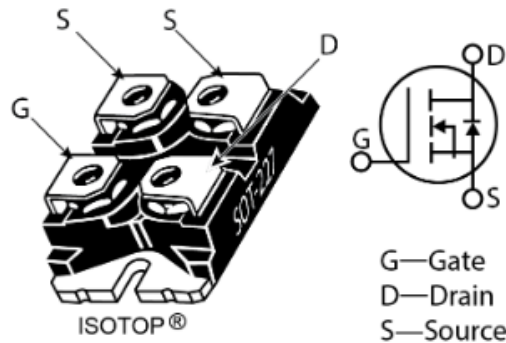


MSC025SMA120J Silicon Carbide N-Channel Power MOSFET

1 Product Overview

This section shows the product overview for the MSC025SMA120J device.



1.1 Features

The following are key features of the MSC025SMA120J device:

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

1.2 Benefits

The following are benefits of the MSC025SMA120J 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

1.3 Applications

The MSC025SMA120J 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

2 Device Specifications

This section shows the specifications for the MSC025SMA120J device.

2.1 Absolute Maximum Ratings

The following table shows the absolute maximum ratings for the MSC025SMA120J 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	77	A
	Continuous drain current at T _c = 100 °C	54	
I _{DM}	Pulsed drain current ¹	275	
V _{GS}	Gate-source voltage	25 to –10	V
P _D	Total power dissipation at T _c = 25 °C	278	W
	Linear derating factor	1.67	

Note:

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

The following table shows the thermal and mechanical characteristics for the MSC025SMA120J device.

Table 2 • Thermal and Mechanical Characteristics

Symbol	Characteristic	Min	Typ	Max	Unit
R _{θJC}	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	
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

2.2 Electrical Performance

The following table shows the static characteristics for the MSC025SMA120J device. $T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise specified.

Table 3 • Static Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$, $I_D = 100\text{ }\mu\text{A}$	1200			V
$R_{DS(on)}$	Drain-source on resistance ¹	$V_{GS} = 20\text{ V}$, $I_D = 40\text{ A}$		25	31	m Ω
$V_{GS(th)}$	Gate-source threshold voltage	$V_{GS} = V_{DS}$, $I_D = 1\text{ mA}$	1.8	2.8		V
$\Delta V_{GS(th)}/\Delta T_J$	Threshold voltage coefficient	$V_{GS} = V_{DS}$, $I_D = 1\text{ mA}$		-3.5		mV/ $^{\circ}\text{C}$
I_{DSS}	Zero gate voltage drain current	$V_{DS} = 1200\text{ V}$, $V_{GS} = 0\text{ V}$			100	μA
		$V_{DS} = 1200\text{ V}$, $V_{GS} = 0\text{ V}$ $T_J = 125\text{ }^{\circ}\text{C}$			500	
I_{GSS}	Gate-source leakage current	$V_{GS} = 20\text{ V}/-10\text{ V}$			± 100	nA

Note:

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

The following table shows the dynamic characteristics for the MSC025SMA120J device. $T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise specified.

Table 4 • Dynamic Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
C_{iss}	Input capacitance	$V_{GS} = 0\text{ V}$		3020		pF
C_{rss}	Reverse transfer capacitance	$V_{DD} = 1000\text{ V}$ $V_{AC} = 25\text{ mV}$ $f = 1\text{ MHz}$		25		
C_{oss}	Output capacitance			270		
Q_g	Total gate charge	$V_{GS} = -5\text{ V}/20\text{ V}$		232		nC
Q_{gs}	Gate-source charge	$V_{DD} = 800\text{ V}$ $I_D = 40\text{ A}$		41		
Q_{gd}	Gate-drain charge			50		
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 800\text{ V}$		14		ns
t_r	Current rise time	$V_{GS} = 0\text{ V}/20\text{ V}$ $I_D = 40\text{ A}$		11		
$t_{d(off)}$	Turn-off delay time	$R_{G(ext)} = 3.3\text{ }\Omega$ ¹		69		
t_f	Current fall time	Freewheeling diode = MSC020SDA120B		33		
E_{on2}	Turn-on switching energy ²			1040		μJ
E_{off}	Turn-off switching energy			670		
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 800\text{ V}$		12		ns
t_r	Current rise time	$V_{GS} = 0\text{ V}/20\text{ V}$ $I_D = 40\text{ A}$		11		
$t_{d(off)}$	Turn-off delay time	$R_{G(ext)} = 3.3\text{ }\Omega$ ¹		69		
t_f	Current fall time	$T_c = 150\text{ }^{\circ}\text{C}$		33		
E_{on2}	Turn-on switching energy ²	Freewheeling diode = MSC020SDA120B		975		μJ
E_{off}	Turn-off switching energy			950		
ESR	Equivalent series resistance	$f = 1\text{ MHz}$, 25 mV, drain short		0.88		Ω
SCWT	Short circuit withstand time	$V_{DS} = 960\text{ V}$, $V_{GS} = 20\text{ V}$		3		μs

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
E_{AS}	Avalanche energy, single pulse	$V_{DS} = 150\text{ V}$, $V_{GS} = 20\text{ V}$, $I_D = 40\text{ A}$		3500		mJ

Notes:

1. R_G is the total effective external gate resistance.
2. E_{on2} includes energy of MSC020SDA120B freewheeling diode.

The following table shows the body diode characteristics for the MSC025SMA120J device. $T_J = 25\text{ }^\circ\text{C}$ unless otherwise specified.

Table 5 • Body Diode Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{SD}	Diode forward voltage	$I_{SD} = 40\text{ A}$, $V_{GS} = 0\text{ V}$		4.0		V
		$I_{SD} = 40\text{ A}$, $V_{GS} = -5\text{ V}$		4.2		V
t_{rr}	Reverse recovery time	$I_{SD} = 40\text{ A}$, $V_{GS} = -5\text{ V}$		90		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 800\text{ V}$ $di/dt = -1000\text{ A}/\mu\text{s}$		550		nC
I_{RRM}	Reverse recovery current			13.5		A

2.3 Typical Performance Curves

This section shows the typical performance curves for the MSC025SMA120J device.

Figure 1 • Drain Current vs. Drain-to-Source Voltage

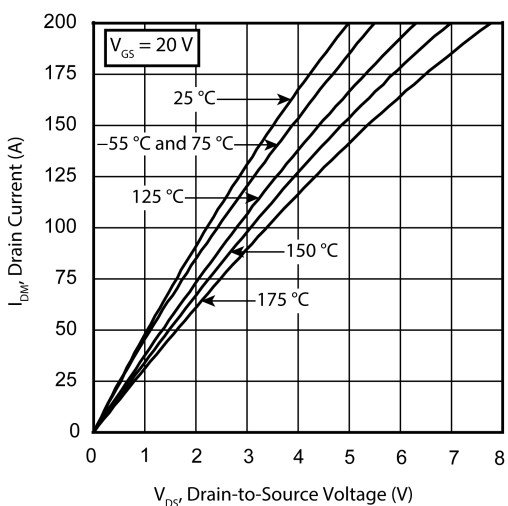


Figure 2 • Drain Current vs. Drain-to-Source Voltage

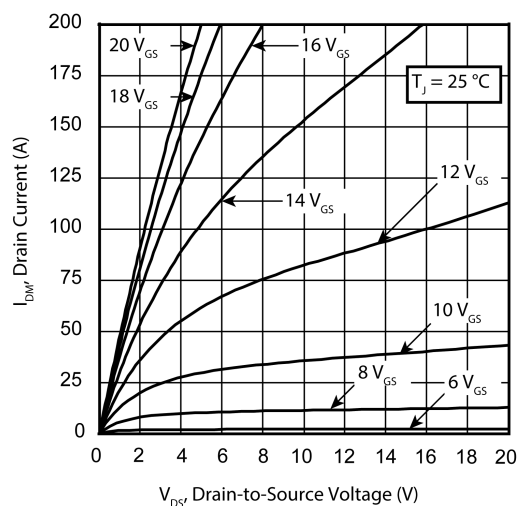


Figure 3 • Drain Current vs. Drain-to-Source Voltage

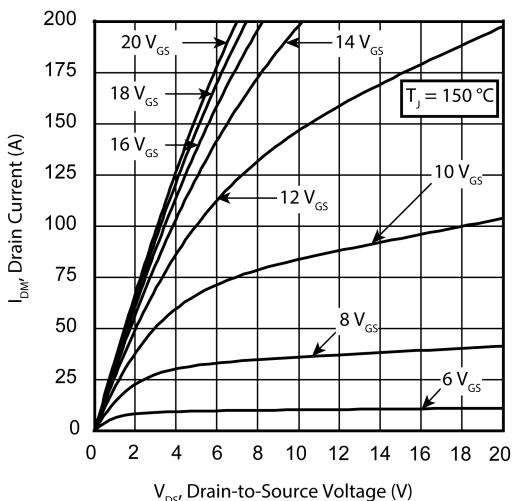


Figure 4 • Drain Current vs. Drain-to-Source Voltage

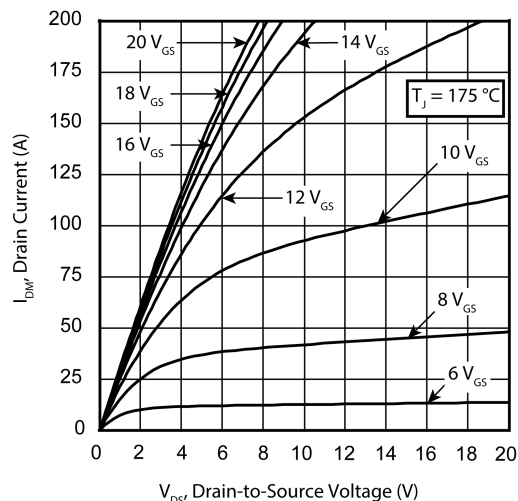


Figure 5 • RDS(on) vs. Junction Temperature

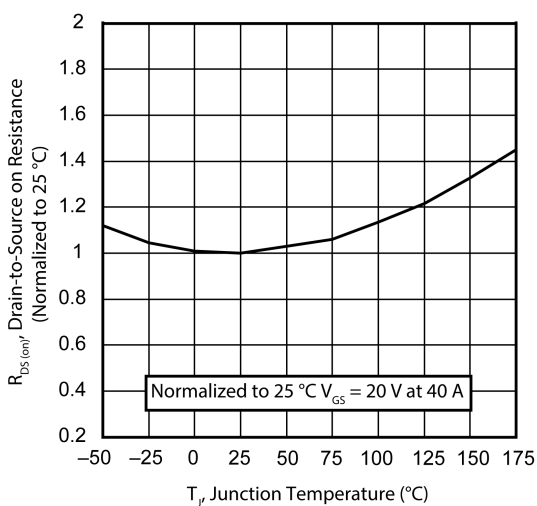


Figure 6 • Gate Charge Characteristics

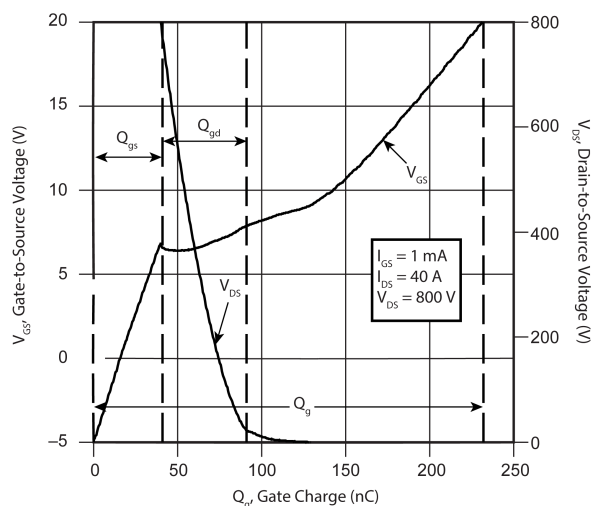


Figure 7 • Capacitance vs. Drain-to-Source Voltage

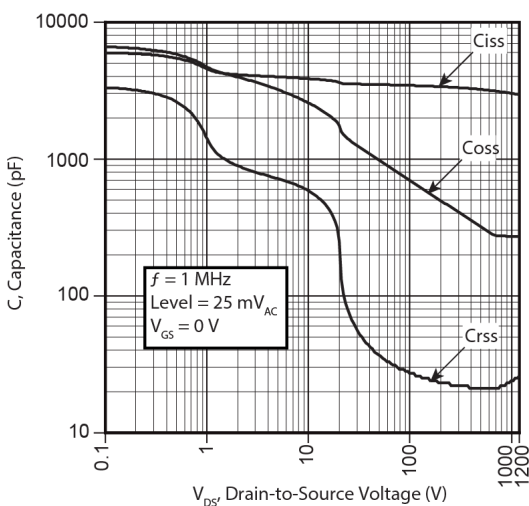


Figure 8 • IDM vs. Gate-to-Source Voltage

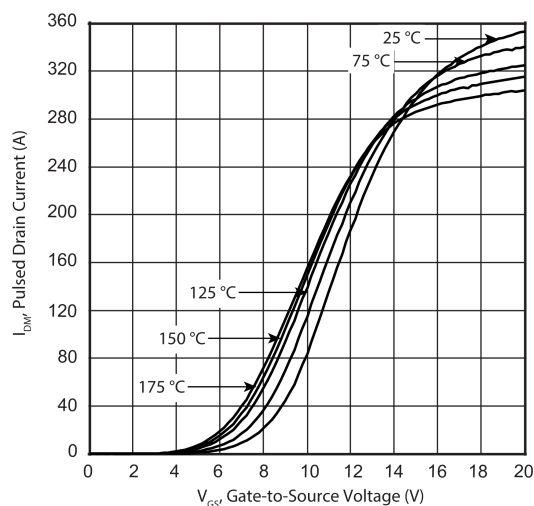


Figure 9 • IDM vs. VDS Third Quadrant Conduction

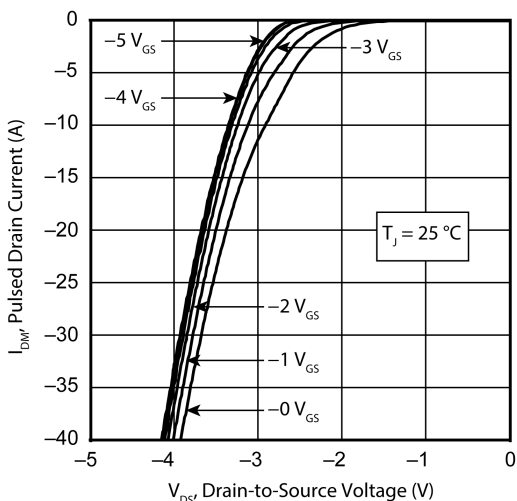


Figure 10 • IDM vs. VDS Third Quadrant Conduction

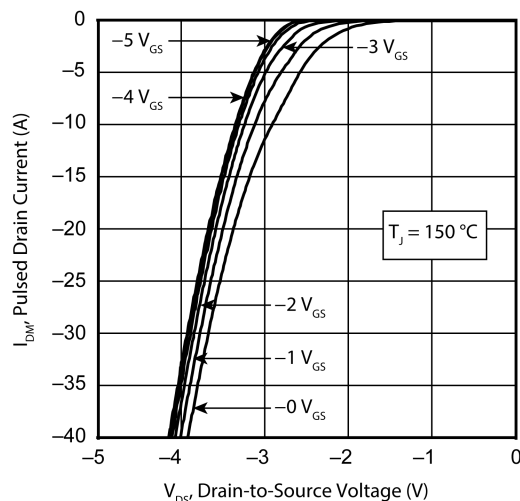


Figure 11 • VGS(th) vs. Junction Temperature

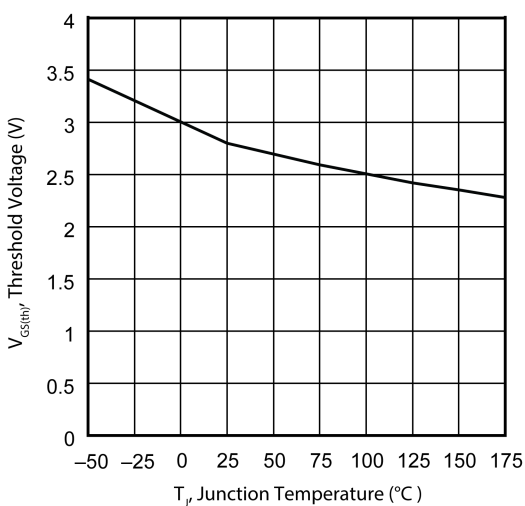


Figure 12 • Forward Safe Operating Area

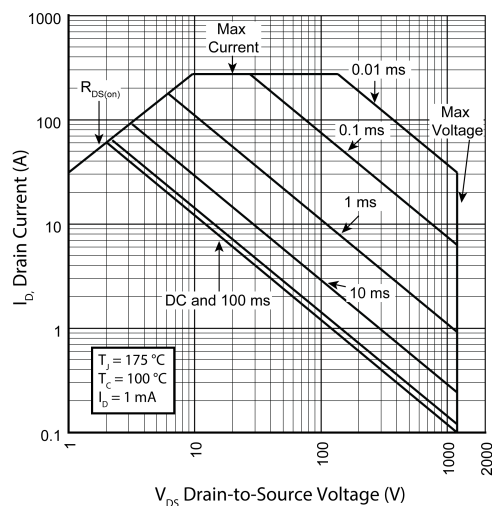
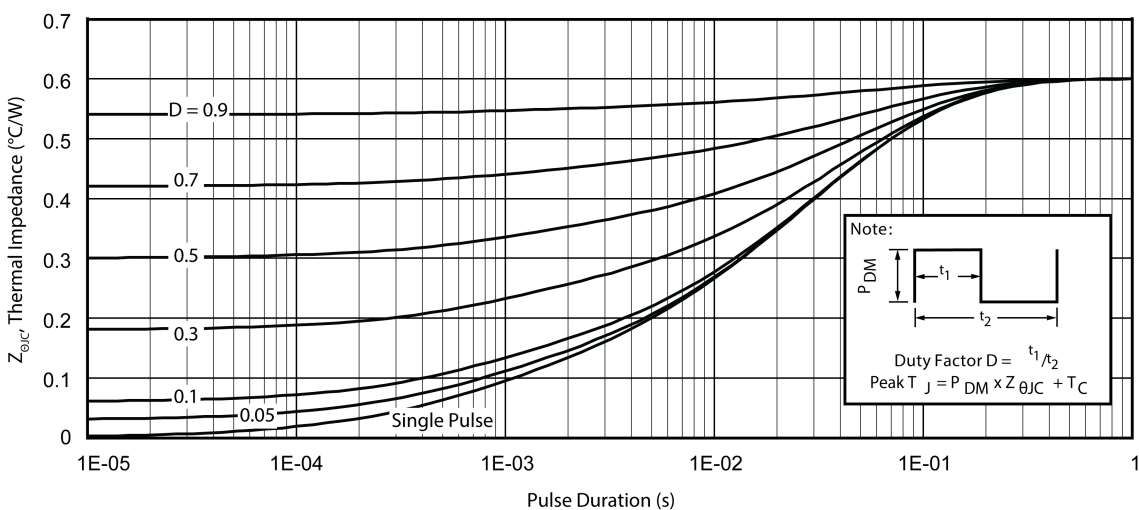


Figure 13 • Maximum Transient Thermal Impedance



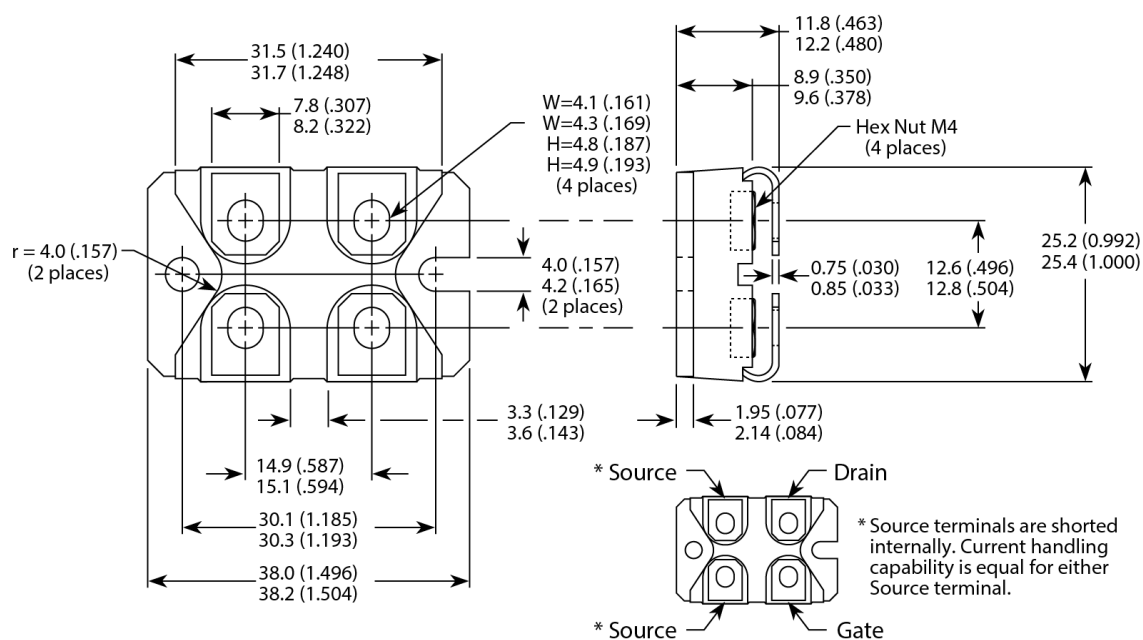
3 Package Specification

This section shows the package specification for the MSC025SMA120J device.

3.1 Package Outline Drawing

This section shows the SOT-227 package drawing for the MSC025SMA120J device. The dimensions in the figure below are in millimeters and (inches).

Figure 14 • Package Outline Drawing



**Microsemi Headquarters**

One Enterprise, Aliso Viejo,
CA 92656 USA
Within the USA: +1 (800) 713-4113
Outside the USA: +1 (949) 380-6100
Sales: +1 (949) 380-6136
Fax: +1 (949) 215-4996
Email: sales.support@microsemi.com
www.microsemi.com

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