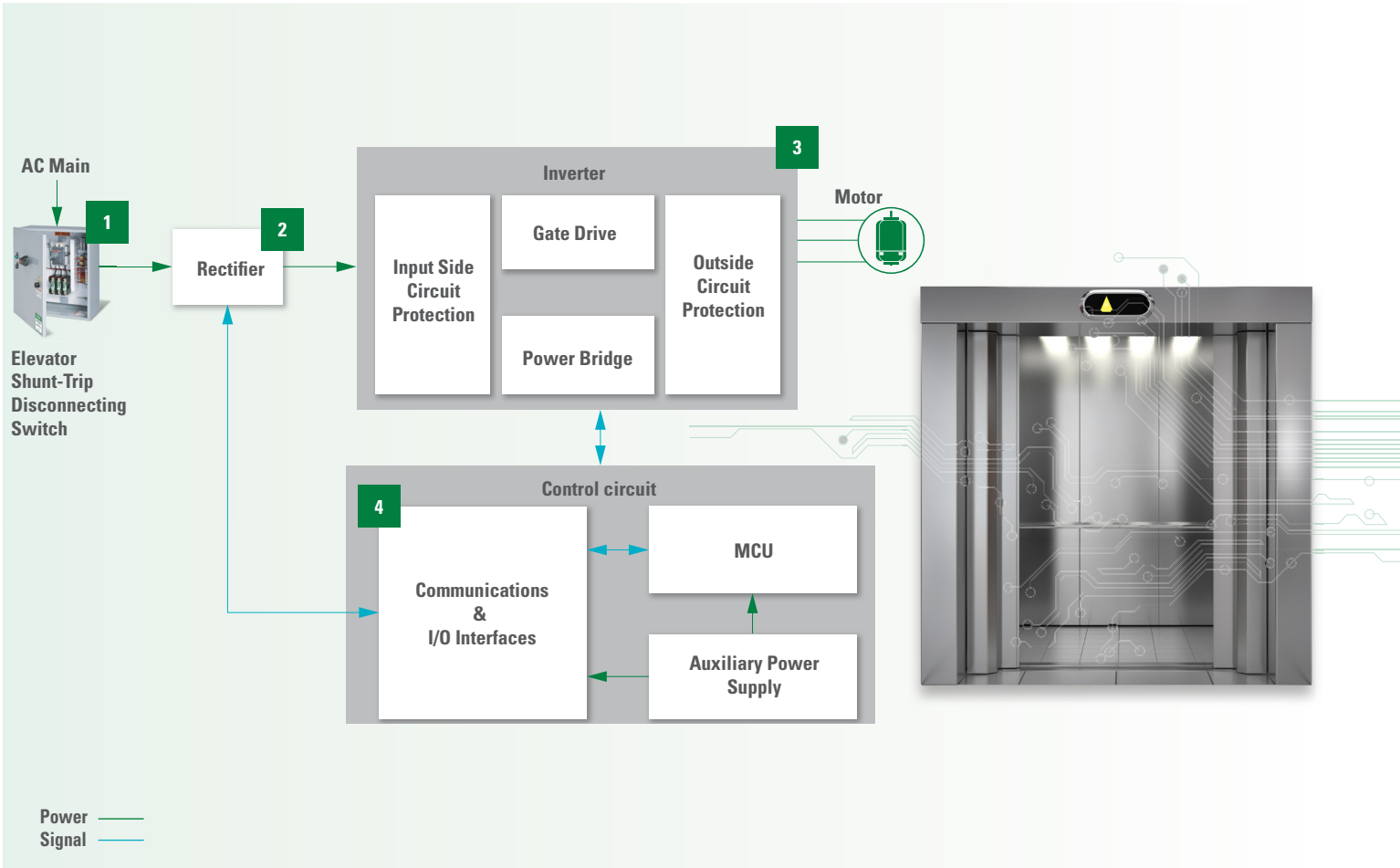
Power ———  
Signal ———

	Technology	Function in Application	Product Series	Features
2	Rectifier Module	Converts AC line voltage supplied to the drive to DC	<a href="#">MDD</a> <a href="#">VUQ</a>	Package with DCB ceramic; very low forward voltage drop and low leakage current
3	IGBT Module	Switching power supplies	<a href="#">MIXA</a> <a href="#">MIXG</a>	Rugged design with thin wafer technology; short-circuit rated for 10 μsec, low gate charge; low EMI and competitive low $V_{ce(sat)}$
	TVS Diode	IGBT gate protection	<a href="#">SMBJ</a> <a href="#">SMCJ</a>	Critical for IGBT active clamping during an IGBT turn-off event and helps in operating an IGBT in a safe and active mode
	High-speed Fuse	Protects semiconductor devices in inverter	<a href="#">QS</a> <a href="#">PSR</a>	QS: 500–700 VAC, 450–700 VDC 35–800 A; PSR: 550–1300 VAC, 500–1000 VDC, 40–2000 A
	NTC	Semiconductor temperature measurement	<a href="#">USUR1000</a> <a href="#">SM</a>	UL recognized with ring lug mounting; SM NTCs is in hermetically sealed MELF package suitable for operation up to 220° C
4	TVS Diode Array	Protects wireless chipsets from ESD induced by user	<a href="#">SP3213</a>	Space-efficient 0201 form factor; third-party compliance; low capacitance
5	Polymer ESD Suppressor	Protects the Wi-Fi chipset from user-induced ESD events	<a href="#">PGB10603</a> <a href="#">PGB10402</a>	Ultra-low capacitance; compact form factor; low leakage current; fast response time
6	TVS Diode	Overvoltage protection	<a href="#">15KPA</a>	Excellent clamping capability; 15 kW peak pulse capability



# Elevator/Escalator Drive System

Elevator motor control systems provide precise vertical lift and speed measurement control for elevators, allowing them to stop level with the floor. By determining the position and speed of travel of the elevator, that information can be used to control and adjust the elevator's motor speed.

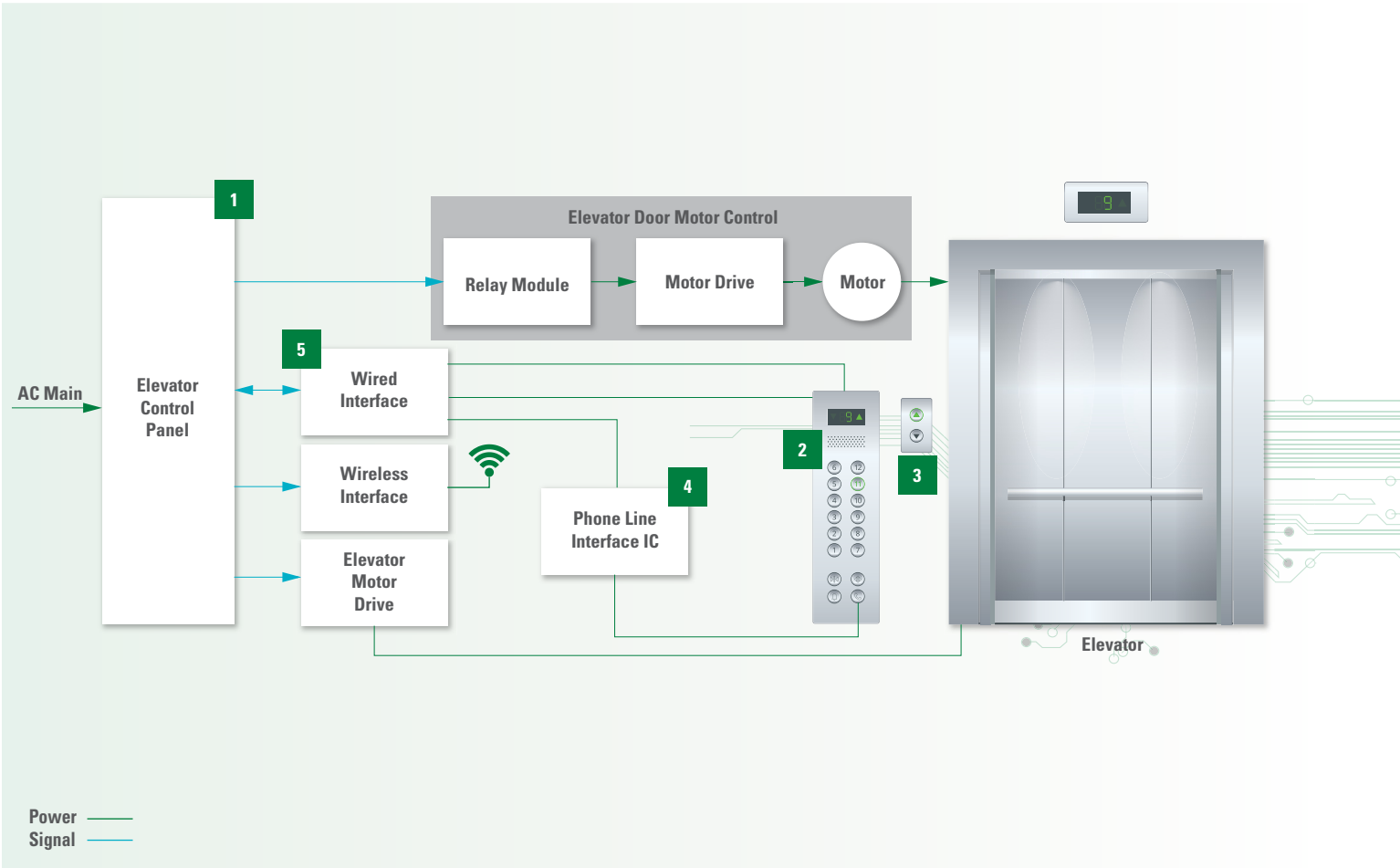


	Technology	Function in Application	Product Series	Features
1	Elevator Shunt-Trip Disconnecting Switch	Selective coordination and shunt-trip disconnecting means	<a href="#">LPS</a>	UL-listed pre-engineered solutions; 200 kA SCCR; meets NEC 620.91 requirement for elevators and legally required standby systems
2	Rectifier Module	Converts AC line voltage supplied to the drive to DC	<a href="#">MDD</a> <a href="#">VUO</a>	Packaged with DCB ceramic; very low forward voltage drop and low leakage current
3	IGBT Module	Switching power supplies	<a href="#">MIXA</a> <a href="#">MIXG</a>	Rugged design with thin wafer technology; short-circuit rated for 10 μsec; low gate charge; low EMI and competitive low $V_{ce(sat)}$
	High-speed Fuse and Micro-switch	Protects semi-conductor devices inside the inverter	<a href="#">QS</a> <a href="#">PSR</a>	Various current and voltage ratings
4	TVS Diode Array	Protects from ESD, EFT, and lightning-induced surges	<a href="#">SP1004</a> <a href="#">SP0402</a> , <a href="#">SM712</a>	Ultra-low capacitance (0.2 pF); low clamping voltage; small form factor



# Elevator Cabin Solutions

Elevator access control systems determine the floors that a user can reach based on the door access control credentials. Once appropriate access is determined, users can control the elevator through the user interface to take them to the desired floor.



	Technology	Function in Application	Product Series	Features
1	Reed Switch	Provides open and close control signal to the electronic panel	<a href="#">59145</a>	Magnetically operated proximity sensor; rated for high-temperature application up to 105° C; customer-defined sensitivity
	Magnetic Actuator		<a href="#">57145</a>	
2	Solid State Relay	Elevator load control	<a href="#">CPC1510</a> <a href="#">CPC1511</a>	Integrated current limit and thermal shutdown; blocking voltage up to 230 V and load current up to 450 mA
3	Solid State Relay	Isolation switch	<a href="#">CPC40055ST</a> <a href="#">CPC1998J</a>	Blocking voltage up to 800 V and load current up to 20 A <sub>RMS</sub> ; input-to-output isolation - 2500 V <sub>RMS</sub>
4	Solid State Relay	Creates isolation barrier between low voltage equipment and high-voltage telephone networks	<a href="#">CPC5622</a>	3 kV <sub>RMS</sub> line isolation; superior voice solution with low noise and excellent part-to-part gain accuracy; transmits power up to +10 dBm in to 600 Ω
5	TVS Diode Array	Protects from ESD, EFT, and lightning-induced surges	<a href="#">SP1004</a> <a href="#">SP0402</a> , <a href="#">SM712</a>	Ultra-low capacitance (0.2 pF); low clamping voltage; small form factor

# Intelligent Appliances

Intelligent appliances are now part of smart home automation. Refrigerators, coffee machines, robotic vacuum cleaners, air purifiers, robotic lawn mowers, smart lights, and blinds and many more belong to this category. Littelfuse offers solutions for a wide variety of circuit protection, power semiconductor, and sensing products for these applications. Scan or click to download detailed presentations about these applications below.



Large Appliances



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Surge Protection Devices

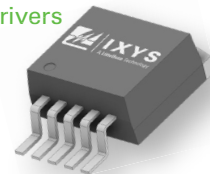
TVS Diode Arrays



Fuses



Gate Drivers



Industrial & UL-Class Fuses



High-Speed Fuses



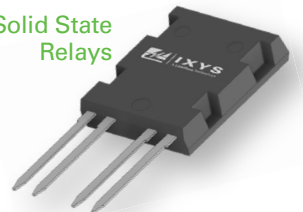
Multi-Oxide Varistors



SMD Fuses



Solid State Relays



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### Circuit Protection Products Selection Guide

This guide provides a summary of key circuit protection consideration factors, descriptions of the technologies Littelfuse offers, and product selection tables. It is designed to help you quickly find a protection solution appropriate to your application.



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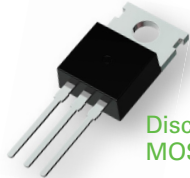
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PPTCs



Discrete MOSFETs



SCR Thyristors

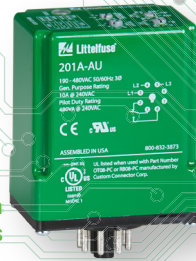


TVS Diodes

Reed Switches



Protection Relays



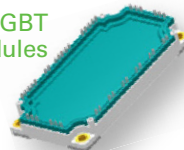
Discrete IGBTs



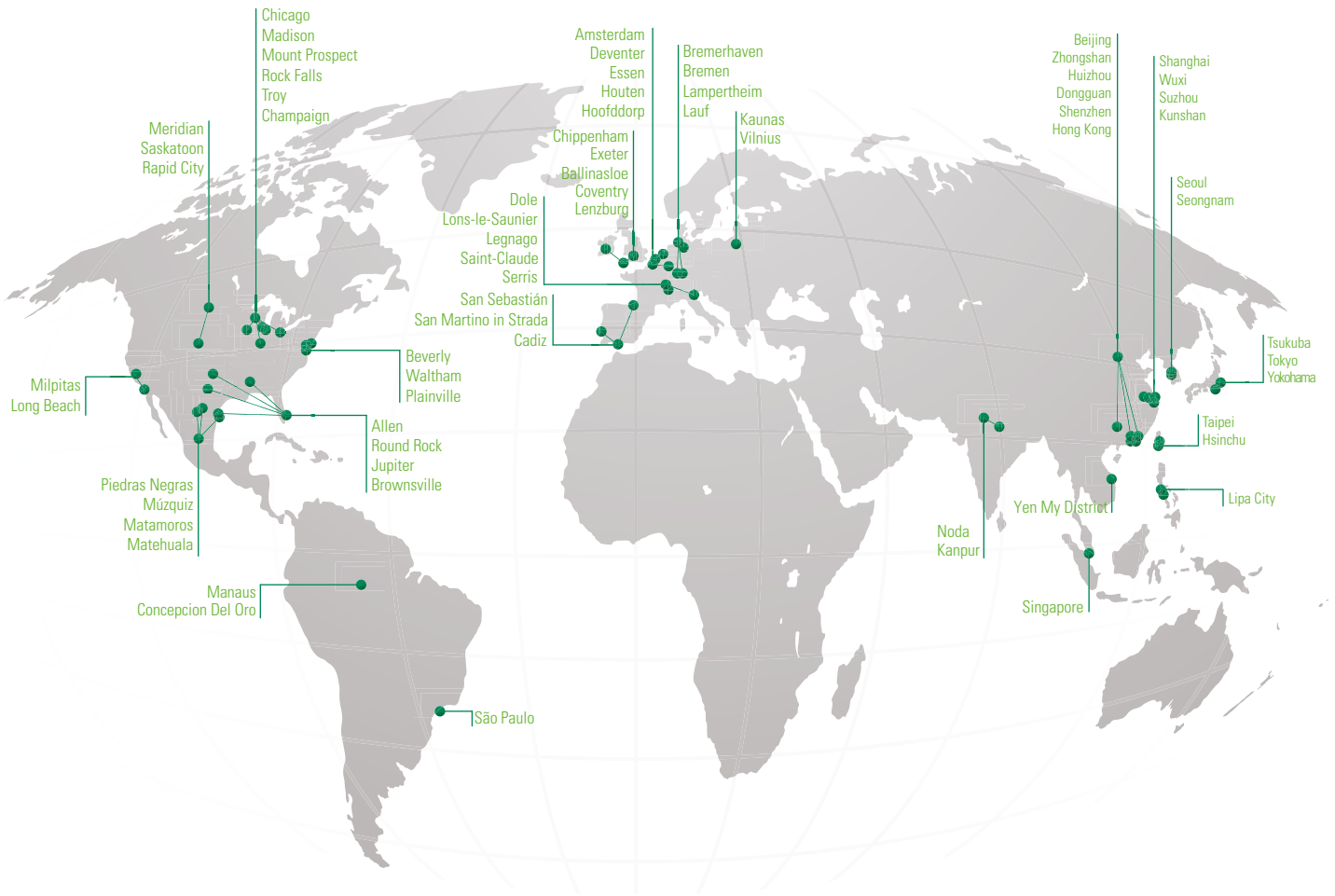
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IGBT Modules



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