

## P-Channel 12-V (D-S) MOSFET

PRODUCT SUMMARY			
$V_{DS}$ (V)	$R_{DS(on)}$ ( $\Omega$ )	$I_D$ (A)	$Q_g$ (Typ.)
- 12	0.013 at $V_{GS} = - 4.5$ V	- 16 <sup>a</sup>	46 nC
	0.017 at $V_{GS} = - 2.5$ V	- 16 <sup>a</sup>	
	0.024 at $V_{GS} = - 1.8$ V	- 16 <sup>a</sup>	

### FEATURES

- Halogen-free Option Available
- TrenchFET<sup>®</sup> Power MOSFET

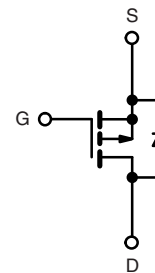
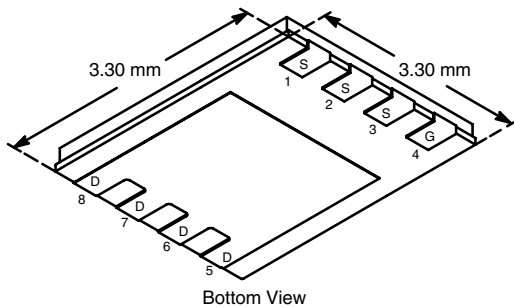


**RoHS**  
COMPLIANT

### APPLICATIONS

- Load Switch, PA Switch and Power Switch for Portable Devices

PowerPAK 1212-8



P-Channel MOSFET

Ordering Information: Si7405BDN-T1-E3 (Lead (Pb)-free)  
Si7405BDN-T1-GE3 (Lead (Pb)-free and Halogen-free)

ABSOLUTE MAXIMUM RATINGS $T_A = 25$ °C, unless otherwise noted			
Parameter	Symbol	Limit	Unit
Drain-Source Voltage	$V_{DS}$	- 12	V
Gate-Source Voltage	$V_{GS}$	$\pm 8$	
Continuous Drain Current ( $T_J = 150$ °C)	$I_D$	$T_C = 25$ °C	- 16 <sup>a</sup>
		$T_C = 70$ °C	- 16 <sup>a</sup>
		$T_A = 25$ °C	- 13.5 <sup>b, c</sup>
		$T_A = 70$ °C	- 11 <sup>b, c</sup>
Pulsed Drain Current	$I_{DM}$	- 40	A
Continuous Source-Drain Diode Current	$I_S$	$T_C = 25$ °C	
		$T_A = 25$ °C	- 3 <sup>b, c</sup>
Maximum Power Dissipation	$P_D$	$T_C = 25$ °C	33
		$T_C = 70$ °C	21
		$T_A = 25$ °C	3.6 <sup>b, c</sup>
		$T_A = 70$ °C	2.3 <sup>b, c</sup>
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to 150	°C
Soldering Recommendations (Peak Temperature) <sup>d, e</sup>		260	

THERMAL RESISTANCE RATINGS					
Parameter		Symbol	Typical	Maximum	Unit
Maximum Junction-to-Ambient <sup>b, f</sup>	$t \leq 10$ s	$R_{thJA}$	28	35	°C/W
Maximum Junction-to-Case (Drain)	Steady State	$R_{thJC}$	2.9	3.8	

Notes:

- Package limited.
- Surface Mounted on 1" x 1" FR4 board.
- $t = 10$  s.
- See Solder Profile (<http://www.vishay.com/ppg?73257>).. The PowerPAK 1212-8 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 is 81 °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	$V_{DS}$	$V_{GS} = 0\text{ V}$ , $I_D = -250\text{ }\mu\text{A}$	-12			V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = -250\text{ }\mu\text{A}$		-10		mV/°C
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$			3		
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$ , $I_D = -250\text{ }\mu\text{A}$	-0.4		-1	V
Gate-Source Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 8\text{ V}$			$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = -12\text{ V}$ , $V_{GS} = 0\text{ V}$			-1	$\mu\text{A}$
		$V_{DS} = -12\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 55\text{ }^\circ\text{C}$			-10	
On-State Drain Current <sup>a</sup>	$I_{D(on)}$	$V_{DS} \leq -5\text{ V}$ , $V_{GS} = -4.5\text{ V}$	-20			A
Drain-Source On-State Resistance <sup>a</sup>	$R_{DS(on)}$	$V_{GS} = -4.5\text{ V}$ , $I_D = -13.5\text{ A}$		0.009	0.013	$\Omega$
		$V_{GS} = -2.5\text{ V}$ , $I_D = -12\text{ A}$		0.012	0.017	
		$V_{GS} = -1.8\text{ V}$ , $I_D = -4.2\text{ A}$		0.016	0.024	
Forward Transconductance <sup>a</sup>	$g_{fs}$	$V_{DS} = -6\text{ V}$ , $I_D = -13.5\text{ A}$		55		S
<b>Dynamic<sup>b</sup></b>						
Input Capacitance	$C_{iss}$	$V_{DS} = -6\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1\text{ MHz}$		3500		$\mu\text{F}$
Output Capacitance	$C_{oss}$			910		
Reverse Transfer Capacitance	$C_{rss}$			860		
Total Gate Charge	$Q_g$	$V_{DS} = -6\text{ V}$ , $V_{GS} = -8\text{ V}$ , $I_D = -10\text{ A}$		75	115	nC
				46	70	
Gate-Source Charge	$Q_{gs}$	$V_{DS} = -6\text{ V}$ , $V_{GS} = -4.5\text{ V}$ , $I_D = -10\text{ A}$		4.5		
Gate-Drain Charge	$Q_{gd}$			14		
Gate Resistance	$R_g$	$f = 1\text{ MHz}$		3		$\Omega$
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -6\text{ V}$ , $R_L = 0.6\text{ }\Omega$ $I_D \cong -10\text{ A}$ , $V_{GEN} = -4.5\text{ V}$ , $R_g = 1\text{ }\Omega$		22	35	ns
Rise Time	$t_r$			60	90	
Turn-Off Delay Time	$t_{d(off)}$			80	120	
Fall Time	$t_f$			45	70	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -6\text{ V}$ , $R_L = 0.6\text{ }\Omega$ $I_D \cong -10\text{ A}$ , $V_{GEN} = -8\text{ V}$ , $R_g = 1\text{ }\Omega$		12	20	
Rise Time	$t_r$			15	25	
Turn-Off Delay Time	$t_{d(off)}$			75	115	
Fall Time	$t_f$			45	70	
<b>Drain-Source Body Diode Characteristics</b>						
Continuous Source-Drain Diode Current	$I_S$	$T_C = 25\text{ }^\circ\text{C}$			-12	A
Pulse Diode Forward Current	$I_{SM}$				30	
Body Diode Voltage	$V_{SD}$	$I_S = -10\text{ A}$ , $V_{GS} = 0\text{ V}$		-0.8	-1.2	V
Body Diode Reverse Recovery Time	$t_{rr}$	$I_F = -10\text{ A}$ , $dI/dt = 100\text{ A}/\mu\text{s}$ , $T_J = 25\text{ }^\circ\text{C}$		50	75	ns
Body Diode Reverse Recovery Charge	$Q_{rr}$			30	45	nC
Reverse Recovery Fall Time	$t_a$			20		ns
Reverse Recovery Rise Time	$t_b$			30		

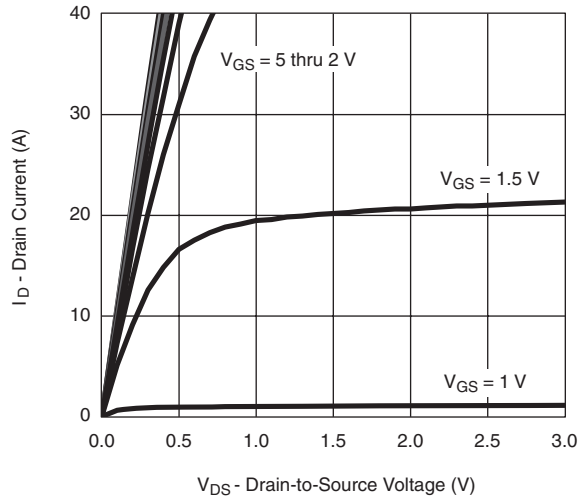
Notes:

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

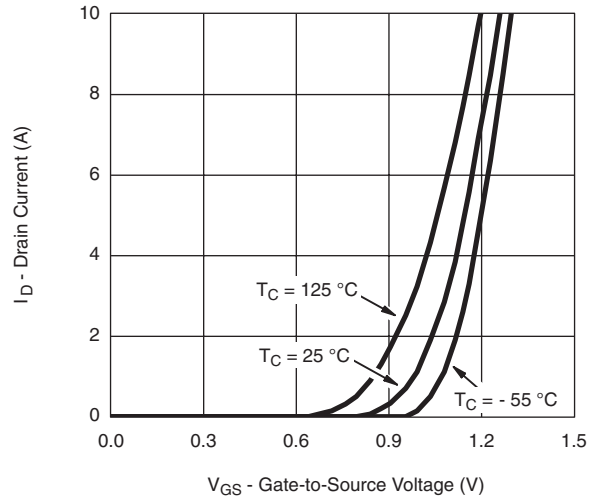
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



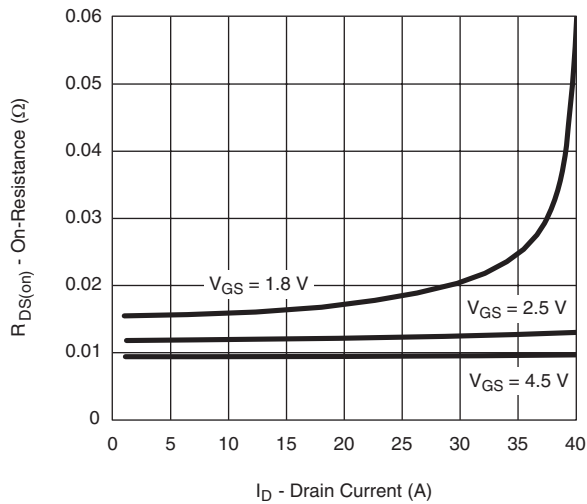
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



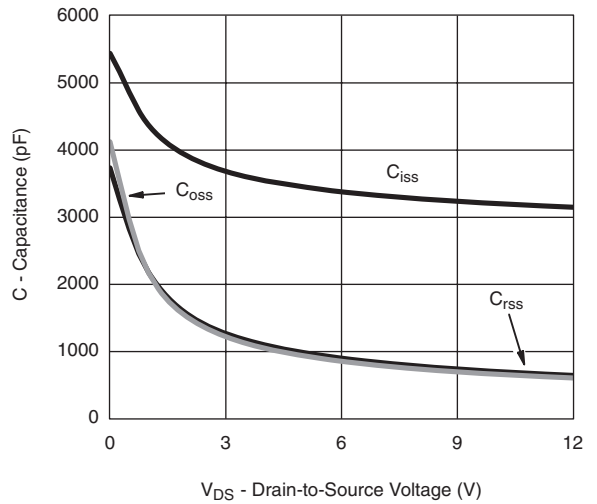
**Output Characteristics**



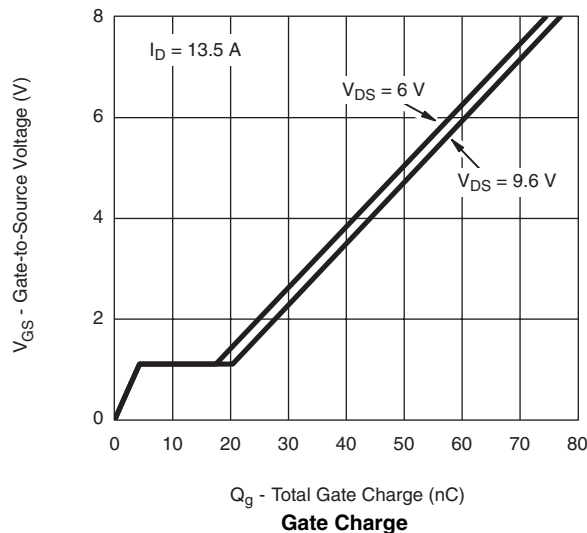
**Transfer Characteristics**



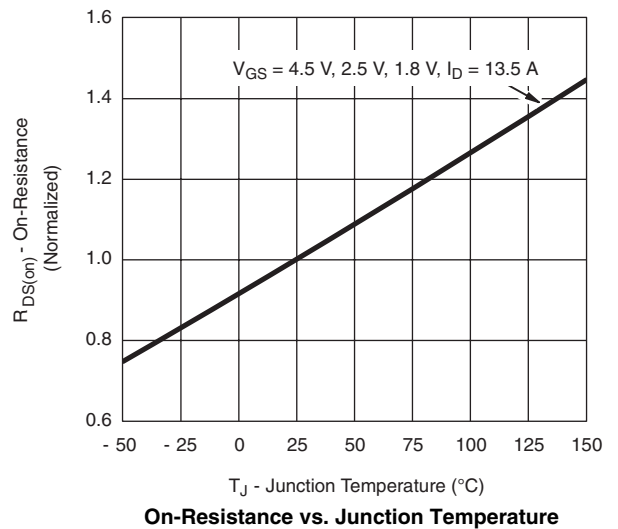
**On-Resistance vs. Drain Current and Gate Voltage**



**Capacitance**



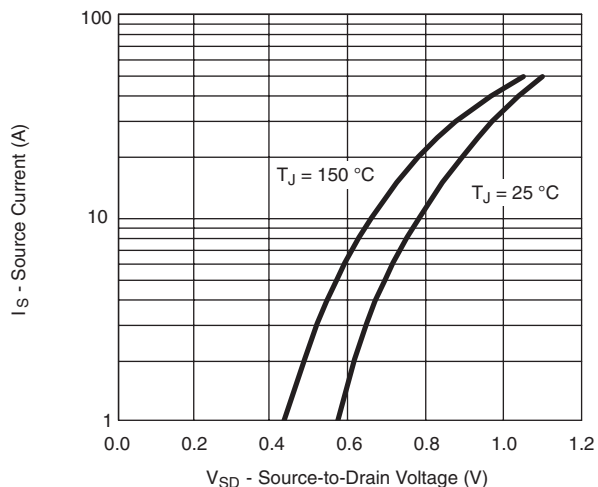
**Gate Charge**



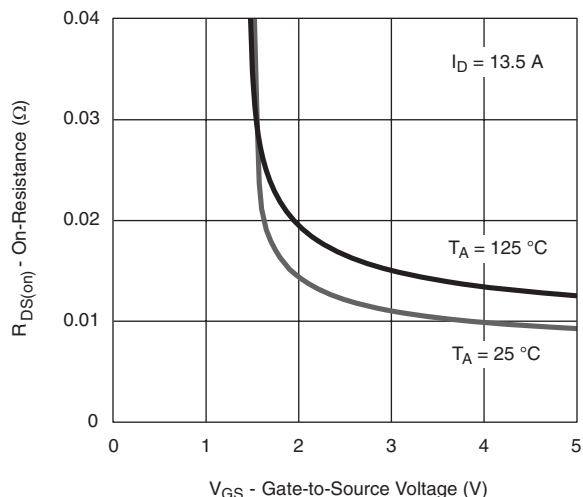
**On-Resistance vs. Junction Temperature**



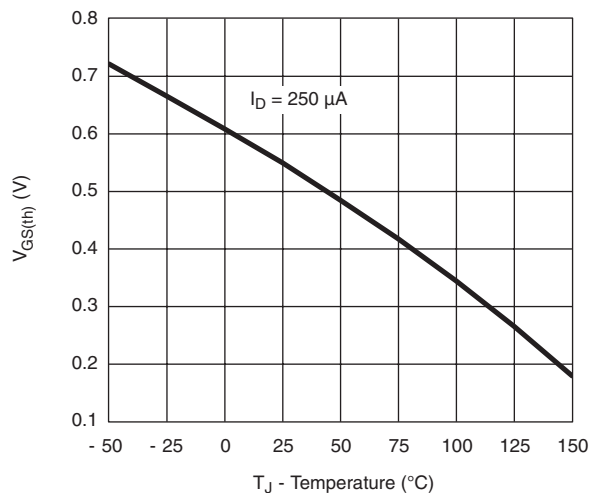
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



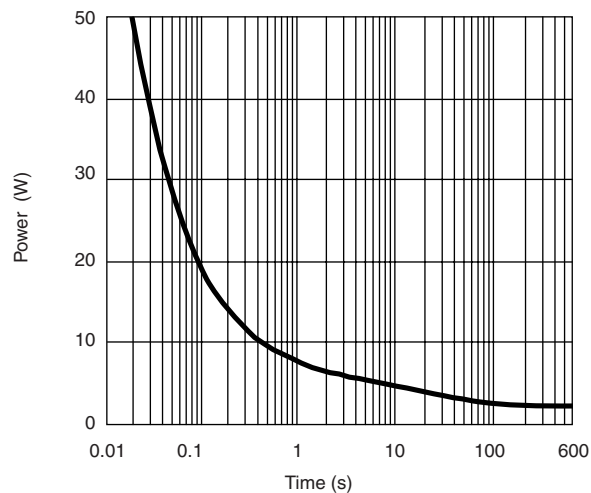
**Source-Drain Diode Forward Voltage**



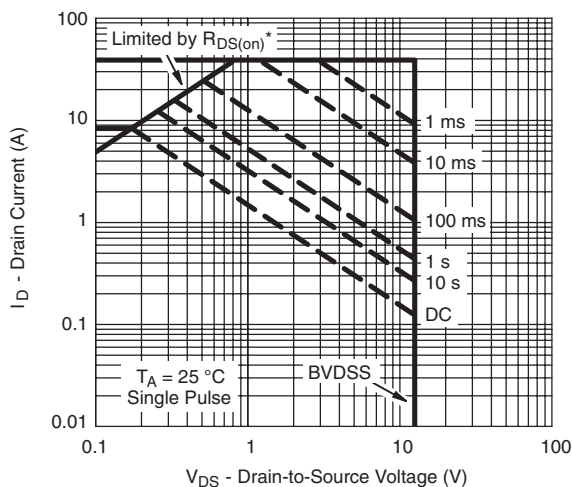
**On-Resistance vs. Gate-to-Source Voltage**



**Threshold Voltage**



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

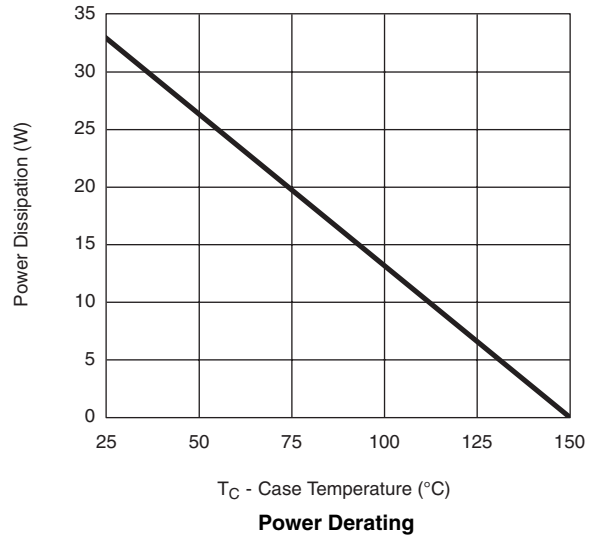
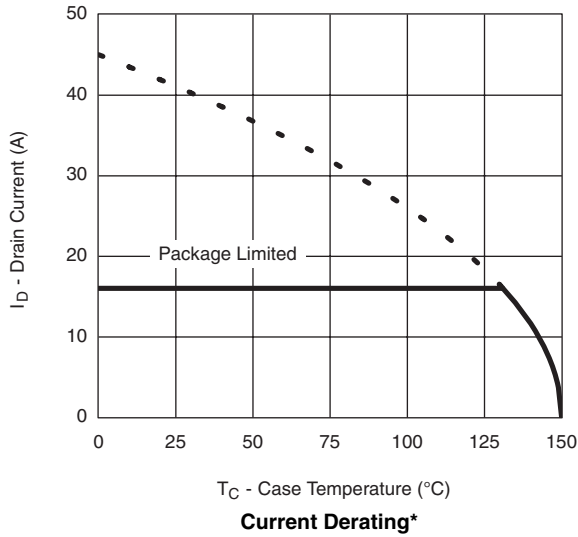


\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified

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



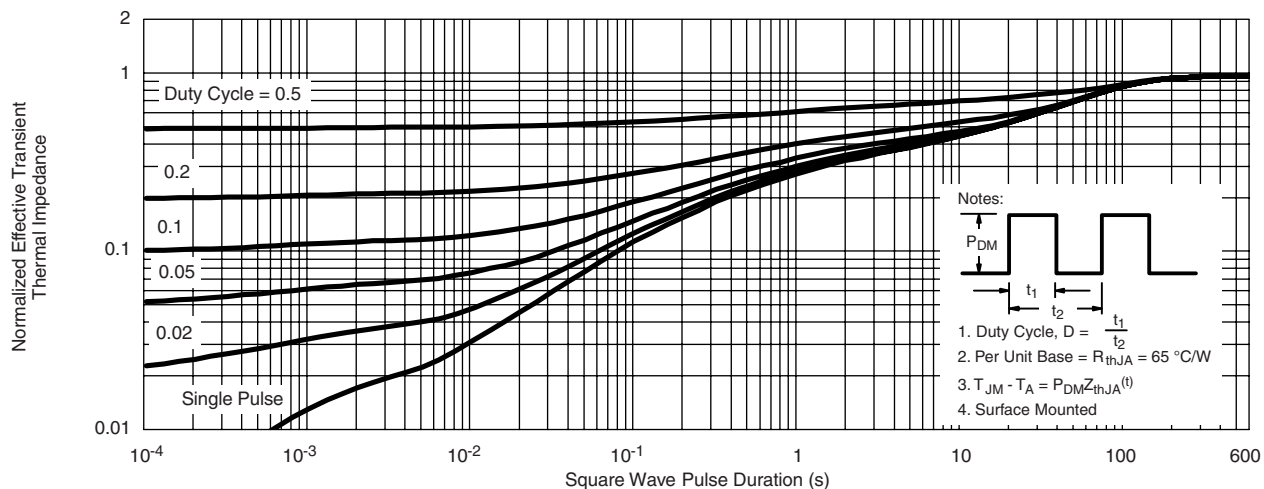
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



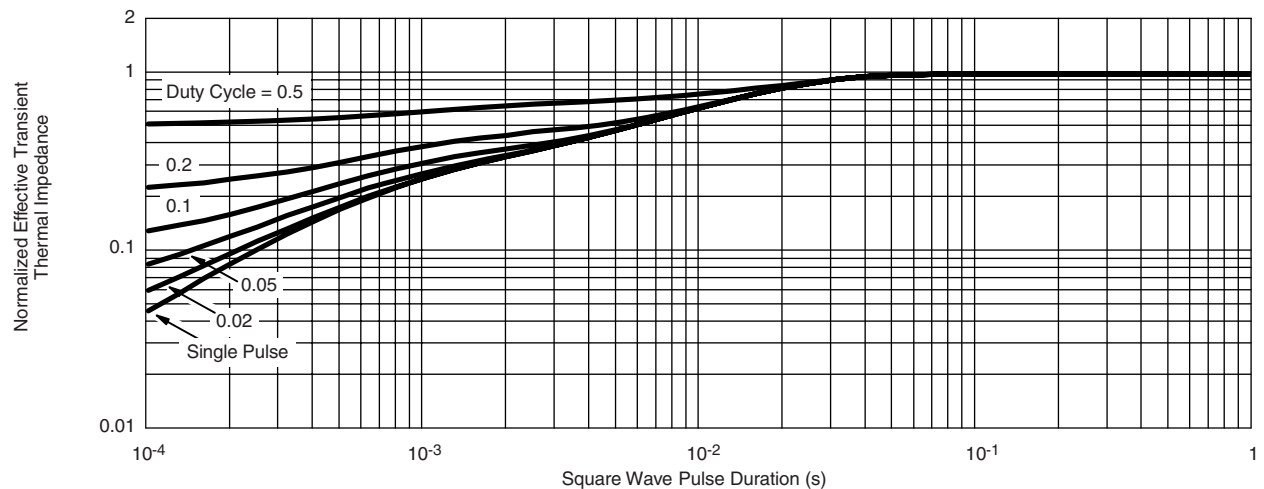
\* The power dissipation  $P_D$  is based on  $T_{J(max)} = 150$  °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package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



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



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



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

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