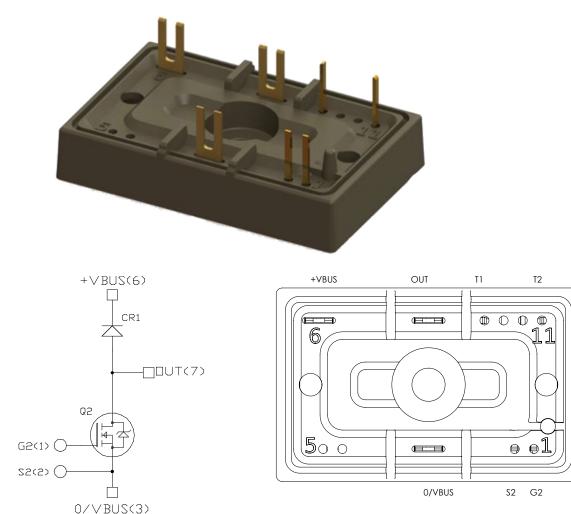


Boost Chopper SiC MOSFET Power Module

Product Overview

The MSCSM120DAM31CTBL1NG device is a 1200 V, 79 A boost chopper silicon carbide (SiC) MOSFET power module.



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

8777) R1

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

- T2<11>

T1(8))

Features

The following are the key features of MSCSM120DAM31CTBL1NG device:

- SiC Power MOSFET
 - Low R_{DS(on)}
 - High speed switching
- SiC Schottky Diode
 - Zero reverse recovery
 - Zero forward recovery
 - Temperature independent switching behavior
 - Positive temperature coefficient on V_F
- Very low stray inductance
- Ultra-low weight and profile
- Kelvin source for easy drive
- Si₃N₄ substrate with thick copper for improved thermal performance
- Internal thermistor for temperature monitoring
- Extended temperature range

Benefits

The following are the benefits of MSCSM120DAM31CTBL1NG device:

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

Application

The following are the applications of MSCSM120DAM31CTBL1NG device:

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

1. Electrical Specifications

This section provides the electrical specifications of the MSCSM120DAM31CTBL1NG device.

1.1 SiC MOSFET Characteristics (Per SiC MOSFET)

The following table lists the absolute maximum ratings of MSCSM120DAM31CTBL1NG 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 °C	79	А
		T _H = 80 °C	63	
I _{DM}	Pulsed drain current		160	
V _{GS}	Gate-Source voltage		-10/25	V
R _{DS(on)}	Drain-Source ON resistance		31	mΩ
P _D	Power dissipation	T _H = 25 °C	310	W

The following table lists the electrical characteristics of MSCSM120DAM31CTBL1NG device.

Symbol	Characteristic	Test Conditions		Min	Тур	Max	Unit
I _{DSS}	Zero gate voltage drain current	V _{GS} = 0 V V _{DS} = 1200 V			10	100	μA
R _{DS(on)}	Drain–Source on resistance	V _{GS} = 20 V I _D = 40 A	T _J = 25 °C T _J = 175 °C		25 40	31 —	mΩ
V _{GS(th)}	Gate threshold voltage	V _{GS} = V _{DS} I _D = 1 mA		1.8	2.8	—	V
I _{GSS}	Gate–Source leakage current	V _{GS} = 20 V V _{DS} = 0 V				150	nA

Table 1-2. Electrical Characteristics

Electrical Specifications

The following table lists the dynamic characteristics of MSCSM120DAM31CTBL1NG device.

Symbol	Characteristic	Test Conditions		Min	Тур	Max	Unit
C _{iss}	Input capacitance	V _{GS} = 0 V		-	3020	-	pF
C _{oss}	Output capacitance	V _{DS} = 1000 V		—	270	-	
C _{rss}	Reverse transfer capacitance	f = 1 MHz		_	25	_	-
Qg	Total gate charge	V _{GS} = -5 V/20 V		_	232	-	nC
Qgs	Gate-Source charge	V _{Bus} = 800 V		_	41	_	
Q _{gd}	Gate-Drain charge	I _D = 40 A		-	50	-	
T _{d(on)}	Turn-on delay time	V _{GS} = -5 V/20 V		_	30	_	ns
Tr	Rise time	V _{Bus} = 600 V		_	30	-	
T _{d(off)}	Turn-off delay time	I _D = 50 A		_	50	_	
Τ _f	Fall time	R _{Gon} = 8 Ω R _{Goff} = 4.7 Ω			25	_	
Eon	Turn-on energy	V _{GS} = -5 V/20 V	T _J = 150 °C	_	0.99	_	mJ
Eoff	Turn-off energy	V _{Bus} = 600 V I _D = 50 A R _{Gon} = 8 Ω R _{Goff} = 4.7 Ω	TJ = 150 °C	_	0.66	-	
RGint	Internal gate resistance			-	0.88	-	Ω
R _{thJH}	Junction-to-heatsink ther	mal resistance	λ = 3.4 W/mK	-	0.483	-	°C/W

Table 1-3. Dynamic Characteristics

The following table lists the body diode ratings and characteristics of MSCSM120DAM31CTBL1NG device.

Table 1-4. Body Diode Ratings and Characteristics

Symbol	Characteristic	Test Conditions	Min	Тур	Мах	Unit
V_{SD}	Diode forward voltage	V _{GS} = 0 V		4	—	V
		I _{SD} = 40 A				
		V_{GS} = -5 V		4.2	—	
		I _{SD} = 40 A				
t _{rr}	Reverse recovery time	I _{SD} = 40 A		90	—	ns
Q _{rr}	Reverse recovery charge	$V_{GS} = -5 V$		550	—	nC
Irr	Reverse recovery current	V _R = 800 V		13.5	—	А
		di _F /dt = 1000 A/µs				

Electrical Specifications

1.2 SiC Diode Ratings and Characteristics (Per SiC Diode)

The following table lists the SiC diode ratings and characteristics of MSCSM120DAM31CTBL1NG device.

			-					
Symbol	Characteristic	Test Conditi	ons		Min	Тур	Max	Unit
V _{RRM}	Peak repetitive reverse vo	oltage			_	—	1200	V
I _{RM}	Reverse leakage current	V _R = 1200 V		T _J = 25 °C	-	10	200	μA
				T _J = 175 °C	_	250	_	
I _F	DC forward current			T _H = 100 °C	-	50	—	А
V _F	Diode forward voltage	I _F = 50 A		T _J = 25 °C	_	1.5	1.8	V
				T _J = 175 °C	_	2.1	—	
Q _C	Total capacitive charge	V _R = 600 V			_	224	_	nC
С	Total capacitance	f = 1 MHz V _R = 400 V			-	246	—	pF
		f = 1 MHz V _R = 800 V			-	182	-	
R _{thJH}	Junction-to-heatsink therr resistance	nal	$\lambda_{\text{paste}} = 3.$	4 W/mK	—	0.635	—	°C/W

Table 1-5. SiC Diode Ratings and Characteristics

1.3 Thermal and Package Characteristics

The following table lists the thermal and package characteristics of the MSCSM120DAM31CTBL1NG device.

Table 1-6. Thermal and Package Characteristics

Symbol	Characteristic			Min	Тур	Max	Unit
V _{ISOL}	RMS isolation voltage, any termin 50 Hz/60 Hz	nal to case t = 1 m	nin,	2500	_	—	V
TJ	Operating junction temperature r	ange		-55	_	175	°C
T _{JOP}	Recommended junction tempera conditions	ture under switchi	ng	-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

Electrical Specifications

The following table lists the temperature sensor NTC of the MSCSM120DAM31CTBL1NG device.

Table 1-7. Temperature Sensor NTC

Symbol	Characteristic		Min	Тур	Max	Unit
R ₂₅	Resistance at 25 °C		—	50	—	kΩ
$\Delta R_{25}/R_{25}$	—		—	5	_	%
B _{25/85}	T ₂₅ = 298.15 K		_	3952	_	К
ΔΒ/Β	-	T _C = 100 °C	_	4	_	%

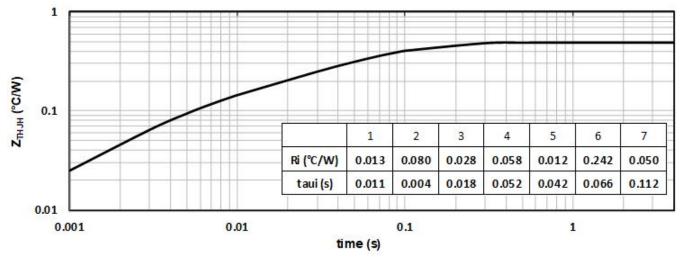
 $R_{T} = \frac{R_{25}}{\exp \left[B_{25/85} \left(\frac{1}{T_{25}} - \frac{1}{T} \right) \right]} \quad \text{T: Thermistor temperature} \\ R_{T}: \text{Thermistor value at T}$

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

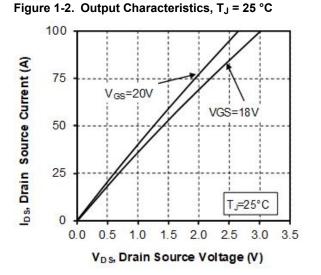
1.4 Typical SiC MOSFET Performance Curve (Per SiC MOSFET)

This section shows the typical SiC MOSFET performance curves of the MSCSM120DAM31CTBL1NG device.

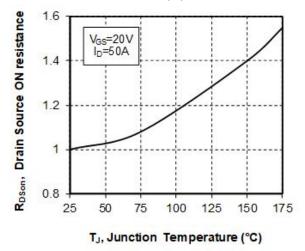
Figure 1-1. Junction-to-Heatsink Thermal Impedance



Electrical Specifications







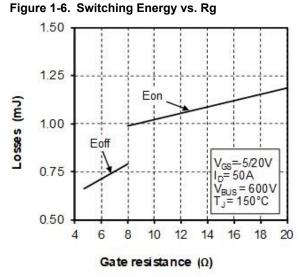


Figure 1-7. Switching Energy vs. Current

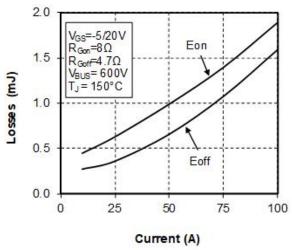


Figure 1-3. Output Characteristics, T_J = 175 °C

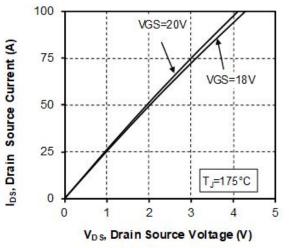
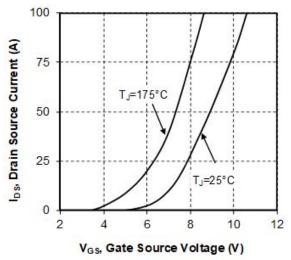
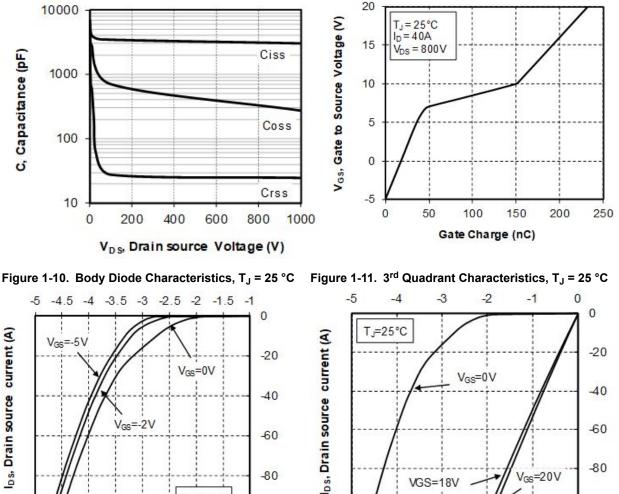


Figure 1-5. Transfer Characteristics

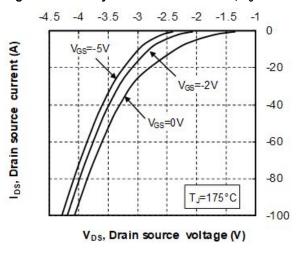


Electrical Specifications



-80 VGS=18V T_=25°C -100 V_{DS}, Drain source voltage (V) V_{DS}, Drain source voltage (V)





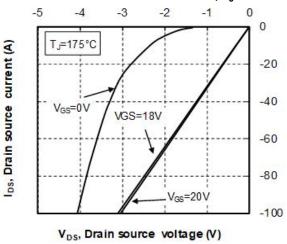


Figure 1-8. Capacitance vs. Drain Source Voltage

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

-80

-100

VGS=20V

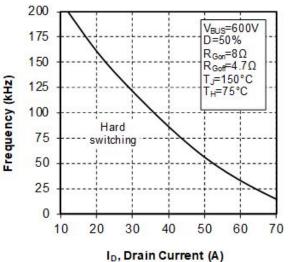


Figure 1-14. Operating Frequency vs Drain Current

1.5 Typical SiC Diode Performance Curves (Per SiC Diode)

This section shows the typical SiC diode performance curves of the MSCSM120DAM31CTBL1NG device.

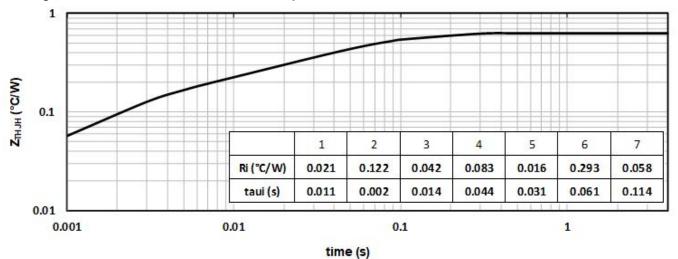


Figure 1-15. Junction-to-Heatsink Thermal Impedance

Electrical Specifications

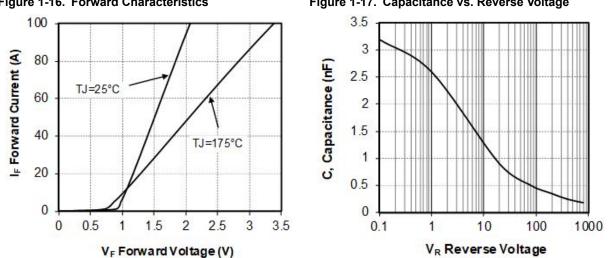


Figure 1-16. Forward Characteristics

Figure 1-17. Capacitance vs. Reverse Voltage

Package Specifications

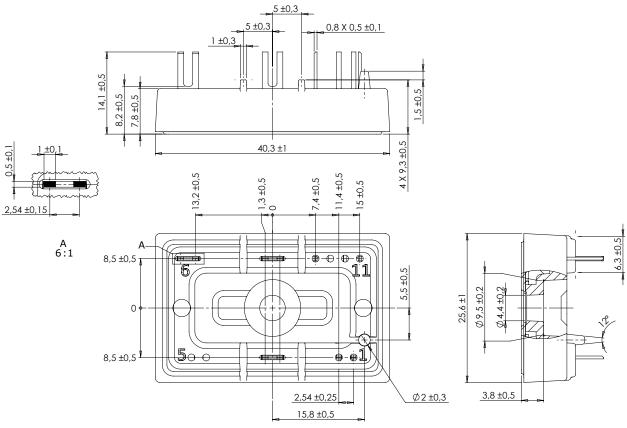
2. Package Specifications

The following section shows the package specification of the MSCSM120DAM31CTBL1NG device.

2.1 Package Outline

The following figure shows the package outline drawing of MSCSM120DAM31CTBL1NG device. The dimensions in the following figure are in millimeters.

Figure 2-1. Package Outline Drawing



3. Revision History

Revision	Date	Description
Α	07/2021	Initial Revision

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