Drug Delivery Device Ecosystem

Healthcare Solutions

REV0324

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

Connected devices

Smart wearable

Insulin pump

Inhaler

Continuous Glucose Monitors (CGM)

Wearable injector

Auto-injectors and pens

Digital interfaces

Patient app and dashboard for healthcare professionals

Cloud platform

Secure cloud platform

Health insurance and medical records

Therapy data and other health analytics
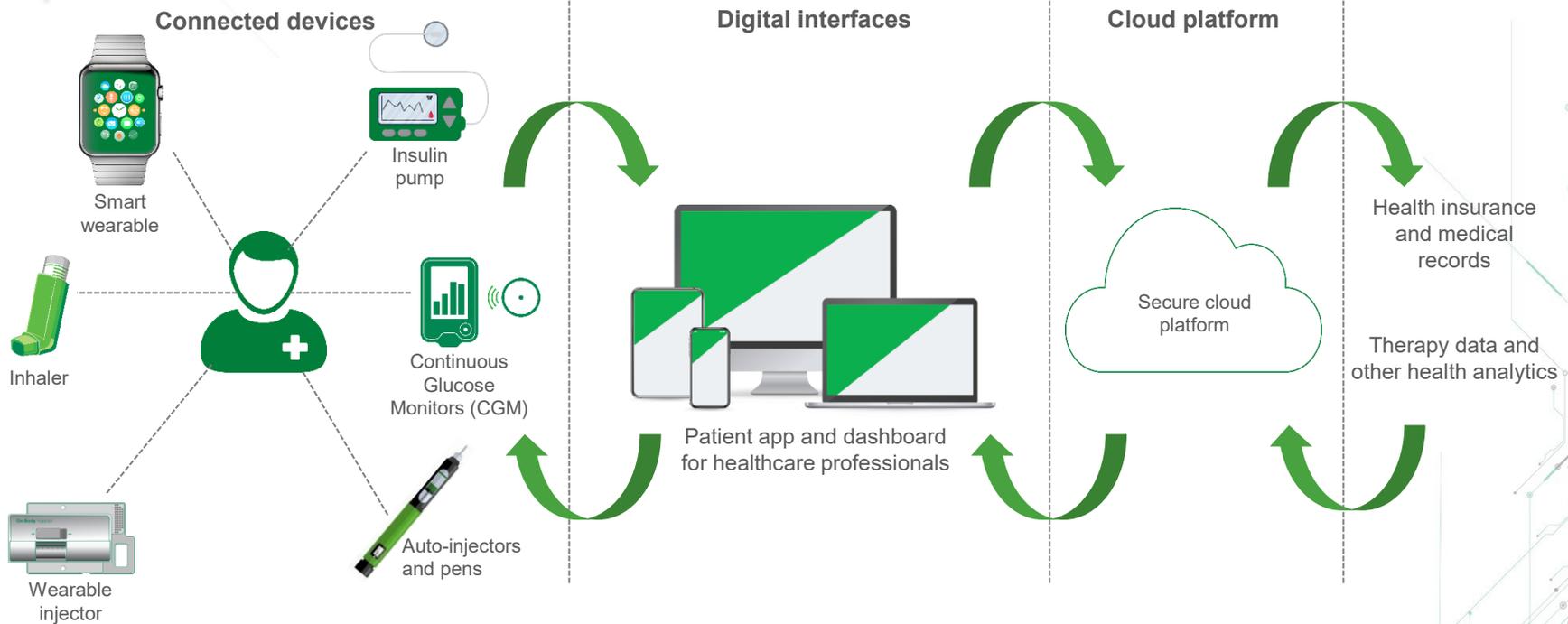
Connected healthcare helps achieve lower healthcare costs, improves efficiency, and empowers patients.

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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.
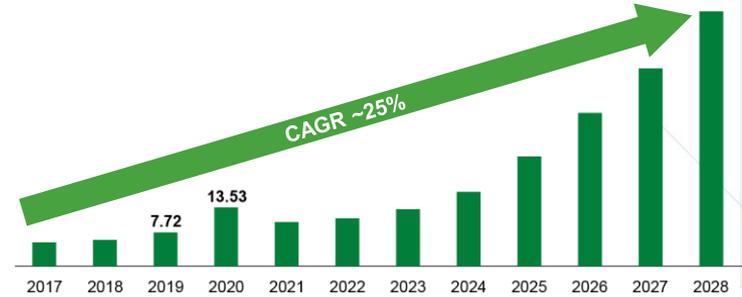
North America IoMT market size, 2017 to 2028 ($B)

CAGR ~25%

7.72   13.53

2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028

Global IoMT market share by product, 2020

37.9%

- Stationary medical devices
- Implanted medical devices
- Wearable external medical devices
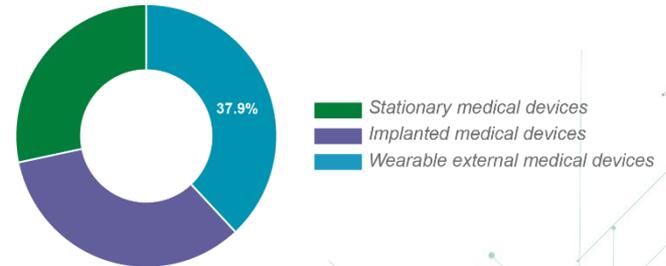
Sources: Fortune Business Insights

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Auto-injectors or drug delivery pens
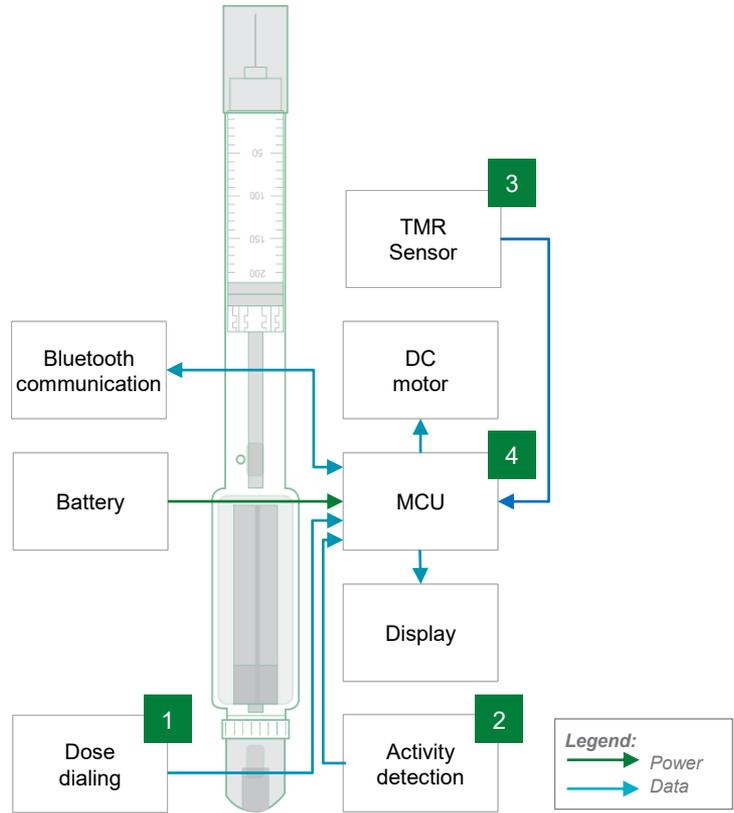
	Technology	Product series
1	Detect Switch	HDT, FDSD, FDSE
2	Tactile Switch	NanoT, KXT, KMT0, PTS, KMT0 D
	Detect Switch	HDT, FDSE, HDS
	Reed Switch	59177
	TMR Switch	TMR
3	TMR Position Sensor	Under development; contact sales
4	Microcontroller	Z8F1625*, Z8F3224 (No LCD) S3F8S19, Z8F6482 (With LCD)

*Z8F1625 is under development

Legend:
→ Power
→ Data

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Features and benefits of Littelfuse products

	Technology	Function in application	Product series	Benefits	Features
1	Detect Switch	Detects position of the dose dial	HDT, FDSD, FDSE	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)	NanoT, KXT, KMT0, PTS, KMT0 D	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		HDT, FDSE, HDS	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		59177	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		TMR	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, Z8F3224 (No LCD) S3F8S19, Z8F6482 (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

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Wearable injectors

1 **Power management**
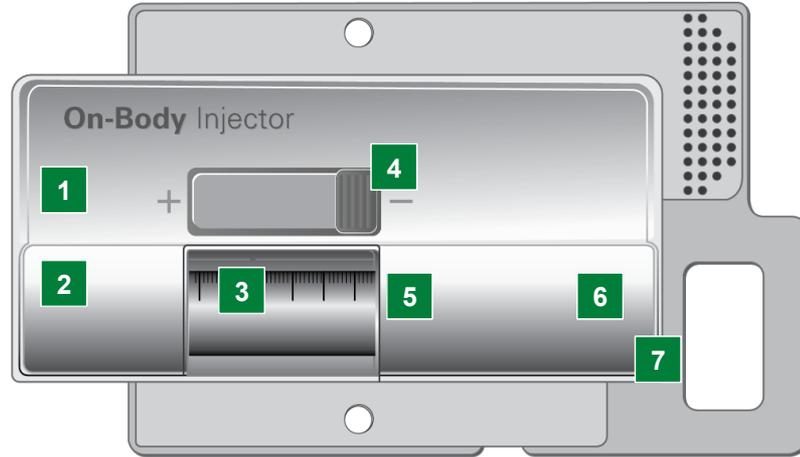eFuse, PPTC

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

6 **Control unit**
Microcontroller

7 **Motor control**
TVS Diode, Gate Driver

On-Body Injector

1 2 3 4 5 6 7

Wearable injectors functional block diagram

Legend:
- Power (green)
- Data (blue)

	Technology	Product series
1	eFuse (USB-C)	LS0504EDD12
	PPTC (for USB-A or -B)	Low Rho
2	TVS Diode Array	SC1205-01UTG, SP1006-01UTG
3	Detect Switch	HDT, FDSD, FDSE
4	Tactile Switch	NanoT, KXT, KMT0, PTS, KMT0 D
	Detect Switch	HDT, FDSE, HDS
	Reed Switch	59177
	TMR Switch	TMR
5	TMR position sensor	Under development; contact sales
6	Microcontroller	Z8F1625*, Z8F3224 (No LCD) S3F8S19, Z8F6482 (With LCD)
7	TVS Diode	SMAJ
	Gate Driver	LF2101N, LF2103N

Features and benefits of Littelfuse products

	Technology	Function in application	Product series	Benefits	Features
1	eFuse (USB-C)	Integrated overcurrent and overvoltage protection	LS0504EDD12	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	Low Rho	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	SC1205-01UTG, SP1006-01UTG	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	HDT, FDSD, FDSE	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)	NanoT, KXT, KMT0, PTS, KMT0 D	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		HDT, FDSE, HDS	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		59177	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		TMR	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	Z8F1625, Z8F3224 (No LCD) S3F8S19, Z8F6482 (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	SMAJ	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	LF2101N, LF2103N	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

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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
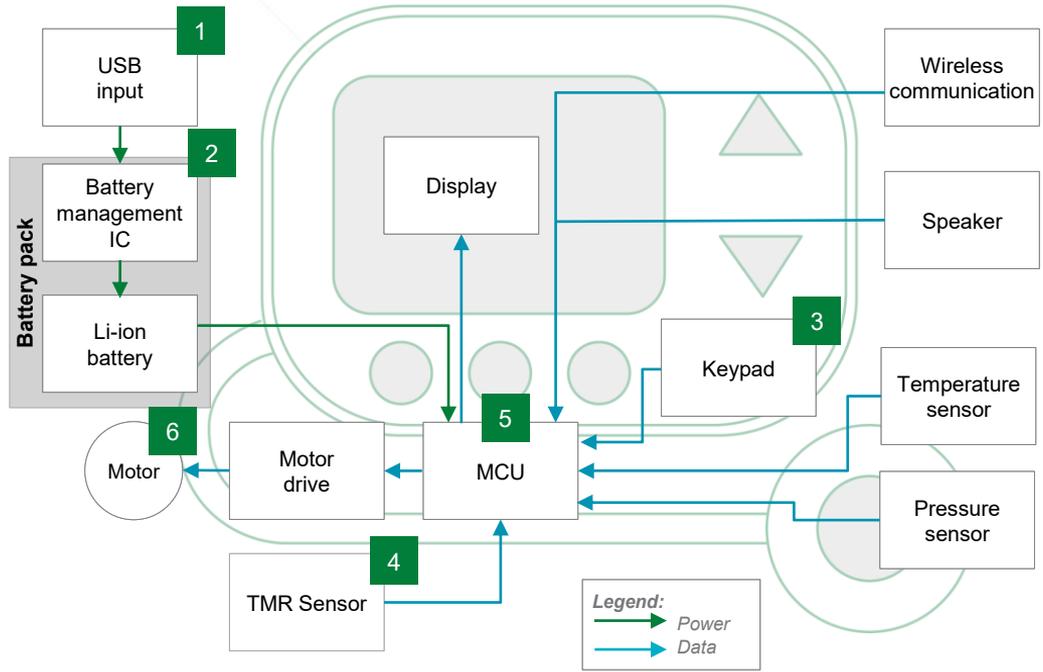
5 **Control unit**
Microcontroller
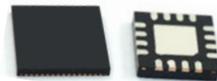
6 **Motor control**
TVS Diode, Gate Driver

Insulin pump functional block diagram

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

Features and benefits of Littelfuse products

	Technology	Function in application	Product series	Benefits	Features
1	eFuse (USB-C)	Integrated overcurrent and overvoltage protection	LS0504EDD12	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	Low Rho	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	SC1205-01UTG, SP1006-01UTG	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	NanoT, KXT, KMT0, PTS, HDT, KMT0 D, FDSE, HDS,	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	Z8F3224, S3F8S19, Z8F6482, S3F8S7B	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	SMAJ	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	LF2101N, LF2103N	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

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Fitness and medical tracker

1 **Wireless charging**
PPTC, Battery mini-breakers, eFuse

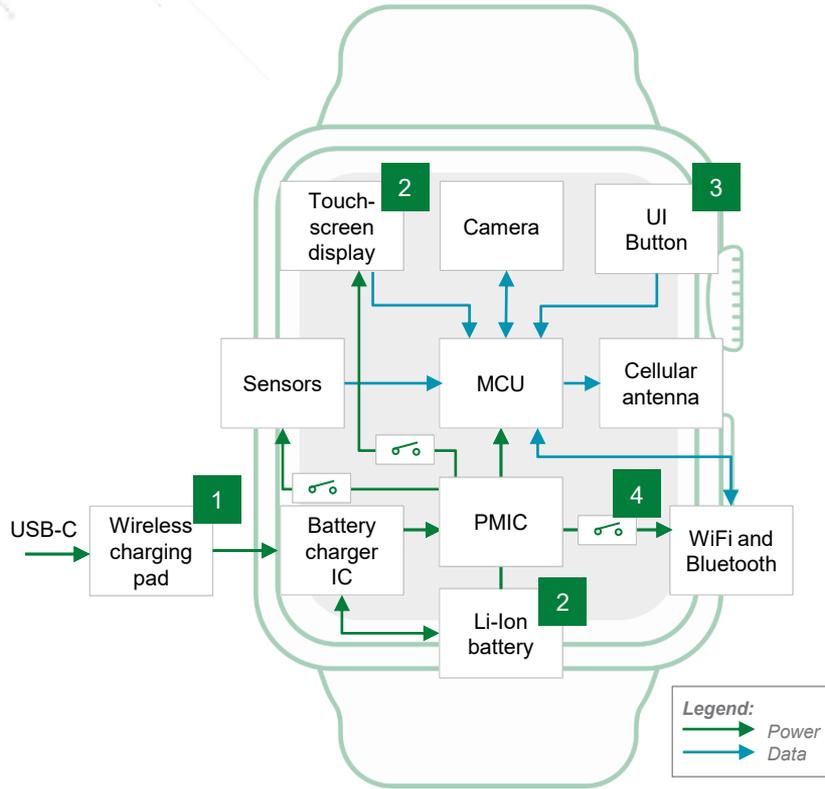**2** **Touch screen display**
TVS Diode Array

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)	LS0505EVD22, LS0504EDD12
	PPTC *OR* Battery Mini-breakers	0603L MHP-TAS*
2	TVS Diode Array	SPxx, SP1006-01UTG
3	Switch	NanoT
4	Load Switch IC	LQ0502, LQ0504

* Contact Littelfuse sales for more details.

Legend:
→ Power
→ Data

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	LS0505EVD22, LS0504EDD12	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 *OR* Battery Mini-breakers	Overcurrent and over-temperature protection	0603L 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	SPxx, SP1006-01UTG	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	NanoT	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	LQ0502, LQ0504	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

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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.

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Littelfuse purposely built parts for drug delivery device ecosystem

Purposely built parts
- Platform-based design
- Tailored to existing assembly space
- Broad technology portfolio (mechanical micro-switches, magnetic switches & sensors, and temperature, power, and voltage level sensing)

Co-design/customer-specific design
- Partner from development through design verification process to product launch: IATF16949, EN9100, used to ISO13485 environment
- Following ISO11608-1, ISO11608-4, IEC60601, IEC60529, IEC60068-2, etc.
- Avoid complexity, streamline development, and minimize cost

Miniaturization
- High precision mass production experience
- World's smallest tactile switches
- xMR parts in semiconductor packages
- SMT components

Full vertical integration
- Full quality control
- Cost known upfront
- Reduce time to market
- Customized haptics
- Signal Integrity

FEM Modeling
- Mechanical, magnetic, and electrical modeling
- Modeling for construction, dimensioning, & design in
- Modeling on part and system level
- Application-specific integration

Quality and reliability
- Switches designed to meet IP67 or IP68 standard
- Harsh environmental compatibility
- Sweat-resistance testing
- SO2 and SO4 gas testing

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Customization

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Sustainability: Environmental, Social, and Governance

More information can be found in our third Littelfuse 2022 Sustainability Report on 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

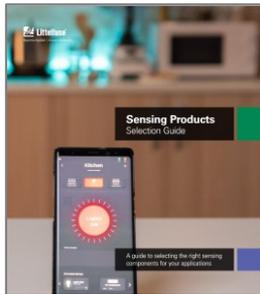Central ESG software to manage and internally audit our ESG data

~5000 Hours
of Cybersecurity and Data Privacy training globally

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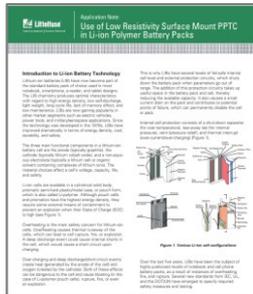# More information can be found at Littelfuse.com

Explore the world of Littelfuse with the electronic ecatalogs (ecatalogs.littelfuse.com)
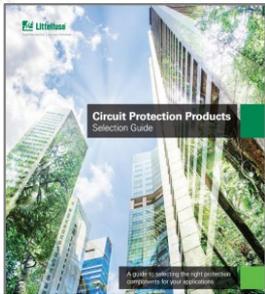
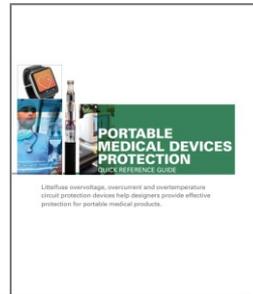**Circuit Protection Selection Guide**

Sensing Products Selection Guide

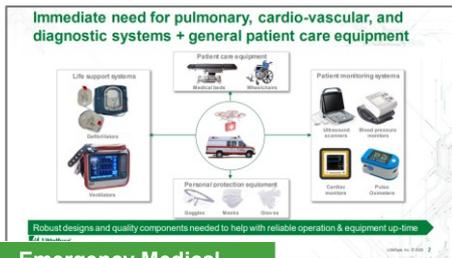**Lithium-Ion Battery Pack Protection with PPTC**

Portable Medical Devices Protection Guide
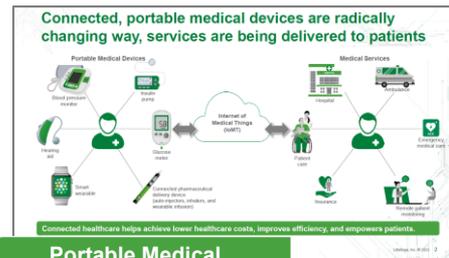

Switches for Medical Applications

Click the images for more information

Emergency Medical Equipment Spotlight

Personal Care Solutions Spotlight

Portable Medical Devices Spotlight

Scan the code to learn more

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Local resources supporting our global customers

Chicago
Champaign
Madison
Mount Prospect
Rock Falls
Troy

Deventer
Hoofddorp

Bremen
Bremerhaven
Dortmund
Essen
Lampertheim
Lauf an der Pegnitz

Beijing
Kunshan
Shanghai
Suzhou
Wuxi

Ballinasloe

Saskatoon

Chippenham
Coventry
Exeter

Kaunas

Meridian
Rapid City

Beverly
Plainville
Waltham

Legnago
San Martino
in Strada

Dongguan
Hong Kong
Huizhou
Shenzhen
Zhongshan

Tokyo
Tsukuba
Yokohama

Long Beach
Milpitas

Allen
Brownsville
Jupiter
Round Rock

Dole
Saint-Claude
Serris

Seongnam
Seoul

Matamoros
Matehuala
Muzquiz
Piedras Negras

Cadiz
San Sebastián

Kanpur
Noida

Hsinchu
Taipei

Binan
Lipa City

Manaus

Singapore

Yen My District

São Paulo

Legend
Sales
R&D
Manufacturing

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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.

Safety

Sustainability

Connectivity

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