N-Channel Reduced Q_g, Fast Switching MOSFET

PRODUCT SUMMARY

| V_{DS} (V)	$R_{DS(on)}$ (Ω)	I_D (A)
30	0.0095 at V_{GS} = 10 V	16
	0.0125 at V_{GS} = 4.5 V	16

FEATURES

- **Halogen-free According to IEC 61249-2-21 Available**
- TrenchFET[®] Power MOSFET
- PWM Optimized for High Efficiency
- New Low Thermal Resistance PowerPAK[®] Package with Low 1.07 mm Profile
- 100 % R_g Tested

APPLICATIONS

- Buck Converter
  - High Side or Low Side
- Synchronous Rectifier
  - Secondary Rectifier

PowerPAK SO-8

6.15 mm 5.15 mm

Bottom View

N-Channel MOSFET
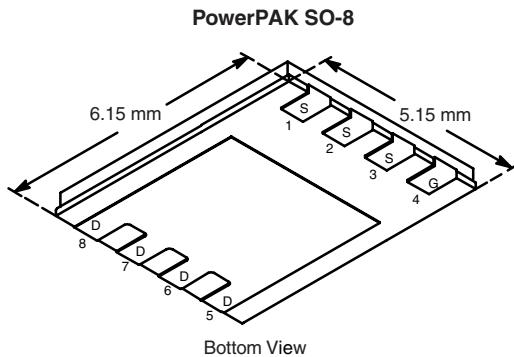
Ordering Information: Si7860ADP-T1-E3 (Lead (Pb)-free)
Si7860ADP-T1-GE3 (Lead (Pb)-free and Halogen-free)
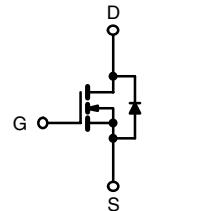
ABSOLUTE MAXIMUM RATINGS T_A = 25 °C, unless otherwise noted

Parameter		Symbol	10 s	Steady State	Unit
Drain-Source Voltage		V_{DS}	30		V
Gate-Source Voltage		V_{GS}	± 20		
Continuous Drain Current (T_J = 150 °C)[a]	T_A = 25 °C	I_D	16	11	A
	T_A = 70 °C		13	8	
Pulsed Drain Current		I_{DM}	± 50		
Continuous Source Current (Diode Conduction)[a]		I_S	4.1	1.5	
Avalanche Current	L = 0.1 mH	I_{AS}	35		
Single Pulse Avalanche Energy		E_{AS}	60		mJ
Maximum Power Dissipation[a]	T_A = 25 °C	P_D	4.8	1.8	W
	T_A = 70 °C		3.1	1.1	
Operating Junction and Storage Temperature Range		T_J, T_{stg}	- 55 to 150		°C
Soldering Recommendations (Peak Temperature)[b, c]			260		

THERMAL RESISTANCE RATINGS

Parameter		Symbol	Typical	Maximum	Unit
Maximum Junction-to-Ambient (MOSFET)[a]	t ≤ 10 s	R_{thJA}	21	26	°C/W
	Steady State		56	70	
Maximum Junction-to-Case (Drain)	Steady State	R_{thJC}	1.9	2.5	

Notes:
a. Surface Mounted on 1" x 1" FR4 board.
b. See Solder Profile (*http://www.vishay.com/ppg?73257*). The PowerPAK SO-8 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.
c. Rework Conditions: manual soldering with a soldering iron is not recommended for leadless components.

MOSFET SPECIFICATIONS T_J = 25 °C, unless otherwise noted

| Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Static						
Gate Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250 µA	1.0		3.0	V
Gate-Body Leakage	I_{GSS}	V_{DS} = 0 V, V_{GS} = ± 20 V			± 100	nA
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 30 V, V_{GS} = 0 V			1	µA
		V_{DS} = 30 V, V_{GS} = 0 V, T_J = 70 °C			5	
On-State Drain Current[a]	$I_{D(on)}$	$V_{DS} \geq$ 5 V, V_{GS} = 10 V	40			A
Drain-Source On-State Resistance[a]	$R_{DS(on)}$	V_{GS} = 10 V, I_D = 16 A		0.0079	0.0095	Ω
		V_{GS} = 4.5 V, I_D = 14 A		0.0105	0.0125	
Forward Transconductance[a]	g_{fs}	V_{DS} = 15 V, I_D = 16 A		60		S
Diode Forward Voltage[a]	V_{SD}	I_S = 3 A, V_{GS} = 0 V		0.70	1.1	V
Dynamic[b]						
Total Gate Charge	Q_g			13	18	
Gate-Source Charge	Q_{gs}	V_{DS} = 15 V, V_{GS} = 4.5 V, I_D = 16 A		5		nC
Gate-Drain Charge	Q_{gd}			4.0		
Gate Resistance	R_g		0.5	1.7	3.2	Ω
Turn-On Delay Time	$t_{d(on)}$			18	27	
Rise Time	t_r	V_{DD} = 15 V, R_L = 15 Ω		12	18	
Turn-Off Delay Time	$t_{d(off)}$	$I_D \cong$ 1 A, V_{GEN} = 10 V, R_g = 6 Ω		46	70	ns
Fall Time	t_f			19	30	
Source-Drain Reverse Recovery Time	t_{rr}	I_F = 3 A, dI/dt = 100 A/µs		40	70	

Notes:
a. Pulse test; pulse width $\leq$ 300 µs, 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

Output Characteristics

Transfer Characteristics

![VISHAY logo]
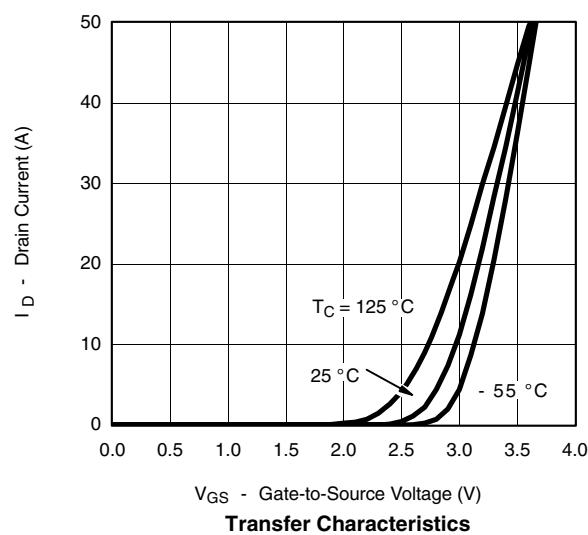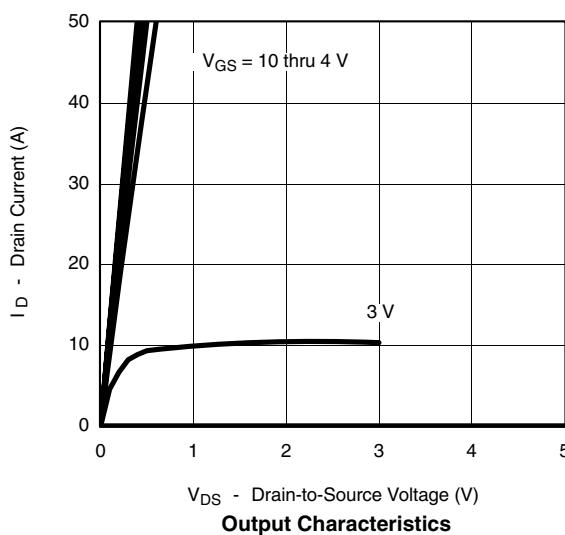
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted
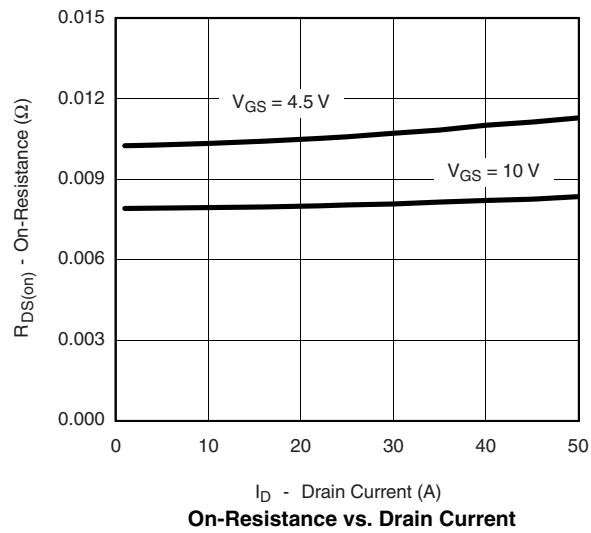
On-Resistance vs. Drain Current

Graph: $R_{DS(on)}$ - On-Resistance (Ω) vs I_D - Drain Current (A). Curves for V_{GS} = 4.5 V and V_{GS} = 10 V.

Capacitance

Graph: C - Capacitance (pF) vs V_{DS} - Drain-to-Source Voltage (V). Curves for C_{iss}, C_{oss}, C_{rss}.

Gate Charge

Graph: V_{GS} - Gate-to-Source Voltage (V) vs Q_g - Total Gate Charge (nC). V_{DS} = 15 V, I_D = 16 A.
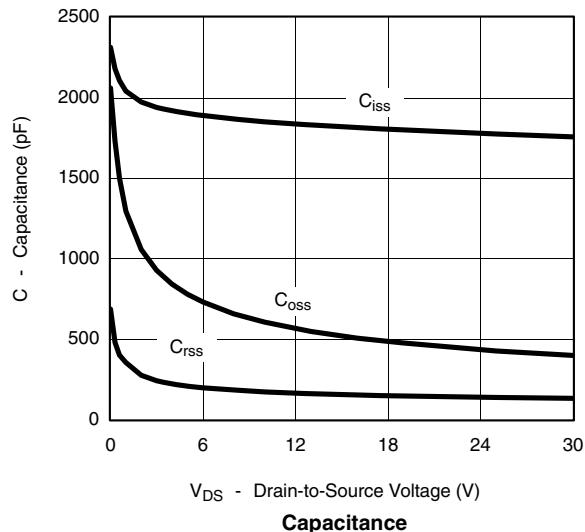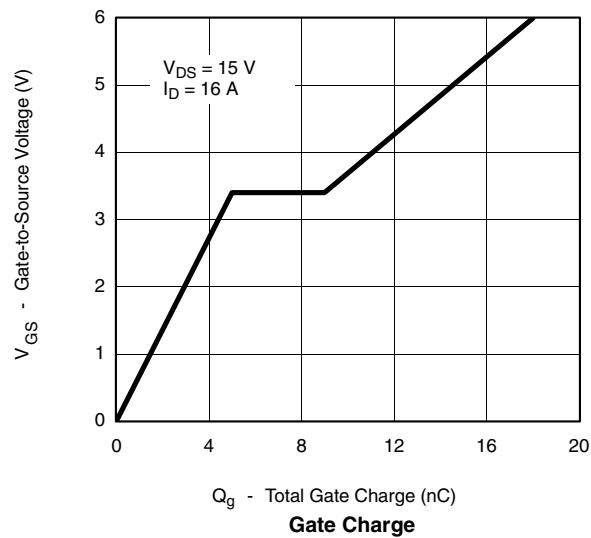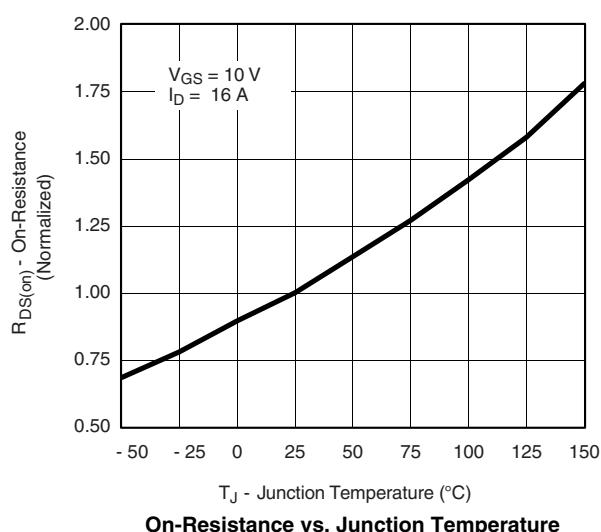
On-Resistance vs. Junction Temperature

Graph: $R_{DS(on)}$ - On-Resistance (Normalized) vs T_J - Junction Temperature (°C). V_{GS} = 10 V, I_D = 16 A.
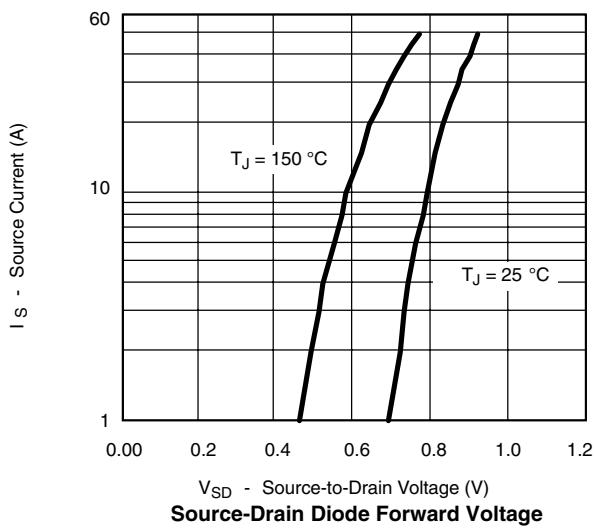
Source-Drain Diode Forward Voltage

Graph: I_S - Source Current (A) vs V_{SD} - Source-to-Drain Voltage (V). Curves for T_J = 150 °C and T_J = 25 °C.
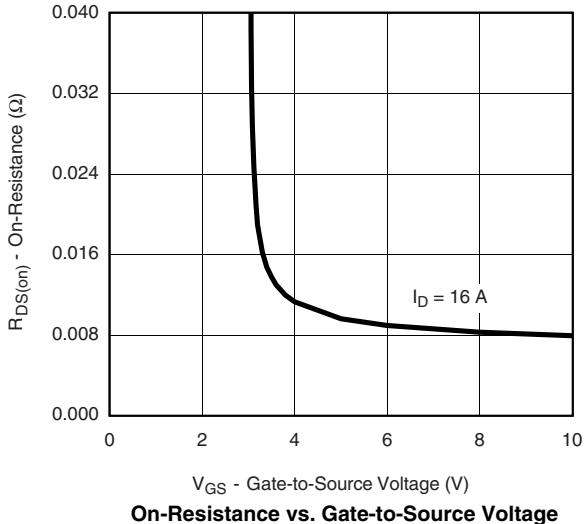
On-Resistance vs. Gate-to-Source Voltage
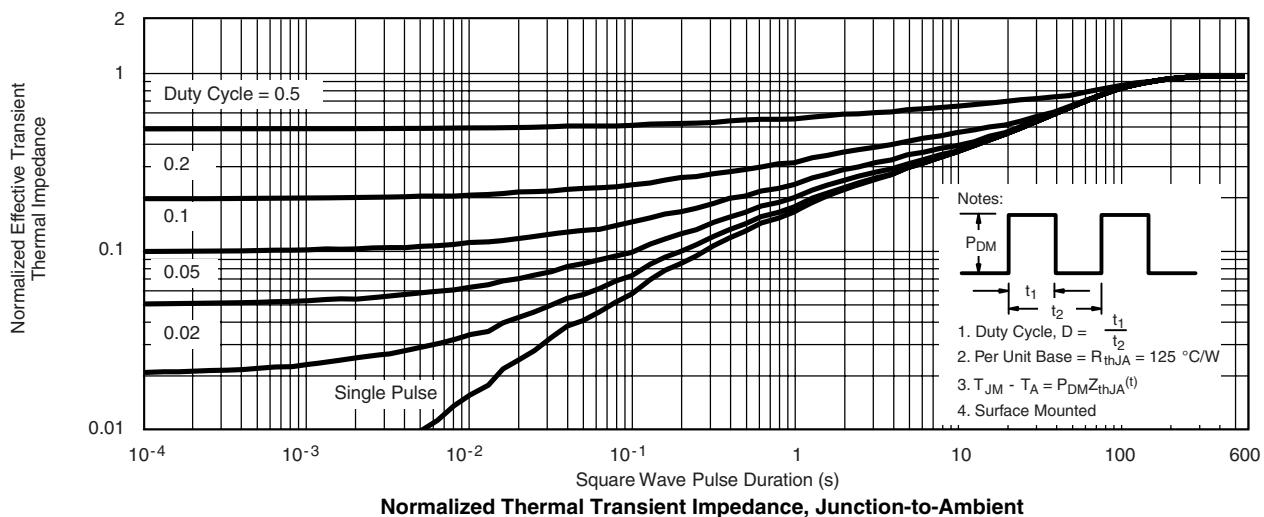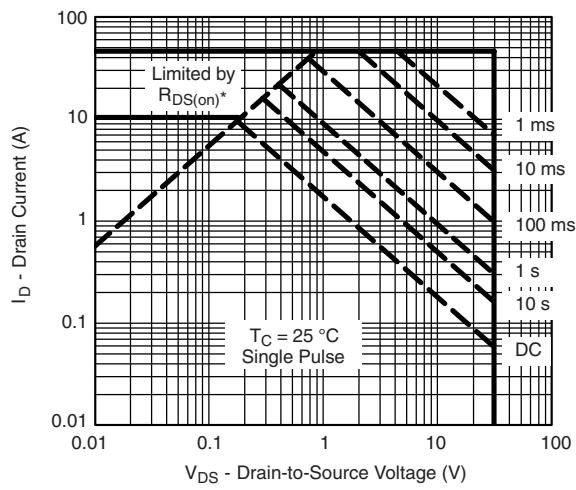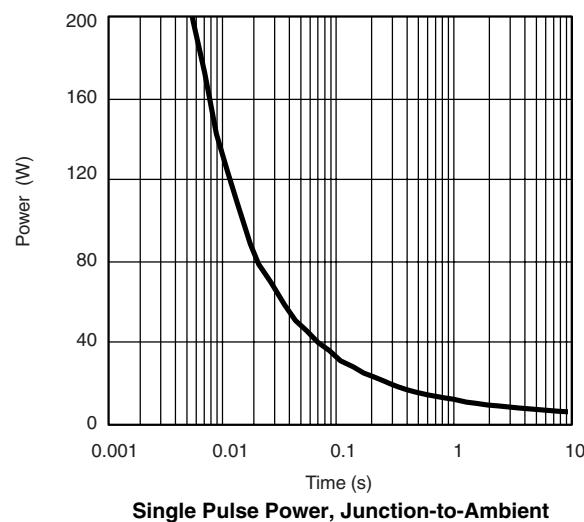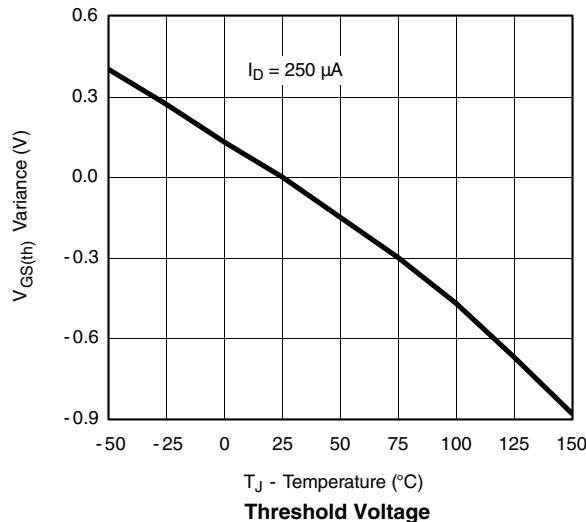
Graph: $R_{DS(on)}$ - On-Resistance (Ω) vs V_{GS} - Gate-to-Source Voltage (V). I_D = 16 A.

TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

$I_D = 250 \mu A$

Threshold Voltage

Single Pulse Power, Junction-to-Ambient

Limited by $R_{DS(on)}$*

1 ms
10 ms
100 ms
1 s
10 s
DC

$T_C = 25$ °C
Single Pulse

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

Safe Operating Area, Junction-to-Case

Duty Cycle = 0.5
0.2
0.1
0.05
0.02

Single Pulse

Notes:

P_{DM}

t_1
t_2

1. Duty Cycle, D = $\frac{t_1}{t_2}$
2. Per Unit Base = R_{thJA} = 125 °C/W
3. $T_{JM} - T_A = P_{DM}Z_{thJA}^{(t)}$
4. Surface Mounted

Normalized Thermal Transient Impedance, Junction-to-Ambient

TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

Normalized Effective Transient Thermal Impedance

Duty Cycle = 0.5

0.2

0.1

0.05

0.02

Single Pulse

Square Wave Pulse Duration (s)

Normalized Thermal Transient Impedance, Junction-to-Case

PowerPAK® SO-8, (Single/Dual)

Backside View of Single Pad

Backside View of Dual Pad

Detail Z
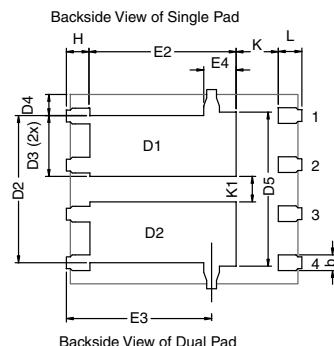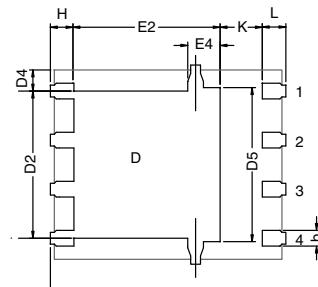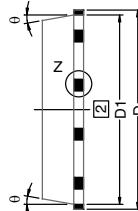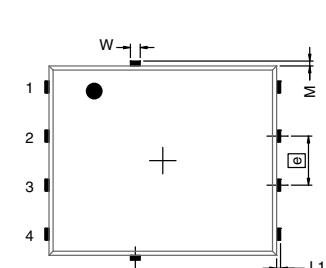
Notes
1. Inch will govern.
2. Dimensions exclusive of mold gate burrs.
3. Dimensions exclusive of mold flash and cutting burrs.

DIM.	MILLIMETERS			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.97	1.04	1.12	0.038	0.041	0.044
A1		-	0.05	0	-	0.002
b	0.33	0.41	0.51	0.013	0.016	0.020
c	0.23	0.28	0.33	0.009	0.011	0.013
D	5.05	5.15	5.26	0.199	0.203	0.207
D1	4.80	4.90	5.00	0.189	0.193	0.197
D2	3.56	3.76	3.91	0.140	0.148	0.154
D3	1.32	1.50	1.68	0.052	0.059	0.066
D4	0.57 typ.			0.0225 typ.		
D5	3.98 typ.			0.157 typ.		
E	6.05	6.15	6.25	0.238	0.242	0.246
E1	5.79	5.89	5.99	0.228	0.232	0.236
E2 (for AL product)	3.30	3.48	3.66	0.130	0.137	0.144
E2 (for other product)	3.48	3.66	3.84	0.137	0.144	0.151
E3	3.68	3.78	3.91	0.145	0.149	0.154
E4 (for AL product)	0.58 typ.			0.023 typ.		
E4 (for other product)	0.75 typ.			0.030 typ.		
e	1.27 BSC			0.050 BSC		
K (for AL product)	1.45 typ.			0.057 typ.		
K (for other product)	1.27 typ.			0.050 typ.		
K1	0.56	-	-	0.022	-	-
H	0.51	0.61	0.71	0.020	0.024	0.028
L	0.51	0.61	0.71	0.020	0.024	0.028
L1	0.06	0.13	0.20	0.002	0.005	0.008
θ	0°	-	12°	0°	-	12°
W	0.15	0.25	0.36	0.006	0.010	0.014
M	0.125 typ.			0.005 typ.		

ECN: C13-0702-Rev. K, 20-May-13
DWG: 5881

RECOMMENDED MINIMUM PADS FOR PowerPAK® SO-8 Single
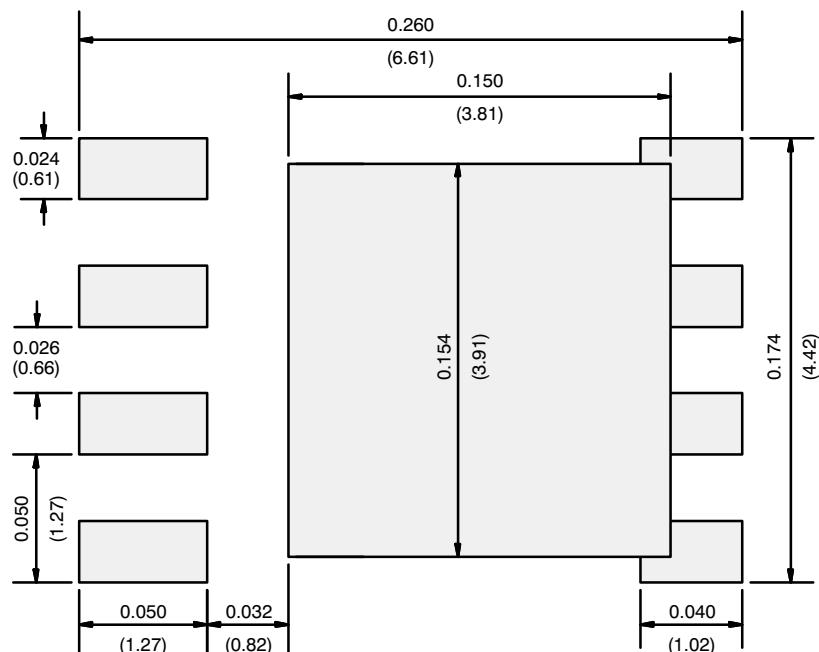
Recommended Minimum Pads
Dimensions in Inches/(mm)

Return to Index

APPLICATION NOTE

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.

Material Category Policy

Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.

Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.

Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.