

# Complementary N- and P-Channel 40-V (D-S) MOSFET

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	40	0.030 at V <sub>GS</sub> = 10 V	8	9.6
		0.034 at V <sub>GS</sub> = 4.5 V	8	
P-Channel	- 40	0.032 at V <sub>GS</sub> = - 10 V	- 8	21
		0.041 at V <sub>GS</sub> = - 4.5 V	- 8	

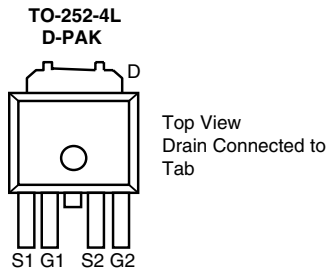
### FEATURES

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

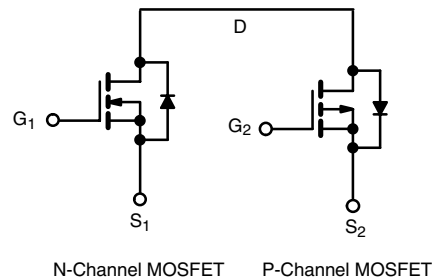


### APPLICATIONS

- CCFL Inverter
- LCD TV and Monitor



Ordering Information: SUD50NP04-62-T4-E3 (Lead (Pb)-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>	40	- 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	8	- 8	A
		T <sub>C</sub> = 70 °C	8	- 8	
		T <sub>A</sub> = 25 °C	8 <sup>b, c</sup>	- 8 <sup>b, c</sup>	
		T <sub>A</sub> = 70 °C	8 <sup>b, c</sup>	- 8 <sup>b, c</sup>	
Pulsed Drain Current (10 μs Pulse Width)	I <sub>DM</sub>	35	- 35	A	
Source-Drain Current Diode Current	I <sub>S</sub>	T <sub>C</sub> = 25 °C	8		- 8
		T <sub>A</sub> = 25 °C	5 <sup>b, c</sup>	- 5.5 <sup>b, c</sup>	
Pulsed Source-Drain Current	I <sub>SM</sub>	35	- 35	A	
Single Pulse Avalanche Current	I <sub>AS</sub>	10	20		
Single Pulse Avalanche Energy	E <sub>AS</sub>	5	20	mJ	
Maximum Power Dissipation	P <sub>D</sub>	T <sub>C</sub> = 25 °C	15.6	23.5	W
		T <sub>C</sub> = 70 °C	10	15	
		T <sub>A</sub> = 25 °C	6 <sup>b, c</sup>	6.7 <sup>b, c</sup>	
		T <sub>A</sub> = 70 °C	3.9 <sup>b, c</sup>	4.3 <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>	17	20.5	15.2	18.5	°C/W
Maximum Junction-to-Case (Drain)	R <sub>thJC</sub>	6.6	8	4.4	5.3	

Notes:

- Based on T<sub>C</sub> = 25 °C.
- Surface Mounted on 1" x 1" FR4 Board.
- t = 10 sec.
- Maximum under Steady State conditions is 53 °C/W (N-Channel) and 50 °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	40		V	
		$V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$	P-Ch	-40			
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = 250\text{ }\mu\text{A}$	N-Ch		37		
		$I_D = -250\text{ }\mu\text{A}$	P-Ch		-38		
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$	$I_D = 250\text{ }\mu\text{A}$	N-Ch		-5		
		$I_D = -250\text{ }\mu\text{A}$	P-Ch		4.0		
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	N-Ch	0.6	2.0		
		$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$	P-Ch	-0.8	-2.2		
Gate-Body Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 16\text{ V}$	N-Ch		100	nA	
			P-Ch		-100		
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 40\text{ V}, V_{GS} = 0\text{ V}$	N-Ch		1	$\mu\text{A}$	
		$V_{DS} = -40\text{ V}, V_{GS} = 0\text{ V}$	P-Ch		-1		
		$V_{DS} = 40\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^\circ\text{C}$	N-Ch		10		
		$V_{DS} = -40\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^\circ\text{C}$	P-Ch		-10		
On-State Drain Current <sup>b</sup>	$I_{D(on)}$	$V_{DS} = 5\text{ V}, V_{GS} = 10\text{ V}$	N-Ch	20		A	
		$V_{DS} = -5\text{ V}, V_{GS} = -10\text{ V}$	P-Ch	-20			
Drain-Source On-State Resistance <sup>b</sup>	$r_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 6\text{ A}$	N-Ch		0.025	0.030	$\Omega$
		$V_{GS} = -10\text{ V}, I_D = -6\text{ A}$	P-Ch		0.026	0.032	
		$V_{GS} = 4.5\text{ V}, I_D = 4.8\text{ A}$	N-Ch		0.028	0.034	
		$V_{GS} = -4.5\text{ V}, I_D = -4.9\text{ A}$	P-Ch		0.034	0.041	
Forward Transconductance <sup>b</sup>	$g_{fs}$	$V_{DS} = 15\text{ V}, I_D = 6\text{ A}$	N-Ch		20	S	
		$V_{DS} = -15\text{ V}, I_D = -6\text{ A}$	P-Ch		17		
<b>Dynamic<sup>a</sup></b>							
Input Capacitance	$C_{iss}$	$V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$  $V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	N-Ch		855	$\mu\text{F}$	
			P-Ch		1505		
Output Capacitance	$C_{oss}$		N-Ch		105		
			P-Ch		230		
Reverse Transfer Capacitance	$C_{rss}$		N-Ch		65		
			P-Ch		175		
Total Gate Charge	$Q_g$	$V_{DS} = 20\text{ V}, V_{GS} = 10\text{ V}, I_D = 5\text{ A}$	N-Ch		21	32	nC
		$V_{DS} = -20\text{ V}, V_{GS} = -10\text{ V}, I_D = -5\text{ A}$	P-Ch		41	62	
Gate-Source Charge	$Q_{gs}$	$V_{DS} = 20\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 5\text{ A}$	N-Ch		9.6	14.5	
			P-Ch		21	31	
Gate-Drain Charge	$Q_{gd}$	$V_{DS} = -20\text{ V}, V_{GS} = -4.5\text{ V}, I_D = -5\text{ A}$	N-Ch		2.3		
			P-Ch		4.5		
Gate Resistance	$R_g$	$f = 1\text{ MHz}$	N-Ch		2.5	3.8	$\Omega$
			P-Ch		6.5	10	



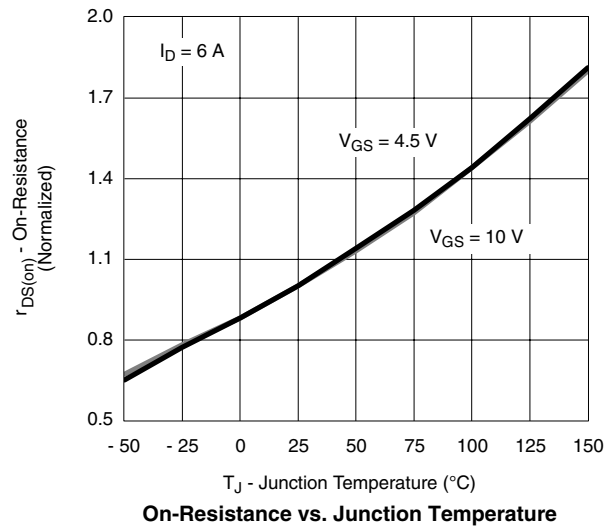
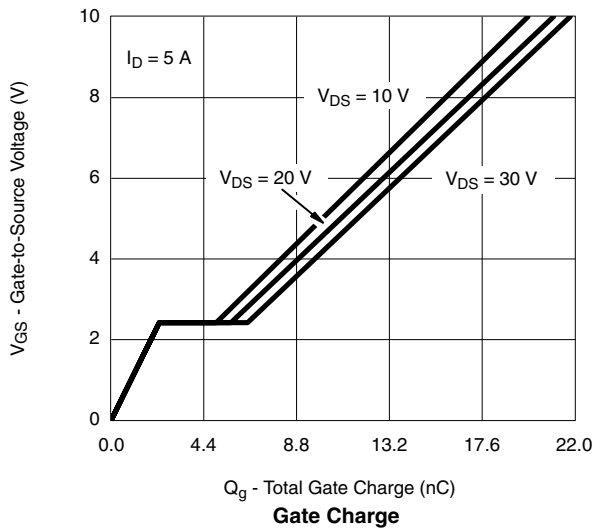
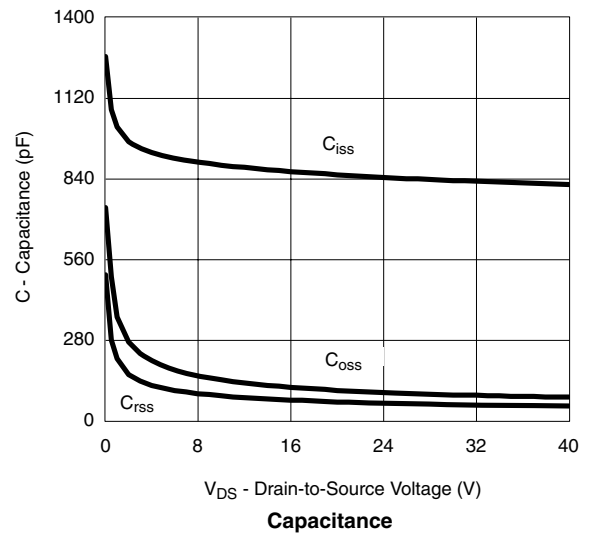
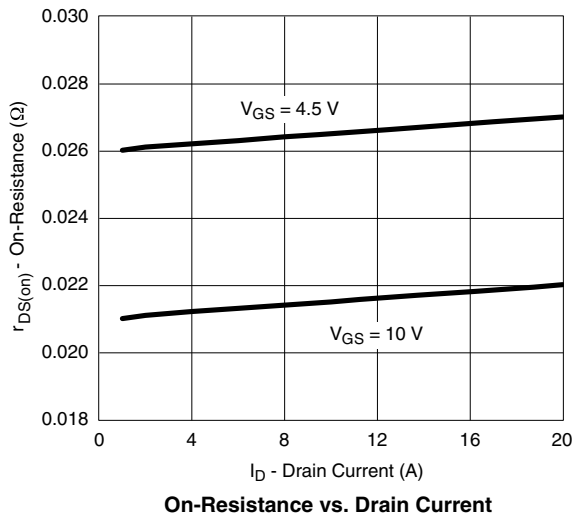
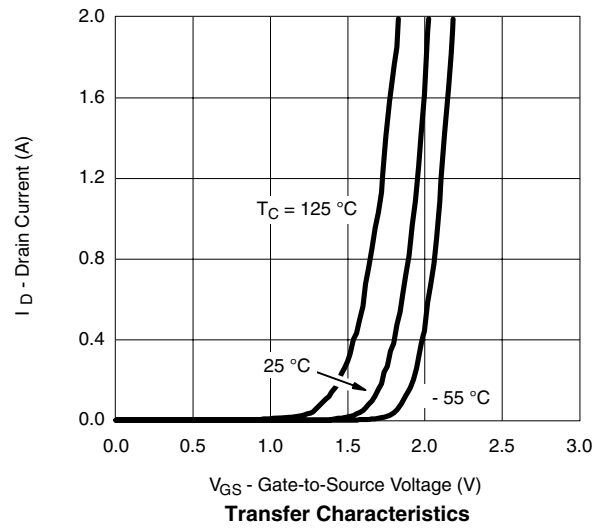
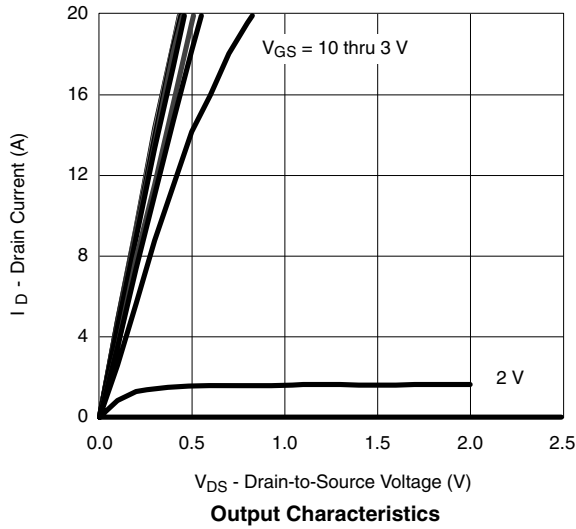
SPECIFICATIONS $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted							
Parameter	Symbol	Test Conditions	Min	Typ <sup>a</sup>	Max	Unit	
<b>Dynamic<sup>a</sup></b>							
Turn-On Delay Time	$t_{d(on)}$	N-Channel $V_{DD} = 20\text{ V}, R_L = 4\ \Omega$ $I_D \cong 5\text{ A}, V_{GEN} = 10\text{ V}, R_g = 1\ \Omega$  P-Channel $V_{DD} = -20\text{ V}, R_L = 4\ \Omega$ $I_D \cong -5\text{ A}, V_{GEN} = -10\text{ V}, R_g = 1\ \Omega$	N-Ch		6	12	ns
			P-Ch		7	14	
Rise Time	$t_r$		N-Ch		21	32	
			P-Ch		23	35	
Turn-Off Delay Time	$t_{d(off)}$		N-Ch		24	36	
			P-Ch		51	77	
Fall Time	$t_f$		N-Ch		9	15	
			P-Ch		50	80	
Turn-On Delay Time	$t_{d(on)}$	N-Channel $V_{DD} = 20\text{ V}, R_L = 4\ \Omega$ $I_D \cong 5\text{ A}, V_{GEN} = 4.5\text{ V}, R_g = 1\ \Omega$  P-Channel $V_{DD} = -20\text{ V}, R_L = 4\ \Omega$ $I_D \cong -5\text{ A}, V_{GEN} = -4.5\text{ V}, R_g = 1\ \Omega$	N-Ch		12	20	
			P-Ch		40	60	
Rise Time	$t_r$		N-Ch		75	115	
			P-Ch		106	160	
Turn-Off Delay Time	$t_{d(off)}$		N-Ch		40	60	
			P-Ch		45	70	
Fall Time	$t_f$		N-Ch		56	85	
			P-Ch		50	75	
<b>Drain-Source Body Diode Characteristics</b>							
Continuous Source-Drain Diode Current	$I_S$	$T_C = 25\text{ }^\circ\text{C}$	N-Ch			8	A
			P-Ch			-8	
Pulse Diode Forward Current <sup>a</sup>	$I_{SM}$		N-Ch			35	
			P-Ch			-35	
Body Diode Voltage	$V_{SD}$	$I_S = 1.5\text{ A}$ $I_S = -1.6\text{ A}$	N-Ch		0.73	1.2	V
			P-Ch		-0.73	-1.2	
Body Diode Reverse Recovery Time	$t_{rr}$	N-Channel $I_F = 5\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, T_J = 25\text{ }^\circ\text{C}$  P-Channel $I_F = -5\text{ A}, di/dt = -100\text{ A}/\mu\text{s}, T_J = 25\text{ }^\circ\text{C}$	N-Ch		26	40	ns
P-Ch			30	45			
Body Diode Reverse Recovery Charge	$Q_{rr}$		N-Ch		21	32	nC
			P-Ch		24	36	
Reverse Recovery Fall Time	$t_a$		N-Ch		13		ns
			P-Ch		15		
Reverse Recovery Rise Time	$t_b$	N-Ch		13			
		P-Ch		15			

Notes:

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

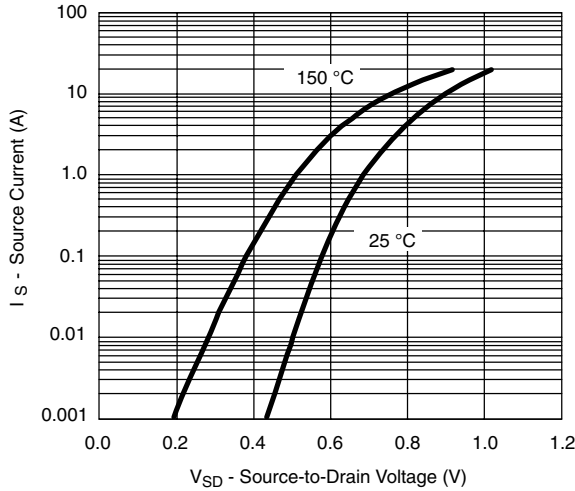
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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

**N-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless noted

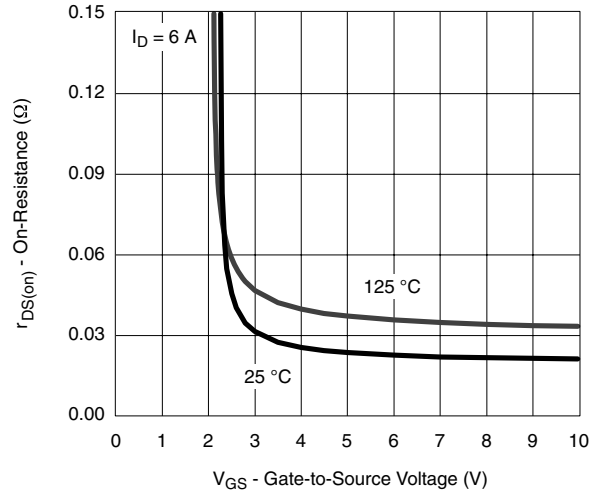




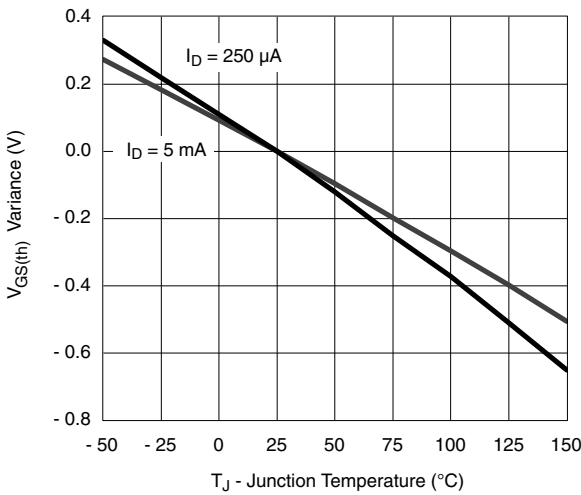
**N-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless noted



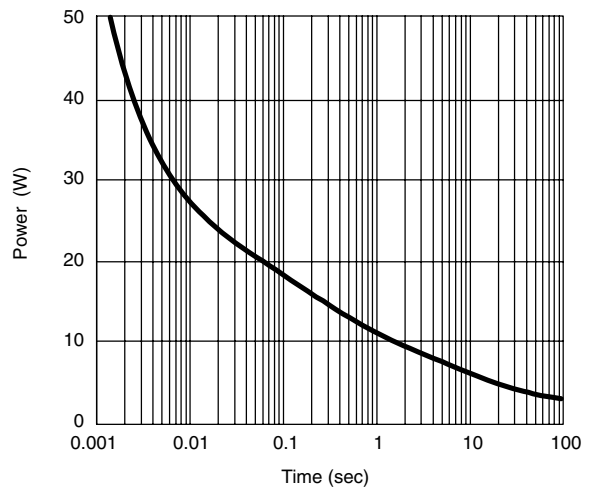
**Source-Drain Diode Forward Voltage**



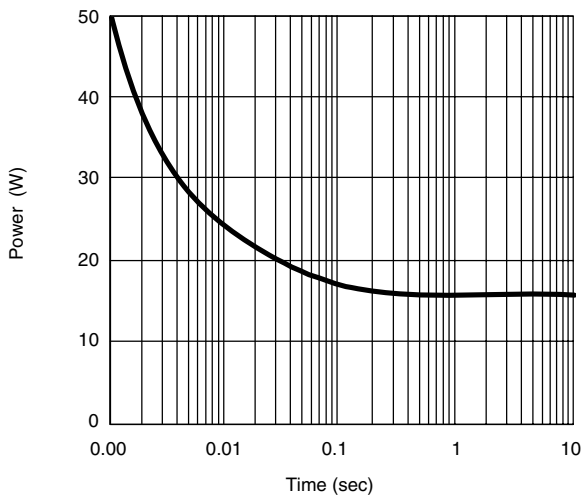
**On-Resistance vs. Gate-to-Source Voltage**



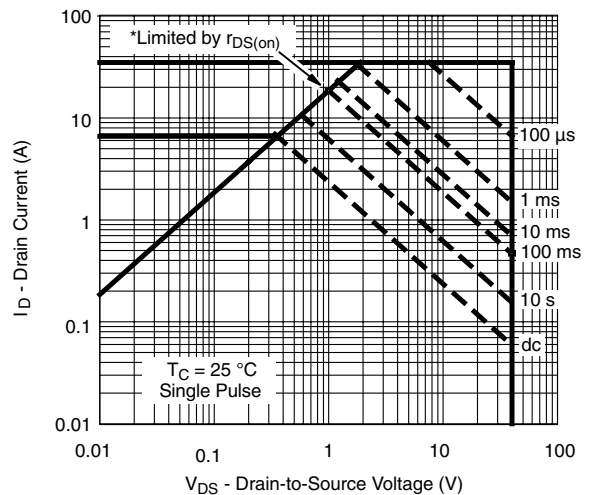
**Threshold Voltage**



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



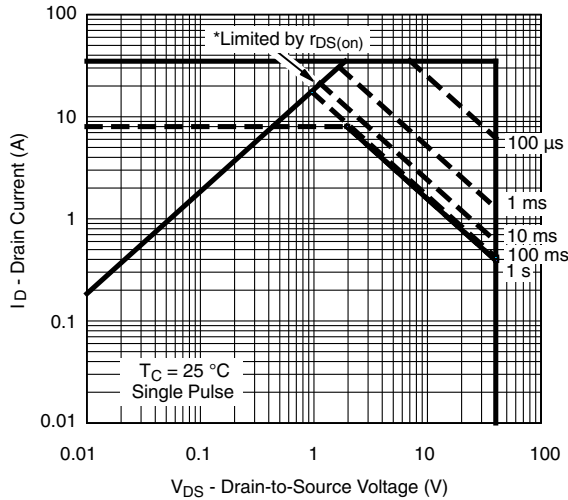
**Single Pulse Power, Junction-to-Case**



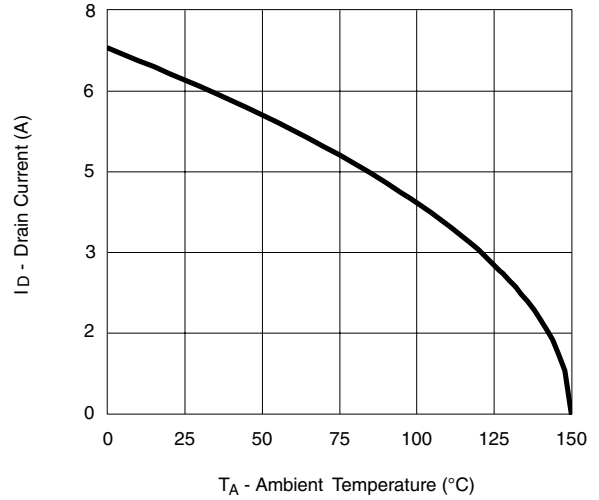
\*V<sub>GS</sub> > minimum V<sub>GS</sub> at which r<sub>DS(on)</sub> is specified

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

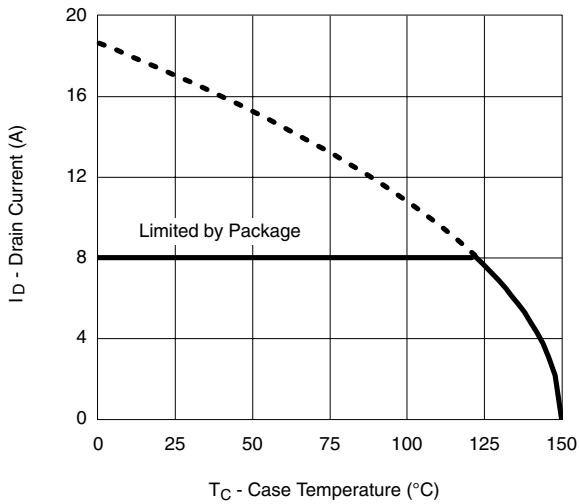
## N-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless noted



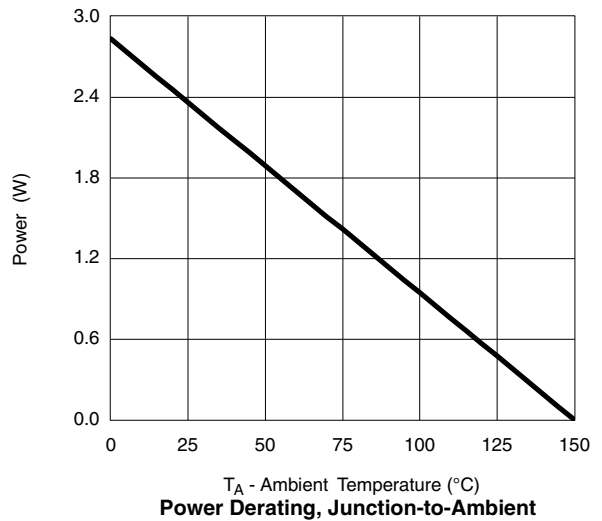
$T_C = 25\text{ }^\circ\text{C}$   
Single Pulse  
**Safe Operating Area, Junction-to-Case**



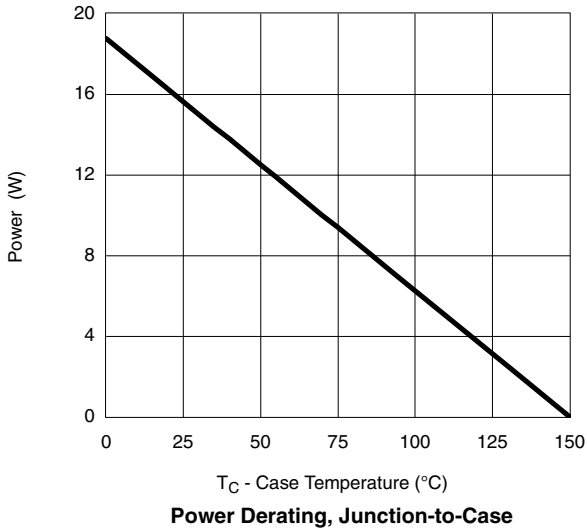
**Current Derating, Junction-to-Ambient**



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



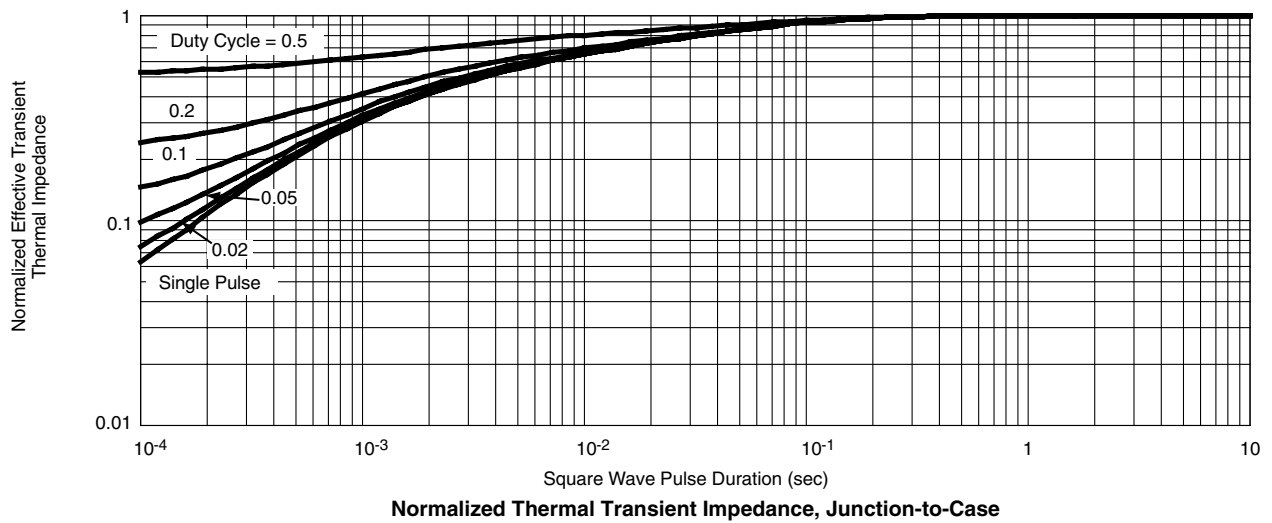
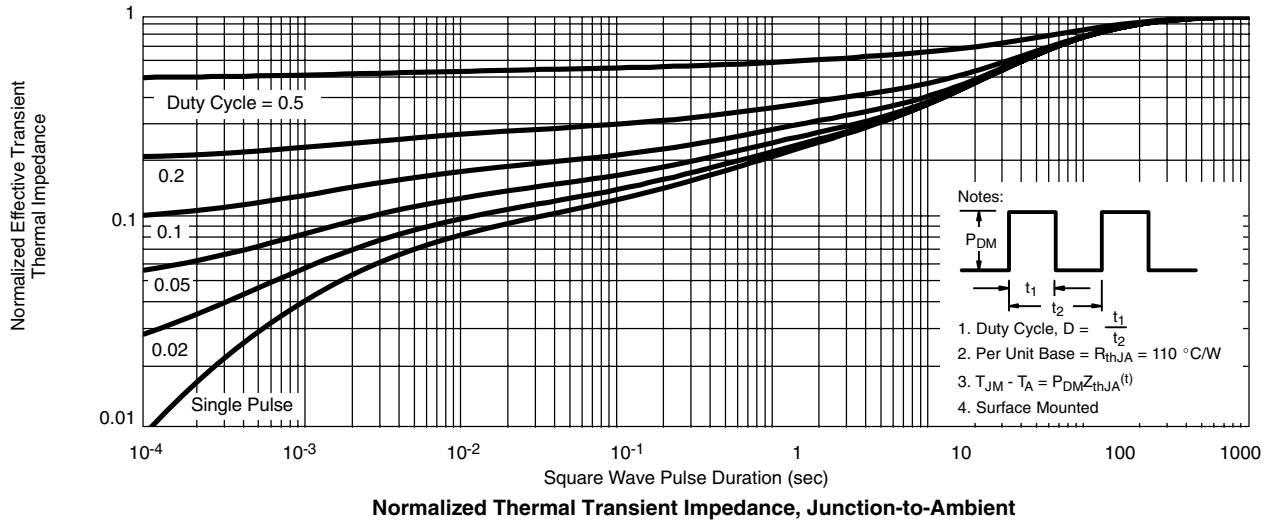
**Power Derating, Junction-to-Ambient**



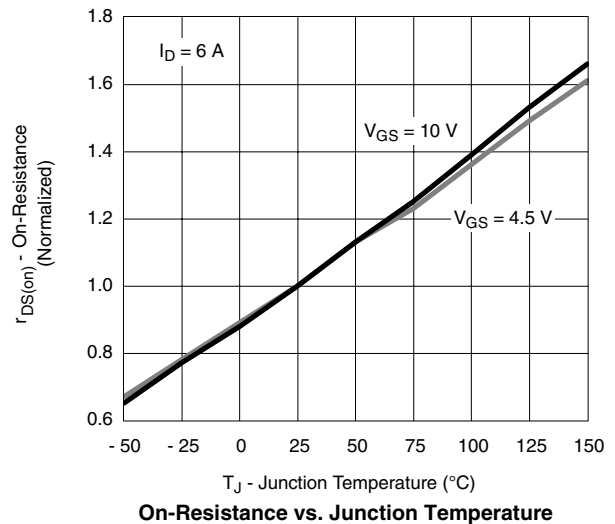
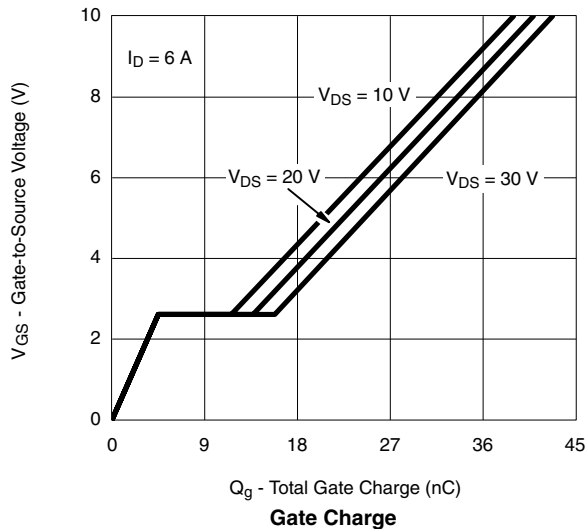
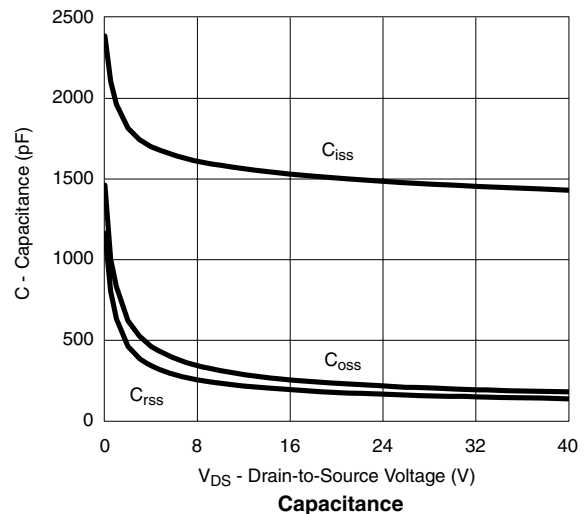
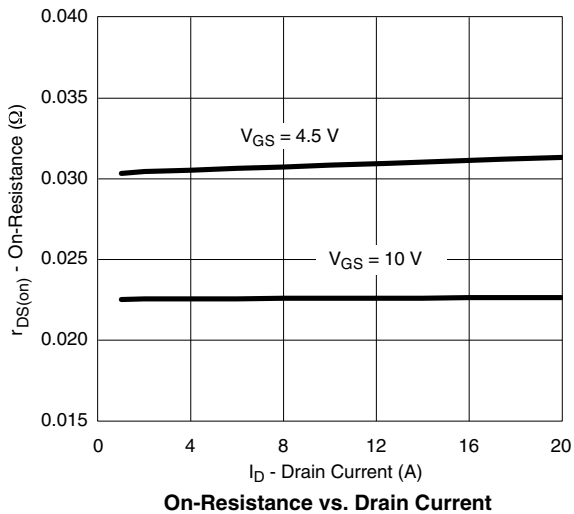
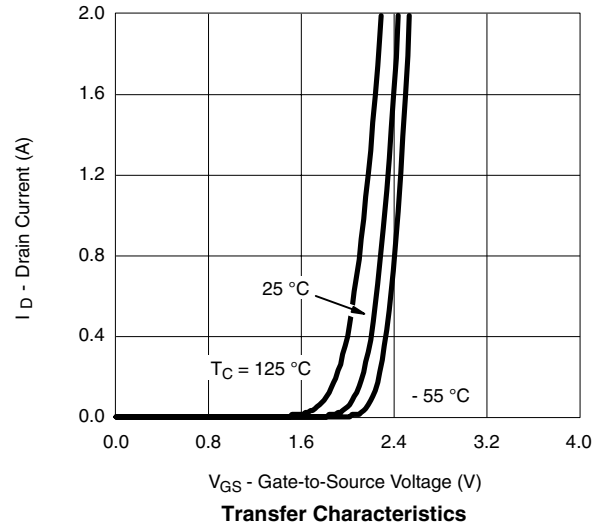
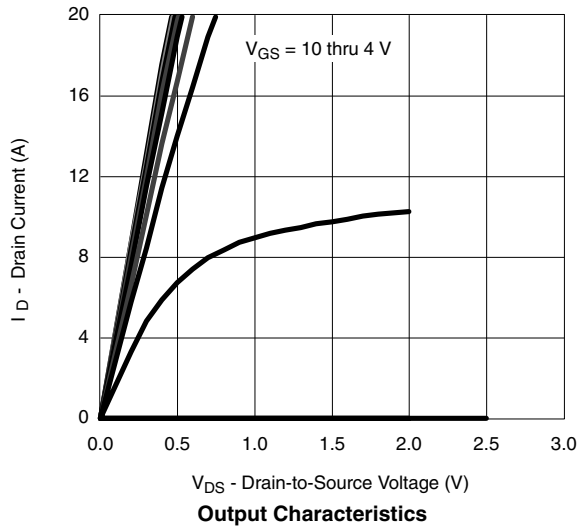
**Power Derating, Junction-to-Case**

\*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.

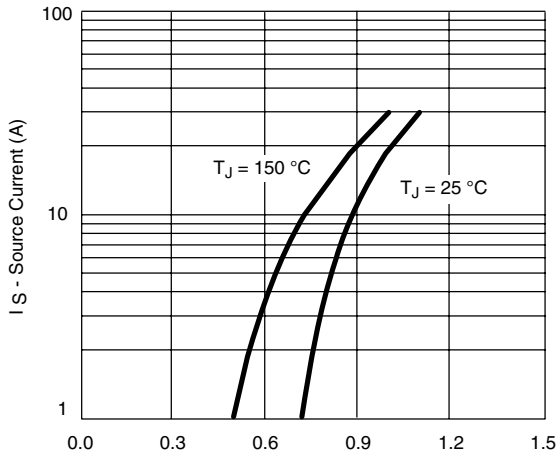
**N-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless noted



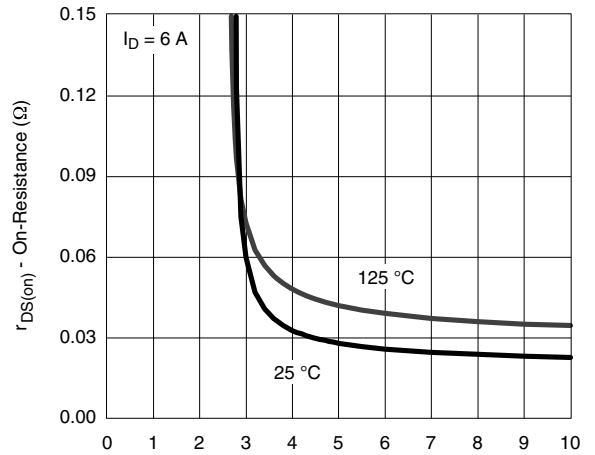
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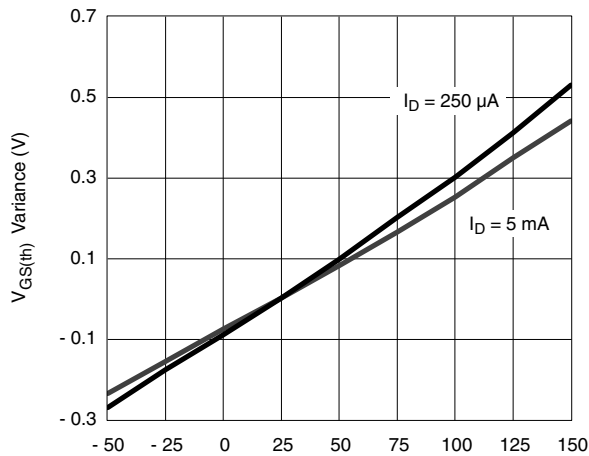


**P-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless noted


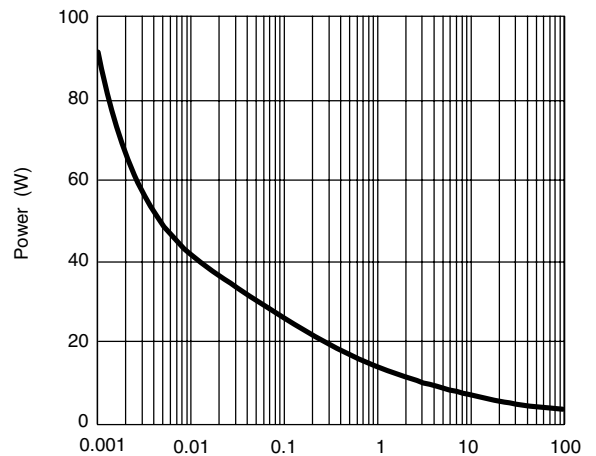
Source-Drain Diode Forward Voltage



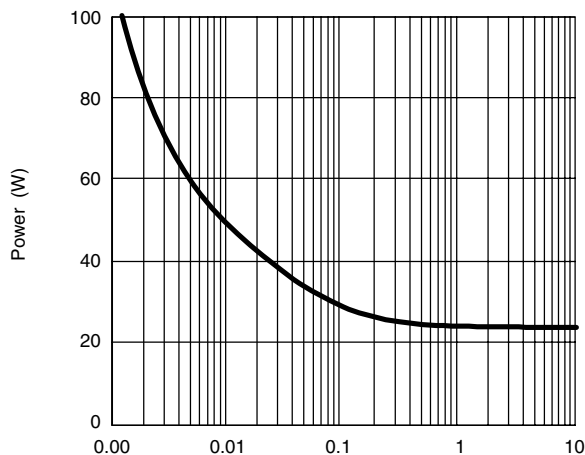
On-Resistance vs. Gate-to-Source Voltage



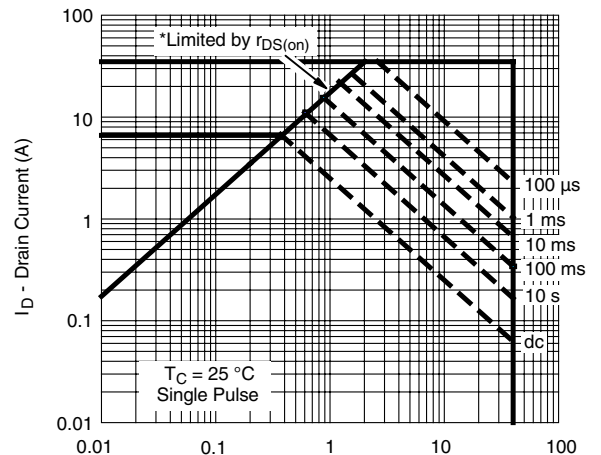
Threshold Voltage



Single Pulse Power, Junction-to-Ambient

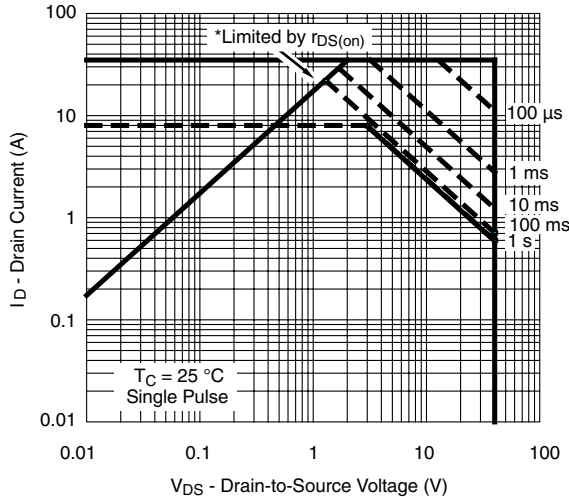


Single Pulse Power, Junction-to-Case

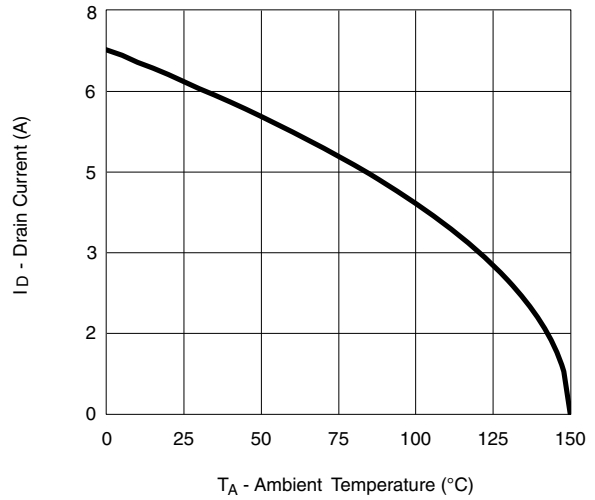


Safe Operating Area, Junction-to-Ambient

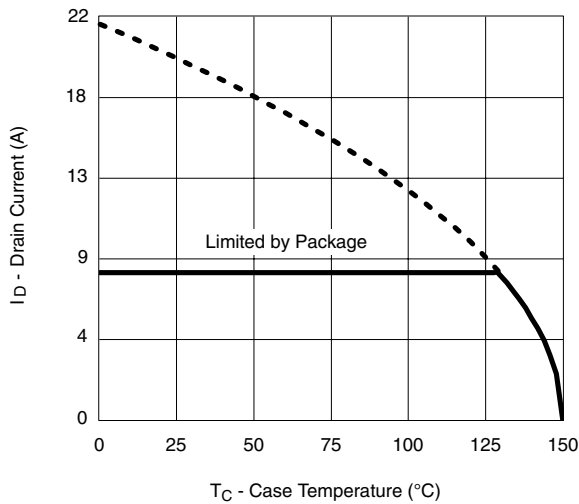
**P-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless noted



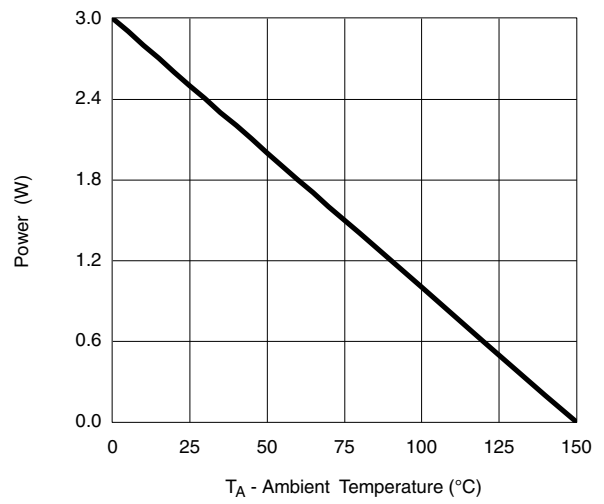
\* $V_{GS} >$  minimum  $V_{GS}$  at which  $r_{DS(on)}$  is specified  
**Safe Operating Area, Junction-to-Case**



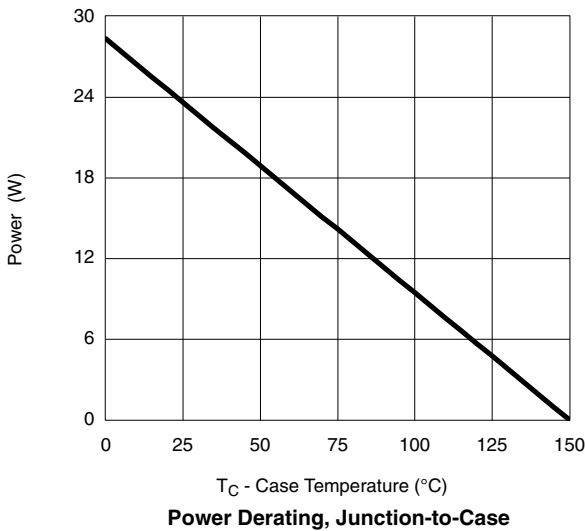
**Current Derating, Junction-to-Ambient**



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



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

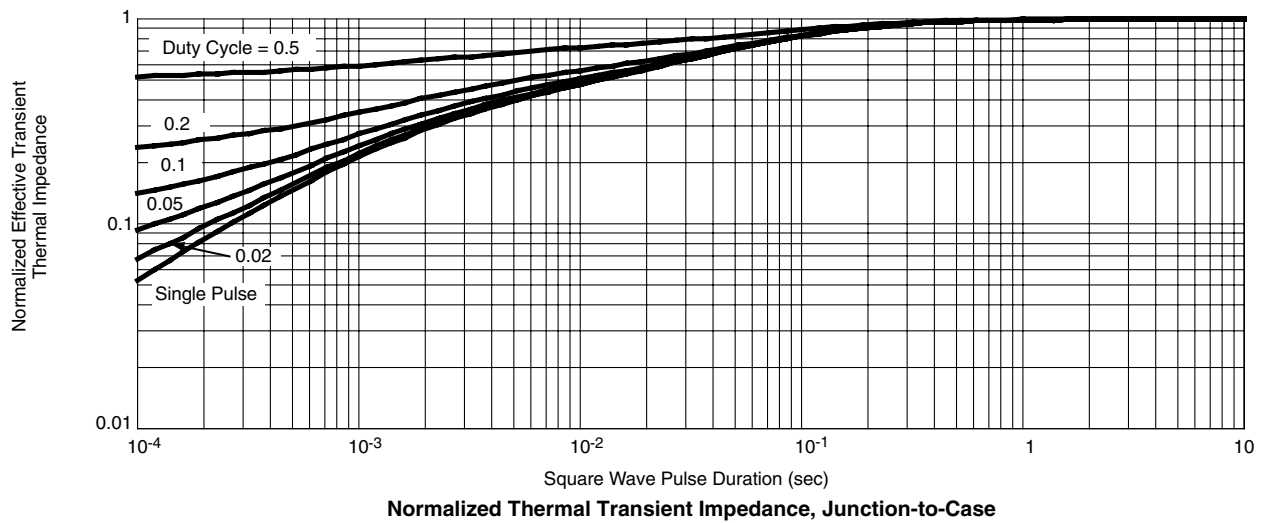
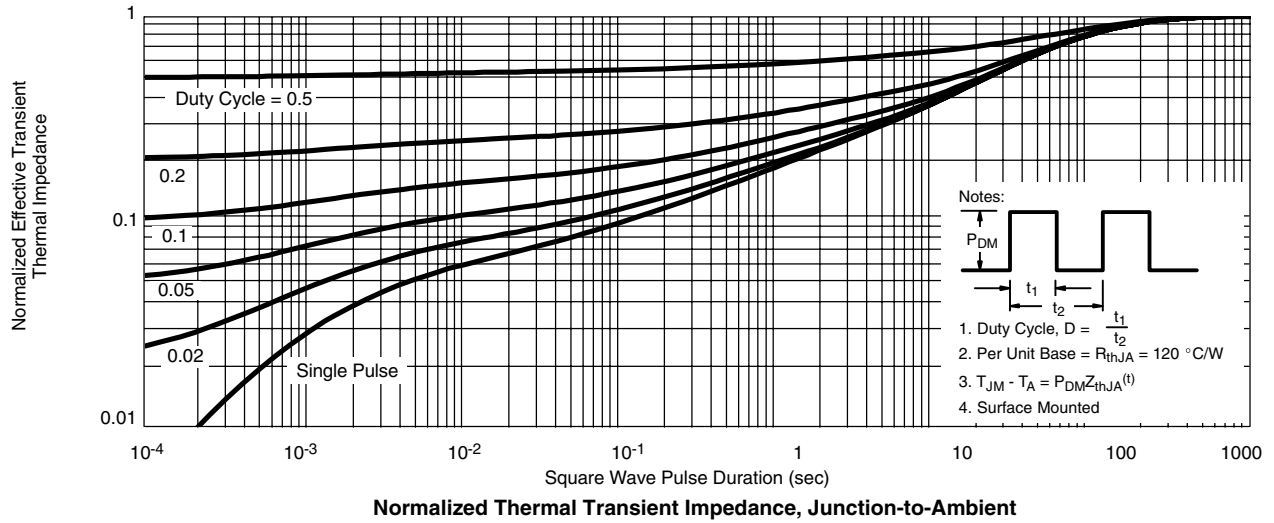


**Power Derating, Junction-to-Case**

\*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.



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



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