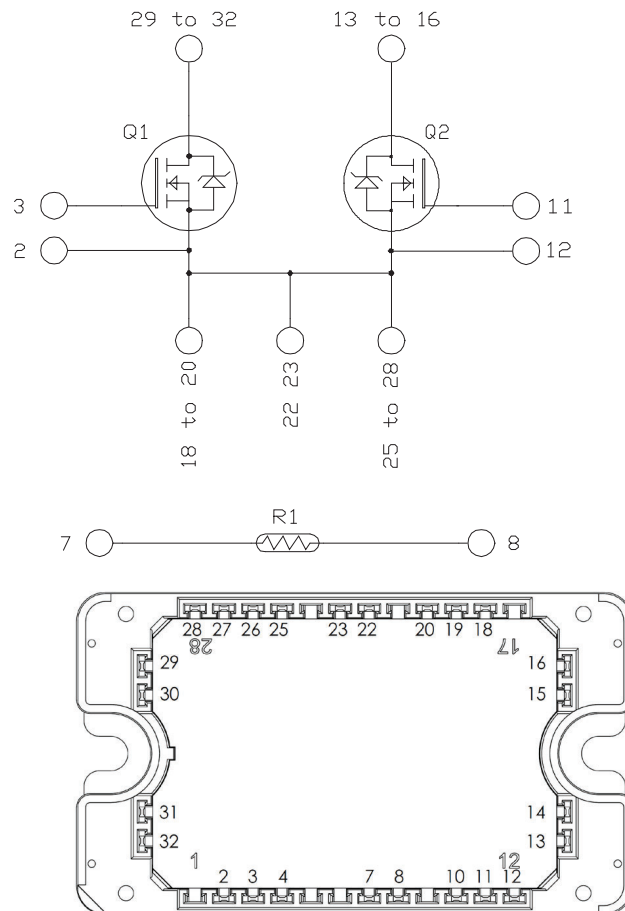# MSCSM70DUM10T3AG

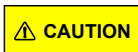## Dual Common Source SiC MOSFET Power Module

Product Overview

The MSCSM70DUM10T3AG device is a 700V/241A dual common source silicon carbide (SiC) MOSFET power module.

All multiple inputs and outputs must be shorted together
13/14/15/16 ; 18/19/20/22/23/25/26/27/28 ; 29/30/31/32

All ratings at T_J = 25 °C, unless otherwise specified.

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

Features

The following are the key features of MSCSM70DUM10T3AG device:

- SiC Power MOSFET
  - Low $R_{DS(on)}$
  - High temperature performance
- Kelvin source for easy drive
- Low stray inductance
- High level of integration
- Aluminum Nitride (AlN) substrate for improved thermal performance
- Internal thermistor for temperature monitoring

Benefits

The following are the benefits of MSCSM70DUM10T3AG device:

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

Application

The following are the applications of MSCSM70DUM10T3AG device:

- AC switches

1. Electrical Specifications

This section provides the electrical specifications of the MSCSM70DUM10T3AG device.

1.1 SiC MOSFET Characteristics (Per SiC MOSFET)

The following table lists the absolute maximum ratings of the MSCSM70DUM10T3AG 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 °C	241	A
		T_C = 80 °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	mΩ
P_D	Power dissipation	T_C = 25 °C	690	W

The following table lists the electrical characteristics of the MSCSM70DUM10T3AG 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	µA
$R_{DS(on)}$	Drain–Source on resistance	V_{GS} = 20V I_D = 80A	T_J = 25 °C	—	7.5	9.5	mΩ
			T_J = 175 °C	—	9.5	—	
$V_{GS(th)}$	Gate threshold voltage	V_{GS} = V_{DS} I_D = 8 mA		1.9	2.4	—	V
I_{GSS}	Gate–Source leakage current	V_{GS} = 20V V_{DS} = 0V		—	—	200	nA

The following table lists the dynamic characteristics of the MSCSM70DUM10T3AG 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	$f = 1\ MHz$		—	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	$V_{GS} = -5V/20V$	$T_J = 150\ °C$	—	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	$R_{Gon} = 13.5Ω$ $R_{Goff} = 2.4Ω$			20	—	
E_{on}	Turn-on energy	$V_{GS} = -5V/20V$	$T_J = 150\ °C$	—	1300	—	µJ
E_{off}	Turn-off energy	$V_{Bus} = 400V$ $I_D = 160A$ $R_{Gon} = 13.5Ω$ $R_{Goff} = 2.4Ω$	$T_J = 150\ °C$	—	372	—	
R_{Gint}	Internal gate resistance			—	2.8	—	Ω
R_{thJC}	Junction-to-case thermal resistance			—	—	0.217	°C/W

The following table lists the body diode ratings and characteristics of the MSCSM70DUM10T3AG 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	$V_R = 400V$ $di_F/dt = 2000A/µs$	—	29.6	—	A

1.2 Thermal and Package Characteristics

The following table lists the thermal and package characteristics of the MSCSM70DUM10T3AG 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 case temperature			–40	125	
T_C	Operating case temperature			–40	125	
Torque	Mounting torque	To heatsink	M4	2	3	N.m
Wt	Package weight			—	110	g

The following table lists the temperature sensor NTC of the MSCSM70DUM10T3AG device.

Table 1-6. Temperature Sensor NTC

Symbol	Characteristic		Min.	Typ.	Max.	Unit
R_{25}	Resistance at 25 °C		—	50	—	kΩ
$\Delta R_{25}/R_{25}$	—		—	5	—	%
$B_{25/85}$	T_{25} = 298.15K		—	3952	—	K
$\Delta B/B$	—	T_C = 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_T: Thermistor value at T

Note: See APT0406—Using NTC Temperature Sensor Integrated into Power Module for more information.

1.3 Typical SiC MOSFET Performance Curve (Per SiC MOSFET)

This section shows the typical SiC MOSFET performance curves of the MSCSM70DUM10T3AG device.

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

	1	2	3	4	5	6	7
Ri (°C/W)	0.005	0.056	0.013	0.051	0.009	0.055	0.030
taui (s)	0.004	0.003	0.008	0.029	0.026	0.009	0.055
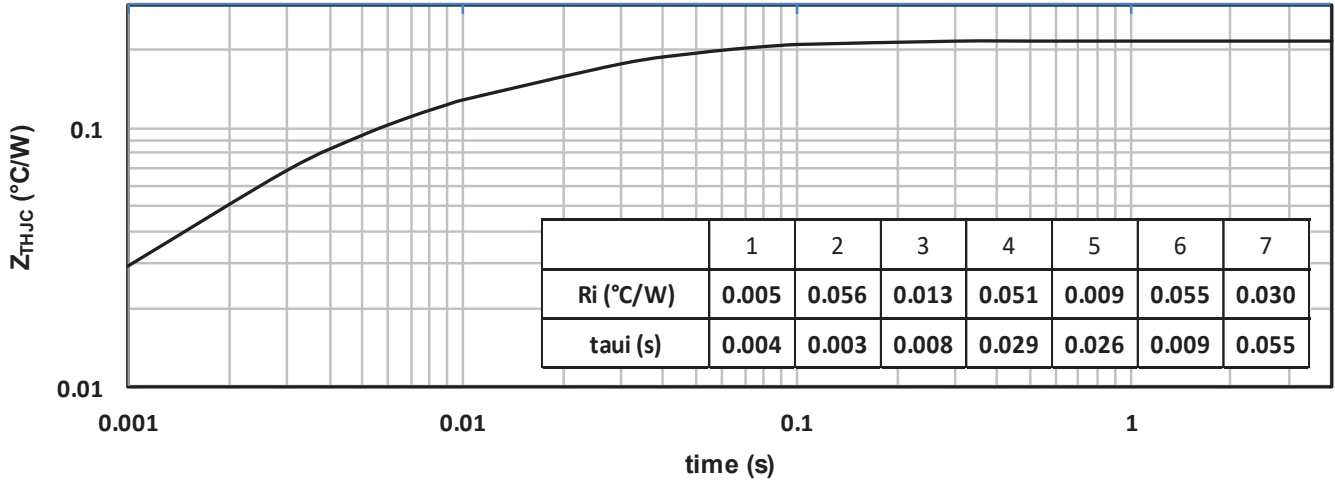
Figure 1-2. Output Characteristics, T_J = 25 °C
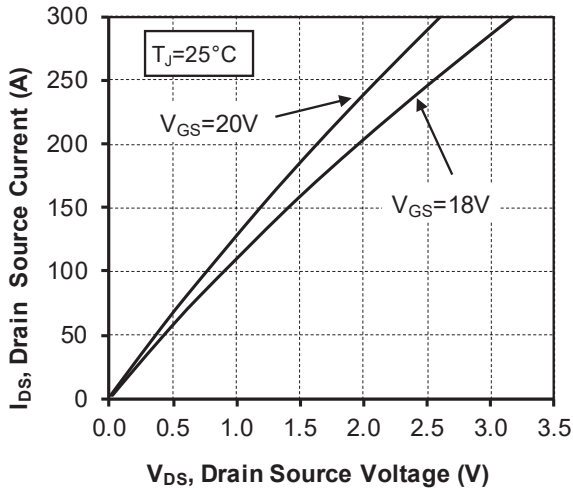
Figure 1-3. Output Characteristics, T_J = 175 °C
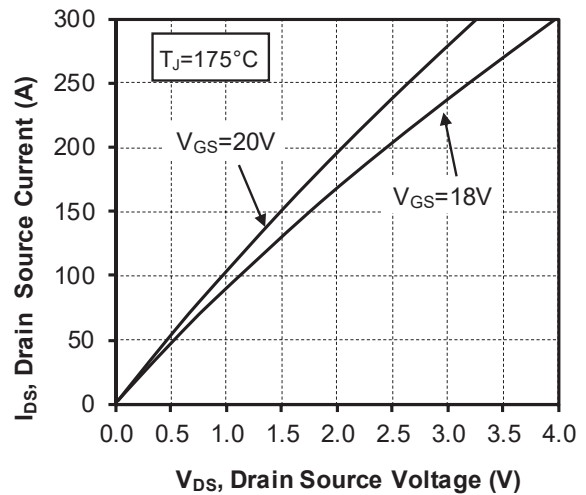
Figure 1-4. Normalized $R_{DS(on)}$ vs. Temperature

V_{GS}=20V
I_D=80A

X-axis: T_J, Junction Temperature (°C)
Y-axis: R_{DSon}, Drain Source ON resistance
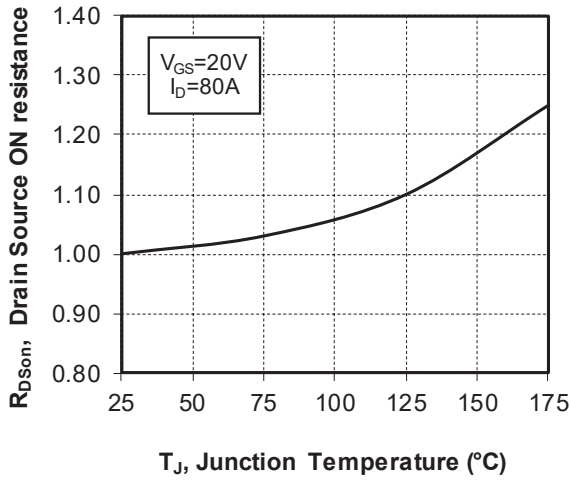
Figure 1-5. Transfer Characteristics

T_J=175°C
T_J=25°C

X-axis: V_{GS}, Gate Source Voltage (V)
Y-axis: I_{DS}, Drain Source Current (A)
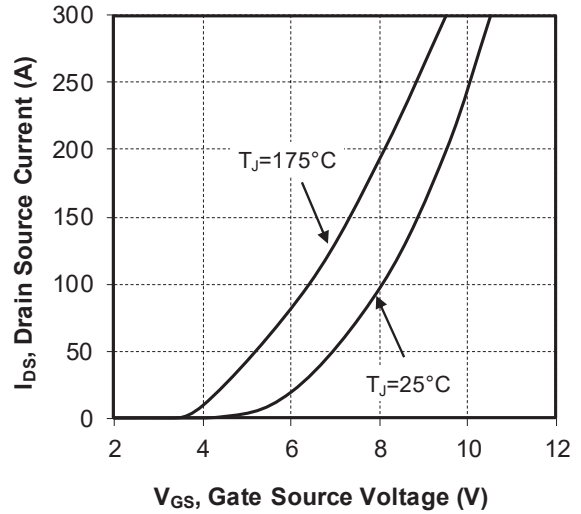
Figure 1-6. Capacitance vs. Drain Source Voltage

Ciss
Coss
Crss

X-axis: V_{DS}, Drain source Voltage (V)
Y-axis: C, Capacitance (pF)
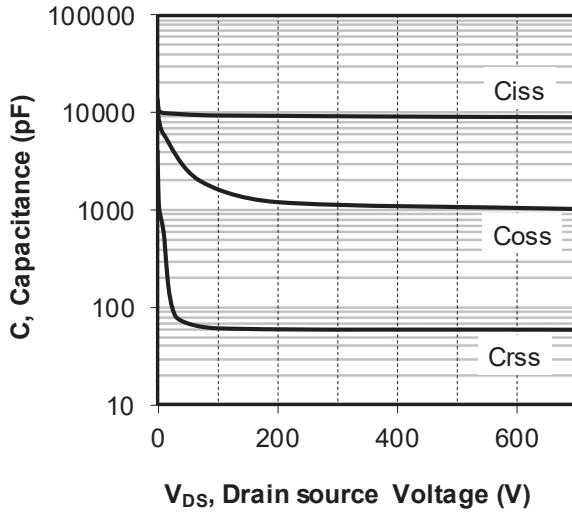
Figure 1-7. Gate Charge vs. Gate Source Voltage

T_J = 25°C
I_D = 80A
V_{DS} = 470V

X-axis: Gate Charge (nC)
Y-axis: V_{GS}, Gate to Source Voltage (V)
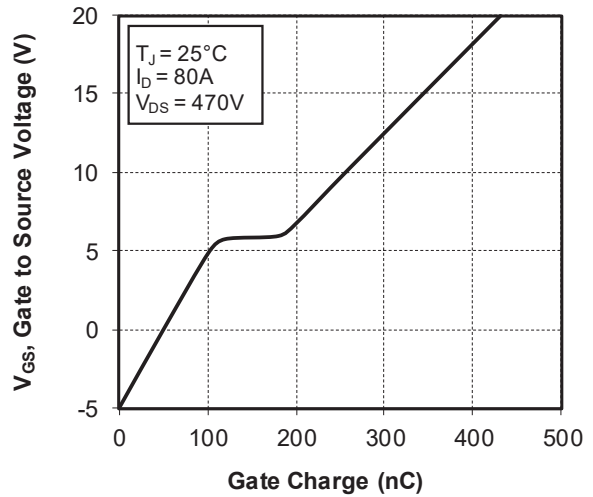
Figure 1-8. Body Diode Characteristics, T_J = 25 °C

V_{GS}=-5V
V_{GS}=0V
V_{GS}=-2V
T_J=25°C

X-axis: V_{DS}, Drain source voltage (V)
Y-axis: I_{DS}, Drain source current (A)
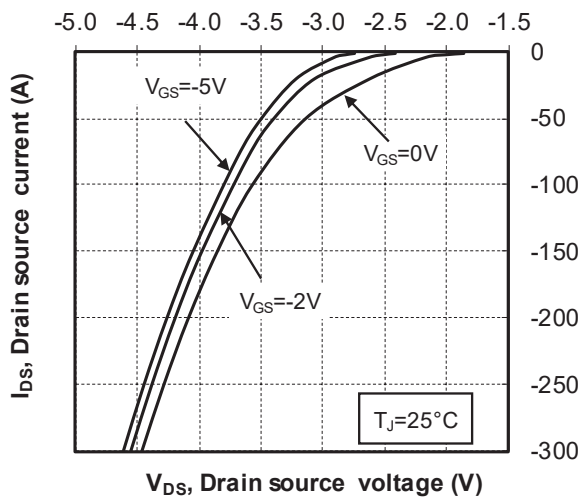
Figure 1-9. 3rd Quadrant Characteristics, T_J = 25 °C

T_J=25°C
V_{GS}=0V
V_{GS}=5V
V_{GS}=18V
V_{GS}=20V

X-axis: V_{DS}, Drain source voltage (V)
Y-axis: I_{DS}, Drain source current (A)
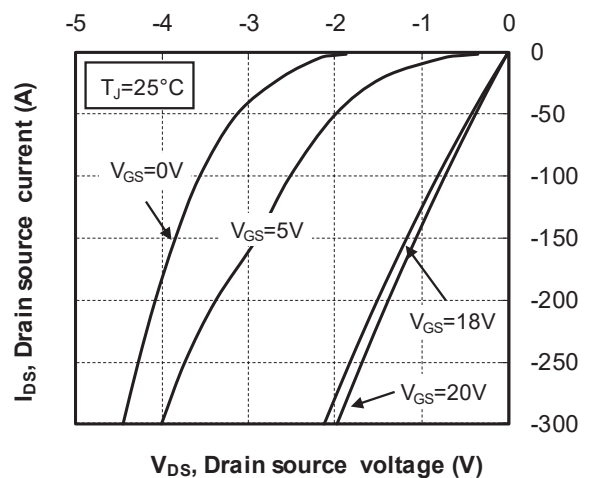
Figure 1-10. Body Diode Characteristics, T$_J$ = 175 °C
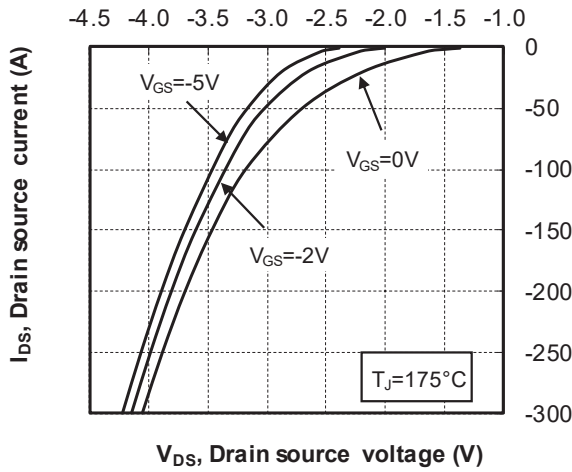
Figure 1-11. 3rd Quadrant Characteristics, T$_J$ = 175 °C
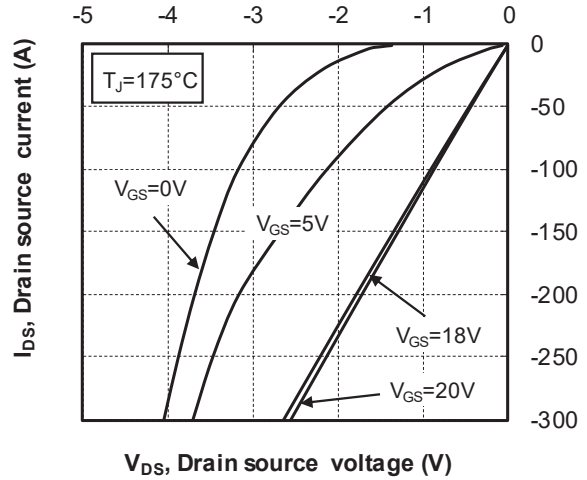
Figure 1-12. Turn On Energy vs. Rg
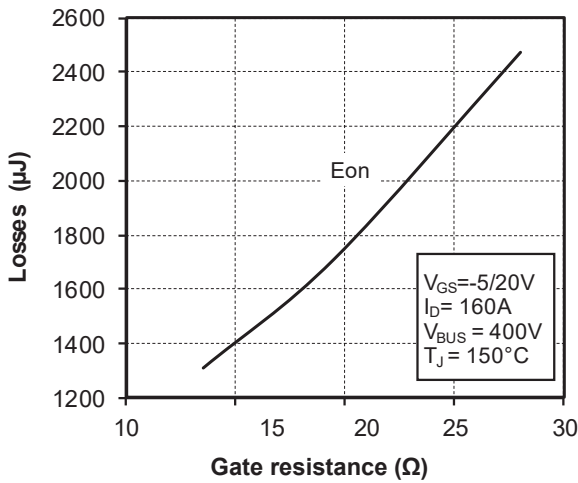
Figure 1-13. Turn Off Energy vs. Rg
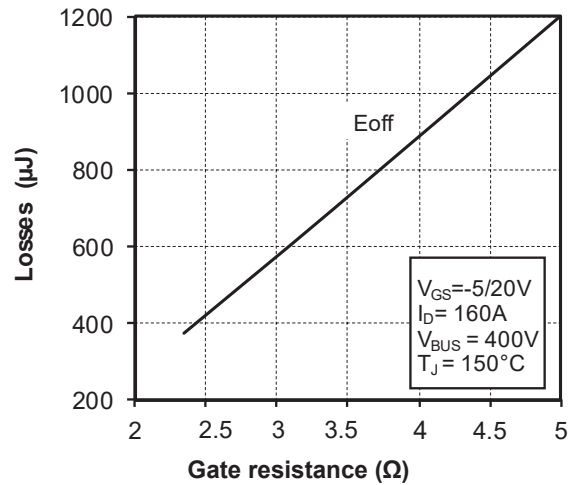
Figure 1-14. Switching Energy vs. Current
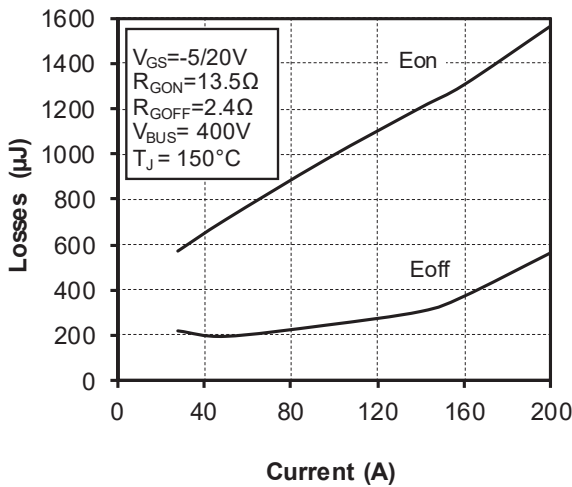
Figure 1-15. Operating Frequency vs. Drain Current
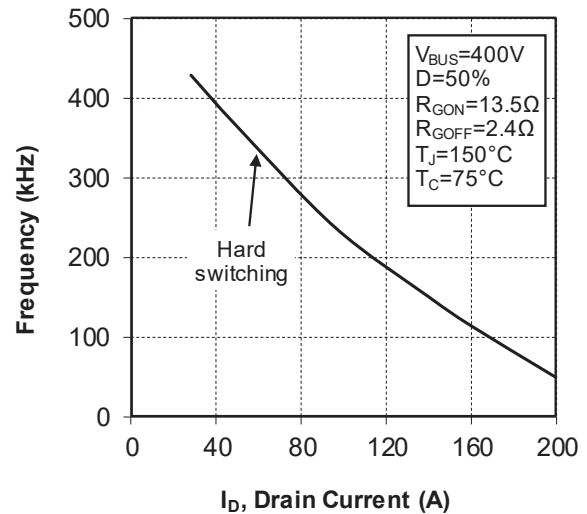
2.   Package Specifications

The following section shows the package specification of the MSCSM70DUM10T3AG device.

2.1   Package Outline

The following figure shows the package outline drawing of the MSCSM70DUM10T3AG device. The dimensions in the following figure are in millimeters.

Figure 2-1. Package Outline Drawing
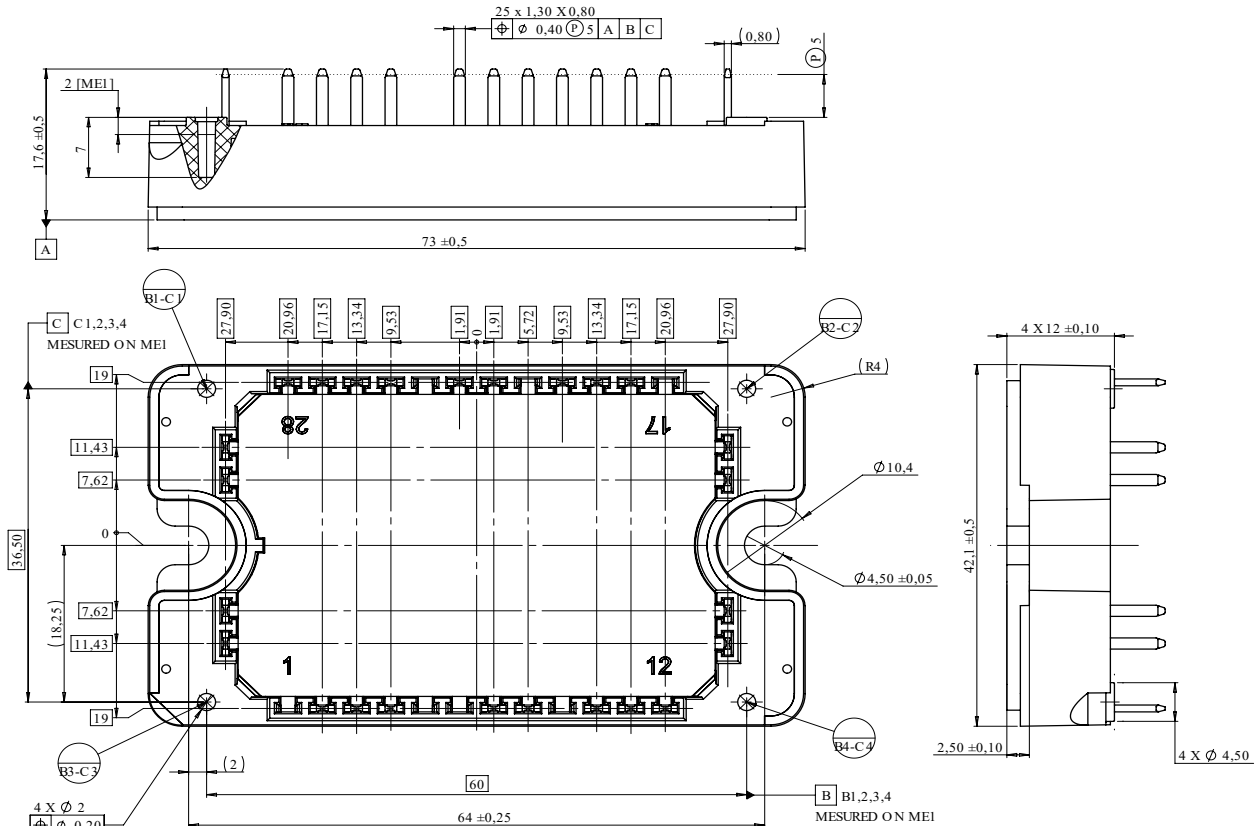
Note: See application note AN3500A—Mounting Instructions for SP1F and SP3F Power Modules for more information.

3. Revision History

Revision	Date	Description
A	12/2021	Initial Revision

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