

## N- and P-Channel for Level Shift Load Switch

PRODUCT SUMMARY				
	V <sub>DS</sub> (V)	R <sub>DS(on)</sub> (Ω)	I <sub>D</sub> (A)	Q <sub>g</sub> (Typ.)
N-Channel	20	0.225 at V <sub>GS</sub> = 4.5 V	1.5 <sup>a</sup>	1.1 nC
		0.270 at V <sub>GS</sub> = 2.5 V	1.5 <sup>a</sup>	
		0.345 at V <sub>GS</sub> = 1.8 V	1.5 <sup>a</sup>	
		0.960 at V <sub>GS</sub> = 1.5 V	0.5	
P-Channel	- 12	0.057 at V <sub>GS</sub> = - 4.5 V	- 4.5 <sup>a</sup>	5 nC
		0.077 at V <sub>GS</sub> = - 2.5 V	- 4.5 <sup>a</sup>	
		0.115 at V <sub>GS</sub> = - 1.8 V	- 4.5 <sup>a</sup>	
		0.200 at V <sub>GS</sub> = - 1.5 V	- 1.5	

### FEATURES

- Halogen-free According to IEC 61249-2-21 Definition
- TrenchFET® Power MOSFETs
- Typical ESD Protection: N-Channel 2800 V P-Channel 1900 V
- 100 % R<sub>g</sub> Tested
- Compliant to RoHS Directive 2002/95/EC

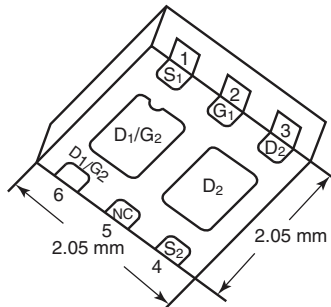


**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

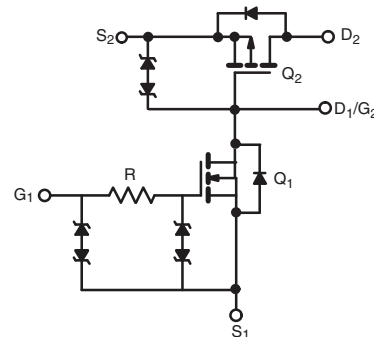
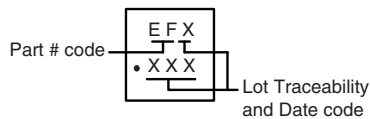
### APPLICATIONS

- Load Switch with Level Shift for Portable Devices
  - N-Channel for Level Shift Drive
  - P-Channel for Main Switch

PowerPAK® SC-70-6 Dual



Marking Code



Ordering Information: SiA777EDJ-T1-GE3 (Lead (Pb)-free and Halogen-free)

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	- 12	V	
Gate-Source Voltage	V <sub>GS</sub>	± 6	± 8		
Continuous Drain Current (T <sub>J</sub> = 150 °C)	I <sub>D</sub>	T <sub>C</sub> = 25 °C	1.5 <sup>a</sup>	- 4.5 <sup>a</sup>	A
		T <sub>C</sub> = 70 °C	1.5 <sup>a</sup>	- 4.5 <sup>a</sup>	
		T <sub>A</sub> = 25 °C	1.5 <sup>a, b, c</sup>	- 4.5 <sup>a, b, c</sup>	
		T <sub>A</sub> = 70 °C	1.5 <sup>a, b, c</sup>	- 3.9 <sup>b, c</sup>	
Pulsed Drain Current	I <sub>DM</sub>	4	- 15		
Source Drain Current Diode Current	I <sub>S</sub>	T <sub>C</sub> = 25 °C	1.5 <sup>a</sup>	- 4.5 <sup>a</sup>	
		T <sub>A</sub> = 25 °C	1.6 <sup>b, c</sup>	- 1.6 <sup>b, c</sup>	
Maximum Power Dissipation	P <sub>D</sub>	T <sub>C</sub> = 25 °C	5	7.8	W
		T <sub>C</sub> = 70 °C	3.2	5	
		T <sub>A</sub> = 25 °C	1.9 <sup>b, c</sup>	1.9 <sup>b, c</sup>	
		T <sub>A</sub> = 70 °C	1.2 <sup>b, c</sup>	1.2 <sup>b, c</sup>	
Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	- 55 to 150		°C	
Soldering Recommendations (Peak Temperature) <sup>d, e</sup>		260			

THERMAL RESISTANCE RATINGS						
Parameter	Symbol	N-Channel		P-Channel		Unit
		Typ.	Max.	Typ.	Max.	
Maximum Junction-to-Ambient <sup>b, f</sup>	R <sub>thJA</sub>	52	65	52	65	°C/W
Maximum Junction-to-Case (Drain)	R <sub>thJC</sub>	20	25	12.5	16	

Notes:

- Package limited.
- Surface mounted on 1" x 1" FR4 board.
- t = 5 s.
- See solder profile ([www.vishay.com/doc?73257](http://www.vishay.com/doc?73257)). The PowerPAK SC-70 is a leadless package. The end of the lead terminal is exposed copper (not plated) as a result of the singulation process in manufacturing. A solder fillet at the exposed copper tip cannot be guaranteed and is not required to ensure adequate bottom side solder interconnection.
- Rework Conditions: manual soldering with a soldering iron is not recommended for leadless components.
- Maximum under steady state conditions for channel 1 and channel 2 is 110 °C/W.

SPECIFICATIONS $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted							
Parameter	Symbol	Test Conditions	Min.	Typ.	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	-12			
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = 250\text{ }\mu\text{A}$	N-Ch		21		mV/°C
		$I_D = -250\text{ }\mu\text{A}$	P-Ch		-3		
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$	$I_D = 250\text{ }\mu\text{A}$	N-Ch		-2.3		mV/°C
		$I_D = -250\text{ }\mu\text{A}$	P-Ch		2.3		
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	N-Ch	0.4		1.0	V
		$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$	P-Ch	-0.4		-1	
Gate-Body Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 3\text{ V}$	N-Ch			$\pm 1$	$\mu\text{A}$
		$V_{DS} = 0\text{ V}, V_{GS} = \pm 4.5\text{ V}$	P-Ch			$\pm 0.5$	
		$V_{DS} = 0\text{ V}, V_{GS} = \pm 6\text{ V}$	N-Ch			$\pm 1$	mA
		$V_{DS} = 0\text{ V}, V_{GS} = \pm 8\text{ V}$	P-Ch			$\pm 3$	
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}$	N-Ch			1	$\mu\text{A}$
		$V_{DS} = -12\text{ V}, V_{GS} = 0\text{ V}$	P-Ch			-1	
		$V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^\circ\text{C}$	N-Ch			10	
		$V_{DS} = -12\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^\circ\text{C}$	P-Ch			-10	
On-State Drain Current <sup>b</sup>	$I_{D(on)}$	$V_{DS} \geq 5\text{ V}, V_{GS} = 4.5\text{ V}$	N-Ch	4			A
		$V_{DS} \leq -5\text{ V}, V_{GS} = -4.5\text{ V}$	P-Ch	-10			
Drain-Source On-State Resistance <sup>b</sup>	$R_{DS(on)}$	$V_{GS} = 4.5\text{ V}, I_D = 1.6\text{ A}$	N-Ch		0.183	0.225	$\Omega$
		$V_{GS} = -4.5\text{ V}, I_D = -3.8\text{ A}$	P-Ch		0.047	0.057	
		$V_{GS} = 2.5\text{ V}, I_D = 1.5\text{ A}$	N-Ch		0.220	0.270	
		$V_{GS} = -2.5\text{ V}, I_D = -3.3\text{ A}$	P-Ch		0.063	0.077	
		$V_{GS} = 1.8\text{ V}, I_D = 1.3\text{ A}$	N-Ch		0.275	0.345	
		$V_{GS} = -1.8\text{ V}, I_D = 2.6\text{ A}$	P-Ch		0.095	0.115	
		$V_{GS} = 1.5\text{ V}, I_D = 0.3\text{ A}$	N-Ch		0.320	0.960	
		$V_{GS} = -1.5\text{ V}, I_D = 1\text{ A}$	P-Ch		0.125	0.200	
Forward Transconductance <sup>b</sup>	$g_{fs}$	$V_{DS} = 10\text{ V}, I_D = 1.6\text{ A}$	N-Ch		3.5		S
		$V_{DS} = -10\text{ V}, I_D = -3.8\text{ A}$	P-Ch		11		
<b>Dynamic<sup>a</sup></b>							
Total Gate Charge	$Q_g$	$V_{DS} = 10\text{ V}, V_{GS} = 5\text{ V}, I_D = 1.7\text{ A}$	N-Ch		1.3	2.2	nC
		$V_{DS} = -6\text{ V}, V_{GS} = -8\text{ V}, I_D = -4.9\text{ A}$	P-Ch		7.5	12	
Gate-Source Charge	$Q_{gs}$	N-Channel $V_{DS} = 10\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 1.7\text{ A}$	N-Ch		1.1	1.7	
			P-Ch		5	8	
Gate-Drain Charge	$Q_{gd}$	P-Channel $V_{DS} = -6\text{ V}, V_{GS} = -4.5\text{ V}, I_D = -4.9\text{ A}$	N-Ch		0.2		
			P-Ch		0.6		
Gate Resistance	$R_g$	$f = 1\text{ MHz}$	N-Ch	40	200	400	$\Omega$
			P-Ch	2	10	20	

## Notes:

a. Guaranteed by design, not subject to production testing.

b. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .



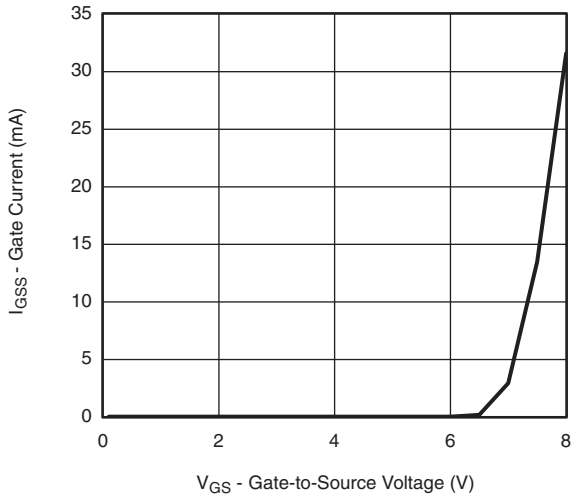
<b>SPECIFICATIONS</b> $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted								
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit		
<b>Dynamic<sup>a</sup></b>								
Turn-On Delay Time	$t_{d(on)}$	N-Channel $V_{DD} = 10\text{ V}$ , $R_L = 7.7\ \Omega$ $I_D \cong 1.3\text{ A}$ , $V_{GEN} = 4.5\text{ V}$ , $R_g = 1\ \Omega$	N-Ch		20	30	ns	
Rise Time	$t_r$		P-Ch		20	30		
Turn-Off Delay Time	$t_{d(off)}$	P-Channel $V_{DD} = -6\text{ V}$ , $R_L = 1.5\ \Omega$ $I_D \cong -3.9\text{ A}$ , $V_{GEN} = -4.5\text{ V}$ , $R_g = 1\ \Omega$	N-Ch		12	20		
			P-Ch		20	30		
Fall Time	$t_f$		N-Ch		70	105		
			P-Ch		32	50		
			N-Ch		20	30		
			P-Ch		16	25		
<b>Drain-Source Body Diode Characteristics</b>								
Continuous Source-Drain Diode Current	$I_S$		$T_C = 25\text{ }^\circ\text{C}$	N-Ch			1.5	A
			P-Ch			-4.5		
Pulse Diode Forward Current <sup>a</sup>	$I_{SM}$		N-Ch			4	A	
			P-Ch			-15		
Body Diode Voltage	$V_{SD}$	$I_S = 1.3\text{ A}$ , $V_{GS} = 0\text{ V}$	N-Ch		0.9	1.2	V	
		$I_S = -3.9\text{ A}$ , $V_{GS} = 0\text{ V}$	P-Ch		-0.8	-1.2		
Body Diode Reverse Recovery Time	$t_{rr}$	N-Channel $I_F = 1.3\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $T_J = 25\text{ }^\circ\text{C}$	N-Ch		50	75	ns	
			P-Ch		45	70		
Body Diode Reverse Recovery Charge	$Q_{rr}$		P-Channel $I_F = -3.9\text{ A}$ , $di/dt = -100\text{ A}/\mu\text{s}$ , $T_J = 25\text{ }^\circ\text{C}$	N-Ch		30	45	nC
				P-Ch		25	40	
Reverse Recovery Fall Time	$t_a$		N-Ch		15		ns	
Reverse Recovery Rise Time	$t_b$		P-Ch		15			
			N-Ch		35			
			P-Ch		30			

Notes:

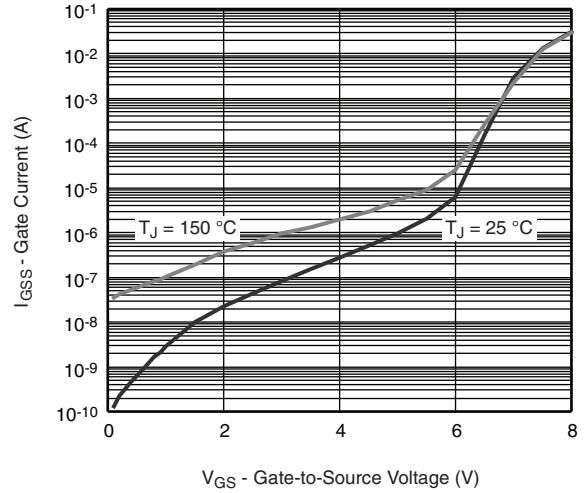
- a. Guaranteed by design, not subject to production testing.
- b. Pulse test; pulse width  $\leq 300\ \mu\text{s}$ , duty cycle  $\leq 2\%$ .

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.

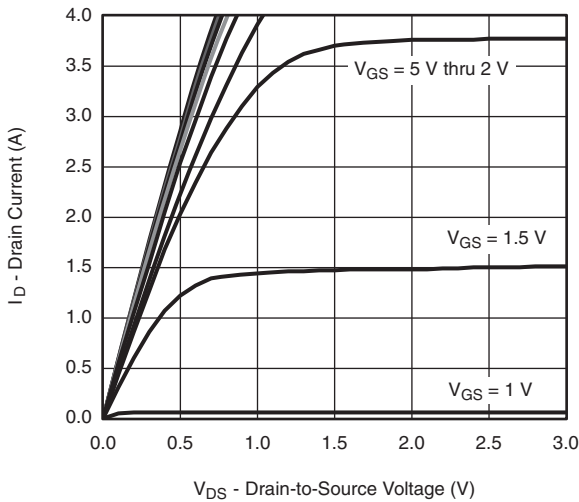
**N-CHANNEL TYPICAL CHARACTERISTICS**  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted



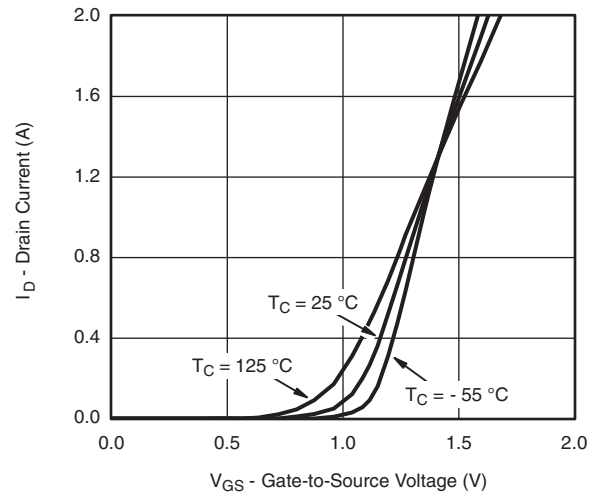
**Gate Current vs. Gate-to-Source Voltage**



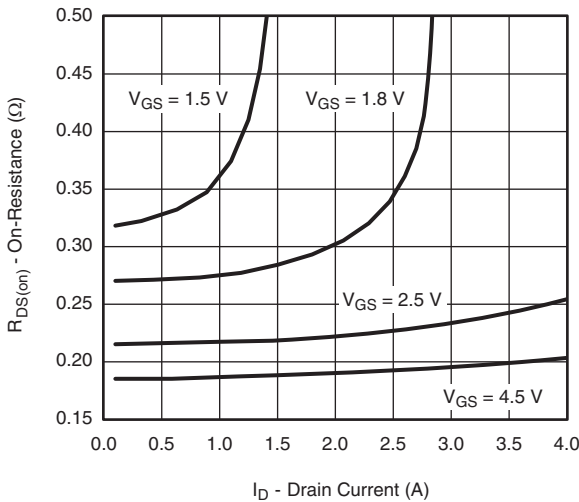
**Gate Current vs. Gate-to-Source Voltage**



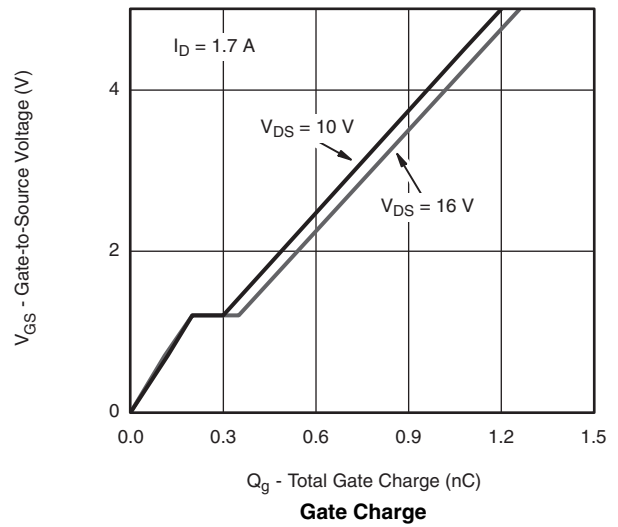
**Output Characteristics**



**Transfer Characteristics**

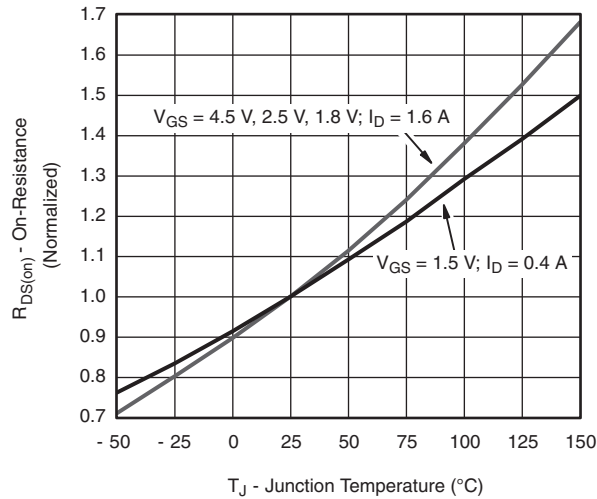


**On-Resistance vs. Drain Current**

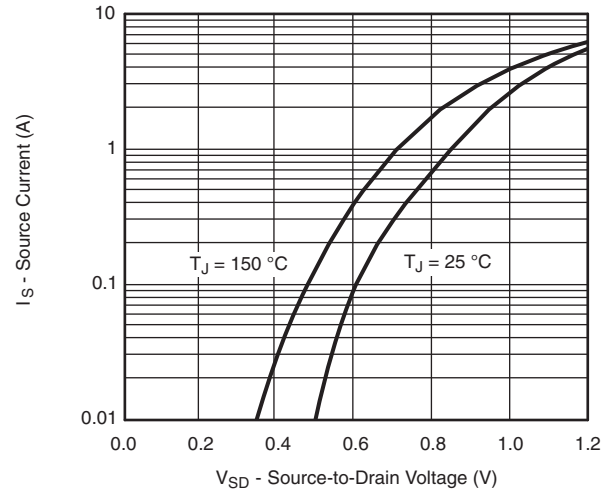


**Gate Charge**

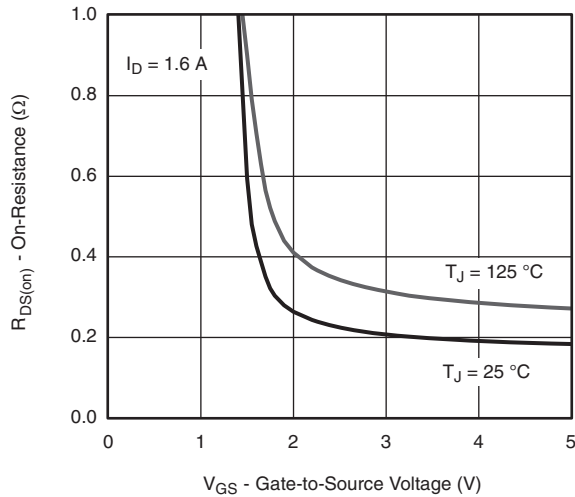
## N-CHANNEL TYPICAL CHARACTERISTICS $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted



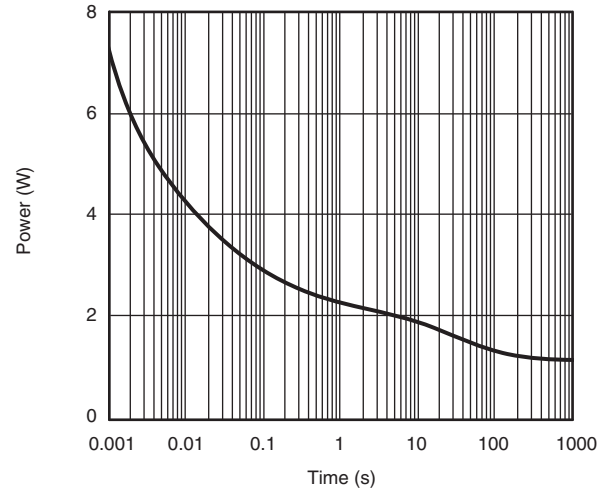
Normalized On-Resistance vs. Junction Temperature



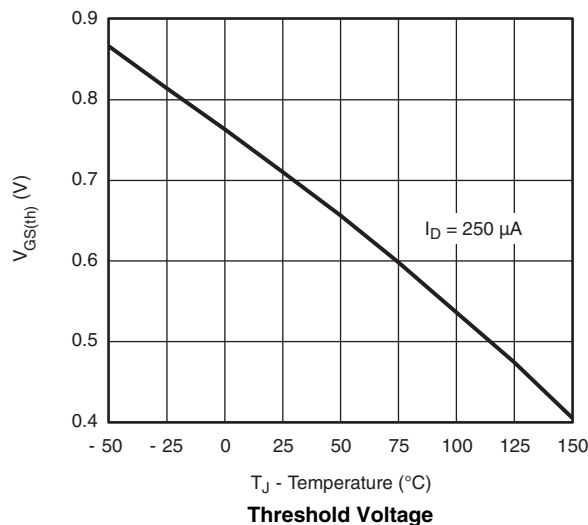
Source-Drain Diode Forward Voltage



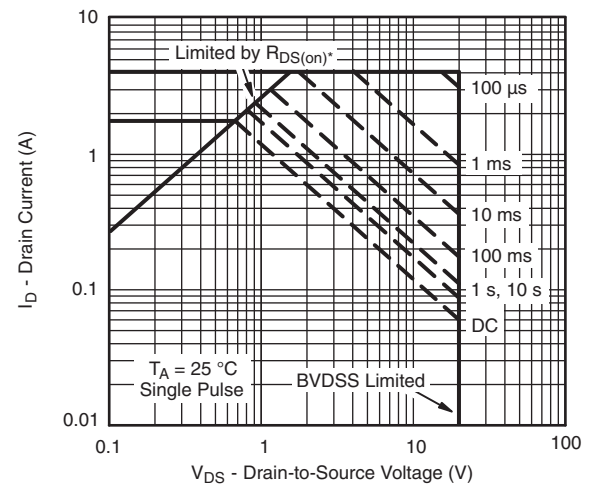
On-Resistance vs. Gate-to-Source Voltage



Single Pulse Power, Junction-to-Ambient

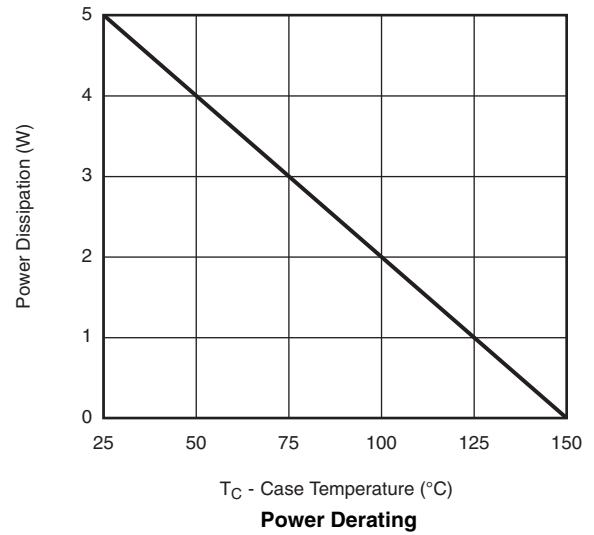
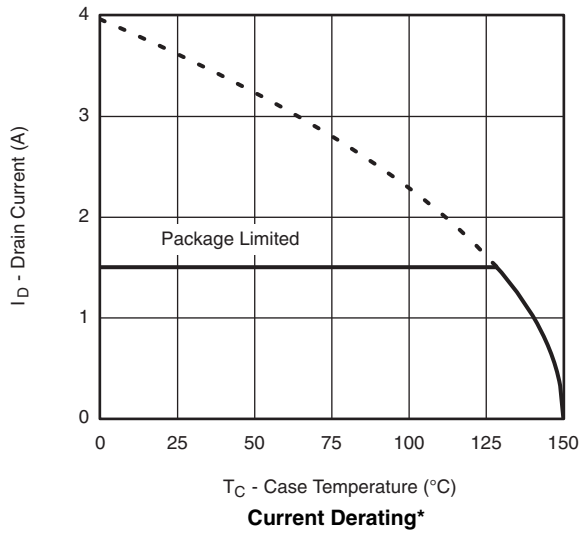


Threshold Voltage



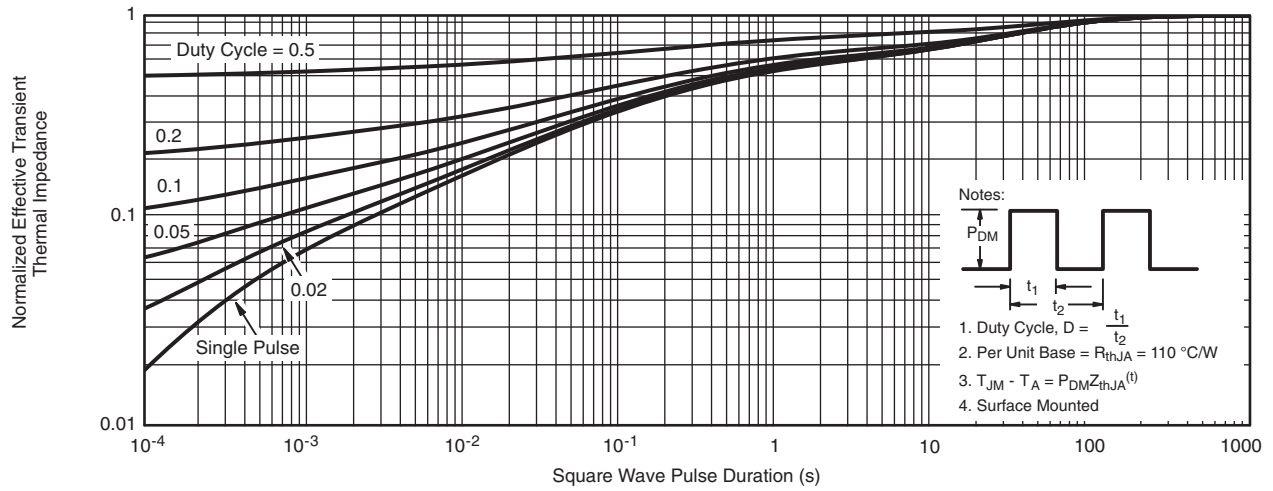
\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified  
Safe Operating Area, Junction-to-Ambient

**N-CHANNEL TYPICAL CHARACTERISTICS**  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted

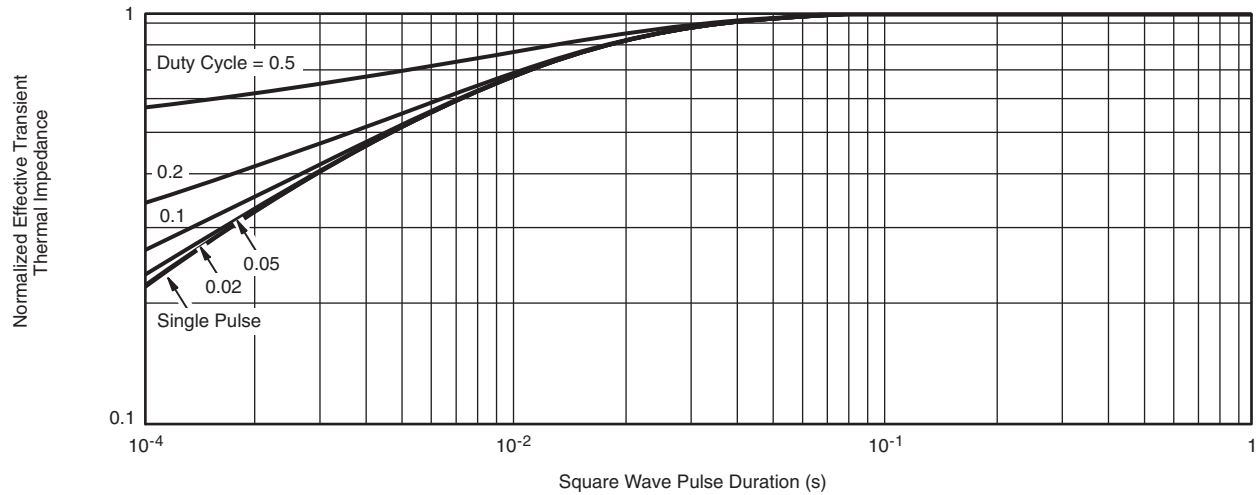


\* The power dissipation  $P_D$  is based on  $T_{J(max)} = 150\text{ }^\circ\text{C}$ , using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls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

**N-CHANNEL TYPICAL CHARACTERISTICS**  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted

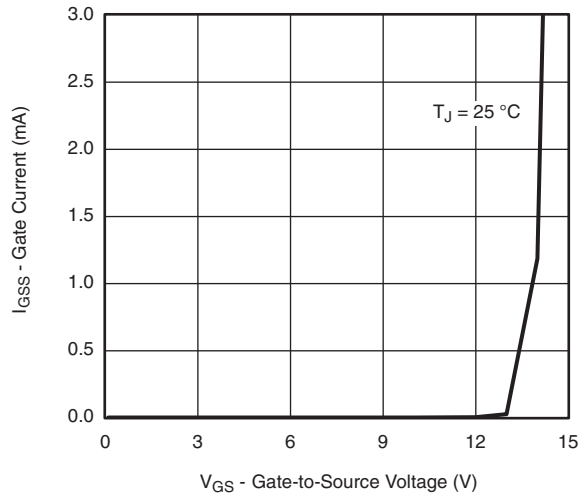


**Normalized Thermal Transient Impedance, Junction-to-Ambient**

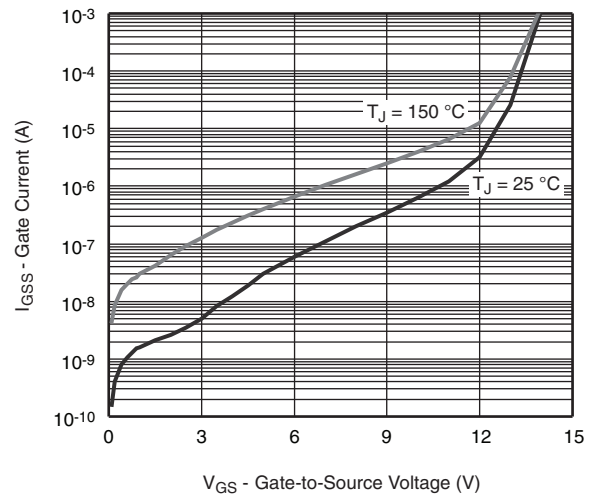


**Normalized Thermal Transient Impedance, Junction-to-Case**

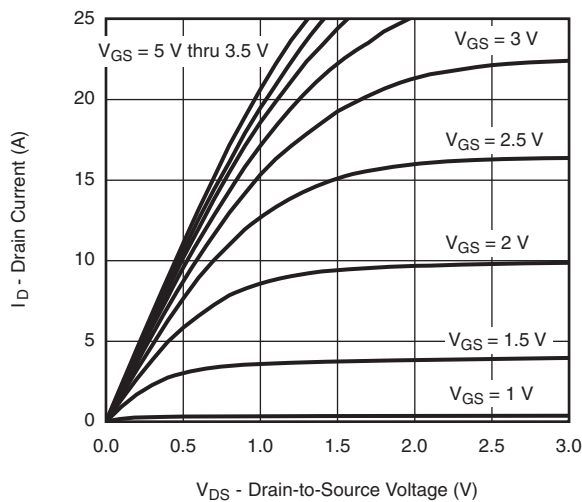
**P-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



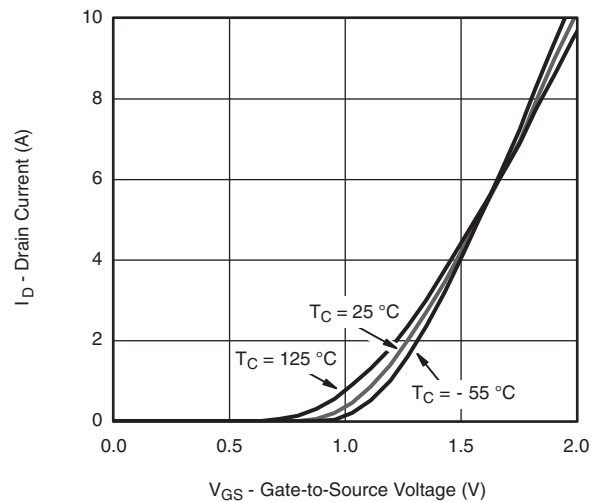
**Gate Current vs. Gate-Source Voltage**



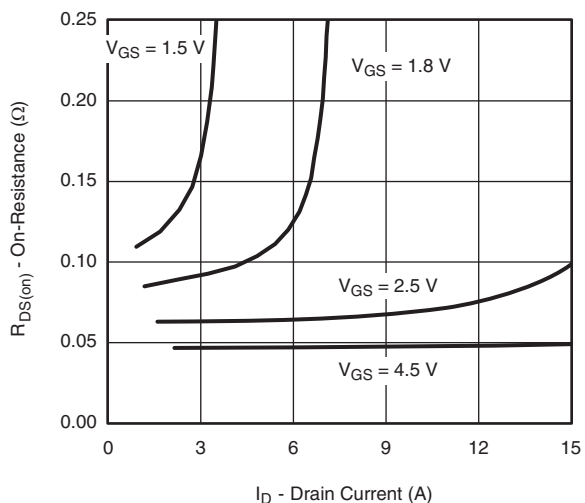
**Gate Current vs. Gate-Source Voltage**



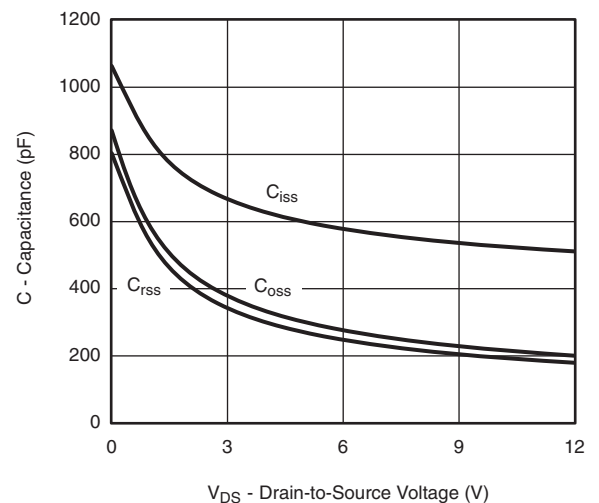
**Output Characteristics**



**Transfer Characteristics**



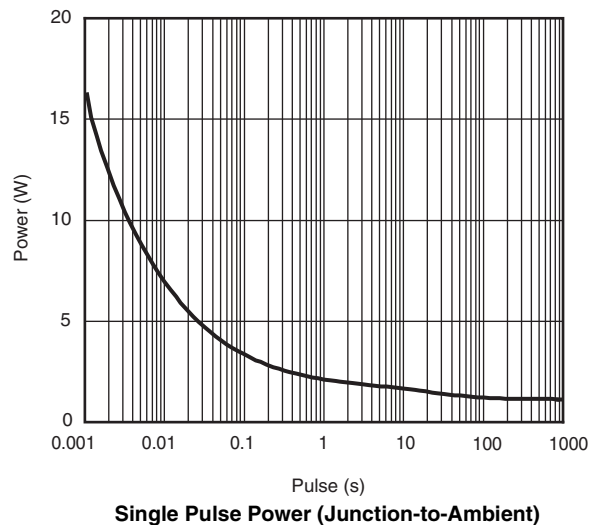
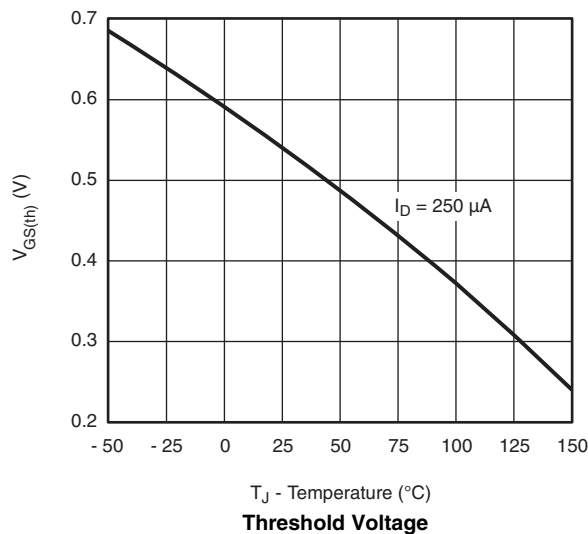
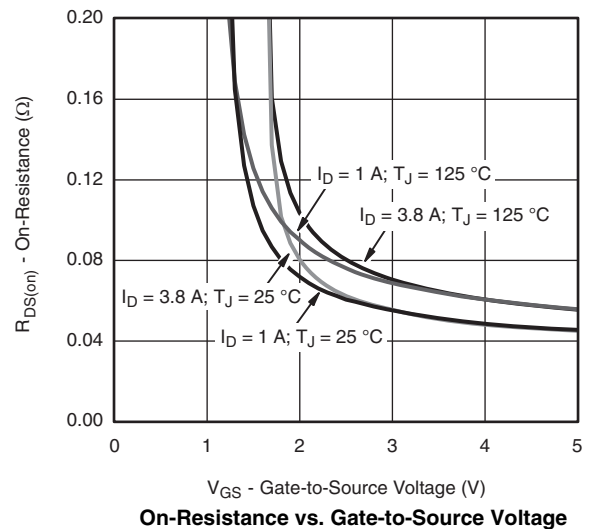
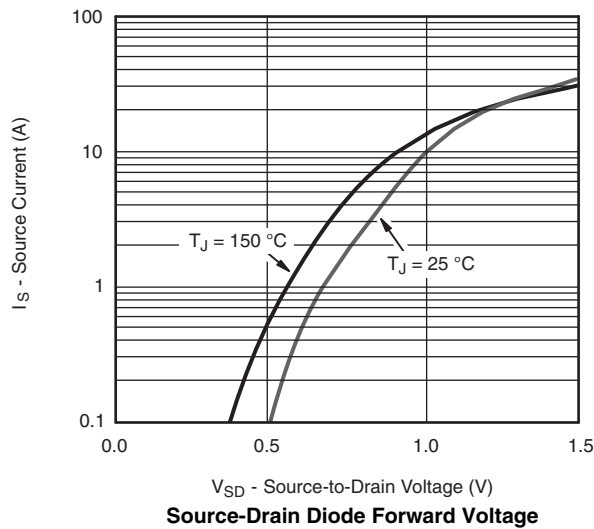
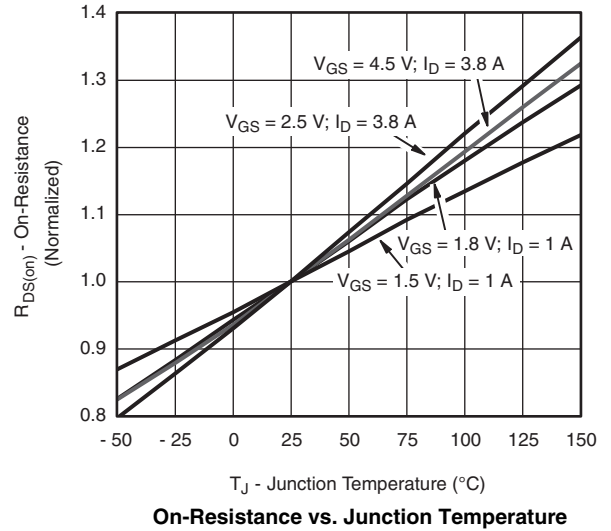
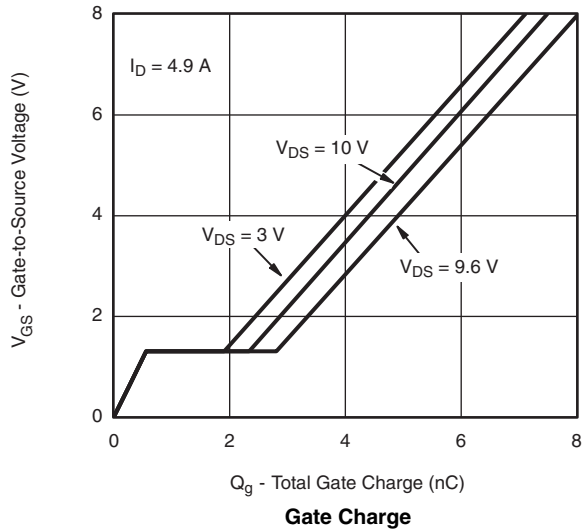
**On-Resistance vs. Drain Current and Gate Voltage**



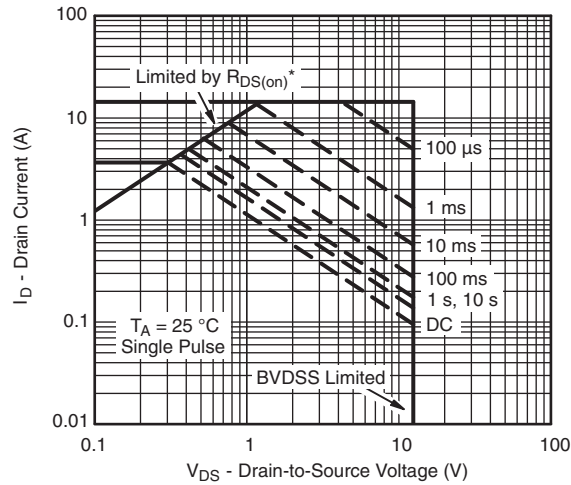
**Capacitance**



**P-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted

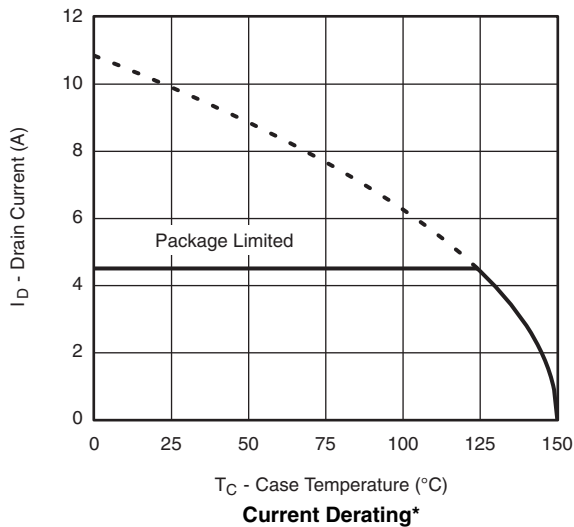


**P-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted

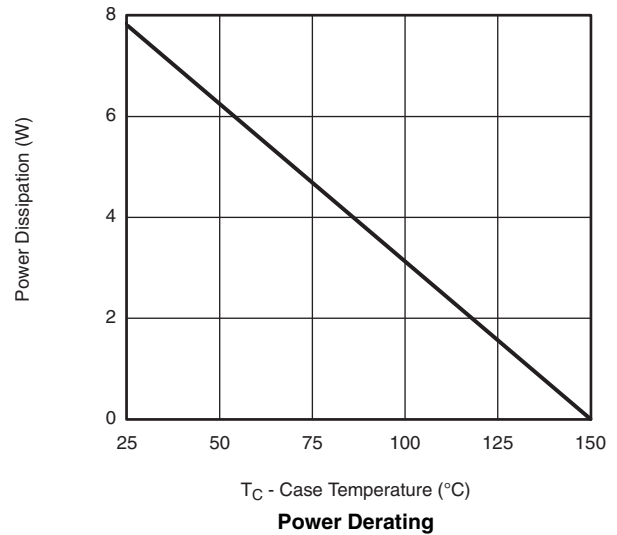


\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified

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



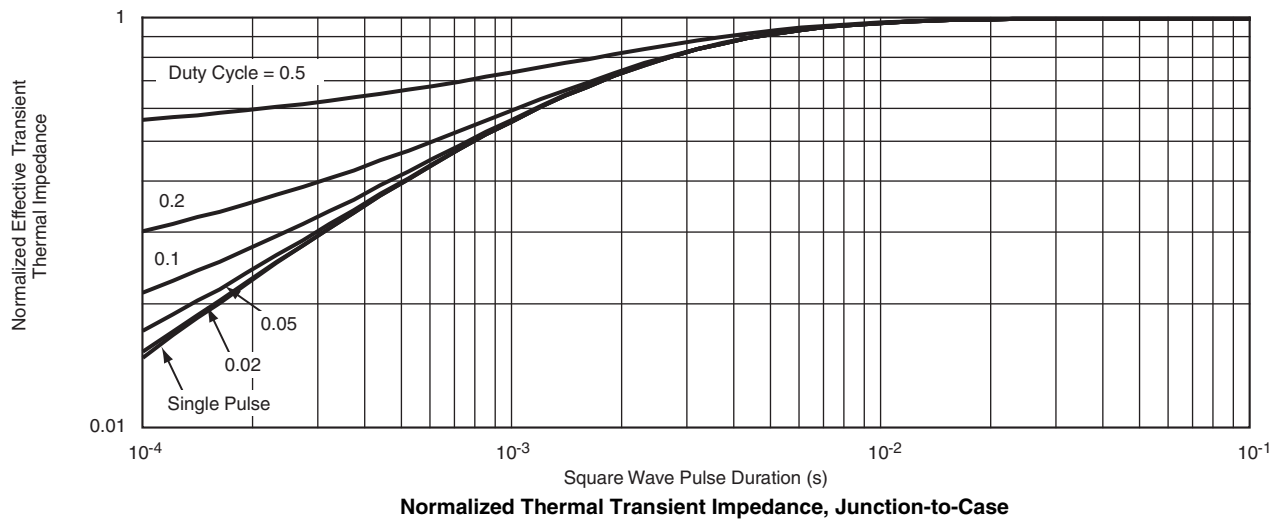
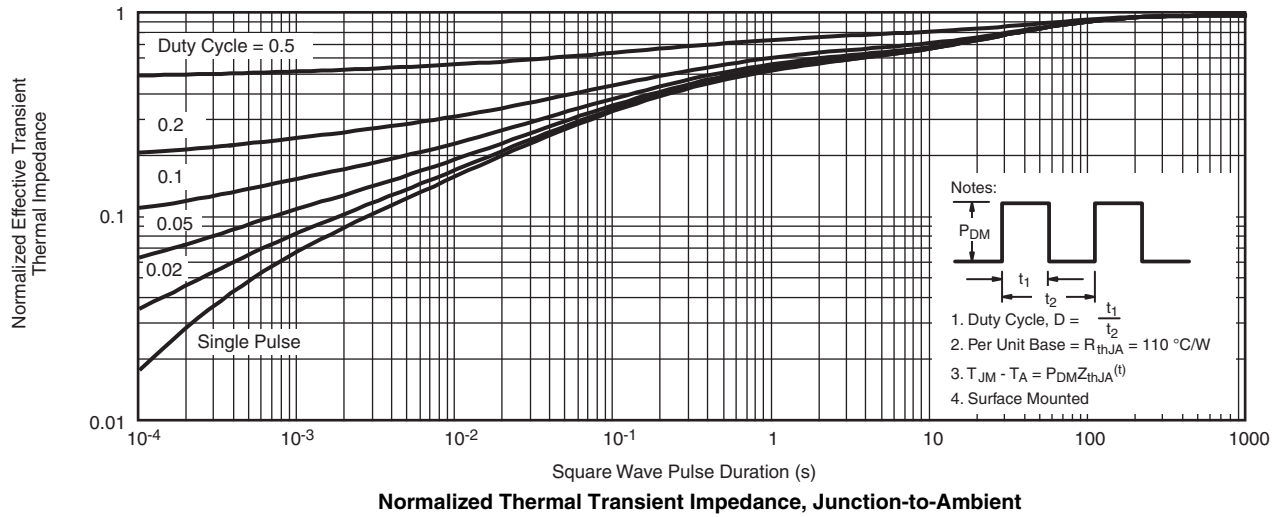
**Current Derating\***



**Power Derating**

\* The power dissipation  $P_D$  is based on  $T_{J(max)} = 150^\circ\text{C}$ , 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.

**P-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



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