

## N- and P-Channel 20 V (D-S) MOSFET



**RoHS**  
COMPLIANT

PRODUCT SUMMARY				
	V <sub>DS</sub> (V)	R <sub>DS(on)</sub> (Ω)	I <sub>D</sub> (A) <sup>a</sup>	Q <sub>g</sub> (TYP.)
N-Channel	20	0.076 at V <sub>GS</sub> = 4.5 V	2.7	0.55
		0.096 at V <sub>GS</sub> = 2.7 V	2.5	
		0.128 at V <sub>GS</sub> = 2.5 V	2.5	
P-Channel	-20	0.143 at V <sub>GS</sub> = -4.5 V	-1.5	0.95
		0.182 at V <sub>GS</sub> = -2.7 V	-1.5	
		0.230 at V <sub>GS</sub> = -2.5 V	-1.3	

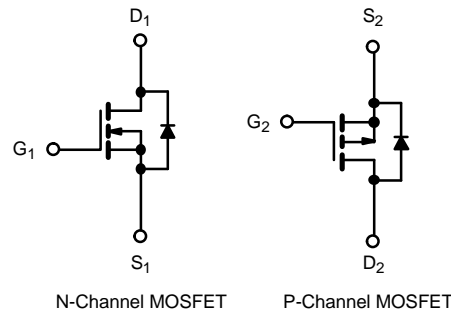
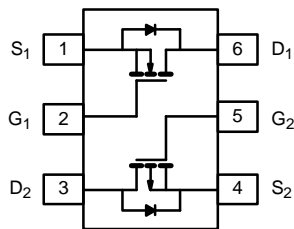
### FEATURES

- DT-Trench Power MOSFET
- 100 % R<sub>g</sub> tested

### APPLICATIONS

- Load switch
- DC/DC converter

**SOT-323-6**



### ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25 °C, unless otherwise noted)

PARAMETER	SYMBOL	N-CHANNEL	P-CHANNEL	UNIT	
Drain-Source Voltage	V <sub>DS</sub>	20	-20	V	
Gate-Source Voltage	V <sub>GS</sub>	± 12			
Continuous Drain Current (T <sub>J</sub> = 150 °C)	I <sub>D</sub>	T <sub>C</sub> = 25 °C	2.7	-1.5	A
		T <sub>C</sub> = 70 °C	2.6	-1.4	
		T <sub>A</sub> = 25 °C	2.7 <sup>b, c</sup>	-1.4 <sup>b, c</sup>	
		T <sub>A</sub> = 70 °C	2.5 <sup>b, c</sup>	-1.4 <sup>b, c</sup>	
Source-Drain Current Diode Current	I <sub>S</sub>	T <sub>C</sub> = 25 °C	2.3	-1.3	A
		T <sub>A</sub> = 25 °C	2.2 <sup>b, c</sup>	-1.2 <sup>b, c</sup>	
Pulsed Drain Current (t = 300 μs)	I <sub>DM</sub>	8	-5	A	
Maximum Power Dissipation	P <sub>D</sub>	T <sub>C</sub> = 25 °C	0.34	0.34	W
		T <sub>C</sub> = 70 °C	0.22	0.22	
		T <sub>A</sub> = 25 °C	0.29 <sup>b, c</sup>	0.29 <sup>b, c</sup>	
		T <sub>A</sub> = 70 °C	0.18 <sup>b, c</sup>	0.18 <sup>b, c</sup>	
Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	-55 to 150		°C	

### THERMAL RESISTANCE RATINGS

PARAMETER	SYMBOL	N-CHANNEL		P-CHANNEL		UNIT
		TYP.	MAX.	TYP.	MAX.	
Maximum Junction-to-Ambient <sup>b, d</sup>	R <sub>thJA</sub>	165	238	165	238	°C/W
Maximum Junction-to-Foot (Drain)	R <sub>thJF</sub>	108	270	108	270	

#### Notes

- Based on T<sub>C</sub> = 25 °C.
- Surface mounted on 1" x 1" FR4 board.
- t = 10 s.
- Maximum under steady state conditions is 186 °C/W (N-Channel) and 186 °C/W (P-Channel).

<b>SPECIFICATIONS</b> ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP. <sup>a</sup>	MAX.	UNIT	
<b>Static</b>							
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	N-Ch	20	-	-	V
		$V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$	P-Ch	-20	-	-	
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = 250\text{ }\mu\text{A}$	N-Ch	-	24	-	mV/ $^\circ\text{C}$
		$I_D = -250\text{ }\mu\text{A}$	P-Ch	-	-13	-	
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$	$I_D = 250\text{ }\mu\text{A}$	N-Ch	-	-1.8	-	mV/ $^\circ\text{C}$
		$I_D = -250\text{ }\mu\text{A}$	P-Ch	-	2.3	-	
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	N-Ch	0.5	-	1.5	V
		$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$	P-Ch	-0.3	-	-1.5	
Gate-Source Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 12\text{ V}$	N-Ch	-	-	$\pm 100$	nA
			P-Ch	-	-	$\pm 100$	
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}$	N-Ch	-	-	1	$\mu\text{A}$
		$V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}$	P-Ch	-	-	-1	
		$V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^\circ\text{C}$	N-Ch	-	-	10	
		$V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^\circ\text{C}$	P-Ch	-	-	-10	
On-State Drain Current <sup>b</sup>	$I_{D(on)}$	$V_{DS} = 5\text{ V}, V_{GS} = 5\text{ V}$	N-Ch	2	-	-	A
		$V_{DS} = -5\text{ V}, V_{GS} = -5\text{ V}$	P-Ch	-1	-	-	
Drain-Source On-State Resistance <sup>b</sup>	$R_{DS(on)}$	$V_{GS} = 4.5\text{ V}, I_D = 0.7\text{ A}$	N-Ch	-	0.076	0.084	$\Omega$
		$V_{GS} = -4.5\text{ V}, I_D = -0.4\text{ A}$	P-Ch	-	0.143	0.157	
		$V_{GS} = 2.7\text{ V}, I_D = 0.4\text{ A}$	N-Ch	-	0.096	0.106	
		$V_{GS} = -2.7\text{ V}, I_D = -0.2\text{ A}$	P-Ch	-	0.182	0.201	
		$V_{GS} = 2.5\text{ V}, I_D = 0.4\text{ A}$	N-Ch	-	0.128	0.150	
		$V_{GS} = -2.5\text{ V}, I_D = -0.2\text{ A}$	P-Ch	-	0.230	0.253	
Forward Transconductance <sup>b</sup>	$g_{fs}$	$V_{DS} = 15\text{ V}, I_D = 0.7\text{ A}$	N-Ch	-	1.5	-	S
		$V_{DS} = -15\text{ V}, I_D = -0.5\text{ A}$	P-Ch	-	0.8	-	
<b>Dynamic <sup>a</sup></b>							
Input Capacitance	$C_{iss}$	N-Channel $V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	N-Ch	-	221	-	pF
Output Capacitance	$C_{oss}$		P-Ch	-	228	-	
Reverse Transfer Capacitance	$C_{rss}$	P-Channel $V_{DS} = -10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	N-Ch	-	14	-	pF
			P-Ch	-	16	-	
Total Gate Charge	$Q_g$	$V_{DS} = 10\text{ V}, V_{GS} = 10\text{ V}, I_D = 0.7\text{ A}$	N-Ch	-	1.2	1.8	nC
		$V_{DS} = -10\text{ V}, V_{GS} = -10\text{ V}, I_D = -0.5\text{ A}$	P-Ch	-	1.9	3	
		N-Channel $V_{DS} = 10\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 0.5\text{ A}$	N-Ch	-	0.55	1.1	
			P-Ch	-	0.95	1.5	
Gate-Source Charge	$Q_{gs}$	P-Channel $V_{DS} = -10\text{ V}, V_{GS} = -4.5\text{ V}, I_D = -0.4\text{ A}$	N-Ch	-	0.15	-	nC
			P-Ch	-	0.25	-	
Gate-Drain Charge	$Q_{gd}$		N-Ch	-	0.15	-	nC
			P-Ch	-	0.25	-	
Gate Resistance	$R_g$	$f = 1\text{ MHz}$	N-Ch	1.5	7.2	14.4	$\Omega$
			P-Ch	2.1	10.3	20.6	

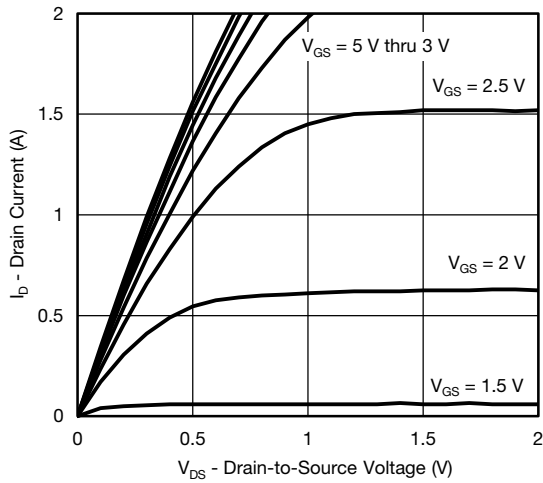
SPECIFICATIONS (T <sub>J</sub> = 25 °C, unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP. <sup>a</sup>	MAX.	UNIT	
<b>Dynamic <sup>a</sup></b>							
Turn-On Delay Time	t <sub>d(on)</sub>	N-Channel V <sub>DD</sub> = 10 V, R <sub>L</sub> = 20 Ω I <sub>D</sub> ≅ 0.5 A, V <sub>GEN</sub> = 10 V, R <sub>g</sub> = 1 Ω	N-Ch	-	2	4	ns
Rise Time	t <sub>r</sub>		P-Ch	-	2	4	
Turn-Off Delay Time	t <sub>d(off)</sub>	P-Channel V <sub>DD</sub> = -10 V, R <sub>L</sub> = 25 Ω I <sub>D</sub> ≅ -0.4 A, V <sub>GEN</sub> = -10 V, R <sub>g</sub> = 1 Ω	N-Ch	-	14	21	
			P-Ch	-	9	18	
Fall Time	t <sub>f</sub>		N-Ch	-	11	20	
			P-Ch	-	10	20	
Turn-On Delay Time	t <sub>d(on)</sub>	N-Channel V <sub>DD</sub> = 10 V, R <sub>L</sub> = 20 Ω I <sub>D</sub> ≅ 0.5 A, V <sub>GEN</sub> = 4.5 V, R <sub>g</sub> = 1 Ω	N-Ch	-	7	14	
			P-Ch	-	7	14	
Rise Time	t <sub>r</sub>	P-Channel V <sub>DD</sub> = -10 V, R <sub>L</sub> = 25 Ω I <sub>D</sub> ≅ -0.4 A, V <sub>GEN</sub> = -4.5 V, R <sub>g</sub> = 1 Ω	N-Ch	-	16	24	
			P-Ch	-	15	23	
Turn-Off Delay Time	t <sub>d(off)</sub>		N-Ch	-	22	33	
			P-Ch	-	15	23	
Fall Time	t <sub>f</sub>		N-Ch	-	22	33	
			P-Ch	-	12	20	
<b>Drain-Source Body Diode Characteristics</b>							
Continuous Source-Drain Diode Current	I <sub>S</sub>	T <sub>C</sub> = 25 °C	N-Ch	-	-	2.7	A
			P-Ch	-	-	-1.5	
Pulse Diode Forward Current <sup>a</sup>	I <sub>SM</sub>		N-Ch	-	-	8	
			P-Ch	-	-	-5	
Body Diode Voltage	V <sub>SD</sub>	I <sub>S</sub> = 0.5 A	N-Ch	-	0.8	1.2	V
		I <sub>S</sub> = -0.4 A	P-Ch	-	-0.8	-1.2	
Body Diode Reverse Recovery Time	t <sub>rr</sub>	N-Channel I <sub>F</sub> = 0.5 A, di/dt = 100 A/μs, T <sub>J</sub> = 25 °C	N-Ch	-	8	15	ns
			P-Ch	-	12	20	
Body Diode Reverse Recovery Charge	Q <sub>rr</sub>	P-Channel I <sub>F</sub> = -0.4 A, di/dt = -100 A/μs, T <sub>J</sub> = 25 °C	N-Ch	-	1	2	nC
			P-Ch	-	5	10	
Reverse Recovery Fall Time	t <sub>a</sub>		N-Ch	-	4	-	ns
			P-Ch	-	9	-	
Reverse Recovery Rise Time	t <sub>b</sub>		N-Ch	-	4	-	
			P-Ch	-	3	-	

**Notes**

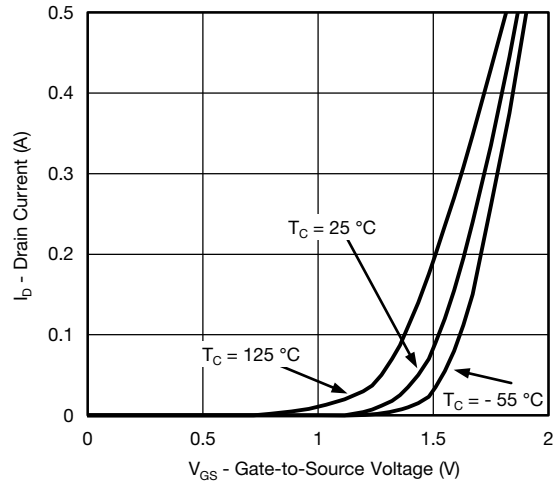
- a. Guaranteed by design, not subject to production testing.
- b. Pulse test; pulse width ≤ 300 μs, duty cycle ≤ 2 %.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

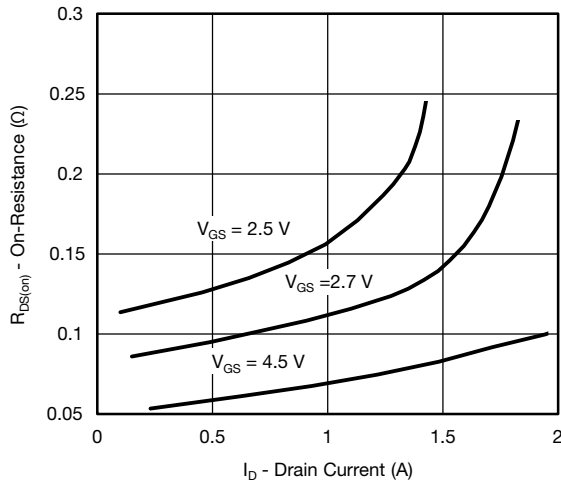
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



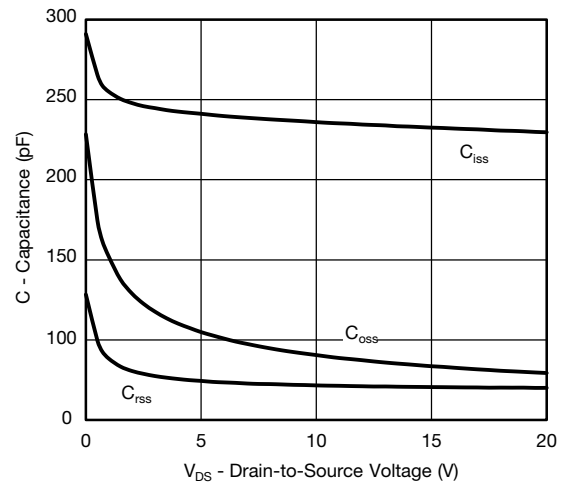
**Output Characteristics**



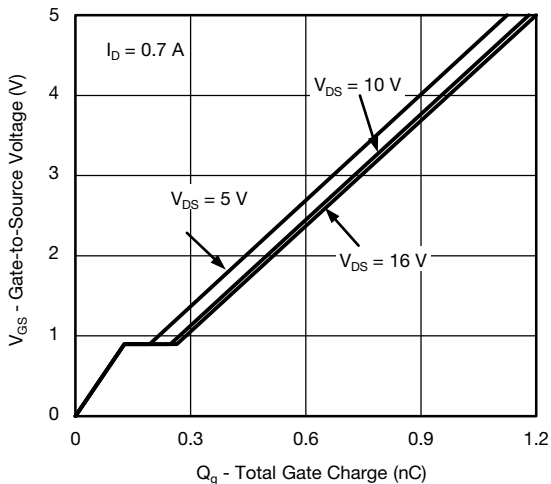
**Transfer Characteristics**



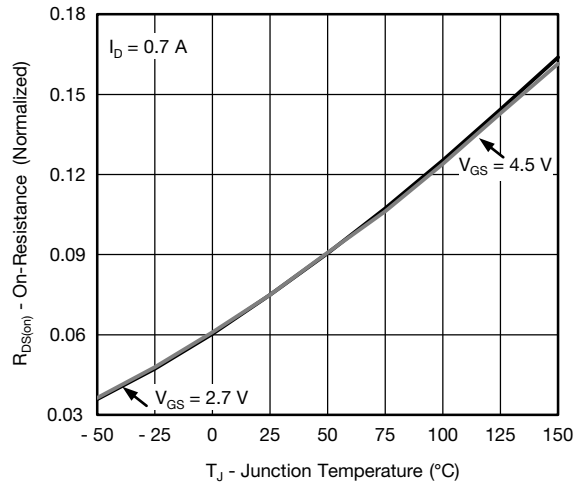
**On-Resistance vs. Drain Current and Gate Voltage**



**Capacitance**

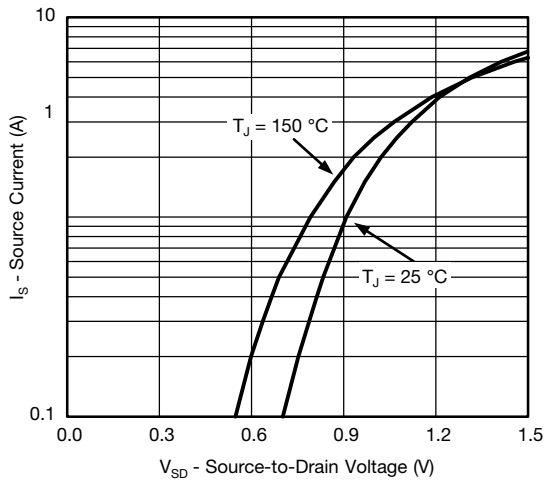


**Gate Charge**

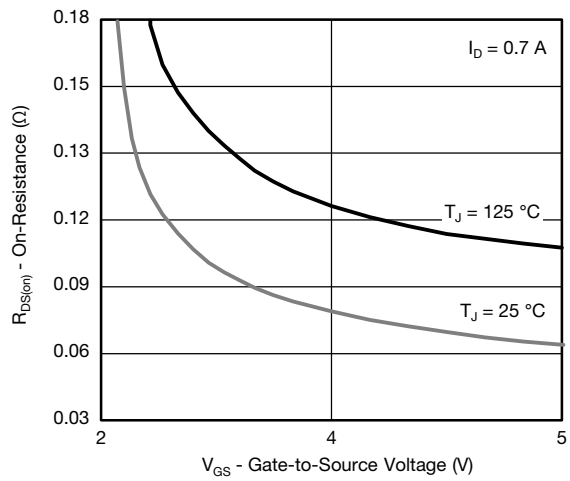


**On-Resistance vs. Junction Temperature**

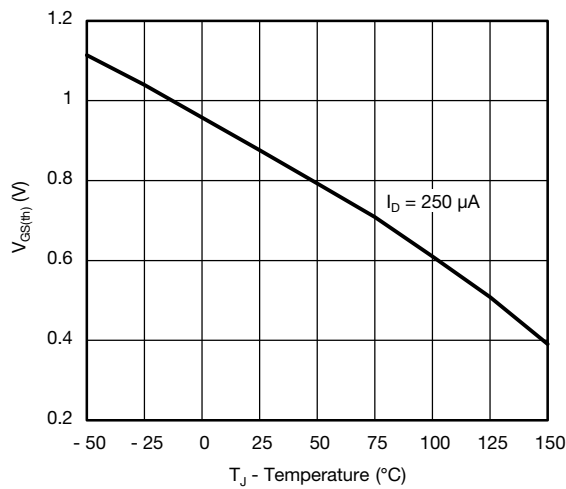
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



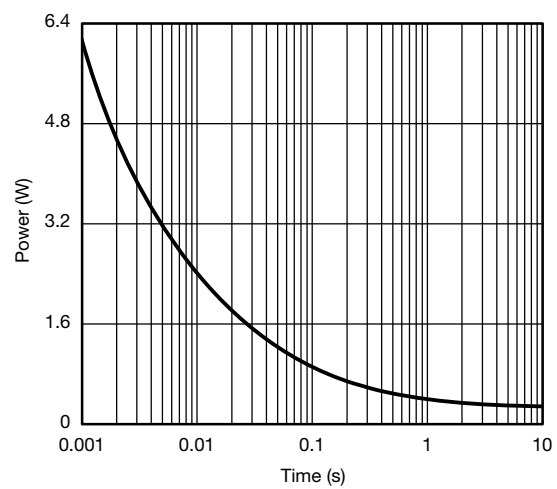
**Source-Drain Diode Forward Voltage**



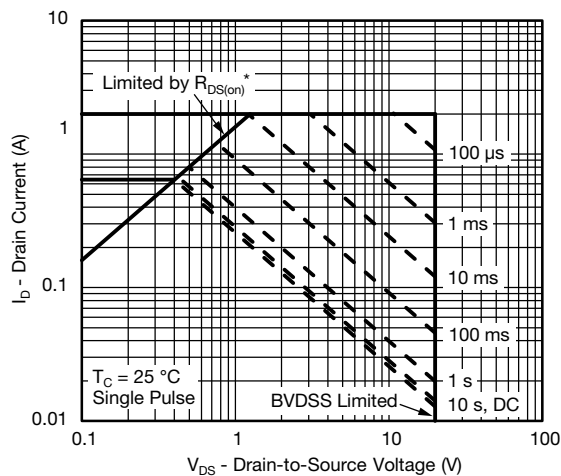
**On-Resistance vs. Gate-to-Source Voltage**



**Threshold Voltage**



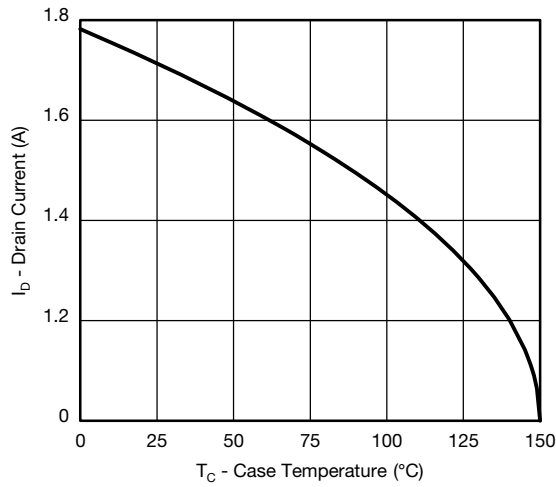
**Single Pulse Power, Junction-to-Ambient**



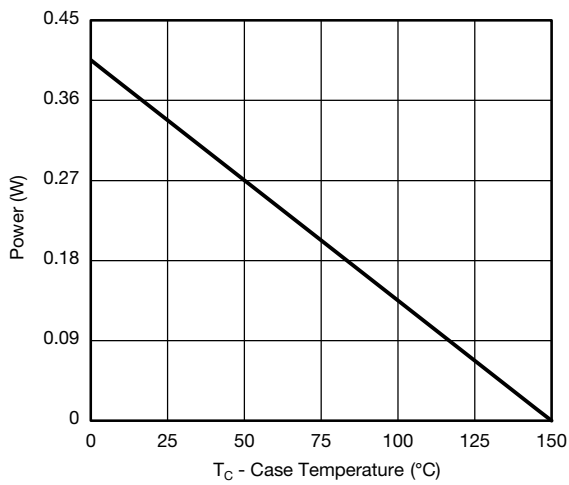
**Safe Operating Area, Junction-to-Ambient**

\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified

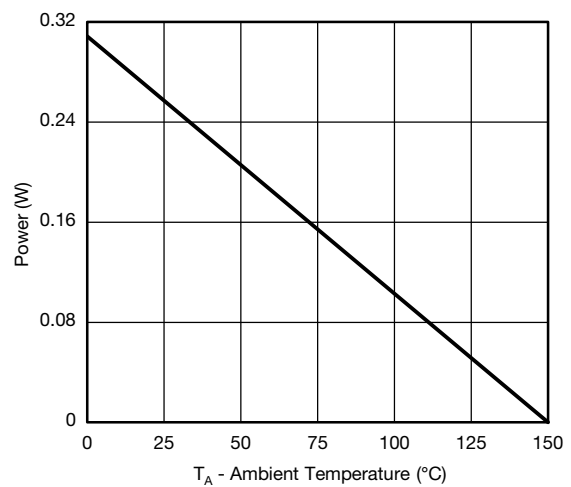
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



**Current Derating\***



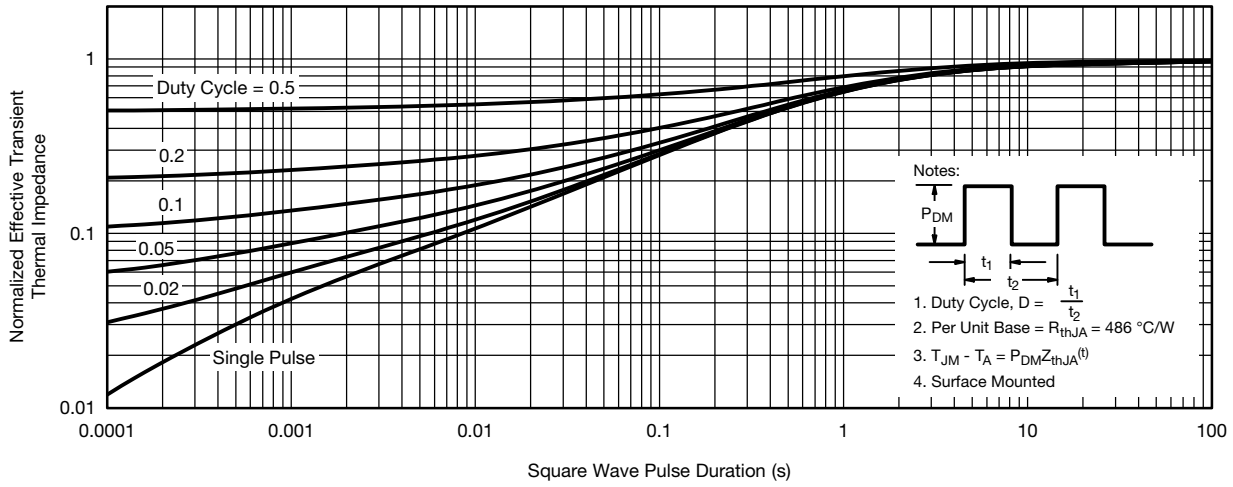
**Power Derating, Junction-to-Foot**



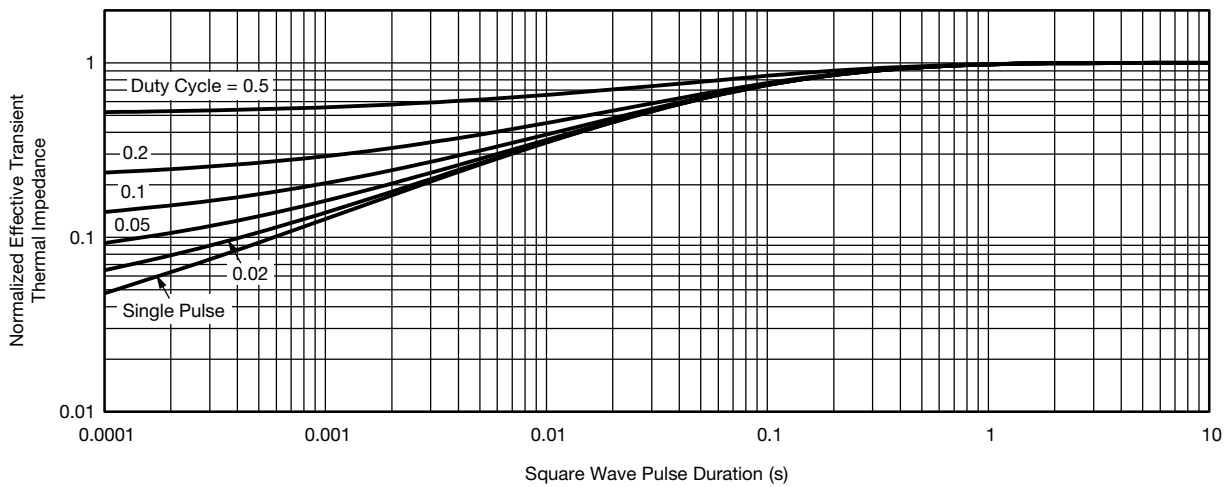
**Power Derating, Junction-to-Ambient**

\* The power dissipation P<sub>D</sub> is based on T<sub>J (max.)</sub> = 150 °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

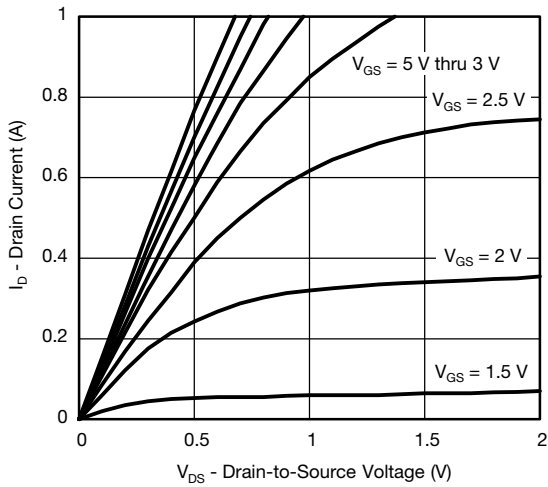


**Normalized Thermal Transient Impedance, Junction-to-Ambient**

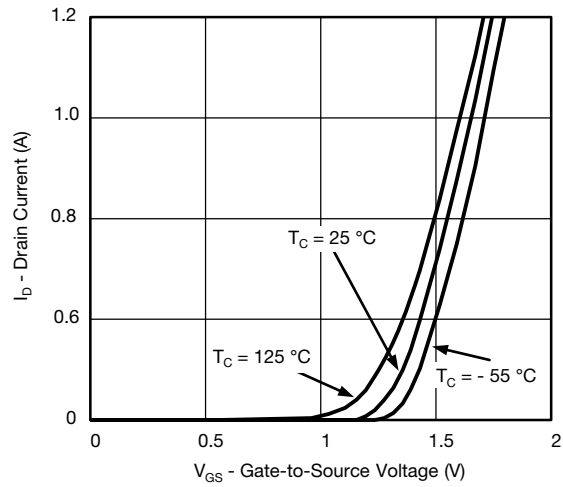


**Normalized Thermal Transient Impedance, Junction-to-Foot**

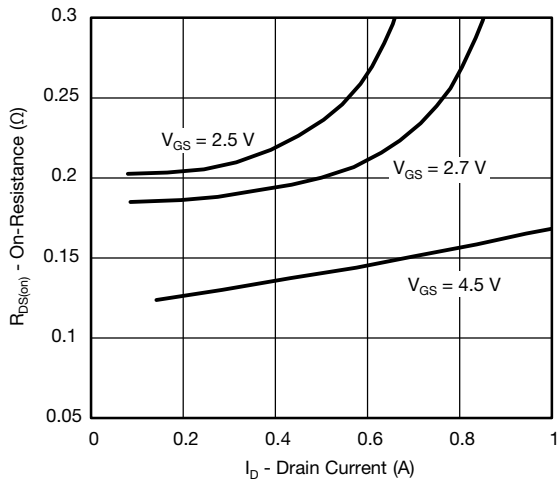
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



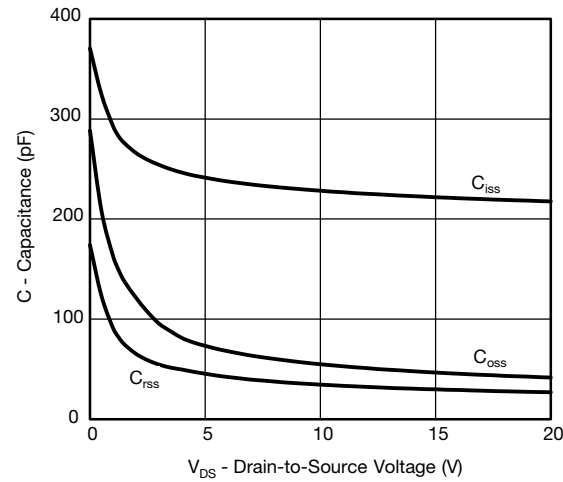
**Output Characteristics**



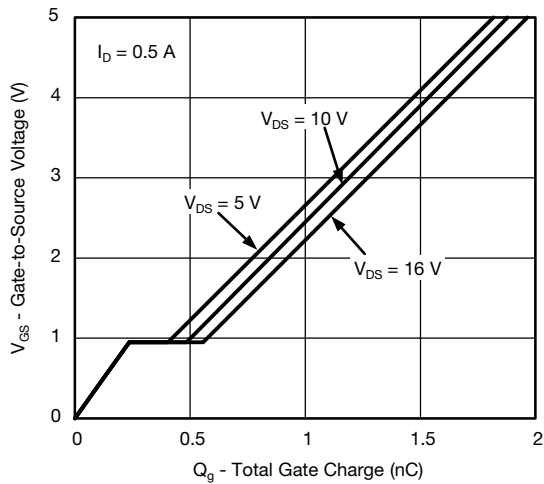
**Transfer Characteristics**



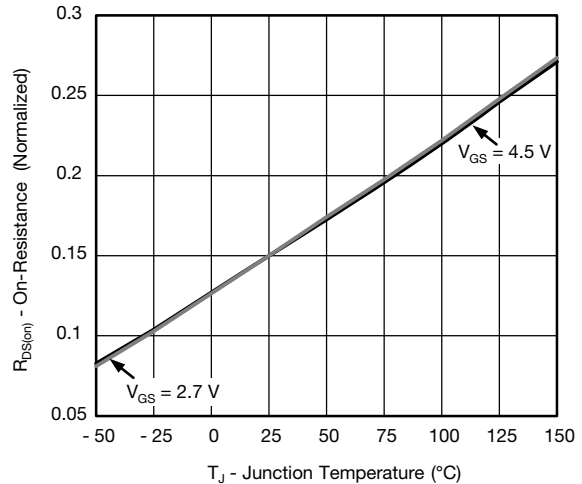
**On-Resistance vs. Drain Current and Gate Voltage**



**Capacitance**



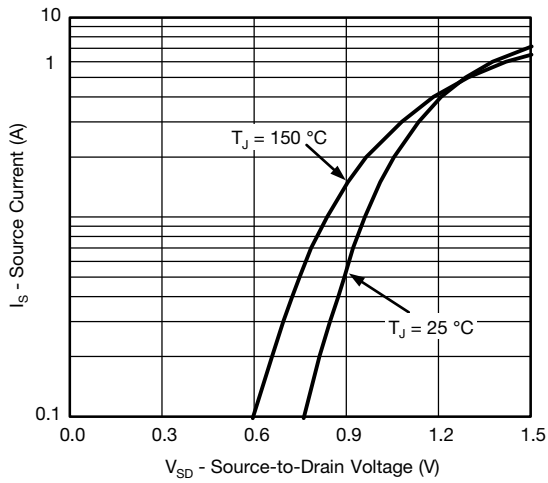
**Gate Charge**



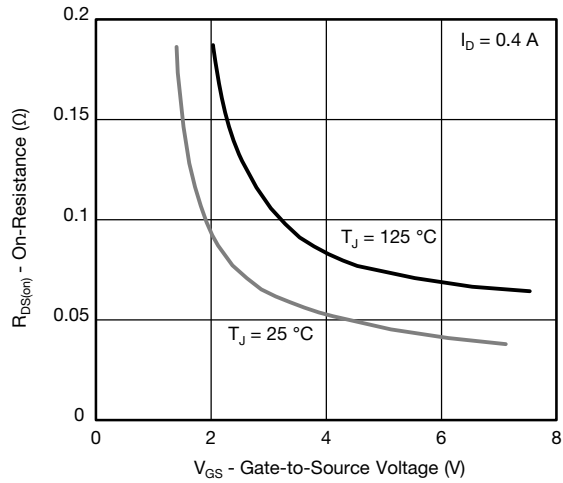
**On-Resistance vs. Junction Temperature**



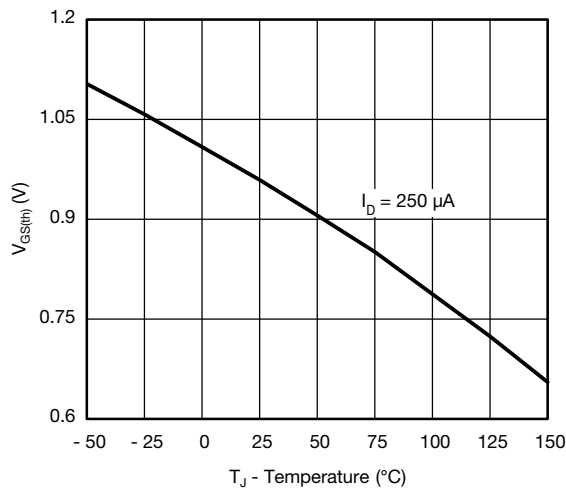
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



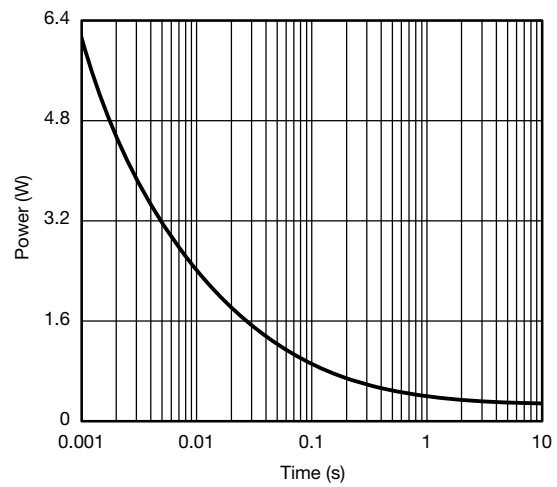
**Source-Drain Diode Forward Voltage**



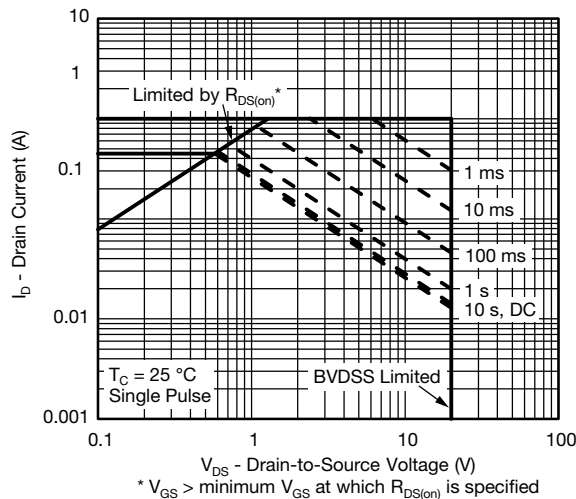
**On-Resistance vs. Gate-to-Source Voltage**



**Threshold Voltage**

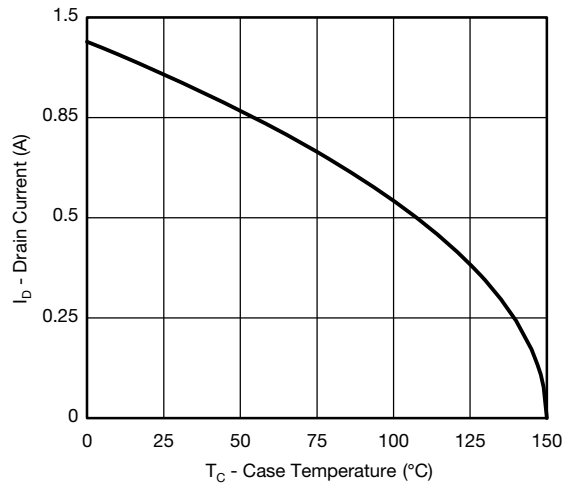


**Single Pulse Power, Junction-to-Ambient**

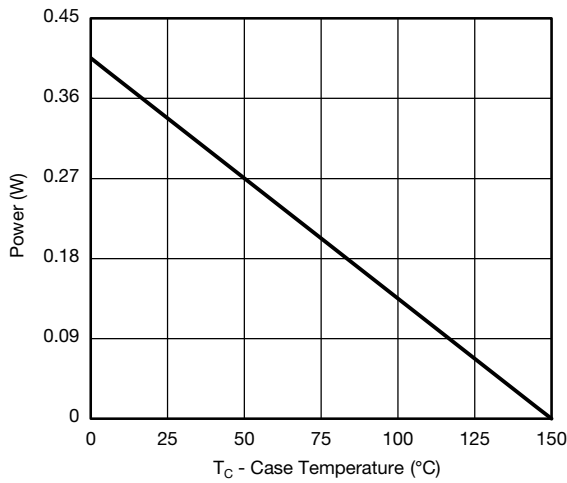


**Safe Operating Area, Junction-to-Ambient**

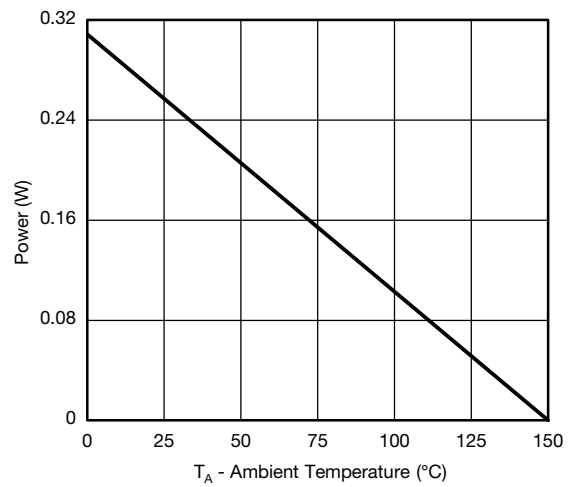
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



**Current Derating\***



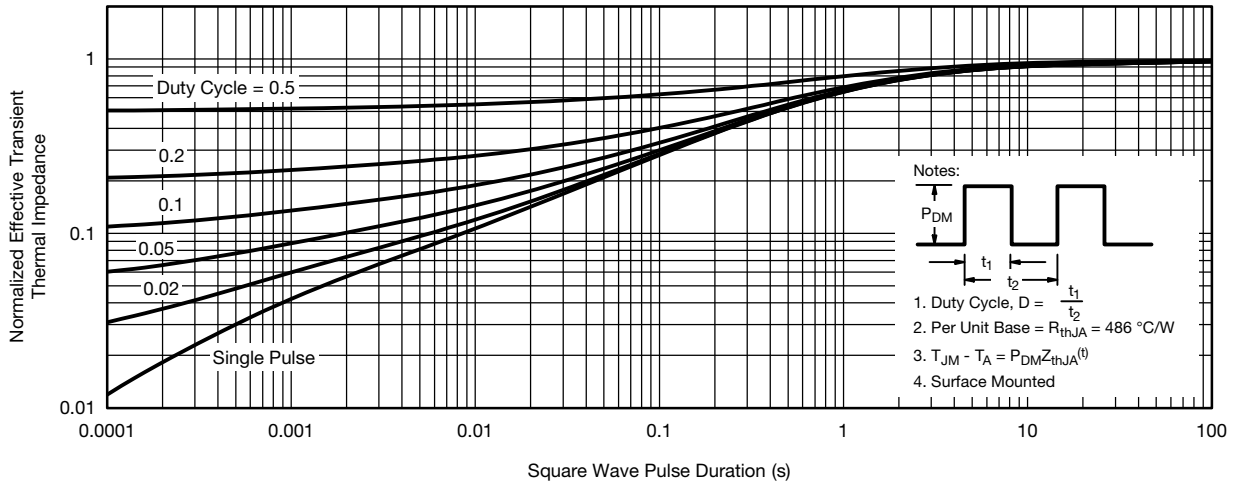
**Power Derating, Junction-to-Foot**



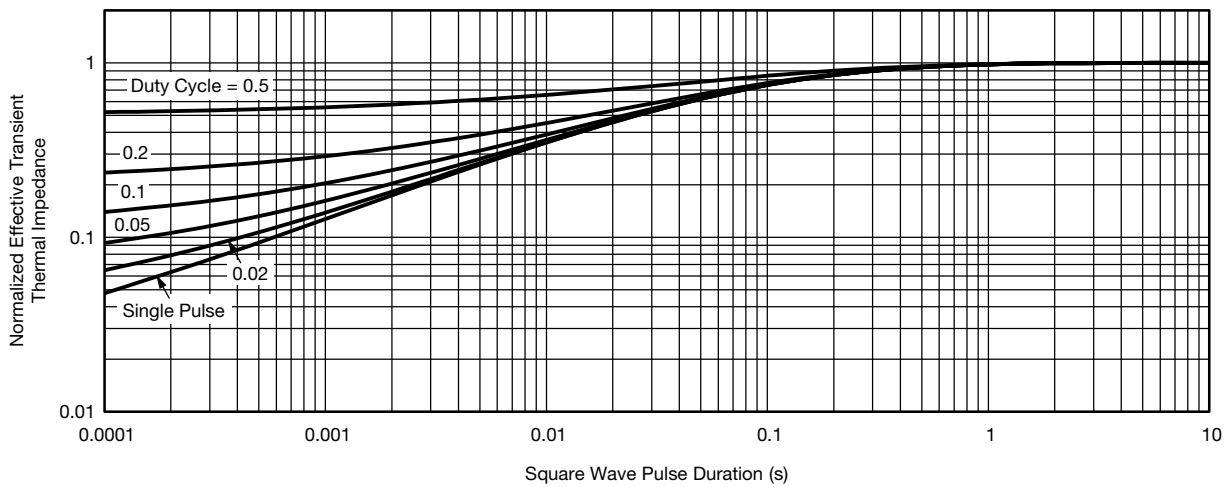
**Power Derating, Junction-to-Ambient**

\* The power dissipation  $P_D$  is based on  $T_{J(max.)} = 150$  °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

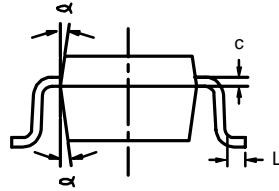
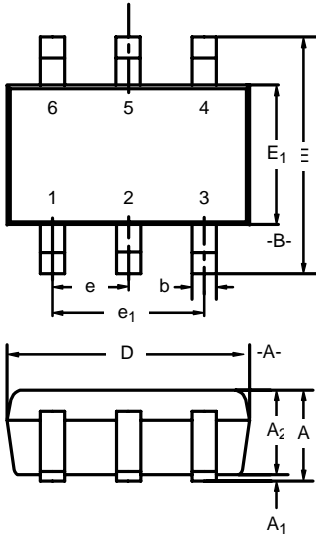
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



**Normalized Thermal Transient Impedance, Junction-to-Ambient**

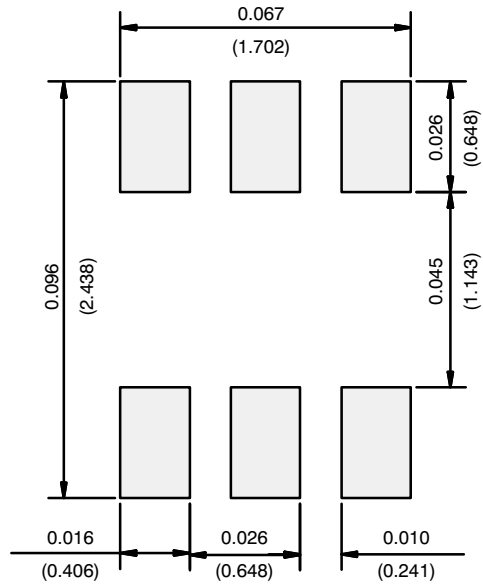


**Normalized Thermal Transient Impedance, Junction-to-Foot**



Dim	MILLIMETERS			INCHES		
	Min	Nom	Max	Min	Nom	Max
<b>A</b>	0.90	-	1.10	0.035	-	0.043
<b>A<sub>1</sub></b>	-	-	0.10	-	-	0.004
<b>A<sub>2</sub></b>	0.80	-	1.00	0.031	-	0.039
<b>b</b>	0.15	-	0.30	0.006	-	0.012
<b>c</b>	0.10	-	0.25	0.004	-	0.010
<b>D</b>	1.80	2.00	2.20	0.071	0.079	0.087
<b>E</b>	1.80	2.10	2.40	0.071	0.083	0.094
<b>E<sub>1</sub></b>	1.15	1.25	1.35	0.045	0.049	0.053
<b>e</b>	0.65BSC			0.026BSC		
<b>e<sub>1</sub></b>	1.20	1.30	1.40	0.047	0.051	0.055
<b>L</b>	0.10	0.20	0.30	0.004	0.008	0.012
<b>α</b>	7°Nom			7°Nom		

**RECOMMENDED MINIMUM PADS FOR SOT323: 6-Lead**



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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