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[SI5999EDU-T1-GE3](#)

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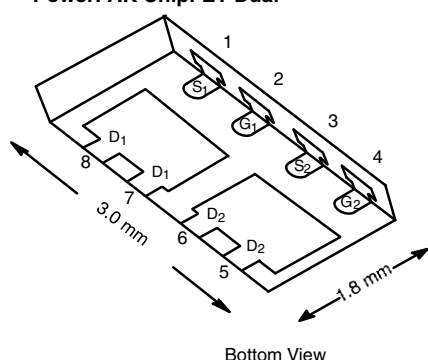
Si5999EDU
Vishay Siliconix

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	

PowerPAK ChipFET Dual



Marking Code

OA XXX

Lot Traceability
and Date Code

Part #
Code

FEATURES

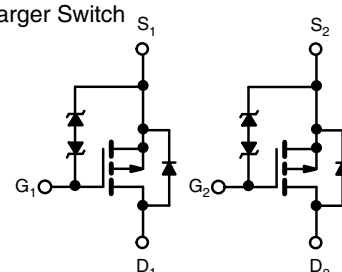
- Halogen-free According to IEC 61249-2-21 Definition
- TrenchFET® Power MOSFET
- New Thermally Enhanced PowerPAK® ChipFET® Package
 - Small Footprint Area
 - Low On-Resistance
 - Thin 0.8 mm Profile
- Typical ESD Performance 1500 V in HBM
- Compliant to RoHS Directive 2002/95/EC



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 ($T_A = 25^\circ\text{C}$, unless otherwise noted)

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	V_{DS}	- 20	V
Gate-Source Voltage	V_{GS}	± 12	
Continuous Drain Current ($T_J = 150^\circ\text{C}$)	I_D	$T_C = 25^\circ\text{C}$	- 6 ^a
		$T_C = 70^\circ\text{C}$	- 6 ^a
		$T_A = 25^\circ\text{C}$	- 5 ^{b, c}
		$T_A = 70^\circ\text{C}$	- 4 ^{b, c}
Pulsed Drain Current ($t = 300 \mu\text{s}$)	I_{DM}	- 20	
Continuous Source-Drain Diode Current	I_S	$T_C = 25^\circ\text{C}$	- 6 ^a
		$T_A = 25^\circ\text{C}$	- 1.9 ^{b, c}
Maximum Power Dissipation	P_D	$T_C = 25^\circ\text{C}$	10.4
		$T_C = 70^\circ\text{C}$	6.7
		$T_A = 25^\circ\text{C}$	2.3 ^{b, c}
		$T_A = 70^\circ\text{C}$	1.5 ^{b, c}
Operating Junction and Storage Temperature Range	T_J, T_{stg}	- 55 to 150	$^\circ\text{C}$
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	$^\circ\text{C}/\text{W}$
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/ppg273257). 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 $105^\circ\text{C}/\text{W}$.

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SPECIFICATIONS (T _J = 25 °C, unless otherwise noted)							
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit	
Static							
Drain-Source Breakdown Voltage	V _{DS}	V _{GS} = 0 V, I _D = - 250 μA	- 20			V	
V _{DS} Temperature Coefficient	ΔV _{DS} /T _J	I _D = - 250 μA		- 16		mV/°C	
V _{GS(th)} Temperature Coefficient	ΔV _{GS(th)} /T _J			3			
Gate-Source Threshold Voltage	V _{GS(th)}	V _{DS} = V _{GS} , I _D = - 250 μA	- 0.6		- 1.5	V	
Gate-Source Leakage	I _{GSS}	V _{DS} = 0 V, V _{GS} = ± 12 V			± 10	μA	
		V _{DS} = 0 V, V _{GS} = ± 4.5 V			± 1		
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = - 20 V, V _{GS} = 0 V			- 1		
		V _{DS} = - 20 V, V _{GS} = 0 V, T _J = 55 °C			- 10		
On-State Drain Current ^a	I _{D(on)}	V _{DS} ≤ - 5 V, V _{GS} = - 4.5 V	- 20			A	
Drain-Source On-State Resistance ^a	R _{DS(on)}	V _{GS} = - 4.5 V, I _D = - 3.5 A		0.047	0.059	Ω	
		V _{GS} = - 2.5 V, I _D = - 1.5 A		0.077	0.096		
Forward Transconductance ^a	g _{fs}	V _{DS} = - 10 V, I _D = - 3.5 A		11		S	
Dynamic ^b							
Input Capacitance	C _{iss}	V _{DS} = - 10 V, V _{GS} = 0 V, f = 1 MHz		496		pF	
Output Capacitance	C _{oss}			141			
Reverse Transfer Capacitance	C _{rss}			121			
Total Gate Charge	Q _g	V _{DS} = - 10 V, V _{GS} = - 10 V, I _D = - 5 A		13.2	20	nC	
				6.9	10.5		
	Gate-Source Charge	Q _{gs}	V _{DS} = - 10 V, V _{GS} = - 4.5 V, I _D = - 5 A		1.6		
	Gate-Drain Charge	Q _{gd}		1.8			
Gate Resistance	R _g	f = 1 MHz	2	8	16	Ω	
Turn-On Delay Time	t _{d(on)}	V _{DD} = - 10 V, R _L = 2.5 Ω I _D ≅ - 4 A, V _{GEN} = - 4.5 V, R _g = 1 Ω		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 V, R _L = 2.5 Ω I _D ≅ - 4 A, V _{GEN} = - 10 V, R _g = 1 Ω		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 °C			- 6	A	
Pulse Diode Forward Current	I _{SM}				- 20		
Body Diode Voltage	V _{SD}	I _S = - 4 A, V _{GS} = 0 V		- 0.85	- 1.2	V	
Body Diode Reverse Recovery Time	t _{rr}	I _F = - 4 A, dI/dt = 100 A/μs, T _J = 25 °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.

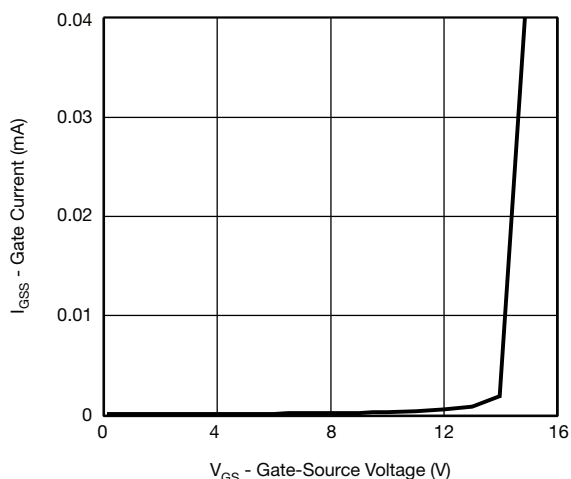
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



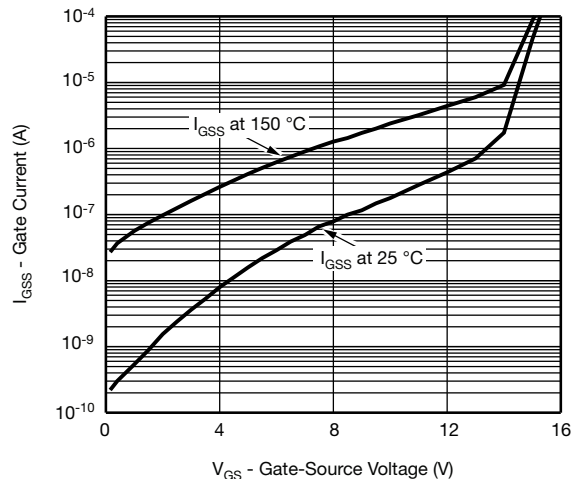
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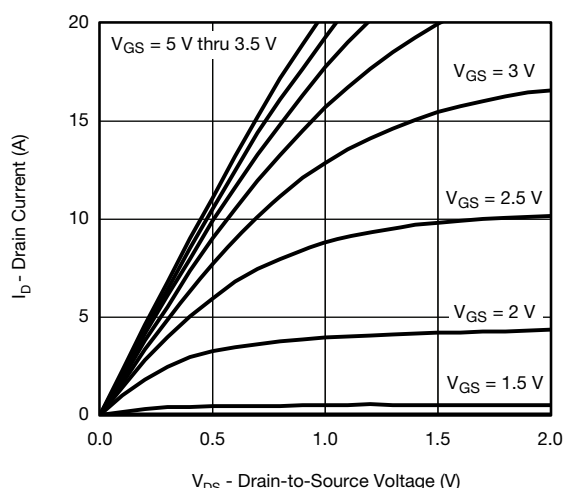
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



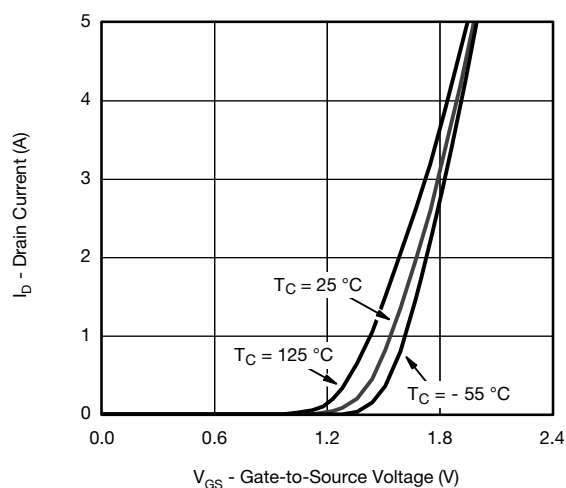
Gate Current vs. Gate-Source Voltage



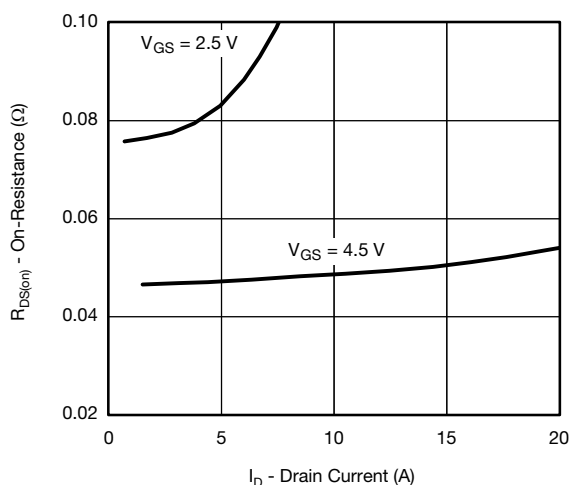
Gate Current vs. Gate-Source Voltage



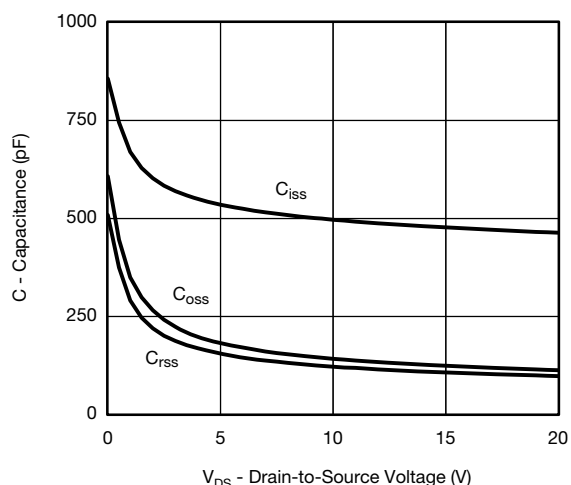
Output Characteristics



Transfer Characteristics



On-Resistance vs. Drain Current



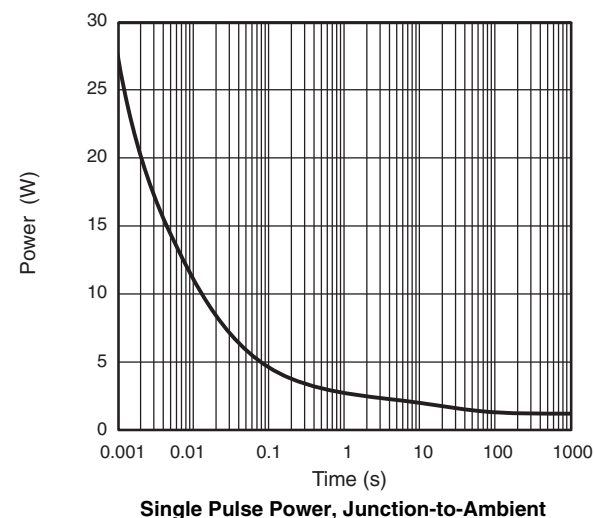
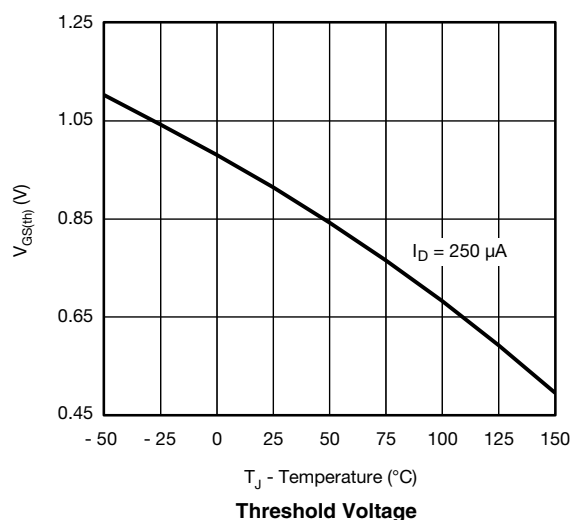
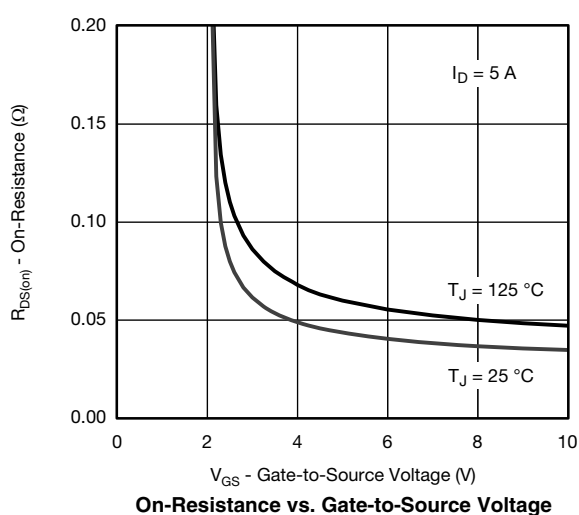
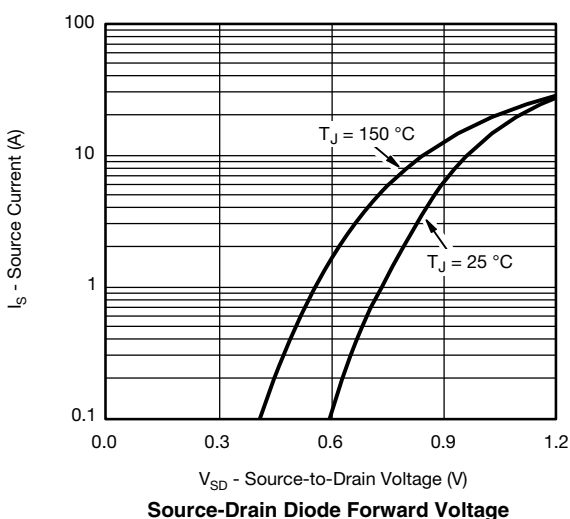
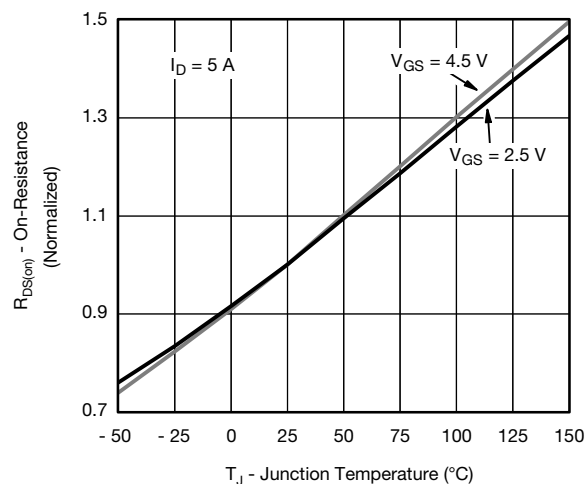
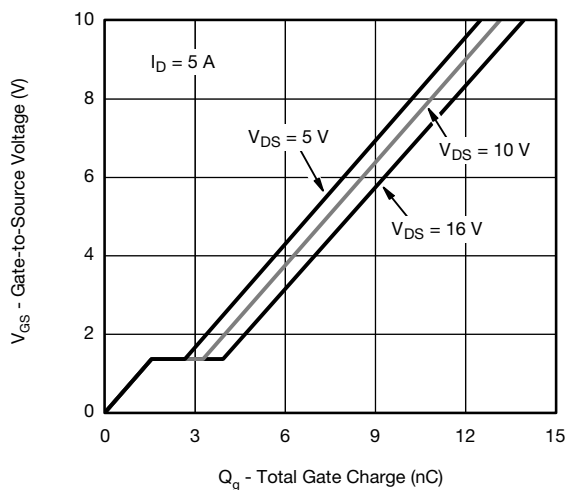
Capacitance

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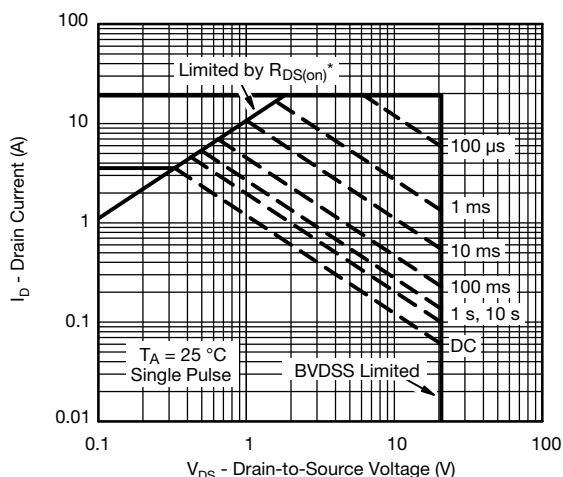
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)





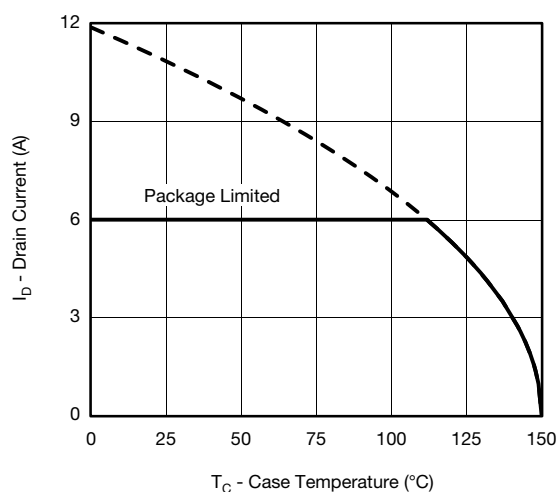
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TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

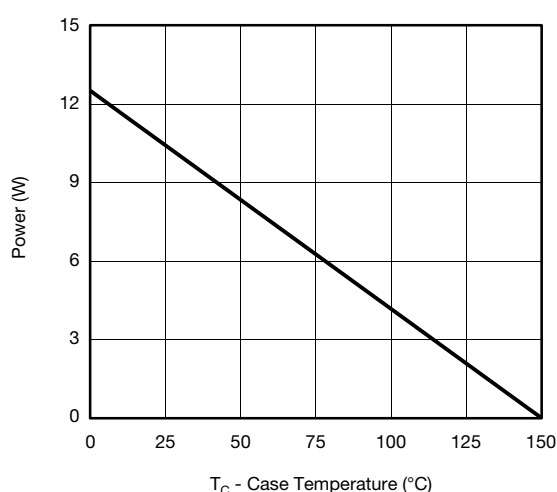


* $V_{GS} >$ minimum V_{GS} at which $R_{DS(on)}$ is specified

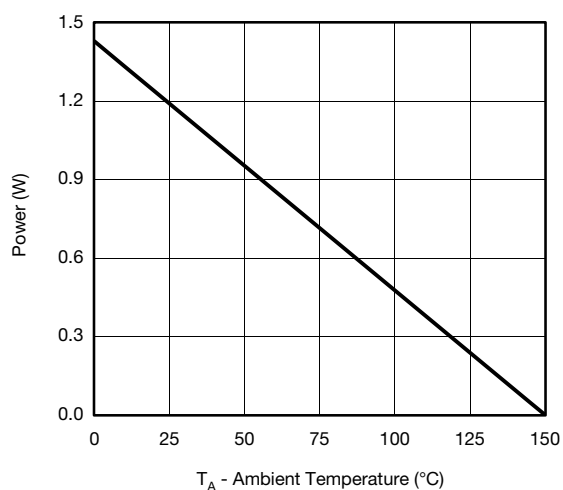
Safe Operating Area, Junction-to-Ambient



Current Derating*



Power Derating, Junction-to-Case



Power Derating, Junction-to-Ambient

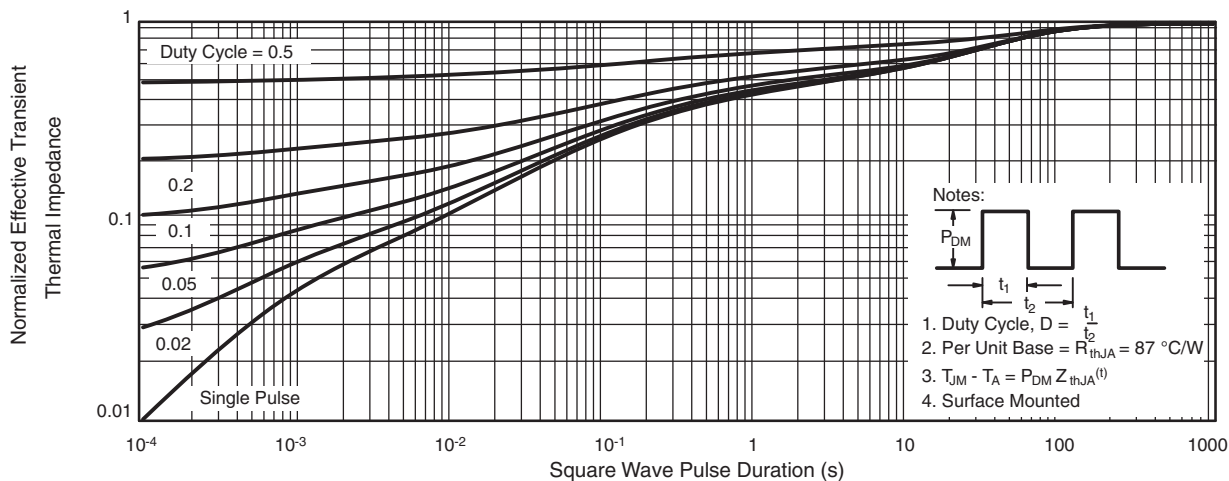
* The power dissipation P_D is based on $T_{J(max)} = 150\text{ }^{\circ}\text{C}$, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls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

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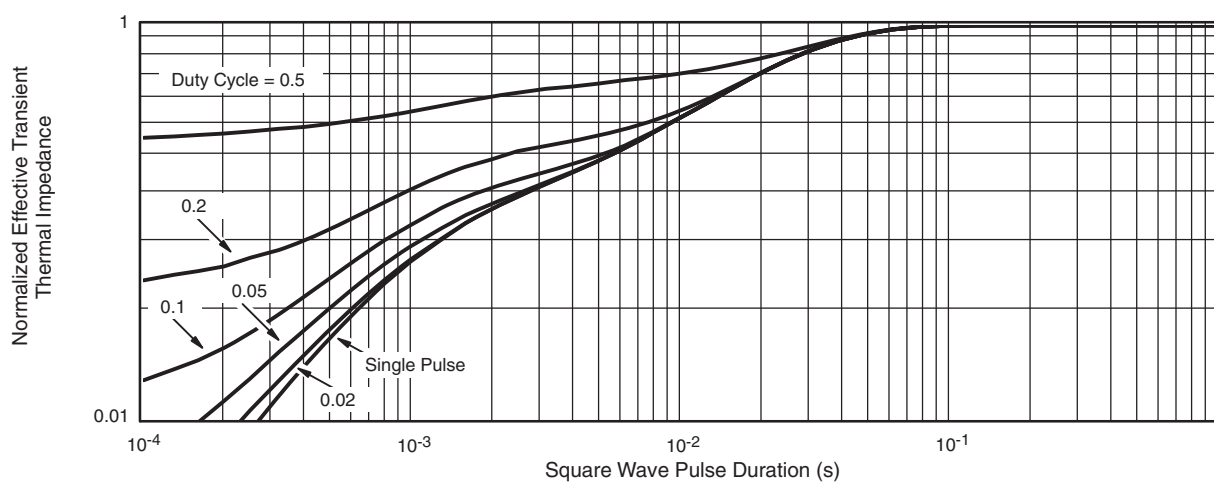
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TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



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/ppg767019.

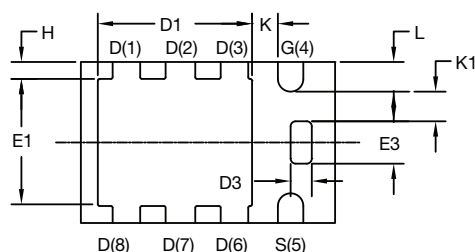
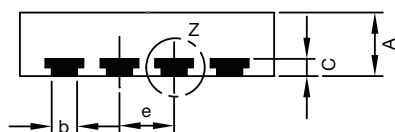
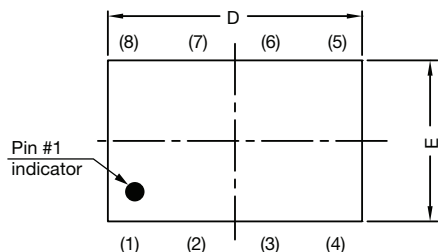


www.vishay.com

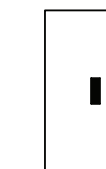
Package Information

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PowerPAK® ChipFET® Case Outline



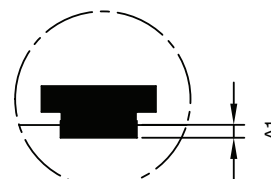
Backside view of single pad



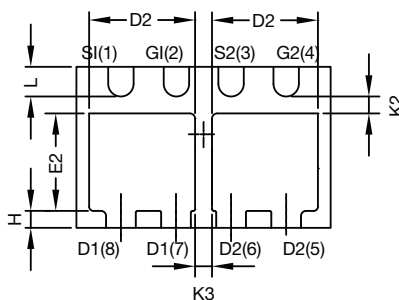
Side view of single



Side view of dual



Detail Z



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
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

Revision: 21-Jul-14

1

Document Number: 73203

For technical questions, contact: pmstechsupport@vishay.com

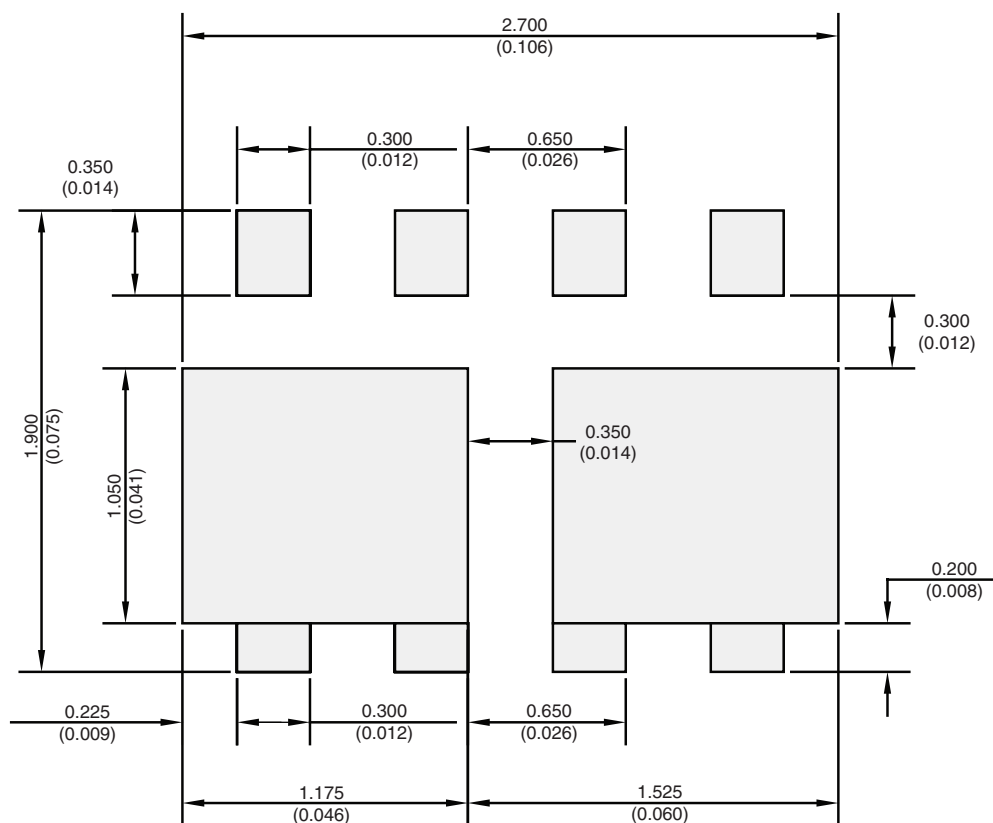
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Application Note 826

Vishay Siliconix



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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