



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



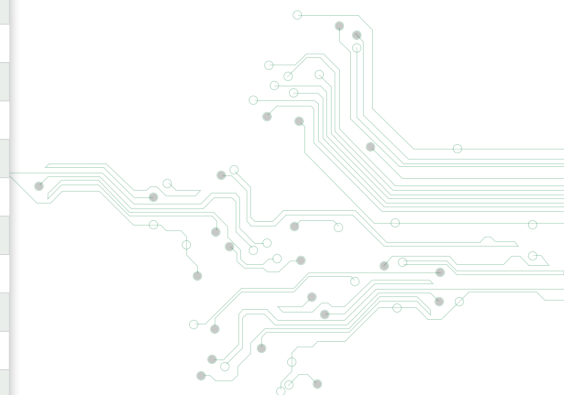
Smart Meter



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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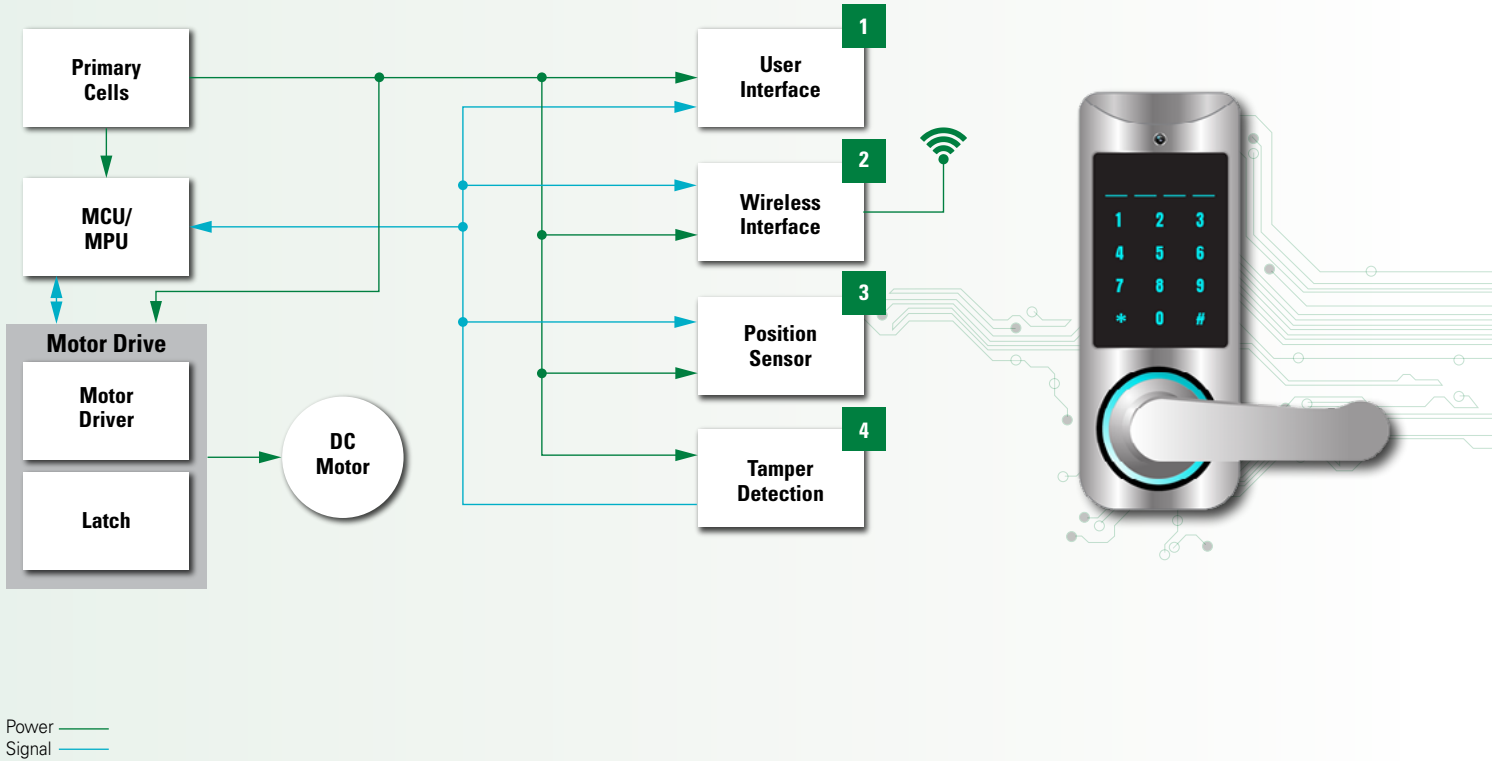


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Smart Lock

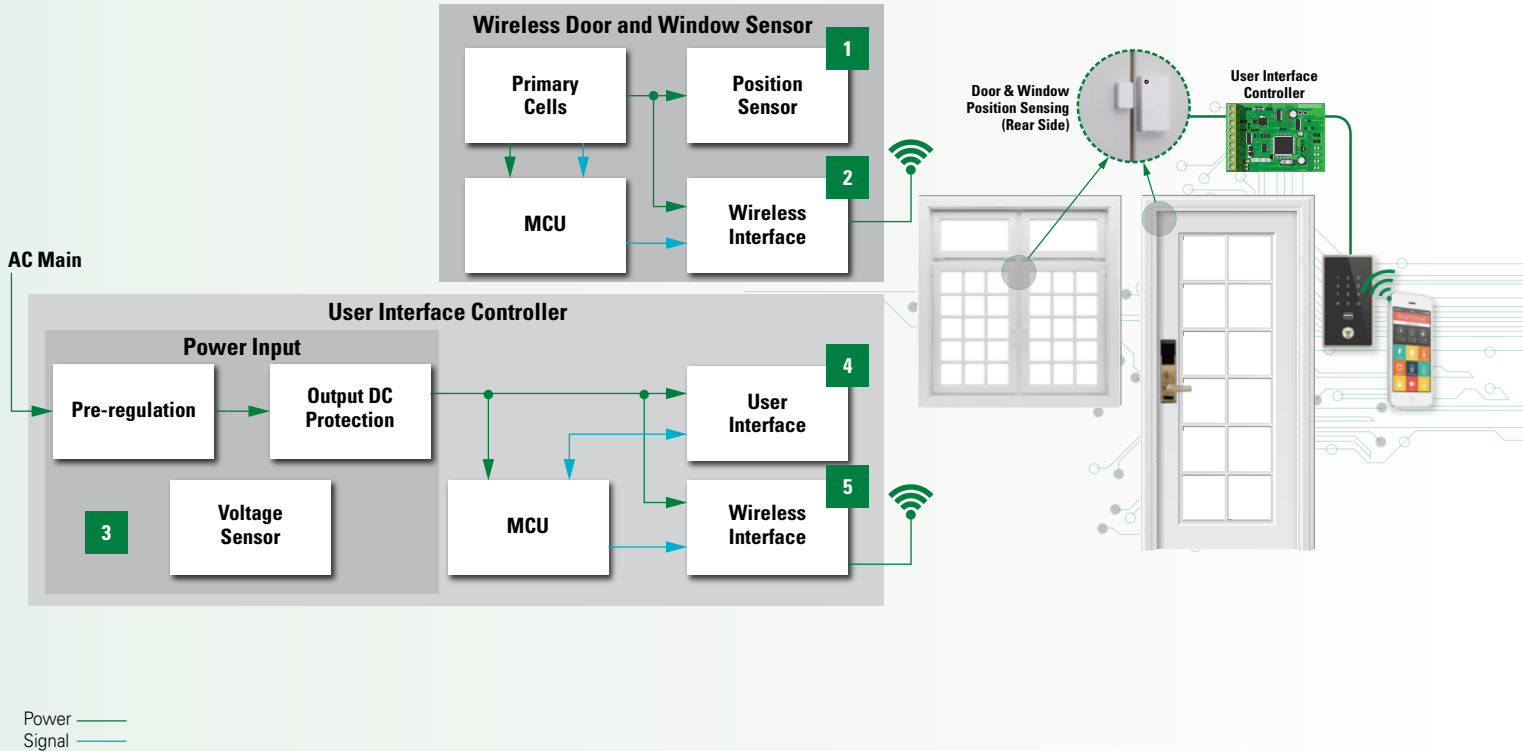
A smart lock on a door is more than a simple lock; it is a system that includes a user interface, position sensors, battery, processor, and DC motor that moves the latch. Smart locks use a wireless interface, allowing local control through a smartphone and remote control via a PC connected to a communications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



	Technology	Function in Application	Product Series	Features
1	TVS Diode Array	Protects touchscreen ICs from user-induced ESD events	SP1012 SP1003	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	PGB10603 PGB10402	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	MDSM-4 MDSR-10, H-36	Hermetically sealed; magnetically operated contacts
4	Reed Switch	Alerts user if someone is tampering with the lock	59166	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.

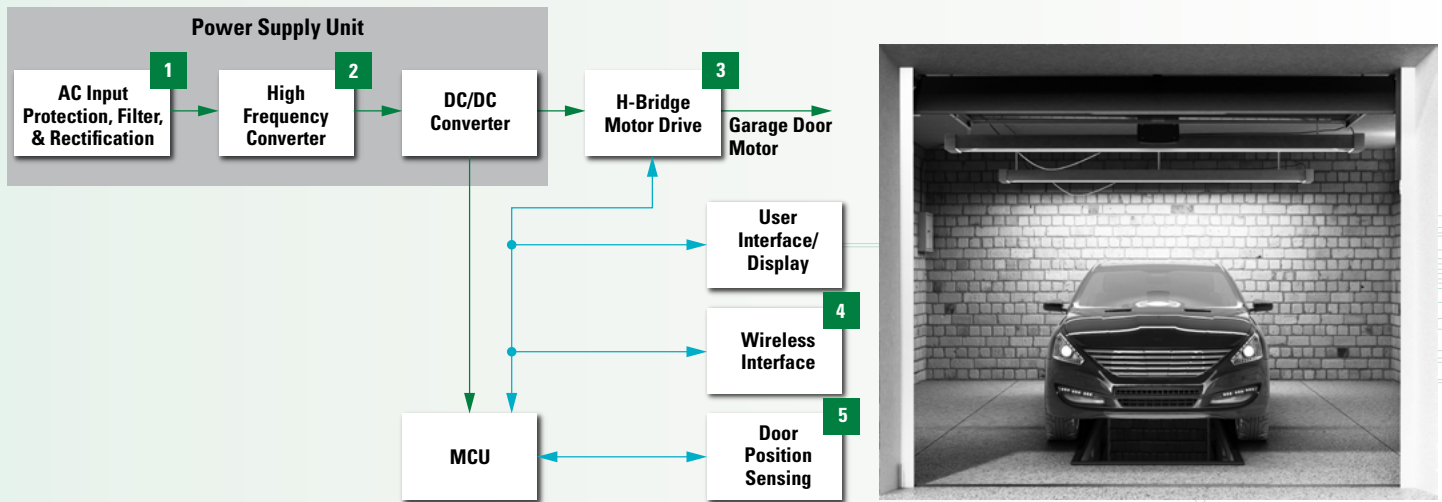


	Technology	Function in Application	Product Series	Features
1	Reed Switch and Magnetic Actuator	Open/closed proximity detection of the window or door	MDSM-4 MDSR-10, H-36	Hermetically sealed; magnetically operated contacts
2	Polymer ESD Suppressor	Protects the Wi-Fi chipset from user-induced ESD events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



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 ———

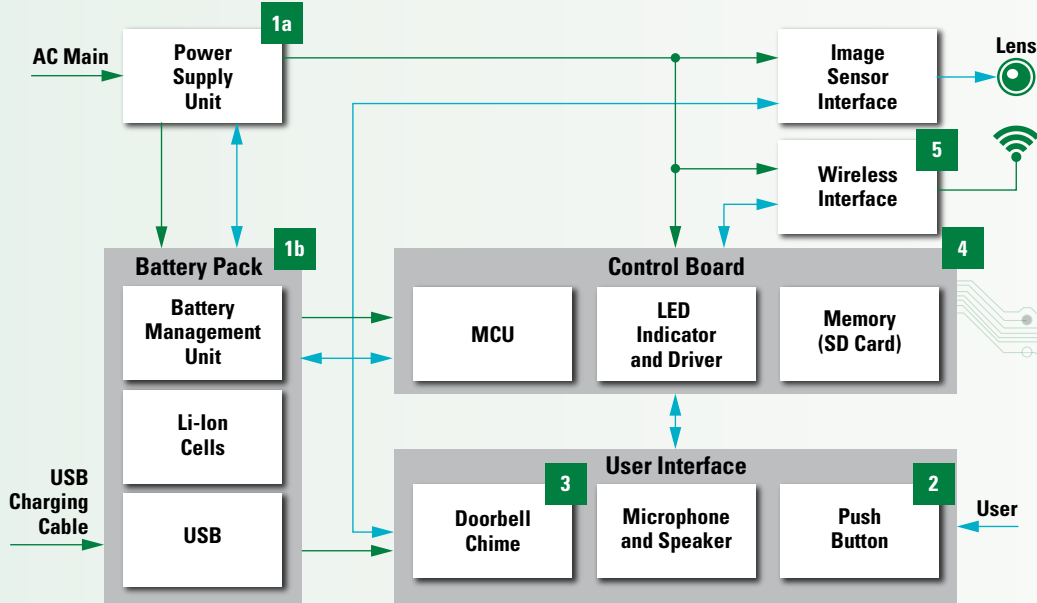
	Technology	Function in Application	Product Series	Features
1	Fuse	Protects power stage from overcurrent events	835 215	Third-party compliance (UL/IEC); low internal resistance; shock safe; vibration resistant
	MOV	Protects power supply from line voltage surges and meets regulatory requirements	UltraMOV TMOV	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	X2 Class	Low Rds(on), dv/dt ruggedness
3	Hall Effect Sensor	Position and speed sensing of the motor	55140 55100	Magnetically operated position sensing; built-in temperature compensation; high switching speed up to 10 kHz
	NTC	Temperature sensing of the door motor	USUR1000 SM	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	SP3213	Space efficient, 0201 form factor; third-party compliance; low capacitance
5	Reed Switch	Proximity detection of the door to verify if fully open/closed	59166 MDSM-4 , MDSM-10	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.



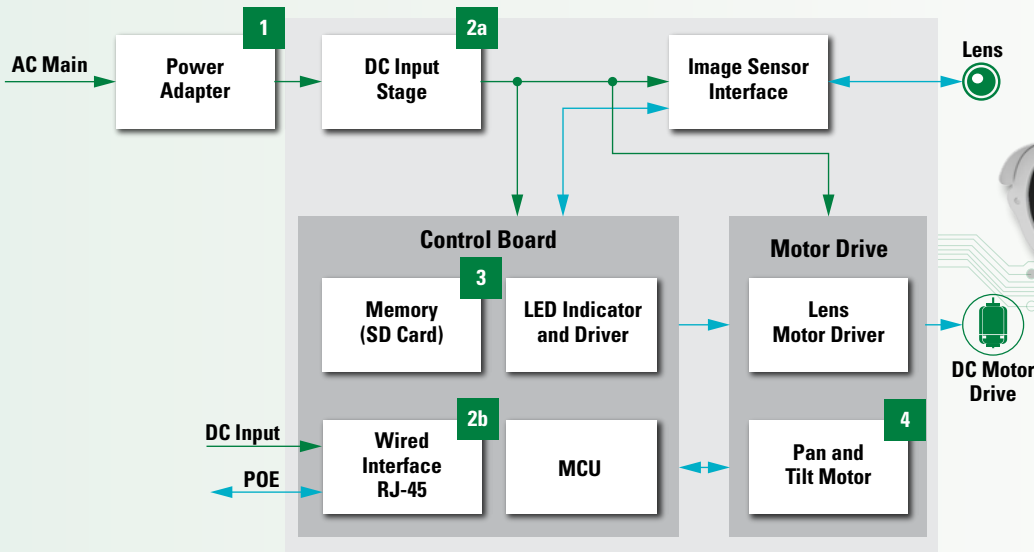
Power ———
Signal ———

	Technology	Function in Application	Product Series	Features
1a	Fuse	Protects the power stage from overcurrent events	443 449	Surface mountable; wide range of current ratings, time lag
	Solid State Relay	Optically isolated switch	PLB190	5000 V _{RMS} input/output isolation; no EMI/RFI generation; arc-free with no snubbing circuits
	TVS Diode	Protects sensitive electronic components from voltage transients	4.0SMDJ24A	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	469 449	Surface mountable; wide range of current ratings available
	TVS Diode	Protects sensitive electronic components from voltage transients	SMBJ	600 W peak pulse power capability; fast response time (<1.0 ps)
	MLV	ESD protection for data lines	MLA	Bidirectional clamping, low form factor; wide operational temperature range
2	TVS Diode Array	Protects memory card from user-induced ESD event	SP1006	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	LCB710	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	SP1006	Industry-smallest footprint available (0201); low leakage current
5	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



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.

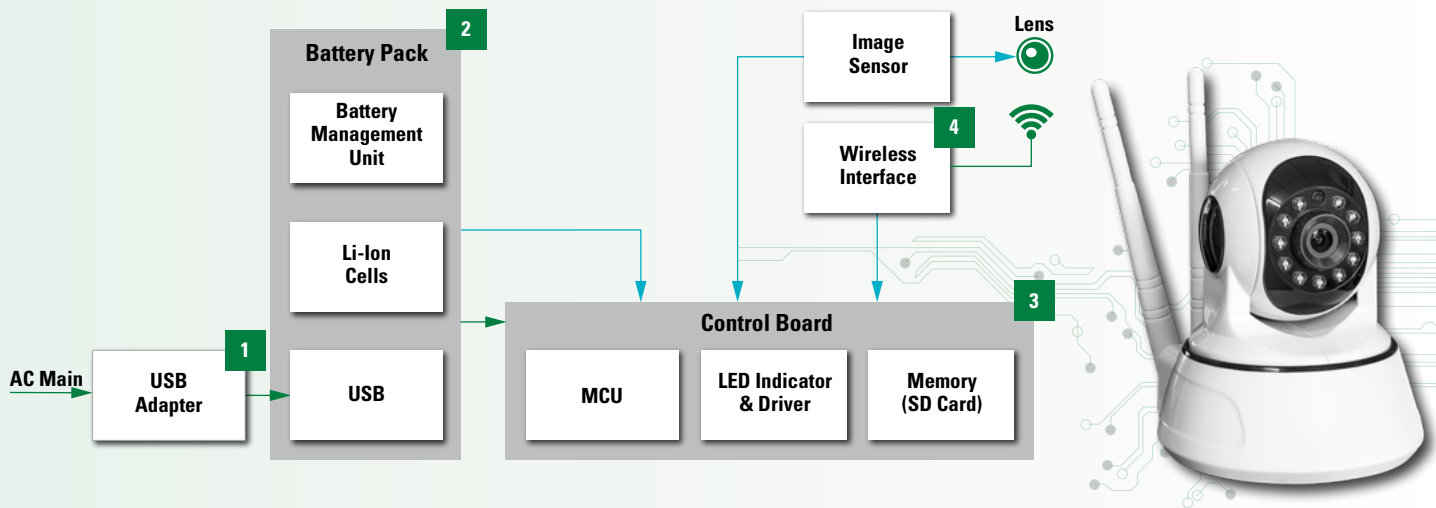


	Technology	Function in Application	Product Series	Features
1	Fuse	Protects power stage from overcurrent events	875 807, 373	Third-party compliance (UL/IEC); low internal resistance; shock safe; vibration resistant
	MOV	Protects power unit from voltage transients and lightning	C-III, LA UltraMOV	High 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
2a	Fuse	Protects the power stage from overcurrent events	461, 449 picoSMD	Surface mountable; resettable option
	TVS Diode	Protects sensitive electronic parts in the power stage from voltage transients	5.0SMDJ	5000 W peak pulse capability
2b	Fuse, PPTC	Protects power stage from overcurrent events	461, 449 picoSMD	Surface mountable; resettable option
	TVS Diode Array	Protects the sensitive electronic parts from voltage transients	SRV05-4HTG SP0504SHTG	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	SP1006	Industry's smallest footprint available (0201); low leakage current
4	Solid State Relay	Optically isolated switch to drive motor	CPC1651	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.



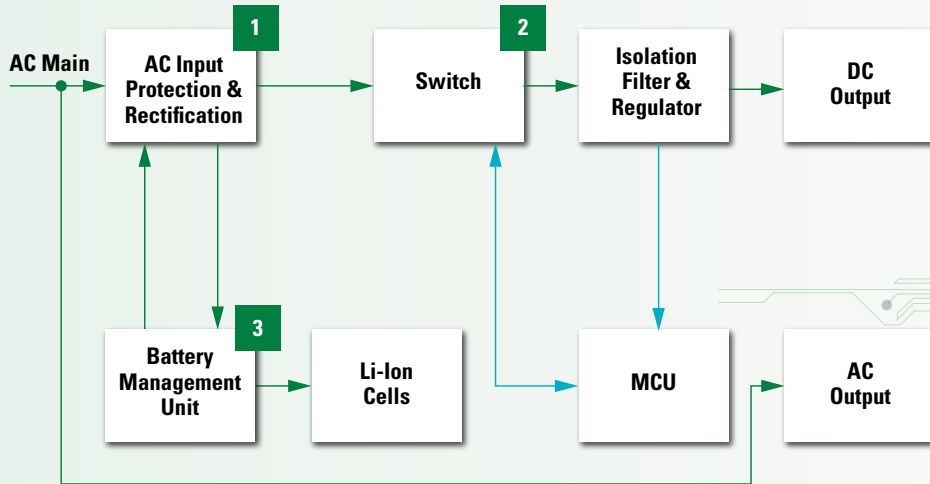
Power ———
Signal ———

	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

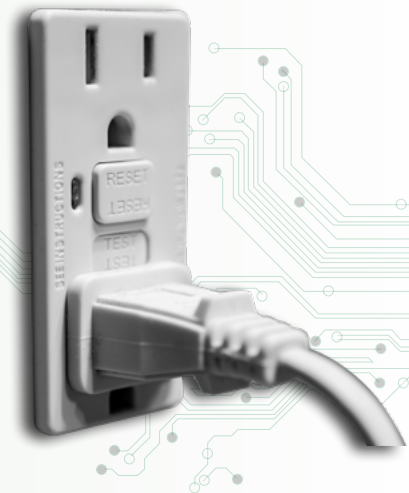
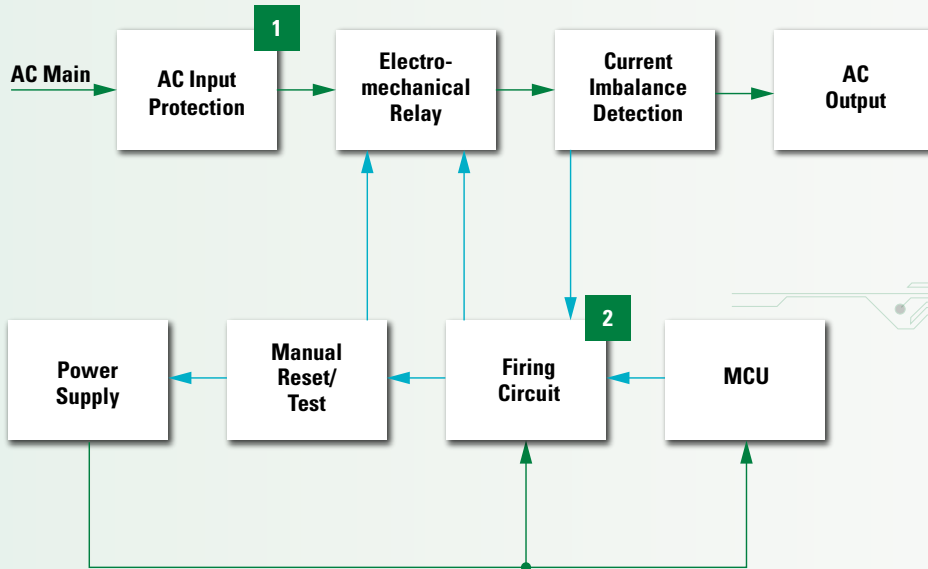
Power ———
Signal ———

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



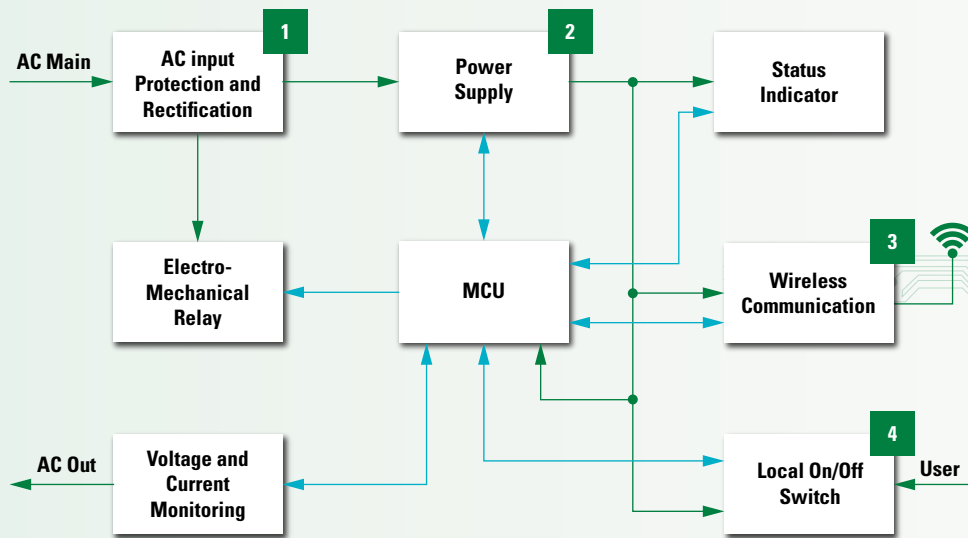
Power ———
Signal ———

	Technology	Function in Application	Product Series	Features
1	Fuse	Protects input power stage and downstream components from faults due to overcurrent	Nano Pico	Third-party compliance UL/IEC; low internal resistance; shock safe; vibration resistant
	MOV	Protects power unit from voltage surges, such as lightning and transients	UltraMOV	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	SMCJ	1500 W peak pulse capability; low, dynamic resistance; 0402 footprint
	SCR	Triggers electro-mechanical relay to disengage electrical contacts during fault	Sjxx08xSx / Sjxx08xx	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 ———

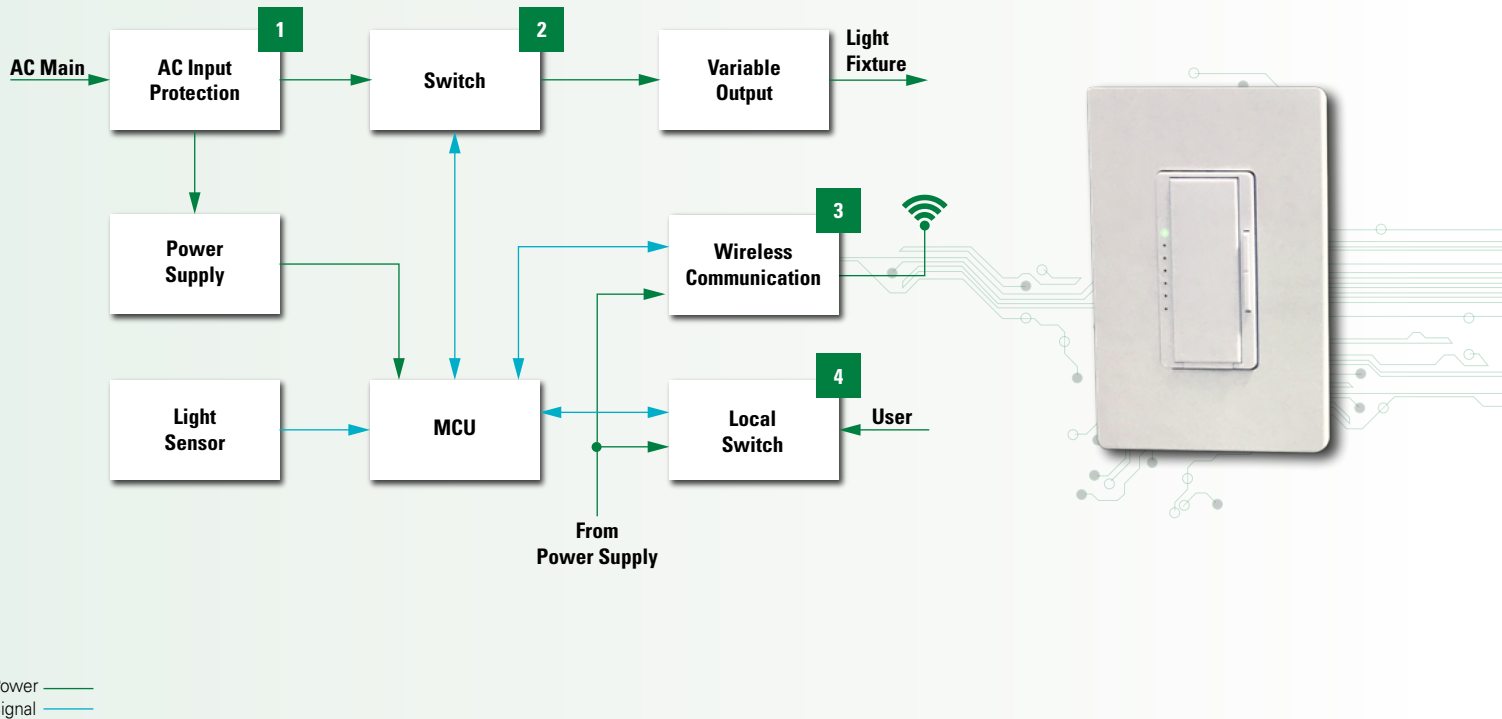


	Technology	Function in Application	Product Series	Features
1	Fuse	Protects input power stage and downstream components from faults due to overcurrent	Nano Pico	Third-party compliance UL/IEC; low internal resistance; shock safe; vibration resistant
	MOV	Protects power unit from voltage surges, such as lightning and transients	UltraMOV	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	SMCJ	1500 W peak pulse capability; low, dynamic resistance; 0402 footprint
2	Schottky Diode	Rectification and blocking in power supply units	DST	Ultra low forward voltage drop; high frequency operation
3	TVS Diode Array	Protects wireless chipsets from ESD induced by user	SP3213	Space-efficient 0201 form factor; third-party compliance; low capacitance
	Polymer ESD Suppressor	Protects wireless chipsets from ESD induced by user	PESD	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	SP3213 PESD	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.

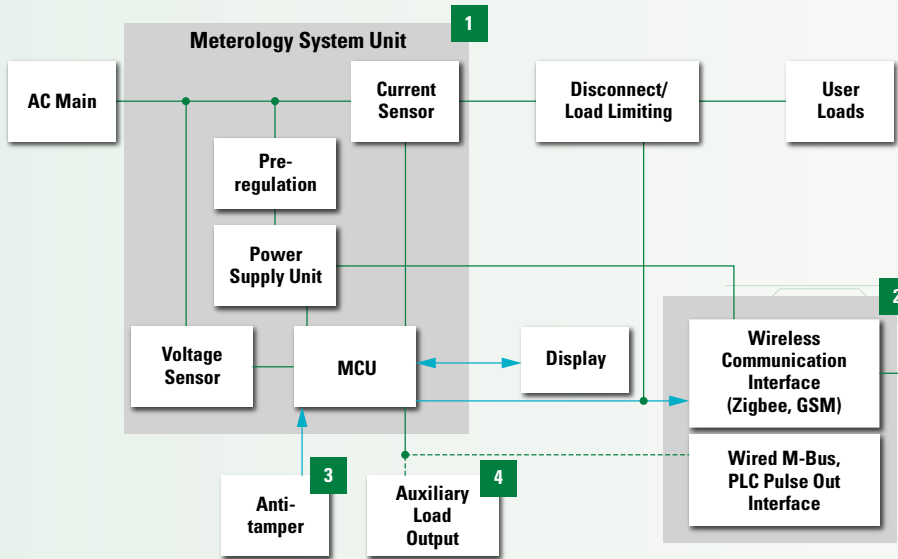


	Technology	Function in Application	Product Series	Features
1	Fuse	Protects input power stage and downstream components from faults due to overcurrent	Nano Pico	Third party compliance UL/IEC; low internal resistance; shock safe; vibration resistant
	MOV	Protects power supply from line voltage surges and meets regulatory requirements	UltraMOV	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	SMCJ	1500 W peak pulse capability; low, dynamic resistance; 0402 footprint
2	Triac	AC switching for dimming light	Q6008xH1LED	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	IX4340	Capable of sourcing and sinking up to 5 A
	MOSFET	Turns power supply units on and off	X2 Class	Low Rds(on), dv/dt ruggedness
	MOV	Protects power supply from line voltage surges and meets regulatory requirements	TMOV	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	SP3213	Space-efficient 0201 form factor; third-party compliance; low capacitance
	Polymer ESD Suppressor	Protects wireless chipsets from ESD induced by user	PESD	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	SP3213 PESD	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.



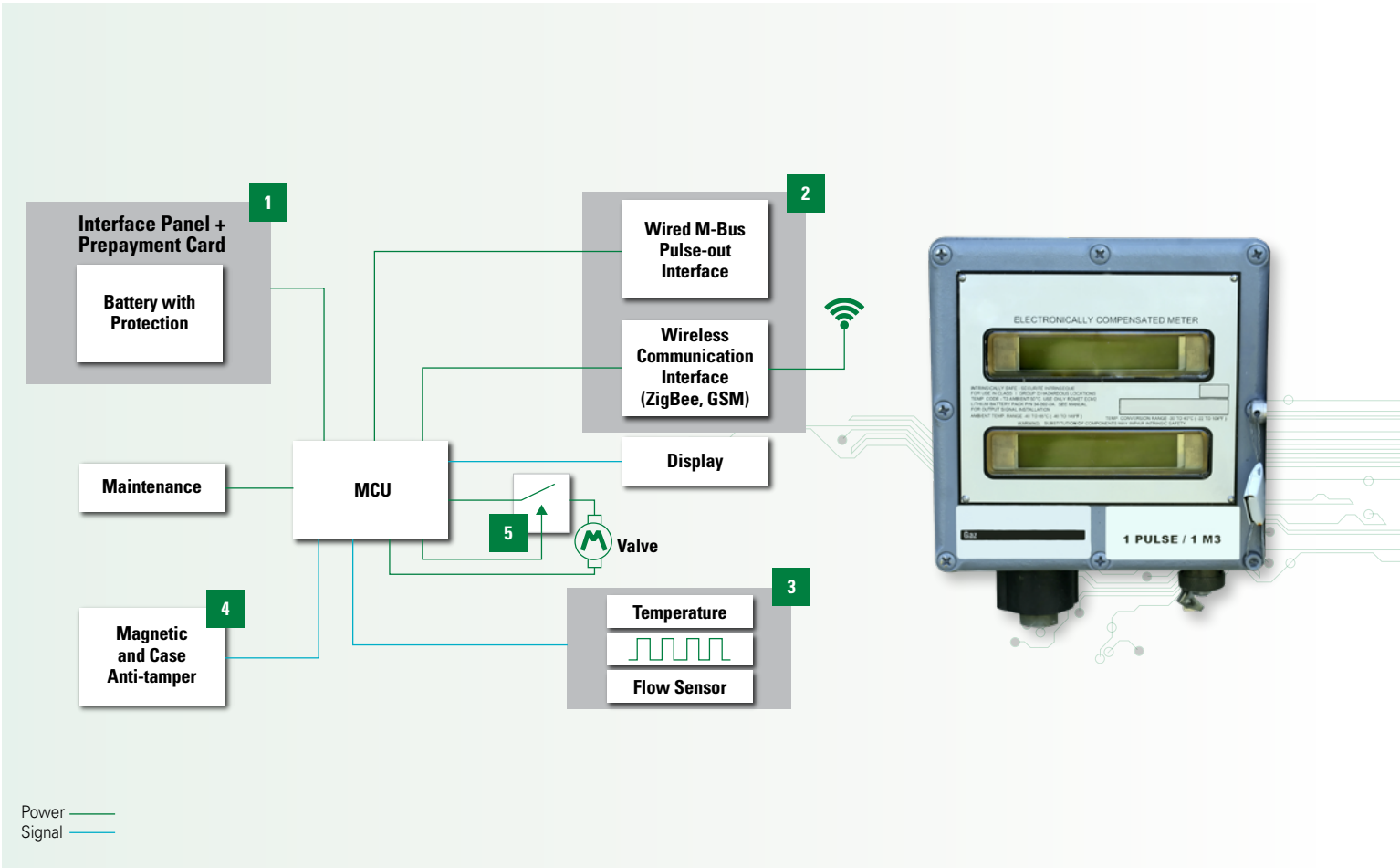
Power ———
Signal ———

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

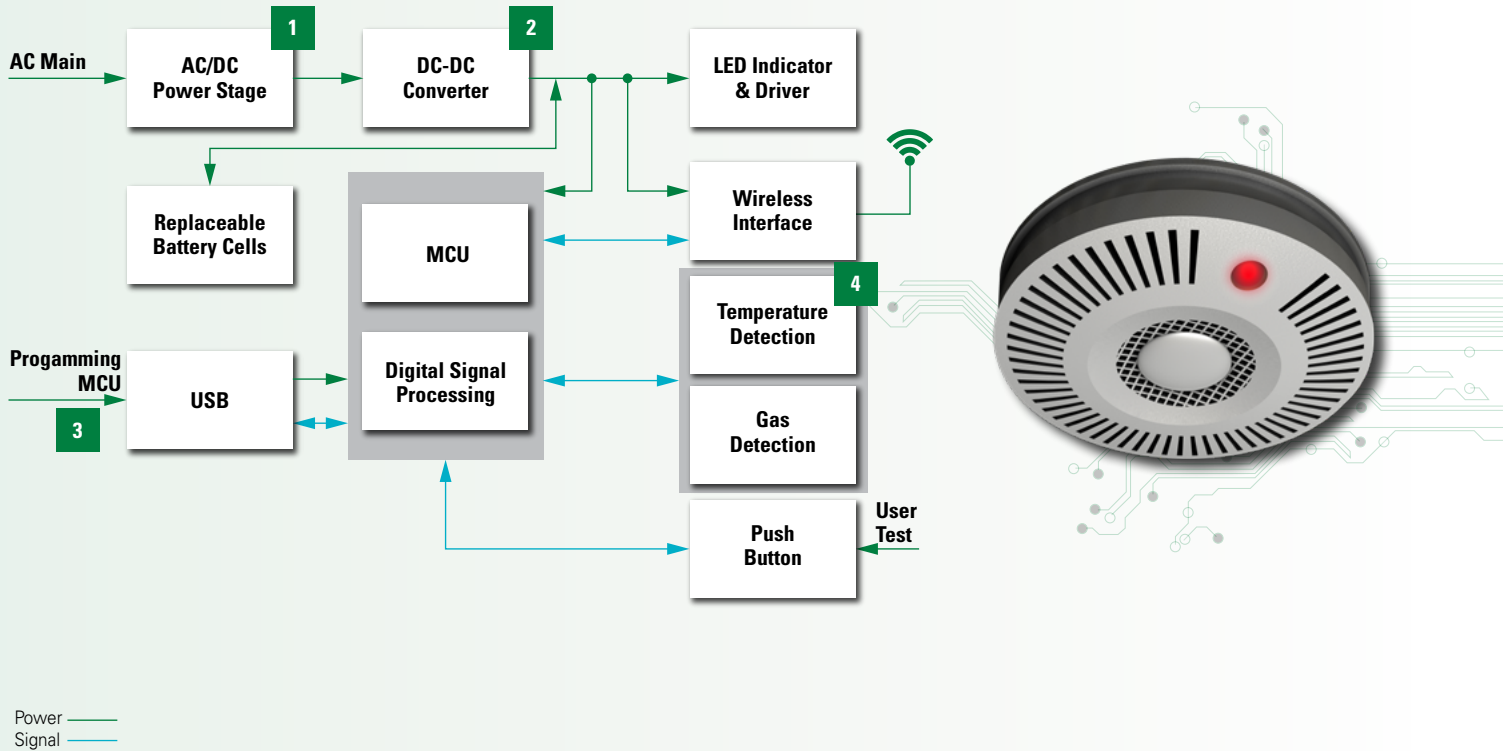


	Technology	Function in Application	Product Series	Features
1	Fuse PPTC	Protects power stage from overcurrent events	Atex 259 / 304, 437 Femto, Nano	Resettable; third-party compliance (UL/IEC); low internal resistance
	TVS Diode	Protects sensitive electronic components from voltage transients	SMBJ, SMCJ	1500 W peak pulse capability; low and dynamic resistance; 0402 footprint
2	TVS Diode Array	Protects wired communication interface from user induced ESD events	AQxx-02HTG	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	SEP0xx	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	PLA192, CPC1394 PLA193, PLA194	Up to 3750 V _{RMS} input/output isolation; UL/IEC certified; low drive power
	NTC	Sensing temperature of gas or water in specific meters	MELF style, End-banded Chip, Thermistor assembly	Surface mountable; fast thermal response
4	Reed Switch	Sensing flow of gas or water in specific meters	MDSR-10	Hermetically sealed; magnetically operated contacts
	Reed Switch	Prevents magnetically induced tampering	59166 MDSM-4	Hermetically sealed; magnetically operated contacts
5	Solid State Relay	Provides isolation from MCU for pulse-out signal	PLA192, CPC1394 CPC1983YE, PLA193, PLA194	Up to 3750 V _{RMS} 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.

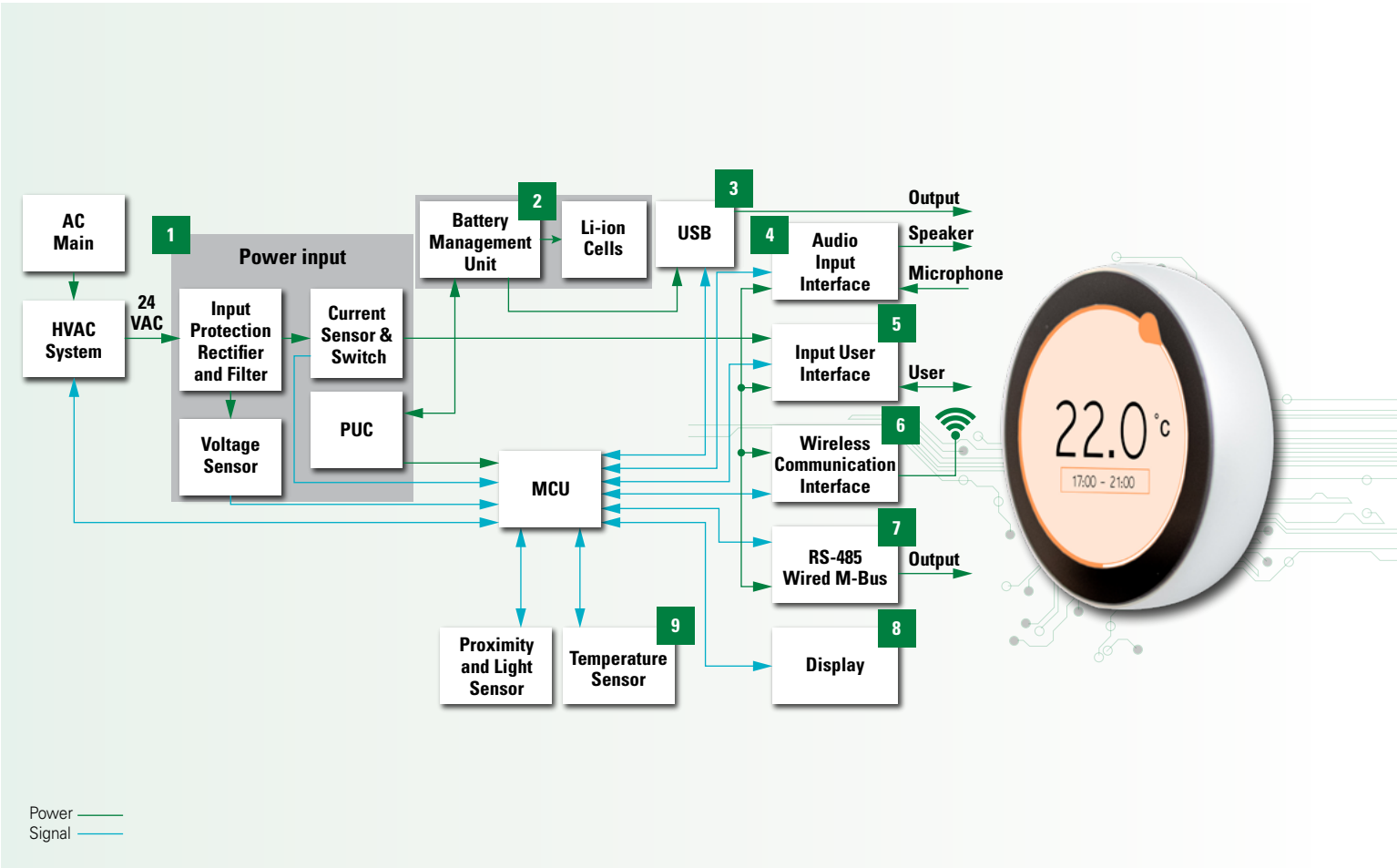


	Technology	Function in Application	Product Series	Features
1	Fuse	Protects power stage from overcurrent events	875 807, 373	Third-party compliance (UL/IEC); low internal resistance; shock safe; vibration resistant
	MOV	Helps protect power unit from voltage surges and lightning events on AC line	C-III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

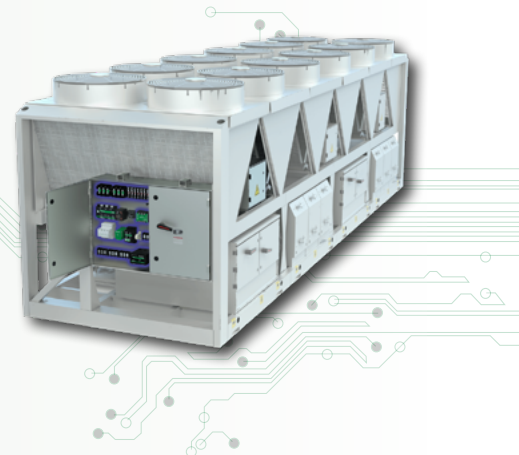
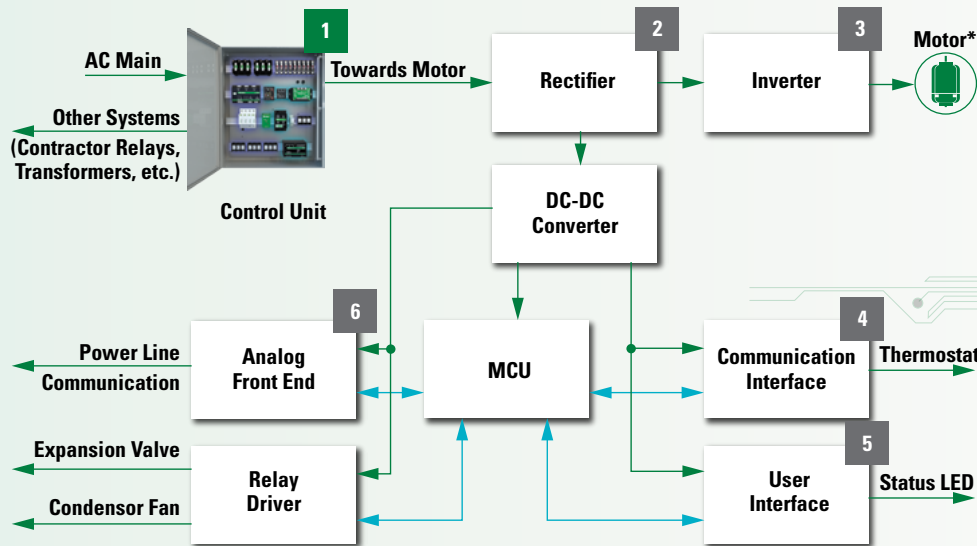


	Technology	Function in Application	Product Series	Features
1	Chip Fuse 24 VAC	Power unit protection from overcurrent	437, 468	-55° C - 150° C operating temperature
	PPTC	Power unit protection from OC or OT	2920L, SMDC	Low profile
	TVS Diode	Power unit protection from voltage transients	SACB, SMAJ, SMF3.3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



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

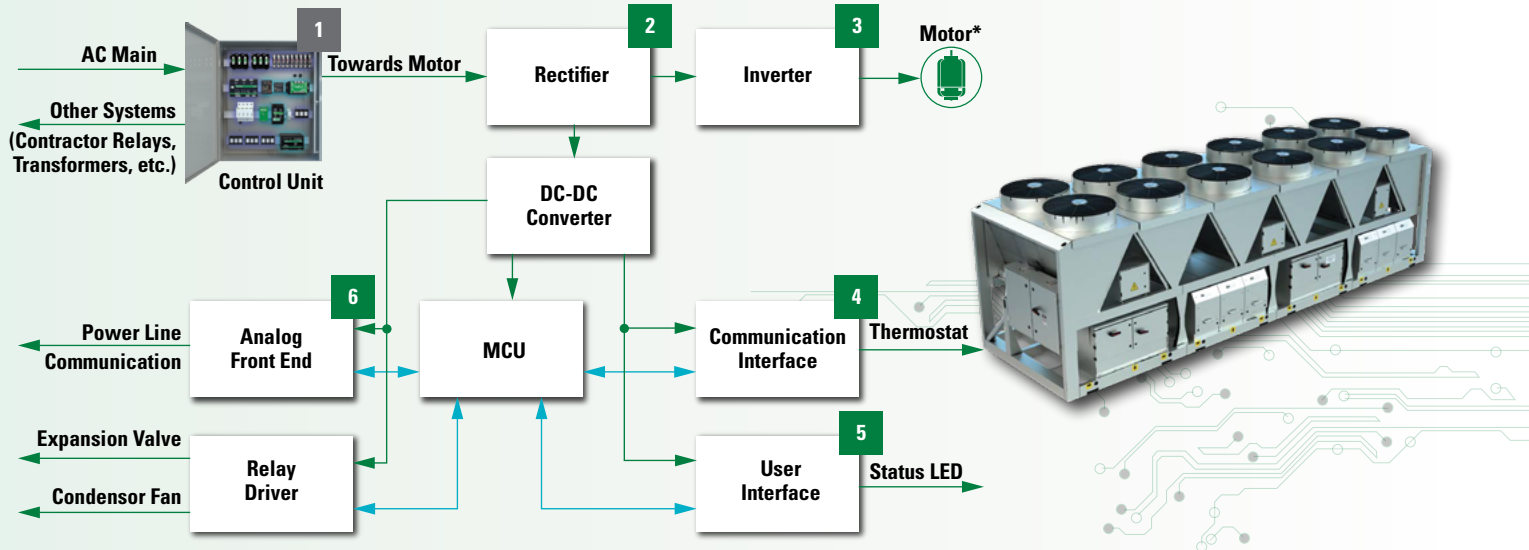
Power ———
Signal ———

Technology	Function in Application	Product Series	Features
UL Class Fuses	Protects HVAC system from overload and short circuits	CCMR, KLDB, KLKR, KLKD, FLNR, FLSR, JLLN, JLLS, JTD	Voltage range 0–600 V and current ratings from 0.1–1200 A
Type 2 Surge Protection Devices	Protects from power fluctuations or surges	SPD2	20 kA nominal interrupting rating and 50 kA maximum interrupting rating
SIDACTor® + MOV	Low clamp protection for AC power line	Pxxx0FNL Pxxx0ME + UltraMOV	Lower clamping voltage, lower leakage current (NA level)
TVS Diode	Protects power line from transient surges	High Voltage AK LTKAK	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	460, 201A 250A, 455	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	TCSA20, LSRX-C, LSRX	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	TMV, CT1, TRU1, TS1, TH1, TDUH, TDUB	Universal AC/DC operating voltage; solid-state output and total encapsulation for protection against shock, vibration, and humidity
Solid State Relay	Isolation switch	CPC40055ST CPC1998J	Blocking voltage up to 800 V and load current up to 20 A _{RMS} ; input-to-output isolation - 2500 V _{RMS}
Reed Sensor	Provides open/close detection to protect from physical harm or equipment damage	59140 57140	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.

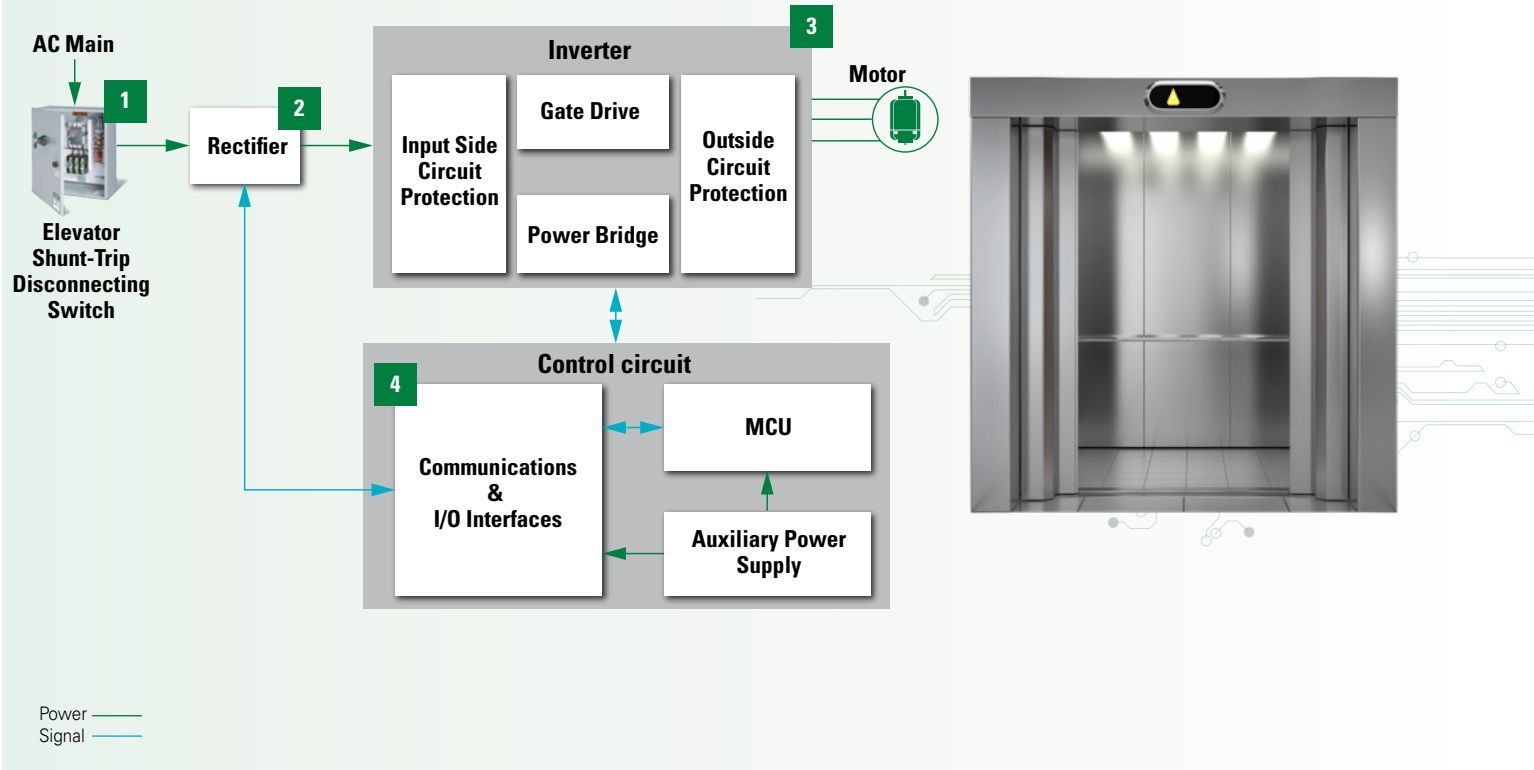
Power ———
Signal ———

	Technology	Function in Application	Product Series	Features
2	Rectifier Module	Converts AC line voltage supplied to the drive to DC	MDD VUQ	Package with DCB ceramic; very low forward voltage drop and low leakage current
3	IGBT Module	Switching power supplies	MIXA MIXG	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	SMBJ SMCJ	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	QS PSR	QS: 500–700 VAC, 450–700 VDC 35–800 A; PSR: 550–1300 VAC, 500–1000 VDC, 40–2000 A
	NTC	Semiconductor temperature measurement	USUR1000 SM	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	SP3213	Space-efficient 0201 form factor; third-party compliance; low capacitance
5	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
6	TVS Diode	Overvoltage protection	15KPA	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.

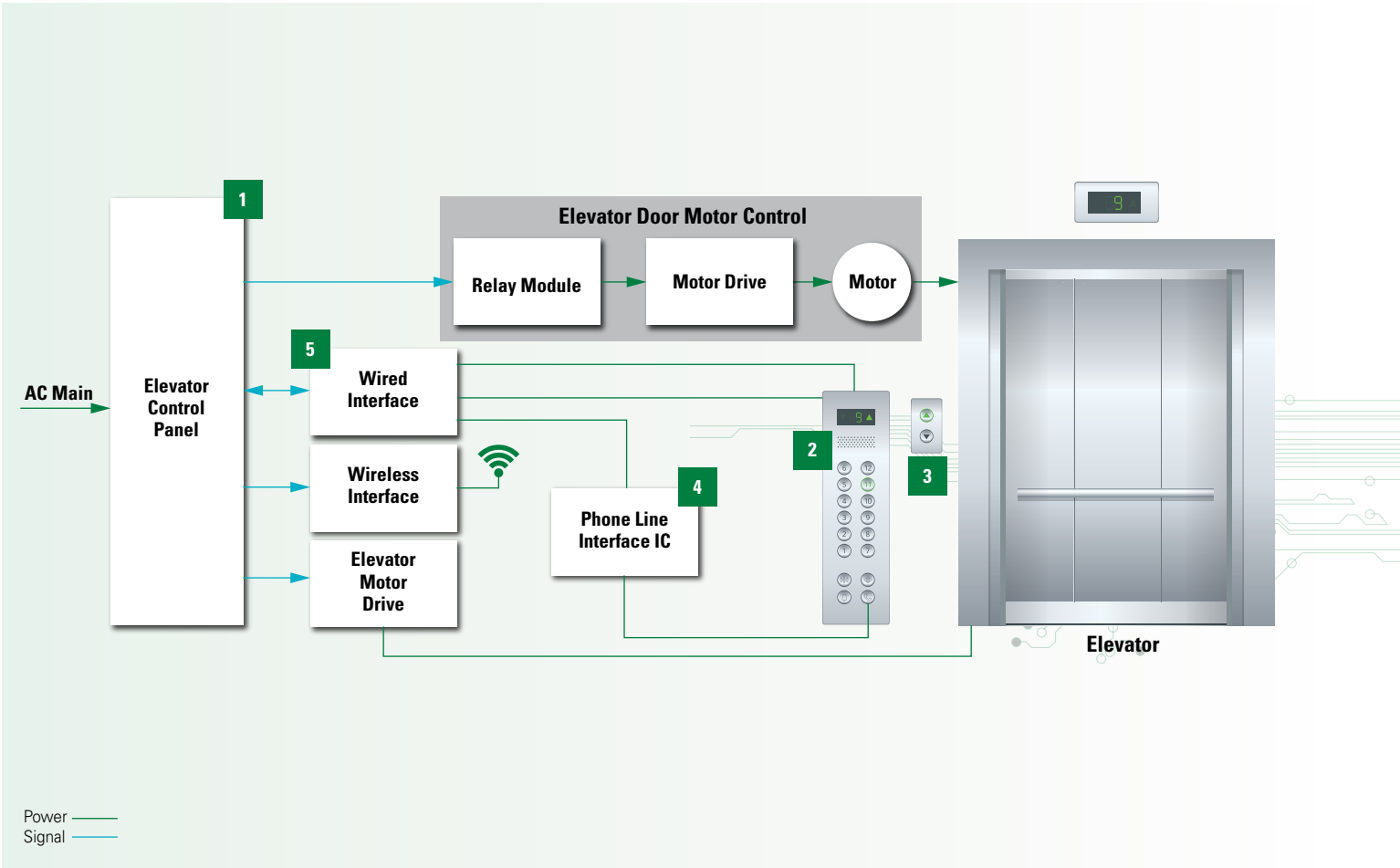


	Technology	Function in Application	Product Series	Features
1	Elevator Shunt-Trip Disconnecting Switch	Selective coordination and shunt-trip disconnecting means	LPS	UL-listed pre-engineered solutions; 200 kA SCCR; meets NEC 620.91 requirement for elevators and legally required standby systems
2	Rectifier Module	Converts AC line voltage supplied to the drive to DC	MDD VUO	Packaged with DCB ceramic; very low forward voltage drop and low leakage current
3	IGBT Module	Switching power supplies	MIXA MIXG	Rugged design with thin wafer technology; short-circuit rated for 10 μ sec; low gate charge; low EMI and competitive low $V_{ce(sat)}$
	High-speed Fuse and Micro-switch	Protects semi-conductor devices inside the inverter	QS PSR	Various current and voltage ratings
4	TVS Diode Array	Protects from ESD, EFT, and lightning-induced surges	SP1004 SP0402 , SM712	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	59145	Magnetically operated proximity sensor; rated for high-temperature application up to 105° C; customer-defined sensitivity
	Magnetic Actuator		57145	
2	Solid State Relay	Elevator load control	CPC1510 CPC1511	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	CPC40055ST CPC1998J	Blocking voltage up to 800 V and load current up to 20 A _{RMS} ; input-to-output isolation - 2500 V _{RMS}
4	Solid State Relay	Creates isolation barrier between low voltage equipment and high-voltage telephone networks	CPC5622	3 kV _{RMS} 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	SP1004 SP0402 , SM712	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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Robotic Appliances



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Surge Protection Devices

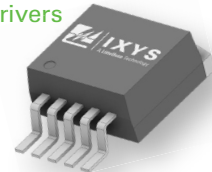
TVS Diode Arrays



Fuses



Gate Drivers



Industrial & UL-Class Fuses



High-Speed Fuses



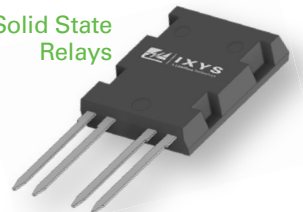
Multi-Oxide Varistors



SMD Fuses



Solid State Relays



Additional Resources



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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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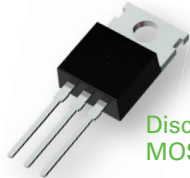
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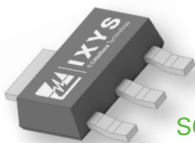
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PPTCs



Discrete MOSFETs



SCR Thyristors

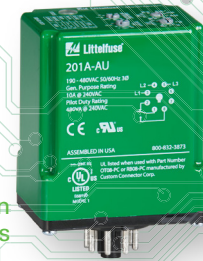


TVS Diodes

Reed Switches



Protection Relays



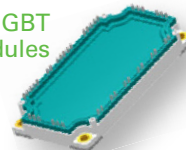
Discrete IGBTs



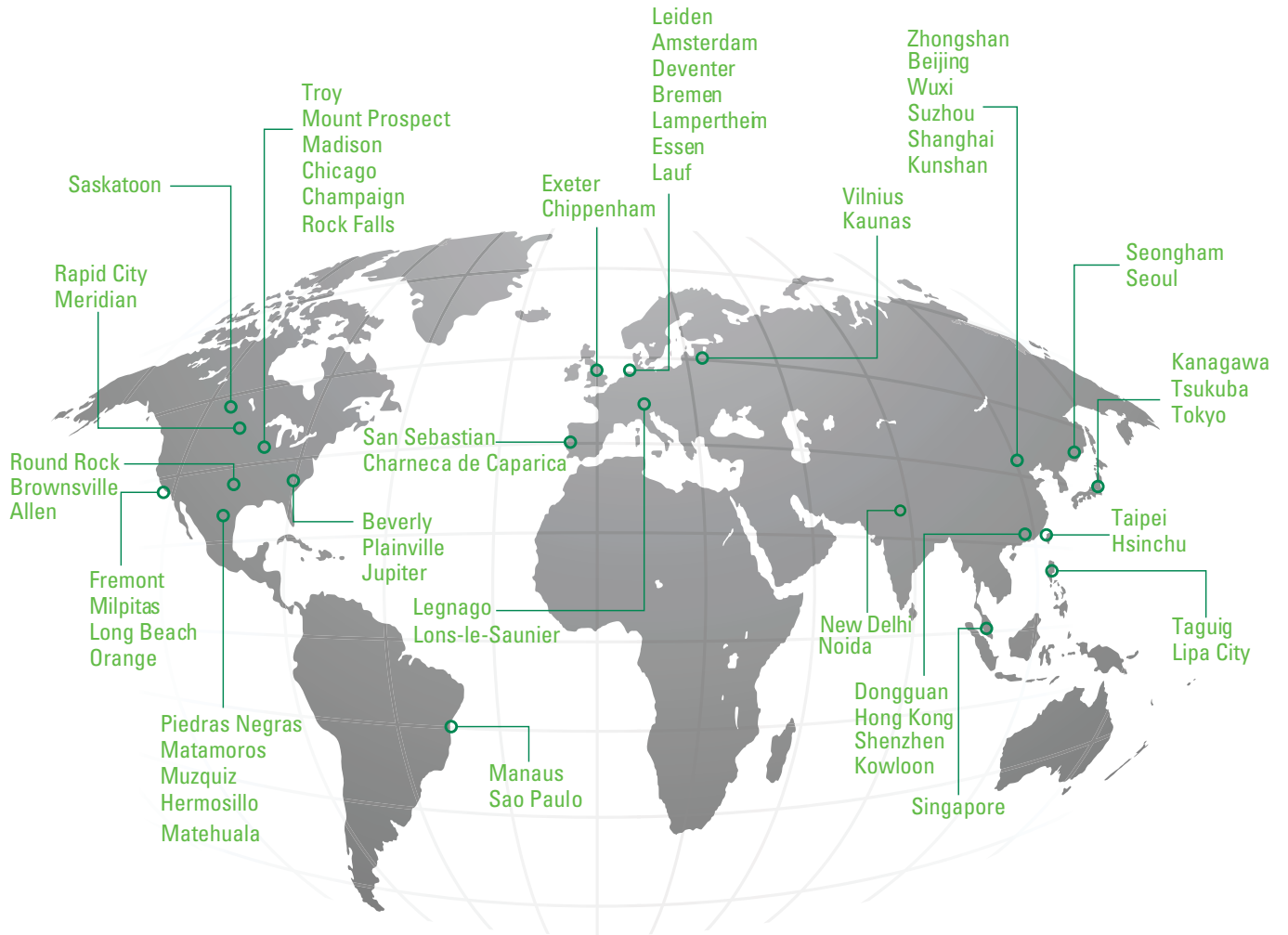
TRIACs



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