



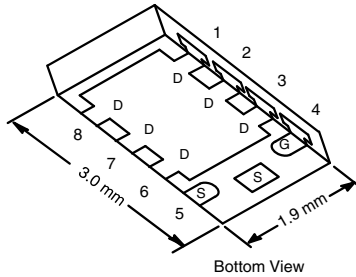
**THE DATASHEET OF  
SI5411EDU-T1-GE3**



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

PRODUCT SUMMARY			
V <sub>DS</sub> (V)	R <sub>DS(on)</sub> (Ω) (Max.)	I <sub>D</sub> (A)	Q <sub>g</sub> (Typ.)
- 12	0.0082 at V <sub>GS</sub> = - 4.5 V	- 25 <sup>a</sup>	43 nC
	0.0094 at V <sub>GS</sub> = - 3.7 V	- 25 <sup>a</sup>	
	0.0117 at V <sub>GS</sub> = - 2.5 V	- 25 <sup>a</sup>	
	0.0206 at V <sub>GS</sub> = - 1.8 V	- 15	

PowerPAK ChipFET Single


**Ordering Information:**

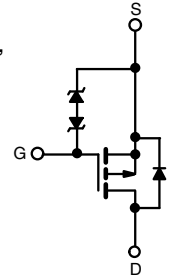
Si5411EDU-T1-GE3 (Lead (Pb)-free and Halogen-free)

**FEATURES**

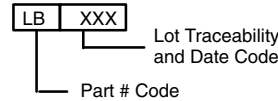
- TrenchFET® Power MOSFET
- Thermally Enhanced PowerPAK® ChipFET Package
  - Small Footprint Area
  - Low On-Resistance
- 100 % R<sub>g</sub> and UIS Tested
- Typical ESD Protection: 5000 V (HBM)
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
 COMPLIANT  
 HALOGEN  
**FREE**
**APPLICATIONS**

- Portable Devices such as Smart Phones, Tablet PCs and Mobile Computing
  - Battery Switch
  - Load Switch
  - Power Management



P-Channel MOSFET

**Marking Code**

**ABSOLUTE MAXIMUM RATINGS** (T<sub>C</sub> = 25 °C, unless otherwise noted)

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	V <sub>DS</sub>	- 12	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	- 25 <sup>a</sup>
		T <sub>C</sub> = 70 °C	- 25 <sup>a</sup>
		T <sub>A</sub> = 25 °C	- 16.5 <sup>b, c</sup>
		T <sub>A</sub> = 70 °C	- 13 <sup>b, c</sup>
Pulsed Drain Current (t = 100 μs)	I <sub>DM</sub>	- 140	A
Continuous Source-Drain Diode Current	I <sub>S</sub>	T <sub>C</sub> = 25 °C	
		T <sub>A</sub> = 25 °C	- 2.6 <sup>b, c</sup>
Single Avalanche Current	I <sub>AS</sub>	- 15	mJ
Single Avalanche Energy	E <sub>AS</sub>	11	
Maximum Power Dissipation	P <sub>D</sub>	T <sub>C</sub> = 25 °C	31
		T <sub>C</sub> = 70 °C	20
		T <sub>A</sub> = 25 °C	3.1 <sup>b, c</sup>
		T <sub>A</sub> = 70 °C	2 <sup>b, c</sup>
Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	- 50 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>	R <sub>thJA</sub>	34	40	°C/W
Maximum Junction-to-Case (Drain)	R <sub>thJC</sub>	3	4	

**Notes**

- Package limited.
- Surface mounted on 1" x 1" FR4 board.
- t = 5 s.
- See solder profile ([www.vishay.com/doc?73257](http://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 90 °C/W.



<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	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$	-12			V	
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = -250\text{ }\mu\text{A}$		-5		mV/ $^\circ\text{C}$	
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$		1.8				
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$	-0.4		-0.9	V	
Gate-Source Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 8\text{ V}$			$\pm 2$	$\mu\text{A}$	
		$V_{DS} = 0\text{ V}, V_{GS} = \pm 4.5\text{ V}$			$\pm 0.2$		
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = -12\text{ V}, V_{GS} = 0\text{ V}$			-1		
		$V_{DS} = -12\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^\circ\text{C}$			-10		
On-State Drain Current <sup>a</sup>	$I_{D(on)}$	$V_{DS} \leq -5\text{ V}, V_{GS} = -4.5\text{ V}$	-10			A	
Drain-Source On-State Resistance <sup>a</sup>	$R_{DS(on)}$	$V_{GS} = -4.5\text{ V}, I_D = -6\text{ A}$		0.0066	0.0082	$\Omega$	
		$V_{GS} = -3.7\text{ V}, I_D = -5\text{ A}$		0.0073	0.0094		
		$V_{GS} = -2.5\text{ V}, I_D = -5\text{ A}$		0.0095	0.0117		
		$V_{GS} = -1.8\text{ V}, I_D = -2\text{ A}$		0.0155	0.0206		
Forward Transconductance <sup>a</sup>	$g_{fs}$	$V_{GS} = -6\text{ V}, I_D = -6\text{ A}$		45		S	
<b>Dynamic<sup>b</sup></b>							
Input Capacitance	$C_{iss}$	$V_{DS} = -6\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$		4100		pF	
Output Capacitance	$C_{oss}$		860				
Reverse Transfer Capacitance	$C_{rss}$		870				
Total Gate Charge	$Q_g$	$V_{DS} = -6\text{ V}, V_{GS} = -8\text{ V}, I_D = -15\text{ A}$		70	105	nC	
Gate-Source Charge	$Q_{gs}$	$V_{DS} = -6\text{ V}, V_{GS} = -4.5\text{ V}, I_D = -15\text{ A}$		43	65		
Gate-Drain Charge	$Q_{gd}$			5.5			
Gate Resistance	$R_g$			10.5			
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -6\text{ V}, R_L = 0.6\text{ }\Omega$ $I_D \cong -10\text{ A}, V_{GEN} = -4.5\text{ V}, R_g = 1\text{ }\Omega$	0.7	3.6	7.2	ns	
Rise Time	$t_r$			30	60		
Turn-Off Delay Time	$t_{d(off)}$			70	140		
Fall Time	$t_f$			35	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	25		
Rise Time	$t_r$			5	10		
Turn-Off Delay Time	$t_{d(off)}$			80	160		
Fall Time	$t_f$			25	50		
<b>Drain-Source Body Diode Characteristics</b>							
Continuous Source-Drain Diode Current	$I_S$	$T_C = 25\text{ }^\circ\text{C}$			-25		A
Pulse Diode Forward Current (100 $\mu\text{s}$ )	$I_{SM}$				-140		
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	$t_{rr}$	$I_F = -10\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, T_J = 25\text{ }^\circ\text{C}$		45	90	ns	
Body Diode Reverse Recovery Charge	$Q_{rr}$			35	70	nC	
Reverse Recovery Fall Time	$t_a$			17		ns	
Reverse Recovery Rise Time	$t_b$			28			

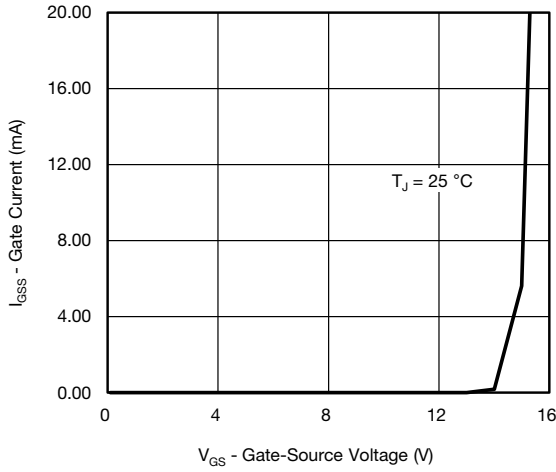
**Notes**

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

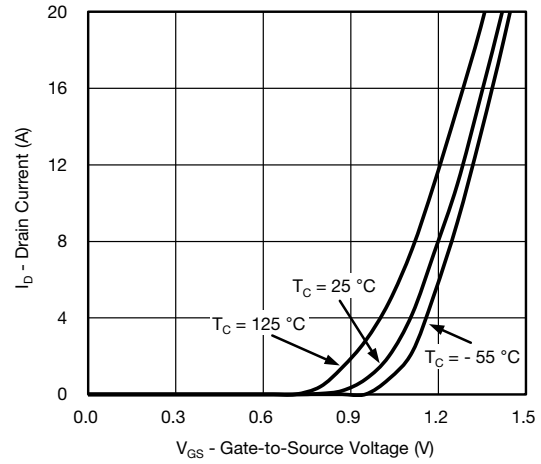
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



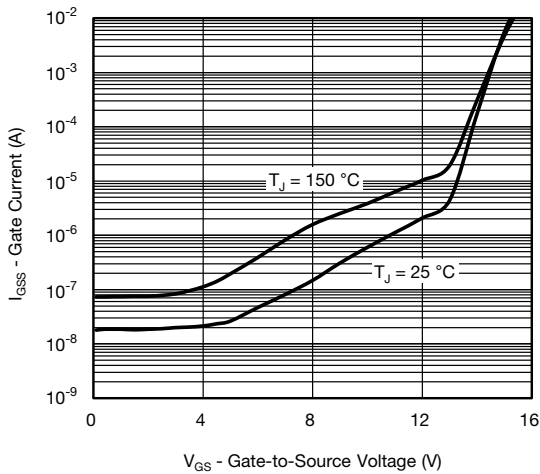
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



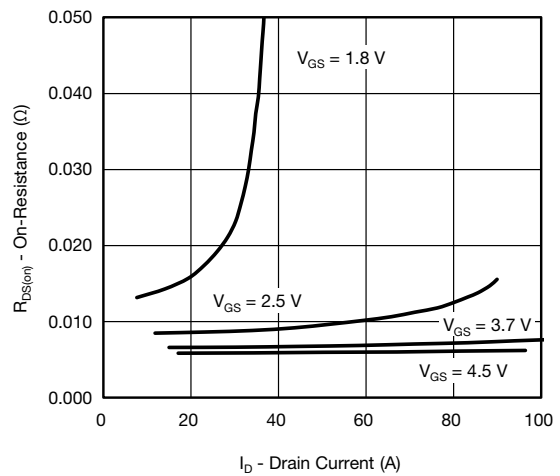
Gate Current vs. Gate-Source Voltage



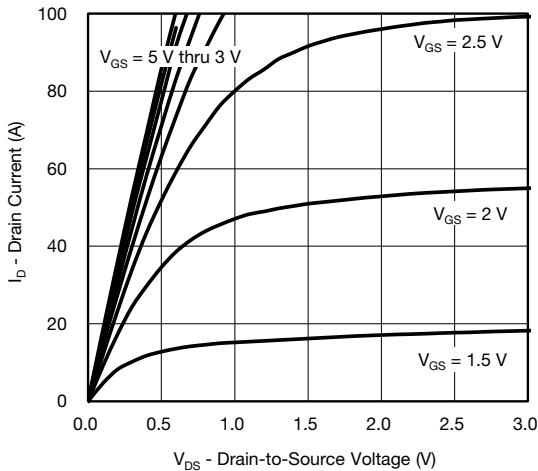
Transfer Characteristics



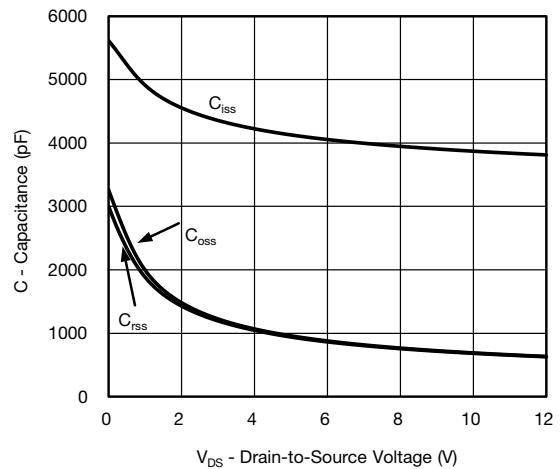
Gate Current vs. Gate-Source Voltage



On-Resistance vs. Drain Current and Gate Voltage

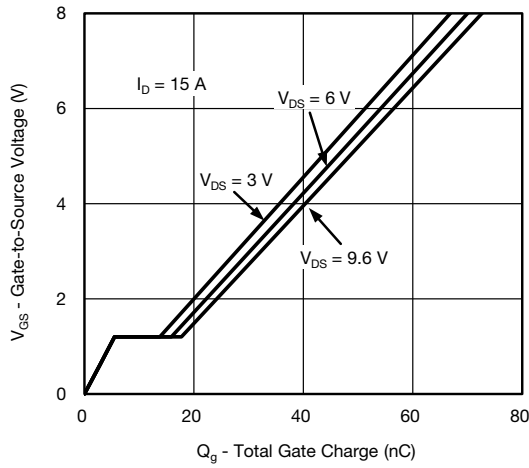


Output Characteristics

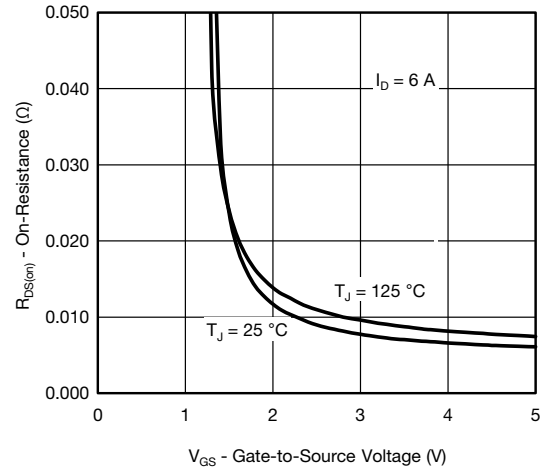


Capacitance

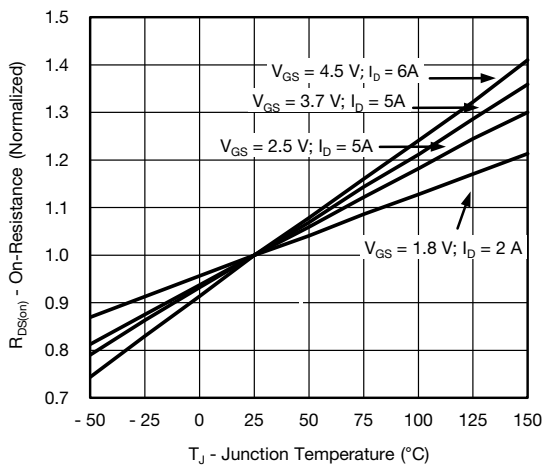
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



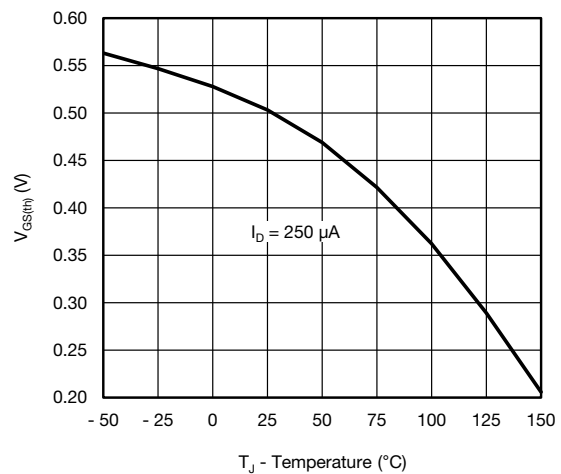
**Gate Charge**



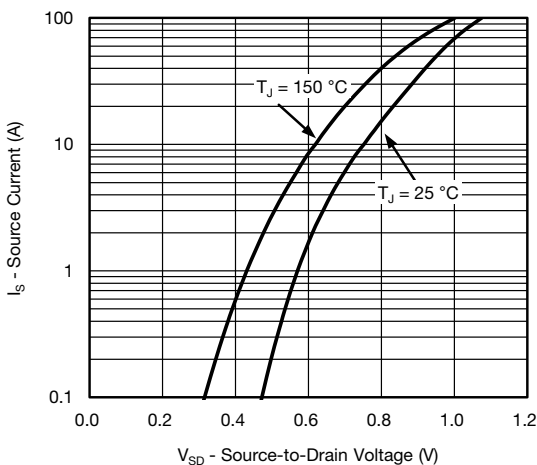
**On-Resistance vs. Gate-to-Source Voltage**



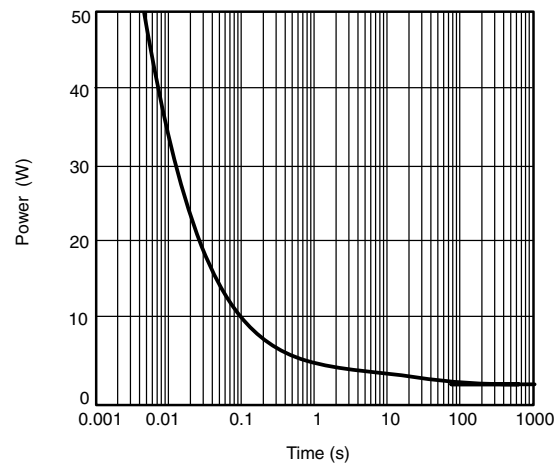
**On-Resistance vs. Junction Temperature**



**Threshold Voltage**



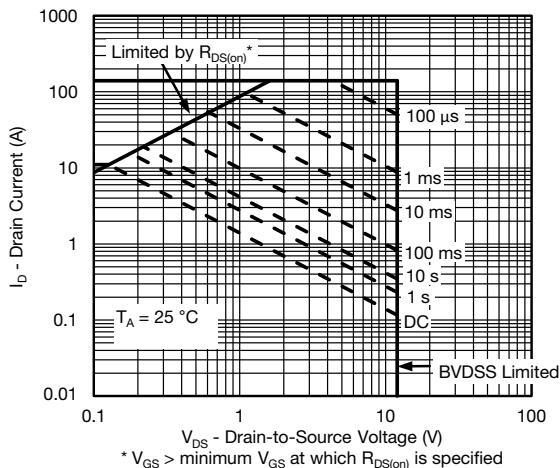
**Source-Drain Diode Forward Voltage**



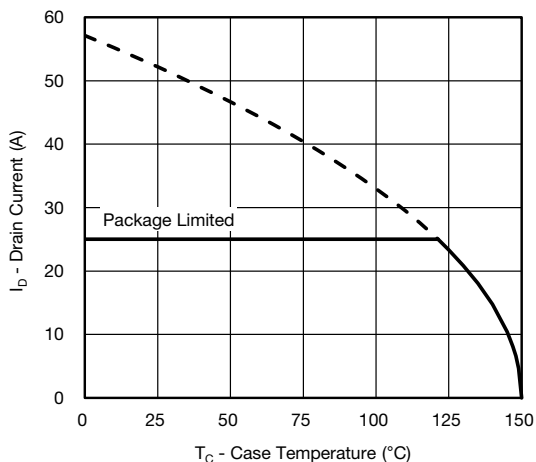
**Single Pulse Power, Junction-to-Ambient**



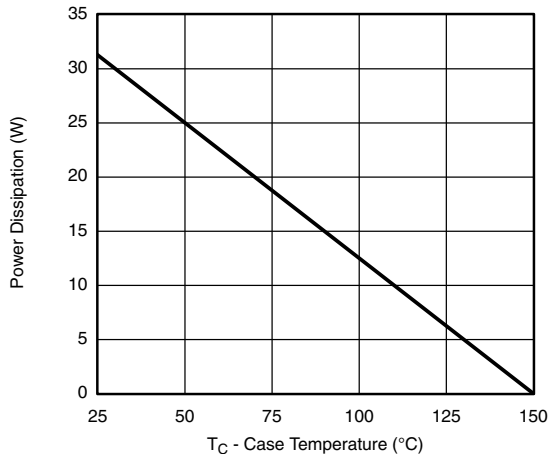
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



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



**Current Derating\***

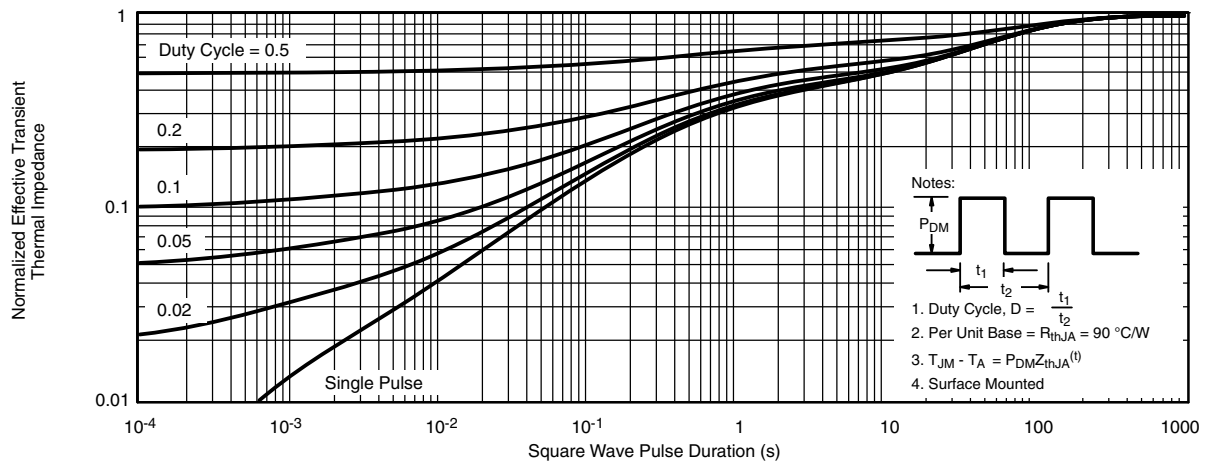


**Power Derating**

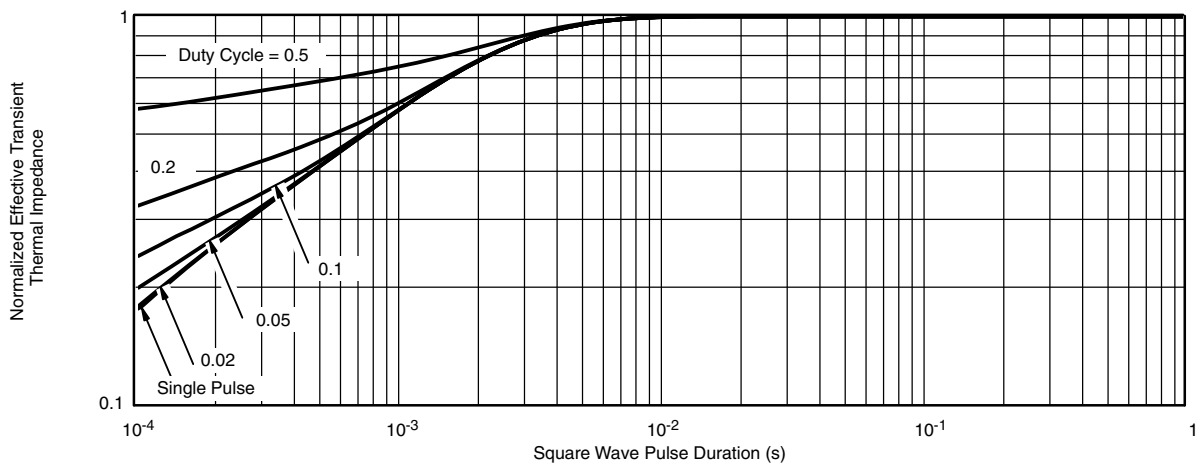
\* The power dissipation  $P_D$  is based on  $T_{J(max.)} = 150$  °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package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



TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



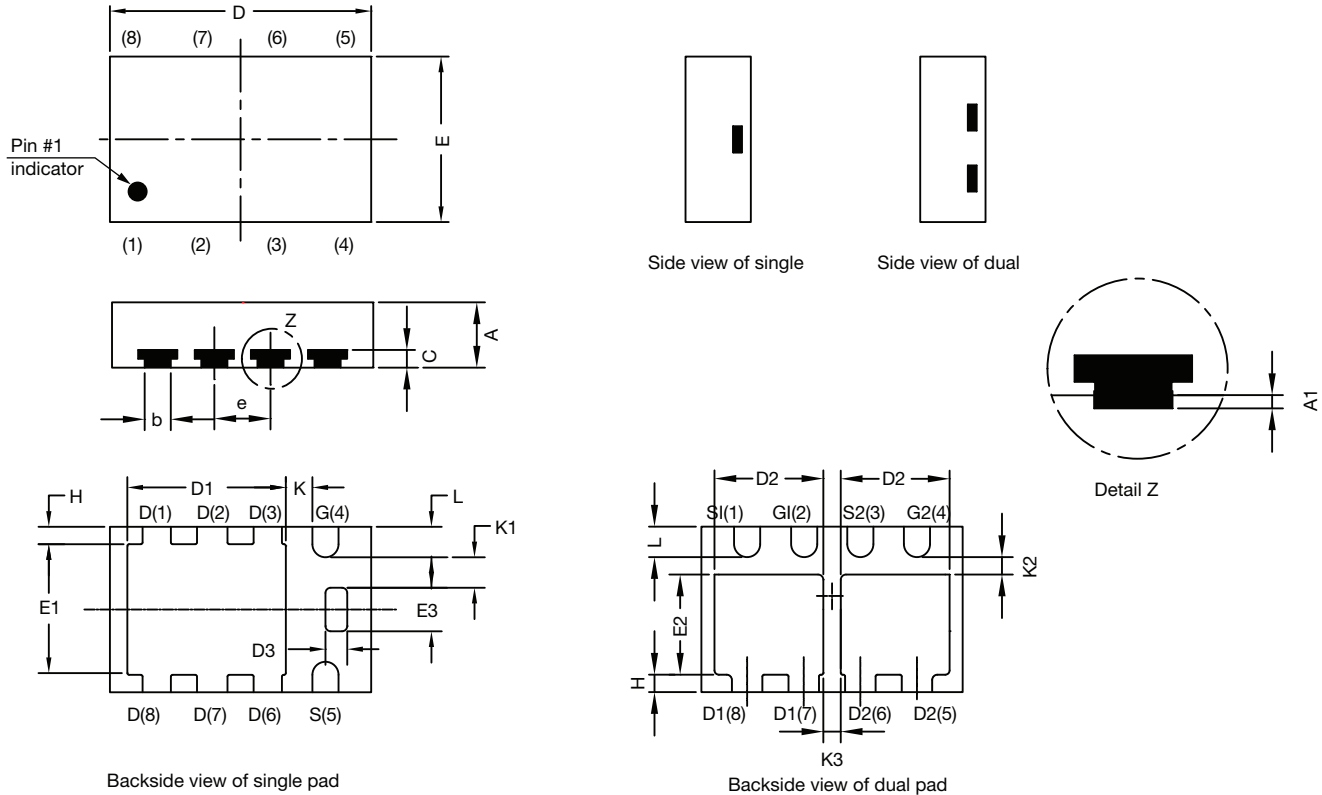
Normalized Thermal Transient Impedance, Junction-to-Ambient



Normalized Thermal Transient Impedance, Junction-to-Case

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### PowerPAK® ChipFET® Case Outline



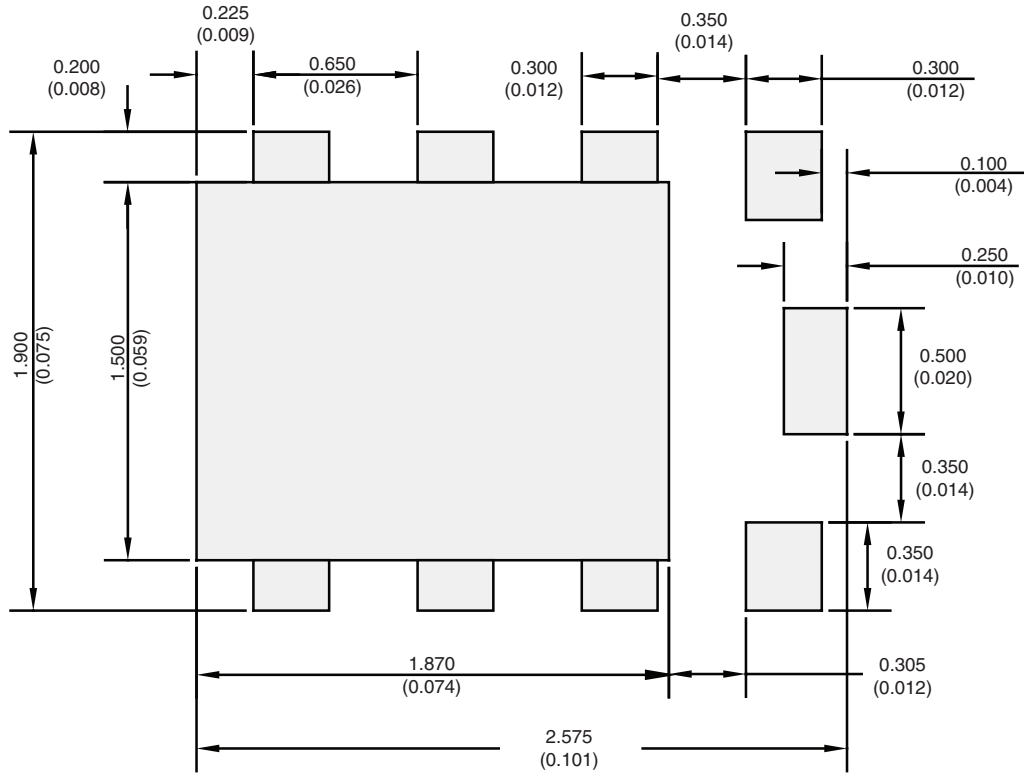
DIM.	MILLIMETERS			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.70	0.75	0.85	0.028	0.030	0.033
A1	0	-	0.05	0	-	0.002
b	0.25	0.30	0.35	0.010	0.012	0.014
C	0.15	0.20	0.25	0.006	0.008	0.010
D	2.92	3.00	3.08	0.115	0.118	0.121
D1	1.75	1.87	2.00	0.069	0.074	0.079
D2	1.07	1.20	1.32	0.042	0.047	0.052
D3	0.20	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® Single



Recommended Minimum Pads  
Dimensions in mm/(Inches)

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