



**PROTECT  
CONTROL  
SENSE**

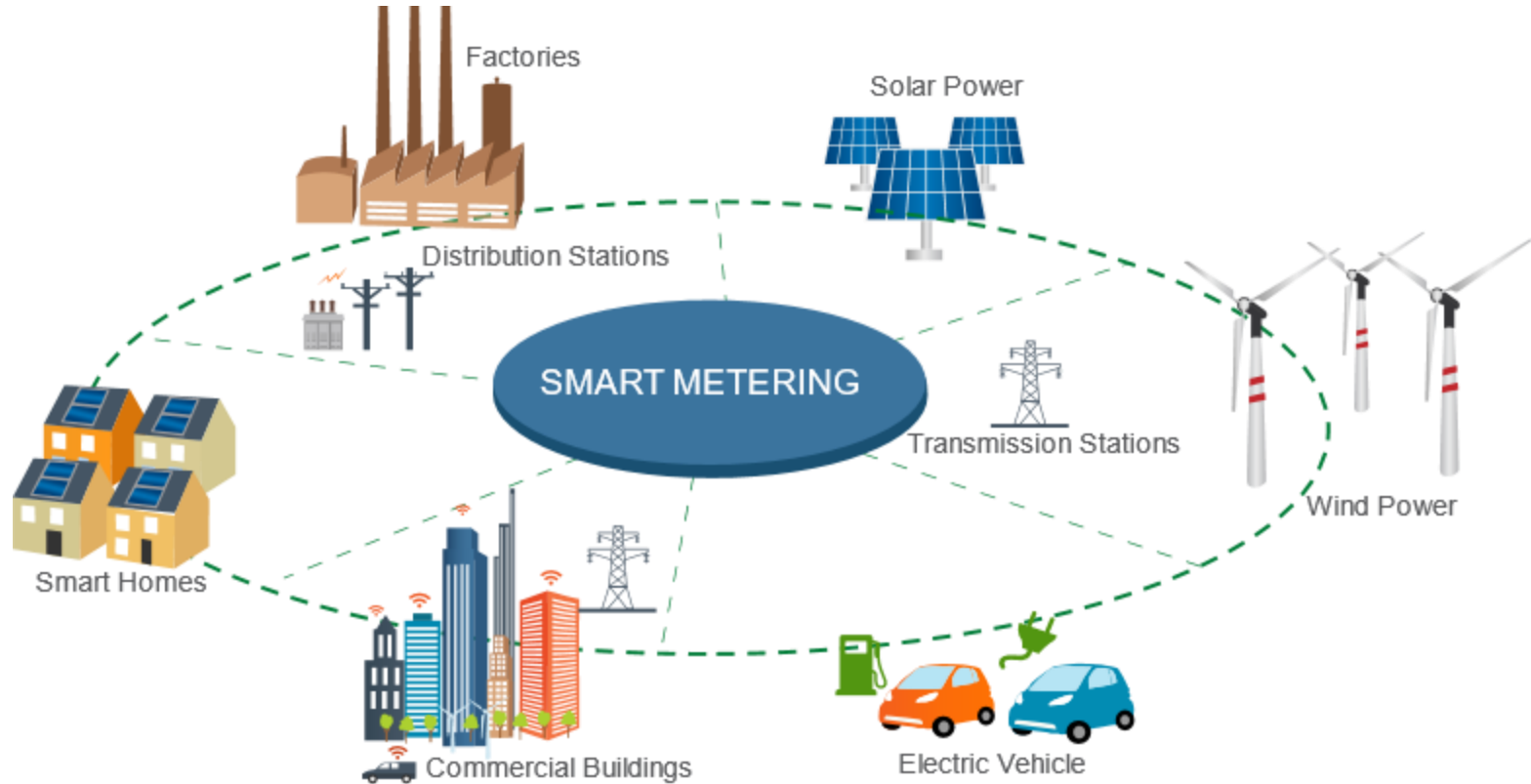


# Smart Metering

 Building automation

 **Littelfuse®**  
Expertise Applied | Answers Delivered

# Smart meters key to advanced energy management



# Smart meter market poised for continued growth!

## Market Trends and Drivers

The smart meters market was valued at USD 123 million in 2019, at a CAGR of 7% over the forecast period (2020 – 2025)

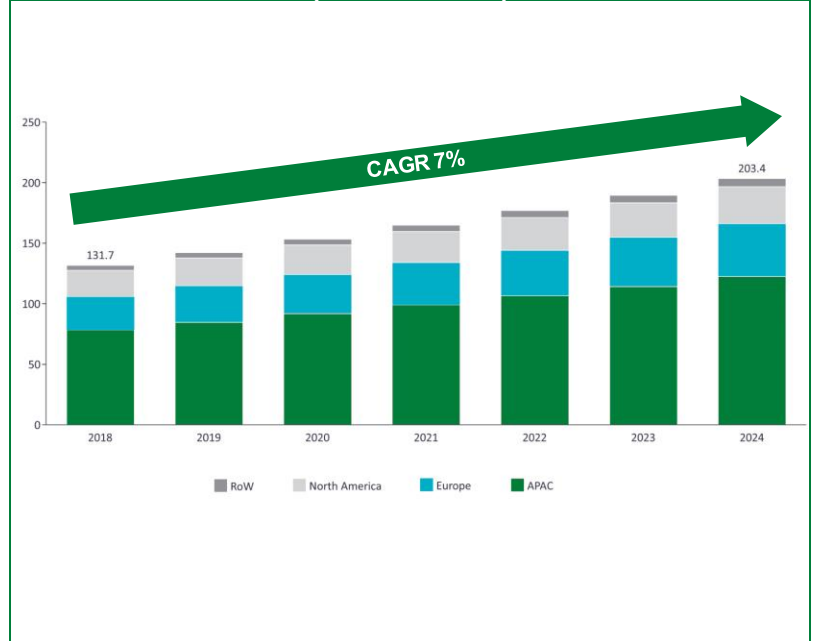
- **Electric Meter:** To grow at a CAGR of 2.31% (105.73 – 121.26 million units)
- **Gas Meter:** Valued at USD 1.84 billion in 2019 and is expected to reach USD 3.17 billion by 2025
- **Water Meter:** Expected to grow at a CAGR of 9.7% (14.75 – 25.71 million units)

Smart meters have reached 14% in global penetration

- **North America:** Matured market with stable growth (30 – 40% penetration)
- **Europe:** 80% penetration of Electricity Meter by 2020 and 40% penetration for Gas and Water meter. Italy, Sweden, and Netherlands are leading in the implementation of smart meters. Germany, Belgium, and Portugal have opted out of the EU Smart Meter rollout plan
- **Asia Pacific:** Leading region for overall shipments (60% of Global shipment volume); China being the leader followed by India, Japan, and South Korea

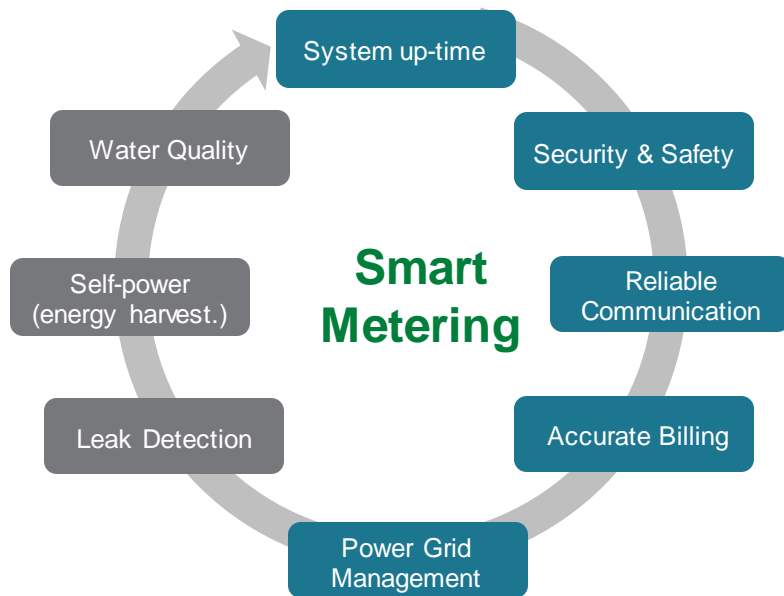
Competitive landscape: Market is highly dominated by top five to six players, such as Landis+Gyr, Itron, Elster Group, Sensus, Wasion

## Global Smart Meter Shipment Volume by Region ( Million Units)



Source: 1. [Smart Meters](#)  
2. [Electricity Meters](#)  
3. [Gas Meters](#)  
4. [Water Meters](#)  
5. [IoT Analytics Research 2019](#)

# Littelfuse & metering: changing from no-electronic content to most key functions based on dependable electronics



## Littelfuse: Key know-how to help customers implement more reliable & safer smart meters

- Electric Transients & Overcurrent Protection
- Anti-tamper Solutions
- Flow Measurement Devices
- Low Power Consumption Sensors
- Load Switching & Energy Pulse Out
- Over-temp Detection & Temp Measurement
- Power Management

Littelfuse can help with Cross-functional System-level Expertise & Application Testing

# Smart electricity meter

## Anti-tamper

- Reed switch



## Metrology System Unit

- MOV
- Fuse
- TVS diode
- MOSFET/SiC MOSFET
- PPTC
- NTC



## Communication Interface

- RF
- SIDActor
- Opto-isolator

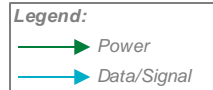
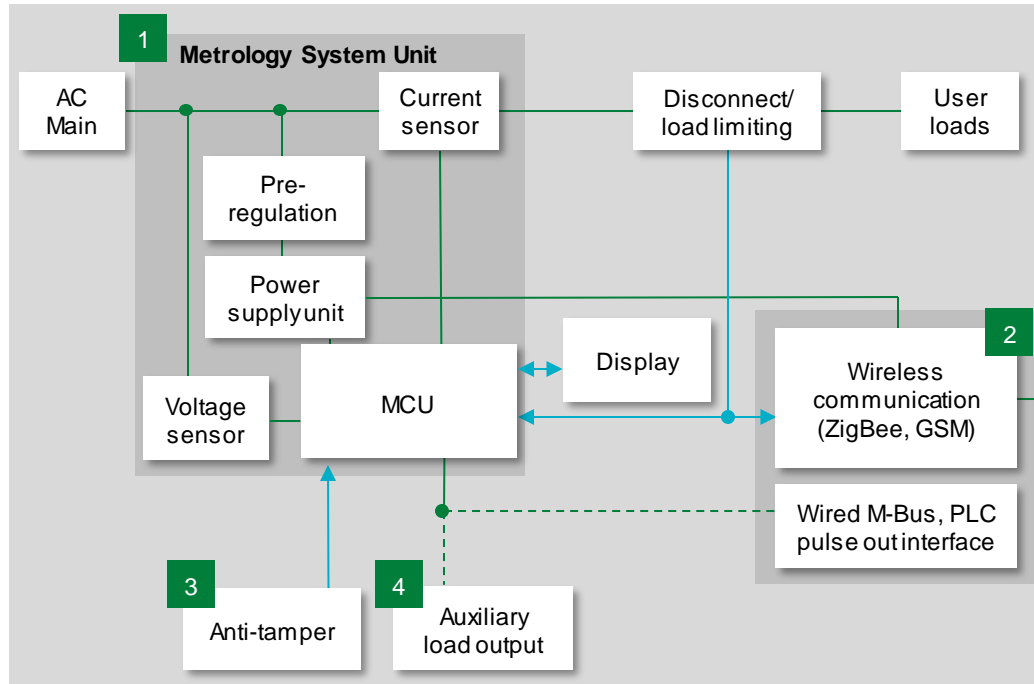


## I/O Protection and Control

- SSR
- Fuse
- TVS, MOV
- SSR



# E-metering high-level block diagram



	Technology	Series
1	MOV	<a href="#">Ultra MOV</a> , <a href="#">CIII</a> , <a href="#">TMOV</a>
	Cartridge fuse	<a href="#">215</a> , <a href="#">514</a> , <a href="#">835</a>
	TVS diode	<a href="#">SMAJ</a> , <a href="#">SMBJ</a>
	NTC	<a href="#">ST</a> , <a href="#">End-banded Chip</a>
	MOSFET/SiC MOSFET	<a href="#">Polar™</a> , <a href="#">X2-class</a> , <a href="#">LSICMO170E1000</a>
	PPTC	<a href="#">TRF600-150</a>
2	MOSFET	<a href="#">X2-class</a>
	Diode array	<a href="#">AQxx-02HTG</a> , <a href="#">LC03-3.3</a>
	SIDActor®	<a href="#">SEP0xx</a>
3	Solid state relay	<a href="#">PLA192</a> , <a href="#">CPC1394</a> , <a href="#">PLA193</a> , <a href="#">PLA194</a>
4	Reed switch/TMR	<a href="#">MDSR-10</a> , <a href="#">TMR</a>
	Solid state relay	<a href="#">PLA192</a> , <a href="#">CPC1394</a> , <a href="#">CPC1983YE</a> , <a href="#">PLA193</a> , <a href="#">PLA194</a>
	TVS diode/MOV	<a href="#">SMCJ</a> , <a href="#">SMZ</a>



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

# Benefits of Littelfuse products for electric meter

	Technology	Function in application	Series	Benefits	Features
1	MOV	Protects power unit from voltage transients and lightning	<a href="#">Ultra MOV</a> , <a href="#">CIII</a> , <a href="#">TMOV</a>	Reduces customer qualification time by complying with third-party safety standards such as UL/IEC	High energy absorption capability: 40–530 J (2 ms)
	Cartridge fuse	Protects power stage from overcurrent events	<a href="#">215</a> , <a href="#">514</a> , <a href="#">835</a>	Reduces customer qualification time by complying with third-party safety standards such as UL/IEC	Third-party compliance (UL/IEC); low internal resistance; shock safe; vibration resistant
	TVS diode	Protects sensitive electronic component from voltage transients	<a href="#">SMAJ</a> , <a href="#">SMBJ</a>	Improves system reliability	1500 W peak pulse capability; compatible with lead-free solder reflow temperature profile
	NTC	Protects power stage from high inrush current	<a href="#">ST</a> , <a href="#">End-banded Chip</a>	Protects downstream components such as smoothing capacitors from inrush current	Unique design enables them to handle extremely high current and voltage levels
	MOSFET/SiC MOSFET	Provides high-frequency load switching	<a href="#">Polar™</a> , <a href="#">X2-class</a> , <a href="#">LSICMO170E1000</a>	High power density and low power consumption promotes an efficient design	Dynamic dv/dt rating; low $R_{DS(ON)}$ and $Q_g$ avalanche rated low package inductance
	PPTC	Protects power stage from overcurrent events	<a href="#">TRF600-150</a>	Low maintenance; compact form-factor saves space	Resettable overcurrent protection; fast time-to-trip resistance sorted and matched devices available
	MOSFET	Provides switching function in pre-regulation circuit for charging capacitor	<a href="#">X2-class</a>	Robust switching operation, high power density; extremely low thermal dissipation	Ultra-low on-resistance $R_{DS(ON)}$ and gate charge $Q_g$ ; dv/dt ruggedness; low package inductance
2	Diode array	Protects wired communication interface from user induced ESD events	<a href="#">AQxx-02HTG</a> , <a href="#">LC03-3.3</a>	Promotes robust communication channel operation while maintaining high signal integrity	ESD: IEC 61000-4-2, ±30 kV contact, ±30 kV air, EFT: IEC 61000-4-4, 50 A (5/50 ns)
	SIDACtor®	Protects sensitive electronic components damage due to lightning surges	<a href="#">SEP0xx</a>	Promotes robust operation of communication channel with minimal impact on signal integrity	Low insertion loss, log-linear capacitance; low clamping voltage
	Solid state relay	Provides isolation of pulse-out signal between MCU and MBus	<a href="#">PLA192</a> , <a href="#">CPC1394</a> , <a href="#">PLA193</a> , <a href="#">PLA194</a>	High reliability & electrical isolation; robust design; no EMI/RFI generation	Up to 3750 V <sub>RMS</sub> input/output isolation; UL/IEC certified; low drive power
3	Reed switch	Prevents magnetically induced tampering	<a href="#">MDSR-10</a>	Lowest power consumption for longest battery life	Hermetically sealed; magnetically operated contacts
4	Solid state relay	Provides isolation from MCU for pulse-out signal	<a href="#">PLA192</a> , <a href="#">CPC1394</a> , <a href="#">CPC1983YE</a> , <a href="#">PLA193</a>	High reliability & electrical isolation; robust design; no EMI/RFI generation	Up to 3750 V <sub>RMS</sub> input/output isolation; UL/IEC certified; low drive power
	TVS diode/MOV	Protects auxiliary I/O from voltage transients due to overload	<a href="#">SMCJ</a> , <a href="#">SM7</a>	Promotes robust operation maintaining high signal integrity; saves board space	Excellent clamping capability; low incremental surge resistance

# Smart water and gas meter

## Battery & Interface Panel

- PPTC
- Fuse
- ATEX fuse
- TVS diode



## Anti-tamper

- Reed Switch
- Hall Effect sensor



## Communication Interface

- RF
- SIDACtor
- Opto-isolator
- SSR



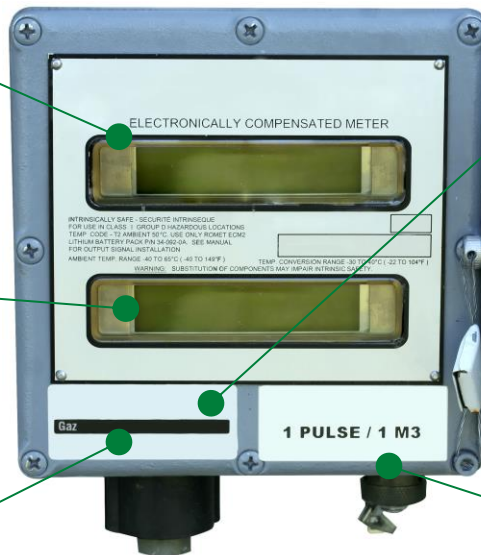
## Safety Valve

- SSR



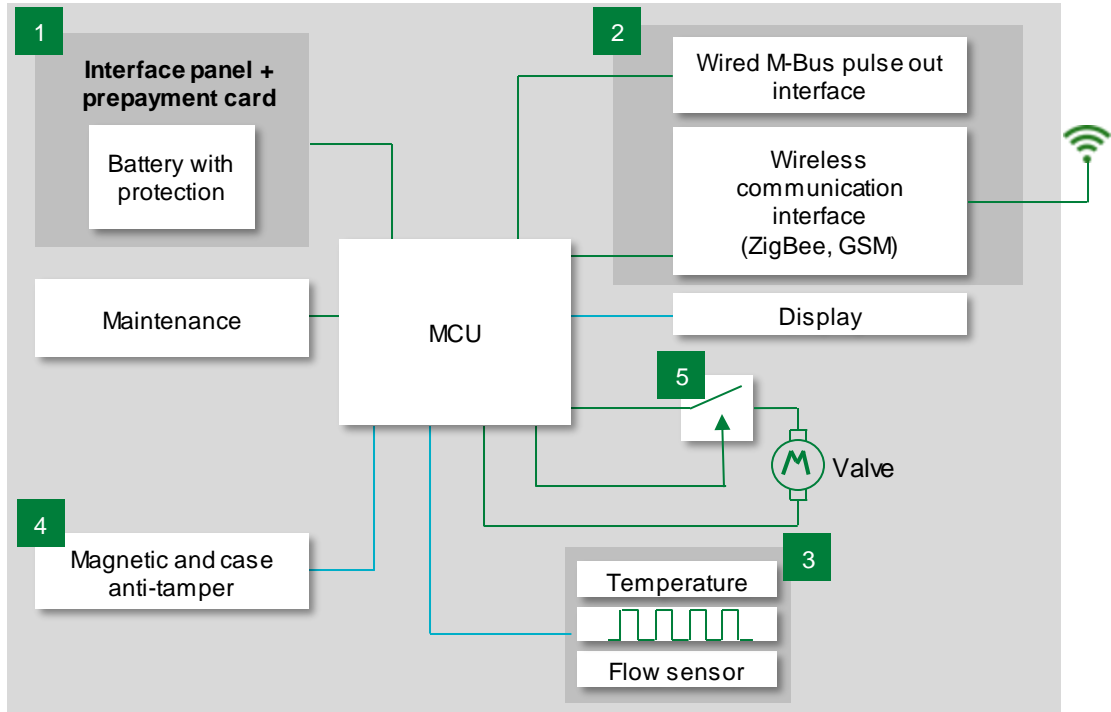
## Flow Measurement

- NTC Thermistor
- Reed switch





# Gas and water meters share many functional blocks



	Technology	Series
1	Fuse PPTC	<a href="#">Atex 259/304, 437</a> <a href="#">Femto, Nano</a>
	TVS diode	<a href="#">SMBJ, SMCJ</a>
2	Diode array	<a href="#">AQxx-02HTG</a>
	SIDACtor	<a href="#">SEP0xx</a>
	Solid state relay	<a href="#">PLA192, CPC1394, PLA193, PLA194</a>
3	NTC	<a href="#">MELF style, End-banded Chip, Thermistor assembly</a>
	Reed switch	<a href="#">MDSR-10</a>
4	Reed switch	<a href="#">59166, MDSM-4</a>
5	Solid state relay	<a href="#">PLA192, CPC1394, CPC1983YE, PLA193, PLA194</a>



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

# Benefits of Littelfuse products for water/gas meter

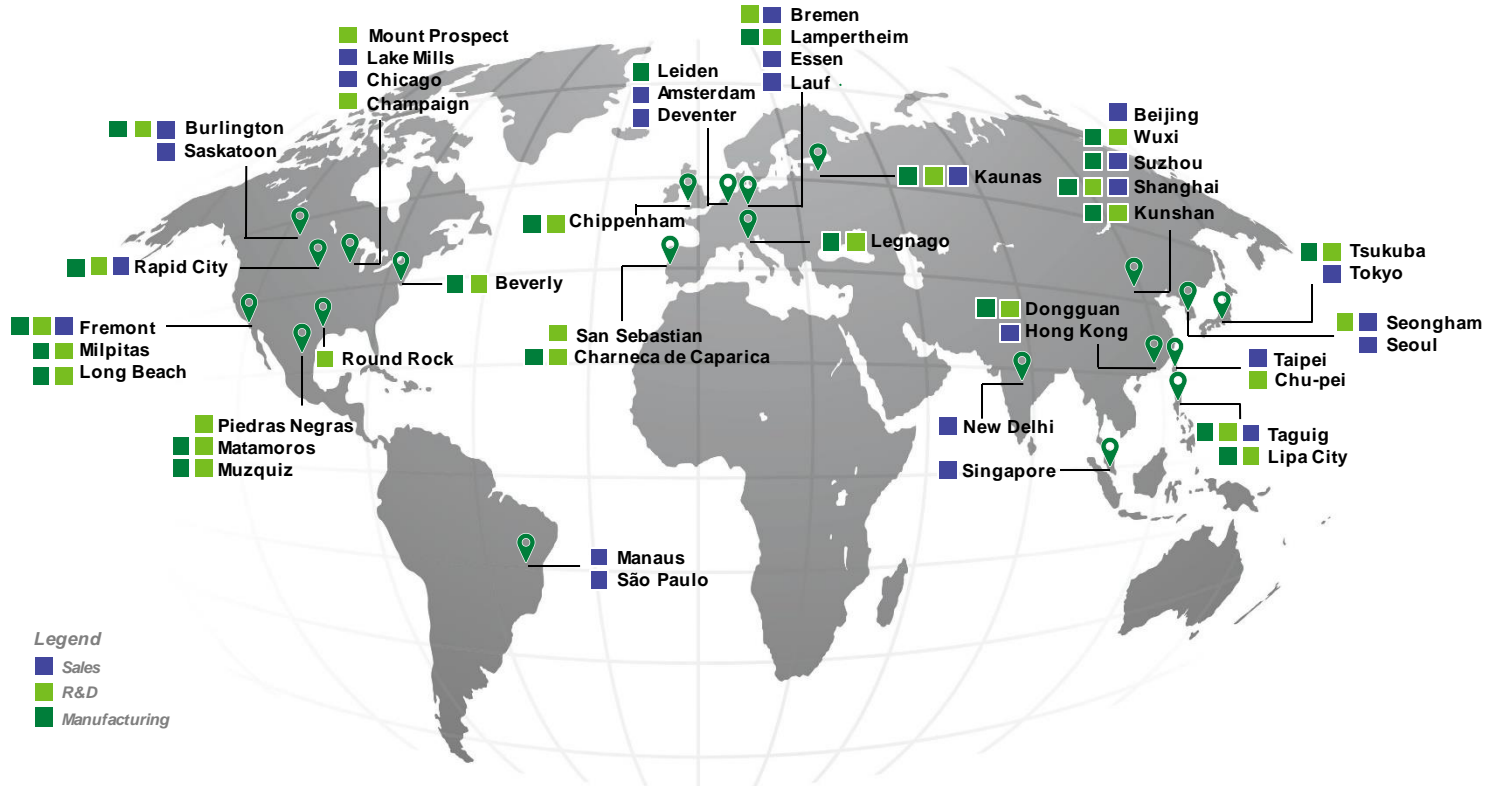
	Technology	Function in application	Series	Benefits	Features
1	Fuse PPTC	Protects power stage from overcurrent events	<a href="#">Atex 259/304</a> , <a href="#">437 Fento</a> , <a href="#">Nano</a>	Reduces customer qualification time by complying with third-party safety standards such as UL/IEC	Resettable; third-party compliance (UL/IEC); low internal resistance
	TVS Diode	Protects sensitive electronic components from voltage transients	<a href="#">SMBJ</a> , <a href="#">SMCJ</a>	Improves system reliability by protecting downstream components by clamping voltage at safe levels during transients on power lines	1500 W peak pulse capability; compatible with lead-free solder reflow temperature profile
2	Diode array	Protects wired communication interface from user induced ESD events	<a href="#">AQxx-02HTG</a>	Promotes robust communication channel operation while maintaining high signal integrity	ESD: IEC 61000-4-2, ±30 kV contact, ±30 kV air; EFT: IEC 61000-4-4, 50 A (5/50 ns); low clamping voltage
	SIDACTor	Protects sensitive electronic components damage due to lightning surges	<a href="#">SEP0xx</a>	Promotes robust operation of communication channel with minimal impact on signal integrity	Low insertion loss, log-linear capacitance; combined longitudinal and metallic protection fast clamping; low clamping voltage
	Solid State Relay	Provides isolation of pulse-out signal between MCU and MBus	<a href="#">PLA192</a> , <a href="#">CPC1394</a> , <a href="#">PLA193</a> , <a href="#">PLA194</a>	High reliability & electrical isolation; robust design; no EM/RFI generation	Up to 3750 V <sub>RMS</sub> input/output isolation; UL/IEC certified; low drive power
3	NTC	Sensing temperature of gas or water in specific meters	<a href="#">MELE style</a> , <a href="#">End-banded Chip</a> , <a href="#">Thermistor assembly</a>	SMD form-factor allows for compact design; non-standards resistance values available	Surface mountable; fast thermal response
	Reed Switch	Sensing flow of gas or water in specific meters	<a href="#">MDSR-10</a>	Lowest power consumption for longest battery life	Hermetically sealed; magnetically operated contacts
4	Reed Switch	Prevent magnetically induced tampering	<a href="#">59166</a> , <a href="#">MDSM-4</a>	Lowest power consumption for longest battery life	Hermetically sealed; magnetically operated contacts
5	Solid State Relay	Provides isolation from MCU for pulse out signal	<a href="#">PLA192</a> , <a href="#">CPC1394</a> , <a href="#">CPC1983YE</a> , <a href="#">PLA193</a> , <a href="#">PLA194</a>	High reliability & electrical isolation; robust design; no EM/RFI generation	Up to 3750 V <sub>RMS</sub> input/output isolation; UL/IEC certified; low drive power



# Select standards for electricity meters

Standard	Title	General Scope	Region
UL 2735	Safety standard for Electric Utility Meters	These requirements cover the electrical safety of electric utility (revenue) meters rated up to 600 V, which measure, monitor, record, transmit, or receive electrical energy generation or consumption information.	North America
IEC 62052	Electricity Metering Equipment (AC)	This part of IEC 62052 covers type tests for electricity metering equipment for indoor and outdoor application and applies to newly manufactured equipment designed to measure the electrical energy on 50 Hz or 60 Hz networks, with a voltage up to 600 V.	Global
IEC 62059	Dependability of Electrical Metering Equipment	Part 11: Metering Equipment Part 31: Product Safety Requirements and Tests	Global
IEC 62053	Active Energy Electrical Metering Equipment – Accuracy	Part 11: Electromechanical meters for active energy (classes 0,5, 1 and 2) Part 21: Static meters for active energy (classes 1 & 2) Part 23: Static meters for reactive energy (classes 2 and 3) Part 24: Static meters for reactive energy at fundamental frequency (classes 0,5 S, 1 S and 1) Part 61: Power consumption and voltage requirements	Global
IEC 61000-4-2	Testing – Electrostatic Discharge (ESD)	This standard is made to check the capability of the equipment to survive repetitive electrical fast transients and bursts	Global
IEC 61000-4-4	Electrical fast transient/burst immunity test	Evaluating the immunity of equipment when subjected to electrical fast transient/bursts on supply, signal, control, and earth ports.	Global
IEC 61000-4-5	Fast Transient Surge Test	Evaluate the immunity of equipment when subjected to surges	Global

# Local resources supporting our global customers

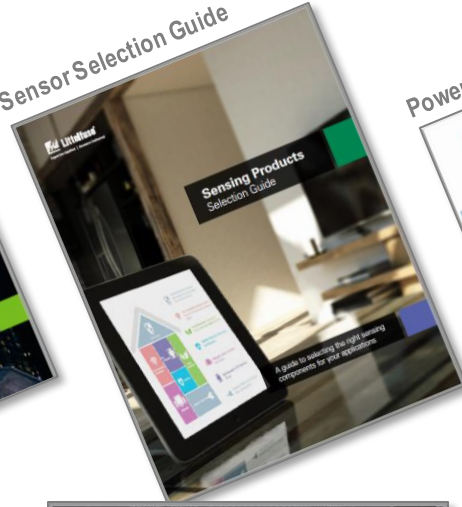


# Additional information can be found on [littelfuse.com](https://www.littelfuse.com)

Circuit Protection  
Selection Guide



Sensor Selection Guide



Power Semiconductor



ESD Protection  
Design Guide



Click on each  
image to open the  
catalog

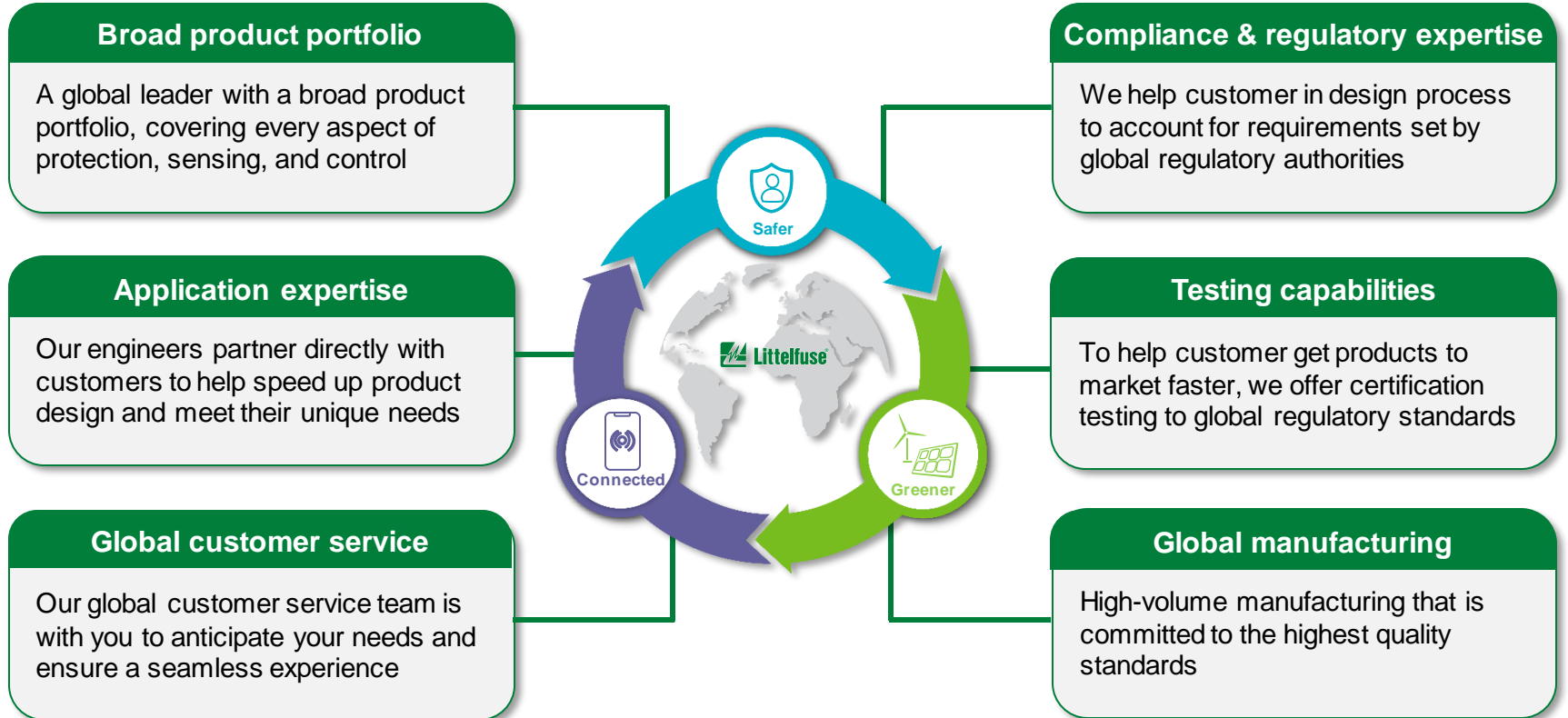
Integrated Circuits Catalog



ESD Suppression Selection Guide



# Partner for tomorrow's electronic systems





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## Supplementary Slides





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CONTROL  
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ISKRA

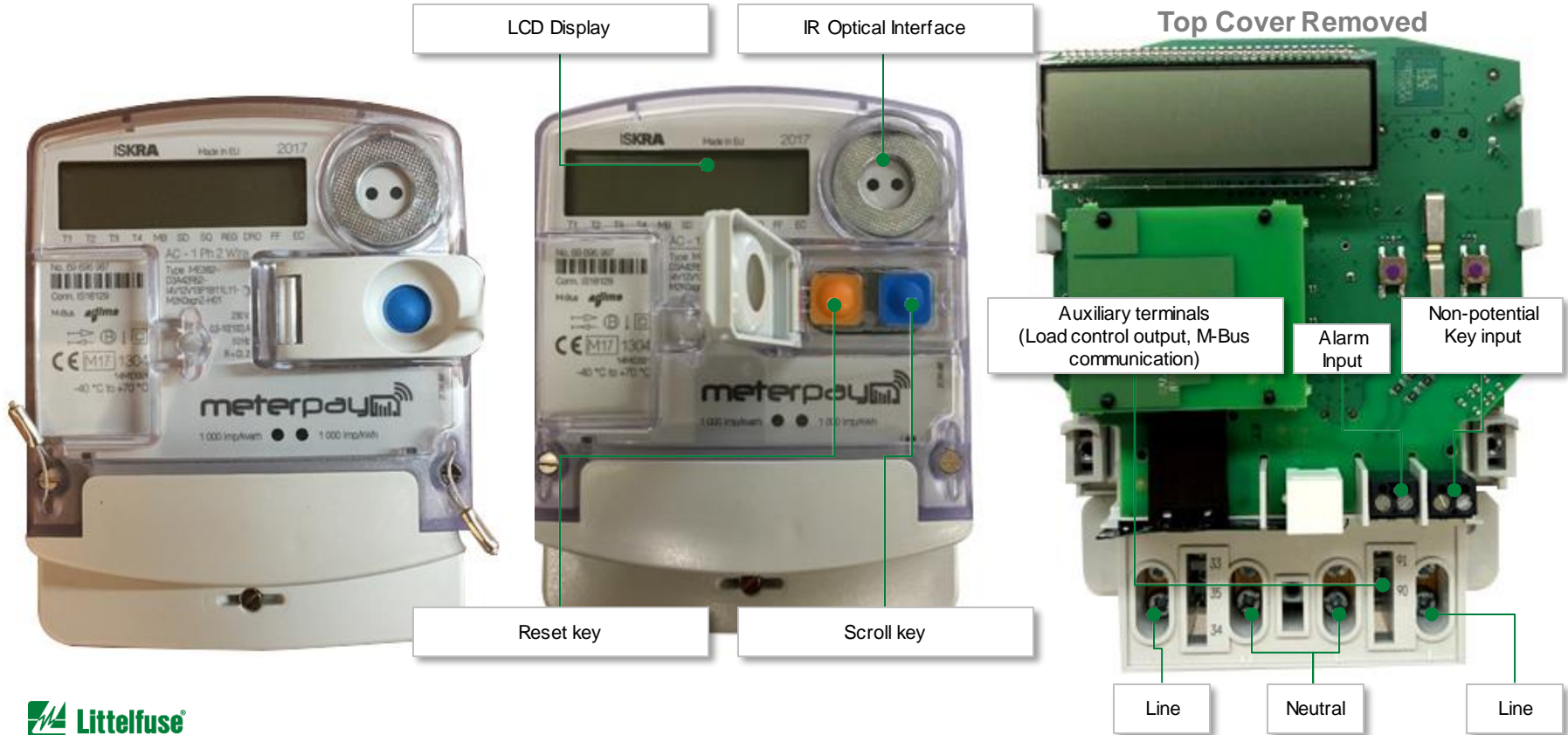
# Design wins & teardown: ISKRA ME382 Smart Electric Meter



ISKRA ME382 Smart  
Electric Meter

Model number & specification	
Name	ISKRA Smart Electric Meter
Model Number	ME382 Meterpay
Description	Single-phase SMART electricity meter, based on GSM/GPRS/UMTS communication provides the most reliable data transmission in smart residential and mid-size commercial environments
Specifications	<ul style="list-style-type: none"> <li>▪ IDIS interoperability</li> <li>▪ Remote connection/disconnection</li> <li>▪ Multi-Energy management (gas, water, heat)</li> <li>▪ Extensive anti-tampering features</li> <li>▪ Customer port for in-house display (RJ11)</li> <li>▪ Secure communication with encryption and authentication</li> <li>▪ Photovoltaic friendly design</li> <li>▪ Integrated demand/response functions</li> </ul>
Other manufacturers of similar products	Landis+Gyr, Itron, Elster Group, Sensus, Wasion
Littelfuse-recommended products	MOV - <a href="#">Ultra MOV</a> , <a href="#">CIII</a> , <a href="#">TMOV</a> , <a href="#">SMZ</a> , MOSFET - <a href="#">IXFA7N80P</a> , TVS Diode - <a href="#">1.5KE</a> , SIDACtor – <a href="#">MC</a> , Reed Switch - <a href="#">59166</a>

# ISKRA: 230 Vac single-phase/two-wire

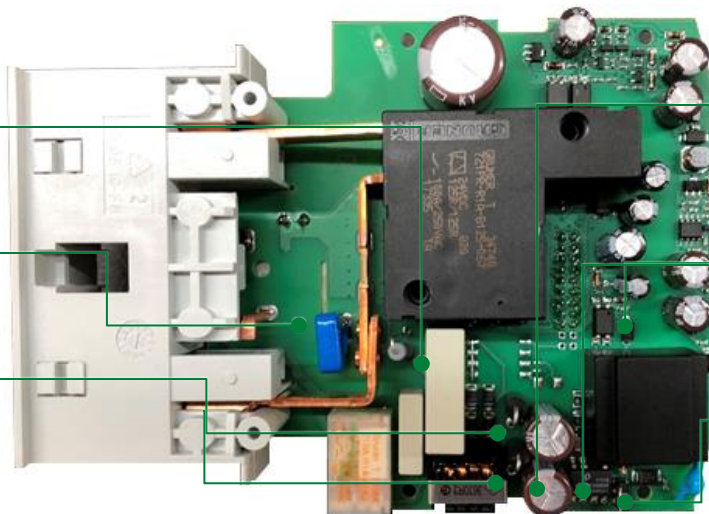


# Main board: top side

Primary Capacitor 0.33  $\mu$ F/275 V  
 Make: ISKRA  
 Part number: [KNB1530](#)

MOV 510 Vrms, 14 mm  
 Make: Stackpole Electronics  
**LFUS: UltraMOV, C-III, TMOV**

TVS Diode 342 Vrms, 1500 W  
 Make: Unknown  
**LFUS: 1.5KE**



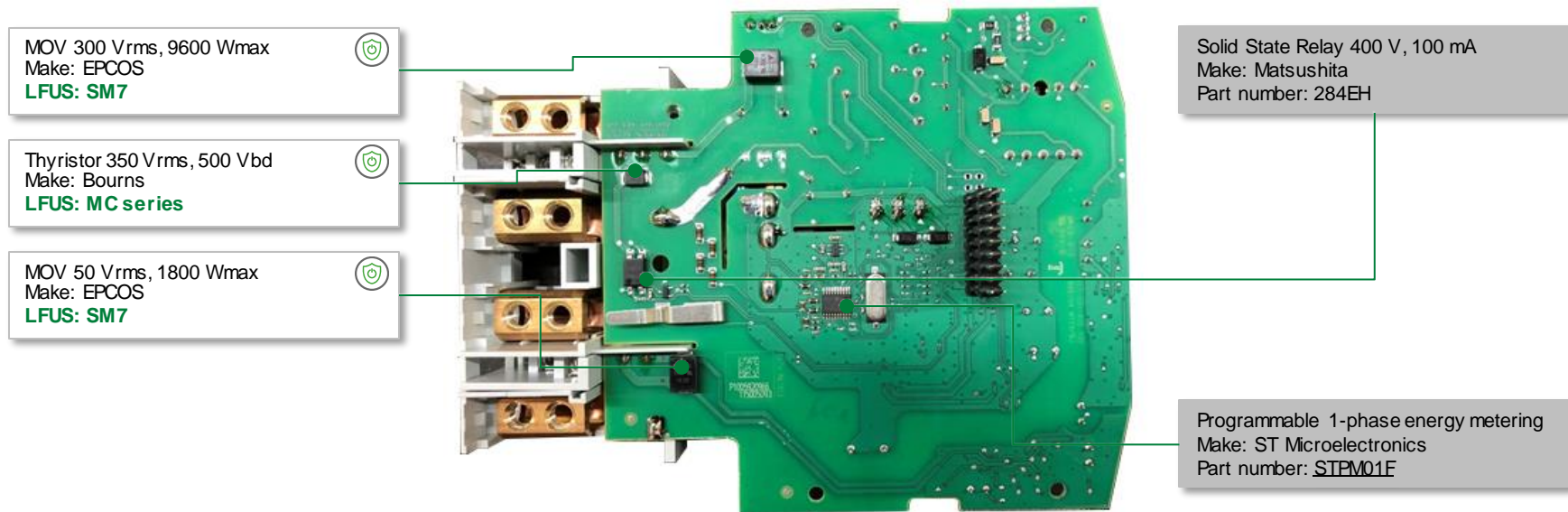
Smoothing Capacitor  
 10  $\mu$ F/450 V

PMIC with integrated 700V MOSFET  
 Make: Power Integrations  
 Part number: TNY268GN

Power MOSFET 800 V, 2.8  $\Omega$   
 Make: Infineon  
**LFUS: IXFA7N80P**

Technology	Function in application	Littelfuse Series	Benefits	Features
MOV	Protects power unit from voltage transients and lightning	<a href="#">UltraMOV</a> , <a href="#">CIII</a> , <a href="#">TMOV</a>	Reduces customer qualification time by complying with third-party safety standards such as UL/IEC	High energy absorption capability: 40–530 J (2 ms)
MOSFET	Provides high frequency load switching	<a href="#">IXFA7N80P</a>	High power density and low power consumption promotes an efficient design	Dynamic $dv/dt$ rating, low $R_{DS(ON)}$ and $Q_g$ avalanche rated low package inductance
TVS diode	Protects power unit from voltage transients induced by lightning and other transient voltage events	<a href="#">1.5KE</a>	Promotes robust operation; fast response time to transients allows for quick arrest of faults and strong protection	Fast response time: typically less than 1.0ps from 0 Volts to BV min; excellent clamping capability typical failure mode is short from over-specified voltage or current

# Main board: bottom side



MOV 300 Vrms, 9600 Wmax  
 Make: EPCOS  
 LFUS: **SM7**

Thyristor 350 Vrms, 500 Vbd  
 Make: Bourns  
 LFUS: **MC series**

MOV 50 Vrms, 1800 Wmax  
 Make: EPCOS  
 LFUS: **SM7**

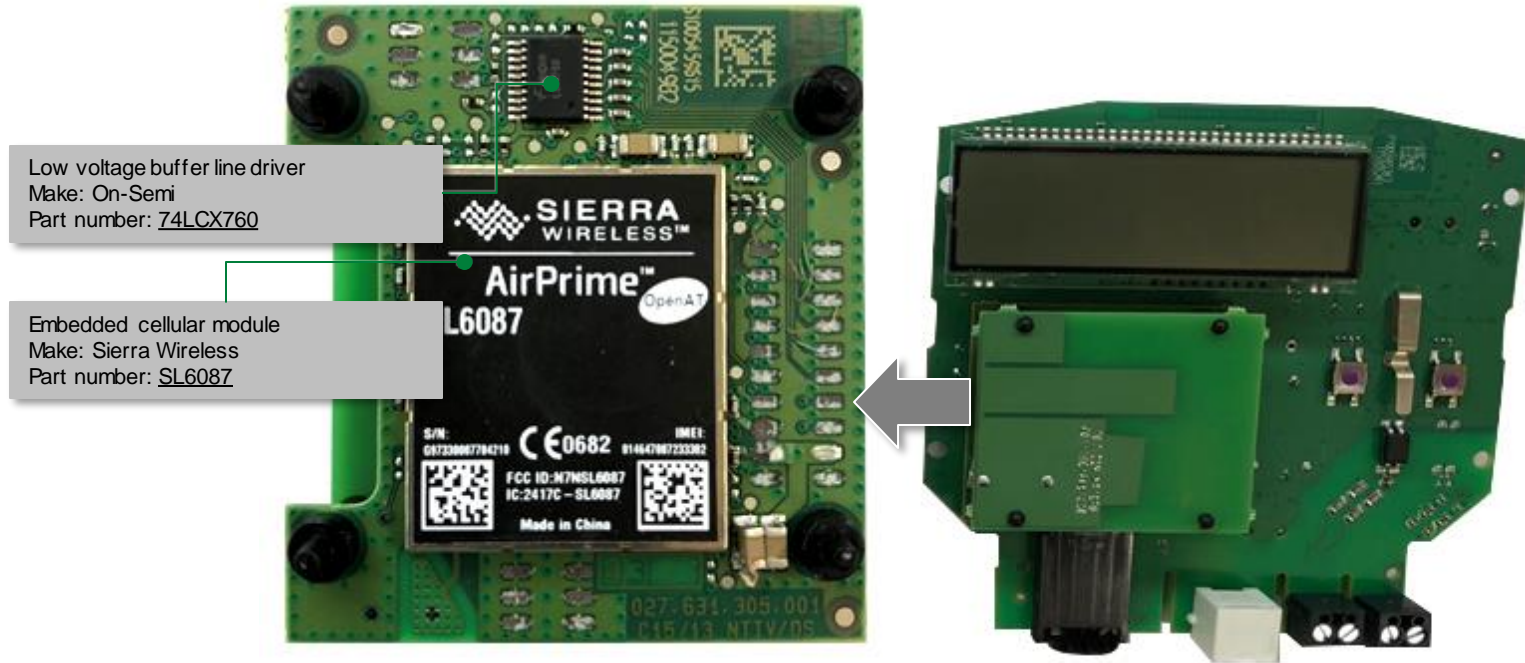
Solid State Relay 400 V, 100 mA  
 Make: Matsushita  
 Part number: 284EH

Programmable 1-phase energy metering  
 Make: ST Microelectronics  
 Part number: STPM01F

Technology	Function in application	Littelfuse Series	Benefits	Features
MOV	Protects auxiliary I/O from voltage transients due to overload	<a href="#">SMZ</a>	Promotes robust operation maintaining high signal integrity; saves board space	Excellent clamping capability; low incremental surge resistance; typical IR less than 1 $\mu$ a when VBR min > 12 V; surface mountable
SIDACtor	Protects sensitive electronic components damage due to lightning surges	<a href="#">MC</a>	Promotes robust operation of communication channel with minimal impact on signal integrity	Low voltage overshoot; low on-state voltage; surge withstand capability after multiple surge events within limit.



# Auxiliary board: top side



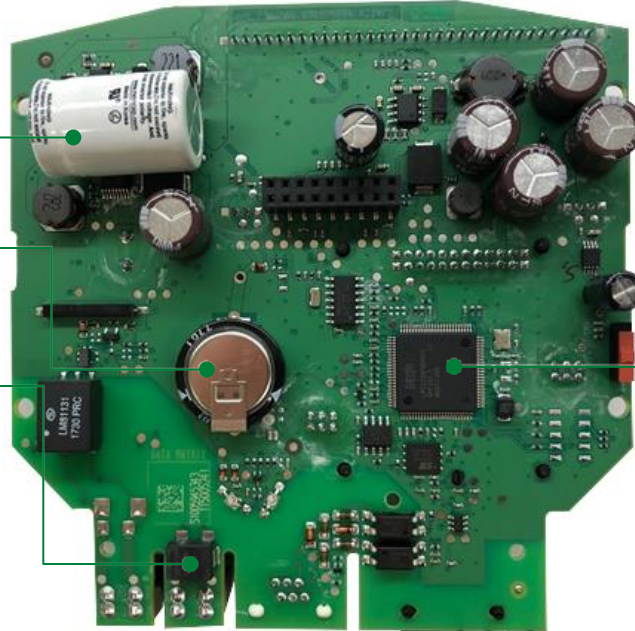
# Auxiliary board: bottom side

Ultracapacitor 2.7 V , 25 F,  
3.7 A (continuous current)  
Make: NESSCAP

Ultracapacitor 5.5 V , 1.5 F, Coin cell  
Make: Cooper Bussman

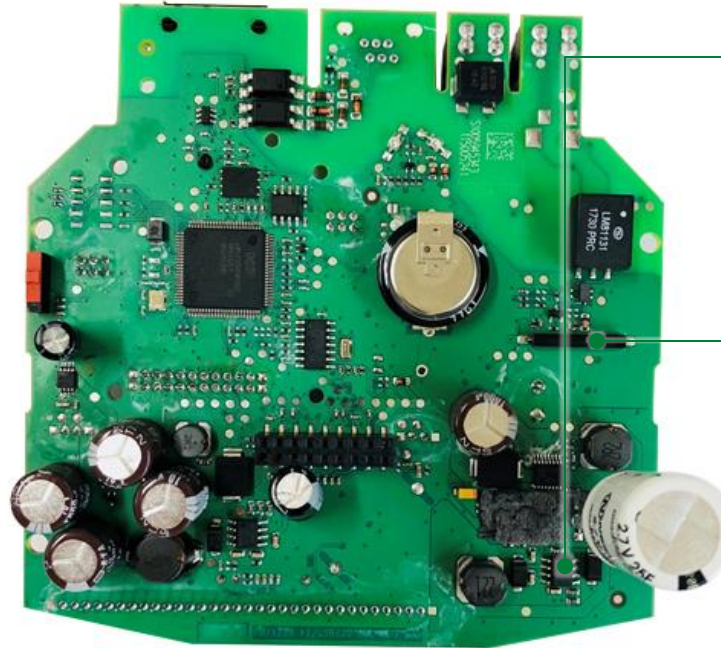
MOV 300 Vrms, 9600 Wmax  
Make: EPCOS  
**LFUS: SM7**

Microcontroller  
Make: NXP  
Part number: [LPC2368FBD](#)



Technology	Function in application	Littelfuse Series	Benefits	Features
MOV	Protects auxiliary I/O from voltage transients due to overload	<a href="#">SMZ</a>	Promotes robust operation maintaining high signal integrity; saves board space	Excellent clamping capability; low incremental surge resistance; typical IR less than 1 $\mu$ a when VBR min>12 V; surface mountable

# Auxiliary board: bottom side (ultra-cap upright)



Step-up DC-DC converter  
Make: MAXIM Integra

Reed Sw itch  
Make: Littelf use Inc.  
**LFUS: 59166**



Technology	Function in application	Littelfuse Series	Benefits	Features
Reed Sw itch	Prevent magnetically induced tampering	<a href="#">59166</a>	Low est power consumption for longest battery life	Hermetically sealed; magnetically operated contacts



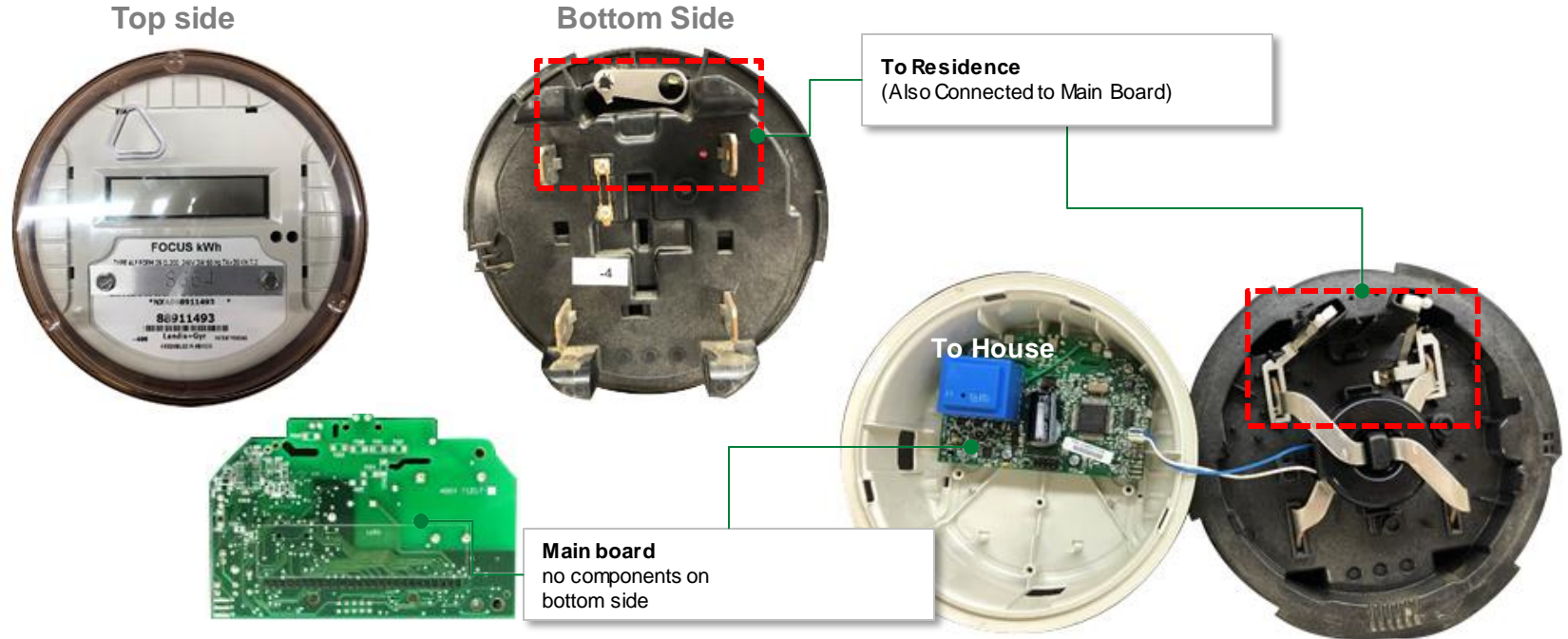
# Design wins and teardown: Landis+Gyr CL200 Smart Electric Meter



Landis+Gyr CL200  
Smart Electric Meter

Model number & specification	
Name	Landis+Gyr Smart Electric Meter
Model Number	CL200
Description	A new generation of meters as IoT grid sensors benefitting both utilities and their customers
Specifications	<ul style="list-style-type: none"> <li>▪ IoT sensing that leverages high-speed 15 kHz Waveform data</li> <li>▪ Real-time intelligence and visibility at the grid edge</li> <li>▪ Gridstream Connect App OS enabled sensor</li> <li>▪ Communications flexibility</li> <li>▪ Gridstream Connect App OS ready</li> <li>▪ Richer harmonics measurement</li> <li>▪ High-resolution billing system (ready for the future of transactive energy)</li> <li>▪ 200 A and 320 A remote disconnect</li> <li>▪ Micro arc sensing at the meter blades</li> <li>▪ Wi-Fi and internet enabled</li> </ul>
Other manufacturers of similar products	Itron, Elster Group, Sensus, Wasion, Iskara
Littelfuse-recommended products	TVS Diode - <a href="#">SMCJ</a>

# Landis+Gyr: 240 Vac, 3 W, 60 Hz: CL200 series

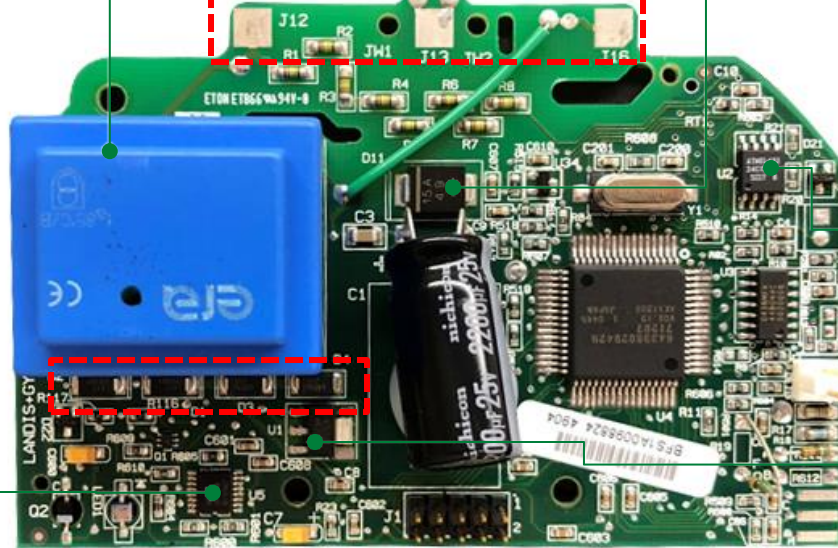


# Main control board top side

Step-down Transformer  
 Primary: 240V / 60Hz  
 Secondary: 9V

Connection From Outer Pin

TVS Diode, Vwm: 15V, Vbr: 18.5V  
 Make: Vishay  
**LFUS: SMCJ**



2 Wire Serial EEPROM  
 Part number: 24C128W  
 Make: Atmel

8-Channel Analog Mux/Demux  
 Part Number: CM053B  
 Make: TI

0.8A LDO Regulator  
 Part number: LM1117IMPX-5.0  
 Make: National Semiconductor

Technology	Function in application	Littelfuse Series	Benefits	Features
TVS Diode	Protects sensitive electronic component from voltage transients	<a href="#">SMCJ</a>	Improves system reliability by protecting downstream components by clamping voltage at safe levels during transients on power lines	1500 W peak pulse capability; compatible with lead-free solder reflow temperature profile



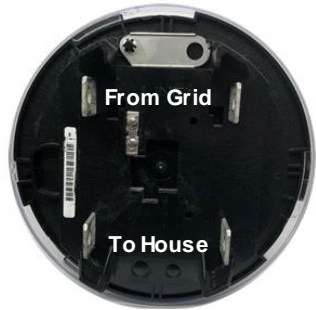
**PROTECT  
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Itron

# Design wins and teardown: Itron CL200 Smart Electric Meter



Itron Smart Electric Meter  
(240 V, 3 W, Single Phase)  
Model: CL200

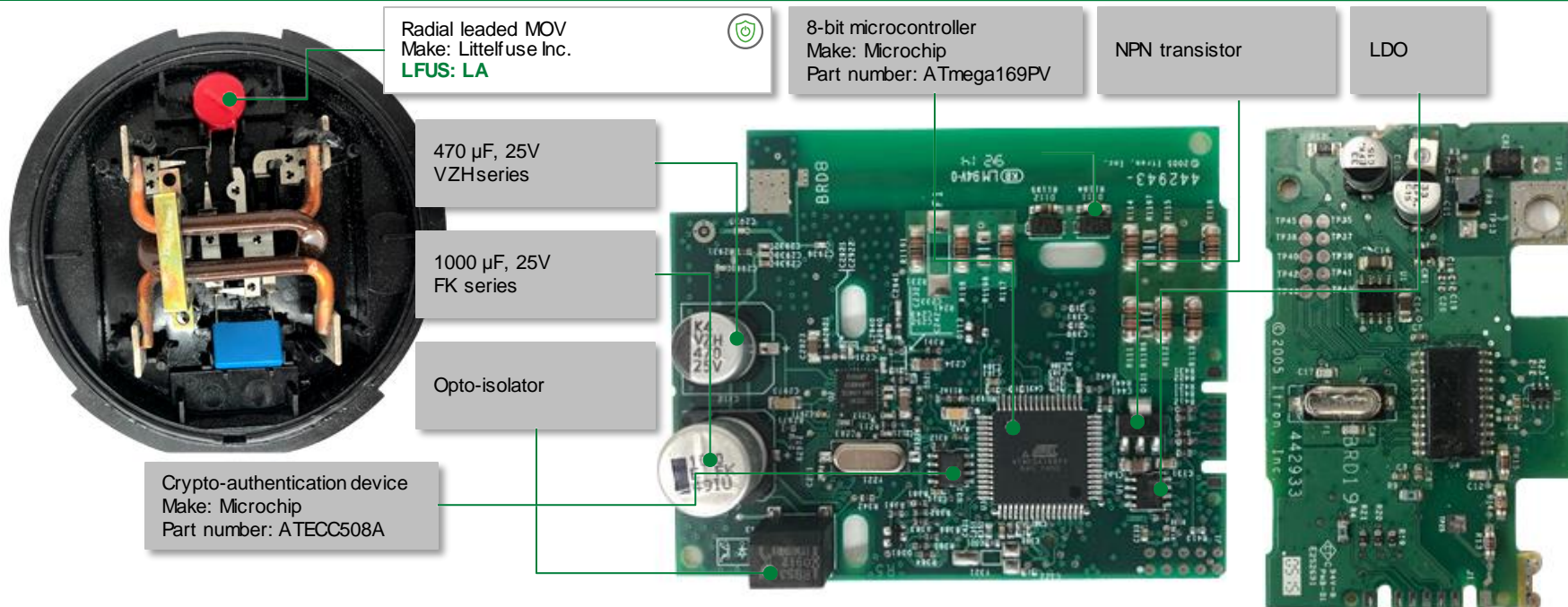


Expertise Applied | Answers Delivered

Model number & specification	
Name	Itron Smart Electric Meter
Model Number	CL200
Description	A solid-state, single-phase residential electricity meter that provides utilities with unparalleled digital accuracy, reliability, serviceability and cost-effectiveness
Specifications	<ul style="list-style-type: none"> <li>▪ Cord length: 2.5 m</li> <li>▪ Total height: 1018 mm</li> <li>▪ Airflow max settings: 412l/s</li> <li>▪ HEPA filter: 360 Glass</li> <li>▪ 360° Glass HEPA filter</li> <li>▪ Intelligent purification</li> <li>▪ Dual function - Cooling fan in the summer</li> <li>▪ Air Multiplier™ technology - Amplifies surrounding air, giving an uninterrupted stream of purified airflow</li> <li>▪ Smooth oscillation - Projects and circulates purified air across the room</li> </ul>
Other manufacturers of similar products	Landis+Gyr, Elster Group, Sensus, Wasion, Iskara, Siemens, ABB
Littelfuse-recommended products	MOV - <a href="#">LA</a>



# Key findings: Littelfuse MOV



Technology	Function in application	Littelfuse Series	Benefits	Features
MOV	Protects power unit from voltage transients and lightning	LA	Reduces customer qualification time by complying with third-party safety standards such as UL/IEC	High energy absorption capability : 40–530 J (2 ms)



Expertise Applied | Answers Delivered



[Littelfuse.com](https://www.littelfuse.com)