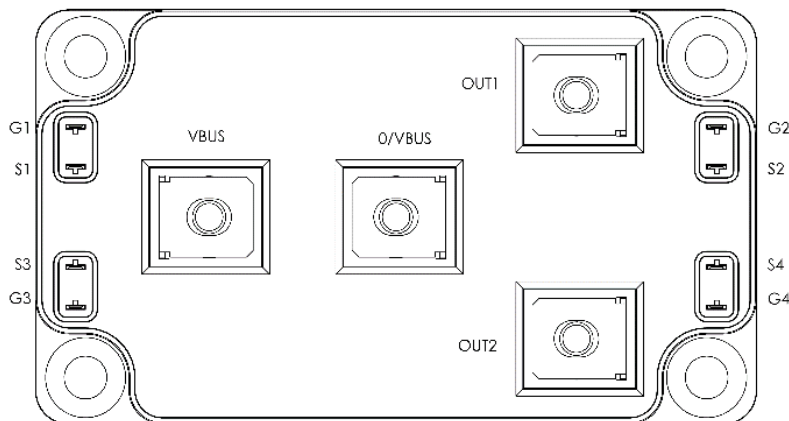
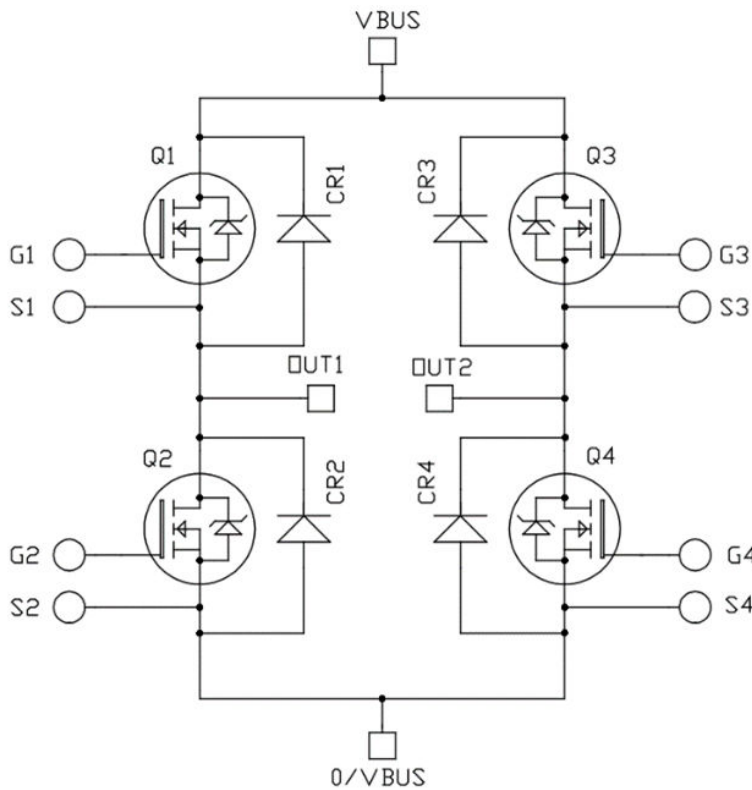


Full Bridge SiC Power Module

Product Overview

The MSCSM120HM083CAG device is a 1200 V, 251 A full bridge silicon carbide (SiC) power module.



All ratings at $T_J = 25\text{ }^{\circ}\text{C}$, unless otherwise specified.

Caution: These devices are sensitive to electrostatic discharge. Proper handling procedures must be followed.

Features

The following are the key features of MSCSM120HM083CAG device:

- 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 source for easy drive
- Low stray inductance
- M5 power connectors
- Aluminum Nitride (AlN) substrate for improved thermal performance

Benefits

The following are the benefits of MSCSM120HM083CAG device:

- High efficiency converter
- Outstanding performance at high frequency operation
- Stable temperature behavior
- Direct mounting to heatsink (isolated package)
- Low junction-to-case thermal resistance
- RoHS Compliant

Application

The following are the applications of MSCSM120HM083CAG device:

- Welding converters
- Switched mode power supplies
- Uninterruptible power supplies
- EV motor and traction drive

1. Electrical Specifications

This section provides the electrical specifications of the MSCSM120HM083CAG device.

1.1 SiC MOSFET Characteristics (per SiC MOSFET)

The following table lists the absolute maximum ratings per SiC MOSFET of the MSCSM120HM083CAG device.

Table 1-1. Absolute Maximum Ratings

Symbol	Parameter		Maximum Ratings	Unit
V_{DS}	Drain-source voltage		1200	V
I_D	Continuous drain current	$T_C = 25\text{ }^{\circ}\text{C}$	251	A
		$T_C = 80\text{ }^{\circ}\text{C}$	200	
I_{DM}	Pulsed drain current		500	
V_{GS}	Gate-source voltage		–10/25	V
$R_{DS(on)}$	Drain-source ON resistance		10.4	m Ω
P_D	Power dissipation	$T_C = 25\text{ }^{\circ}\text{C}$	1042	W

The following table lists the electrical characteristics per SiC MOSFET of the MSCSM120HM083CAG device.

Table 1-2. Electrical Characteristics

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$; $V_{DS} = 1200\text{ V}$		—	30	300	μA
$R_{DS(on)}$	Drain–Source on resistance	$V_{GS} = 20\text{ V}$ $I_D = 120\text{ A}$	$T_J = 25\text{ }^{\circ}\text{C}$	—	8.3	10.4	m Ω
			$T_J = 175\text{ }^{\circ}\text{C}$	—	13.3	—	
$V_{GS(th)}$	Gate threshold voltage	$V_{GS} = V_{DS}$; $I_D = 3\text{ mA}$		1.8	2.8	—	V
I_{GSS}	Gate–Source leakage current	$V_{GS} = 20\text{ V}$; $V_{DS} = 0\text{ V}$		—	—	300	nA

The following table lists the dynamic characteristics per SiC MOSFET of the MSCSM120HM083CAG device.

Table 1-3. Dynamic Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
C_{iss}	Input capacitance	$V_{GS} = 0\text{ V}$	—	9	—	nF
C_{oss}	Output capacitance	$V_{DS} = 1000\text{ V}$	—	0.81	—	
C_{rss}	Reverse transfer capacitance	$f = 1\text{ MHz}$	—	0.07	—	
Q_g	Total gate charge	$V_{GS} = -5\text{ V}/20\text{ V}$	—	696	—	nC
Q_{gs}	Gate-source charge	$V_{Bus} = 800\text{ V}$	—	123	—	
Q_{gd}	Gate-drain charge	$I_D = 120\text{ A}$	—	150	—	
$T_{d(on)}$	Turn-on delay time	$T_J = 150\text{ °C}$	—	56	—	ns
T_r	Rise time	$V_{GS} = -5\text{ V}/20\text{ V}$	—	55	—	
$T_{d(off)}$	Turn-off delay time	$V_{Bus} = 600\text{ V}$	—	166	—	
T_f	Fall time	$I_D = 150\text{ A}$ $R_{GON} = 2.7\text{ }\Omega$ $R_{GOFF} = 1.6\text{ }\Omega$	—	67	—	
E_{on}	Turn-on energy	Inductive switching $V_{GS} = -5\text{ V}/20\text{ V}$ $T_J = 150\text{ °C}$	—	3	—	mJ
E_{off}	Turn-off energy	$V_{Bus} = 600\text{ V}$ $I_D = 150\text{ A}$ $R_{GON} = 2.7\text{ }\Omega$ $R_{GOFF} = 1.6\text{ }\Omega$ $T_J = 150\text{ °C}$	—	2.7	—	
R_{Gint}	Internal gate resistance		—	2	—	Ω
R_{thJC}	Junction-to-case thermal resistance		—	—	0.144	$^{\circ}\text{C}/\text{W}$

The following table lists the body diode ratings and characteristics per SiC MOSFET of the MSCSM120HM083CAG device.

Table 1-4. Body Diode Ratings and Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
V_{SD}	Diode forward voltage	$V_{GS} = 0\text{ V}; I_{SD} = 120\text{ A}$	—	4	—	V
		$V_{GS} = -5\text{ V}; I_{SD} = 120\text{ A}$	—	4.2	—	
t_{rr}	Reverse recovery time	$I_{SD} = 120\text{ A}$	—	90	—	ns
Q_{rr}	Reverse recovery charge	$V_{GS} = -5\text{ V}$	—	1650	—	nC
I_{rr}	Reverse recovery current	$V_R = 800\text{ V}$ $di_F/dt = 3000\text{ A}/\mu\text{s}$	—	41	—	A

1.2 SiC Schottky Diode Characteristics (per SiC Diode)

The following table lists the SiC Schottky diode ratings and characteristics of the MSCSM120HM083CAG device.

Table 1-5. SiC 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	$V_R = 1200\text{ V}$	$T_J = 25\text{ °C}$	—	30	600	μA
			$T_J = 175\text{ °C}$	—	450	—	
I_F	DC forward current	—	$T_C = 100\text{ °C}$	—	90	—	A
V_F	Diode forward voltage	$I_F = 90\text{ A}$	$T_J = 25\text{ °C}$	—	1.5	1.8	V
			$T_J = 175\text{ °C}$	—	2.1	—	
Q_C	Total capacitive charge	$V_R = 600\text{ V}$		—	390	—	nC
C	Total capacitance	$f = 1\text{ MHz}, V_R = 400\text{ V}$		—	423	—	pF
		$f = 1\text{ MHz}, V_R = 800\text{ V}$		—	315	—	
R_{thJC}	Junction-to-case thermal resistance			—	—	0.34	$^{\circ}\text{C/W}$

1.3 Thermal and Package Characteristics

The following table lists the thermal and package characteristics of the MSCSM120HM083CAG device.

Table 1-6. Thermal and Package Characteristics

Symbol	Characteristic			Min	Max	Unit
V_{ISOL}	RMS isolation voltage, any terminal to case $t = 1\text{ min}$, 50 Hz/60 Hz			4000	—	V
T_J	Operating junction temperature range			−40	175	$^{\circ}\text{C}$
T_{JOP}	Recommended junction temperature under switching conditions			−40	$T_{Jmax} - 25$	
T_{STG}	Storage case temperature			−40	125	
T_C	Operating case temperature			−40	125	
Torque	Mounting torque	To heatsink	M6	3	5	N.m
		For terminals	M5	2	3.5	
Wt	Package weight			—	300	g

1.4 Typical SiC MOSFET Performance Curve

This section shows the typical SiC MOSFET performance curves of the MSCSM120HM083CAG device.

Figure 1-1. Maximum Thermal Impedance

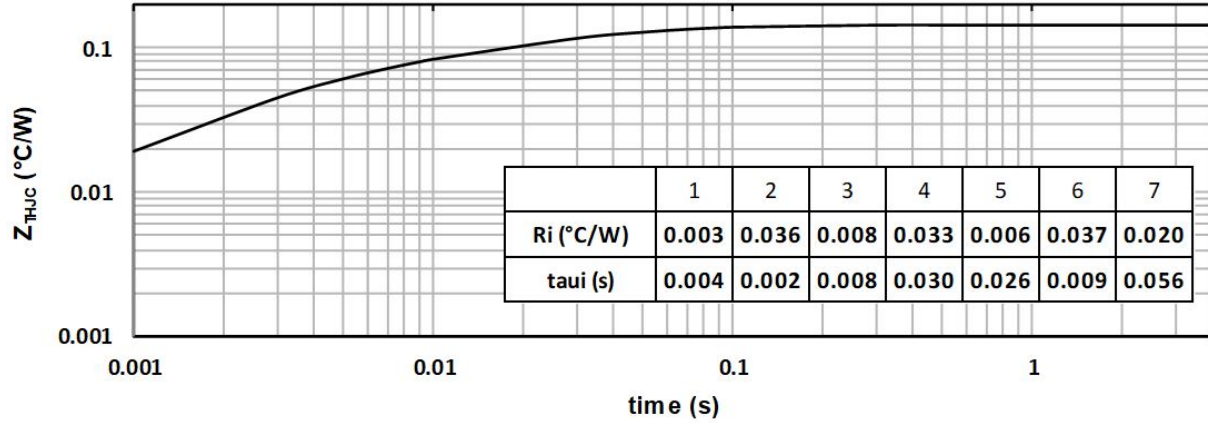


Figure 1-2. Output Characteristics, $T_J = 25^\circ\text{C}$

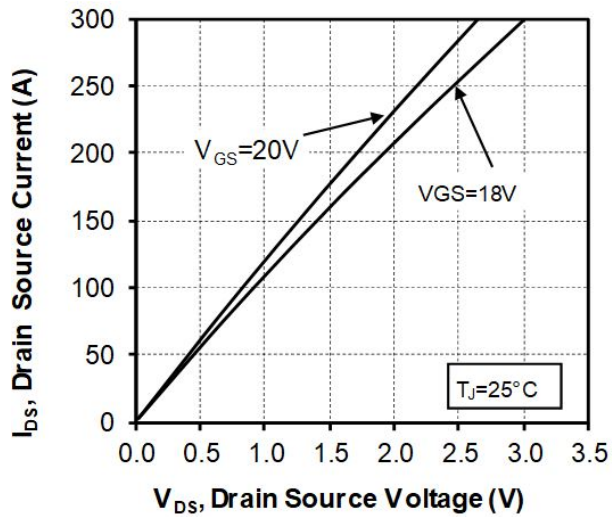


Figure 1-3. Output Characteristics, $T_J = 175^\circ\text{C}$

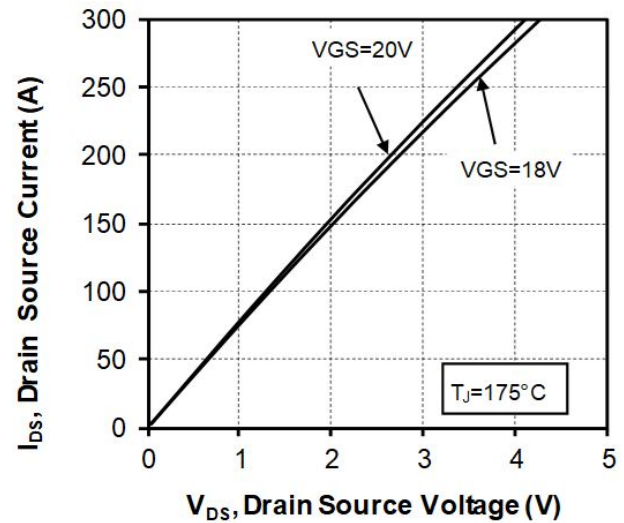


Figure 1-4. Normalized $R_{DS(on)}$ vs. Temperature

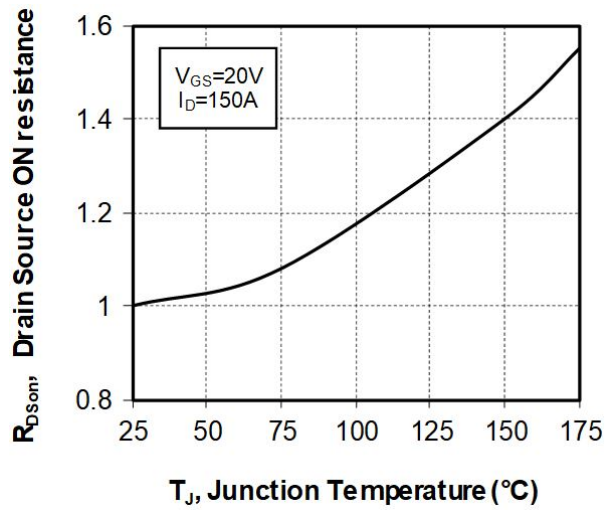


Figure 1-5. Transfer Characteristics

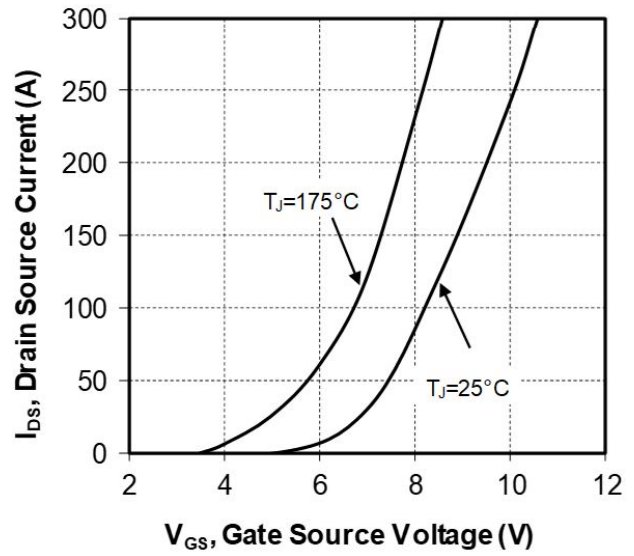


Figure 1-6. Switching Energy vs. R_g

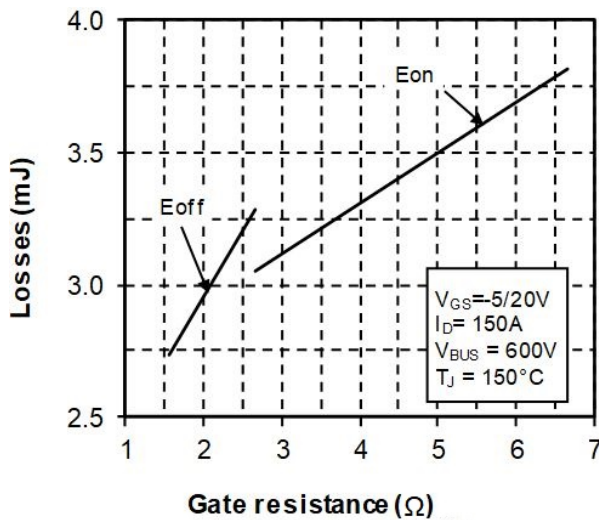


Figure 1-7. Switching Energy vs. Current

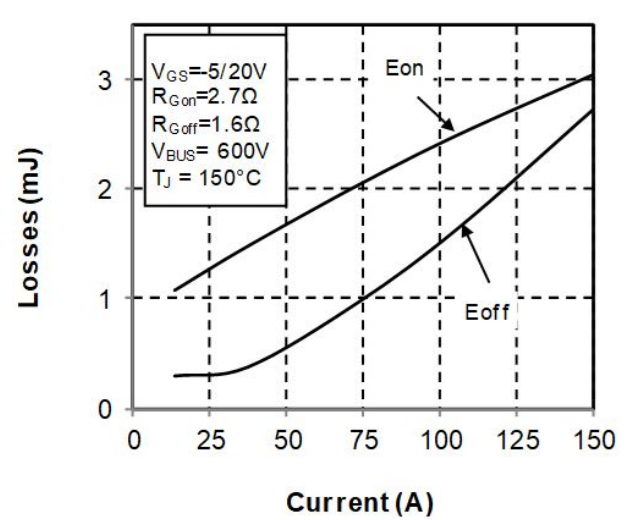


Figure 1-8. Capacitance vs. Drain Source Voltage

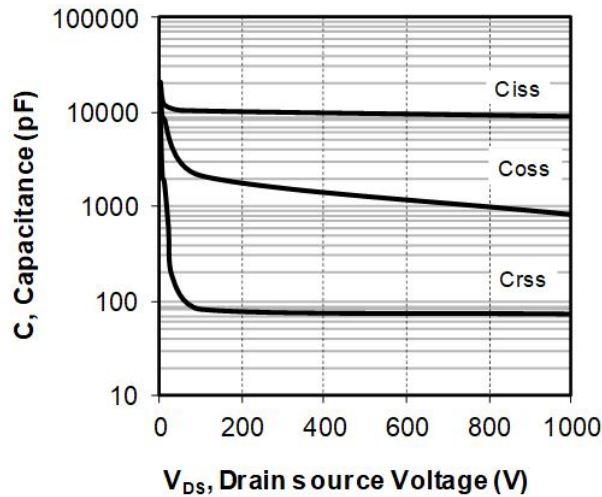


Figure 1-9. Gate Charge vs. Gate Source Voltage

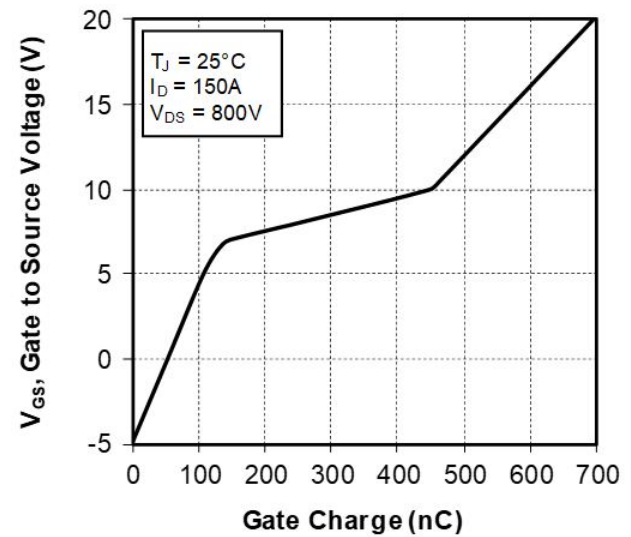


Figure 1-10. Body Diode Characteristics, $T_J = 25^\circ\text{C}$

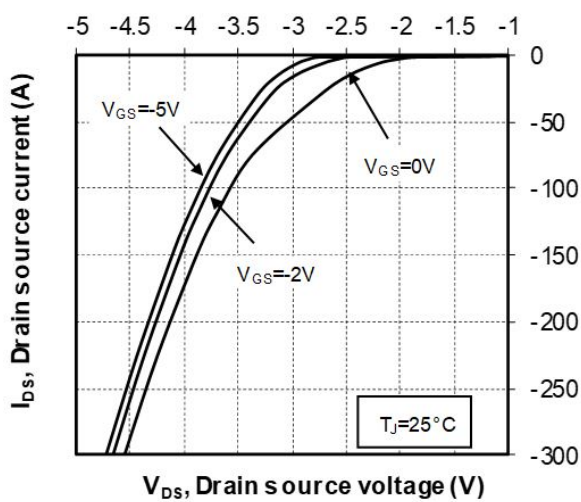


Figure 1-11. 3rd Quadrant Characteristics, $T_J = 25^\circ\text{C}$

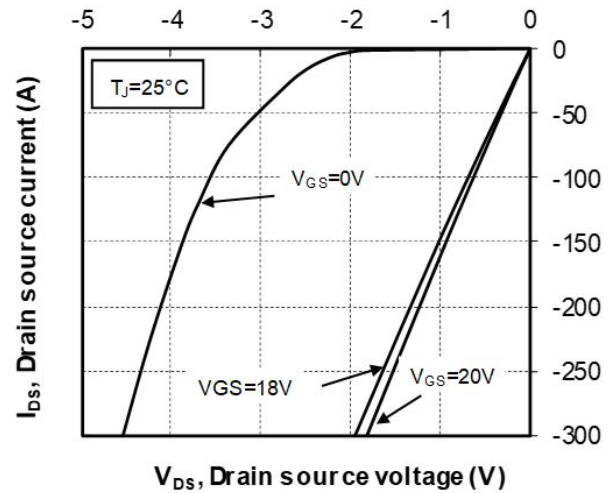


Figure 1-12. Body Diode Characteristics, $T_J = 175^\circ\text{C}$

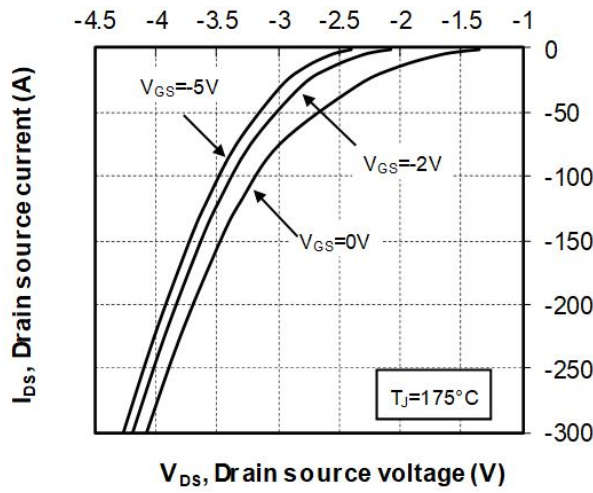


Figure 1-13. 3rd Quadrant Characteristics, $T_J = 175^\circ\text{C}$

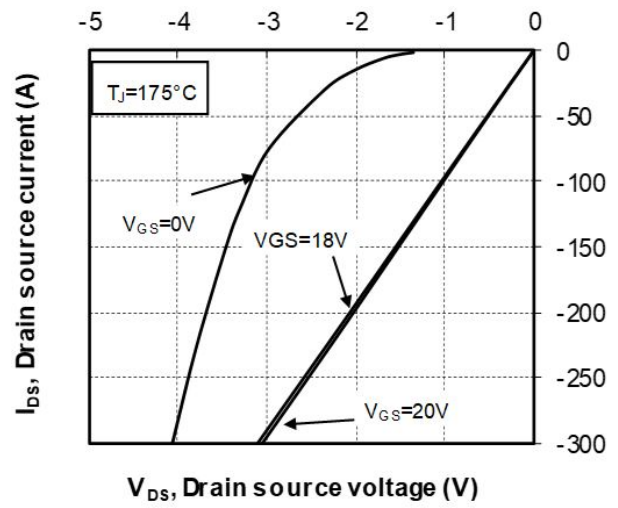
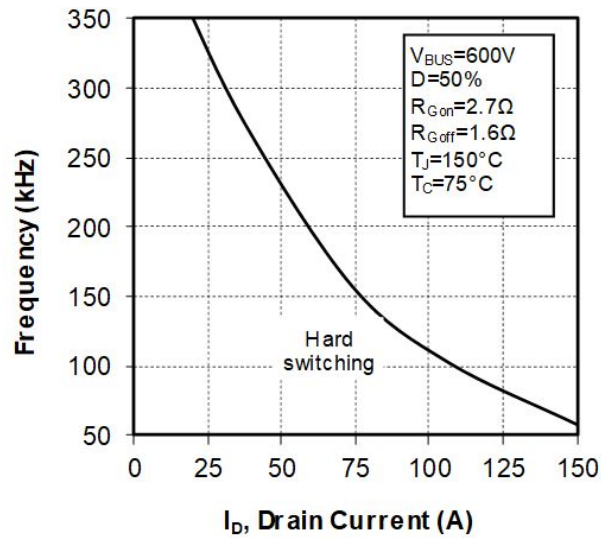


Figure 1-14. Operating Frequency vs Drain Current



1.5 Typical SiC Diode Performance Curves

This section shows the typical SiC diode performance curves of the MSCSM120HM083CAG device.

Figure 1-15. Maximum Thermal Impedance

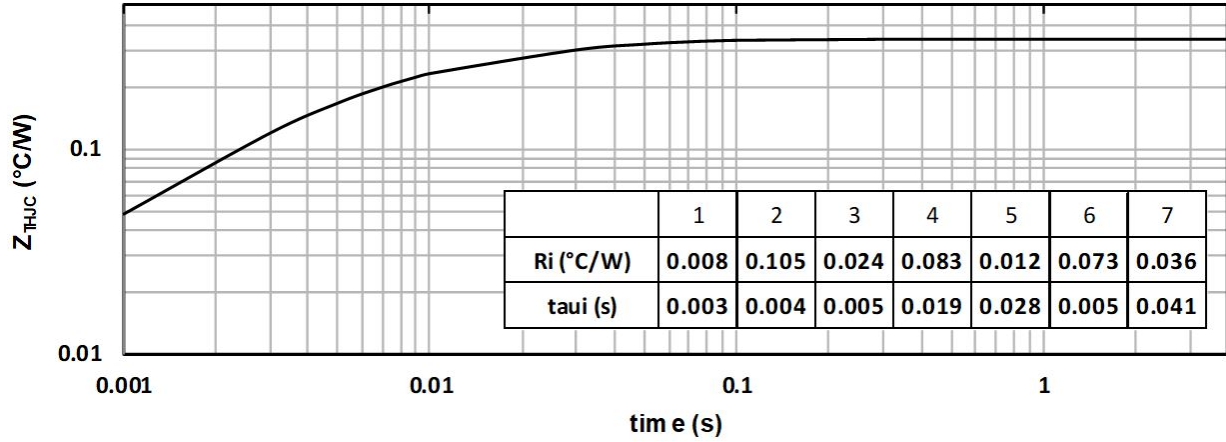


Figure 1-16. Forward Characteristics

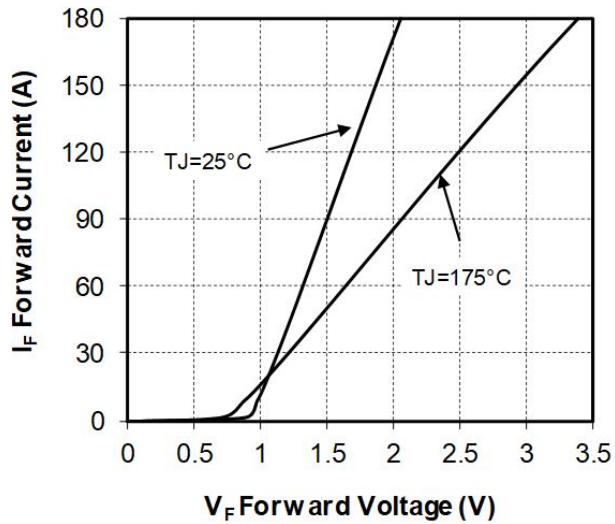
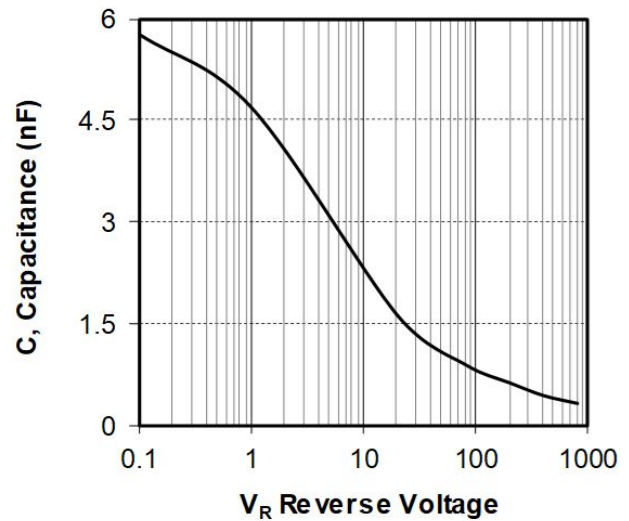


Figure 1-17. Capacitance vs. Reverse Voltage



The following section shows the package specification of the MSCSM120HM083CAG device.

The following figure shows the package outline drawing of the MSCSM120HM083CAG device. The dimensions in the following figure are in millimeters.

[illegible]

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Revision	Date	Description
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