MSCMC120AM07CT6LIAG

Datasheet

Very Low Stray Inductance Phase Leg SiC MOSFET Power Module

Final

May 2018

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Power Matters.™

Contents

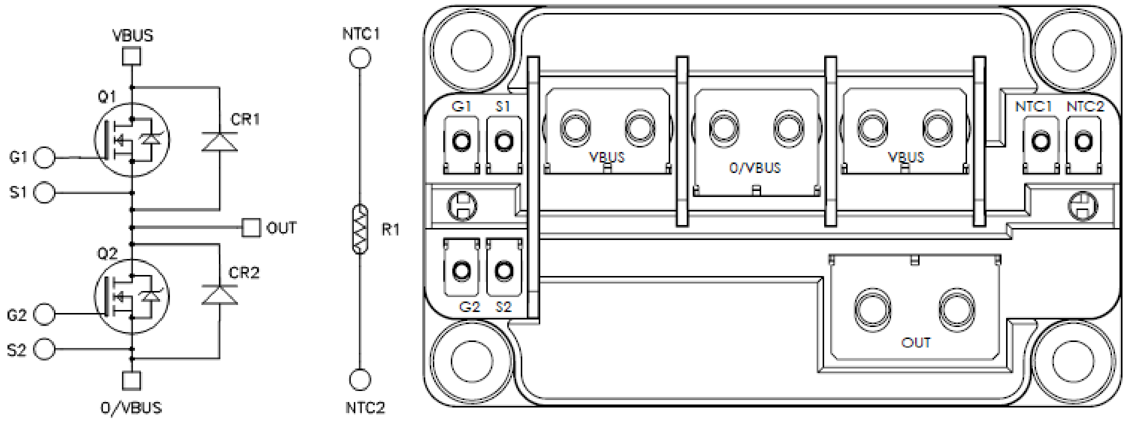
1 Revision History

The revision history describes the changes that were implemented in the document. The changes are listed by revision, starting with the most current publication.

1.1 Revision A

Revision A was published in May 2018. It is the first publication of this document.

2 Product Overview



2.1 Features

The following are key features of the MSCMC120AM07CT6LIAG device:

- Very low stray inductance
- Internal thermistor for temperature monitoring
- M4 and M5 power connectors
- M2.5 signals connectors
- AlN substrate for improved thermal performance

SiC Power MOSFET

- Low $R_{DS(on)}$
- High temperature performance

SiC Schottky Diode

- Zero reverse recovery
- Zero forward recovery
- Temperature independent switching behavior
- Positive temperature coefficient on VF

2.2 Benefits

The following are benefits of the MSCMC120AM07CT6LIAG device:

- Outstanding performance at high frequency operation
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- Low profile
- RoHS compliant

2.3 Applications

The MSCMC120AM07CT6LIAG device is designed for the following applications:

- Motor control

*All ratings taken at TJ= 25 °C unless otherwise specified.

Caution: The devices are sensitive to electrostatic discharge. Proper handling precautions should be followed.

3 Electrical Specifications

This section details the electrical specifications for the MSCMC120AM07CT6LIAG device.

3.1 Absolute Maximum Ratings

The following table shows the SiC MOSFET absolute maximum ratings (per SiC MOSFET) for the MSCMC120AM07CT6LIAG device.

Table 1 • Absolute Maximum Ratings

Symbol	Parameter		Ratings	Unit
V_{DSS}	Drain- source voltage		1200	V
I_D	Continuous drain current	T_c = 25 °C	264	A
		T_c = 80 °C	210	
I_{DM}	Pulsed drain current		530	
V_{GS}	Gate- source voltage		–10 to 23	V
V_{GSOP}	Gate- source voltage; recommended operation values		–5 to 18	
R_{DSon}	Drain- source ON resistance		8.7	mΩ
P_D	Power dissipation	T_c = 25 °C	1350	W

3.2 Electrical Performance

The following tables show the SiC MOSFET characteristics (per SiC MOSFET) of the MSCMC120AM07CT6LIAG device.

Table 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			50	600	µA
$R_{DS(on)}$	Drain- source on resistance	V_{GS} = 20 V; I_D = 240 A	T_J = 25 °C		6.7	8.7	mΩ
		V_{GS} = 18 V; I_D = 240 A	T_J = 175 °C		15		
$V_{GS(th)}$	Gate threshold voltage	V_{GS} = V_{DS}, I_D = 60 mA		2	2.6	4	V
I_{GSS}	Gate- source leakage current	V_{GS} = 20 V, V_{DS} = 0 V				1.5	µA

Table 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			11.4		nF
C_{oss}	Output capacitance				0.9		
C_{rss}	Reverse transfer capacitance				0.06		
Q_g	Total gate charge	V_{GS} = –5 to 20 V V_{Bus} = 800 V I_D = 240 A			690		nC
Q_{gs}	Gate – source charge				168		
Q_{gd}	Gate – drain charge				222		
$T_{d(on)}$	Turn-on delay time	V_{GS} = –5 to 20 V V_{Bus} = 600 V I_D = 240 A R_L = 2.5 Ω ; R_G = 0.75 Ω			21		ns
T_r	Rise time				19		
$T_{d(off)}$	Turn-off delay time				50		
T_f	Fall time				30		
E_{on}	Turn on energy	Inductive Switching V_{GS} = –5 to 20 V V_{Bus} = 600 V I_D = 200 A R_G = 0.75 Ω	T_J = 150 °C		3		mJ
E_{off}	Turn off energy		T_J = 150 °C		2		
R_{Gint}	Internal gate resistance				1		Ω
R_{thJC}	Junction-to-case thermal resistance					0.111	°C/W

Table 4 • Body Diode Ratings and Characteristics

Symbol	Characteristic	Test conditions		Min	Typ	Max	Unit
V_{SD}	Diode forward voltage	V_{GS} = –5 V I_{SD} = 120 A	T_J = 25 °C		4.1		V
			T_J = 175 °C		3.5		
t_{rr}	Reverse recovery time	I_{SD} = 120 A ; V_{GS} = –5 V			54		ns

Symbol	Characteristic	Test conditions	Min	Typ	Max	Unit
Q_{rr}	Reverse recovery charge	V_R = 800 V ; di_F/dt = 6000 A/µs		1.7		µC
I_{rr}	Reverse recovery current			90		A

The following table shows the SiC diode characteristics (per SiC diode) of the MSCMC120AM07CT6LIAG device.

Table 5 • SiC Diode Characteristics

Symbol	Characteristics	Test conditions		Min	Typ	Max	Unit
V_{RRM}	Peak repetitive reverse voltage					1200	V
I_{RM}	Reverse leakage current	V_R = 1200 V	T_J = 25 °C		0.2	1.2	mA
			T_J = 175 °C		0.4	2.4	
I_F	DC forward current		T_C = 95 °C		120		A
V_F	Diode forward voltage	I_F = 120 A	T_J = 25 °C		1.5	1.8	V
			T_J = 175 °C		2.2	3	
Q_C	Total capacitive charge	V_R = 800 V			594		nC
C	Total capacitance	f = 1 MHz, V_R = 400 V			558		pF
		f = 1 MHz, V_R = 800 V			402		
R_{thJC}	Junction-to-case thermal resistance					0.214	°C/W

The following tables show the thermal and package characteristics of the MSCMC120AM07CT6LIAG device.

Table 6 • Package Characteristics

Symbol	Characteristic			Min	Max	Unit
V_{ISOL}	RMS isolation voltage, any terminal to case t =1 min, 50 to 60 Hz			4000		V
T_J	Operating junction temperature range			–40	175	°C
T_{JOP}	Recommended junction temperature under switching conditions			–40	$T_J$max –25	
T_{STG}	Storage temperature range			–40	125	
T_C	Operating case temperature			–40	125	
Torque	Mounting torque	For terminals	M2.5	0.4	0.6	N.m
			M4	2	3	
			M5	2	3.5	
		To heatsink	M6	3	5	
L_{DC}	Module stray inductance between VBUS and 0/VBUS				3	nH
Wt	Package weight				320	g

Table 7 • Temperature Sensor NTC

Symbol	Characteristic	Min	Typ	Max	Unit
R_{25}	Resistance at 25 °C		50		kΩ
ΔR_{25}/R25			5		%
$B_{25/85}$	T_{25} = 298.15 K		3952		K
ΔB/B	T_C = 100 °C		4		%

Note: See application note APT0406 on www.microsemi.com

Figure 1 • NTC Formula

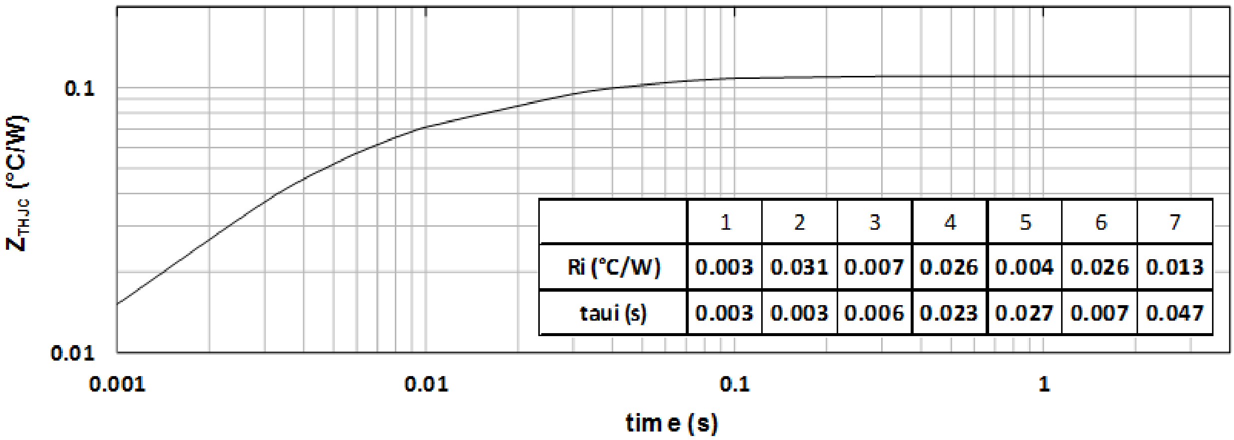
$$R_T = \frac{R_{25}}{\exp\left[B_{25/85}\left(\frac{1}{T_{25}} - \frac{1}{T}\right)\right]}$$

3.3 Typical Performance Curves

This section shows the typical performance curves for the MSCMC120AM07CT6LIAG device.

The following section details the typical performance curves for SiC MOSFET.

Figure 2 • Maximum Thermal Impedance



	1	2	3	4	5	6	7
Ri (°C/W)	0.003	0.031	0.007	0.026	0.004	0.026	0.013
taui (s)	0.003	0.003	0.006	0.023	0.027	0.007	0.047

Figure 3 • Output Characteristics

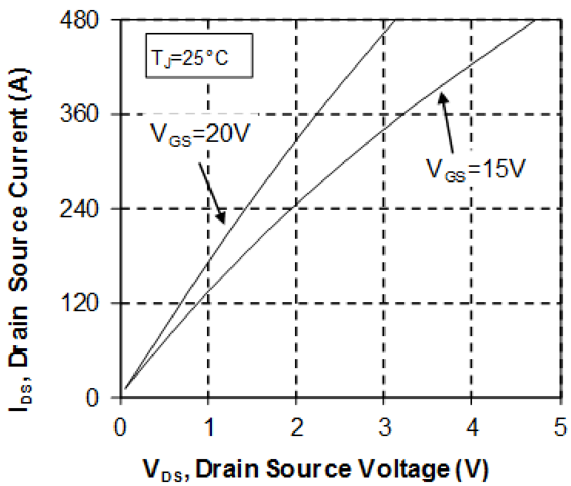


Figure 4 • Output Characteristics II

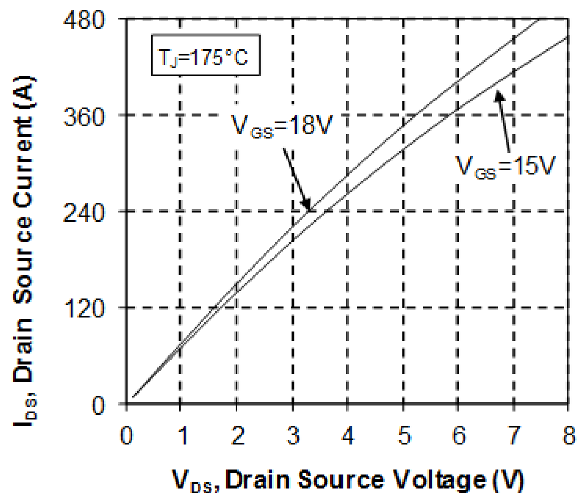


Figure 5 • Normalized Rds(on) vs. Temperature

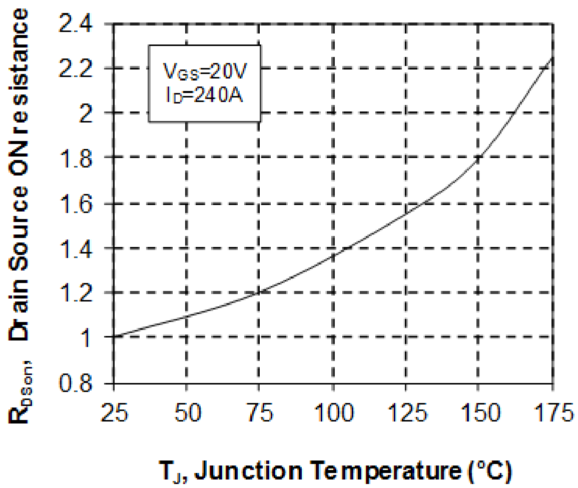


Figure 6 • Transfer Characteristics

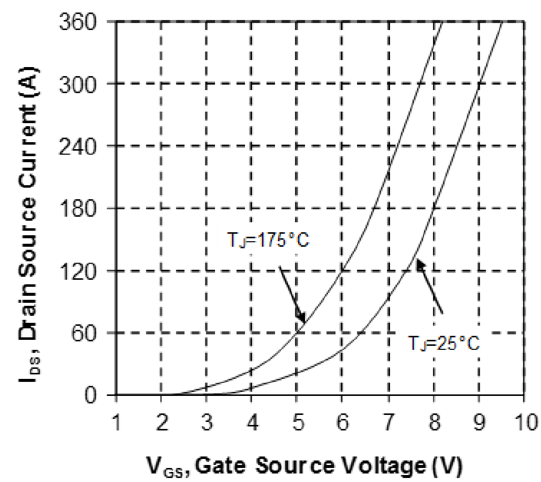


Figure 7 • Switching Energy vs. Rg

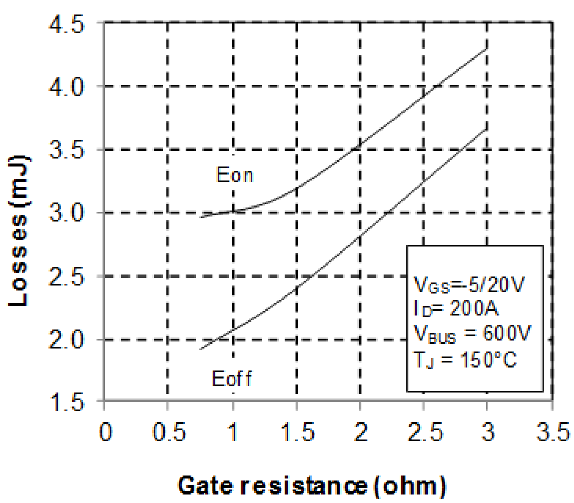


Figure 8 • Switching Energy vs. Current

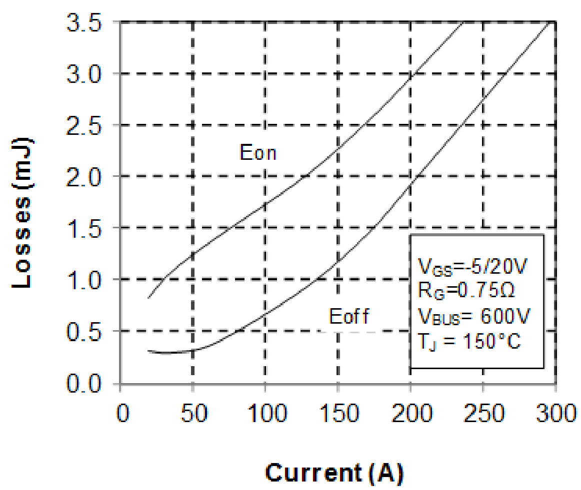


Figure 9 • Capacitance vs. Drain Source Voltage

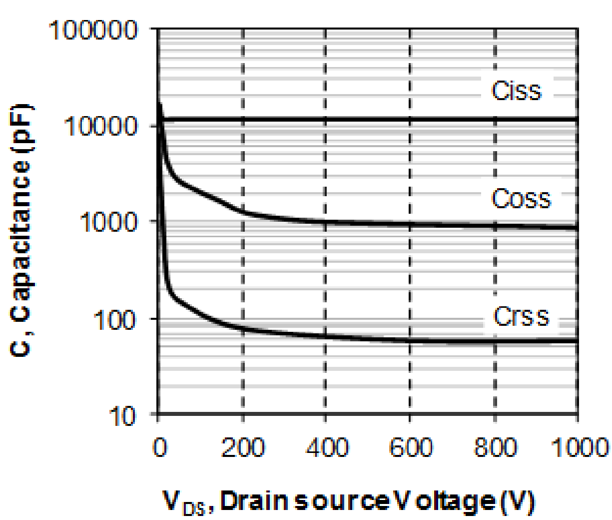


Figure 10 • Gate Charge vs. Gate Source Voltage

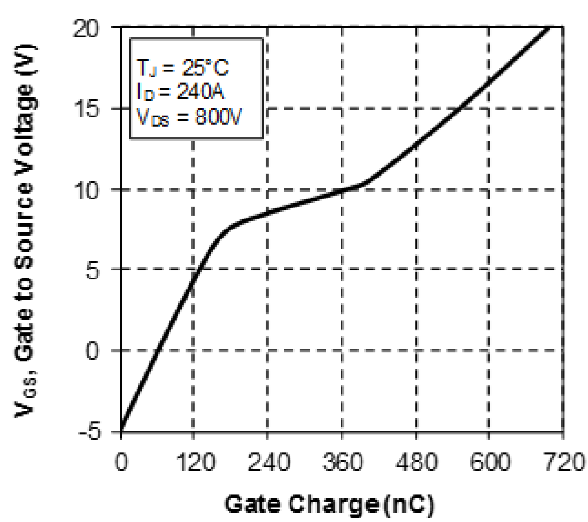


Figure 11 • Body Diode Characteristics

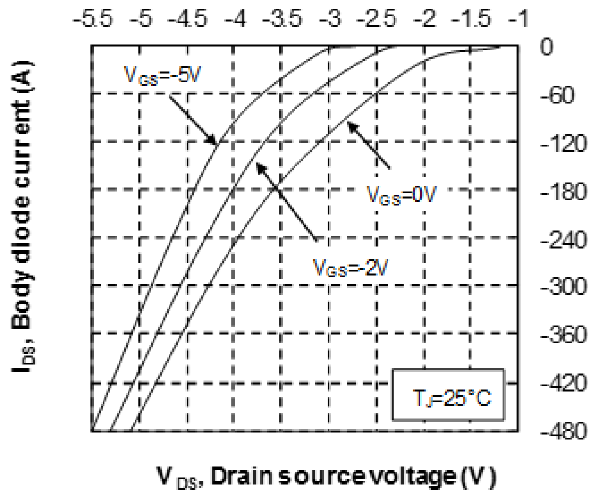


Figure 12 • 3rd Quadrant Characteristics

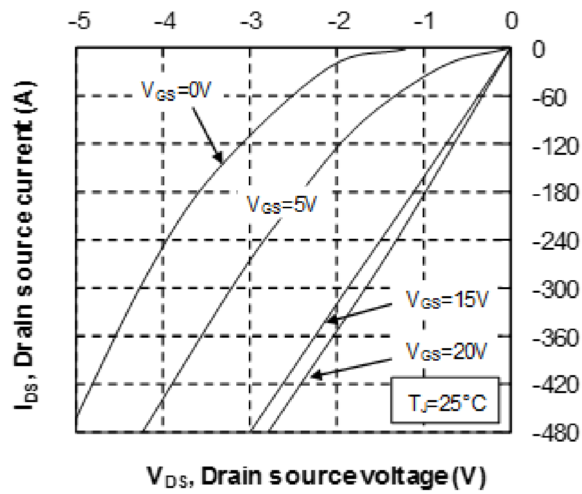


Figure 13 • Body Diode Characteristics II

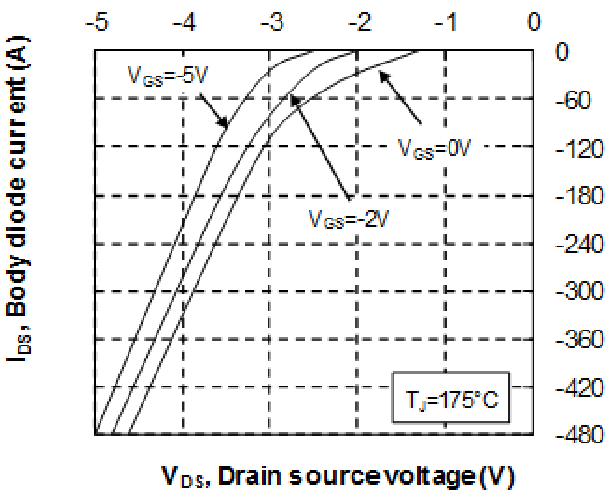


Figure 14 • 3rd Quadrant Characteristics

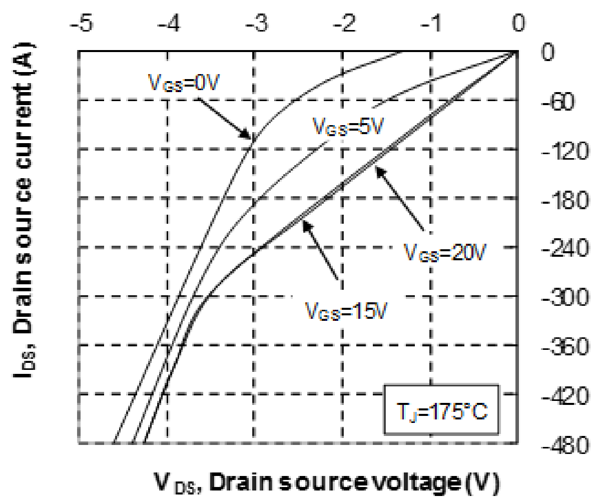
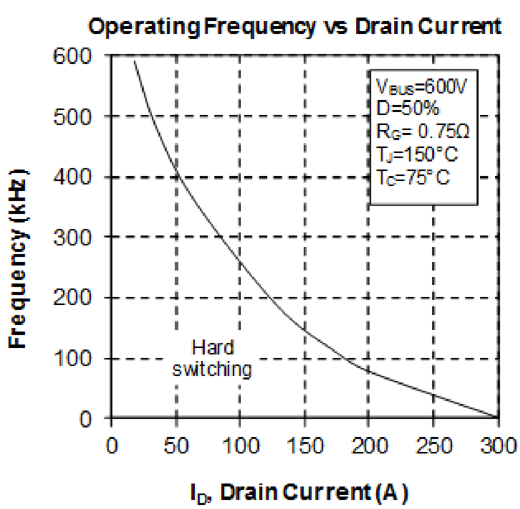
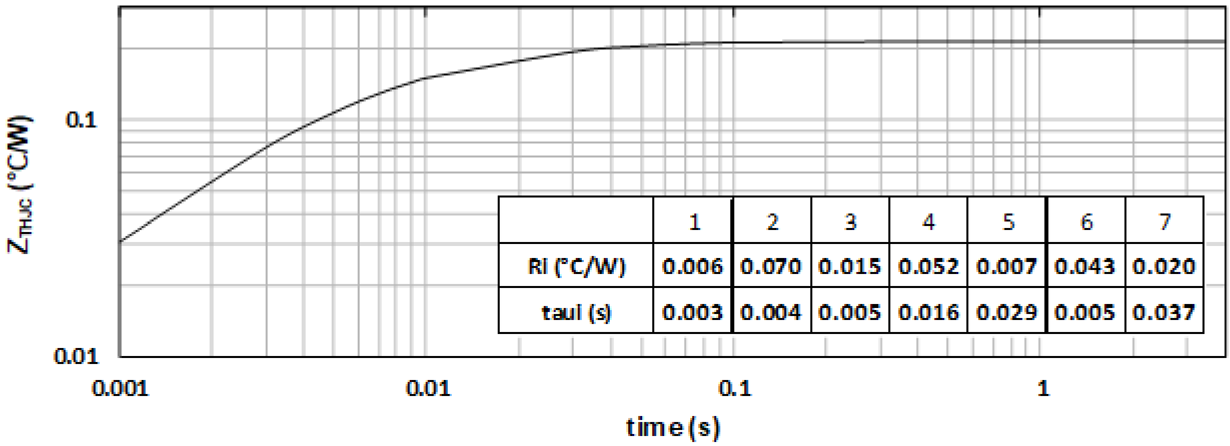


Figure 15 • Operating Frequency vs. Drain Current



The following section details the typical performance curves for SiC Diode.

Figure 16 • SiC Diode Maximum Thermal Impedance



	1	2	3	4	5	6	7
RI (°C/W)	0.006	0.070	0.015	0.052	0.007	0.043	0.020
taul (s)	0.003	0.004	0.005	0.016	0.029	0.005	0.037

Figure 17 • Forward Characteristics

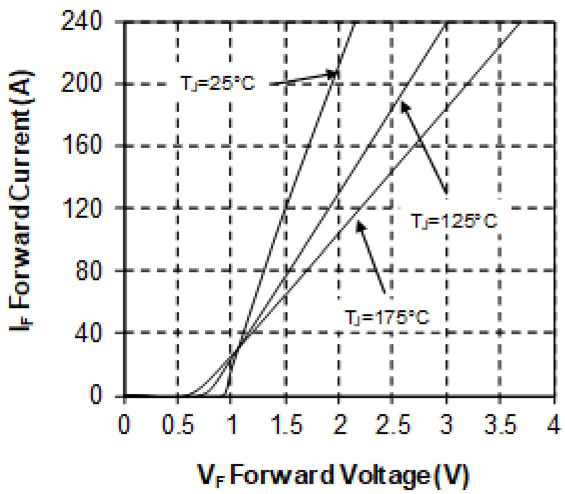


Figure 18 • Reverse Characteristics

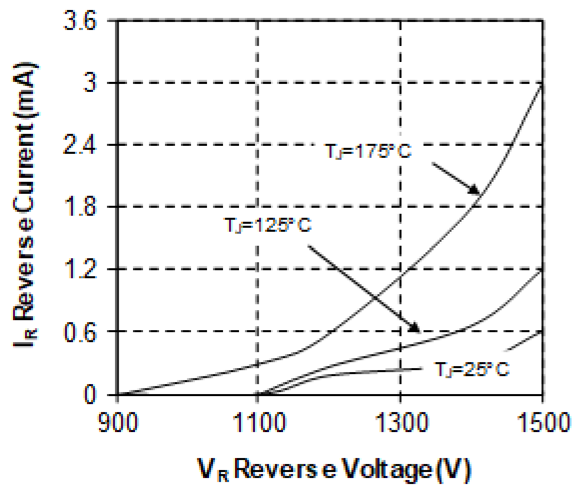
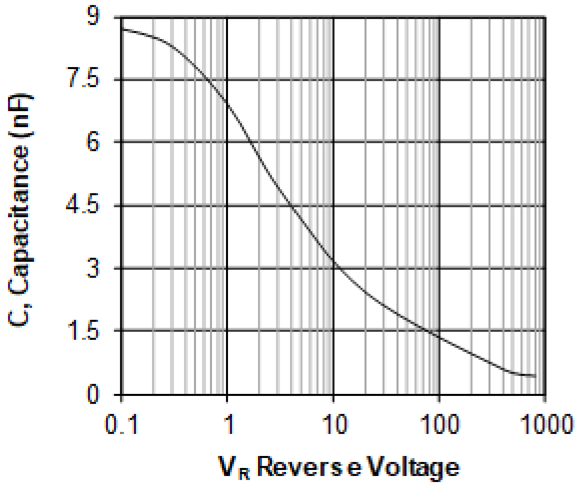


Figure 19 • Capacitance vs. Reverse Voltage



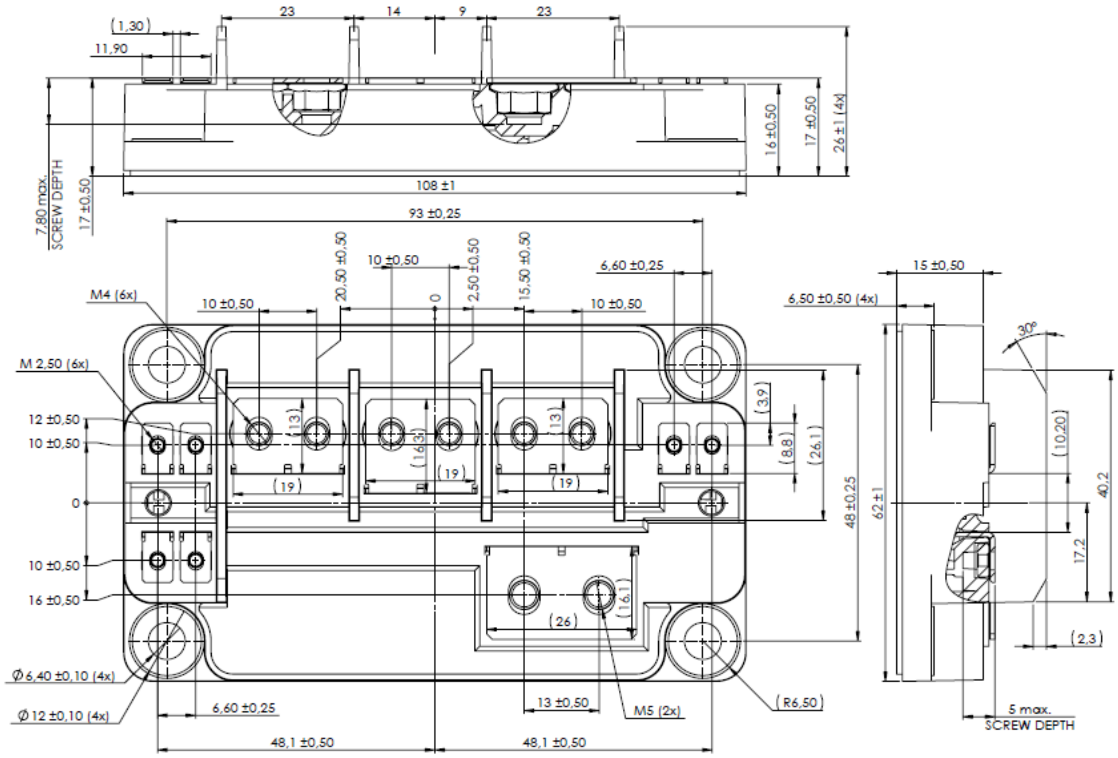
4 Package Specification

This section outlines the package specification for the MSCMC120AM07CT6LIAG device.

4.1 Package Outline Drawing

This section details the package drawing of the MSCMC120AM07CT6LIAG device. Dimensions are in millimeters.

Figure 20 • Package Outline Drawing



Note: See application note AN1911 containing the mounting instructions for SP6 low inductance power module on www.microsemi.com

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