

Dual P-Channel 20 V (D-S) MOSFET

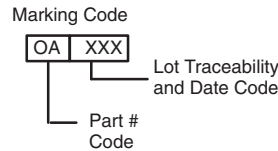
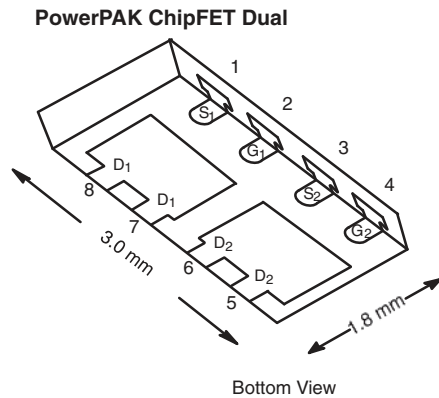
PRODUCT SUMMARY			
V_{DS} (V)	$R_{DS(on)}$ (Ω)	I_D (A)	Q_g (Typ.)
- 20	0.059 at $V_{GS} = -4.5$ V	- 6 ^a	6.9 nC
	0.096 at $V_{GS} = -2.5$ V	- 6 ^a	

FEATURES

- Halogen-free According to IEC 61249-2-21 Definition
- TrenchFET[®] Power MOSFET
- New Thermally Enhanced PowerPAK[®] ChipFET[®] Package
 - Small Footprint Area
 - Low On-Resistance
 - Thin 0.8 mm Profile
- Typical ESD Performance 1500 V in HBM
- Compliant to RoHS Directive 2002/95/EC

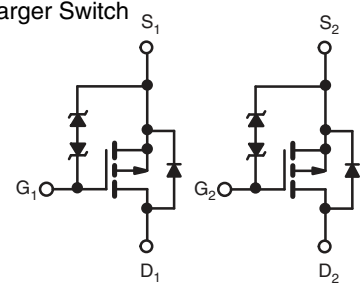


RoHS
COMPLIANT
HALOGEN
FREE



APPLICATIONS

- Load Switch and Charger Switch for Portable Devices
- DC/DC Converters



Ordering Information: Si5999EDU-T1-GE3 (Lead (Pb)-free and Halogen-free)

P-Channel MOSFET P-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS ($T_A = 25$ °C, unless otherwise noted)				
Parameter	Symbol	Limit	Unit	
Drain-Source Voltage	V_{DS}	- 20	V	
Gate-Source Voltage	V_{GS}	± 12		
Continuous Drain Current ($T_J = 150$ °C)	I_D	$T_C = 25$ °C	- 6 ^a	A
		$T_C = 70$ °C	- 6 ^a	
		$T_A = 25$ °C	- 5 ^{b, c}	
		$T_A = 70$ °C	- 4 ^{b, c}	
Pulsed Drain Current ($t = 300$ μ s)	I_{DM}	- 20		
Continuous Source-Drain Diode Current	I_S	$T_C = 25$ °C	- 6 ^a	
		$T_A = 25$ °C	- 1.9 ^{b, c}	
Maximum Power Dissipation	P_D	$T_C = 25$ °C	10.4	W
		$T_C = 70$ °C	6.7	
		$T_A = 25$ °C	2.3 ^{b, c}	
		$T_A = 70$ °C	1.5 ^{b, c}	
Operating Junction and Storage Temperature Range	T_J, T_{stg}	- 55 to 150	°C	
Soldering Recommendations (Peak Temperature) ^{d, e}		260		

THERMAL RESISTANCE RATINGS				
Parameter	Symbol	Typical	Maximum	Unit
Maximum Junction-to-Ambient ^{b, f}	R_{thJA}	43	55	°C/W
Maximum Junction-to-Case (Drain)	R_{thJC}	9.5	12	

Notes:

- Package limited.
- Surface mounted on 1" x 1" FR4 board.
- $t = 5$ s.
- See solder profile (www.vishay.com/doc?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.
- Rework conditions: manual soldering with a soldering iron is not recommended for leadless components.
- Maximum under steady state conditions is 105 °C/W.

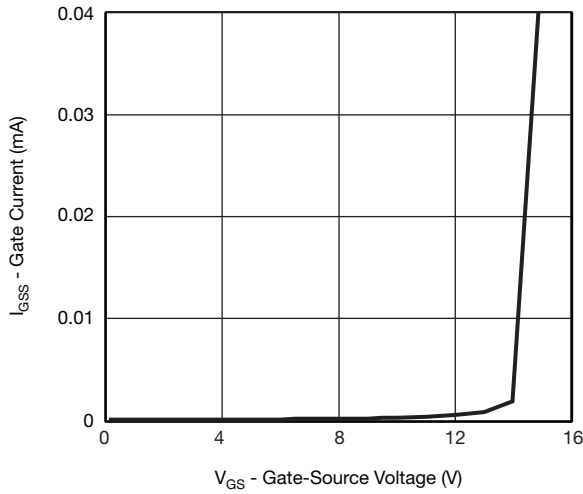
SPECIFICATIONS ($T_J = 25\text{ }^\circ\text{C}$, unless otherwise noted)						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Static						
Drain-Source Breakdown Voltage	V_{DS}	$V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$	- 20			V
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = -250\text{ }\mu\text{A}$		- 16		mV/ $^\circ\text{C}$
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$		3			
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$	- 0.6		- 1.5	V
Gate-Source Leakage	I_{GSS}	$V_{DS} = 0\text{ V}, V_{GS} = \pm 12\text{ V}$			± 10	μA
		$V_{DS} = 0\text{ V}, V_{GS} = \pm 4.5\text{ V}$			± 1	
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}$			- 1	
		$V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^\circ\text{C}$			- 10	
On-State Drain Current ^a	$I_{D(on)}$	$V_{DS} \leq -5\text{ V}, V_{GS} = -4.5\text{ V}$	- 20			A
Drain-Source On-State Resistance ^a	$R_{DS(on)}$	$V_{GS} = -4.5\text{ V}, I_D = -3.5\text{ A}$		0.047	0.059	Ω
		$V_{GS} = -2.5\text{ V}, I_D = -1.5\text{ A}$		0.077	0.096	
Forward Transconductance ^a	g_{fs}	$V_{DS} = -10\text{ V}, I_D = -3.5\text{ A}$		11		S
Dynamic^b						
Input Capacitance	C_{iss}	$V_{DS} = -10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$		496		pF
Output Capacitance	C_{oss}			141		
Reverse Transfer Capacitance	C_{rss}			121		
Total Gate Charge	Q_g	$V_{DS} = -10\text{ V}, V_{GS} = -10\text{ V}, I_D = -5\text{ A}$		13.2	20	nC
		$V_{DS} = -10\text{ V}, V_{GS} = -4.5\text{ V}, I_D = -5\text{ A}$		6.9	10.5	
Gate-Source Charge	Q_{gs}			1.6		
Gate-Drain Charge	Q_{gd}		1.8			
Gate Resistance	R_g	$f = 1\text{ MHz}$	2	8	16	Ω
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -10\text{ V}, R_L = 2.5\text{ }\Omega$ $I_D \cong -4\text{ A}, V_{GEN} = -4.5\text{ V}, R_g = 1\text{ }\Omega$		17	26	ns
Rise Time	t_r			21	32	
Turn-Off Delay Time	$t_{d(off)}$			26	40	
Fall Time	t_f			13	20	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -10\text{ V}, R_L = 2.5\text{ }\Omega$ $I_D \cong -4\text{ A}, V_{GEN} = -10\text{ V}, R_g = 1\text{ }\Omega$		6	12	
Rise Time	t_r			11	22	
Turn-Off Delay Time	$t_{d(off)}$			23	35	
Fall Time	t_f			11	22	
Drain-Source Body Diode Characteristics						
Continuous Source-Drain Diode Current	I_S	$T_C = 25\text{ }^\circ\text{C}$			- 6	A
Pulse Diode Forward Current	I_{SM}				- 20	
Body Diode Voltage	V_{SD}	$I_S = -4\text{ A}, V_{GS} = 0\text{ V}$		- 0.85	- 1.2	V
Body Diode Reverse Recovery Time	t_{rr}	$I_F = -4\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, T_J = 25\text{ }^\circ\text{C}$		24	48	ns
Body Diode Reverse Recovery Charge	Q_{rr}			10	20	nC
Reverse Recovery Fall Time	t_a			14		ns
Reverse Recovery Rise Time	t_b			10		

Notes:

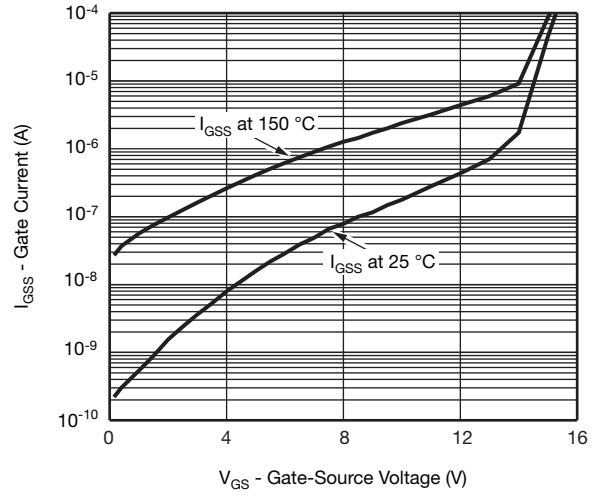
- a. Pulse test; pulse width $\leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$.
b. Guaranteed by design, not subject to production testing.

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.

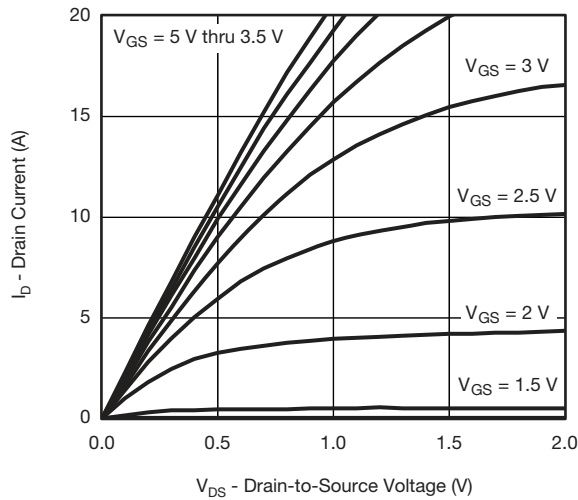
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



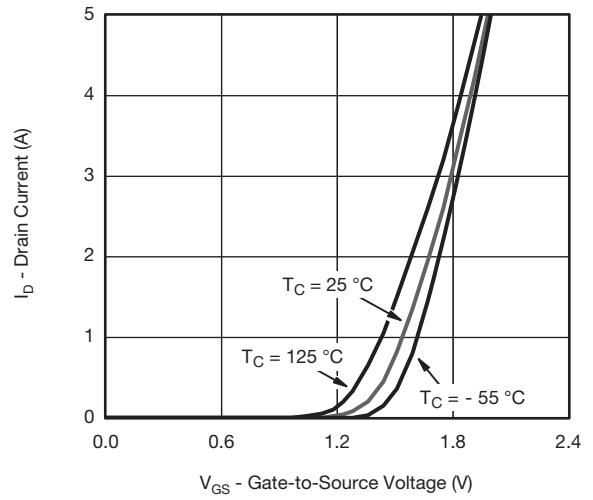
Gate Current vs. Gate-Source Voltage



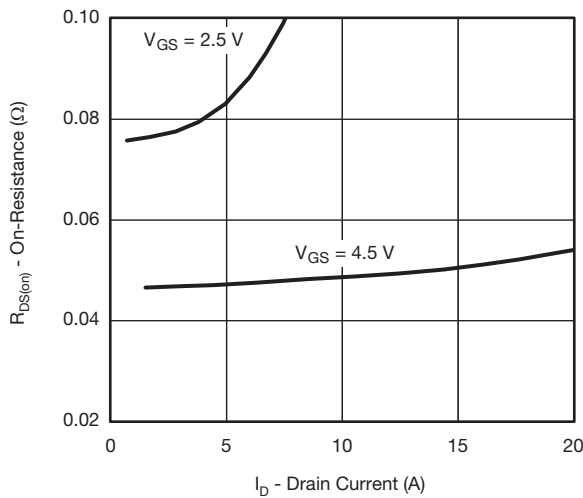
Gate Current vs. Gate-Source Voltage



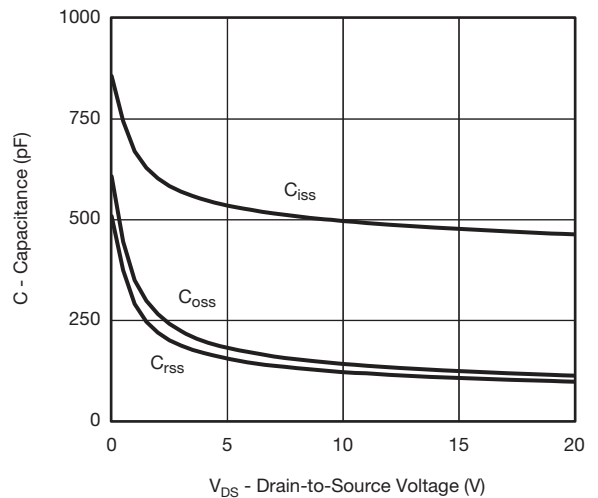
Output Characteristics



Transfer Characteristics

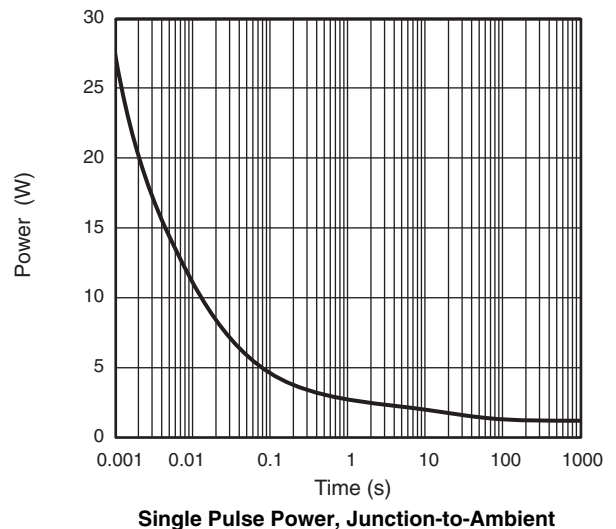
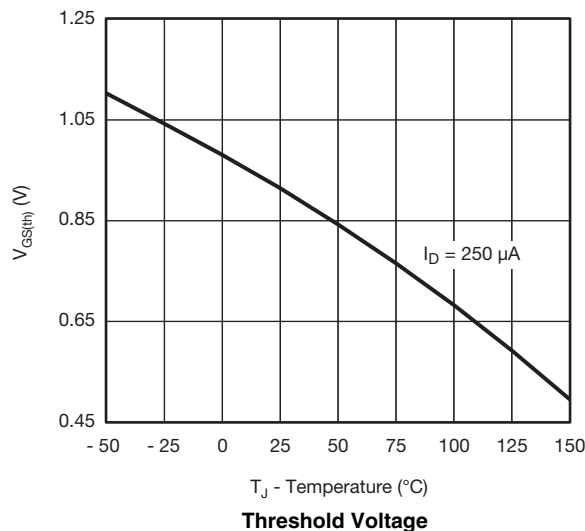
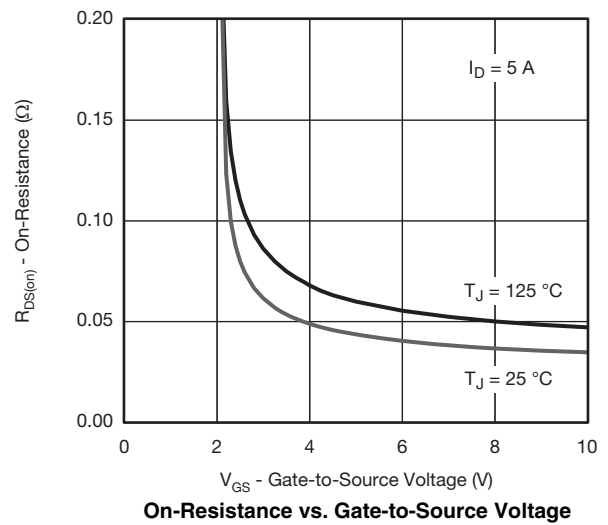
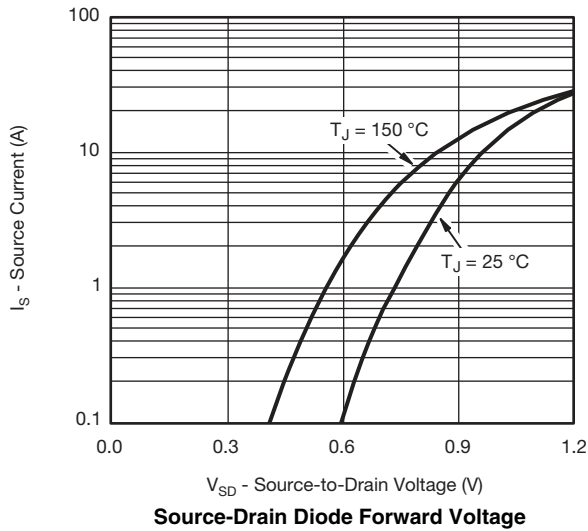
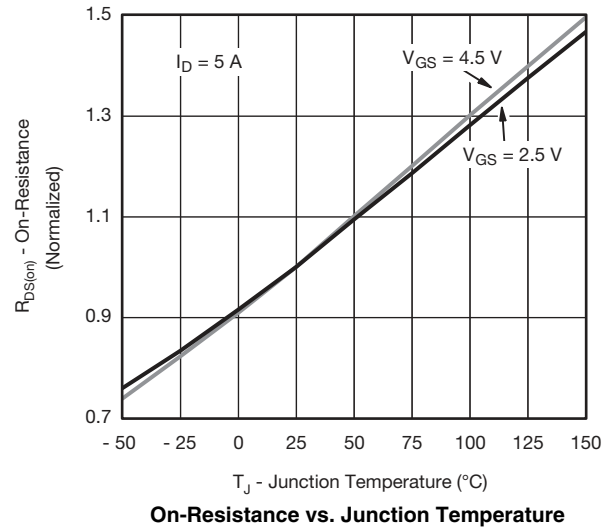
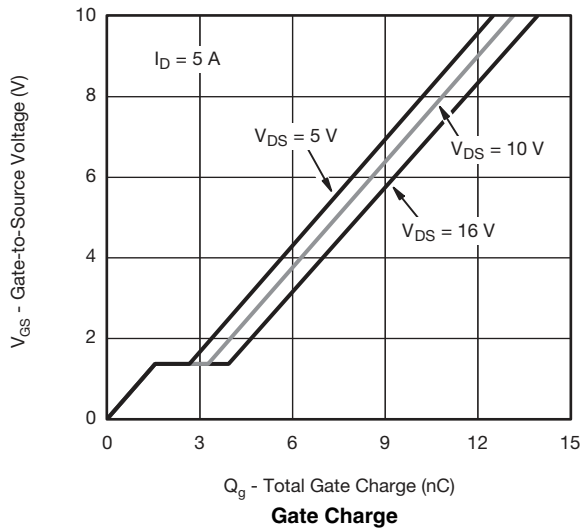


On-Resistance vs. Drain Current

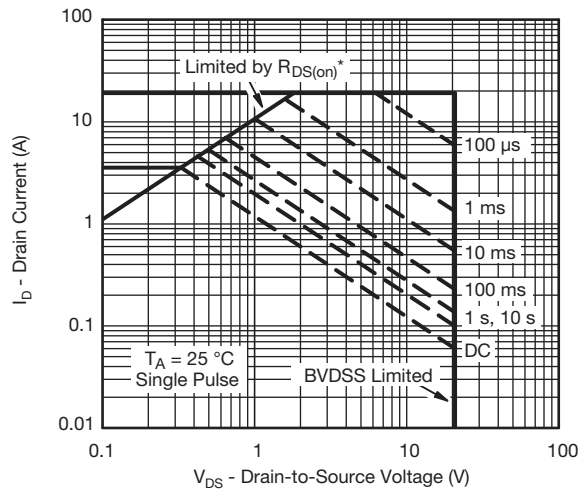


Capacitance

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

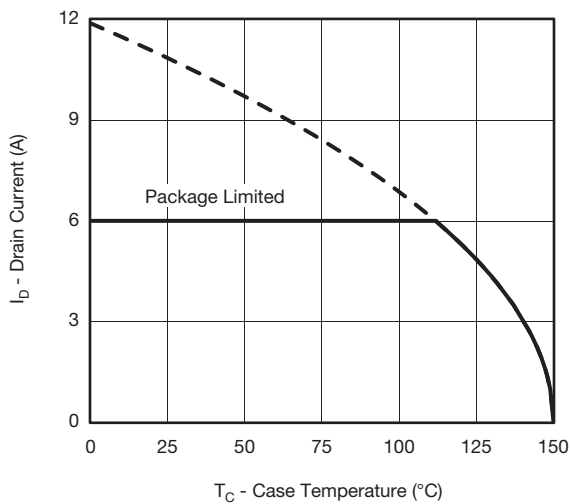


TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

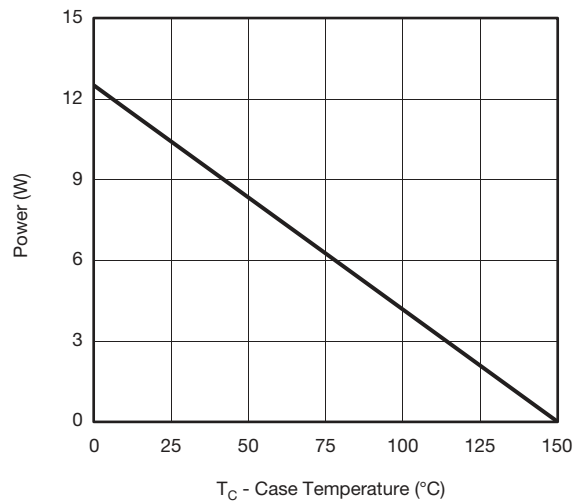


* $V_{GS} >$ minimum V_{GS} at which $R_{DS(on)}$ is specified

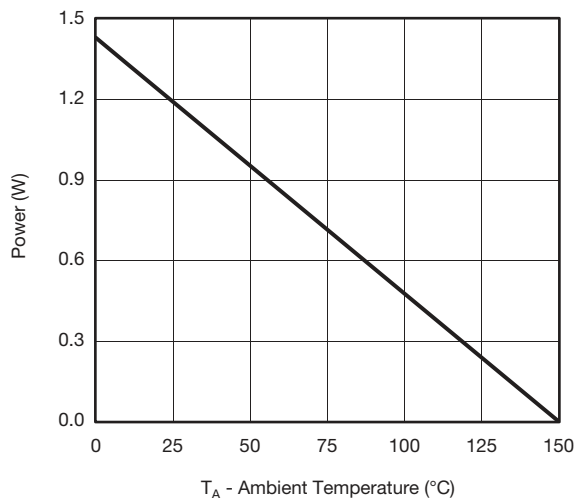
Safe Operating Area, Junction-to-Ambient



Current Derating*



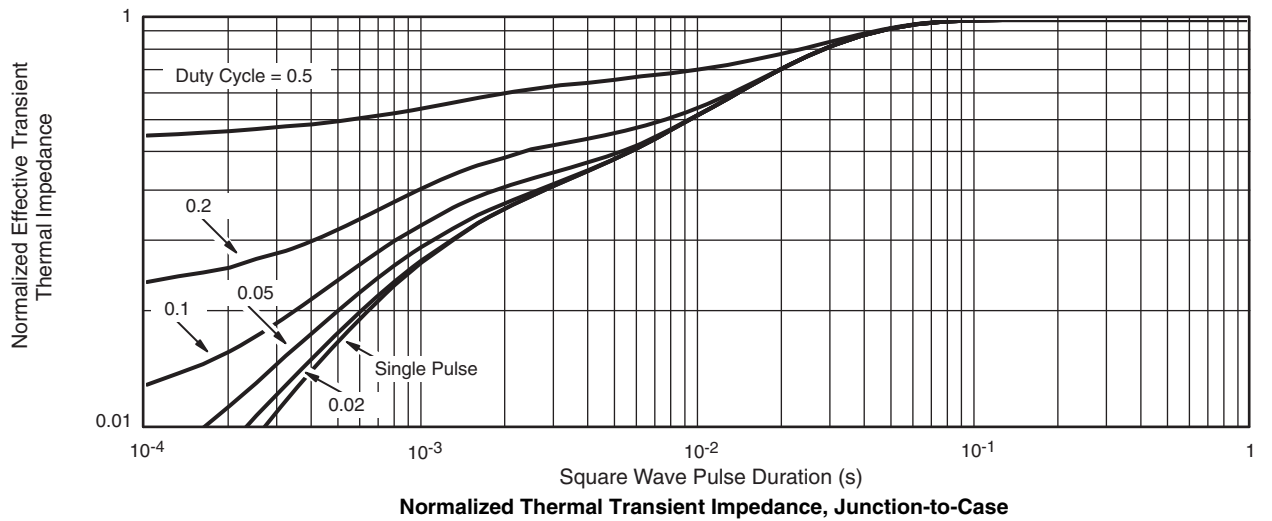
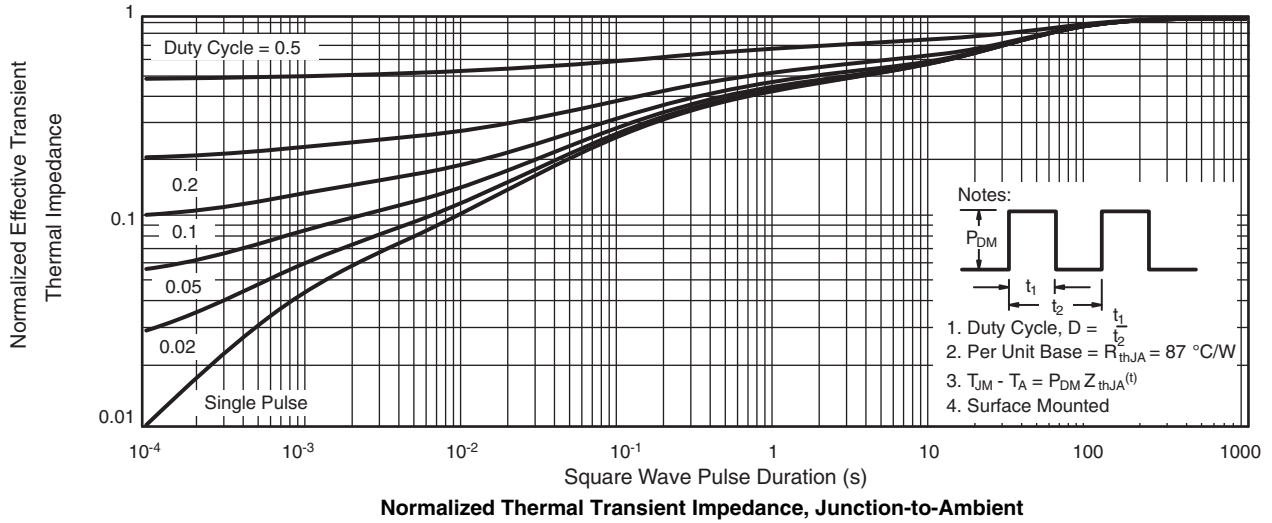
Power Derating, Junction-to-Case



Power Derating, Junction-to-Ambient

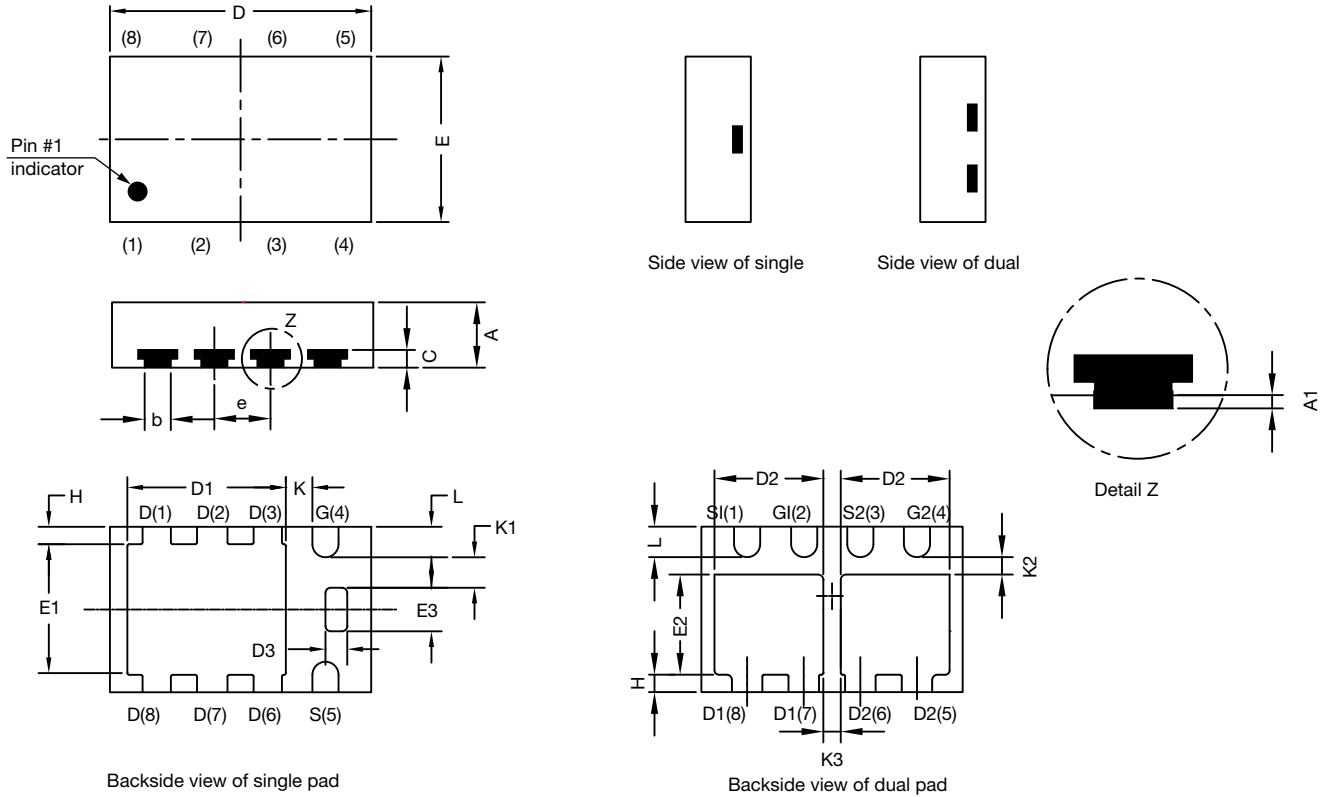
* The power dissipation P_D is based on $T_{J(max)} = 150\text{ }^\circ\text{C}$, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below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

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



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PowerPAK[®] ChipFET[®] Case Outline



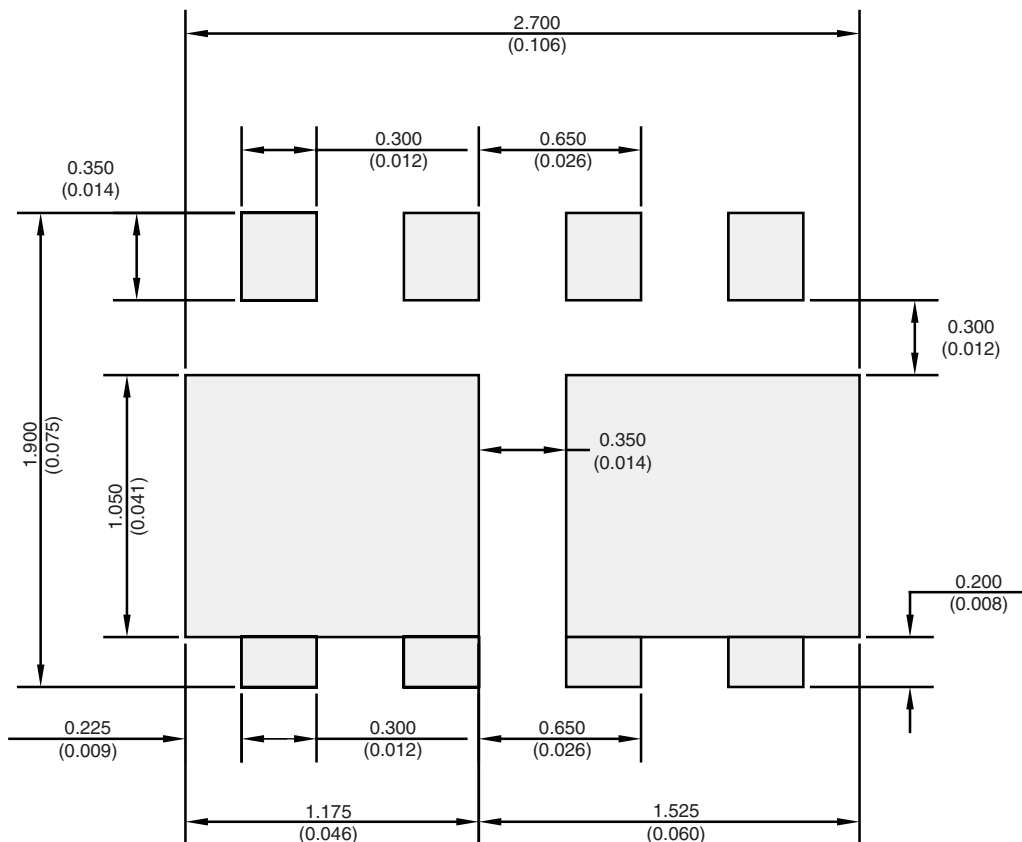
DIM.	MILLIMETERS			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.70	0.75	0.85	0.028	0.030	0.033
A1	0	-	0.05	0	-	0.002
b	0.25	0.30	0.35	0.010	0.012	0.014
C	0.15	0.20	0.25	0.006	0.008	0.010
D	2.92	3.00	3.08	0.115	0.118	0.121
D1	1.75	1.87	2.00	0.069	0.074	0.079
D2	1.07	1.20	1.32	0.042	0.047	0.052
D3	0.20	0.25	0.30	0.008	0.010	0.012
E	1.82	1.90	1.98	0.072	0.075	0.078
E1	1.38	1.50	1.63	0.054	0.059	0.064
E2	0.92	1.05	1.17	0.036	0.041	0.046
E3	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	-	-
K1	0.30	-	-	0.012	-	-
K2	0.20	-	-	0.008	-	-
K3	0.20	-	-	0.008	-	-
L	0.30	0.35	0.40	0.012	0.014	0.016

C14-0630-Rev. E, 21-Jul-14
DWG: 5940

Note

- Millimeters will govern

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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