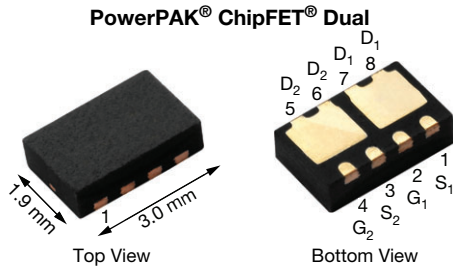


N- and P-Channel 20 V (D-S) MOSFET



Marking code: EA

PRODUCT SUMMARY		
	N-CHANNEL	P-CHANNEL
V_{DS} (V)	20	-20
$R_{DS(on)}$ (Ω) at $V_{GS} = \pm 4.5$ V	0.039	0.072
$R_{DS(on)}$ (Ω) at $V_{GS} = \pm 2.5$ V	0.045	0.100
$R_{DS(on)}$ (Ω) at $V_{GS} = \pm 1.8$ V	0.055	0.131
Q_g typ. (nC)	6	5.5
I_D (A) ^a	6	-6
Configuration	N- and p-pair	

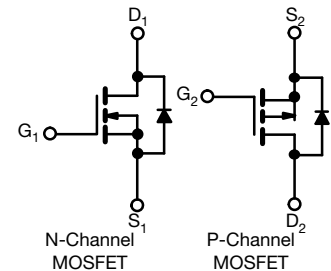
FEATURES

- TrenchFET® power MOSFETs
- Thermally enhanced PowerPAK ChipFET package
 - Small footprint area
 - Low on-resistance
 - Thin 0.8 mm profile
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912


RoHS
 COMPLIANT
 HALOGEN
FREE

APPLICATIONS

- Complementary MOSFET for portable devices
 - Ideal for buck-boost circuits



ORDERING INFORMATION	
Package	PowerPAK ChipFET
Lead (Pb)-free and halogen-free	Si5517DU-T1-GE3

ABSOLUTE MAXIMUM RATINGS ($T_A = 25$ °C, unless otherwise noted)					
PARAMETER	SYMBOL	N-CHANNEL	P-CHANNEL	UNIT	
Drain-source voltage	V_{DS}	20	-20	V	
Gate-source voltage	V_{GS}	± 8	± 8		
Continuous drain current ($T_J = 150$ °C)	I_D	$T_C = 25$ °C	6 ^a	-6 ^a	A
		$T_C = 70$ °C	6 ^a	-6 ^a	
		$T_A = 25$ °C	7.2 ^{b, c}	-4.6 ^{b, c}	
		$T_A = 70$ °C	5.8 ^{b, c}	-3.7 ^{b, c}	
Pulsed drain current	I_{DM}	20	-15		
Source-drain current diode current	I_S	$T_C = 25$ °C	6.9	-6.9	
		$T_A = 25$ °C	1.9 ^{b, c}	-1.9 ^{b, c}	
Maximum power dissipation	P_D	$T_C = 25$ °C	8.3	8.3	W
		$T_C = 70$ °C	5.3	5.3	
		$T_A = 25$ °C	2.3 ^{b, c}	2.3 ^{b, c}	
		$T_A = 70$ °C	1.5 ^{b, 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	N-CHANNEL		P-CHANNEL		UNIT	
		TYP.	MAX.	TYP.	MAX.		
Maximum junction-to-ambient ^{b, f}	$t \leq 5$ s	R_{thJA}	45	55	45	55	°C/W
Maximum junction-to-case (drain)	Steady state	R_{thJC}	12	15	12	15	

Notes

- Based on $T_C = 25$ °C
- 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 for both channels



SPECIFICATIONS ($T_J = 25\text{ }^\circ\text{C}$, unless otherwise noted)									
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP. ^a	MAX.	UNIT			
Static									
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	-	mV/ $^\circ\text{C}$		
		$I_D = -250\text{ }\mu\text{A}$	P-Ch	-	2.4	-			
Gate-source 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_{BSS}	$V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}$	N-Ch	-	-	1	μA		
		$V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}$	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 ^b	$I_{D(on)}$	$V_{DS} \leq 5\text{ V}, V_{GS} = 4.5\text{ V}$	N-Ch	20	-	-	A		
		$V_{DS} \leq -5\text{ V}, V_{GS} = -4.5\text{ V}$	P-Ch	-15	-	-			
Drain-source on-state resistance ^b	$R_{DS(on)}$	$V_{GS} = 4.5\text{ V}, I_D = 4.4\text{ A}$	N-Ch	-	0.0320	0.0390	Ω		
		$V_{GS} = -4.5\text{ V}, I_D = -3.3\text{ A}$	P-Ch	-	0.0600	0.0720			
		$V_{GS} = 2.5\text{ V}, I_D = 4.1\text{ A}$	N-Ch	-	0.0370	0.0450			
		$V_{GS} = -2.5\text{ V}, I_D = -2.8\text{ A}$	P-Ch	-	0.0830	0.1000			
		$V_{GS} = 1.8\text{ V}, I_D = 1.8\text{ A}$	N-Ch	-	0.0455	0.0550			
		$V_{GS} = -1.8\text{ V}, I_D = -0.76\text{ A}$	P-Ch	-	0.1080	0.1310			
Forward transconductance ^b	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	-	0.9	-			
Dynamic ^a									
Input capacitance	C_{iss}	N-channel $V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$ P-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}		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	nC		
		$V_{DS} = -10\text{ V}, V_{GS} = -8\text{ V}, I_D = -4.6\text{ A}$	P-Ch	-	9.1	14			
		$V_{DS} = 10\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 4.4\text{ A}$	N-Ch	-	6	9			
		$V_{DS} = -10\text{ V}, V_{GS} = -4.5\text{ V}, I_D = -1.8\text{ A}$	P-Ch	-	5.5	8.5			
Gate-source charge	Q_{gs}	N-channel $V_{DS} = 10\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 4.4\text{ A}$ P-channel $V_{DS} = -10\text{ V}, V_{GS} = -4.5\text{ V}, I_D = -1.8\text{ A}$	N-Ch	-	0.91	-	nC		
			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		-	Ω
				P-Ch	-	8		-	



SPECIFICATIONS (T _J = 25 °C, unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP. ^a	MAX.	UNIT	
Dynamic ^a							
Turn-on delay time	t _{d(on)}	N-channel V _{DD} = 10 V, R _L = 2.8 Ω, I _D ≅ 3.6 A, V _{GEN} = 4.5 V, R _g = 1 Ω	N-Ch	-	20	30	ns
			P-Ch	-	8	15	
Rise time	t _r	P-channel V _{DD} = -10 V, R _L = 2.7 Ω, I _D ≅ -3.7 A, V _{GEN} = -4.5 V, R _g = 1 Ω	N-Ch	-	65	100	
			P-Ch	-	35	55	
Turn-off delay time	t _{d(off)}	N-channel V _{DD} = 10 V, R _L = 2.8 Ω, I _D ≅ 3.6 A, V _{GEN} = 4.5 V, R _g = 1 Ω	N-Ch	-	40	60	
			P-Ch	-	40	60	
Fall time	t _f	P-channel V _{DD} = -10 V, R _L = 2.7 Ω, I _D ≅ -3.7 A, V _{GEN} = -4.5 V, R _g = 1 Ω	N-Ch	-	10	15	
			P-Ch	-	55	85	
Turn-on delay time	t _{d(on)}	N-channel V _{DD} = 10 V, R _L = 2.8 Ω, I _D ≅ 3.6 A, V _{GEN} = 8 V, R _g = 1 Ω	N-Ch	-	5	10	
			P-Ch	-	5	10	
Rise time	t _r	P-channel V _{DD} = -10 V, R _L = 2.7 Ω, I _D ≅ -3.7 A, V _{GEN} = -8 V, R _g = 1 Ω	N-Ch	-	12	20	
			P-Ch	-	15	25	
Turn-off delay time	t _{d(off)}	N-channel V _{DD} = 10 V, R _L = 2.8 Ω, I _D ≅ 3.6 A, V _{GEN} = 4.5 V, R _g = 1 Ω	N-Ch	-	26	40	
			P-Ch	-	30	45	
Fall Time	t _f	P-channel V _{DD} = -10 V, R _L = 2.7 Ω, I _D ≅ -3.7 A, V _{GEN} = -8 V, R _g = 1 Ω	N-Ch	-	8	15	
			P-Ch	-	45	70	
Drain-Source Body Diode Characteristics							
Continuous source-drain diode current	I _S	T _C = 25 °C	N-Ch	-	-	6.9	A
			P-Ch	-	-	-6.9	
Pulse diode forward current ^a	I _{SM}		N-Ch	-	-	20	A
			P-Ch	-	-	-15	
Body diode voltage	V _{SD}	I _S = 1.2 A, V _{GS} = 0 V	N-Ch	-	0.8	1.2	V
		I _S = -1.0 A, V _{GS} = 0 V	P-Ch	-	-0.8	-1.2	
Body diode reverse recovery time	t _{rr}	N-channel I _F = 1.2 A, di/dt = 100 A/μs, T _J = 25 °C	N-Ch	-	45	70	ns
			P-Ch	-	30	60	
Body diode reverse recovery charge	Q _{rr}	P-channel I _F = -1 A, di/dt = -100 A/μs, T _J = 25 °C	N-Ch	-	21	32	nC
			P-Ch	-	15	30	
Reverse recovery fall time	t _a	N-channel I _F = 1.2 A, di/dt = 100 A/μs, T _J = 25 °C	N-Ch	-	29	-	ns
			P-Ch	-	11	-	
Reverse recovery rise time	t _b	P-channel I _F = -1 A, di/dt = -100 A/μs, T _J = 25 °C	N-Ch	-	16	-	
			P-Ch	-	19	-	

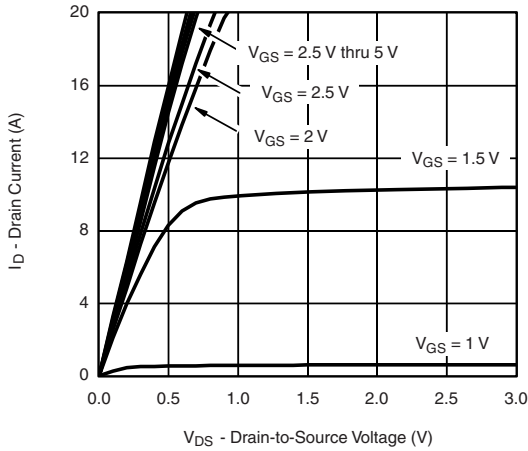
Notes

- a. Guaranteed by design, not subject to production testing
- b. Pulse test; pulse width ≤ 300 μs, duty cycle ≤ 2 %

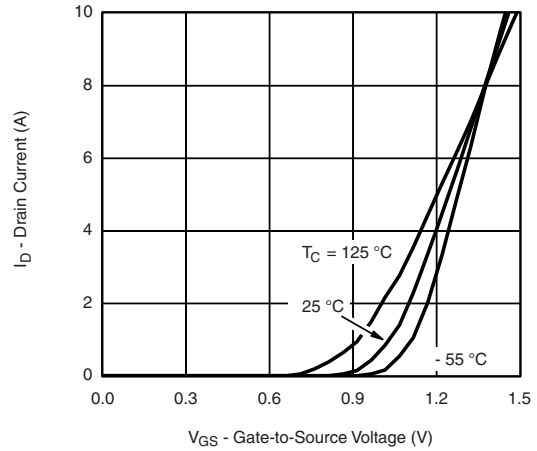
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



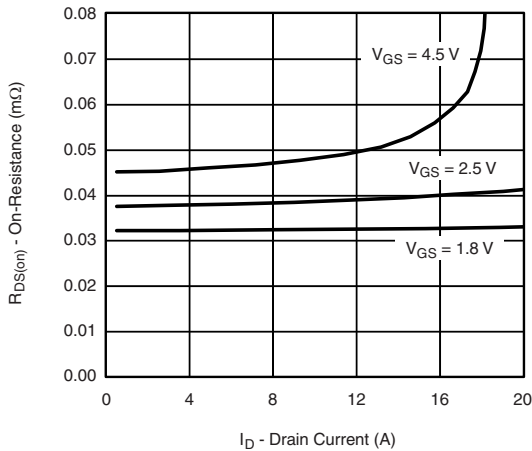
N-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



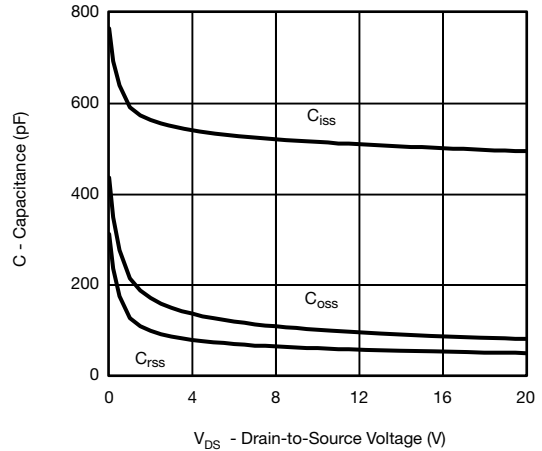
Output Characteristics



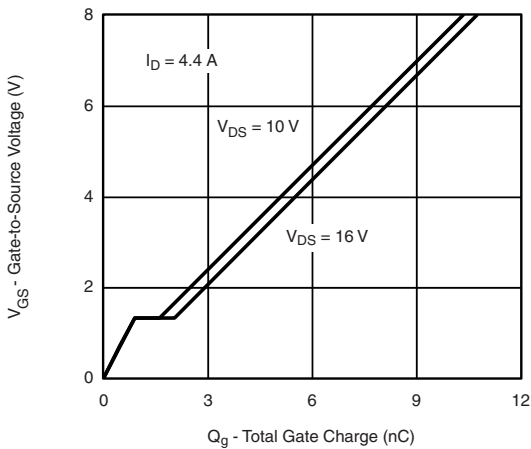
Transfer Characteristics



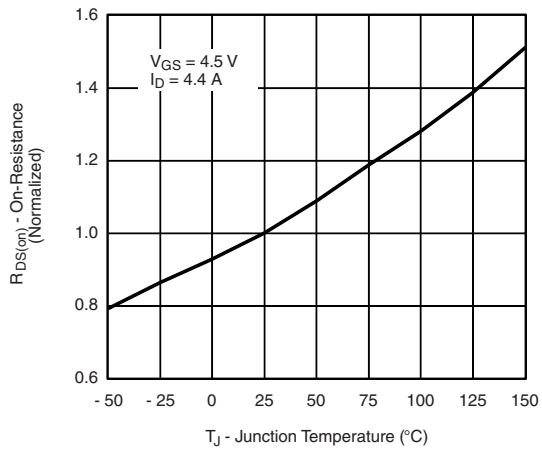
On-Resistance vs. Drain Current and Gate Voltage



Capacitance



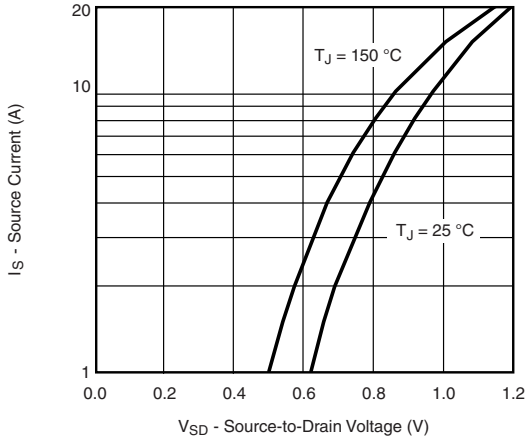
Gate Charge



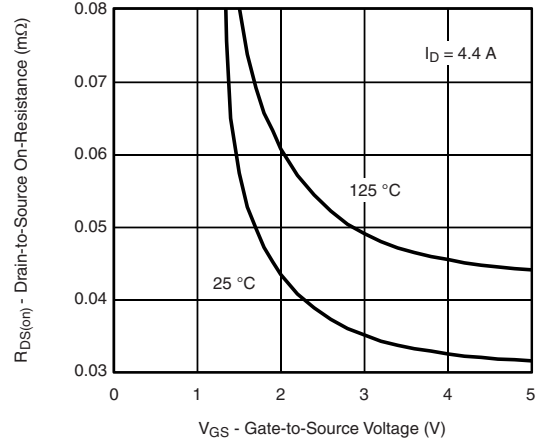
On-Resistance vs. Junction Temperature



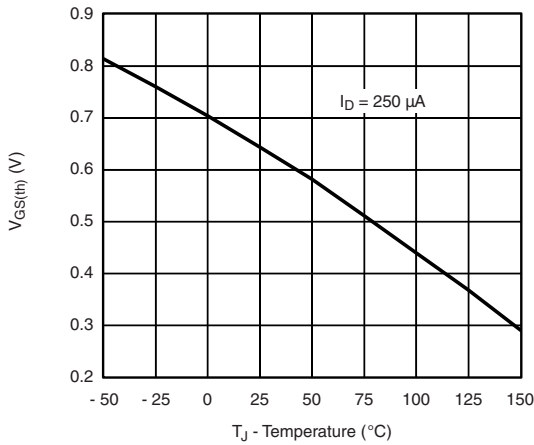
N-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



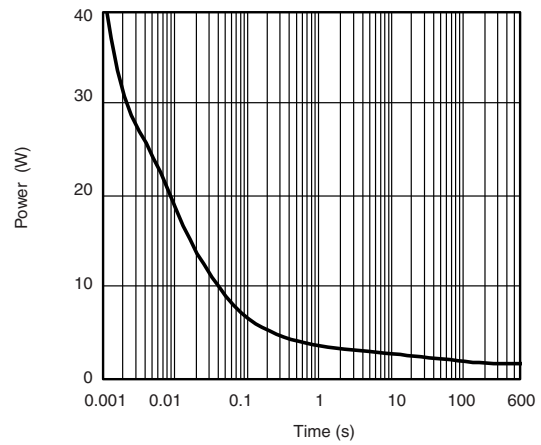
Source-Drain Diode Forward Voltage



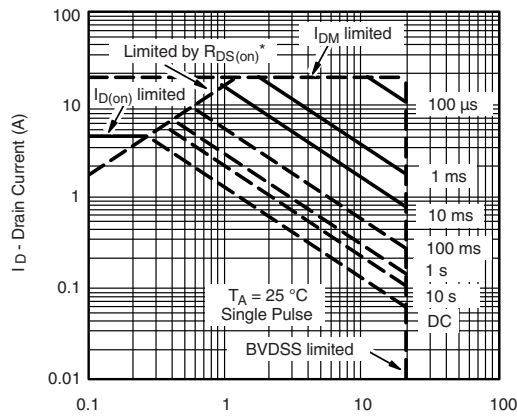
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage



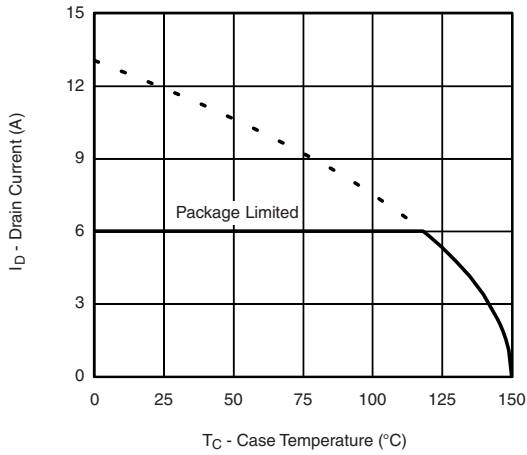
Single Pulse Power, Junction-to-Ambient



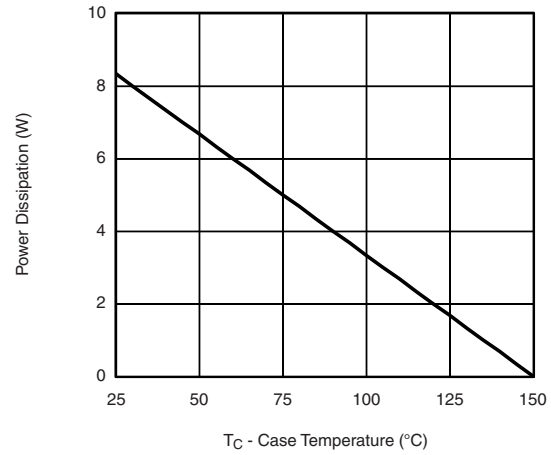
Safe Operating Area, Junction-to-Ambient



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



Current Derating ^a



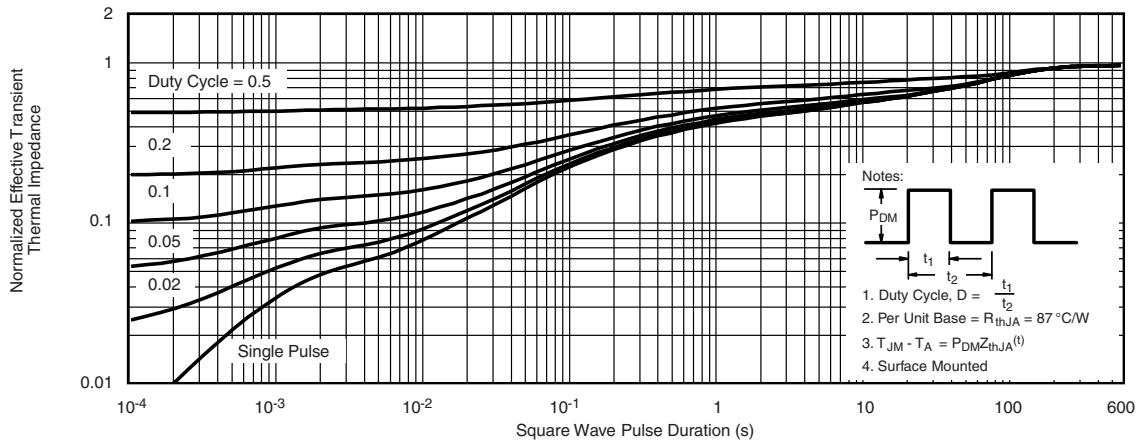
Power Derating

Note

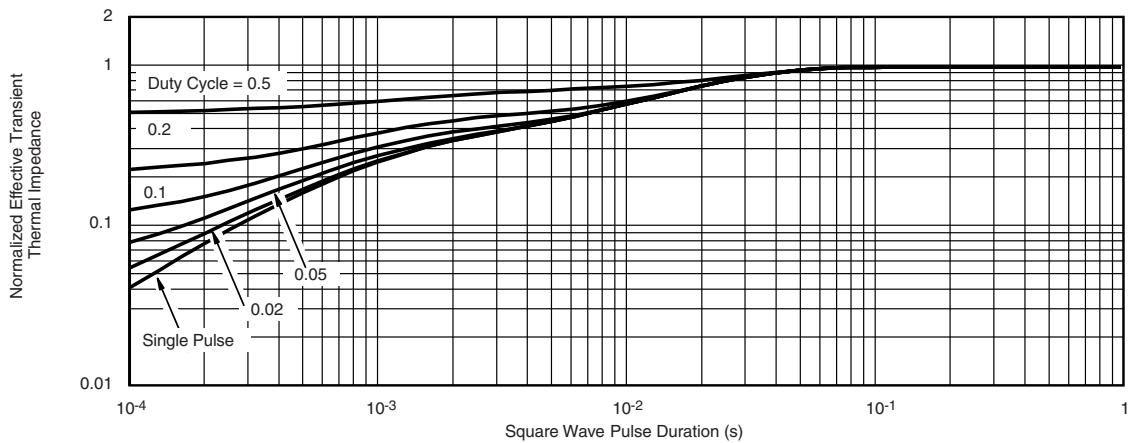
- a. The power dissipation P_D is based on $T_J \text{ max.} = 150 \text{ }^\circ\text{C}$, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating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



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



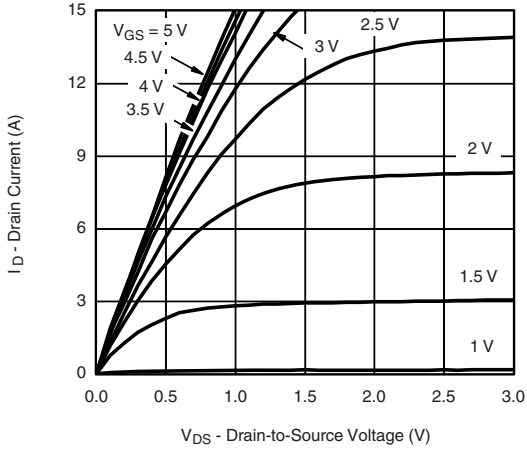
Normalized Thermal Transient Impedance, Junction-to-Ambient



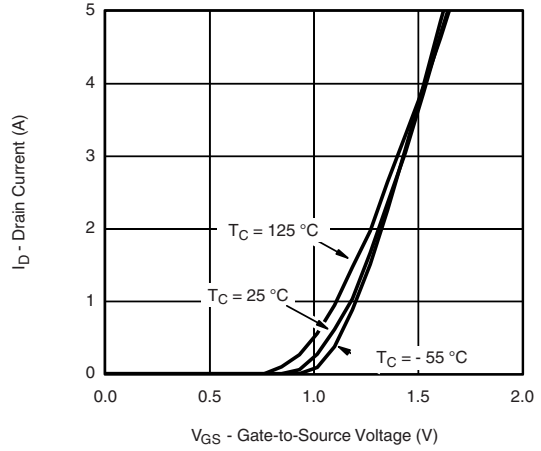
Normalized Thermal Transient Impedance, Junction-to-Case



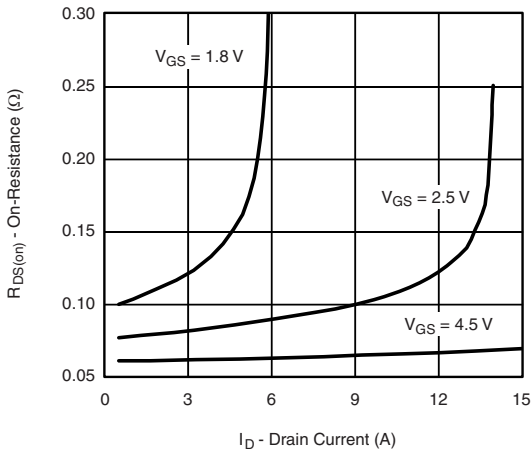
P-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



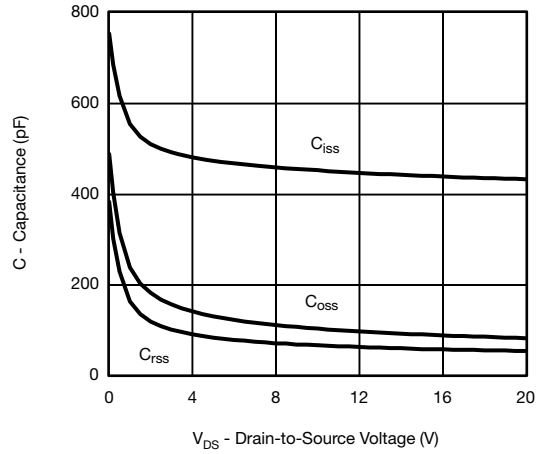
Output Characteristics



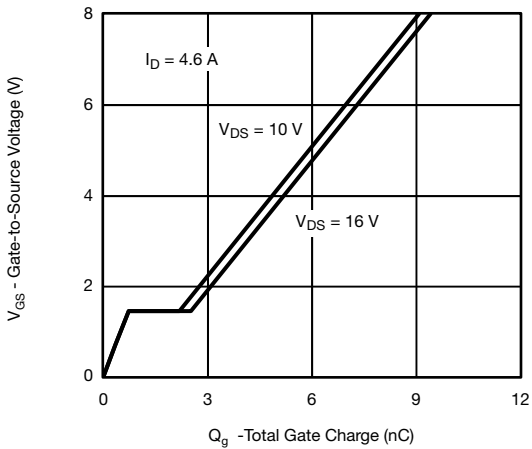
Transfer Characteristics



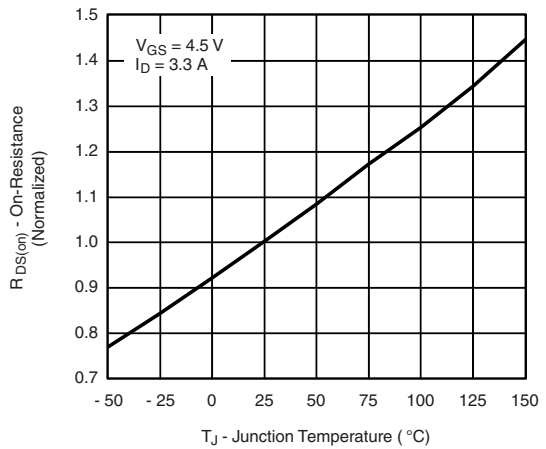
On-Resistance vs. Drain Current and Gate Voltage



Capacitance



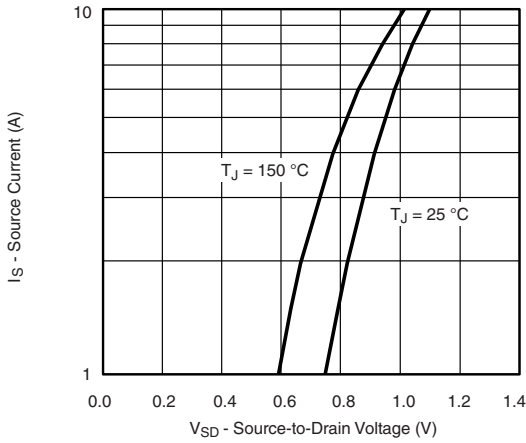
Gate Charge



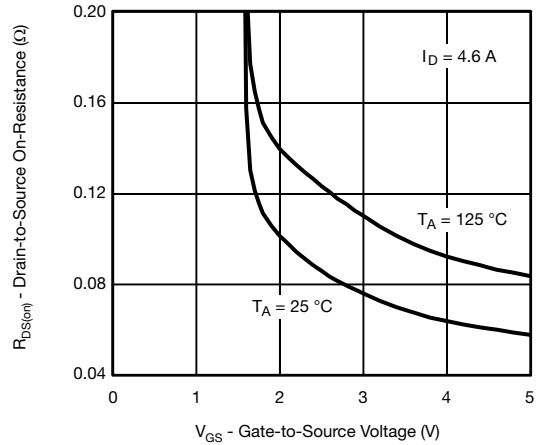
On-Resistance vs. Junction Temperature



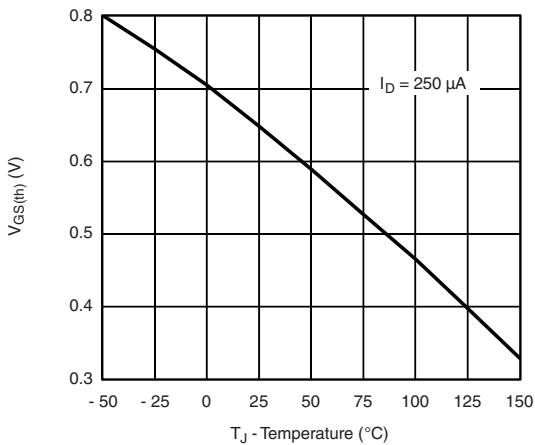
P-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



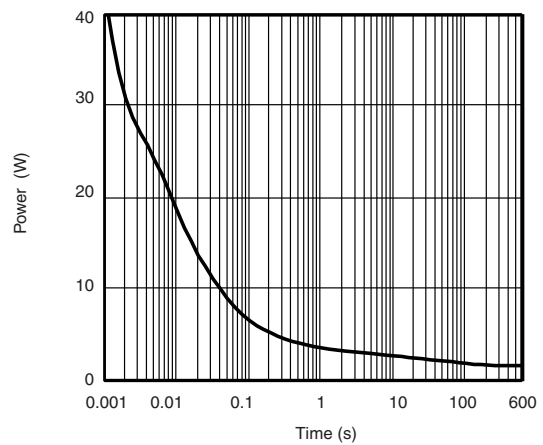
Source-Drain Diode Forward Voltage



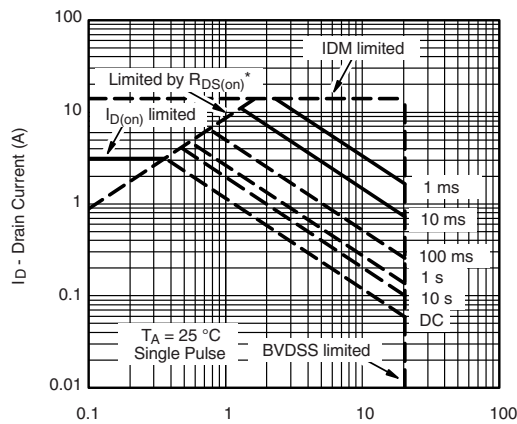
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage



Single Pulse Power, Junction-to-Ambient

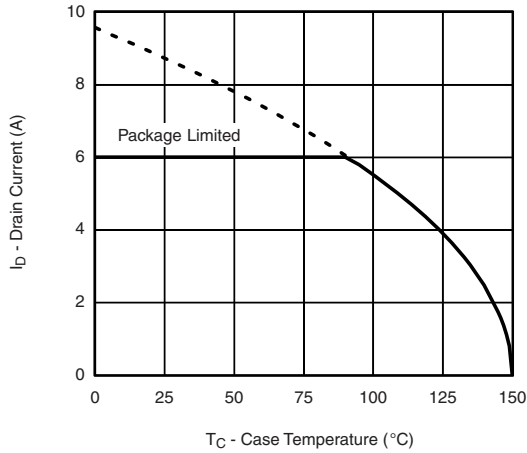


* $V_{GS} >$ minimum V_{GS} at which $R_{DS(on)}$ is specified

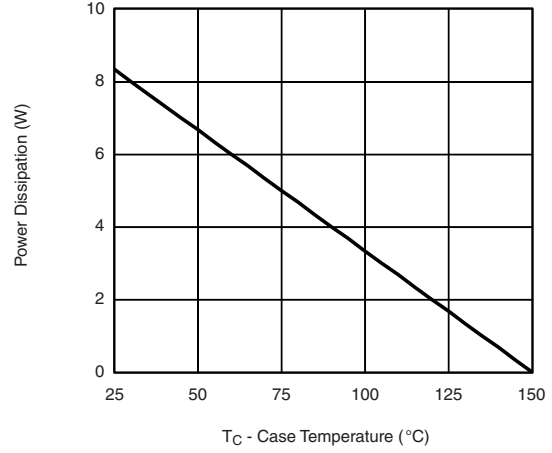
Safe Operating Area, Junction-to-Case



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



Current Derating ^a



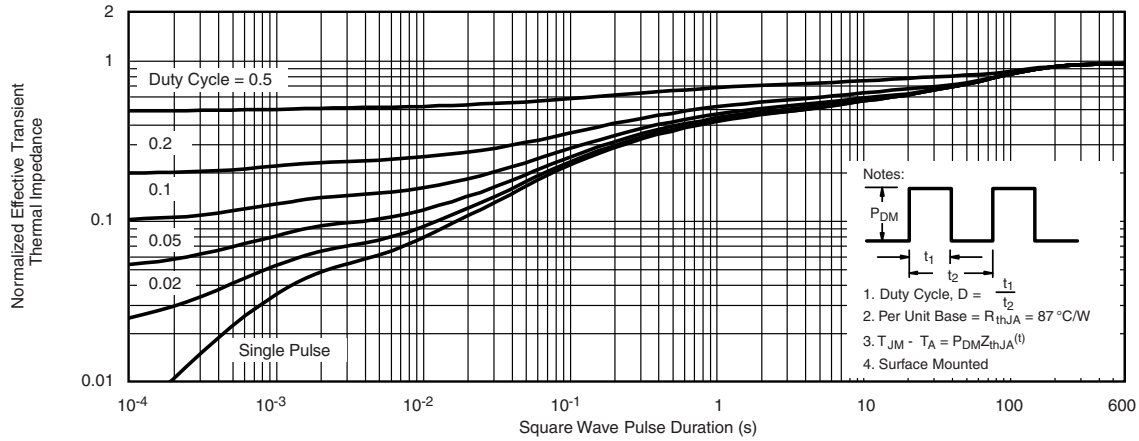
Power Derating

Note

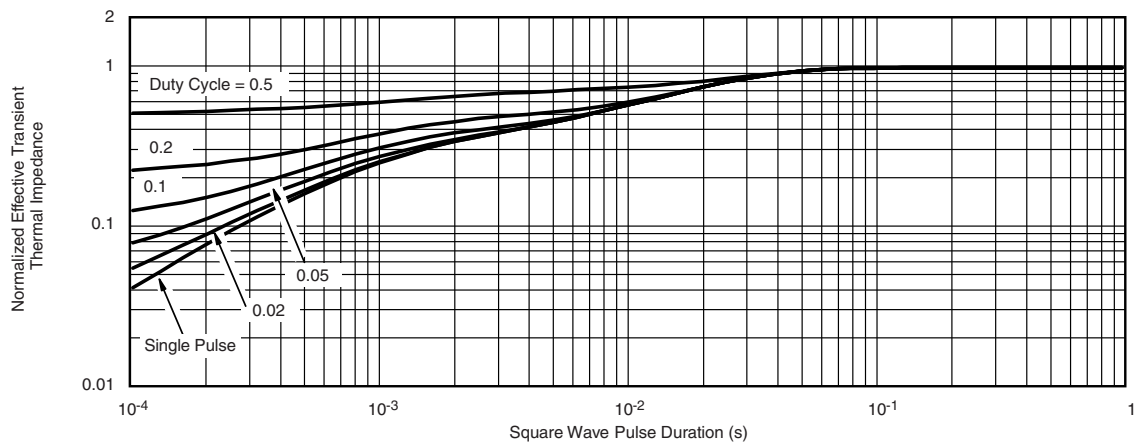
- a. The power dissipation P_D is based on $T_J \text{ max.} = 150 \text{ }^\circ\text{C}$, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating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



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



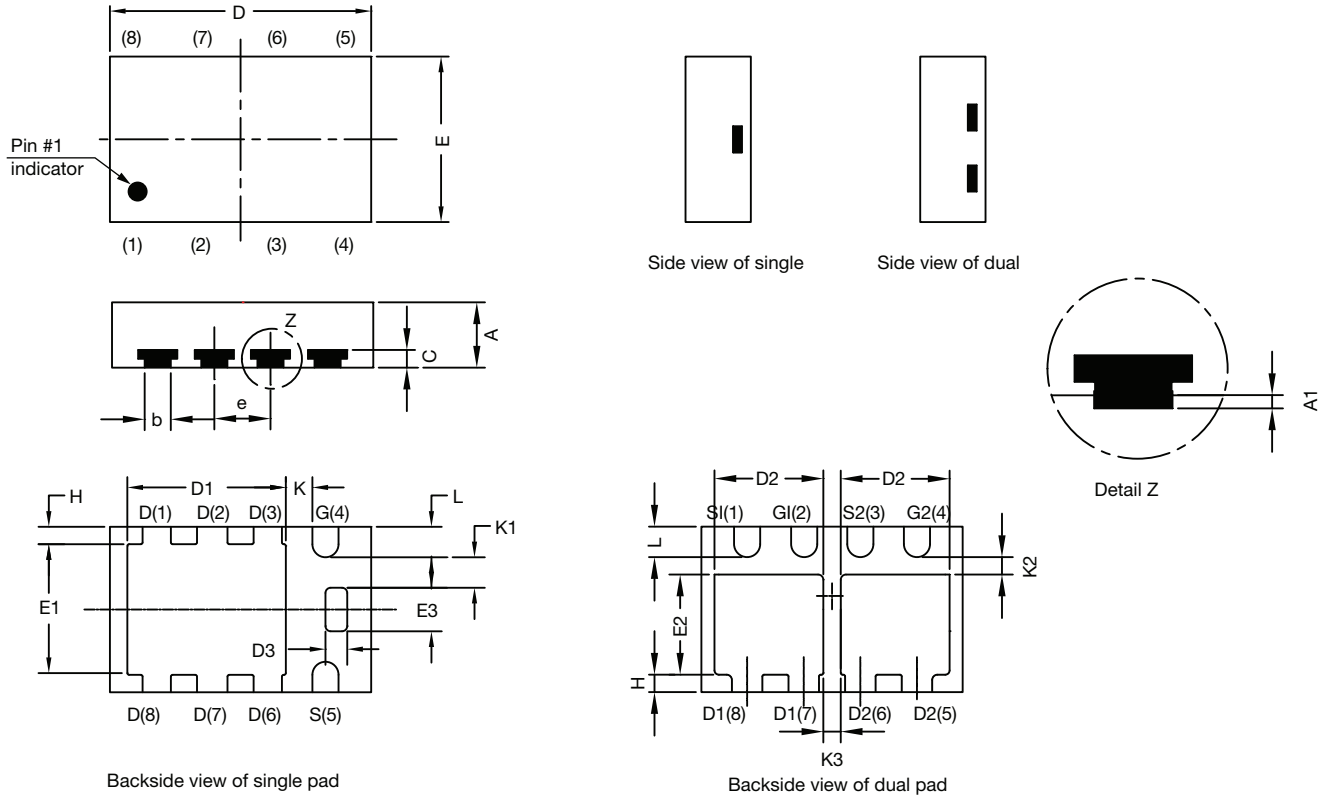
Normalized Thermal Transient Impedance, Junction-to-Ambient



Normalized Thermal Transient Impedance, Junction-to-Case

Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package / tape drawings, part marking, and reliability data, see www.vishay.com/ppg?73529.

PowerPAK® ChipFET® Case Outline



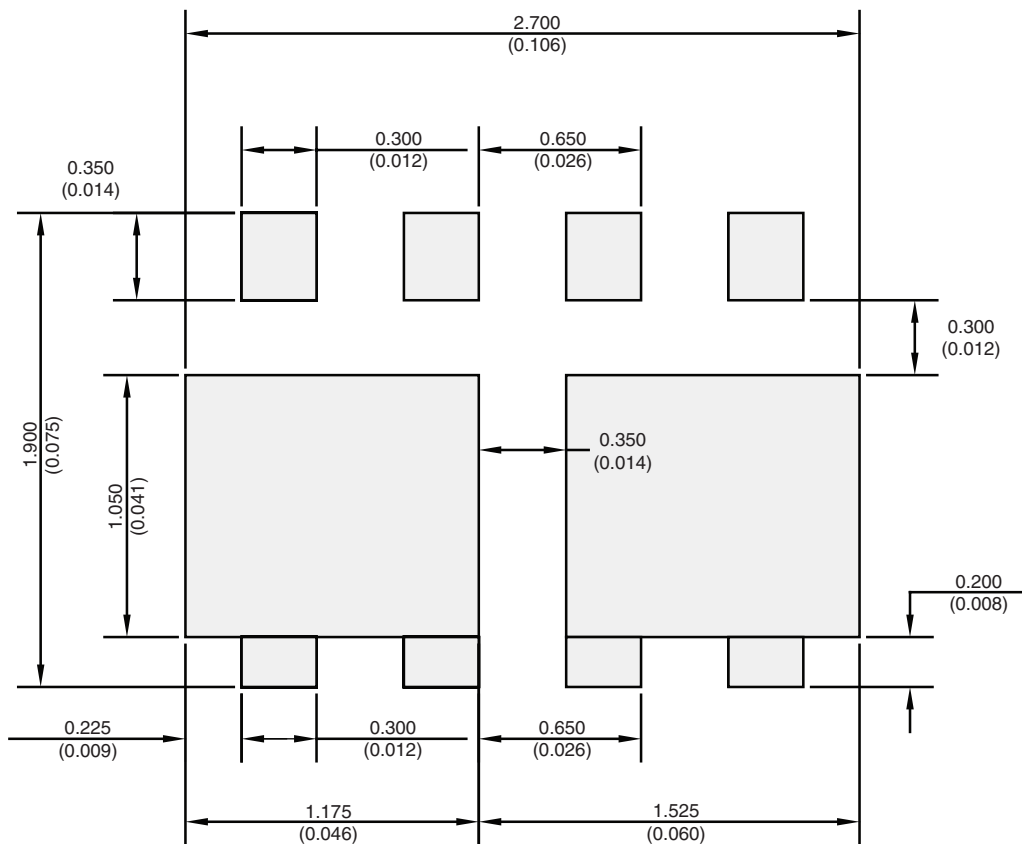
DIM.	MILLIMETERS			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.70	0.75	0.85	0.028	0.030	0.033
A1	0	-	0.05	0	-	0.002
b	0.25	0.30	0.35	0.010	0.012	0.014
C	0.15	0.20	0.25	0.006	0.008	0.010
D	2.92	3.00	3.08	0.115	0.118	0.121
D1	1.75	1.87	2.00	0.069	0.074	0.079
D2	1.07	1.20	1.32	0.042	0.047	0.052
D3	0.20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

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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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