

Product Overview

The MSCSM120AM08CT3AG device is a phase leg 1200V, 337A Silicon Carbide (SiC) power module. The following figures show the electrical diagram and pinout location of the device.

Figure 1. Electrical Diagram

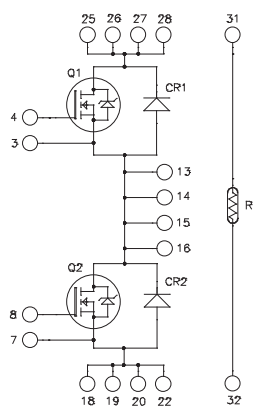


Figure 2. Pinout Location



Notes:

- Pins 25 to 28 must be shorted together
- Pins 13 to 16 must be shorted together
- Pins 18, 19, 20, and 22 must be shorted together
- All ratings at $T_j = 25\text{ }^{\circ}\text{C}$, unless otherwise specified



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

Features

The MSCSM120AM08CT3AG device has the following key features:

- SiC Power MOSFET
 - High speed switching
 - Low $R_{DS(on)}$
 - Ultra low loss
- SiC Schottky Diode
 - Zero reverse recovery
 - Zero forward recovery
 - Temperature independent switching behavior
 - Positive temperature coefficient on V_F
- Very low stray inductance
- Kelvin source for easy drive
- Internal thermistor for temperature monitoring
- AlN substrate for improved thermal performance

Benefits

The MSCSM120AM08CT3AG device has the following benefits:

- High efficiency converter
- Outstanding performance at high frequency operation
- Direct mounting to heatsink (isolated package)
- Low junction-to-case thermal resistance
- Solderable terminals both for power and signal for easy PCB mounting
- Low profile
- RoHS compliant

Applications

The MSCSM120AM08CT3AG device has the following applications:

- Inductor heating and welding
- Solar inverter
- Electric Vehicle (EV) motor and traction drive

1. Electrical Specifications

The following sections show the electrical specifications of the MSCSM120AM08CT3AG device.

1.1 SiC MOSFET Characteristics (Per SiC MOSFET)

The following table lists the absolute maximum ratings (per SiC MOSFET) of the MSCSM120AM08CT3AG device.

Table 1-1. Absolute Maximum Ratings

Symbol	Parameter	Maximum Ratings	Unit
V_{DS}	Drain-source voltage	1200	V
I_D	Continuous drain current	$T_C = 25\text{ }^{\circ}\text{C}$ 337 ¹	A
		$T_C = 80\text{ }^{\circ}\text{C}$ 268 ¹	
I_{DM}	Pulsed drain current	675	
V_{GS}	Gate-source voltage	-10/23	V
$R_{DS(on)}$	Drain-source ON resistance	7.8	m Ω
P_D	Power dissipation	$T_C = 25\text{ }^{\circ}\text{C}$ 1409	W

Note:

1. The specification of the SiC MOSFET device, but output current must be limited due to the size of the power connectors.

The following table lists the electrical characteristics (per SiC MOSFET) of the MSCSM120AM08CT3AG device.

Table 1-2. Electrical Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0V$; $V_{DS} = 1200V$	—	40	400	μA
$R_{DS(on)}$	Drain-source ON resistance	$V_{GS} = 20V$ $T_J = 25\text{ }^{\circ}\text{C}$	—	6.3	7.8	m Ω
		$I_D = 160A$ $T_J = 175\text{ }^{\circ}\text{C}$	—	10	—	
$V_{GS(th)}$	Gate threshold voltage	$V_{GS} = V_{DS}$; $I_D = 4\text{ mA}$	1.8	2.8	—	V
I_{GSS}	Gate-source leakage current	$V_{GS} = 20V$; $V_{DS} = 0V$	—	—	400	nA

The following table lists the dynamic characteristics (per SiC MOSFET) of the MSCSM120AM08CT3AG device.

Table 1-3. Dynamic Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{GS} = 0V$	—	12.08	—	nF
C_{oss}	Output capacitance	$V_{DS} = 1000V$	—	1	—	
C_{rss}	Reverse transfer capacitance	$f = 1\text{ MHz}$	—	0.1	—	
Q_g	Total gate charge	$V_{GS} = -5V/20V$	—	928	—	nC
Q_{gs}	Gate-source charge	$V_{Bus} = 800V$	—	164	—	
Q_{gd}	Gate-drain charge	$I_D = 160A$	—	200	—	
$T_{d(on)}$	Turn-on delay time	$V_{GS} = -5V/20V$	$T_J = 150\text{ }^{\circ}C$	—	30	ns
T_r	Rise time	$V_{Bus} = 600V$		—	30	
$T_{d(off)}$	Turn-off delay time	$I_D = 200A$		—	50	
T_f	Fall time	$R_{GON} = 2\Omega$ $R_{GOFF} = 1.2\Omega$		—	25	
E_{on}	Turn-on energy	Inductive switching	$T_J = 150\text{ }^{\circ}C$	—	4	mJ
E_{off}	Turn-off energy	$V_{GS} = -5V/20V$		—	2.6	
		$V_{Bus} = 600V$ $I_D = 200A$ $R_{GON} = 2\Omega$ $R_{GOFF} = 1.2\Omega$				
R_{Gint}	Internal gate resistance		—	1.5	—	Ω
R_{thJC}	Junction-to-case thermal resistance		—	—	0.106	$^{\circ}C/W$

The following table lists the body diode ratings and characteristics (per SiC MOSFET) of the MSCSM120AM08CT3AG device.

Table 1-4. Body Diode Ratings and Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
V_{SD}	Diode forward voltage	$V_{GS} = 0V; I_{SD} = 160A$	—	4	—	V
		$V_{GS} = -5V; I_{SD} = 160A$	—	4.2	—	
t_{rr}	Reverse recovery time	$I_{SD} = 160A$	—	90	—	ns
Q_{rr}	Reverse recovery charge	$V_{GS} = -5V$	—	2200	—	nC
I_{rr}	Reverse recovery current	$V_R = 800V$ $di_F/dt = 4000\text{ A}/\mu s$	—	54	—	A

1.2 SiC Schottky Diode Ratings and Characteristics (Per SiC Diode)

The following table lists the SiC schottky diode ratings and characteristics (per SiC diode) of the MSCSM120AM08CT3AG device.

Table 1-5. Diode Ratings and Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
V_{RRM}	Peak repetitive reverse voltage		—	—	1200	V
I_{RRM}	Reverse leakage current	$V_R = 1200V$ $T_J = 25\text{ }^{\circ}C$	—	40	800	μA
		$T_J = 175\text{ }^{\circ}C$	—	600	—	
I_F	DC forward current	$T_C = 100\text{ }^{\circ}C$	—	120	—	A
V_F	Diode forward voltage	$I_F = 120A$ $T_J = 25\text{ }^{\circ}C$	—	1.5	1.8	V
		$T_J = 175\text{ }^{\circ}C$	—	2.1	—	
Q_C	Total capacitive charge	$I_F = 120A$	—	520	—	nC
C	Total capacitance	$f = 1\text{ MHz}$ $V_R = 400V$	—	564	—	pF
		$f = 1\text{ MHz}$ $V_R = 800V$	—	420	—	
R_{thJC}	Junction-to-case thermal resistance		—	—	0.252	$^{\circ}C/W$

1.3 Temperature Sensor NTC

The following table lists the temperature sensor NTC of the MSCSM120AM08CT3AG device.

Table 1-6. Temperature Sensor NTC

Symbol	Characteristic	Min.	Typ.	Max.	Unit
R_{25}	Resistance at 25 $^{\circ}C$	—	50	—	k Ω
$\Delta R_{25}/R_{25}$	—	—	5	—	%
$B_{25/85}$	$T_{25} = 298.15K$	—	3952	—	K
$\Delta B/B$	—	$T_C = 100\text{ }^{\circ}C$	4	—	%

$$R_T = \frac{R_{25}}{\exp\left[B_{25/85}\left(\frac{1}{T_{25}} - \frac{1}{T}\right)\right]}$$

T: Thermistor temperature
 R_T : Thermistor value at T

Note: For more information, see [APT0406—Using NTC Temperature Sensor Integrated into Power Module](#).

1.4 Thermal and Package Characteristics

The following table lists the thermal and package characteristics of the MSCSM120AM08CT3AG device.

Table 1-7. Thermal and Package Characteristics

Symbol	Characteristic				Min.	Max.	Unit
V _{ISOL}	RMS isolation voltage, any terminal to case t = 1 min, 50/60 Hz				4000	—	V
T _J	Operating junction temperature range				–40	175	°C
T _{JOP}	Recommended junction temperature under switching conditions				–40	T _{Jmax} –25	
T _{STG}	Storage temperature range				–40	125	
T _C	Operating case temperature				–40	125	
Torque	Mounting torque	To heatsink	M4	2	3	N.m	
Wt	Package weight				—	110	g

1.5 Typical SiC MOSFET Performance Curve

The following figures show the SiC MOSFET performance curves of the MSCSM120AM08CT3AG device.

Figure 1-1. Maximum Thermal Impedance

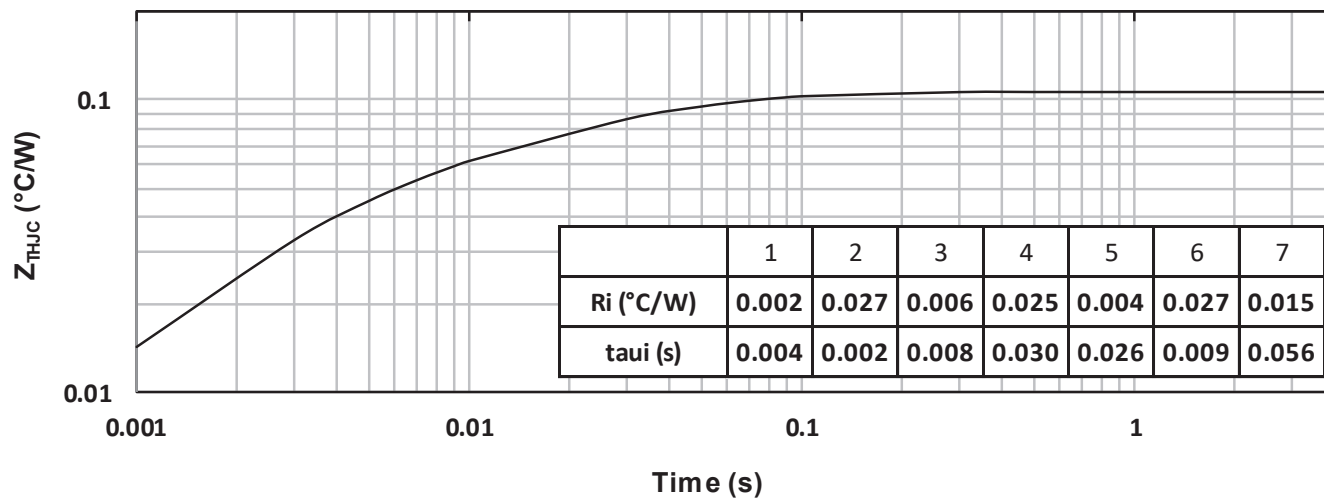


Figure 1-2. Output Characteristics, $T_J = 25^\circ\text{C}$

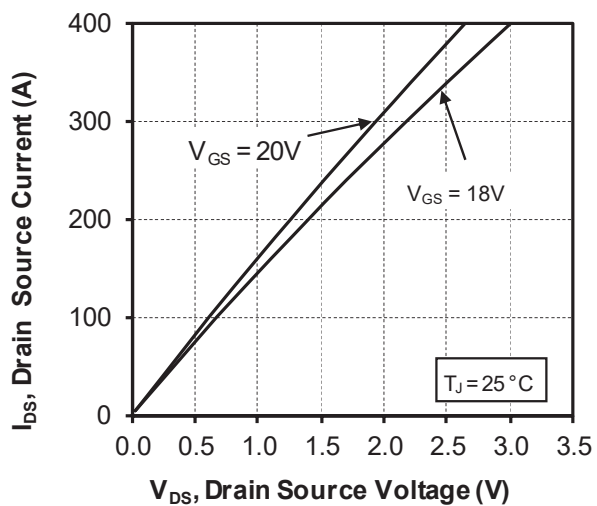


Figure 1-3. Output Characteristics, $T_J = 175^\circ\text{C}$

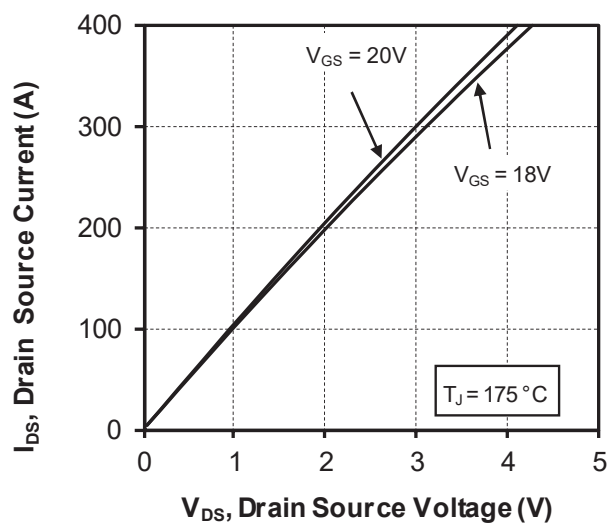


Figure 1-4. Normalized $R_{DS(on)}$ vs. Temperature

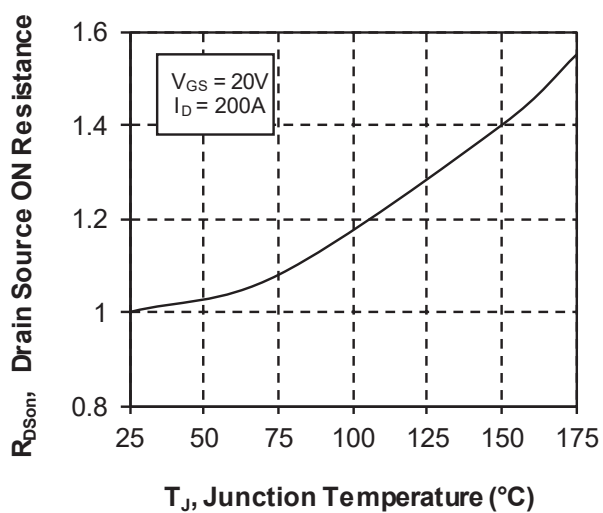


Figure 1-5. Transfer Characteristics

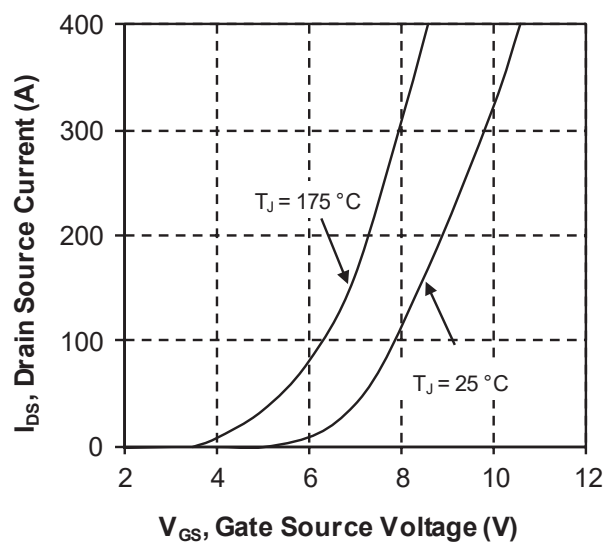


Figure 1-6. Switching Energy vs. R_g

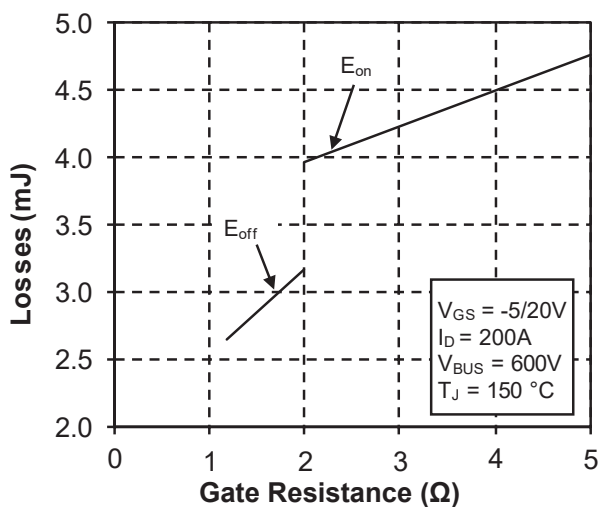


Figure 1-7. Switching Energy vs. Current

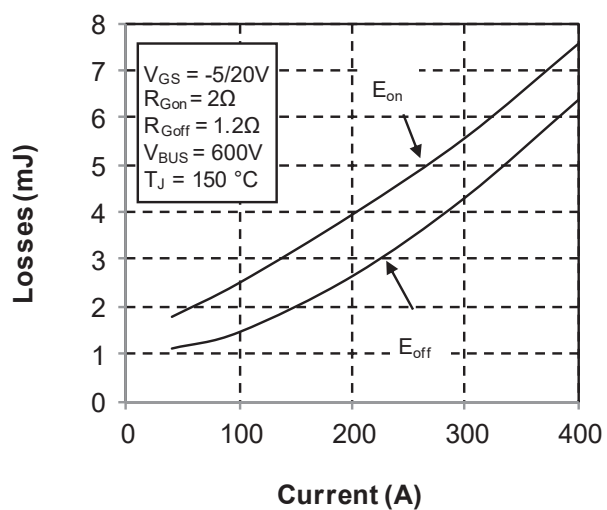


Figure 1-8. Capacitance vs. Drain Source Voltage

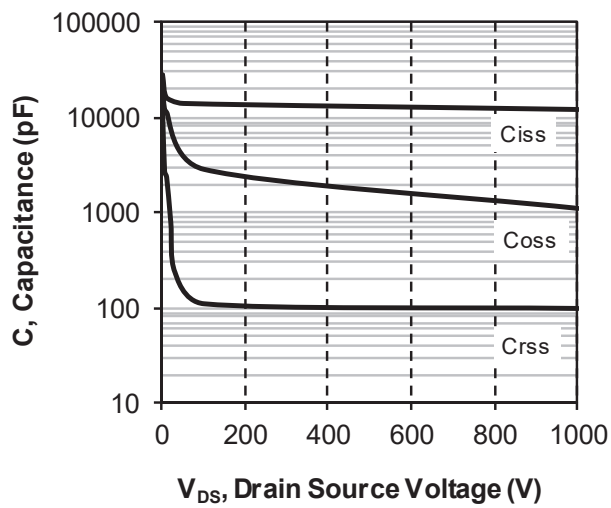


Figure 1-9. Gate Charge vs. Gate Source Voltage

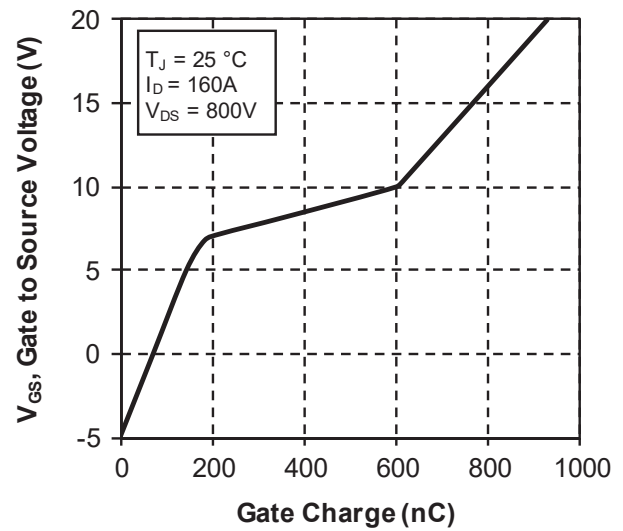


Figure 1-10. Body Diode Characteristics, $T_J = 25^\circ\text{C}$

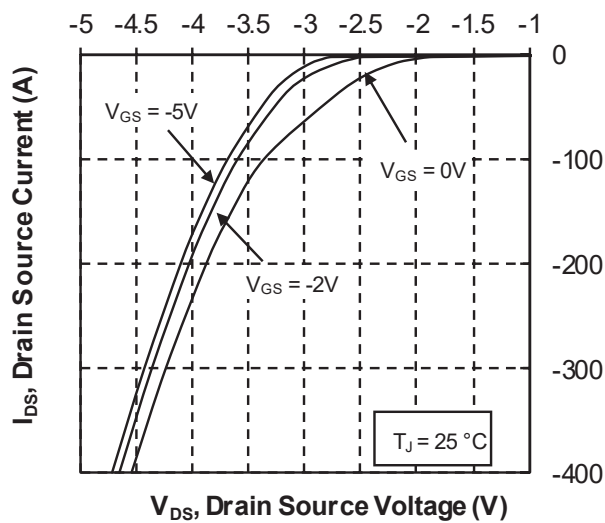


Figure 1-11. 3rd Quadrant Characteristics, $T_J = 25^\circ\text{C}$

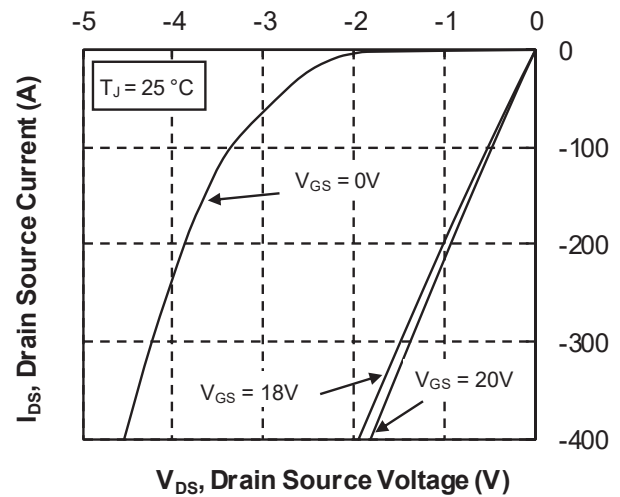


Figure 1-12. Body Diode Characteristics, $T_J = 175\text{ }^{\circ}\text{C}$

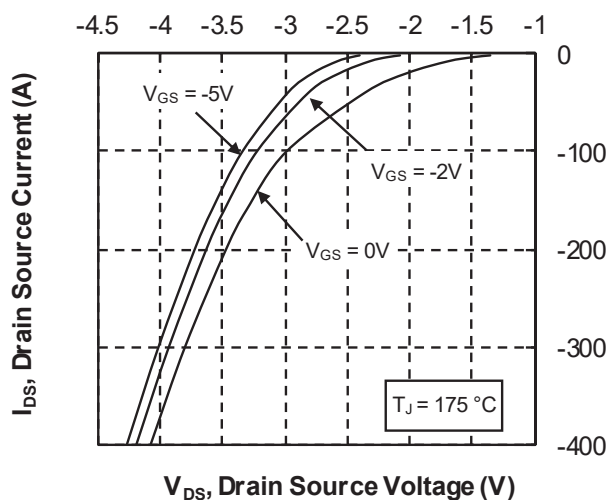


Figure 1-13. 3rd Quadrant Characteristics, $T_J = 175\text{ }^{\circ}\text{C}$

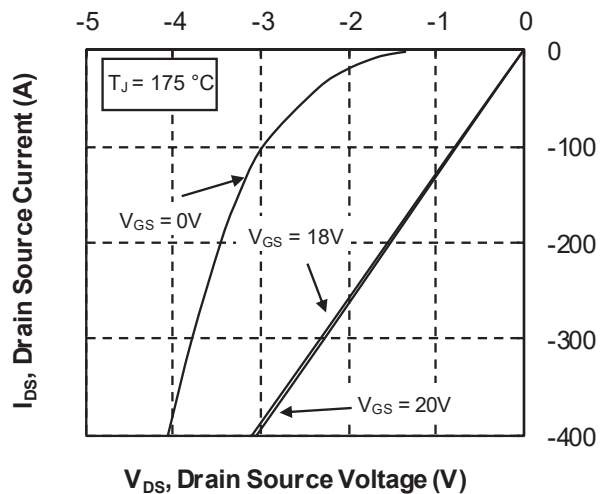
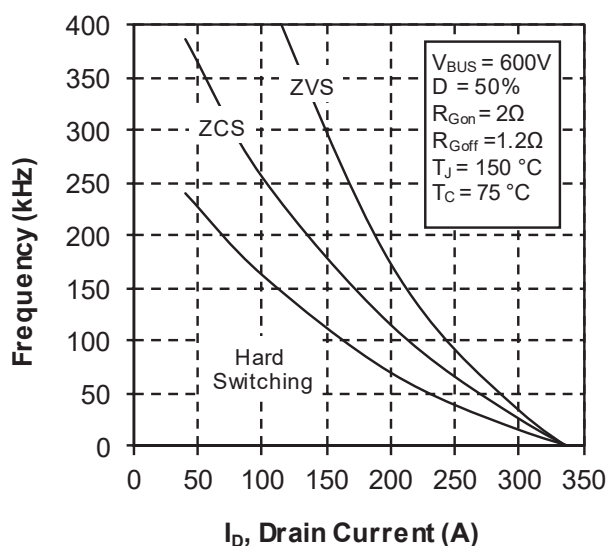


Figure 1-14. Operating Frequency vs. Drain Current



1.6 Typical SiC Diode Performance Curve

The following figures show the SiC diode performance curves of the MSCSM120AM08CT3AG device.

Figure 1-15. Maximum Thermal Impedance

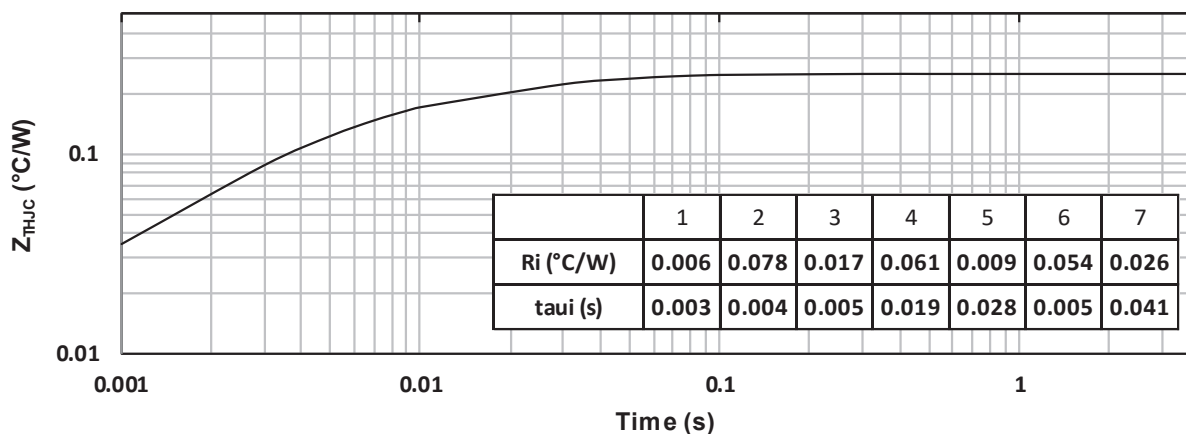


Figure 1-16. Forward Characteristics

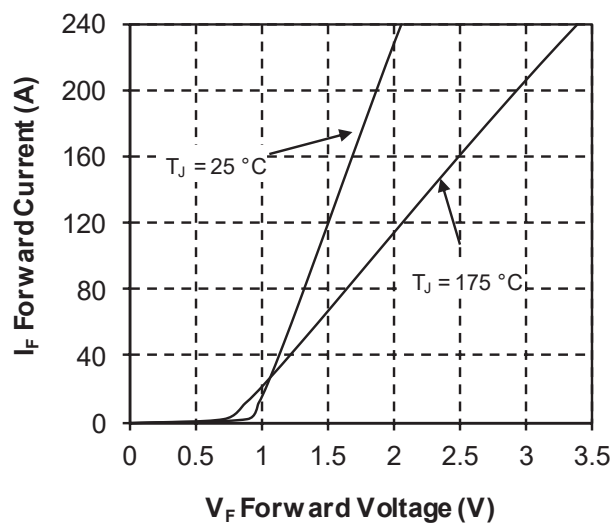
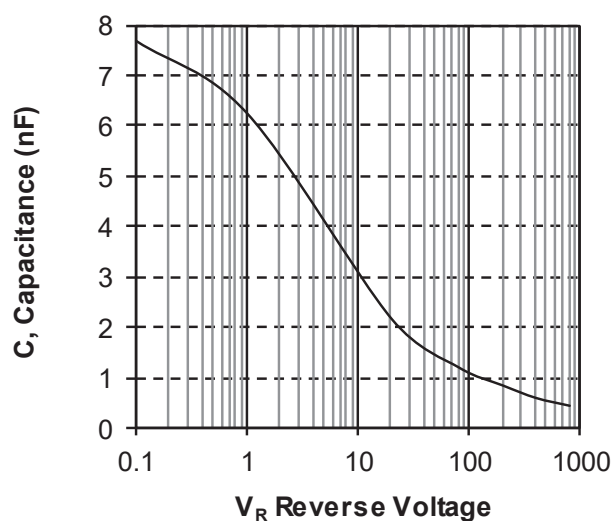


Figure 1-17. Capacitance vs. Reverse Voltage



Note: For more information, see application note [AN3500A-Mounting Instructions for SP1F and SP3F Power Modules](#).

3. Revision History

The revision history describes the changes that were implemented in the document. The changes are listed by revision, starting with the most current publication.

Revision	Date	Description
A	06/2023	Initial revision

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