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# Heat Pumps

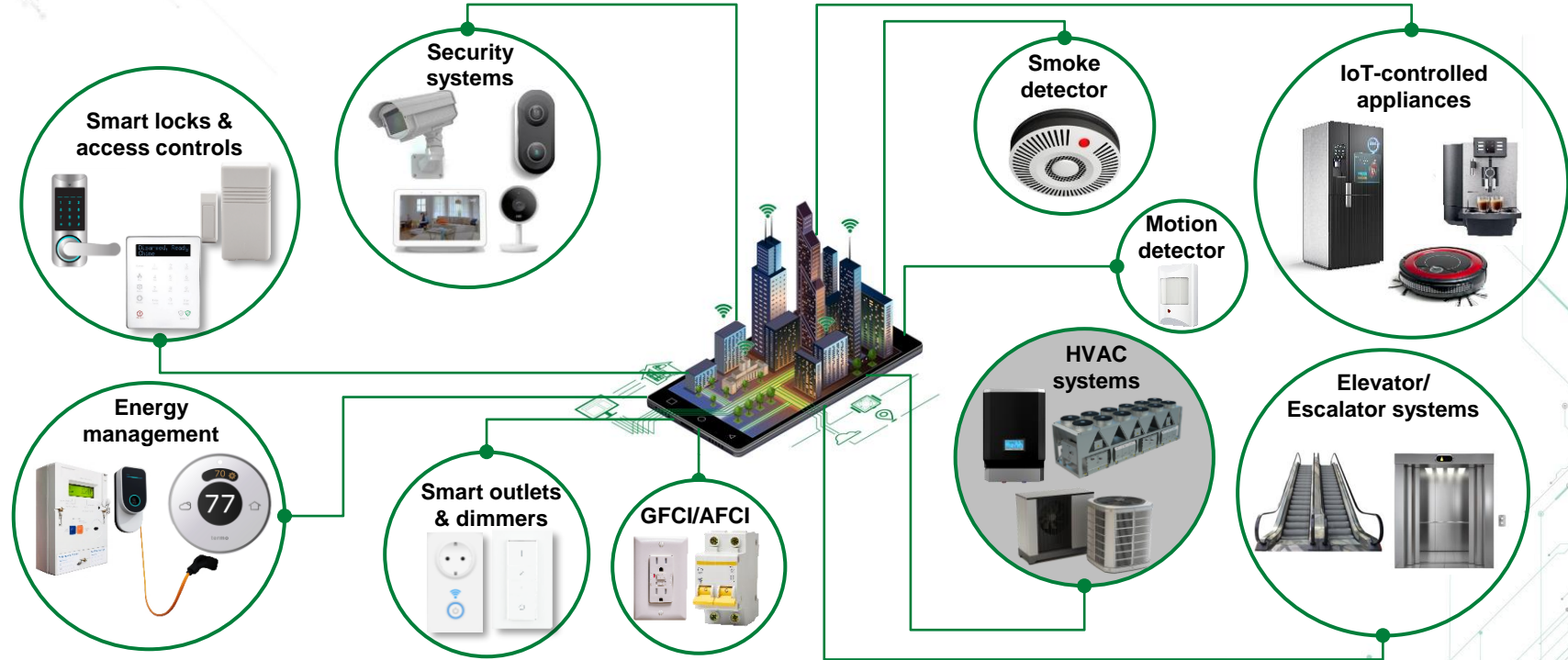
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Building automation

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# Smart homes are equipped with intelligent technologies for convenient and energy-efficient living



Littelfuse offers protect, control, and sense technologies to improve the safety, reliability, and energy efficiency of buildings.

# Market trends of heat pumps

## Market trends and drivers

Global annual installations are expected to increase from 10M units in 2020 to 15M units in 2025, growing at an 8.5% CAGR

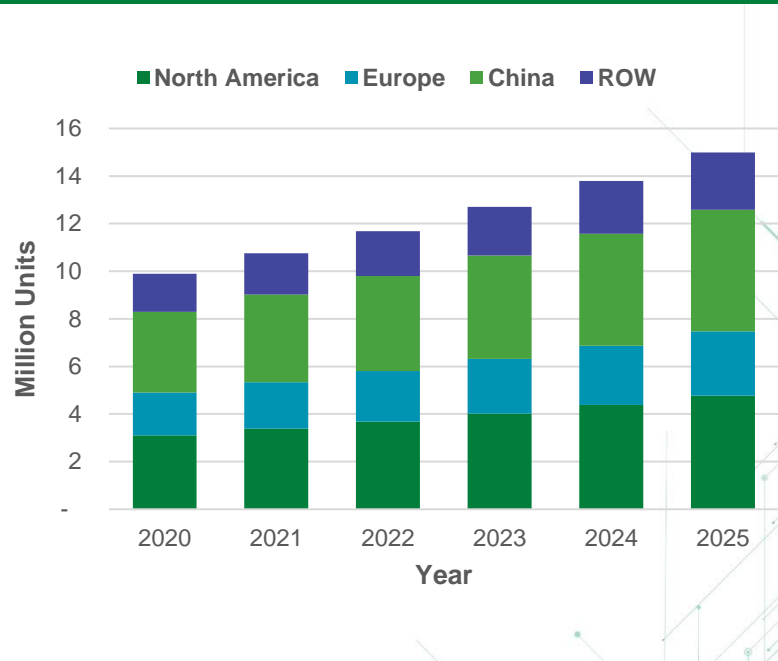
The residential market accounts for 81% of the volume due to installations in newly constructed homes

Inverter-driven motors are improving system efficiencies, allowing heat pumps to be used in a wider range of climates

The Net-Zero Emissions (NZE) initiative is driving over 80 countries to reduce greenhouse gas emissions by 50% by 2030 and to net-zero by 2050; heat pumps are a critical part of emission reduction strategy

To reach NZE targets, annual installations will need to increase from 15M to 85M units by 2030. Rebates and government initiatives will help close the gap; major growth of >15% expected between 2025 and 2030

## Heat pump installations



Sources: [Heat Pumps](#) (IEA, 2021), [Heat Pump Market Report](#) (GVR, 2019)

# Recommended Littelfuse components for heat pumps

## 1 Main power supply

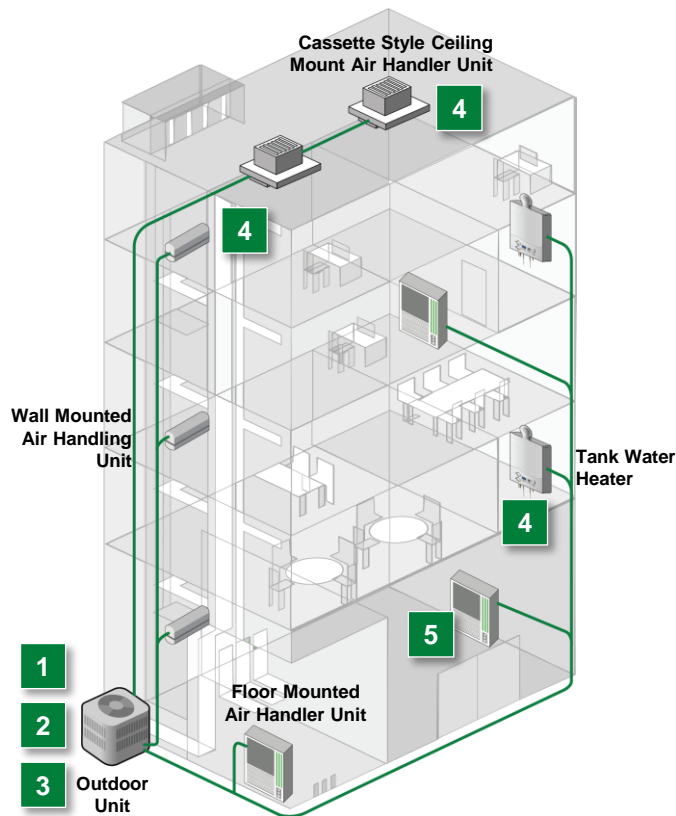
- Fuse
- MOV
- Fuse Holder
- SPD

## 2 Motor contactors

- Single or Multi-pole Contactor

## 3 Rectifier + PFC + Inverter

- MOSFET
- IGBT
- Diodes
- Rectifier Modules
- Gate Driver
- Temperature Sensors



## 4 Air handler unit

- Fuses
- MOV
- TVS Diode
- Temperature Sensors
- Reed Sensor

## 5 Wireless interface

- TVS Diode Array
- Polymer ESD

### Acronyms:

MOV: Metal Oxide Varistor

SPD: Surge Protection Device

NTC: Negative Temperature Coefficient

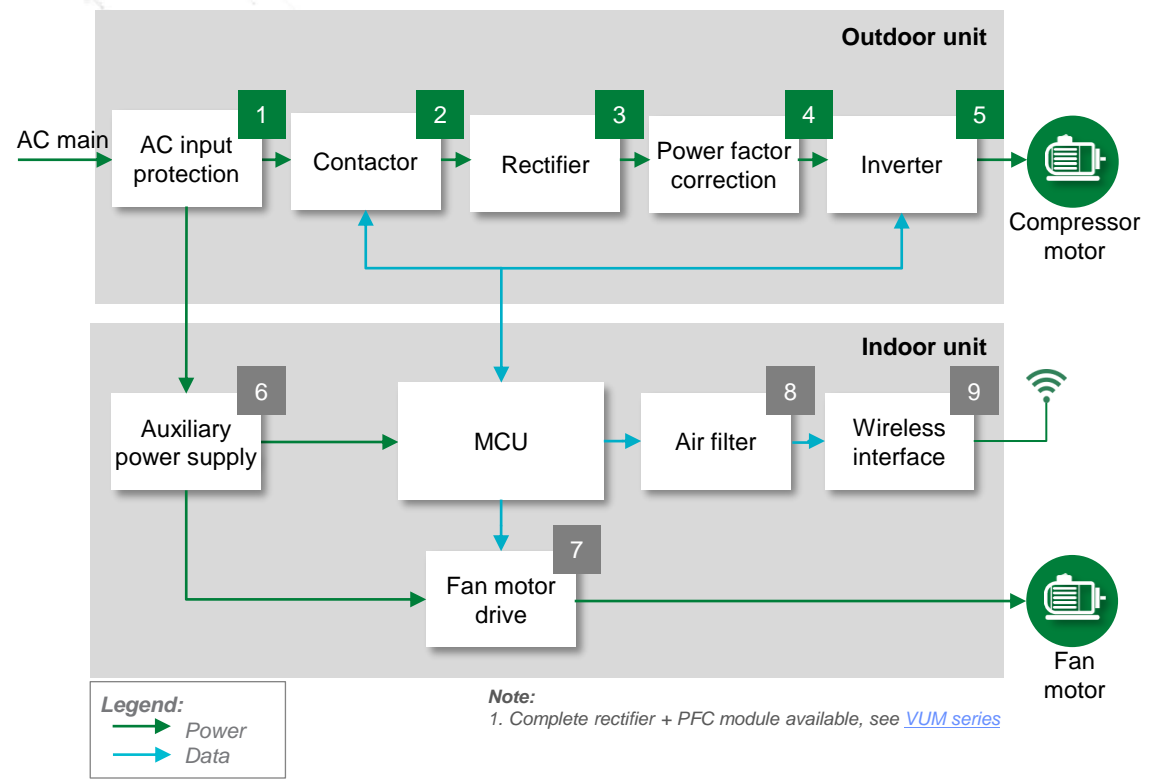
TVS: Transient Voltage Suppression

ESD: Electrostatic Discharge

PFC: Power Factor Correction

Click on the product series in the table below for more info

# Heat pump block diagram



	Technology	Series
1	Fuse	<a href="#">505</a>
	Fuseholder	<a href="#">102</a>
	MOV	<a href="#">UltraMOV</a> , <a href="#">TMOV</a>
	Surge Protection Device	<a href="#">SPD2</a>
	Contactor	<a href="#">HCC</a> , <a href="#">HCD</a>
2	Rectifier Module <sup>1</sup>	<a href="#">MDD</a> , <a href="#">VUO</a> , <a href="#">MDMA</a>
	MOSFET	<a href="#">X2-Class</a> , <a href="#">X3-Class</a>
	Gate Driver	<a href="#">IXD_6xx</a>
3	Integrated PFC Boost <sup>1</sup>	<a href="#">FMD15</a>
	MOSFET	<a href="#">X-Class</a> , <a href="#">X2-Class</a> , <a href="#">HiPerFET™</a>
	Diode	<a href="#">LSIC2SD</a> , <a href="#">DHG</a> , <a href="#">DSEI</a> , <a href="#">DSEPxx</a>
	Gate Driver	<a href="#">IXD_6xx</a> , <a href="#">IX4351NE</a>
	IGBT Module	<a href="#">MIXA</a>
4	IGBT	<a href="#">SMPD</a>
	Gate Driver	<a href="#">IXD_6xx</a> , <a href="#">IX4351NE</a>
	Temperature Sensor	<a href="#">USPXXX</a> , <a href="#">SM</a>



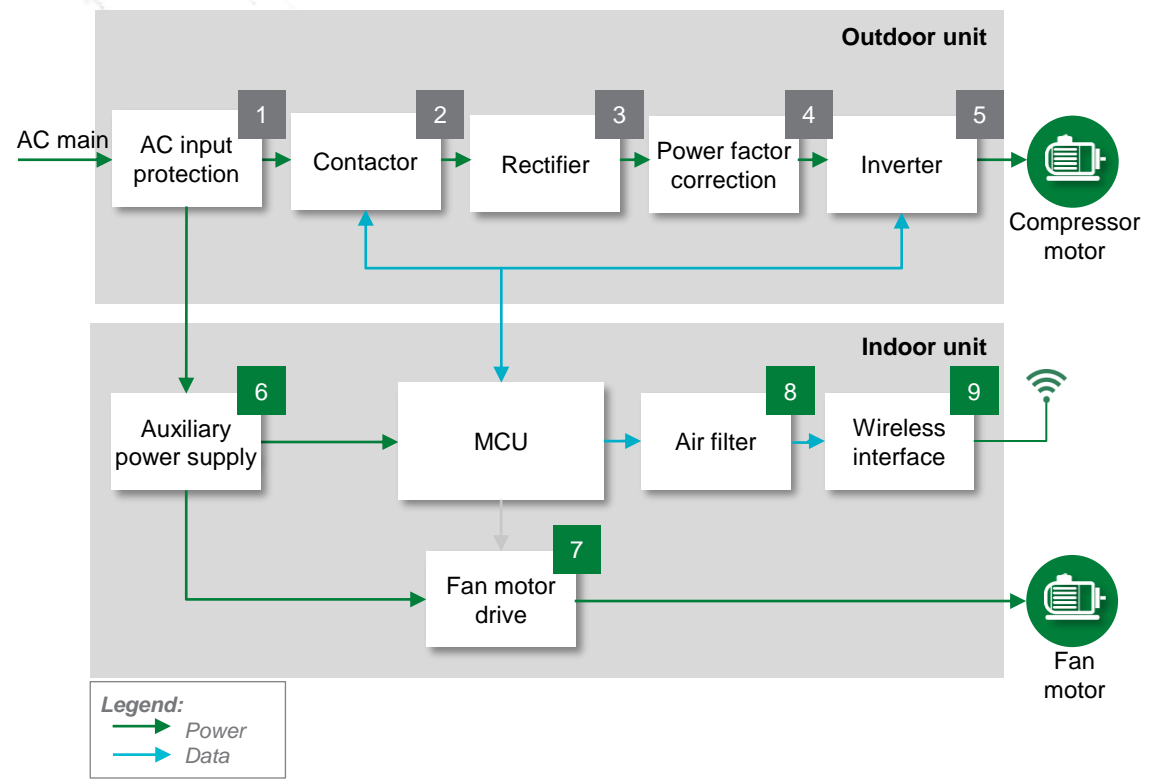
Click on the product series in the table below for more info

# Benefits of Littelfuse components used in heat pumps

	Technology	Function in application	Product Series	Benefits	Features
1	Fuse	Protects equipment and users from hazards due to overcurrent equipment faults	<a href="#">505</a>	Reduces customer qualification time by complying with regulatory safety standards such as UL/IEC	Compliant with UL/IEC standards; low internal resistance; shock safe; vibration resistant
	Fuseholder	Provides enclosure between PCB and fuse for easy replacement	<a href="#">102</a>	Enables easy fuse installation and replacement	Compliant with UL/IEC standards
	MOV	Helps protect equipment from voltage surges and grid fluctuations	<a href="#">UltraMOV, TMOV</a>	Reduces qualification time for compliance with UL/IEC safety standards	High energy absorption capabilities
	Surge Protection Device	Protects from power fluctuations or surges	<a href="#">SPD2</a>	Withstands high-energy transients to prevent disruption, downtime, and degradation or damage to equipment	20 kA nominal interrupting rating and 50 kA maximum interrupting rating
2	Contactors	Safety cutoff to prevent abnormal current supply	<a href="#">HCC, HCD</a>	High reliability; available in one to four poles for design flexibility	Compliant with UL/IEC standards; silver alloy contacts for best-in-call performance
3	Rectifier Module	Converts AC line voltage supplied to the drive to DC	<a href="#">MDD, VUO, MDMA</a>	Allows for low heat signature during operation	Package with DCB ceramic; very low forward voltage drop and low leakage current
	MOSFET	High-frequency switching	<a href="#">X2-Class, X3-Class</a>	Low power consumption; high efficiency system operation	Ultra low on-resistance $R_{DS(ON)}$ and gate charge $Q_g$ ; fast body diode dv/dt ruggedness
	Gate Driver	Controls the IGBT/MOSFET	<a href="#">IXD_6xx</a>	Dual outputs provide space-efficient design; high immunity to latch-up; rise/fall times less than 10 ns	Tight tolerance; small form factor; fast thermal response
4	Integrated PFC Boost	Integrated switching for PFC (power factor correction)	<a href="#">FMD15</a>	High power density; reduces component count, PCB space savings	Integrated MOSFET with FRED diode in single package
	MOSFET	Discrete switching for PFC (power factor correction)	<a href="#">X-Class, X2-Class, HiPerFET™</a>	Optimized for high-frequency applications	Ultra-low output capacitance and on-resistance
	Diode		<a href="#">LSIC2SD, DHG, DSEI, DSEPxx</a>	Improves power supply unit efficiency	Low forward voltage drop; high-frequency operation; high junction temperature
	Gate Driver	Controls the IGBT/MOSFET	<a href="#">IXD_6xx, IX4351NE</a>	Dual outputs provide space-efficient design; high immunity to latch-up; rise/fall times less than 10 ns	Tight tolerance; small form factor; fast thermal response
5	IGBT Module	Integrated switching for variable speed motor	<a href="#">MIXA</a>	Allows for low power consumption and fast response	Rugged design with thin wafer technology; short circuit rated for 10 $\mu$ sec; low gate charge; low EMI and competitive low $V_{CE(SAT)}$
	IGBT	Discrete switching for variable speed motor	<a href="#">SMPD</a>	Board space savings; offers more design flexibility	Ultra-low and compact package profile; low package inductance; excellent thermal capability; high power cycling capability
	Gate Driver	Controls the IGBT/MOSFET	<a href="#">IXD_6xx, IX4351NE</a>	Dual outputs provide space-efficient design; high immunity to latch-up; rise/fall times less than 10 ns	Tight tolerance; small form factor; fast thermal response
	Temperature Sensor	Temperature sensing of various motor coils, refrigerant lines, ambient, semiconductors	<a href="#">USPXXX, SM</a>	Allows for high precision temperature measurement in harsher environments	UL Recognized with ring lug mounting; SM NTCs is in hermetically sealed MELF package suitable for operation up to 220 °C

Click on the product series in the table below for more info

# Heat pump block diagram



	Technology	Series
6	Fuse	<a href="#">215, 216, 314/324, 325/326</a>
	Fuseholder	<a href="#">100, 102, 122</a>
	MOV	<a href="#">UltraMOV, TMOV</a>
	Replaceable Fuse	<a href="#">287</a>
	TVS Diode	<a href="#">SACB, SMAJ, SMF3.3</a>
7	TVS Diode	<a href="#">SMF, 1.5SMC</a>
	Temperature Sensor	<a href="#">USPXXX, SM</a>
8	Reed Sensor + Actuator	<a href="#">59140 + 57140</a>
9	TVS Diode Array	<a href="#">SP3213-01UTG</a>
	Polymer ESD	<a href="#">PESD</a>



Click on the product series in the table below for more info

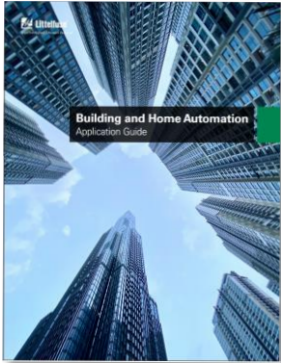
# Benefits of Littelfuse components used in heat pumps

	Technology	Function in application	Product Series	Benefits	Features
6	Fuse	Helps to protect equipment and users from hazards due to overcurrent equipment faults	<a href="#">215</a> , <a href="#">216</a> , <a href="#">314/324</a> , <a href="#">325/326</a>	Reduces customer qualification time by complying with regulatory safety standards such as UL/IEC	Compliant with UL/IEC standards; low internal resistance; shock safe; vibration resistant
	Fuseholder	Provides enclosure between PCB and fuse for easy replacement	<a href="#">100</a> , <a href="#">102</a> , <a href="#">122</a>	Enables easy fuse installation and replacement	Compliant with UL/IEC standards
	MOV	Helps protect equipment from voltage surges	<a href="#">UltraMOV</a> , <a href="#">TMOV</a>	Reduces qualification time for compliance with UL/IEC safety standards	High energy absorption capabilities
	Replaceable Fuse	Protects components on control board	<a href="#">287</a>	Protects low voltage electronics from surge events	Automotive style replaceable fuse
	TVS Diode	Power unit protection from voltage transients	<a href="#">SACB</a> , <a href="#">SMAJ</a> , <a href="#">SMF3.3</a>	Protects ICs and other sensitive components	Excellent clamping capability
7	TVS Diode	Protects IPM from voltage transients	<a href="#">SMF</a> , <a href="#">1.5SMC</a>	Improves system reliability by clamping the voltage at safe levels during transients	200 W peak pulse power capability; excellent clamping capability; low profile
	Temperature Sensors	Temperature sensing of various motor coils, refrigerant lines, ambient, and semiconductors	<a href="#">USPXXX</a> , <a href="#">SM</a>	Allows for high precision temperature measurement in harsher environments	UL Recognized with ring lug mounting; SM NTCs is in hermetically sealed MELF package suitable for operation up to 220 °C
8	Reed Sensor + Actuator	Detects the position of the filter in the air handling unit	<a href="#">59140</a> + <a href="#">57140</a>	Hermetically sealed, suitable for humid, wet or contaminated environments	Application-specific customization available, wide range of sensitivity available
9	TVS Diode Array	Protects ICs from ESD	<a href="#">SP3213-01UTG</a>	Absorbs repetitive ESD	Low capacitance of 1.0 pF per I/O
	Polymer ESD	Protects ICs from ESD	<a href="#">PESD</a>	Supports passing agency requirements	Low leakage current

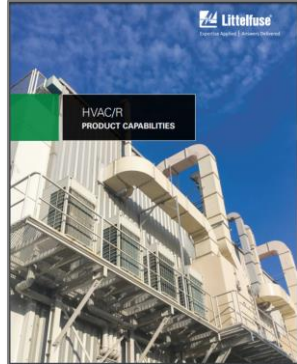
# Additional information can be found on Littelfuse.com

Explore the world of Littelfuse with the electronics eCatalogs (<http://electronicscatalogs.littelfuse.com/>)

Building Automation Guide



HVAC Capability Brochure



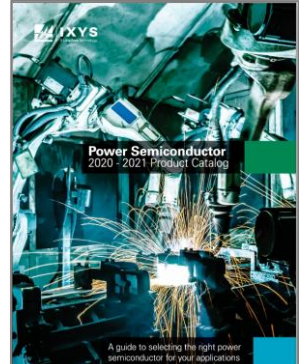
Sensor Selection Guide



Industrial Fuses Catalog

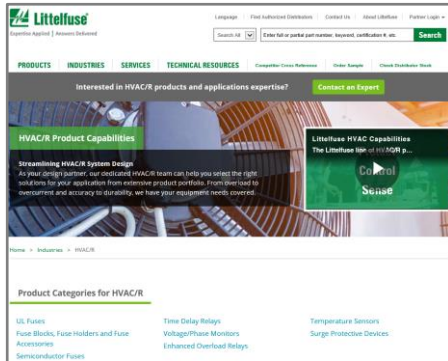


Power Semiconductor Guide

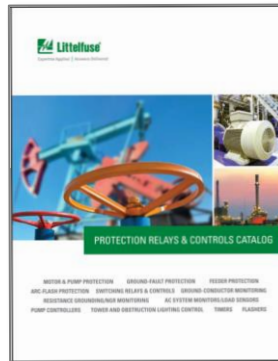


Click on images to open the catalog

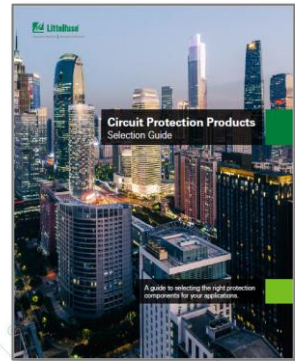
Interactive HVAC Guide



Power Relay & Control Catalog



Circuit Protection Selection Guide



# Local resources supporting our global customers



## Legend

- Sales
- R&D
- Manufacturing

# Partner for tomorrow's electronic systems

## BROAD PRODUCT PORTFOLIO

An industrial technology manufacturing company empowering a sustainable, connected, and safer world

## APPLICATION EXPERTISE

Our engineers partner directly with customers to help speed up product design and meet their unique needs

## GLOBAL CUSTOMER SERVICE

Our global customer service team is with you to anticipate your needs and ensure a seamless experience

## COMPLIANCE AND REGULATORY EXPERTISE

We help customers in the design process to account for requirements set by global regulatory authorities

## TESTING CAPABILITIES

We help customers get products to market faster, we offer certification testing to global regulatory standards

## GLOBAL MANUFACTURING

High-volume manufacturing that is committed to the highest quality standards



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