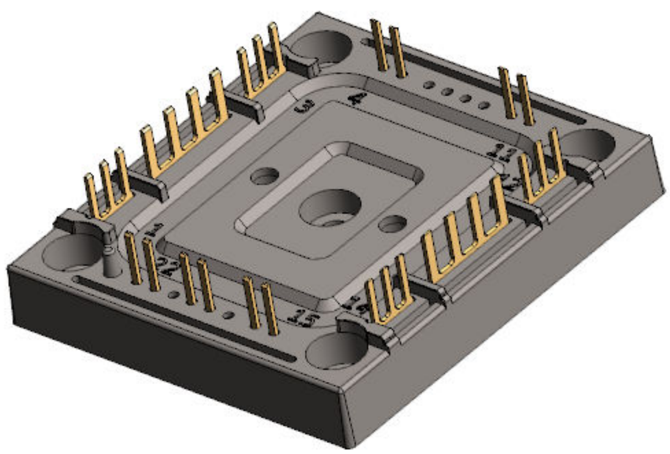
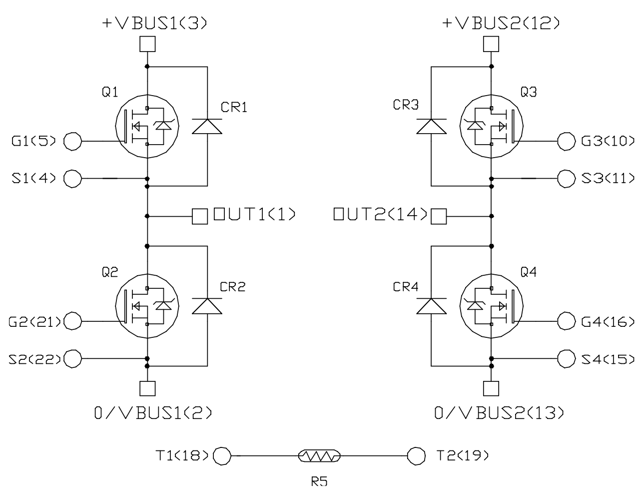
MSCSM120HM16CTBL3NG

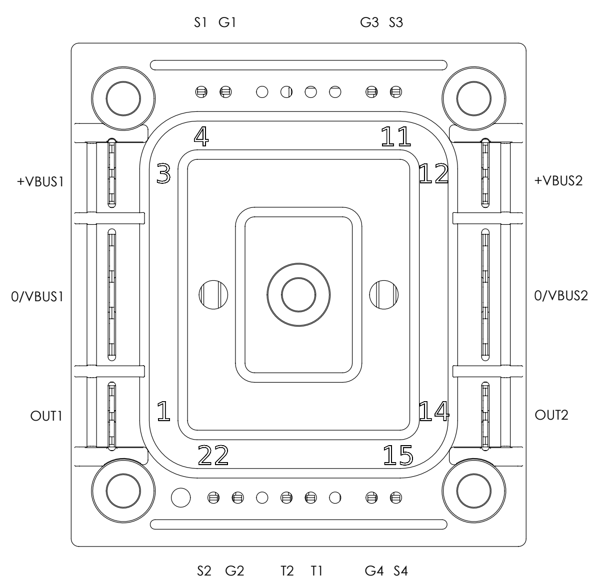
Dual Phase Leg SiC MOSFET Power Module

Product Overview

The MSCSM120HM16CTBL3NG device is a dual phase leg 1200 V/150 A silicon carbide (SiC) MOSFET power module.







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 MSCSM120HM16CTBL3NG 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 MSCSM120HM16CTBL3NG device:

- High efficiency converter
- 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
- Very integrated power conversion system

Application

The following are the applications of MSCSM120HM16CTBL3NG 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 MSCSM120HM16CTBL3NG device.

1.1 SiC MOSFET Characteristics (Per SiC MOSFET)

The following table lists the absolute maximum ratings of MSCSM120HM16CTBL3NG 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	150	A
		T_H = 80 °C	120	
I_{DM}	Pulsed drain current		300	
V_{GS}	Gate-Source voltage		–10/25	V
$R_{DS(on)}$	Drain-Source ON resistance		16	mΩ
P_D	Power dissipation	T_H = 25 °C	560	W

The following table lists the electrical characteristics of MSCSM120HM16CTBL3NG device.

Table 1-2. Electrical Characteristics

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

The following table lists the dynamic characteristics of MSCSM120HM16CTBL3NG device.

Table 1-3. Dynamic Characteristics

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
C_{iss}	Input capacitance	V_{GS} = 0 V V_{DS} = 1000 V f = 1 MHz		—	6040	—	pF
C_{oss}	Output capacitance			—	540	—	
C_{rss}	Reverse transfer capacitance			—	50	—	
Q_g	Total gate charge	V_{GS} = –5 V/20 V V_{Bus} = 800 V I_D = 80 A		—	464	—	nC
Q_{gs}	Gate-Source charge			—	82	—	
Q_{gd}	Gate-Drain charge			—	100	—	
$T_{d(on)}$	Turn-on delay time	V_{GS} = –5 V/20 V V_{Bus} = 600 V I_D = 100 A R_{Gon} = 4 Ω; R_{Goff} = 2.4 Ω		—	30	—	ns
T_r	Rise time			—	30	—	
$T_{d(off)}$	Turn-off delay time			—	50	—	
T_f	Fall time				25	—	
E_{on}	Turn-on energy	V_{GS} = –5 V/20 V V_{Bus} = 600 V I_D = 100 A R_{Gon} = 4 Ω R_{Goff} = 2.4 Ω	T_J = 150 °C	—	1.98	—	mJ
E_{off}	Turn-off energy		T_J = 150 °C	—	1.3	—	
R_{Gint}	Internal gate resistance			—	1.94	—	Ω
R_{thJH}	Junction-to-heatsink thermal resistance		λ = 3.4 W/mK	—	0.268	—	°C/W

The following table lists the body diode ratings and characteristics of MSCSM120HM16CTBL3NG device.

Table 1-4. Body Diode Ratings and Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
V_{SD}	Diode forward voltage	V_{GS} = 0 V; I_{SD} = 80 A	—	4	—	V
		V_{GS} = –5 V; I_{SD} = 80 A	—	4.2	—	
t_{rr}	Reverse recovery time	I_{SD} = 80 A; V_{GS} = –5 V V_R = 800 V; di_F/dt = 2000 A/μs	—	90	—	ns
Q_{rr}	Reverse recovery charge		—	1100	—	nC
I_{rr}	Reverse recovery current		—	27	—	A

1.2 SiC Diode Ratings and Characteristics (Per SiC Diode)

The following table lists the SiC diode ratings and characteristics of MSCSM120HM16CTBL3NG device.

Table 1-5. SiC Diode Ratings and Characteristics (Per SiC Diode)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V_{RRM}	Peak repetitive reverse voltage			—	—	1200	V
I_{RRM}	Reverse leakage current	V_R = 1200 V	T_J = 25 °C	—	20	400	µA
			T_J = 175 °C	—	300	—	
I_F	DC forward current		T_H = 100 °C	—	60	—	A
V_F	Diode forward voltage	I_F = 60 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		—	260	—	nC
C	Total capacitance	f = 1 MHz, V_R = 400 V		—	282	—	pF
		f = 1 MHz, V_R = 800 V		—	210	—	
R_{thJH}	Junction-to-heatsink thermal resistance	λ_{paste} = 3.4 W/mK		—	0.45	—	°C/W

1.3 Thermal and Package Characteristics

The following table lists the thermal and package characteristics of MSCSM120HM16CTBL3NG device.

Table 1-6. 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	M3	0.7	—	0.9	N.m
Wt	Package weight			—	32.5	—	g

The following table lists the temperature sensor NTC of the MSCSM120HM16CTBL3NG device.

Table 1-7. 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} = 298.15 K	—	—	3952	—	K
ΔB/B	—	T_C = 100°C	—	4	—	%

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

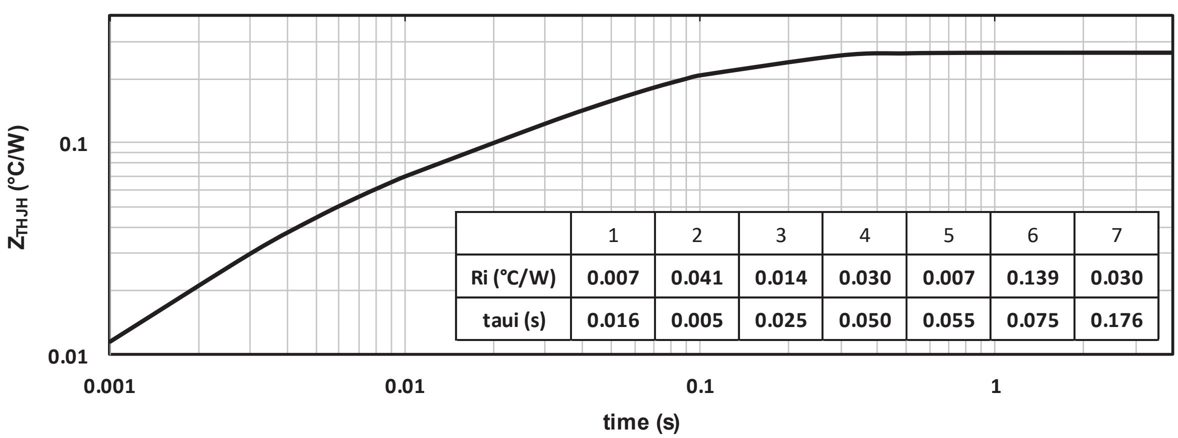
T: Thermistor temperature
R_T: Thermistor value at T

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

1.4 Typical SiC MOSFET Performance Curve

This section shows the typical SiC MOSFET performance curves of the MSCSM120HM16CTBL3NG device.

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



	1	2	3	4	5	6	7
Ri (°C/W)	0.007	0.041	0.014	0.030	0.007	0.139	0.030
taui (s)	0.016	0.005	0.025	0.050	0.055	0.075	0.176

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

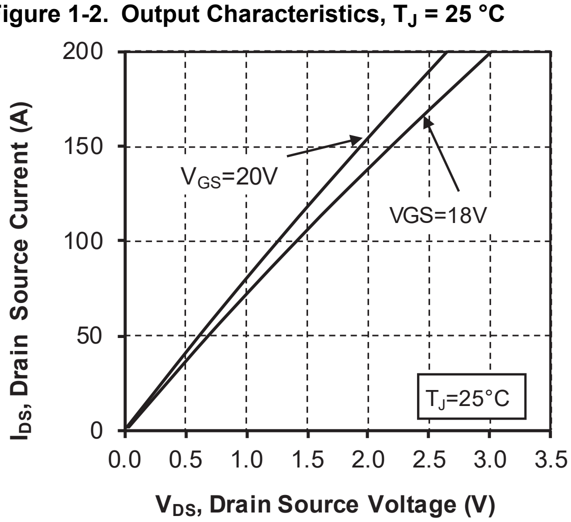


Figure 1-3. Output Characteristics, T_J = 175 °C

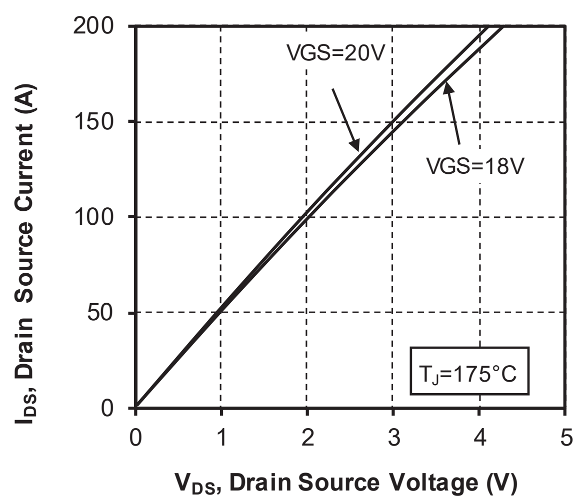


Figure 1-4. Normalized $R_{DS(on)}$ vs. Temperature

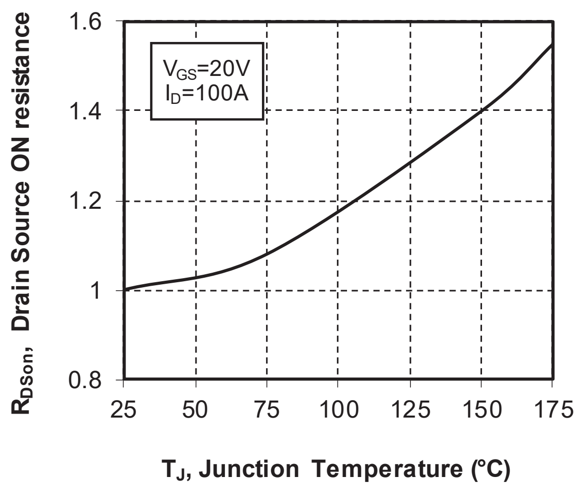


Figure 1-5. Transfer Characteristics

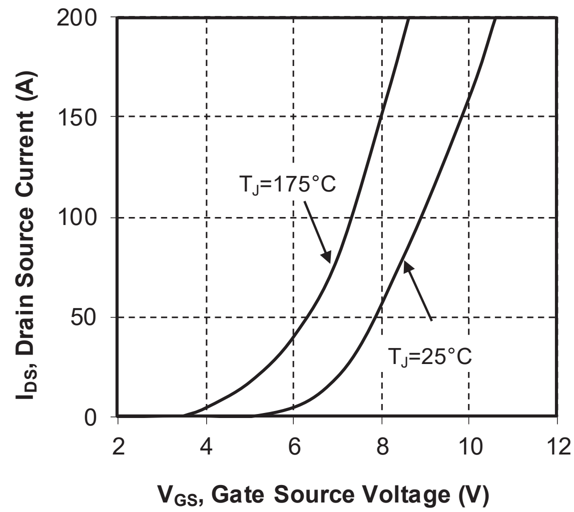


Figure 1-6. Switching Energy vs. Rg

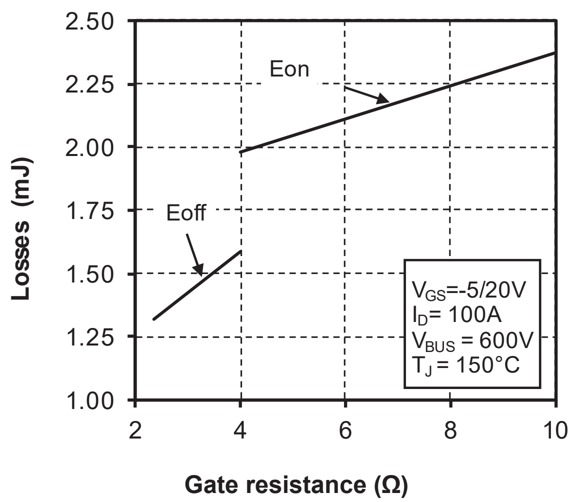


Figure 1-7. Switching Energy vs. Current

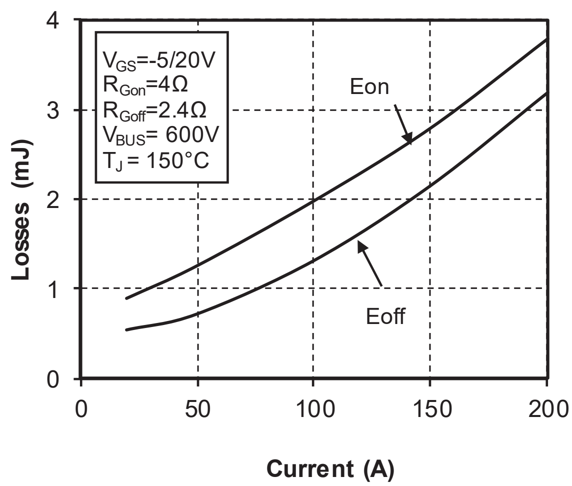


Figure 1-8. Capacitance vs. Drain Source Voltage

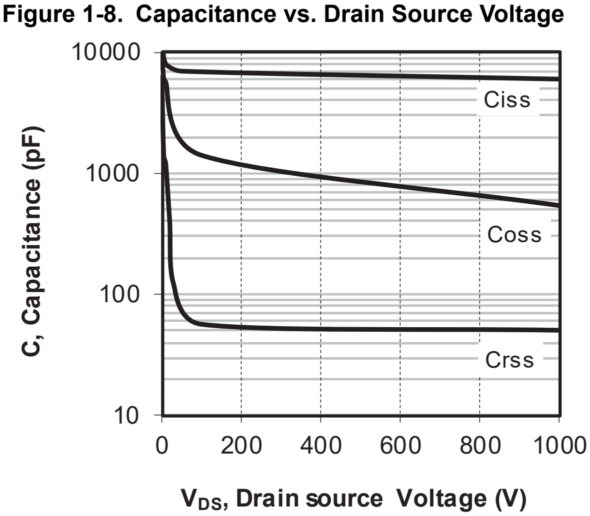


Figure 1-9. Gate Charge vs. Gate Source Voltage

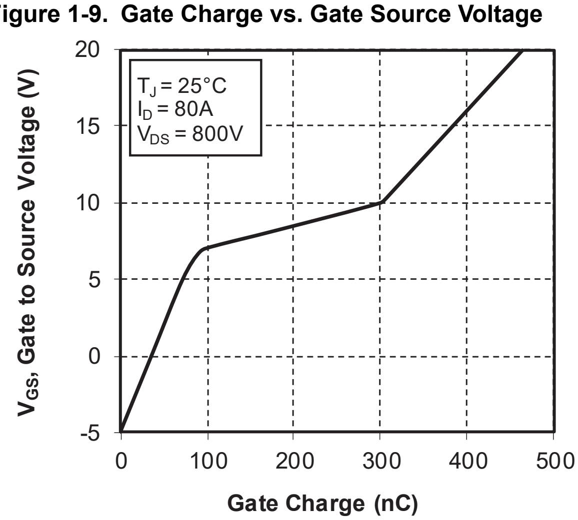


Figure 1-10. Body Diode Characteristics, T_J = 25 °C

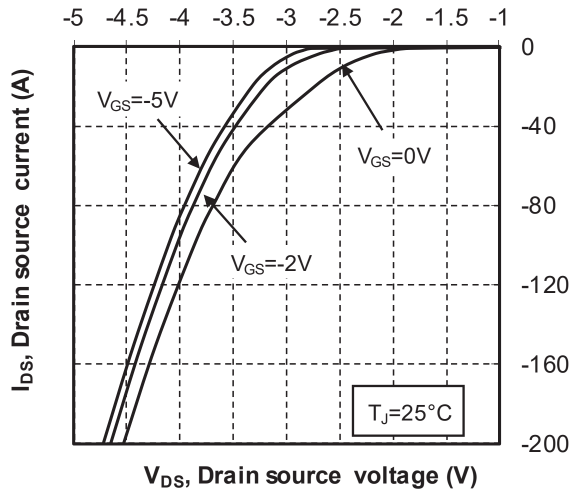


Figure 1-11. 3rd Quadrant Characteristics, T_J = 25 °C

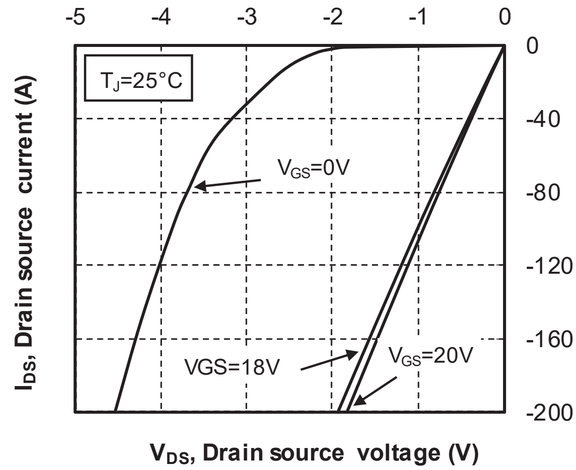


Figure 1-12. Body Diode Characteristics, T_J = 175 °C

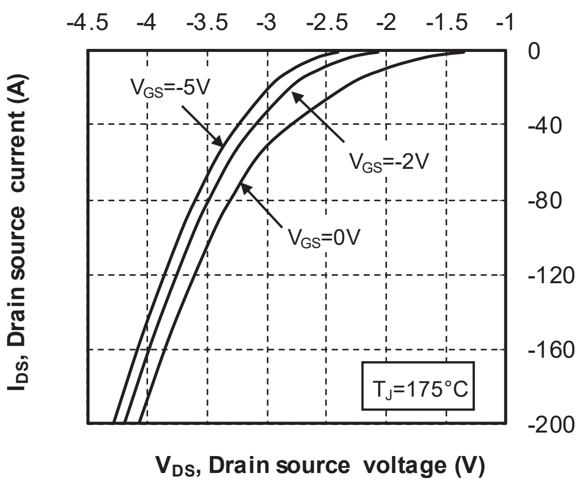


Figure 1-13. 3rd Quadrant Characteristics, T_J = 175 °C

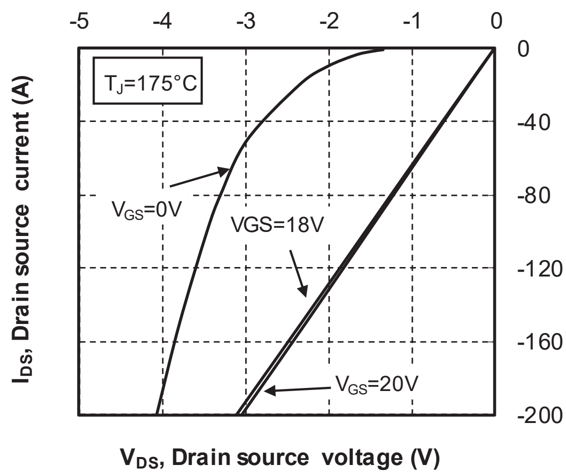
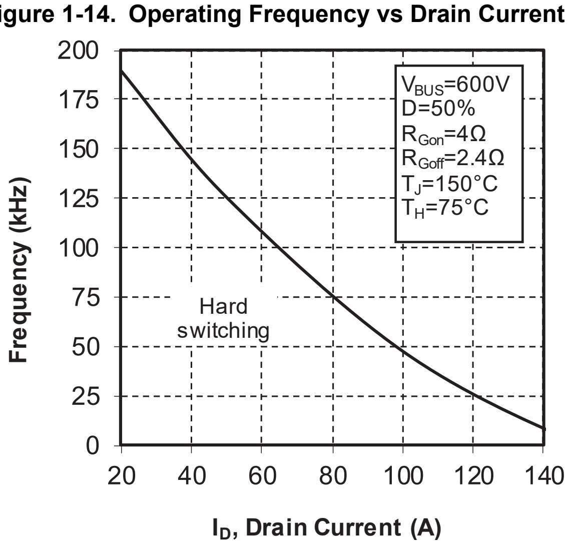


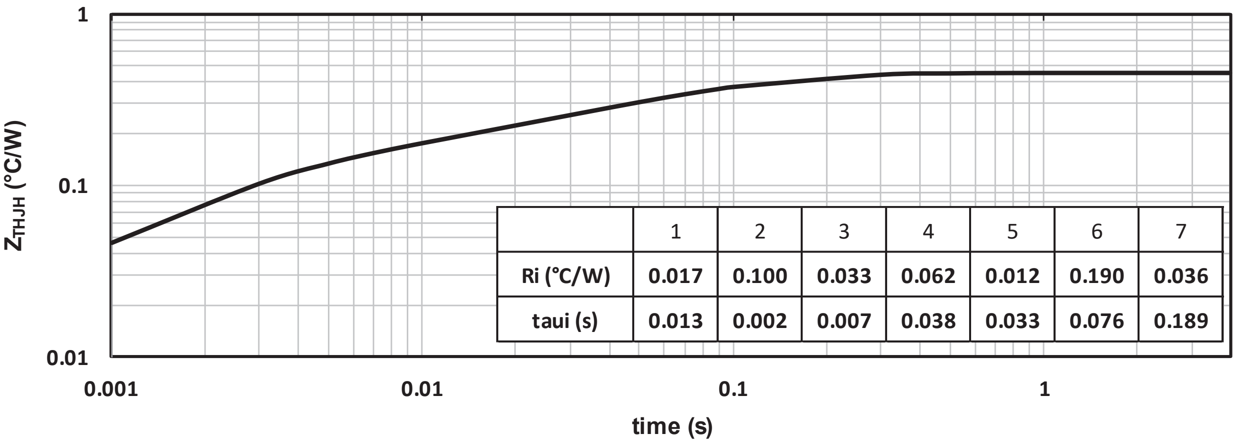
Figure 1-14. Operating Frequency vs Drain Current



1.5 Typical SiC Diode Performance Curves

This section shows the typical SiC diode performance curves of the MSCSM120HM16CTBL3NG device.

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



	1	2	3	4	5	6	7
Ri (°C/W)	0.017	0.100	0.033	0.062	0.012	0.190	0.036
taui (s)	0.013	0.002	0.007	0.038	0.033	0.076	0.189

Figure 1-16. Forward Characteristics

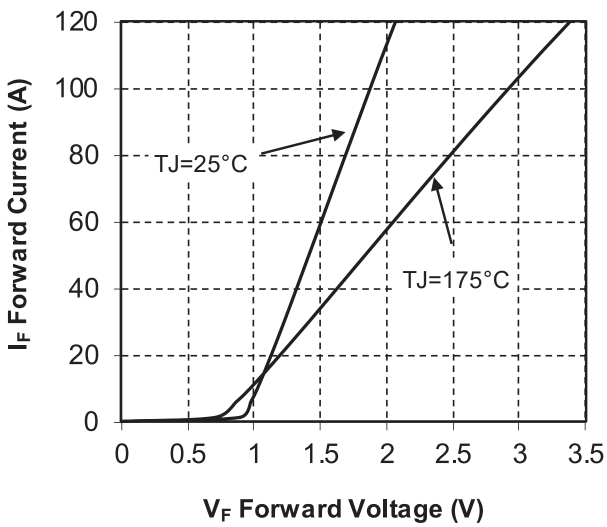
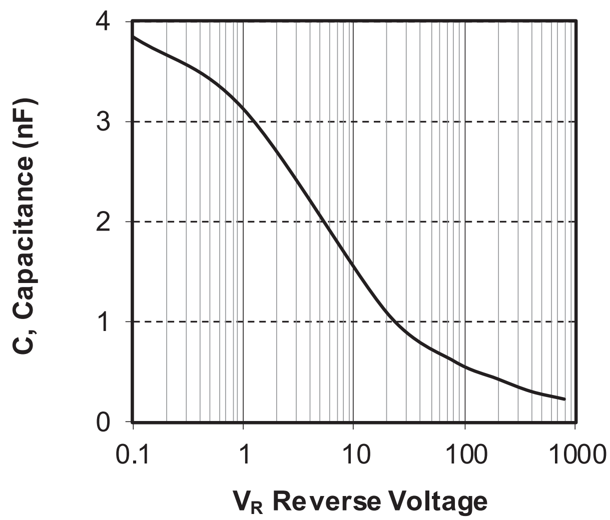


Figure 1-17. Capacitance vs. Reverse Voltage



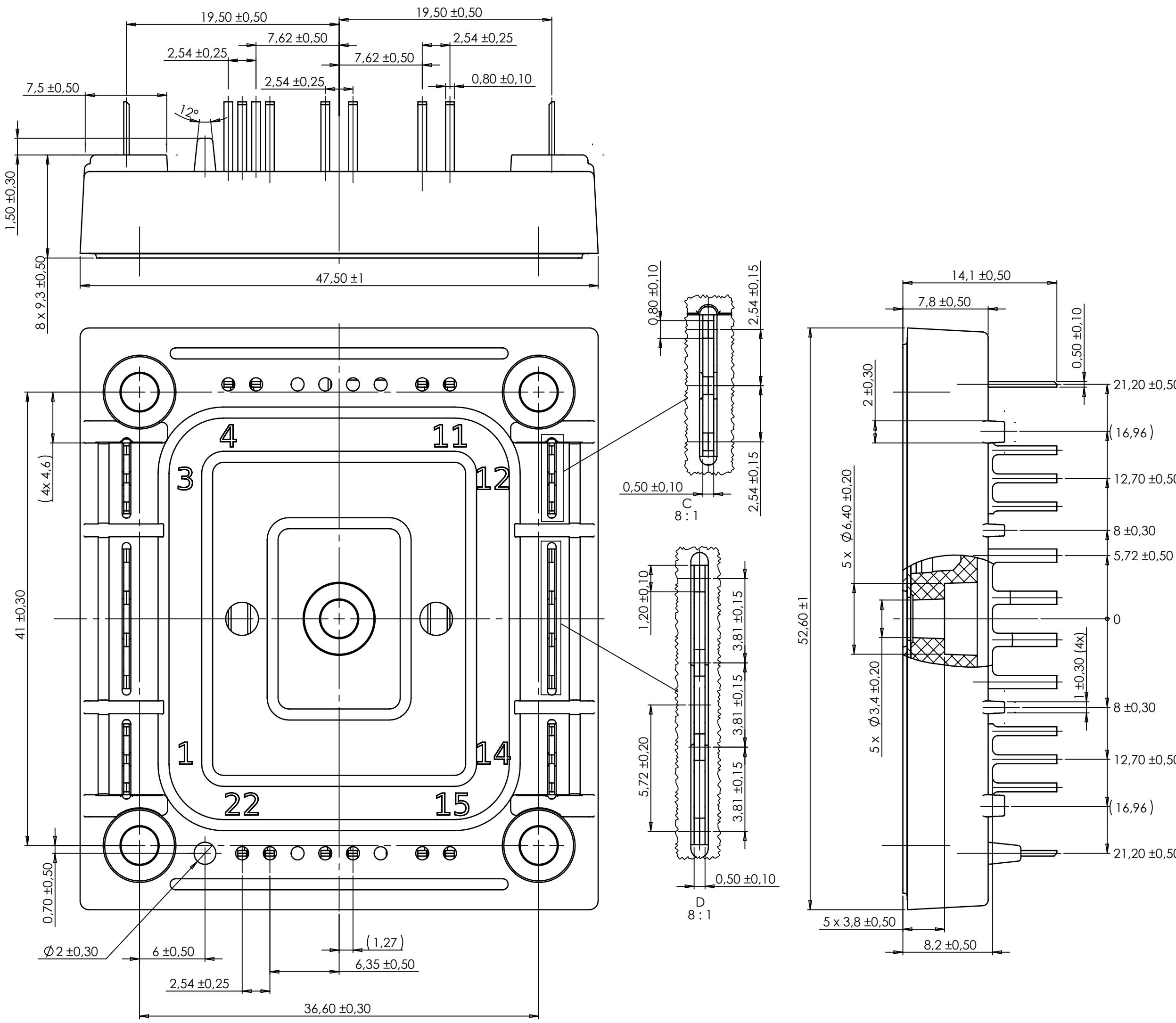
2. Package Specifications

The following section shows the package specification of MSCSM120HM16CTBL3NG device.

2.1 Package Outline

The following figure shows the package outline drawing of MSCSM120HM16CTBL3NG device. The dimensions in the following figure are in millimeters.

Figure 2-1. Package Outline Drawing



3. Revision History

Revision	Date	Description
A	07/2021	Initial revision

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