Smart Thermostats

April 2019
Other products with similar needs to smart thermostats

- Smart Thermostat
- Smoke Detector
- Security Camera
- Access Controls
- Door Lock/unlock
- Smart Home Hub
- Smart Outlet
- Alarms
- Security
- Smart Home
- Safety
- Speakers
Smart thermostat market

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

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

Year 2023; Units by Region (in millions)

- North America: 16.8
- Europe: 9.7
- Asia Pacific: 11.5

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

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
NTC thermistors used in thermostats

- **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

Legend:
- Power Line
- Signal Line

Utility
- 120-240 Vac

HVAC System
- 24Vac

Power Input
- Input Protection
- Rectifier & Filter
- Current Sensor & Switch
- Voltage sensor

Battery Management unit
- Li-Ion Cells

MCU/MPU

Smart Thermostat
- Audio Input Interface
- User Interface
- (Touch, Haptic feedback)
- Wireless Communication Interface
- ZigBee

User Interface
- Speaker
- Microphone

Output

Input Protection
- Rectifier & Filter

Current Sensor & Switch

Voltage sensor

PSU

MCU/MPU

Li-Ion Cells

USB

User Interface

Audio Input Interface

Input Interface

(Touch, Haptic feedback)

Wireless Communication Interface

ZigBee

RS-485, Wired M-Bus

Proximity and Light sensor

Temperature Sensor

Display

Technology
- Chip Fuse (24V AC)
- PPTC
- TVS Diode
- Latching Relay Driver
- TVS Diode, MLV
- Strap PPTC
- TVS Array
- PPTC
- TVS Array
- TVS Array
- TVS Array
- TVS Array
- TVS diode, MLV
- NTC

Series
- 437, 468
- 2920L, SMDC
- SACB, SMAJ, SMF3.3
- CPC1600
- MLA, SMF
- femtoSMD, nanoSMD, picoSMD
- MXP, SL
- SESD, SPXX
- 0402L, femtoSMD
- SACB, SMAJ, SMBJ
- PESD, SP3213-01UTG
- SP3213-01UTG
- PESD
- SM712
- MLA, PLED, SMF
- SM Series, RB, DO-35
## Potential Littelfuse products for IoT control units

<table>
<thead>
<tr>
<th>Technology</th>
<th>Function in Application</th>
<th>Series</th>
<th>Benefits</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Chip Fuse (24V AC)</td>
<td>Power unit protection from overcurrent</td>
<td>437, 468</td>
<td>Protects ICs and assists safety</td>
<td>-55°C - 150°C operating temperature</td>
</tr>
<tr>
<td>PPTC</td>
<td>Power unit protection from OC or OT</td>
<td>2920L, SMDC</td>
<td>Resettable overcurrent protection</td>
<td>Low profile</td>
</tr>
<tr>
<td>TVS Diode</td>
<td>Power unit protection from voltage transients</td>
<td>SACB, SMAJ, SMF3.3</td>
<td>Protects ICs</td>
<td>Excellent clamping capability</td>
</tr>
<tr>
<td>Latching Relay Driver</td>
<td>Latching relay driver</td>
<td>CPC1600</td>
<td>Saves battery power</td>
<td></td>
</tr>
<tr>
<td>2 TVS Diode, MLV PPTC</td>
<td>Protect IC from transient voltage surge</td>
<td>MLA, SMF</td>
<td>Protects against transient events</td>
<td>Meets IEC global standards</td>
</tr>
<tr>
<td>Strap PPTC</td>
<td>Rechargeable battery cell protection</td>
<td>femtoSMD, nanoSMD, picoSMD</td>
<td>Protects against overcharging battery</td>
<td>Compact design with many options</td>
</tr>
<tr>
<td>3 TVS Array</td>
<td>USB - Protect ICs from ESD</td>
<td>SESD, SPXX</td>
<td>Absorbs repetitive ESD</td>
<td>Low capacitance of 1.0pF per I/O</td>
</tr>
<tr>
<td>PPTC</td>
<td>USB - Protect electronics from OC</td>
<td>0402L, femtoSMD</td>
<td>Resettable OC protection</td>
<td></td>
</tr>
<tr>
<td>4 TVS Array</td>
<td>Audio interface -Protect ICs from ESD</td>
<td>SACB, SMAJ, SMBJ</td>
<td>Absorbs repetitive ESD</td>
<td>Excellent clamping capability</td>
</tr>
<tr>
<td>5 TVS Array</td>
<td>User interface - Protect ICs from ESD</td>
<td>PESD, SP3213-01UTG</td>
<td>Absorbs repetitive ESD</td>
<td>Low capacitance of 1.0pF per I/O</td>
</tr>
<tr>
<td>6 TVS Array</td>
<td>Wireless interface - Protect ICs from ESD</td>
<td>SP3213-01UTG</td>
<td>Absorbs repetitive ESD</td>
<td>Low capacitance of 1.0pF per I/O</td>
</tr>
<tr>
<td>Polymer ESD</td>
<td>Wireless interface - Protect ICs from ESD</td>
<td>PESD</td>
<td>Support passing agency requirements</td>
<td>Low leakage current</td>
</tr>
<tr>
<td>7 TVS Array</td>
<td>RS-485 - Protect ICs from ESD</td>
<td>SM712</td>
<td>Protects ESD, EFT &amp; lightning surge</td>
<td>+12V/-7V Standoff</td>
</tr>
<tr>
<td>8 TVS diode, MLV PPTC</td>
<td>Display - Protect ICs from ESD</td>
<td>MLA, PLED, SMF</td>
<td>Absorbs repetitive ESD</td>
<td>Low capacitance of 1.0pF per I/O</td>
</tr>
<tr>
<td>9 NTC</td>
<td>Temperature sensing</td>
<td>SM Series, DQ-35</td>
<td>Excellent long term stability</td>
<td>Glass encapsulated thermistors</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RB</td>
<td>Surface mountable</td>
<td>Used in hybrid substrates, integrated circuits/PCBs</td>
</tr>
</tbody>
</table>
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:

Electrostatic Discharge (ESD) Suppression Design Guide:

Electronic Discharge (ESD) Protection Design Guide:

Temperature Sensor Overview:

Circuit Protection Solutions:

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