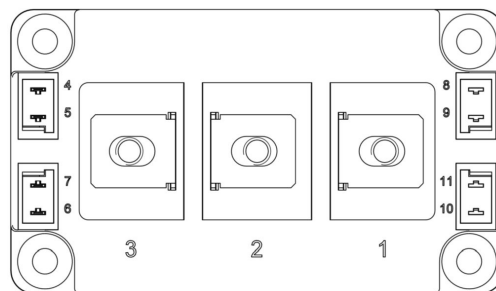
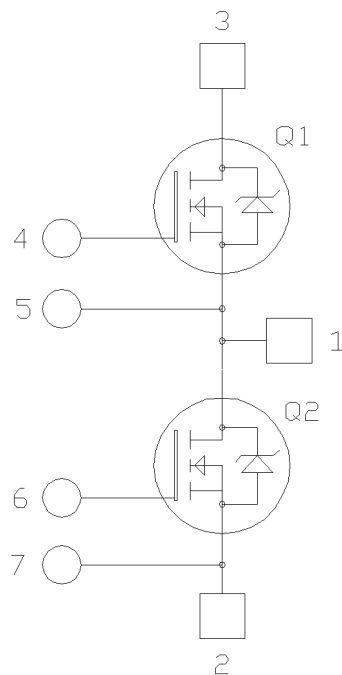


Phase Leg SiC Power Module

Product Overview

The MSCSM70AM025D3AG device is a 700V/689A phase leg silicon carbide (SiC) power module.



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



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

Features

The following are the key features of the MSCSM70AM025D3AG device:

- SiC Power MOSFET
 - Low $R_{DS(on)}$
 - High temperature performance
- Kelvin source for easy drive
- High level of integration
- Aluminum Nitride (AlN) substrate for improved thermal performance
- M6 power connectors

Benefits

The following are the benefits of the MSCSM70AM025D3AG device:

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

Applications

The following are the applications of the MSCSM70AM025D3AG device:

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

1. Electrical Specifications

This section provides the electrical specifications of the MSCSM70AM025D3AG device.

1.1 SiC MOSFET Characteristics (Per SiC MOSFET)

The following table lists the absolute maximum ratings of the MSCSM70AM025D3AG device.

Table 1-1. Absolute Maximum Ratings

Symbol	Parameter		Maximum Ratings	Unit
V_{DSS}	Drain-Source voltage		700	V
I_D	Continuous drain current	$T_C = 25\text{ }^{\circ}\text{C}$	689 ¹	A
		$T_C = 80\text{ }^{\circ}\text{C}$	548 ¹	
I_{DM}	Pulsed drain current		1380	
V_{GS}	Gate-Source voltage		-10/23	V
$R_{DS(on)}$	Drain-Source ON resistance		3.2	m Ω
P_D	Power dissipation	$T_C = 25\text{ }^{\circ}\text{C}$	1882	W

Note:

1. Specification of SiC MOSFET device but output current must be limited due to size of power connectors.

The following table lists the electrical characteristics of the MSCSM70AM025D3AG device.

Table 1-2. Electrical Characteristics

Symbol	Characteristic	Test Conditions		Min.	Typ.	Max.	Unit
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0V$ $V_{DS} = 700V$		—	—	600	μA
$R_{DS(on)}$	Drain-Source on resistance	$V_{GS} = 20V$ $I_D = 240A$	$T_J = 25\text{ }^{\circ}\text{C}$	—	2.5	3.2	m Ω
			$T_J = 175\text{ }^{\circ}\text{C}$	—	3.2	—	
$V_{GS(th)}$	Gate threshold voltage	$V_{GS} = V_{DS}$ $I_D = 24\text{ mA}$		1.9	2.4	—	V
I_{GSS}	Gate-Source leakage current	$V_{GS} = 20V$ $V_{DS} = 0V$		—	—	600	nA

The following table lists the dynamic characteristics of the MSCSM70AM025D3AG device.

Table 1-3. Dynamic Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{GS} = 0V$	—	27	—	nF
C_{oss}	Output capacitance	$V_{DS} = 700V$	—	3	—	
C_{rss}	Reverse transfer capacitance	$f = 1\text{ MHz}$	—	0.17	—	
Q_g	Total gate charge	$V_{GS} = -5V/20V$	—	1290	—	nC
Q_{gs}	Gate-source charge	$V_{Bus} = 470V$	—	348	—	
Q_{gd}	Gate-drain charge	$I_D = 240A$	—	210	—	
$T_{d(on)}$	Turn-on delay time	$V_{GS} = -5V/20V$	—	78	—	ns
T_r	Rise time	$V_{Bus} = 400V$	—	125	—	
$T_{d(off)}$	Turn-off delay time	$I_D = 480A$	—	214	—	
T_f	Fall time	$T_J = 150\text{ }^{\circ}C$ $R_{GON} = 12\Omega$ $R_{GOFF} = 2.7\Omega$	—	92	—	
E_{on}	Turn-on energy	$V_{GS} = -5V/20V$	—	10	—	mJ
E_{off}	Turn-off energy	$V_{Bus} = 400V$ $I_D = 480A$ $R_{GON} = 12\Omega$ $R_{GOFF} = 2.7\Omega$	—	10.5	—	mJ
R_{Gint}	Internal gate resistance		—	0.95	—	Ω
R_{thJC}	Junction-to-case thermal resistance		—	—	0.08	$^{\circ}C/W$

The following table lists the body diode ratings and characteristics of the MSCSM70AM025D3AG device.

Table 1-4. Body Diode Ratings and Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
V_{SD}	Diode forward voltage	$V_{GS} = 0V$ $I_{SD} = 240A$	—	3.4	—	V
		$V_{GS} = -5V$ $I_{SD} = 240A$	—	3.8	—	
t_{rr}	Reverse recovery time	$I_{SD} = 240A$	—	40	—	ns
Q_{rr}	Reverse recovery charge	$V_{GS} = -5V$	—	1.9	—	μC
I_{rr}	Reverse recovery current	$V_R = 400V$ $di_F/dt = 6000\text{ A}/\mu s$	—	89	—	A

1.2 Thermal and Package Characteristics

The following table lists the package characteristics of the MSCSM70AM025D3AG device.

Table 1-5. Thermal and Package Characteristics

Symbol	Characteristic			Min.	Max.	Unit
V _{ISOL}	RMS isolation voltage, any terminal to case t = 1 min, 50 Hz/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	M6	3	5	N.m
		For terminals	M5	2	3.5	
Wt	Package weight			—	300	g

1.3 Typical SiC MOSFET Performance Curve

The following figures show the SiC MOSFET performance curves of the MSCSM70AM025D3AG device.

Figure 1-1. Maximum Thermal Impedance

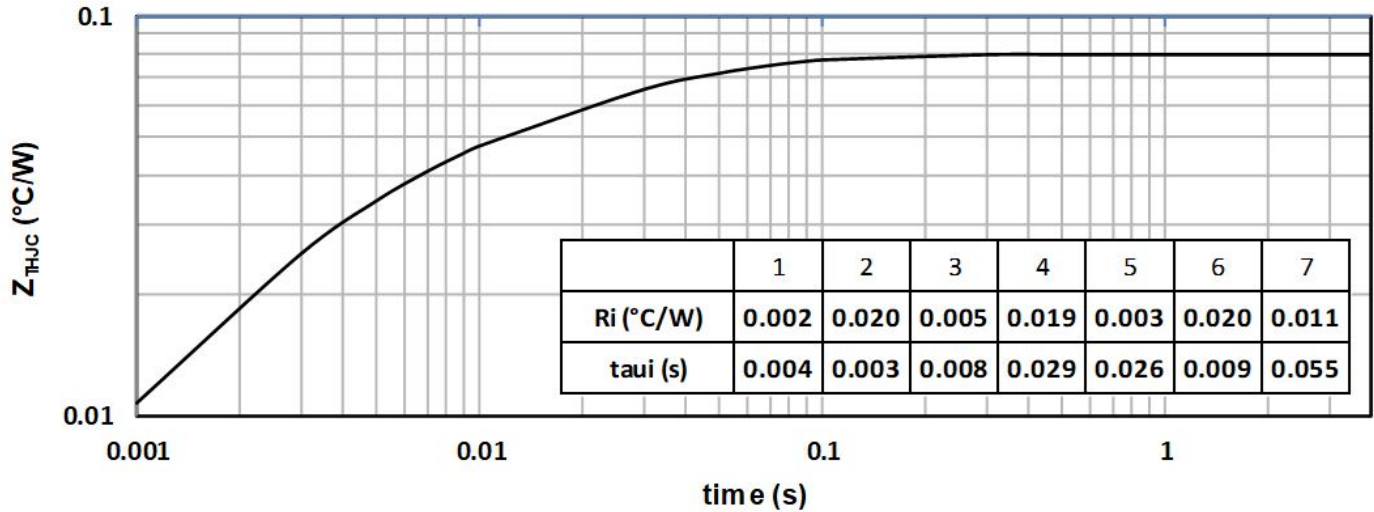


Figure 1-2. Output Characteristics, $T_J = 25^\circ\text{C}$

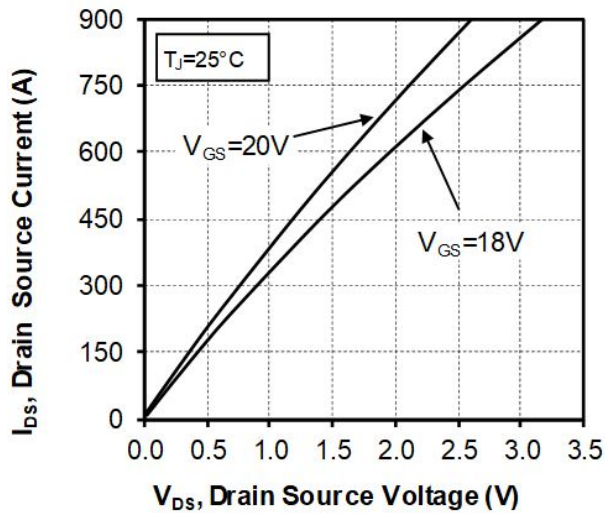


Figure 1-3. Output Characteristics, $T_J = 175^\circ\text{C}$

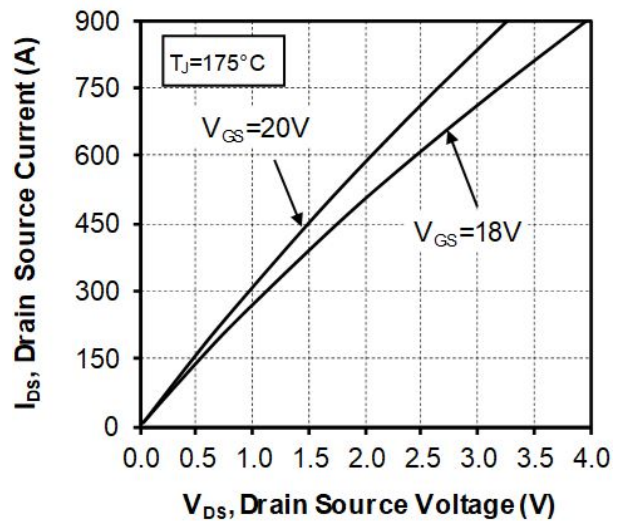


Figure 1-4. Normalized $R_{DS(on)}$ vs. Temperature

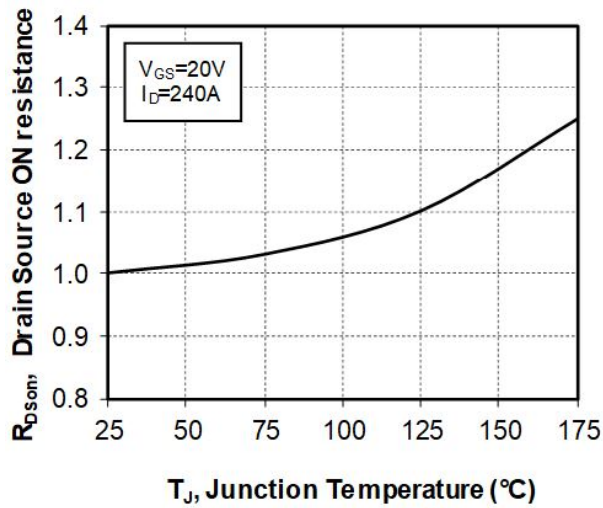


Figure 1-5. Transfer Characteristics

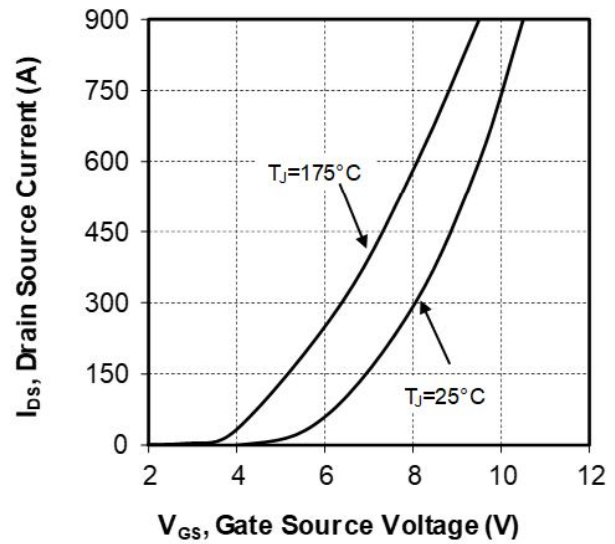


Figure 1-6. Turn On Energy vs Rg

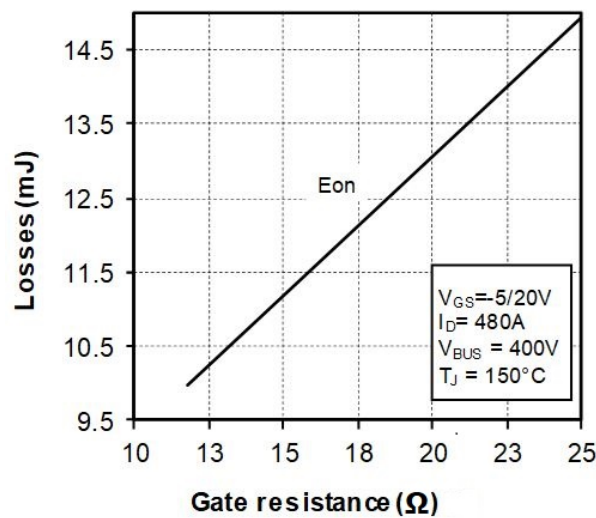


Figure 1-7. Switching Energy vs. Current

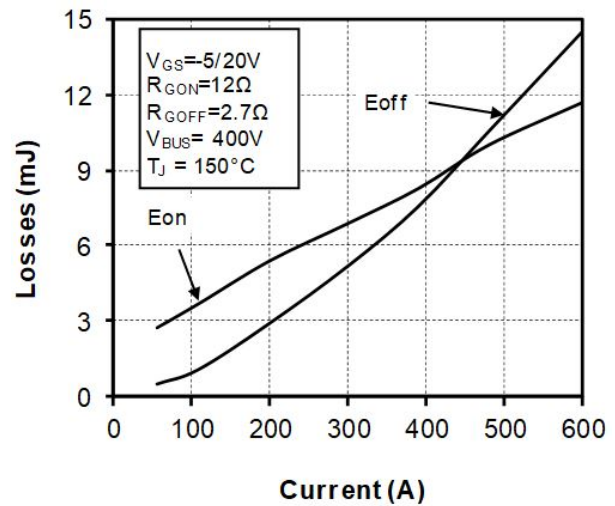


Figure 1-8. Capacitance vs. Drain Source Voltage

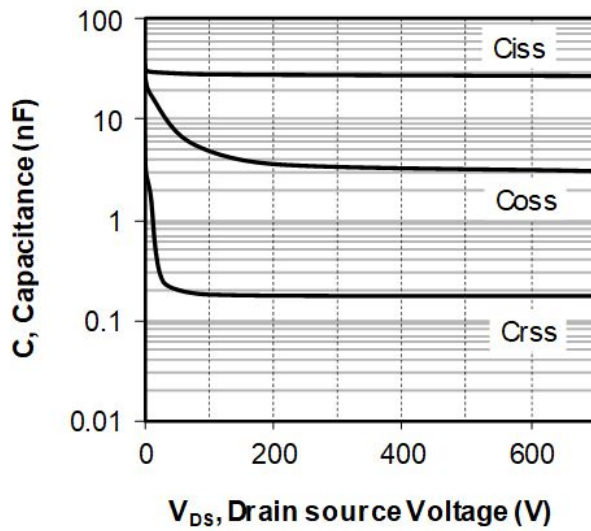


Figure 1-9. Gate Charge vs. Gate Source Voltage

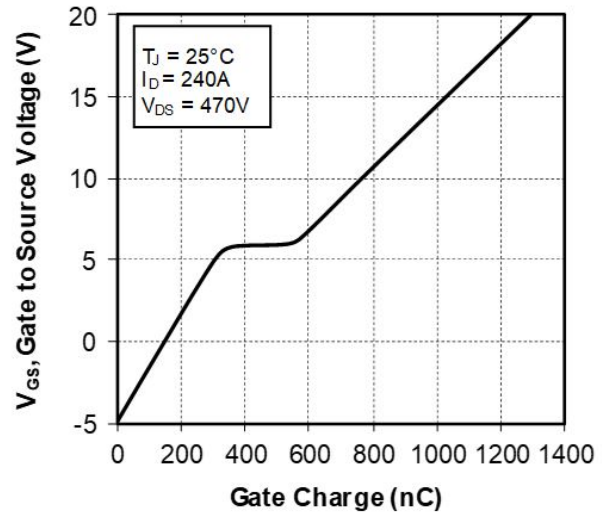


Figure 1-10. Body Diode Characteristics, $T_J = 25^\circ\text{C}$

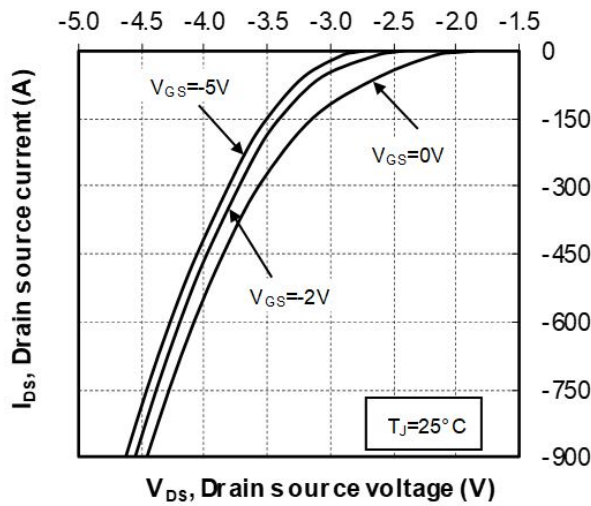


Figure 1-11. 3rd Quadrant Characteristics, $T_J = 25^\circ\text{C}$

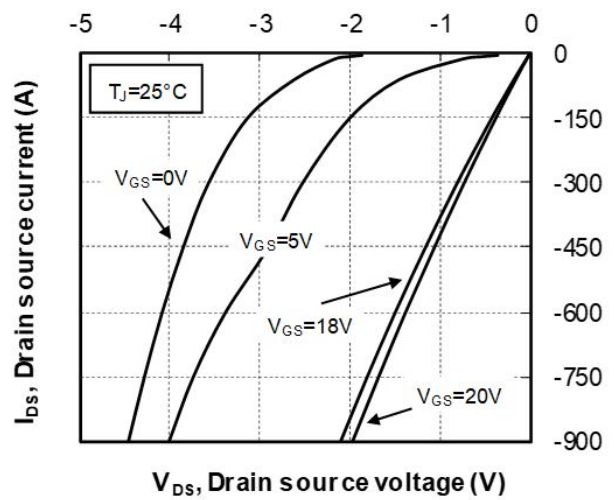


Figure 1-12. Body Diode Characteristics, $T_J = 175^\circ\text{C}$

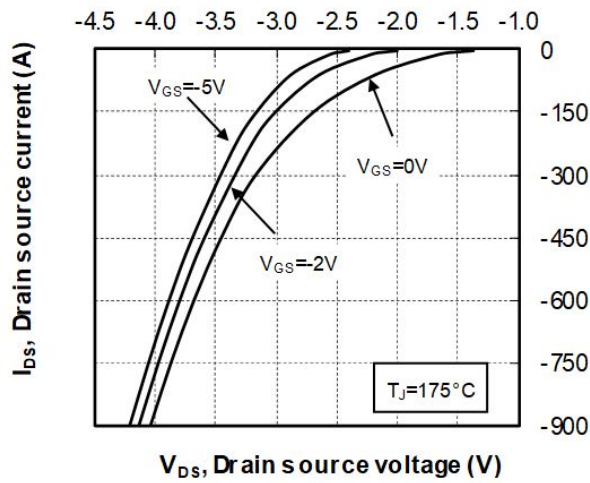


Figure 1-13. 3rd Quadrant Characteristics, $T_J = 175^\circ\text{C}$

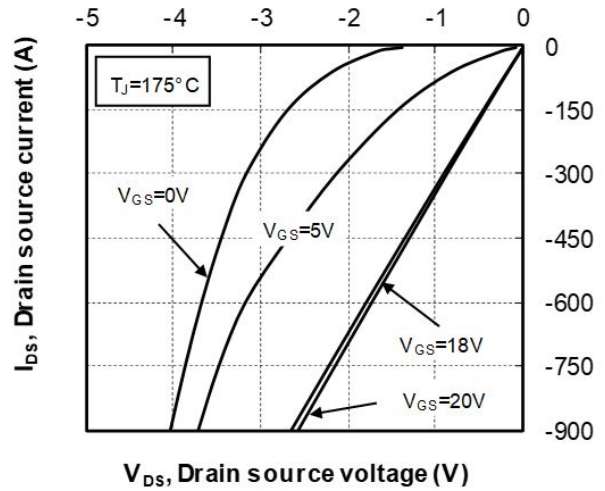


Figure 1-14. Operating Frequency vs. Drain Current

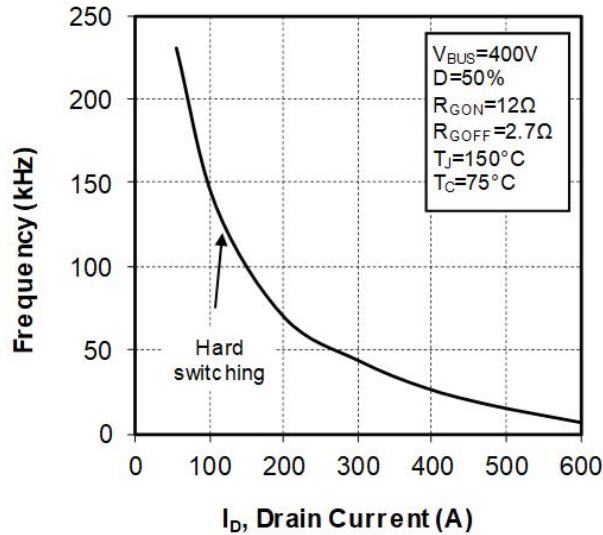
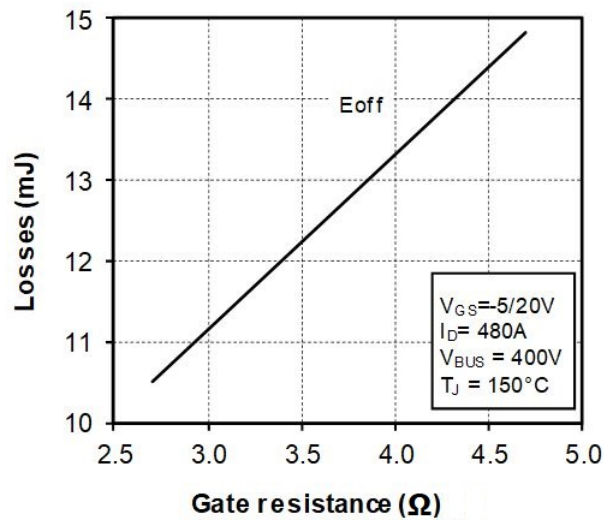


Figure 1-15. Turn Off Energy vs. Rg



The following section shows the package specification of the MSCSM70AM025D3AG device.

Figure 2-1. Package Outline Drawing



3. Revision History

Revision	Date	Description
A	06/2022	Initial Revision

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