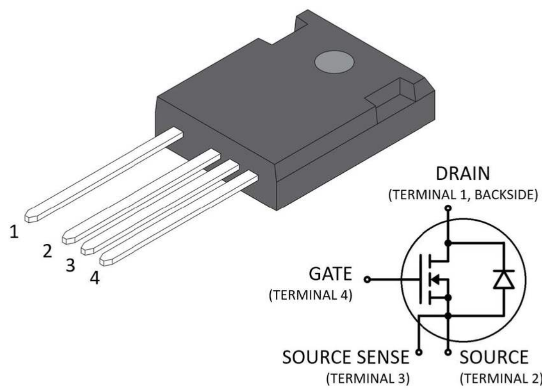
MICROCHIP

MSC080SMA120B4

1200 V, 80 mΩ SiC N-Channel Power MOSFET

Product Overview

TO-247 4-lead Package with a Source Sense, Typ. 80 mΩ at 20 V_{GS}



Features

The following are key features of the MSC080SMA120B4 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

Benefits

The following are benefits of the MSC080SMA120B4 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 MSC080SMA120B4 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 MSC080SMA120B4 device.

1.1 Absolute Maximum Ratings

The following table shows the absolute maximum ratings of the MSC080SMA120B4 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 °C	40	A
	Continuous drain current at T_C = 100 °C	28	
I_{DM}	Pulsed drain current[1]	90	
V_{GS}	Gate-source voltage	23 to –10	V
P_D	Total power dissipation at T_C = 25 °C	231	W
	Linear derating factor	1.54	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 MSC080SMA120B4 device.

Table 1-2. Thermal and Mechanical Characteristics

Symbol	Characteristic/Test Conditions	Min	Typ	Max	Unit
$R_{\theta JC}$	Junction-to-case thermal resistance		0.50	0.65	°C/W
T_J	Operating junction temperature	–55		175	°C
T_{STG}	Storage temperature	–55		150	°C
T_L	Lead temperature for 10 seconds			300	°C
	Mounting torque, 6-32 or M3 screw			10	lbf-in
				1.1	N-m
Wt	Package weight		0.22		oz
			6.2		g

1.2 Electrical Performance

The following table shows the static characteristics of the MSC080SMA120B4 device. T_J = 25 °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 V, I_D = 100 µA	1200			V
$R_{DS(on)}$	Drain-source on resistance[1]	V_{GS} = 20 V, I_D = 15 A		80	100	mΩ

...........continued						
Symbol	**Characteristic**	**Test Conditions**	**Min**	**Typ**	**Max**	**Unit**
$V_{GS(th)}$	Gate-source threshold voltage	$V_{GS} = V_{DS}$, I_D = 1 mA	1.9	3.0	4.5	V
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 MSC080SMA120B4 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 = 200 kHz		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} = 850 V V_{GS} = –5 V/20 V I_D = 20 A $R_{g(ext)}$ = 8 Ω Freewheeling diode = MSC080SMA120B4 (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			469		µJ
E_{off}	Turn-off switching energy			47		
ESR	Gate equivalent series resistance	f = 1 MHz, 25 mV, drain short		1.9		Ω
SWCT	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 = 15 A		100		mJ

The following table shows the body diode characteristics of the MSC080SMA120B4 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 A, V_{DD} = 850 V, V_{GS} = –5 V, dI/dt = –1000 A/µs, Drive Rg = 8 Ω		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 MSC080SMA120B4 device.

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

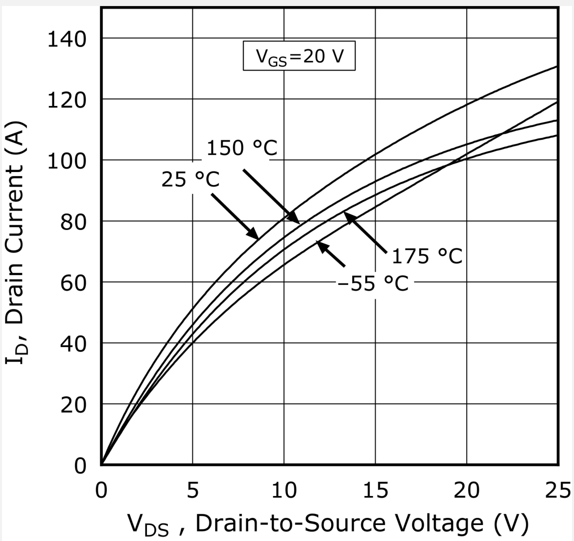


Figure 1-2. Drain Current vs. V_{DS} at V_{GS}

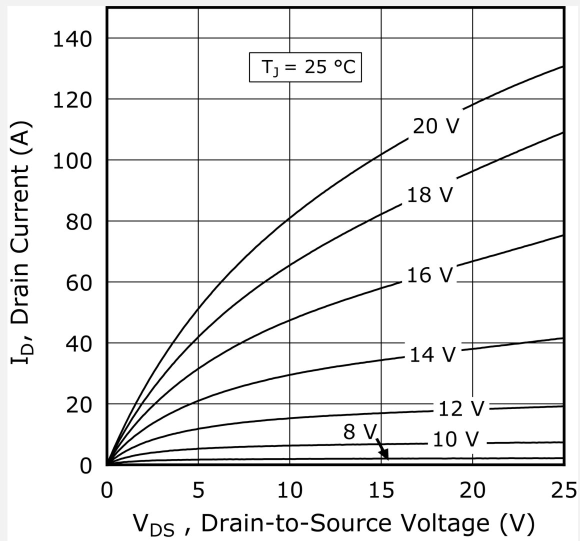


Figure 1-3. Drain Current vs. V_{DS} at V_{GS}

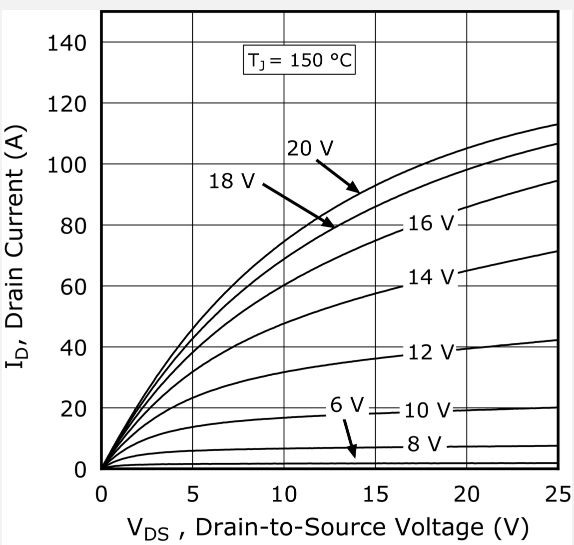


Figure 1-4. Drain Current vs. V_{DS} at V_{GS}

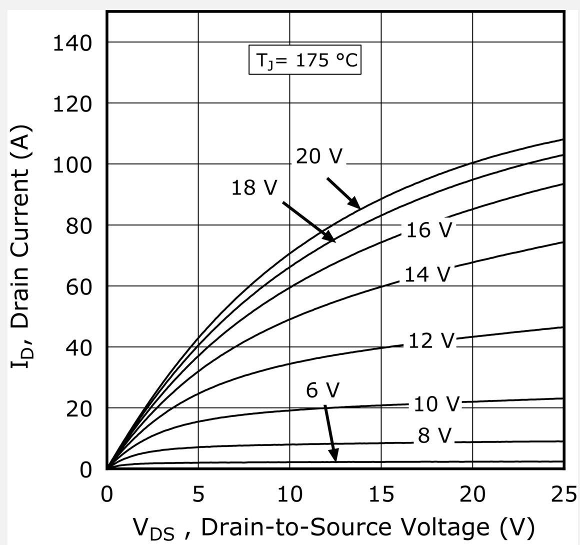


Figure 1-5. $R_{DS(on)}$ vs. Junction Temperature

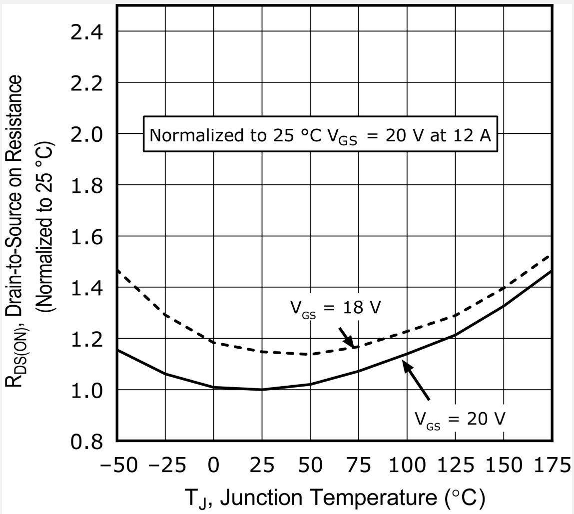


Figure 1-6. Gate Charge Characteristics

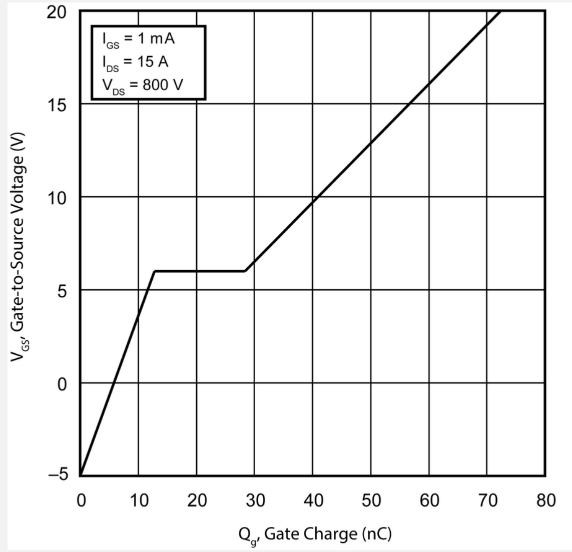


Figure 1-7. Capacitance vs. Drain-to-Source Voltage

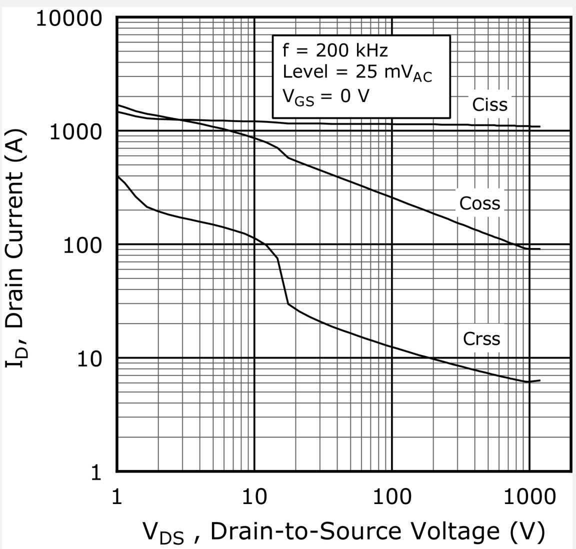


Figure 1-8. I_D vs. V_{DS} 3rd Quadrant Conduction

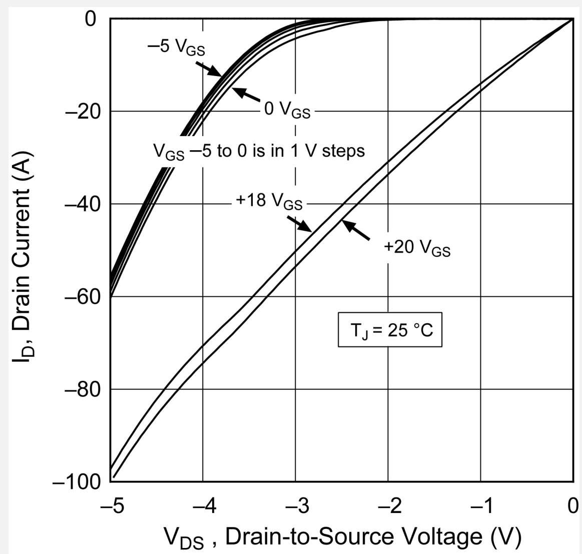


Figure 1-9. I_D vs. V_{DS} 3rd Quadrant Conduction

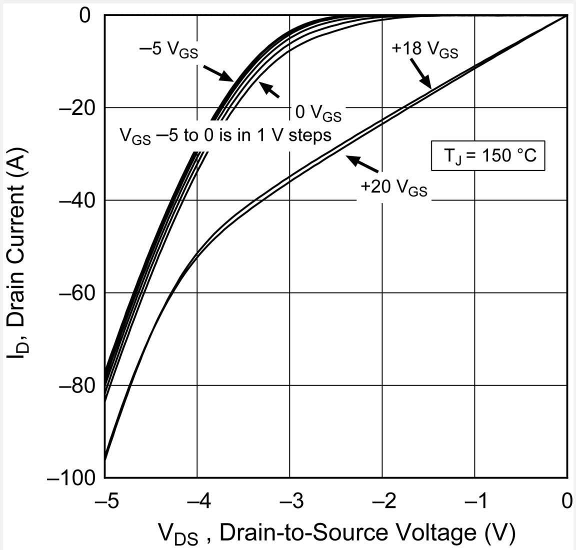


Figure 1-10. Switching Energy Eon vs. V_{DS} & I_D

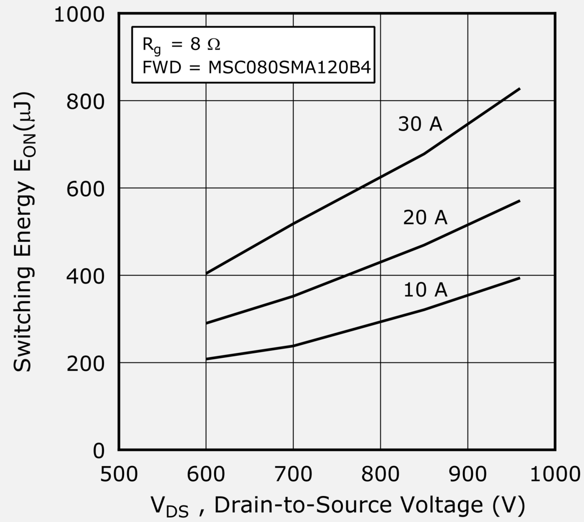


Figure 1-11. Switching Energy Eoff vs. V_{DS} & I_D

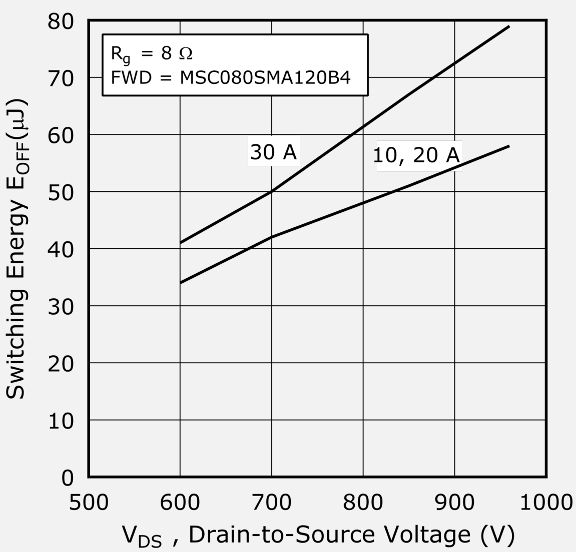


Figure 1-12. Switching Energy vs. R_g

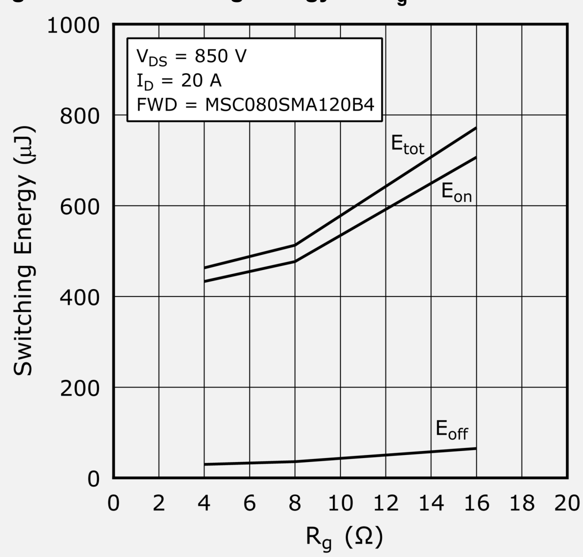


Figure 1-13. Switching Energy vs. Junction Temperature

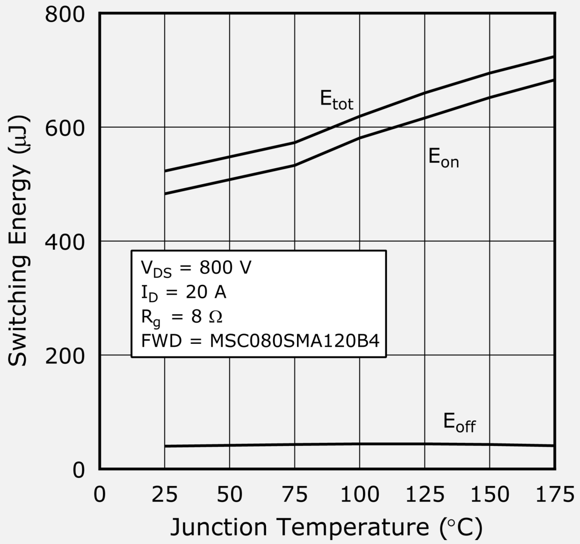


Figure 1-14. Threshold Voltage vs. Junction Temperature

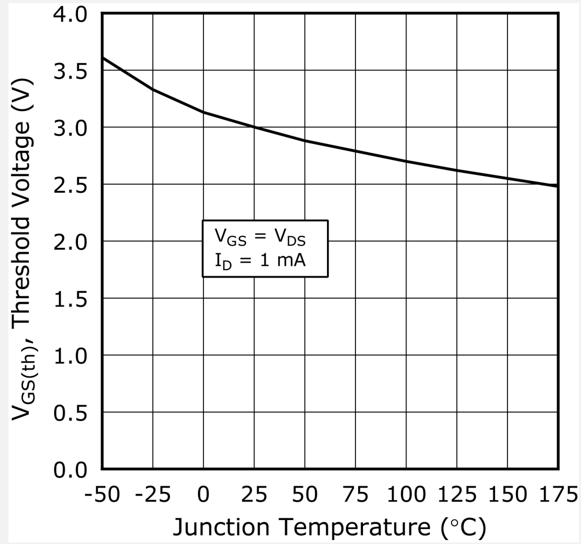


Figure 1-15. Forward Safe Operating Area

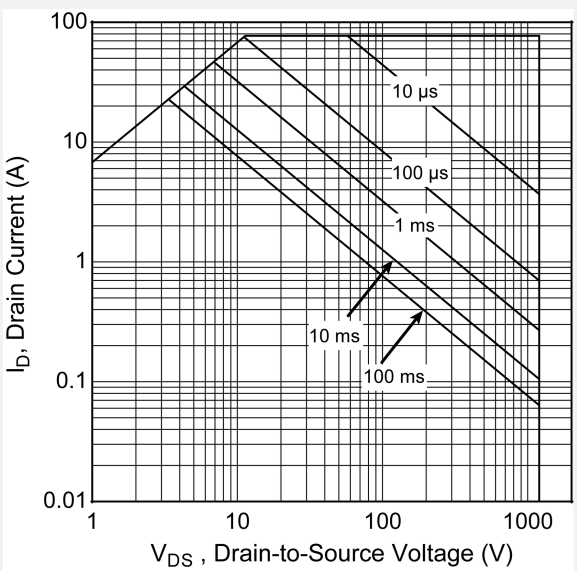
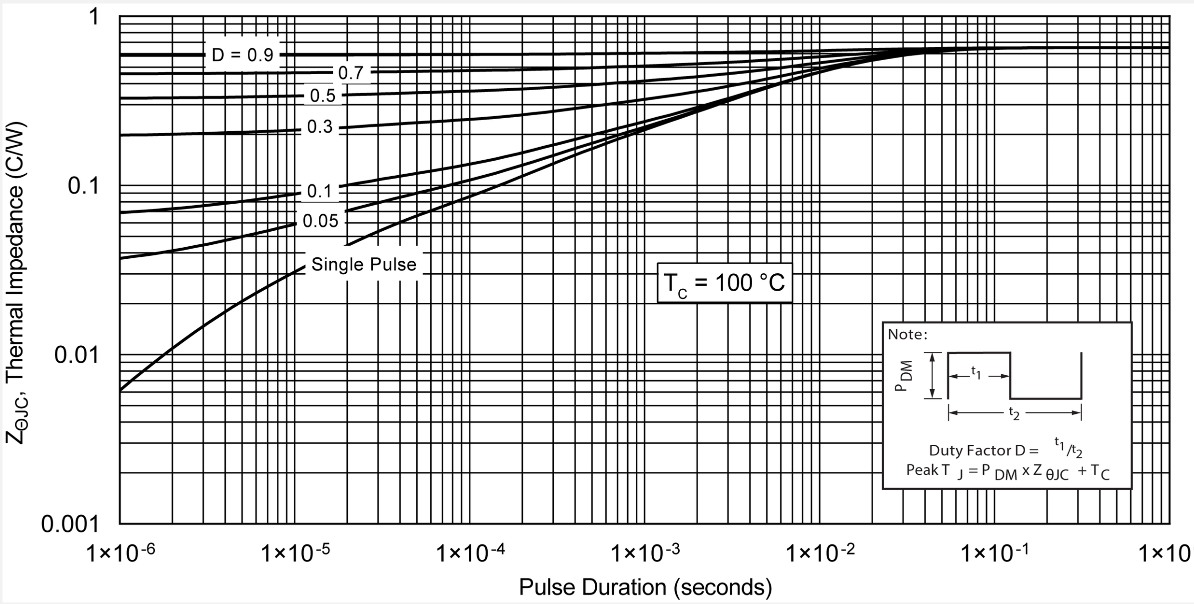
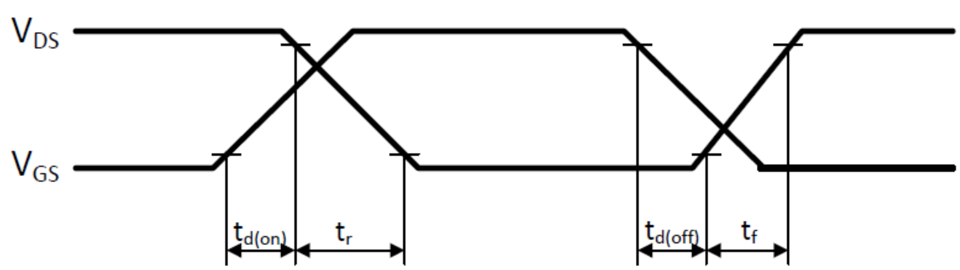


Figure 1-16. Maximum Transient Thermal Impedance



The following figure shows the switching waveform diagram of the MSC080SMA120B4 device.

Figure 1-17. Switching Waveform



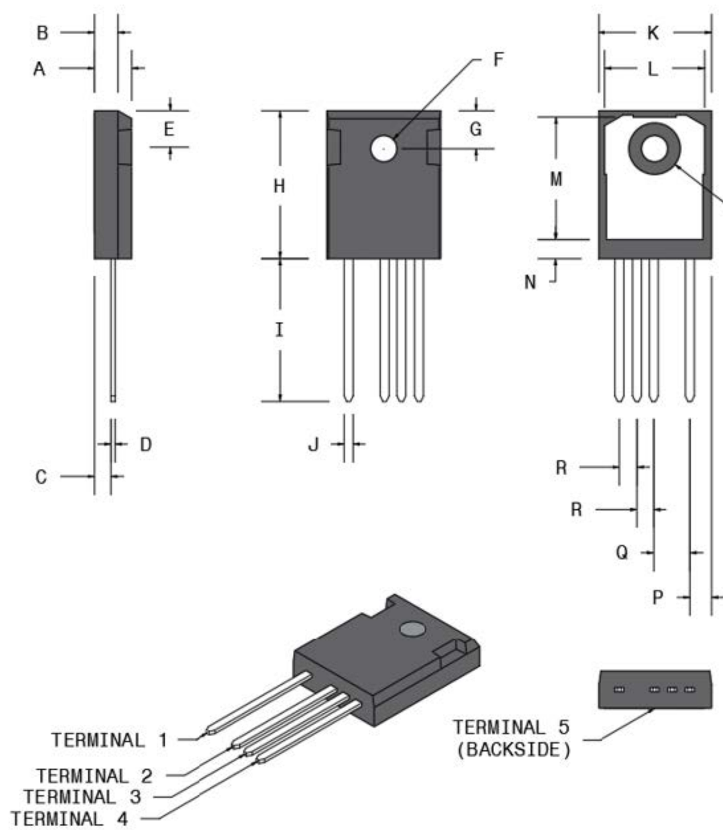
2. Package Specification

This section shows the package specification of the MSC080SMA120B4 device.

2.1 Package Outline Drawing

The following figure illustrates the TO-247-4L package outline of the MSC080SMA120B4 device.

Figure 2-1. Package Outline Drawing



The following table shows the TO-247-4L dimensions and should be used in conjunction with the package outline drawing.

Table 2-1. TO-247-4L Dimensions

Symbol	Min (mm)	Max (mm)	Min (in.)	Max (in.)
A	4.90	5.17	0.193	0.204
B	1.85	2.11	0.073	0.083
C	2.25	2.51	0.089	0.099
D	0.55	0.68	0.022	0.027
E	5.49	5.74	0.216	0.226
F	3.56	3.66	0.140	0.144
G	6.15 BSC		0.242 BSC	
H	20.83	21.08	0.820	0.830

...........continued

Symbol	Min (mm)	Max (mm)	Min (in.)	Max (in.)
I	19.81	20.32	0.780	0.800
J	1.07	1.33	0.042	0.052
K	15.77	16.03	0.621	0.631
L	13.89	14.15	0.547	0.557
M	16.25	16.85	0.640	0.663
N	2.00	2.75	0.079	0.108
O	7.10	7.50	0.280	0.295
P	2.87 BSC		0.113 BSC	
Q	5.08 BSC		0.200 BSC	
R	2.54 BSC		0.100 BSC	
Terminal 1	Drain			
Terminal 2	Source			
Terminal 3	Source sense			
Terminal 4	Gate			
Terminal 5	Drain			

3. 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.

Table 3-1. Revision History

Revision	Date	Description
B	12/2022	• Updated values in Table 1-4 table. • Updated values in Table 1-3 table. • Updated Figure 1-14.
A	08/2022	Document migrated from Microsemi template to Microchip template; Assigned Microchip literature number DS-00004673A,which replaces the previous Microsemi literature number 050-7755.
Initial release (Microsemi Revision A)	09/2019	Document created.

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