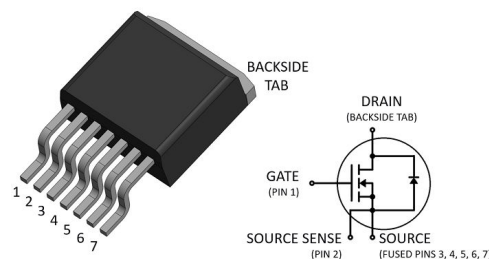


1200 V, 80 mΩ SiC N-Channel Power MOSFET

Product Overview

The silicon carbide (SiC) power MOSFET product line from Microchip increases the performance over silicon MOSFET and silicon IGBT solutions while lowering the total cost of ownership for high-voltage applications. The MSC080SMA120SA device is a 1200 V, 80 mΩ SiC MOSFET in a TO-263 7-lead package with a source sense.



Features

The following are key features of the MSC080SMA120SA 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

Benefits

The following are benefits of the MSC080SMA120SA 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 MSC080SMA120SA 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

1. Device Specifications

This section shows the specifications of the MSC080SMA120SA device.

1.1 Absolute Maximum Ratings

The following table shows the absolute maximum ratings of the MSC080SMA120SA device.

Table 1-1. Absolute Maximum Ratings

Symbol	Parameter	Ratings	Unit
V_{DSS}	Drain source voltage	1200	V
I_D	Continuous drain current at $T_C = 25\text{ }^{\circ}\text{C}$	43	A
	Continuous drain current at $T_C = 100\text{ }^{\circ}\text{C}$	30	
I_{DM}	Pulsed drain current ¹	91	
V_{GS}	Gate-source voltage	23 to -10	V
P_D	Total power dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	268	W
	Linear derating factor	1.8	W/ $^{\circ}\text{C}$

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 MSC080SMA120SA device.

Table 1-2. Thermal and Mechanical Characteristics

Symbol	Characteristic/Test Conditions	Min	Typ	Max	Unit
$R_{\theta JC}$	Junction-to-case thermal resistance		0.43	0.56	$^{\circ}\text{C}/\text{W}$
T_J	Operating junction temperature	-55		175	$^{\circ}\text{C}$
T_{STG}	Storage temperature	-55		150	$^{\circ}\text{C}$
	Reflow temperature			260	$^{\circ}\text{C}$
Wt	Package weight		0.05		oz
			1.42		g

1.2 Electrical Performance

The following table shows the static characteristics of the MSC080SMA120SA device. $T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise specified.

Table 1-3. 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	$V_{GS} = 20\text{ V}$, $I_D = 15\text{ A}$		80	100	m Ω
$V_{GS(th)}$	Gate-source threshold voltage	$V_{GS} = V_{DS}$, $I_D = 1\text{ mA}$	1.8	2.8		V

.....continued

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
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 MSC080SMA120SA device. T_J = 25 °C unless otherwise specified.

Table 1-4. 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, f = 1 MHz		1100		pF
C _{rss}	Reverse transfer capacitance			6.2		
C _{oss}	Output capacitance			91		
Q _g	Total gate charge	V _{GS} = –5 V/20 V, V _{DD} = 800 V, I _D = 15 A		64		nC
Q _{gs}	Gate-source charge			12		
Q _{gd}	Gate-drain charge			19		
t _{d(on)}	Turn-on delay time	V _{DD} = 800 V, V _{GS} = –5 V/20 V, I _D = 15 A, R _{g(ext)} = 8 Ω, Freewheeling diode = MSC080SMA120SA (V _{GS} = –5 V); reference Fig. 1-17		13		ns
t _r	Voltage rise time			11		
t _{d(off)}	Turn-off delay time			22		
t _f	Voltage fall time			12		
E _{on}	Turn-on switching energy	f = 1 MHz, 25 mV, drain short		469		μJ
E _{off}	Turn-off switching energy			47		
ESR	Gate equivalent series resistance	f = 1 MHz, 25 mV, drain short		1.9		Ω
SCWT	Short circuit withstand time	V _{DS} = 560 V, V _{GS} = 20 V		3		μs
E _{AS}	Avalanche energy, single pulse	V _{DS} = 150 V, I _D = 20 A		1000		mJ

The following table shows the body diode characteristics of the MSC080SMA120SA device. T_J = 25 °C unless otherwise specified.

Table 1-5. Body Diode Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
V _{SD}	Diode forward voltage	I _{SD} = 15 A, V _{GS} = 0 V		4.0		V
		I _{SD} = 15 A, V _{GS} = –5 V		4.2		

.....continued

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
t_{rr}	Reverse recovery time	$I_{SD} = 20\text{ A}$, $V_{GS} = -5\text{ V}$, $V_{DD} = 850\text{ V}$, $di/dt = -10000\text{ A}/\mu\text{s}$, Drive $R_g = 8\ \Omega$		12		ns
Q_{rr}	Reverse recovery charge			416		nC
I_{RRM}	Reverse recovery current			59		A

1.3 Typical Performance Curves

This section shows the typical performance curves of the MSC080SMA120SA device.

Figure 1-1. Drain Current vs. V_{DS} at T_J

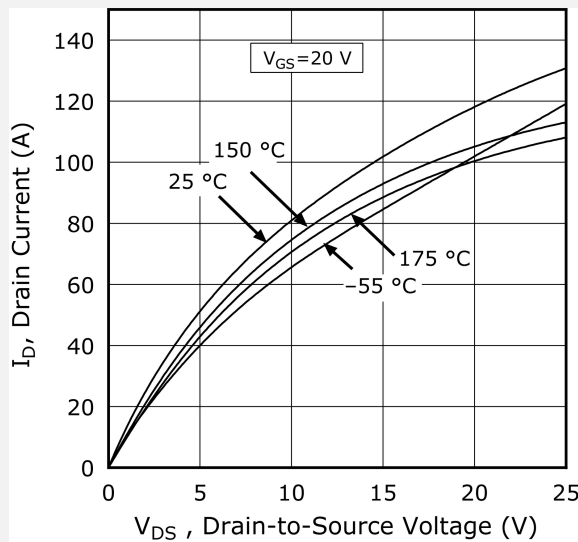


Figure 1-2. Drain Current vs. V_{DS} at V_{GS}

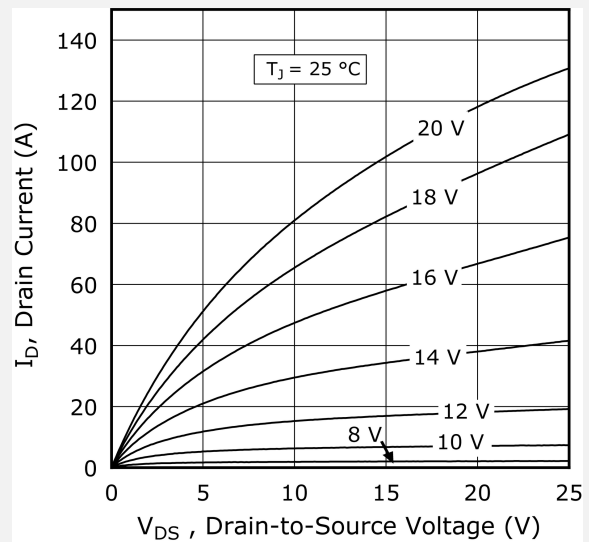


Figure 1-3. Drain Current vs. V_{DS} at V_{GS}

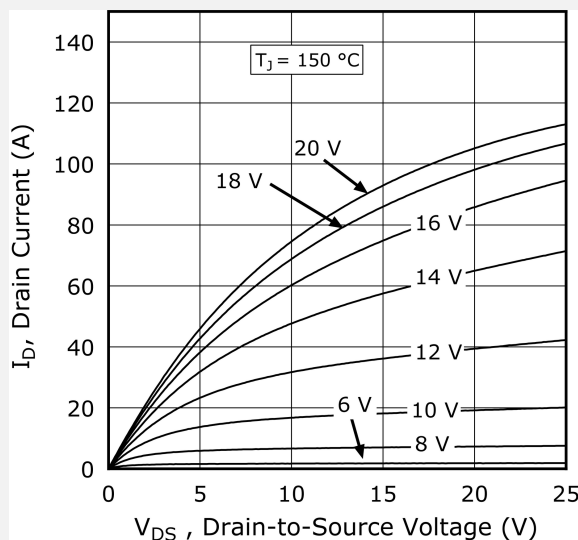


Figure 1-4. Drain Current vs. V_{DS} at V_{GS}

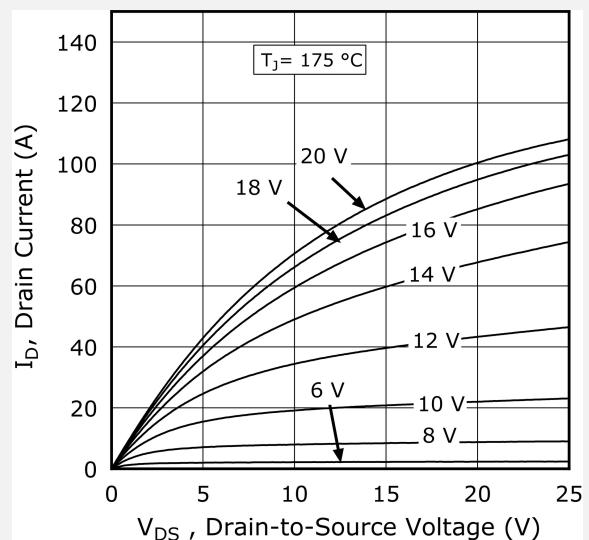


Figure 1-5. $R_{DS(on)}$ vs. Junction Temperature

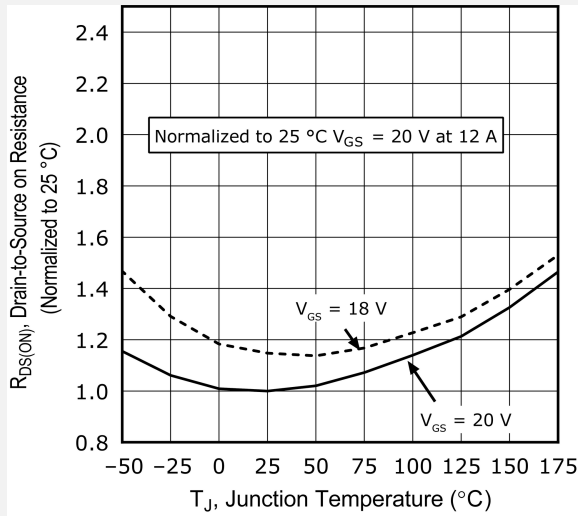


Figure 1-6. Gate Charge Characteristics

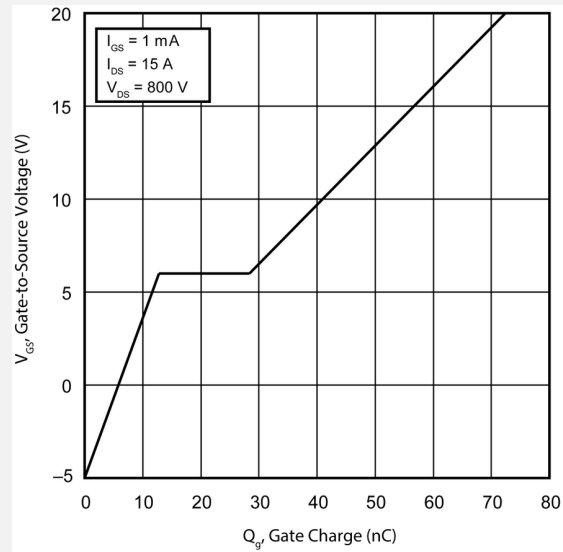


Figure 1-7. Capacitance vs. Drain-to-Source Voltage

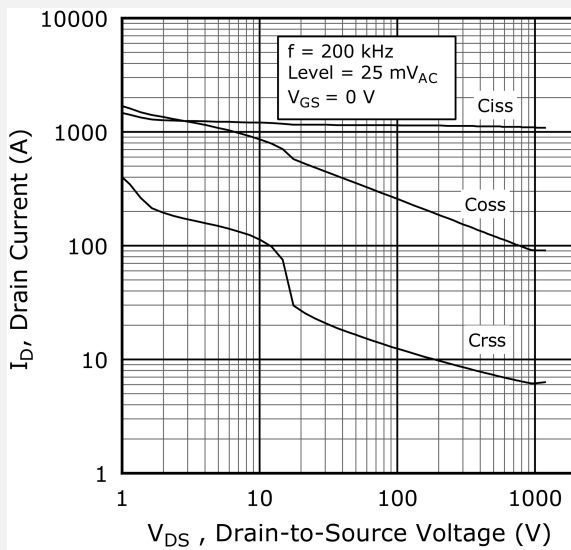


Figure 1-8. I_D vs. V_{DS} 3rd Quadrant Conduction

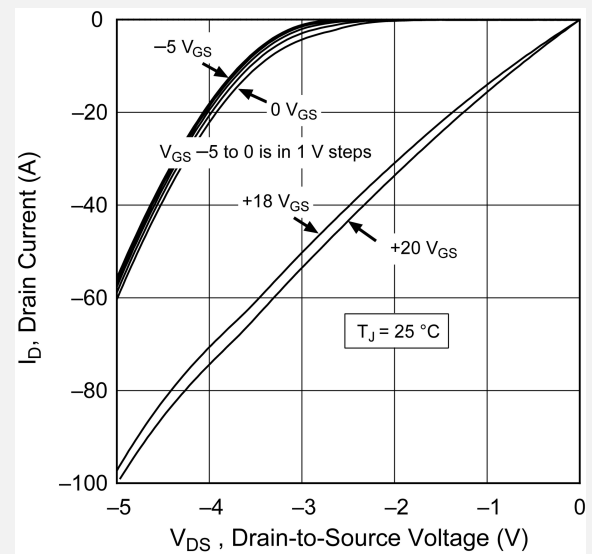


Figure 1-9. I_D vs. V_{DS} 3rd Quadrant Conduction

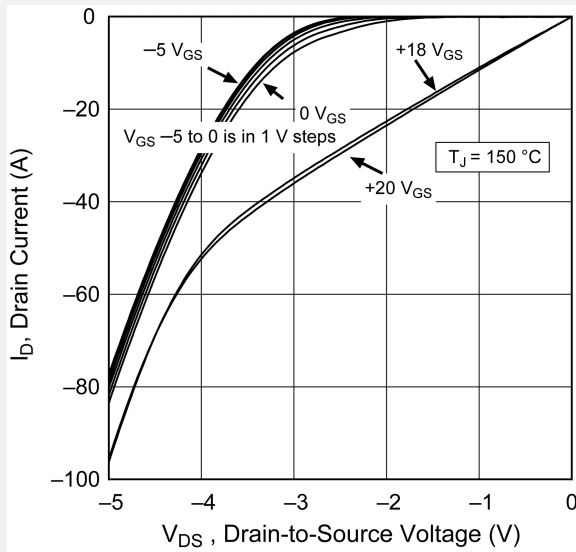


Figure 1-10. Switching Energy E_{on} vs. V_{DS} & I_D

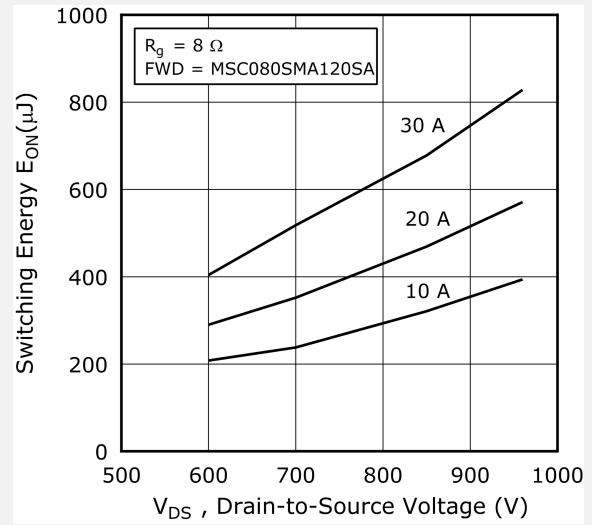


Figure 1-11. Switching Energy E_{off} vs. V_{DS} & I_D

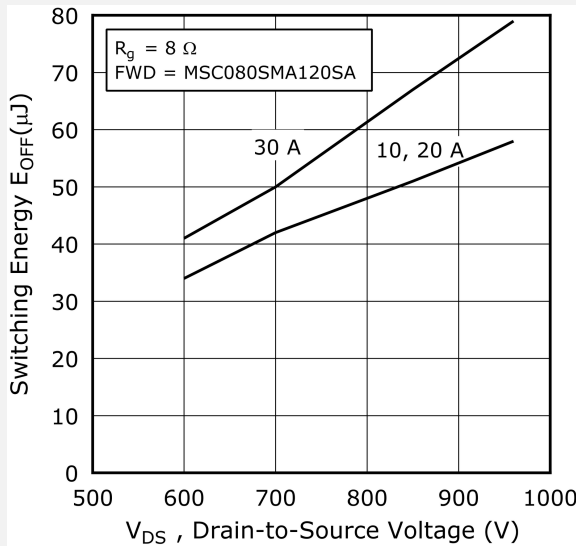


Figure 1-12. Switching Energy vs. R_g

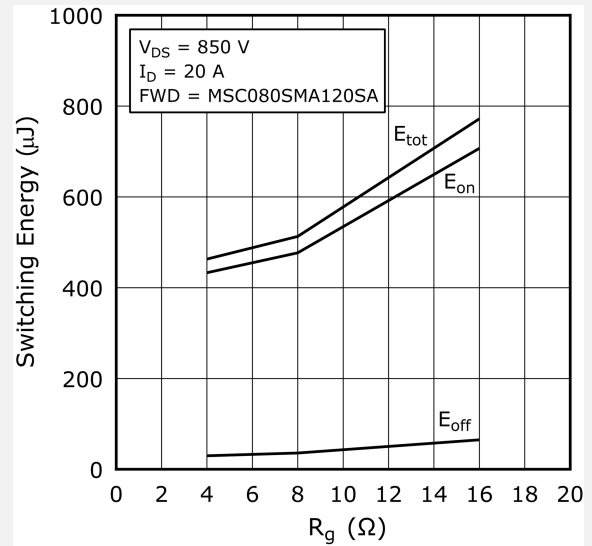


Figure 1-13. Switching Energy vs. Temperature

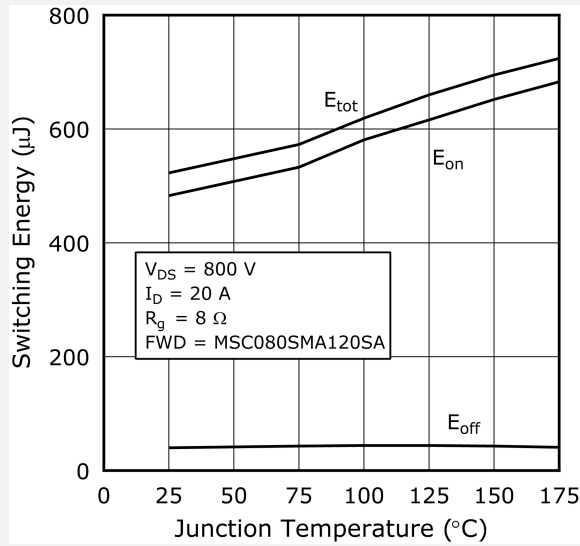


Figure 1-14. Threshold Voltage vs. Junction Temp.

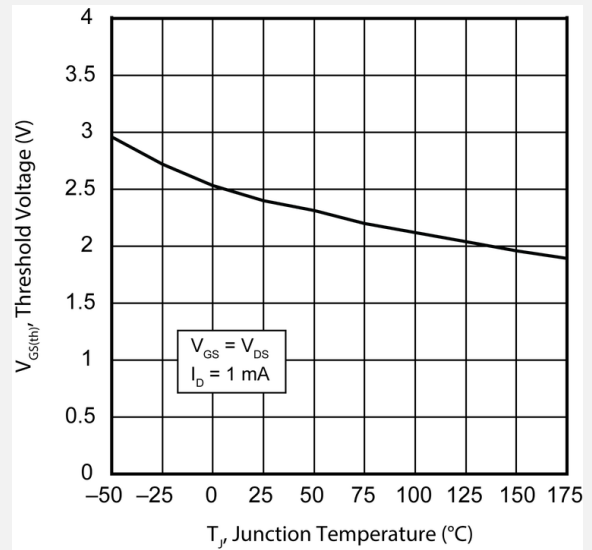


Figure 1-15. Forward Safe Operating Area

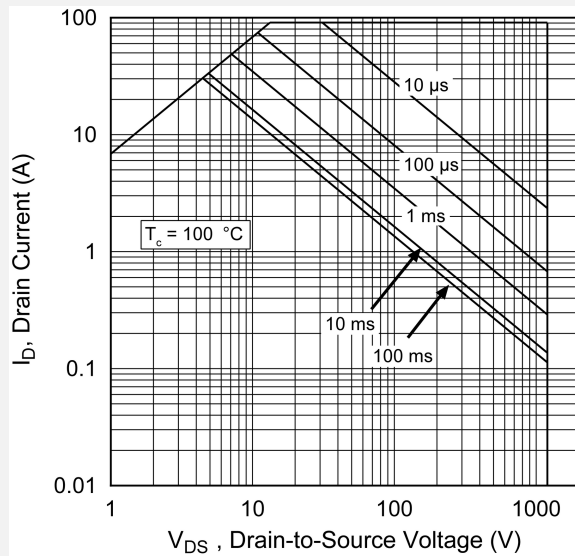
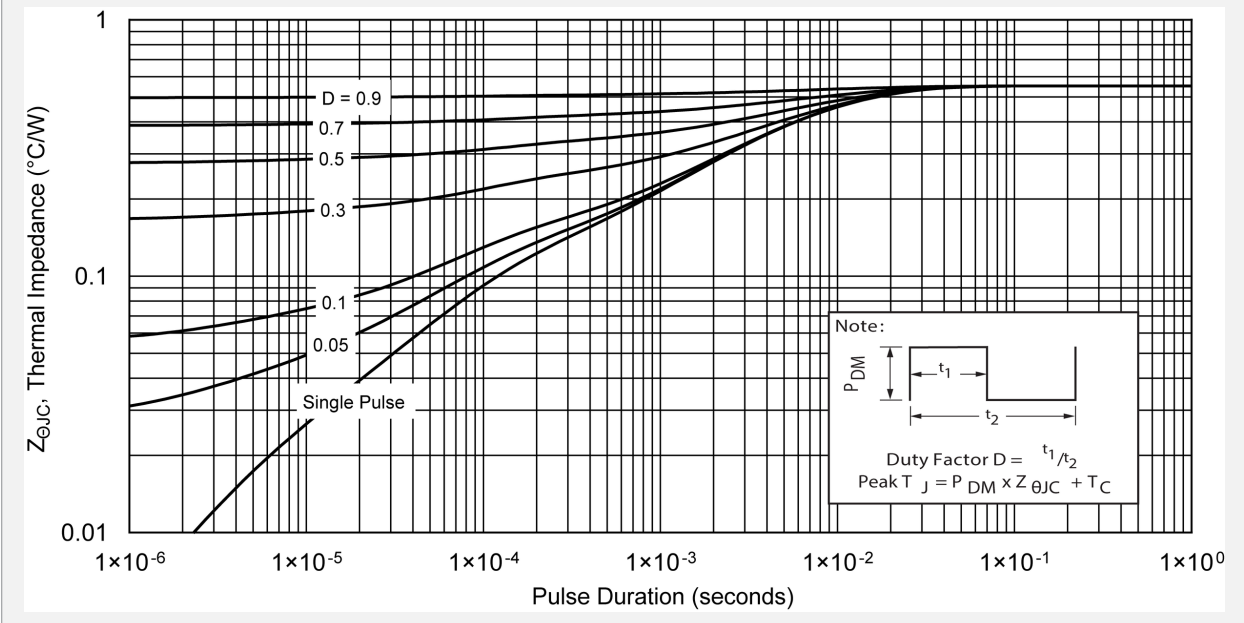
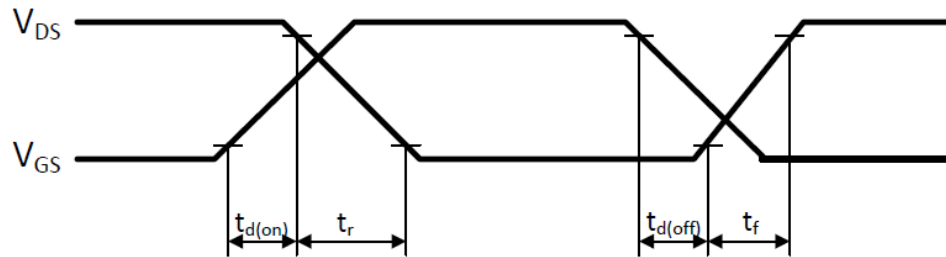


Figure 1-16. Maximum Transient Thermal Impedance



The following figure shows the switching waveform diagram of the MSC080SMA120SA device.

Figure 1-17. Switching Waveform



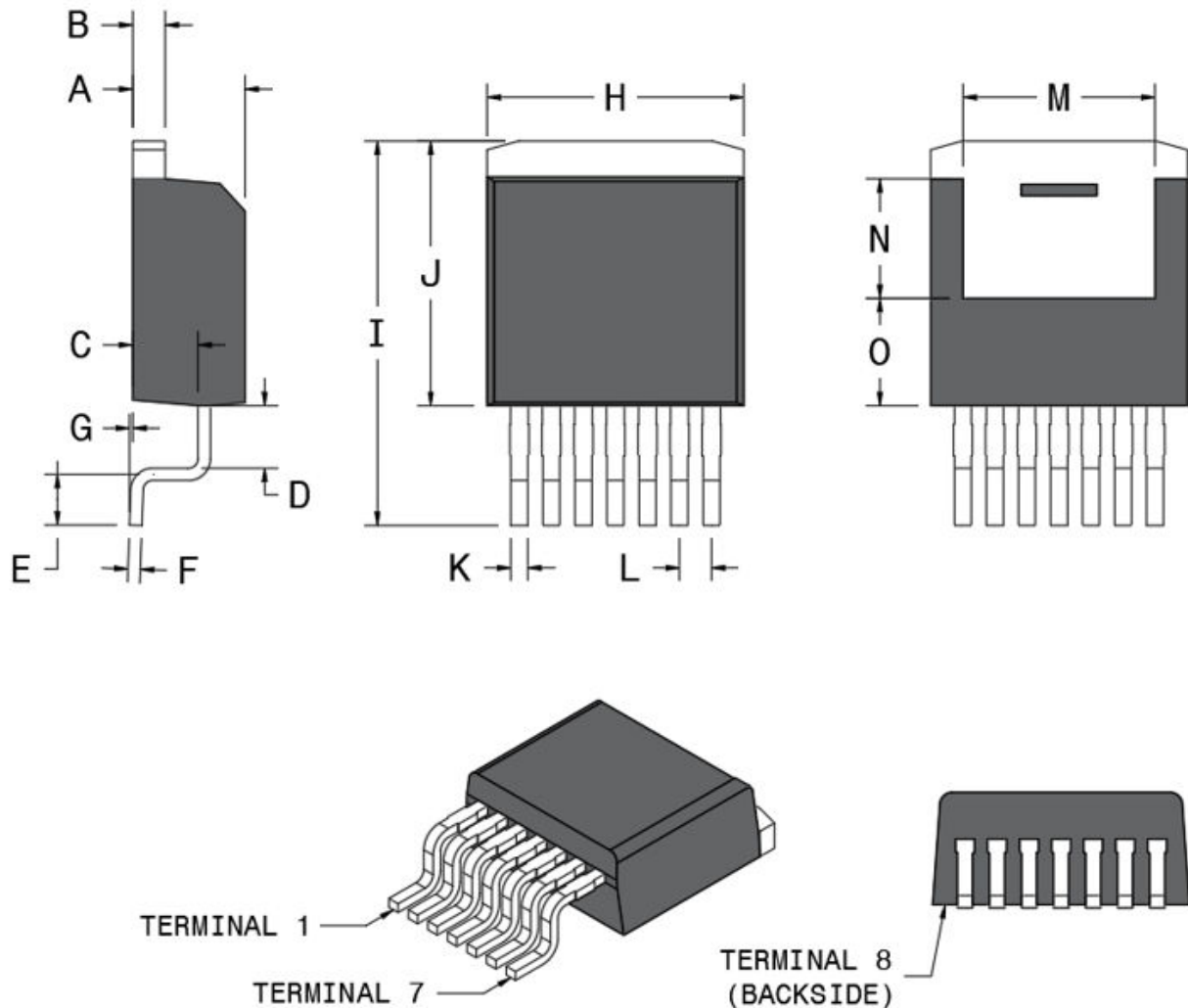
2. Package Specification

This section shows the package specification of the MSC080SMA120SA device.

2.1 Package Outline Drawing

The following figure illustrates the TO-263 7-lead package outline of the MSC080SMA120SA device.

Figure 2-1. Package Outline Drawing



The following table shows the TO-263 7-lead dimensions and should be used in conjunction with the package outline drawing.

Table 2-1. TO-263 Dimensions

Symbol	Min (mm)	Max (mm)	Min (in.)	Max (in.)
A	4.30	4.57	0.169	0.180
B	1.17	1.40	0.046	0.055
C	2.50	2.70	0.098	0.106

.....continued

Symbol	Min (mm)	Max (mm)	Min (in.)	Max (in.)
D	2.85	2.95	0.112	0.116
E	2.32	2.70	0.091	0.106
F	0.33	0.65	0.013	0.026
G	0.00	0.25	0.00	0.010
H	10.13	10.23	0.399	0.403
I	15.04	17.12	0.592	0.674
J	10.19	10.80	0.401	0.425
K	0.50	0.70	0.020	0.028
L	1.27 BSC		0.050 BSC	
M	6.78	7.67	0.267	0.302
N	4.66	4.81	0.183	0.189
O	4.20	4.30	0.165	0.169
Terminal 1	Gate			
Terminal 2	Source sense			
Terminal 3	Source			
Terminal 4	Source			
Terminal 5	Source			
Terminal 6	Source			
Terminal 7	Source			
Terminal 8	Drain			

3. Revision History

Table 3-1. Revision History

Revision	Date	Description
A	08/2022	Document created.

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ISBN: 978-1-6683-0828-8

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