



Expertise Applied | Answers Delivered

# Drug Delivery Device Ecosystem

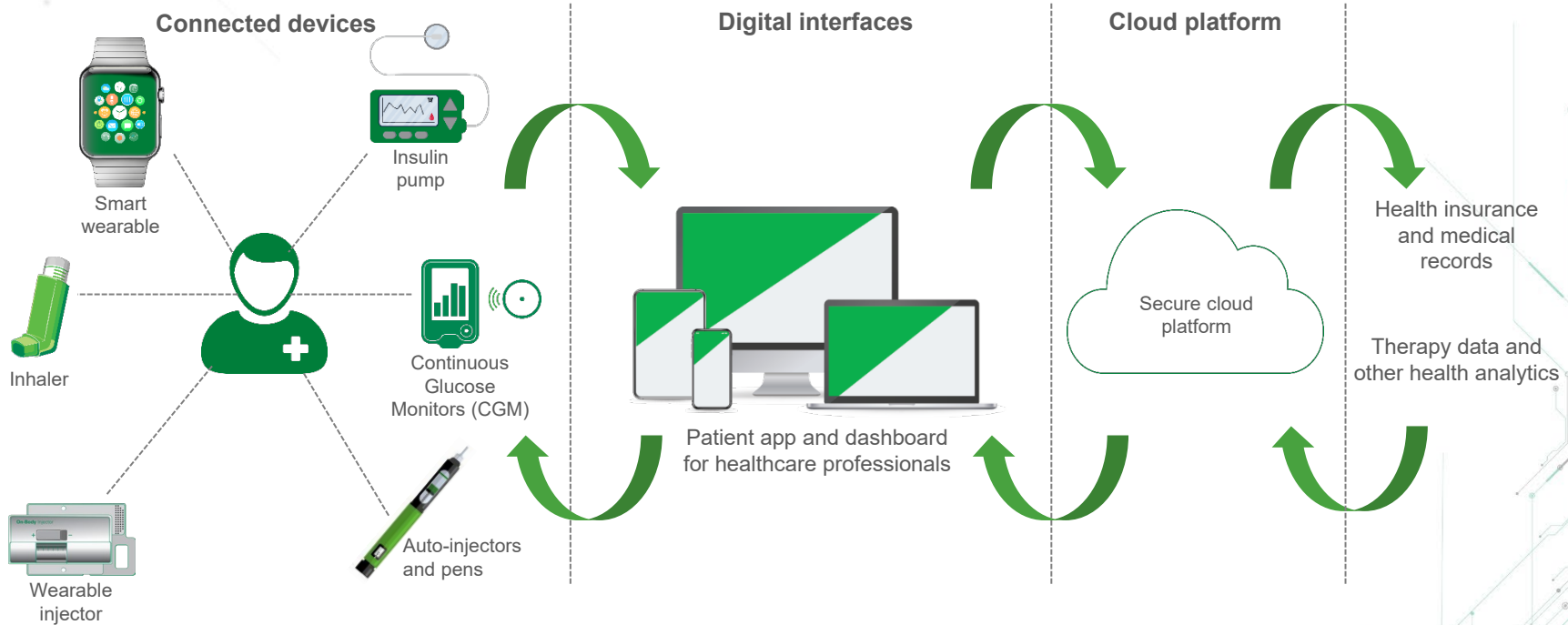
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Healthcare Solutions

*Users must independently evaluate the suitability of and test each product selected for their own specific applications. It is the User's sole responsibility to determine fitness for a particular system or use based on their own performance criteria, conditions, specific application, compatibility with other parts, and environmental conditions. Users must independently provide appropriate design and operating safeguards to minimize any risks associated with their applications and products. Littelfuse products are not designed for, and may not be used in, all applications. Read complete Disclaimer Notice at [littelfuse.com/disclaimer-electronics](https://www.littelfuse.com/disclaimer-electronics).*

# Connected drug delivery systems are radically changing how services are being delivered to patients



Connected healthcare helps achieve lower healthcare costs, improves efficiency, and empowers patients.

# Drug delivery device ecosystem is growing at ~25% CAGR

## Market trends and drivers

The market size growth for connected medical devices is projected to reach \$251.57 billion by 2030, with CAGR estimated at 25.3% from 2021-'28.

Personal, portable, connected medical devices with CE\* mark, FDA\*\* approval, and NMPA\*\*\* certifications allow healthcare professionals to receive and act on data.

Connected auto-injectors and pens are an emerging tech in a mature fast-growing drug market. Delivery systems include multiple dose reusable systems, single dose delivery systems, and on-body large volume delivery systems.

Decentralized healthcare relies on personal, wearable, and connected devices for patients to self-administer tests and medicines, necessitating precise data and high-performance electronic components.

Healthcare is ready for disruption, and 5G, AI, and ML are essential for connected care.

The global market for decentralized connected health and wellness solutions is expanding rapidly, with no sub-segment is being left behind. Diagnosis and treatment (includes connected pharmaceutical delivery), wellness and prevention, monitoring, and others are all experiencing accelerated growth.

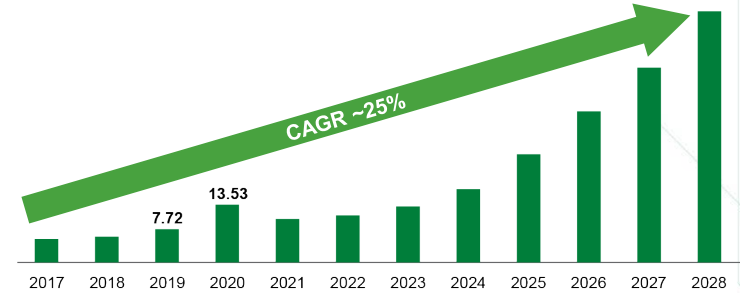
Country Oversight and Compliance to standards:

\* CE Mark: Europe

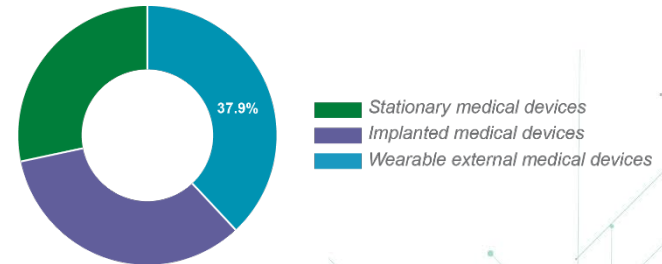
\*\* FDA – Food and Drug Administration: USA

\*\*\* NMPA – National Medical Products Administration: China

## North America IoT market size, 2017 to 2028 (\$B)



## Global IoT market share by product, 2020



Sources: [Fortune Business Insights](#)

Acronyms:

CAGR – Compound Annual Growth Rate

TMR – Tunnel Magnetoresistance Effect

ESD – Electro-Static Discharge

AI – Artificial Intelligence

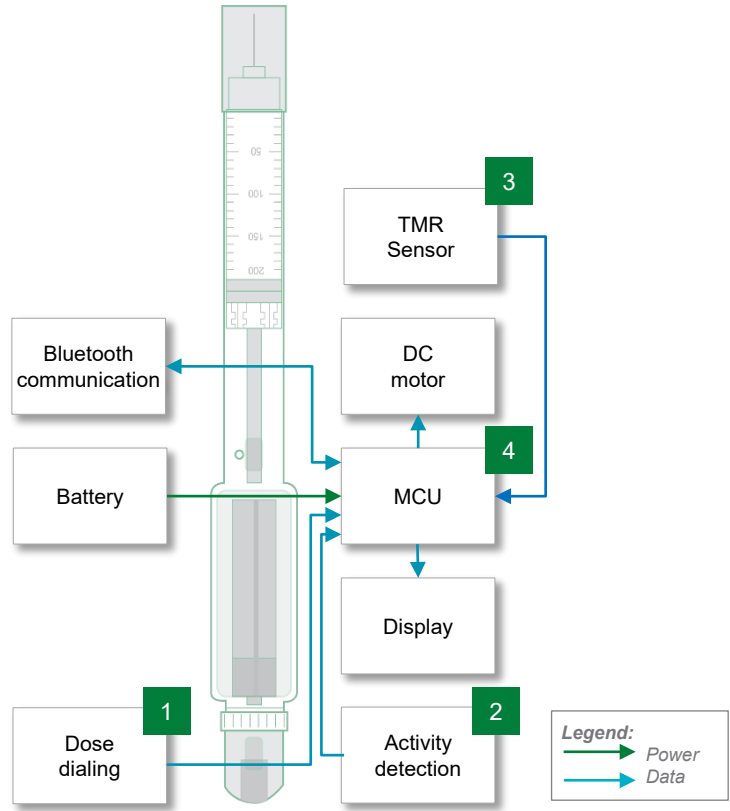
ML – Machine Learning

IoT – Internet of Medical Things

Littelfuse, Inc. © 2024

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

# Auto-injectors or drug delivery pens



	Technology	Product series
1	Detect Switch	<a href="#">HDI</a> , <a href="#">FDSD</a> , <a href="#">FDSE</a>
2	Tactile Switch	<a href="#">NanoT</a> , <a href="#">KXT</a> , <a href="#">KMT0</a> , <a href="#">PTS</a> , <a href="#">KMT0 D</a>
	Detect Switch	<a href="#">HDI</a> , <a href="#">FDSE</a> , <a href="#">HDS</a>
	Reed Switch	<a href="#">59177</a>
	TMR Switch	<a href="#">TMR</a>
3	TMR Position Sensor	Under development; contact sales
4	Microcontroller	Z8F1625*, <a href="#">Z8F3224</a> (No LCD) <a href="#">S3F8S19</a> , <a href="#">Z8F6482</a> (With LCD)

\*Z8F1625 is under development



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

# Features and benefits of Littelfuse products

	Technology	Function in application	Product series	Benefits	Features
1	Detect Switch	Detects position of the dose dial	<a href="#">HDT</a> , <a href="#">FDSD</a> , <a href="#">FDSE</a>	Extremely small package size	Integrated mechanism and lever; lead free
2	Tactile Switch	For various activity detection (for example reliable navigation; dose dialing, dose counting, cap on/off detection, activation, detection of vial in correct position, contact with patient body/skin contact)	<a href="#">NanoT</a> , <a href="#">KXT</a> , <a href="#">KMT0</a> , <a href="#">PTS</a> , <a href="#">KMT0 D</a>	Board space saving and design flexibility; long life; compatible with harsh environment	Ultra-compact size; up to 1000 K life cycles; up to IP68 for sealed versions; compatibility with PCB coatings
	Detect Switch		<a href="#">HDT</a> , <a href="#">FDSE</a> , <a href="#">HDS</a>	Micro-miniature; long life; up to IP 68 sealing properties; micro-detect switches; over-travel, low actuation magnetic stress; 35 g max; low profile	Excellent performance; response to touch and feel; design allows for top or side actuation; low-profile package; normally closed circuit (FDSE)
	Reed Switch		<a href="#">59177</a>	Ease of integration within space-constrained environments; no degradation in performance; no leakage current in 'open' state—ideal for battery-powered IoT applications	Ultra-miniature size switch 9.0 mm x 2.5 mm x 2.4 mm (0.354"x 0.098" x 0.094"); capable of switching 170 Vdc or 0.25 A at up to 10 W; available in select sensitivities (operating distances)
	TMR Switch		<a href="#">TMR</a>	Ultra-low power consumption; excellent thermal stability	Ultra-low power consumption: 200 nA at 50 Hz response or 1.5 uA at 1 kHz response
3	TMR position sensor	Under development; contact sales			
4	Microcontroller	Bluetooth control for communication LCD display, and DC motor control	Z8F1625, <a href="#">Z8F3224</a> (No LCD) <a href="#">S3F8S19</a> , <a href="#">Z8F6482</a> (With LCD)	Lower standby current; charging battery charges with high-resolution ADC; high-resolution PWM for motor control	8-bit MCU; 12- or 14-bit ADC and LCD controller

# Wearable injectors

1

**Power management**  
eFuse, PPTC



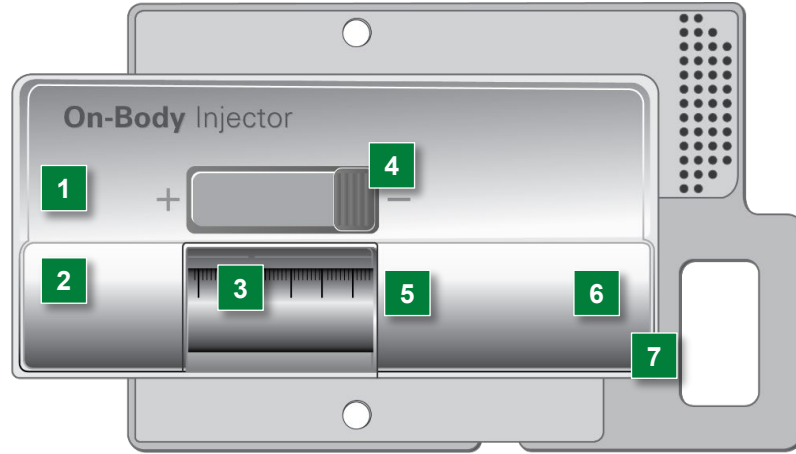
2

**USB**  
TVS Diode Array



3

**Dose dialing**  
Detect Switch



4

**Activity detection**  
Tactile Switch, Detect Switch,  
Reed Switch, TMR Switch



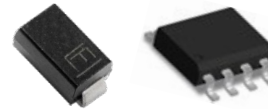
5

**Plunger position measurement**  
TMR Sensor

Under development,  
contact sales

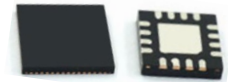
7

**Motor control**  
TVS Diode, Gate Driver

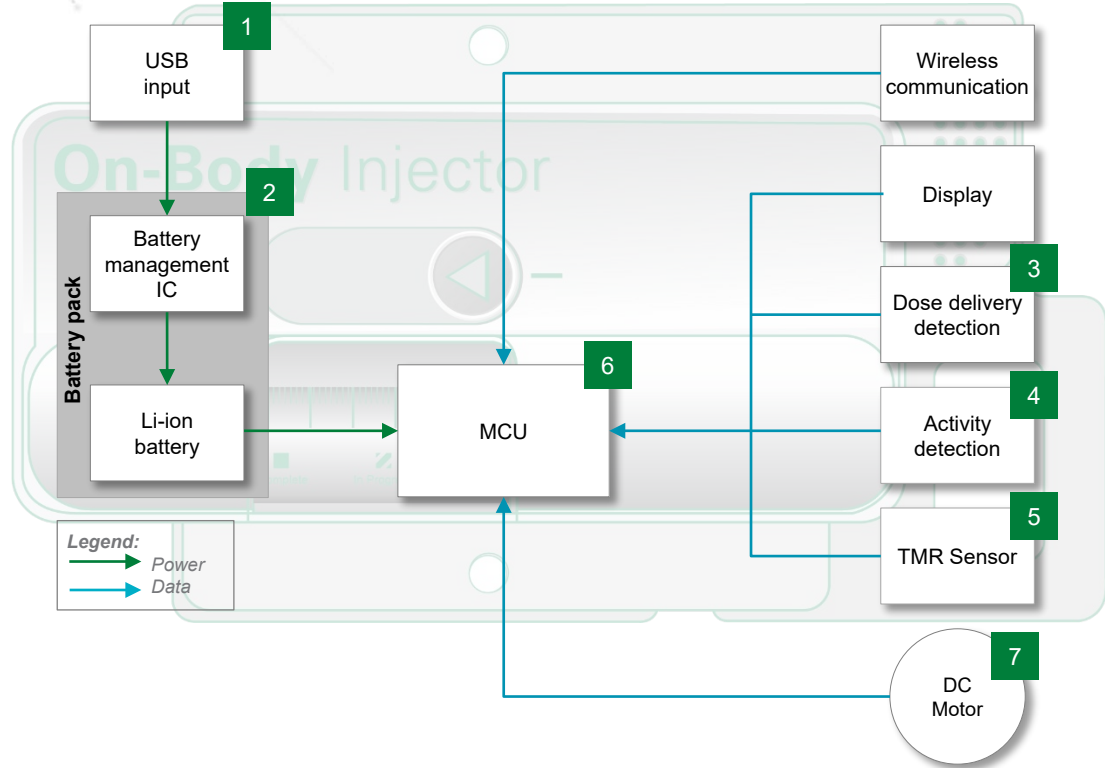


6

**Control unit**  
Microcontroller




# Wearable injectors functional block diagram



	Technology	Product series
1	eFuse (USB-C)	<a href="#">LS0504EDD12</a>
	PPTC (for USB-A or -B)	<a href="#">Low Rho</a>
2	TVS Diode Array	<a href="#">SC1205-01UTG</a> , <a href="#">SP1006-01UTG</a>
3	Detect Switch	<a href="#">HDI</a> , <a href="#">FDSD</a> , <a href="#">FDSE</a>
4	Tactile Switch	<a href="#">NanoI</a> , <a href="#">KXT</a> , <a href="#">KMT0</a> , <a href="#">PTS</a> , <a href="#">KMT0 D</a>
	Detect Switch	<a href="#">HDI</a> , <a href="#">FDSE</a> , <a href="#">HDS</a>
	Reed Switch	<a href="#">5917Z</a>
	TMR Switch	<a href="#">TMR</a>
5	TMR position sensor	Under development; contact sales
6	Microcontroller	Z8F1625*, <a href="#">Z8F3224</a> (No LCD)
		<a href="#">S3F8S19</a> , <a href="#">Z8F6482</a> (With LCD)
7	TVS Diode	<a href="#">SMAJ</a>
	Gate Driver	<a href="#">LF2101N</a> , <a href="#">LF2103N</a>



 *Click the product series in the table below for more info.*

# Features and benefits of Littelfuse products

	Technology	Function in application	Product series	Benefits	Features
1	eFuse (USB-C)	Integrated overcurrent and overvoltage protection	<a href="#">LS0504EDD12</a>	Wide input range from 1.8 V to 5.5 V; internal soft start	Hiccup mode for short circuits and overcurrents
	PPTC (for USB-A or -B)	Protects 5 V DC power supply from overcurrent and over-temperature events	<a href="#">Low Rho</a>	Offers fast response to overcurrent events; suitable for compact portable devices	Ultra-low internal resistance; higher current holding in smallest SMD package
2	TVS Diode Array	Protects against ESD on data lines	<a href="#">SC1205-01UTG</a> , <a href="#">SP1006-01UTG</a>	Enables compact design; reduces assembly time	Complies with IEC standards; low leakage current of 100 nA; compact form factor
3	Detect Switch	Detects position of the dose dial	<a href="#">HDT</a> , <a href="#">FDSD</a> , <a href="#">FDSE</a>	Extremely small package size	Integrated mechanism and lever; lead free
4	Tactile Switch	For various activity detection (for example reliable navigation; dose dialing, dose counting, cap on/off detection, activation, detection of vial in correct position, contact with patient body/skin contact)	<a href="#">NanoT</a> , <a href="#">KXT</a> , <a href="#">KMT0</a> , <a href="#">PTS</a> , <a href="#">KMT0 D</a>	Board space saving and design flexibility; long life; compatible with harsh environments	Ultra-compact size; up to 1000 K life cycles; up to IP68 for sealed versions; compatibility with PCB coatings
	Detect Switch		<a href="#">HDT</a> , <a href="#">FDSE</a> , <a href="#">HDS</a>	Micro-miniature; long life; up to IP 68 sealing properties; micro-detect switches; over-travel, low actuation magnetic stress: 35 g max; low profile	Excellent performance; response to touch and feel; design allows for top or side actuation; low-profile package; normally closed circuit (FDSE)
	Reed Switch		<a href="#">59177</a>	Ease of integration within space-constrained environments; no degradation in performance; no leakage current in 'open' state	Ultra-miniature size switch 9.0 mm x 2.5 mm x 2.4 mm (0.354"x 0.098" x 0.094"); capable of switching 170 Vdc or 0.25 A at up to 10 W
	TMR Switch		<a href="#">TMR</a>	Ultra-low power consumption; excellent thermal stability	Ultra-low power consumption: 200 nA at 50 Hz response or 1.5 uA at 1 kHz response
5	TMR position sensor	Under development; contact sales			
6	Microcontroller	Bluetooth control for communication, LCD display, and DC motor control	<a href="#">Z8F1625</a> , <a href="#">Z8F3224</a> (No LCD) <a href="#">S3F8S19</a> , <a href="#">Z8F6482</a> (With LCD)	Lower standby current; battery charges with high-resolution ADC and high-resolution PWM for motor control	8-bit MCU; 12- or 14-bit ADC and LCD controller
7	TVS Diode	Surge protection	<a href="#">SMAJ</a>	Offers board space saving; excellent clamping capability	Low-profile package; IEC-61000-4-2 ESD 30 kV (Air), 30 kV (Contact); fast response time
	Gate Driver	Controls the motor	<a href="#">LF2101N</a> , <a href="#">LF2103N</a>	Shoot-through protection; more precise control and lower torque ripple; board space saving	Logic inputs are 3.3 V logic level compatible; available in SOIC-8

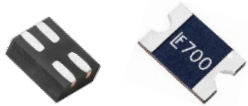


# Insulin pump

1

## Power management

eFuse, PPTC



2

## USB

TVS Diode Array



3

## Keypad

Tactile Switch, Detect Switch



4

## Plunger position measurement

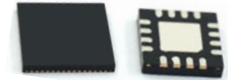
TMR Sensor

Under development,  
contact sales

5

## Control unit

Microcontroller



6

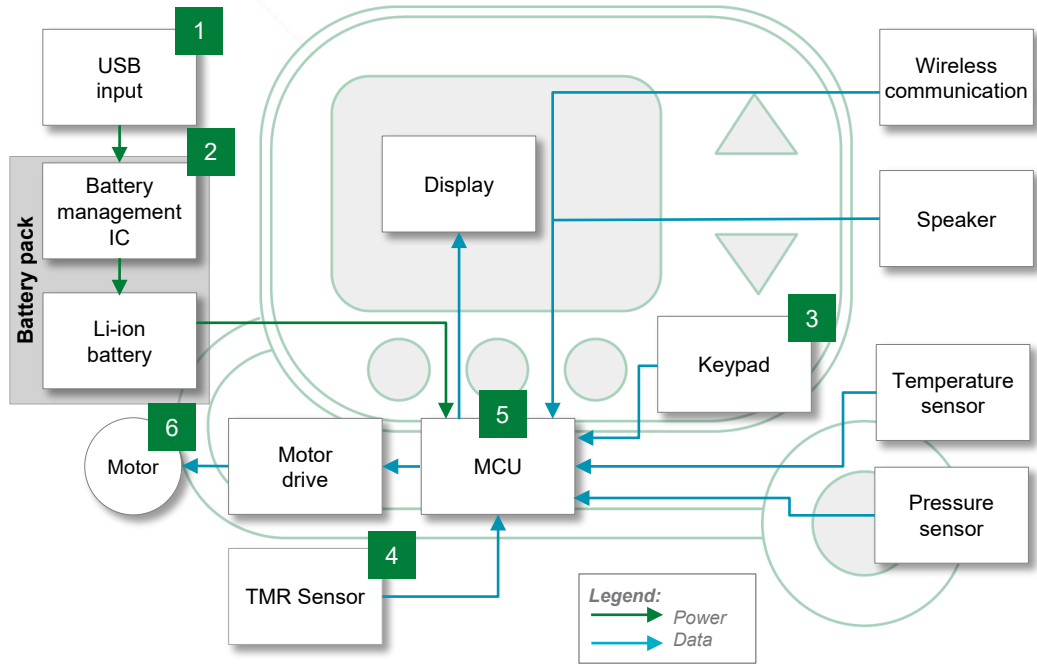
## Motor control

TVS Diode, Gate Driver



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

# Insulin pump functional block diagram



	Technology	Product series
1	eFuse (USB-C)	<a href="#">LS0504EDD12</a>
	PPTC (for USB-A or -B)	<a href="#">Low Rho</a>
2	TVS Diode Array	<a href="#">SC1205-01UTG</a> , <a href="#">SP1006-01UTG</a>
3	Switch	<a href="#">NanoT</a> , <a href="#">KXT</a> , <a href="#">KMT0</a> , <a href="#">KMR</a> , <a href="#">HDT</a> , <a href="#">KMT0 D</a>
4	TMR position sensor	Under development; contact sales
5	Microcontroller	<a href="#">Z8F3224</a> , <a href="#">S3F8S19</a> , <a href="#">Z8F6482</a> , <a href="#">S3F8S7B</a>
6	TVS Diode	<a href="#">SMAJ</a>
	Gate Driver	<a href="#">LF2101N</a> , <a href="#">LF2103N</a>



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

# Features and benefits of Littelfuse products

	Technology	Function in application	Product series	Benefits	Features
1	eFuse (USB-C)	Integrated overcurrent and overvoltage protection	<a href="#">LS0504EDD12</a>	Wide input range from 1.8 V to 5.5 V; internal soft start	Hiccup mode for short circuits and overcurrents
	PPTC (for USB-A or -B)	Protects 5 V DC power supply from overcurrent and over-temperature events	<a href="#">Low Rho</a>	Offers fast response to overcurrent events; suitable for compact portable devices	Ultra-low internal resistance; higher current holding in smallest SMD package
2	TVS Diode Array	Protects against ESD on data lines	<a href="#">SC1205-01UTG</a> , <a href="#">SP1006-01UTG</a>	Enables compact design; reduces assembly time	Complies with IEC standards; low leakage current of 100 nA; compact form factor
3	Switch	Reliable navigation; dose dialing and activation	<a href="#">NanoT</a> , <a href="#">KXT</a> , <a href="#">KMT0</a> , <a href="#">PTS</a> , <a href="#">HDT</a> , <a href="#">KMT0 D</a> , <a href="#">FDSE</a> , <a href="#">HDS</a>	Micro-miniature; long life; up to IP 68 sealing properties; micro-detect switches; over-travel, low actuation magnetic stress: 35 g max; low profile	Excellent performance; response to touch and feel; design allows for top or side actuation; low-profile package; normally closed circuit (FDSE)
4	TMR position sensor	Under development; contact sales			
5	Microcontroller	Overall system control	<a href="#">Z8F3224</a> , <a href="#">S3F8S19</a> , <a href="#">Z8F6482</a> , <a href="#">S3F8S7B</a>	Lower standby power, high resolution PWM for Motor control, direct LCD display control	8bit MCU, 12/14bit ADC , LCD controller
6	TVS Diode	Surge protection	<a href="#">SMAJ</a>	Offers board space saving; excellent clamping capability	Low profile package; IEC-61000-4-2 ESD 30 kV (Air) and 30 kV (Contact); fast response time
	Gate Driver	Controls the motor	<a href="#">LF2101N</a> , <a href="#">LF2103N</a>	Shoot-through protection; more precise control and lower torque ripple; board space saving	Logic inputs are 3.3 V logic level compatible; available in SOIC-8

# Fitness and medical tracker

1

## Wireless charging

PPTC, Battery mini-breakers,  
eFuse



2

## Touch screen display

TVS Diode Array



3

## UI buttons

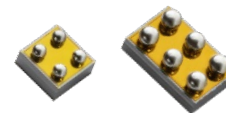
Tactile Switch



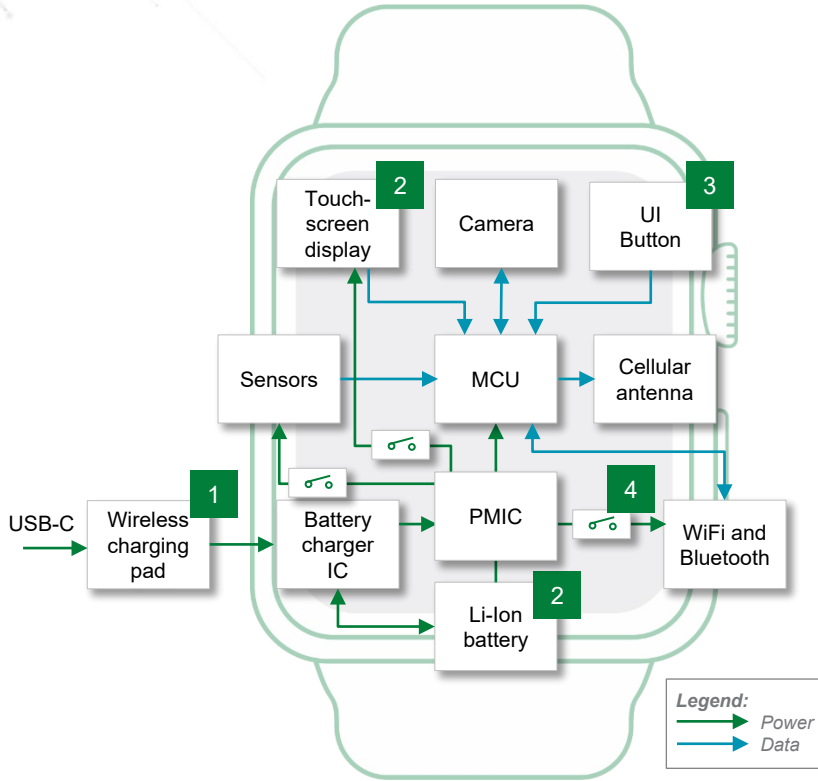
4

## Load switching

Load Switch IC



# Fitness and medical tracker functional block diagram



	Technology	Product series
1	Protection IC (eFuse) (USB-C)	<a href="#">LS0505EVD22</a> , <a href="#">LS0504EDD12</a>
	PPTC <b>OR</b> Battery Mini-breakers	<a href="#">0603L</a> MHP-TAS*
2	TVS Diode Array	<a href="#">SPxx</a> , <a href="#">SP1006-01UTG</a>
3	Switch	<a href="#">NanoT</a>
4	Load Switch IC	<a href="#">LQ0502</a> , <a href="#">LQ0504</a>

\* Contact Littelfuse sales for more details.



Click the product series in the table below for more info

# Features and benefits of Littelfuse products

	Technology	Function in application	Product series	Benefits	Features
1	Protection IC (eFuse) (USB-C)	Integrated overcurrent and overvoltage protection	<a href="#">LS0505EVD22</a> , <a href="#">LS0504EDD12</a>	Integrated solution with features like current limit protection, thermal shutdown, and internal soft start	5 V, 5 A eFuse with 30 V max and overvoltage protection and overcurrent protection
	PPTC <b>OR</b> Battery Mini-breakers	Overcurrent and over-temperature protection	<a href="#">0603L</a> MHP-TAS*	Compact design suitable for situations where space is at a premium and resettable protection is desired (for example, smart watches)	Low profile; fast response to short-circuit currents; low resistance
2	TVS Diode Array	Protects against ESD	<a href="#">SPxx</a> , <a href="#">SP1006-01UTG</a>	Maintains signal integrity of high-speed data lines; reliable ESD protection	Small footprint; extremely low dynamic resistance
3	Switch	Controls Bluetooth functions of wearable devices	<a href="#">NanoT</a>	Board space saving and design flexibility; reduces cost and integration difficulties versus designing full interface button; improves lifetime and reliability of the end equipment	Ultra-compact size; up to 300000 life cycles; IP67 for sealed switch compatibility with PCB coatings
4	Load Switch IC	Integrated electronic switches used to turn on and turn off power rails	<a href="#">LQ0502</a> , <a href="#">LQ0504</a>	Reduces parasitic leakage current; improves system efficiency; increases battery lifetime; board space saving; low power consumption	Lowest quiescent current (IQ) and shutdown current (ISD); integrated slew rate control and output discharge switch; small package

# Driving device design: personal, portable, & connected

*Understanding these standards and the impact on the device during development is critical*

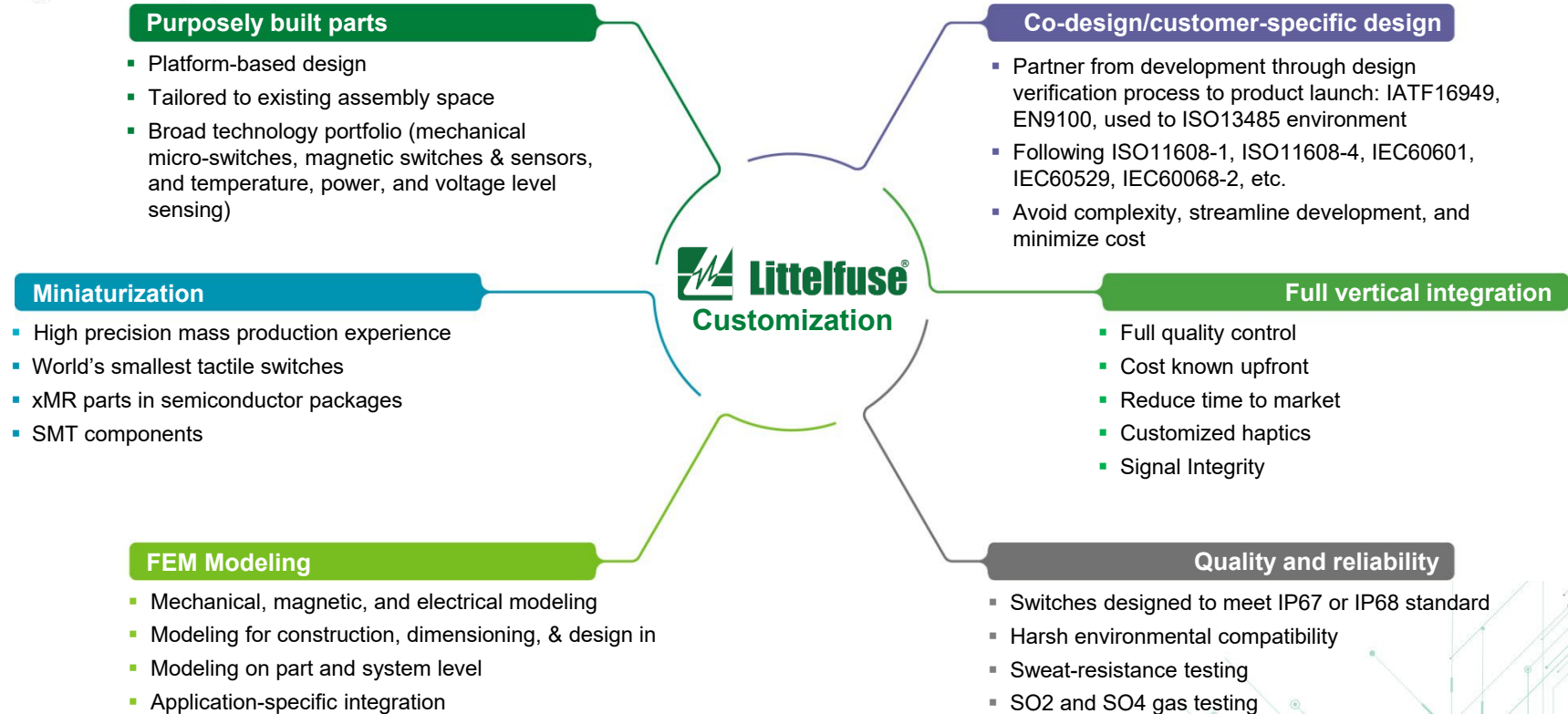
Standard	Title	General scope	Market
ISO 11608-1	Needle-based injection systems for medical use. Part 1: Needle-based injection systems	Specifies requirements and test methods for Needle-Based Injection Systems (NISs) for single-patient use intended to deliver discrete volumes (bolus) of medicinal product, which can be delivered through needles or soft cannulas for intradermal, subcutaneous, and/or intramuscular delivery, or all three incorporating pre-filled or user-filled, replaceable, or non-replaceable containers.	Global
ISO 11608-4	Needle-based injection systems for medical use. Part 4: Needle-based injection systems containing electronics	Specifies requirements and test methods for needle-based injection systems (NISs) containing electronics with or without software (NIS-Es).	Global
IEC 60601	Medical Electrical Equipment Testing and Certification	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.	Global
IEC 60529	Degrees of protection provided by enclosures (IP Code)	Developed to rate and grade the resistance of enclosures of electrical and electronic devices against the intrusion of dust and liquids. It also rates how easy it is for individuals to access the potentially hazardous parts within the enclosure.	Global
IEC 60068-2-XX	Environmental testing of electrotechnical products	A collection of methods for environmental testing of electronic equipment and products to assess their ability to perform under environmental conditions including extreme cold and dry heat.	Global

CE Mark, FDA Approval, and NMPA certifications provide for actionable data for medical professionals.





# Littelfuse purposely built parts for drug delivery device ecosystem



# Sustainability: Environmental, Social, and Governance

More information can be found in our third [Littelfuse 2022 Sustainability Report](http://www.littelfuse.com) on [www.littelfuse.com](http://www.littelfuse.com)

## Environmental

**22%**

decrease in Scope 2 GHG emissions intensity

**138%**

increase in renewable energy

**12%**

decrease in overall energy intensity

**84%**

manufacturing sites ISO 14001 certified

**70%**

of our generated waste is recycled

**Cobalt and Mica**

included in supply chain due diligence

## Social



Respect



Customer Focus



Agility



Collaboration

Refined values to support long-term growth strategy

America's Best Midsize Employer Recognition from Forbes

**~20%**

Reduced total case incident rate

**574**

significant suppliers screened from ESG perspective



Started US pay equity analysis

## Governance

**2.5 Hours per Employee**

of Ethics and Compliance training with

**99%**

Average completion



Expanded Enterprise Risk Management, formed climate-related risk and opportunities committee, and implemented supplier assessments



Formal ESG Policy



Manufacturing site sustainability teams



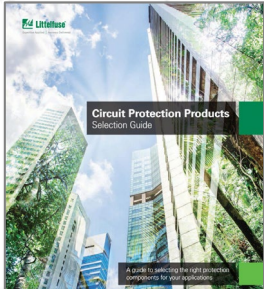
Central ESG software to manage and internally audit our ESG data

**~5000 Hours**

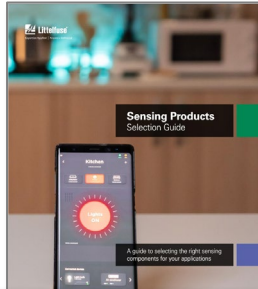
of Cybersecurity and Data Privacy training globally

# More information can be found at [Littelfuse.com](http://Littelfuse.com)

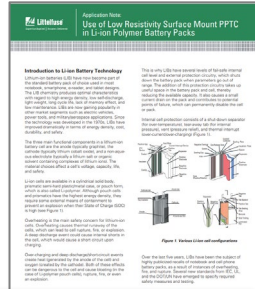
Explore the world of Littelfuse with the electronic catalogs ([catalogs.littelfuse.com](http://catalogs.littelfuse.com))



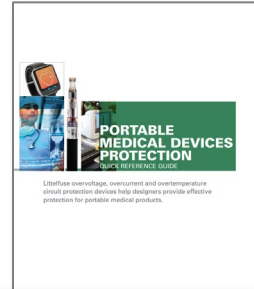
**Circuit Protection  
Selection Guide**



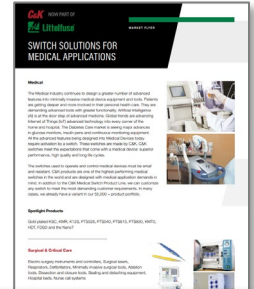
**Sensing Products  
Selection Guide**



**Lithium-Ion Battery Pack  
Protection with PPTC**

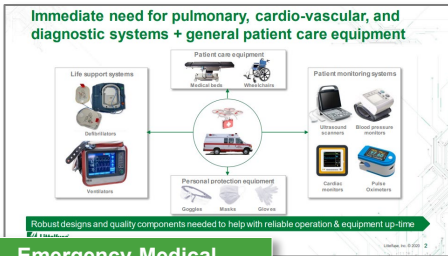


**Portable Medical Devices  
Protection Guide**



**Switches for Medical  
Applications**

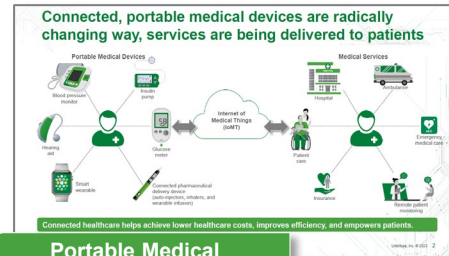
Click the images for more information



**Emergency Medical  
Equipment Spotlight**



**Personal Care  
Solutions Spotlight**



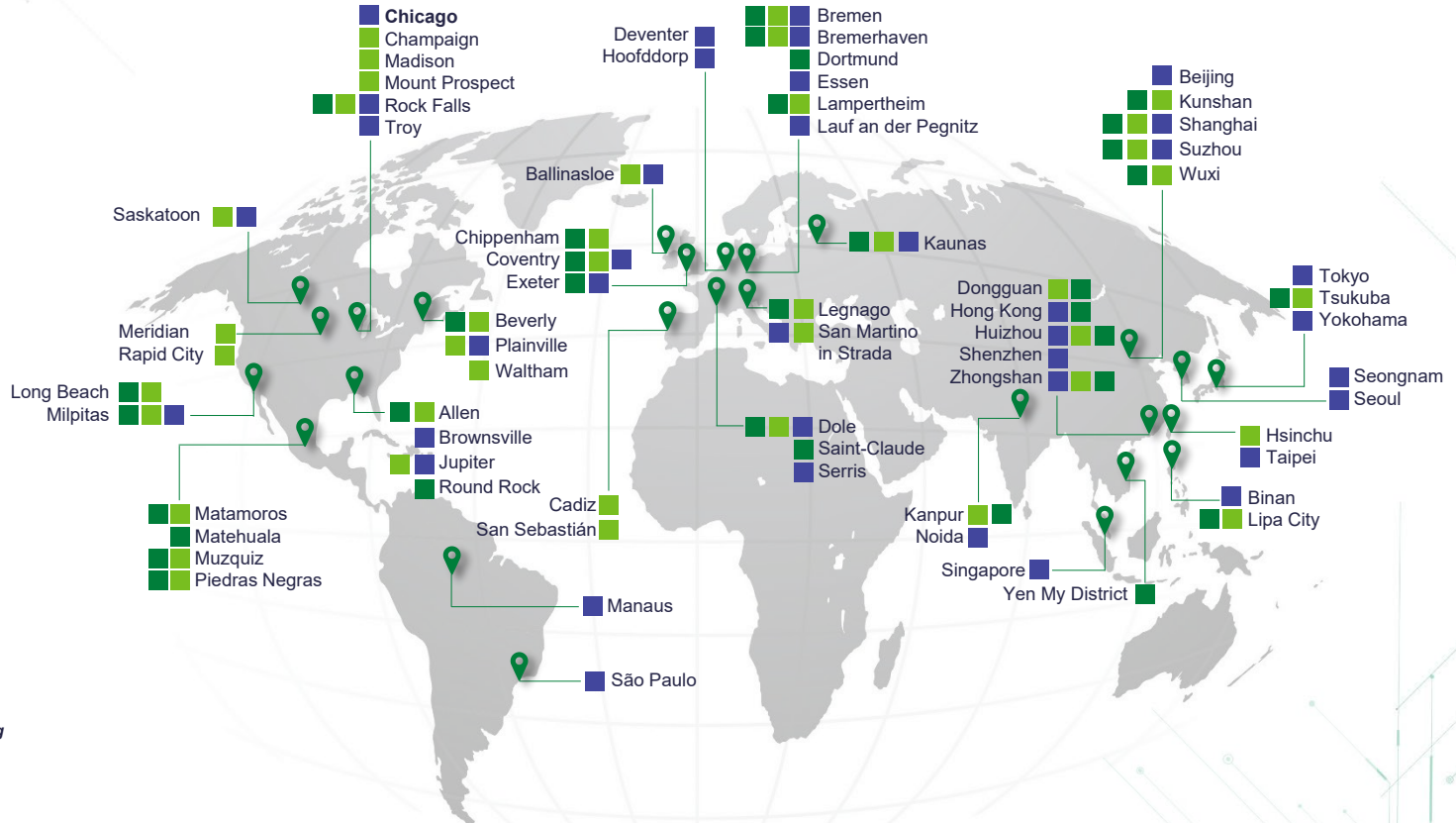
**Portable Medical  
Devices Spotlight**



Scan the code  
to learn more



# Local resources supporting our global customers



## Legend

- Sales
- R&D
- Manufacturing

# Partner for tomorrow's electronic systems

## Broad Product Portfolio

We are an industrial technology manufacturing company empowering a sustainable, connected, and safer world.

## Testing Capabilities

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

## Application Expertise

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

## Compliance and Regulatory

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

## Global Customer Service

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

## Global Manufacturing

Our high-volume manufacturing that is committed to the highest quality standards.



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Expertise Applied | Answers Delivered

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