

**CoolSiC™ 2000 V SiC Trench MOSFET
defines an enhanced benchmark for
increased power density in new
energy applications**

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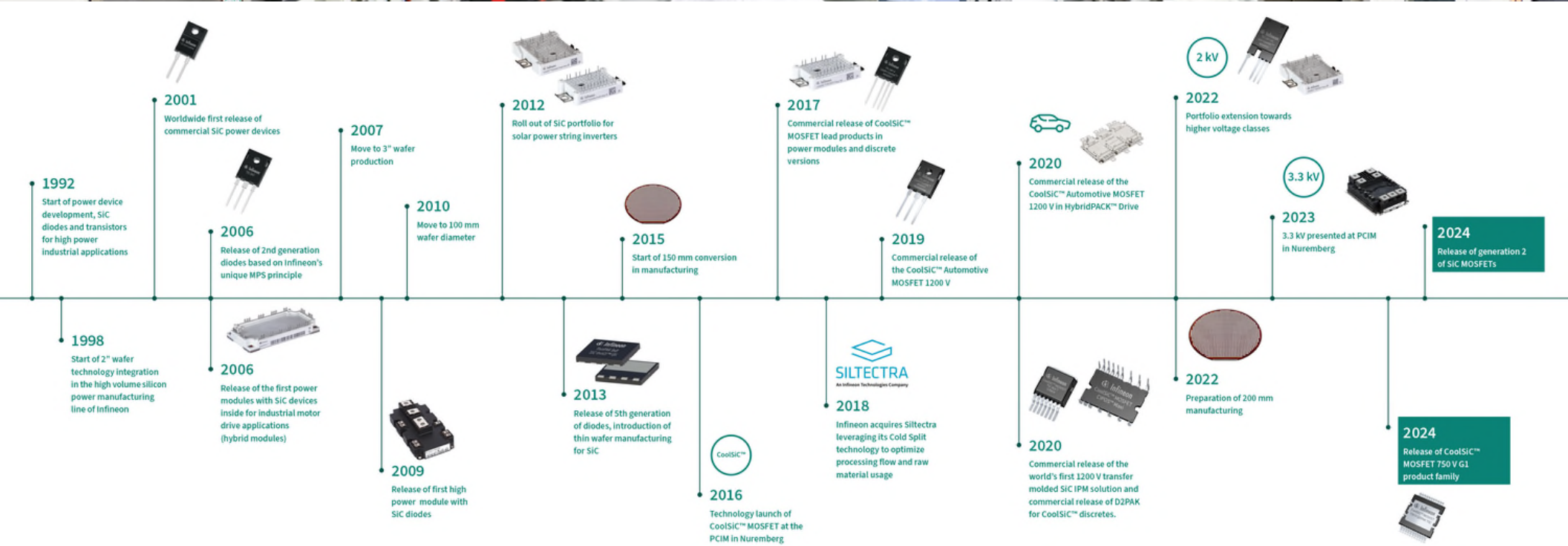
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Infinion has more than 25 years of field experience with SiC products

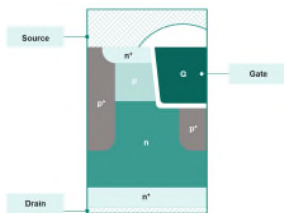


SiC is at the strategic core to address key market trends for sustainable energy generation and consumption

Silicon Carbide must haves – getting ready today to continue shaping the market tomorrow

1. Trench technology

- Optimal balance between performance and robustness
- Keeping up with state-of-the-art IGBT robustness, while boosting efficiency performance to new levels.



2. Synergies between chip and package

- Offering highest degree of innovation by leveraging strong expertise in interconnect technologies
- Sophisticated soldering processes for maximum chip performance



3. Manufacturing know-how and supply security

- Supporting steep volume growth of our customers
- Capacity invest along with dedicated projects to increase output and to ensure supply security



4. Scalable portfolio and system offering

- Providing multiple choices for different system requirements of our customers
- Extensive CoolSiC™ and recommended EiceDRIVER™ isolated gate driver portfolio



Scalability through flexible portfolio

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The 2 kV SiC technology brings additional power density increase and leads to system cost reduction



2 kV brings power density increase

Additional benefits using 2 kV CoolSiC™



Courtesy: Kaco and pv magazine

	2008	2011	2016	2018	2022
	100 kW	50 kW	50 kW	125 kW	2 kV
	1129 kg	151 kg	70 kg	77 kg	>2
kW/kg	0.09	0.33	0.7	1.6	

- Realization of higher system voltage
- Simplification of designs
- System cost reduction
- High efficiency & high reliability
- Ready for emerging use-cases



Base technology has passed all relevant qualification test, especially these extended 2 kV relevant tests



Test	Test conditions	Serial release : stress time
HTRB	VDS = 1800 V T=Tvjop_max	1000 h
HTGS	VDS = 0 V VGS = +23 V/-20 V T=Tvjop_max	1000 h
HV-H3TRB	VDS = 1600 V T = 85°C Relative humidity = 85%	1000 h
Dynamic H3TRB	VDS = pulsed voltage T = 85°C Relative humidity = 85%	1000 h



- Long-term stability test at voltage level associated to 2 kV

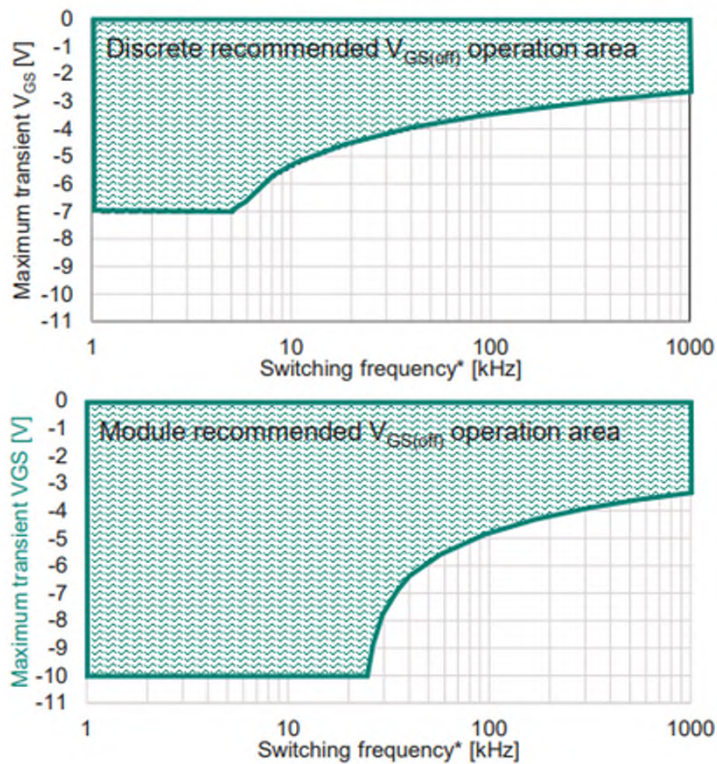


- Full humidity robustness according to harsh environment condition

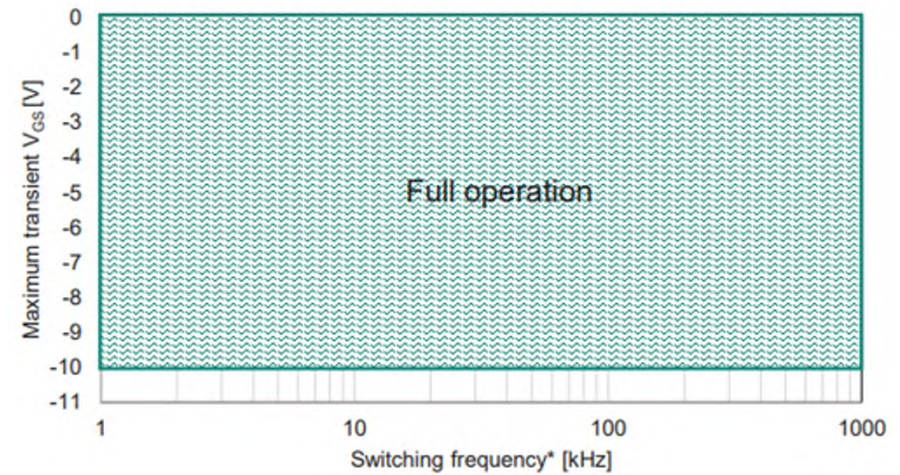
In addition to 2 kV voltage, the latest CoolSiC™ base technology advancements gives full freedom in choosing the gate voltage



Previous gate voltage recommendation area



New gate voltage recommendation area

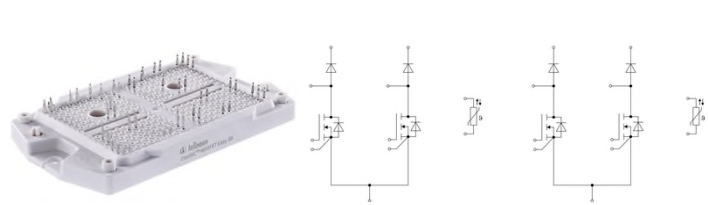


- Ease of use with maximum negative gate-source voltage down to -10 V

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2 kV CoolSiC™ portfolio



- EasyPACK™ package
- Four channel boost configuration with 2 kV SiC MOSFET and 2 kV SiC diodes
 - RDS(on) of MOSFET @25°C: 19 mOhm / channel
 - Current rating of diode: 40 A / channel
- Target application: MPPT of 1500 V PV string inverter

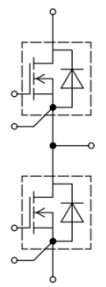
R _{Dson} [mOhm]	Product
19	DF4-19MR20W3M1HF_B11



- 62 mm package
- Half-bridge configuration
- Target application:
 - Aux. Traction Converter
 - EV Charging
 - Energy Storage
 - Circuit Breaker

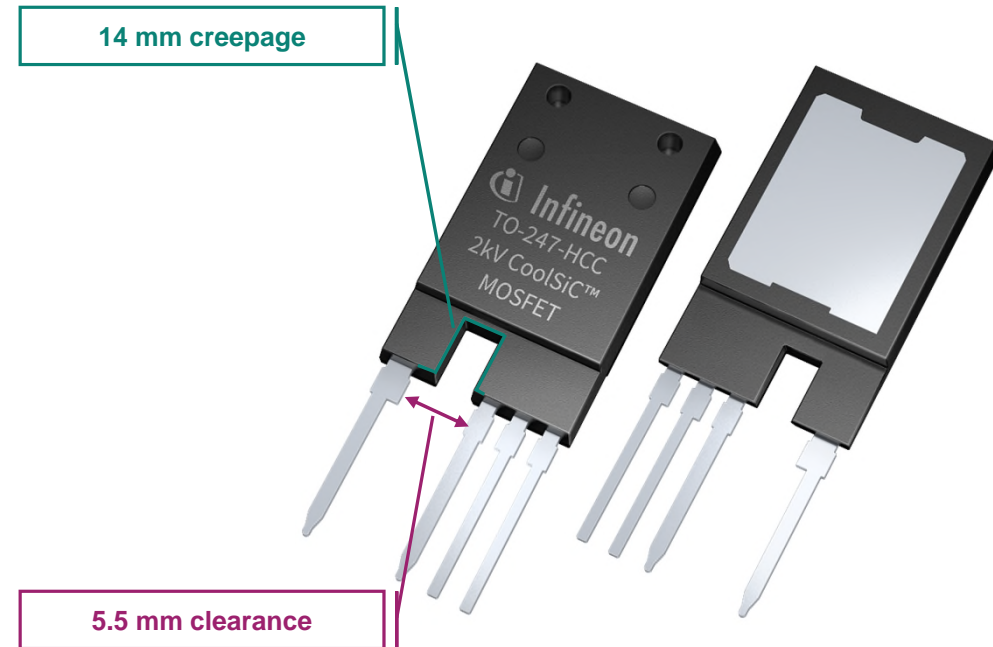
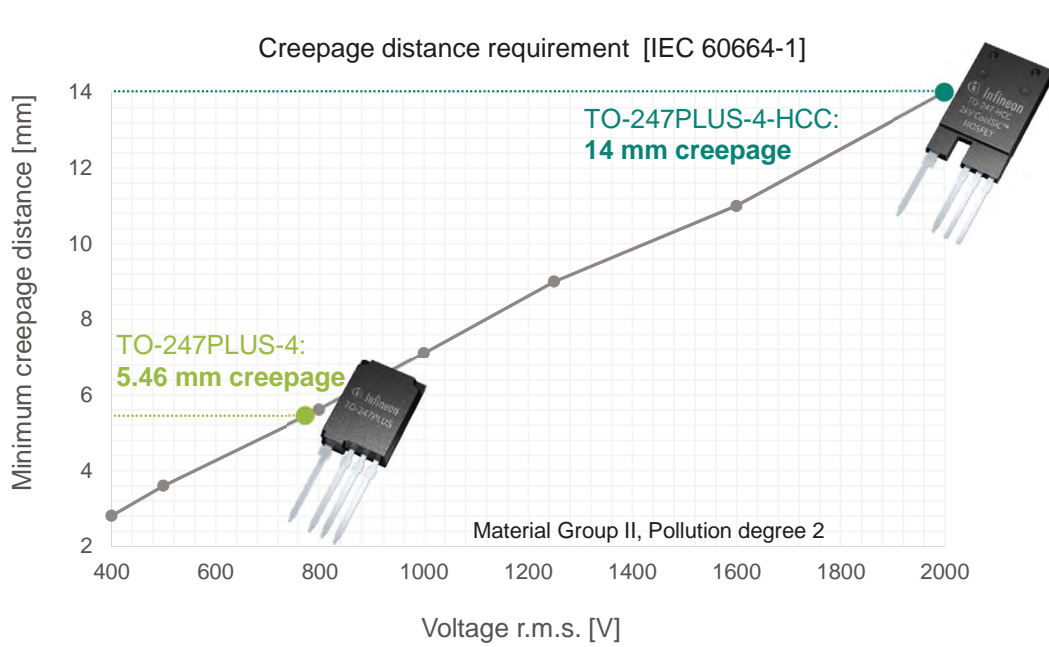
R _{Dson} [mOhm]	Product
3	FF3MR20KM1H*
4	FF4MR20KM1H*
5	FF5MR20KM1H*

- Also available with TIM, indicated by P at the end
- Also available as common source, indicated by _S at the end

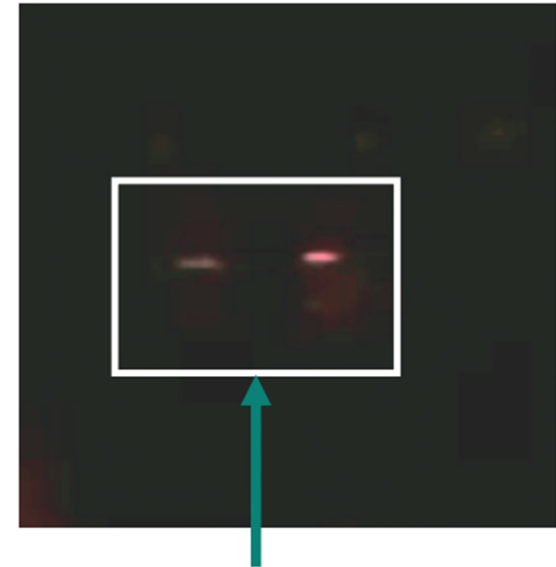
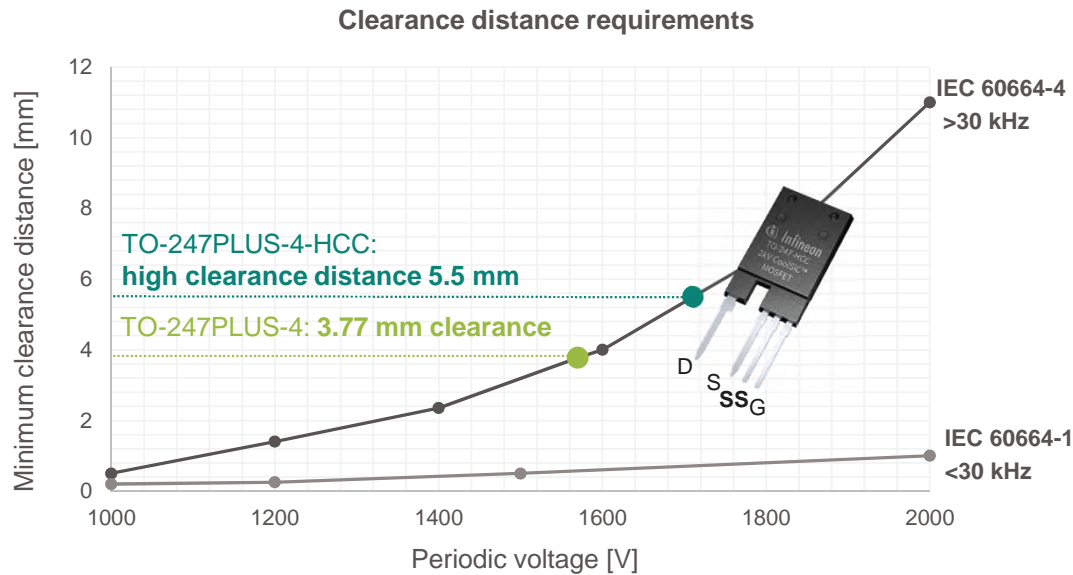


- New 2 kV package in a TO247-PLUS body
 - 14 mm creepage
 - 5.5 mm clearance distance
 - Utilizing the award-winning latest .XT interconnection technology
- Target application:
 - PV
 - EV Charging
 - Energy Storage
 - Circuit Breaker

TO-247PLUS-4-HCC package with high creepage contributes to reliable high voltage operation



Higher voltage in combination with higher frequency requires much higher clearance



Corona high frequency discharge

Clearance distance requirement is much higher with higher switching frequency

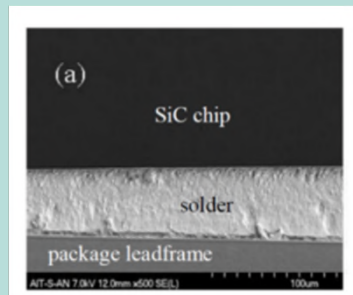
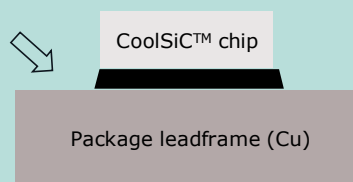
Extra care needs to be considered in system design

Test conditions: TO247 3 pin
Clearance distance: ~ 2.6 mm
Continuous turn off
Voltage spike: ~ 1.6 kV
Switching freq.: ~ 80 kHz

CoolSiC™ MOSFET 2000 V discrete Significant improvement of thermal capabilities by .XT interconnection

Standard interconnection

Standard soldering

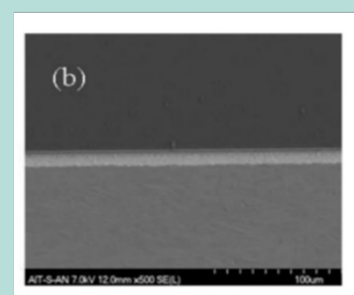
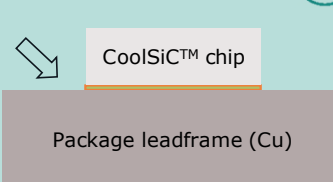


Standard soldering

.XT interconnection

Diffusion soldering

.XT



Elimination of solder joint through diffusion soldering

.XT technology benefits

.XT

Higher thermal conductivity

- Reduction of junction-to-case thermal resistance ($R_{thj-case}$)
- Reduction of junction-to-case thermal impedance ($Z_{thj-case}$)

Better assembly control

- Prevents die tilt and solder bleed-out

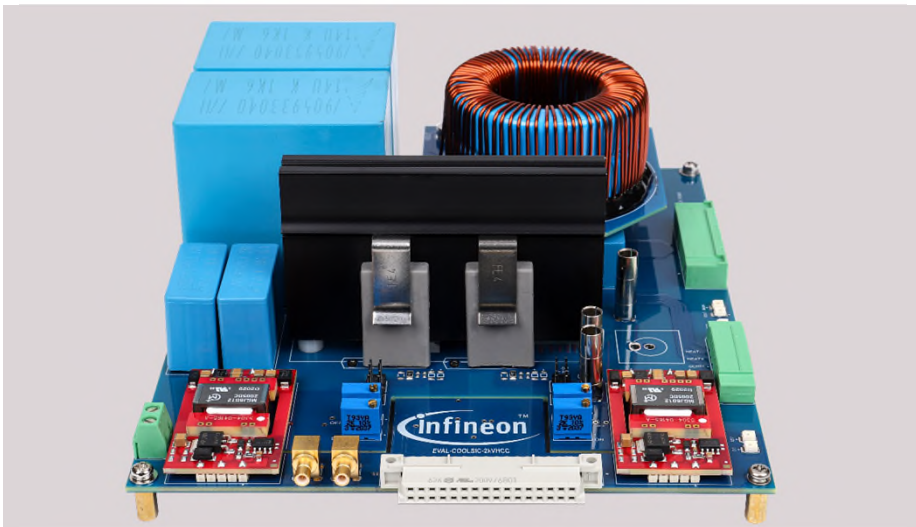
Better performance under thermo-mechanical stress

- Increases active and passive thermal cycling capacity due lower operating temperature

EVAL-COOLSIC-2kVHCC overview

Evaluation board for discrete CoolSiC™ MOSFETs 2000 V

CoolSiC™ - Front side



Main Features

- Double pulse or continuous PWM operation
- Withstands up to 1500 V_{DC}
- Compatible with TO-247PLUS-4-HCC and TO-247-2 packages
- Adjustable gate voltage level
- Supports external XMC™ controller
- Space reservation for DC-link snubber evaluation
- EiceDRIVER™ Compact single-channel isolated gate driver ,1ED3124MU12H

Benefits

- Flexible universal design
- Accurate test platform for high voltage discretes
- High power density
- Supports different operation modes

Applications



Solar



Energy storage


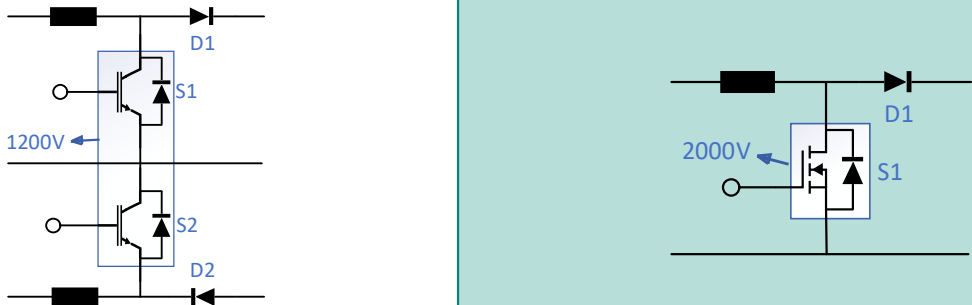

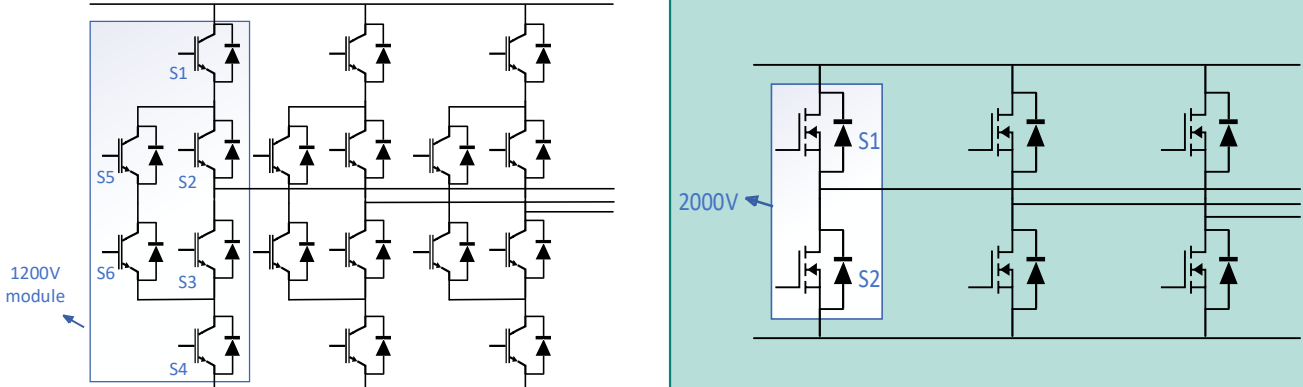


EV charging

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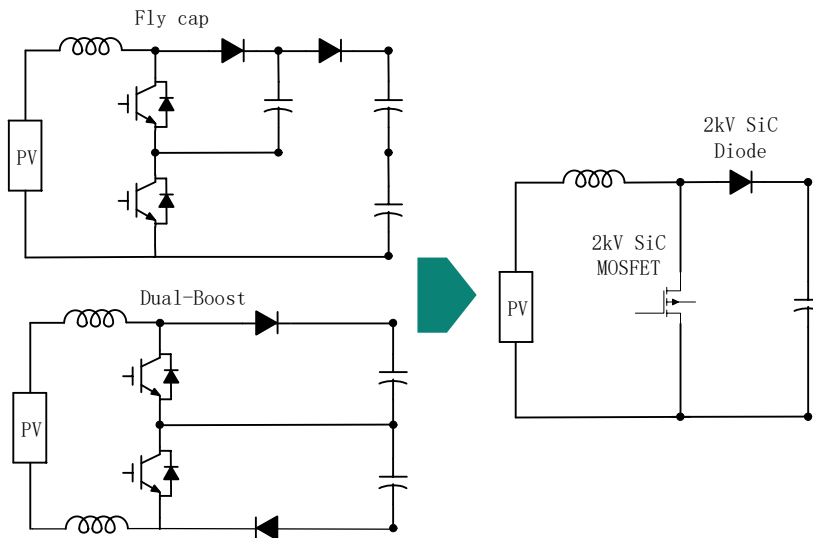
CoolSiC™ MOSFET 2000 V products in solar application

Topologies	<div style="display: flex; justify-content: space-around; align-items: center;"> ← 1200 V → 2000 V </div>	Value proposition
<p>DC/DC stage</p> 		<p>1</p> <p>~3x Lower losses ^[1]</p> <p>2</p> <p>~3x Increased power density ^[1]</p>
<p>DC/AC stage</p> 		<p>3</p> <p>50% less part count</p> <p>4</p> <p>Simple control design</p>

Note: [1] $P_{out} = 30 \text{ kW}$, $F_{sw} = 25 \text{ kHz}$, $V_{out} = 1300 \text{ V}$

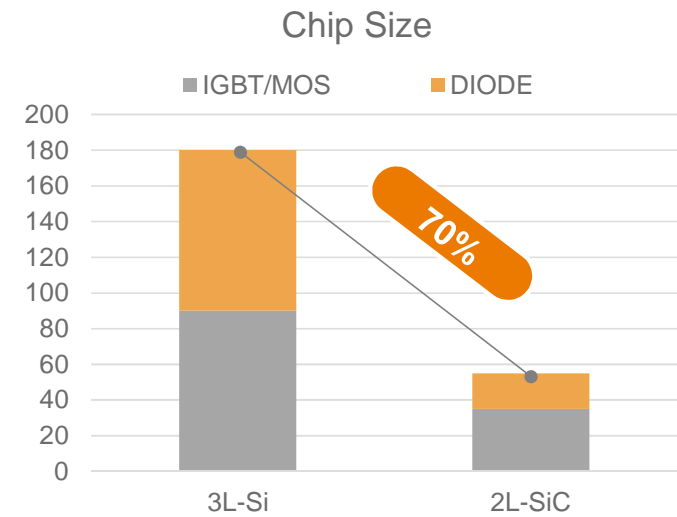
Solar application – 2000 V SiC MOSFET simplify Boost topology

The 3-level can be replaced by two-level by using 2000V SiC MOSFET



Benefits

- The chip size is smaller
- The module power density is higher



Solar application – 2000 V SiC MOSFET improve Boost efficiency

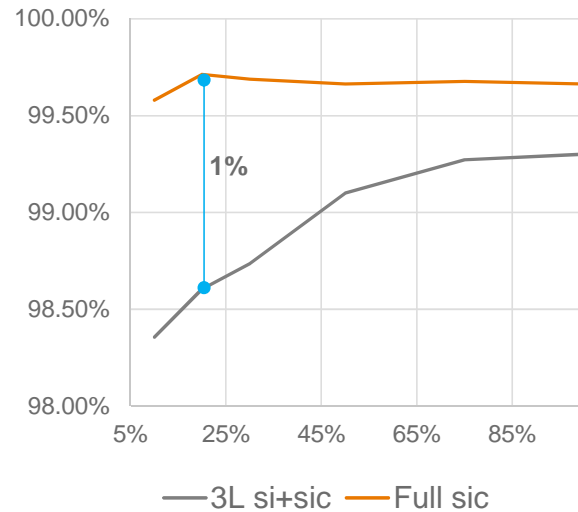
Benefits

- Boost efficiency increased by 1% at light loads
- Boost efficiency increased by 0.5% on average under all working conditions

Loss Comparison



Boost Efficiency



3L Si+SiC

2L Full-SiC

