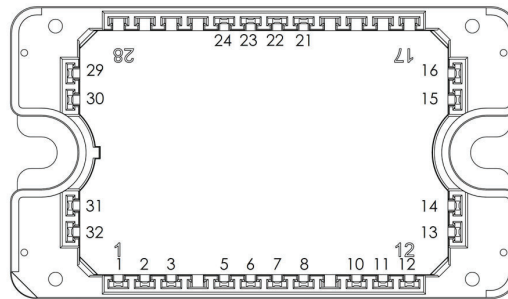
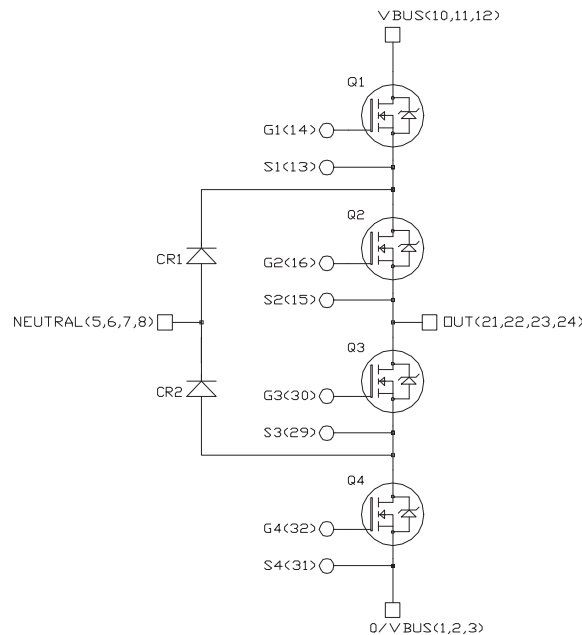


## Three Level Inverter SiC MOSFET Power Module

### Product Overview

The MSCSM70TLM10C3AG device is a 700V/241A, three level inverter silicon carbide (SiC) MOSFET power module.



All multiple inputs and outputs must be shorted together  
 1/2/3 ; 10/11/12 ; 5/6/7/8 ; 21/22/23/24

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 the key features of MSCSM70TLM10C3AG 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 emitter for easy drive
- Low stray inductance
- High level of integration
- Aluminum Nitride (AlN) substrate for improved thermal performance

## Benefits

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The following are the benefits of MSCSM70TLM10C3AG device:

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

## Application

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The following are the applications of MSCSM70TLM10C3AG device:

- Uninterruptible power supplies

## 1. Electrical Specifications

This section provides the electrical specifications of the MSCSM70TLM10C3AG device.

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

The following table lists the absolute maximum ratings per SiC MOSFET of the MSCSM70TLM10C3AG device.

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

Symbol	Parameter	Maximum Ratings	Unit
$V_{DSS}$	Drain-Source voltage	700	V
$I_D$	Continuous drain current	$T_C = 25\text{ }^\circ\text{C}$	241
		$T_C = 80\text{ }^\circ\text{C}$	192
$I_{DM}$	Pulsed drain current	482	
$V_{GSmax}$	Gate-Source voltage	-10/25	V
$R_{DS(on)}$	Drain-Source ON resistance	9.5	m $\Omega$
$P_D$	Power dissipation	$T_C = 25\text{ }^\circ\text{C}$	690

The following table lists the electrical characteristics per SiC MOSFET of the MSCSM70TLM10C3AG device.

**Table 1-2. Electrical Characteristics**

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0V$ $V_{DS} = 700V$	—	—	200	$\mu\text{A}$
$R_{DS(on)}$	Drain-Source on resistance	$V_{GS} = 20V$ $I_D = 80A$	$T_J = 25\text{ }^\circ\text{C}$	—	7.5	9.5
			$T_J = 175\text{ }^\circ\text{C}$	—	9.5	—
$V_{GS(th)}$	Gate threshold voltage	$V_{GS} = V_{DS}$ $I_D = 8\text{ mA}$	1.9	2.4	—	V
$I_{GSS}$	Gate-Source leakage current	$V_{GS} = 20V$ $V_{DS} = 0V$	—	—	200	nA

# MSCSM70TLM10C3AG

## Electrical Specifications

The following table lists the dynamic characteristics per SiC MOSFET of the MSCSM70TLM10C3AG device.

**Table 1-3. Dynamic Characteristics**

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit	
$C_{iss}$	Input capacitance	$V_{GS} = 0V$	—	9000	—	pF	
$C_{oss}$	Output capacitance	$V_{DS} = 700V$	—	1020	—		
$C_{rss}$	Reverse transfer capacitance	$f = 1\text{ MHz}$	—	58	—		
$Q_g$	Total gate charge	$V_{GS} = -5V/20V$	—	430	—	nC	
$Q_{gs}$	Gate-source charge	$V_{Bus} = 470V$	—	116	—		
$Q_{gd}$	Gate-drain charge	$I_D = 80A$	—	70	—		
$T_{d(on)}$	Turn-on delay time	$V_{GS} = -5V/20V$	$T_J = 150\text{ }^\circ\text{C}$	—	40	—	ns
$T_r$	Rise time	$V_{Bus} = 400V$		—	35	—	
$T_{d(off)}$	Turn-off delay time	$I_D = 160A$		—	50	—	
$T_f$	Fall time	$R_{G(on)} = 13.5\Omega$ $R_{G(off)} = 2.4\Omega$		—	20	—	
$E_{on}$	Turn-on energy	$V_{GS} = -5V/20V$	$T_J = 150\text{ }^\circ\text{C}$	—	1090	—	$\mu\text{J}$
$E_{off}$	Turn-off energy	$V_{Bus} = 400V$ $I_D = 160A$ $R_{G(on)} = 13.5\Omega$ $R_{G(off)} = 2.4\Omega$	$T_J = 150\text{ }^\circ\text{C}$	—	372	—	
$R_{Gint}$	Internal gate resistance		—	2.8	—	$\Omega$	
$R_{thJC}$	Junction-to-case thermal resistance		—	—	0.217	$^\circ\text{C/W}$	

The following table lists the body diode ratings and characteristics per SiC MOSFET of the MSCSM70TLM10C3AG device.

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

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
$V_{SD}$	Diode forward voltage	$V_{GS} = 0V$ $I_{SD} = 80A$	—	3.4	—	V
		$V_{GS} = -5V$ $I_{SD} = 80A$	—	3.8	—	
$t_{rr}$	Reverse recovery time	$I_{SD} = 80A$	—	38	—	ns
$Q_{rr}$	Reverse recovery charge	$V_{GS} = -5V$	—	636	—	nC
$I_{rr}$	Reverse recovery current	$V_R = 400V$ $di_F/dt = 2000A/\mu\text{s}$	—	29.6	—	A

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

The following table lists the SiC diode ratings and characteristics per SiC diode of MSCSM70TLM10C3AG device.

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

Symbol	Characteristic	Test Conditions		Min.	Typ.	Max.	Unit
$V_{RRM}$	Peak repetitive reverse voltage			—	—	700	V
$I_{RRM}$	Reverse leakage current	$V_R = 700V$	$T_J = 25\text{ }^\circ\text{C}$	—	15	200	$\mu\text{A}$
			$T_J = 175\text{ }^\circ\text{C}$	—	250	—	
$I_F$	DC forward current			—	50	—	A
$V_F$	Diode forward voltage	$I_F = 50A$	$T_J = 25\text{ }^\circ\text{C}$	—	1.5	1.8	V
			$T_J = 175\text{ }^\circ\text{C}$	—	1.9	—	
$Q_C$	Total capacitive charge	$V_R = 400V$		—	133	—	nC
C	Total capacitance	$f = 1\text{ MHz}$ $V_R = 200V$		—	248	—	pF
		$f = 1\text{ MHz}$ $V_R = 400V$		—	216	—	
$R_{thJC}$	Junction-to-case thermal resistance			—	—	0.86	$^\circ\text{C/W}$

### 1.3 Thermal and Package Characteristics

The following table lists the thermal and package characteristics of the MSCSM70TLM10C3AG device.

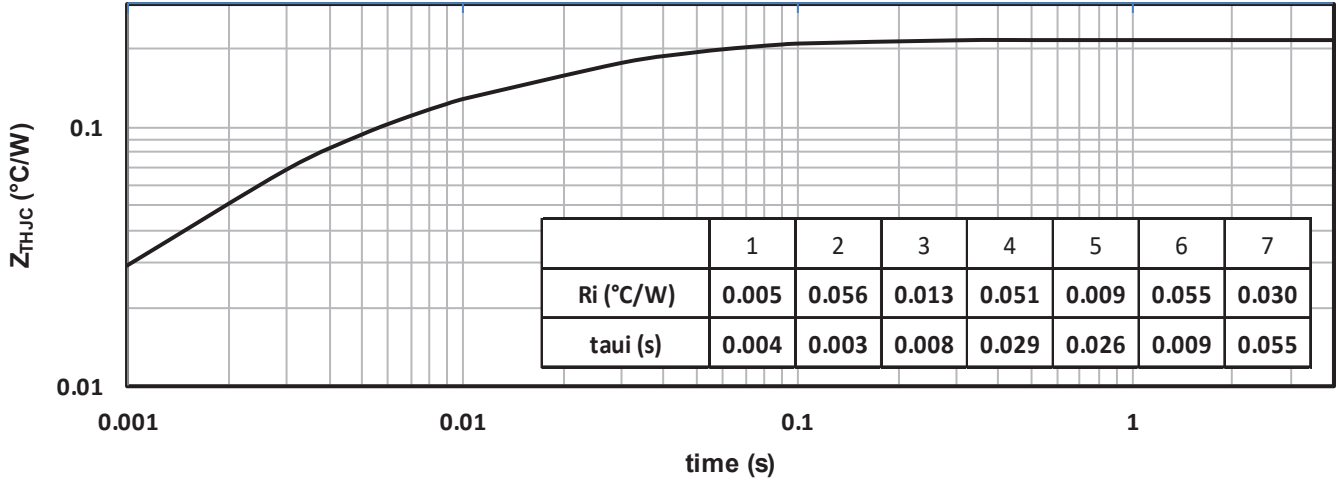
**Table 1-6. Thermal and Package Characteristics**

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	M4	2	3	
Wt	Package weight			—	110	g

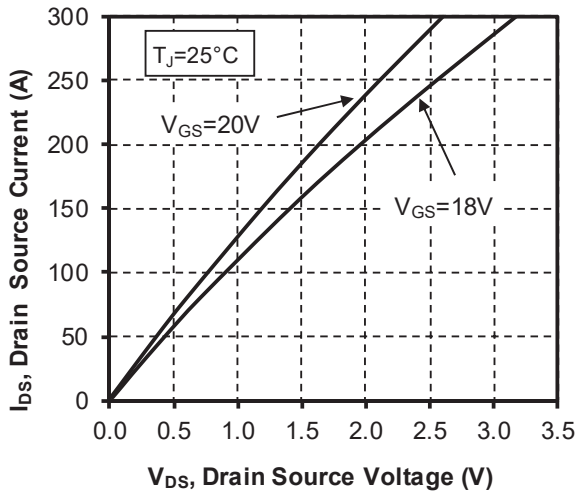
### 1.4 Typical SiC MOSFET Performance Curve

This section shows the typical SiC MOSFET performance curves of the MSCSM70TLM10C3AG device.

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



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



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

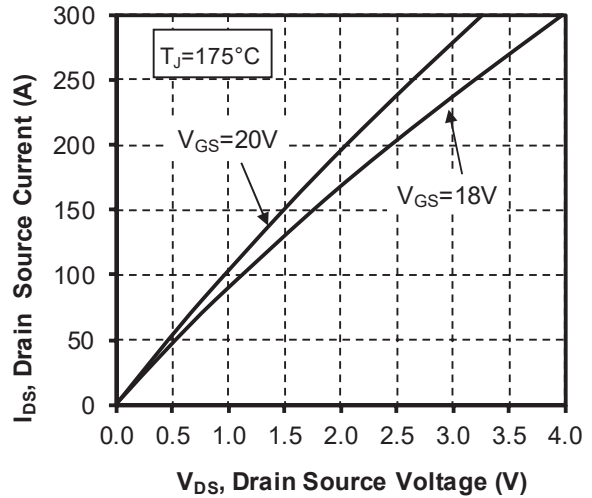


Figure 1-4. Normalized  $R_{DS(on)}$  vs. Temperature

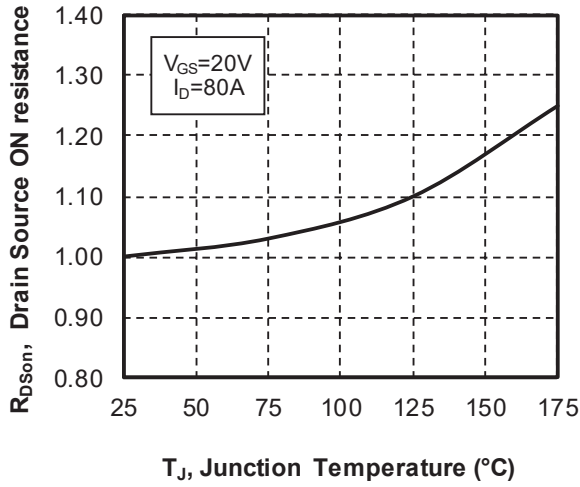


Figure 1-5. Transfer Characteristics

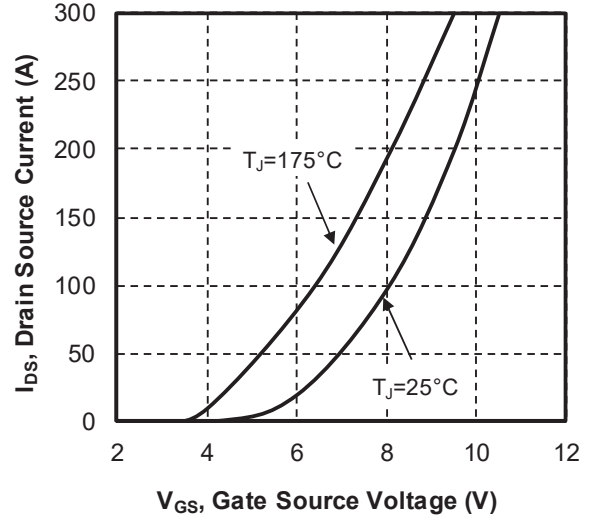


Figure 1-6. Capacitance vs. Drain Source Voltage

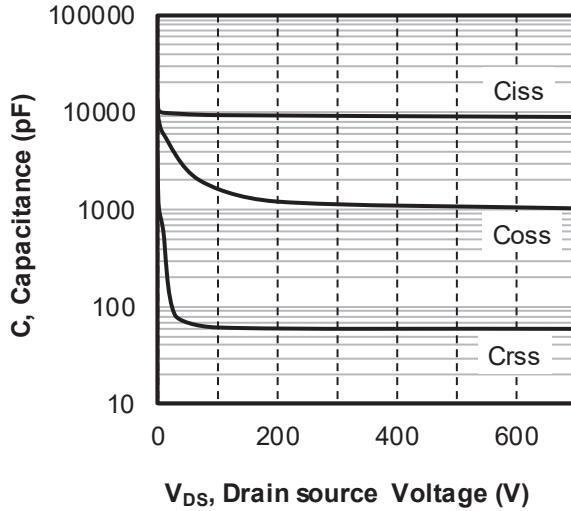


Figure 1-7. Gate Charge vs. Gate Source Voltage

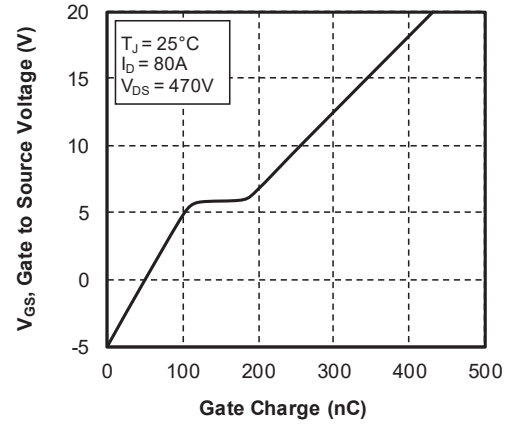


Figure 1-8. Body Diode Characteristics,  $T_J = 25^{\circ}C$

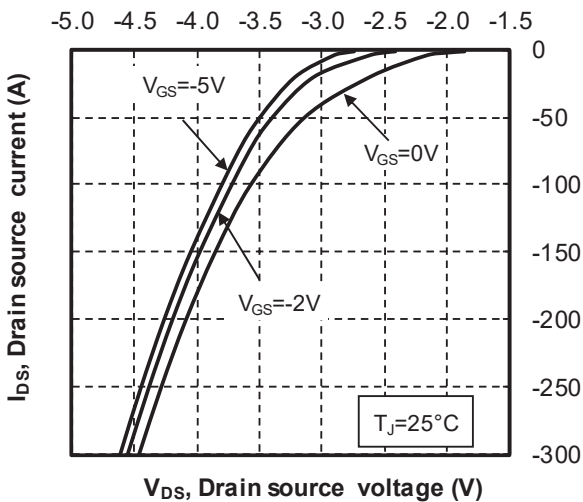


Figure 1-9. 3<sup>rd</sup> Quadrant Characteristics,  $T_J = 25^{\circ}C$

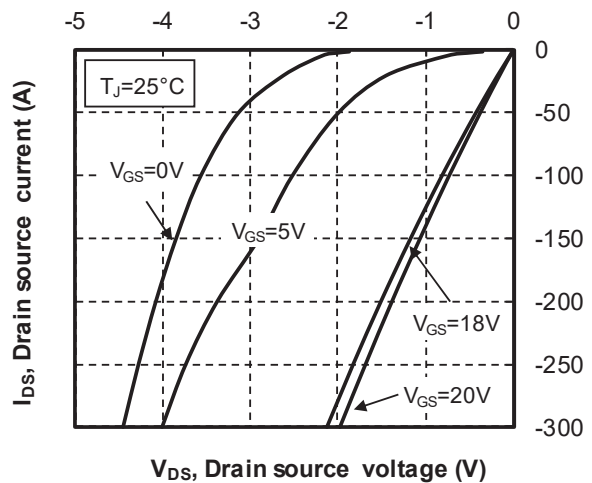


Figure 1-10. Body Diode Characteristics,  $T_J = 175^\circ\text{C}$

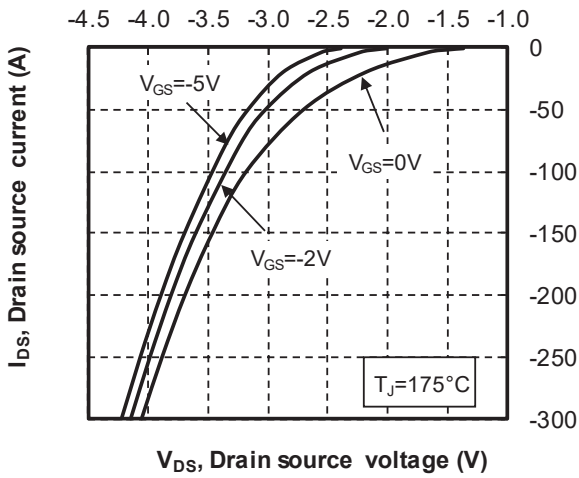


Figure 1-11. 3<sup>rd</sup> Quadrant Characteristics,  $T_J = 175^\circ\text{C}$

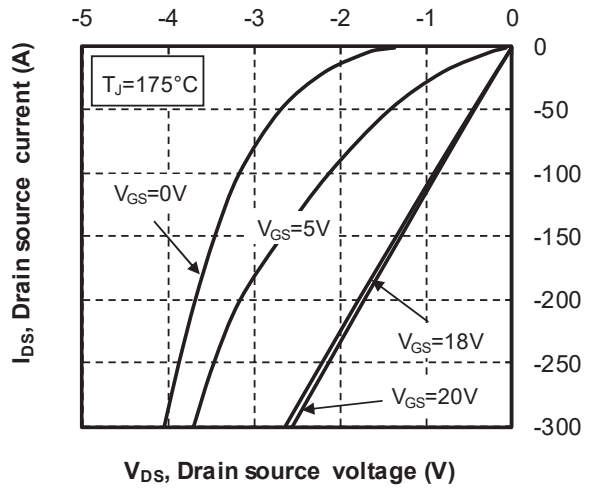


Figure 1-12. Turn On Energy vs.  $R_g$

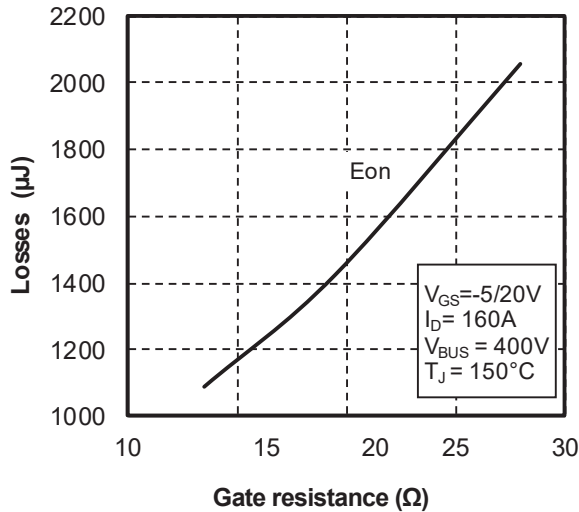


Figure 1-13. Turn Off Energy vs.  $R_g$

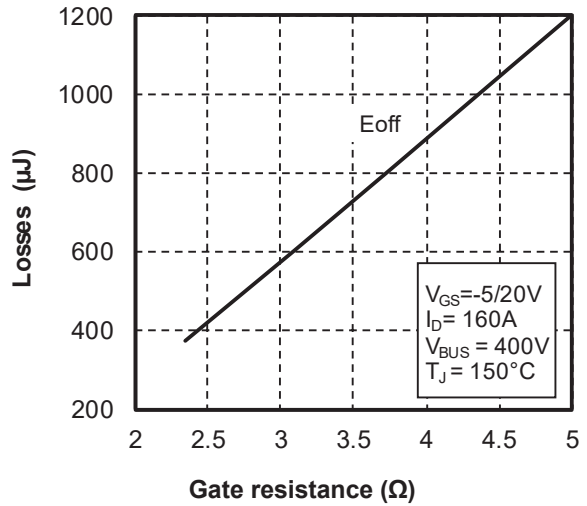


Figure 1-14. Switching Energy vs. Current

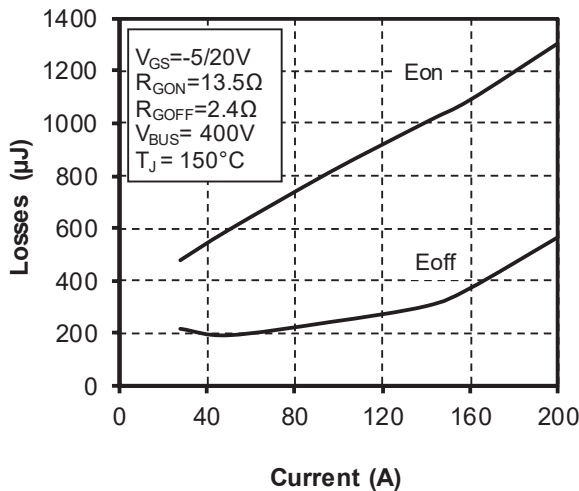
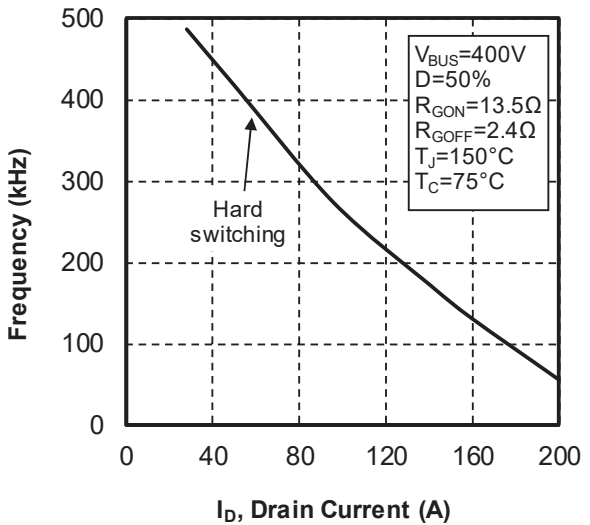


Figure 1-15. Operating Frequency vs. Drain Current

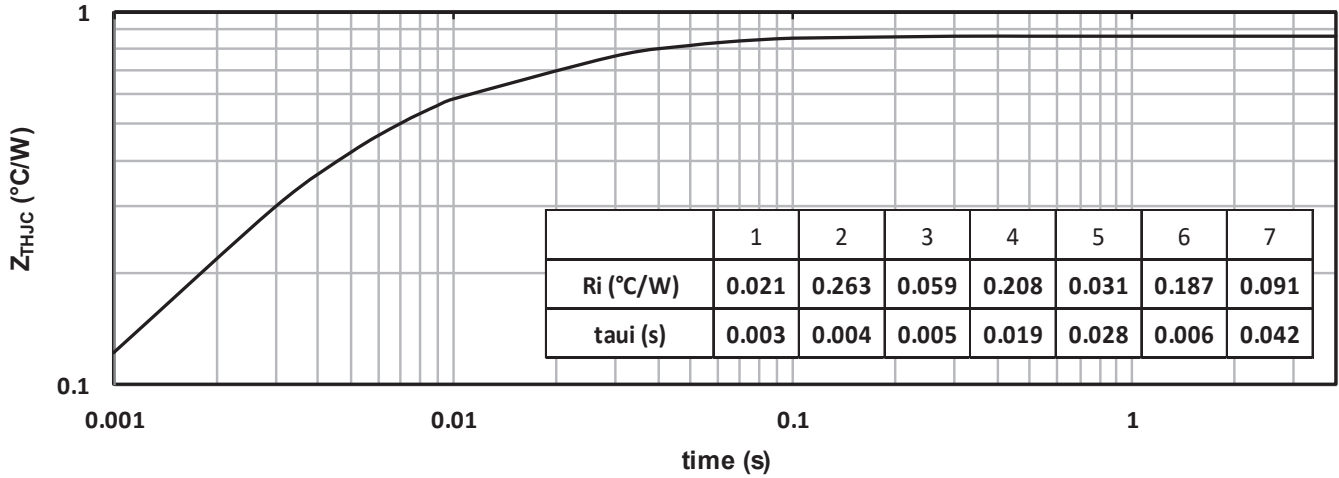




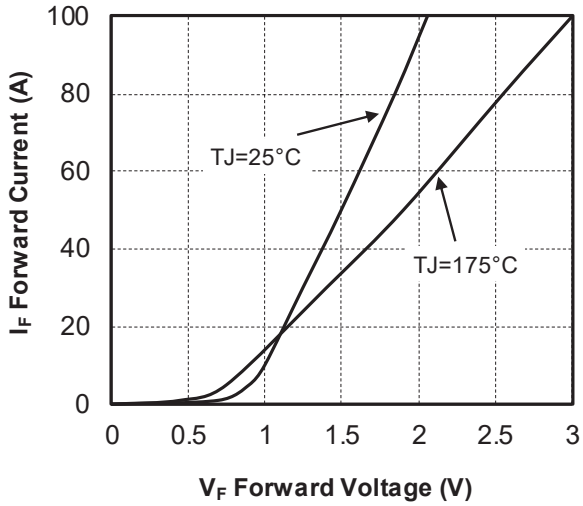
### 1.5 Typical SiC Diode Performance Curves

This section shows the typical SiC diode performance curves of the MSCSM70TLM10C3AG device.

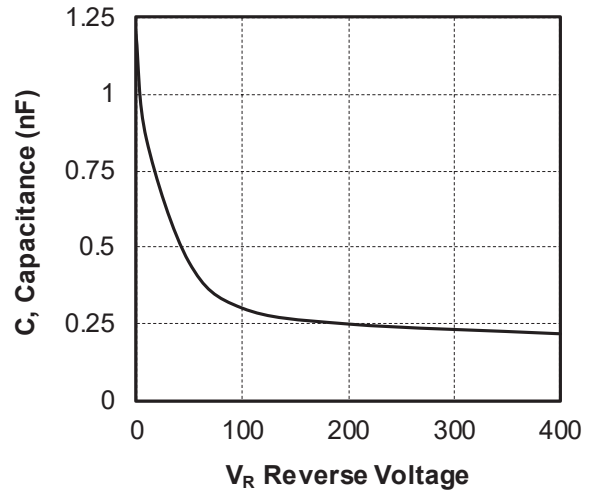
**Figure 1-16. Maximum Thermal Impedance**



**Figure 1-17. Forward Characteristics**



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



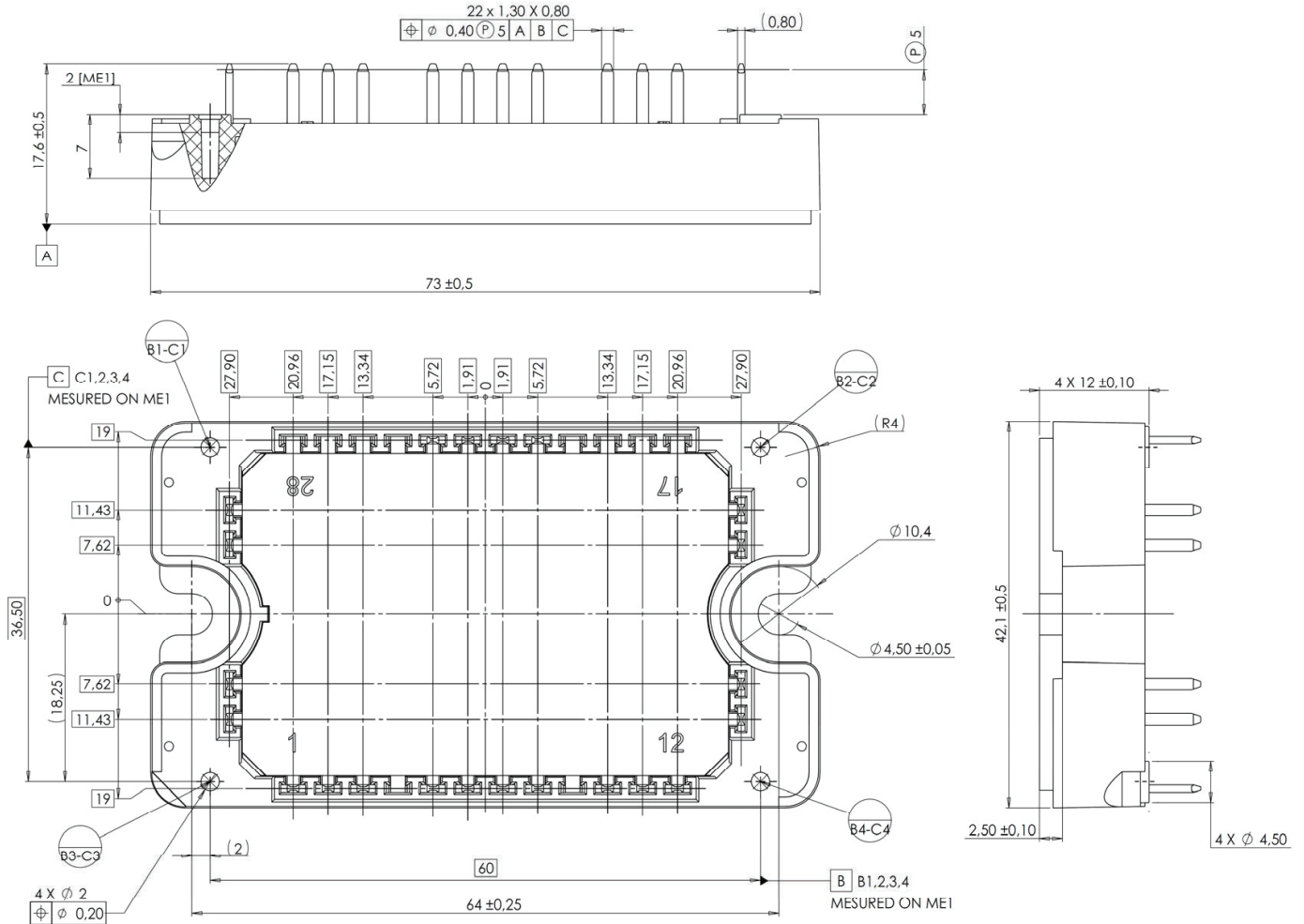
## 2. Package Specifications

The following section shows the package specification of the MSCSM70TLM10C3AG device.

### 2.1 Package Outline

The following figure shows the package outline drawing of the MSCSM70TLM10C3AG device. The dimensions in the following figure are in millimeters.

Figure 2-1. Package Outline Drawing



**Note:** See application note [AN3500A—Mounting Instructions for SP1F and SP3F Power Modules](#) for more information.

### 3. Revision History

Revision	Date	Description
A	12/2021	Initial Revision.

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ISBN: 978-1-5224-9428-7

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