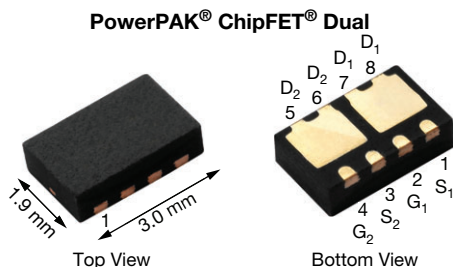


N- and P-Channel 20 V (D-S) MOSFET



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	

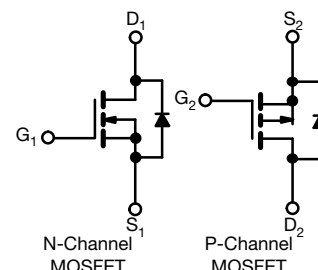
FEATURES

- 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)	T _C = 25 °C	I _D	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	T _C = 25 °C	I _S	6.9	-6.9	
	T _A = 25 °C		1.9 ^{b, c}	-1.9 ^{b, c}	
Maximum power dissipation	T _C = 25 °C	P _D	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	
			TYP.	MAX.	TYP.	MAX.
Maximum junction-to-ambient ^{b, f}	$t \leq 5$ s	R_{thJA}	45	55	45	55
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 °C, unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP. ^a	MAX.	UNIT
Static							
Drain-source breakdown voltage	V _{DS}	V _{GS} = 0 V, I _D = 1 mA	N-Ch	20	-	-	V
		V _{GS} = 0 V, I _D = -1 mA	P-Ch	-20	-	-	
V _{DS} temperature coefficient	ΔV _{DS} /T _J	I _D = 250 μA	N-Ch	-	17	-	mV/°C
		I _D = -250 μA	P-Ch	-	-20	-	
V _{GS(th)} temperature coefficient	ΔV _{GS(th)} /T _J	I _D = 250 μA	N-Ch	-	-2.6	-	
		I _D = -250 μA	P-Ch	-	2.4	-	
Gate-source threshold voltage	V _{GS(th)}	V _{DS} = V _{GS} , I _D = 250 μA	N-Ch	0.4	-	1	V
		V _{DS} = V _{GS} , I _D = -250 μA	P-Ch	-0.4	-	-1	
Gate-body leakage	I _{GSS}	V _{DS} = 0 V, V _{GS} = ± 8 V	N-Ch	-	-	100	nA
			P-Ch	-	-	-100	
Zero gate voltage drain current	I _{DSS}	V _{DS} = 20 V, V _{GS} = 0 V	N-Ch	-	-	1	μA
		V _{DS} = -20 V, V _{GS} = 0 V	P-Ch	-	-	-1	
		V _{DS} = 20 V, V _{GS} = 0 V, T _J = 55 °C	N-Ch	-	-	10	
		V _{DS} = -20 V, V _{GS} = 0 V, T _J = 55 °C	P-Ch	-	-	-10	
On-state drain current ^b	I _{D(on)}	V _{DS} ≤ 5 V, V _{GS} = 4.5 V	N-Ch	20	-	-	A
		V _{DS} ≤ -5 V, V _{GS} = -4.5 V	P-Ch	-15	-	-	
Drain-source on-state resistance ^b	R _{DS(on)}	V _{GS} = 4.5 V, I _D = 4.4 A	N-Ch	-	0.0320	0.0390	Ω
		V _{GS} = -4.5 V, I _D = -3.3 A	P-Ch	-	0.0600	0.0720	
		V _{GS} = 2.5 V, I _D = 4.1 A	N-Ch	-	0.0370	0.0450	
		V _{GS} = -2.5 V, I _D = -2.8 A	P-Ch	-	0.0830	0.1000	
		V _{GS} = 1.8 V, I _D = 1.8 A	N-Ch	-	0.0455	0.0550	
		V _{GS} = -1.8 V, I _D = -0.76 A	P-Ch	-	0.1080	0.1310	
Forward transconductance ^b	g _{fs}	V _{DS} = 10 V, I _D = 4.4 A	N-Ch	-	22	-	S
		V _{DS} = -10 V, I _D = -3.3 A	P-Ch	-	0.9	-	
Dynamic ^a							
Input capacitance	C _{iss}	N-channel V _{DS} = 10 V, V _{GS} = 0 V, f = 1 MHz P-channel V _{DS} = -10 V, V _{GS} = 0 V, f = 1 MHz	N-Ch	-	520	-	pF
Output capacitance	C _{oss}		P-Ch	-	455	-	
			N-Ch	-	100	-	
Reverse transfer capacitance	C _{rss}		P-Ch	-	105	-	
		N-Ch	-	60	-		
Total gate charge	Q _g	V _{DS} = 10 V, V _{GS} = 8 V, I _D = 4.4 A V _{DS} = -10 V, V _{GS} = -8 V, I _D = -4.6 A V _{DS} = 10 V, V _{GS} = 4.5 V I _D = 4.4 A V _{DS} = -10 V, V _{GS} = -4.5 V, I _D = -1.8 A	N-Ch	-	10.5	16	nC
			P-Ch	-	9.1	14	
			N-Ch	-	6	9	
			P-Ch	-	5.5	8.5	
Gate-source charge	Q _{gs}	N-channel V _{DS} = 10 V, V _{GS} = 4.5 V I _D = 4.4 A	N-Ch	-	0.91	-	
			P-Ch	-	0.75	-	
Gate-drain charge	Q _{gd}	P-channel V _{DS} = -10 V, V _{GS} = -4.5 V, I _D = -1.8 A	N-Ch	-	0.7	-	
			P-Ch	-	1.5	-	
Gate resistance	R _g	f = 1 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 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	-	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)}		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 V, R _L = 2.8 Ω, I _D ≅ 3.6 A, V _{GEN} = 8 V, R _g = 1 Ω 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	-	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)}		N-Ch	-	26	40	
			P-Ch	-	30	45	
Fall Time	t _f		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	
			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}		N-Ch	-	21	32	nC
			P-Ch	-	15	30	
Reverse recovery fall time	t _a	P-channel I _F = -1 A, di/dt = -100 A/μs, T _J = 25 °C	N-Ch	-	29	-	ns
			P-Ch	-	11	-	
Reverse recovery rise time	t _b		N-Ch	-	16	-	
			P-Ch	-	19	-	

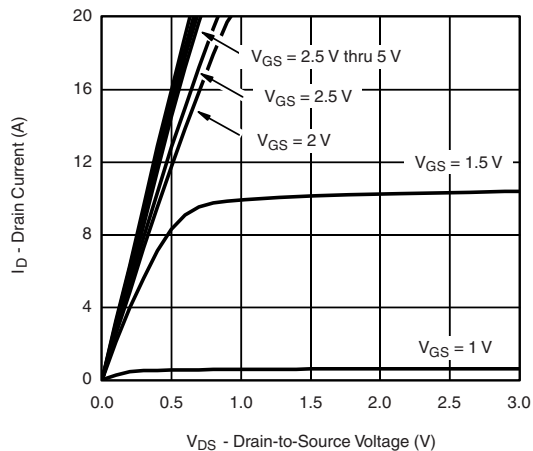
Notes

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

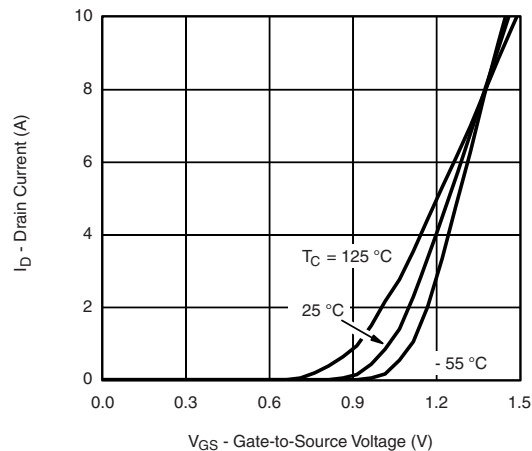
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



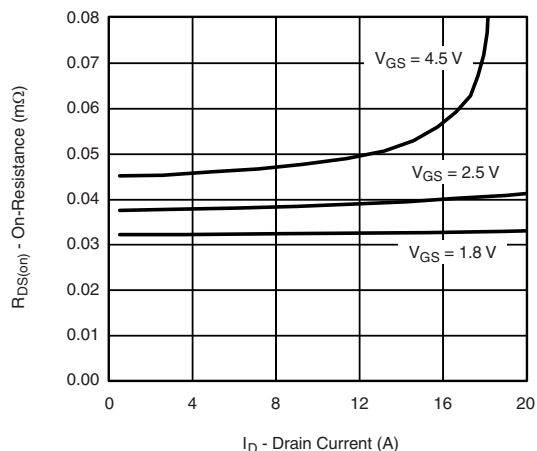
N-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



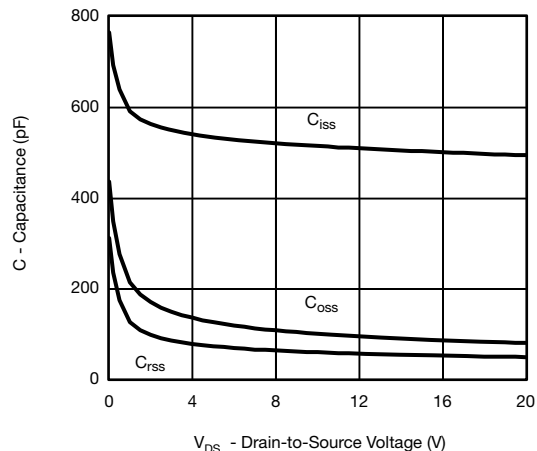
Output Characteristics



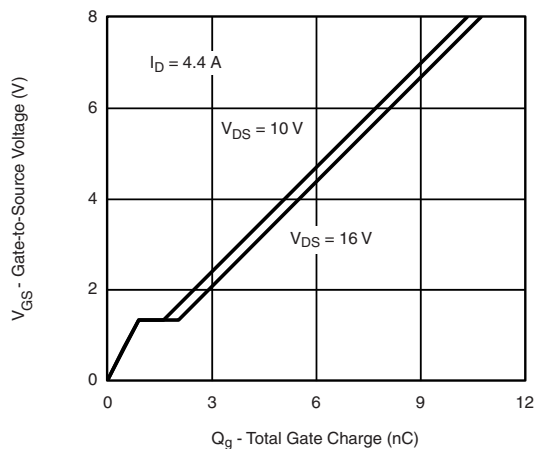
Transfer Characteristics



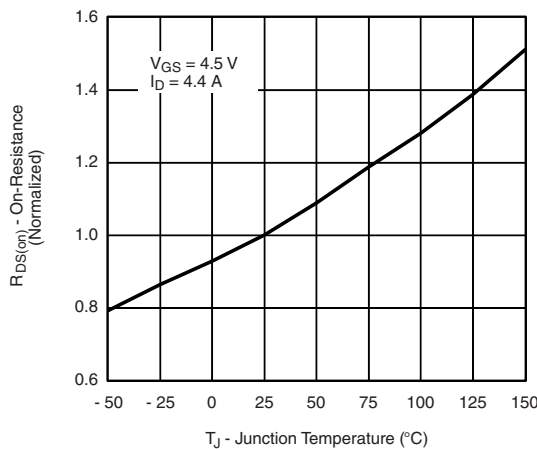
On-Resistance vs. Drain Current and Gate Voltage



Capacitance



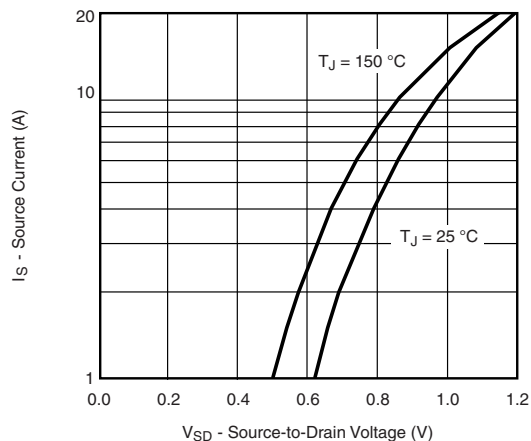
Gate Charge



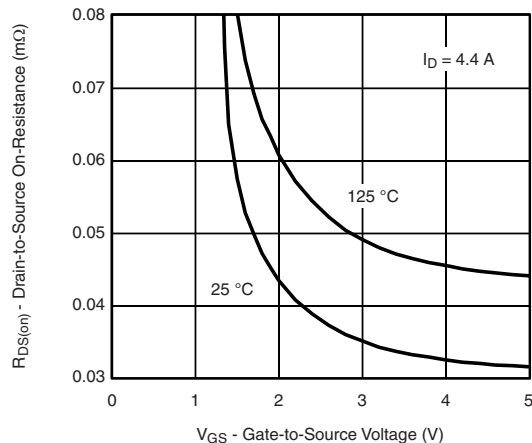
On-Resistance vs. Junction Temperature



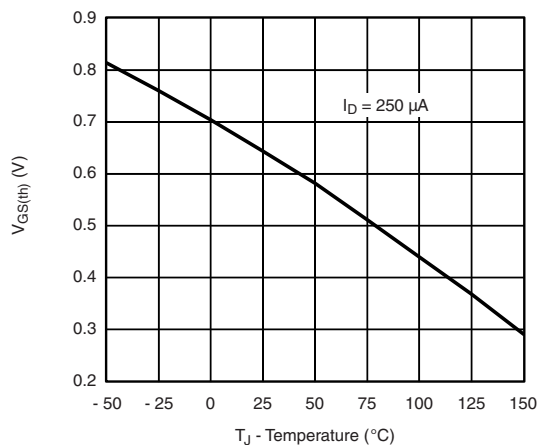
N-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



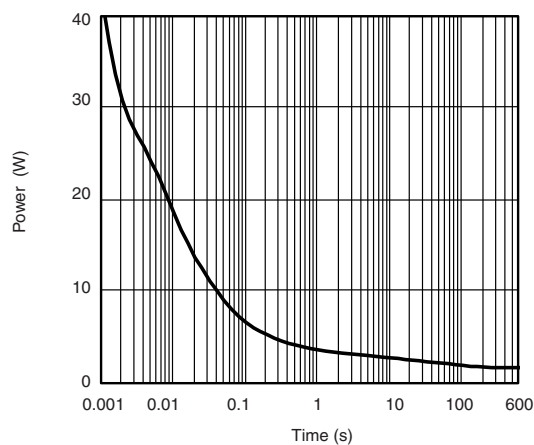
Source-Drain Diode Forward Voltage



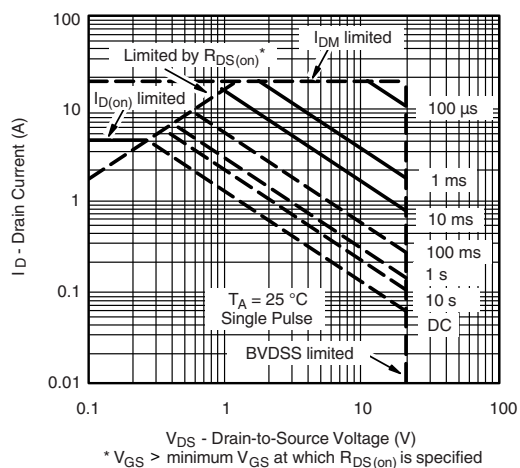
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage



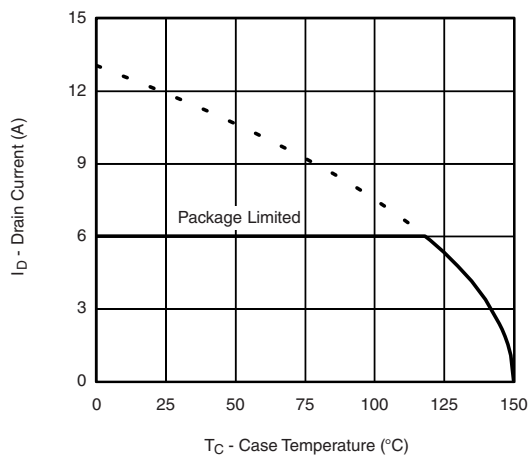
Single Pulse Power, Junction-to-Ambient



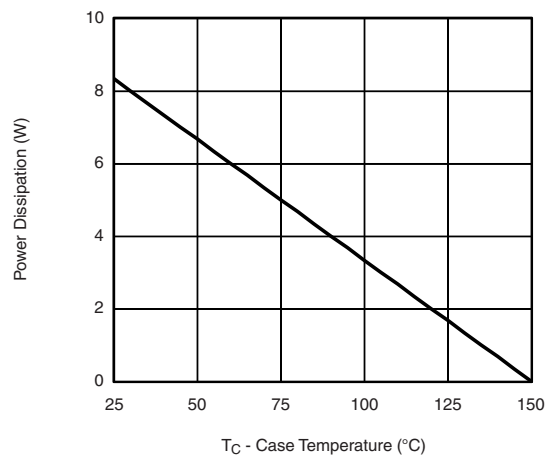
Safe Operating Area, Junction-to-Ambient



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



Current Derating ^a



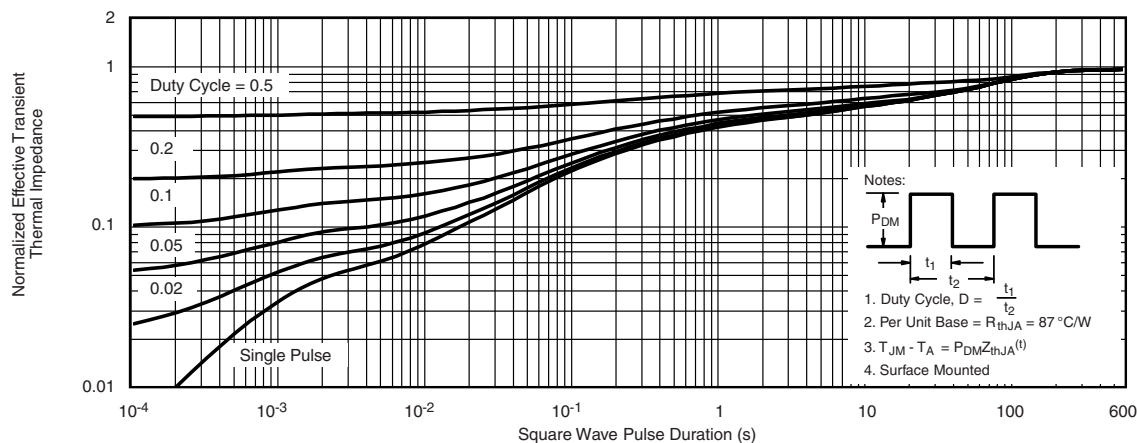
Power Derating

Note

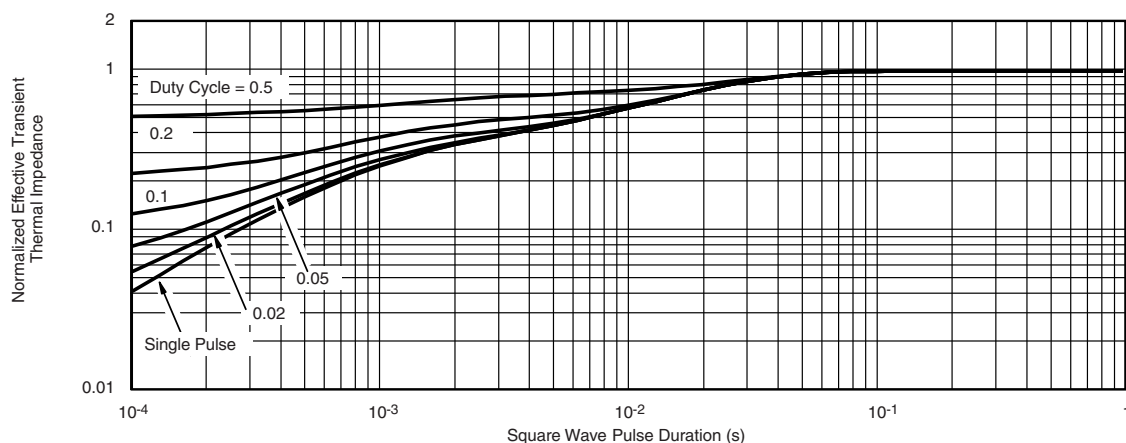
- a. The power dissipation P_D is based on T_J max. = 150 °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit



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



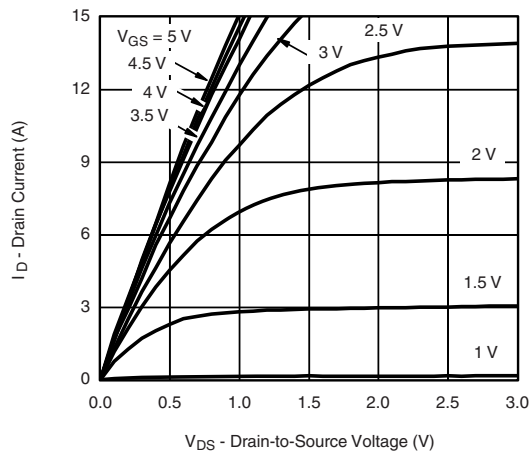
Normalized Thermal Transient Impedance, Junction-to-Ambient



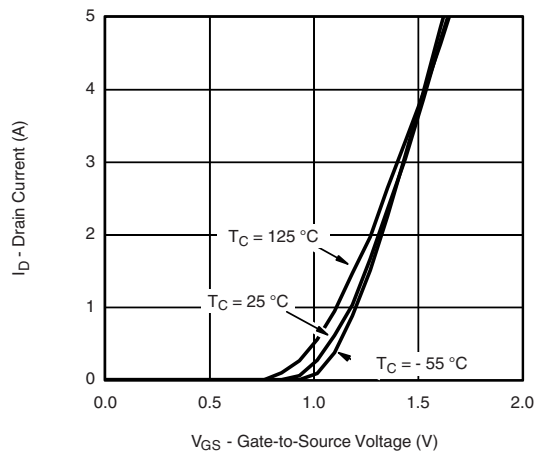
Normalized Thermal Transient Impedance, Junction-to-Case



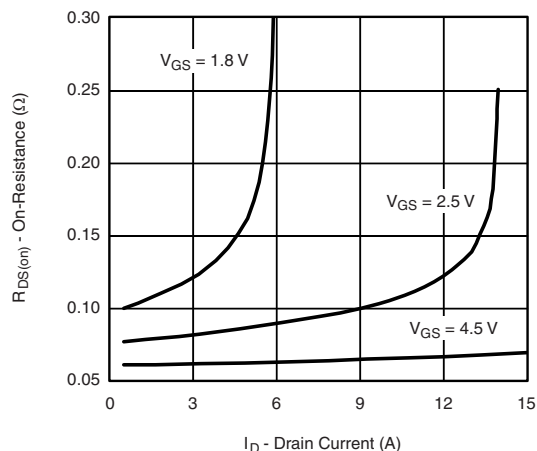
P-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



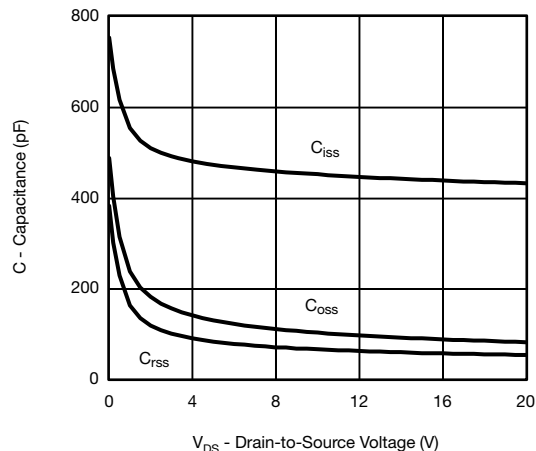
Output Characteristics



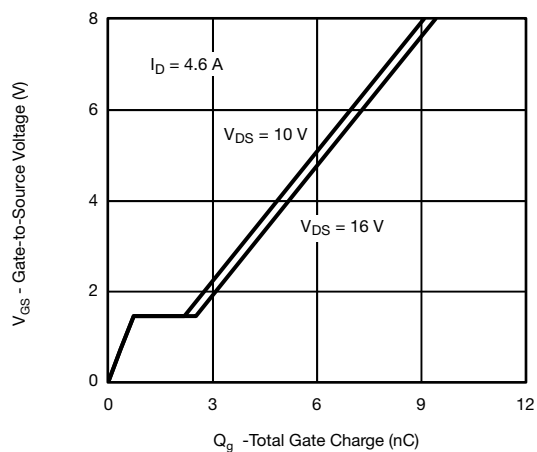
Transfer Characteristics



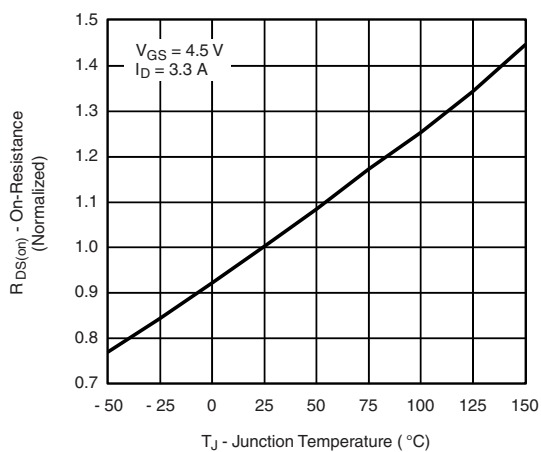
On-Resistance vs. Drain Current and Gate Voltage



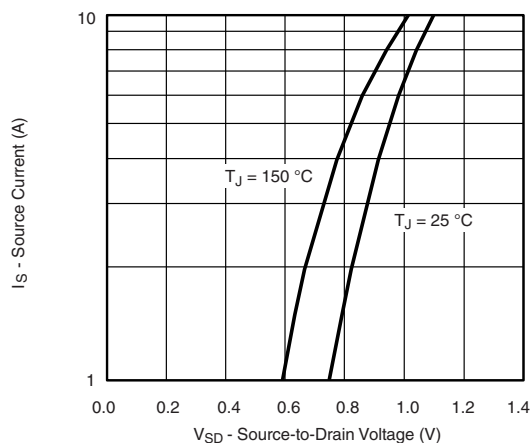
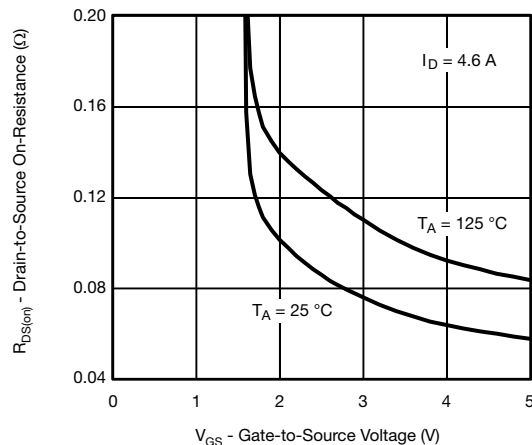
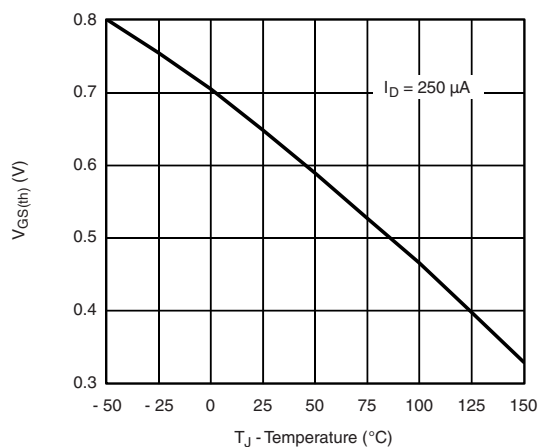
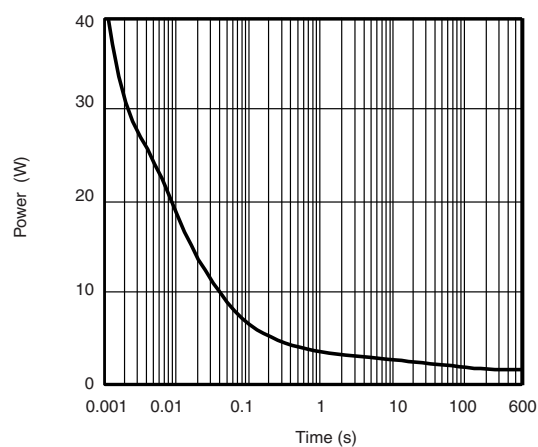
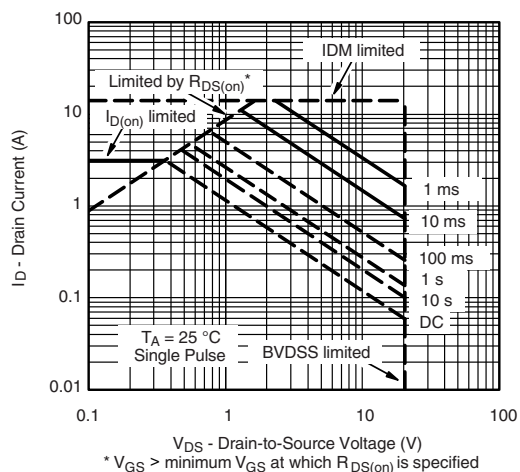
Capacitance

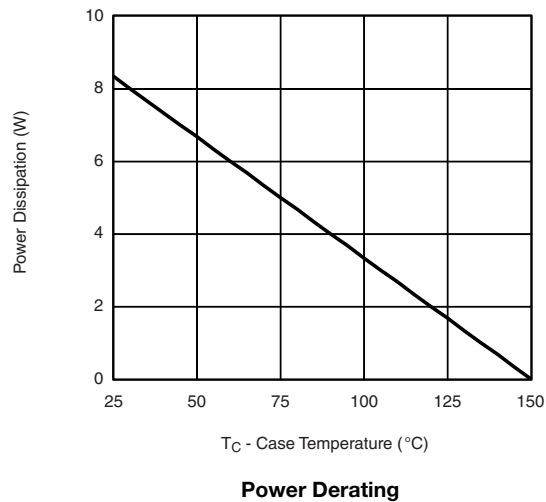
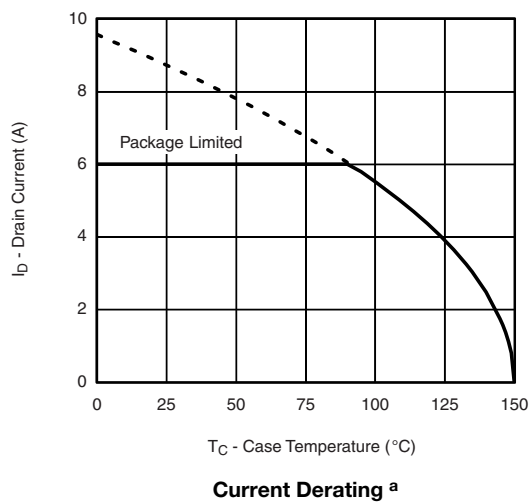


Gate Charge



On-Resistance vs. Junction Temperature

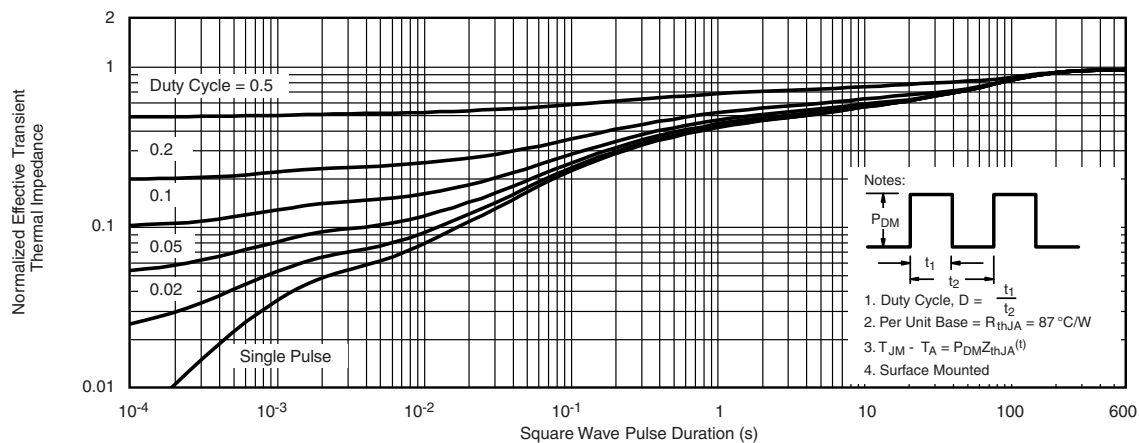
P-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

Source-Drain Diode Forward Voltage

On-Resistance vs. Gate-to-Source Voltage

Threshold Voltage

Single Pulse Power, Junction-to-Ambient

Safe Operating Area, Junction-to-Case

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

Note

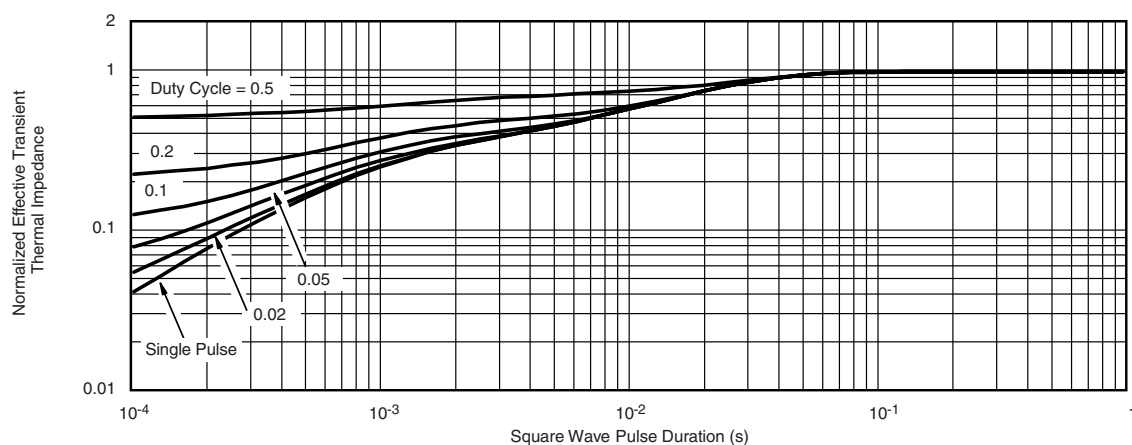
- a. The power dissipation P_D is based on $T_J \text{ max.} = 150^\circ\text{C}$, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below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



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



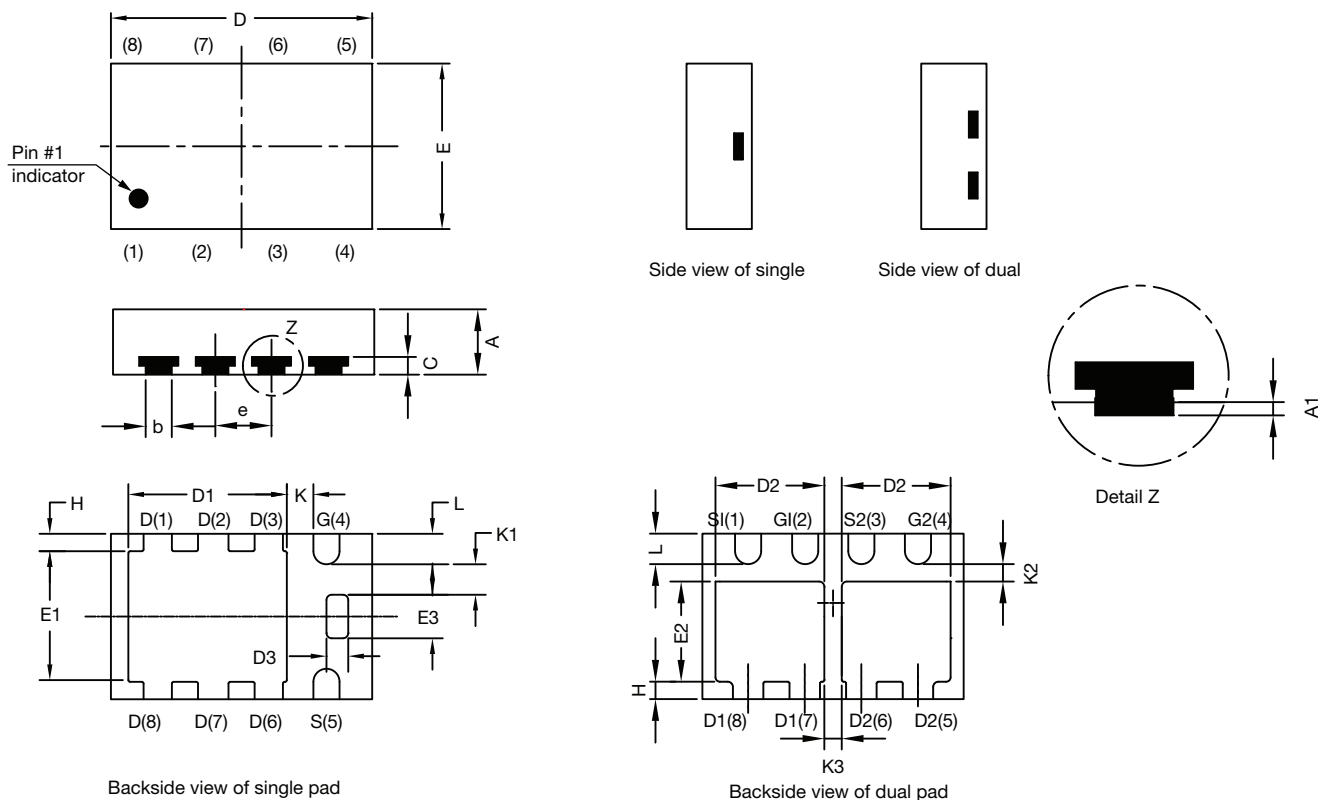
Normalized Thermal Transient Impedance, Junction-to-Ambient



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

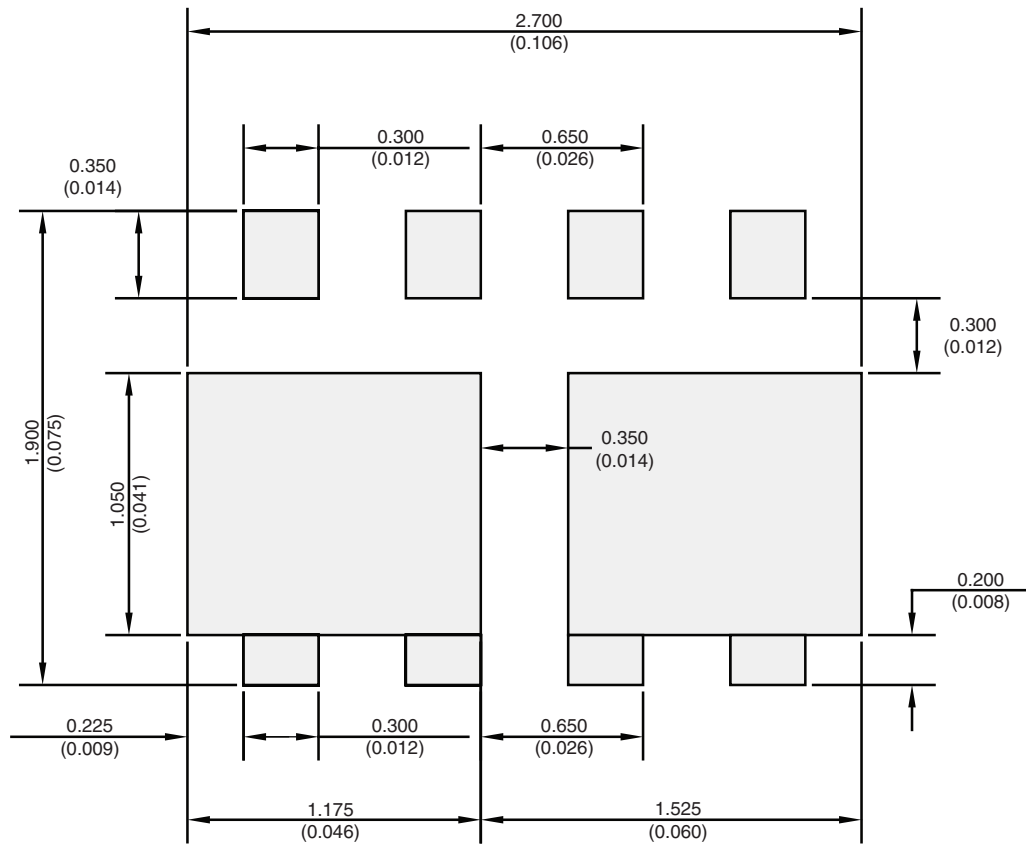


DIM.	MILLIMETERS			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.70	0.75	0.85	0.028	0.030	0.033
A1	0	-	0.05	0	-	0.002
b	0.25	0.30	0.35	0.010	0.012	0.014
C	0.15	0.20	0.25	0.006	0.008	0.010
D	2.92	3.00	3.08	0.115	0.118	0.121
D1	1.75	1.87	2.00	0.069	0.074	0.079
D2	1.07	1.20	1.32	0.042	0.047	0.052
D3	0.20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



Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.