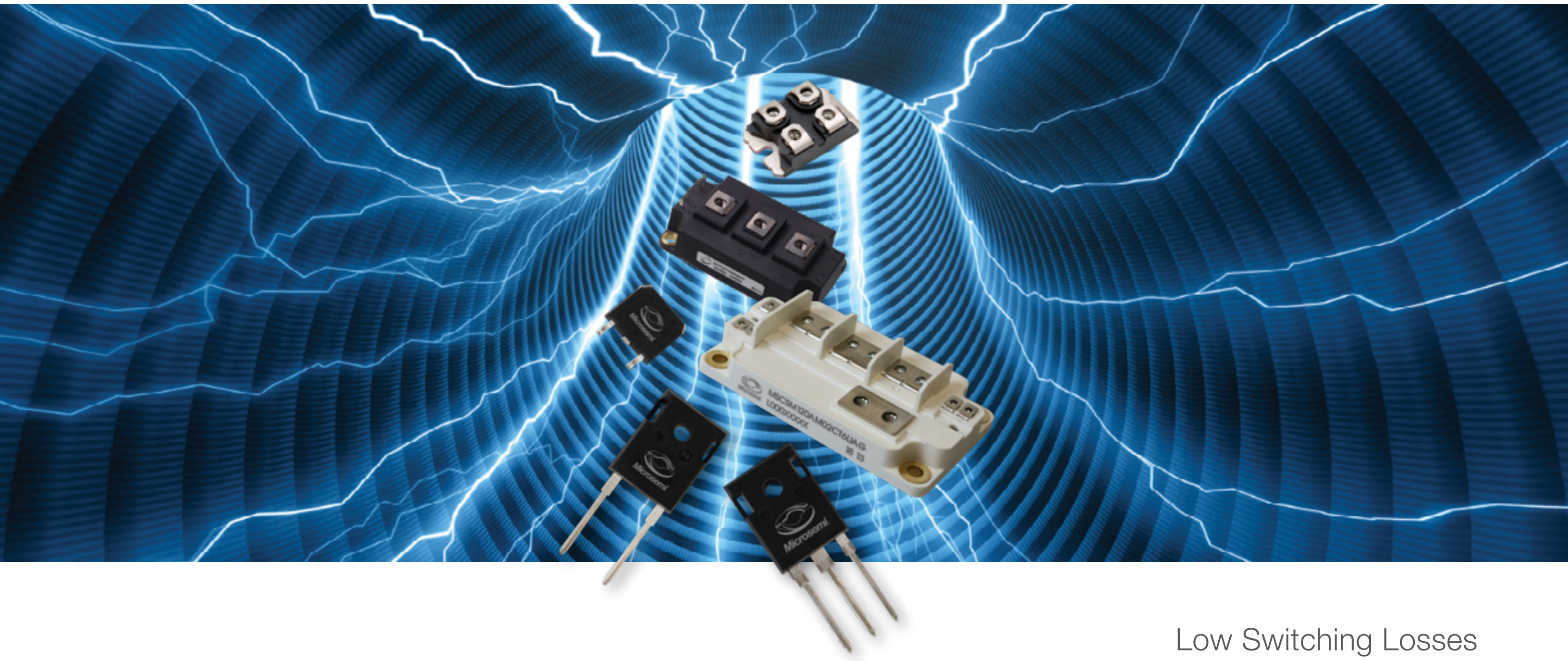
Silicon Carbide Semiconductor Products



Low Switching Losses

Low Gate Resistance

High Power Density

High Thermal Conductivity

High Avalanche (UIS) Rating

Reduced Heat Sink Requirements

High Temperature Operation

Reduced Circuit Size and System Costs

Microsemi®
Power Matters.™

Overview

Breakthrough Technology Combines High Performance with Low Losses

Extremely Low Switching Losses

- Zero reverse recovery charge improves system efficiency

High Power Density

- Smaller footprint device reduces system size and weight

High Thermal Conductivity

- 2.5x more thermally conductive than silicon

Reduced Sink Requirements

- Results in lower cost and smaller size

High Temperature Operation

- Increased power density and improved reliability

Silicon Carbide (SiC) semiconductors are an innovative new option for power electronic designers looking for improved system efficiency, smaller form factor and higher operating temperature in products covering industrial, medical, mil-aerospace, aviation, and communcation market segments. Microsemi's next-generation SiC MOSFETS and SiC SBDs are designed with higher repetitive unclamped inductive switching (UIS) capability at rated current, with no degradation or failures. The new SiC MOSFETs maintain high UIS capability at approximately 10-15 Joules per square centimeter (J/cm2) and robust short circuit protection at 3-5 microseconds. The company's SiC 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, its SiC MOSFET and SiC SBD die can paired together for use in modules. SiC MOSFET and SiC SBD products from Microsemi will be qualified to the AEC-Q101 standard.

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

Higher Switching Frequency

Silicon Carbide (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—EV battery charger, onboard chargers, hybrid electric vehicle (HEV)/electric vehicle (EV) powertrain, DC–DC converter, energy recovery
- Smart energy—PV inverter, wind turbine
- 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 product lines from Microsemi 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.

Full In-House and Foundry Capabilities

Design

- Silvaco design and process simulator
- TCAD-TMA
- Mask-making and layout
- Solid works and FEA

Process

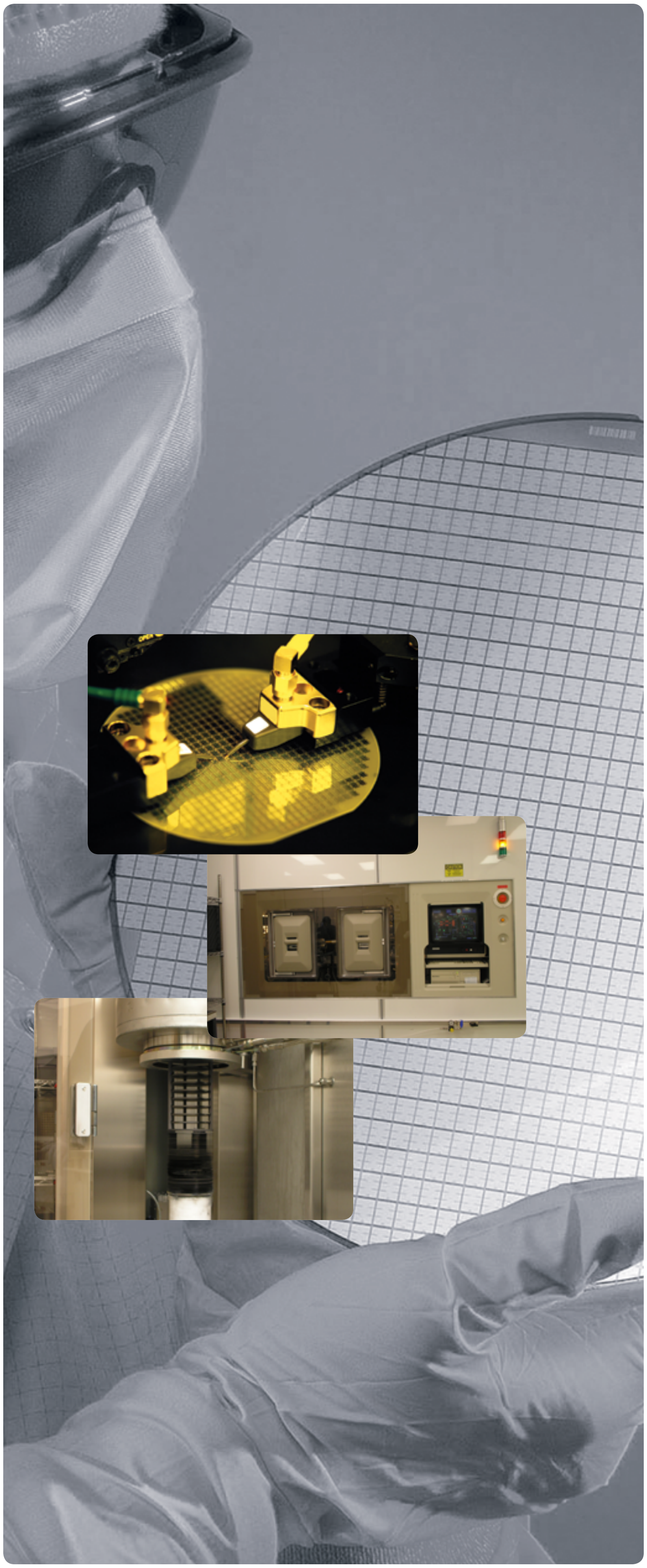
- High-temperature ion implantation
- High-temperature annealing
- SiC MOSFET gate oxide
- ASML steppers
- RIE and plasma etching
- Sputtered and evaporated metal deposition

Analytical and Support

- SEM/EDAX
- Thermal imaging
- Photo Emission Microscope system (Phemos 1000)

Reliability Testing and Screening

- AEC-Q101
- HTRB and HTGB
- Sonoscan and X-ray



SiC Discretes and Modules Nomenclature

SiC Discretes

MSC nnn Sxy vvv p

MSC
Microsemi Corporation

nnn
SiC SBD: Current
SiC MOSFET: RDS(on)

Sxy
S: Silicon Carbide (SiC)
x: D = Diode
M = MOSFET
y: Revision or generation

vvv
Voltage
070 = 700 V
120 = 1200 V
170 = 1700 V

p
Package code
B = TO-247
K = TO-220
S = D3PAK
J = SOT-227

SP6LI SiC Power Modules

MSC MC 120 A M02 C T 6LI N _ G

MSC = Microsemi Corporation

Semiconductor type:
SM = MSC SiC MOSFET
MC = Wolfspeed

Breakdown voltage:
90 = 900 V
120 = 1200 V
170 = 1700 V

Electrical topology:
A = Phase Leg

RDS(on):
M02 = 02 mOhms
M03 = 03 mOhms
M08 = 08 mOhms

Anti-parallel Diode:
C = added SiC Diode
Left blank = no diode

Temperature Sensor:
T = Thermistor (NTC)
Left blank = no NTC

Package:
6LI = SP6 Low Inductance

Substrate material:
A = AlN
N = Si3N4

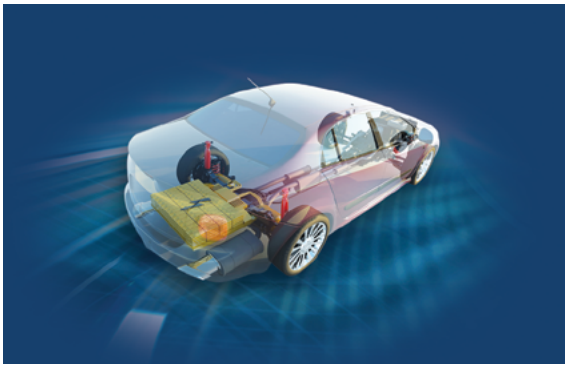
Baseplate material:
M = AlSiC
Left blank = Copper

G = RoHS compliant

Discrete Products

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
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

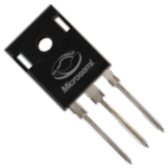


SiC MOSFETs

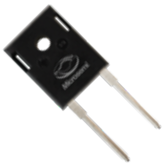
Part Number	Voltage (V)	RDS(on)	Package
MSC090SMA070B	700	90 mΩ	TO-247
MSC090SMA070S			D3PAK
MSC060SMA070B		60 mΩ	TO-247
MSC060SMA070S			D3PAK
MSC035SMA070B		35 mΩ	TO-247
MSC035SMA070S			D3PAK
MSC015SMA070B		15 mΩ	TO-247
MSC015SMA070S			D3PAK
MSC280SMA120B	1200	280 mΩ	TO-247
MSC280SMA120S			D3PAK
MSC140SMA120B		140 mΩ	TO-247
MSC140SMA120S			D3PAK
MSC080SMA120B		80 mΩ	TO-247
MSC080SMA120S			D3PAK
MSC080SMA120J			SOT-227
MSC040SMA120B		40 mΩ	TO-247
MSC040SMA120S			D3PAK
MSC040SMA120J			SOT-227
MSC025SMA120B		25 mΩ	TO-247
MSC025SMA120S			D3PAK
MSC025SMA120J			SOT-227
MSC750SMA170B	1700	750 mΩ	TO-247
MSC750SMA170S			D3PAK
MSC045SMA170B		45 mΩ	TO-247
MSC045SMA170S			D3PAK

SiC MOSFET Features and Benefits

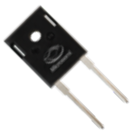
Characteristics	SiC vs. Si	Results	Benefits
Breakdown field (MV/cm)	10x higher	Lower on-resistance	Higher efficiency
Electron sat. velocity (cm/s)	2x higher	Faster switching	Size reduction
Bandgap energy (ev)	3x higher	Higher junction temperature	Improved cooling
Thermal conductivity (W/m.K)	3x higher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



TO-247-3L



TO-247



TO-220

D3PAK
(TO-268)

SOT-227

Power Modules

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 & custom modules
- Choice of Si/SiC devices

Standard Modules

Part Number	Type	Electrical Topology	Voltage (V)	Current	Package
APT2X20DC60J	SiC Diode module	Dual diode	600	20	SOT227
APT2X30DC60J				30	SOT227
APT2X50DC60J				50	SOT227
APT2X60DC60J				60	SOT227
APT2X20DC120J			1200	20	SOT227
APT2X40DC120J				40	SOT227
APT2X50DC120J				50	SOT227
APT2X60DC120J				60	SOT227
APT40DC60HJ		Full bridge	600	40	SOT227
APTDC40H601G				40	SP1
APT10DC120HJ			1200	10	SOT227
APT20DC120HJ				20	SOT227
APTDC20H1201G				20	SP1
APT40DC120HJ				40	SOT227
APTDC40H1201G				40	SP1
APT50MC120JCU2	SiC MOSFET module	Boost chopper	1200	50	SOT227
APT100MC120JCU2				100	SOT227
APTMC120HM17CT3AG		Full bridge		110	SP3F
APTMC120AM55CT1AG		Phase leg		40	SP1
APTMC120AM25CT3AG				80	SP3F
APTMC120AM20CT1AG				100	SP1
APTMC120AM16CD3AG				100	D3
APTMC120AM12CT3AG				150	SP3F
APTMC120AM08CD3AG				185	D3
APTMC120AM09CT3AG				200	SP3F
APTMC170AM60CT1AG			1700	40	SP1
APTMC170AM30CT1AG				80	SP1
APTMC60TL11CT3AG		Three level inverter	600	20	SP3F
APTMC60TLM55CT3AG				40	SP3F
APTMC60TLM14CAG				160	SP6
APTMC120HR11CT3AG			1200	20	SP3F
APTMC120HRM40CT3AG				50	SP3F
APTMC120TAM34CT3AG		Three phase bridge Triple phase leg		55	SP3F
APTMC120TAM33CTPAG				60	SP6P
APTMC120TAM17CTPAG				100	SP6P
APTMC120TAM12CTPAG				150	SP6P
MSCMC120AM07CT6LIAG	Very Low Inductance SiC MOSFET module	Phase leg	1200	210	SP6LI
MSCMC120AM04CT6LIAG				307	SP6LI
MSCMC120AM03CT6LIAG				475	SP6LI
MSCMC120AM02CT6LIAG				586	SP6LI
MSCMC170AM08CT6LIAG		Phase leg	1700	207	SP6LI

Customization

Microsemi offers a complete engineering solution with mix and match capabilities in terms of package, interconnection, configuration, performance, and cost.

Out of the existing standard power modules product line, Microsemi can offer simple, modified, or fully customized parts to meet 100% of our customers' needs.

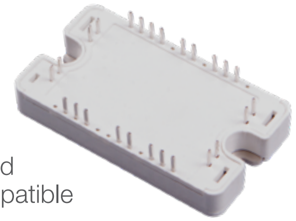
- Design expertise
- High power density
- Low profile packages
- Extended temperature capabilities
- Pin locating flexibility
- Mix of silicon

Gate Driver Solutions

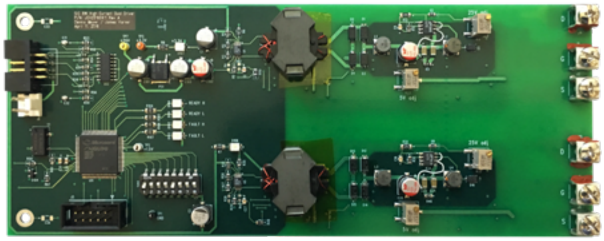
Microsemi and our partner ecosystem provide open-source, user friendly SiC MOSFET driver solutions that enable faster time to market for customers using our SiC MOSFETs and power modules. Customers can use isolated dual-gate driver referenced designs with our SiC MOSFETS in a number of SiC topologies.

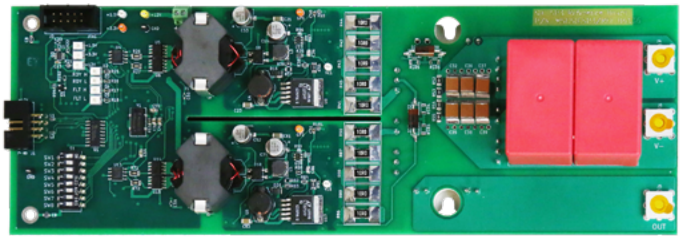
SiC MOSFET Driver Reference Designs With Isolation

Part Number	Gate Drive Voltage (V)	Freq. (max)	Per Side Drive Power
MSCSICMDD/REF	-5/+20	400 kHz	8 W
MSCSICSP3/REF2	-5/+20	400 kHz	16 W



SP3F standard
package compatible





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

- 400kHz maximum switching frequency
- 8 W of gate drive power per side
- 30 A 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

www.microsemi.com/product-directory/reference-designs/MSCSICMDD-REF1

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

- 400kHz maximum switching frequency
- 16 W of gate drive power per side
- 30 A 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

www.microsemi.com/product-directory/reference-designs/MSCSICSP3-REF2

Microsemi is continually adding new products to its industry-leading portfolio.

For the most recent updates to our product line and for detailed information and specifications, please call, email, or visit our website.

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