

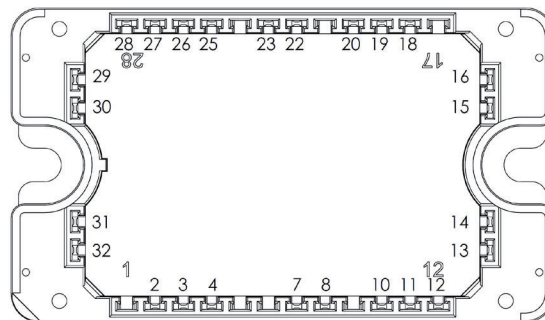
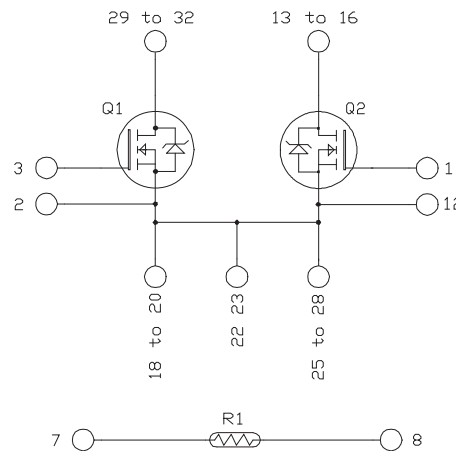


MSCSM120DUM16T3AG

Dual Common Source SiC MOSFET Power Module

Product Overview

The MSCSM120DUM16T3AG device is a 1200V/173A dual common source silicon carbide (SiC) MOSFET power module.



All multiple inputs & 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 $T_J = 25\text{ }^\circ\text{C}$, unless otherwise specified.



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

Features

The following are the key features of MSCSM120DUM16T3AG 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 MSCSM120DUM16T3AG device:

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

Application

The following are the applications of MSCSM120DUM16T3AG device:

- AC switches

1. Electrical Specifications

This section provides the electrical specifications of the MSCSM120DUM16T3AG device.

1.1 SiC MOSFET Characteristics (Per SiC MOSFET)

The following table lists the absolute maximum ratings of MSCSM120DUM16T3AG device.

Table 1-1. Absolute Maximum Ratings

Symbol	Parameter	Maximum Ratings	Unit
V_{DSS}	Drain-Source voltage	1200	V
I_D	Continuous drain current	$T_C = 25\text{ }^\circ\text{C}$	173
		$T_C = 80\text{ }^\circ\text{C}$	138
I_{DM}	Pulsed drain current	350	
V_{GSmax}	Gate-Source voltage	-10/25	V
$R_{DS(on)}$	Drain-Source ON resistance	16	$m\Omega$
P_D	Power dissipation	$T_C = 25\text{ }^\circ\text{C}$	745

The following table lists the electrical characteristics of MSCSM120DUM16T3AG device.

Table 1-2. Electrical Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit	
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0V$ $V_{DS} = 1200V$	—	20	200	μA	
$R_{DS(on)}$	Drain-Source on resistance	$V_{GS} = 20V$ $I_D = 80A$	$T_J = 25\text{ }^\circ\text{C}$	—	12.5	16	$m\Omega$
			$T_J = 175\text{ }^\circ\text{C}$	—	20	—	
$V_{GS(th)}$	Gate threshold voltage	$V_{GS} = V_{DS}$ $I_D = 2\text{ mA}$	1.8	2.8	—	V	
I_{GSS}	Gate-Source leakage current	$V_{GS} = 20V$ $V_{DS} = 0V$	—	—	200	nA	

MSCSM120DUM16T3AG

Electrical Specifications

The following table lists the dynamic characteristics of MSCSM120DUM16T3AG device.

Table 1-3. Dynamic Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
C _{iss}	Input capacitance	V _{GS} = 0V	—	6040	—	pF
C _{oss}	Output capacitance	V _{DS} = 1000V	—	540	—	
C _{rss}	Reverse transfer capacitance	f = 1 MHz	—	50	—	
Q _g	Total gate charge	V _{GS} = -5V/20V	—	464	—	nC
Q _{gs}	Gate-Source charge	V _{Bus} = 800V	—	82	—	
Q _{gd}	Gate-Drain charge	I _D = 80A	—	100	—	
T _{d(on)}	Turn-on delay time	V _{GS} = -5V/20V	—	30	—	ns
T _r	Rise time	V _{Bus} = 600V	—	30	—	
T _{d(off)}	Turn-off delay time	I _D = 100A	—	50	—	
T _f	Fall time	R _{Gon} = 4Ω R _{Goff} = 2.4Ω	—	25	—	
E _{on}	Turn-on energy	V _{GS} = -5V/20V	—	2.4	—	mJ
E _{off}	Turn-off energy	V _{Bus} = 600V I _D = 100A R _{Gon} = 4Ω R _{Goff} = 2.4Ω				
R _{Gint}	Internal gate resistance		—	2.94	—	Ω
R _{thJC}	Junction-to-case thermal resistance		—	—	0.2	°C/W

The following table lists the body diode ratings and characteristics of MSCSM120DUM16T3AG 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	—	4	—	V
		V _{GS} = -5V I _{SD} = 80A	—	4.2	—	
t _{rr}	Reverse recovery time	I _{SD} = 80A	—	90	—	ns
Q _{rr}	Reverse recovery charge	V _{GS} = -5V	—	1100	—	nC
I _{rr}	Reverse recovery current	V _R = 800V di _F /dt = 2000A/μs	—	27	—	A

1.2 Thermal and Package Characteristics

The following table lists the thermal and package characteristics of the MSCSM120DUM16T3AG 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 MSCSM120DUM16T3AG device.

Table 1-6. Temperature Sensor NTC

Symbol	Characteristic	Min.	Typ.	Max.	Unit
R ₂₅	Resistance at 25 °C	—	50	—	kΩ
ΔR ₂₅ /R ₂₅	—	—	5	—	%
B _{25/85}	T ₂₅ = 298.15 K	—	3952	—	K
ΔB/B	—	T _C = 100 °C	4	—	%

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

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 MSCSM120DUM16T3AG device.

Figure 1-1. Maximum Thermal Impedance

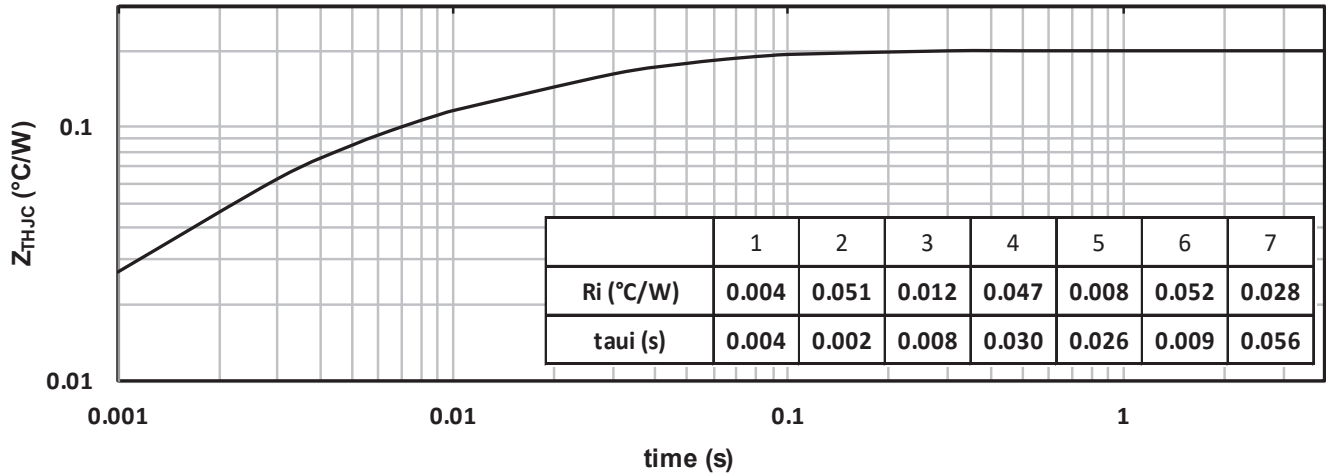


Figure 1-2. Output Characteristics, $T_J = 25^{\circ}\text{C}$

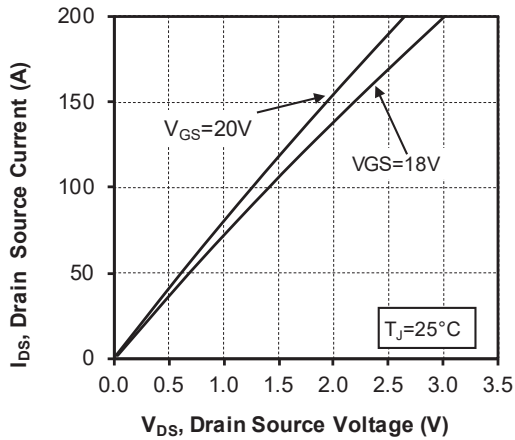


Figure 1-3. Output Characteristics, $T_J = 175^{\circ}\text{C}$

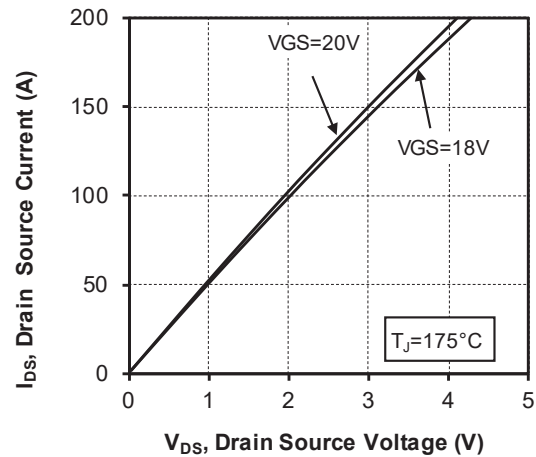


Figure 1-4. Normalized $R_{DS(on)}$ vs. Temperature

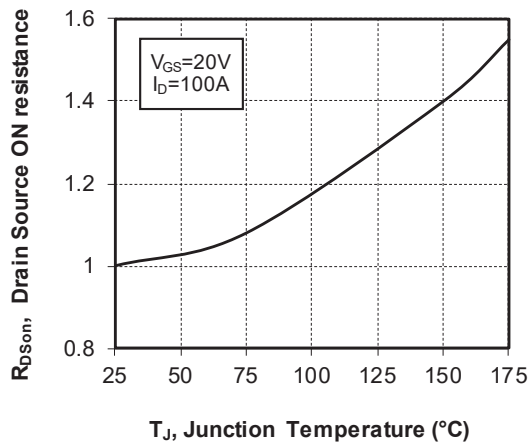


Figure 1-5. Transfer Characteristics

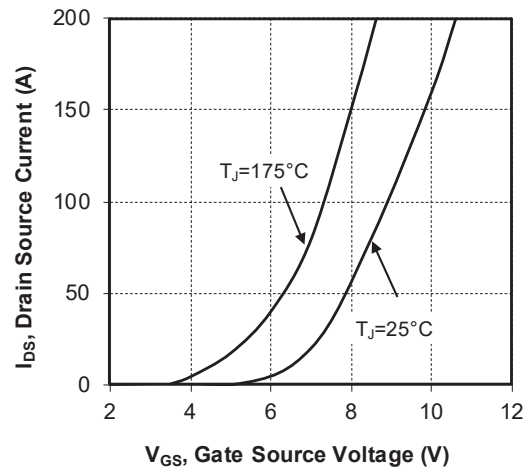


Figure 1-6. Body Diode Characteristics, $T_J = 25^{\circ}C$

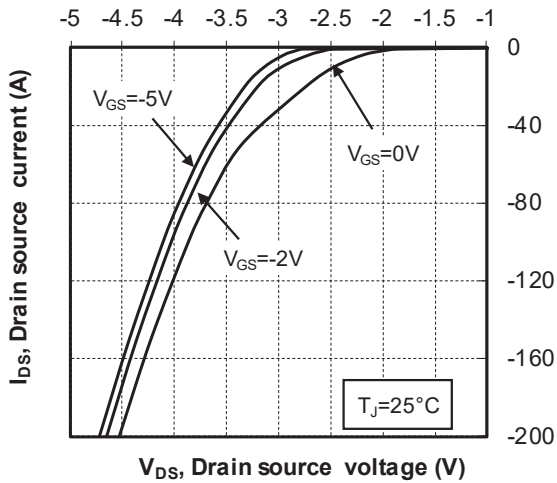


Figure 1-7. 3rd Quadrant Characteristics, $T_J = 25^{\circ}C$

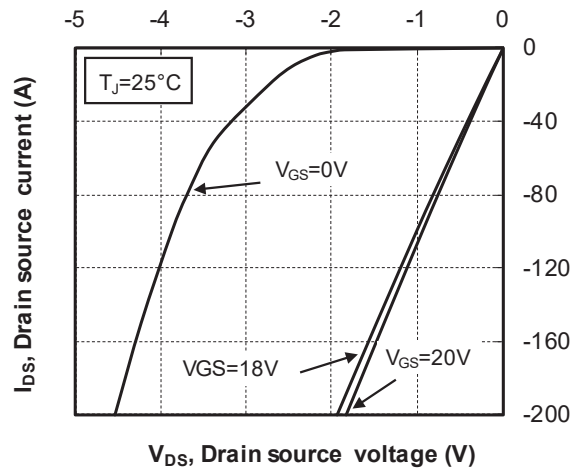


Figure 1-8. Body Diode Characteristics, $T_J = 175^{\circ}C$

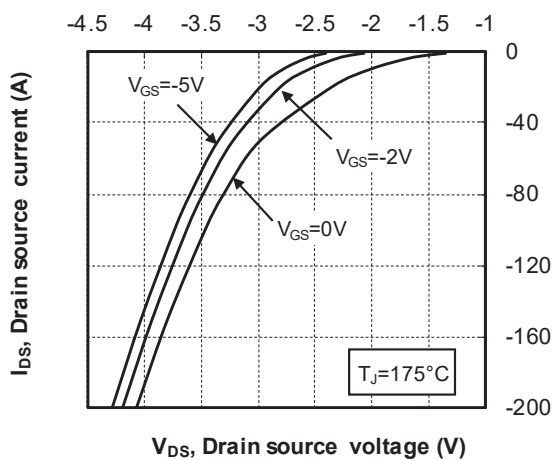


Figure 1-9. 3rd Quadrant Characteristics, $T_J = 175^{\circ}C$

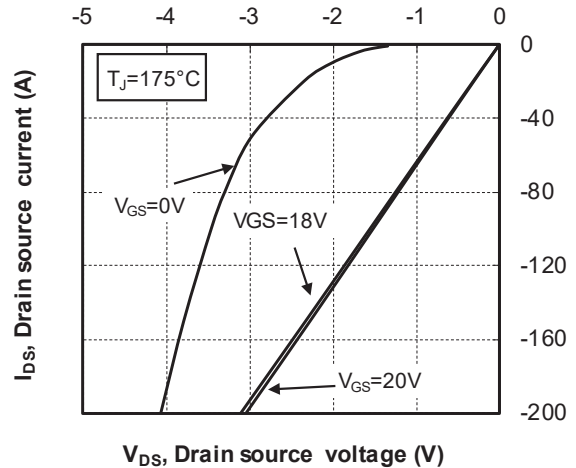


Figure 1-10. Switching Energy vs. Rg

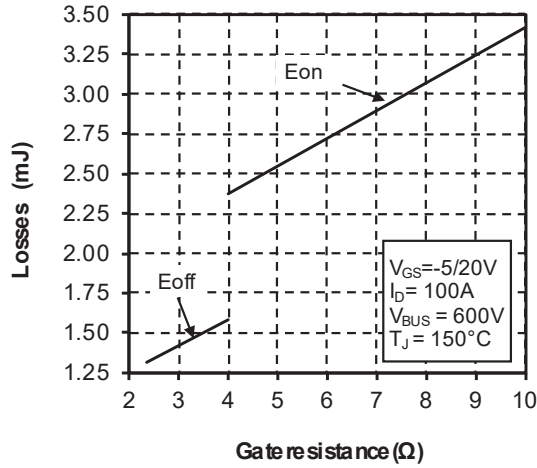


Figure 1-11. Switching Energy vs. Current

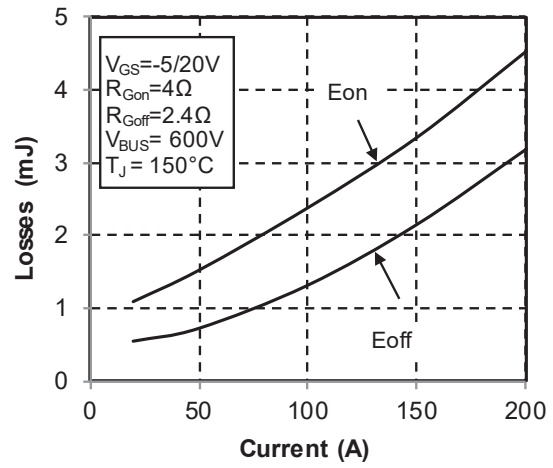
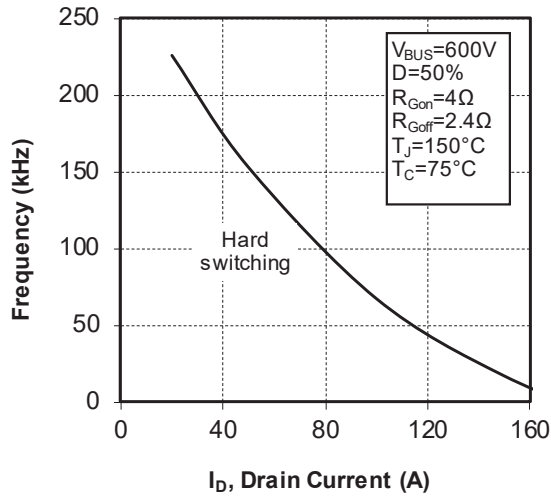


Figure 1-12. Operating Frequency vs. Drain Current



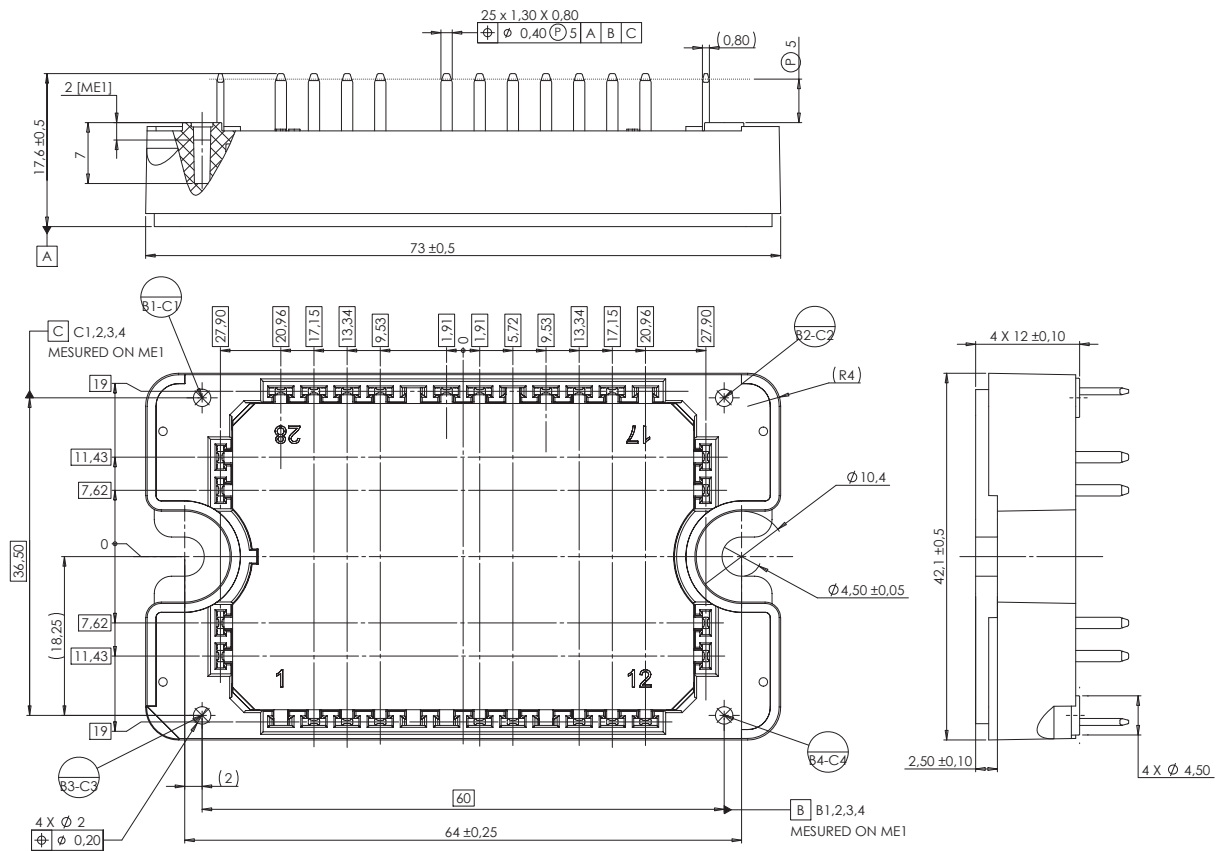
2. Package Specifications

The following section shows the package specification of the MSCSM120DUM16T3AG device.

2.1 Package Outline

The following figure shows the package outline drawing of the MSCSM120DUM16T3AG 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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