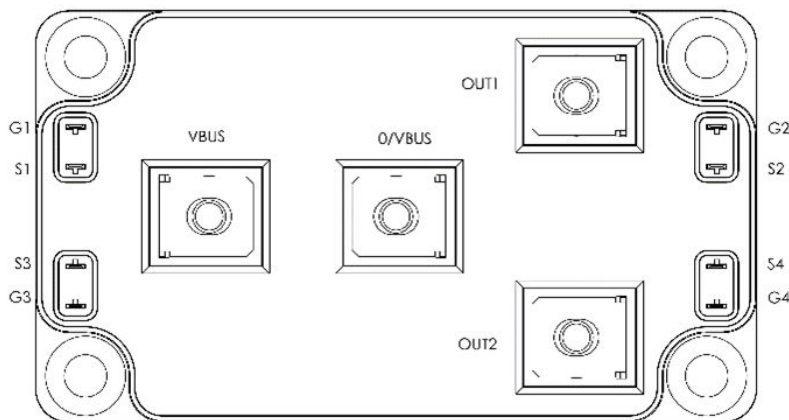
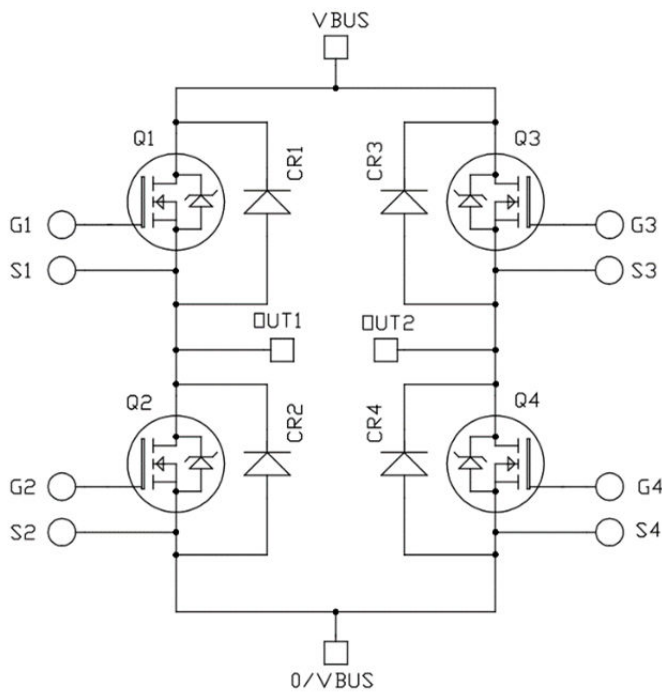


## Full Bridge SiC Power Module

### Product Overview

The MSCSM70HM05CAG device is a full bridge 700 V, 349 A 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 key features of the MSCSM70HM05CAG device:

- SiC Schottky Diode
  - Zero reverse recovery
  - Zero forward recovery
  - Temperature independent switching behavior
  - Positive temperature coefficient on VF
- SiC Power MOSFET
  - Low  $R_{DS(on)}$
  - High temperature performance
- Kelvin emitter for easy drive
- Low stray inductance
- AlN substrate for improved thermal performance
- M5 power connectors

## Benefits

The following are benefits of the MSCSM70HM05CAG 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 MSCSM70HM05CAG device is designed for the following applications:

- 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 MSCSM70HM05CAG device.

### 1.1 SiC MOSFET Characteristics

The following table lists the absolute maximum ratings per SiC MOSFET of the MSCSM70HM05CAG device.

**Table 1-1. Absolute Maximum Ratings**

Symbol	Parameter	Maximum Ratings	Unit
$V_{DSS}$	Drain-Source voltage	700	V
$I_D$	Continuous drain current	$T_C = 25\text{ }^\circ\text{C}$	349
		$T_C = 80\text{ }^\circ\text{C}$	278
$I_{DM}$	Pulsed drain current	700	
$V_{GS}$	Gate-Source voltage	-10/25	V
$R_{DS(on)}$	Drain-Source ON resistance	6.4	m $\Omega$
$P_D$	Power dissipation	$T_C = 25\text{ }^\circ\text{C}$	966

The following table lists the electrical characteristics per SiC MOSFET of the MSCSM70HM05CAG device.

**Table 1-2. Electrical Characteristics**

Symbol	Characteristics	Test Conditions	Min	Typ	Max	Unit	
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0\text{ V}; V_{DS} = 700\text{ V}$	—	—	300	$\mu\text{A}$	
$R_{DS(on)}$	Drain-Source on resistance	$V_{GS} = 20\text{ V}$ $I_D = 120\text{ A}$	—	$T_J = 25\text{ }^\circ\text{C}$	5	6.4	m $\Omega$
		$T_J = 175\text{ }^\circ\text{C}$		6.3			
$V_{GS(th)}$	Gate threshold voltage	$V_{GS} = V_{DS}, I_D = 12\text{ mA}$	1.9	2.4	—	V	
$I_{GSS}$	Gate-Source leakage current	$V_{GS} = 20\text{ V}, V_{DS} = 0\text{ V}$	—	—	300	nA	

# MSCSM70HM05CAG

## Electrical Specifications

The following table lists the dynamic characteristics per SiC MOSFET of the MSCSM70HM05CAG device.

**Table 1-3. Dynamic Characteristics**

Symbol	Characteristics	Test Conditions	Min	Typ	Max	Unit
$C_{iss}$	Input capacitance	$V_{GS} = 0\text{ V}$	—	13.5	—	nF
$C_{oss}$	Output capacitance	$V_{DS} = 700\text{ V}$	—	1.5	—	
$C_{riss}$	Reverse transfer capacitance	$f = 1\text{ MHz}$	—	0.09	—	
$Q_g$	Total gate charge	$V_{GS} = -5\text{ V}/20\text{ V}$	—	645	—	nC
$Q_{gs}$	Gate–Source charge	$V_{Bus} = 470\text{ V}$	—	174	—	
$Q_{gd}$	Gate–Drain charge	$I_D = 120\text{ A}$	—	105	—	
$T_{d(on)}$	Turn-on delay time	$V_{GS} = -5\text{ V}/20\text{ V}$	—	78	—	ns
$T_r$	Rise time	$V_{Bus} = 400\text{ V}$	—	125	—	
$T_{d(off)}$	Turn-off delay time	$I_D = 240\text{ A}; T_J = 150\text{ °C}$	—	214	—	
$T_f$	Fall time	$R_{G(ON)} = 9.4\text{ }\Omega; R_{G(OFF)} = 5.4\text{ }\Omega$	—	92	—	
$E_{on}$	Turn-on energy	$V_{GS} = -5\text{ V}/20\text{ V}$	$T_J = 150\text{ °C}$	3	—	mJ
$E_{off}$	Turn-off energy	$V_{Bus} = 400\text{ V}$ $I_D = 240\text{ A}$ $R_{G(ON)} = 9.4\text{ }\Omega$ $R_{G(OFF)} = 5.4\text{ }\Omega$		5.3	—	mJ
$R_{Gint}$	Internal gate resistance		—	1.9	—	$\Omega$
$R_{thJC}$	Junction-to-case thermal resistance		—	—	0.155	$^{\circ}\text{C}/\text{W}$

The following table lists the body diode ratings and characteristics per SiC MOSFET of the MSCSM70HM05CAG device.

**Table 1-4. Body Diode Ratings and Characteristics**

Symbol	Characteristics	Test Conditions	Min	Typ	Max	Unit
$V_{SD}$	Diode forward voltage	$V_{GS} = 0\text{ V}; I_{SD} = 120\text{ A}$	—	3.4	—	V
		$V_{GS} = -5\text{ V}; I_{SD} = 120\text{ A}$	—	3.8	—	
$t_{rr}$	Reverse recovery time	$I_{SD} = 120\text{ A}$ $V_{GS} = -5\text{ V}$	—	40	—	ns
$Q_{rr}$	Reverse recovery charge	$V_R = 400\text{ V}$ $di_F/dt = 3000\text{ A}/\mu\text{s}$	—	1.5	—	$\mu\text{C}$
$I_{rr}$	Reverse recovery current		—	57	—	A

### 1.2 SiC Schottky Diode and Characteristics

The following table lists the SiC diode ratings and characteristics per SiC diode of the MSCSM70HM05CAG device.

**Table 1-5. SiC Schottky Diode Ratings and Characteristics**

Symbol	Characteristics	Test Conditions		Min	Typ	Max	Unit
$V_{RRM}$	Peak repetitive reverse voltage			—	—	700	V
$I_{RRM}$	Reverse leakage current	$V_R = 700\text{ V}$	$T_J = 25\text{ °C}$	—	45	600	$\mu\text{A}$
			$T_J = 175\text{ °C}$	—	750	—	
$I_F$	DC forward current	—	$T_C = 65\text{ °C}$	—	150	—	A
$V_F$	Diode forward voltage	$I_F = 150\text{ A}$	$T_J = 25\text{ °C}$	—	1.5	1.8	V
			$T_J = 175\text{ °C}$	—	1.9	—	
$Q_C$	Total capacitive charge	$V_R = 400\text{ V}$	—	—	399	—	nC
C	Total capacitance	$f = 1\text{ MHz}, V_R = 200\text{ V}$		—	744	—	pF
		$f = 1\text{ MHz}, V_R = 400\text{ V}$		—	648	—	
$R_{thJC}$	Junction-to-case thermal resistance			—	—	0.326	$^{\circ}\text{C/W}$

### 1.3 Thermal and Package Characteristics

The following table lists the thermal and package characteristics of MSCSM70HM05CAG device.

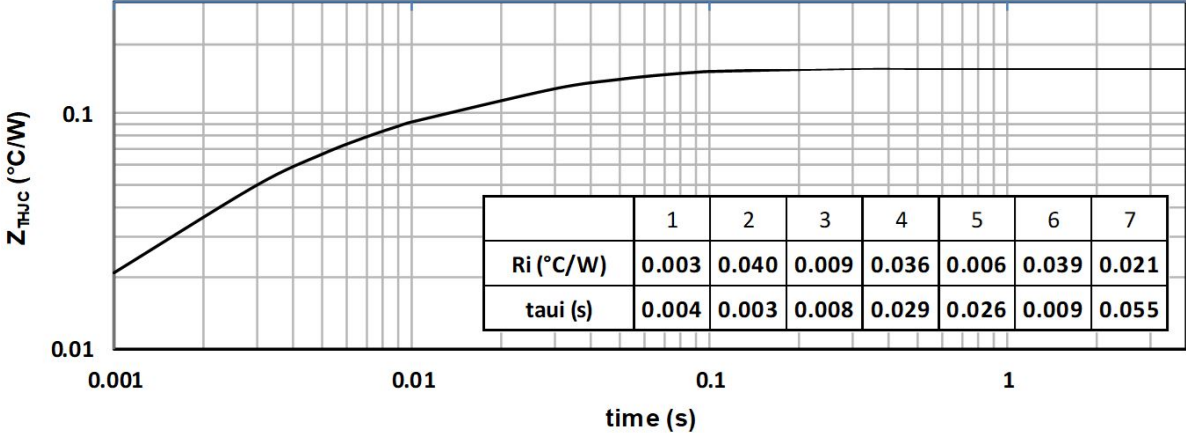
**Table 1-6. Thermal and Package Characteristics**

Symbol	Characteristics		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 temperature range		–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	

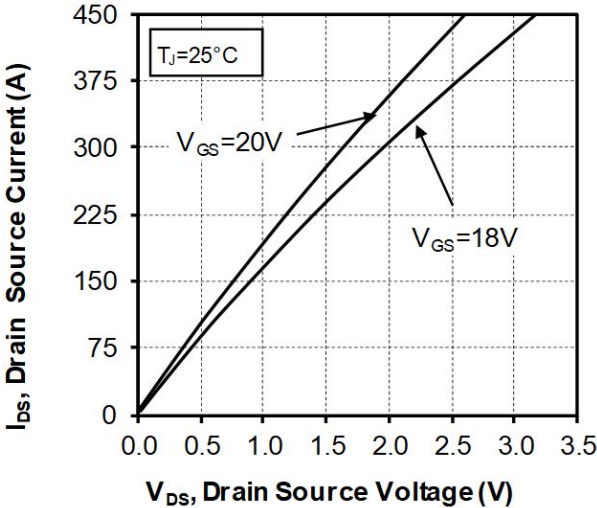
**1.4 Typical SiC MOSFET Performance Curve**

This section shows the typical SiC MOSFET performance curves of the MSCSM70HM05CAG device.

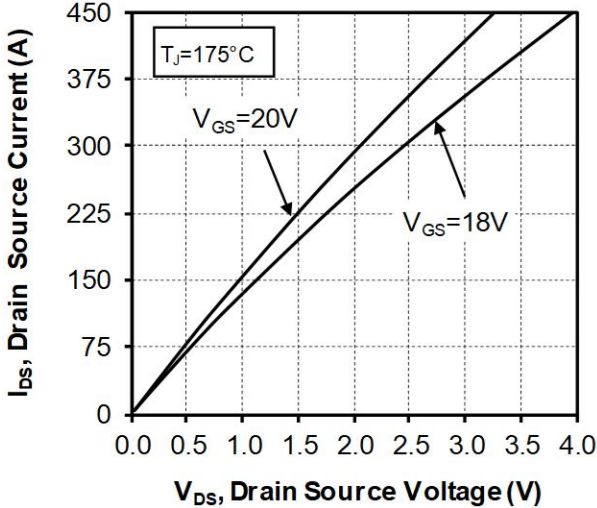
**Figure 1-1. Maximum Thermal Impedance**



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



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



# MSCSM70HM05CAG

## Electrical Specifications

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

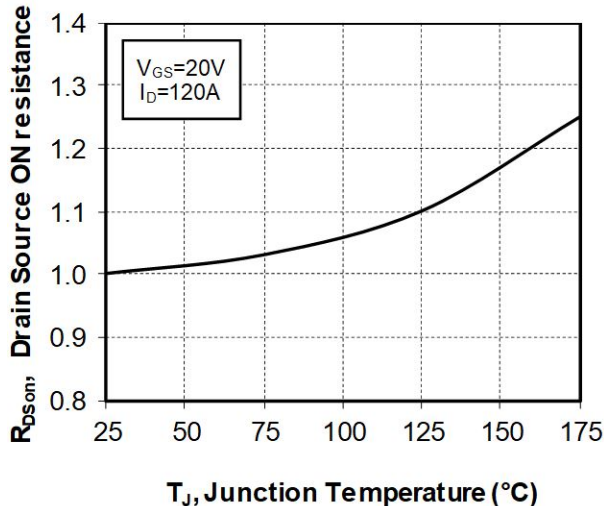


Figure 1-5. Transfer Characteristics

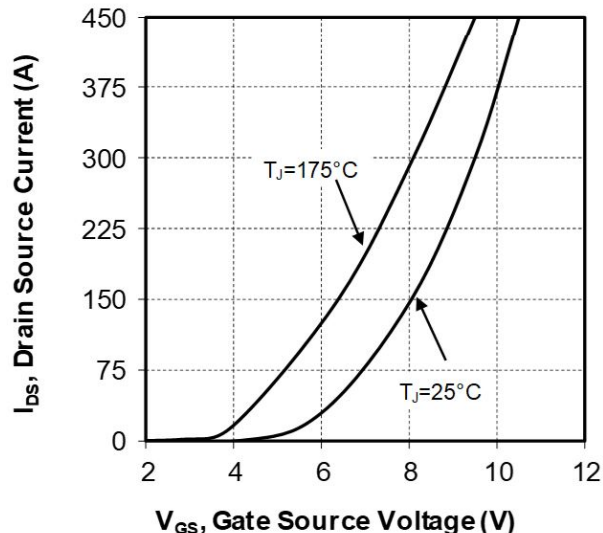


Figure 1-6. Capacitance vs. Drain Source Voltage

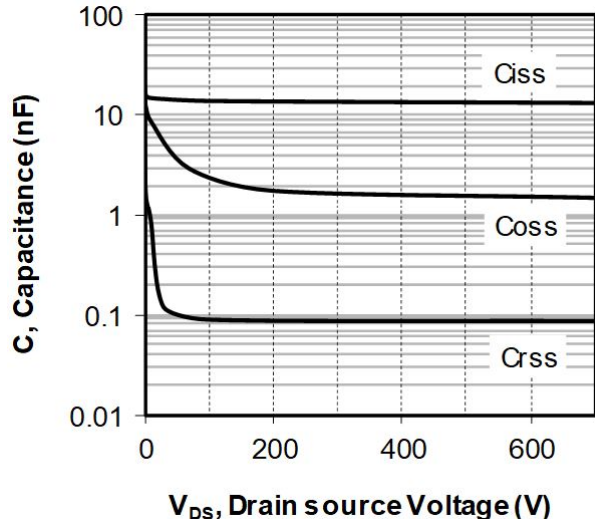
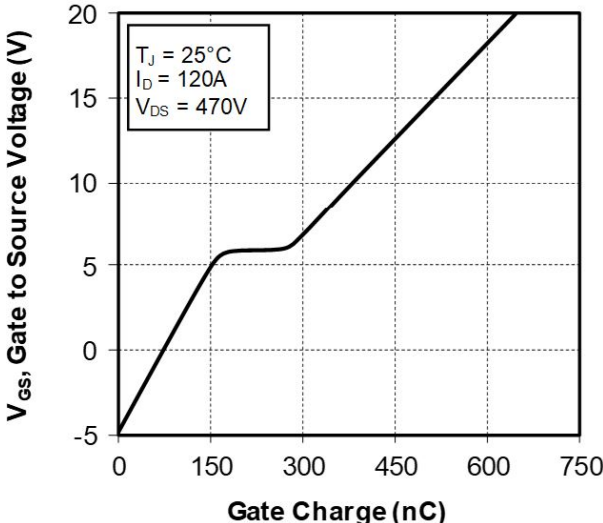
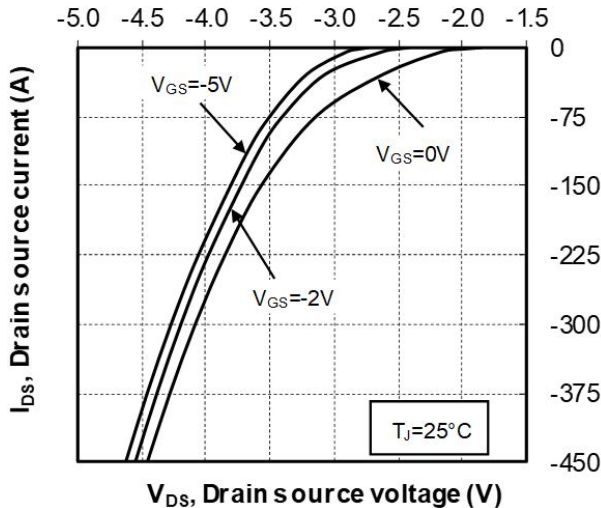


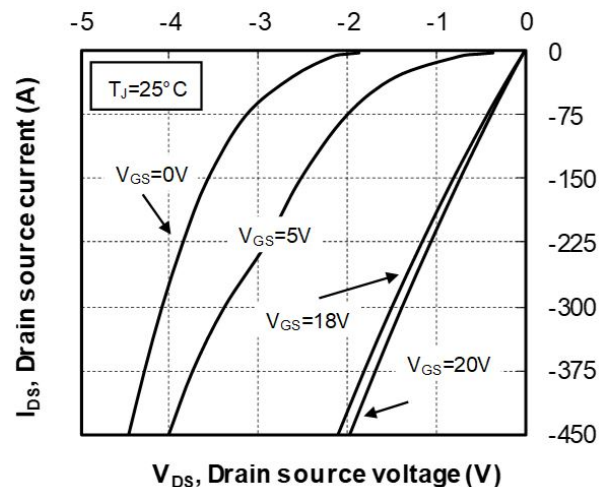
Figure 1-7. Gate Charge vs. Gate Source Voltage



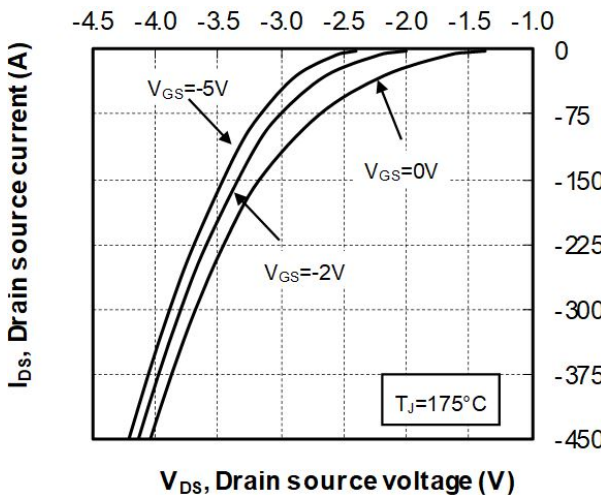
**Figure 1-8. Body Diode Characteristics,  $T_J = 25^\circ\text{C}$**



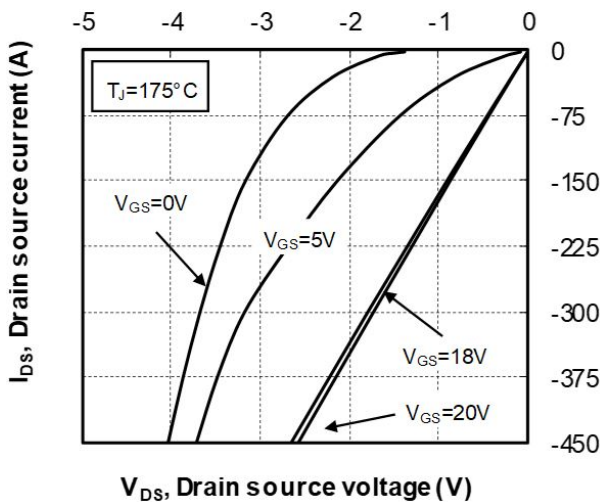
**Figure 1-9. 3rd Quadrant Characteristics,  $T_J = 25^\circ\text{C}$**



**Figure 1-10. Body Diode Characteristics,  $T_J = 175^\circ\text{C}$**

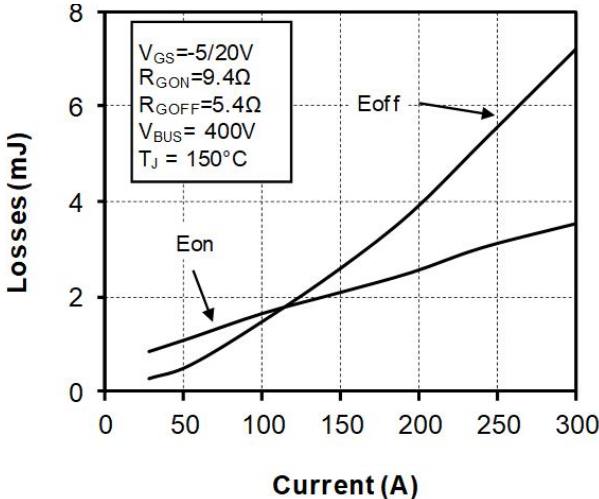


**Figure 1-11. 3rd Quadrant Characteristics,  $T_J = 175^\circ\text{C}$**

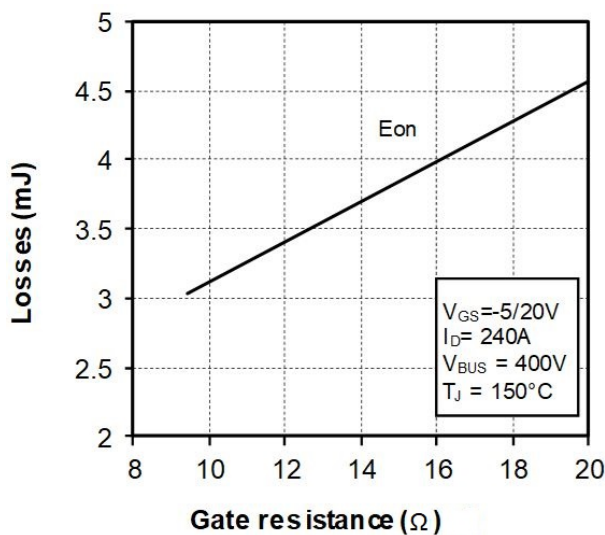




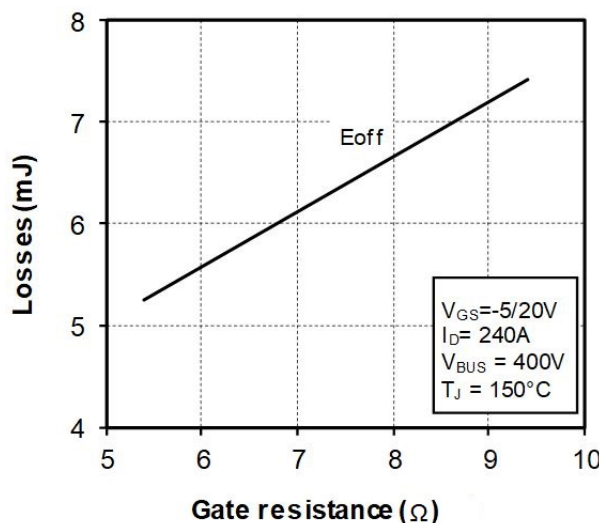
**Figure 1-12. Switching Energy vs. Current**



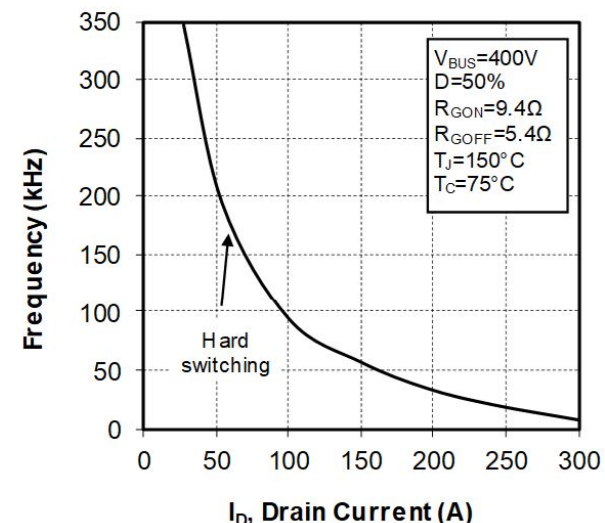
**Figure 1-13. Turn On Energy vs. Rg**



**Figure 1-14. Turn Off Energy vs. Rg**



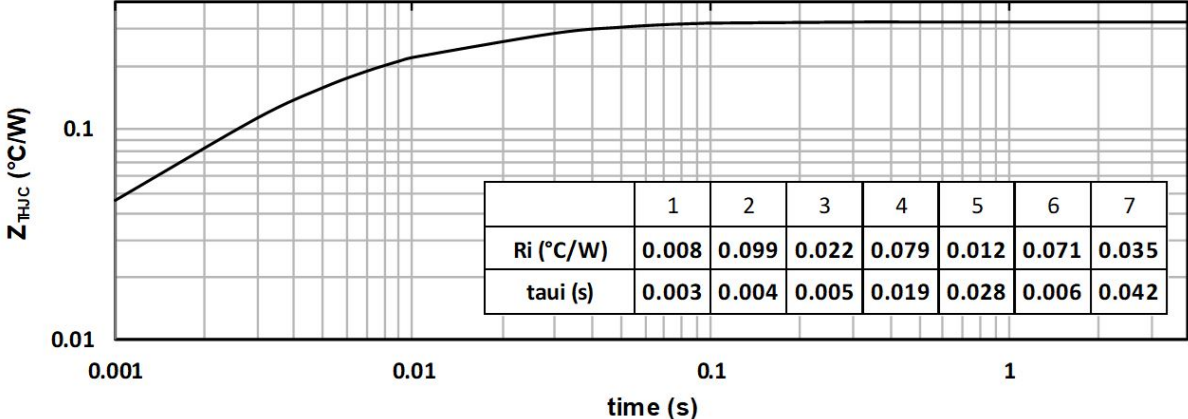
**Figure 1-15. Operating Frequency vs. Drain Current**



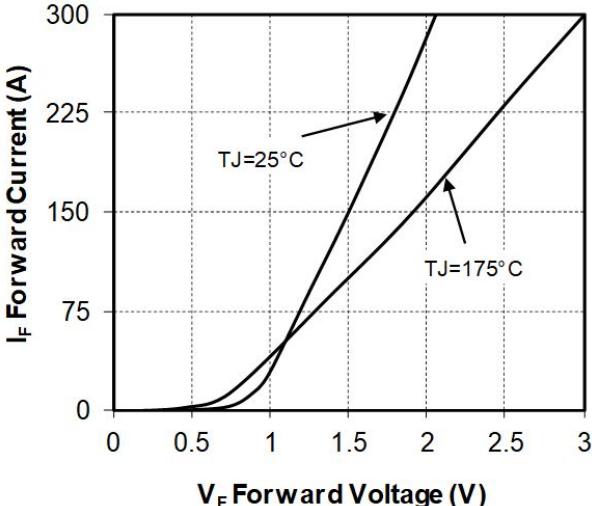
**1.5 Typical SiC Diode Performance Curve**

This section shows the typical SiC diode performance curves of MSCSM70HM05CAG device.

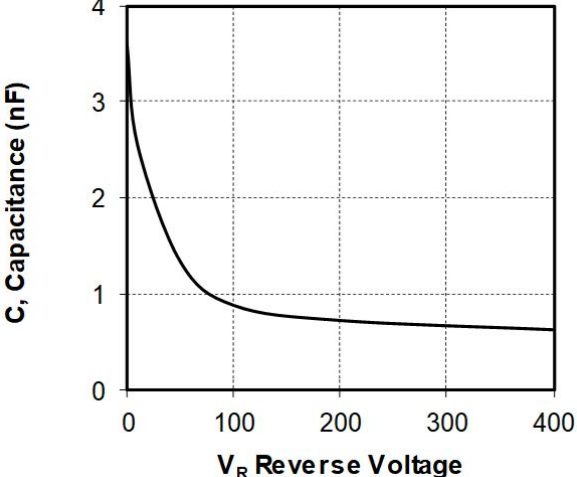
**Figure 1-16. Maximum Thermal Impedance**



**Figure 1-17. Forward Characteristics**



**Figure 1-18. Capacitance vs. Reverse Voltage**



# MSCSM70HM05CAG

## Package Specifications

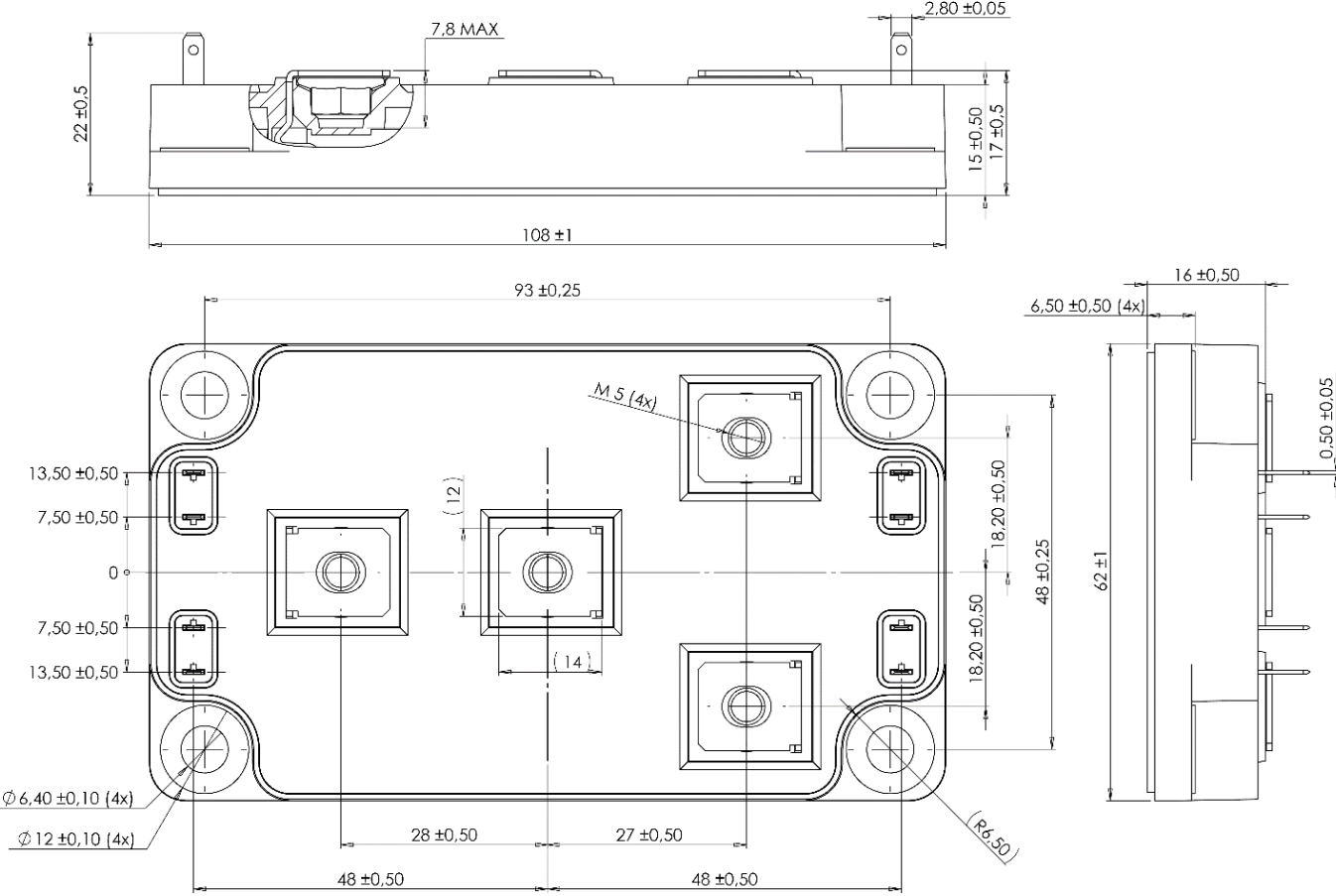
## 2. Package Specifications

The following section shows the package specification of MSCSM70HM05CAG device.

### 2.1 Package Outline

The following figure shows the package outline drawing of MSCSM70HM05CAG device. The dimensions are in millimeters.

**Figure 2-1. Package Outline Drawing**



**Note:** See application note [APT0601—Mounting instructions for SP6 Power Modules](#) for more information.

**3. Revision History**

Revision	Date	Description
A	04/2021	This is the first publication of this document.

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