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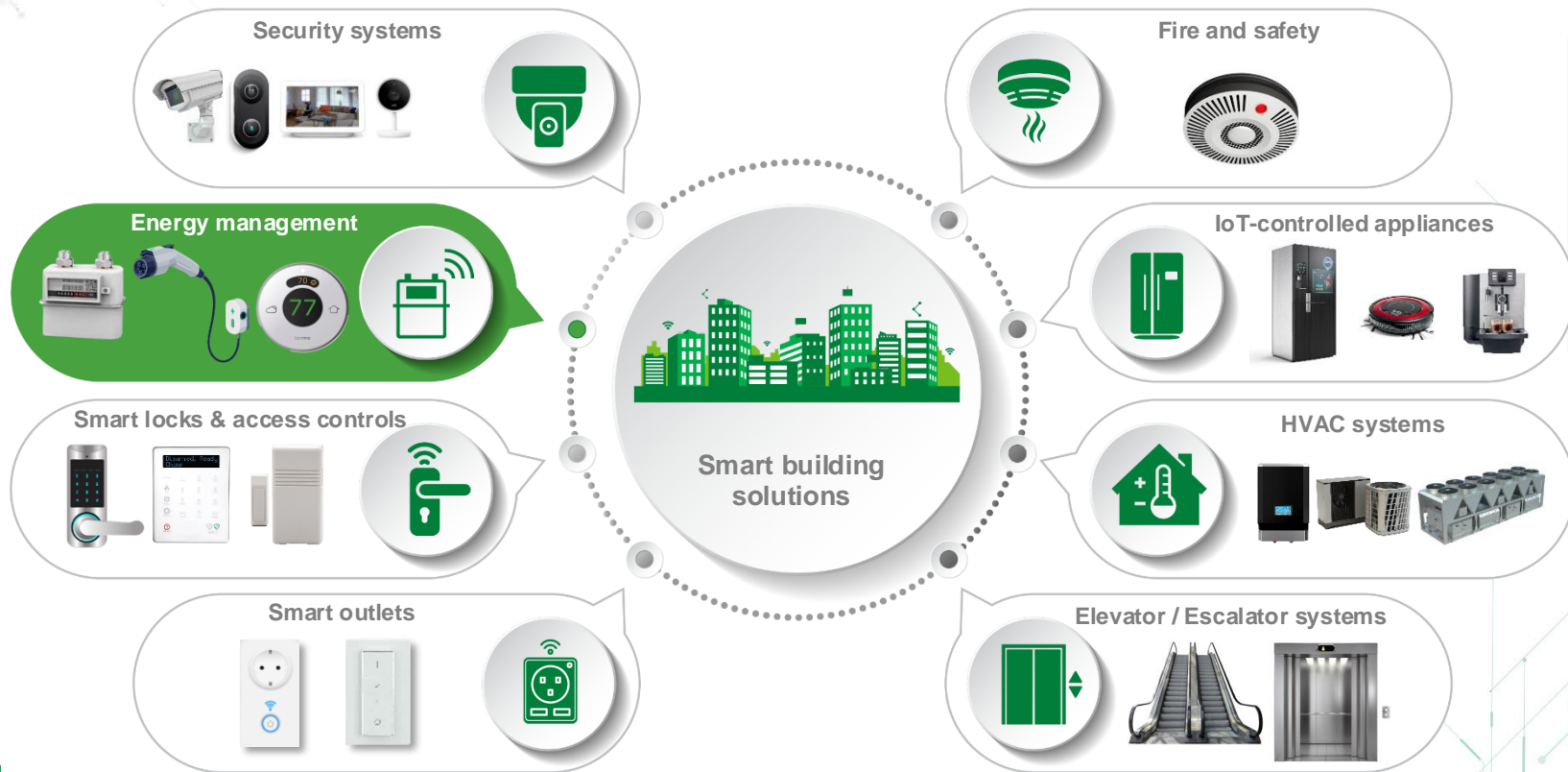
# Smart Thermostat



Building Automation

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# Smart buildings & homes are equipped with intelligent technologies that make lives more convenient & energy efficient



# Market trends of smart thermostats

## Market trends and drivers

An estimated 32 million smart thermostats were sold in 2022, and that figure is estimated to grow to 53 million by 2025

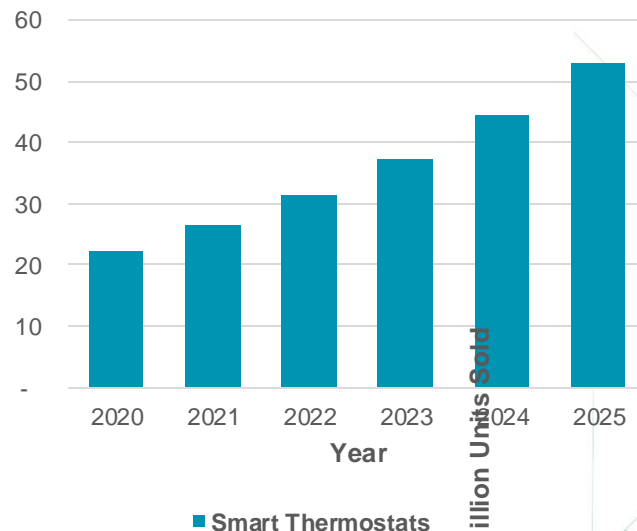
Energy savings is the primary value proposition and can provide very fast return on investments both in households and commercial spaces

It's estimated that smart thermostats can save up to 12% on heating costs and 15% on air conditioning costs

Smart thermostats can be controlled remotely through smartphone and self-learning capabilities can now identify user behavior and patterns to adjust HVAC systems automatically

North America is the largest market for smart thermostats, but rising energy costs globally are driving additional growth in Europe and Asia

## Smart thermostats sold worldwide



Sources: [Smart home devices: Statista](#)

# Recommended products for smart thermostats

1

## 24 V input protection

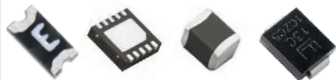
Fuse, PPTC, TVS Diode



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## Battery protection

PPTC, Protection IC, MLV, TVS Diode



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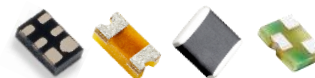
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## Communication interfaces

TVS Diode Array, Polymer ESD, MLV, TVS Diode



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## Sensors and switches

Tactile Switch, Slide Switch, NTC, PIR Sensor



### Acronyms:

PPTC: Polymeric Positive Temperature Coefficient

TVS: Transient-Voltage Suppression

MLV: Multi-layer Varistor

ESD: Electrostatic Discharge

NTC: Negative Temperature Coefficient

PIR: Passive Infrared



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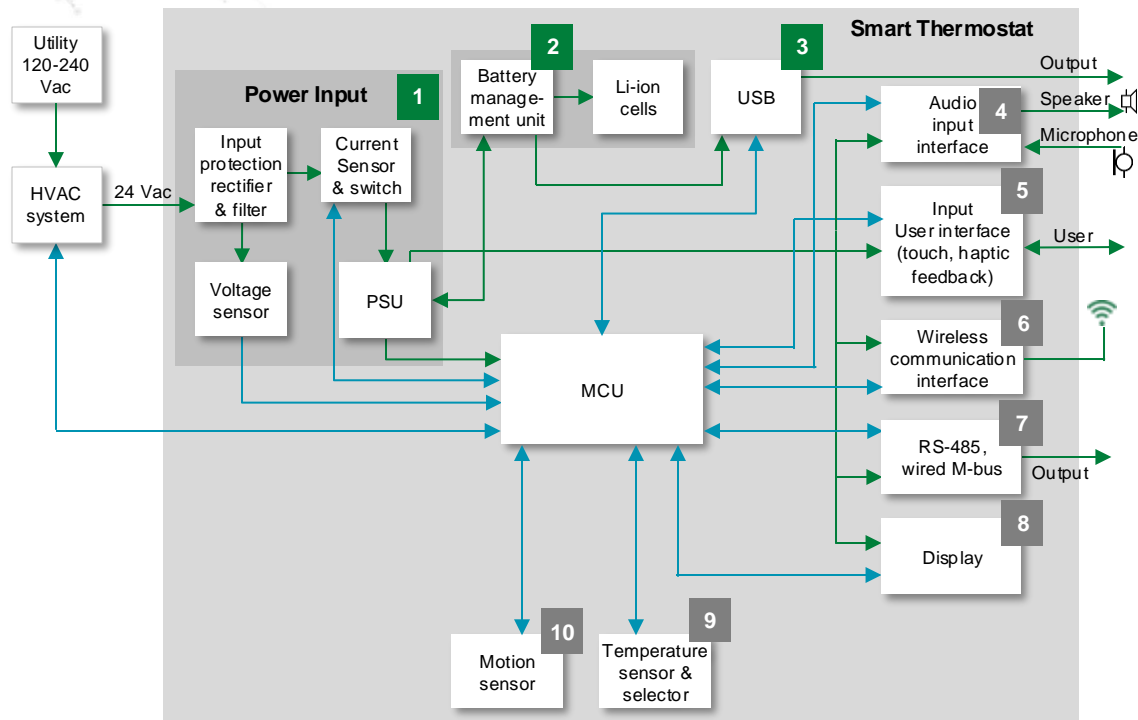
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Click the product series in the table below for more info

# Smart thermostat system



## Legend:

Power  
Data

	Technology	Series
1	Fuse	<a href="#">437</a> , <a href="#">468</a>
	PPTC	<a href="#">2920L</a>
	TVS Diode	<a href="#">SACB</a> , <a href="#">SMAJ</a> , <a href="#">SMF3.3</a>
2	Solid State Latching Relay	CPC1601M
	MLV, TVS Diode	<a href="#">MLA</a> , <a href="#">SMF</a>
	PPTC	<a href="#">1812L</a>
3	Protection IC (eFuse)	<a href="#">LS2405IDD23</a>
	TVS Diode Array	<a href="#">SP0201U</a> , <a href="#">SP0201B</a>
	PPTC	<a href="#">0402L</a>
	Protection IC (eFuse)	<a href="#">LS0505EVD22</a> , <a href="#">LS0504EVT233</a>



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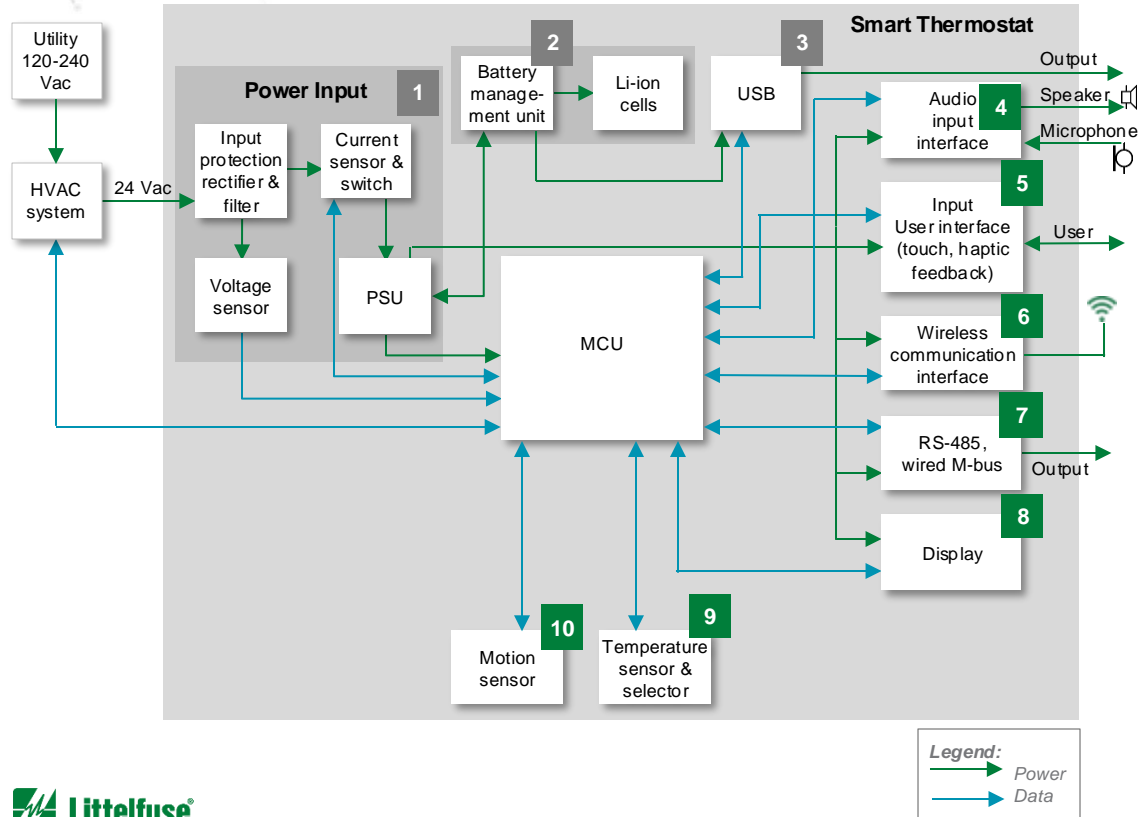


Click the product series in the table below for more info

# Benefits of Littelfuse products for smart thermostats

	Technology	Function in application	Product series	Benefits	Features
1	Fuse	Protects battery and downstream components from inrush current	<a href="#">437</a> , <a href="#">468</a>	SMD form-factor allows for compact design	Third-party compliance UL / IEC; low internal resistance; shock safe; vibration resistant
	PPTC	Protects system from over temperature and over-current events; prevent nuisance opening of fuse	<a href="#">2920L</a>	Third-party agency certification at component level reduces OEM qualification time/effort at device level	Resettable; surface mountable; compact design with wide range of form factors
	TVS Diode	Protects sensitive electronic component from voltage transients	<a href="#">SACB</a> , <a href="#">SMAJ</a> , <a href="#">SMF3.3</a>	Improves system reliability by clamping the voltage at safe levels during transients	Excellent clamping capability
	Solid State Latching Relay	Integrated power regulator saves the auxiliary power supply, and it simplifies the circuitry	CPC1601M	When driven by the load the relay takes zero current from the system supply thus helping extend battery life	Small 3x3 mm DFN package; 60 V peak, 2 A continuous AC or DC load capability with zero cross circuitry
2	MLV, TVS Diode	Protects sensitive electronic component from voltage transients	<a href="#">MLA</a> , <a href="#">SMF</a>	Fast clamping response; rigid performance under high temperatures	Bidirectional clamping; low form factor; wide operational temperature range
	PPTC	Protect battery from over current and over temperature events	<a href="#">1812L</a>	Auto resets after fault is removed; allows for compact design	Resettable; low resistance; compact design
	Protection IC (eFuse)	Provides reverse current blocking for power mux	<a href="#">LS2405IDD23</a>	Low power dissipation and auto switch over between multiple power sources	2.7 V ~ 24 V operation voltage and 5 A continuous current
3	TVS Diode Array	Protects against ESD on high-speed data lines	<a href="#">SP0201U</a> , <a href="#">SP0201B</a>	Absorbs repetitive ESD	Very low capacitance
	PPTC	Protect downstream components from overcurrent and overtemperature events	<a href="#">0402L</a>	Suitable for compact designs	Low resistance in very small package; compatible with high temperature solders
	Protection IC (eFuse)	Provides overcurrent, overvoltage, and overtemperature protection	<a href="#">LS0505EVD22</a> , <a href="#">LS0504EVT233</a>	Integrated solution with current limit protection; thermal shutdown; internal soft start	5V, 5A eFuse with 30 V <sub>max</sub>

# Smart thermostat system



	Technology	Series
4	TVS Diode	<a href="#">SACB</a> , <a href="#">SMAJ</a> , <a href="#">SMBJ</a>
5	TVS Diode Array	<a href="#">SP0402U</a> , <a href="#">SP0402B</a>
	Polymer ESD	<a href="#">PESD</a>
	Tactile Switch	<a href="#">KSC</a>
6	TVS Diode Array	<a href="#">AQ3118E</a> , <a href="#">AQ3130E</a>
	Polymer ESD	<a href="#">PGB10603</a> , <a href="#">PGB10402</a>
7	TVS Diode Array	<a href="#">SP712</a>
8	MLV, TVS diode	<a href="#">MLA</a> , <a href="#">SMF</a>
9	NTC	<a href="#">RB</a> , <a href="#">DO-35</a>
	Slide Switch	<a href="#">JS</a>
10	PIR Sensor + MCU	<a href="#">ZMOTION</a>



Click the product series in the table below for more info

# Benefits of Littelfuse products for smart thermostats

	Technology	Function in application	Product series	Benefits	Features
4	TVS Diode	Protects sensitive electronic component from voltage transients	<a href="#">SACB</a> , <a href="#">SMAJ</a> , <a href="#">SMBJ</a>	Improves system reliability by clamping the voltage at safe levels during transients	Bidirectional clamping; low form factor; wide operational temperature range
5	TVS Diode Array	Protect downstream ICs from ESD events	<a href="#">SP0402U</a> , <a href="#">SP0402B</a>	Maintain signal integrity of high-speed data lines; reliable ESD protection	Very low capacitance
	Polymer ESD	Protect downstream ICs from ESD events	<a href="#">PESD</a>	Enables compact design and low clearance between antenna and casing	Ultra-low capacitance; compact form factor; low leakage current; fast response time
	Tactile Switch	Button inputs for selecting settings	<a href="#">KSC</a>	Rugged sealing and resistant to corrosion; very long operating life	Operating life up to 10 million cycles; illumination options available; water- and dust-proof
6	TVS Diode Array	Protects Wi-Fi chipset from user-induced ESD events	<a href="#">AQ3118E</a> , <a href="#">AQ3130E</a>	Absorbs repetitive ESD	Very low capacitance
	Polymer ESD	Protects Wi-Fi chipset from user-induced ESD events	<a href="#">PGB10603</a> , <a href="#">PGB10402</a>	Enables compact design and low clearance between antenna and casing	Ultra-low capacitance; compact form factor; low leakage current; fast response time
7	TVS Diode Array	Protects sensitive electronic component from voltage transients	<a href="#">SP712</a>	Specifically designed to protect RS-485	-7 V / +12 V standoff
8	MLV, TVS Diode	Protects sensitive electronic component from voltage transients	<a href="#">MLA</a> , <a href="#">SMF</a>	Fast clamping response; rigid performance under high temperatures	Bidirectional clamping; low form factor; wide operational temperature range
9	NTC	Detect ambient temperature	<a href="#">RB</a> , <a href="#">DQ-35</a>	Provides accurate and reliable temperature sensing	Compact form factor; fast thermal response
	Slide Switch	User selected temperature adjustment	<a href="#">JS</a>	Long life; very reliable in a low-profile package	Positive detent; low profile; SMT or thru hole
10	PIR Sensor + MCU	Motion detection of user	<a href="#">ZMOTION</a>	Reduces component count and saves space; allows for lower-cost ceramic capacitors	Real-time control of motion sensitivity

# Safety standards for smart thermostats

Standard	Title	General scope	Region
ANSI/UL 60730-1	Automatic Electrical Controls–Part 1: General Requirements	These requirements cover electrical equipment for control of air-conditioning, heating, cooking, refrigeration, and humidity, rated 600 volts or less, to be used in ordinary locations (that is, non-hazardous locations)	United States
CAN/CSA-E60730-1	Automatic Electrical Controls for Household and Similar Use–Part 1: General Requirements		Canada
IEC 60730-1	Automatic electrical controls–Part 1: General requirements		Worldwide
EN 60730-1	Automatic electrical controls for household and similar use–Part 1: General requirements		Europe
ANSI/UL 60730-2-9	Automatic Electrical Controls–Part 2-9: Particular Requirements for Temperature Sensing Controls	This part applies to automatic electrical temperature sensing controls for use in, on or in association with equipment, including electrical controls for heating, air-conditioning and similar applications. The equipment may use electricity, gas, oil, solid fuel, solar thermal energy, and so on, or a combination thereof	United States
CAN/CSA-E60730-2-9	Automatic Electrical Controls for Household and Similar Use–Part 2-9: Particular Requirements for Temperature Sensing Controls		Canada
IEC 60730-2-9	Automatic electrical controls–Part 2-9: Particular requirements for temperature sensing controls		Worldwide
EN 60730-2-9	Automatic electrical controls–Part 2-9: Particular requirements for temperature sensing control		Europe

# Safety standards for typical components in smart thermostats

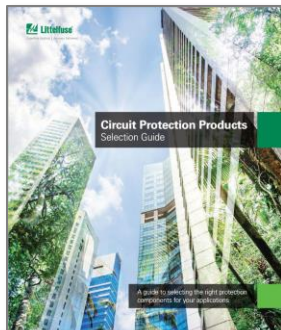
Components	Standard	Title	General scope	Region
Surge protection	UL 1449	Surge Protective Devices	Surge protective devices including MOVs shall comply with the requirements in the Standard for Surge Protection Devices	United States
	UL 497B	Standard for Safety Protectors for Data Communications and Fire-Alarm Circuits	These requirements apply to TVS Diodes	United States
Overcurrent protection	UL 1434	Thermistor-Type Devices	Thermistors (PTCs and NTCs) shall comply with Standard for Thermistor-Type Devices	United States
	UL 248-1	Standard for Safety Low-Voltage Fuses—Part 1: General Requirements	Fuses shall comply with Standards for fuses	United States
	UL 248-14	Standard for Low-Voltage Fuses—Part 14: Supplemental Fuses		United States
Battery	UL 1642	Lithium Batteries	Applicable standards for Lithium-Ion batteries	United States
	UL 2054	Household and Commercial batteries		United States
	IEC 62281	Safety of Primary and Secondary Lithium Cells and Batteries during transport		Worldwide

# Additional information can be found on Littelfuse.com

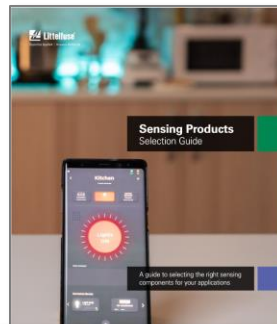
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