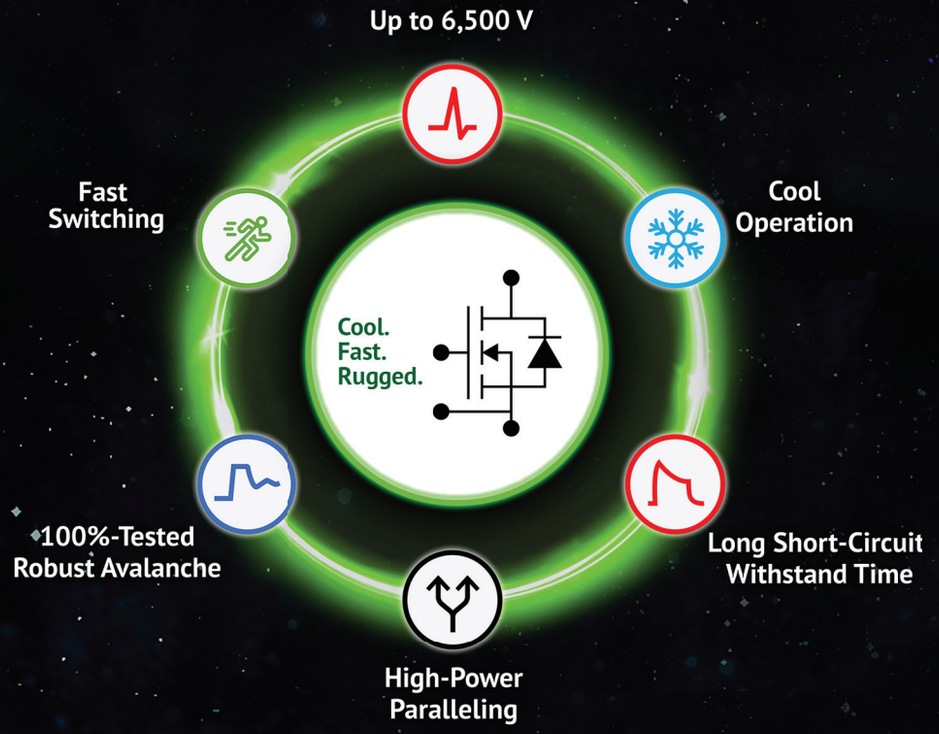
GeneSiC™ Power Devices

Electrify Our World ™



GeneSiC

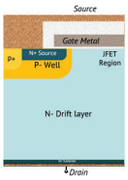
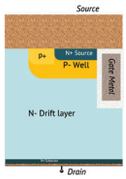
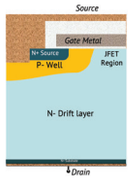
Markets and Technology

In applications from 20 W to 20 MW, and with device voltages from 650 V to 6.5 kV, GeneSiC silicon carbide (SiC) MOSFETs and Schottky MPS™ diodes drive high-speed, high-efficiency power conversion across diverse markets including EV, industrial automation, solar, wind, grid, motor drives and defense. High-volume, high-quality shipments ensure application performance, reliability and uptime availability.




Trench-Assisted Planar Gate: No-Compromise Technology

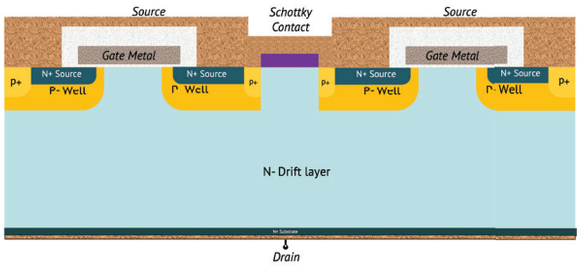
SiC MOSFETs offer superior conductivity and switching performance compared to silicon (Si) due to their 'wide bandgap' characteristics and high electric-field strength. However, traditional designs using legacy planar or trench techniques must compromise between manufacturability, performance, and/or reliability.
GeneSiC's patented trench-assisted planar gate design is a no-compromise, next-generation solution; high-yield manufacturing, fast and cool operation, and extended, long-life reliability.

	Planar	*Trench*	*GeneSiC*
			
Manufacturability	» *Repeatable* » *High yield* » *Low cost*	» *Inconsistent trench etch* » *Lower yields* » *High cost*	» *Repeatable* » *High yield* » *Low cost*
Performance	» *High $R_{DS(ON)}$ / area* » *Slow switching* » *High $R_{DS(ON)}$ / Δ temp*	» *Lower $R_{DS(ON)}$ / area* » *Faster switching* » *High $R_{DS(ON)}$ / Δ temp*	» *Lower $R_{DS(ON)}$ / area* » *Fastest switching* » *Lowest $R_{DS(ON)}$ / Δ temp*
Reliability	» *Rugged gate oxide (stable V_{TH})*	» *Failures due to non-uniform gate oxide* » *Lower short-circuit capability*	» *Highest 100% tested avalanche* » *Long short-circuit withstand time* » *Rugged gate oxide (stable V_{TH})*

High Voltage Pioneers

GeneSiC have pioneered robust, high-voltage, high-efficiency SiC MOSFETs which are critical for reliable, harsh environment, high-power applications

- ***Unique, advanced, integrated 6.5 kV technology***
  - » Double-implanted metal oxide semiconductor (DMOSFET)
  - » Monolithically-integrated Junction barrier Schottky (JBS) rectifier
  - » Superior high-power performance
- ***Higher efficiency bi-directional performance***
  - » Temperature independent switching
  - » Fast (low switching loss) and cool (low conduction losses)
  - » Longer-term reliability
  - » Easy-to-parallel for high power (V_{TH} stability)



Alternative Energy
Solar and Wind Inverters

Automotive
Electric Vehicles and Fast Chargers

Industrial
Power Supply, Traction and Welding

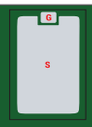
Transportation
Rail and Ship Board

Power Grid
HVDC Transmission and FACTS

Aerospace and Defense
High Temperature

Oil Drilling
Rectifiers and Motor Drives

Widest Range of SiC MOSFETs 750 V - 6.5 kV

$V_{BR(DSS)}$ (V)	$R_{DS(ON)}$ typ. (mΩ)	 TO-263-7 (D2PAK-7L)	 TO-247-3	 TO-247-4	 SOT-227	 Bare Chip
750	10					*G3R10MT07-CAx*
	12					*G4R12MT07-CAx*
	60	G3R60MT07J	G3R60MT07D	G3R60MT07K		
1200	10					*G4R10MT12-CAx*
	12			G3R12MT12K		G3R12MT12-CAL
	20			G3R20MT12K	G3R20MT12N	G3R20MT12-CAL
	30	G3R30MT12J		G3R30MT12K		G3R30MT12-CAL
	40	G3R40MT12J	G3R40MT12D	G3R40MT12K		
	75	G3R75MT12J	G3R75MT12D	G3R75MT12K		
	160	G3R160MT12J	G3R160MT12D			
	350	G3R350MT12J	G3R350MT12D			
1700	20			G3R20MT17K	G3R20MT17N	G3R20MT17-CAL
	45		G3R45MT17D	G3R45MT17K		G3R45MT17-CAL
	160	G3R160MT17J	G3R160MT17D			
	450	G3R450MT17J	G3R450MT17D			
	1000	G2R1000MT17J	G2R1000MT17D			
3300	15					*G2R15MT33-CAL*
	50			G2R50MT33K		G2R50MT33-CAL
	120	G2R120MT33J				G2R120MT33-CAL
	1000	G2R1000MT33J				
6500	50					*G2R50MT65-CAL*
	300					*G2R300MT65-CAL*
	50					*G2R50MS65-CAL*
	325					*G2R325MS65-CAL*

Engineering Samples

GeneSiC

Cool. Fast.

Efficient, cost-effective power conversion relies on a comprehensive understanding of modern circuit topologies and high-speed (frequency) switching techniques. There are two main device factors;

- ***How well does the MOSFET conduct current (measured in $R_{DS(ON)}$)?***
- ***How efficiently does the device 'switch' (measured by energy loss, or E_{XX})?***

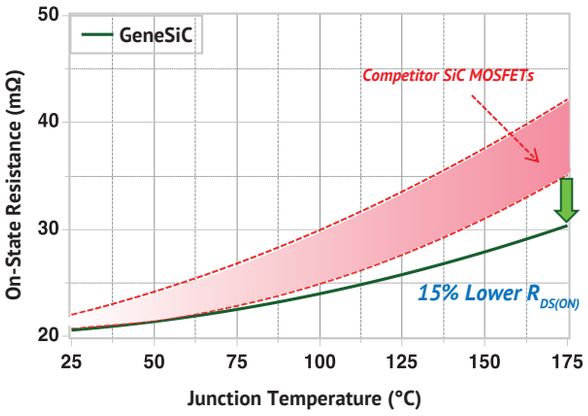
For each question, we must understand the answer in both 'hard-switch' and 'soft-switch' topologies, and under tough high-temperature and high-speed conditions. Combined, a high-temperature, high-speed (frequency) figure-of-merit (FoM) is critical for system performance and reliability.

Supplier	Resistance		Energy Loss		Figure-of-Merit *(Low number is better)*	
	$R_{DS(ON)}$ @ 25°C (mΩ)	$R_{DS(ON)}$ @ 175°C (mΩ)	$E_{ON} + E_{OFF}$ (µJ)	E_{ZVS} (µJ)	Hard-Switching R_{DS} @ 175°C x (E_{ON}+E_{OFF}) (Ω-µJ)	Soft-Switching R_{DS} @ 175°C x E_{ZVS} (Ω-µJ)
GeneSiC	40	57	680	46	**38.8**	**2.6**
#2	40	68	680	40	46.2	2.7
#3	40	80	1240	355	99.2	28.4
#4	40	71	700	115	49.7	8.2
#5	45	85	585	36	49.7	3.1

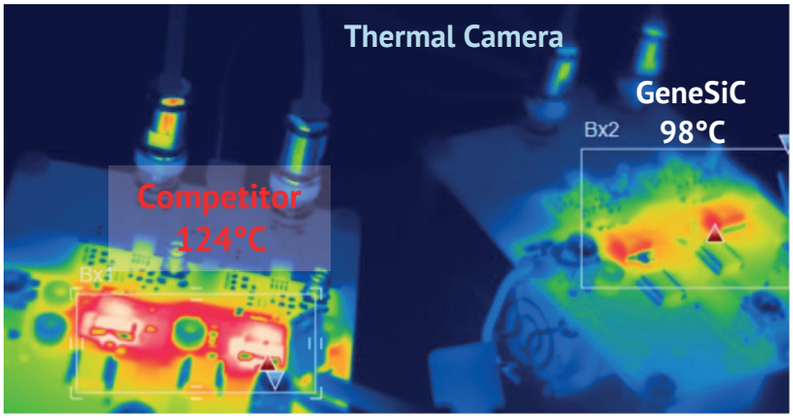
Lowest power loss at high temp, high speed = ***Highest Efficiency, Energy Savings Small Size, Light Weight, Low System Costs!***

GeneSiC patented trench-assisted planar-gate technology delivers the lowest $R_{DS(ON)}$ at high temperature and the lowest energy losses at high speeds. This enables unprecedented, industry-leading levels of performance, robustness and quality.

$R_{DS(ON)}$ vs T_j



In-Circuit, High-Speed Test



- ***GeneSiC vs. competitor SiC FET***
  - » 1200 V, 20 mΩ, TO-247-4L
  - » Higher drain current
  - » Lower conduction losses
  - » Cooler operation

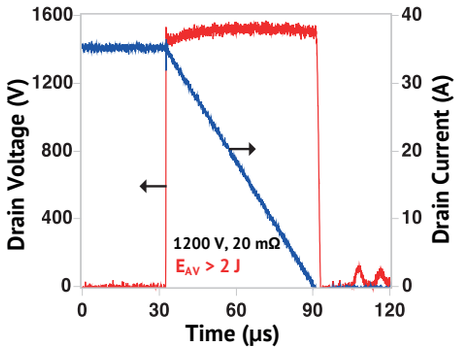
- ***GeneSiC vs. competitor SiC FET***
  - » 1200 V, 40 mΩ, D2pak in half-bridge
  - » 150 kHz switching = ~10x faster than Si IGBT
  - » 30% lower FET loss vs. other SiC
  - » 25°C cooler operation = 3x longer lifetime

GeneSiC

Rugged.

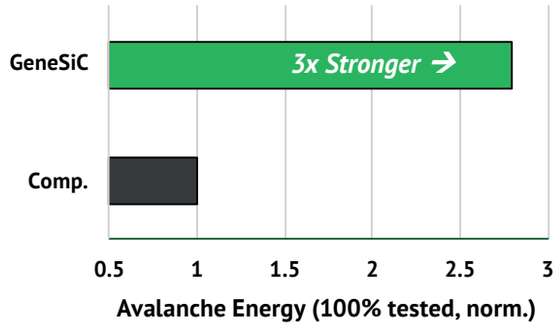
100%-Tested Avalanche

Highest published capability to handle excess energy in fault condition



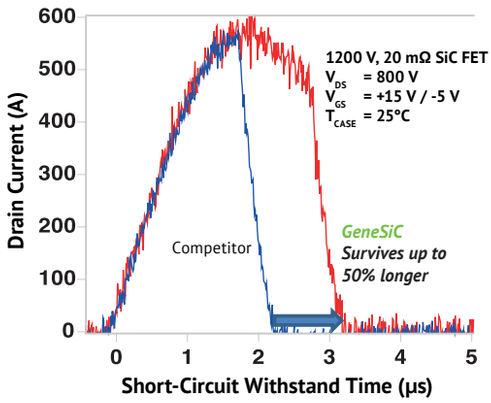
*refer to datasheet for EAS rating

Critical in applications like motor drives to withstand unclamped inductive load (UIL) energy dump in situations like motor open-circuit (O.C.)

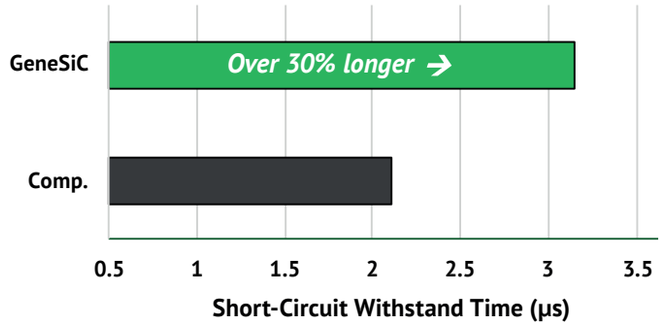


Long Short-Circuit Withstand Time

World-class survival duration in fault condition



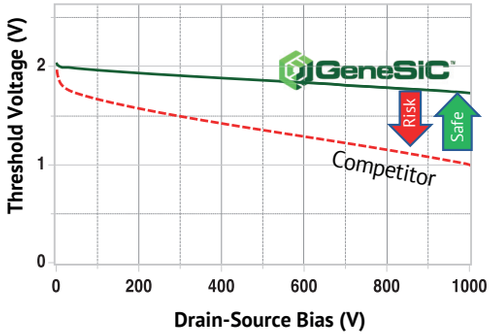
Critical to prevent failures like motor short circuit where the FET faces full voltage (V_{DD}) in ON-state.



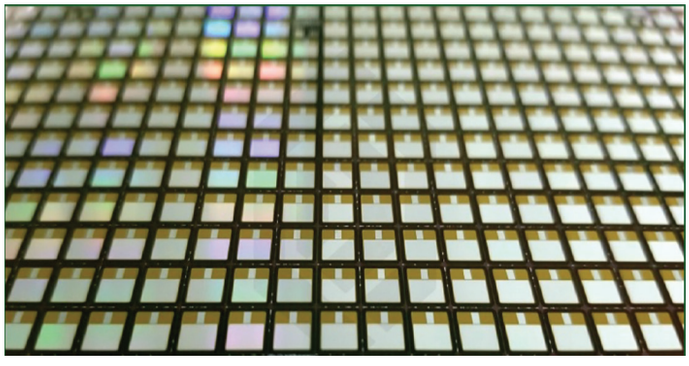
High Power Paralleling

Matching currents (Stable V_{TH})

Competitor products allow threshold voltage to drop under high voltage, creating risk of turn-on error



GeneSiC packaged and bare-die FETs can be paralleled reliably for high-power applications



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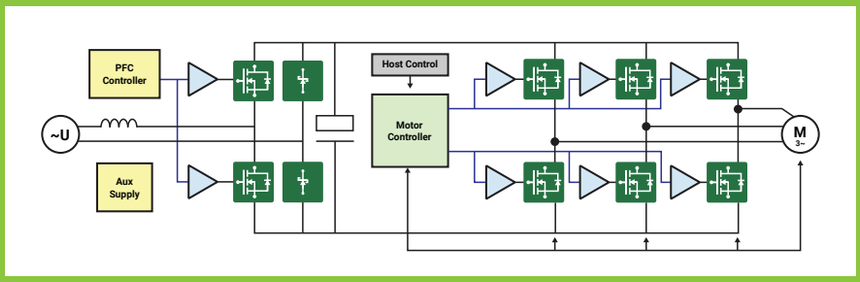
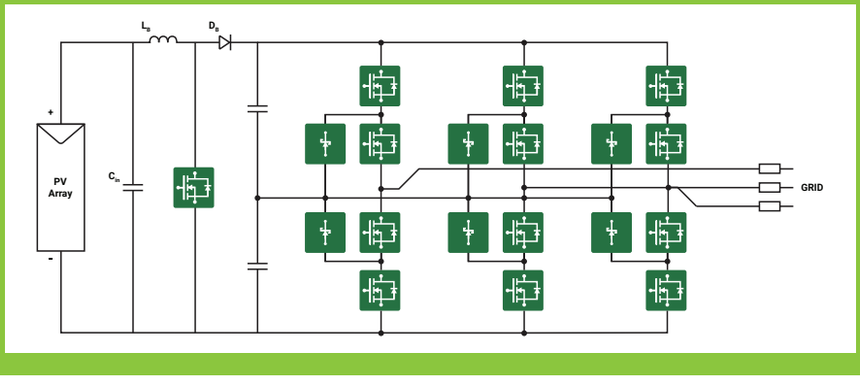
Typical Circuits

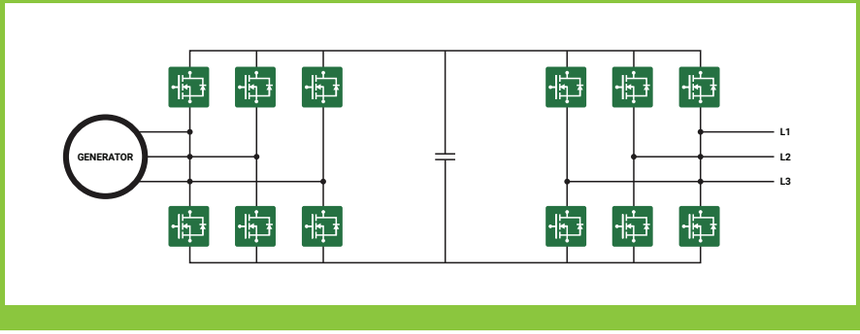
PFC and 3-Phase Motor Drive using 750 V SiC MOSFETs and Diodes



Transformer-Less, 3-phase, 3-level NPC, using 1200 V SiC MOSFETs and Diodes

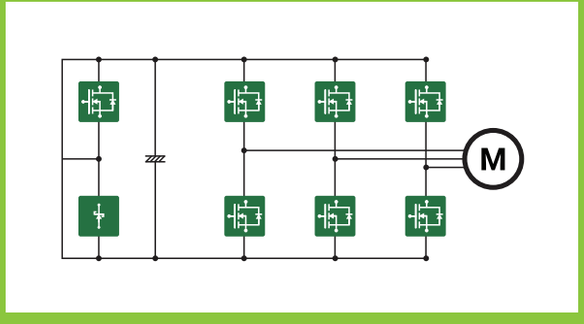


4-quadrant Full-Power Converter using 1700 V SiC MOSFETs

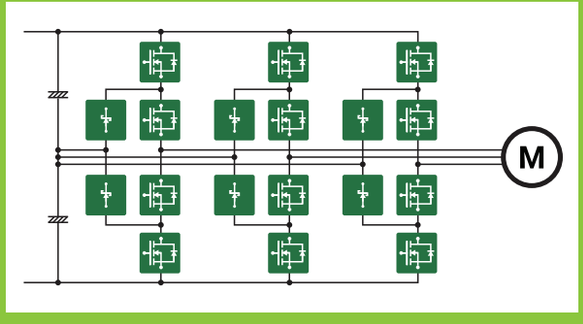


Locomotive Traction Inverters using 3.3 kV & 6.5 kV SiC MOSFETs and Diodes

2-Level Inverter (6.5 kV)



3-Level Inverter (3.3 kV)



SiC Schottky MPS™ Diodes

Merged-PIN Schottky (MPS) Diodes combine two beneficial features from the PIN and Schottky diode. The PIN sustains excessive surge currents with low leakage, while the Schottky element offers low forward-voltage drop and fast-switching characteristics. Target applications include PFC, Boost, and high-voltage, higher-power motor drives.

V_{RRM} (V)	I_F (A)	 DO-214	 TO-252-2	 TO-263-7 (D2PAK-7L)	 TO-220-2	 TO-247-2	 TO-247-3	 SOT-227	 Bare Chip
650	1	GB01SLT06-214							
	4		GE04MPS06E		GE04MPS06A				
	6		GE06MPS06E		GE06MPS06A				
	8		GE08MPS06E		GE08MPS06A				
	10		GE10MPS06E		GE10MPS06A				
	16						GE2X8MPS06D		
	20						GE2X10MPS06D		
	30			GD30MPS06J	GD30MPS06A	GD30MPS06H			
	60					GD60MPS06H	GD2X30MPS06D	GD2X30MPS06N	
	120							GD2X60MPS06N	
	200							GD2X100MPS06N	
	300							GD2X150MPS06N	
1200	1	GB01SLT12-214	GB01SLT12-252						
	2	GB02SLT12-214	GD02MPS12E		GC02MPS12-220				
	5		GC05MPS12-252						
	8		GC08MPS12-252		GC08MPS12-220				
	10		GD10MPS12E		GD10MPS12A	GD10MPS12H	GC2X5MPS12-247		
	15				GC15MPS12-220	GC15MPS12-247	GC2X8MPS12-247		
	20				GD20MPS12A	GD20MPS12H	GD2X10MPS12D		
	30					GD30MPS12H	GC2X15MPS12-247		GD30MPS12-CAL
	40						GD2X20MPS12D		
	50					GD50MPS12H			GD50MPS12-CAL
	60						GD2X30MPS12D	GD2X30MPS12N	
	100							GD2X50MPS12N	GD100MPS12-CAL
	200							GD2X100MPS12N	
1700	5			GB05MPS17-263		GD05MPS17H			
	10					GD10MPS17H			
	15					GD15MPS17H			
	25					GD25MPS17H			
	50					GB50MPS17-247			
	60					GD60MPS17H			
	75								GD75MPS17-CAL
	100							GB2X50MPS17-227	
	150							GD2X75MPS17N	
3300	0.3	GAP3SLT33-214			GAP3SLT33-220 (FP)				
	5		GC05MPS33J						
	50					GC50MPS33H			GC50MPS33-CAL

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