






Smart Metering

Building Solutions

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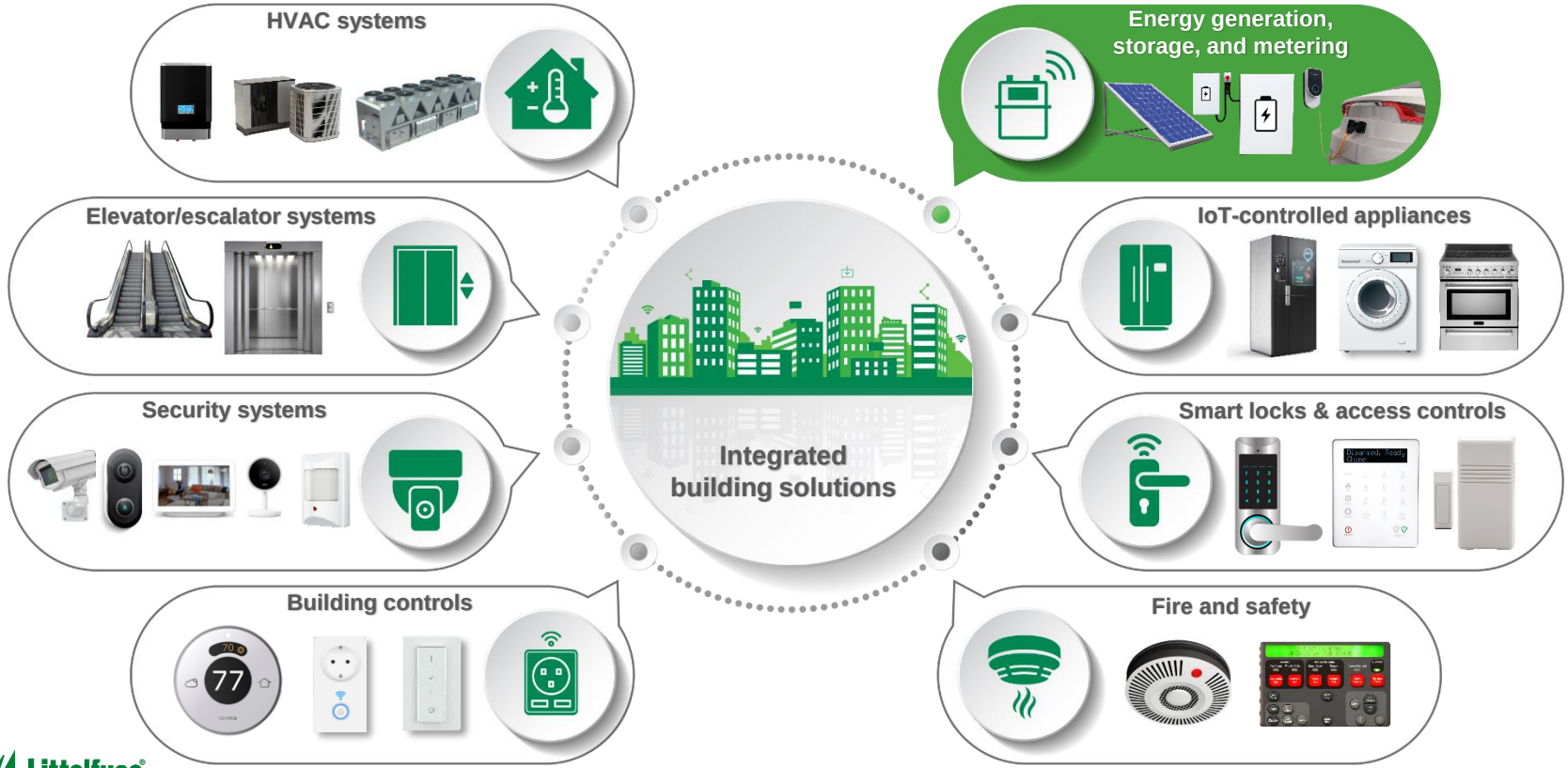
Buildings are evolving into networks of electric and electronic systems to help reach net-zero goals



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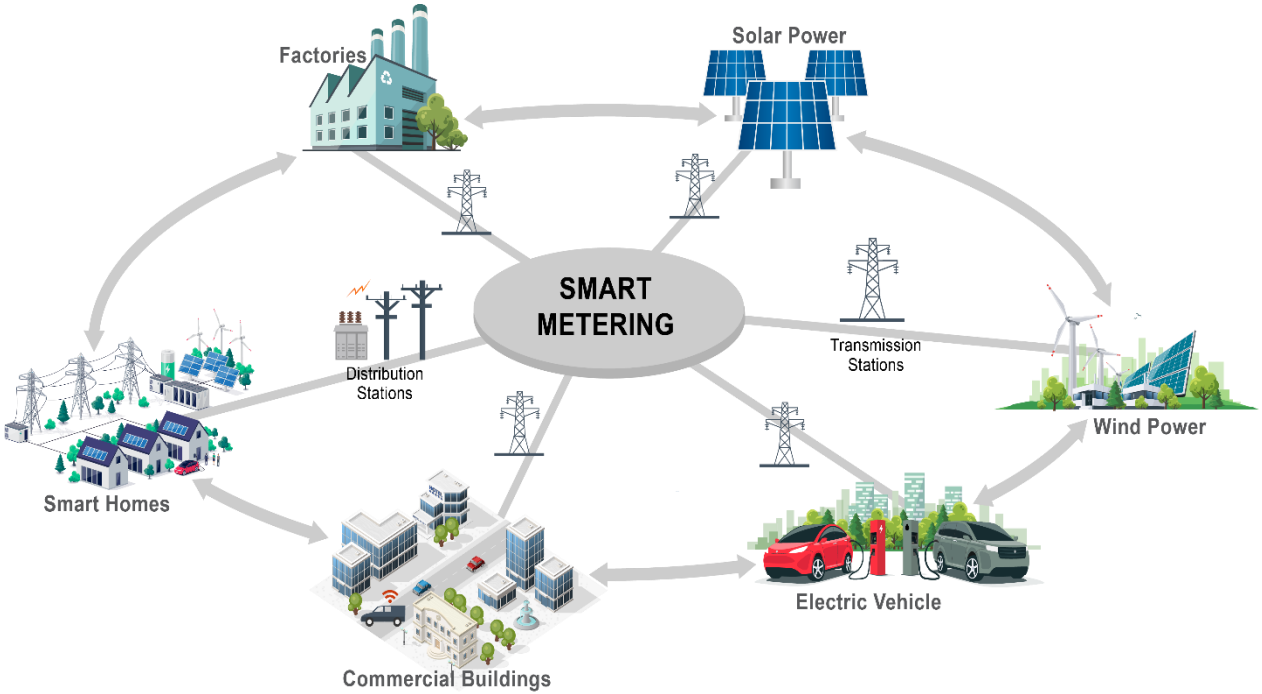
Smart meters–key to advanced energy management



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

- Electric transients and overcurrent protection
- Anti-tamper solutions
- Flow measurement devices
- Low power consumption sensors
- Load switching and energy pulse out
- Over-temp detection and temperature measurement
- Power management
- Button inputs and controls

Littelfuse can help with cross-functional system-level expertise and application testing

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Market trends of smart meters

Market trends and drivers

A total of 160 million smart meters were installed globally in 2021; 125 million electricity meters and 35 million gas or water meters

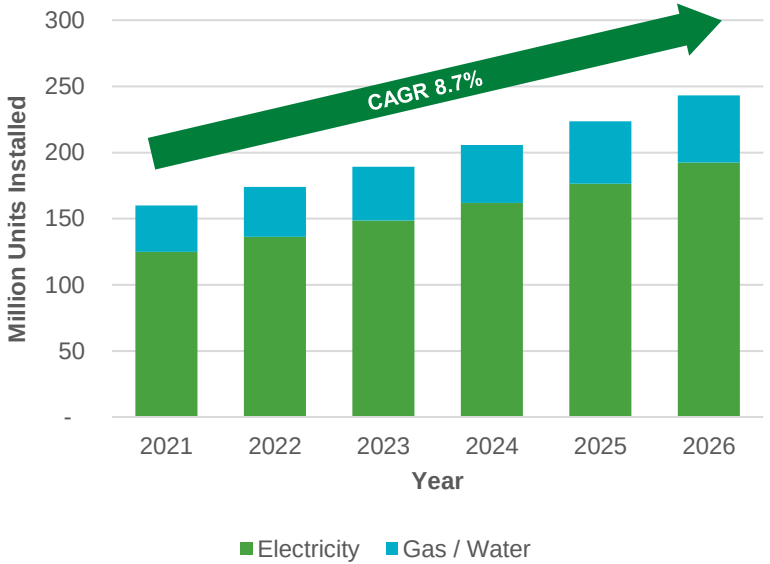
65% of all smart meters are installed in the Asia region, 20% in Europe, and 15% in the Americas

Major benefits of smart meters include detecting leakages, eliminating costly manual readings by municipality personnel, and detecting theft

The transition from gas and oil to electricity for heating, cooking, and transportation is accelerating the deployment of electricity meters

In the United States, Canada, and some countries of Europe, the first-generation smart meters are starting to reach their end of life. Replacement installations expected over the next several years.

Smart meters installed worldwide annually



Sources: 1. Smart Meters Market
2. Global Smart Electricity Meters Market
3. Internal marketing estimates

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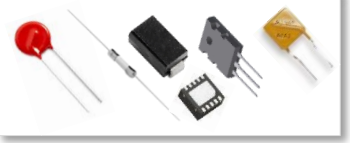
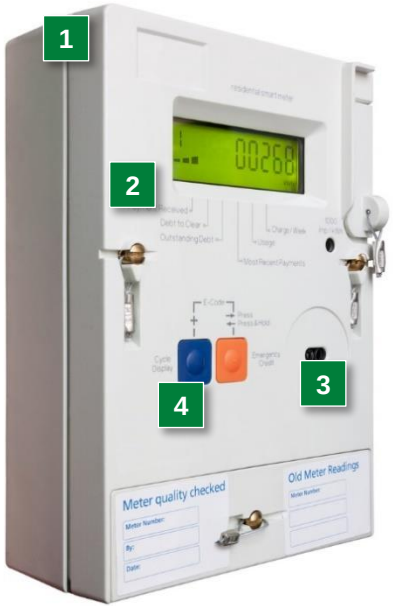
Smart electricity meter

1 Anti-tamper
Reed Switch, TMR,
Detect Switch

2 Metrology System Unit
MOV, Fuse, TVS Diode, eFuse,
SiC MOSFET, PPTC, NTC





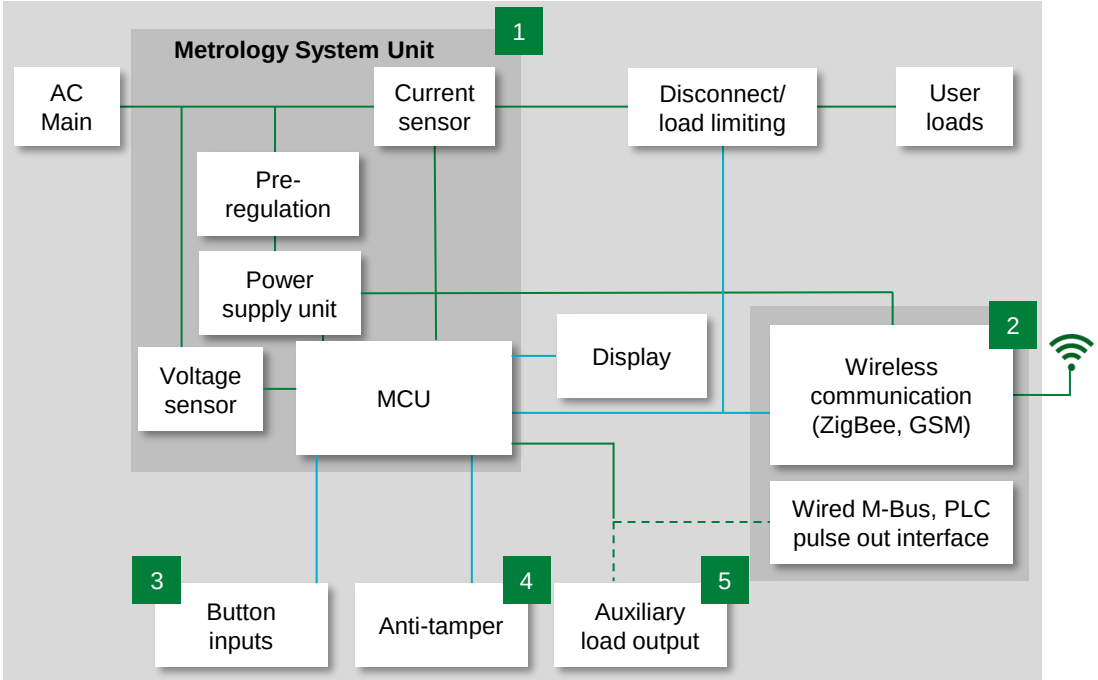
3 Communication Interface
TVS Diode Array,
SIDACtor®, Optocoupler

4 I/O Protection and Control
SSR, Fuse, TVS Diode,
MOV, Tactile Switch

Acronyms:
TMR: tunneling magnetoresistive
MOV: metal oxide varistor
TVS: transient-voltage suppression
SiC: silicon carbide
PPTC: polymeric positive temperature coefficient
NTC: negative temperature coefficient
SSR: solid state relay

Click the product series in the table below for more info

Electricity meter system block diagram



Acronyms:
AC: alternate current
MCU: microcontroller unit
GSM: global system for mobile communication
PLC: power line communication

	Technology	Product series
1	MOV	Ultra MOV, CIII, TMOV
	Fuse	215, 514, 835
	TVS Diode	SMAJ, SMBJ
	NTC	ST, End-banded Chip
	MOSFET/ SiC MOSFET	Polar™, X2-class/ LSICMO170E1000
	PPTC	TRF600-150
	Protection IC (eFuse)	LS0502SCD33, LS0502SCD33S LS2406ERQ23
	MOSFET	X2-class
2	TVS Diode Array	SC1205, SC1210
	SIDACtor®	SEP0xx
	Solid State Relay / Optocoupler	PLA192, CPC1394, PLA193, PLA194, CPC1303
3	Tactile Switch	KSC, KSE, PTS
4	Reed Switch / TMR	59177, MDSR-10 / TMR
	Detect Switch	SDS, DDS
5	Solid State Relay	PLA192, CPC1394, CPC1983YE, PLA193, PLA194
	TVS Diode / MOV	SMCJ/SM7

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Click the product series in the table below for more info

Benefits of Littelfuse products for electric meters

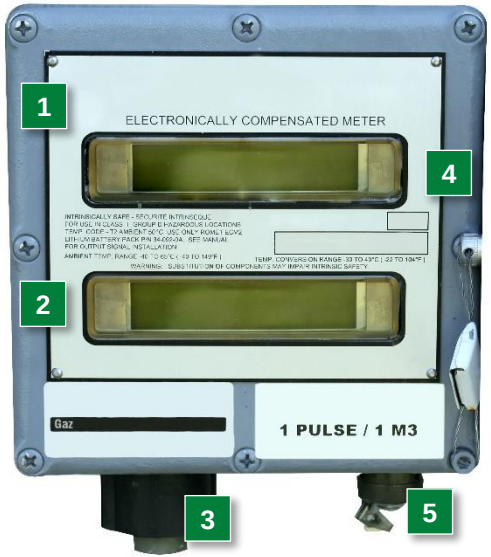
	Technology	Function in application	Product series	Benefits	Features
1	MOV	Protects power unit from voltage transients and lightning	Ultra MOV, CIII, TMOV	Reduces customer qualification time by complying with third-party safety standards such as UL / IEC	High energy absorption capability: 40–530 J (2 ms)
	Fuse	Protects power stage from overcurrent events	215, 514, 835	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	SMAJ, SMBJ	Improves system reliability	1500 W peak pulse capability; compatible with lead-free solder reflow temperature profile
	NTC	Senses temperature of power semiconductors devices	ST, End-banded Chip	SMD form-factor allows for compact design; non-standard resistance values available	Surface mountable; fast thermal response
	MOSFET / SiC MOSFET	Provides high-frequency load switching	Polar™, X2-class / LSICMO170E1000	High power density and low power consumption promotes an efficient design	Dynamic dv/dt rating; low $R_{DS(ON)}$ and Q_g avalanche rate; low package inductance
	PPTC	Protects power stage from overcurrent events	TRF600-150	Low maintenance; compact form-factor saves space	Resettable overcurrent protection; fast time-to-trip resistance; sorted and matched devices available
	Protection IC (eFuse)	Helps protect the supercapacitor system and provides charge/discharge control circuitry	LS0502SCD33, LS0502SCD33S, LS2406ERQ23	High integration with multiple protections (OCP, OVP, OTP, and reverse current blocking in small package	Programmable 1.1V to 5.3V cap voltage range; automatic main/backup switchover and cell balancing
	MOSFET	Provides switching function in pre-regulation circuit for charging capacitor	X2-class	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	TVS Diode Array	Protects wired communication interface from user- induced ESD events	SC1205, SC1210	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, 40 A (5/50 ns)
	SIDACtor®	Protects sensitive electronic components from damage due to lightning surges	SEP0xx	Promotes robust operation of communication channel with minimal impact on signal integrity	Low insertion loss, log-linear capacitance; low clamping voltage
	Solid State Relay / Optocoupler	Provides isolation of pulse-out signal between MCU and M-Bus or PLC interface	PLA192, CPC1394, PLA193, PLA194, CPC1303	High reliability & electrical isolation; robust design; no EMI/RFI generation	Up to 3750 V_{RMS} input/output isolation; UL/IEC certified; low drive power
3	Tactile Switch	Switch for triggering display, resetting, etc.	KSC, KSE, PTS	Available in wide range of operating forces; rugged sealing and resistant to corrosion	Ultra-low current consumption; operating life up to 1M cycles
4	Reed Switch	Prevents magnetically induced tampering	59177, MDSR-10 / TMR	Lowest power consumption for longest battery life	Hermetically sealed; magnetically operated contacts
	Detect Switch	Detects tampering of the meter casing	SDS, DDS	Compact and reliable tamper detection	Low profile package; available in vertical and horizontal configurations; SMT or through-hole
5	Solid State Relay	Provides isolation from MCU and load output	PLA192, CPC1394, CPC1983YE, PLA193, PLA194	High reliability and electrical isolation; robust design; no EMI/RFI generation	Up to 3750 V_{RMS} input/output isolation; UL/IEC certified; low drive power
	TVS Diode / MOV	Protects auxiliary I/O from voltage transients due to overload	SMCJ / SM7	Promotes robust operation maintaining high signal integrity; saves board space	Excellent clamping capability; low incremental surge resistance

Smart water and gas meter

1 Battery and Interface Panel
PPTC, Fuse, eFuse, ATEX Fuse, TVS Diode, Tactile Switch

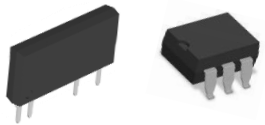
2 Communication Interface
TVS Diode Array, SIDACtor®, SSR, Optocoupler

3 Flow Measurement
NTC Thermistor, Reed Switch



4 Anti-tamper
Reed Switch, TMR, Detect Switch

5 Safety Valve
Solid State Relay



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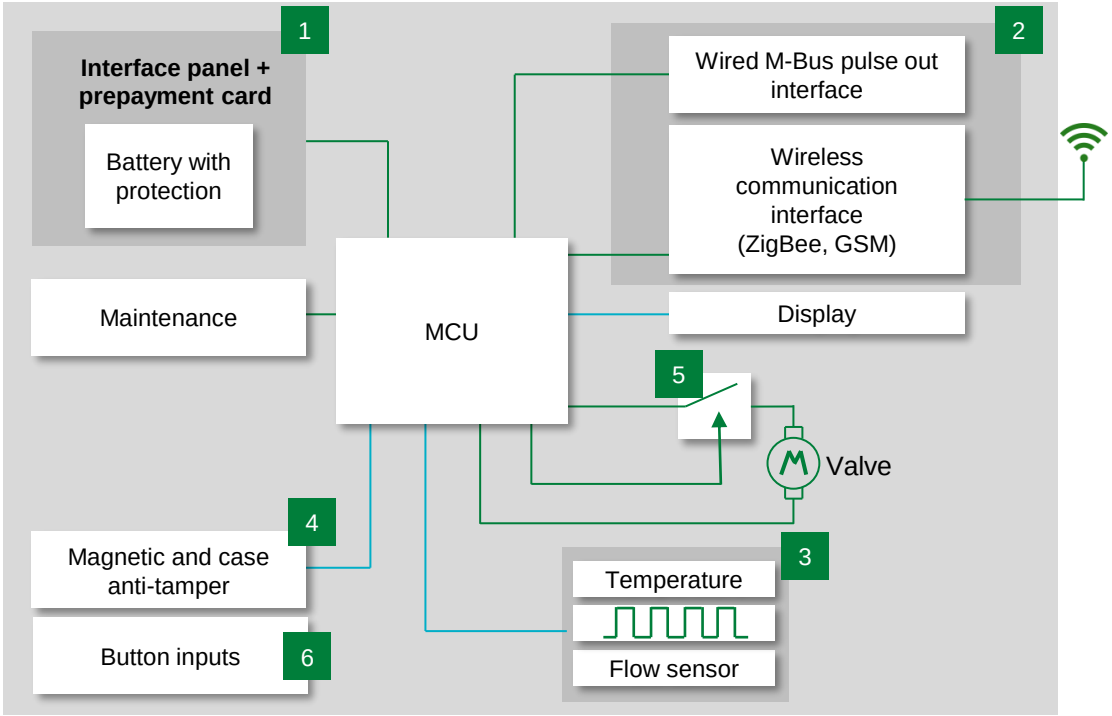
Click the product series in the table below for more info

Gas and water meters share many functional blocks



	Technology	Product series
1	Fuse	Atex 259 / 304, 437
	PPTC	1812L
	Protection IC (eFuse)	LS0502SCD33, LS0502SCD33,S LS2406ERQ23
	TVS Diode	SMBJ, SMCJ
2	TVS Diode Array	SC1205, SC1210
	SIDACtor®	Pxxx0SLR
	Solid State Relay / Optocoupler	PLA192, CPC1394, PLA193, PLA194, CPC1303
3	NTC	MELF style, End-banded Chip, Thermistor assembly
	Reed Switch	MDSR-10
4	Reed Switch, TMR	59166, 59177, MDSM-4, TMR
	Detect Switch	SDS, DDS
5	Solid State Relay	PLA192, CPC1394, CPC1983YE, PLA193, PLA194
6	Tactile Switch	KSC, KSE, PTS

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Click the product series in the table below for more info

Benefits of Littelfuse products for water/gas meters

	Technology	Function in application	Product series	Benefits	Features
1	Fuse	Protects power stage from overcurrent events	Atex 259 / 304, 437	Reduces customer qualification time by complying with third-party safety standards such as UL / IEC	Third-party compliance (UL / IEC); low internal resistance
	PPTC	Protect battery from over current and over temperature events	1812L	Auto resets after fault is removed; allows for compact design	Resettable; low resistance; compact design
	Protection IC (eFuse)	Provides OCP, OVP, OTP, and reverse current blocking	LS0502SCD33, LS0502SCD33S, LS2406ERQ23	High integration with multiple protections in small package	3−24 V Operation voltage and 6 A continuous current with 24 mΩ Ron
	TVS Diode	Protects sensitive electronic components from voltage transients	SMBJ, SMCJ	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	TVS Diode Array	Protects wired communication interface from user-induced ESD events	SC1205, SC1210	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, 40 A (5 / 50 ns)
	SIDACtor®	Protects sensitive electronic components from damage due to lightning surges	Pxxx0SLR	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 / Optocoupler	Provides isolation of pulse-out signal between MCU and M-Bus	PLA192, CPC1394, PLA193, PLA194, CPC1303	High reliability and electrical isolation; robust design; no EMI / RFI generation	Up to 3750 V_{RMS} input/output isolation; UL / IEC certified; low drive power
3	NTC	Sensing temperature of gas or water in specific meters	MELF style, End-banded Chip, Thermistor assembly	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	MDSR-10	Lowest power consumption for longest battery life	Hermetically sealed; magnetically operated contacts
4	Reed Switch	Detects magnetically induced tampering	59166, MDSM-4, TMR	Lowest power consumption for longest battery life	Hermetically sealed; magnetically operated contacts; available overmold for added robustness
	Detect Switch	Detects tampering of the meter casing	SDS, DDS	Compact and reliable tamper detection	Low profile package; available in vertical and horizontal configurations; SMT or through-hole
5	Solid State Relay	Provides isolation from MCU and relief valve motor	PLA192, CPC1394, CPC1983YE, PLA193, PLA194	High reliability & electrical isolation; robust design; no EMI / RFI generation	Up to 3750 V_{RMS} input/output isolation; UL / IEC certified; low drive power
6	Tactile Switch	Switch for triggering display, resetting, etc.	KSC, KSE, PTS	Available in wide range of operating forces; rugged sealing & resistant to corrosion; very long operating life	Ultra-low current consumption; operating life up to 1 million cycles

Safety standards for electricity meters

Standard	Title	General scope	Market
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.	United States
ANSI C12.1	Code for Electricity Metering	This Code is a reference for utilities, manufacturers, and regulatory bodies. It establishes acceptable performance criteria for new types of AC watthour meters, describes acceptable in-service performance levels for meters and devices used in revenue metering, and includes information on related subjects such as recommended measurements, installation requirements, test methods, and test schedules.	United States
ANSI/IEEE C62.41.1	Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits	Describes the mutual interactions between surge protective devices (SPDs) and power system disturbances.	United States
ANSI/IEEE C62.41.2	Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits	Provides guidance on how to assess by testing the effects of surges.	United States
IEEE C62.45	IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits		United States
UL 2735C	Electric Utility Meters for Canada	Similar to UL 2735.	Canada
CAN3-C17-M84	Alternating-Current Electricity Metering	Applies to the types of meters and associated devices normally used in the measurement of energy, power, or both in the supply and distribution of electricity as a commodity.	Canada

Safety standards for electricity meters (cont'd)

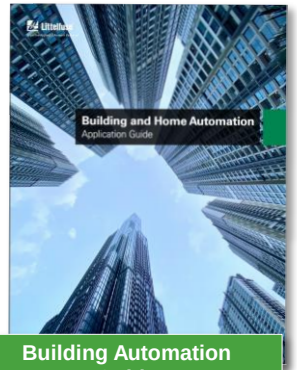
Standard	Title	General scope	Market
EN 62052 Series	Electricity metering equipment – General requirements, tests, and test conditions	Similar to IEC 62052 Series.	Europe
EN 62053 Series	Electricity metering equipment – Particular requirements	Similar to IEC 62053 Series, with the exception of DC (part 41), not yet published by CENELEC.	Europe
IEC 61000-4-2	Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test	This standard is made to check the capability of the equipment to survive repetitive electrical fast transients and bursts	Global
IEC 61000-4-4	Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – 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	Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test	Evaluate the immunity of equipment when subjected to surges.	Global
IEC 62052 Series	Electricity metering equipment – General requirements, tests, and test conditions	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 50–60 Hz networks, with a voltage up to 600 V.	Global
IEC 62053 Series	Electricity metering equipment – Particular requirements	Part 21: Static meters for active energy (classes 1 & 2) Part 23: Static meters for reactive energy (classes 2 & 3) Part 24: Static meters for reactive energy at fundamental frequency (classes 0.5 S, 1 S, and 1) Part 41: Static meters for DC energy (classes 0.5 & 1) Part 61: Power consumption and voltage requirements	Global

Safety standards for typical components in smart meters

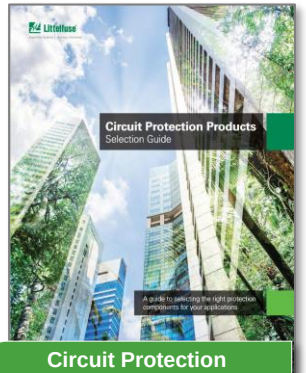
		Standard	Title	General scope	Market
Component	Surge protection	UL 1449	Surge Protective Devices	Surge protective devices including MOVs shall comply with the requirements in the Standard for Surge Protection Devices.	United States
		UL 497B	Standard for Safety Protectors for Data Communications and Fire-Alarm Circuits	These requirements apply to TVS Diodes.	United States
	Overcurrent protection	UL 1434	Thermistor-Type Devices	Thermistors (PTCs and NTCs) shall comply with Standard for Thermistor-Type Devices.	United States
		UL 248-1	Standard for Safety Low-Voltage Fuses – Part 1: General Requirements	Fuses shall comply with Standards for fuses.	United States
		UL 248-14	Standard for Low-Voltage Fuses - Part 14: Supplemental Fuses		United States
	Battery	UL 1642	Lithium Batteries	Applicable standards that Li-ion batteries shall comply with.	United States
		UL 2054	Household and Commercial Batteries		United States
		IEC 62281	Safety of Primary and Secondary Lithium Cells and Batteries During Transport		Worldwide

Additional information can be found at Littelfuse.com

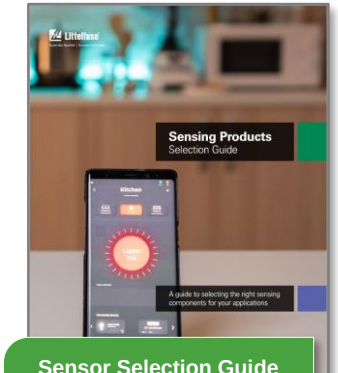
Explore the world of Littelfuse with the Electronics eCatalogs (electronicscatalogs.littelfuse.com)



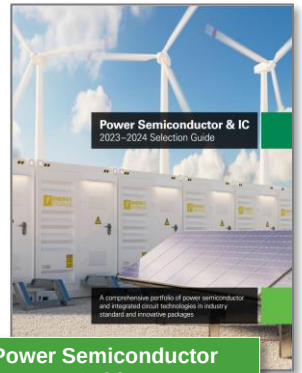
Building Automation Guide



Circuit Protection Selection Guide

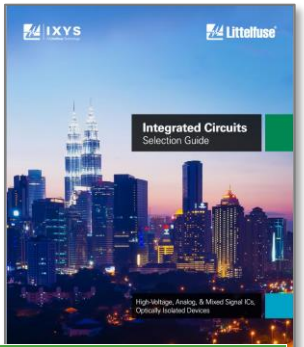


Sensor Selection Guide



Power Semiconductor Guide

Click on images for more information



Integrated Circuit Selection Guide

C&K Switches Selection Guide

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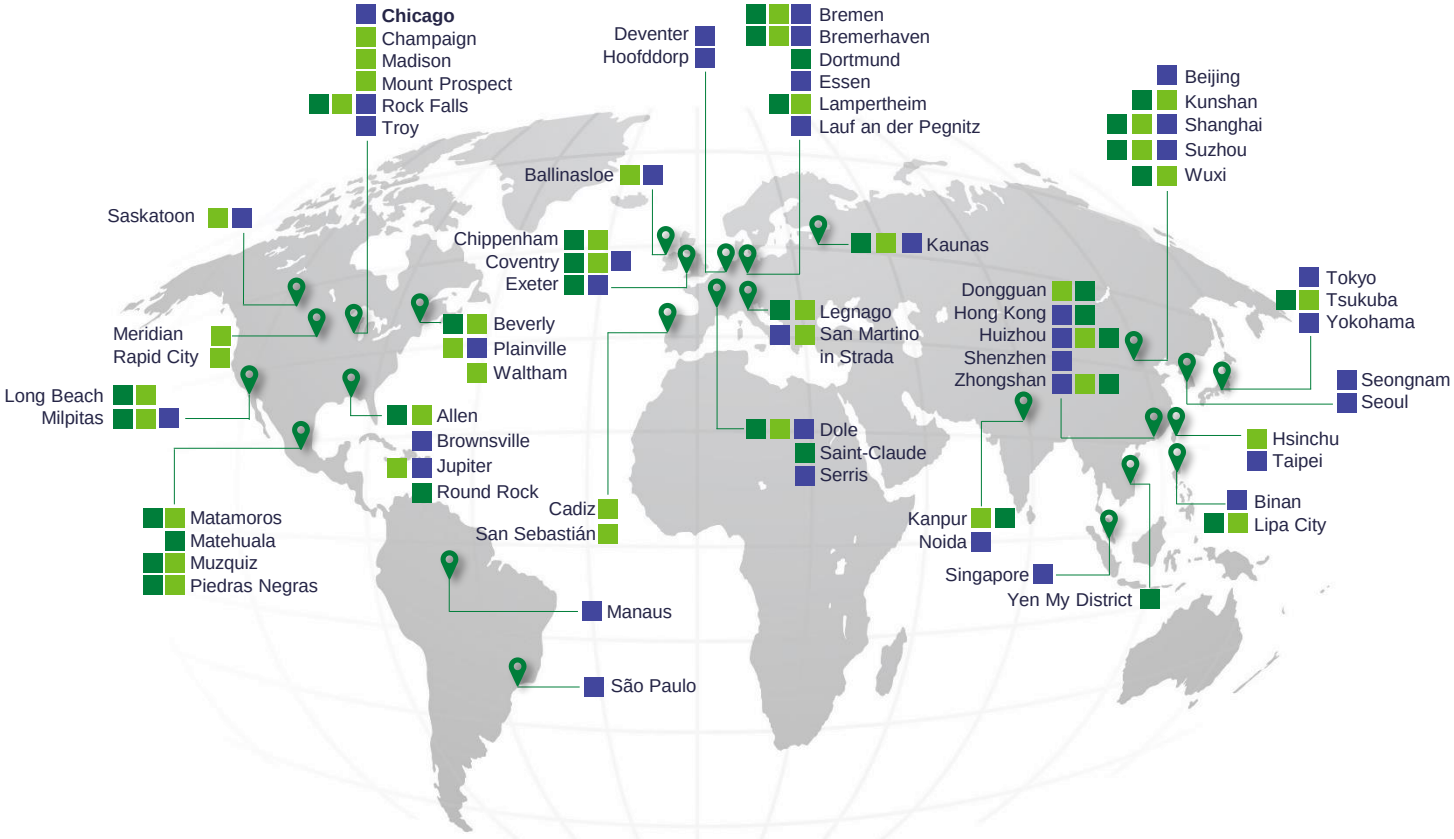
Local resources supporting our global customers



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Partner for tomorrow’s electronic systems

Broad Product Portfolio

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

Testing Capabilities

We help customers get products to market faster, 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 & 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

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

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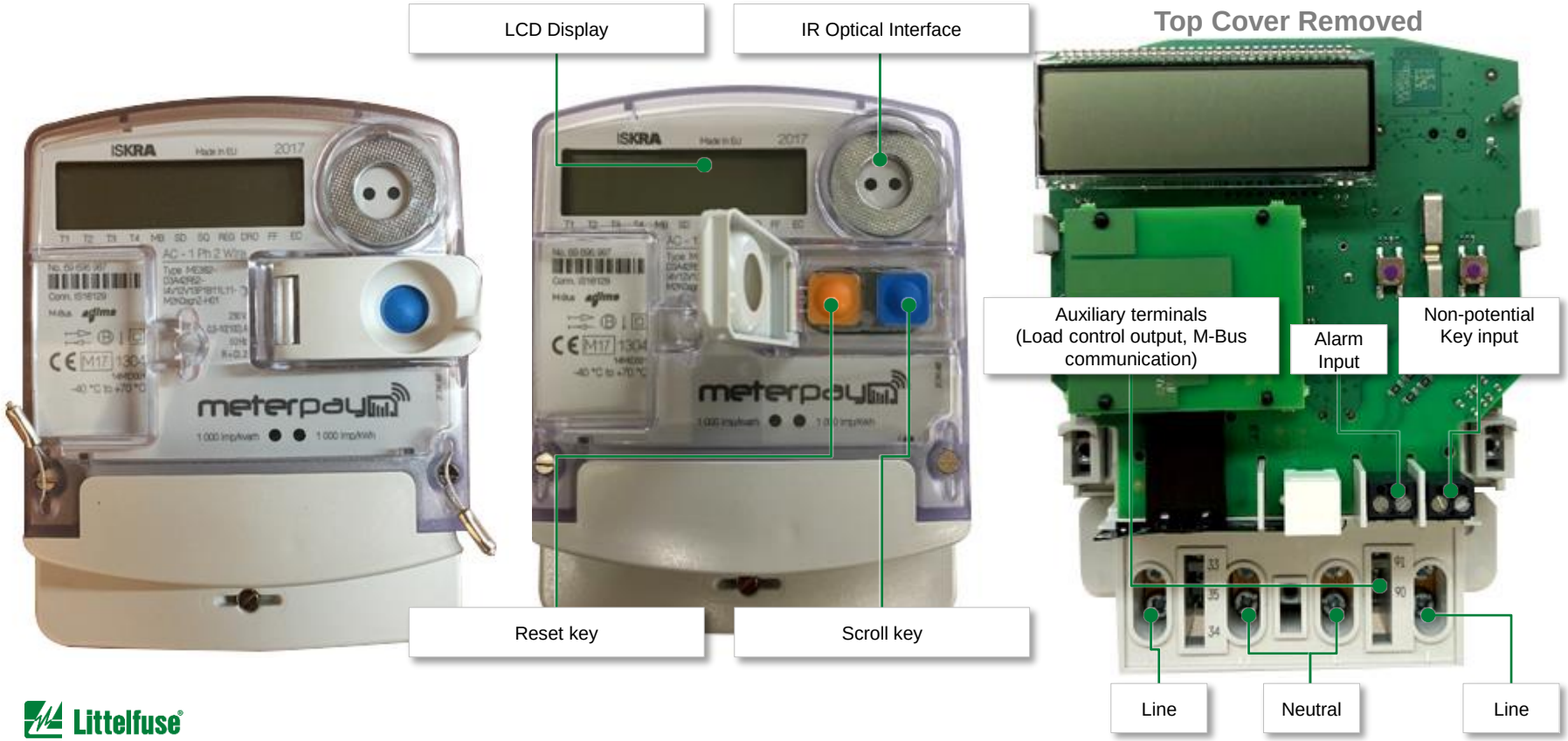
Design wins and teardowns

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, that provides the most reliable data transmission in smart residential and mid-size commercial environments
Specifications	▪ IDIS interoperability ▪ Remote connection/disconnection ▪ Multi-energy management (gas, water, and heat) ▪ Extensive anti-tampering features ▪ Customer port for in-house display (RJ11) ▪ Secure communication with encryption and authentication ▪ Photovoltaic friendly design ▪ Integrated demand/response functions
Manufacturers of similar products	Landis+Gyr, Itron, Elster Group, Sensus, Wasion
Littelfuse-recommended products	MOV – Ultra MOV, CIII, TMOV, SM7, MOSFET – IXFA7N80P, TVS Diode – 1.5KE, SIDACtor – MC, Reed Switch – 59166

ISKRA: 230 Vac single-phase/two-wire

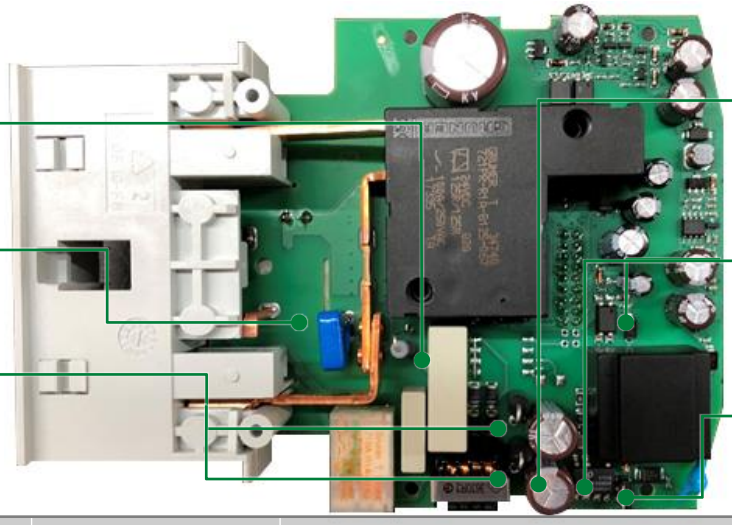


Main board: top side

Primary Capacitor 0.33 µF/275 V
Make: ISKRA

MOV 510 Vrms, 14 mm
LFUS: UltraMOV, C-III, TMOV

TVS Diode 342 Vrms, 1500 W
LFUS: 1.5KE



Smoothening Capacitor
10 µF/450 V

PMIC with integrated 700V MOSFET
Make: Power Integrations

Power MOSFET 800 V, 2.8 Ω
LFUS: IXFA7N80P

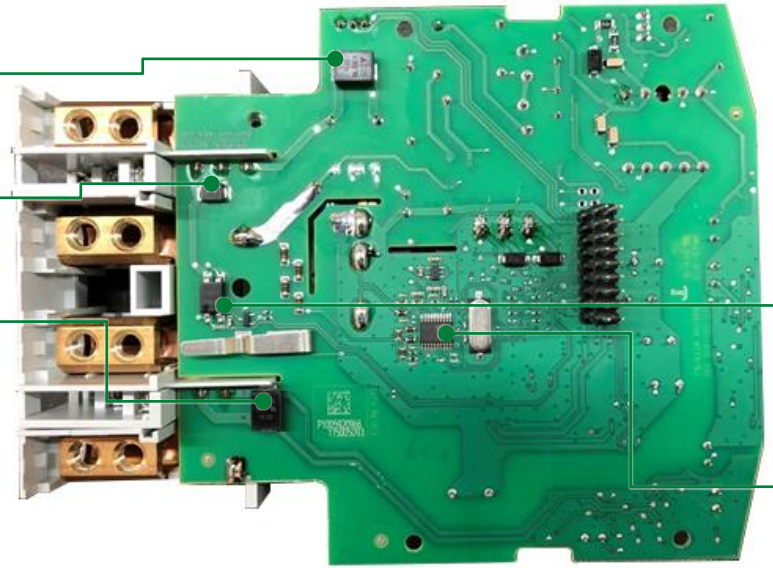
Technology	Function in application	Product series	Benefits	Features
MOV	Protects power unit from voltage transients and lightning	Ultra MOV, CIII, TMOV	Reduces customer qualification time by complying with third-party safety standards such as UL/IEC	High energy absorption capability: 40–530 J (2 ms)
MOSFET	Provides high-frequency load switching	IXFA7N80P	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	1.5KE	Promotes robust operation; fast response time to transients allows for quick arrest of faults and strong protection	Fast response time: typically, less than 1.0 ps 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
LFUS: SM7

Thyristor 350 Vrms, 500 Vbd
LFUS: MC Series

MOV 50 Vrms, 1800 Wmax
LFUS: SM7

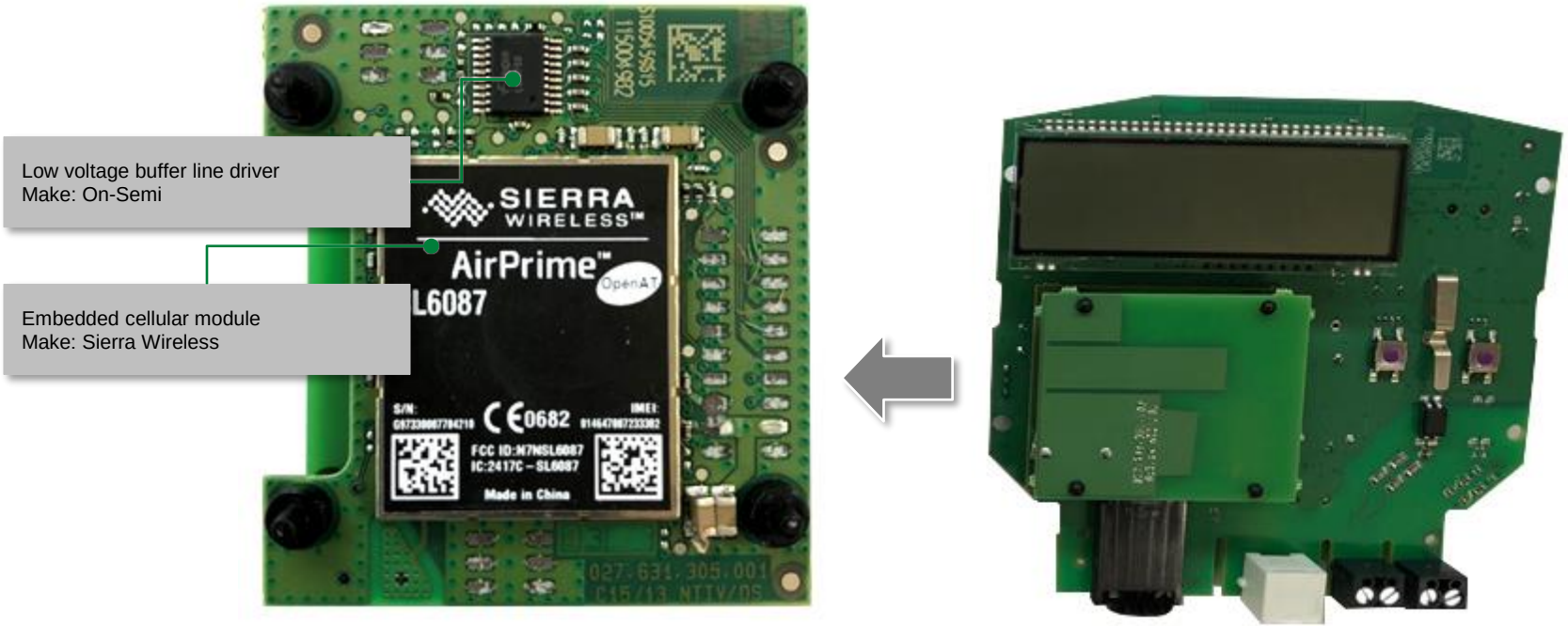


Solid State Relay 400 V, 100 mA
Make: Matsushita

Programmable 1-phase energy metering
Make: ST Microelectronics

Technology	Function in application	Product series	Benefits	Features
MOV	Protects auxiliary I/O from voltage transients due to overload	SM7	Promotes robust operation maintaining high signal integrity; saves board space	Excellent clamping capability; low incremental surge resistance; typical IR less than 1 µa when VBR min >12 V; surface mountable
SIDACtor	Protects sensitive electronic components from damage due to lightning surges	MC	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

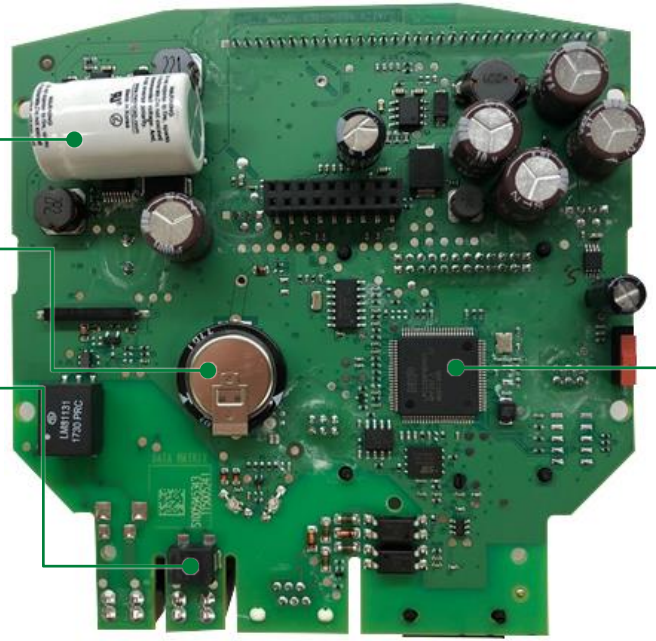


Auxiliary board: bottom side

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

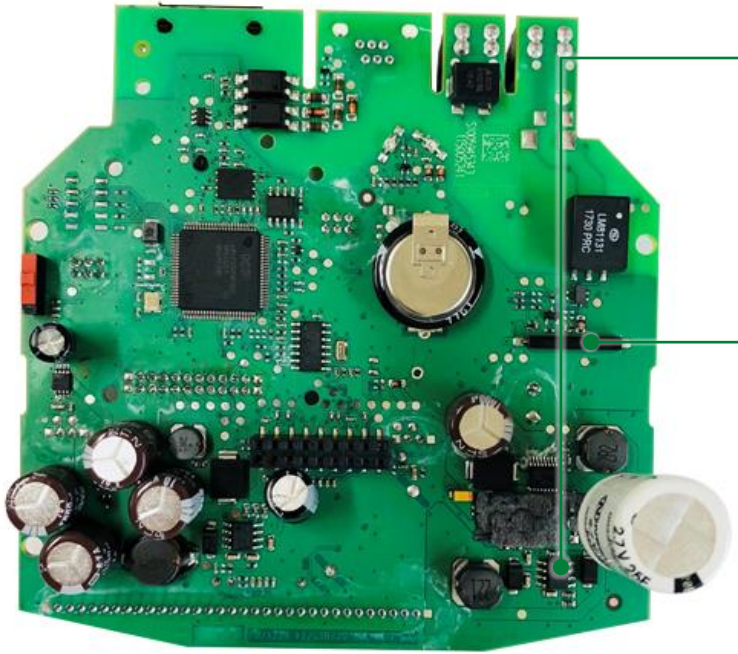
MOV 300 Vrms, 9600 Wmax
LFUS: SM7



Microcontroller
Make: NXP

Technology	Function in application	Product series	Benefits	Features
MOV	Protects auxiliary I/O from voltage transients due to overload	SM7	Promotes robust operation maintaining high signal integrity; saves board space	Excellent clamping capability; low incremental surge resistance; typical IR less than 1 µa when VBR min >12 V; surface mountable

Auxiliary board: bottom side (ultra-cap upright)



Step-up DC-DC converter
Make: MAXIM Integra

Reed Switch
Make: Littelfuse Inc.
LFUS: 59166

Technology	Function in application	Product series	Benefits	Features
Reed Switch	Prevent magnetically induced tampering	59166	Lowest power consumption for longest battery life	Hermetically sealed; magnetically operated contacts

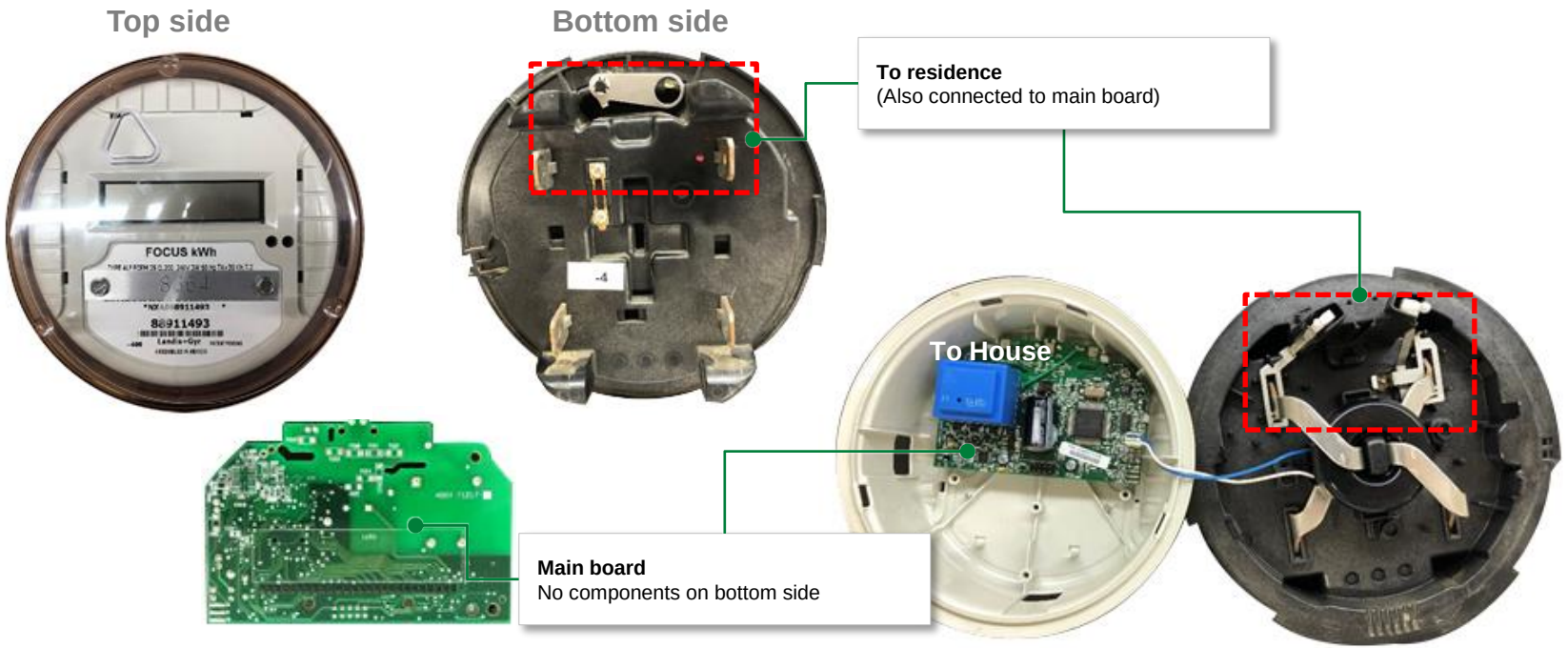
Landis+Gyr

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

Landis+Gyr CL200
Smart Electric Meter

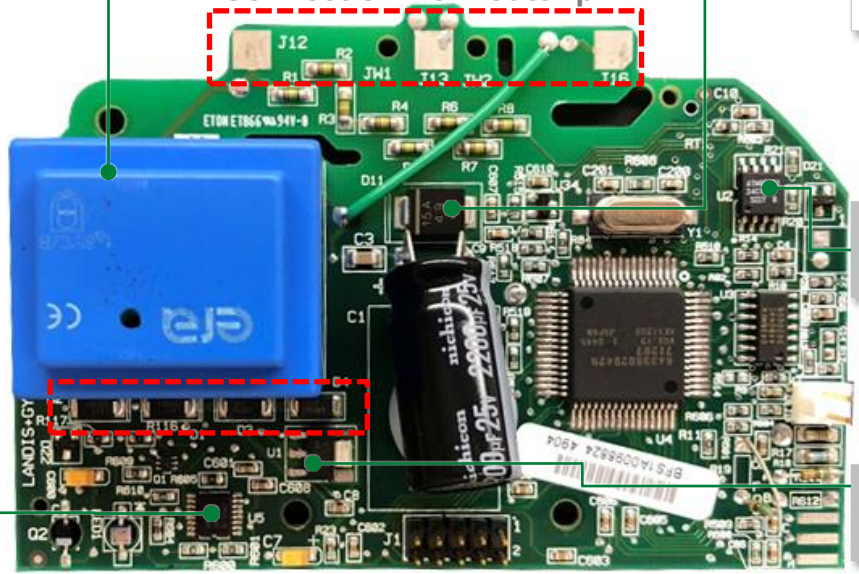
Model number & specification	
Name	Landis+Gyr Smart Electric Meter
Model Number	CL200
Description	A new generation of meters as IoT grid sensors benefitting both utilities and their customers
Specifications	▪ IoT sensing that leverages high-speed 15 kHz waveform data ▪ Real-time intelligence and visibility at the grid edge ▪ Gridstream Connect App OS-enabled sensor ▪ Communications flexibility ▪ Gridstream Connect App OS-ready ▪ Richer harmonics measurement ▪ High-resolution billing system (ready for the future of transactive energy) ▪ 200 A and 320 A remote disconnect ▪ Micro arc sensing at the meter blades ▪ Wi-Fi and internet enabled
Manufacturers of similar products	Itron, Elster Group, Sensus, Wasion, Iskara
Littelfuse-recommended products	TVS Diode – SMCJ

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



Main control board top side

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



TVS Diode, Vwm: 15 V, Vbr: 18.5 V
LFUS: SMCJ

2 Wire Serial EEPROM
Make: Atmel

8-Channel Analog Mux/Demux
Make: TI

0.8 A LDO Regulator
Make: National Semiconductor

Technology	Function in application	Product series	Benefits	Features
TVS Diode	Protects sensitive electronic component from voltage transients	SMCJ	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

Itron

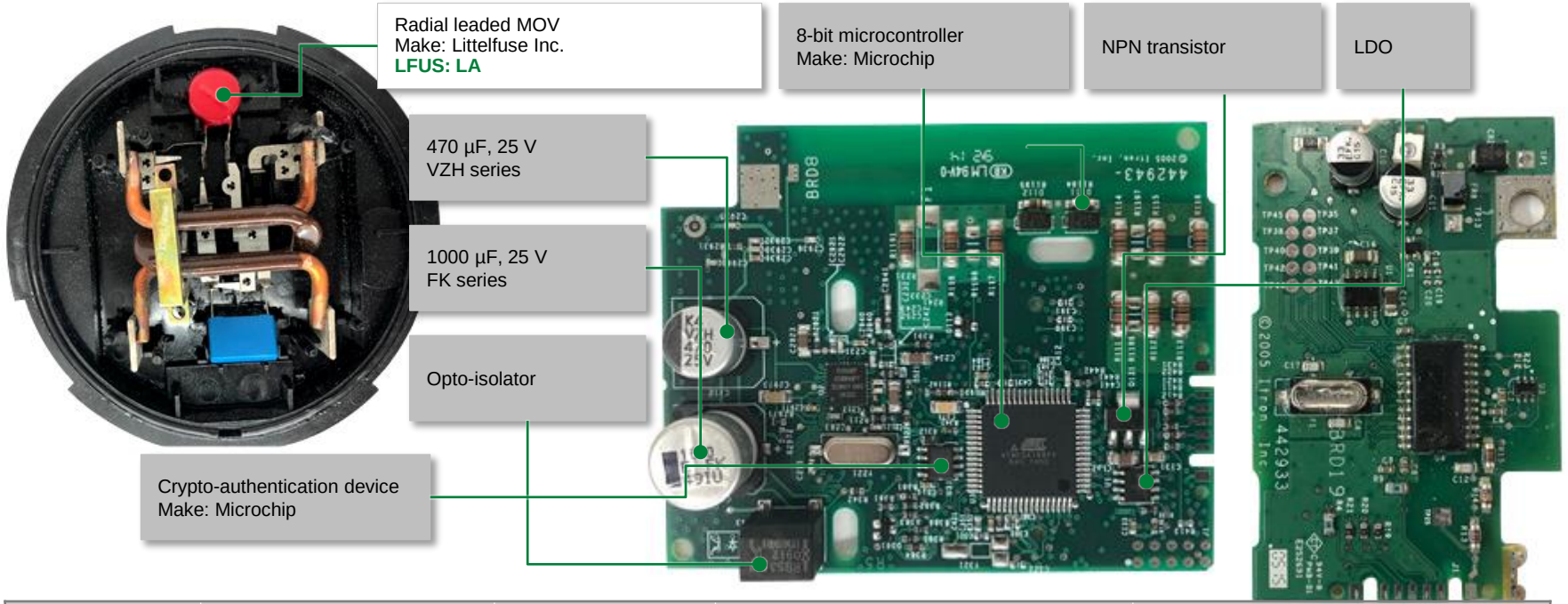
Design wins and teardown: Itron CL200 Smart Electric Meter

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

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	▪ Cord length: 2.5 m ▪ Total height: 1018 mm ▪ Airflow max settings: 412l/s ▪ HEPA filter: 360 Glass ▪ 360° Glass HEPA filter ▪ Intelligent purification ▪ Dual function − Cooling fan in the summer ▪ Air Multiplier™ technology − Amplifies surrounding air, giving an uninterrupted stream of purified airflow ▪ Smooth oscillation − Projects and circulates purified air across the room
Manufacturers of similar products	Landis+Gyr, Elster Group, Sensus, Wasion, Iskara, Siemens, ABB
Littelfuse-recommended products	MOV – LA

Littelfuse
Expertise Applied | Answers Delivered

Key findings: Littelfuse MOV



Technology	Function in application	Product 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)

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