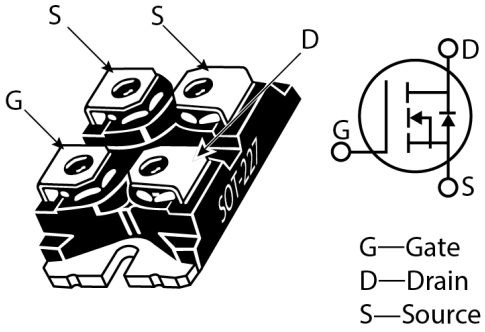
MSC017SMA120J Silicon Carbide N-Channel Power MOSFET

Product Overview

The silicon carbide (SiC) power MOSFET product line from Microsemi increases the performance over silicon MOSFET and silicon IGBT solutions while lowering the total cost of ownership for high-voltage applications. The MSC017SMA120J device is a 1200 V, 17 mΩ SiC MOSFET in a SOT-227 package.



Features

The following are key features of the MSC017SMA120J device:

- Low capacitances and low gate charge
- Fast switching speed due to low internal gate resistance (ESR)
- Stable operation at high junction temperature, $T_{J(max)}$ = 175 °C
- Fast and reliable body diode
- Superior avalanche ruggedness
- RoHS compliant
- Isolated voltage to 2500 V

Benefits

The following are benefits of the MSC017SMA120J device:

- High efficiency to enable lighter, more compact system
- Simple to drive and easy to parallel
- Improved thermal capabilities and lower switching losses
- Eliminates the need for external freewheeling diode
- Lower system cost of ownership

Applications

The MSC017SMA120J device is designed for the following applications:

- PV inverter, converter, and industrial motor drives
- Smart grid transmission and distribution
- Induction heating and welding
- H/EV powertrain and EV charger
- Power supply and distribution

Device Specifications

This section shows the specifications of the MSC017SMA120J device.

Absolute Maximum Ratings

The following table shows the absolute maximum ratings of the MSC017SMA120J device.

Table 1 • Absolute Maximum Ratings

Symbol	Parameter	Ratings	Unit
V_{DSS}	Drain source voltage	1200	V
I_D	Continuous drain current at T_C = 25 °C	88	A
	Continuous drain current at T_C = 100 °C	62	
I_{DM}	Pulsed drain current[1]	280	
V_{GS}	Gate-source voltage	23 to –10	V
P_D	Total power dissipation at T_C = 25 °C	278	W
	Linear derating factor	3.33	W/°C

Note:

1. Repetitive rating: pulse width and case temperature limited by maximum junction temperature.

The following table shows the thermal and mechanical characteristics of the MSC017SMA120J device.

Table 2 • Thermal and Mechanical Characteristics

Symbol	Characteristic	Min	Typ	Max	Unit
$R_{\theta JC}$	Junction-to-case thermal resistance		0.36	0.54	°C/W
T_J	Operating junction temperature	–55		175	°C
T_{STG}	Storage temperature	–55		150	
T_L	Soldering temperature for 10 seconds (1.6 mm from case)			300	°C
$V_{ISOLATION}$	RMS voltage (50 Hz–60 Hz sinusoidal waveform from terminals to mounting base for 1 minute)	2500			V
	Mounting torque, M4 screw			10	lbf-in
				1.1	N-m
Wt	Package weight		1.03		oz
			29.2		g

Electrical Performance

The following table shows the static characteristics of the MSC017SMA120J device. T_J = 25 °C unless otherwise specified.

Table 3 • Static Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0 V, I_D = 100 µA	1200			V
$R_{DS(on)}$	Drain-source on resistance[1]	V_{GS} = 20 V, I_D = 40 A		17.6	22	mΩ
$V_{GS(th)}$	Gate-source threshold voltage	V_{GS} = V_{DS}, I_D = 4.5 mA	1.9	2.7		V
$\Delta V_{GS(th)}/\Delta T_J$	Threshold voltage coefficient	V_{GS} = V_{DS}, I_D = 4.5 mA		–4.6		mV/°C
I_{DSS}	Zero gate voltage drain current	V_{DS} = 1200 V, V_{GS} = 0 V			100	µA
		V_{DS} = 1200 V, V_{GS} = 0 V T_J = 125 °C			500	
I_{GSS}	Gate-source leakage current	V_{GS} = 20 V/–10 V			±100	nA

Note:

1. Pulse test: pulse width < 380 µs, duty cycle < 2%.

The following table shows the dynamic characteristics of the MSC017SMA120J device. T_J = 25 °C unless otherwise specified.

Table 4 • Dynamic Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
C_{iss}	Input capacitance	V_{GS} = 0 V, V_{DD} = 1000 V V_{AC} = 25 mV, ƒ = 1 MHz		5280		pF
C_{rss}	Reverse transfer capacitance			12		
C_{oss}	Output capacitance			265		
Q_g	Total gate charge	V_{GS} = –5 V/20 V, V_{DD} = 800 V I_D = 40 A		249		nC
Q_{gs}	Gate-source charge			63		
Q_{gd}	Gate-drain charge			32		
$t_{d(on)}$	Turn-on delay time	V_{DD} = 800 V, V_{GS} = –5 V/20 V, I_D = 50 A, $R_{g(ext)}$ = 4.0 Ω, Freewheeling diode = MSC017SMA120J (V_{GS} = –5 V)		TBD		ns
t_f	Voltage fall time			TBD		
$t_{d(off)}$	Turn-off delay time			TBD		
t_r	Voltage rise time			TBD		
E_{on}	Turn-on switching energy			TBD		µJ
E_{off}	Turn-off switching energy			TBD		
$t_{d(on)}$	Turn-on delay time	V_{DD} = 800 V, V_{GS} = –5 V/20 V, I_D = 50 A, $R_{g(ext)}$ = 4.0 Ω Freewheeling diode = MSC050SDA120B		TBD		ns
t_f	Voltage fall time			TBD		
$t_{d(off)}$	Turn-off delay time			TBD		
t_r	Voltage rise time			TBD		
E_{on}	Turn-on switching energy			TBD		µJ
E_{off}	Turn-off switching energy			TBD		
ESR	Equivalent series resistance	f = 1 MHz, 25 mV, drain short		0.71		Ω
SCWT	Short circuit withstand time	V_{DS} = 960 V, V_{GS} = 20 V		3		µs
E_{AS}	Avalanche energy, single pulse	V_{DS} = 150 V, I_D = 30 A		3500		mJ

The following table shows the body diode characteristics of the MSC017SMA120J device. T_J = 25 °C unless otherwise specified.

Table 5 • Body Diode Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
V_{SD}	Diode forward voltage	I_{SD} = 40 A, V_{GS} = 0 V		3.5		V
		I_{SD} = 40 A, V_{GS} = –5 V		3.9		V
t_{rr}	Reverse recovery time	I_{SD} = 50 A, V_{GS} = –5 V, Drive Rg = 4 Ω V_{DD} = 800 V, dI/dt = –2500 A/µs		40		ns
Q_{rr}	Reverse recovery charge			490		nC
I_{RRM}	Reverse recovery current			22		A

Typical Performance Curves

This section shows the typical performance curves of the MSC017SMA120J device.

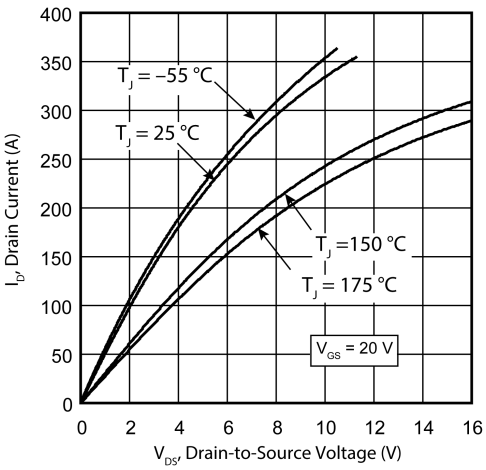


Figure 1 • Drain Current vs. V_{DS}

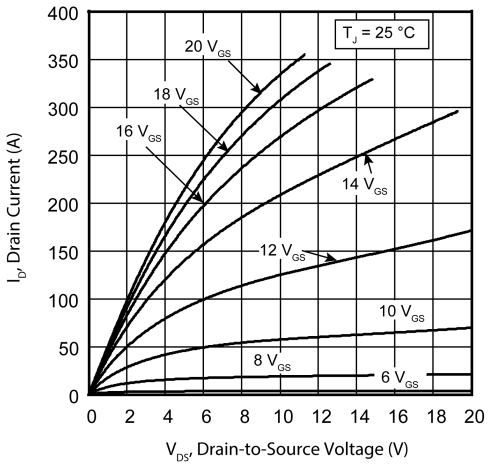


Figure 2 • Drain Current vs. V_{DS}

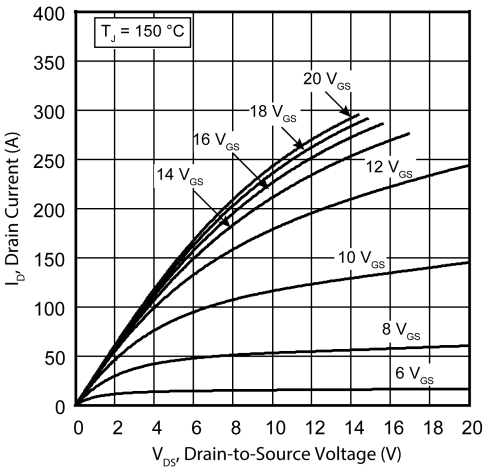


Figure 3 • Drain Current vs. V_{DS}

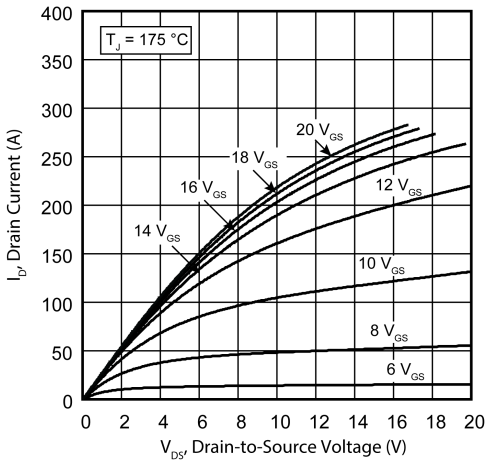


Figure 4 • Drain Current vs. V_{DS}

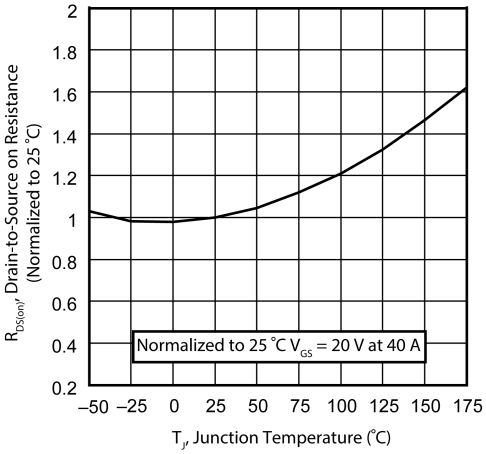


Figure 5 • RDS(on) vs. Junction Temperature

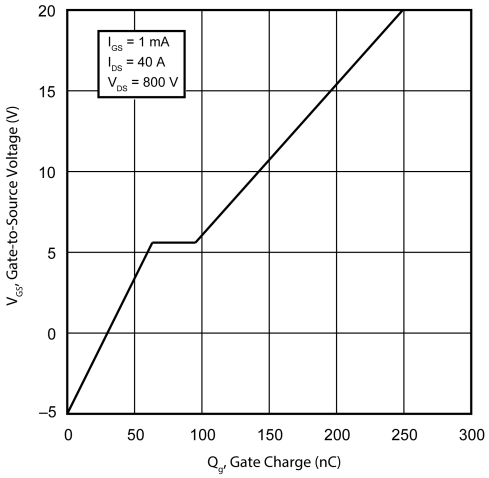


Figure 6 • Gate Charge Characteristics

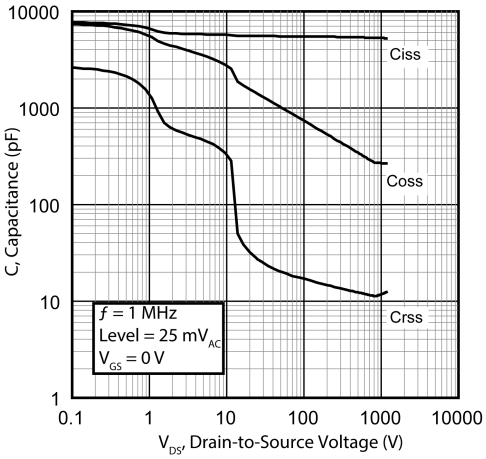


Figure 7 • Capacitance vs. Drain-to-Source Voltage

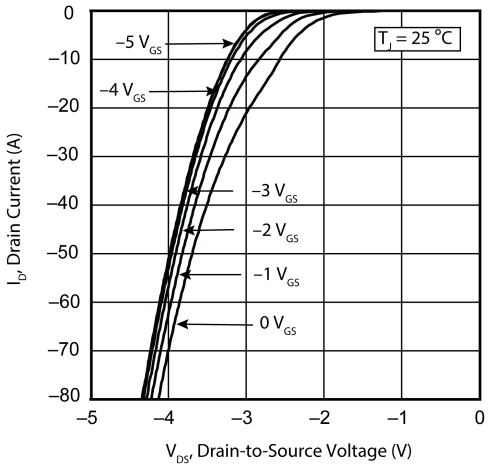


Figure 8 • I_D vs. V_{DS} 3rd Quadrant Conduction

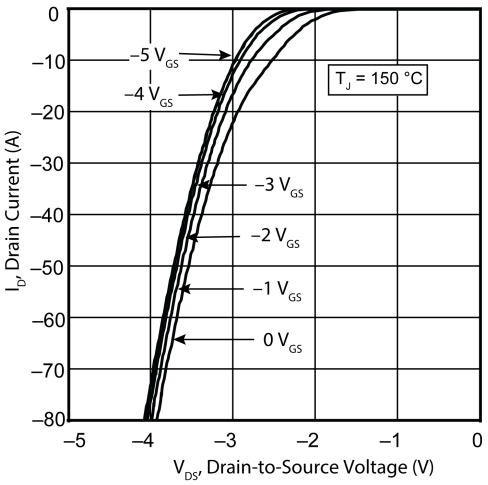


Figure 9 • I_D vs. V_{DS} 3rd Quadrant Conduction

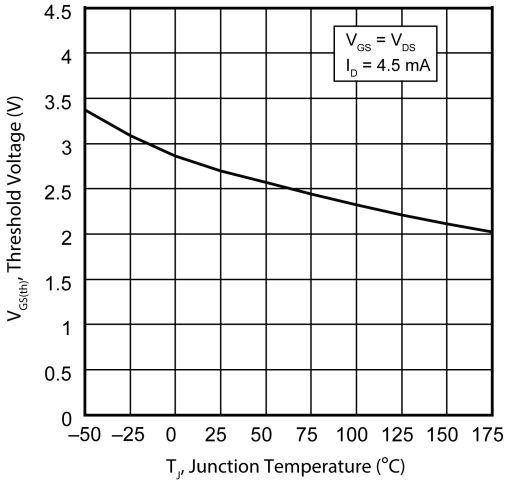


Figure 10 • Threshold Voltage vs. Junction Temp.

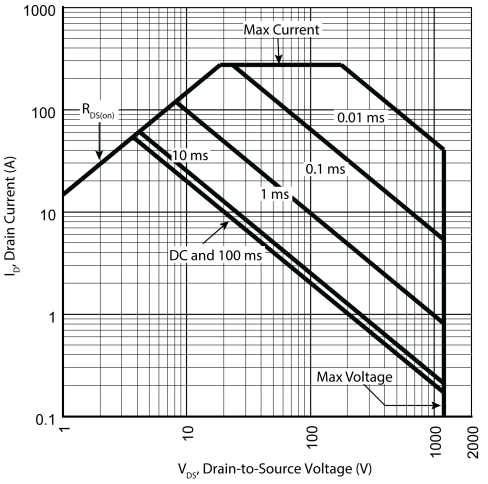


Figure 11 • Forward Safe Operating Area

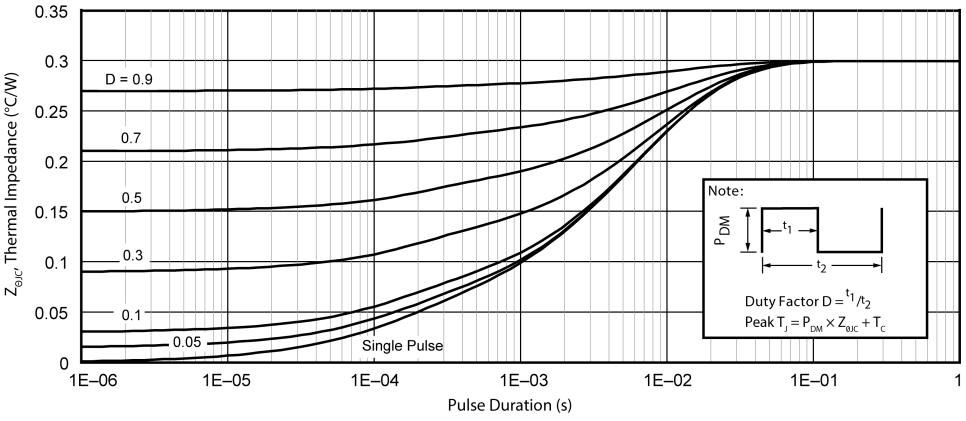


Figure 12 • Maximum Transient Thermal Impedance

Package Specification

This section shows the package specification of the MSC017SMA120J device.

Package Outline Drawing

The following figure illustrates the SOT-227 package outline of the MSC017SMA120J device. The dimensions in the figure below are in millimeters and (inches).

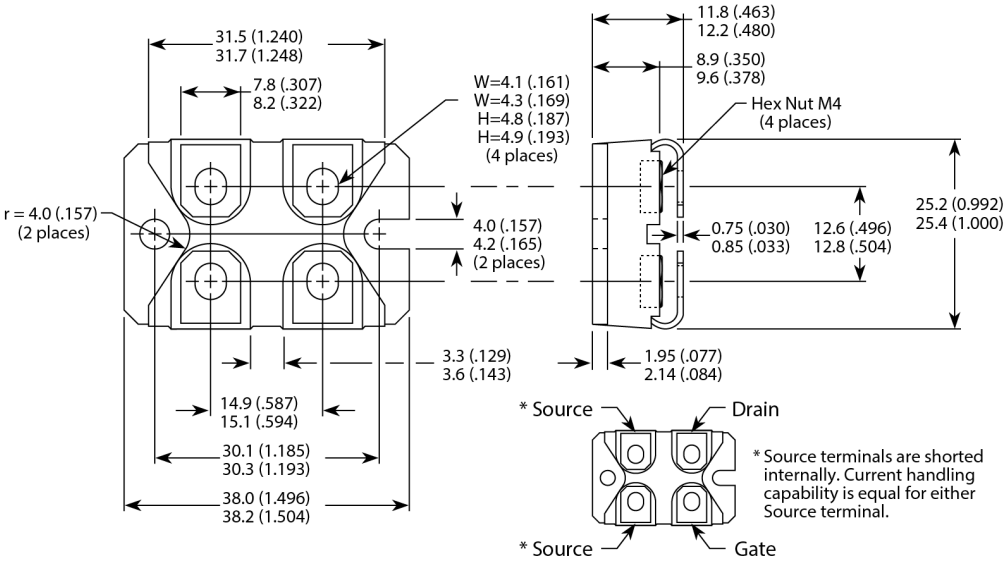


Figure 13 • Package Outline Drawing

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