

## Automotive P-Channel 12 V (D-S) 175 °C MOSFET

 AUTOMOTIVE  
GRADE

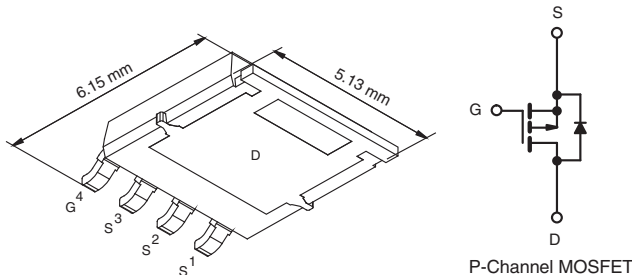
**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

PRODUCT SUMMARY	
$V_{DS}$ (V)	- 12
$R_{DS(on)}$ ( $\Omega$ ) at $V_{GS} = -4.5$ V	0.0060
$R_{DS(on)}$ ( $\Omega$ ) at $V_{GS} = -2.5$ V	0.0080
$I_D$ (A)	- 32
Configuration	Single

### FEATURES

- Halogen-free According to IEC 61249-2-21 Definition
- TrenchFET® Power MOSFET
- AEC-Q101 Qualified<sup>d</sup>
- 100 %  $R_g$  and UIS Tested
- Compliant to RoHS Directive 2002/95/EC

PowerPAK® SO-8L Single



P-Channel MOSFET

ORDERING INFORMATION	
Package	PowerPAK SO-8L
Lead (Pb)-free and Halogen-free	SQJ401EP-T1-GE3

ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °C, unless otherwise noted)			
PARAMETER	SYMBOL	LIMIT	UNIT
Drain-Source Voltage	$V_{DS}$	- 12	V
Gate-Source Voltage	$V_{GS}$	$\pm 8$	
Continuous Drain Current <sup>a</sup>	$I_D$	$T_C = 25$ °C	- 32
		$T_C = 125$ °C	- 32
Continuous Source Current (Diode Conduction) <sup>a</sup>	$I_S$	- 32	A
Pulsed Drain Current <sup>b</sup>	$I_{DM}$	- 120	mJ
Single Pulse Avalanche Current	$I_{AS}$	- 30	
Single Pulse Avalanche Energy	$E_{AS}$	45	
Maximum Power Dissipation <sup>b</sup>	$P_D$	$T_C = 25$ °C	83
		$T_C = 125$ °C	27
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to + 175	°C
Soldering Recommendations (Peak Temperature) <sup>e, f</sup>		260	

THERMAL RESISTANCE RATINGS			
PARAMETER	SYMBOL	LIMIT	UNIT
Junction-to-Ambient	$R_{thJA}$	65	°C/W
Junction-to-Case (Drain)	$R_{thJC}$	1.8	

### Notes

- Package limited.
- Pulse test; pulse width  $\leq 300$   $\mu$ s, duty cycle  $\leq 2$  %.
- When mounted on 1" square PCB (FR-4 material).
- Parametric verification ongoing.
- See Solder Profile ([www.vishay.com/doc?73257](http://www.vishay.com/doc?73257)). The PowerPAK SO-8L. 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.



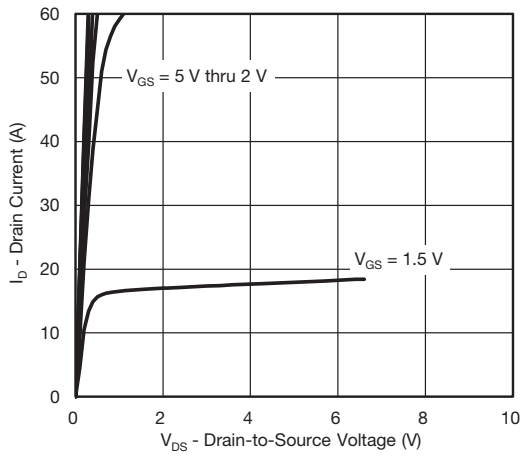
<b>SPECIFICATIONS</b> ( $T_C = 25\text{ }^\circ\text{C}$ , unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
<b>Static</b>							
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$		-12	-	-	V
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$		-0.45	-0.6	-1.5	
Gate-Source Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 8\text{ V}$		-	-	$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}$	$V_{DS} = -12\text{ V}$	-	-	-1	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$	$V_{DS} = -12\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	-	-50	
		$V_{GS} = 0\text{ V}$	$V_{DS} = -12\text{ V}, T_J = 175\text{ }^\circ\text{C}$	-	-	-250	
On-State Drain Current <sup>a</sup>	$I_{D(on)}$	$V_{GS} = -4.5\text{ V}$	$V_{DS} \leq -5\text{ V}$	-30	-	-	A
Drain-Source On-State Resistance <sup>a</sup>	$R_{DS(on)}$	$V_{GS} = -4.5\text{ V}$	$I_D = -15\text{ A}$	-	0.0050	0.0060	$\Omega$
		$V_{GS} = -4.5\text{ V}$	$I_D = -15\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	-	0.0073	
		$V_{GS} = -4.5\text{ V}$	$I_D = -15\text{ A}, T_J = 175\text{ }^\circ\text{C}$	-	-	0.0080	
		$V_{GS} = -2.5\text{ V}$	$I_D = -15\text{ A}$	-	0.0065	0.0080	
Forward Transconductance <sup>b</sup>	$g_{fs}$	$V_{DS} = -15\text{ V}, I_D = -15\text{ A}$		-	60	-	S
<b>Dynamic<sup>b</sup></b>							
Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}$	$V_{DS} = -6\text{ V}, f = 1\text{ MHz}$	-	8012	10 015	$\text{pF}$
Output Capacitance	$C_{oss}$			-	3808	4760	
Reverse Transfer Capacitance	$C_{rss}$			-	3320	4150	
Total Gate Charge <sup>c</sup>	$Q_g$	$V_{GS} = -4.5\text{ V}$	$V_{DS} = -6\text{ V}, I_D = -8.9\text{ A}$	-	109	164	$\text{nC}$
Gate-Source Charge <sup>c</sup>	$Q_{gs}$			-	11	-	
Gate-Drain Charge <sup>c</sup>	$Q_{gd}$			-	29	-	
Gate Resistance	$R_g$	$f = 1\text{ MHz}$		1.8	3.7	5.6	$\Omega$
Turn-On Delay Time <sup>c</sup>	$t_{d(on)}$	$V_{DD} = -6\text{ V}, R_L = 6\text{ }\Omega$ $I_D \equiv -1\text{ A}, V_{GEN} = -4.5\text{ V}, R_g = 1\text{ }\Omega$		-	43	65	$\text{ns}$
Rise Time <sup>c</sup>	$t_r$			-	63	95	
Turn-Off Delay Time <sup>c</sup>	$t_{d(off)}$			-	263	395	
Fall Time <sup>c</sup>	$t_f$			-	166	250	
<b>Source-Drain Diode Ratings and Characteristics<sup>b</sup></b>							
Pulsed Current <sup>a</sup>	$I_{SM}$			-	-	-120	A
Forward Voltage	$V_{SD}$	$I_F = -25\text{ A}, V_{GS} = 0$		-	-0.8	-1.2	V

**Notes**

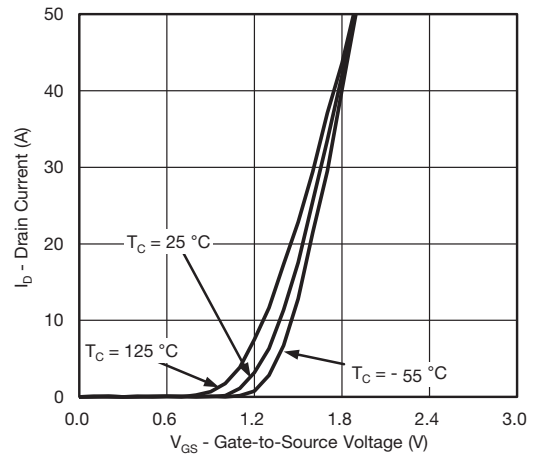
- a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .
- b. Guaranteed by design, not subject to production testing.
- c. Independent of operating temperature.

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.

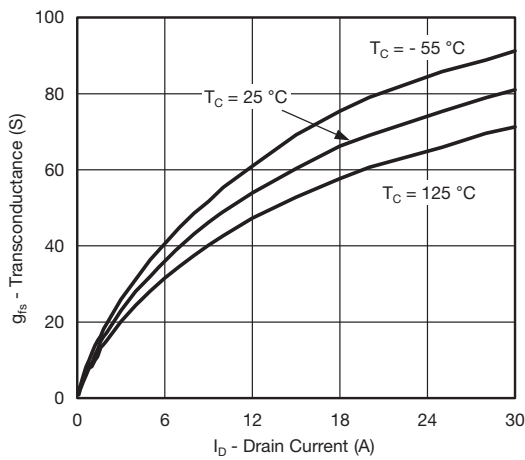
**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



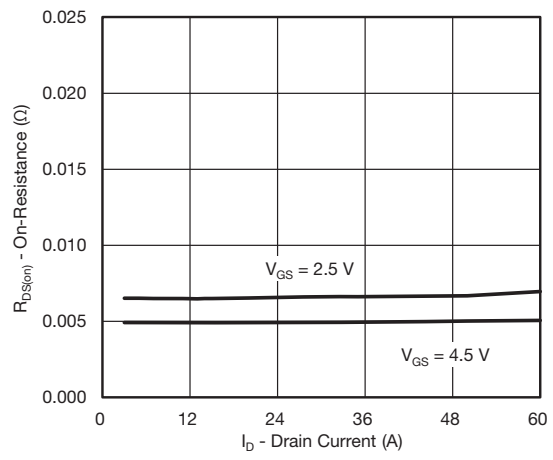
**Output Characteristics**



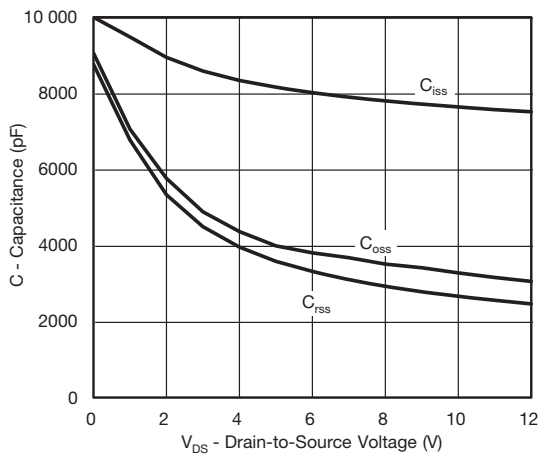
**Transfer Characteristics**



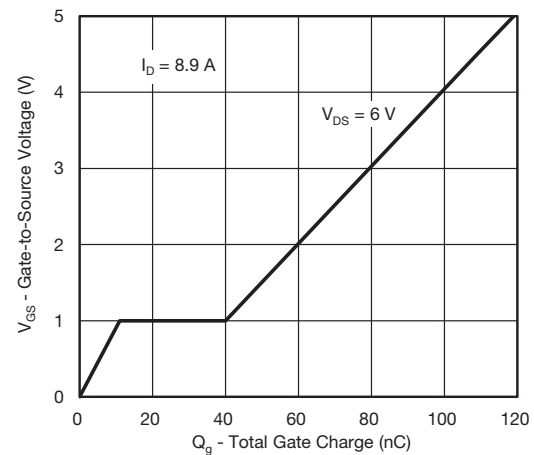
**Transconductance**



**On-Resistance vs. Drain Current**

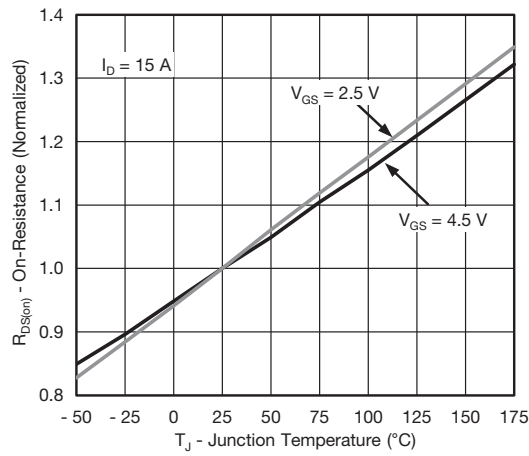


**Capacitance**

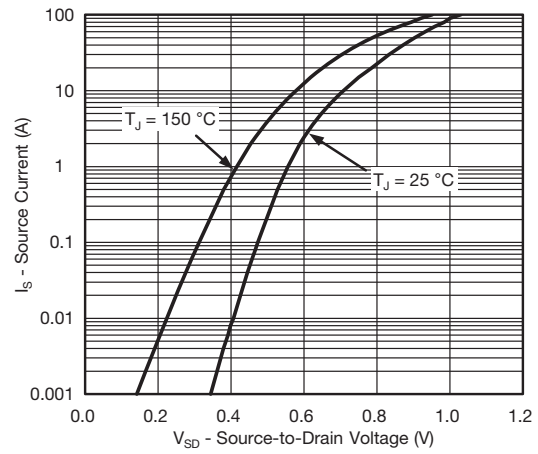


**Gate Charge**

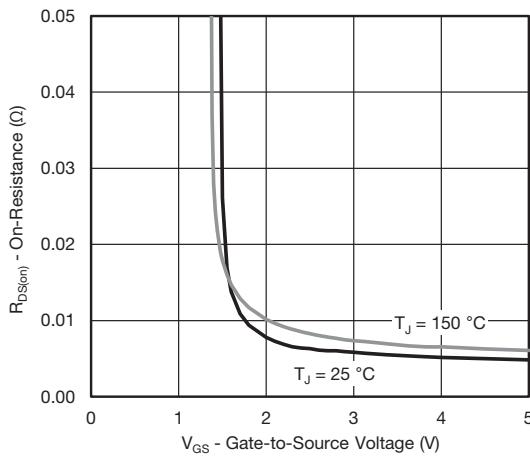
**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



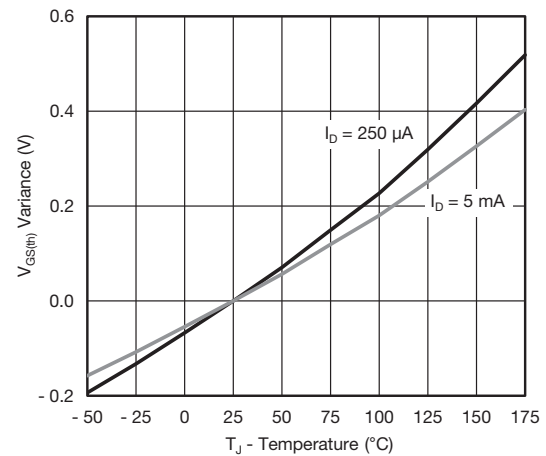
**On-Resistance vs. Junction Temperature**



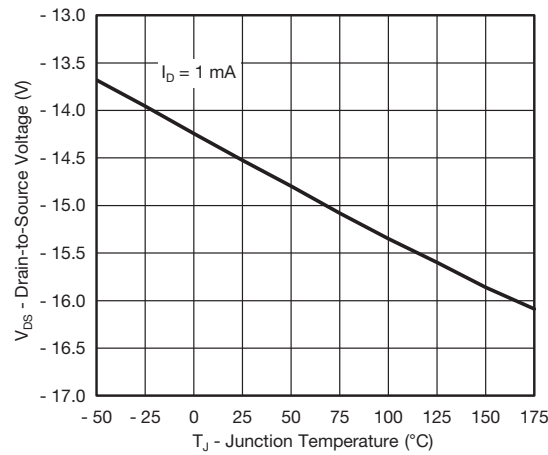
**Source-Drain Diode Forward Voltage**



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



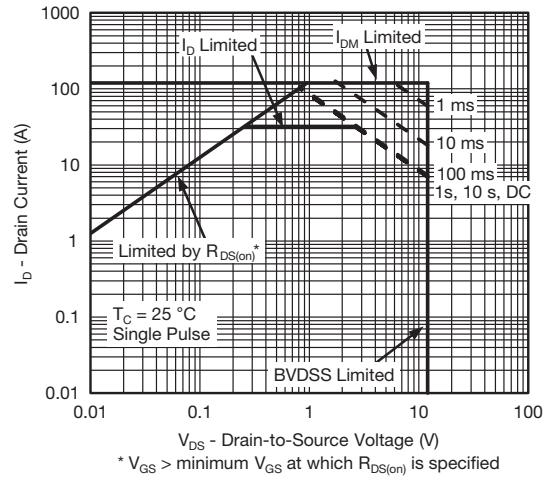
**Threshold Voltage**



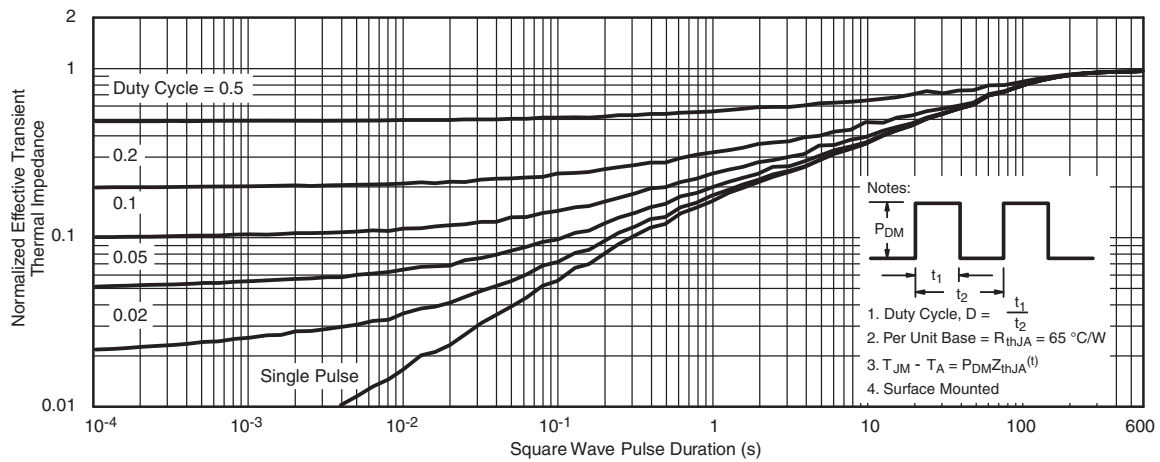
**Drain Source Breakdown vs. Junction Temperature**



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



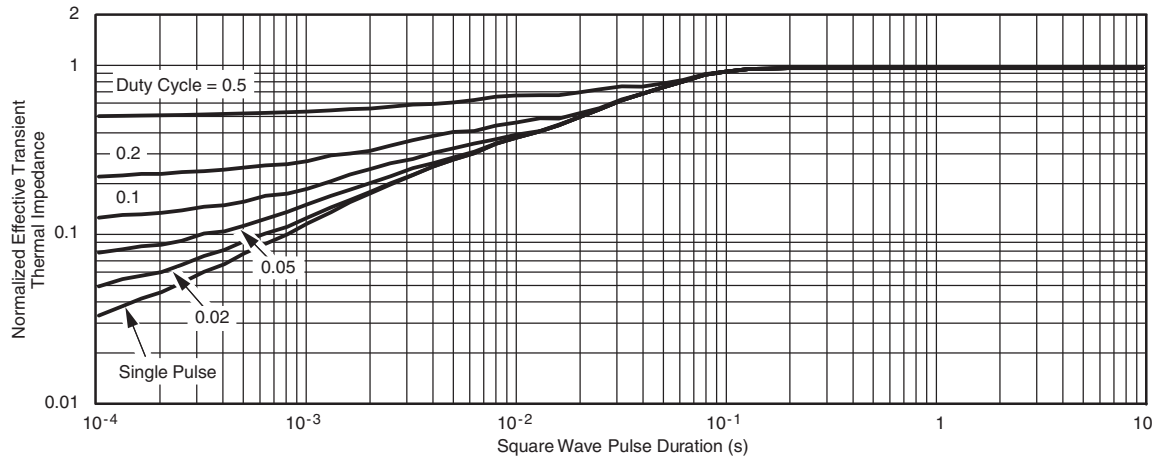
**Safe Operating Area**



**Normalized Thermal Transient Impedance, Junction-to-Ambient**



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



**Normalized Thermal Transient Impedance, Junction-to-Case**

**Note**

- The characteristics shown in the two graphs
  - Normalized Transient Thermal Impedance Junction-to-Ambient ( $25\text{ }^\circ\text{C}$ )
  - Normalized Transient Thermal Impedance Junction-to-Case ( $25\text{ }^\circ\text{C}$ )are given for general guidelines only to enable the user to get a “ball park” indication of part capabilities. The data are extracted from single pulse transient thermal impedance characteristics which are developed from empirical measurements. The latter is valid for the part mounted on printed circuit board - FR4, size 1" x 1" x 0.062", double sided with 2 oz. copper, 100 % on both sides. The part capabilities can widely vary depending on actual application parameters and operating conditions.

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# PowerPAK<sup>®</sup> SO-8L Case Outline 1



Topside view



Backside view (single)



Backside view (dual)



DIM.	MILLIMETERS			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	1.00	1.07	1.14	0.039	0.042	0.045
A1	0.00	-	0.127	0.00	-	0.005
b	0.33	0.41	0.48	0.013	0.016	0.019
b1	0.44	0.51	0.58	0.017	0.020	0.023
b2	4.80	4.90	5.00	0.189	0.193	0.197
b3	0.094			0.004		
b4	0.47			0.019		
c	0.20	0.25	0.30	0.008	0.010	0.012
D	5.00	5.13	5.25	0.197	0.202	0.207
D1	4.80	4.90	5.00	0.189	0.193	0.197
D2	3.86	3.96	4.06	0.152	0.156	0.160
D3	1.63	1.73	1.83	0.064	0.068	0.072
e	1.27 BSC			0.050 BSC		
E	6.05	6.15	6.25	0.238	0.242	0.246
E1	4.27	4.37	4.47	0.168	0.172	0.176
E2	3.18	3.28	3.38	0.125	0.129	0.133
F	-	-	0.15	-	-	0.006
L	0.62	0.72	0.82	0.024	0.028	0.032
L1	0.92	1.07	1.22	0.036	0.042	0.048
K	0.51			0.020		
W	0.23			0.009		
W1	0.41			0.016		
W2	2.82			0.111		
W3	2.96			0.117		
θ	0°	-	10°	0°	-	10°

ECN: S19-0643-Rev. E, 05-Aug-2019  
 DWG: 5976

Note

- Millimeters will govern





**RECOMMENDED MINIMUM PAD FOR PowerPAK® SO-8L SINGLE**



Recommended Minimum Pads  
Dimensions in mm (inches)



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