

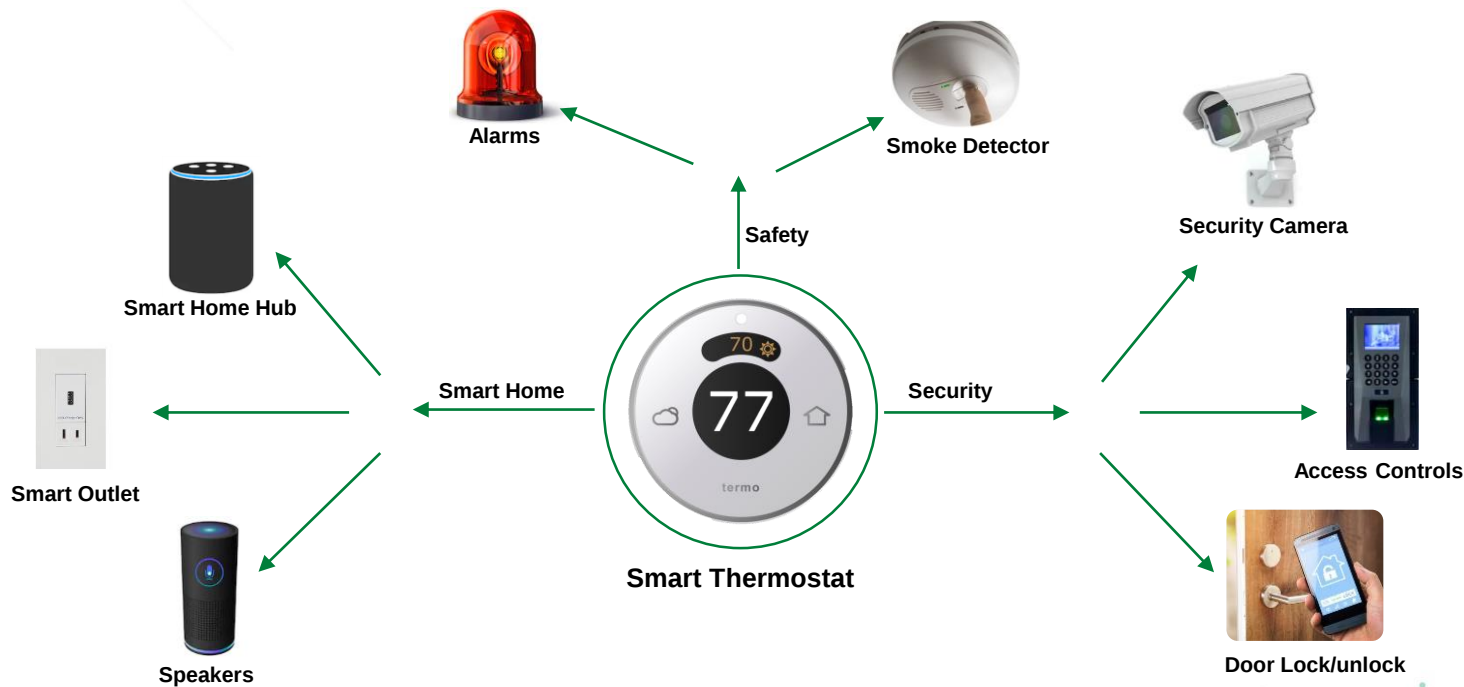


Expertise Applied | Answers Delivered

Smart Thermostats

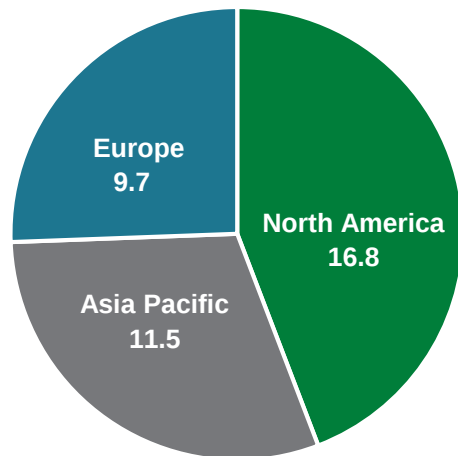
April 2019

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

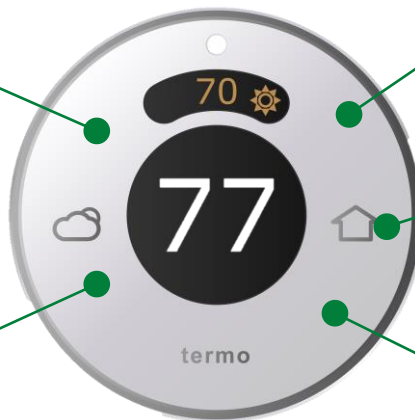
- SSR Load Switching

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-banded chip thermistors 0603 type



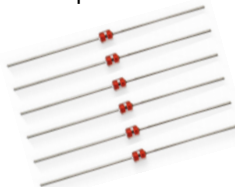
SM Series

Surface Mount NTC LL-34 MiniMELF style



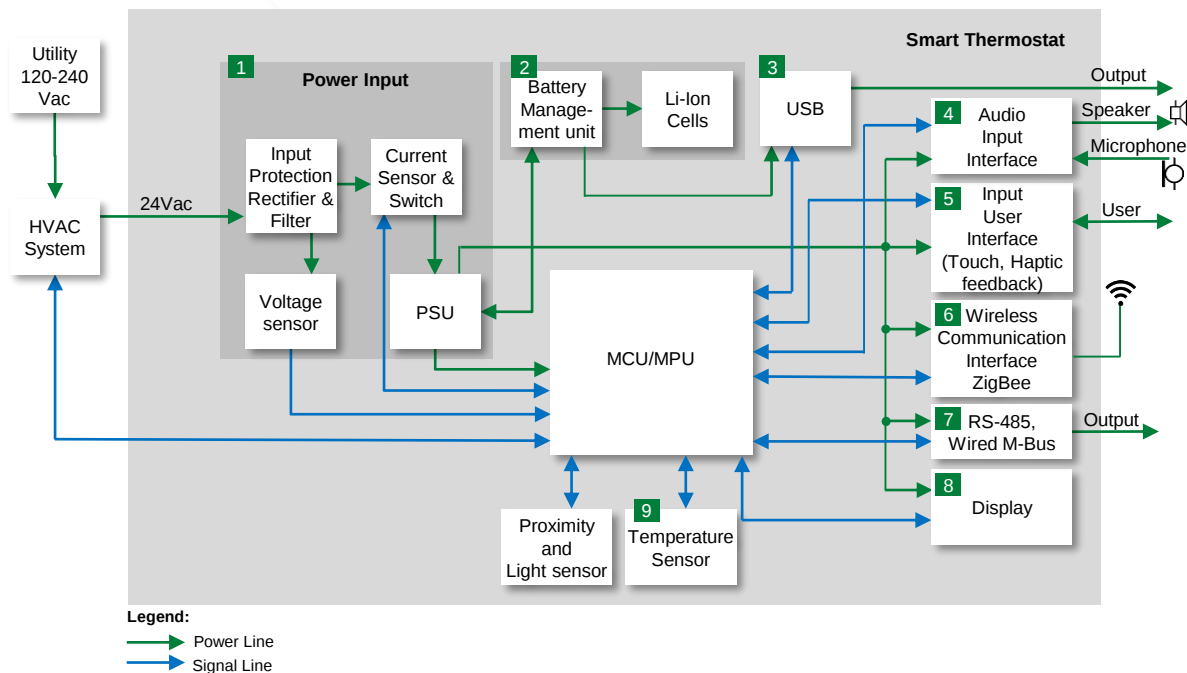
DO-35 Standard Series

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
7	Polymer ESD	PESD
8	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 , SME	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 , SME	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 :

https://www.littelfuse.com/~media/electronics/design_guides/esd/littelfuse_esd_protection_design_guide.pdf.pdf

Temperature Sensor Overview:

https://www.littelfuse.com/~media/electronics/new_product_flyers/littelfuse_temperature_sensor_overview_flyer.pdf.pdf

Circuit Protection Solutions:

https://www.littelfuse.com/~media/electronics/product_catalogs/littelfuse_product_selection_guide.pdf.pdf

HVAC/R link

<https://www.littelfuse.com/industries/hvac.aspx>

General

www.Littelfuse.com

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
- Global company with local support

We are committed to supporting your success



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