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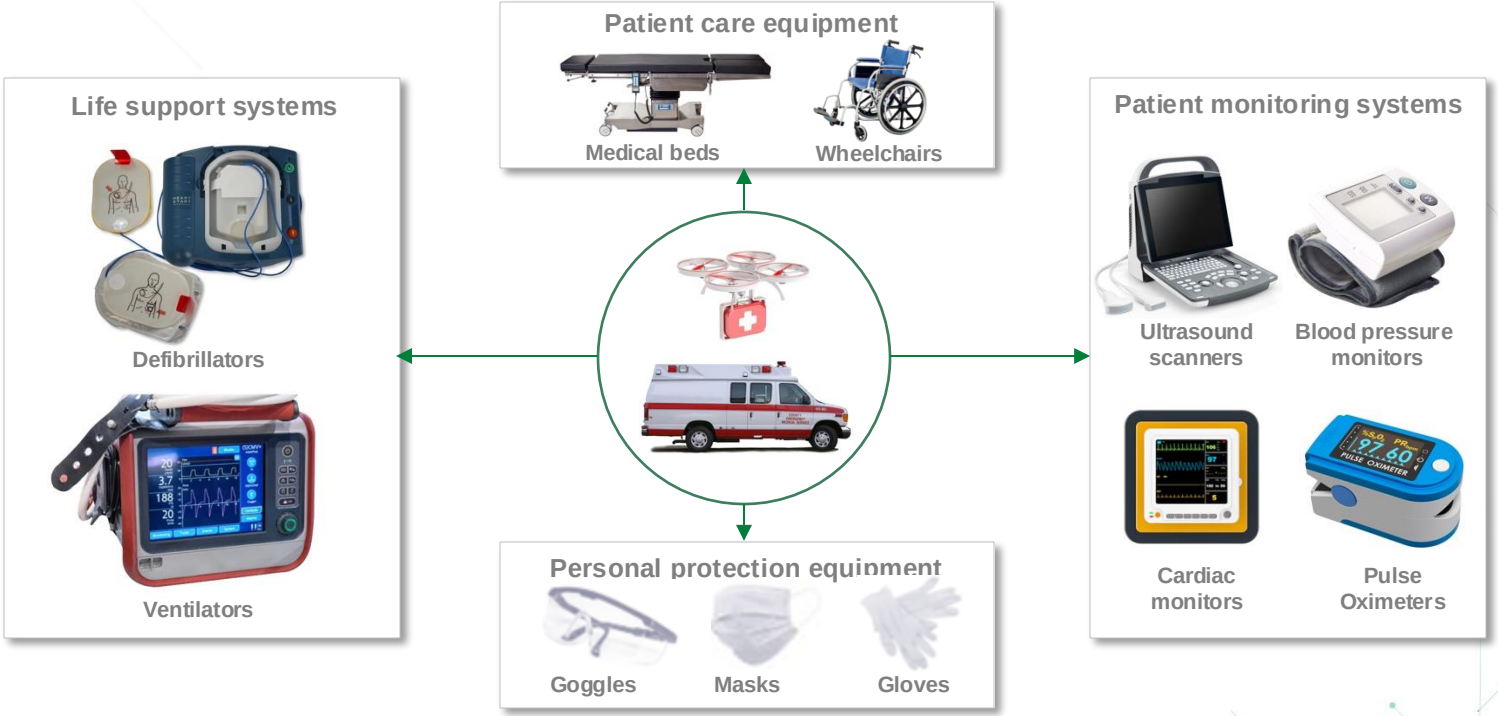
Emergency medical equipment solutions

Healthcare Systems

REV0420

Immediate need for pulmonary, cardio-vascular, and diagnostic systems + general patient care equipment



Robust designs and quality components needed to help with reliable operation & equipment up-time

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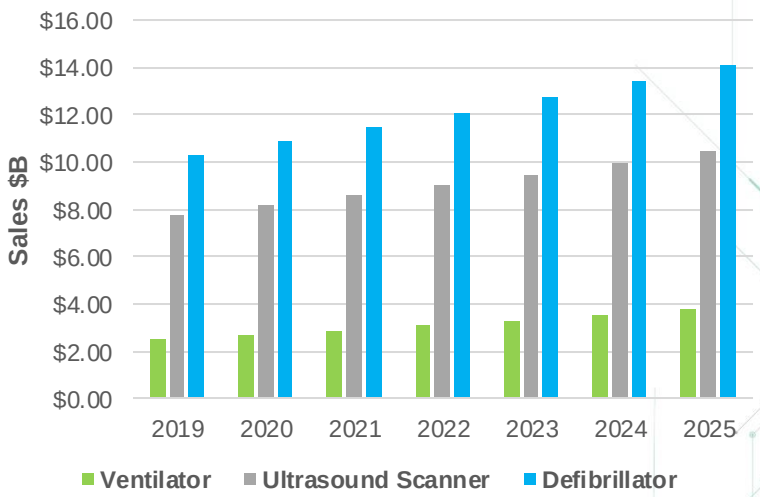
Demand for EMS* equipment is growing at a CAGR of ~6%**

Market trends and drivers
The global EMS* equipment market is broadly classified as *Life Support System, Patient Care Equipment, Patient Monitoring Systems, and Personal Protection Equipment*
Rise in demand of EMS* equipment like ventilators due to sudden coronavirus outbreak; other factors include trauma injuries, road accidents, increased government expenditure on EMS infrastructure, etc.
Worldwide shortage of ventilators due to COVID-19 emergency (for example, in 2019, 77,000 pcs were enough for the entire planet vs. in April 2020, when New York City alone needs 30,000 pcs)
The global defibrillator market is expected to grow at a CAGR of ~5.3%; the increasing prevalence of out-of-hospital cardiac arrest, congenial heart diseases, obesity, diabetes, etc. is expected to boost the growth of external defibrillators
The global ultrasound equipment market is set to grow at a CAGR of ~5.1%; technology advancements (compact, handheld with smartphone connectivity), improvements in diagnostic procedures, and point-of-care testing are major factors driving the market.

Global growth rate of ~6% CAGR**



*** The above -mentioned growth numbers are based on estimates prior to the COVID-19 outbreak. The future demand for these devices after the COVID-19 pandemic needs to be assessed.*

** - Emergency Medical Services*

Source: Ventilator report, Defibrillator report, Ultrasound report

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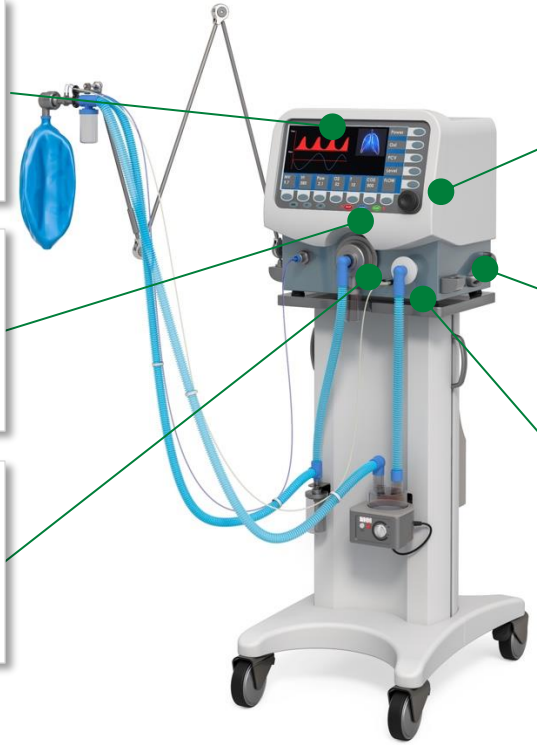
Littelfuse solutions for ventilator systems

Power supply
- PPTC or Fuse
- MOV
- Schottky diode
- Solid state relay

Battery management unit
- PPTC
- TVS diode

Control board
- NTC



User interface
- TVS diode

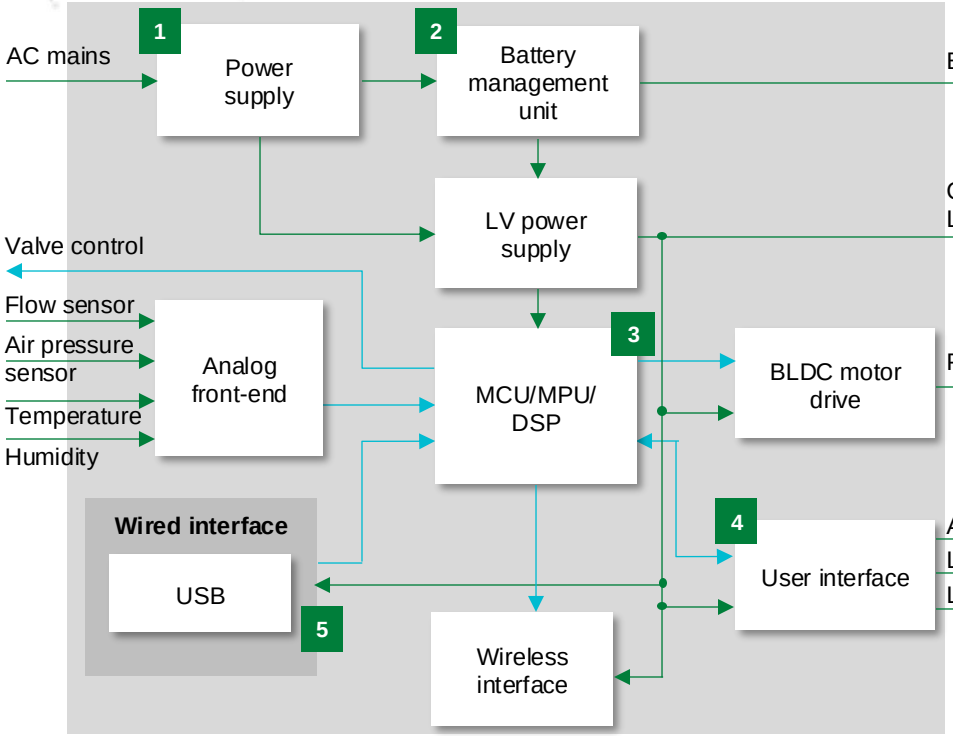
Wired interface
- TVS diode array
- Temperature indicator setP™
- PPTC

Other technologies
- Pressure sensor
- Flow sensor

Protect Control Sense

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

Ventilator block diagram



	Technology	Series
1	Fuse, PPTC	215, 150, LVR
	MOV, MLV	UltraMOV, MLA
	TVS diode	SMCJ33CA, SMBJ36A
	Schottky diode	DST560S
	Solid state relay*	CPC1017N, PLA134S
2	PPTC	2016L, 1206L
	Diode array	SP05, SP1305, SP1001
	TVS diode	SMA6J28A, SMF, 1.5SMC
3	NTC	LC
4	Diode array	SP1103
	TVS diode	SMF3.3A
5	Diode array	SP3019,SP3400
	Temperature indicator**	setP™
	PPTC	miniSMDC, 0805L
	MLV	MLA

** CPC1017N & PLA134S isolation switch which can be used in multiple functions in a ventilator.*
*** The setP™ solution is recommended for USB type C port protection.*

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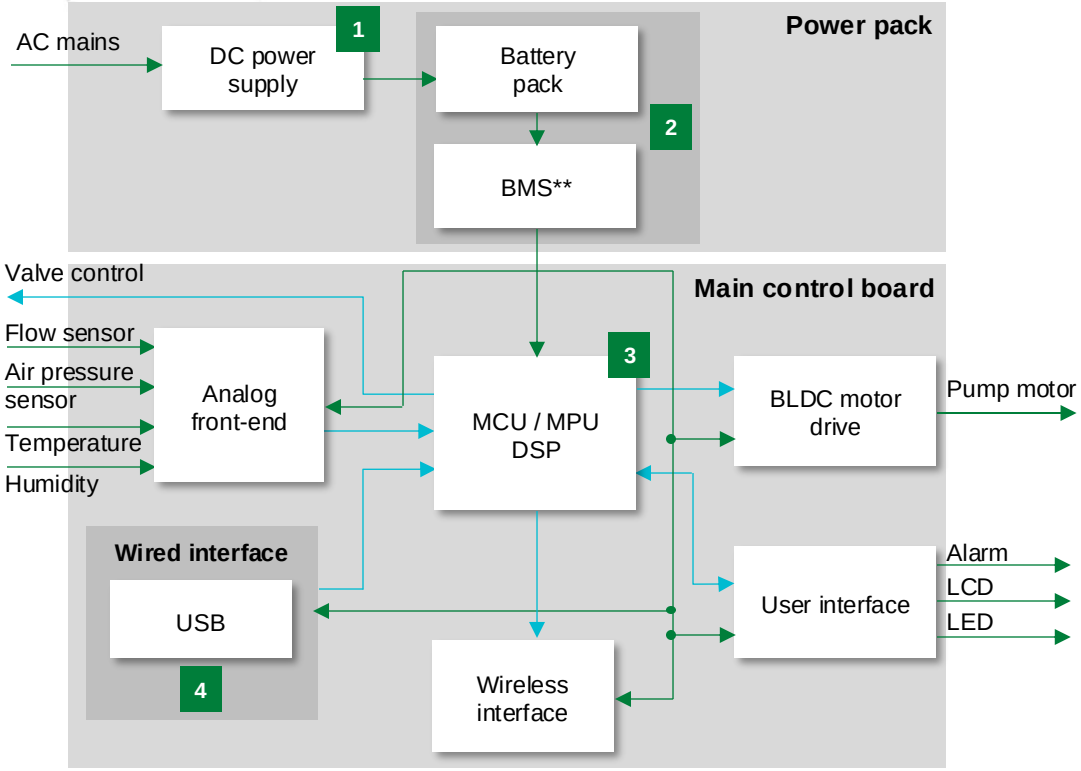
Click on the product series in the table below for more info

Benefits of Littelfuse products for ventilators

	Technology	Function in application	Product series	Benefits	Features
1	Fuse, PPTC	Protect power stage from overcurrent events	215, 150, LVR	Reduces customer qualification time; compact design	Resettable option; third-party compliance UL/IEC; low internal resistance, shock safe,
	MOV, MLV	Protects from voltage surges, such as lighting and transients	UltraMOV, MLA	Reduces customer qualification time; compact design	High energy absorption capability: 40 J – 530 J (2 ms)
	TVS diode	Protects from voltage transients	SMCJ33CA, SMBJ36A	Clamping transients to safe levels	Fast response time <1 ps; small form factor
	Schottky diode	Rectification and blocking in power supply units	DST560S	Enables the design of high-efficiency power supplies	Ultra-low forward voltage drop; high frequency operation
	Solid state relay	Isolation switch	CPC1017N, PLA134S	High reliability & electrical isolation; robust design; no EMI/RFI generation	Up to 3750 V_{RMS} input/output isolation; UL/IEC certified; low drive power
2	PPTC	Protect BMS MOSFET from high currents due to external shorts	2016L, 1206L	Reduces customer qualification time; compact design	Surface mountable; third-party compliance UL/IEC
	Diode array	ESD protection for BMS	SP05, SP1305, SP1001	Multiline protections; compact design	Fast response time; small form factor
	TVS diode	Protects BMS from voltage transients	SMA6J28A, SMF, 1.5SMC	Clamping transients to safe levels	Low inductance; excellent clamping
3	NTC	To sense ambient temperature of the board	LC	Provides accurate temperature (component/ ambient) for enabling safe device operation	High reliability; small form factor; fast thermal response
4	Diode array, TVS diode	Protect ICs from ESD through display	SP1103, SMF3.3A	Multiline protections; compact design	Low capacitance of 1.0 pF per I/O
5	Diode Array	Protection of data lines and equipment from ESD & lighting	SP3019, SP3400	Clamp transient to a safe level preventing catastrophic failure; compact design	Low capacitance 0.3 pF; leakage current (0.01 µA); small form factor µDFN
	Temperature indicator	Protect USB-C plugs and receptacles from overheating	setP™	Helps improve reliability and user experience	Fast response to thermal events; small form factor; zero IR loss contribution
	PPTC	Overcurrent protection for USB chipset	miniSMDC, 0805L	Auto reset after fault is removed; allows for compact design	Resettable; low resistance; compact design
	MLV	ESD protection for data lines	MLA	Fast clamping response; rigid performance under high temperatures	Bidirectional clamping, low form factor; wide operational temperature range

Potential usage of Littelfuse components – example Medtronic Puritan Bennett 560 (PB560)*

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



	Technology	Series	Qty per board
1	Fuse	0215010.MXP,	1
	Fuse holder	150274	1
	MLV	V42MLA1206	1
	TVS diode	SMCJ33CA	1
2	TVS diode	SMBJ36A	2
	PPTC	2016L100PR	1
	Diode array	SP05, SP1305	5
	TVS diode	SMA6J28A	7
	MLV	V5.5MLA0603	2
3	NTC	LC103J2J	1
4	PPTC	miniSMDC	1
	MLV	V5.5MLA0603	9

** In response to the COVID-19 pandemic, "…and in support of the public health and medical response of governmental agencies around the world, Medtronic has publicly posted design specifications for the Puritan Bennett 560 (PB560) ventilator to allow innovators, inventors, start-ups, and academic institutions to leverage their own expertise and resources to evaluate options for rapid ventilator manufacturing."*

The Medtronic ventilator information for model PB560 can be obtained at: https://www.medtronic.com/us-en/e/open-files.html

**BMS: Battery Management System*

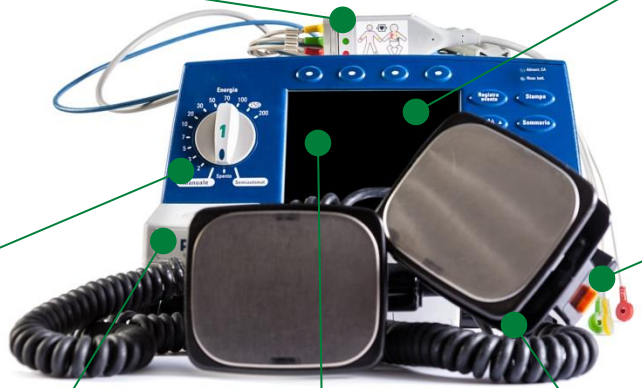
Legend:
Power Line
Signal Line

Littelfuse solutions for defibrillators

Power supply
- PPTC or fuse
- MOV

Battery management unit
- PPTC
- Diode array

Outer selector switch
- Reed switch
- Solid state relay



User interface
- MLV

Wired interface
- PPTC
- Diode array

Wireless interface
- Polymer ESD suppressor

H-bridge
- IGBT
- Gate driver

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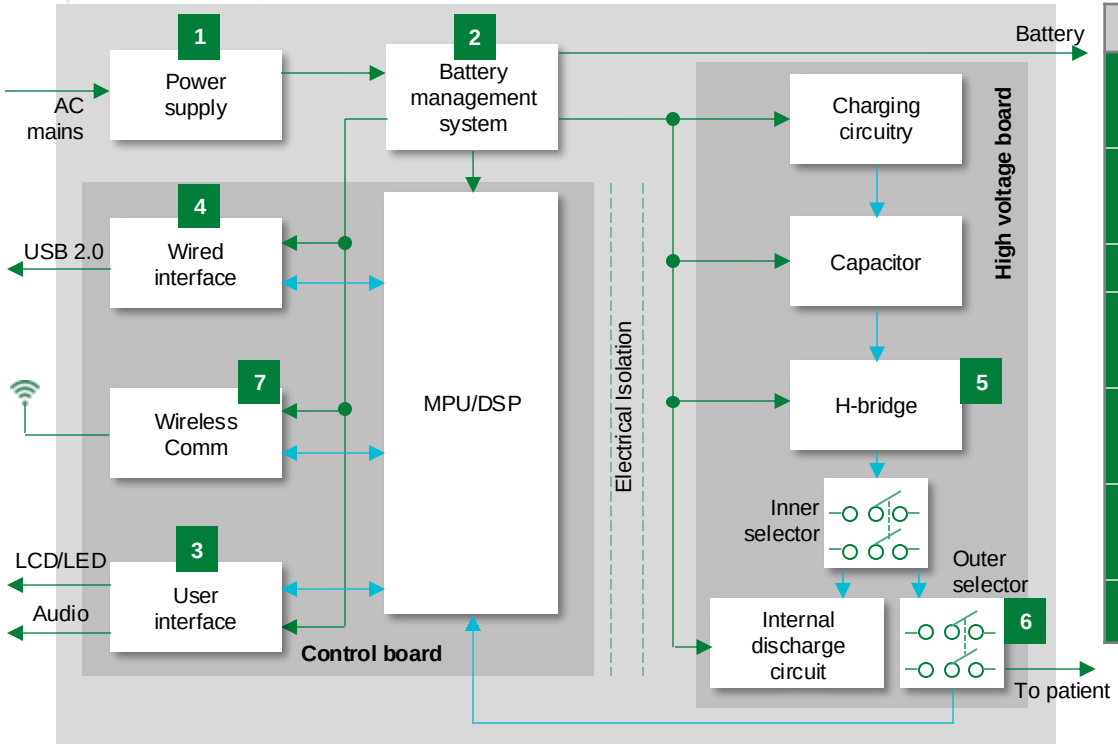
Protect Control Sense

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

Defibrillator block diagram



	Technology	Series
1*	Fuse	313
	Varistor**	UltraMOV
2	PPTC	nanoSMD, femtoSMD
	Diode array	SP11xx
3	MLV	MLA
4	PPTC	LoRho
	Diode array	SP3019, SP3400
5	IGBT	Discrete IGBTs
	Gate driver	IXD_604, IXD_609,
6	Reed switch	Custom sensor
	Solid state relay	CPC1966B
7	Polymer ESD suppressor	PGB10603, PGB10402

** Power supply block is needed for an in-ICU defibrillator*

*** High-power TVS diodes (AK Series) are an alternative solution*

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

Benefits of Littelfuse products in defibrillators

	Technology	Function in application	Product series	Benefits	Features
1	Fuse	Protection against short circuit and overload conditions	313	Reduces damage to equipment compact design; energy efficiency protection	Third-party compliance; low internal resistance
	Varistor	Protection against severe surge transients	UltraMOV	Reduces customer qualification time by complying with third-party safety standards	High energy absorption capability; small package; operating temperature up to 125° C
2	PPTC	Protection against short circuit and overload current conditions	nanoSMD, femtoSMD	Offers fast response to over current events; suitable for compact portable devices	Ultra-low internal resistance; higher current holding in smallest SMD package
	Diode array	Surge and ESD protection	SP11xx	Ensure safety of equipment from repetitive ESD strikes without performance degradation	Low leakage current of 100 nA; small form factor; multiple voltages available
3	Diode array	Protects touchscreen ICs from user-induced ESD events	MLA	Fast clamping response; rigid performance under high temperatures	Bidirectional clamping; low form-factor; wide operational temperature range
4	PPTC	Protect 5 VDC power supply from overcurrent & overtemperature	LoRho	Offers fast response to over current events; suitable for compact portable devices	Ultra-low internal resistance; higher current holding in smallest SMD package
	Diode array	Protection of data lines and equipment from ESD & lighting	SP3019, SP3400	Clamp transient to a safe level preventing catastrophic failure; compact design	Low capacitance 0.3 pF; leakage current (0.01 µA); small form factor µDFN
5	IGBT	Controlling biphasic voltage waveform applied to patient	Discrete IGBTs	Lower heat signatures; fast switching response to high currents	Ultra low on state resistance; fast switching speed
	Gate driver	To drive high-power IGBTs	IXD_604, IXD_609,	Quick turn-on and turn-off of power IGBT; eliminates the need for separate supply	9 A peak current; low propagation delay time
6	Reed sensor	Proximity sensor to detect the position of the handle	Custom sensor	Different customization options (new package, modification of existing package, etc.)	Wide array of sensor output options with engineering services
	Solid state relay	Switch high voltage pulses to the patient during defibrillation	CPC1966B	Enables robust design; high noise immunity	High Noise Immunity; rapid turn-on; 5 mA sensitivity
7	Polymer ESD suppressor	Protects the Wi-Fi chipset from user-induced ESD events	PGB10603, PGB10402	Enables compact design and low clearance between antenna and casing; retains RF signal integrity; improves system reliability	Ultra-low capacitance; compact form factor; low leakage current; fast response time

Littelfuse solutions for portable ultrasound scanners

Battery management unit
- PPTC
- Diode array

HV pulse generator
- MOSFET
- Fast recovery diode

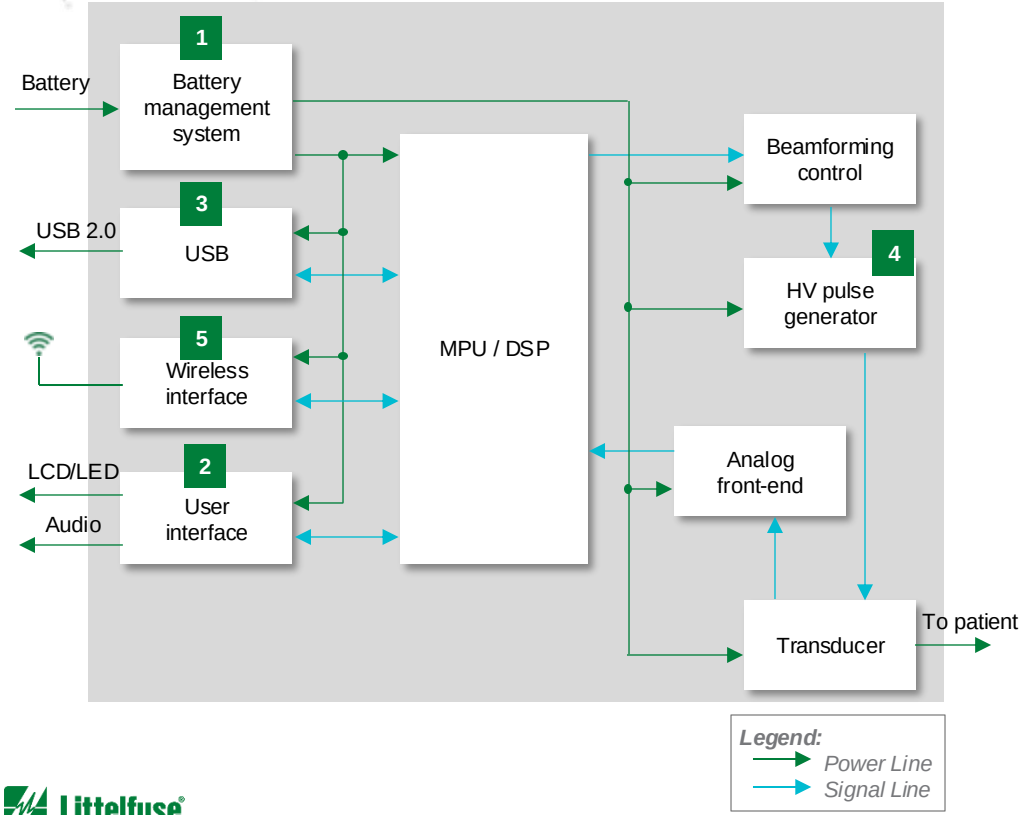
User interface
- Diode array

Wired interface
- PPTC
- Diode array

Wireless interface
- Polymer ESD suppressor

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

Portable ultrasound scanner block diagram



	Technology	Series
1	PPTC	nanoSMD, femtoSMD
	Diode array	SP11xx
2	Diode array	SP1103
3	PPTC	LoRho
	Diode array	SP3019, SP3400
4	MOSFET	HiPerFETs
	Fast recovery diode	HIPERDYN
5	Polymer ESD suppressor	PGB10603, PGB10402

Acronyms:
MOV: metal oxide varistor
TVS: transient voltage suppressor
ESD: electrostatic discharge

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

Benefits of Littelfuse products in ultrasound scanners

	Technology	Function in application	Product series	Benefits	Features
1	PPTC	Protection against short circuit and overload current conditions	nanoSMD, femtoSMD	Offers fast response to over current events; suitable for compact portable devices	Ultra-low internal resistance; higher current holding in smallest SMD package
	Diode array	Surge and ESD protection	SP11xx	Ensure safety of equipment from repetitive ESD strikes without performance degradation	Low leakage current of 100 nA; small form factor; multiple voltages available
2	Diode array	Protects touchscreen ICs from user-induced ESD events	SP1103	Helps comply with IEC standards (61000-4-2: ±15 kV contact, ±30 kV air; 61000-4-4: 40 A (5/50 nS); enables a compact design; retains high signal integrity	Low dynamic resistance; five-channel protection in a small 0402 footprint; maintains high signal integrity
3	PPTC	Protect 5 VDC power supply from overcurrent & overtemperature	LoRho	Offers fast response to over current events; suitable for compact portable devices	Ultra-low internal resistance; higher current holding in smallest SMD package
	Diode array	Protection of data lines against ESD	SP3019,SP3400	Clamp transient to a safe level preventing catastrophic failure; compact design	Low capacitance 0.3 pF & leakage current (0.01 µA); small form factor µDFN
4	MOSFET	Used as a switch to generate high-frequency pulse by varying the external gate resistance	HiPerFETs	Small package allows space saving and ease of mounting; high power density	Up to 1200 V with fast intrinsic diodes; low R_{dson} per silicon area; high-speed switching; excellent thermal performance
	Fast recovery diodes	Rectification of high-frequency pulse	HIPERDYN	Avalanche voltage rated for reliable operation; soft reverse recovery for low EMI/RFI; low power dissipation	VRRM from 300, 600, and 1200 V; I_{FAV} range: 6 A to 55 A; very low capacitance <15 pf
5	Polymer ESD suppressor	Protects the Wi-Fi chipset from user-induced ESD events	PGB10603, PGB10402	Enables compact design and low clearance between antenna and casing; retains RF signal integrity; improves system reliability	Ultra-low capacitance; compact form factor; low leakage current; fast response time

Select safety standards for medical equipment

Standard	Title	General scope	Littelfuse Technology	Market
IEC 60601-1-2	Medical Electrical Equipment Part 1-2	General Requirements for Basic Safety and Essential Performance – Collateral Standard: Electromagnetic Disturbances – Requirements & Tests	TVS diode; Diode array	Global
IEC 62311-2	Secondary cells and batteries containing alkaline or other non-acid electrolytes	Safety requirements for portable sealed secondary lithium cells, and for batteries made from them, for use in portable applications - Part 2: Lithium systems	Fuse; PPTC	Global
IEC 60601-1-11	Medical Electrical Equipment Part 1-11	General Requirements for Basic Safety and Essential Performance – Collateral Standard: Requirements for Medical Electrical Equipment and Medical Electrical Systems Used in the Home Healthcare Environment	Fuse	Global

COVID-19

SAFETY MEASURES

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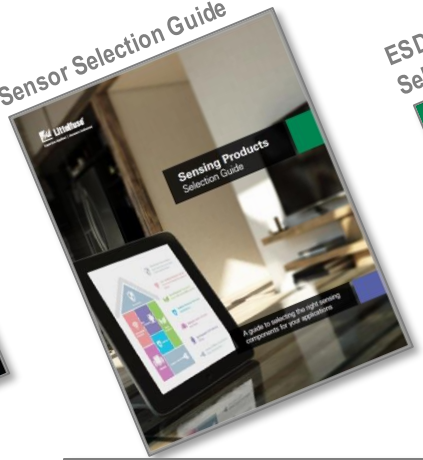
Additional information can be found on littelfuse.com

Circuit Protection Selection Guide

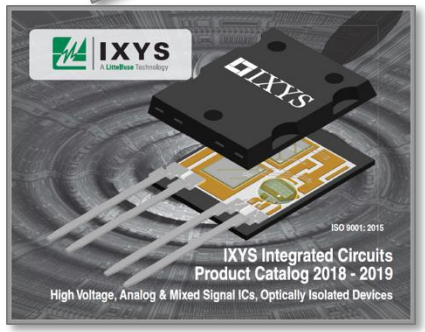
Sensor Selection Guide



ESD Suppression Selection Guide

ESD Protection Selection Guide

Integrated Circuits Catalog



Power Semiconductor Catalog

Click on each image to open the catalog

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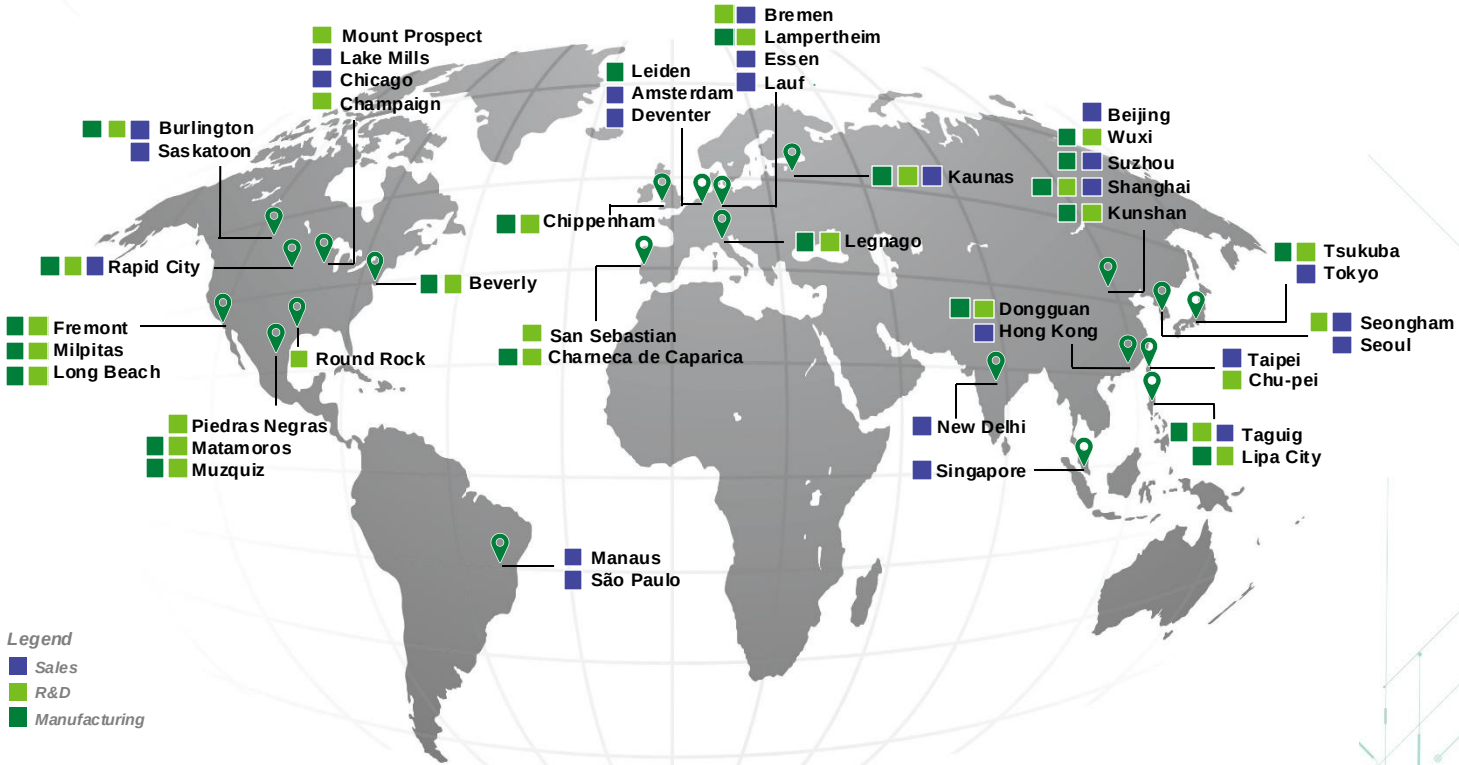
Local resources supporting our global customers



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Partner for tomorrow’s electronic systems

Broad product portfolio

A global leader with a broad product portfolio, covering every aspect of protection, sensing, and control

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 & regulatory expertise

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

Testing capabilities

To 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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