

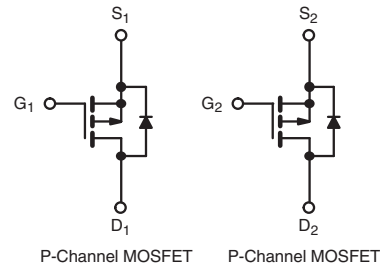
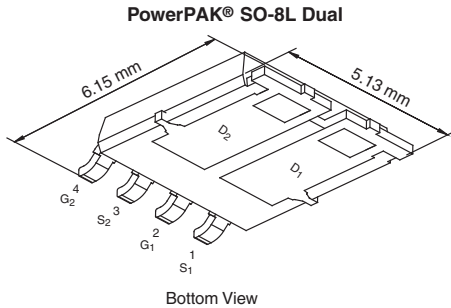
Automotive Dual P-Channel 60 V (D-S) 175 °C MOSFET

PRODUCT SUMMARY	
V_{DS} (V)	- 60
$R_{DS(on)}$ (Ω) at $V_{GS} = -10$ V	0.085
$R_{DS(on)}$ (Ω) at $V_{GS} = -4.5$ V	0.115
I_D (A) per leg	- 8
Configuration	Dual

FEATURES

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

AUTOMOTIVE GRADE


RoHS
 COMPLIANT
 HALOGEN
FREE


ORDERING INFORMATION	
Package	PowerPAK SO-8L
Lead (Pb)-free and Halogen-free	SQJ963EP-T1-GE3

ABSOLUTE MAXIMUM RATINGS ($T_C = 25$ °C, unless otherwise noted)				
PARAMETER	SYMBOL	LIMIT	UNIT	
Drain-Source Voltage	V_{DS}	- 60	V	
Gate-Source Voltage	V_{GS}	± 20		
Continuous Drain Current	I_D	$T_C = 25$ °C ^a	- 8	
		$T_C = 125$ °C	- 7	
Continuous Source Current (Diode Conduction) ^a	I_S	- 8	A	
Pulsed Drain Current ^b	I_{DM}	- 25		
Single Pulse Avalanche Current	I_{AS}	L = 0.1 mH		- 20
Single Pulse Avalanche Energy				E_{AS}
Maximum Power Dissipation ^b	P_D	$T_C = 25$ °C	27	
		$T_C = 125$ °C	9	
Operating Junction and Storage Temperature Range	T_J, T_{stg}	- 55 to + 175	°C	
Soldering Recommendations (Peak Temperature) ^{e, f}		260		

THERMAL RESISTANCE RATINGS			
PARAMETER	SYMBOL	LIMIT	UNIT
Junction-to-Ambient	R_{thJA}	85	°C/W
Junction-to-Case (Drain)			

Notes

- Package limited.
- Pulse test; pulse width ≤ 300 μ s, duty cycle ≤ 2 %.
- When mounted on 1" square PCB (FR4 material).
- Parametric verification ongoing.
- See solder profile (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.



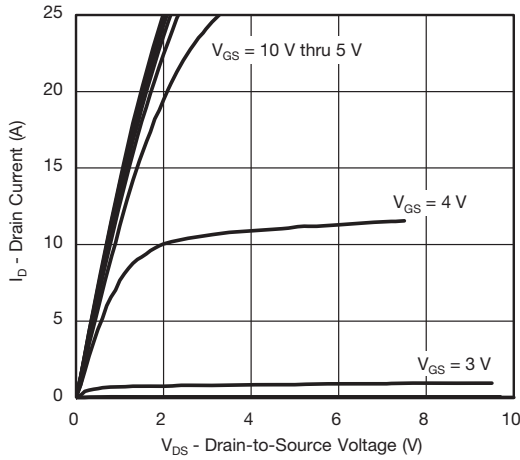
SPECIFICATIONS ($T_C = 25\text{ }^\circ\text{C}$, unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT	
Static							
Drain-Source Breakdown Voltage	V_{DS}	$V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$	-60	-	-	V	
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$	-1.5	-2.0	-2.5		
Gate-Source Leakage	I_{GSS}	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$	-	-	± 100	nA	
Zero Gate Voltage Drain Current	I_{DSS}	$V_{GS} = 0\text{ V}$	$V_{DS} = -60\text{ V}$	-	-	-1	μA
		$V_{GS} = 0\text{ V}$	$V_{DS} = -60\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	-	-50	
		$V_{GS} = 0\text{ V}$	$V_{DS} = -60\text{ V}, T_J = 175\text{ }^\circ\text{C}$	-	-	-150	
On-State Drain Current ^a	$I_{D(on)}$	$V_{GS} = -10\text{ V}$	$V_{DS} \leq -5\text{ V}$	-12	-	A	
Drain-Source On-State Resistance ^a	$R_{DS(on)}$	$V_{GS} = -10\text{ V}$	$I_D = -3.5\text{ A}$	-	0.067	0.085	Ω
		$V_{GS} = -10\text{ V}$	$I_D = -3.5\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	-	0.143	
		$V_{GS} = -10\text{ V}$	$I_D = -3.5\text{ A}, T_J = 175\text{ }^\circ\text{C}$	-	-	0.176	
		$V_{GS} = -4.5\text{ V}$	$I_D = -2.5\text{ A}$	-	0.087	0.115	
Forward Transconductance ^b	g_{fs}	$V_{DS} = -15\text{ V}, I_D = -3.5\text{ A}$	-	10	-	S	
Dynamic^b							
Input Capacitance	C_{iss}	$V_{GS} = 0\text{ V}$	$V_{DS} = -30\text{ V}, f = 1\text{ MHz}$	-	912	1140	μF
Output Capacitance	C_{oss}			-	100	125	
Reverse Transfer Capacitance	C_{rss}			-	60	75	
Total Gate Charge ^c	Q_g	$V_{GS} = -10\text{ V}$	$V_{DS} = -30\text{ V}, I_D = -4.3\text{ A}$	-	26.5	40	nC
Gate-Source Charge ^c	Q_{gs}			-	3.8	-	
Gate-Drain Charge ^c	Q_{gd}			-	5.8	-	
Gate Resistance	R_g	f = 1 MHz		3.4	6.9	10.4	Ω
Turn-On Delay Time ^c	$t_{d(on)}$	$V_{DD} = -30\text{ V}, R_L = 8.8\text{ }\Omega$ $I_D \cong -3.4\text{ A}, V_{GEN} = -10\text{ V}, R_g = 1\text{ }\Omega$	-	11	17	ns	
Rise Time ^c	t_r		-	13	20		
Turn-Off Delay Time ^c	$t_{d(off)}$		-	36	54		
Fall Time ^c	t_f		-	8	12		
Source-Drain Diode Ratings and Characteristics^b							
Pulsed Current ^a	I_{SM}		-	-	-25	A	
Forward Voltage	V_{SD}	$I_F = -3\text{ A}, V_{GS} = 0\text{ V}$	-	-0.84	-1.2	V	

Notes

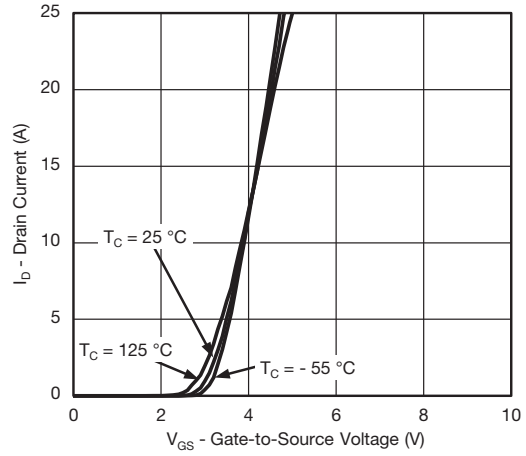
- a. Pulse test; pulse width $\leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$.
- b. Guaranteed by design, not subject to production testing.
- c. Independent of operating temperature.

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.

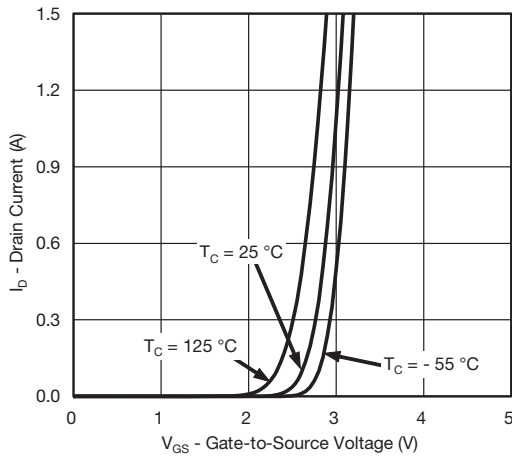
TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^\circ\text{C}$, unless otherwise noted)



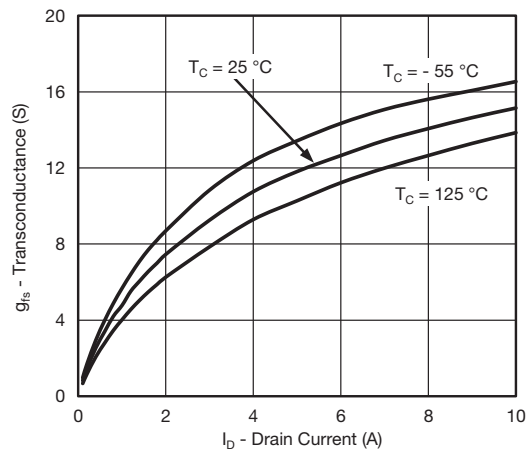
Output Characteristics



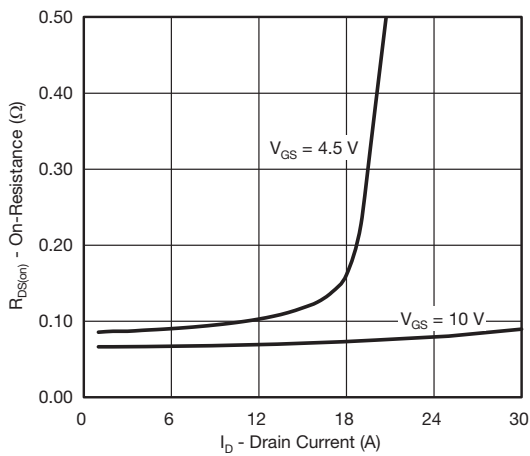
Transfer Characteristics



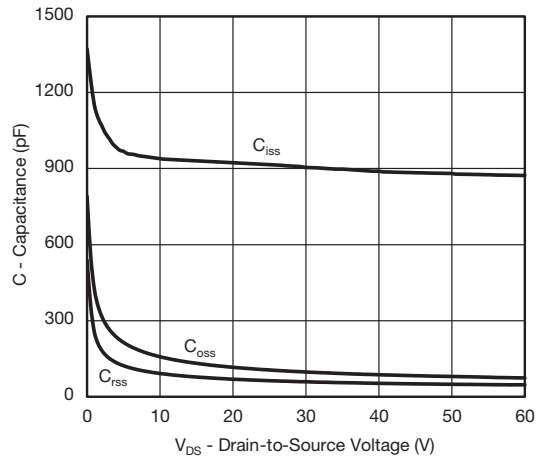
Transfer Characteristics



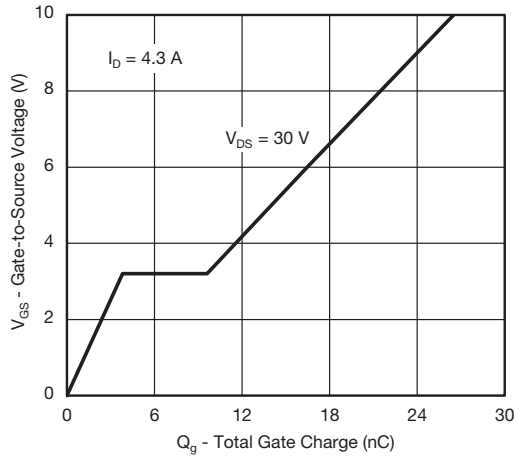
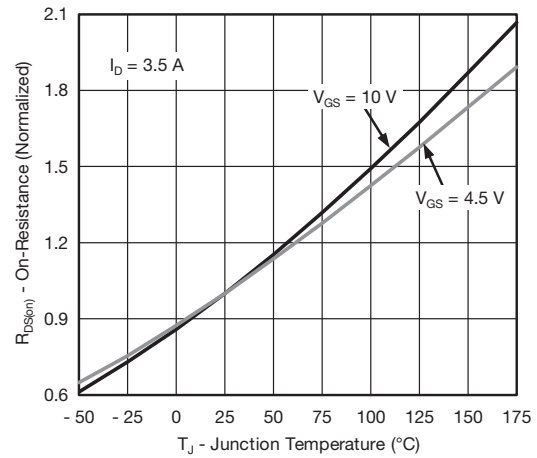
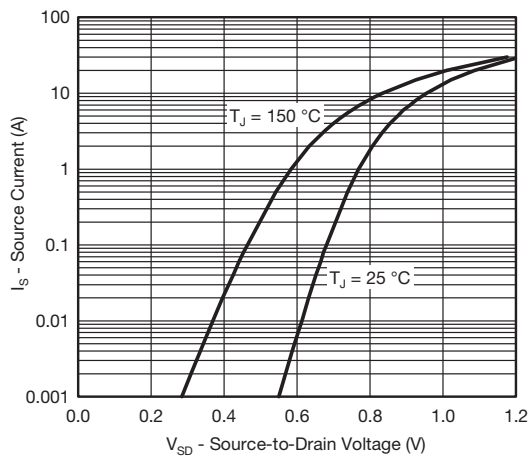
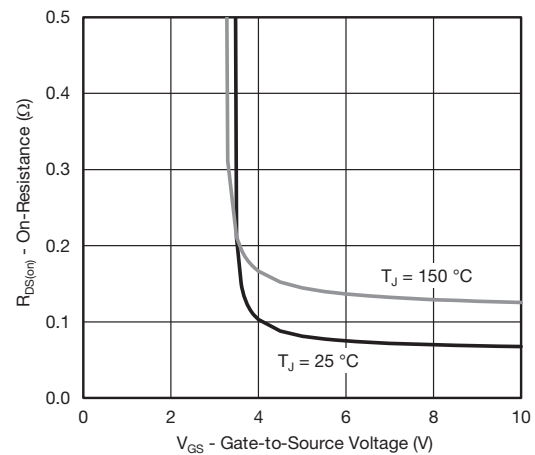
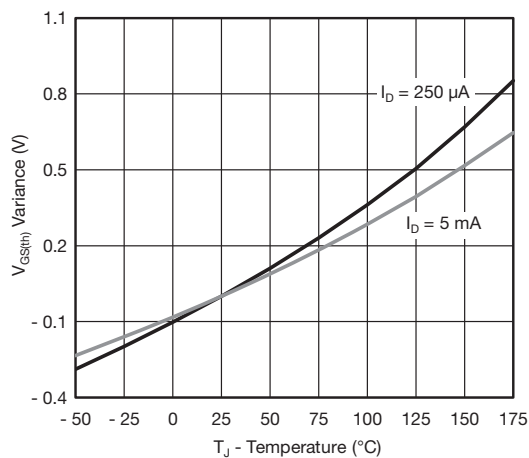
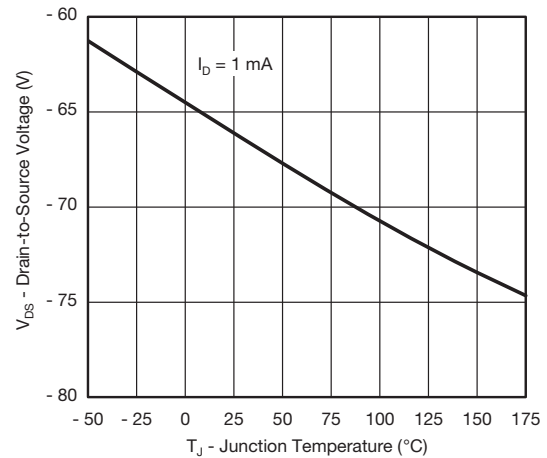
Transconductance



On-Resistance vs. Drain Current

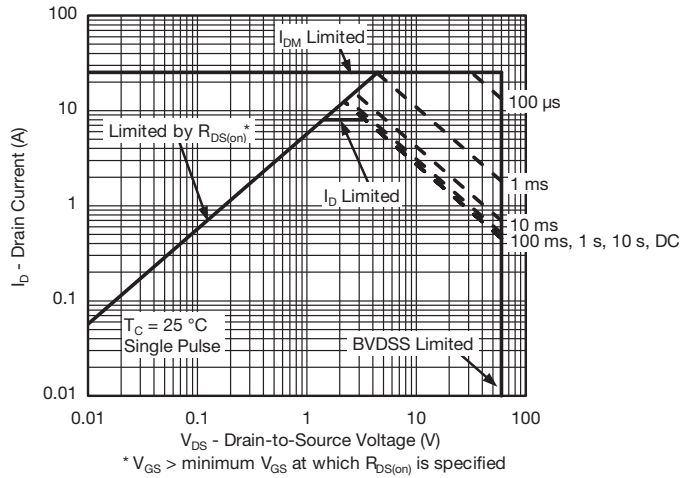


Capacitance

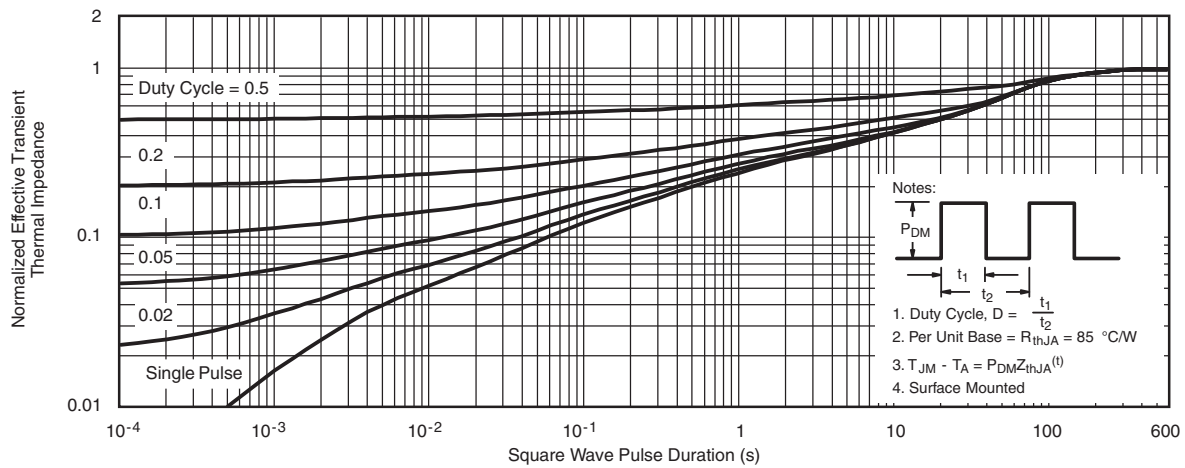
TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^\circ\text{C}$, unless otherwise noted)

Gate Charge

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)



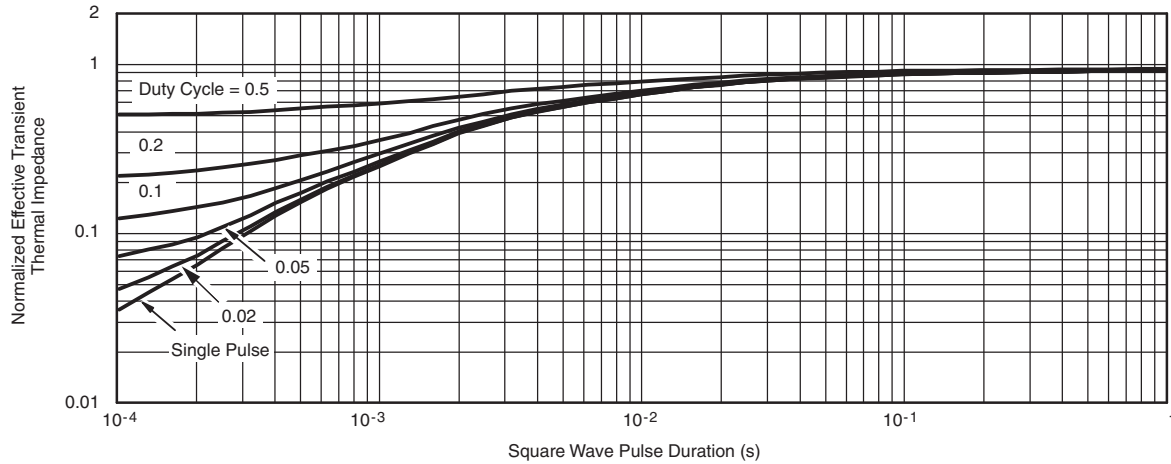
Safe Operating Area



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 °C)
 - Normalized Transient Thermal Impedance Junction-to-Case (25 °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.

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?67581.



PowerPAK® SO-8L

Ordering codes for the SQ rugged series power MOSFETs in the PowerPAK SO-8L package:

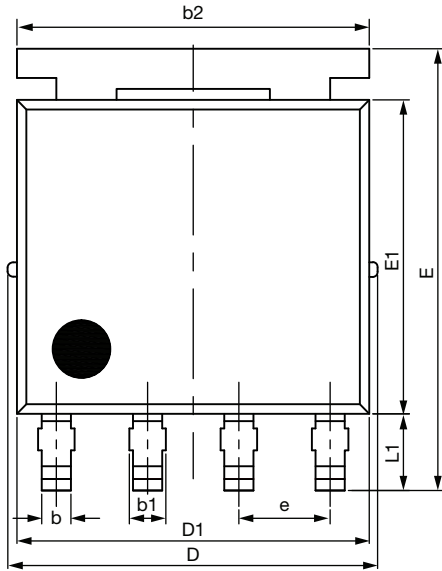
DATASHEET PART NUMBER	OLD ORDERING CODE ^a	NEW ORDERING CODE
SQJ200EP	-	SQJ200EP-T1_GE3
SQJ202EP	-	SQJ202EP-T1_GE3
SQJ401EP	SQJ401EP-T1-GE3	SQJ401EP-T1_GE3
SQJ402EP	SQJ402EP-T1-GE3	SQJ402EP-T1_GE3
SQJ403EEP	SQJ403EEP-T1-GE3	SQJ403EEP-T1_GE3
SQJ403EP	-	SQJ403EP-T1_GE3
SQJ410EP	SQJ410EP-T1-GE3	SQJ410EP-T1_GE3
SQJ412EP	SQJ412EP-T1-GE3	SQJ412EP-T1_GE3
SQJ416EP	-	SQJ416EP-T1_GE3
SQJ418EP	-	SQJ418EP-T1_GE3
SQJ422EP	SQJ422EP-T1-GE3	SQJ422EP-T1_GE3
SQJ423EP	-	SQJ423EP-T1_GE3
SQJ431EP	SQJ431EP-T1-GE3	SQJ431EP-T1_GE3
SQJ443EP	SQJ443EP-T1-GE3	SQJ443EP-T1_GE3
SQJ444EP	-	SQJ444EP-T1_GE3
SQJ446EP	-	SQJ446EP-T1_GE3
SQJ456EP	SQJ456EP-T1-GE3	SQJ456EP-T1_GE3
SQJ457EP	-	SQJ457EP-T1_GE3
SQJ459EP	-	SQJ459EP-T1_GE3
SQJ460AEP	-	SQJ460AEP-T1_GE3
SQJ461EP	SQJ461EP-T1-GE3	SQJ461EP-T1_GE3
SQJ463EP	SQJ463EP-T1-GE3	SQJ463EP-T1_GE3
SQJ465EP	SQJ465EP-T1-GE3	SQJ465EP-T1_GE3
SQJ469EP	SQJ469EP-T1-GE3	SQJ469EP-T1_GE3
SQJ474EP	-	SQJ474EP-T1_GE3
SQJ476EP	-	SQJ476EP-T1_GE3
SQJ479EP	-	SQJ479EP-T1_GE3
SQJ486EP	SQJ486EP-T1-GE3	SQJ486EP-T1_GE3
SQJ488EP	SQJ488EP-T1-GE3	SQJ488EP-T1_GE3
SQJ500AEP	SQJ500AEP-T1-GE3	SQJ500AEP-T1_GE3
SQJ840EP	SQJ840EP-T1-GE3	SQJ840EP-T1_GE3
SQJ844AEP	SQJ844AEP-T1-GE3	SQJ844AEP-T1_GE3
SQJ850EP	SQJ850EP-T1-GE3	SQJ850EP-T1_GE3
SQJ858AEP	SQJ858AEP-T1-GE3	SQJ858AEP-T1_GE3
SQJ868EP	-	SQJ868EP-T1_GE3
SQJ886EP	SQJ886EP-T1-GE3	SQJ886EP-T1_GE3
SQJ910AEP	SQJ910AEP-T1-GE3	SQJ910AEP-T1_GE3
SQJ912AEP	SQJ912AEP-T1-GE3	SQJ912AEP-T1_GE3
SQJ940EP	SQJ940EP-T1-GE3	SQJ940EP-T1_GE3
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SQJ963EP	SQJ963EP-T1-GE3	SQJ963EP-T1_GE3
SQJ968EP	SQJ968EP-T1-GE3	SQJ968EP-T1_GE3
SQJ980AEP	SQJ980AEP-T1-GE3	SQJ980AEP-T1_GE3
SQJ992EP	SQJ992EP-T1-GE3	SQJ992EP-T1_GE3

Note

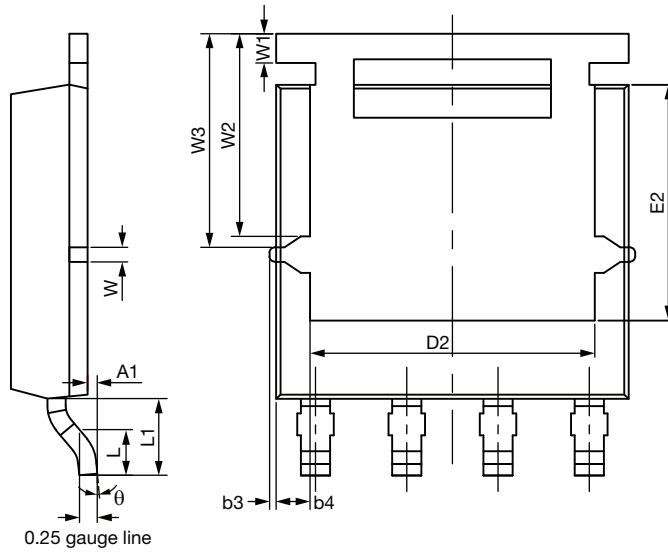
a. Old ordering code is obsolete and no longer valid for new orders



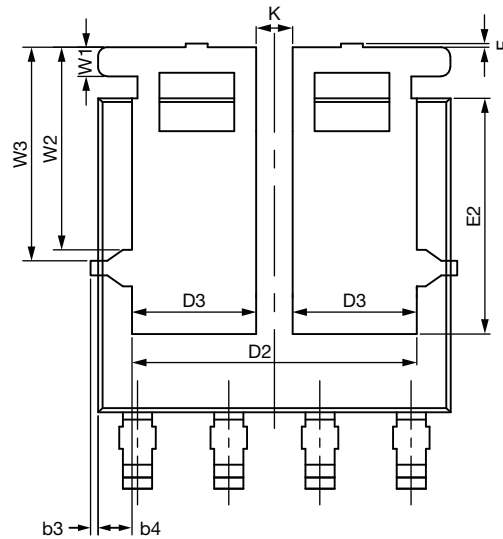
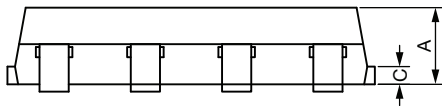
PowerPAK® SO-8L Case Outline for Non-AI Parts



Topside view



Backside view (single)



Backside view (dual)



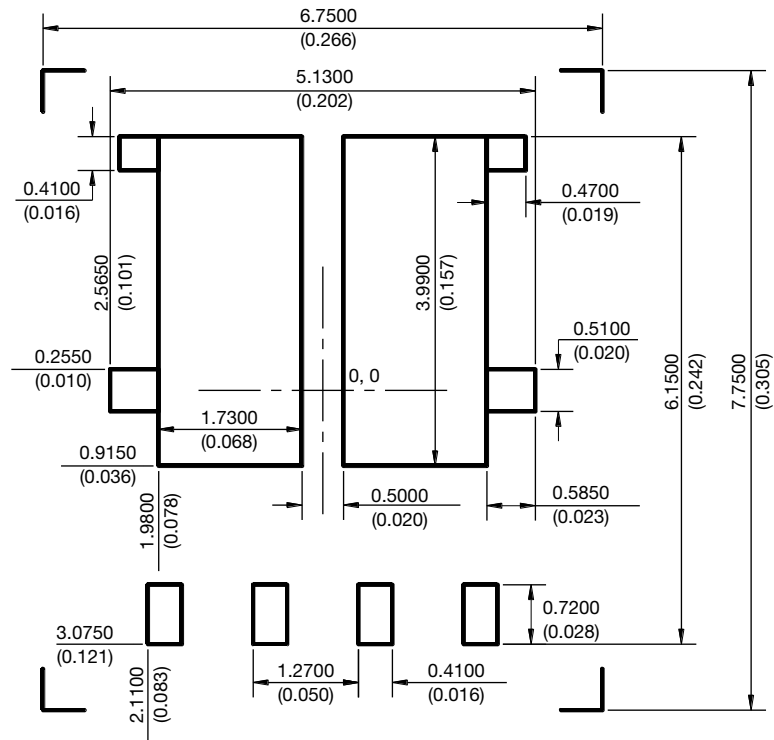
DIM.	MILLIMETERS			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	1.00	1.07	1.14	0.039	0.042	0.045
A1	0.00	-	0.127	0.00	-	0.005
b	0.33	0.41	0.48	0.013	0.016	0.019
b1	0.44	0.51	0.58	0.017	0.020	0.023
b2	4.80	4.90	5.00	0.189	0.193	0.197
b3	0.094			0.004		
b4	0.47			0.019		
c	0.20	0.25	0.30	0.008	0.010	0.012
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: T16-0221-Rev. D, 16-May-16 DWG: 5976						

Note

- Millimeters will govern



RECOMMENDED MINIMUM PAD FOR PowerPAK® SO-8L DUAL



Recommended Minimum Pads
Dimensions in mm (inches)
Keep-out 6.75 (0.266) x 7.75 (0.305)



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