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# Residential Solar Solutions

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Renewable Energy



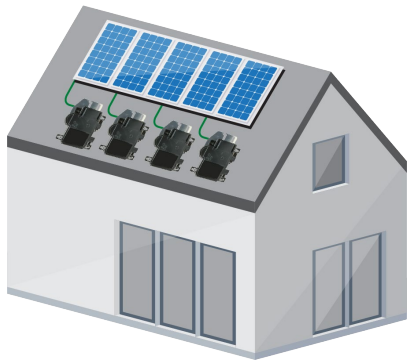
Building Solutions

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# Types of solar inverters for residential applications

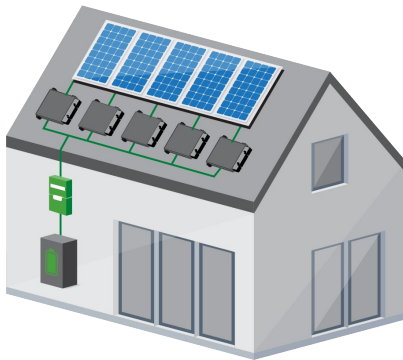
## Micro inverter



### Features

- Panel-level DC to AC conversion
- Single phase; rated up to 300 W range; output voltage 110–230 V
- Power output of each panel is optimized independently
- Easily expandable systems to meet future needs
- Battery back-up AC coupled

## Power optimizer + string inverter



### Features

- Centralized DC to AC conversion
- Rated up to 300 W range; output voltage 50 VDC (per panel)
- Power output of each panel is optimized independently
- Provide both system- and panel-level monitoring
- Battery back-up can be high-voltage DC coupled

## String inverter



### Features

- Centralized DC to AC conversion
- Rated 1 kW–10 kW; output voltage: single-phase 230 V and three-phase 400 V
- Easier system maintenance with no electronics on the roof
- Known for their availability and reliability
- Battery back-up can be high-voltage DC coupled

# Residential solar inverter market is growing at CAGR of 11%

## Market trends and drivers

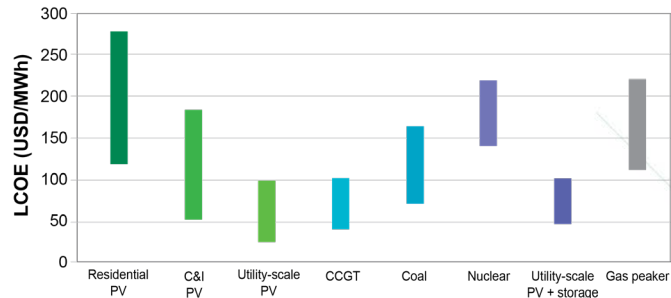
Both the rooftop and utility-scale segments experienced strong growth in 2022. The energy crisis played a role, and the reaction from citizens was immediate: the rooftop market increased by 50% in 2022, with installations reaching 118 GW from 79 GW the year before.

The impressive growth of the rooftop segment was seen across the world in 2022 - Brazil added an additional 5.3 GW, Italy 127%, Spain 105%, and China 51.1 GW (54% of it's 2022 installations.)

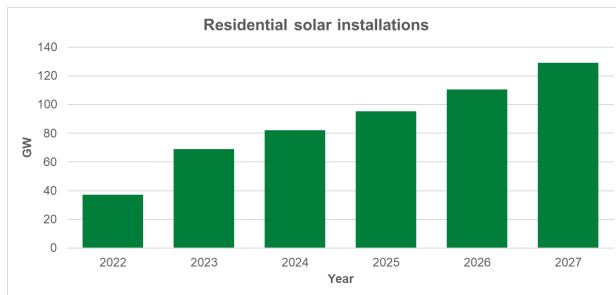
In 2023, the rooftop segment is expected to further increase to 159 GW, a 35% growth from 2022. We expect a slight slowdown in the growth rate of the rooftop segment in the following years, as energy prices are expected to return to lower levels. The annual installed rooftop capacity is forecasted to increase to 183 GW in 2024 and up to 268 GW in 2027.

Solar panels are becoming integral building materials, and smart cities are embracing small-scale distributed solar panels combined with storage and digital solutions.

## Solar electricity generation cost in comparison with conventional power sources 2023



## Residential solar inverter is fastest growing segment in the solar PV market



Source:

1. [Residential Solar PV Inverter Market](#)
2. [PV Inverter Market Size](#)

3. [Iea.org](#)
4. [Global Market Outlook 2023-2027](#)

# Littelfuse recommended solutions for residential solar inverters

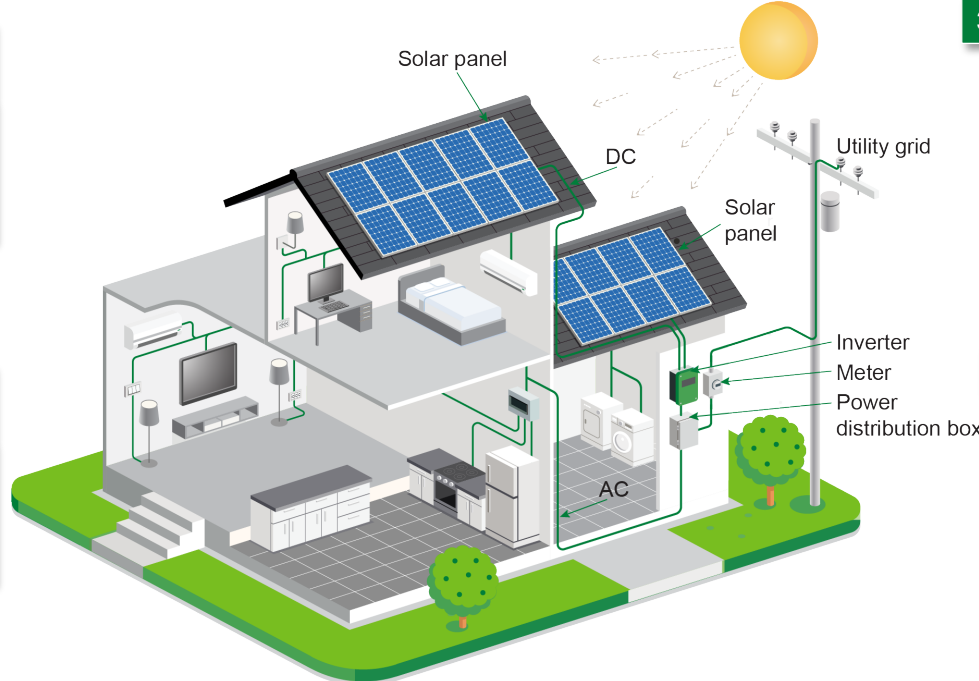
**1**

**Input protection**  
Fuse, MOV, GDT, NTC



**2**

**Power conversion**  
MOSFET, IGBT, Power Module, Schottky Diode, Gate Driver



**3**

**Output protection**  
Fuse, Fuseholder, MOV, SPD, TVS Diode



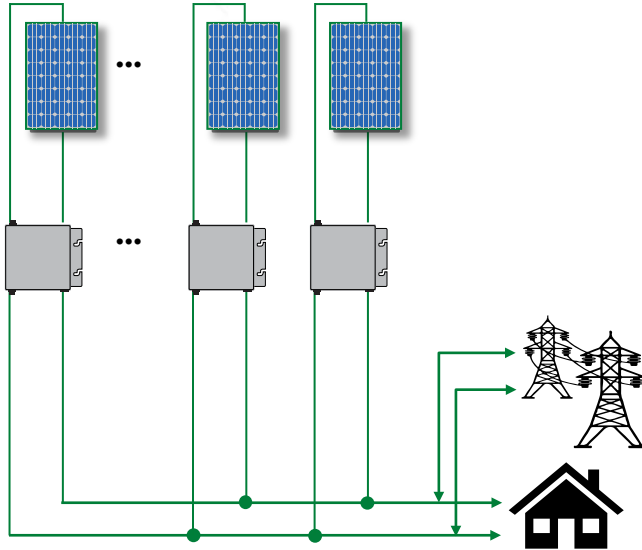
**4**

**Communication and user interface**  
TVS Diode Array, MLV, Switch

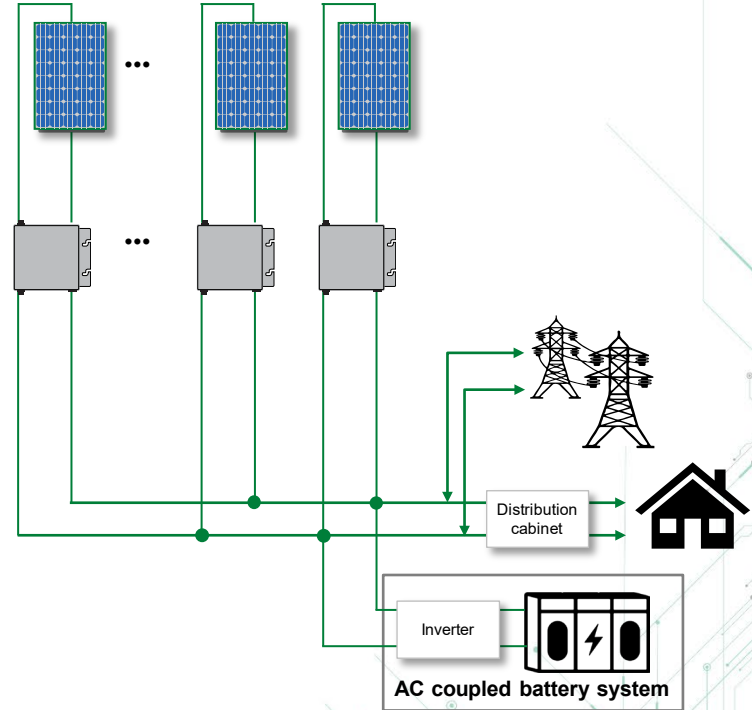


# Microinverter topologies

## Microinverter

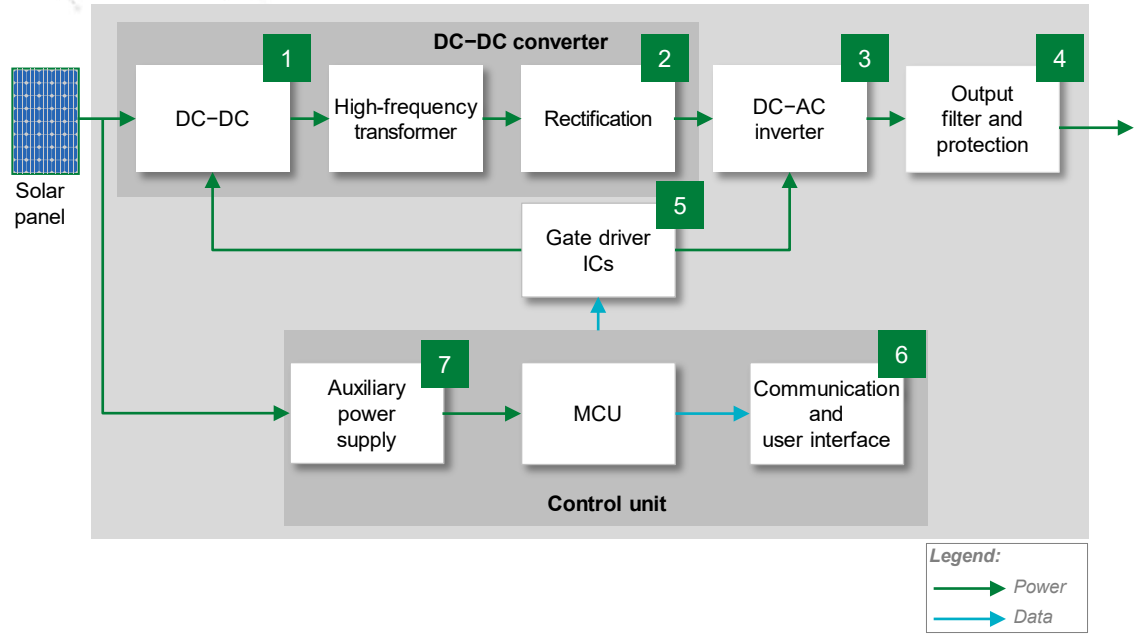


## Microinverter + Energy Storage System



Click the product series in the table below for more information

# Microinverter block diagram



	Technology	Product series
1	MOSFET	<a href="#">Trench Gate Gen2, X4-Class</a>
	TVS Diode	<a href="#">SMCJ, SMDJ</a>
	NTC	<a href="#">RA, RB, KR</a>
2	SiC Schottky Diode	<a href="#">650V Diodes</a>
3	MOSFET or IGBT	<a href="#">Ultra-junction X2, X4-Class</a>
	TVS Diode	<a href="#">650 V Trench SMBJ</a>
4	MOV	<a href="#">TMOV, UltraMOV, LA</a>
	GDT	<a href="#">CG3/CG4</a>
	Fuse	<a href="#">215, 369</a>
5	Gate Driver	<a href="#">IXD 6xxSI</a>
	TVS Diode	<a href="#">SMBJ</a>
6	TVS Diode Array	<a href="#">SP712, SP2555NUTG</a>
7	MOSFET	<a href="#">650V X2-Class, 650V X3-Class</a>





Click the product series in the table below for more information

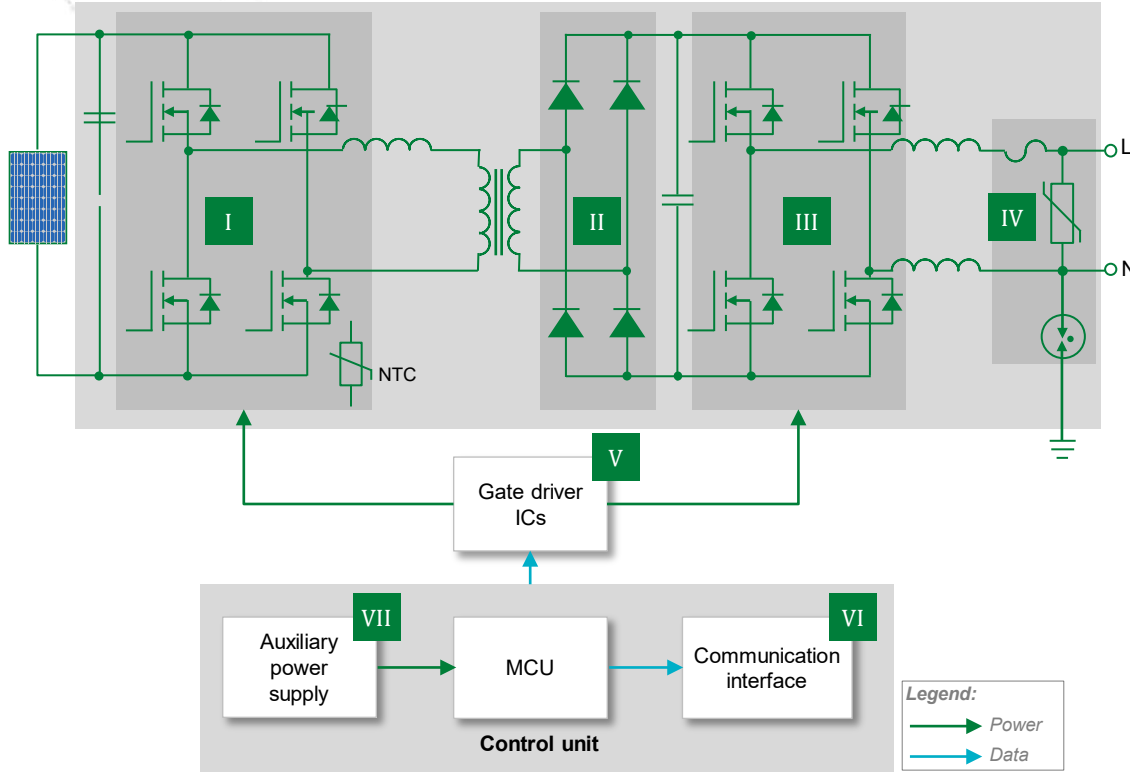
# Recommended Littelfuse products for microinverters

	Technology	Function in application	Series	Benefits	Features
1	MOSFET	High-frequency switching	<a href="#">Trench Gate Gen2, X4-Class</a>	High power density; easy to mount; space-saving	Ultra low on-resistance $R_{DS}$ ; high current handling capability; fast body diode
	TVS Diode	Protects MOSFET from voltage transients	<a href="#">SMCJ, SMDJ</a>	Enables compact design; improves system reliability	3000 W $P_{PPM}$ capability; low profile package
	NTC	High temperature detection due to high sunlight, power component failure, etc.	<a href="#">RA, RB, KR</a>	Provides safe operation of PV panels; smaller footprint saves space	Surface mountable; small form factor
2	SiC Schottky Diodes	Used for rectification	<a href="#">650V Diodes</a>	Reduces switching losses; increases system efficiency, reliability, and thermal management	High surge capability; negligible reverse recovery current; $T_J = 175\text{ }^\circ\text{C}$
3	MOSFET or IGBT	Convert DC voltage from PV panel to AC line voltage	<a href="#">Ultra-junction X2, X4-Class</a> <a href="#">650 V Trench</a>	High efficiency; high power density; easy to mount Reduced thermal resistance; low energy losses; fast switching	Ultra low on-resistance $R_{DS(ON)}$ and gate charge $Q_g$ ; low package inductance; dv/dt ruggedness Low $V_{sat}$ , low $E_{on}/E_{off}$ , high surge current capability; positive thermal co-efficient of $V_{CE(sat)}$
	TVS Diode	Protects IGBTs from transient overload event	<a href="#">SMBJ</a>	Enables compact design; improves system reliability	600 W peak pulse power capability; excellent clamping capability; small footprint
4	MOV	Protects power unit from voltage transients and lightning	<a href="#">TMOV, UltraMOV, LA</a>	Reduces customer qualification time by complying with third-party safety standards	High energy absorption capability: 40–530 J (2 ms)
	GDT	Protects from voltage transients and lightning	<a href="#">CG3/CG4</a>	Small form-factor allows compact system design; enables product to comply with IEC/UL standards	High energy absorption capability; small form-factor; low leakage current
	Fuse	Protects from overcurrent events	<a href="#">215, 369</a>	Reduces customer qualification time by complying with third-party safety standards	High breaking capacity; meets the IEC 60127-2
5	Gate Driver	Controls the switching MOSFETs	<a href="#">IXD 6xxSI</a>	Dual outputs provide space-efficient design; high immunity to latch-up; rise/fall times <10 ns	Tight tolerance; small form factor; fast thermal response
	TVS Diode	Protects gate driver from transient overload event	<a href="#">SMBJ</a>	Enables compact design; improves system reliability	600 W peak pulse power capability; excellent clamping capability; small footprint
6	TVS Diode Array	Protects data lines from ESD/EFT and surge events	<a href="#">SP712, SP2555NUTG</a>	Minimizes signal distortion; reduces voltage over-shoot, and simplified PCB design	Low capacitance of 2.5 pF; low leakage current of 0.1 $\mu\text{A}$ ; small form factor
7	MOSFET	High-frequency switching	<a href="#">650V X2-Class, 650V X3-Class</a>	High power density; easy to mount; space-saving	Ultra-low on-resistance $R_{DS}$ ; high current handling capability; fast body diode



Click the product series in the table below for more information

# Typical schematic of a microinverter

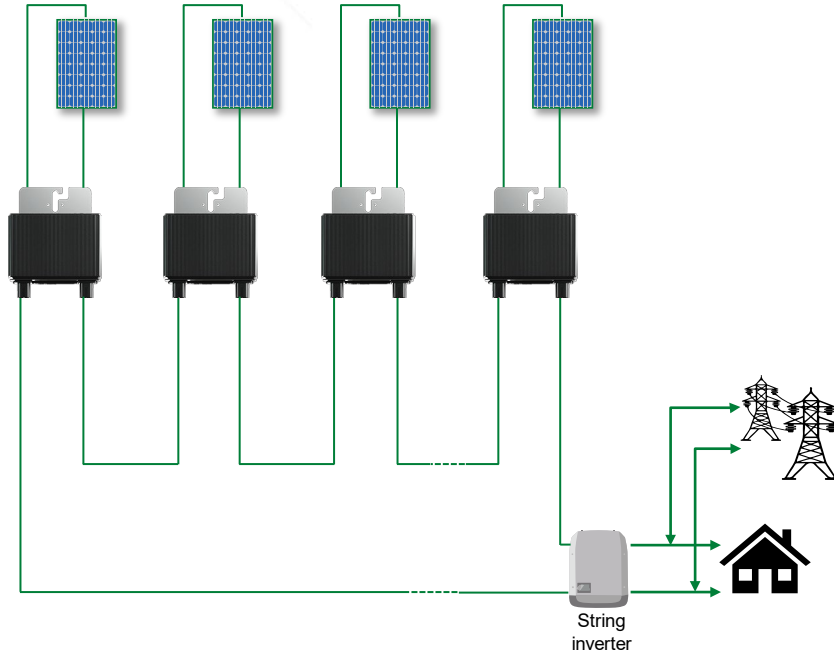


	Technology	Product series
I	MOSFET	<a href="#">Trench Gate Gen2, X4-Class</a>
	TVS Diode	<a href="#">SMCJ, SMDJ</a>
	NTC	<a href="#">RA, RB, KR</a>
II	SiC Schottky Diode	<a href="#">650V Diodes</a>
III	MOSFET or IGBT	<a href="#">Ultra-junction X2, X4-Class</a> <a href="#">650 V Trench</a>
	TVS Diode	<a href="#">SMBJ</a>
IV	MOV	<a href="#">TMOV, UltraMOV, LA</a>
	GDT	<a href="#">CG3/CG4</a>
V	Fuse	<a href="#">215, 369</a>
	Gate Driver	<a href="#">IXD_6xxSI</a>
VI	TVS Diode Array	<a href="#">SP712</a> <a href="#">SP2555NUTG</a>
VII	MOSFET	<a href="#">650V X2-Class, 650V X3-Class</a>

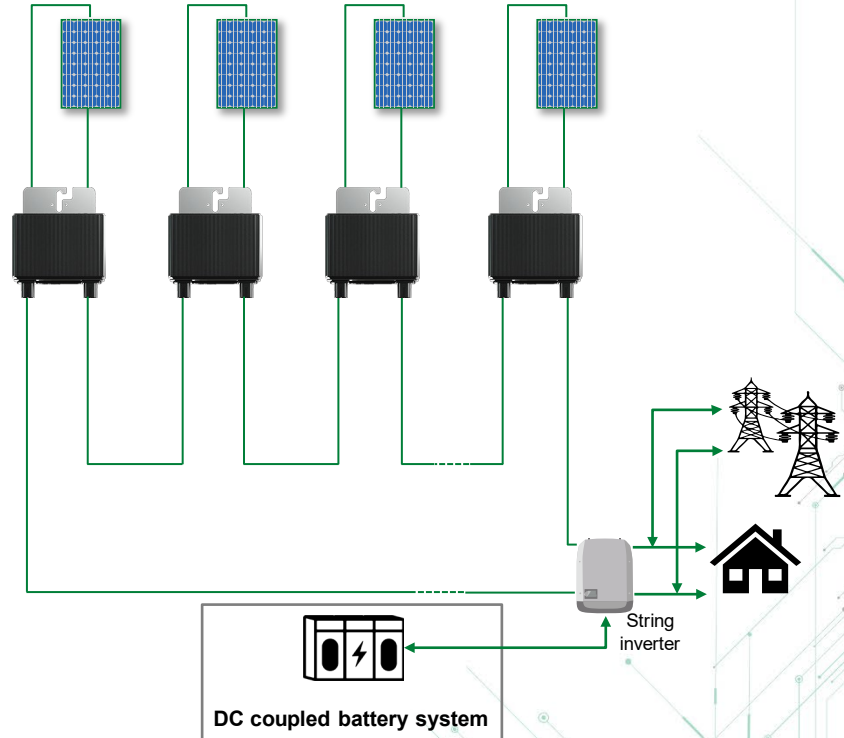
# Power optimizer topologies

*(Power optimizers may not be included in all string inverter-based PV systems)*

Power optimizers



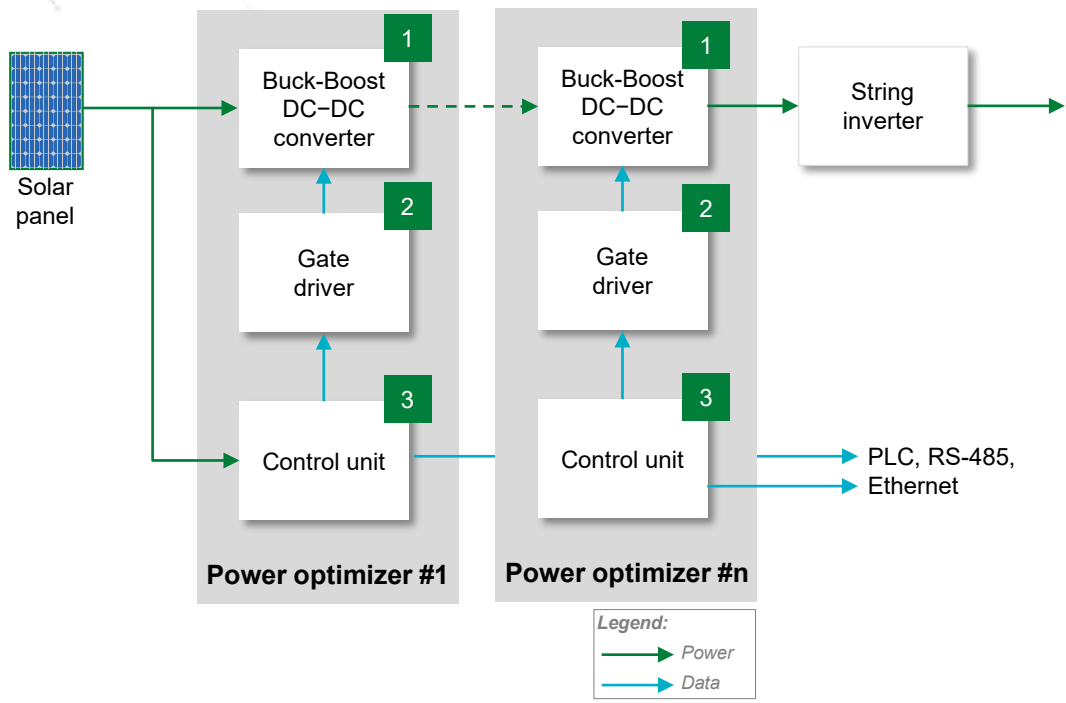
Power optimizers + DC coupled Energy Storage System (ESS)





Click the product series in the table below for more information

# Power optimizer block diagram



	Technology	Product series
1	MOSFET	<a href="#">Trench Gate Gen2, X4-Class</a>
	TVS Diode	<a href="#">SMCJ, SMDJ, 1.5SMC</a>
	NTC	<a href="#">RA, RB, KR</a>
2	Gate Driver	<a href="#">IXD_6xxSI</a>
	TVS Diode	<a href="#">SMBJ</a>
3	TVS Diode Array	<a href="#">SP712, SP2555NUTG, SM712, SP3130</a>



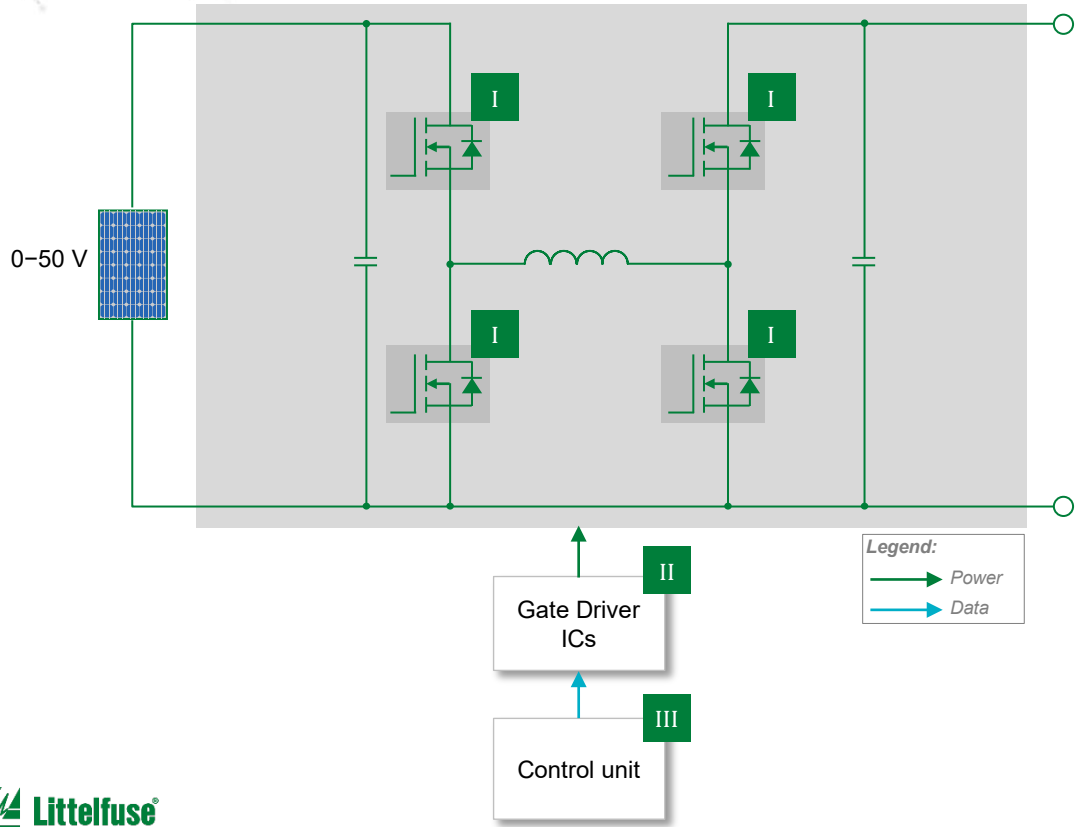
Click the product series in the table below for more information

# Recommended Littelfuse products for power optimizers

	Technology	Function in application	Series	Benefits	Features
1	MOSFET	High-frequency switching	<a href="#">Trench Gate Gen2, X4-Class</a>	High power density; easy to mount; space-saving	Ultra-low on-resistance RDS; high current handling capability; fast body diode
	TVS Diode	Protects MOSFET from voltage transients	<a href="#">SMCJ, SMDJ, 1.5SMC</a>	Enables compact design; improves system reliability	3000 W P <sub>PPM</sub> capability; low-profile package
	NTC	High temperature detection due to high sunlight, power component failure, etc.	<a href="#">RA, RB, KR</a>	Provides safer operation of PV panels; smaller footprint saves space	Surface mountable; small form factor
2	Gate Driver	Controls the switching MOSFETs	<a href="#">IXD_6xxSI</a>	Dual outputs provide space-efficient design; high immunity to latch-up; rise/fall times <10 ns	Tight tolerance; small form factor; fast thermal response
	TVS Diode	Protects gate driver from transient overload event	<a href="#">SMBJ</a>	Enables compact design; improves system reliability	600 W peak pulse power capability; excellent clamping capability; small footprint
3	TVS Diode Array	Protects against ESD and EFT	<a href="#">SP712, SP2555NUTG, SM712, SP3130</a>	Smaller form factor and multi-line protection enables ease of design	Low capacitance of 1.0 pF per I/O

Click the product series in the table below for more information

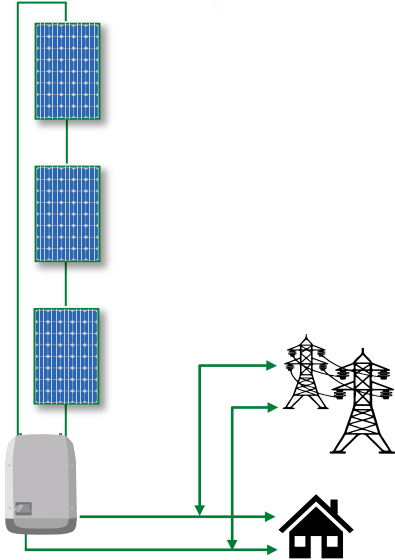
# Typical schematic of a power optimizer



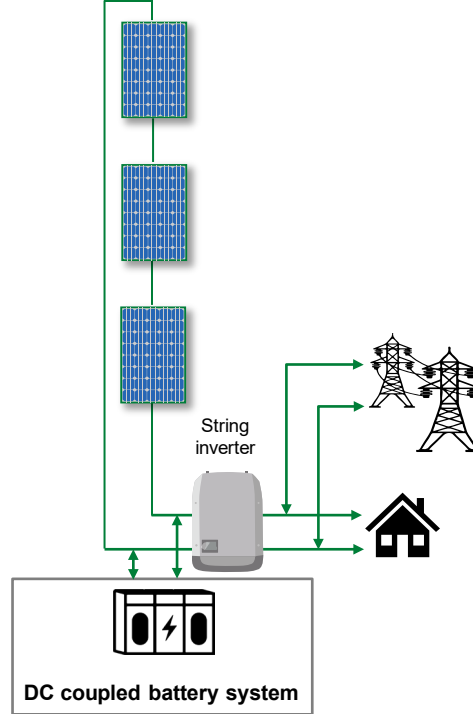
	Technology	Product series
I	MOSFET	<a href="#">Trench Gate Gen2, X4-Class</a>
	TVS Diode	<a href="#">SMCJ</a> , <a href="#">SMDJ</a> , <a href="#">1.5SMC</a>
	NTC	<a href="#">RA</a> , <a href="#">RB</a> , <a href="#">KR</a>
II	Gate Driver	<a href="#">IXD_6xxSI</a>
	TVS Diode	<a href="#">SMBJ</a>
III	TVS Diode Array	<a href="#">SP712</a> , <a href="#">SP2555NUTG</a> , <a href="#">SM712</a> , <a href="#">SP3130</a>

# String inverter topologies

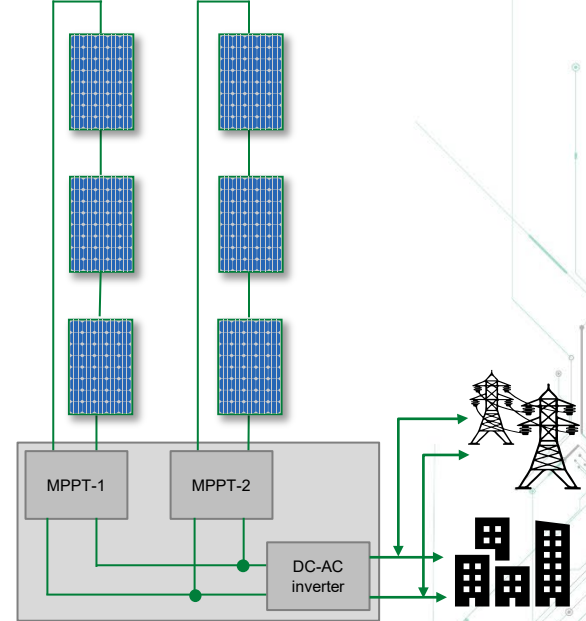
String inverter



String inverter + DC coupled ESS

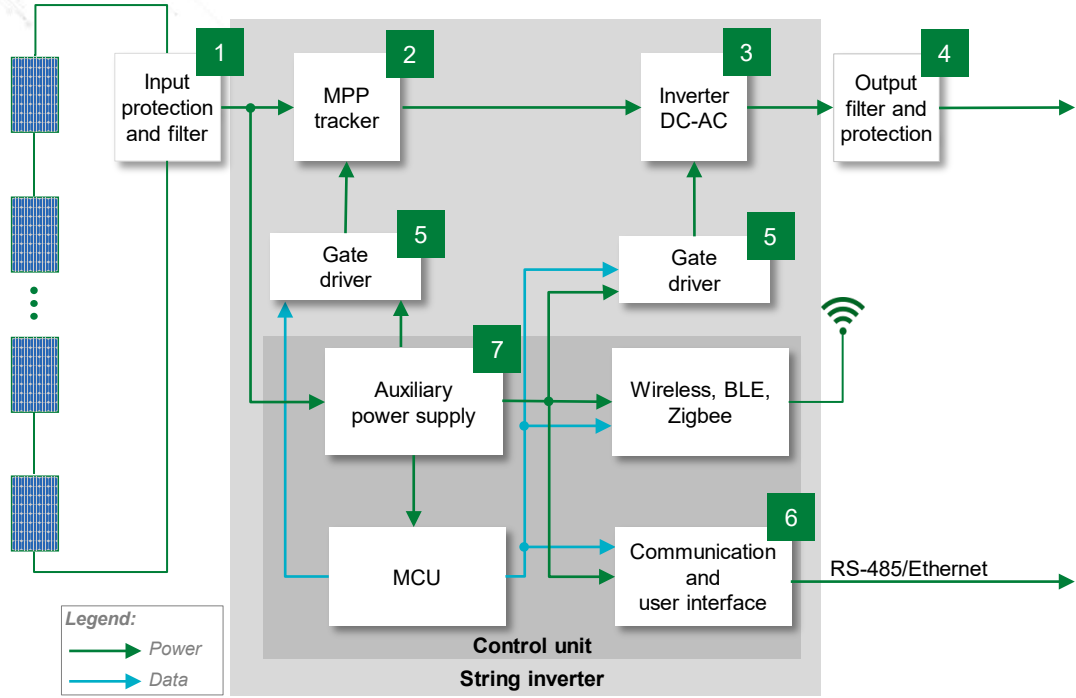


Multi-string inverter



Click the product series in the table below for more information

# String inverter block diagram



	Technology	Product series
1	MOV	<a href="#">UltraMOV, LA, SM20</a>
	MOSFET	<a href="#">650V X2-Class, 650V X3-Class</a>
2	TVS Diode	<a href="#">SMCJ, SMDJ</a>
	SiC Schottky Diode	<a href="#">650V Diodes</a>
3	NTC	<a href="#">RA, RB, KR</a>
	MOSFET or IGBT	<a href="#">650V X2-Class, 650V X3-Class</a> <a href="#">650 V Trench</a>
	TVS Diode	<a href="#">SMBJ</a>
4	MOV	<a href="#">TMOV, UltraMOV, LA</a>
	GDT	<a href="#">CG3/CG4</a>
5	Fuse	<a href="#">Class J, Class RK5, KLKD</a>
	Gate Driver	<a href="#">IXD_6xxSI, IX4351NE</a>
6	TVS Diode	<a href="#">SMBJ</a>
	TVS Diode Array	<a href="#">SP712, SM712</a> <a href="#">SP2555NUTG</a>
	Switch	<a href="#">7000, KSC, ES, KSR</a>
7	MOSFET	<a href="#">650V X2-Class, 650V X3-Class</a>



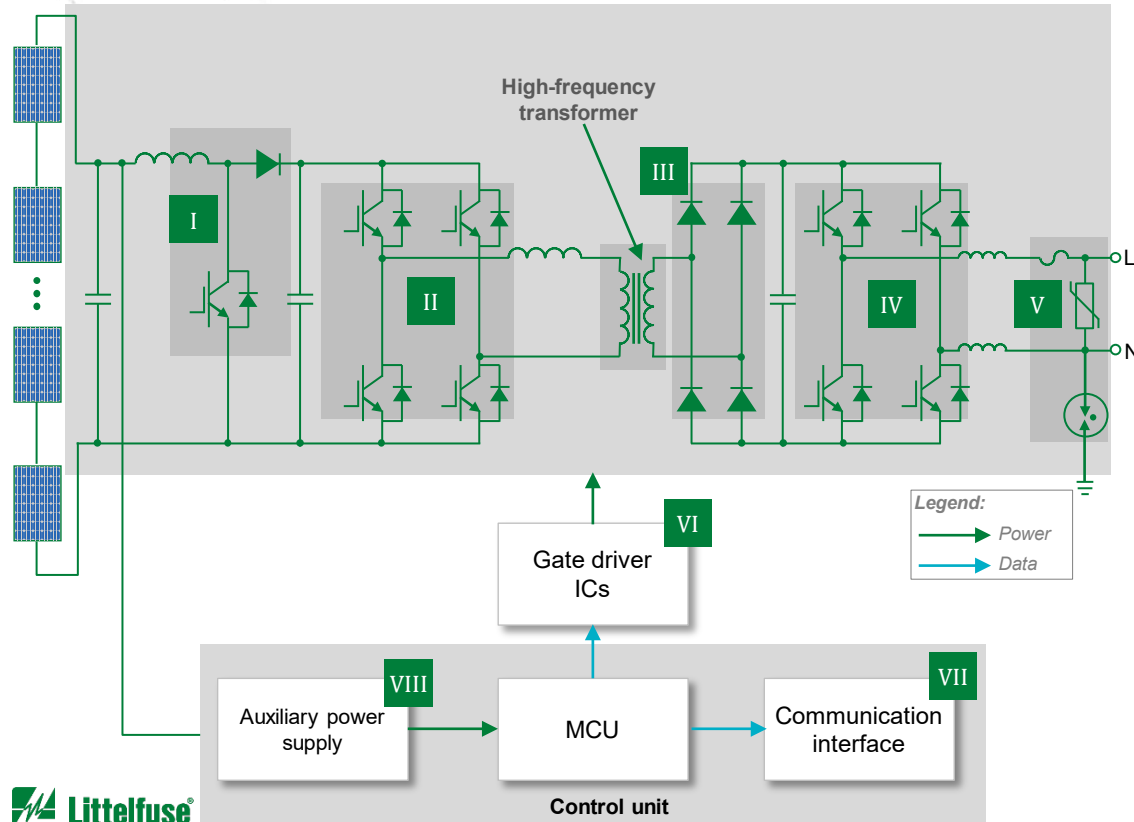


Click the product series in the table below for more information

# Recommended Littelfuse products for string inverters

	Technology	Function in application	Series	Benefits	Features
1	MOV	Protects from voltage transients and lightning surges	<a href="#">UltraMOV, LA, SM20</a>	Reduces customer qualification time by complying with third-party safety standards	High energy absorption capability: 40–530 J (2 ms)
	MOSFET	High-frequency switching	<a href="#">650V X2-Class, 650V X3-Class</a>	High power density; easy to mount; space-saving	Ultra-low on-resistance R <sub>DS</sub> ; high current handling capability; fast body diode
2	TVS Diode	Protects MOSFET from voltage transients	<a href="#">SMCJ, SMDJ</a>	Enables compact design; improves system reliability	3000 W P <sub>PPM</sub> capability; low profile package
	SiC Schottky Diode	Used for rectification	<a href="#">650V Diodes</a>	Reduces switching losses; increases system efficiency, reliability, and thermal management	High surge capability; negligible reverse recovery current; T <sub>J</sub> = 175 °C
3	NTC	High temperature detection due to high sunlight, power component failure, etc.	<a href="#">RA, RB, KR</a>	Provides safe operation of PV panels; smaller footprint saves space	Surface mountable; small form factor
	MOSFET or IGBT	Converts DC voltage from PV panel to AC line voltage	<a href="#">650V X2-Class, 650V X3-Class</a> <a href="#">650 V Trench</a>	High efficiency; high power density; easy to mount Reduces thermal resistance; low energy losses; fast switching	Ultra low on-resistance R <sub>DS(ON)</sub> and gate charge Q <sub>g</sub> ; low package inductance; dv/dt ruggedness Low V <sub>sat</sub> , low E <sub>on</sub> /E <sub>off</sub> , high surge current capability; positive thermal coefficient of V <sub>CE(sat)</sub>
	TVS Diode	Protects IGBTs from transient overload event	<a href="#">SMBJ</a>	Enables compact design; improves system reliability	600 W peak pulse power capability; excellent clamping capability; small footprint
4	MOV	Protects power lines from voltage transients and lightning surges	<a href="#">TMOV, UltraMOV, LA</a>	Reduces customer qualification time by complying with third-party safety standards	High energy absorption capability: 40–530 J (2 ms)
	GDT	Protects from voltage transients and lightning	<a href="#">CG3/CG4</a>	Small form-factor allows for compact system design; enables product to comply with IEC/UL standards	High energy absorption capability; small form-factor; low leakage current
	Fuse	Protects from overcurrent events	<a href="#">Class J, Class RK5, KLKD</a>	Reduces customer qualification time by complying with third-party safety standards	High breaking capacity; meets the IEC 60127-2
5	Gate Driver	Controls the switching MOSFETs	<a href="#">IXD_6xxSI, IX4351NE</a>	Dual outputs provide space-efficient design; high immunity to latch-up; rise/fall times less than 10 ns	Tight tolerance; small form factor; fast thermal response
	TVS Diode	Protects gate driver from transient overload event	<a href="#">SMBJ</a>	Enables compact design; improves system reliability	600 W peak pulse power capability; excellent clamping capability; small footprint
6	TVS Diode Array	Protects data lines from ESD/EFT and surge events	<a href="#">SP712, SM712, SP2555NUTG</a>	Minimizes signal distortion; reduces voltage over-shoot; simplified PCB design	Low capacitance of 2.5 pF; low leakage current of 0.1 μA; small form factor
	Switch	On/Off/Reset switch	<a href="#">7000, KSC, ES, KSR</a>	Micro miniature; long life; low voltage; low power and performance; low voltage leakage	IP 67 sealing; Au plating; operation temps to 125 °C; low contact resistance
7	MOSFET	Power conversion	<a href="#">650V X2-Class, 650V X3-Class</a>	High power density; easy to mount; space-saving	Ultra-low on-resistance R <sub>DS</sub> ; high current handling capability; fast body diode

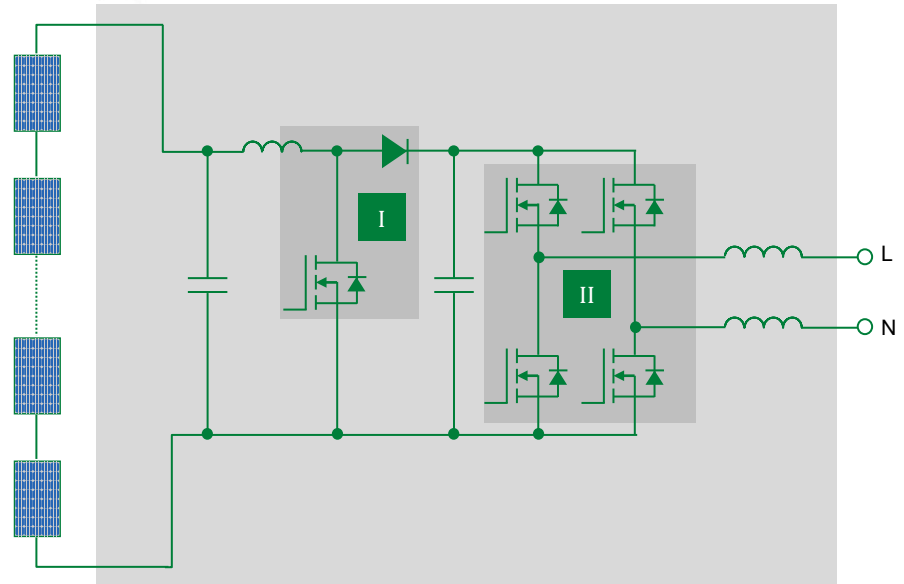
# String inverter using high-frequency transformer



	Technology	Product series
I	MOSFET	<a href="#">X2-Class</a> , <a href="#">X3-Class</a>
	SiC Schottky Diode	<a href="#">650V Diodes</a>
	NTC	<a href="#">RA</a> , <a href="#">RB</a> , <a href="#">KR</a>
II	MOSFET or IGBT	<a href="#">X2-Class</a> , <a href="#">X3-Class</a>
		<a href="#">650 V Trench</a>
III	SiC Schottky Diode	<a href="#">650V Diodes</a>
IV	MOSFET or IGBT	<a href="#">X2-Class</a> , <a href="#">X3-Class</a>
		<a href="#">650 V Trench</a>
V	MOV	<a href="#">TMOV</a> , <a href="#">UltraMOV</a> , <a href="#">LA</a>
	GDT	<a href="#">CG3/CG4</a>
	Fuse	<a href="#">Class J</a> , <a href="#">Class RK5</a> , <a href="#">KLKD</a>
VI	Gate Driver	<a href="#">IXD_6xxSI</a> , <a href="#">IX4351NE</a>
	TVS Diode	<a href="#">SMBJ</a>
VII	TVS Diode Array	<a href="#">SP3130</a> , <a href="#">SP712</a> , <a href="#">SM712</a>
		<a href="#">SP2555NUTG</a>
VIII	Switch	<a href="#">7000</a> , <a href="#">KSC</a> , <a href="#">ES</a> , <a href="#">KSR</a>
		MOSFET

# Transformerless topology for string inverters—Full bridge + MPPT (Boost)

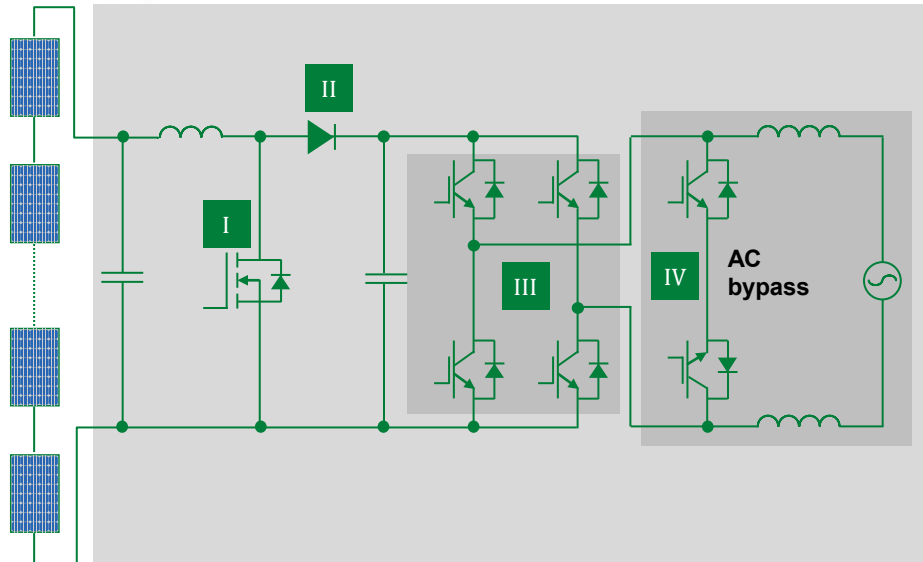
Click the product series in the table below for more information



	Technology	Product series
I	MOSFET	<a href="#">650V X2-Class</a> , <a href="#">650V X3-Class</a>
	SiC Schottky Diode	<a href="#">650V Diodes</a>
	NTC	<a href="#">RA</a> , <a href="#">RB</a> , <a href="#">KR</a>
II	MOSFET or IGBT	<a href="#">650V X2-Class</a> , <a href="#">650V X3-Class</a>
		<a href="#">650 V Trench</a>

# Transformerless topology for string inverters—HERIC Topology + Boost (MPPT)

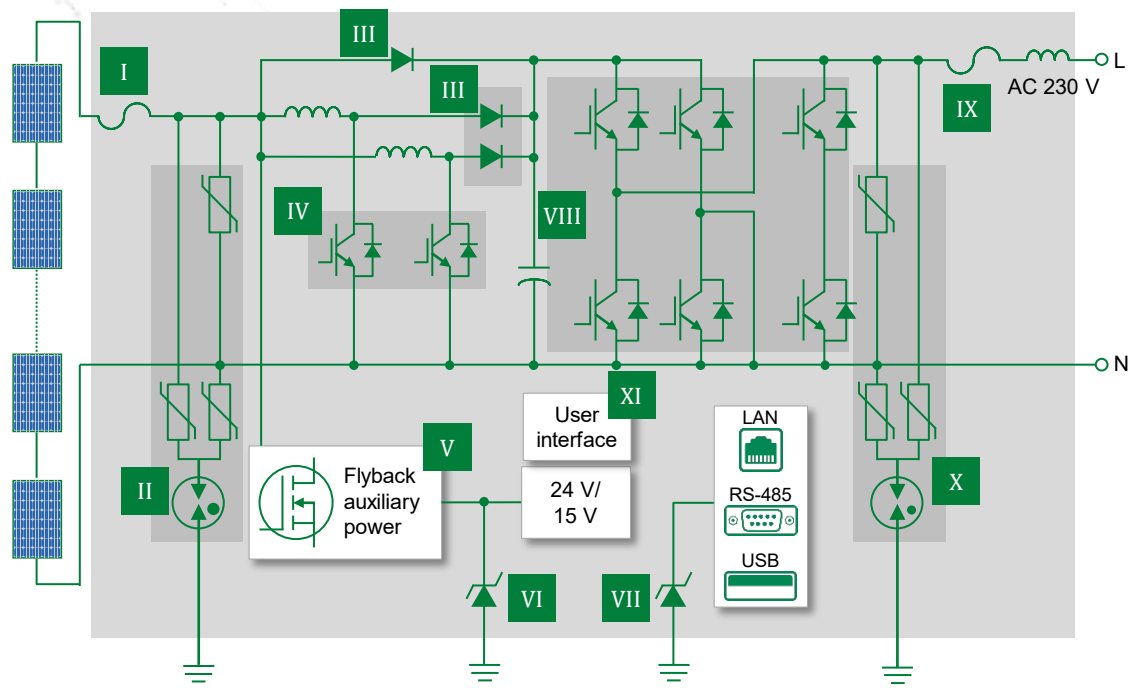
 Click the product series in the table below for more information



	Technology	Product series
<b>I</b>	MOSFET or IGBT	<a href="#">650V X2-Class, 650V X3-Class</a>
		<a href="#">650 V Trench</a>
<b>II</b>	SiC Schottky Diode	<a href="#">650V Diodes</a>
<b>III</b>	IGBT	<a href="#">650 V Trench</a>
<b>IV</b>	IGBT	<a href="#">650 V Trench</a>

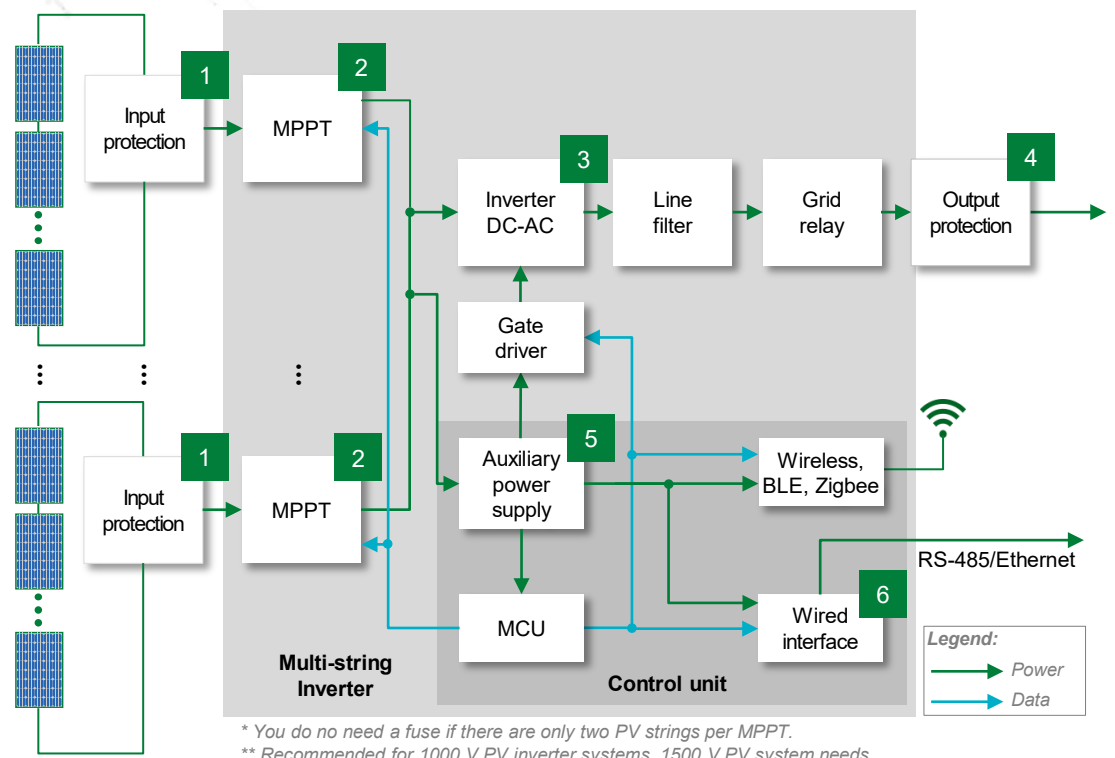
# Transformerless topology for string inverters—(<10 kW, MPPT + HERIC)

Click the product series in the table below for more information



	Technology	Product series
I	Fuse	<a href="#">SPFJ/SPF/SPFI</a>
	Fuse Block	<a href="#">LPHV</a>
II	MOV	<a href="#">Xtreme</a>
	GDT	<a href="#">CG3/CG4</a>
III	Rectifier Diode	<a href="#">DSP/DSI/DLA</a>
	Fast Recovery Diode	<a href="#">DSEI/DSEP</a>
IV	IGBT	<a href="#">XPT</a>
	Gate Driver	<a href="#">IXDN602SIATR</a>
V	SiC MOSFET	<a href="#">LSIC1MO170E0750</a>
	Si MOSFET	<a href="#">High Voltage Series, 1200/1500V Polar/HV</a>
	IGBT	<a href="#">IXG*N170(A)</a>
	Gate Driver	<a href="#">IX4427</a>
	TVS Diode Array	<a href="#">SM15-02HTG</a> , <a href="#">SM712</a>
VII	TVS Diode Array	<a href="#">SMBJ18CA</a> , <a href="#">SMBJ30CA</a>
VIII	IGBT	<a href="#">XPT</a>
	Gate Driver	<a href="#">IXDN602SIATR</a>
IX	Fuse	<a href="#">215/324</a>
X	MOV	<a href="#">M3/Xtreme</a>
	GDT	<a href="#">CG/CG2</a>
XI	Switch	<a href="#">7000</a> , <a href="#">KSC</a> , <a href="#">ES</a> , <a href="#">KSR</a>

# Multi-string inverter block diagram



\* You do not need a fuse if there are only two PV strings per MPPT.  
 \*\* Recommended for 1000 V PV inverter systems. 1500 V PV system needs 1700 V MOSFET or IGBT.

	Technology	Product series
1	Fuse*	<a href="#">SPF, SPEI, SPXV, SPXI</a>
	SPD	<a href="#">SPD2 PV</a>
2	SiC MOSFET or MOSFET**	<a href="#">LSIC1MO120E0120</a> <a href="#">High Voltage Series</a>
	SiC Diode**	<a href="#">1200 V Diode</a>
3	IGBT Module	<a href="#">MIXA, MIXG</a>
	Fuse	<a href="#">L75QS</a>
4	TVS Diode	<a href="#">SMBJ</a>
	Fuse	<a href="#">Class T, Class J</a>
	MOV or SPD	<a href="#">UltraMOV, LA, SM7 SPD type 2</a>
	GDT	<a href="#">CG3/CG4</a>
5	SiC MOSFET or MOSFET	<a href="#">LSIC1MO170E1000, High Voltage Series, 1200/1500V Polar/HV</a>
	Gate Driver	<a href="#">IX4351NE</a>
	TVS Diode	<a href="#">SMF</a>
6	TVS Diode Array	<a href="#">SP712, SM712</a> <a href="#">SP2555NUTG</a>
	Switch	<a href="#">7000, KSC, ES, KSR</a>

Legend:  
 → Power  
 → Data

# Recommended Littelfuse products for multi-string inverters



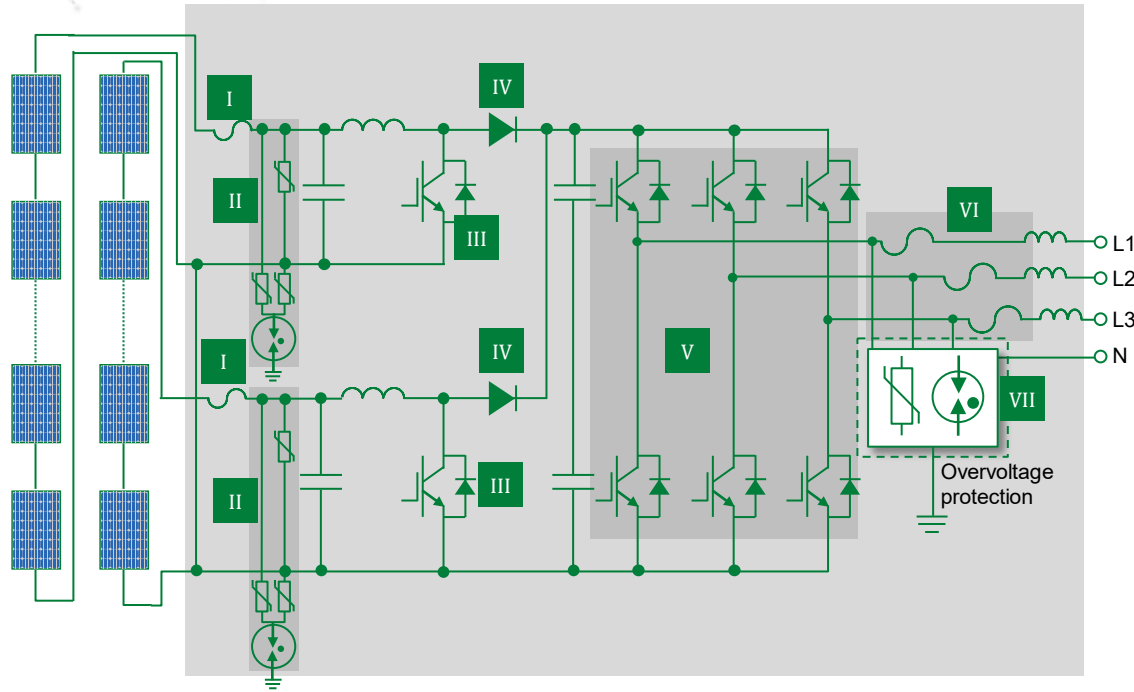
Click the product series in the table below for more information

	Technology	Function in application	Series	Benefits	Features
1	Fuse	Protects PV modules and conductors from reverse overcurrent conditions	<a href="#">SPE</a> , <a href="#">SPFI</a> , <a href="#">SPXV</a> , <a href="#">SPXI</a>	Prevents power generation losses due to nuisance tripping from changes in temperature	Meets UL and IEC standards; 1000 VDC, 1–30 A ratings available; max interrupt rating 50 kA
	SPD	Provides equipment protection from transient overvoltage events	<a href="#">SPD2 PV</a>	Withstands high-energy transients to prevent disruption, downtime, and degradation of equipment	Available in 1100 and 1500 Vdc; compact footprint; capability to clamp and withstand transients
2	SiC MOSFET or MOSFET*	Boost converter for high-frequency switching	<a href="#">LSIC1MO120E0120</a>	Optimized for high-frequency applications	Ultra-low output capacitance and on-resistance
	SiC Diode		<a href="#">High Voltage Series</a>	High power density; easy to mount; space-saving	Fast switching time; ultra-low $R_{DS(on)}$
3	IGBT Module	Switches power supplies	<a href="#">MIXA</a> , <a href="#">MIXG</a>	Allows low power consumption and fast response	Rugged design with thin wafer technology; low gate charge; low EMI and competitive low $V_{CE(SAT)}$
	Fuse	Protects semiconductor devices in inverter	<a href="#">L75QS</a>	Lower $I^2t$ performance allows for quick response to protect devices from higher heat energy	750 VDC, 35–800 A; interrupt rating DC: 50 kA
	TVS Diode	Protects IGBTs from transient overload event	<a href="#">SMBJ</a>	Enables compact design; improves system reliability	600 W peak pulse power capability; excellent clamping capability; small footprint
4	Fuse	Overcurrent or short circuit protection	<a href="#">Class T</a> , <a href="#">Class J</a>	Reduces damage to equipment caused by heating and magnetic effects of short-circuit currents	Extremely current-limiting; small footprint; 200 kA interrupting rating
	MOV or SPD	Protects from power fluctuations or surges	<a href="#">UltraMOV</a> , <a href="#">LA</a> , <a href="#">SM7 SPD type 2</a>	Withstands high-energy transients to prevent disruption, downtime, degradation of equipment	20 kA nominal interrupting rating and 50 kA maximum interrupting rating
	GDT	Protects from voltage transients and lightning	<a href="#">CG3/CG4</a>	Small form-factor allows for compact system design; enables product to comply with IEC/UL standards	High energy absorption capability; small form-factor; low leakage current
5	SiC MOSFET or MOSFET	High-frequency switching	<a href="#">LSIC1MO170E1000</a> , <a href="#">High Voltage Series</a> , <a href="#">1200/1500V Polar/HV</a>	Optimized for high frequency; high-power density; easy to mount; space-saving	extremely low gate charge and output capacitance; ultra low on-resistance; fast switching time
	Gate Driver	To drive SiC MOSFETs and high-power IGBTs	<a href="#">IX4351NE</a>	Eliminates the need for separate negative supply; quick turn-on and turn-off of power SiC MOSFET	Separate 9 A peak source and sink outputs; internal negative charge pump regulator improved $dV/dt$ immunity and faster turn-off
	TVS Diode	Protects SiC MOSFET from voltage transients	<a href="#">SMF</a>	Enables compact design; improves system reliability	200 W peak pulse power capability; excellent clamping capability; low profile
6	TVS Diode Array	Protection of data lines from ESD/EFT and surge events	<a href="#">SP712</a> , <a href="#">SM712</a> , <a href="#">SP2555NUTG</a>	Minimizes signal distortion, reduces voltage overshoot, and provides a simplified PCB design	Low capacitance of 2.5 pF; low leakage current of 0.1 $\mu$ A; small form factor
	Switch	On/Off/Reset switch	<a href="#">7000</a> , <a href="#">KSC</a> , <a href="#">ES</a> , <a href="#">KSR</a>	Micro miniature; long life; and low voltage; low power and performance; low voltage leakage	IP 67 Sealing; Au plating; operation temps to 125 °C; low contact resistance



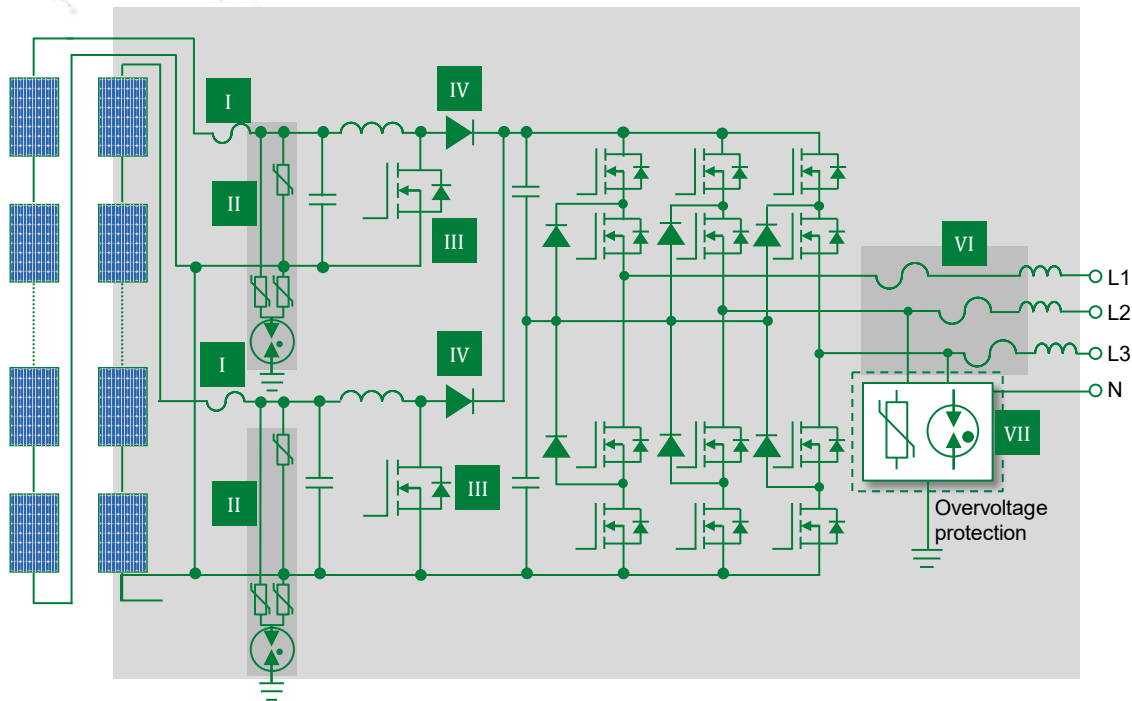
# Multistring inverters for commercial buildings—multiple boost + 2 Level

Click the product series in the table below for more information



	Technology	Product series
I	Fuse	<a href="#">SPE, SPEI</a>
	Fuse Block	<a href="#">LPHV</a>
II	MOV	<a href="#">UltraMOV/Xtreme</a>
	GDT	<a href="#">CG2/CG3</a>
	SPD	<a href="#">SPD2 PV</a>
III	IGBT	<a href="#">XPT</a>
IV	Gate Driver	<a href="#">IXDN602SIATR</a>
	Rectifier Diode	<a href="#">DSP/DSI/DLA</a>
V	Fast Recovery Diode	<a href="#">DSEI/DSEP</a>
	IGBT	<a href="#">IXG*N170(A)</a>
VI	Gate Driver	<a href="#">IXDN604SIA</a>
	Fuse	<a href="#">Class T/ Class J</a>
VII	MOV	<a href="#">UltraMOV/Xtreme</a>
	GDT	<a href="#">CG2/CG3</a>
	SPD	<a href="#">SPD2 PV</a>

# Multistring inverters for commercial buildings—multiple boost + 3 Level



	Technology	Product series
I	Fuse	<a href="#">SPE, SPEI</a>
	Fuse Block	<a href="#">LPHV</a>
II	MOV	<a href="#">UltraMOV/Xtreme</a>
	GDT	<a href="#">CG2/CG3</a>
	SPD	<a href="#">SPD2 PV</a>
III	IGBT	<a href="#">XPT</a>
	MOSFET	<a href="#">X Class</a>
IV	Gate Driver	<a href="#">IXDN602SIATR</a>
	Rectifier Diode	<a href="#">DSP/DSI/DLA</a>
V	Fast Recovery Diode	<a href="#">DSEI/DSEP</a>
	SiC MOSFET	<a href="#">LSIC1MO170E0750</a>
	HV IGBT	<a href="#">IXG*N170(A)</a>
VI	Gate Driver	<a href="#">IXDN604SIA</a>
	Fuse	<a href="#">Class T/ Class J</a>
VII	MOV	<a href="#">UltraMOV/Xtreme</a>
	GDT	<a href="#">CG2/CG3</a>
	SPD	<a href="#">SPD2 PV</a>

# Safety standards for residential solar installations

	Standard	Title	Market
PV system	IEC 60364-1	Low-Voltage Electrical Installations - Part 1: Fundamental principles, assessment of general characteristics, definitions	Global
	IEC 60364-7-712	Low-Voltage Electrical Installations - Part 7-712: Requirements for special installations or locations - Solar photovoltaic (PV) power supply systems	Global
	NFPA 70	National Electrical Code - Article 690 Solar Photovoltaic (PV) Systems	US

# Safety standards for residential solar installations

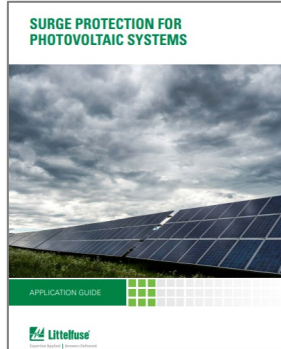
PV inverters	Standard	Title	OC	OV	Breaker & Switch	Relay	Power Semi	Market
	IEC 61683	Photovoltaic systems - Power conditioners - Procedure for measuring efficiency					●	Global
	IEC/UL 62109-1	Safety of Power Converters for Use in Photovoltaic Power Systems - Part 1: General requirements	●	●	●	●	●	Global and US
	IEC/UL 62109-2	Safety of Power Converters for Use in Photovoltaic Power Systems - Part 2: Particular requirements for inverters.	●	●	●	●	●	Global and US
	IEC 60269-6	Low-Voltage Fuses - Part 6: Supplementary requirements for fuse-links for the protection of solar photovoltaic energy systems.	●					Global
	IEC 61643-31	Low-voltage surge protective devices – Part 31: Requirements and test methods for SPDs for photovoltaic installations.		●				Global
	UL 1741	Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources.	●	●	●	●	●	US
	UL 1449	Surge Protective Devices		●				US
	UL 4248-19	Fuseholders - Part 19: Photovoltaic	●					US
	UL 1699B	Photovoltaic (PV) DC Arc-Fault Circuit Protection				●		US
	UL 489B	Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures for Use with Photovoltaic (PV) Systems.			●			US
IEEE 1547	IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces.						Global	
IEEE 1547.1	IEEE Standard Conformance Test Procedures for Equipment Interconnecting Distributed Energy Resources with Electric Power Systems and Associated Interfaces.						Global	

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

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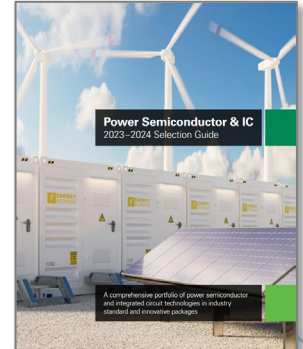
Building Automation Guide



SPDs in PV Systems



Industrial Fuses Catalog



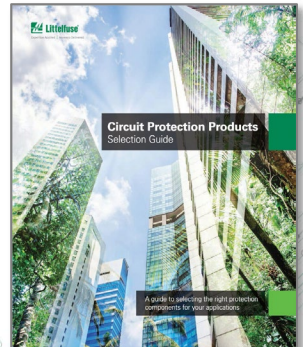
Power Semiconductor Selection Guide



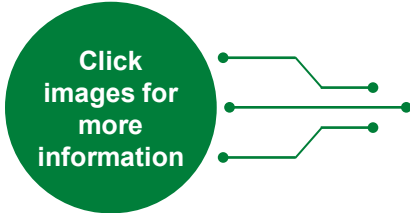
Solar Protection White Paper



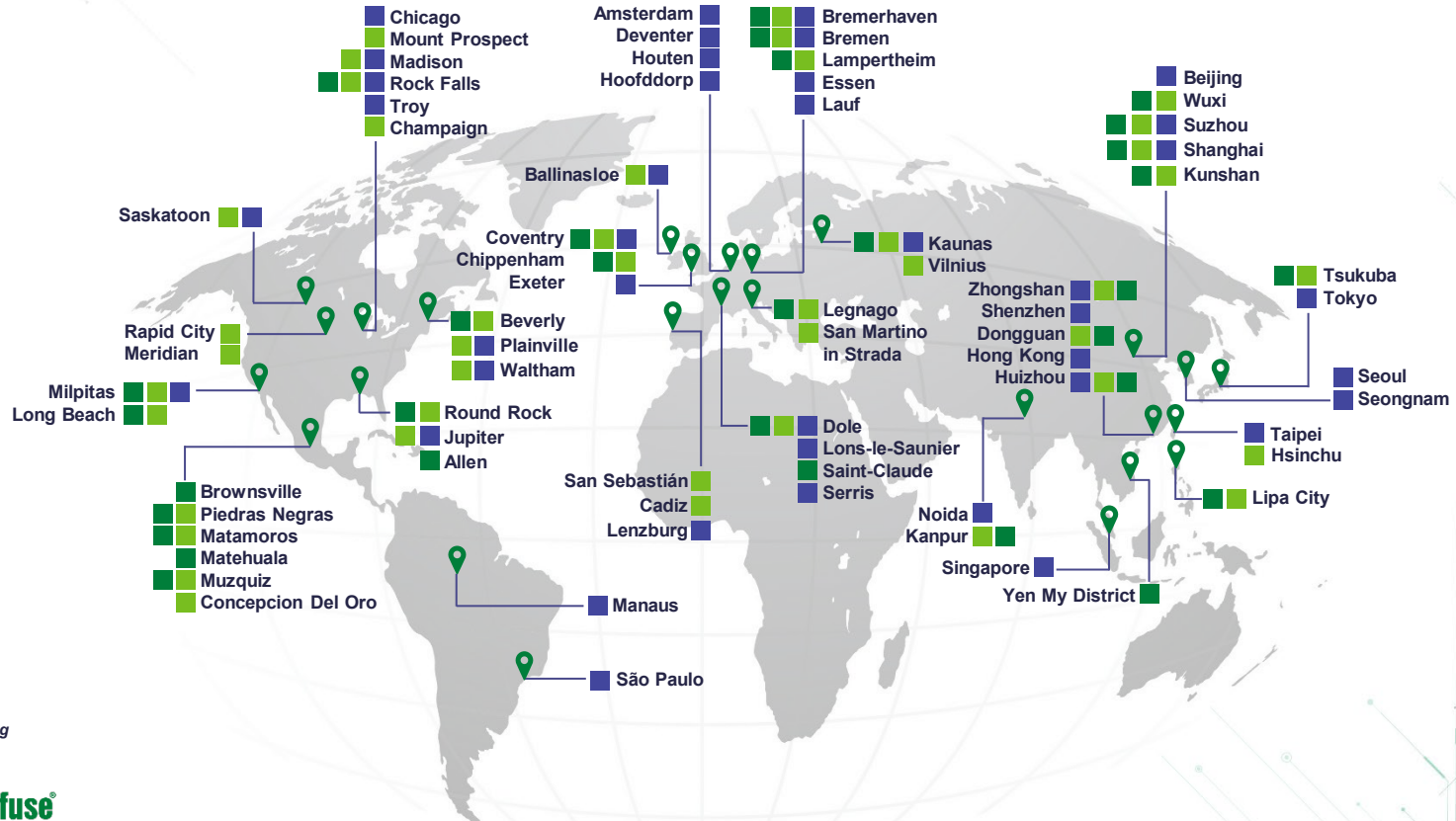
Power Relay & Control Catalog



Circuit Protection Selection Guide



# Local resources supporting our global customers



**Legend**  
 ■ Sales  
 ■ R&D  
 ■ Manufacturing



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## Broad product portfolio

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

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

## Global customer service

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## Compliance & regulatory expertise

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## Global manufacturing

We offer high-quality manufacturing that is committed to the highest quality standards





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