Smart appliances help to simplify daily life, enable healthier living, and improve efficiency.

- Food preparation:
  - Electric cooker
  - Food processor
  - Coffee machine

- Quality living:
  - Humidifier
  - Smart thermostat
  - Portable vacuum cleaner
  - Robotic appliances
Global air purifier shipments show strong growth

Market trends and drivers

Global air purifier unit shipments are expected to increase from ~21 M units in 2018 to ~27 M units in 2023 at a CAGR of 5.2%. In comparison, the total shipments of household appliances are expected to be ~4.25 B units by 2023 at a CAGR of 1.5% between 2018 and 2023. 1, 2

The air purifier market is segmented into four types of filters: the HEPA purifier, the electrostatic precipitator, the stimulated carbon air purifier, and the ion and ozone generator air purifier. The HEPA purifier is likely to overshadow other types with a ~35% market share in 2018 and is expected to capture 38% by 2023.

APAC will account for 35% of the global air purifier market by 2023. China and India are expected to be the highest growth markets in APAC region due to their poor air quality, rising disposable income, and improved lifestyles.

The air purifier markets in North America and Europe are expected to witness moderate growth, while Latin America, the Middle East, and Africa will witness less growth.

*Units shipped are calculated based on forecast price/avg. price per unit of $230

Air purifier growth is strong at ~5% CAGR

Source: 1. Air purifier shipments (Global air purifier market report; August 2018)
2. Global household appliance unit shipments (Statista, August 2018)
Component recommendations for an air purifier

Heater control:
- Fuse
- TRIAC
- Opto-isolator

Motor drive:
- NTC

Power supply:
- Fuse
- MOV
- TVS diode
- MOSFET
- Schottky barrier rectifier diode

Air quality detection sensors:
- Particulate matter (PM 2.0, PM 2.5)
- Humidity
- Gas (NO2, VOCs)

User interface and display:
- NTC
- PESD
- TVS diode array
- Chip fuse

Acronyms:
NTC: negative temperature co-efficient
MOV: metal oxide varistor
TVS: transient voltage suppressor
PESD: polymeric electrostatic discharge suppressor
MOSFET: metal-oxide field effect transistor
TRIAC: triode for alternating current
Component recommendations for power supply

**Technology** | **Product series**
--- | ---
1 | Fuse 875, 877
2 | MOV LA, C-III
3 | TVS diode P6KE, P6SMB
2 | N-channel MOSFET X2-class
3 | Schottky barrier rectifier diode MBR, DST

**Acronyms:**
MOV: metal oxide varistor
TVS: transient voltage suppressor

**Legend:**
- Power
- Signal
# Power supply: Benefits and features of Littelfuse components

<table>
<thead>
<tr>
<th>Technology</th>
<th>Function in application</th>
<th>Product series</th>
<th>Benefits</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fuse</strong></td>
<td>Helps to protects equipment and users from hazards due to overcurrent equipment faults</td>
<td>875, 877</td>
<td>Reduces customer qualification time by complying with regulatory safety standards such as UL/IEC</td>
<td>Compliant with UL/IEC standards, low internal resistance, shock safe, vibration resistant</td>
</tr>
<tr>
<td><strong>MOV</strong></td>
<td>Helps protect power unit from voltage surges and lighting events on AC line</td>
<td>LA, C-III</td>
<td>Reduces customer qualification time by complying with regulatory safety standards such as UL/IEC</td>
<td>Can meet wide-set surge withstand specifications: 40 J – 530 J (2 mS)</td>
</tr>
<tr>
<td><strong>TVS diode</strong></td>
<td>Protect power unit from wide range of voltage transients</td>
<td>P6KE, P6SMB</td>
<td>Fast response time (&lt;1 pS)</td>
<td>600 W peak pulse capability; compatible with high reflow temperature profile (260 °C/40 s)</td>
</tr>
<tr>
<td><strong>MOSFET</strong></td>
<td>Main switching transistor in SMPS</td>
<td>X2-class</td>
<td>Fast response time, low power consumption, and lower heat signature improves operational efficiency</td>
<td>Low Rds (on), low gate charge, dv/dt ruggedness</td>
</tr>
<tr>
<td><strong>Schottky barrier rectifier diode</strong></td>
<td>Rectification and blocking in power supply units</td>
<td>MBR, DST</td>
<td>Low heat generation (efficient) enables compact designs and improves power supply efficiency due to fast recovery time</td>
<td>Low forward voltage drop, high frequency operation, high junction temperature capability</td>
</tr>
</tbody>
</table>
Component recommendations for a heater control board

Legend:
- Green: Power
- Blue: Signal

AC mains → Heater 1
Heater 1 → Input protection & isolation
Heater 2 → switch
Motor current sensing IC

Input protection & isolation → AC switching
AC switching → DC Motor

Legend:
- Power
- Signal

<table>
<thead>
<tr>
<th>Technology</th>
<th>Product series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuse</td>
<td>216</td>
</tr>
<tr>
<td>Opto-isolator</td>
<td>CPC1972</td>
</tr>
<tr>
<td>TRIAC</td>
<td>Qxx10Hx, QJxx16Hx</td>
</tr>
</tbody>
</table>
# Motherboard: benefits and features of Littelfuse components

<table>
<thead>
<tr>
<th>Technology</th>
<th>Function in application</th>
<th>Product series</th>
<th>Benefits</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fuse</strong></td>
<td>Helps to protects equipment and users from hazards due to overcurrent equipment faults</td>
<td>216</td>
<td>Reduces customer qualification time by complying with regulatory safety standards such as UL/IEC</td>
<td>Compliant with UL/IEC standards, low internal resistance, shock safe, vibration resistant</td>
</tr>
<tr>
<td><strong>Opto-isolator</strong></td>
<td>Provides optically isolated control signal to TRIAC</td>
<td>CPC1972</td>
<td>Promotes robust system operation</td>
<td>High noise immunity, low EMI and RFI generation</td>
</tr>
<tr>
<td><strong>TRIAC</strong></td>
<td>AC switching and motor speed control (pump &amp; boiler)</td>
<td>Qxx10Hx, QJxx16xHx</td>
<td>Solid-state switching with no audible noise during operation; enables power efficient operation, compact design</td>
<td>High voltage withstand capability (1kA), high surge capability up to 200A, solid-state switching eliminates contact bounce</td>
</tr>
</tbody>
</table>
User interface, display block diagram

User interface:

Power supply

1. Air temperature sensor
2. Wireless communication interface

Display:

Power supply

1. Backlight LED driver
2. LED/LCD display

Legend:
- Power
- Signal

Technology | Product series
---|---
1 | NTC, KC
2 | PESD, PGB10603

Technology | Product series
---|---
1 | TVS diode array, SP3423, SP1064, SP1002

Acronyms:
- TVS: transient voltage suppressor
- PESD: polymer ESD suppressor
- NTC: negative temperature co-efficient
# Mechanical and displays components usage

## User interface:

<table>
<thead>
<tr>
<th>Technology</th>
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<th>Benefits</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 NTC</td>
<td>Temperature sensing</td>
<td>KC</td>
<td>Provides accurate temperature (component/ambient) for enabling safe device operation</td>
<td>High reliability, small form factor, fast thermal response</td>
</tr>
<tr>
<td>2 PESD</td>
<td>Protects Wi-Fi chipset from user-induced ESD events</td>
<td>PGB10603</td>
<td>Retains RF signal integrity, enables compact design, improves system reliability by quickly clamping voltage to safe levels during ESD</td>
<td>Ultra-low capacitance, compact form factor, low leakage current, fast response time</td>
</tr>
</tbody>
</table>

## Display:

<table>
<thead>
<tr>
<th>Technology</th>
<th>Function in application</th>
<th>Product series</th>
<th>Benefits</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 TVS diode array</td>
<td>Helps protect equipment from user-induced ESD on signal line</td>
<td>SP3423, SP1064, SP1002</td>
<td>Smaller form factor and multi-line protection enables compact designs</td>
<td>Low leakage current, low capacitance per I/O</td>
</tr>
</tbody>
</table>
Motor drive block diagram

<table>
<thead>
<tr>
<th>Technology</th>
<th>Product series</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NTC</td>
</tr>
<tr>
<td>2</td>
<td>NTC</td>
</tr>
</tbody>
</table>

Legend:
- **Green Arrow**: Power
- **Blue Arrow**: Signal
# Benefits of Littelfuse components for motor drive

<table>
<thead>
<tr>
<th>Technology</th>
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<th>Benefits</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 NTC</td>
<td>Temperature sensing</td>
<td>MELF Style Thermistor</td>
<td>Provides accurate temperature (component/ambient) for enabling safe device operation</td>
<td>High reliability, small form factor, fast thermal response.</td>
</tr>
<tr>
<td>2 NTC</td>
<td>Temperature sensing</td>
<td>KW</td>
<td>Provides accurate temperature (component/ambient) for enabling safe device operation</td>
<td>High reliability, small form factor, fast thermal response.</td>
</tr>
</tbody>
</table>
# Standards for air purifier equipment

<table>
<thead>
<tr>
<th>Standard</th>
<th>Title</th>
<th>General scope</th>
<th>Market</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 867</td>
<td>Standard for Safety – Electrostatic Air Cleaners</td>
<td>This standard deals with electrostatic air cleaners rated at 600 volts or less, intended to remove dust and other particles from the air and intended for use in accordance with the National Electrical Code, ANSI/NFPA 70</td>
<td>United States</td>
</tr>
<tr>
<td>CSA C22. No. 187</td>
<td>Electrostatic Air Cleaners</td>
<td>This standard deals with electrostatic air cleaners rated at 600 volts or less, intended to remove dust and other particles from the air and intended for use in accordance with the CSA C22.1, Canadian Electrical Code, Part I</td>
<td>Canada</td>
</tr>
<tr>
<td>UL 507</td>
<td>Standard for Safety – Electric Fans</td>
<td>Fixed or portable air-filtering appliances utilizing mechanical filtration. Rated 600 volts or less and intended for use in accordance with the National Electrical Code, ANSI/NFPA 70</td>
<td>North America</td>
</tr>
<tr>
<td>CSA C22.2 No. 113</td>
<td>Fans and Ventilators</td>
<td>Fixed or portable air-filtering appliances utilizing mechanical filtration. Rated 600 volts or less</td>
<td>Canada</td>
</tr>
<tr>
<td>IEC 60335-2-65</td>
<td>Household and similar electrical appliances – Safety; Part 2-65: Particular requirements for air-cleaning appliances</td>
<td>This International Standard deals with the safety of electric air-cleaning appliances for household and similar purposes, their rated voltage being not more than 250 V for single phase appliances and 480 V for other appliances.</td>
<td>Global</td>
</tr>
<tr>
<td>GB/T 18801-2015</td>
<td>Air Cleaner</td>
<td>This standard specifies air cleaner’s terms and definitions, model and naming method, requirements, test methods, inspection rules, marks, instructions for use, package, transportation and storage.</td>
<td>China</td>
</tr>
</tbody>
</table>
Additional information can be found on littelfuse.com
Local resources supporting our global customers
Why choose Littelfuse?

- It is a global leader with a broad product portfolio, covering every aspect of protection, sensing, and control
- Its application expertise, combined with its product design guidelines, can help you determine the best components for your applications
- Its testing capabilities and assistance support the confirmation of your product selection
- It has standards compliance expertise, including product compliance with many standards and approval support
- It conducts high-volume manufacturing that is committed to the highest quality standards
- It is a global company with local support

We are committed to supporting your success!