



DS00004651A-page 1

Features

The following are the key features of MSCSM120DDUM31TBL2NG device:

- SiC Power MOSFET
 - High speed switching
 - Low $R_{DS(on)}$
- 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 MSCSM120DDUM31TBL2NG device:

- High efficiency converter
- 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
- Very integrated power conversion system
- Low profile
- RoHS compliant

Application

The following are the applications of MSCSM120DDUM31TBL2NG device:

- High reliability power systems
- AC switches

1. Electrical Specifications

This section provides the electrical specifications of the MSCSM120DDUM31TBL2NG device.

1.1 SiC MOSFET Characteristics (Per SiC MOSFET)

The following table lists the absolute maximum ratings per SiC MOSFET of the MSCSM120DDUM31TBL2NG device.

Table 1-1. Absolute Maximum Ratings

Symbol	Parameter		Maximum Ratings	Unit
V_{DS}	Drain-Source voltage		1200	V
I_D	Continuous drain current	$T_H = 25\text{ }^{\circ}\text{C}$	79	A
		$T_H = 80\text{ }^{\circ}\text{C}$	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	W

The following table lists the electrical characteristics per SiC MOSFET of the MSCSM120DDUM31TBL2NG device.

Table 1-2. Electrical Characteristics

Symbol	Characteristics	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 MSCSM120DDUM31TBL2NG device.

Table 1-3. Dynamic Characteristics

Symbol	Characteristics	Test Conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{GS} = 0V$	—	3020	—	pF
C_{oss}	Output capacitance	$V_{DS} = 1000V$	—	270	—	
C_{rss}	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	—	
$T_{d(on)}$	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	$V_{GS} = -5V/20V$	—	1.2	—	mJ
E_{off}	Turn-off energy	$V_{Bus} = 600V$ $I_D = 50A$ $R_{G(on)} = 8\Omega$ $R_{G(off)} = 4.7\Omega$	—	0.66	—	
R_{Gint}	Internal gate resistance		—	0.88	—	Ω
R_{thJH}	Junction-to-heatsink thermal resistance		$\lambda = 3.4\text{ W/mK}$	0.483	—	$^{\circ}\text{C/W}$

The following table lists the body diode ratings and characteristics per SiC MOSFET of the MSCSM120DDUM31TBL2NG device.

Table 1-4. Body Diode Ratings and Characteristics

Symbol	Characteristics	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 MSCSM120DDUM31TBL2NG device.

Table 1-5. Thermal and Package Characteristics

Symbol	Characteristics				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				—	21.5	—	g

The following table lists the temperature sensor NTC of the MSCSM120DDUM31TBL2NG device.

Table 1-6. Temperature Sensor NTC

Symbol	Characteristics		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 MSCSM120DDUM31TBL2NG device.

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

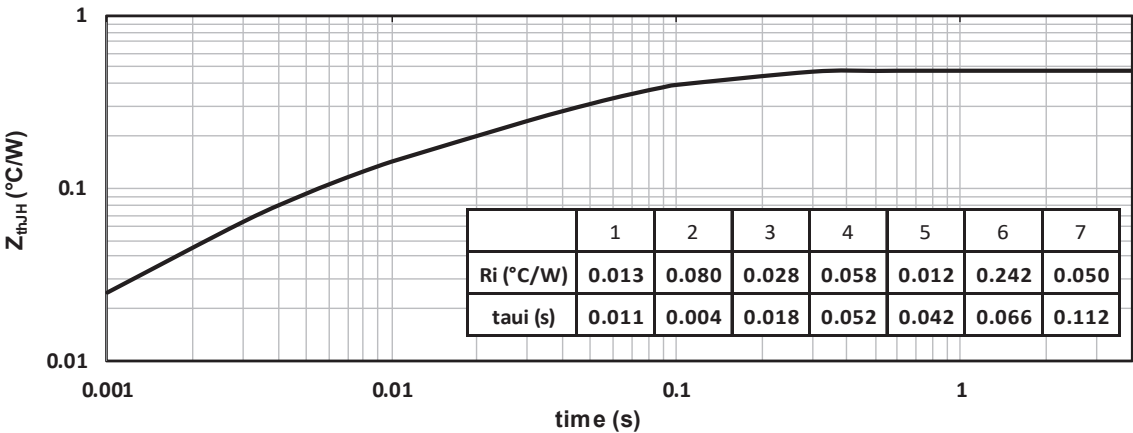


Figure 1-2. Output Characteristics, T_J = 25 °C

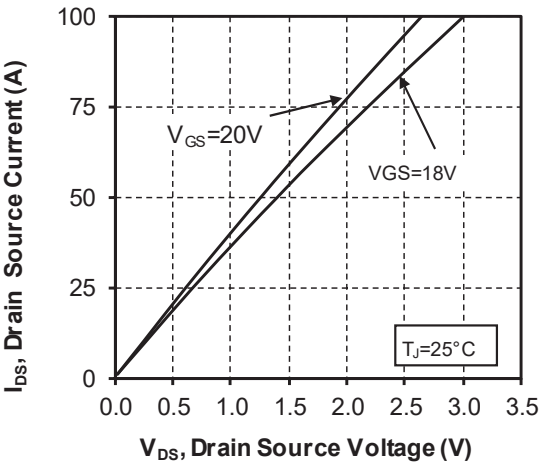


Figure 1-3. Output Characteristics, T_J = 175 °C

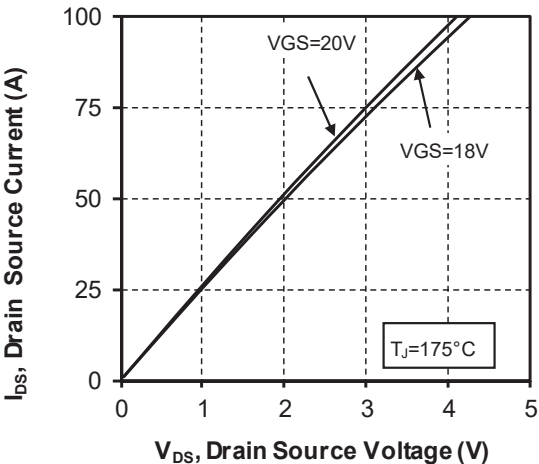


Figure 1-4. Normalized $R_{DS(on)}$ vs. Temperature

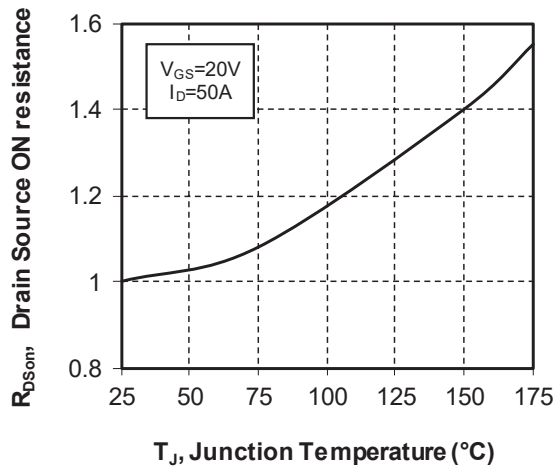


Figure 1-5. Transfer Characteristics

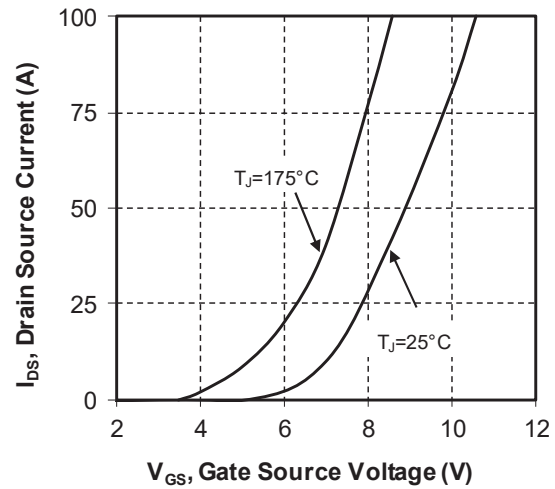


Figure 1-6. Switching Energy vs. R_g

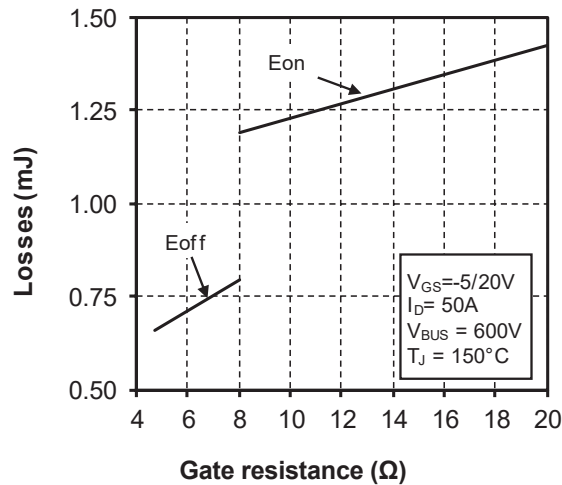


Figure 1-7. Switching Energy vs. Current

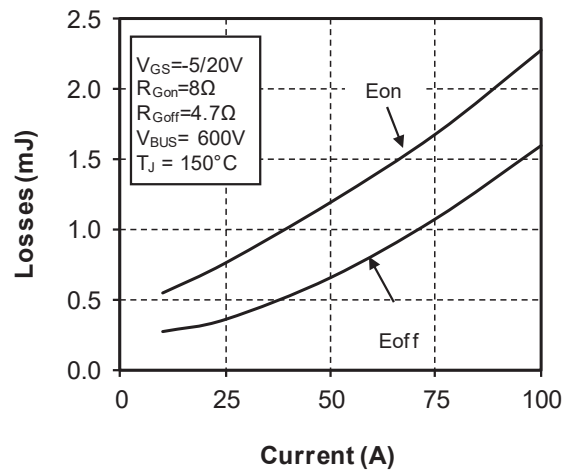


Figure 1-8. Capacitance vs. Drain Source Voltage

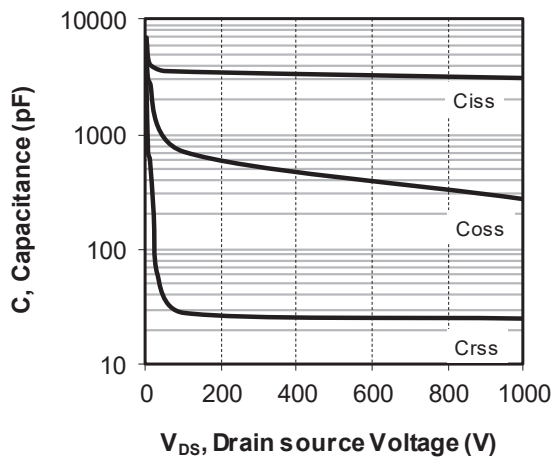


Figure 1-9. Gate Charge vs. Gate Source Voltage

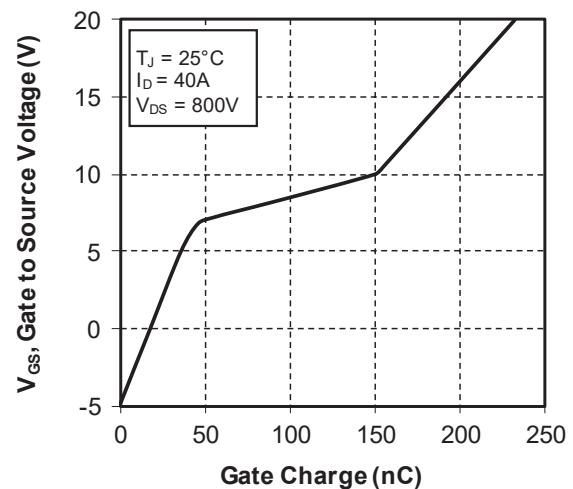


Figure 1-10. Body Diode Characteristics, $T_J = 25^\circ\text{C}$

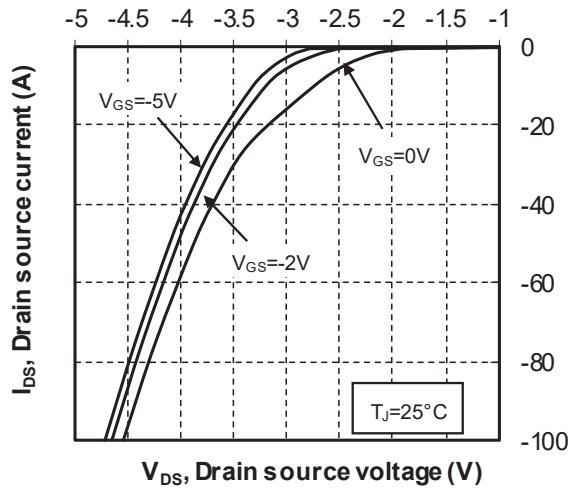


Figure 1-11. 3rd Quadrant Characteristics, $T_J = 25^\circ\text{C}$

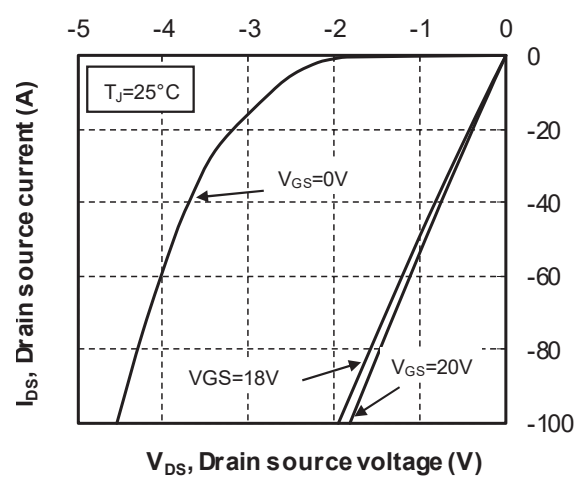


Figure 1-12. Body Diode Characteristics, $T_J = 175^\circ\text{C}$

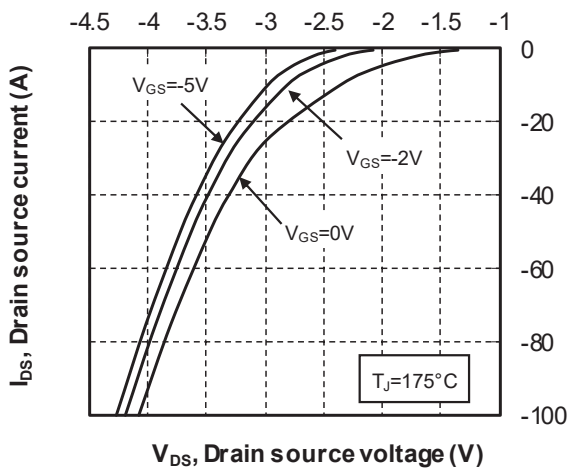


Figure 1-13. 3rd Quadrant Characteristics, $T_J = 175^\circ\text{C}$

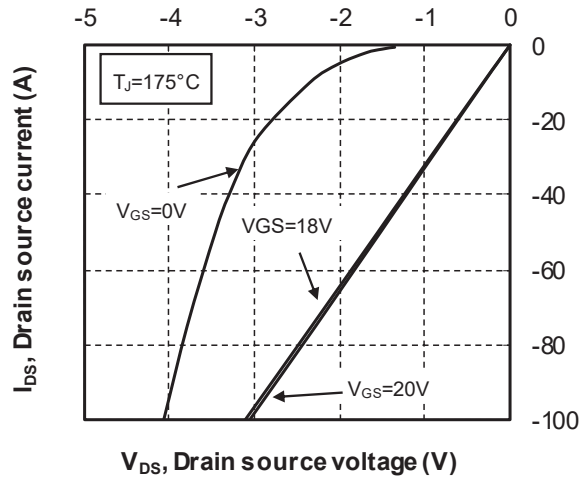
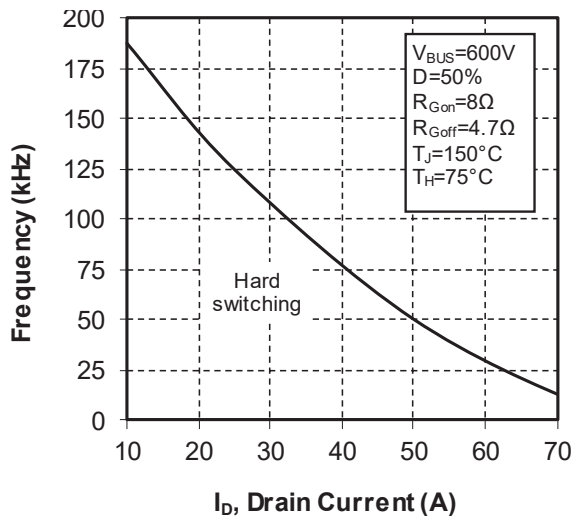


Figure 1-14. Operating Frequency vs Drain Current



The following section shows the package specification of the MSCSM120DDUM31TBL2NG device.

The following figure shows the package outline drawing of the MSCSM120DDUM31TBL2NG device. The dimensions in the following figure are in millimeters.

Technical drawing of a 6x8 A connector, showing three views: front, top, and side. Dimensions are in mm.

Front View (Top):

- Overall width: $43,6 \pm 1$
- Overall height: $14,1 \pm 0,5$
- Base thickness: $1,5 \pm 0,5$
- Pin pitch: $6,1 \pm 0,3$
- Pin diameter: $0,5 \pm 0,1$
- Pin length: $7,8 \pm 0,5$
- Pin angle: 12°
- Pin spacing: $0,5 \times 0,8 \pm 0,1$

Top View (Middle):

- Overall width: $43,6 \pm 1$
- Overall height: $14,1 \pm 0,5$
- Pin pitch: $6,1 \pm 0,3$
- Pin diameter: $0,5 \pm 0,1$
- Pin length: $7,8 \pm 0,5$
- Pin angle: 12°
- Pin spacing: $0,5 \times 0,8 \pm 0,1$

Side View (Bottom):

- Overall width: $43,6 \pm 1$
- Overall height: $14,1 \pm 0,5$
- Pin pitch: $6,1 \pm 0,3$
- Pin diameter: $0,5 \pm 0,1$
- Pin length: $7,8 \pm 0,5$
- Pin angle: 12°
- Pin spacing: $0,5 \times 0,8 \pm 0,1$

Dimensions:

- Pin pitch: $6,1 \pm 0,3$
- Pin diameter: $0,5 \pm 0,1$
- Pin length: $7,8 \pm 0,5$
- Pin angle: 12°
- Pin spacing: $0,5 \times 0,8 \pm 0,1$
- Pin diameter: $0,5 \pm 0,1$
- Pin length: $7,8 \pm 0,5$
- Pin angle: 12°
- Pin spacing: $0,5 \times 0,8 \pm 0,1$

Note: See [AN4306 — Mounting Instructions for Baseless Power Module](#) for more information.

3. Revision History

Revision	Date	Description
A	06/2022	Initial Revision

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