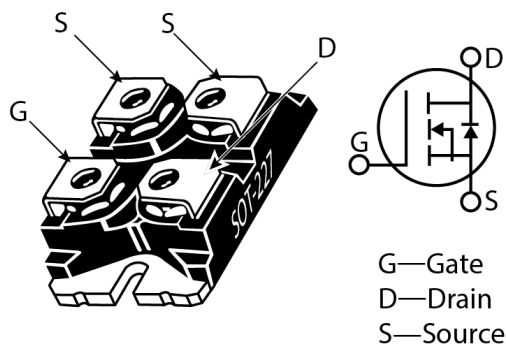



## Product Overview

1200V, 17 mΩ typical at 20 V<sub>GS</sub>, 19 mΩ typical at 18 V<sub>GS</sub>, Silicon Carbide (SiC) N-Channel MOSFET, SOT-227.



### Features

- 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 2500V, UL certified file E145592 

### Benefits

- High efficiency to enable lighter and 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

- Photovoltaic (PV) inverter, converter, and industrial motor drives
- Smart grid transmission and distribution
- Induction heating and welding
- Hybrid Electric Vehicle (HEV) powertrain and Electric Vehicle (EV) charger
- Power supply and distribution

# 1. Device Specifications

This section shows the specifications of this device.

## 1.1 Absolute Maximum Ratings

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

**Table 1-1.** Absolute Maximum Ratings

Symbol	Parameter	Ratings	Unit
$V_{DSS}$	Drain source voltage	1200	V
$I_D$	Continuous drain current at $T_C = 25\text{ }^{\circ}\text{C}$	89	A
	Continuous drain current at $T_C = 100\text{ }^{\circ}\text{C}$	63	
$I_{DM}$	Pulsed drain current <sup>1</sup>	280	
$V_{GS}$	Gate-source voltage	23 to -10	V
	Transient gate-source voltage	25 to -12	
$P_D$	Total power dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	321	W
	Linear derating factor	2.12	

**Note:**

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

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

**Table 1-2.** Thermal and Mechanical Characteristics

Symbol	Characteristic/Test Conditions	Min.	Typ.	Max.	Unit
$R_{\theta JC}$	Junction-to-case thermal resistance	—	0.36	0.47	$^{\circ}\text{C}/\text{W}$
$T_J$	Operating junction temperature	-55	—	175	$^{\circ}\text{C}$
$T_{STG}$	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

ESD practices should comply with JESD-625.

## 1.2 Electrical Performance

The following table shows the static characteristics of this 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 <sup>1</sup>	$V_{GS} = 20\text{V}$ , $I_D = 40\text{A}$	—	17	22	$\text{m}\Omega$
		$V_{GS} = 18\text{V}$ , $I_D = 40\text{A}$	—	19	—	
$V_{GS(th)}$	Gate-source threshold voltage	$V_{GS} = V_{DS}$ , $I_D = 4.5\text{ mA}$	1.9	3	—	V
$I_{DSS}$	Zero gate voltage drain current	$V_{DS} = 1200\text{V}$ , $V_{GS} = 0\text{V}$	—	0.3	40	$\mu\text{A}$
		$V_{DS} = 1200\text{V}$ , $V_{GS} = 0\text{V}$ , $T_J = 175\text{ }^{\circ}\text{C}$	—	3.5	—	

.....continued

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
$I_{GSS}$	Gate-source leakage current	$V_{GS} = 20V/-10V$	—	—	$\pm 100$	nA

**Note:**

1. Pulse test: pulse width < 380  $\mu s$ , duty cycle < 2%.

The following table shows the dynamic characteristics of this device.  $T_J = 25^\circ C$  unless otherwise specified. The dynamic characteristics are characterized, not 100% tested, at the recommended operating  $V_{GS} = 20V/-5V$ .

**Table 1-4. Dynamic Characteristics**

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{GS} = 0V$	—	4960	—	pF
$C_{rss}$	Reverse transfer capacitance	$V_{DD} = 1000V$	—	18	—	
$C_{oss}$	Output capacitance	$V_{AC} = 25\text{ mV}$ $f = 200\text{ KHz}$	—	263	—	
$Q_g$	Total gate charge	$V_{GS} = -5V/20V$	—	249	—	nC
$Q_{gs}$	Gate-source charge	$V_{DD} = 800V$	—	63	—	
$Q_{gd}$	Gate-drain charge	$I_D = 40A$	—	32	—	
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 800V$	—	71	—	ns
$t_f$	Voltage rise time	$V_{GS} = -5V/20V$	—	29	—	
$t_{d(off)}$	Turn-off delay time	$I_D = 50A$	—	38	—	
$t_r$	Voltage fall time	$R_{g(ext)} = 4\Omega$	—	15	—	
$E_{on}$	Turn-on switching energy	Freewheeling diode = MSC017SMA120J ( $V_{GS} = -5V$ ); reference <a href="#">Figure 1-18</a>	—	2364	—	$\mu J$
$E_{off}$	Turn-off switching energy		—	306	—	
ESR	Gate equivalent series resistance	$f = 1\text{ MHz}$ , 25 mV, drain short	—	0.71	—	$\Omega$
SCWT	Short circuit withstand time	$V_{DS} = 960V$ , $V_{GS} = 20V$	—	3	—	$\mu s$
$E_{AS}$	Avalanche energy, single pulse	$I_D = 40A$	—	3500	—	mJ

The following table shows the body diode characteristics of this device.  $T_J = 25^\circ C$  unless otherwise specified.

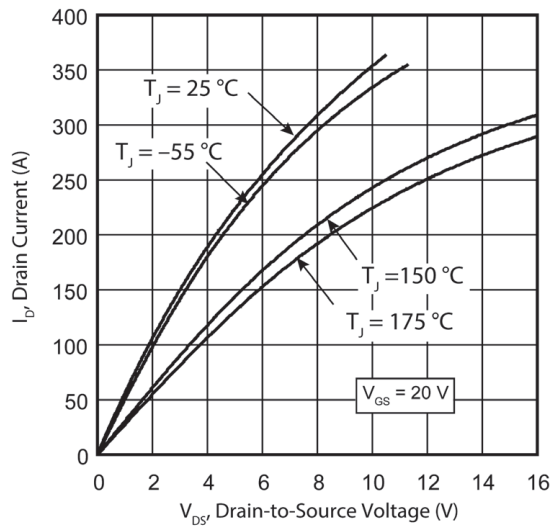
**Table 1-5. Body Diode Characteristics**

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
$V_{SD}$	Diode forward voltage	$I_{SD} = 40A$ , $V_{GS} = 0V$	—	3.5	—	V
		$I_{SD} = 40A$ , $V_{GS} = -5V$	—	3.9	—	
$t_{rr}$	Reverse recovery time	$I_{SD} = 50A$ , $V_{GS} = -5V$ , Drive $R_g = 4\Omega$ , $V_{DD} = 800V$ , $di/dt = -2500\text{ A}/\mu s$	—	40	—	ns
$Q_{rr}$	Reverse recovery charge		—	490	—	nC
$I_{RRM}$	Reverse recovery current		—	22	—	A

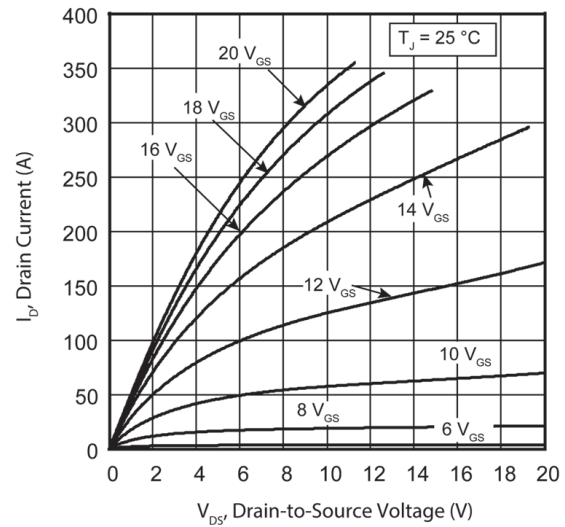
### 1.3 Typical Performance Curves

Data for performance curves are characterized, not 100% tested.

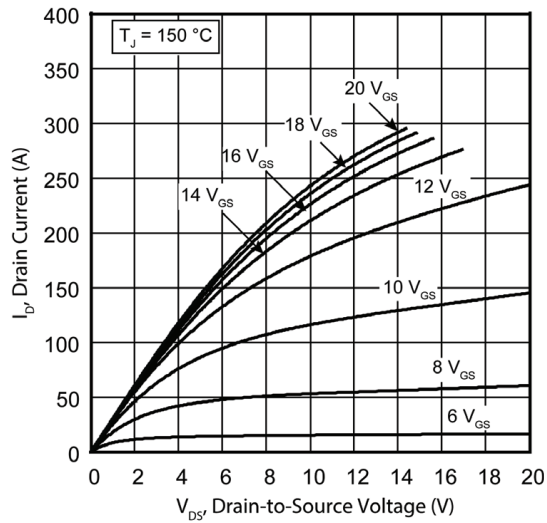
**Figure 1-1.** Drain Current vs.  $V_{DS}$  at  $T_J$



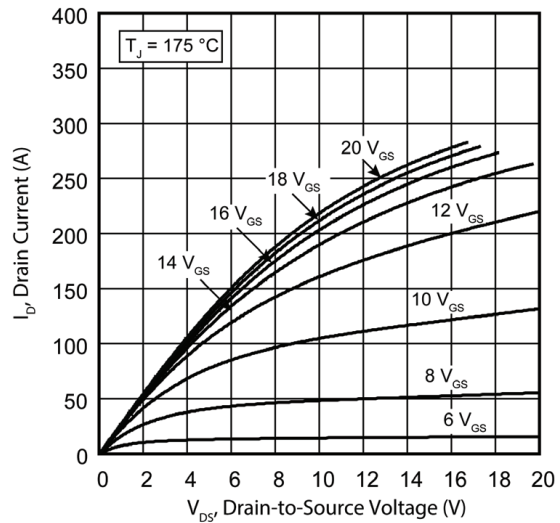
**Figure 1-2.** Drain Current vs.  $V_{DS}$  at  $V_{GS}$



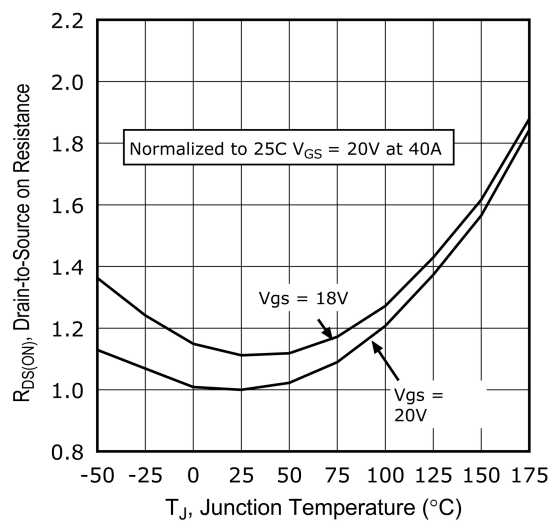
**Figure 1-3.** Drain Current vs.  $V_{DS}$  at  $V_{GS}$



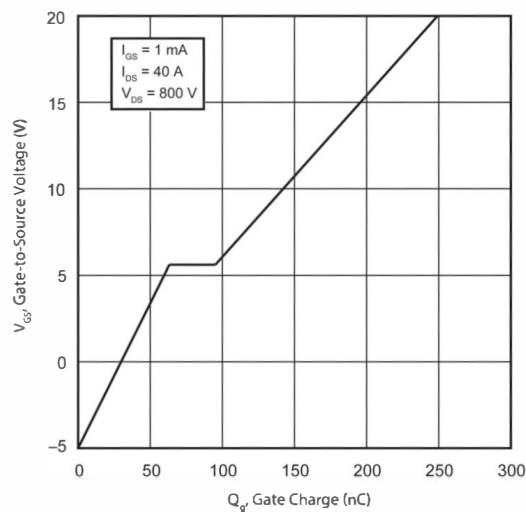
**Figure 1-4.** Drain Current vs.  $V_{DS}$  at  $V_{GS}$



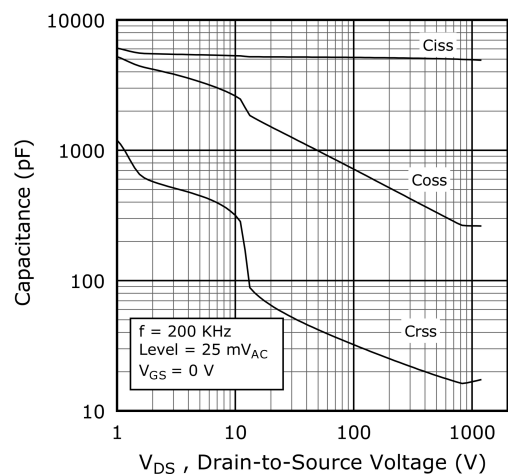
**Figure 1-5.**  $R_{DS(on)}$  vs. Junction Temperature



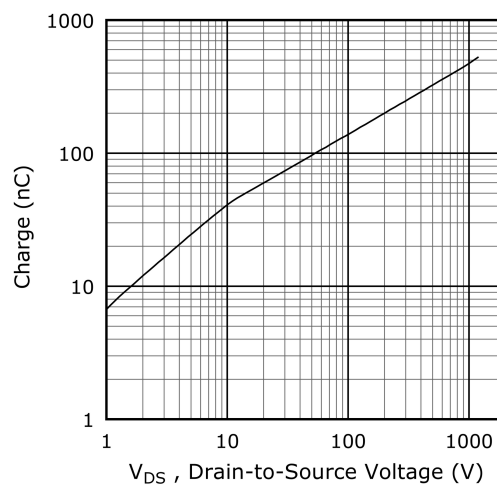
**Figure 1-6.** Gate Charge Characteristics



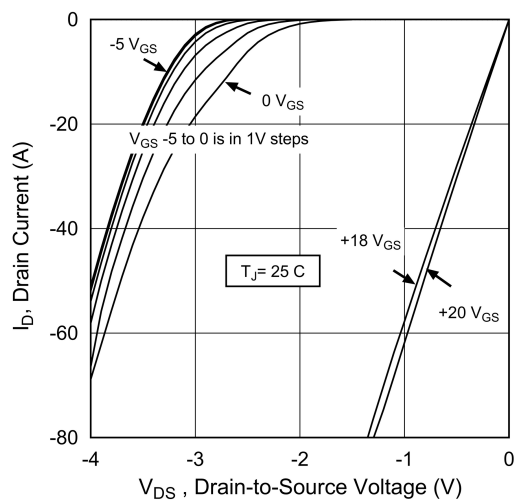
**Figure 1-7.** Capacitance vs. Drain-to-Source Voltage



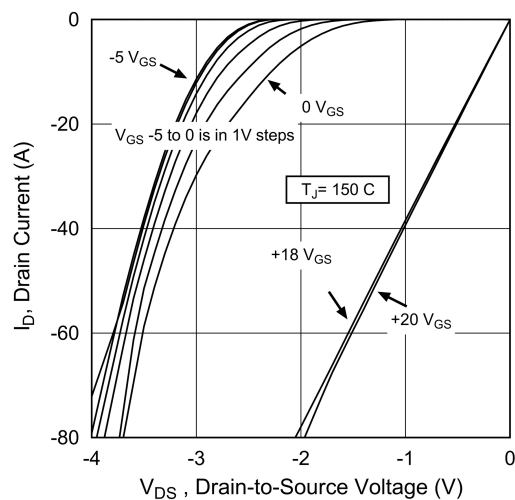
**Figure 1-8.** Output Charge vs. Drain-to-Source Voltage



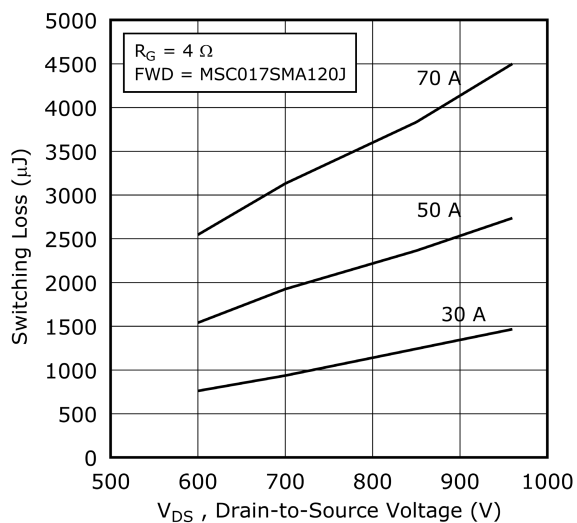
**Figure 1-9.  $I_D$  vs.  $V_{DS}$  3<sup>rd</sup> Quadrant Conduction**



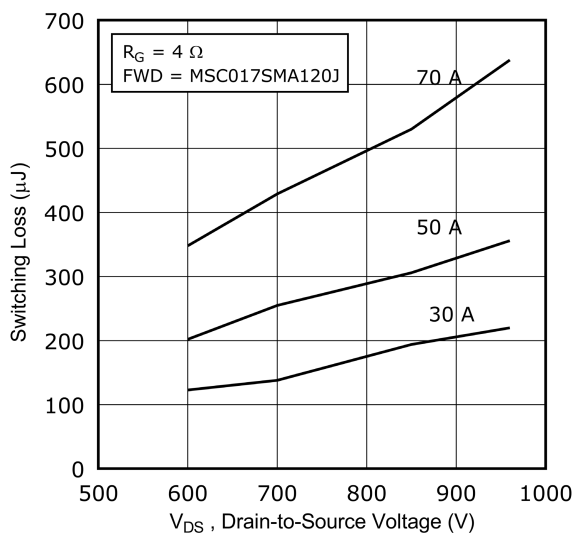
**Figure 1-10.  $I_D$  vs.  $V_{DS}$  3<sup>rd</sup> Quadrant Conduction**



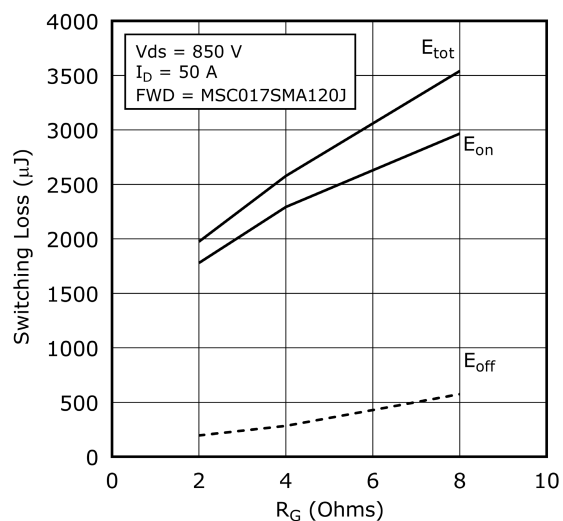
**Figure 1-11. Switching Energy  $E_{on}$  vs.  $V_{DS}$  &  $I_D$**



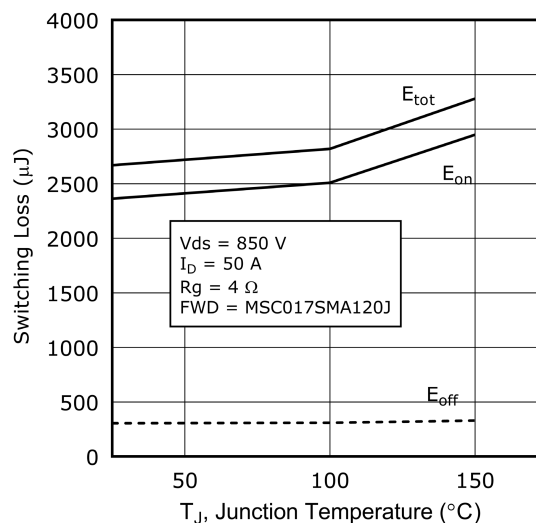
**Figure 1-12. Switching Energy  $E_{off}$  vs.  $V_{DS}$  &  $I_D$**



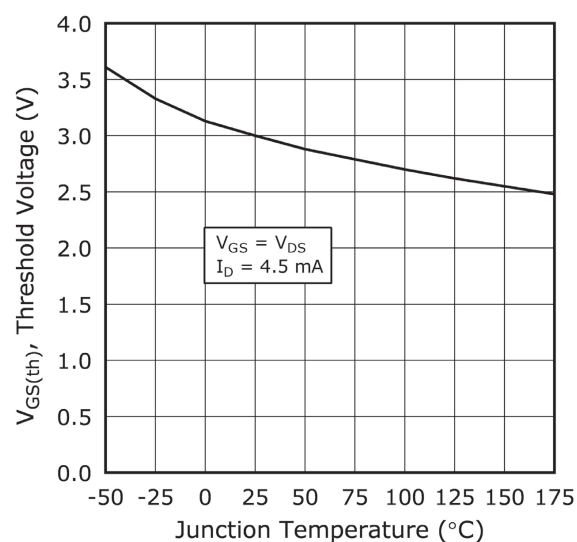
**Figure 1-13. Switching Energy vs.  $R_g$**



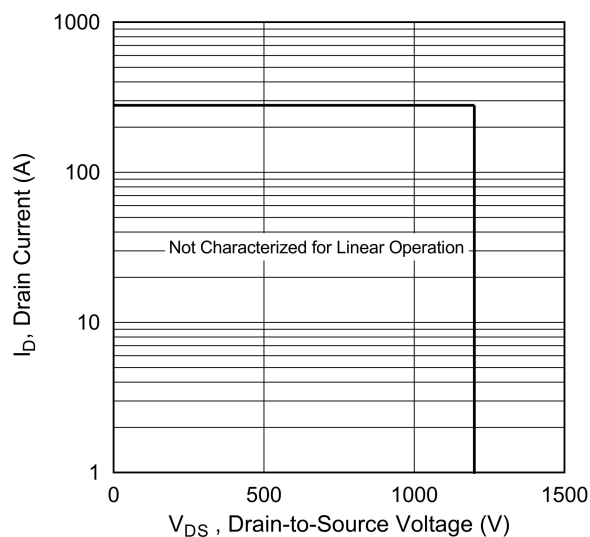
**Figure 1-14. Switching Energy vs. Junction Temperature**



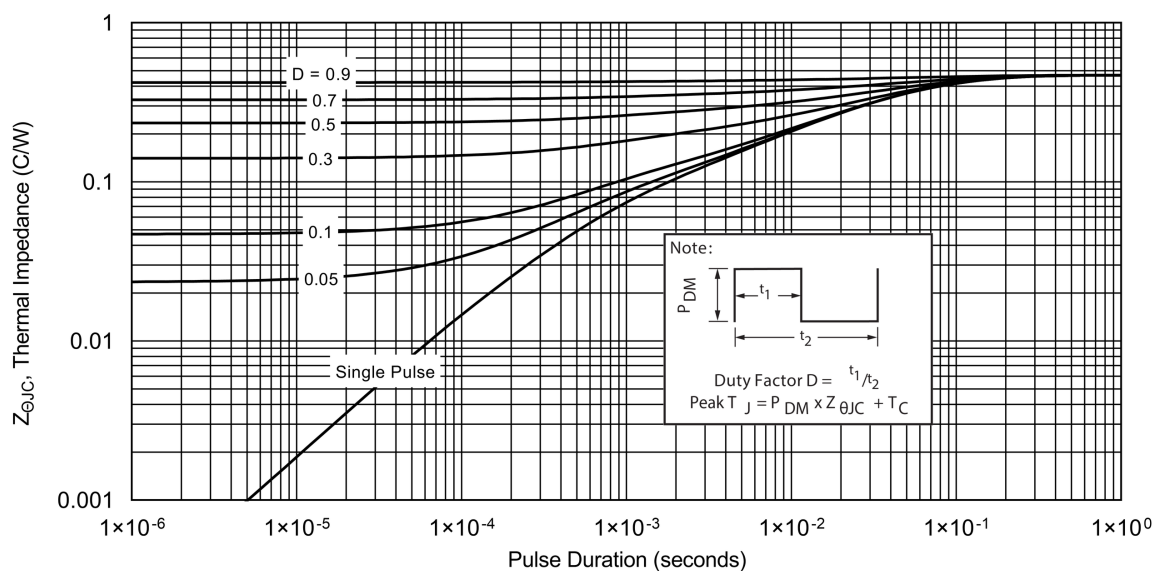
**Figure 1-15. Threshold Voltage vs. Junction Temperature**



**Figure 1-16. Forward Safe Operating Area**

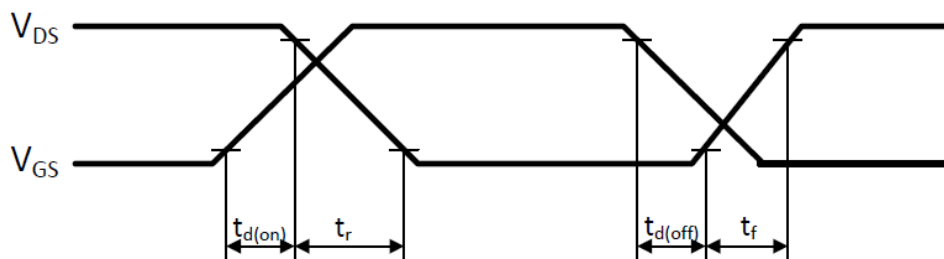


**Figure 1-17. Maximum Transient Thermal Impedance**



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

**Figure 1-18. Switching Waveform**





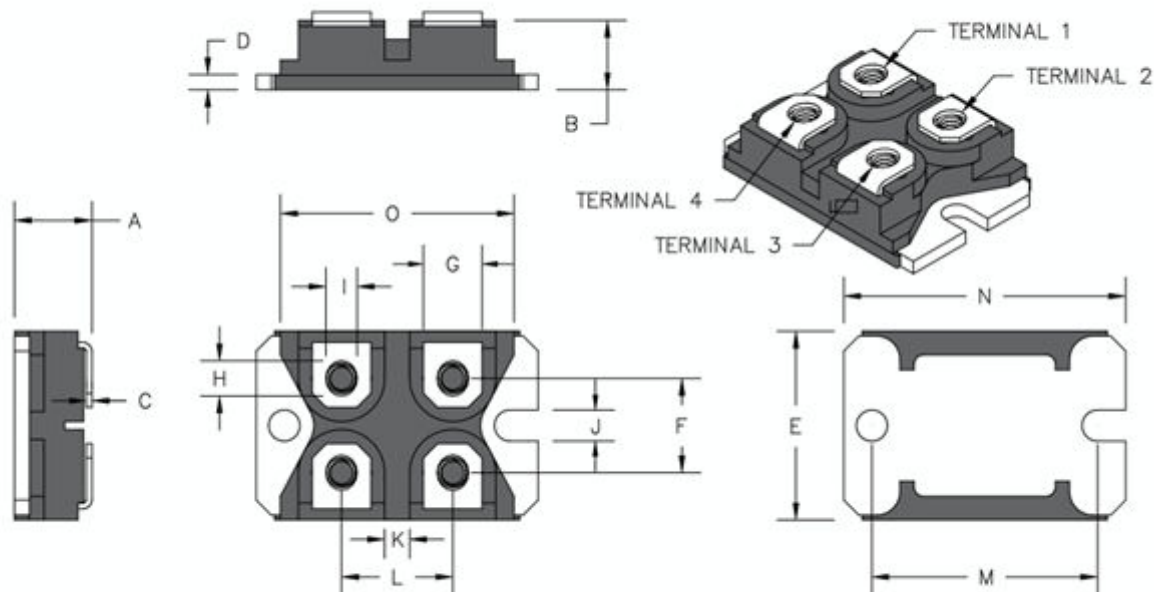
## 2. Package Specification

This section shows the package specification of this device.

### 2.1 Package Outline Drawing

The following figure illustrates the SOT-227 package outline of this device.

**Figure 2-1.** Package Outline Drawing



The following table shows the SOT-227 dimensions and should be used in conjunction with the package outline drawing.

**Table 2-1.** SOT-227 Dimensions

Symbol	Min. (mm)	Max. (mm)	Min. (in.)	Max. (in.)
A	11.8	12.2	0.463	0.480
B	8.9	9.6	0.350	0.378
C	0.75	0.85	0.030	0.033
D	1.95	2.14	0.077	0.084
E	25.2	25.4	0.992	1.000
F	12.6	12.8	0.496	0.504
G	7.8	8.2	0.307	0.322
H	4.8	4.9	0.187	0.193
I	4.1	4.3	0.161	0.169
J	4.0	4.2	0.157	0.165
K	3.3	3.6	0.129	0.143
L	14.9	15.1	0.587	0.594
M	30.1	30.3	1.185	1.193

.....continued

Symbol	Min. (mm)	Max. (mm)	Min. (in.)	Max. (in.)
N	38.0	38.2	1.496	1.504
O	31.5	31.7	1.240	1.248
Terminal 1	Source			
Terminal 2	Drain			
Terminal 3	Gate			
Terminal 4	Source			

### 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
A	09/2023	The following changes are made in this revision of the document: <ul style="list-style-type: none"><li>• Document migrated from Microsemi template to Microchip template; Assigned Microchip literature number DS-00005090A, which replaces the previous Microsemi literature number 050-7779.</li><li>• Added <a href="#">Figure 1-8</a>.</li><li>• Updated <a href="#">Figure 1-9</a>, <a href="#">Figure 1-10</a> and <a href="#">Figure 1-15</a>.</li></ul>
Initial release (Microsemi Revision A)	10/2020	Document created.

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ISBN: 978-1-6683-3155-2

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