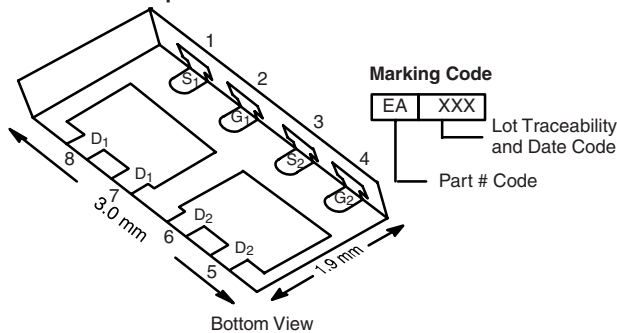


## N- and P-Channel 20-V (D-S) MOSFET

PRODUCT SUMMARY				
	V <sub>DS</sub>	R <sub>DS(on)</sub> (Ω)	I <sub>D</sub> (A) <sup>a</sup>	Q <sub>g</sub>
N-Channel	20	0.039 at V <sub>GS</sub> = 4.5 V	6	6 nc
		0.045 at V <sub>GS</sub> = 2.5 V	6	
		0.055 at V <sub>GS</sub> = 1.8 V	6	
P-Channel	- 20	0.072 at V <sub>GS</sub> = - 4.5 V	- 6	5.5 nc
		0.100 at V <sub>GS</sub> = - 2.5 V	- 6	
		0.131 at V <sub>GS</sub> = - 18 V	- 6	

PowerPAK ChipFET Dual



Ordering Information: Si5517DU-T1-GE3 (Lead (Pb)-free and Halogen-free)

### FEATURES

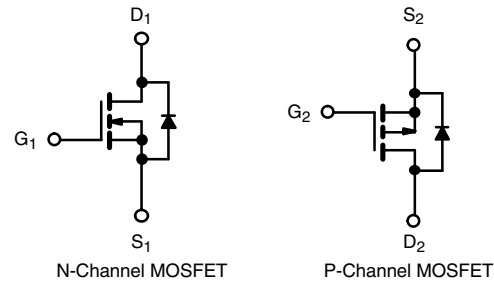
- Halogen-free
- TrenchFET<sup>®</sup> Power MOSFETs
- New Thermally Enhanced PowerPAK<sup>®</sup> ChipFET<sup>®</sup> Package
  - Small Footprint Area
  - Low On-Resistance
  - Thin 0.8 mm Profile



**RoHS**  
COMPLIANT

### APPLICATIONS

- Complementary MOSFET for Portable Devices
- Ideal for Buck-Boost Circuits



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>	± 8			
Continuous Drain Current (T <sub>J</sub> = 150 °C)	I <sub>D</sub>	T <sub>C</sub> = 25 °C	6 <sup>a</sup>	- 6 <sup>a</sup>	A
		T <sub>C</sub> = 70 °C	6 <sup>a</sup>	- 6 <sup>a</sup>	
		T <sub>A</sub> = 25 °C	7.2 <sup>b, c</sup>	- 4.6 <sup>b, c</sup>	
		T <sub>A</sub> = 70 °C	5.8 <sup>b, c</sup>	- 3.7 <sup>b, c</sup>	
Pulsed Drain Current	I <sub>DM</sub>	20	- 15		
Source-Drain Current Diode Current	I <sub>S</sub>	T <sub>C</sub> = 25 °C	6.9	- 6.9	
		T <sub>A</sub> = 25 °C	1.9 <sup>b, c</sup>	- 1.9 <sup>b, c</sup>	
Maximum Power Dissipation	P <sub>D</sub>	T <sub>C</sub> = 25 °C	8.3	8.3	W
		T <sub>C</sub> = 70 °C	5.3	5.3	
		T <sub>A</sub> = 25 °C	2.3 <sup>b, c</sup>	2.3 <sup>b, c</sup>	
		T <sub>A</sub> = 70 °C	1.5 <sup>b, c</sup>	1.5 <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>	45	55	45	55	°C/W
Maximum Junction-to-Case (Drain)	R <sub>thJC</sub>	12	15	12	15	

Notes:

a. Based on T<sub>C</sub> = 25 °C.

b. Surface Mounted on 1" x 1" FR4 board.

c. t = 5 s.

d. See Solder Profile (<http://www.vishay.com/ppg?73257>). The PowerPAK ChipFET 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.

e. Rework Conditions: manual soldering with a soldering iron is not recommended for leadless components.

f. Maximum under Steady State conditions is 105 °C/W for both channels.

<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	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	N-Ch	20		V	
		$V_{GS} = 0\text{ V}, I_D = -1\text{ mA}$	P-Ch	-20			
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = 250\text{ }\mu\text{A}$	N-Ch		17	mV/ $^\circ\text{C}$	
		$I_D = -250\text{ }\mu\text{A}$	P-Ch		-20		
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$	$I_D = 250\text{ }\mu\text{A}$	N-Ch		-2.6		
		$I_D = -250\text{ }\mu\text{A}$	P-Ch		2.4		
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	N-Ch	0.4	1	V	
		$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$	P-Ch	-0.4	-1		
Gate-Body Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 8\text{ V}$	N-Ch		100	nA	
			P-Ch		-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>	$I_{D(on)}$	$V_{DS} \leq 5\text{ V}, V_{GS} = 4.5\text{ V}$	N-Ch	20		A	
		$V_{DS} \leq -5\text{ V}, V_{GS} = -4.5\text{ V}$	P-Ch	-15			
Drain-Source On-State Resistance <sup>b</sup>	$R_{DS(on)}$	$V_{GS} = 4.5\text{ V}, I_D = 4.4\text{ A}$	N-Ch		0.032	0.039	$\Omega$
		$V_{GS} = -4.5\text{ V}, I_D = -3.3\text{ A}$	P-Ch		0.060	0.072	
		$V_{GS} = 2.5\text{ V}, I_D = 4.1\text{ A}$	N-Ch		0.037	0.045	
		$V_{GS} = -2.5\text{ V}, I_D = -2.8\text{ A}$	P-Ch		0.083	0.100	
		$V_{GS} = 1.8\text{ V}, I_D = 1.8\text{ A}$	N-Ch		0.0455	0.055	
		$V_{GS} = -1.8\text{ V}, I_D = -0.76\text{ A}$	P-Ch		0.108	0.131	
Forward Transconductance <sup>b</sup>	$g_{fs}$	$V_{DS} = 10\text{ V}, I_D = 4.4\text{ A}$	N-Ch		22	S	
		$V_{DS} = -10\text{ V}, I_D = -3.3\text{ A}$	P-Ch		9		
<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		520	pF	
			P-Ch		455		
Output Capacitance	$C_{oss}$		N-Ch		100		
			P-Ch		105		
Reverse Transfer Capacitance	$C_{rss}$		P-Channel $V_{DS} = -10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	N-Ch			60
				P-Ch			65
Total Gate Charge	$Q_g$	$V_{DS} = 10\text{ V}, V_{GS} = 8\text{ V}, I_D = 4.4\text{ A}$		N-Ch	10.5	16	
		$V_{DS} = -10\text{ V}, V_{GS} = -8\text{ V}, I_D = -4.6\text{ A}$		P-Ch	9.1	14	
		N-Channel $V_{DS} = 10\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 4.4\text{ A}$		N-Ch	6	9	
				P-Ch	5.5	8.5	
Gate-Source Charge	$Q_{gs}$	P-Channel $V_{DS} = -10\text{ V}, V_{GS} = -4.5\text{ V}, I_D = -1.8\text{ A}$	N-Ch	0.91			
			P-Ch	0.75			
Gate-Drain Charge	$Q_{gd}$		N-Ch	0.7			
			P-Ch	1.5			
Gate Resistance	$R_g$		$f = 1\text{ MHz}$	N-Ch	1.9		$\Omega$
				P-Ch	8		



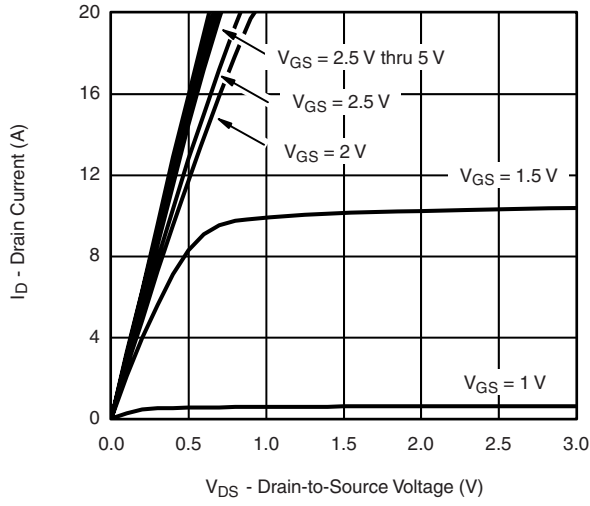
<b>SPECIFICATIONS</b> $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted							
Parameter	Symbol	Test Conditions		Min.	Typ. <sup>a</sup>	Max.	Unit
<b>Dynamic<sup>a</sup></b>							
Turn-On Delay Time	$t_{d(on)}$	N-Channel $V_{DD} = 10\text{ V}, R_L = 2.8\ \Omega$ $I_D \cong 3.6\text{ A}, V_{GEN} = 4.5\text{ V}, R_g = 1\ \Omega$	N-Ch		20	30	ns
			P-Ch		8	15	
Rise Time	$t_r$		N-Ch		65	100	
			P-Ch		35	55	
Turn-Off Delay Time	$t_{d(off)}$	P-Channel $V_{DD} = -10\text{ V}, R_L = 2.7\ \Omega$ $I_D \cong -3.7\text{ A}, V_{GEN} = -4.5\text{ V}, R_g = 1\ \Omega$	N-Ch		40	60	
			P-Ch		40	60	
Fall Time	$t_f$		N-Ch		10	15	
			P-Ch		55	85	
Turn-On Delay Time	$t_{d(on)}$	N-Channel $V_{DD} = 10\text{ V}, R_L = 2.8\ \Omega$ $I_D \cong 3.6\text{ A}, V_{GEN} = 8\text{ V}, R_g = 1\ \Omega$	N-Ch		5	10	
			P-Ch		5	10	
Rise Time	$t_r$		N-Ch		12	20	
			P-Ch		15	25	
Turn-Off Delay Time	$t_{d(off)}$	P-Channel $V_{DD} = -10\text{ V}, R_L = 2.7\ \Omega$ $I_D \cong -3.7\text{ A}, V_{GEN} = -8\text{ V}, R_g = 1\ \Omega$	N-Ch		26	40	
			P-Ch		30	45	
Fall Time	$t_f$		N-Ch		8	15	
			P-Ch		45	70	
<b>Drain-Source Body Diode Characteristics</b>							
Continuous Source-Drain Diode Current	$I_S$	$T_C = 25\text{ }^\circ\text{C}$	N-Ch			6.9	A
			P-Ch			-6.9	
Pulse Diode Forward Current <sup>a</sup>	$I_{SM}$		N-Ch			20	
			P-Ch			-15	
Body Diode Voltage	$V_{SD}$	$I_S = 1.2\text{ A}, V_{GS} = 0\text{ V}$	N-Ch		0.8	1.2	V
		$I_S = -1.0\text{ A}, V_{GS} = 0\text{ V}$	P-Ch		-0.8	-1.2	
Body Diode Reverse Recovery Time	$t_{rr}$	N-Channel $I_F = 1.2\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, T_J = 25\text{ }^\circ\text{C}$	N-Ch		45	70	ns
			P-Ch		30	60	
Body Diode Reverse Recovery Charge	$Q_{rr}$	P-Channel $I_F = -1\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, T_J = 25\text{ }^\circ\text{C}$	N-Ch		21	32	nC
			P-Ch		15	30	
Reverse Recovery Fall Time	$t_a$		N-Ch		29		ns
			P-Ch		11		
Reverse Recovery Rise Time	$t_b$		N-Ch		16		
			P-Ch		19		

Notes:

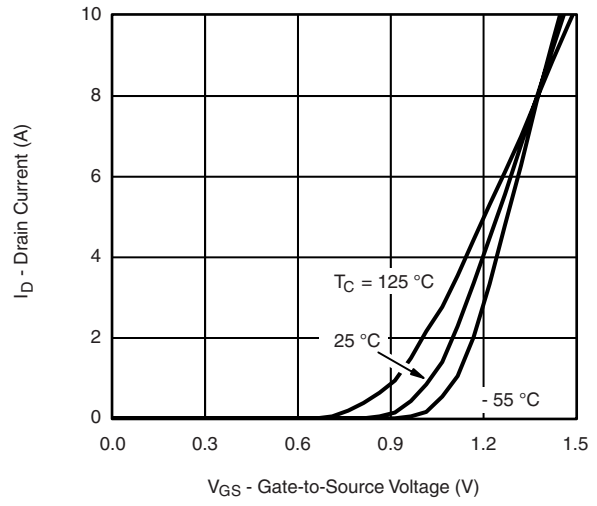
- a. Guaranteed by design, not subject to production testing.
- b. Pulse test; pulse width  $\leq 300\ \mu\text{s}$ , duty cycle  $\leq 2\%$ .

*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.*

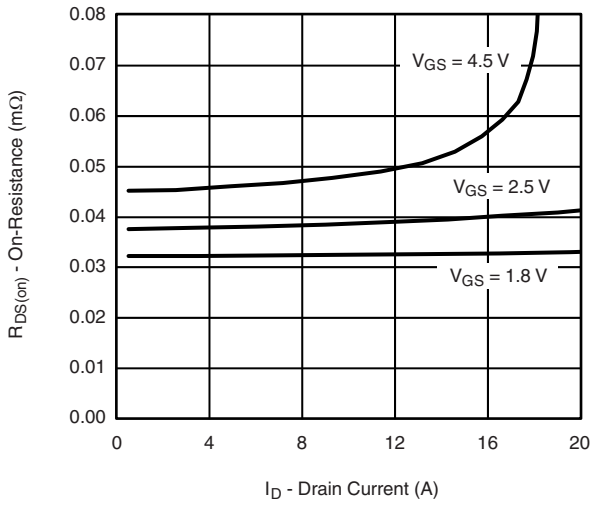
## N-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



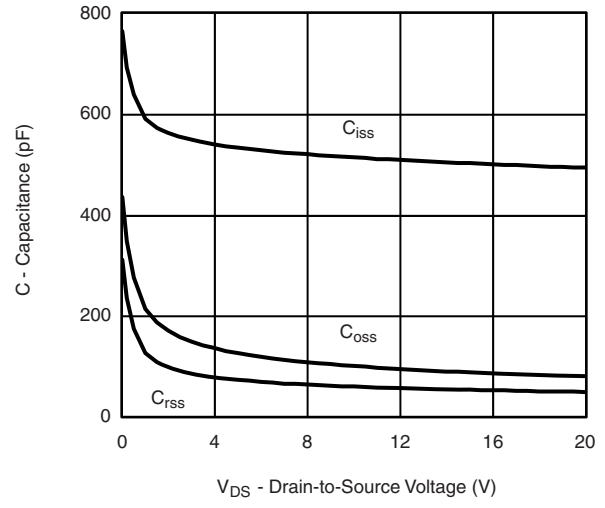
**Output Characteristics**



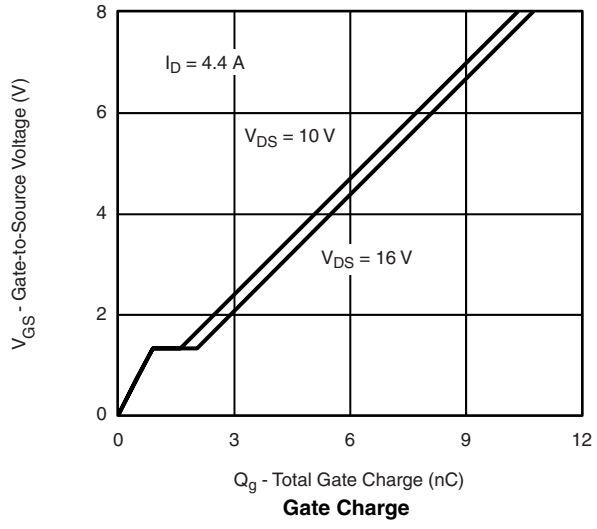
**Transfer Characteristics**



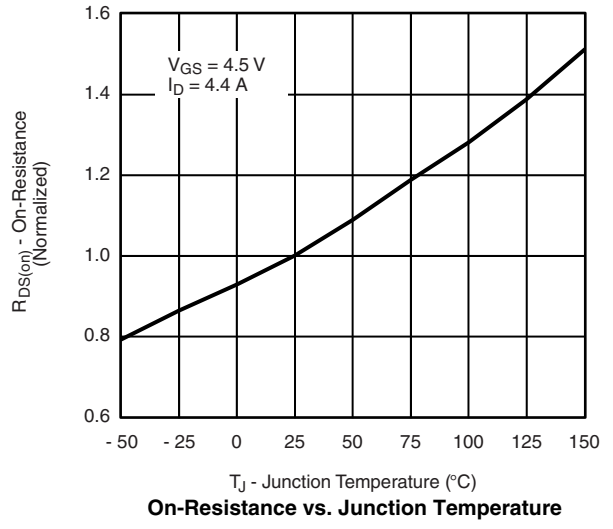
**On-Resistance vs. Drain Current and Gate Voltage**



**Capacitance**



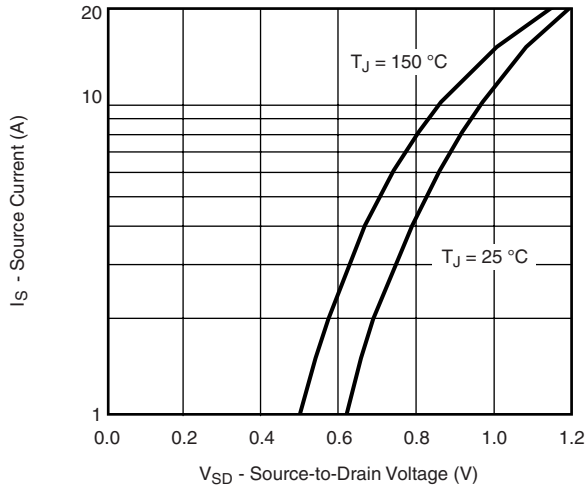
**Gate Charge**



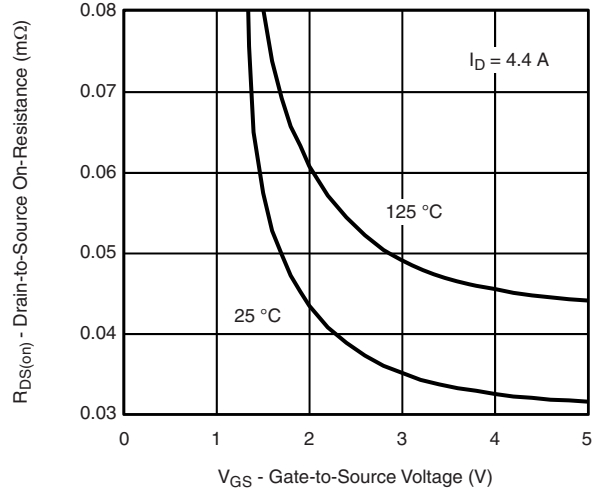
**On-Resistance vs. Junction Temperature**



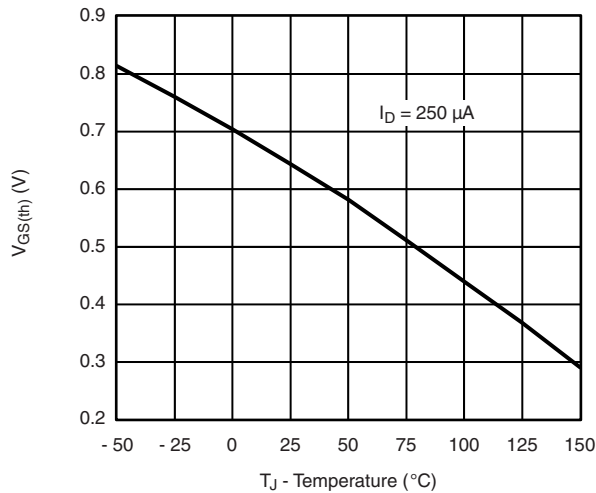
**N-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



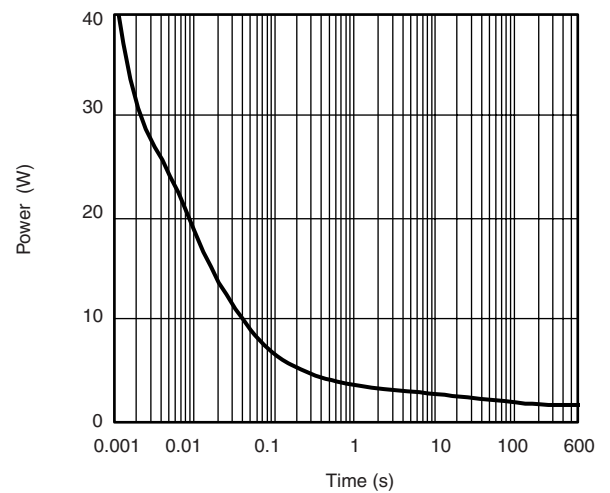
**Source-Drain Diode Forward Voltage**



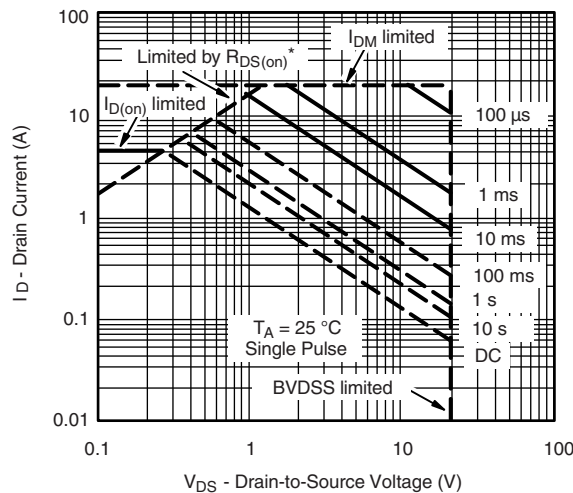
**On-Resistance vs. Gate-to-Source Voltage**



**Threshold Voltage**



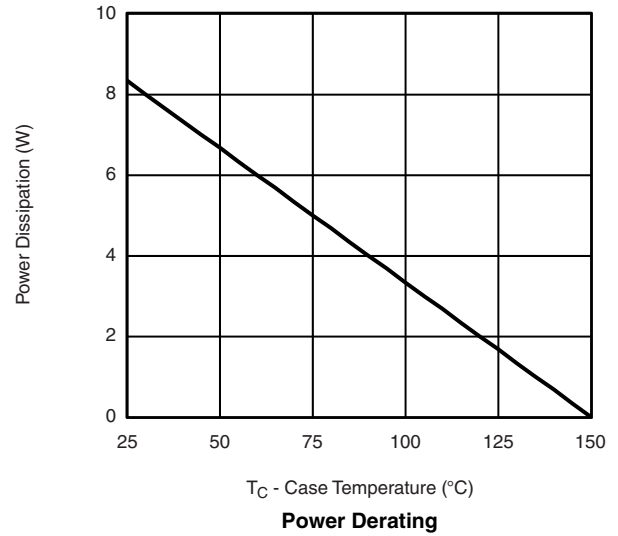
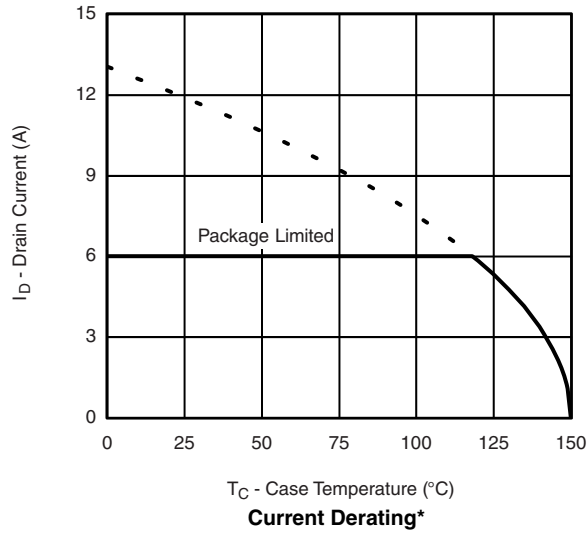
**Single Pulse Power, Junction-to-Ambient**



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

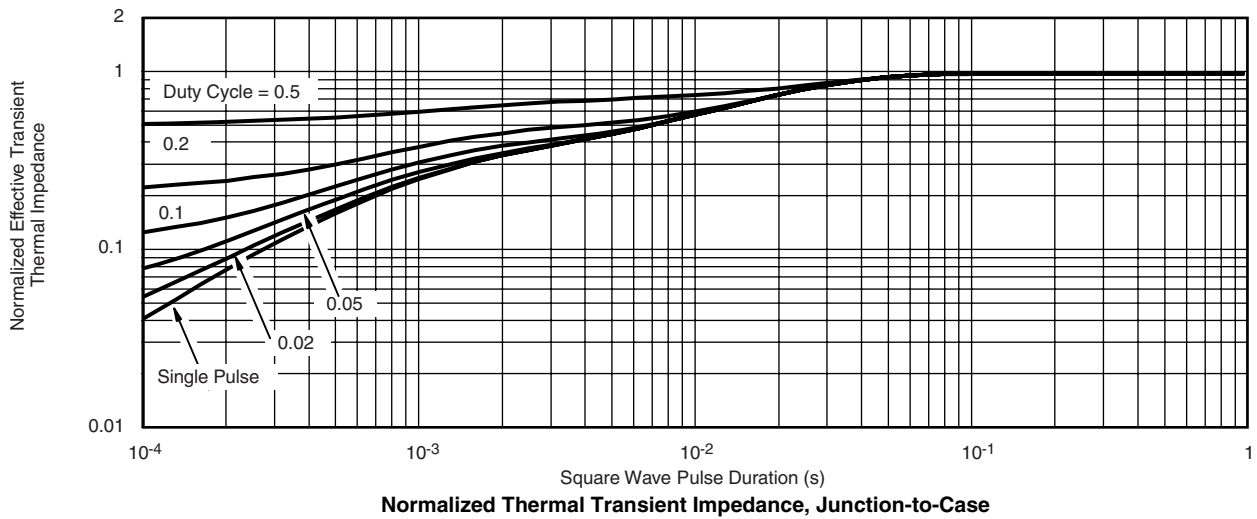
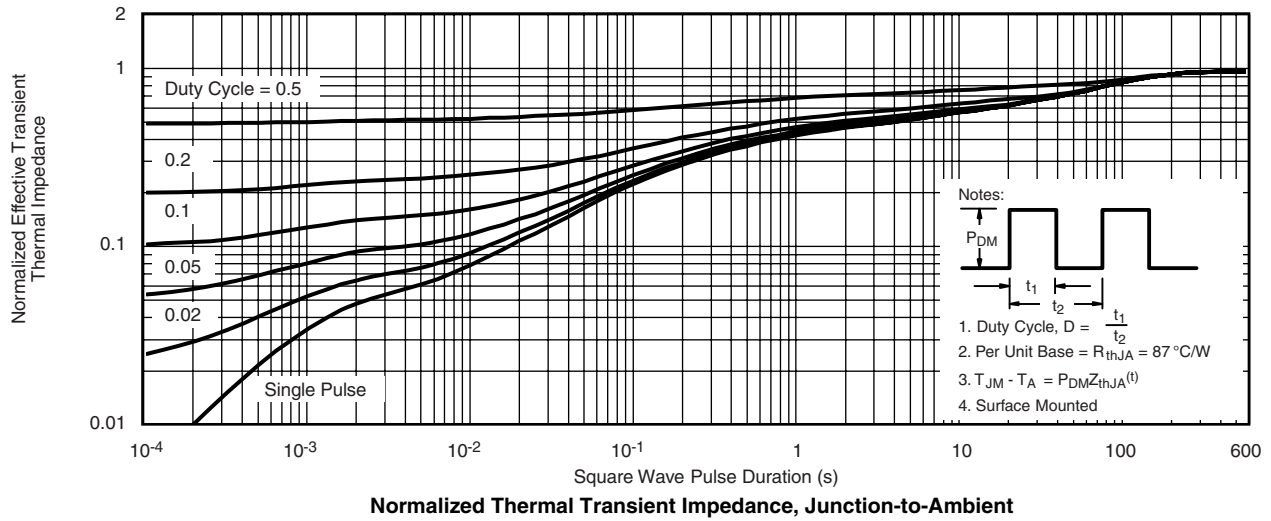
**Safe Operating Area, Junction-to-Ambient**

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

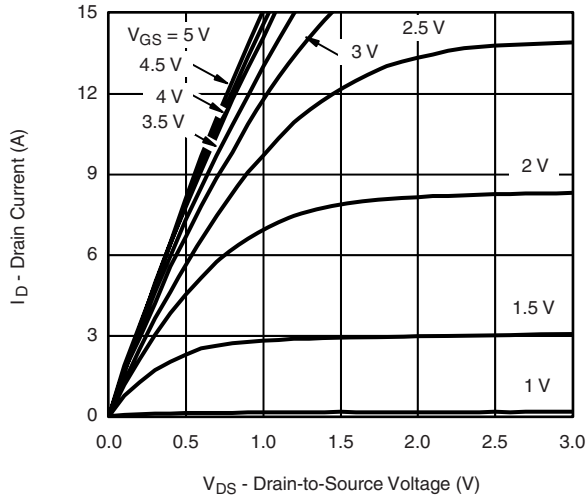


\* The power dissipation  $P_D$  is based on  $T_{J(max)} = 150\text{ °C}$ , using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the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

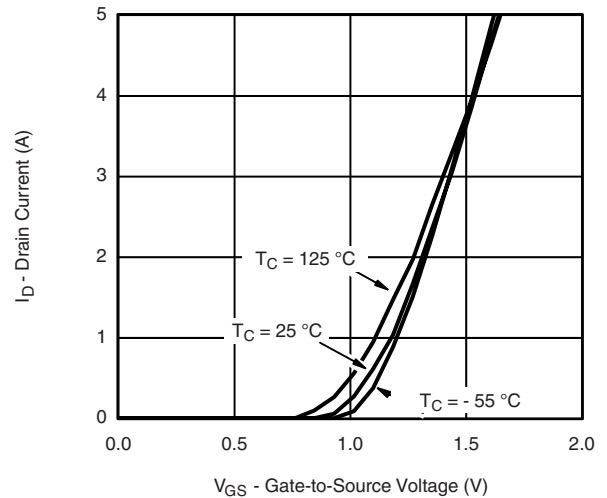
**N-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



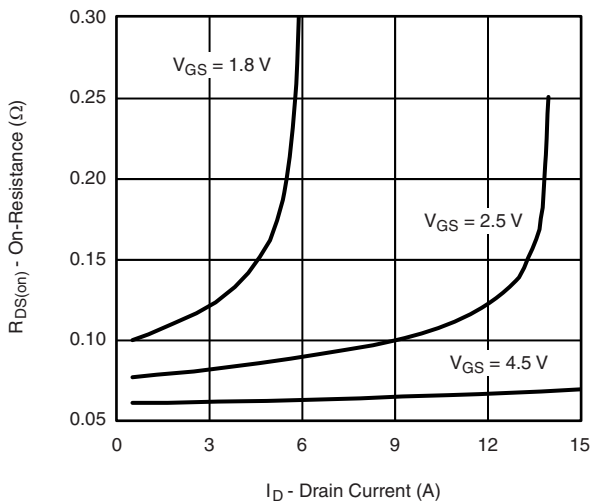
## P-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



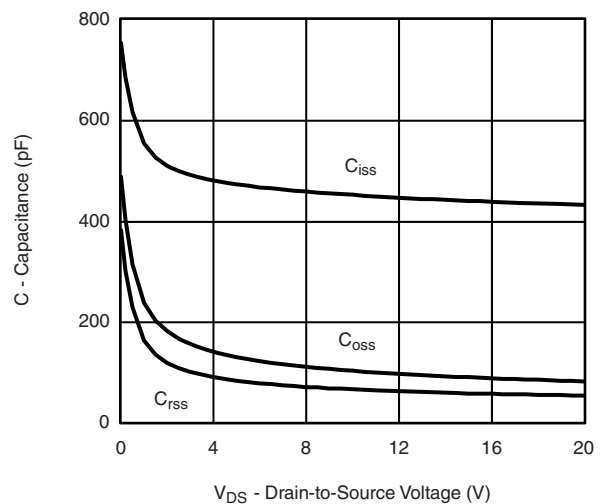
**Output Characteristics**



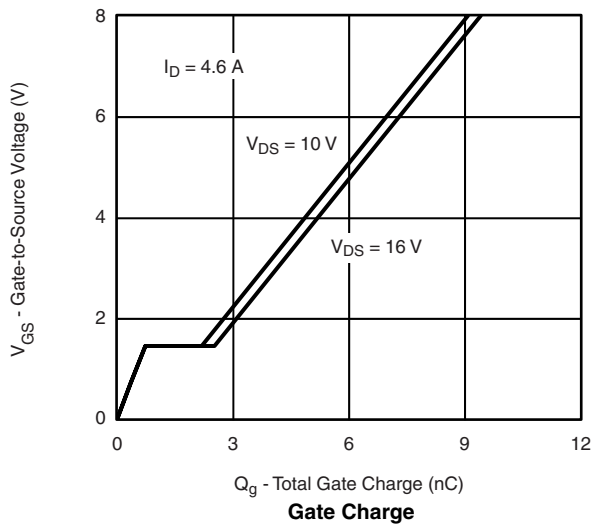
**Transfer Characteristics**



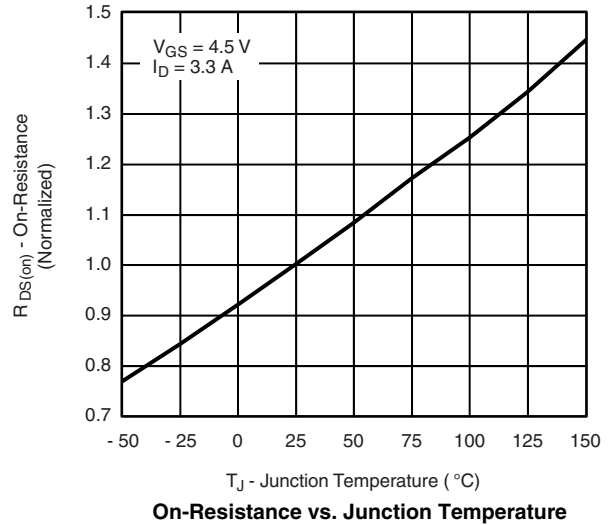
**On-Resistance vs. Drain Current and Gate Voltage**



**Capacitance**



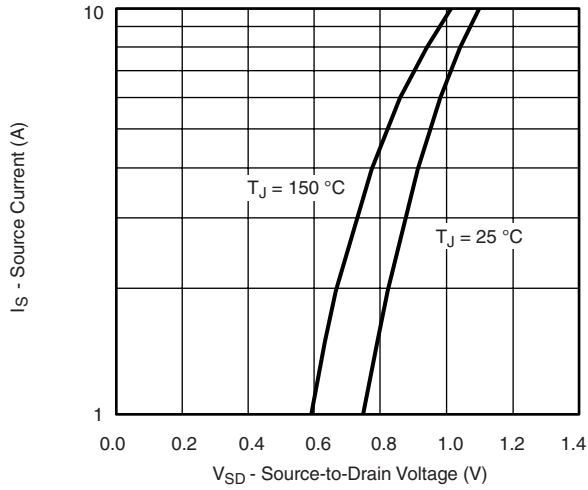
**Gate Charge**



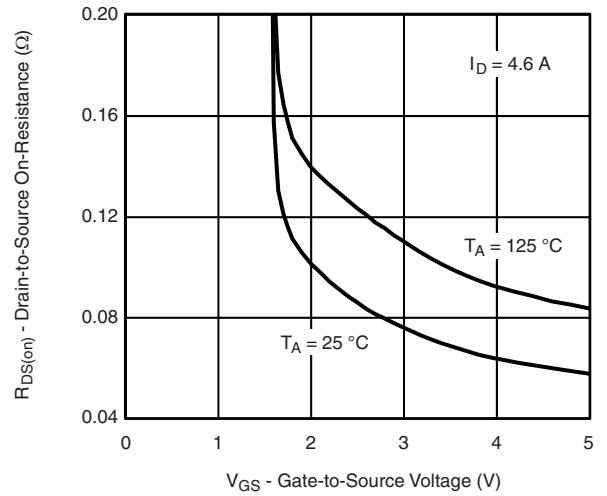
**On-Resistance vs. Junction Temperature**



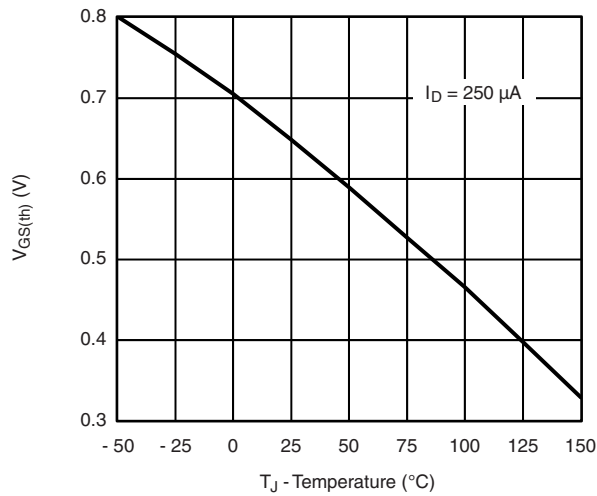
**P-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



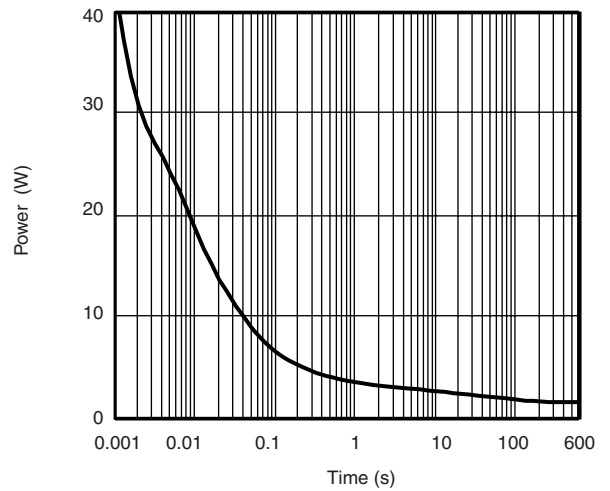
**Source-Drain Diode Forward Voltage**



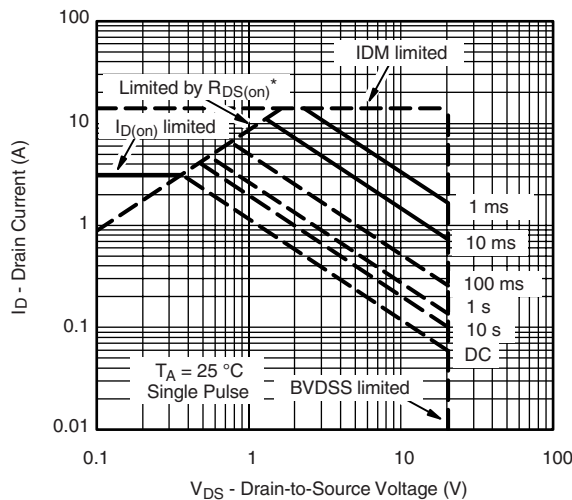
**On-Resistance vs. Gate-to-Source Voltage**



**Threshold Voltage**



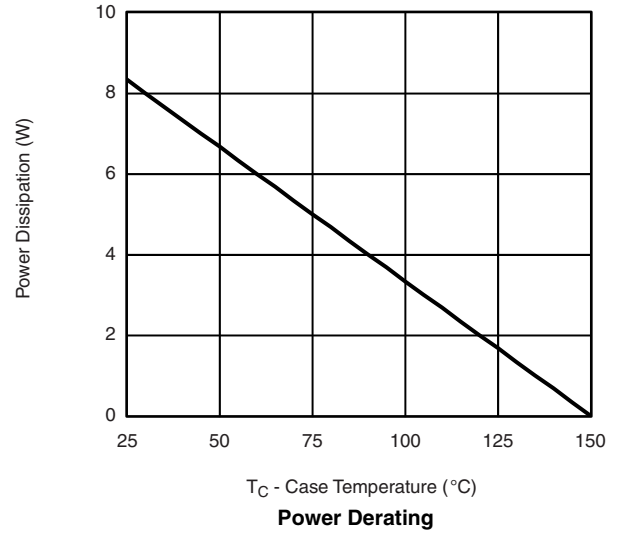
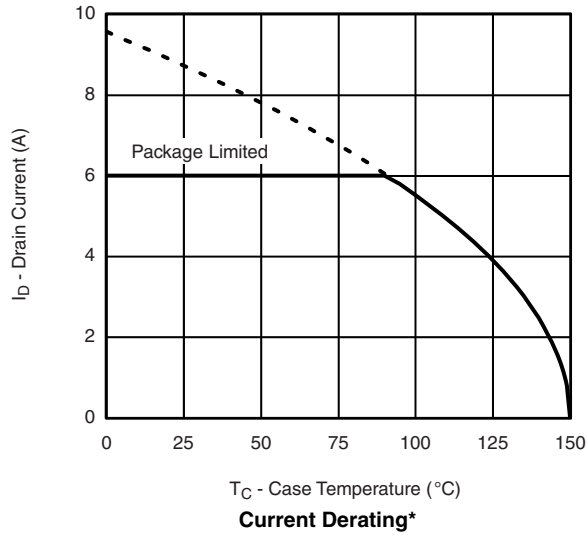
**Single Pulse Power, Junction-to-Ambient**



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

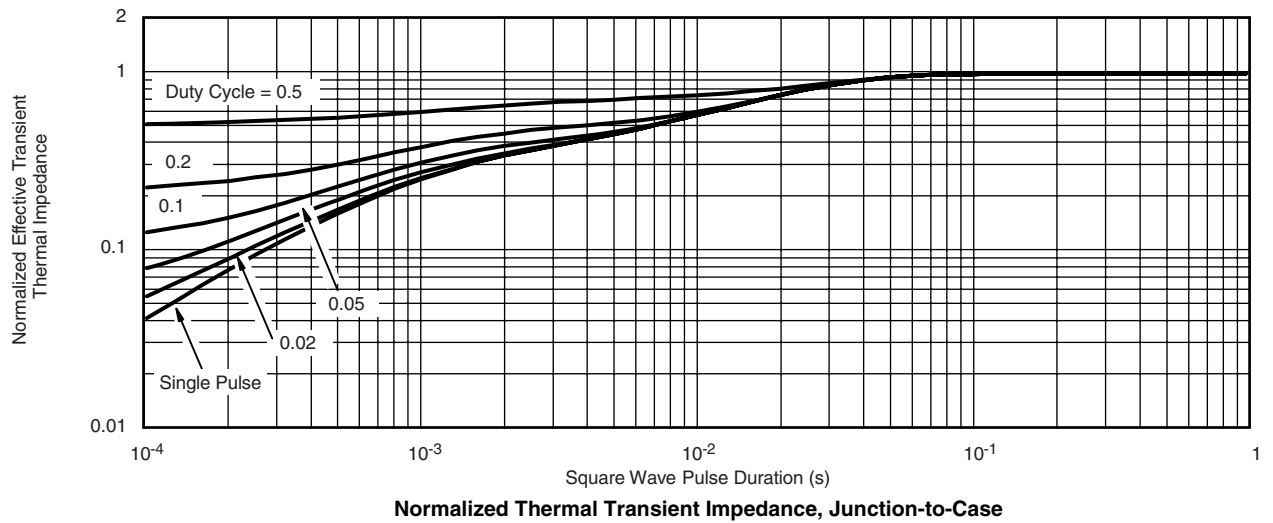
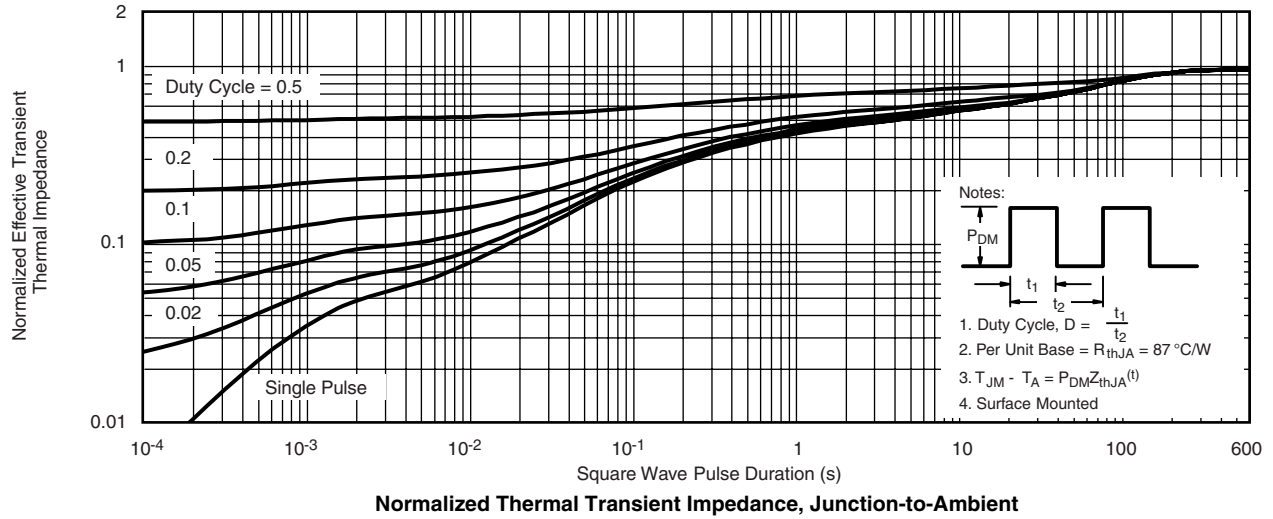
**Safe Operating Area, Junction-to-Case**

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



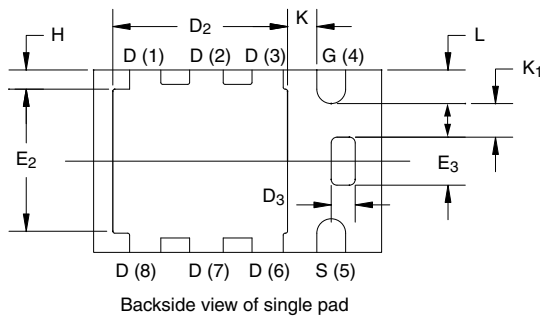
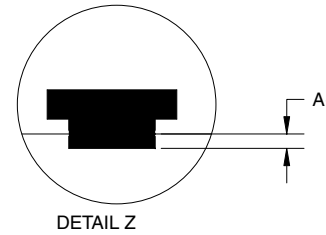
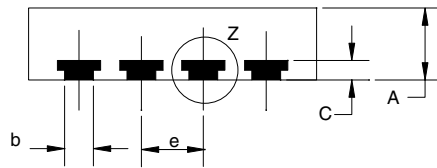
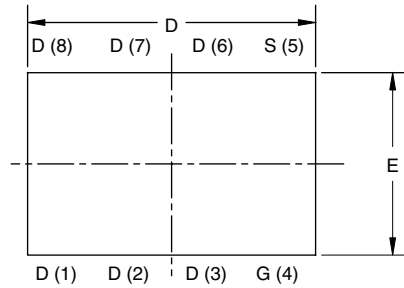
\* The power dissipation  $P_D$  is based on  $T_{J(max)} = 150$  °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package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

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



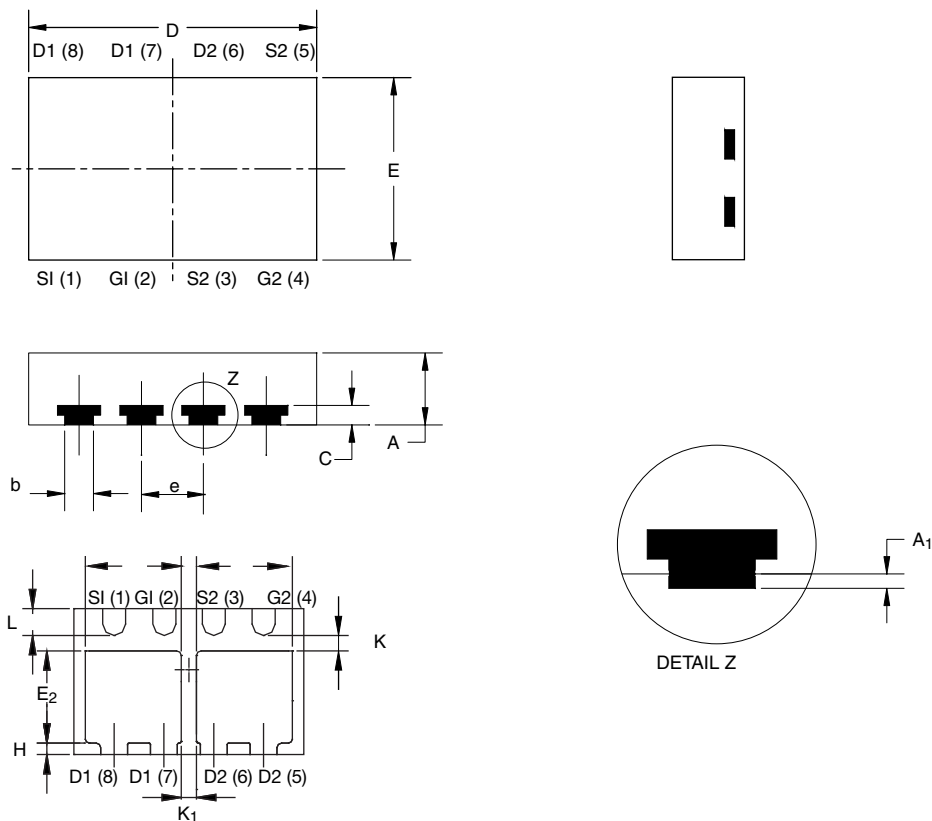
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## PowerPAK® ChipFET® SINGLE PAD



DIM.	MILLIMETERS			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.70	0.75	0.85	0.028	0.030	0.033
A <sub>1</sub>	0	-	0.05	0	-	0.002
b	0.25	0.30	0.35	0.010	0.012	0.014
C	0.15	0.20	0.25	0.006	0.008	0.010
D	2.92	3.00	3.08	0.115	0.118	0.121
D <sub>2</sub>	1.75	1.87	2.00	0.069	0.074	0.079
D <sub>3</sub>	0.20	0.25	0.30	0.008	0.010	0.012
E	1.82	1.90	1.98	0.072	0.075	0.078
E <sub>2</sub>	1.38	1.50	1.63	0.054	0.059	0.064
E <sub>3</sub>	0.45	0.50	0.55	0.018	0.020	0.022
e	0.65 BSC			0.026 BSC		
H	0.15	0.20	0.25	0.006	0.008	0.010
K	0.25	-	-	0.010	-	-
K <sub>1</sub>	0.30	-	-	0.012	-	-
L	0.30	0.35	0.40	0.012	0.014	0.016

## PowerPAK® ChipFET® DUAL PAD



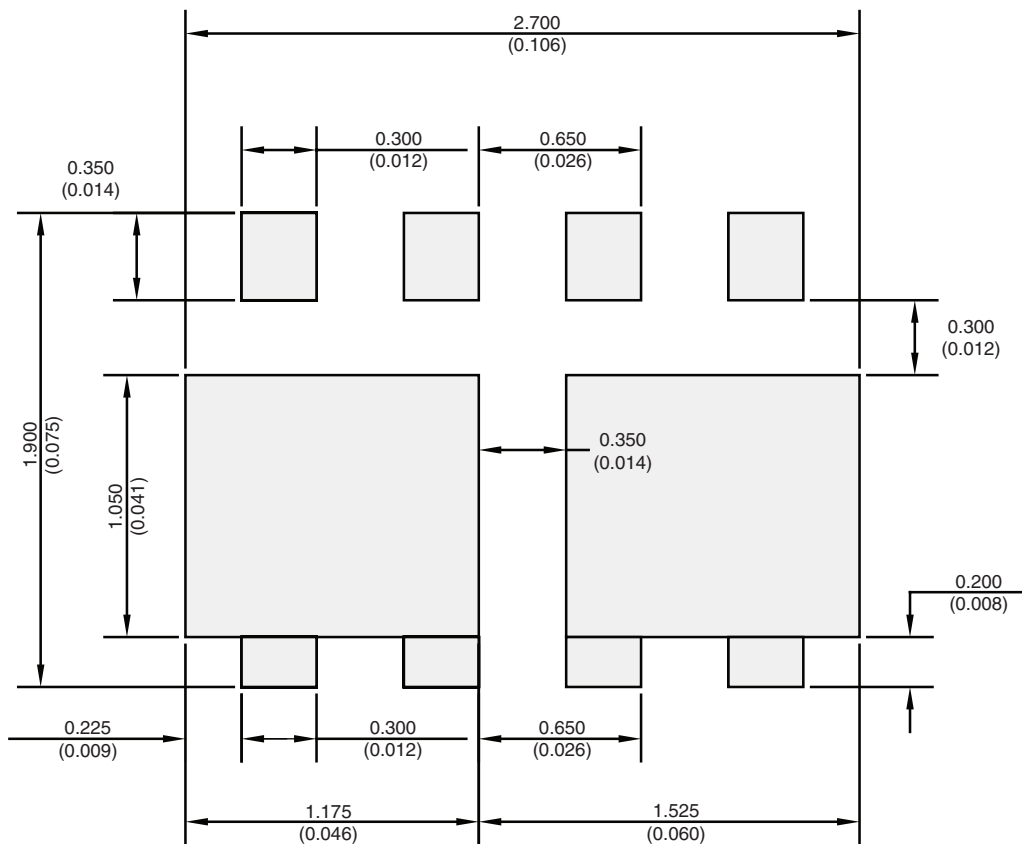
Backside view of dual pad

DIM.	MILLIMETERS			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.70	0.75	0.85	0.028	0.030	0.033
A <sub>1</sub>	0	-	0.05	0	-	0.002
b	0.25	0.30	0.35	0.010	0.012	0.014
C	0.15	0.20	0.25	0.006	0.008	0.010
D	2.92	3.00	3.08	0.115	0.118	0.121
D <sub>2</sub>	1.07	1.20	1.32	0.042	0.047	0.052
E	1.82	1.90	1.98	0.072	0.075	0.078
E <sub>2</sub>	0.92	1.05	1.17	0.036	0.041	0.046
e	0.65 BSC			0.026 BSC		
H	0.15	0.20	0.25	0.006	0.008	0.010
K	0.20	-	-	0.008	-	-
K <sub>1</sub>	0.20	-	-	0.008	-	-
L	0.30	0.35	0.40	0.012	0.014	0.016

ECN: C10-0618-Rev. C, 19-Jul-09

DWG: 5940

## RECOMMENDED MINIMUM PADS FOR PowerPAK® ChipFET® Dual



Recommended Minimum Pads  
Dimensions in mm/(Inches)

Note: This is Flipped Mirror Image  
Pin #1 Location is Top Left Corner



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