

Automotive N- and P-Channel 40 V (D-S) 175 °C MOSFET

PRODUCT SUMMARY

	N-CHANNEL	P-CHANNEL
V_{DS} (V)	40	-40
$R_{DS(on)}$ (Ω) at $V_{GS} = \pm 10$ V	0.0092	0.0270
$R_{DS(on)}$ (Ω) at $V_{GS} = \pm 4.5$ V	0.0112	0.0435
I_D (A)	30	-30
Configuration	N- and P-Pair	

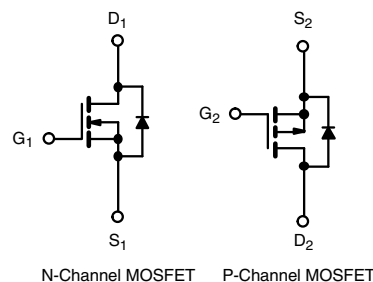
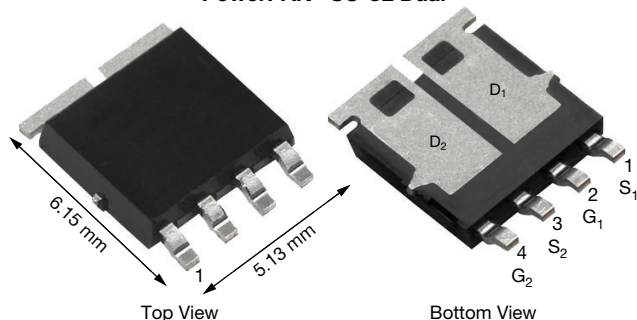
FEATURES

- TrenchFET® Power MOSFET
- AEC-Q101 Qualified^d
- 100 % R_g and UIS Tested
- Material categorization:
For definitions of compliance please see www.vishay.com/doc?99912

AUTOMOTIVE
GRADE

RoHS
COMPLIANT
HALOGEN
FREE

PowerPAK® SO-8L Dual



ORDERING INFORMATION

Package	PowerPAK SO-8L
Lead (Pb)-free and Halogen-free	SQJ500AEP-T1-GE3

ABSOLUTE MAXIMUM RATINGS ($T_C = 25$ °C, unless otherwise noted)

PARAMETER		SYMBOL	N-CHANNEL	P-CHANNEL	UNIT
Drain-Source Voltage		V _{DS}	40	-40	V
Gate-Source Voltage		V _{GS}	± 20		
Continuous Drain Current ^a	T _C = 25 °C	I _D	30	-30	A
	T _C = 125 °C		30	-18	
Continuous Source Current (Diode Conduction) ^a		I _S	30	-30	
Pulsed Drain Current ^b		I _{DM}	120	-120	
Single Pulse Avalanche Current	L = 0.1 mH	I _{AS}	26.5	-25	
Single Pulse Avalanche Energy		E _{AS}	35	31	mJ
Maximum Power Dissipation ^b	T _C = 25 °C	P _D	48	48	W
	T _C = 125 °C		16	16	
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	N-CHANNEL	P-CHANNEL	UNIT
Junction-to-Ambient	R_{thJA}	85	85	°C/W
Junction-to-Case (Drain)	R_{thJC}	3.1	3.1	

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 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.



SPECIFICATIONS (T _C = 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		N-Ch	40	-	-	V
		V _{GS} = 0 V, I _D = - 250 μA		P-Ch	-40	-	-	
Gate-Source Threshold Voltage	V _{GS(th)}	V _{DS} = V _{GS} , I _D = 250 μA		N-Ch	1.3	1.8	2.3	
		V _{DS} = V _{GS} , I _D = - 250 μA		P-Ch	-1.5	-2	-2.5	
Gate-Source Leakage	I _{GSS}	V _{DS} = 0 V, V _{GS} = ± 20 V		N-Ch	-	-	± 100	nA
				P-Ch	-	-	± 100	
Zero Gate Voltage Drain Current	I _{DSS}	V _{GS} = 0 V	V _{DS} = 40 V	N-Ch	-	-	1	μA
		V _{GS} = 0 V	V _{DS} = -40 V	P-Ch	-	-	-1	
		V _{GS} = 0 V	V _{DS} = 40 V, T _J = 125 °C	N-Ch	-	-	50	
		V _{GS} = 0 V	V _{DS} = -40 V, T _J = 125 °C	P-Ch	-	-	-50	
		V _{GS} = 0 V	V _{DS} = 40 V, T _J = 175 °C	N-Ch	-	-	150	
		V _{GS} = 0 V	V _{DS} = -40 V, T _J = 175 °C	P-Ch	-	-	-150	
On-State Drain Current ^a	I _{D(on)}	V _{GS} = 10 V	V _{DS} ≥ 5 V	N-Ch	25	-	-	A
		V _{GS} = -10 V	V _{DS} ≤ 5 V	P-Ch	-25	-	-	
Drain-Source On-State Resistance ^a	R _{DS(on)}	V _{GS} = 10 V	I _D = 9.8 A	N-Ch	-	0.0077	0.0092	Ω
		V _{GS} = -10 V	I _D = -6 A	P-Ch	-	0.0220	0.0270	
		V _{GS} = 10 V	I _D = 9.8 A, T _J = 125 °C	N-Ch	-	-	0.0138	
		V _{GS} = -10 V	I _D = -6 A, T _J = 125 °C	P-Ch	-	-	0.0380	
		V _{GS} = 10 V	I _D = 9.8 A, T _J = 175 °C	N-Ch	-	-	0.0170	
		V _{GS} = -10 V	I _D = -6 A, T _J = 175 °C	P-Ch	-	-	0.0460	
		V _{GS} = 4.5 V	I _D = 8.9 A	N-Ch	-	0.0094	0.0112	
		V _{GS} = -4.5 V	I _D = -4.7 A	P-Ch	-	0.0360	0.0435	
Forward Transconductance ^b	g _{fs}	V _{DS} = 15 V, I _D = 9.8 A		N-Ch	-	65	-	S
		V _{DS} = -15 V, I _D = -6 A		P-Ch	-	16	-	
Dynamic ^b								
Input Capacitance	C _{iss}	V _{GS} = 0 V	V _{DS} = 20 V, f = 1 MHz	N-Ch	-	1474	1843	pF
		V _{GS} = 0 V	V _{DS} = -20 V, f = 1 MHz	P-Ch	-	1302	1628	
Output Capacitance	C _{oss}	V _{GS} = 0 V	V _{DS} = 20 V, f = 1 MHz	N-Ch	-	218	273	
		V _{GS} = 0 V	V _{DS} = -20 V, f = 1 MHz	P-Ch	-	222	278	
Reverse Transfer Capacitance	C _{rss}	V _{GS} = 0 V	V _{DS} = 20 V, f = 1 MHz	N-Ch	-	89	111	
		V _{GS} = 0 V	V _{DS} = -20 V, f = 1 MHz	P-Ch	-	154	193	
Total Gate Charge ^c	Q _g	V _{GS} = 10 V	V _{DS} = 20 V, I _D = 10 A	N-Ch	-	25.5	38.3	nC
		V _{GS} = -10 V	V _{DS} = -20 V, I _D = -10 A	P-Ch	-	30.2	45	
Gate-Source Charge ^c	Q _{gs}	V _{GS} = 10 V	V _{DS} = 20 V, I _D = 10 A	N-Ch	-	4.4	-	
		V _{GS} = -10 V	V _{DS} = -20 V, I _D = -10 A	P-Ch	-	4.1	-	
Gate-Drain Charge ^c	Q _{gd}	V _{GS} = 10 V	V _{DS} = 20 V, I _D = 10 A	N-Ch	-	4.3	-	
		V _{GS} = -10 V	V _{DS} = -20 V, I _D = -10 A	P-Ch	-	7.4	-	
Gate Resistance	R _g	f = 1 MHz		N-Ch	0.65	1.37	2.1	Ω
				P-Ch	3.1	6.15	9.5	

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

PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Turn-On Delay Time ^c	t _{d(on)}	V _{DD} = 20 V, R _L = 2 Ω I _D ≅ 10 A, V _{GEN} = 10 V, R _g = 1 Ω	N-Ch	-	8	12	ns
		V _{DD} = -20 V, R _L = 2 Ω I _D ≅ -10 A, V _{GEN} = -10 V, R _g = 1 Ω	P-Ch	-	7	11	
Rise Time ^c	t _r	V _{DD} = 20 V, R _L = 2 Ω I _D ≅ 10 A, V _{GEN} = 10 V, R _g = 1 Ω	N-Ch	-	12	18	
		V _{DD} = -20 V, R _L = 2 Ω I _D ≅ -10 A, V _{GEN} = -10 V, R _g = 1 Ω	P-Ch	-	9	13	
Turn-Off Delay Time ^c	t _{d(off)}	V _{DD} = 20 V, R _L = 2 Ω I _D ≅ 10 A, V _{GEN} = 10 V, R _g = 1 Ω	N-Ch	-	22	33	
		V _{DD} = -20 V, R _L = 2 Ω I _D ≅ -10 A, V _{GEN} = -10 V, R _g = 1 Ω	P-Ch	-	43	64	
Fall Time ^c	t _f	V _{DD} = 20 V, R _L = 2 Ω I _D ≅ 10 A, V _{GEN} = 10 V, R _g = 1 Ω	N-Ch	-	10	16	
		V _{DD} = -20 V, R _L = 2 Ω I _D ≅ -10 A, V _{GEN} = -10 V, R _g = 1 Ω	P-Ch	-	19	28	
Source-Drain Diode Ratings and Characteristics ^b							
Pulsed Current ^a	I _{SM}		N-Ch	-	-	120	A
			P-Ch	-	-	-120	
Forward Voltage	V _{SD}	I _S = 6.5 A	N-Ch	-	0.79	1.2	V
		I _S = -3.4 A	P-Ch	-	-0.78	-1.2	

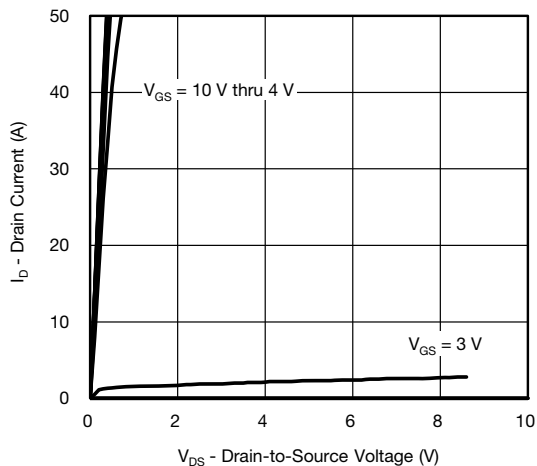
Notes

- 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.

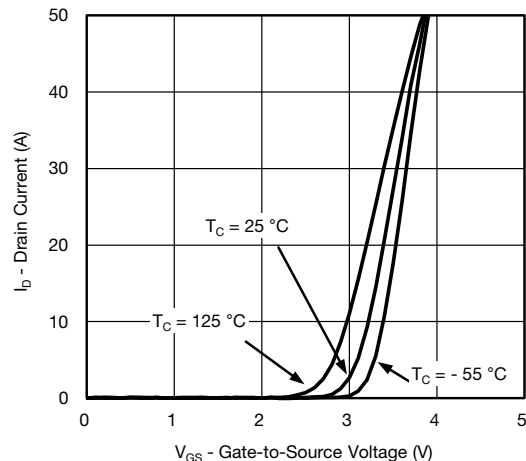
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



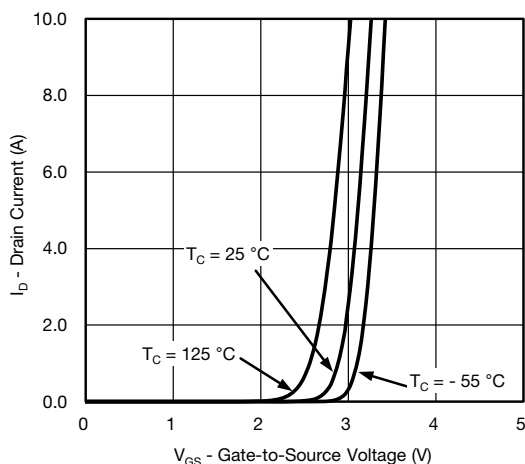
N-CHANNEL TYPICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$, unless otherwise noted)



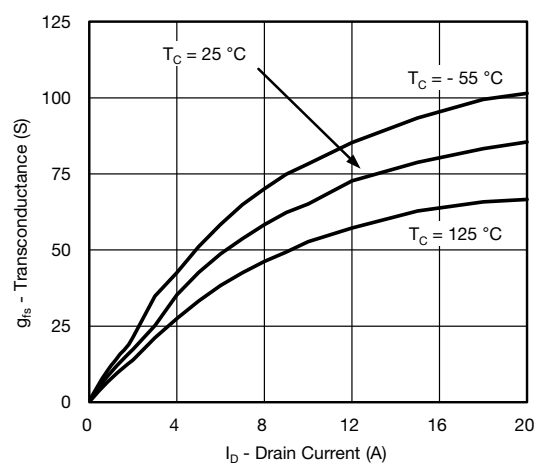
Output Characteristics



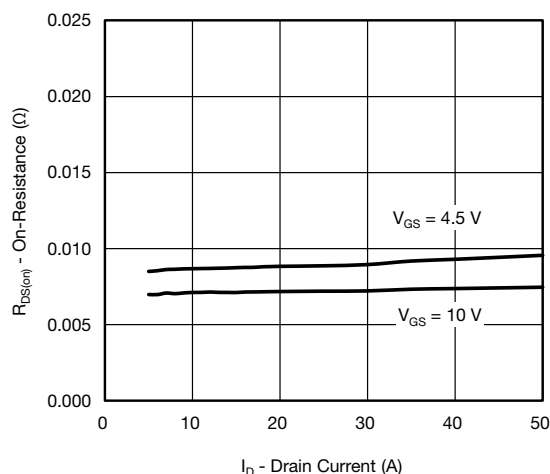
Transfer Characteristics



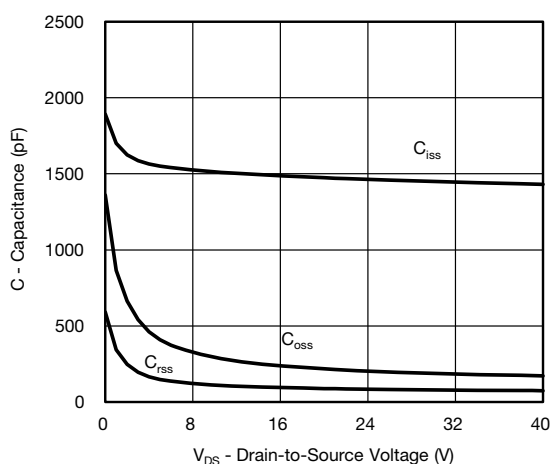
Transfer Characteristics



Transconductance



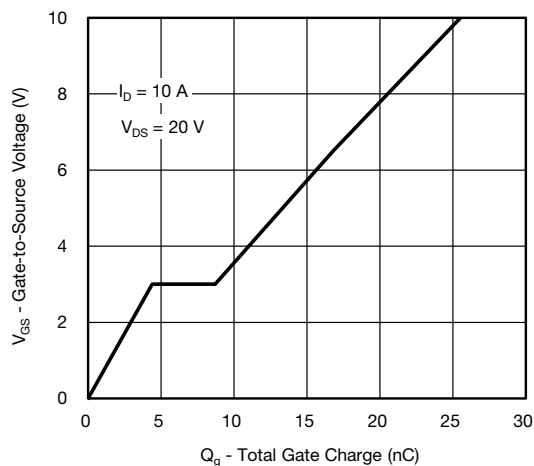
On-Resistance vs. Drain Current



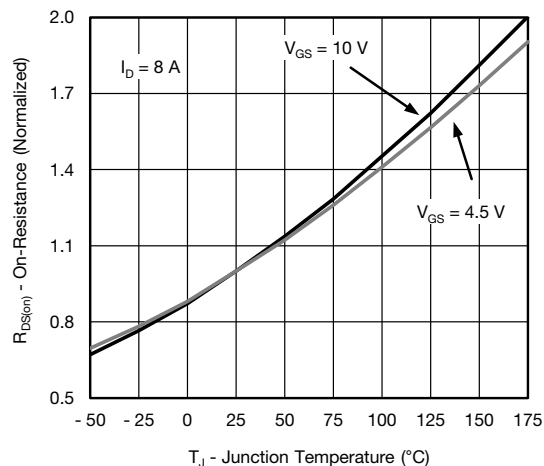
Capacitance



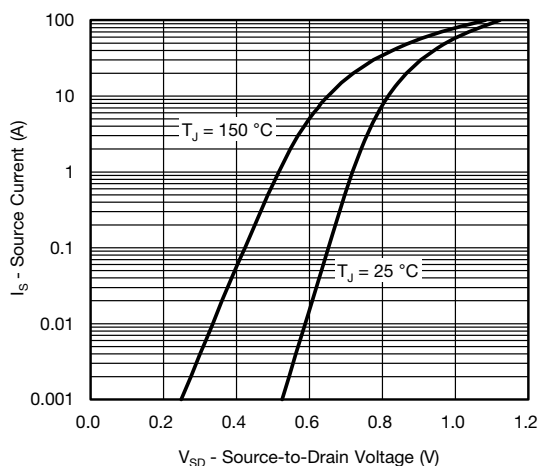
N-CHANNEL TYPICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$, unless otherwise noted)



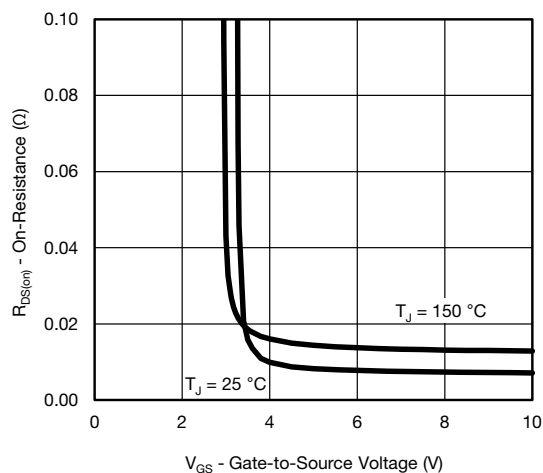
Gate Charge



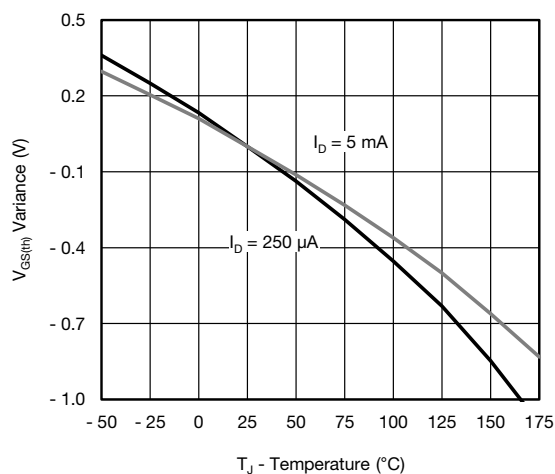
On-Resistance vs. Junction Temperature



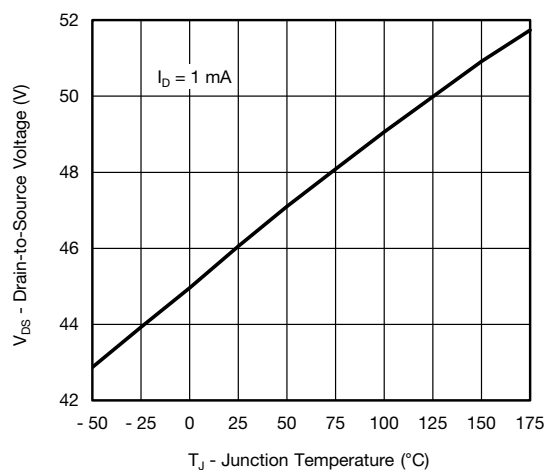
Source Drain Diode Forward Voltage



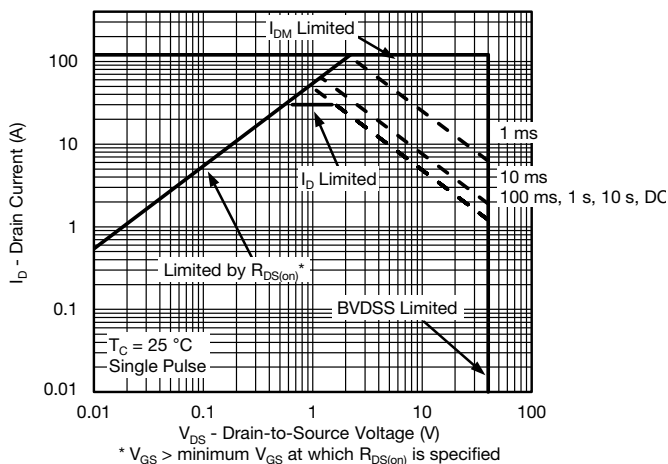
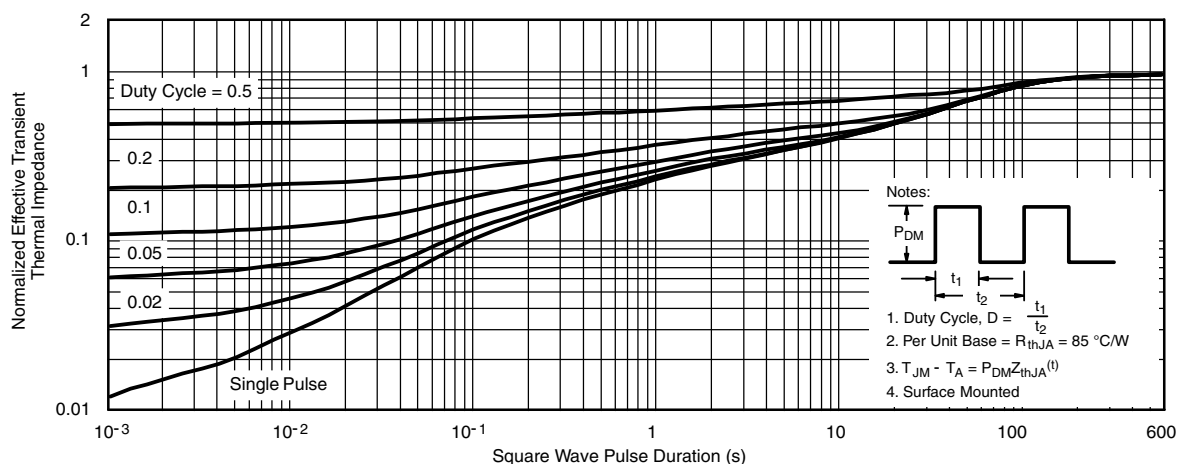
On-Resistance vs. Gate-to-Source Voltage

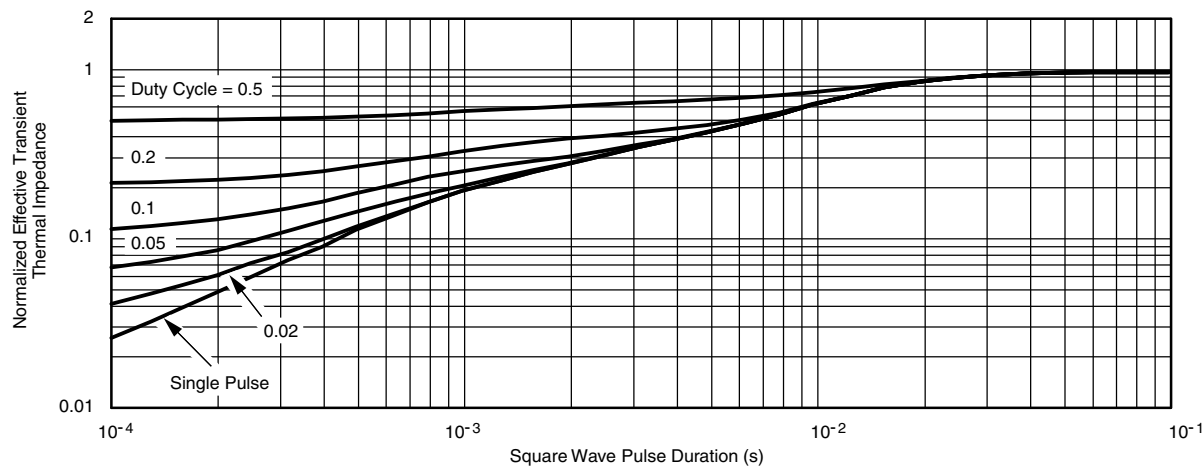


Threshold Voltage



Drain Source Breakdown vs. Junction Temperature

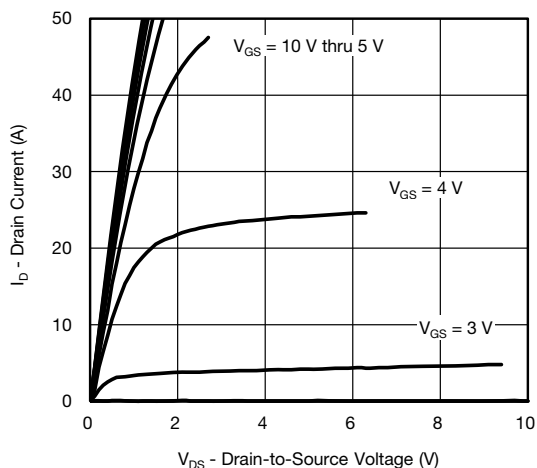
N-CHANNEL TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)

Safe Operating Area

Normalized Thermal Transient Impedance, Junction-to-Ambient

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

Normalized Thermal Transient Impedance, Junction-to-Case
Note

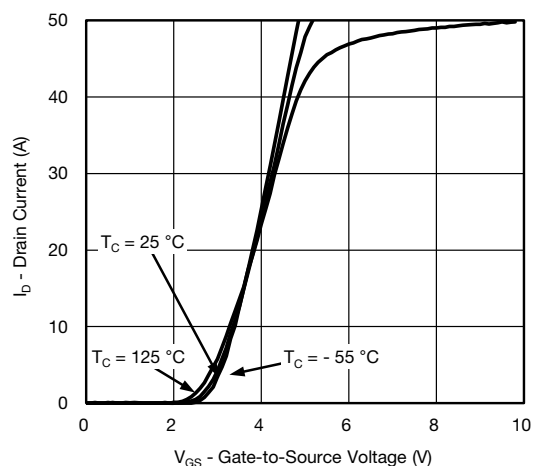
- The characteristics shown in the two graphs
 - Normalized Transient Thermal Impedance Junction-to-Ambient ($25\text{ }^{\circ}\text{C}$)
 - Normalized Transient Thermal Impedance Junction-to-Case ($25\text{ }^{\circ}\text{C}$)
 are given for general guidelines only to enable the user to get a "ball 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.



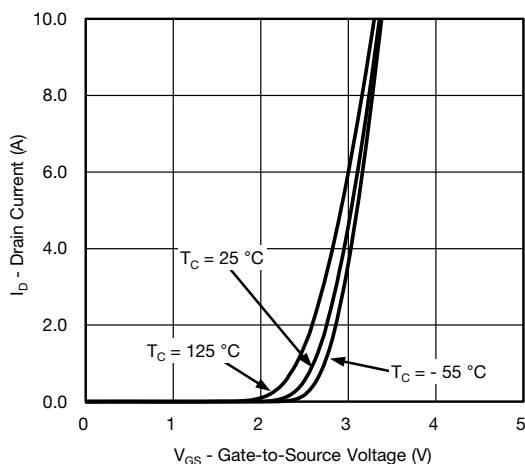
P-CHANNEL TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)



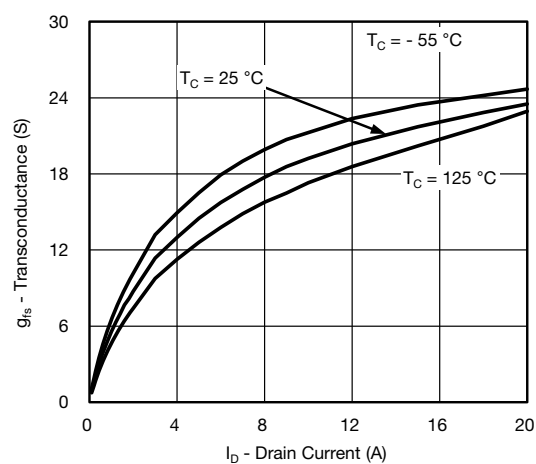
Output Characteristics



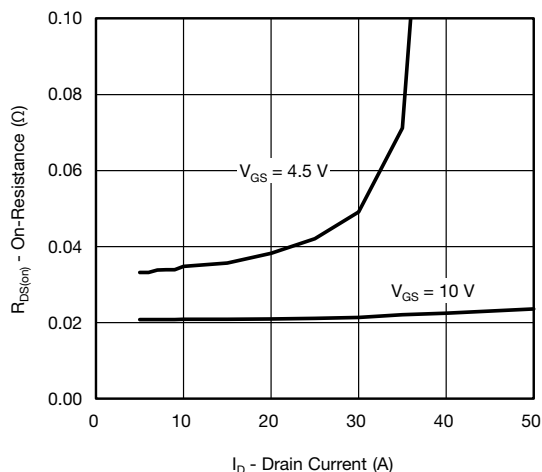
Transfer Characteristics



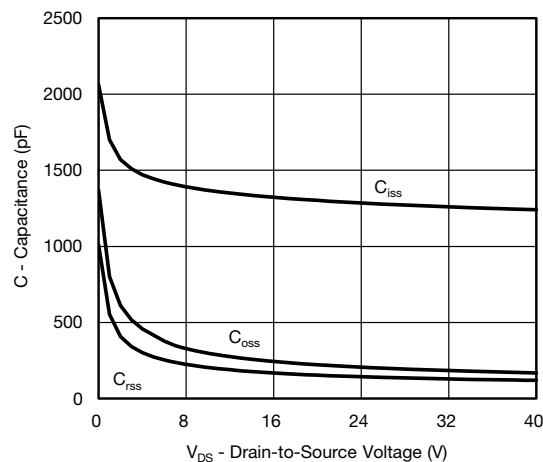
Transfer Characteristics



Transconductance



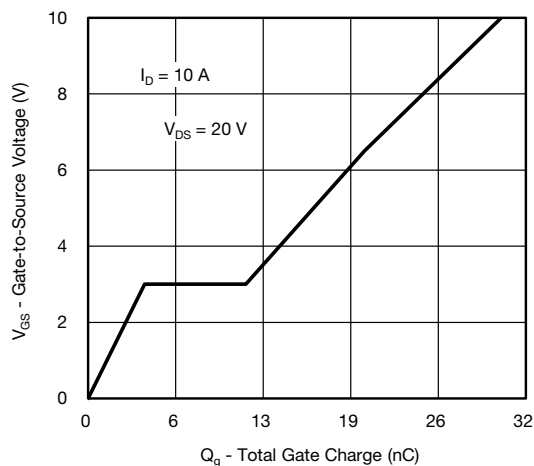
On-Resistance vs. Drain Current



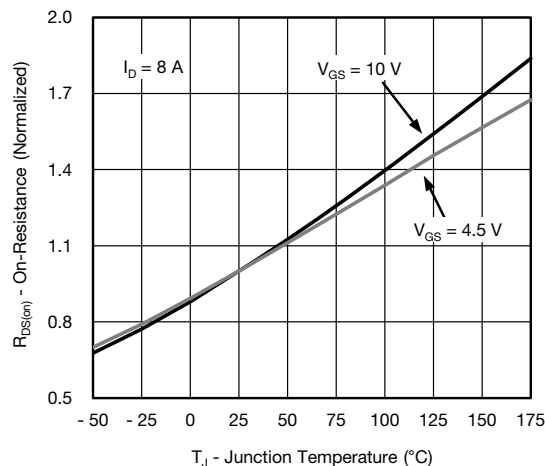
Capacitance



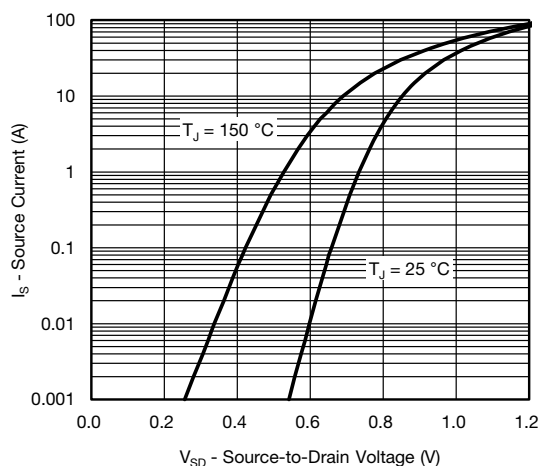
P-CHANNEL TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)



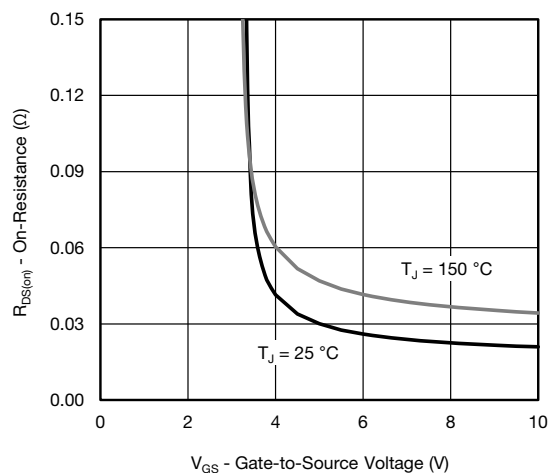
Gate Charge



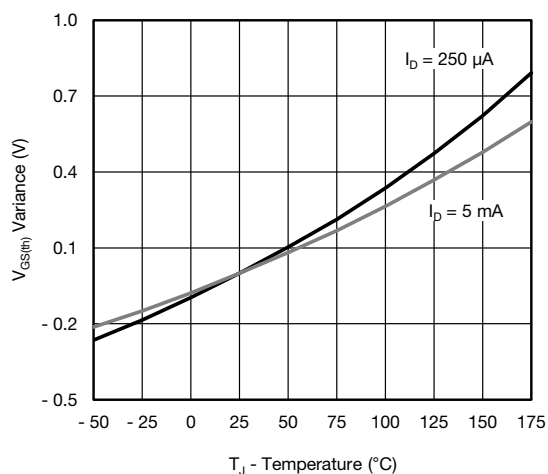
On-Resistance vs. Junction Temperature



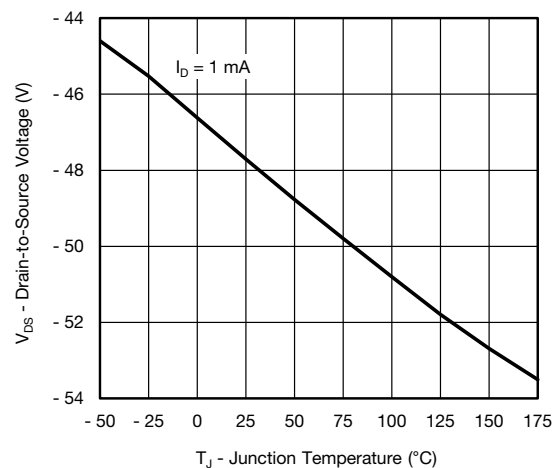
Source Drain Diode Forward Voltage



On-Resistance vs. Gate-to-Source Voltage



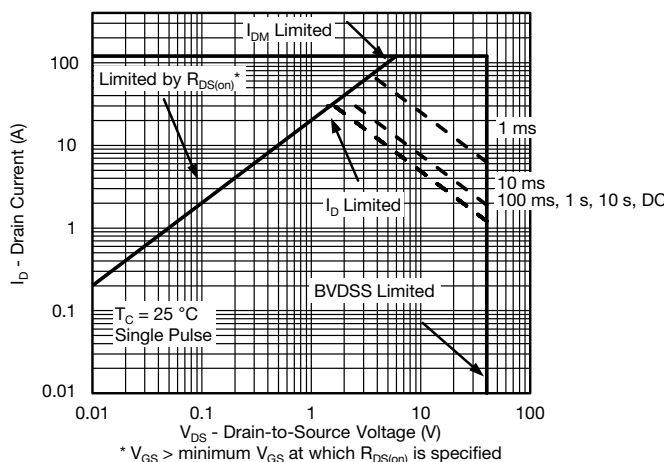
Threshold Voltage



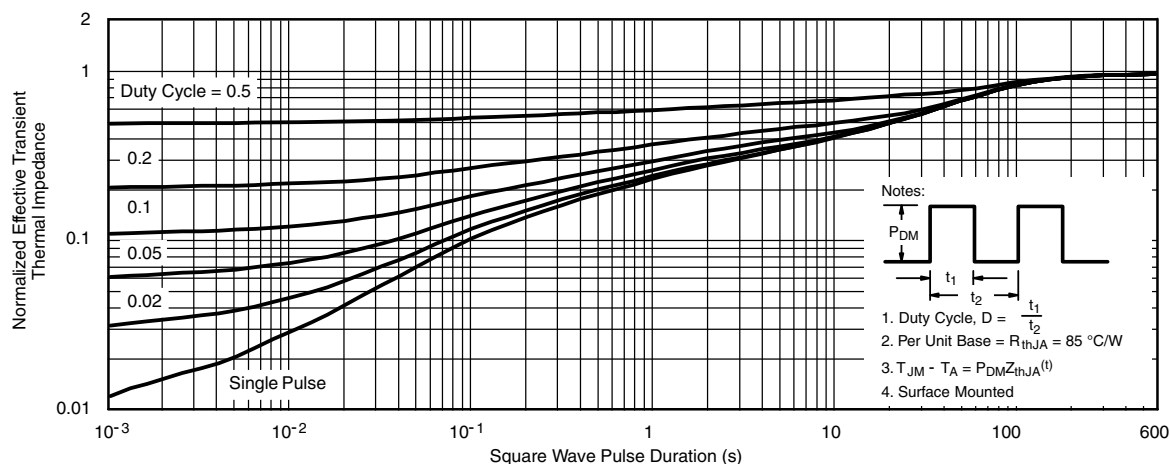
Drain Source Breakdown vs. Junction Temperature



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



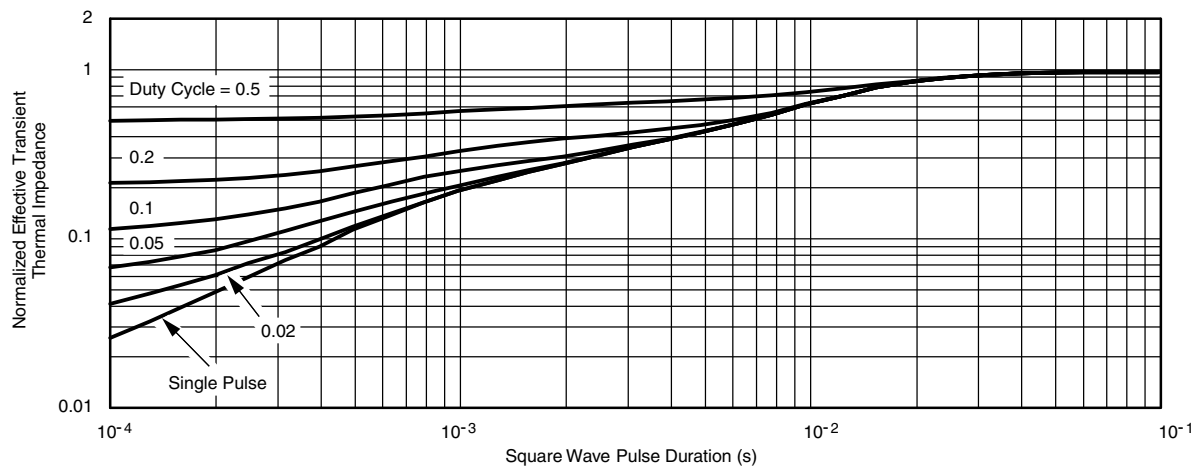
Safe Operating Area



Normalized Thermal Transient Impedance, Junction-to-Ambient



P-CHANNEL TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^{\circ}\text{C}$, 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.

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?62878.

**PowerPAK® SO-8L**

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

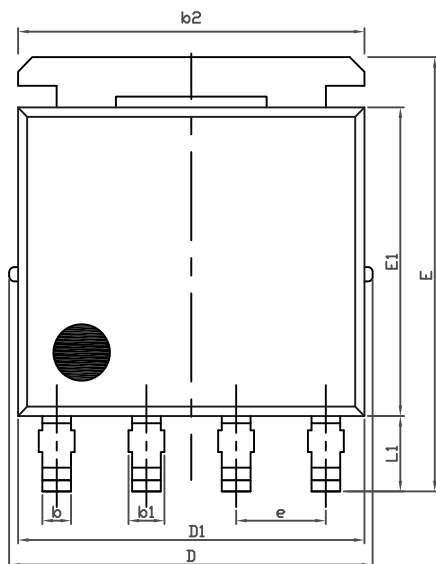
DATASHEET PART NUMBER	OLD ORDERING CODE ^a	NEW ORDERING CODE
SQJ200EP	-	SQJ200EP-T1_GE3
SQJ202EP	-	SQJ202EP-T1_GE3
SQJ401EP	SQJ401EP-T1-GE3	SQJ401EP-T1_GE3
SQJ402EP	SQJ402EP-T1-GE3	SQJ402EP-T1_GE3
SQJ403EEP	SQJ403EEP-T1-GE3	SQJ403EEP-T1_GE3
SQJ403EP	-	SQJ403EP-T1_GE3
SQJ410EP	SQJ410EP-T1-GE3	SQJ410EP-T1_GE3
SQJ412EP	SQJ412EP-T1-GE3	SQJ412EP-T1_GE3
SQJ416EP	-	SQJ416EP-T1_GE3
SQJ418EP	-	SQJ418EP-T1_GE3
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SQJ459EP	-	SQJ459EP-T1_GE3
SQJ460AEP	-	SQJ460AEP-T1_GE3
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SQJ465EP	SQJ465EP-T1-GE3	SQJ465EP-T1_GE3
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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
SQJ942EP	SQJ942EP-T1-GE3	SQJ942EP-T1_GE3
SQJ951EP	SQJ951EP-T1-GE3	SQJ951EP-T1_GE3
SQJ952EP	-	SQJ952EP-T1_GE3
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SQJ960EP	SQJ960EP-T1-GE3	SQJ960EP-T1_GE3
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SQJ968EP	SQJ968EP-T1-GE3	SQJ968EP-T1_GE3
SQJ980AEP	SQJ980AEP-T1-GE3	SQJ980AEP-T1_GE3
SQJ992EP	SQJ992EP-T1-GE3	SQJ992EP-T1_GE3

Note

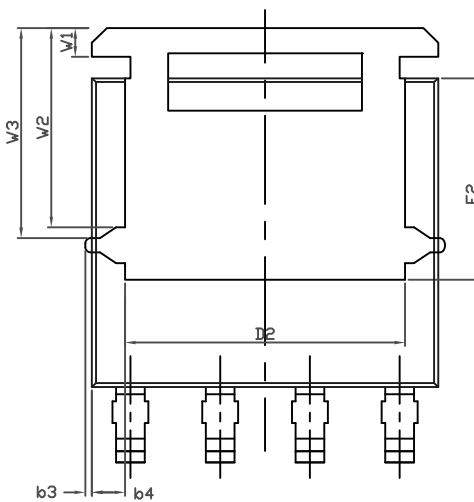
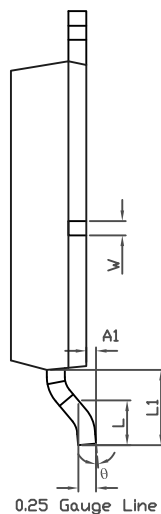
a. Old ordering code is obsolete and no longer valid for new orders



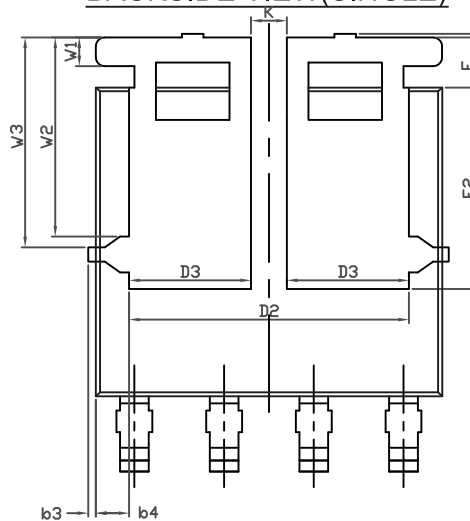
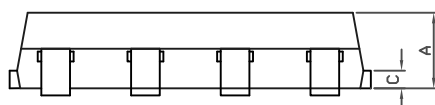
PowerPAK® SO-8L Case Outline for Al Parts



TOPSIDE VIEW



BACKSIDE VIEW(SINGLE)



BACKSIDE VIEW(DUAL)



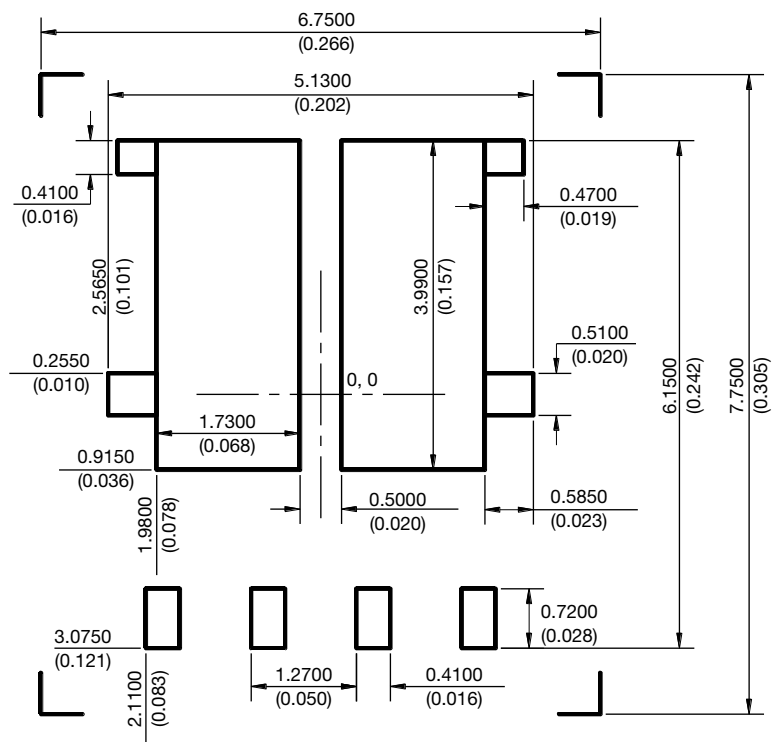
DIM.	MILLIMETERS			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	1.00	1.07	1.14	0.039	0.042	0.045
A1	0.00	-	0.127	0.00	-	0.005
b	0.33	0.41	0.48	0.013	0.016	0.019
b1	0.44	0.51	0.58	0.017	0.020	0.023
b2	4.80	4.90	5.00	0.189	0.193	0.197
b3	0.094			0.004		
b4	0.47			0.019		
c	0.20	0.25	0.30	0.008	0.010	0.012
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	2.75	2.85	2.95	0.108	0.112	0.116
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		
q	0°	-	10°	0°	-	10°
ECN: C15-1203-Rev. A, 07-Sep-15 DWG: 6044						

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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