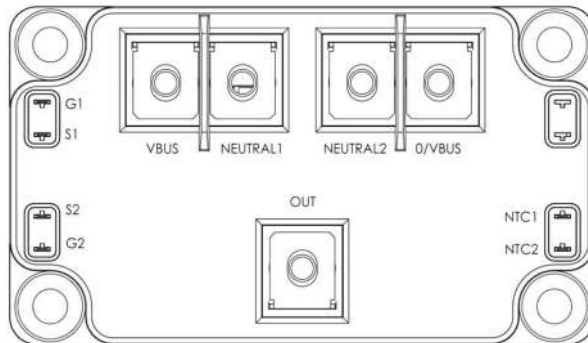
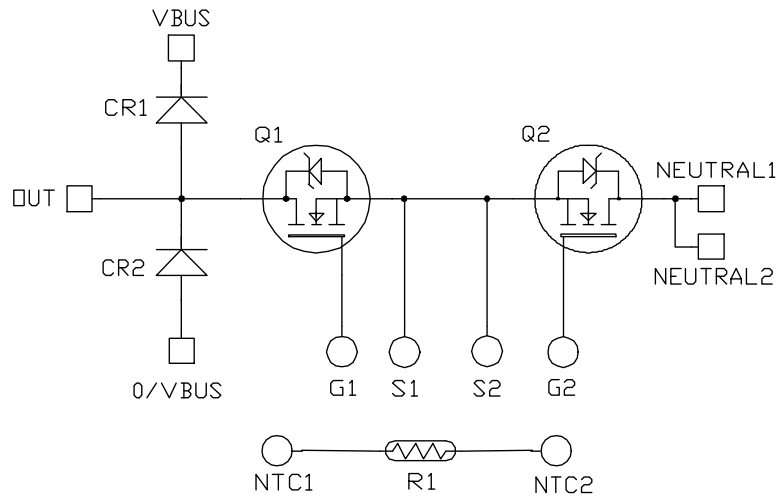


## Vienna Rectifier SiC MOSFET Power Module

### Product Overview

The MSCSM70VR1M03CT6AG device is a Vienna rectifier 700V, 585A silicon carbide (SiC) power module.



**Note:** 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

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The following are key features of the MSCSM70VR1M03CT6AG 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  $V_F$
- Kelvin source for easy drive
- Low stray inductance
- M5 power connectors
- Internal thermistor for temperature monitoring
- Aluminum Nitride (AlN) substrate for improved thermal performance

## Benefits

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The following are the benefits of MSCSM70VR1M03CT6AG device:

- Outstanding performance at high frequency operation
- High-power and high-efficiency rectifiers and converters
- Direct mounting to heatsink (isolated package)
- Low junction-to-case thermal resistance
- Low profile
- RoHS compliant

## Application

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The MSCSM70VR1M03CT6AG device is designed for the following applications:

- Power factor correction
- Switched mode power supplies
- Uninterruptible power supplies

### 1. Electrical Specifications

This section provides the electrical specifications of the MSCSM70VR1M03CT6AG device.

#### 1.1 SiC MOSFET Characteristics (Per SiC MOSFET)

The following table lists the absolute maximum ratings per SiC MOSFET of the MSCSM70VR1M03CT6AG device.

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

Symbol	Parameter	Maximum Ratings	Unit
$V_{DSS}$	Drain-Source voltage	700	V
$I_D$	Continuous drain current	$T_C = 25\text{ }^\circ\text{C}$	585
		$T_C = 80\text{ }^\circ\text{C}$	465
$I_{DM}$	Pulsed drain current	1200	
$V_{GS}$	Gate-Source voltage	-10/23	V
$R_{DS(on)}$	Drain-Source ON resistance	3.8	m $\Omega$
$P_D$	Power dissipation	$T_C = 25\text{ }^\circ\text{C}$	1625

The following table lists the electrical characteristics per SiC MOSFET of the MSCSM70VR1M03CT6AG device.

**Table 1-2. Electrical Characteristics**

Symbol	Characteristics	Test Conditions	Min.	Typ.	Max.	Unit	
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0V$ $V_{DS} = 700V$	—	—	500	$\mu\text{A}$	
$R_{DS(on)}$	Drain-Source on resistance	$V_{GS} = 20V$ $I_D = 200A$	$T_J = 25\text{ }^\circ\text{C}$	—	3	3.8	m $\Omega$
			$T_J = 175\text{ }^\circ\text{C}$	—	3.75	—	
$V_{GS(th)}$	Gate threshold voltage	$V_{GS} = V_{DS}$ $I_D = 20\text{ mA}$	1.9	2.4	—	V	
$I_{GSS}$	Gate-Source leakage current	$V_{GS} = 20V; V_{DS} = 0V$	—	—	500	nA	

# MSCSM70VR1M03CT6AG

## Electrical Specifications

The following table lists the dynamic characteristics per SiC MOSFET of the MSCSM70VR1M03CT6AG device.

**Table 1-3. Dynamic Characteristics**

Symbol	Characteristics	Test Conditions	Min.	Typ.	Max.	Unit	
$C_{iss}$	Input capacitance	$V_{GS} = 0V$	—	22.5	—	nF	
$C_{oss}$	Output capacitance	$V_{DS} = 700V$	—	2.6	—		
$C_{rss}$	Reverse transfer capacitance	$f = 1\text{ MHz}$	—	0.14	—		
$Q_g$	Total gate charge	$V_{GS} = -5V/20V$	—	1075	—	nC	
$Q_{gs}$	Gate-Source charge	$V_{Bus} = 470V$	—	290	—		
$Q_{gd}$	Gate-Drain charge	$I_D = 200A$	—	175	—		
$T_{d(on)}$	Turn-on delay time	$V_{GS} = -5V/20V$	$T_J = 150^\circ\text{C}$	—	78	—	ns
$T_r$	Rise time	$V_{Bus} = 400V$		—	125	—	
$T_{d(off)}$	Turn-off delay time	$I_D = 400A$		—	214	—	
$T_f$	Fall time	$R_{G(on)} = 5.6\Omega$ $R_{G(off)} = 3.2\Omega$		—	92	—	
$E_{on}$	Turn-on energy	$V_{GS} = -5V/20V$	$T_J = 150^\circ\text{C}$	—	5	—	mJ
$E_{off}$	Turn-off energy	$V_{Bus} = 400V$ $I_D = 400A$ $R_{G(on)} = 5.6\Omega$ $R_{G(off)} = 3.2\Omega$	$T_J = 150^\circ\text{C}$	—	8.8	—	
$R_{Gint}$	Internal gate resistance		—	1.1	—	$\Omega$	
$R_{thJC}$	Junction-to-case thermal resistance		—	—	0.092	$^\circ\text{C/W}$	

The following table lists the body diode ratings and characteristics per SiC MOSFET of the MSCSM70VR1M03CT6AG device.

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

Symbol	Characteristics	Test Conditions	Min.	Typ.	Max.	Unit
$V_{SD}$	Diode forward voltage	$V_{GS} = 0V; I_{SD} = 200A$	—	3.4	—	V
		$V_{GS} = -5V; I_{SD} = 200A$	—	3.8	—	
$t_{rr}$	Reverse recovery time	$I_{SD} = 200A; V_{GS} = -5V$	—	40	—	ns
$Q_{rr}$	Reverse recovery charge	$V_R = 470V; di_F/dt = 6000\text{ A}/\mu\text{s}$	—	2.5	—	$\mu\text{C}$
$I_{rr}$	Reverse recovery current		—	95	—	A

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

The following table lists the SiC diode ratings and characteristics of MSCSM70VR1M03CT6AG device.

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

Symbol	Characteristics	Test Conditions	Min.	Typ.	Max.	Unit	
$V_{RRM}$	Peak repetitive reverse voltage		—	—	1200	V	
$I_{RM}$	Reverse leakage current	$V_R = 1200V$	$T_J = 25\text{ }^\circ\text{C}$	—	90	1200	$\mu\text{A}$
			$T_J = 175\text{ }^\circ\text{C}$	—	1500	—	
$I_F$	DC forward current						
$V_F$	Diode forward voltage	$I_F = 300A$	$T_J = 25\text{ }^\circ\text{C}$	—	1.5	1.8	V
			$T_J = 175\text{ }^\circ\text{C}$	—	2.1	—	
$Q_C$	Total capacitive charge	$V_R = 600V$	—	1344	—	nC	
C	Total capacitance	$f = 1\text{ MHz}$ $V_R = 400V$	—	1476	—	pF	
		$f = 1\text{ MHz}$ $V_R = 600V$	—	1092	—		
$R_{thJH}$	Junction-to-case thermal resistance		—	—	0.109	$^\circ\text{C/W}$	

### 1.3 Thermal and Package Characteristics

The following table lists the thermal and package characteristics of the MSCSM70VR1M03CT6AG device.

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

Symbol	Characteristics	Min.	Max.	Unit		
V <sub>ISOL</sub>	RMS isolation voltage, any terminal to case t = 1 min, 50 Hz/60 Hz	4000	—	V		
T <sub>J</sub>	Operating junction temperature range	−40	175	°C		
T <sub>JOP</sub>	Recommended junction temperature under switching conditions	−40	T <sub>Jmax</sub> −25			
T <sub>STG</sub>	Storage temperature range	−40	125			
T <sub>C</sub>	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		

The following table lists the temperature sensor NTC of the MSCSM70VR1M03CT6AG device.

**Table 1-7. Temperature Sensor NTC**

Symbol	Characteristics	Min.	Typ.	Max.	Unit
R <sub>25</sub>	Resistance at 25°C	—	50	—	kΩ
ΔR <sub>25</sub> /R <sub>25</sub>	—	—	5	—	%
B <sub>25/85</sub>	T <sub>25</sub> = 298.15 K	—	3952	—	K
ΔB/B	—	T <sub>C</sub> = 100 °C	4	—	%

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

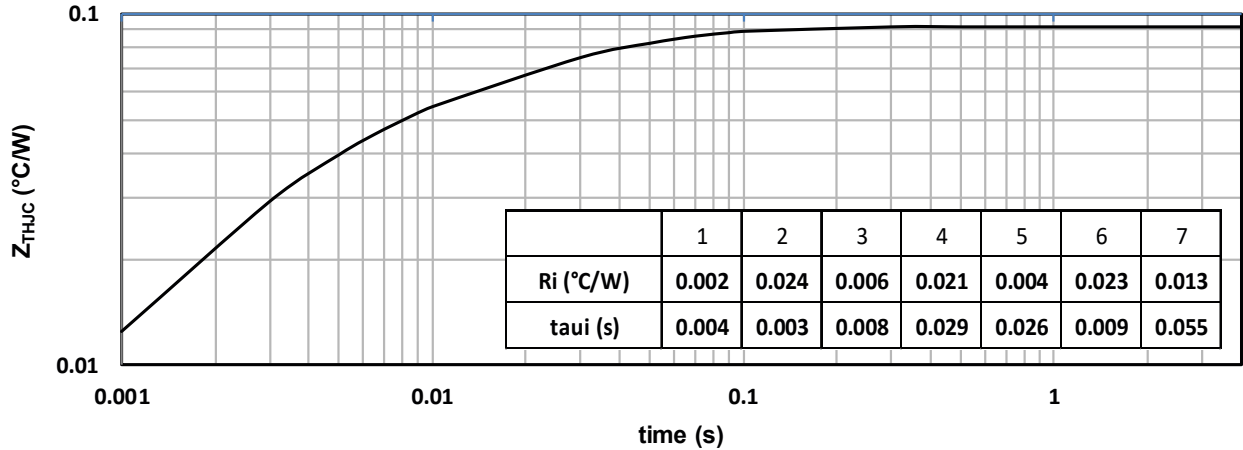
T: Thermistor temperature  
R<sub>T</sub>: Thermistor value at T

**Note:** See [APT0406—Using NTC Temperature Sensor Integrated into Power Module](#) for more information.

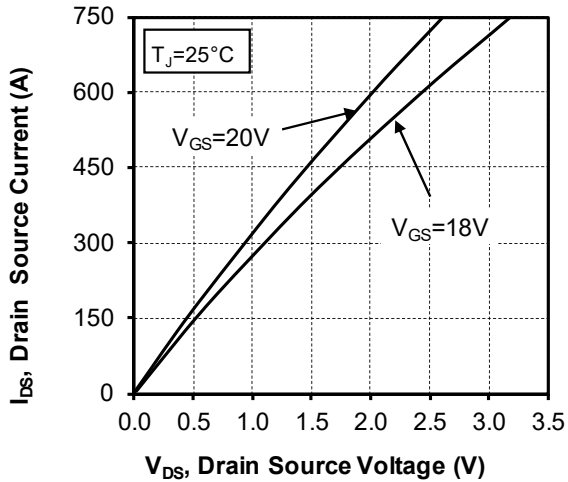
### 1.4 Typical SiC MOSFET Performance Curve

This section shows the typical SiC MOSFET performance curves of the MSCSM70VR1M03CT6AG device.

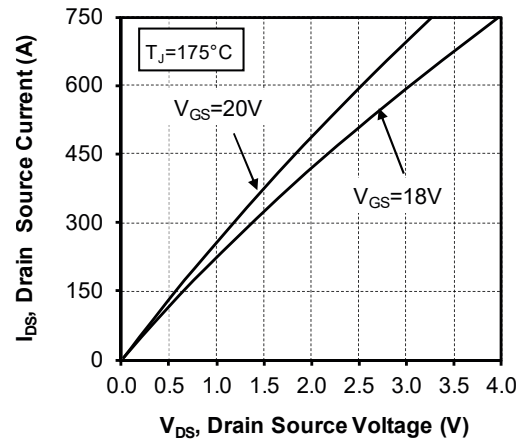
**Figure 1-1. Maximum Thermal Impedance**



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



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



# MSCSM70VR1M03CT6AG

## Electrical Specifications

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

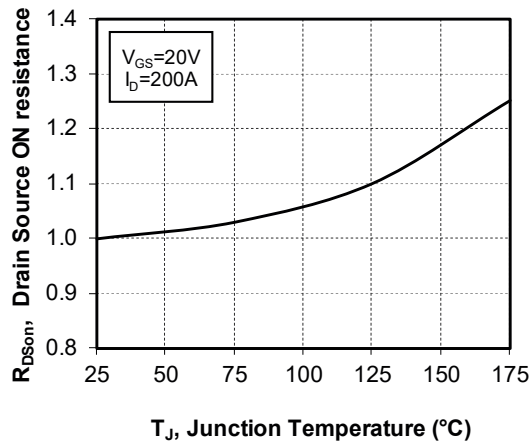


Figure 1-5. Transfer Characteristics

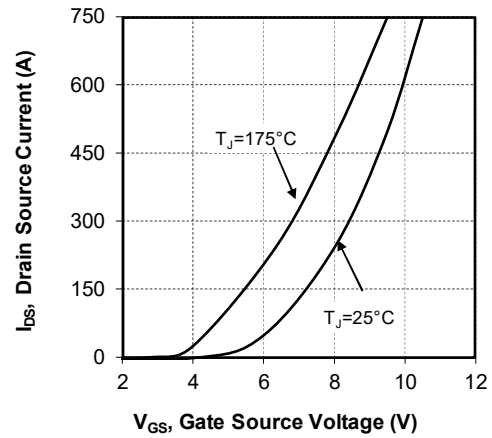


Figure 1-6. Switching Energy vs. Current

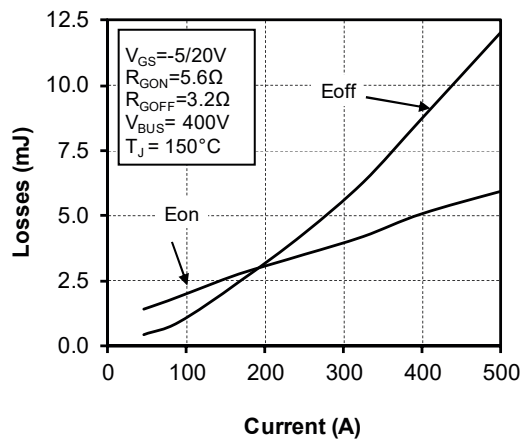


Figure 1-7. Turn On Energy vs.  $R_g$

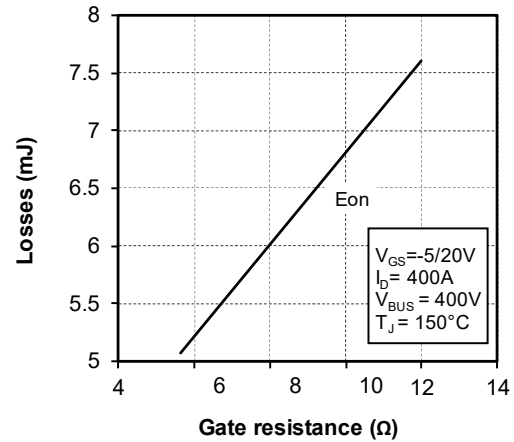


Figure 1-8. Capacitance vs. Drain Source Voltage

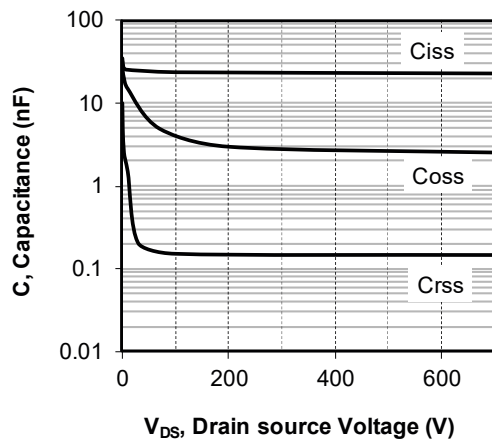
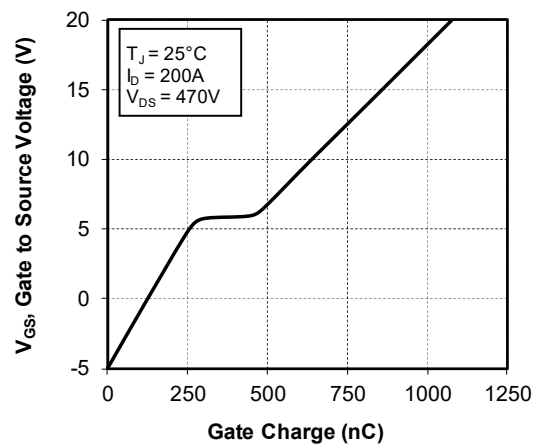


Figure 1-9. Gate Charge vs. Gate Source Voltage





# MSCSM70VR1M03CT6AG

## Electrical Specifications

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

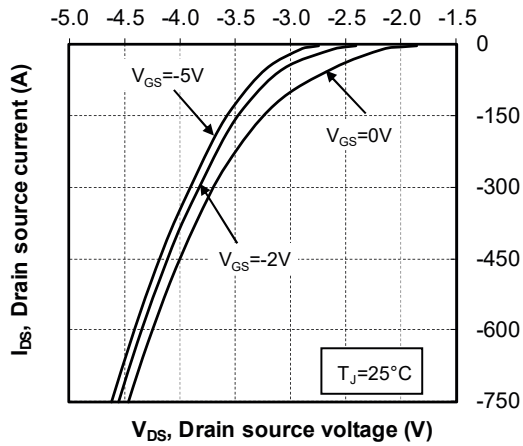


Figure 1-11. 3<sup>rd</sup> Quadrant Characteristics,  $T_J = 25^\circ\text{C}$

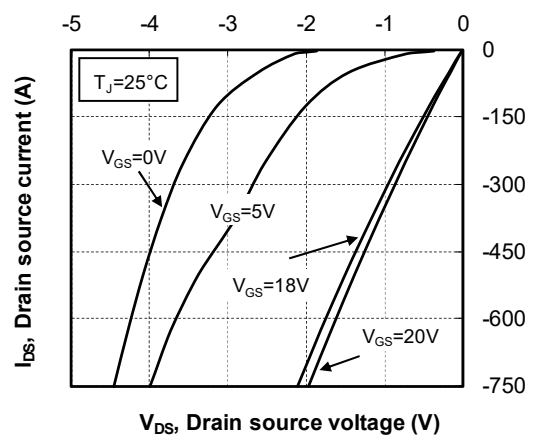


Figure 1-12. Body Diode Characteristics,  $T_J = 175^\circ\text{C}$

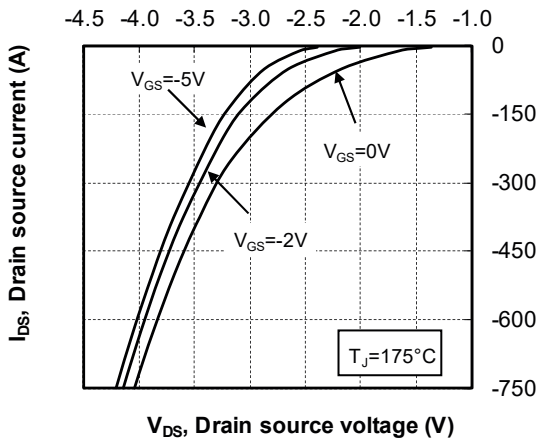


Figure 1-13. 3<sup>rd</sup> Quadrant Characteristics,  $T_J = 175^\circ\text{C}$

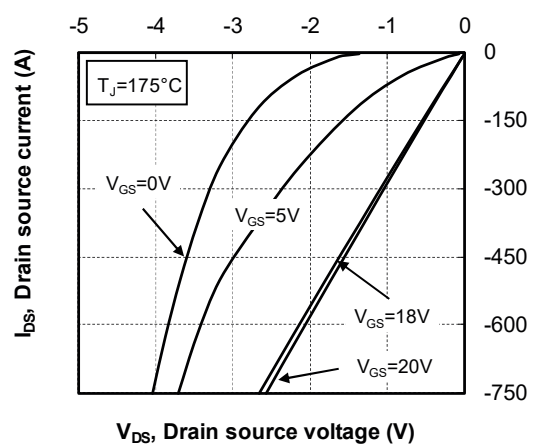


Figure 1-14. Operating Frequency vs Drain Current

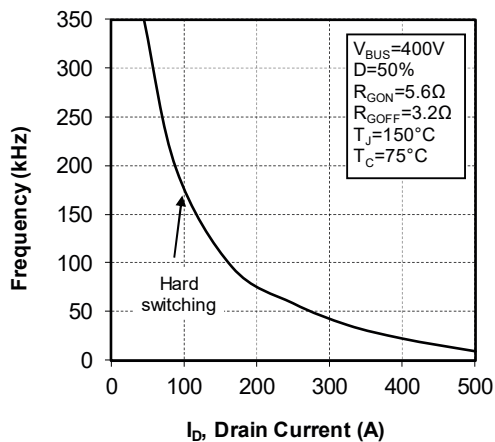
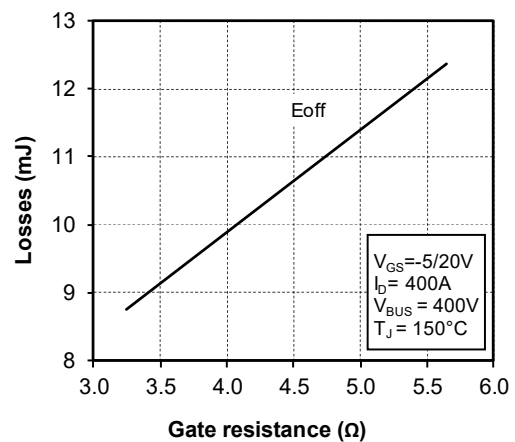


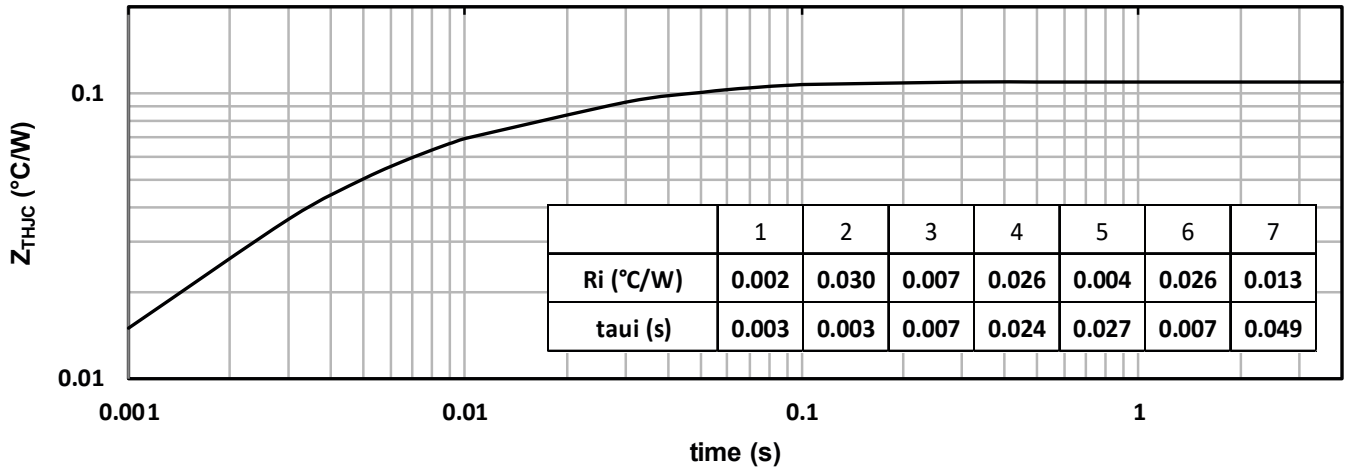
Figure 1-15. Turn Off Energy vs. Rg



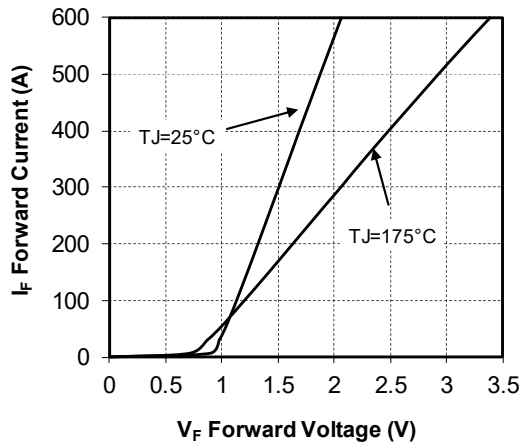
### 1.5 Typical SiC Diode Performance Curves (Per SiC Diode)

This section shows the typical SiC diode performance curves of the MSCSM70VR1M03CT6AG device.

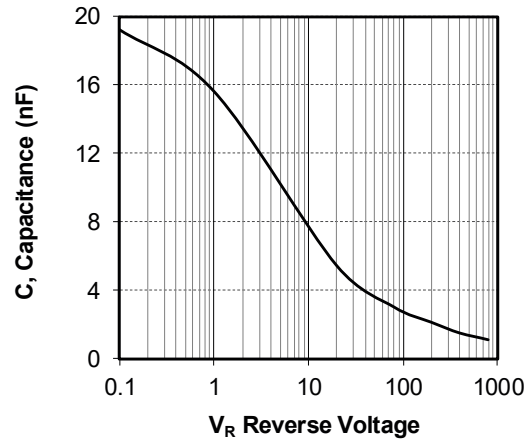
**Figure 1-16. Junction-to-Heatsink Thermal Impedance**



**Figure 1-17. Forward Characteristics**



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



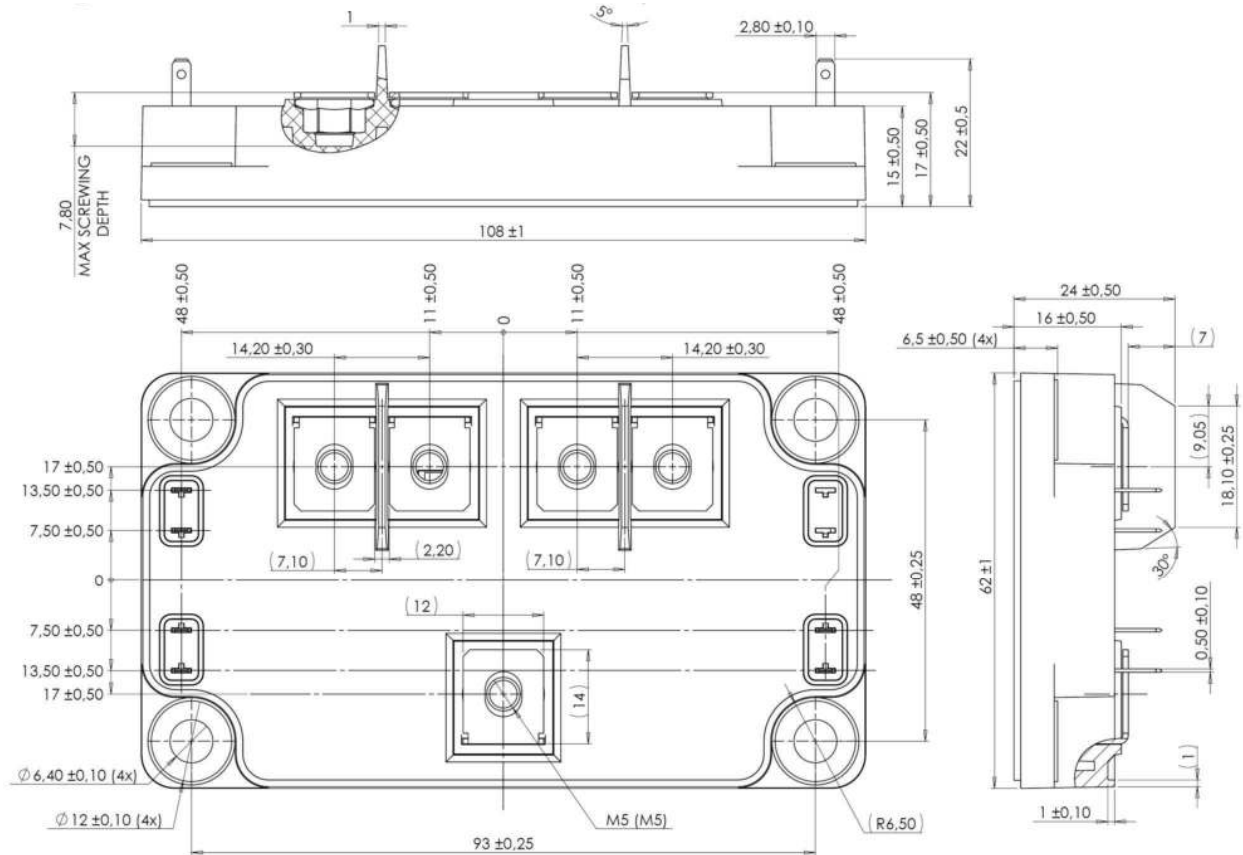
## 2. Package Specifications

The following section shows the package specification of the MSCSM70VR1M03CT6AG device.

### 2.1 Package Outline

The following figure shows the package outline drawing of the MSCSM70VR1M03CT6AG device. The dimensions in the following figure are in millimeters.

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



### 3. Revision History

Revision	Date	Description
A	08/2022	Initial Revision

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