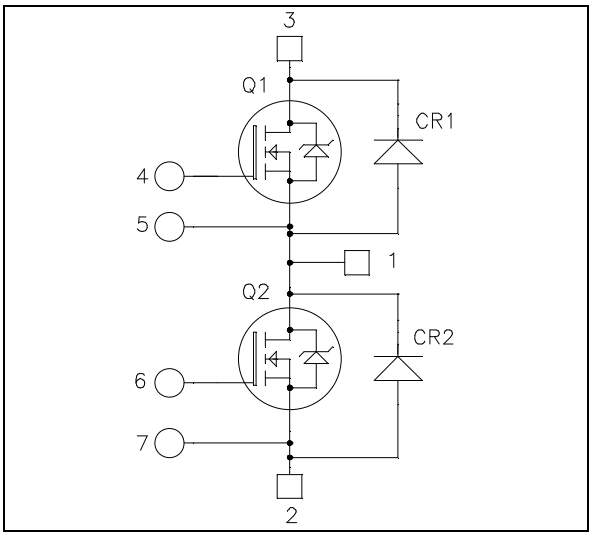
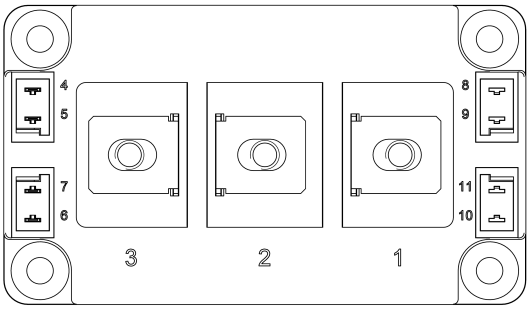
MSCSM120AM13CD3AG

Phase leg
SiC Power Module

V_{DSS} = 1200V
R_{DSon} = 12.5mΩ typ @ Tj = 25°C
I_D = 171A @ Tc = 25°C





Application

- Welding converters
- Switched Mode Power Supplies
- Uninterruptible Power Supplies
- EV motor and traction drive

Features

- ***SiC Power MOSFET***
  - Low $R_{DS(on)}$
  - High temperature performance
- ***SiC Schottky Diode***
  - Zero reverse recovery
  - Zero forward recovery
  - Temperature Independent switching behavior
  - Positive temperature coefficient on VF
- Kelvin emitter for easy drive
- High level of integration
- AlN substrate for improved thermal performance
- M6 power connectors

Benefits

- High efficiency converter
- Stable temperature behavior
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- RoHS Compliant

All ratings @ T_j = 25°C unless otherwise specified

Absolute maximum ratings (per SiC MOSFET)

Symbol	*Parameter*		*Max ratings*	*Unit*
V_{DSS}	Drain - Source Voltage		1200	V
I_D	Continuous Drain Current	T_c = 25°C	171	A
		T_c = 80°C	136	
I_{DM}	Pulsed Drain current		342	
V_{GS}	Gate - Source Voltage		-10/25	V
R_{DSon}	Drain - Source ON Resistance		15.5	mΩ
P_D	Power Dissipation	T_c = 25°C	728	W

CAUTION: These Devices are sensitive to Electrostatic Discharge. Proper Handling Procedures Should Be Followed.

Electrical Characteristics (per SiC MOSFET)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
I_{DSS}	Zero Gate Voltage Drain Current	V_{GS} = 0V ; V_{DS} = 1200V			20	200	µA
$R_{DS(on)}$	Drain – Source on Resistance	V_{GS} = 20V I_D = 80A	T_j = 25°C		12.5	16	mΩ
			T_j = 175°C		20		
$V_{GS(th)}$	Gate Threshold Voltage	V_{GS} = V_{DS}, I_D = 2mA		1.8	2.8		V
I_{GSS}	Gate – Source Leakage Current	V_{GS} = 20 V, V_{DS} = 0V				200	nA

Dynamic Characteristics (per SiC MOSFET)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
C_{iss}	Input Capacitance	V_{GS} = 0V V_{DS} = 1000V f = 1MHz			6040		pF
C_{oss}	Output Capacitance				540		
C_{rss}	Reverse Transfer Capacitance				50		
Q_g	Total gate Charge	V_{GS}= -5/20V V_{Bus} = 800V I_D = 80A			464		nC
Q_{gs}	Gate – Source Charge				82		
Q_{gd}	Gate – Drain Charge				100		
$T_{d(on)}$	Turn-on Delay Time	V_{GS} = -5/20V ; V_{Bus} = 600V I_D = 100A ; T_J =150°C R_{GON} = 4Ω ; R_{GOFF} = 2.4Ω			60		ns
T_r	Rise Time				50		
$T_{d(off)}$	Turn-off Delay Time				180		
T_f	Fall Time				30		
E_{on}	Turn on Energy	Inductive Switching V_{GS} = -5/+20V V_{Bus} =600V; I_D =100A R_{GON}=4Ω;R_{GOFF}=2.4Ω	T_j = 150°C		2.04		mJ
E_{off}	Turn off Energy		T_j = 150°C		1.8		mJ
R_{Gint}	Internal gate resistance				2.94		Ω
R_{thJC}	Junction to Case Thermal Resistance					0.206	°C/W

Body diode ratings and characteristics (per SiC MOSFET)

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
V_{SD}	Diode Forward Voltage	V_{GS} = 0V ; I_{SD} = 80A		4		V
		V_{GS} = -5V ; I_{SD} = 80A		4.2		
t_{rr}	Reverse Recovery Time	I_{SD} = 80A ; V_{GS} = -5V V_R = 800V ; di_F/dt = 2000A/µs		90		ns
Q_{rr}	Reverse Recovery Charge			1100		nC
I_{rr}	Reverse Recovery Current			27		A

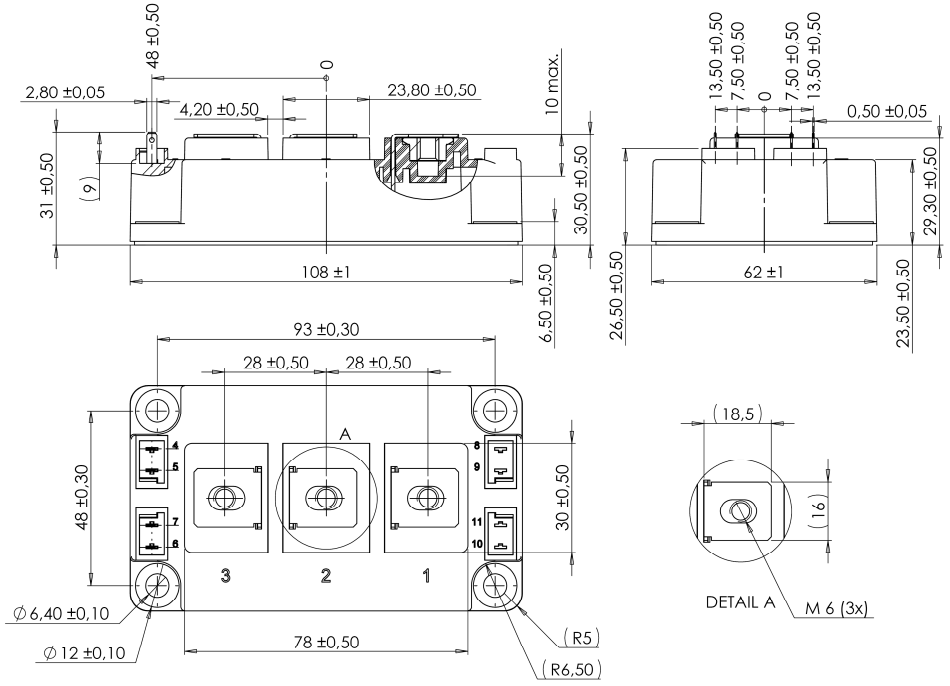
SiC schottky diode ratings and characteristics (per SiC diode)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V_{RRM}	Peak Repetitive Reverse Voltage					1200	V
I_{RRM}	Reverse Leakage Current	V_R=1200V	T_j = 25°C		20	400	µA
			T_j = 175°C		300		
I_F	Forward Current		Tc = 100°C		60		A
V_F	Diode Forward Voltage	I_F = 60A	T_j = 25°C		1.5	1.8	V
			T_j = 175°C		2.1		
Q_C	Total Capacitive Charge	V_R = 600V			260		nC
C	Total Capacitance	f = 1MHz, V_R = 400V			282		pF
		f = 1MHz, V_R = 800V			210		
R_{thJC}	Junction to Case Thermal Resistance					0.49	°C/W

Thermal and package characteristics

Symbol	Characteristic			Min	Max	Unit
V_{ISOL}	RMS Isolation Voltage, any terminal to case t =1 min, 50/60Hz			4000		V
T_J	Operating junction temperature range			-40	175	°C
T_{JOP}	Recommended junction temperature under switching conditions			-40	$T_J$max -25	
T_{STG}	Storage Temperature Range			-40	125	
T_C	Operating Case Temperature			-40	125	
Torque	Mounting torque	For terminals	M6	3	5	N.m
		To Heatsink	M6	3	5	
Wt	Package Weight				350	g

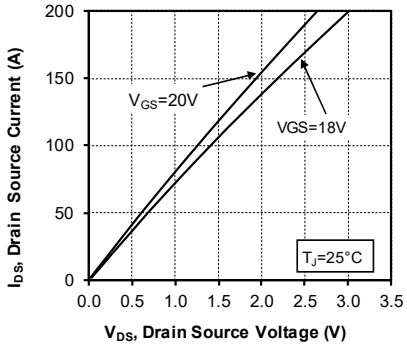
Package outline (dimensions in mm)



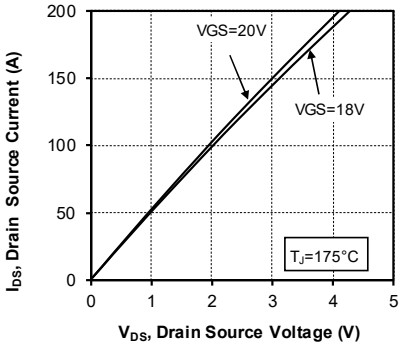
See application note 1908 - Mounting instructions for D3 & D4 power modules

Typical SiC MOSFET Performance Curve

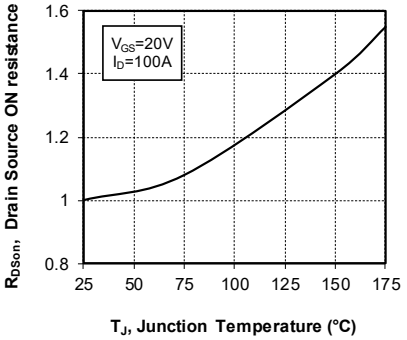
Output Characteristics



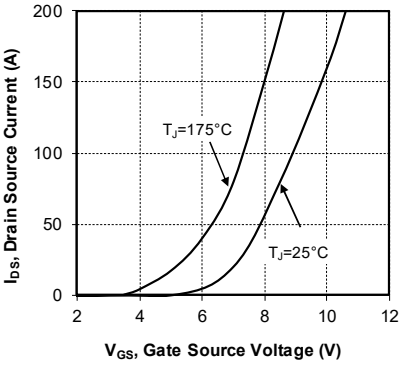
Output Characteristics



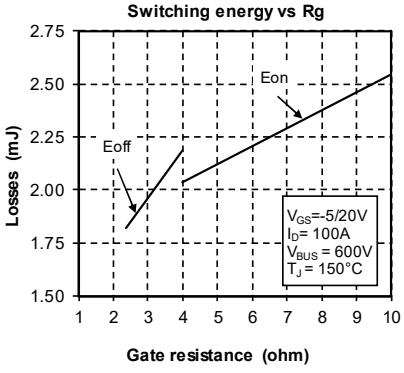
Normalized $R_{DS(on)}$ vs. Temperature



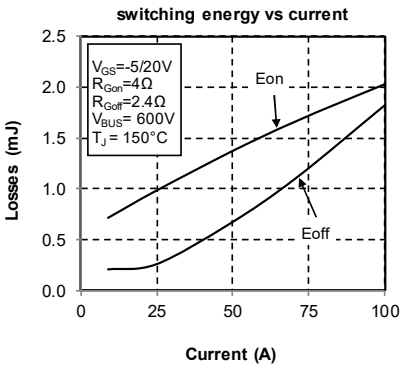
Transfert Characteristics



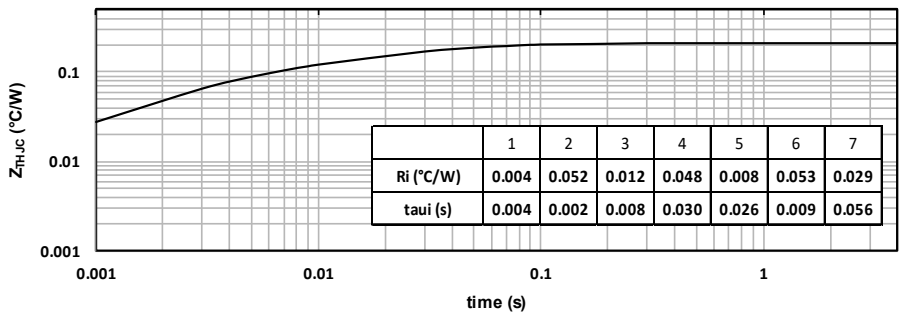
Switching energy vs Rg



switching energy vs current

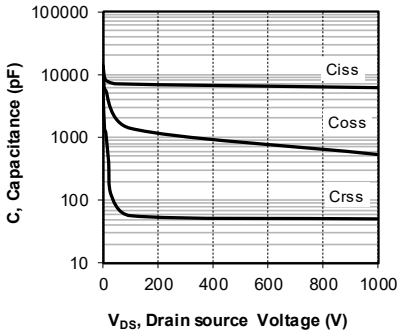


Maximum thermal impedance

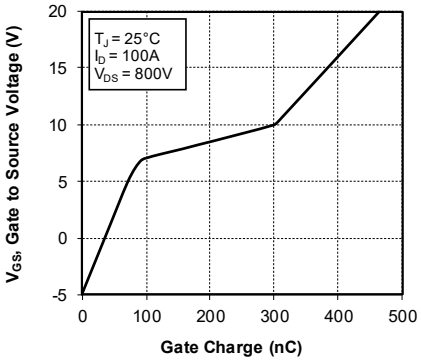


	1	2	3	4	5	6	7
Ri (°C/W)	0.004	0.052	0.012	0.048	0.008	0.053	0.029
taui (s)	0.004	0.002	0.008	0.030	0.026	0.009	0.056

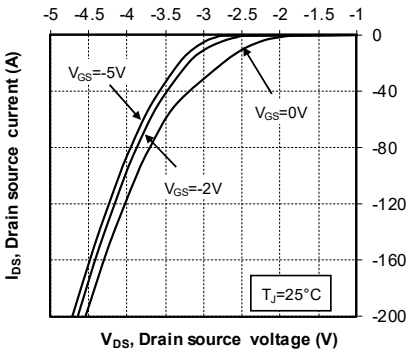
Capacitance vs Drain Source Voltage



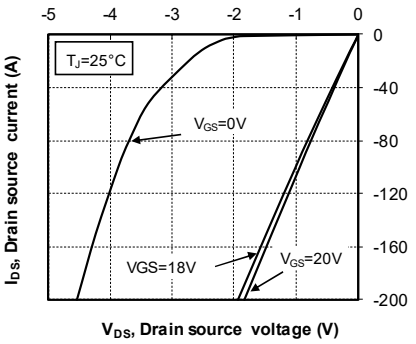
Gate Charge vs Gate Source Voltage



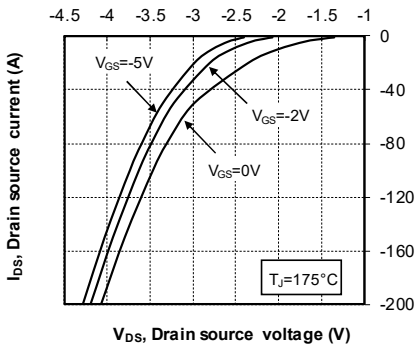
Body diode Characteristics



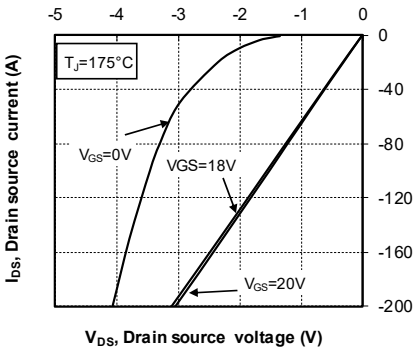
3rd Quadrant Characteristics



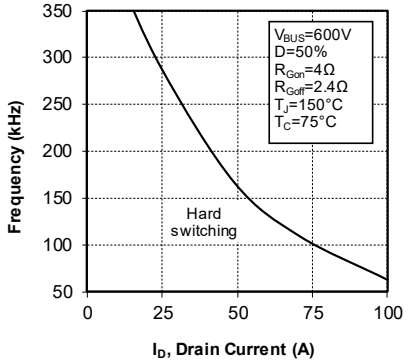
Body diode Characteristics



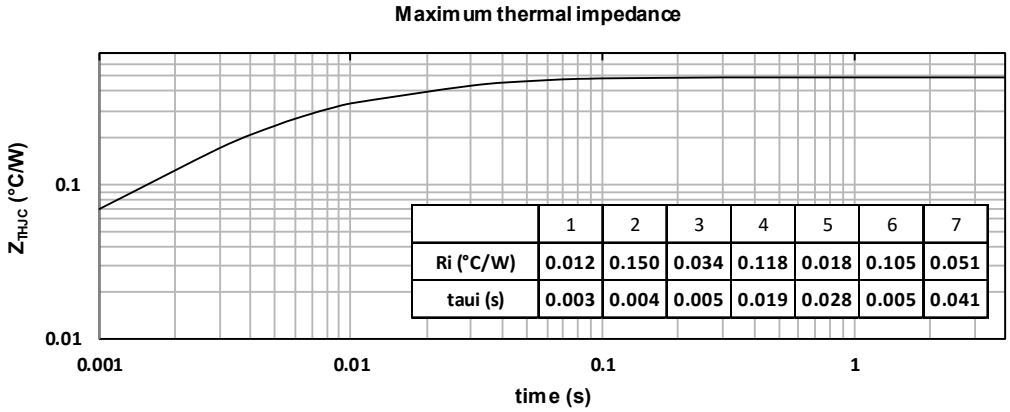
3rd Quadrant Characteristics



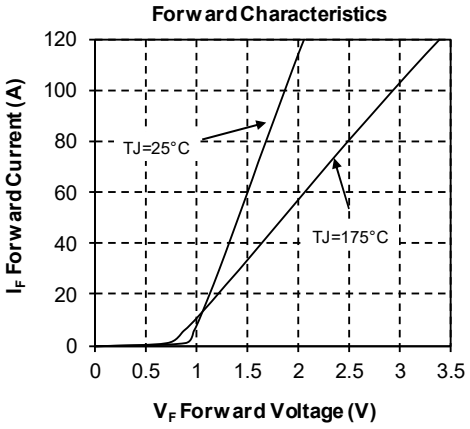
Operating Frequency vs Drain Current

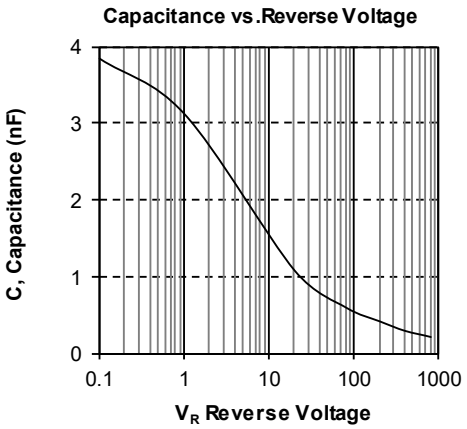


Typical SiC diode Performance Curve



	1	2	3	4	5	6	7
Ri (°C/W)	0.012	0.150	0.034	0.118	0.018	0.105	0.051
taui (s)	0.003	0.004	0.005	0.019	0.028	0.005	0.041





DISCLAIMER

The information contained in the document (unless it is publicly available on the Web without access restrictions) is PROPRIETARY AND CONFIDENTIAL information of Microsemi and cannot be copied, published, uploaded, posted, transmitted, distributed or disclosed or used without the express duly signed written consent of Microsemi. If the recipient of this document has entered into a disclosure agreement with Microsemi, then the terms of such Agreement will also apply. This document and the information contained herein may not be modified, by any person other than authorized personnel of Microsemi. No license under any patent, copyright, trade secret or other intellectual property right is granted to or conferred upon you by disclosure or delivery of the information, either expressly, by implication, inducement, estoppels or otherwise. Any license under such intellectual property rights must be approved by Microsemi in writing signed by an officer of Microsemi.

Microsemi reserves the right to change the configuration, functionality and performance of its products at anytime without any notice. This product has been subject to limited testing and should not be used in conjunction with life-support or other mission-critical equipment or applications. Microsemi assumes no liability whatsoever, and Microsemi disclaims any express or implied warranty, relating to sale and/or use of Microsemi products including liability or warranties relating to fitness for a particular purpose, merchantability, or infringement of any patent, copyright or other intellectual property right. Any performance specifications believed to be reliable but are not verified and customer or user must conduct and complete all performance and other testing of this product as well as any user or customers final application. User or customer shall not rely on any data and performance specifications or parameters provided by Microsemi. It is the customer's and user's responsibility to independently determine suitability of any Microsemi product and to test and verify the same. The information contained herein is provided "AS IS, WHERE IS" and with all faults, and the entire risk associated with such information is entirely with the User. Microsemi specifically disclaims any liability of any kind including for consequential, incidental and punitive damages as well as lost profit. The product is subject to other terms and conditions which can be located on the web at http://www.microsemi.com/legal/tnc.asp

Life Support Application

Seller's Products are not designed, intended, or authorized for use as components in systems intended for space, aviation, surgical implant into the body, in other applications intended to support or sustain life, or for any other application in which the failure of the Seller's Product could create a situation where personal injury, death or property damage or loss may occur (collectively "Life Support Applications").

Buyer agrees not to use Products in any Life Support Applications and to the extent it does it shall conduct extensive testing of the Product in such applications and further agrees to indemnify and hold Seller, and its officers, employees, subsidiaries, affiliates, agents, sales representatives and distributors harmless against all claims, costs, damages and expenses, and attorneys' fees and costs arising, directly or directly, out of any claims of personal injury, death, damage or otherwise associated with the use of the goods in Life Support Applications, even if such claim includes allegations that Seller was negligent regarding the design or manufacture of the goods.

Buyer must notify Seller in writing before using Seller's Products in Life Support Applications. Seller will study with Buyer alternative solutions to meet Buyer application specification based on Sellers sales conditions applicable for the new proposed specific part.