Littelfuse®

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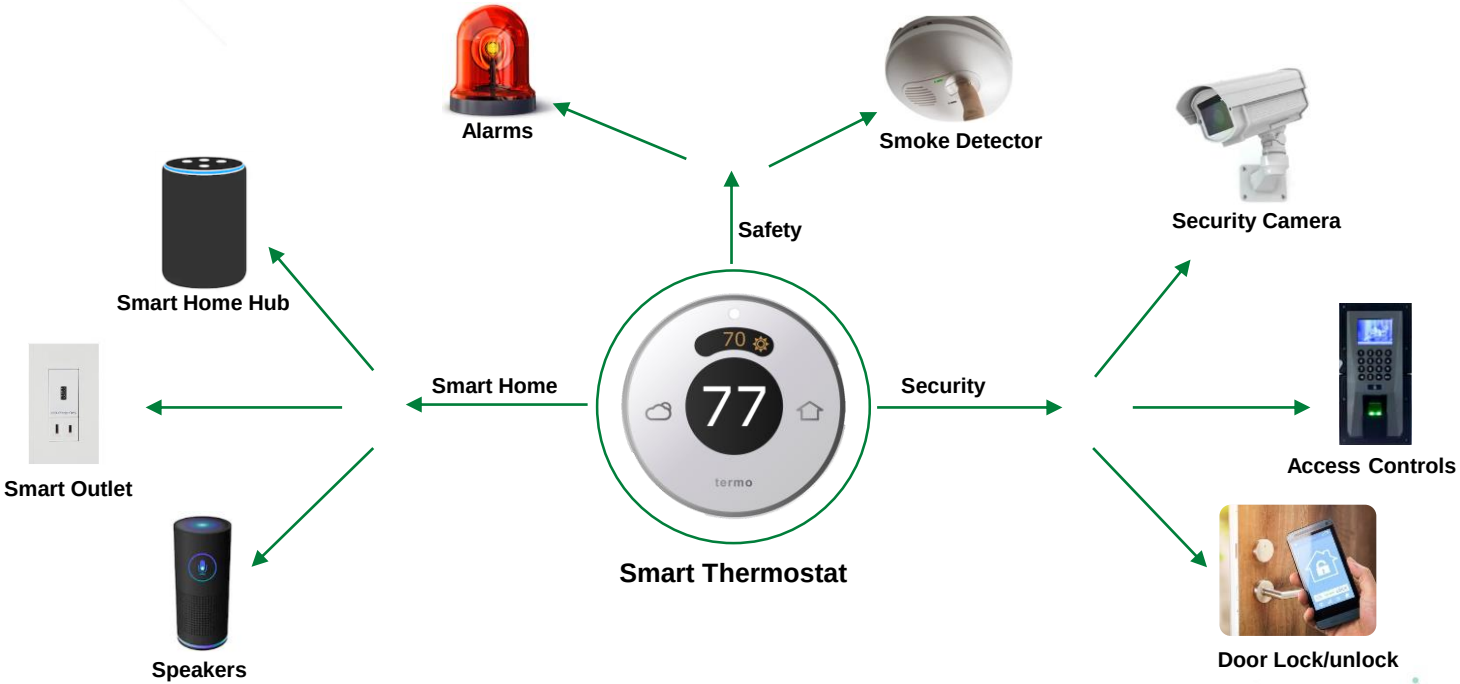
Smart Thermostats

April 2019

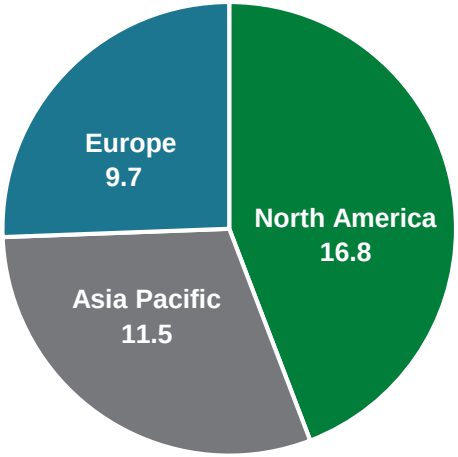
REV0419

Other products with similar needs to smart thermostats



Smart thermostat market

14 million units in 2018 → 38 million units in 2023 CAGR of 22%



Year 2023; Units by Region (in millions)

Sources: Modor Int., Imarc Group, Statista, interviews

Market data and drivers

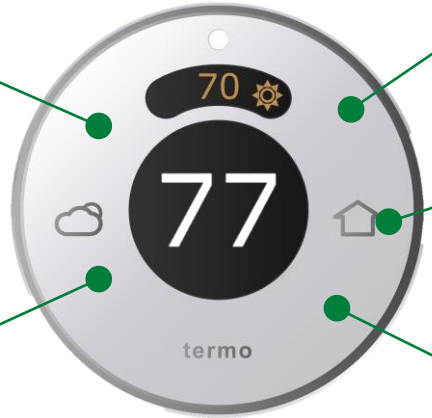
- Energy saving has been primary value proposition
- Over thirty companies design and manufacture thermostats
- The future of smart thermostats will include energy usage audits and verification of energy efficient upgrades
- Ability to connect through IOT is expected. Partnerships enable system solutions. Smart thermostat also becoming residential hubs
- People are tired of living in a smart home and showing up to a dumb building

Thermostat market expected to be very strong through 2023

Smart thermostat

Measurement unit
- NTC thermistor temperature sensing
- Other environmental sensors

Communication interface
- RF ESD protection for wireless systems
- OV & OC protection for RS-485 interface
- Diode arrays 100/1000BaseT protection



Load switching
- SSR Load Switching

Li-ion battery protection
- PPTC overtemperature and overcurrent

24 VAC power protection
- TVS overvoltage protection
- Resettable PPTC fuse power protection

SSR: Solid State Relay
NTC: Negative Temperature Coefficient
PPTC: Polymeric Positive Temperature Coefficient
TVS: Transient-Voltage Suppression
ESD: Electrostatic Discharge
OV: Overvoltage
OC: Overcurrent

Protect Control Sense

NTC thermistors used in thermostats

RB Series

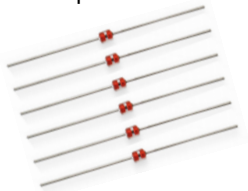
Surface Mount end-bended chip thermistors 0603 type

SM Series

Surface Mount NTC LL-34 MiniMELF style

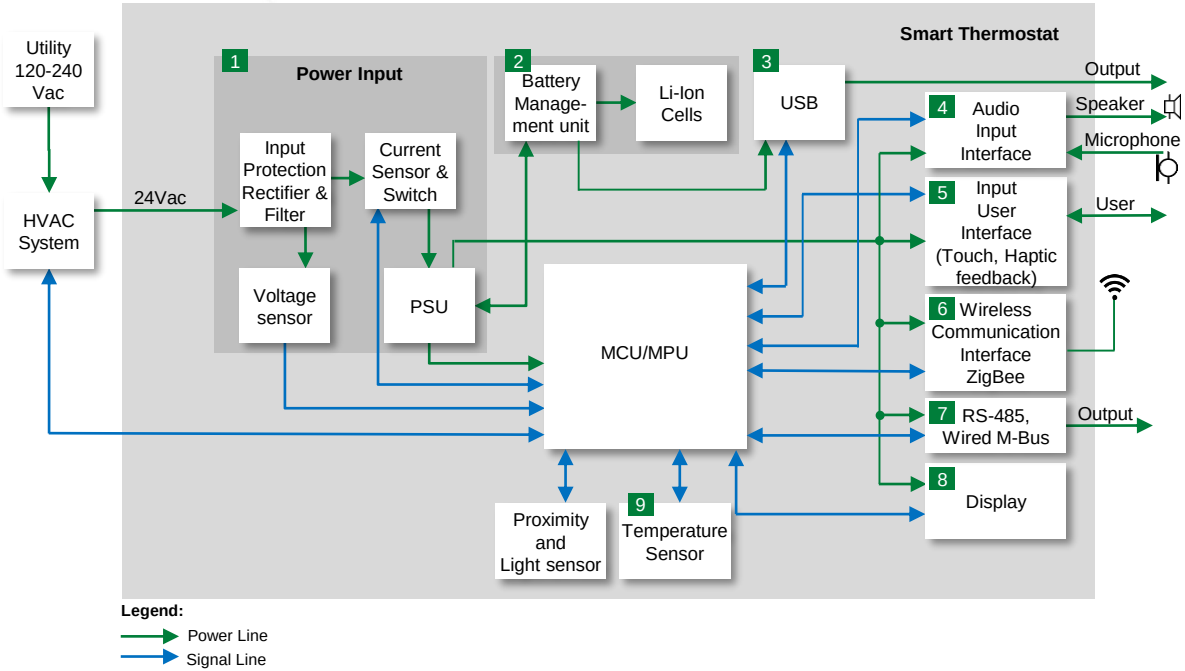
DO-35 Standard Series

Glass encapsulated thermistors



- RB Series surface mount end-banded thermistor elements are designed for use on hybrid substrates, integrated circuits or printed circuit boards. They have a solder coated metallization which is suitable for various contact techniques including wire bond, epoxy or solder.
- SM Series and DO-35 hermetically sealed, glass encapsulated thermistors provide excellent long-term reliability and stability even when subjected to severe environmental conditions.

Smart Thermostat protection and sensing architecture



	Technology	Series
1	Chip Fuse (24V AC)	437, 468
	PPTC	2920L,SMDC
	TVS Diode	SACB, SMAJ, SMF3.3
	Latching Relay Driver	CPC1600
2	TVS Diode, MLV	MLA, SMF
	PPTC	femtoSMD, nanoSMD, picoSMD
	Strap PPTC	MXP, SL
3	TVS Array	SESD, SPXX
	PPTC	0402L, femtoSMD
4	TVS Array	SACB, SMAJ, SMBJ
5	TVS Array	PESD, SP3213-01UTG
6	TVS Array	SP3213-01UTG
	Polymer ESD	PESD
7	TVS Array	SM712
8	TVS diode, MLV	MLA, PLED, SMF
9	NTC	SM Series, RB, DO-35

Potential Littelfuse products for IoT control units

	Technology	Function in Application	Series	Benefits	Features
1	Chip Fuse (24V AC)	Power unit protection from overcurrent	437, 468	Protects ICs and assists safety	-55°C - 150°C operating temperature
	PPTC	Power unit protection from OC or OT	2920L, SMDC	Resettable overcurrent protection	Low profile
	TVS Diode	Power unit protection from voltage transients	SACB, SMAJ, SMF3.3	Protects ICs	Excellent clamping capability
	Latching Relay Driver	Latching relay driver	CPC1600	Saves battery power	No EMI/RFI generation
2	TVS Diode, MLV	Protect IC from transient voltage surge	MLA, SMF	Protects against transient events	Meets IEC global standards
	PPTC	Protect thermostat from OT and OC	femtoSMD, nanoSMD, picoSMD	Protects against overcharging battery	Compact design with many options
	Strap PPTC	Rechargeable battery cell protection	MXP, SL	Reduces OT risk on discharge side	Installs directly on battery
3	TVS Array	USB - Protect ICs from ESD	SESD, SPXX	Absorbs repetitive ESD	Low capacitance of 1.0pF per I/O
	PPTC	USB - Protect electronics from OC	0402L, femtoSMD	Resettable OC protection	Compact design
4	TVS Array	Audio interface -Protect ICs from ESD	SACB, SMAJ, SMBJ	Absorbs repetitive ESD	Excellent clamping capability
5	TVS Array	User interface - Protect ICs from ESD	PESD, SP3213-01UTG	Absorbs repetitive ESD	Low capacitance of 1.0pF per I/O
6	TVS Array	Wireless interface - Protect ICs from ESD	SP3213-01UTG	Absorbs repetitive ESD	Low capacitance of 1.0pF per I/O
	Polymer ESD	Wireless interface - Protect ICs from ESD	PESD	Support passing agency requirements	Low leakage current
7	TVS Array	RS-485 - Protect ICs from ESD	SM712	Protects ESD, EFT & lightning surge	+12V/-7V Standoff
8	TVS diode, MLV	Display - Protect ICs from ESD	MLA, PLED, SMF	Absorbs repetitive ESD	Low capacitance of 1.0pF per I/O
9	NTC	Temperature sensing	SM Series, DO-35	Excellent long term stability	Glass encapsulated thermistors
			RB	Surface mountable	Used in hybrid substrates, integrated circuits/PCBs

Smart thermostat standards compliance

- Basic standard used to investigate products in this category is UL 873, “Temperature-Indicating and -Regulating Equipment”, or ANSI/UL 60730-1, “Automatic Electrical Controls - Part 1: General Requirements”
- ANSI/UL 60730-2-9, “Automatic Electrical Controls - Part 2-9: Particular Requirements for Temperature Sensing Controls”
- UL60730-2-1A, “Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Energy Regulator”
- Surge protective devices including MOVs shall comply with the requirements in the Standard for Surge Protection Devices, UL 1449
- (NTC) Thermistor shall comply with Standard for Thermistor-Type Devices, UL 1434
- Fuseholders shall comply with Standards for Fuseholders – UL 4248-9
- IEC 60335-2-30 Ed. 5.1 b:2016. Household and similar electric appliances- Safety –Part 2-30: Particular requirements for room heaters
- UL 1642: Lithium Batteries
- UL 2054: Household and Commercial batteries
- IEC 62281: Safety of Primary and Secondary Lithium Cells and Batteries during transport

Key links

Fuseology Selection Guide:
https://www.littelfuse.com/~/media/electronics/product_catalogs/littelfuse_fuseology_selection_guide.pdf.pdf

Electrostatic Discharge (ESD) Suppression Design Guide:
https://www.littelfuse.com/~/media/electronics/design_guides/esd/littelfuse_esd_suppression_design_guide.pdf.pdf

Electronic Discharge (ESD) Protection Design Guide :
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Temperature Sensor Overview:
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Circuit Protection Solutions:
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HVAC/R link
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Why choose Littelfuse

- Global leader with broad product portfolio covering every aspect of protection, sensing, and control
- Application expertise combined with product designed guidelines to help you determine best component for your application
- Testing capabilities and assistance to support confirmation of product selection
- Standards compliance expertise including product compliance to many standards and approval support
- High-volume manufacturing, committed to the highest quality standards
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