

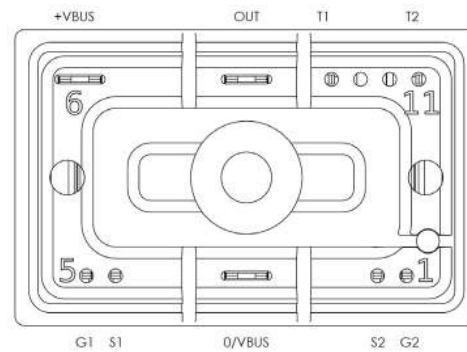
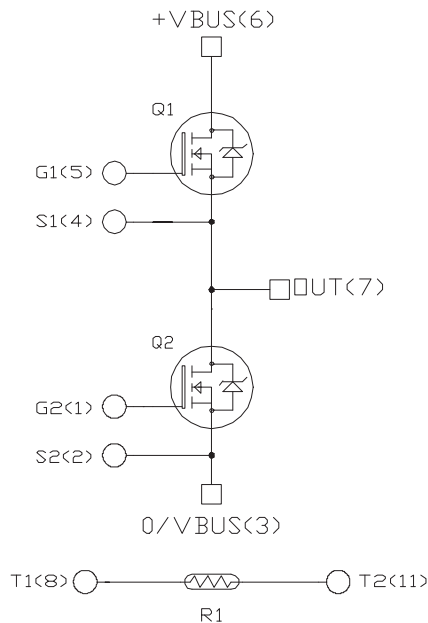
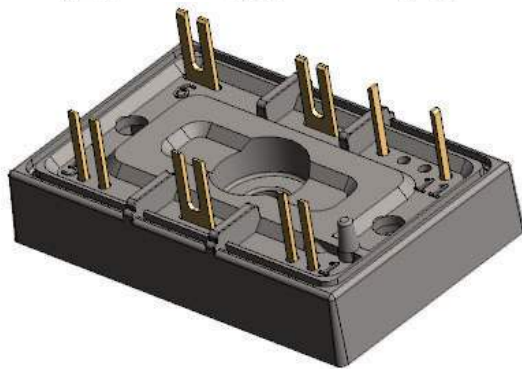


MSCSM120AM31TBL1NG

Phase Leg SiC MOSFET Power Module

Product Overview

The MSCSM120AM31TBL1NG device is a phase leg 1200V, 79A silicon carbide (SiC) MOSFET 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

The following are the key features of MSCSM120AM31TBL1NG device:

- SiC Power MOSFET
 - High speed switching
 - Low $R_{DS(on)}$
- Very low stray inductance
- Ultra-low weight and profile
- Kelvin source for easy drive
- Si_3N_4 substrate with thick copper for improved thermal performance
- Internal thermistor for temperature monitoring
- Extended temperature range

Benefits

The following are the benefits of MSCSM120AM31TBL1NG device:

- High efficiency converter
- Outstanding performance at high frequency operation
- Direct mounting to heatsink (isolated package)
- Low junction-to-heatsink thermal resistance
- Solderable terminals both for power and signal for easy PCB mounting
- Very integrated power conversion system
- Low profile
- RoHS Compliant

Application

The following are the applications of MSCSM120AM31TBL1NG device:

- High reliability power systems
- High efficiency AC/DC and DC/AC converters
- Motor control

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Electrical Specifications

1. Electrical Specifications

This section provides the electrical specifications of the MSCSM120AM31TBL1NG device.

1.1 SiC MOSFET Characteristics (Per SiC MOSFET)

The following table lists the absolute maximum ratings per SiC MOSFET of the MSCSM120AM31TBL1NG device.

Table 1-1. Absolute Maximum Ratings

Symbol	Parameter	Maximum Ratings	Unit
V_{DSS}	Drain-Source voltage	1200	V
I_D	Continuous drain current	$T_H = 25\text{ }^\circ\text{C}$	79
		$T_H = 80\text{ }^\circ\text{C}$	63
I_{DM}	Pulsed drain current	160	
V_{GS}	Gate-Source voltage	-10/23	V
$R_{DS(on)}$	Drain-Source ON resistance	31	m Ω
P_D	Power dissipation	$T_H = 25\text{ }^\circ\text{C}$	310

The following table lists the electrical characteristics per SiC MOSFET of the MSCSM120AM31TBL1NG device.

Table 1-2. Electrical Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit	
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0V$; $V_{DS} = 1200V$	—	10	100	μA	
$R_{DS(on)}$	Drain-Source on resistance	$V_{GS} = 20V$ $I_D = 40A$	$T_J = 25\text{ }^\circ\text{C}$	—	25	31	m Ω
			$T_J = 175\text{ }^\circ\text{C}$	—	40	—	
$V_{GS(th)}$	Gate threshold voltage	$V_{GS} = V_{DS}$; $I_D = 3\text{ mA}$	1.8	2.8	—	V	
I_{GSS}	Gate-Source leakage current	$V_{GS} = 20V$; $V_{DS} = 0V$	—	—	150	nA	

The following table lists the dynamic characteristics per SiC MOSFET of the MSCSM120AM31TBL1NG device.

Table 1-3. Dynamic Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{GS} = 0V$	—	3020	—	pF
C_{oss}	Output capacitance	$V_{DS} = 1000V$	—	270	—	
C_{riss}	Reverse transfer capacitance	$f = 1\text{ MHz}$	—	25	—	
Q_g	Total gate charge	$V_{GS} = -5V/20V$	—	232	—	nC
Q_{gs}	Gate-Source charge	$V_{Bus} = 800V$	—	41	—	
Q_{gd}	Gate-Drain charge	$I_D = 40A$	—	50	—	

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Electrical Specifications

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Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit	
$T_{d(on)}$	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	$I_D = 50A$	—	50	—		
T_f	Fall time	$R_{G(on)} = 8\Omega$ $R_{G(off)} = 4.7\Omega$	—	25	—		
E_{on}	Turn-on energy	$V_{GS} = -5V/20V$	$T_J = 150\text{ }^\circ\text{C}$	—	1.2	—	mJ
E_{off}	Turn-off energy	$V_{Bus} = 600V$ $I_D = 50A$ $R_{G(on)} = 8\Omega$ $R_{G(off)} = 4.7\Omega$	$T_J = 150\text{ }^\circ\text{C}$	—	0.66	—	
R_{Gint}	Internal gate resistance		—	0.88	—	Ω	
R_{thJH}	Junction-to-heatsink thermal resistance		$\lambda = 3.4$ W/mK	—	0.483	—	$^\circ\text{C/W}$

The following table lists the body diode ratings and characteristics per SiC MOSFET of the MSCSM120AM31TBL1NG device.

Table 1-4. Body Diode Ratings and Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
V_{SD}	Diode forward voltage	$V_{GS} = 0V; I_{SD} = 40A$	—	4	—	V
		$V_{GS} = -5V; I_{SD} = 40A$	—	4.2	—	
t_{rr}	Reverse recovery time	$I_{SD} = 40A; V_{GS} = -5V$	—	90	—	ns
Q_{rr}	Reverse recovery charge	$V_R = 800V; di_F/dt = 1000\text{ A}/\mu\text{s}$	—	550	—	nC
I_{rr}	Reverse recovery current		—	13.5	—	A

1.2 Thermal and Package Characteristics

The following table lists the thermal and package characteristics of the MSCSM120AM31TBL1NG device.

Table 1-5. Thermal and Package Characteristics

Symbol	Characteristic	Min.	Typ.	Max.	Unit		
V _{ISOL}	RMS isolation voltage, any terminal to case t = 1 min, 50 Hz/60 Hz	2500	—	—	V		
T _J	Operating junction temperature range	-55	—	175	°C		
T _{JOP}	Recommended junction temperature under switching conditions	-55	—	T _{Jmax} -25			
T _{STG}	Storage case temperature	-55	—	125			
T _C	Operating case temperature	-55	—	125			
Torque	Mounting torque	To heatsink	M4	1.5	—	2	N.m
Wt	Package weight	—	13.5	—	g		

The following table lists the temperature sensor NTC of the MSCSM120AM31TBL1NG 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 = 298.15K	—	3952	—	K	
ΔB/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

This section shows the typical SiC MOSFET performance curves of the MSCSM120AM31TBL1NG device.

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

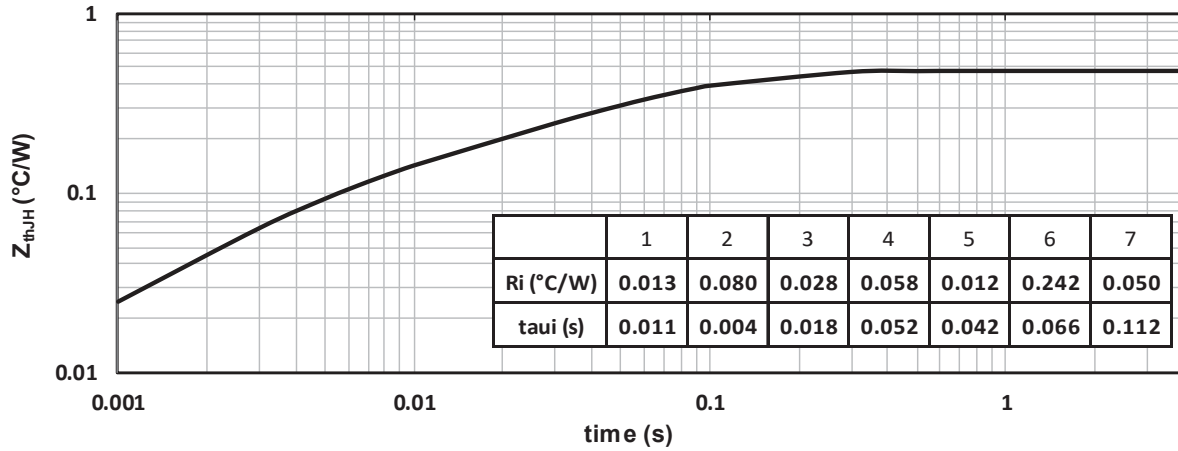


Figure 1-2. Output Characteristics, $T_J = 25^\circ\text{C}$

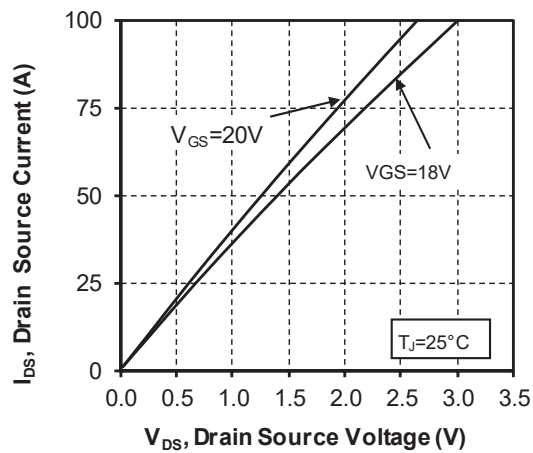
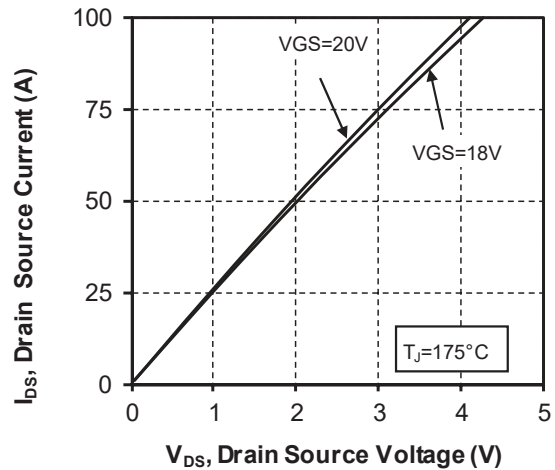


Figure 1-3. Output Characteristics, $T_J = 175^\circ\text{C}$



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

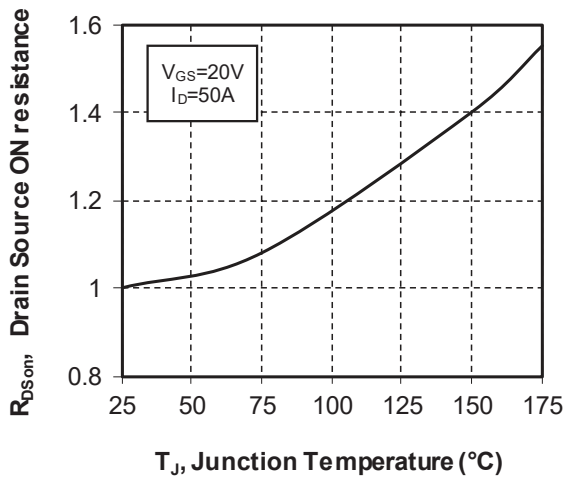


Figure 1-5. Transfer Characteristics

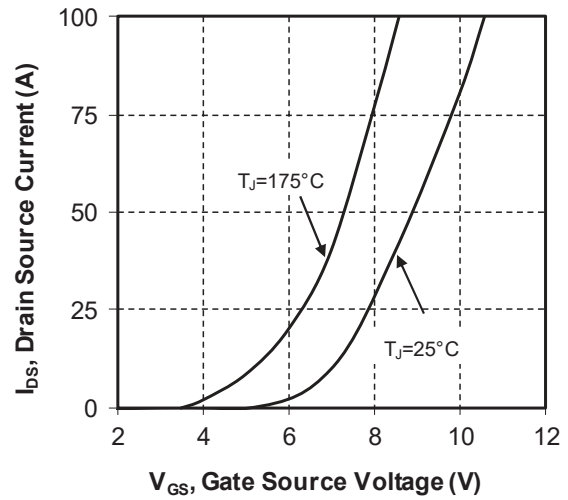


Figure 1-6. Switching Energy vs. R_g

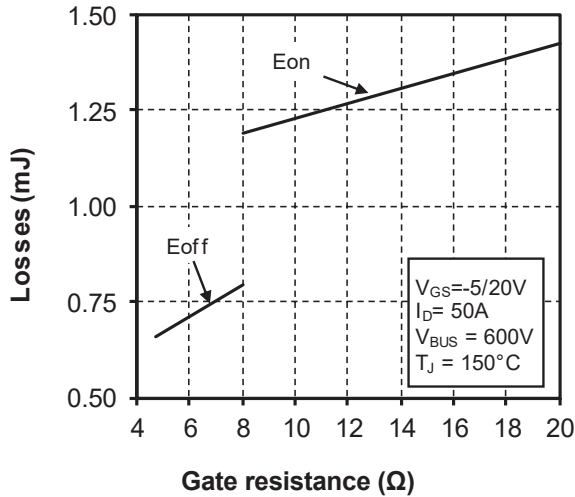


Figure 1-7. Switching Energy vs. Current

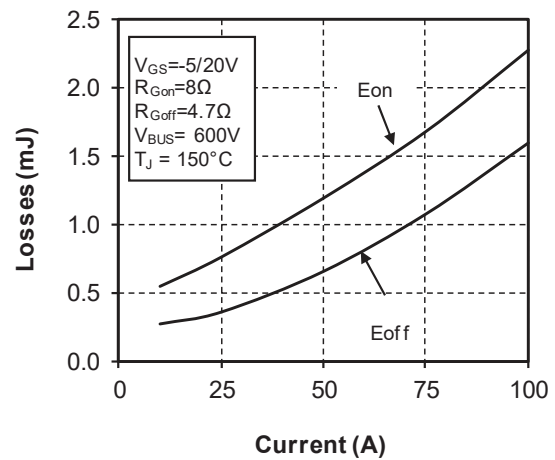


Figure 1-8. Capacitance vs. Drain Source Voltage

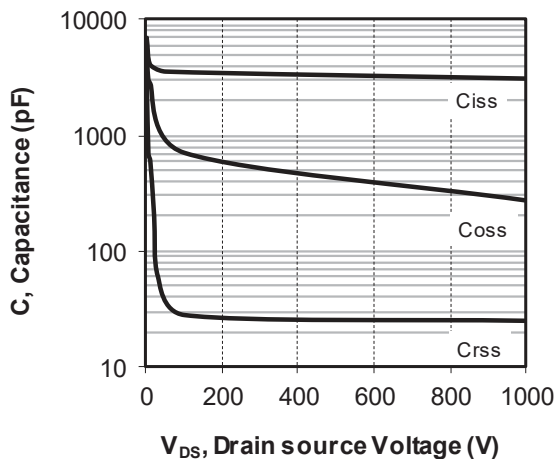
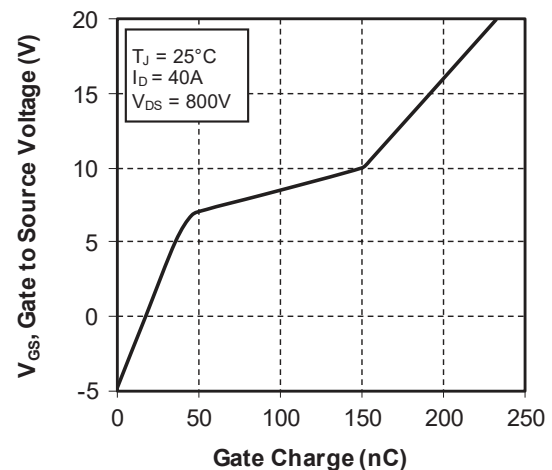


Figure 1-9. Gate Charge vs. Gate Source Voltage



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

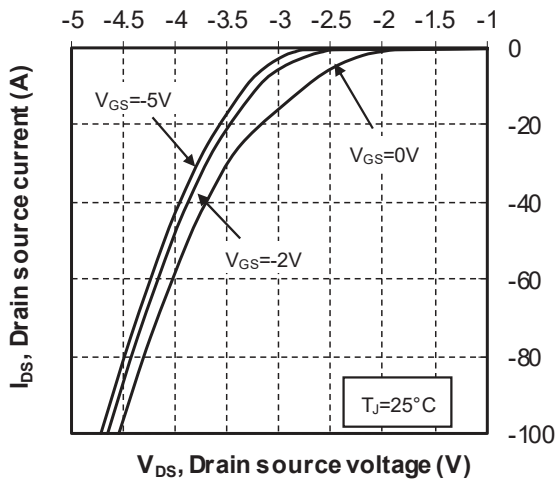


Figure 1-11. 3rd Quadrant Characteristics, $T_J = 25^\circ\text{C}$

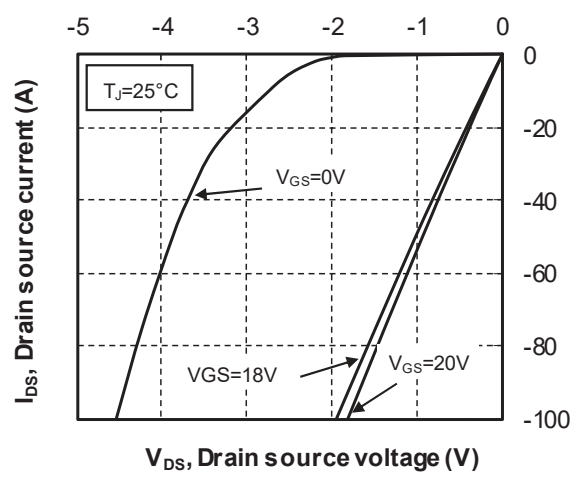


Figure 1-12. Body Diode Characteristics, $T_J = 175^\circ\text{C}$

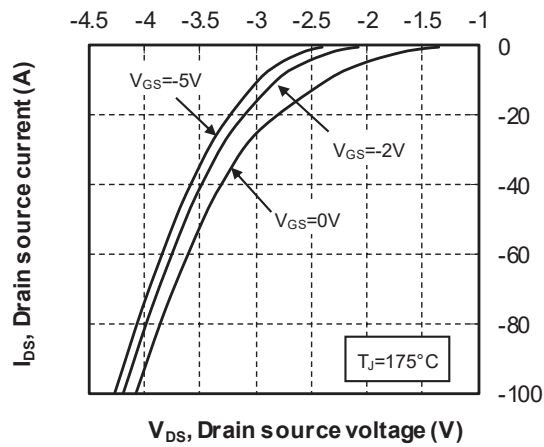


Figure 1-13. 3rd Quadrant Characteristics, $T_J = 175^\circ\text{C}$

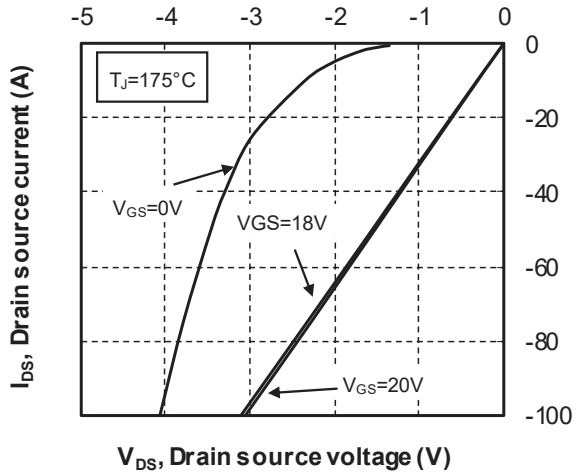
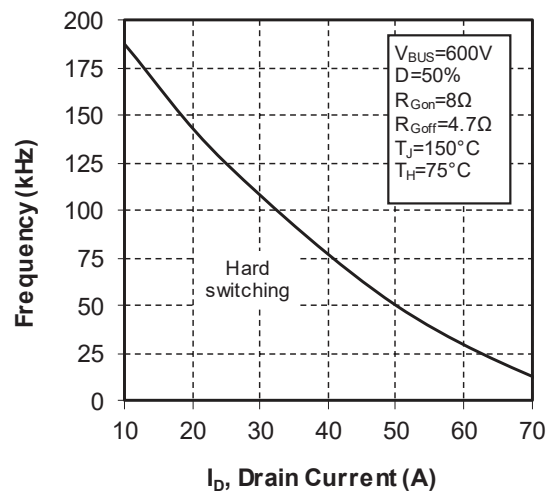


Figure 1-14. Operating Frequency vs Drain Current



3. Revision History

Revision	Date	Description
A	06/2022	Initial Revision

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