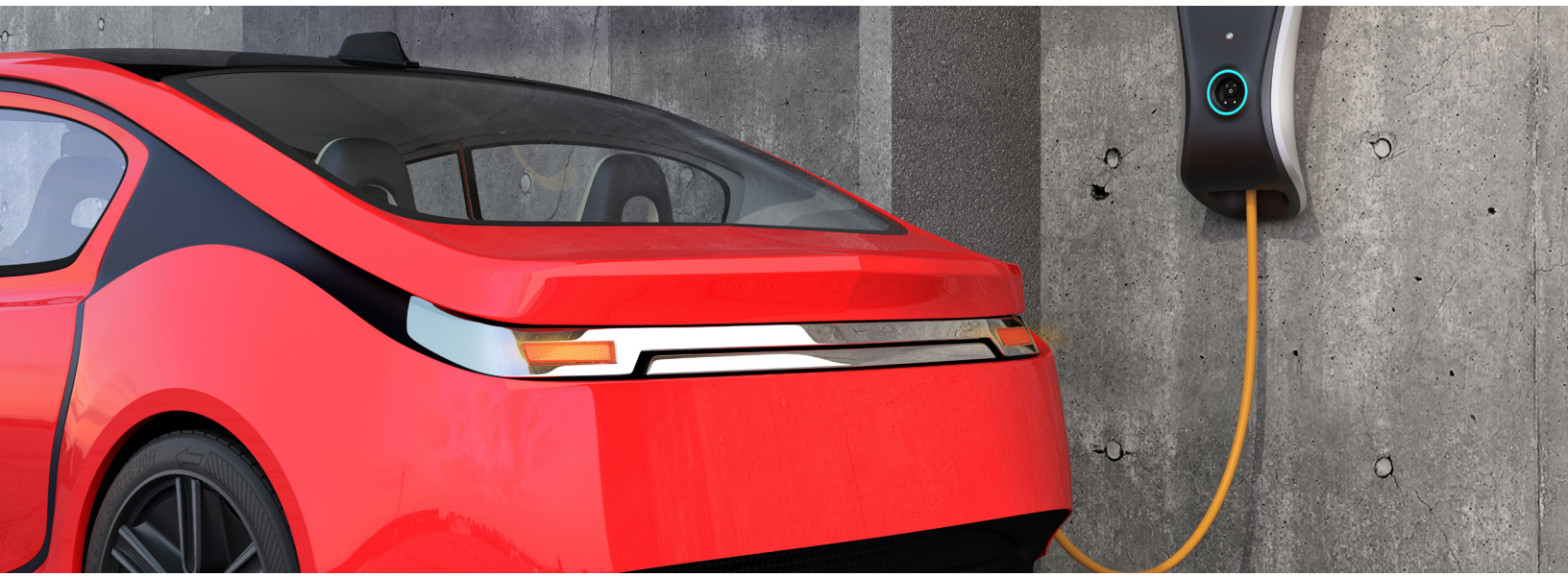
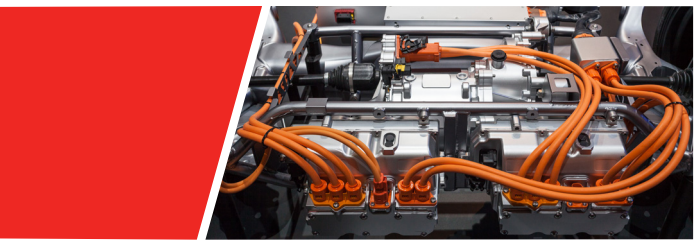
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Silicon Carbide Semiconductor Products









www.microchip.com/SiC

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Breakthrough Technology Combines High Performance With Low Losses

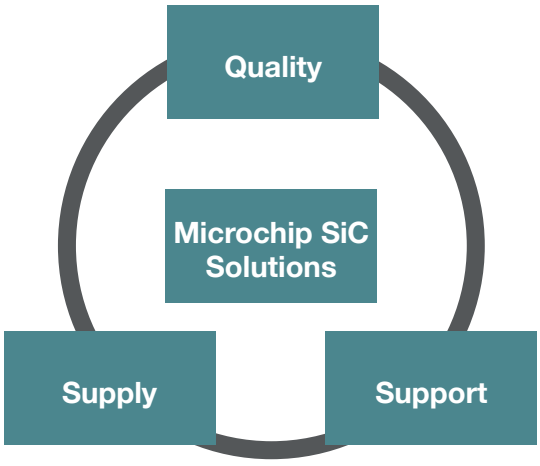
Silicon Carbide (SiC) semiconductors provide an innovative option for power electronic designers looking for improved system efficiency, smaller form factor and higher operating temperature in products covering industrial, transportation/automotive, medical, aerospace/aviation, defense and communcation market segments. Our next-generation SiC MOSFETs and SiC SBDs are designed with higher repetitive Unclamped Inductive Switching (UIS) capability at rated on-resistance or current. Our SiC MOSFETs maintain high UIS capability at approximately 10–25 Joules Per Square Centimeter (J/cm^2) and robust short circuit protection. Microchip's SiC Schottky Barrier Diodes (SBDs) are designed with balanced surge current, forward voltage, thermal resistance and thermal capacitance ratings at low reverse current for lower switching loss. In addition, our SiC MOSFET and SiC SBD die can be paired together for use in modules. SiC MOSFET and SiC SBD products from Microchip will be qualified to the AEC-Q101 standard.

- Extremely-low switching losses improves system efficiency
- High-power density for smaller footprint to reduce size and weight
- 3× more thermally conductive than silicon
- Reduced sink requirements to achieve smaller size, lighter weight
- High-temperature operation improves reliability at increased power density
- Proven reliability/ruggedness, supply chain and support with Microchip quality, supply and support

SiC is the perfect technology to address high-frequency and high-power density applications → Lower power losses Higher frequency cap. Higher junction temp. → Easier cooling Downsized system Higher reliability

Automotive | **Industrial** | **Aviation** | **Defense** | **Medical**





QSS

- **Quality:** proven reliability and ruggedness
- **Supply:** risk averse approach throughout the supply chain
- **Support:** standard discrete, die, module, and gate drive solutions with design and application support for customers

Higher Switching Efficiency

SiC is the ideal technology for higher-switching-frequency, higher-efficiency and higher-power (>650 V) applications. Target markets and applications include:

- Industrial—Motor drives, welding, UPS, SMPS, induction heating
- Transportation/automotive—Electric Vehicle (EV) battery chargers, on board chargers, Hybrid Electric Vehicle (HEV) powertrains, DC-DC converters, energy recovery
- Smart energy—Photovoltaic (PV) inverters, wind turbines
- Medical—MRI power supply, X-ray power supply
- Commercial aviation—Actuation, air conditioning, power distribution
- Defense—Motor drives, auxiliary power supplies, integrated vehicle systems

SiC MOSFET and SiC Schottky Barrier Diode products increase your system efficiency over silicon MOSFET and IGBT solutions while lowering your total cost of ownership by enabling downsized systems and smaller/lower-cost cooling.

Advanced R&D and Manufacturing

Design

- TCAD design and process simulators
- Mask-making and layout
- Finite Element Analysis (FEA) and Electrothermal simulation capabilities
- Design for ruggedness

Process

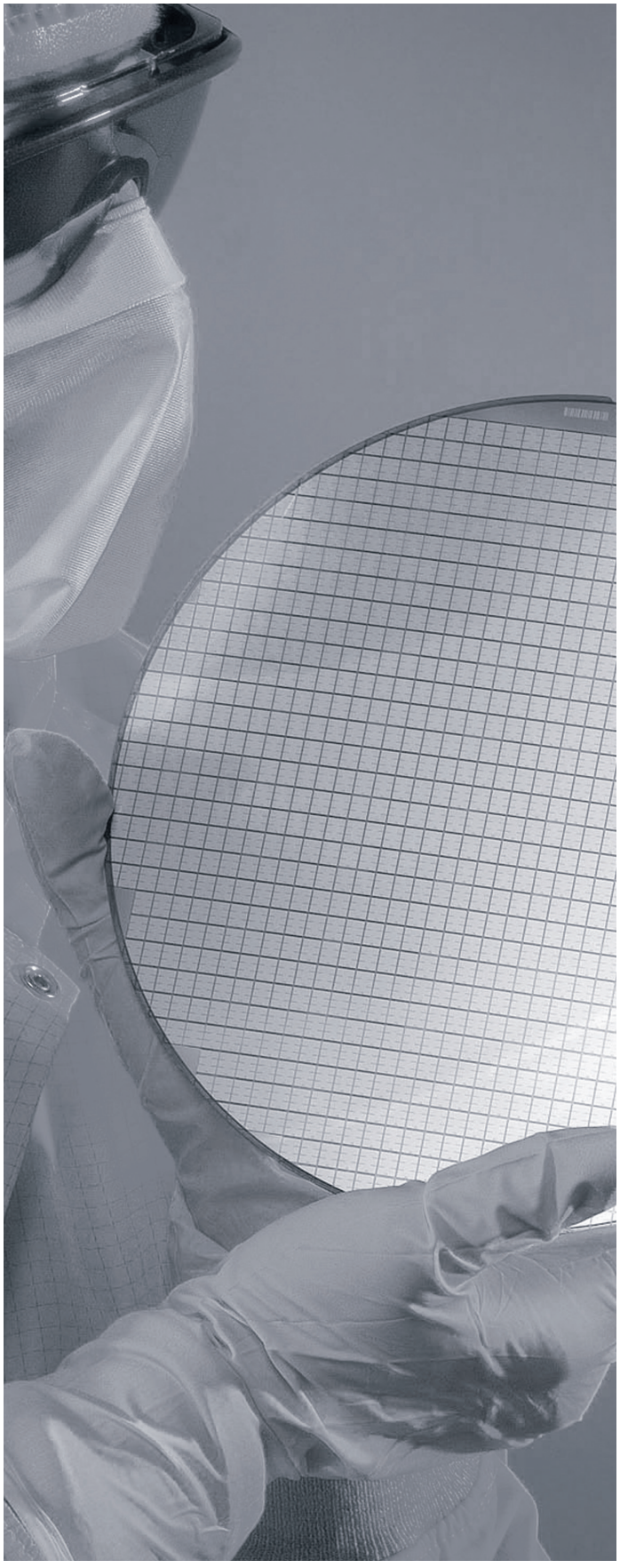
- Automotive quality internal fab and foundry
- Propietary gate oxide process with exceptional reliability
- Specialized tools for SiC processes - implant, anneal, etch, furnaces, metal deposition

Analytical and Support

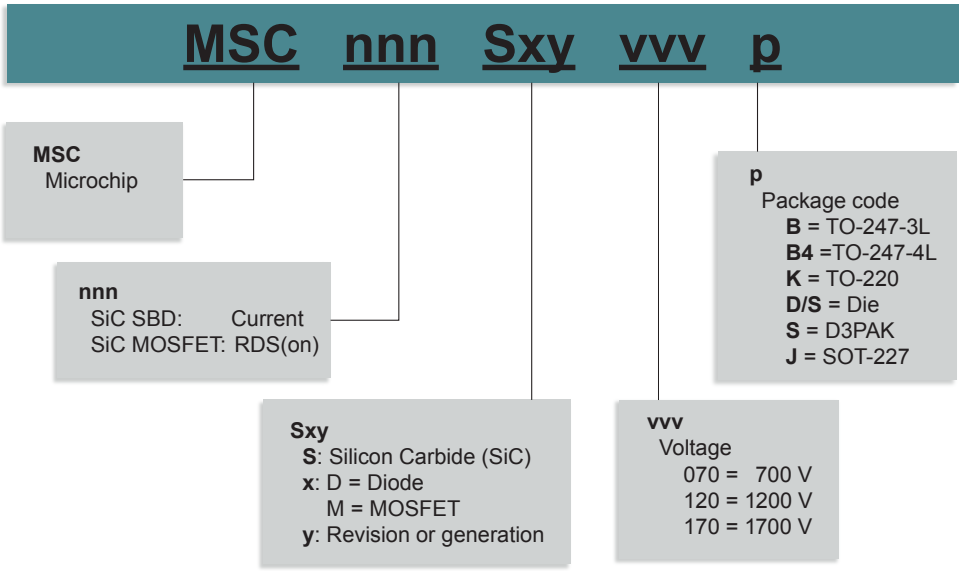
- Full FA capabilities in-house
- SEM/EDAX
- Thermal imaging
- Photo Emission Microscope system (Phemos 1000)

Reliability Testing and Screening

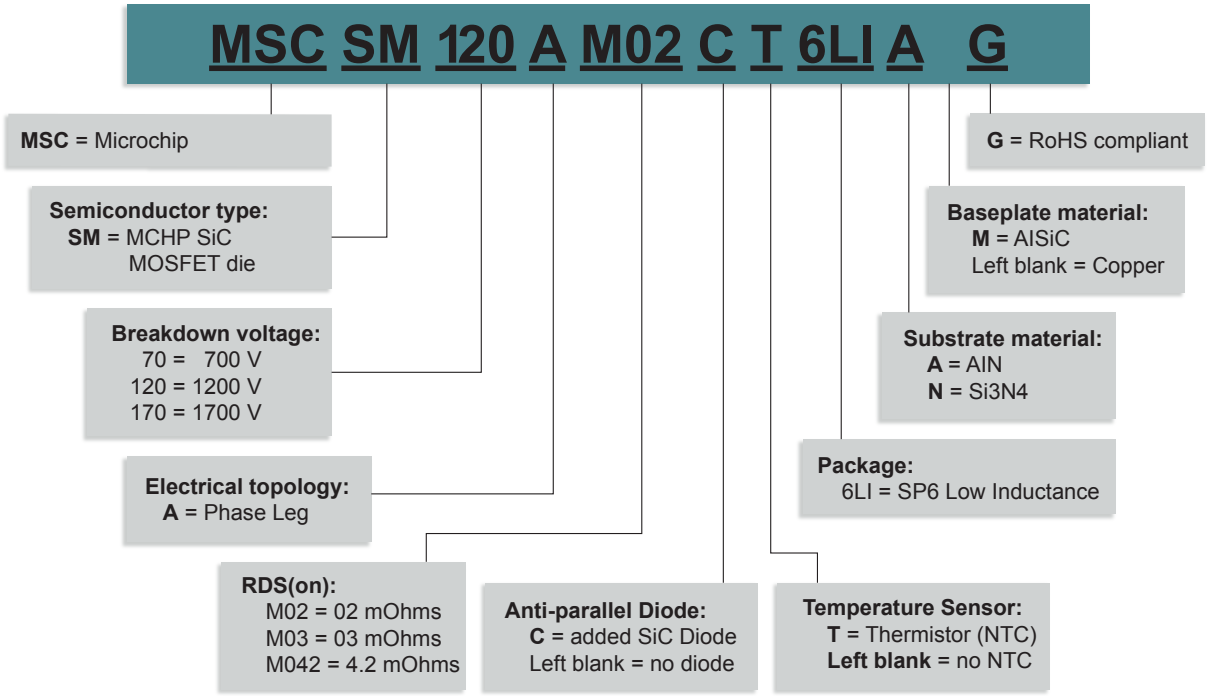
- AEC-Q101
- Full suite of tools and equipment for burn-ins and reliability screening
- Sonoscan and X-ray



SiC Discretes



SP6LI SiC Power Modules



SiC Schottky Barrier Diodes

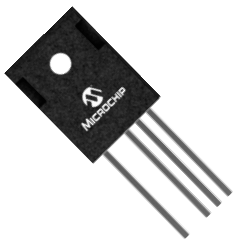
Part Number	Voltage (V)	I_F (A)	Package
MSC010SDA070B	700	10	TO-247
MSC010SDA070K		10	TO-220
MSC030SDA070B		30	TO-247
MSC030SDA070K		30	TO-220
MSC050SDA070B		50	TO-247
MSC010SDA120B	1200	10	TO-247
MSC010SDA120K		10	TO-220
MSC015SDA120B		15	TO-247
MSC015SDA120K		15	TO-220
MSC030SDA120B		30	TO-247
MSC030SDA120K		30	TO-220
MSC030SDA120S		30	D3PAK
MSC050SDA120B		50	TO-247
MSC050SDA120S		50	D3PAK
MSC010SDA170B	1700	10	TO-247
MSC030SDA170B		30	TO-247
MSC050SDA170B		50	TO-247

SiC MOSFETs

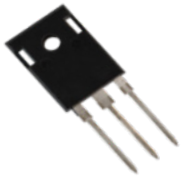
Part Number	Voltage (V)	RDSon (mΩ)	Package
MSC090SMA070B	700	90	TO-247
MSC090SMA070S			D3PAK
MSC060SMA070B		60	TO-247
MSC060SMA070B4			TO-247-4L
MSC060SMA070S			D3PAK
MSC035SMA070B		35	TO-247
MSC035SMA070B4			TO-247-4L
MSC035SMA070S			D3PAK
MSC015SMA070B		15	TO-247
MSC015SMA070B4			TO-247-4L
MSC015SMA070S			D3PAK
MSC080SMA120B	1200	80	TO-247
MSC080SMA120B4			TO-247-4L
MSC080SMA120S			D3PAK
MSC080SMA120J			SOT-227
MSC040SMA120B		40	TO-247
MSC040SMA120B4			TO-247-4L
MSC040SMA120S			D3PAK
MSC040SMA120J			SOT-227
MSC025SMA120B		25	TO-247
MSC025SMA120B4			TO-247-4L
MSC025SMA120S			D3PAK
MSC025SMA120J			SOT-227
MSC750SMA170B	1700	750	TO-247
MSC750SMA170B4			TO-247-4L
MSC750SMA170S			D3PAK
MSC035SMA170B		35	TO-247
MSC035SMA170B4			TO-247-4L
MSC035SMAS170S			D3PAK

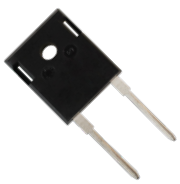
SiC MOSFET Features and Benefits

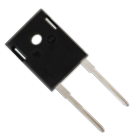
Characteristics	SiC vs. Si	Results	Benefits
Breakdown field (MV/cm)	10× higher	Lower on-resistance	Higher efficiency
Electron sat. velocity (cm/s)	2× higher	Faster switching	Size reduction
Bandgap energy (ev)	3× higher	Higher junction temperature	Improved cooling
Thermal conductivity (W/m.K)	3× higher	Higher power density	Higher current capabilities
Positive temperature coefficient		Self regulation	Easy paralleling



TO-247-4L


TO-247-3L


TO-247-2L


TO-220



TO-268


SOT-227

Power Module Advantages

- High-speed switching
- Low switching losses
- Low-input capacitance
- High-power density
- Low-profile packages
- Minimum parasitic inductance
- Lower system cost
- Standard and custom modules
- 30+ years design experience

Part Number	Type	Electrical Topology	Voltage (V)	RDSon (mΩ)	Current (A) Tc = 80 C	Package	Notes
MSC2X30/31SDA070J	SiC Diode Module	Dual diode (Anti-parallel/parallel)	700	-	30	SOT-227	
MSC2X50/51SDA070J				-	50	SOT-227	
MSC2X100/101SDA070J				-	100	SOT-227	
MSC2X30/31SDA120J			1200	-	30	SOT-227	
MSC2X50/51SDA120J				-	50	SOT-227	
MSC2X100/101SDA120J				-	100	SOT-227	
MSCDC50H701AG		Full bridge	700	-	50	SP1	
MSC50DC70HJ				-	50	SOT-227	
MSCDC100H70AG				-	100	SP6	
MSCDC200H70AG				-	200	SP6	
MSCDC50H1201AG			1200	-	50	SP1	
MSC50DC120HJ				-	50	SOT-227	
MSCDC100H120AG				-	100	SP6	
MSCDC200H120AG				-	200	SP6	
MSCDC100H170AG			1700	-	100	SP6C	
MSCDC200H170AG				-	200	SP6C	
MSCDC50H1701AG				-	50	SP1	
MSC50DC170HJ				-	50	SOT-227	
MSCDC100A70D1PAG		Phase leg	700	-	100	D1P	
MSCDC150A70D1PAG				-	150	D1P	
MSCDC200A70D1PAG				-	200	D1P	
MSCDC300A70AG				-	300	SP6	
MSCDC450A70AG				-	450	SP6	
MSCDC600A70AG				-	600	SP6	
MSCDC100A120D1PAG			1200	-	100	D1P	
MSCDC150A120D1PAG				-	150	D1P	
MSCDC200A120D1PAG				-	200	D1P	
MSCDC300A120AG				-	300	SP6	
MSCDC450A120AG				-	450	SP6	
MSCDC600A120AG				-	600	SP6	
MSCDC300A170AG			1700	-	300	SP6C	
MSCDC450A170AG				-	450	SP6C	
MSCDC600A170AG				-	600	SP6C	
MSCDC100A170D1PAG				-	100	D1P	
MSCDC150A170D1PAG				-	150	D1P	
MSCDC200A170D1PAG				-	200	D1P	
MSCDC100KK70D1PAG		Dual common cathode	700	-	100	D1P	
MSCDC150KK70D1PAG				-	150	D1P	
MSCDC200KK70D1PAG				-	200	D1P	
MSCDC100KK120D1PAG			1200	-	100	D1P	
MSCDC150KK120D1PAG				-	150	D1P	
MSCDC200KK120D1PAG				-	200	D1P	

Part Number	Type	Electrical Topology	Voltage (V)	RDSon (mΩ)	Current (A) Tc = 80 C	Package	Notes
MSCDC100KK170D1PAG	SiC Diode Module	Dual common cathode	1700	-	100	D1P	
MSCDC150KK170D1PAG				-	150	D1P	
MSCDC200KK170D1PAG				-	200	D1P	
MSCDC50X701AG		Three phase bridge	1200	-	50	SP1	
MSCDC50X1201AG				-	50	SP1	
MSCDC50X1701AG			1700	-	50	SP1	
MSC100SM70JCU2	SiC MOSFET Module	Boost chopper	700	15	97	SOT-227	
MSC100SM70JCU3				15	97	SOT-227	
MSC40SM120JCU2			1200	40	44	SOT-227	
MSC70SM120JCU2				25	71	SOT-227	
MSC130SM120JCU2				12.5	138	SOT-227	
MSCSM120DAM11CT3AG				11	202	SP3F	
MSC40SM120JCU3		Buck chopper		40	44	SOT-227	
MSC70SM120JCU3				25	71	SOT-227	
MSC130SM120JCU3				12.5	138	SOT-227	
MSCSM120SKM11CT3AG				11	202	SP3F	
MSCSM70HM19CT3AG		Full bridge	700	15	97	SP3F	
MSCSM120HM31CT3AG			1200	25	71	SP3F	
MSCSM120HM16CT3AG				12.5	138	SP3F	
MSCSM120HM50CT3AG				40	44	SP3F	
MSCSM70AM19CT1AG		Phase leg	700	15	97	SP1F	
MSCSM70AM07CT3AG				5	276	SP3F	
MSCSM70AM10CT3AG				7.5	188	SP3F	
MSCSM70AM025CD3AG				2.5	538	D3	
MSCSM70AM025CT6AG				2.5	538	SP6C	
MSCSM120AM16CT1AG			1200	12.5	138	SP1F	
MSCSM120AM31CT1AG				25	71	SP1F	
MSCSM120AM50CT1AG				40	44	SP1F	
MSCSM120AM08CT3AG				6.25	268	SP3F	
MSCSM120AM11CT3AG				8.33	202	SP3F	
MSCSM120AM042CD3AG				4.2	394	D3	2, 3
MSCSM120AM027CD3AG				2.7	584	D3	2, 3
MSCSM120AM042CT6AG				4.2	394	SP6C	
MSCSM120AM027CT6AG				2.7	584	SP6C	
MSCSM70VM19C3AG		Vienna phase leg	700	15	97	SP3F	
MSCSM70VM10C4AG				7.5	97	SP4	
MSCSM70TAM19CT3AG		Three hase bridge Triple phase leg		15	97	SP3F	
MSCSM70TAM10CTPAG				7.5	186	SP6P	
MSCSM70TAM05TPAG				5	273	SP6P	
MSCSM120TAM31CT3AG			1200	25	71	SP3F	
MSCSM120TAM16CTPAG				12.5	136	SP6P	
MSCSM120TAM11CTPAG				8.33	200	SP6P	
MSCSM70AM025CT6LIAG	Low Inductance SiC MOSFET Module	Phase leg	700	2.5	538	SP6C LI	
MSCSM120AM042CT6LIAG			1200	4.2	394	SP6C LI	1
MSCSM120AM03CT6LIAG				2.5	641	SP6C LI	1
MSCSM120AM02CT6LIAG				2.1	754	SP6C LI	1

1, 2, 3 Refer to Gate Driver Solutions table on page 9

Gate Driver Reference*	Gate Driver Type	Gate Driver Part Number	Adapter Board Part Number
1	Core	2ASC-12A1HP	SP6CA1
2	Core	2ASC-12A1HP	62CA1
3	Plug & Play	62EM1-00001	Not Applicable

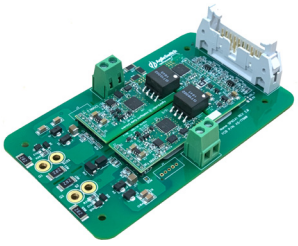
*Refer to footnotes in SiC product tables

2ASC-12A1HP



Improve switching efficiency and EMI performance, all while protecting your valuable SiC devices. The AgileSwitch 2ASC dual-channel high performance gate driver cores are designed to take on your SiC implementation challenges.

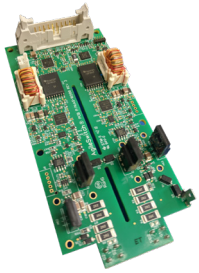
62CA1 and SP6CA1 (Shown with 2ASC-12A1HP connected)





Compatible with the AgileSwitch 2ASC Gate Driver Cores, the family of Module Adapter Boards provides a platform to rapidly evaluate and optimize new SiC power devices. Standard offerings include a reference design for the 1200V SP6LI (SP6CA1) and 1200V D3 (62CA1).

62EM1



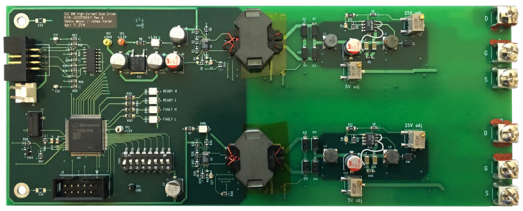
Control, monitor, and protect the latest 62 mm SiC devices using the Plug-and-Play 62EM Gate Driver Boards. Designed for traction applications, the 62EM can drive up to 1.7 kV devices at 100 kHz with configurable fault settings and patented Augmented Switching technology.

User-Friendly Reference Designs

Microchip and our partner ecosystem provide open-source, user friendly SiC MOSFET reference design solutions that enable faster time to market for customers using our SiC MOSFETs and power modules. You can use isolated dual-gate driver reference designs with our SiC MOSFETS in a number of SiC topologies.

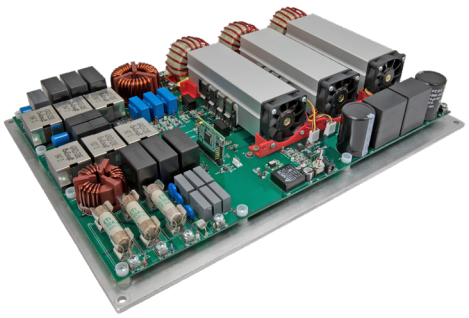
SiC Reference Designs

Part Number	Gate Drive or Line Voltage	KHz, max	Per Side Drive Power (W)	Description
MSCSICMDD/REF	–5 to +20 V	400	8 W	SiC discrete gate driver board
MSCSICSP3/REF2	–5 to +20 V	400	16 W	SiC SP3 module driver board
MSCSICSP6L/REF3	–5 to +20 V	400	16 W	SiC SP6LI module driver board
MSCSICPFC/REF5	In: 400 Vrms, Out: 700 Vdc	140	30 kW	30 kW 3-phase Vienna PFC (design files only)



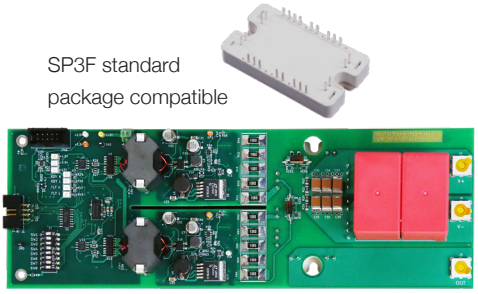
The MSCSICMDD/REF1 is a switch-configurable high/low-side driver with half bridges or independent drive.

- 400 kHz maximum switching frequency
- 8W of gate drive power per side
- 30A peak output current
- –5V/+20 V gate drive voltage
- ±100 kV/uS capability
- Galvanic isolation of more than 2000V on both gate drivers



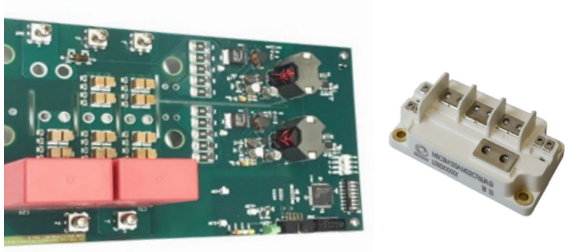
The MSCSICPFC/REF5 is a Vienna 3-Phase PFC reference design for Hybrid Electric Vehicle/Electric Vehicle (HEV/EV) charger and high-power switch mode power supply applications.

- 30 kW Vienna rectifier topoloy at 98.6 % peak efficiency
- 380/400 VAC, 50 Hz/60 Hz input voltage with 700V DC output voltage
- 140 kHz pulse-width modulation switching frequency
- < 5% current THD at half and full loads
- 700 V SiC MOSFETs and 1200 V SiC diodes
- dsPIC33CH using 3-level modulation for digital control



The MSCSICSP3/REF2 is a half bridge driver compatible with SP3F standard package modules.

- 400 kHz maximum switching frequency
- 16W of gate drive power per side
- 30A peak output current
- –5 V/+20 V gate drive voltage
- ±100 kV/uS capability
- Galvanic isolation of more than 2000 V on both gate drivers



The MSCSICSP6/REF3 is a half bridge driver for the low inductance SP6LI power modules.

- Stray inductance < 3 nH to fully benefit from SiC
- Designed to be easy to parallel
- Up to 1200 V and 586 A
- Half Bridge Driver
- Up to 400 kHz switching frequency
- 12 V VIN supply
- Capable of 16 W of gate drive power/side
- 30 A Peak Source output current
- Min.100 KV/µS CMTI

Notes

Support

Microchip is committed to supporting its customers in developing products faster and more efficiently. We maintain a worldwide network of field applications engineers and technical support ready to provide product and system assistance. For more information, please visit www.microchip.com:

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