

## N-Channel 40-V (D-S), 175 °C MOSFET

PRODUCT SUMMARY			
V <sub>DS</sub> (V)	R <sub>DS(on)</sub> (Ω)	I <sub>D</sub> (A) <sup>a, c</sup>	Q <sub>g</sub> (Typ.)
40	0.016 at V <sub>GS</sub> = 10 V	20	15.6 nC
	0.018 at V <sub>GS</sub> = 4.5 V	20	

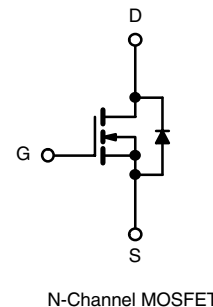
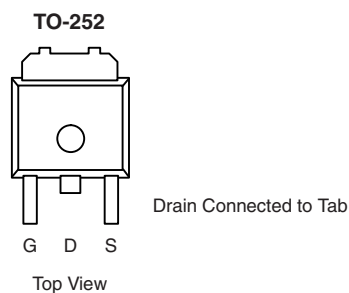
### FEATURES

- TrenchFET<sup>®</sup> Power MOSFET
- 100 % R<sub>g</sub> and UIS Tested


**RoHS**  
COMPLIANT

### APPLICATIONS

- LCD TV Inverter
- Secondary Synchronous Rectification


**Ordering Information:** SUD50N04-16P-E3 (Lead (Pb)-free)

ABSOLUTE MAXIMUM RATINGS T <sub>A</sub> = 25 °C, unless otherwise noted				
Parameter	Symbol	Limit	Unit	
Drain-Source Voltage	V <sub>DS</sub>	40	V	
Gate-Source Voltage	V <sub>GS</sub>	± 16		
Continuous Drain Current (T <sub>J</sub> = 150 °C)	I <sub>D</sub>	T <sub>C</sub> = 25 °C	20 <sup>c</sup>	A
		T <sub>C</sub> = 100 °C	20 <sup>c</sup>	
		T <sub>A</sub> = 25 °C	9.8 <sup>b</sup>	
		T <sub>A</sub> = 100 °C	6.8 <sup>b</sup>	
Pulsed Drain Current	I <sub>DM</sub>	50		
Continuous Source-Drain Diode Current	I <sub>S</sub>	T <sub>C</sub> = 25 °C	20 <sup>c</sup>	
		T <sub>A</sub> = 25 °C	2.5 <sup>b</sup>	
Single Pulse Avalanche Current	I <sub>AS</sub>	20		
Avalanche Energy	E <sub>AS</sub>	20	mJ	
Maximum Power Dissipation	P <sub>D</sub>	T <sub>C</sub> = 25 °C	35.7	W
		T <sub>C</sub> = 100 °C	17.8	
		T <sub>A</sub> = 25 °C	3.1 <sup>b</sup>	
		T <sub>A</sub> = 100 °C	1.5 <sup>b</sup>	
Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	- 55 to 175	°C	

THERMAL RESISTANCE RATINGS					
Parameter		Symbol	Typical	Maximum	Unit
Maximum Junction-to-Ambient <sup>b</sup>	Steady State	R <sub>thJA</sub>	40	50	°C/W
Maximum Junction-to-Case	Steady State	R <sub>thJC</sub>	3.4	5.3	

Notes:

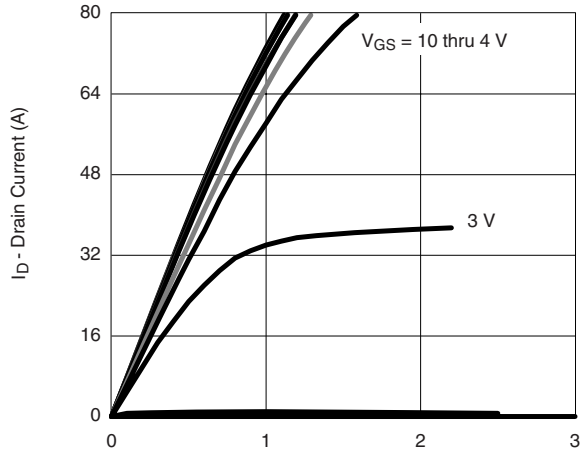
- Based on T<sub>C</sub> = 25 °C.
- Surface Mounted on 1" x 1" FR4 board.
- Package limited.

<b>SPECIFICATIONS</b> $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	40			V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = 250\text{ }\mu\text{A}$		38		mV/ $^\circ\text{C}$
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$			- 5.4		
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	0.8		2.2	V
Gate-Source Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 16\text{ V}$			$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 40\text{ V}, V_{GS} = 0\text{ V}$			1	$\mu\text{A}$
		$V_{DS} = 40\text{ V}, V_{GS} = 0\text{ V}, T_J = 100\text{ }^\circ\text{C}$			20	
On-State Drain Current <sup>a</sup>	$I_{D(on)}$	$V_{DS} \geq 5\text{ V}, V_{GS} = 10\text{ V}$	30			A
Drain-Source On-State Resistance <sup>a</sup>	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 15\text{ A}$		0.0125	0.016	$\Omega$
		$V_{GS} = 4.5\text{ V}, I_D = 10\text{ A}$		0.014	0.018	
Forward Transconductance <sup>a</sup>	$g_{fs}$	$V_{DS} = 15\text{ V}, I_D = 15\text{ A}$		58		S
<b>Dynamic<sup>b</sup></b>						
Input Capacitance	$C_{iss}$	$V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$		1655		pF
Output Capacitance	$C_{oss}$			200		
Reverse Transfer Capacitance	$C_{rss}$			152		
Total Gate Charge	$Q_g$	$V_{DS} = 20\text{ V}, V_{GS} = 10\text{ V}, I_D = 30\text{ A}$		39.2	60	nC
				15.6	24	
Gate-Source Charge	$Q_{gs}$	$V_{DS} = 20\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 30\text{ A}$		4.2		
Gate-Drain Charge	$Q_{gd}$			5.5		
Gate Resistance	$R_g$	$f = 1\text{ MHz}$		2.1	3.2	$\Omega$
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 20\text{ V}, R_L = 0.66\text{ }\Omega$ $I_D \cong 30\text{ A}, V_{GEN} = 4.5\text{ V}, R_g = 1\text{ }\Omega$		19	30	ns
Rise Time	$t_r$			120	180	
Turn-Off Delay Time	$t_{d(off)}$			40	60	
Fall Time	$t_f$			36	55	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 20\text{ V}, R_L = 0.66\text{ }\Omega$ $I_D \cong 30\text{ A}, V_{GEN} = 10\text{ V}, R_g = 1\text{ }\Omega$		8	16	
Rise Time	$t_r$			22	35	
Turn-Off Delay Time	$t_{d(off)}$			24	36	
Fall Time	$t_f$			8	16	
<b>Drain-Source Body Diode Characteristics</b>						
Continuous Source-Drain Diode Current	$I_S$	$T_C = 25\text{ }^\circ\text{C}$			20	A
Pulse Diode Forward Current <sup>a</sup>	$I_{SM}$				50	
Body Diode Voltage	$V_{SD}$	$I_S = 10\text{ A}$		0.84	1.2	V
Body Diode Reverse Recovery Time	$t_{rr}$	$I_F = 20\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, T_J = 25\text{ }^\circ\text{C}$		25	38	ns
Body Diode Reverse Recovery Charge	$Q_{rr}$			22	33	nC
Reverse Recovery Fall Time	$t_a$			15		ns
Reverse Recovery Rise Time	$t_b$			10		

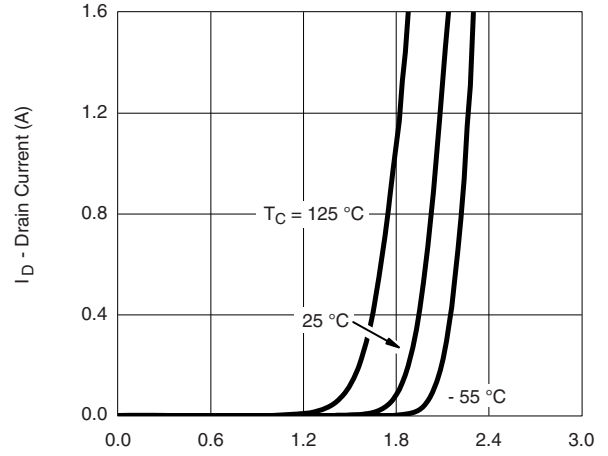
## Notes:

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

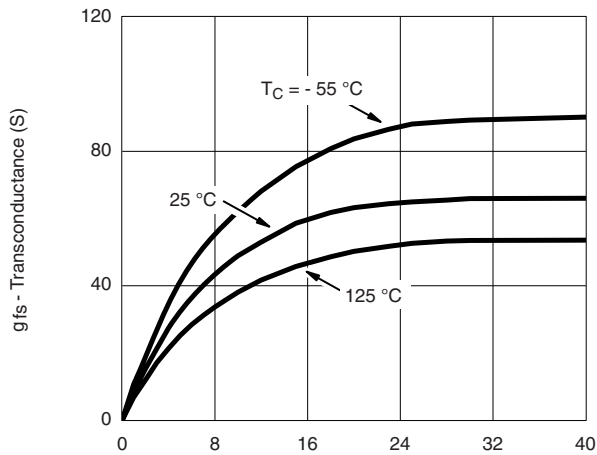
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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

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


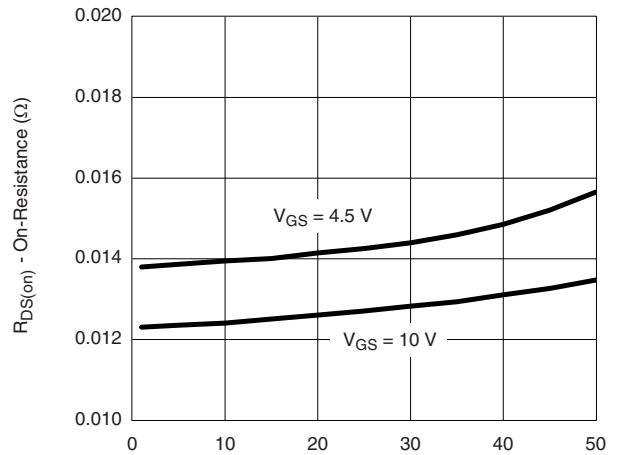
$V_{DS}$  - Drain-to-Source Voltage (V)  
**Output Characteristics**



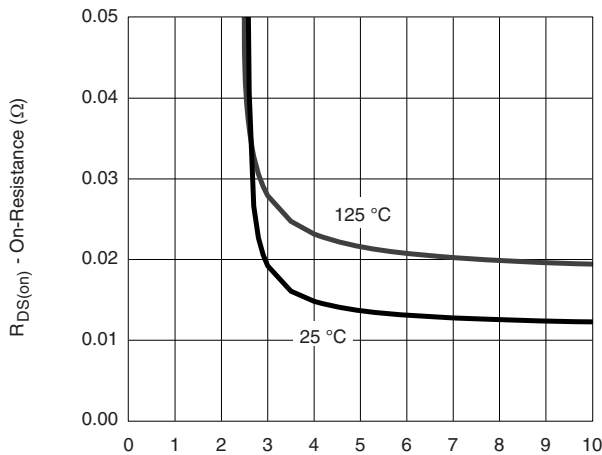
$V_{GS}$  - Gate-to-Source Voltage (V)  
**Transfer Characteristics**



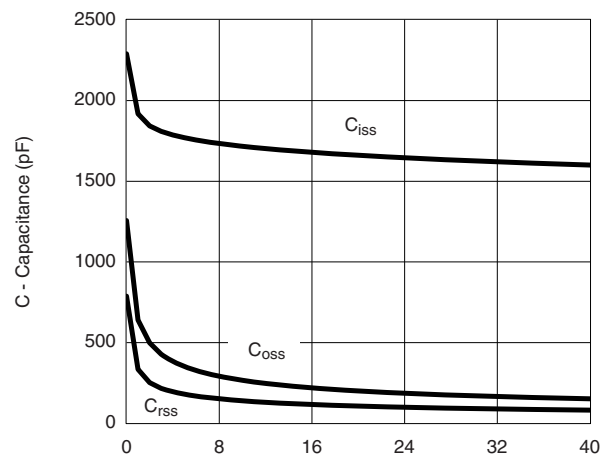
$I_D$  - Drain Current (A)  
**Transconductance**



$I_D$  - Drain Current (A)  
**On-Resistance vs. Drain Current**

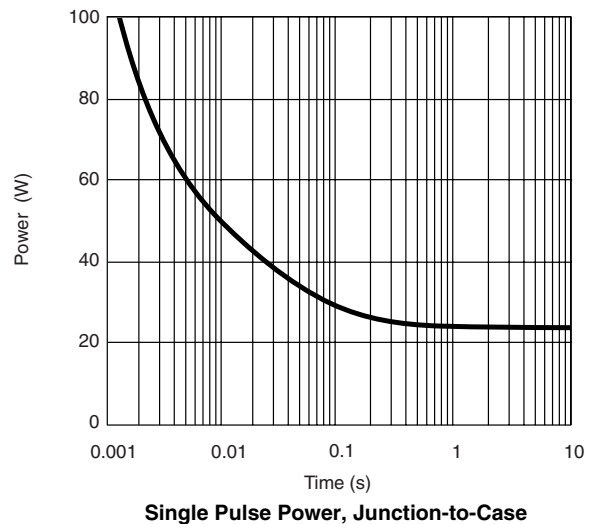
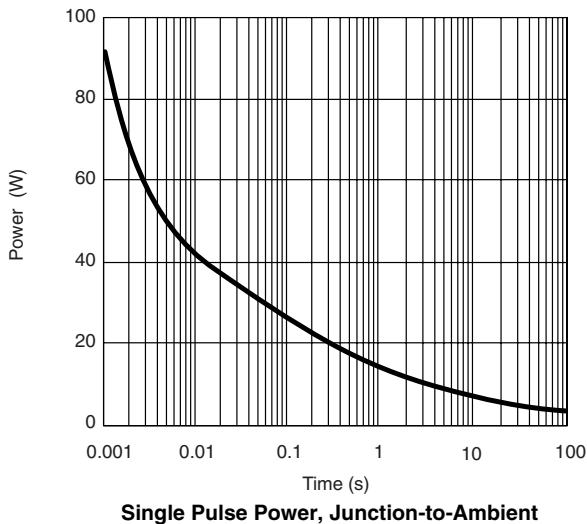
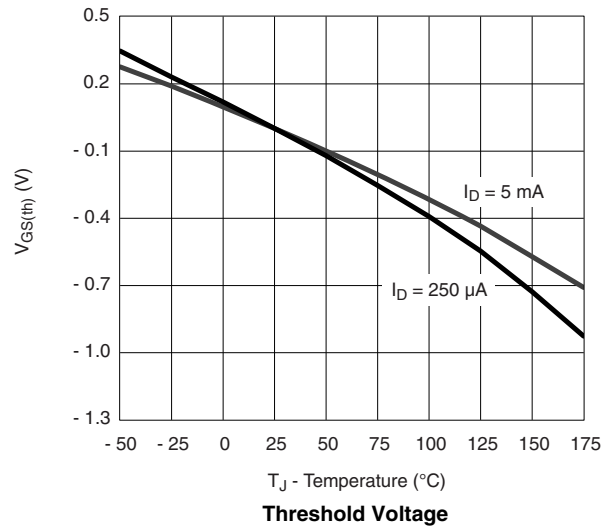
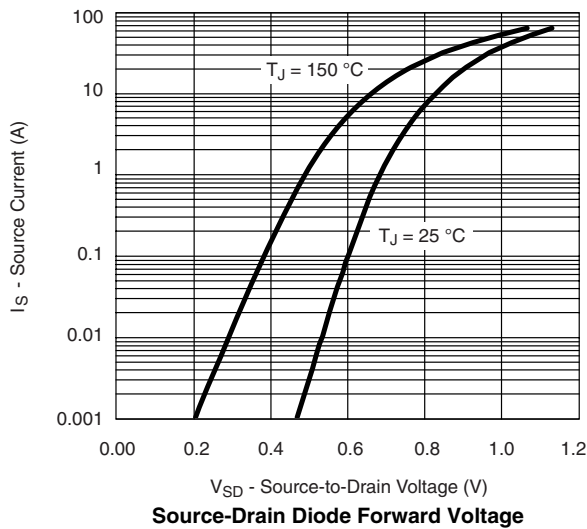
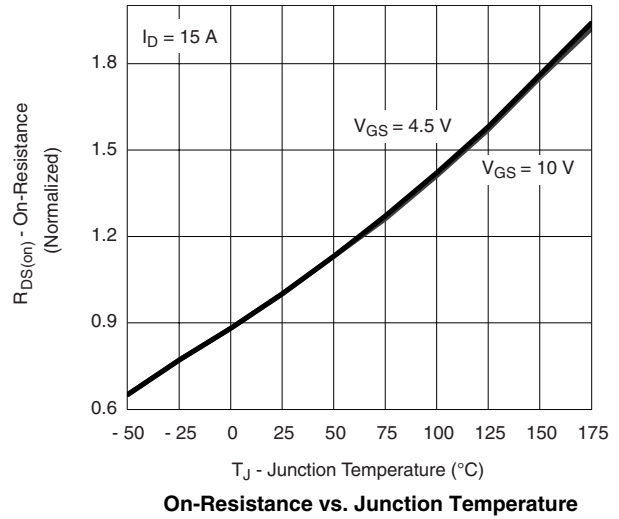
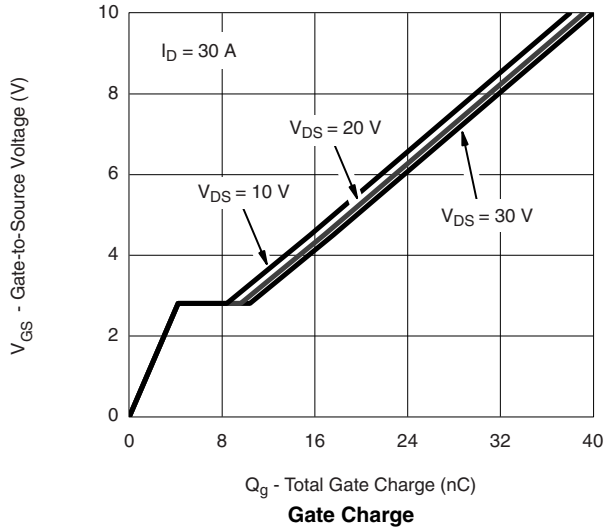


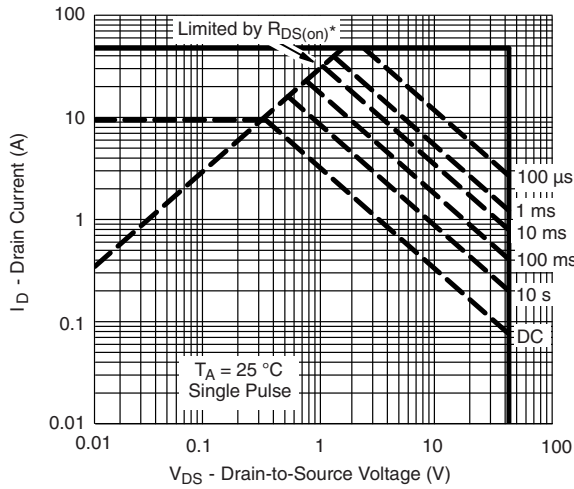
$V_{GS}$  - Gate-to-Source Voltage (V)  
**On-Resistance vs. Gate-to-Source Voltage**



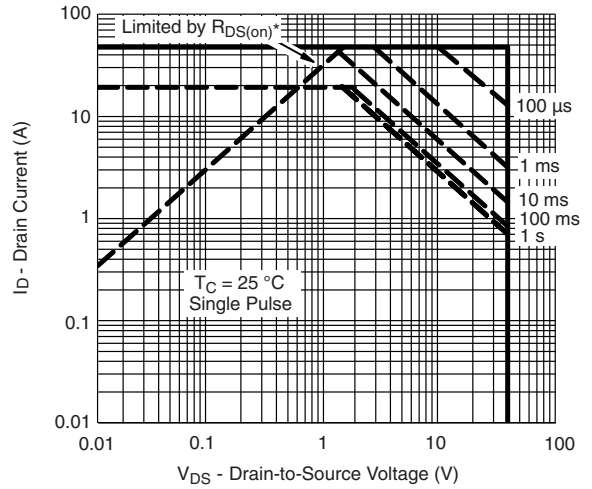
$V_{DS}$  - Drain-to-Source Voltage (V)  
**Capacitance**

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

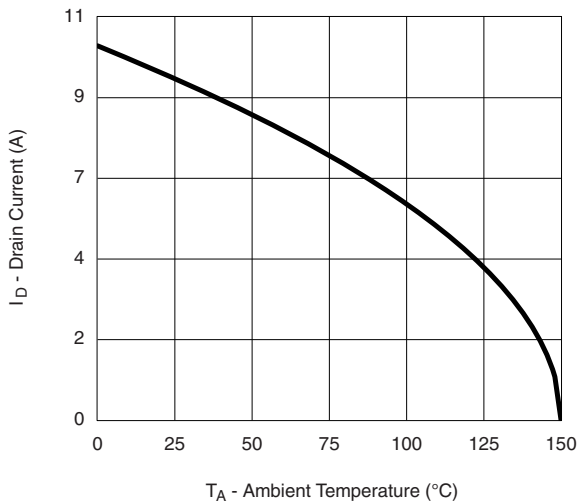


**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted


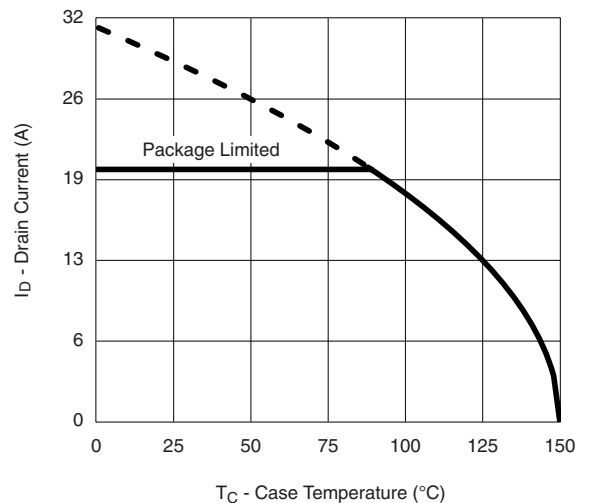
\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified  
**Safe Operating Area, Junction-to-Ambient**



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



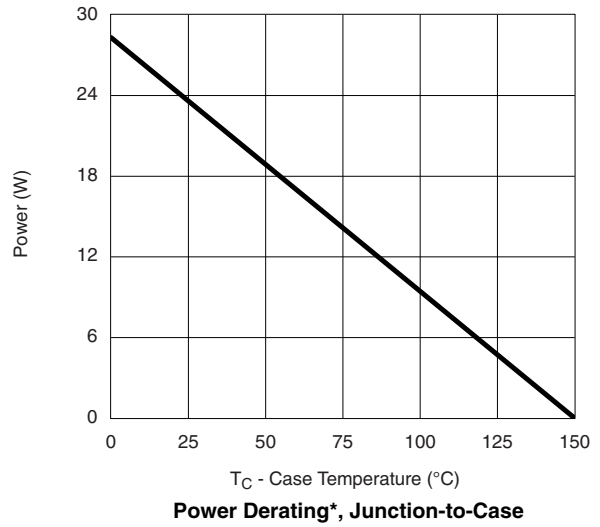
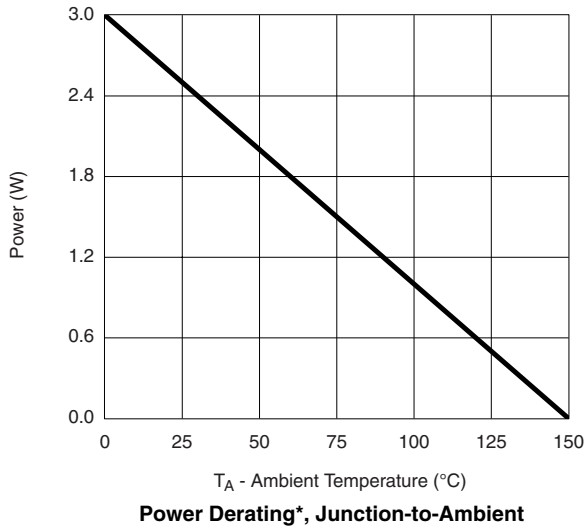
**Current Derating\*\*, Junction-to-Ambient**



**Current Derating\*\*, Junction-to-Case**

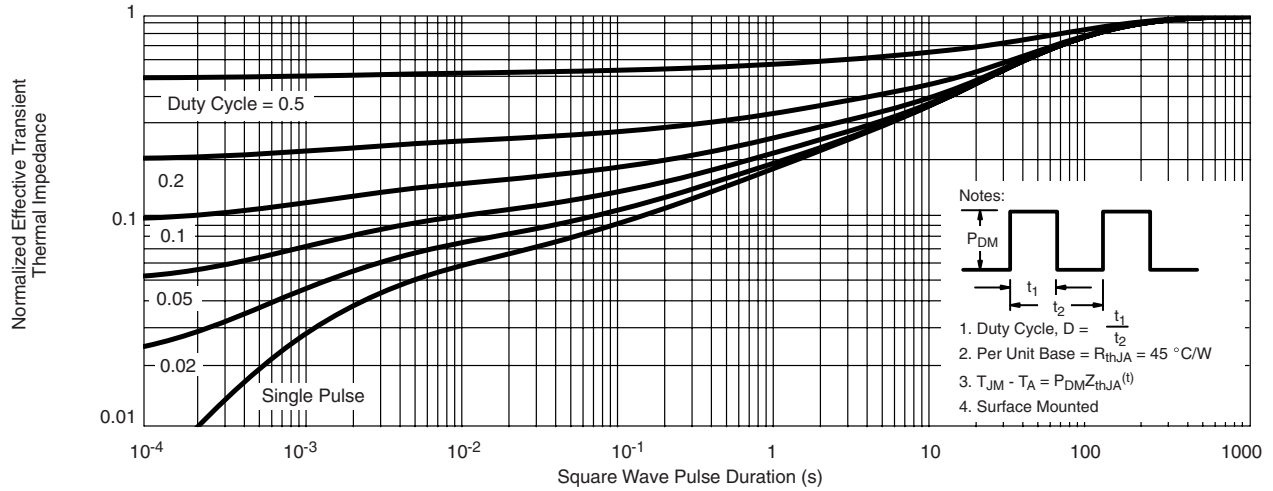
\*\* The power dissipation  $P_D$  is based on  $T_{J(max)} = 175$  °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

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

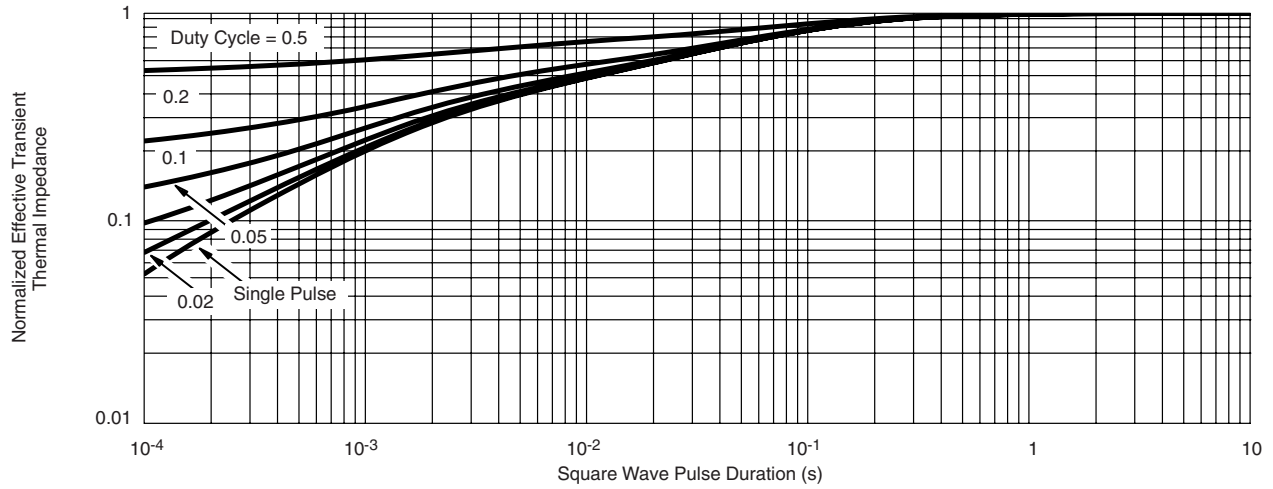


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**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



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



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

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