

Automotive Dual N-Channel 12 V (D-S) 175 °C MOSFETs

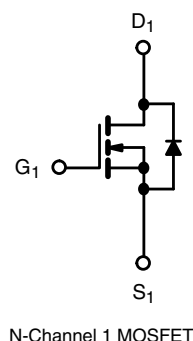
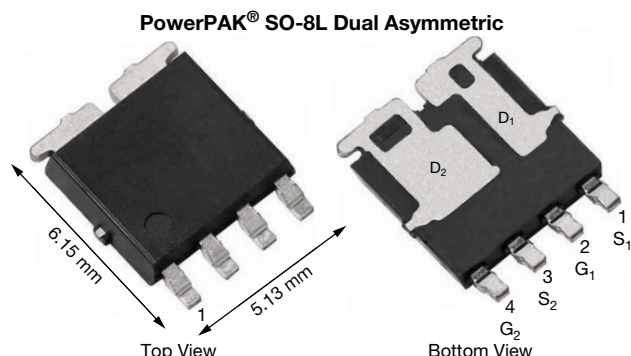
PRODUCT SUMMARY		
	N-CHANNEL 1	N-CHANNEL 2
V_{DS} (V)	12	12
$R_{DS(on)}$ (Ω) at $V_{GS} = 10$ V	0.0065	0.0033
$R_{DS(on)}$ (Ω) at $V_{GS} = 4.5$ V	0.0093	0.0045
I_D (A)	20	60
Configuration	Dual N	
Package	PowerPAK® SO-8L Dual Asymmetric	

FEATURES

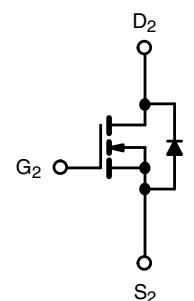
- TrenchFET® power MOSFET
- AEC-Q101 qualified ^d
- 100 % R_g and UIS tested
- Material categorization:
for definitions of compliance please see
www.vishay.com/doc?99912



RoHS
COMPLIANT
HALOGEN
FREE



N-Channel 1 MOSFET



N-Channel 2 MOSFET

ABSOLUTE MAXIMUM RATINGS (T _C = 25 °C, unless otherwise noted)						
PARAMETER			SYMBOL	N-CHANNEL 1	N-CHANNEL 2	UNIT
Drain-Source Voltage			V _{DS}	12	12	V
Gate-Source Voltage			V _{GS}	± 20		
Continuous Drain Current ^a	T _C = 25 °C		I _D	20	60	A
	T _C = 125 °C			20	60	
Continuous Source Current (Diode Conduction)			I _S	20 ^a	44	
Pulsed Drain Current ^b			I _{DM}	80	180	
Single Pulse Avalanche Current		L = 0.1 mH	I _{AS}	18	18	mJ
Single Pulse Avalanche Energy			E _{AS}	16.2	16.2	
Maximum Power Dissipation ^b	T _C = 25 °C		P _D	27	48	W
	T _C = 125 °C			9	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 1	N-CHANNEL 2	UNIT
Junction-to-Ambient	PCB Mount ^c	R_{thJA}	85	85	°C/W
Junction-to-Case (Drain)		R_{thJC}	5.5	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 1	12	-	-	V	
		V _{GS} = 0 V, I _D = 250 μA		N-Ch 2	12	-	-		
Gate-Source Threshold Voltage	V _{GS(th)}	V _{DS} = V _{GS} , I _D = 250 μA		N-Ch 1	1	1.5	2		
		V _{DS} = V _{GS} , I _D = 250 μA		N-Ch 2	1	1.5	2		
Gate-Source Leakage	I _{GSS}	V _{DS} = 0 V, V _{GS} = ± 20 V		N-Ch 1	-	-	± 100	nA	
				N-Ch 2	-	-	± 100		
Zero Gate Voltage Drain Current	I _{DSS}	V _{GS} = 0 V	V _{DS} = 12 V	N-Ch 1	-	-	1	μA	
		V _{GS} = 0 V	V _{DS} = 12 V	N-Ch 2	-	-	1		
		V _{GS} = 0 V	V _{DS} = 12 V, T _J = 125 °C	N-Ch 1	-	-	50		
		V _{GS} = 0 V	V _{DS} = 12 V, T _J = 125 °C	N-Ch 2	-	-	50		
		V _{GS} = 0 V	V _{DS} = 12 V, T _J = 175 °C	N-Ch 1	-	-	500		
		V _{GS} = 0 V	V _{DS} = 12 V, T _J = 175 °C	N-Ch 2	-	-	500		
On-State Drain Current ^a	I _{D(on)}	V _{GS} = 10 V	V _{DS} ≥ 5 V	N-Ch 1	20	-	-	A	
		V _{GS} = 10 V	V _{DS} ≥ 5 V	N-Ch 2	30	-	-		
Drain-Source On-State Resistance ^a	R _{DS(on)}	V _{GS} = 10 V	I _D = 15 A	N-Ch 1	-	0.0052	0.0065	Ω	
		V _{GS} = 10 V	I _D = 20 A	N-Ch 2	-	0.0025	0.0033		
		V _{GS} = 10 V	I _D = 15 A, T _J = 125 °C	N-Ch 1	-	0.0075	-		
		V _{GS} = 10 V	I _D = 20 A, T _J = 125 °C	N-Ch 2	-	0.0031	-		
		V _{GS} = 10 V	I _D = 15 A, T _J = 175 °C	N-Ch 1	-	0.0085	-		
		V _{GS} = 10 V	I _D = 20 A, T _J = 175 °C	N-Ch 2	-	0.0038	-		
		V _{GS} = 4.5 V	I _D = 13 A	N-Ch 1	-	0.0075	0.0093		
		V _{GS} = 4.5 V	I _D = 18 A	N-Ch 2	-	0.0034	0.0045		
Forward Transconductance ^b	g _{fs}	V _{DS} = 10 V, I _D = 15 A		N-Ch 1	-	49	-	S	
		V _{DS} = 10 V, I _D = 20 A		N-Ch 2	-	91	-		
Dynamic ^b									
Input Capacitance	C _{iss}	V _{GS} = 0 V	V _{DS} = 6 V, f = 1 MHz	N-Ch 1	-	777	975	pF	
		V _{GS} = 0 V	V _{DS} = 6 V, f = 1 MHz	N-Ch 2	-	2018	2525		
Output Capacitance	C _{oss}	V _{GS} = 0 V	V _{DS} = 6 V, f = 1 MHz	N-Ch 1	-	539	675		
		V _{GS} = 0 V	V _{DS} = 6 V, f = 1 MHz	N-Ch 2	-	1313	1645		
Reverse Transfer Capacitance	C _{rss}	V _{GS} = 0 V	V _{DS} = 6 V, f = 1 MHz	N-Ch 1	-	270	340		
		V _{GS} = 0 V	V _{DS} = 6 V, f = 1 MHz	N-Ch 2	-	683	855		
Total Gate Charge ^c	Q _g	V _{GS} = 10 V	V _{DS} = 6 V, I _D = 20 A	N-Ch 1	-	14.5	22		
		V _{GS} = 10 V	V _{DS} = 6 V, I _D = 60 A	N-Ch 2	-	35.9	54		
Gate-Source Charge ^c	Q _{gs}	V _{GS} = 10 V	V _{DS} = 6 V, I _D = 20 A	N-Ch 1	-	1.7	-	nC	
		V _{GS} = 10 V	V _{DS} = 6 V, I _D = 60 A	N-Ch 2	-	4.1	-		
Gate-Drain Charge ^c	Q _{gd}	V _{GS} = 10 V	V _{DS} = 6 V, I _D = 20 A	N-Ch 1	-	2.1	-		
		V _{GS} = 10 V	V _{DS} = 6 V, I _D = 60 A	N-Ch 2	-	4.3	-		
Gate Resistance	R _g	f = 1 MHz			N-Ch 1	1.3	2.6	4	Ω
					N-Ch 2	0.5	1.1	1.7	

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.

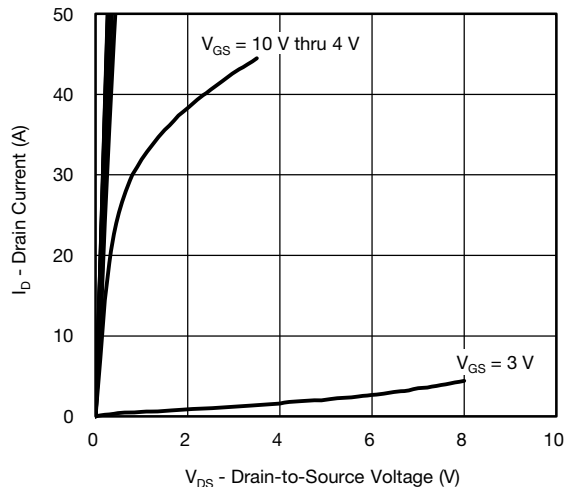
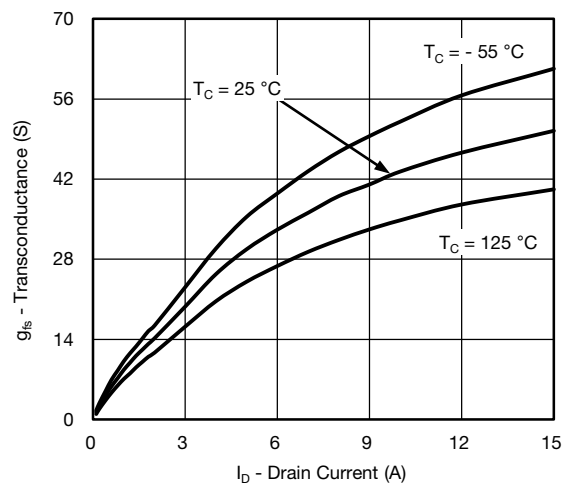
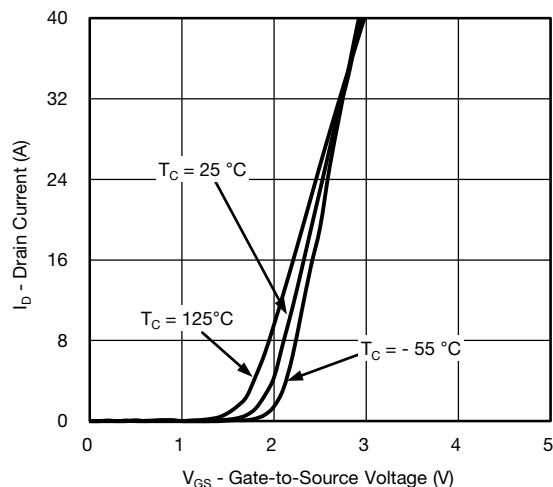
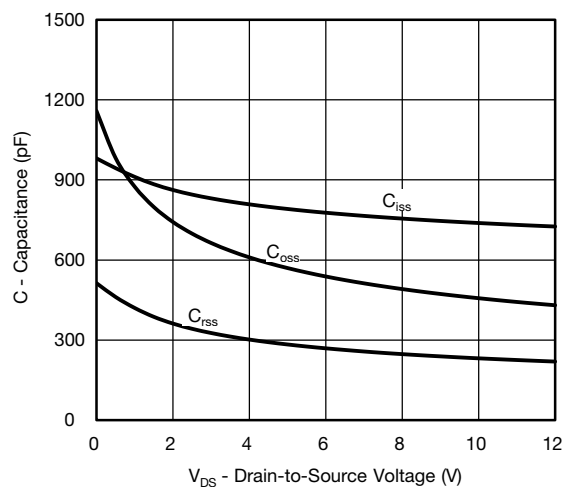
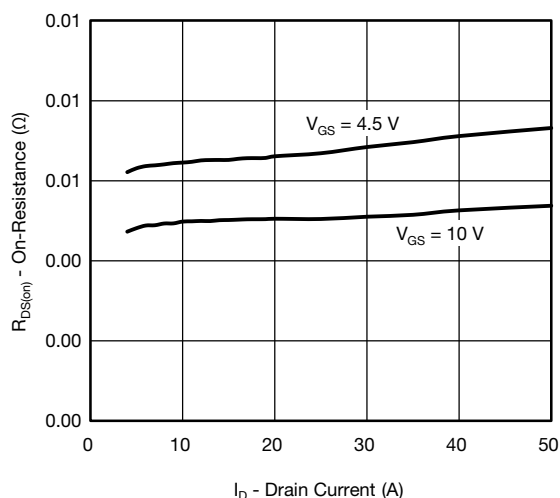
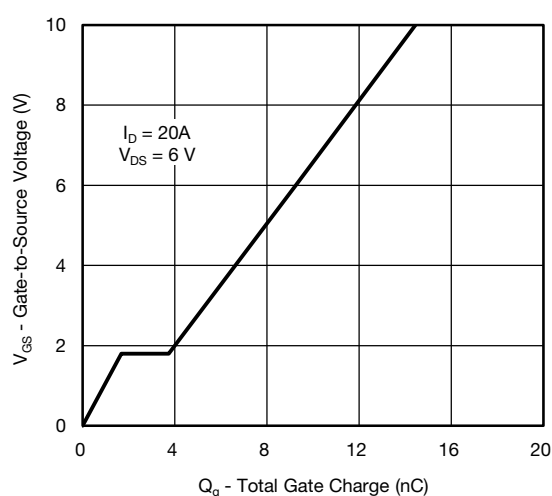


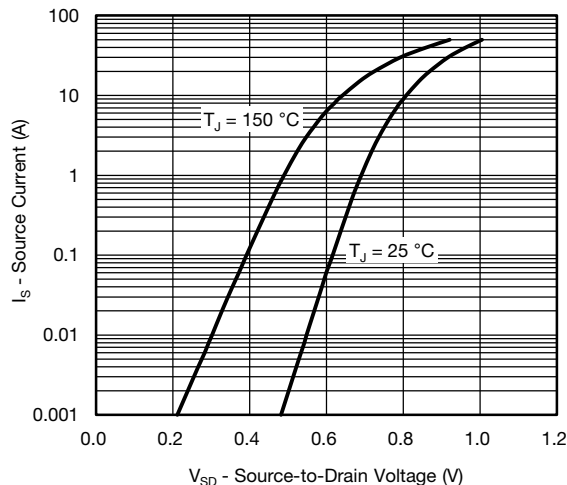
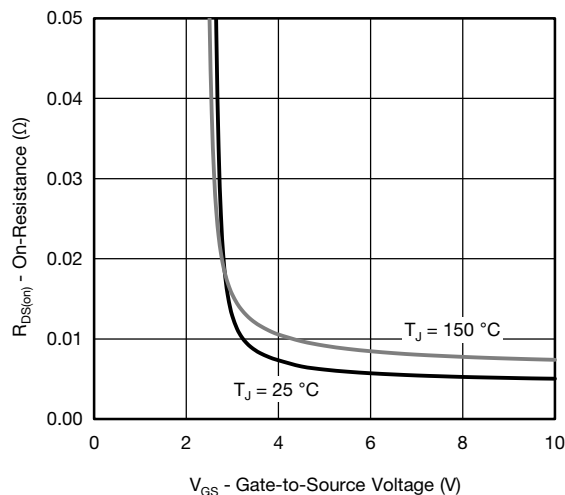
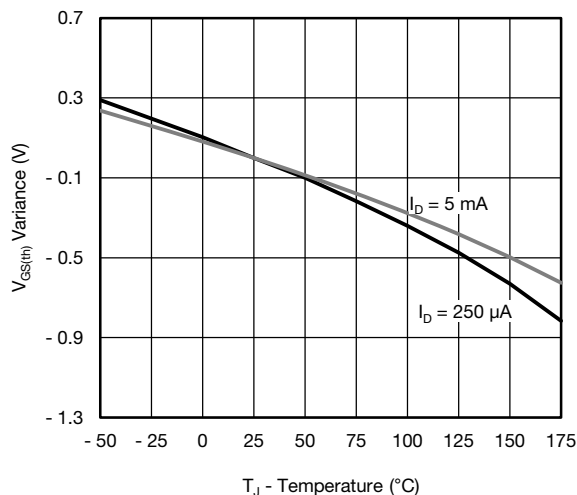
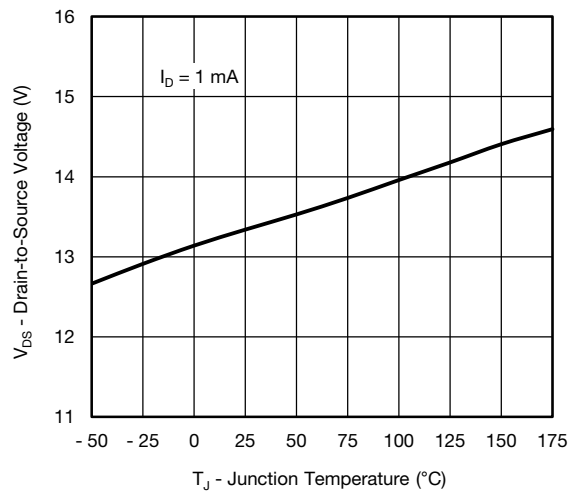
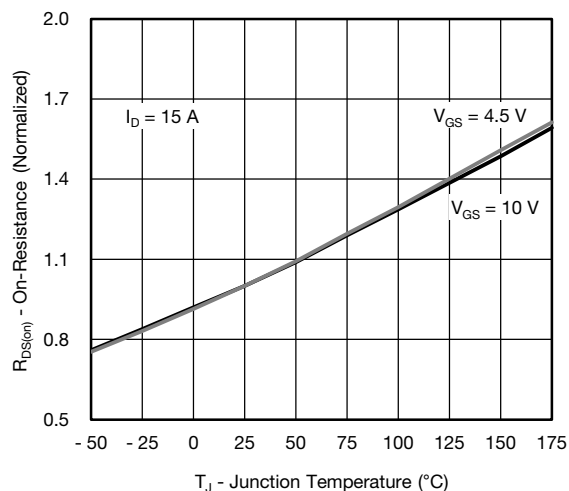
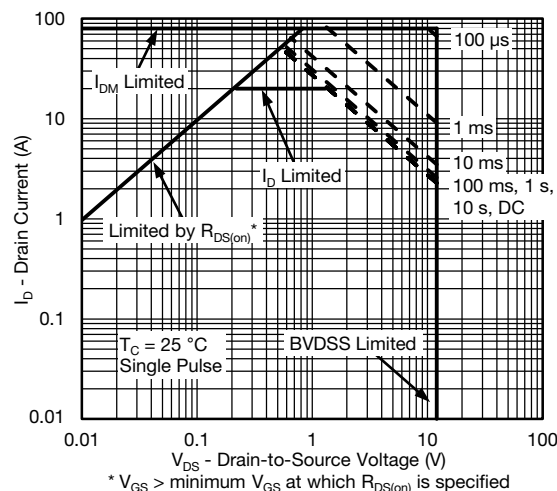
SPECIFICATIONS (T _C = 25 °C, unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Turn-On Delay Time ^c	t _{d(on)}	V _{DD} = 6 V, R _L = 0.3 Ω I _D ≅ 20 A, V _{GEN} = 10 V, R _g = 1 Ω	N-Ch 1	-	8.8	13.5	ns
		V _{DD} = 6 V, R _L = 0.1 Ω I _D ≅ 60 A, V _{GEN} = 10 V, R _g = 1 Ω	N-Ch 2	-	10.7	16.5	
Rise Time ^c	t _r	V _{DD} = 6 V, R _L = 0.3 Ω I _D ≅ 20 A, V _{GEN} = 10 V, R _g = 1 Ω	N-Ch 1	-	3.2	5	
		V _{DD} = 6 V, R _L = 0.1 Ω I _D ≅ 60 A, V _{GEN} = 10 V, R _g = 1 Ω	N-Ch 2	-	4.5	7	
Turn-Off Delay Time ^c	t _{d(off)}	V _{DD} = 6 V, R _L = 0.3 Ω I _D ≅ 20 A, V _{GEN} = 10 V, R _g = 1 Ω	N-Ch 1	-	20	30	
		V _{DD} = 6 V, R _L = 0.1 Ω I _D ≅ 60 A, V _{GEN} = 10 V, R _g = 1 Ω	N-Ch 2	-	28	42	
Fall Time ^c	t _f	V _{DD} = 6 V, R _L = 0.3 Ω I _D ≅ 20 A, V _{GEN} = 10 V, R _g = 1 Ω	N-Ch 1	-	2.6	4	
		V _{DD} = 6 V, R _L = 0.1 Ω I _D ≅ 60 A, V _{GEN} = 10 V, R _g = 1 Ω	N-Ch 2	-	5	8	
Source-Drain Diode Ratings and Characteristics ^b							
Pulsed Current ^a	I _{SM}		N-Ch 1	-	-	80	A
			N-Ch 2	-	-	180	
Forward Voltage	V _{SD}	I _F = 10 A, V _{GS} = 0 V	N-Ch 1	-	0.8	1.2	V
		I _F = 20 A, V _{GS} = 0 V	N-Ch 2	-	0.8	1.2	

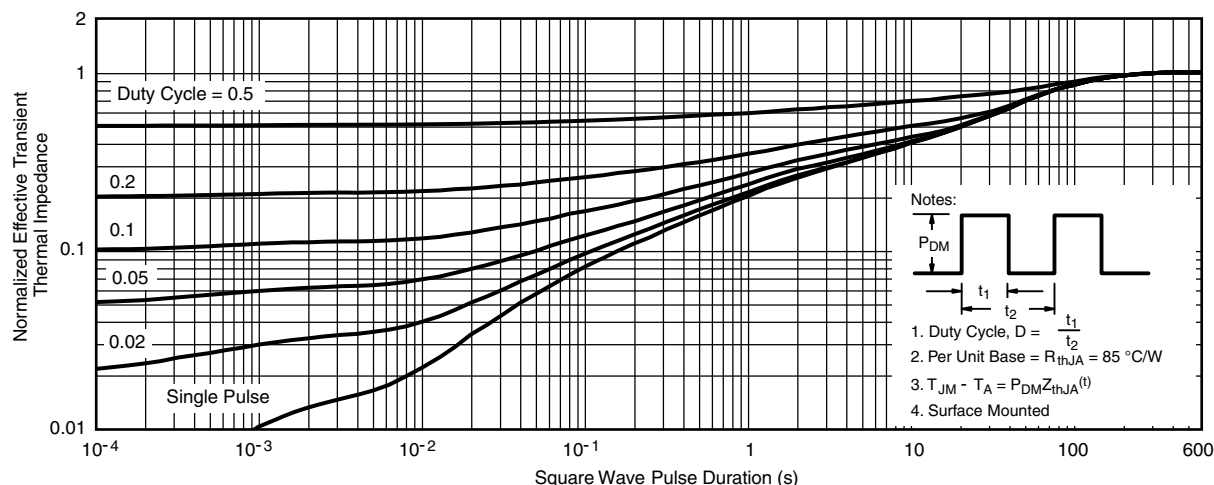
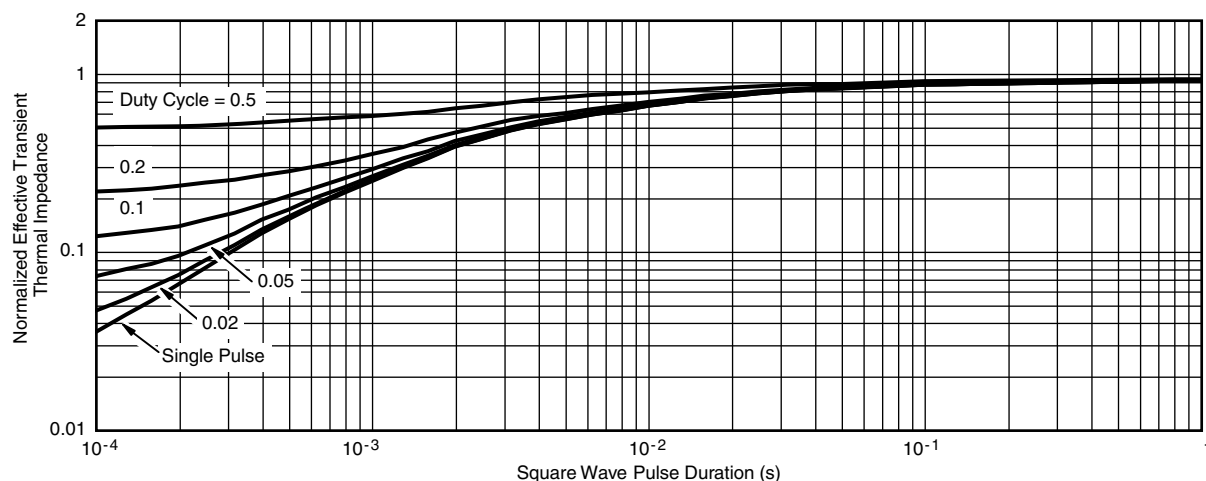
Notes

- a. Pulse test; pulse width $\leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$.
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c. Independent of operating temperature.

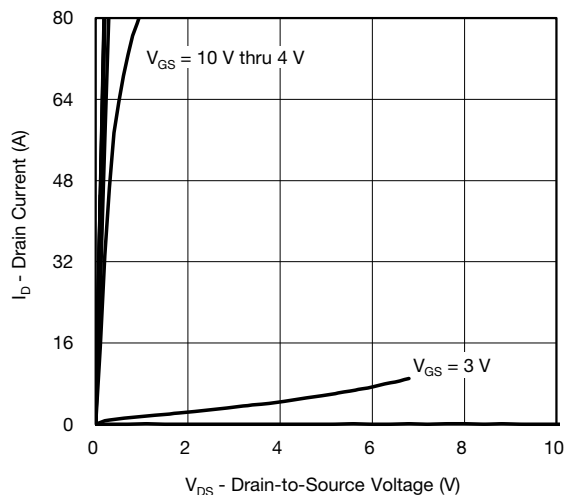
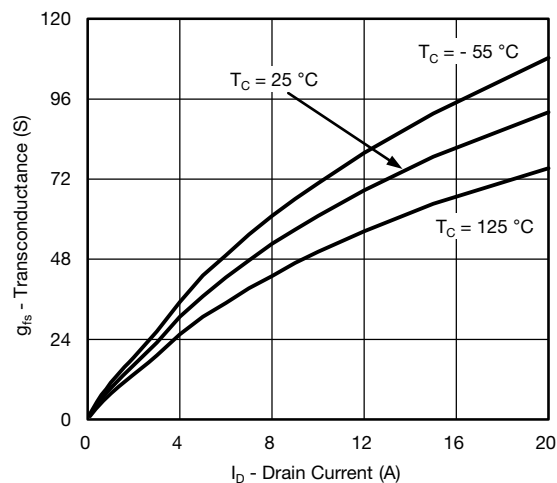
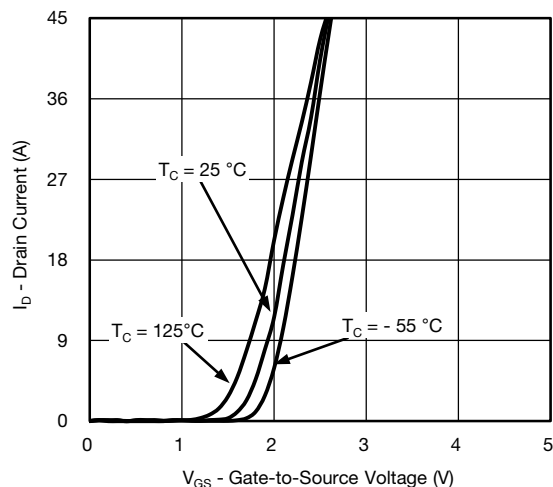
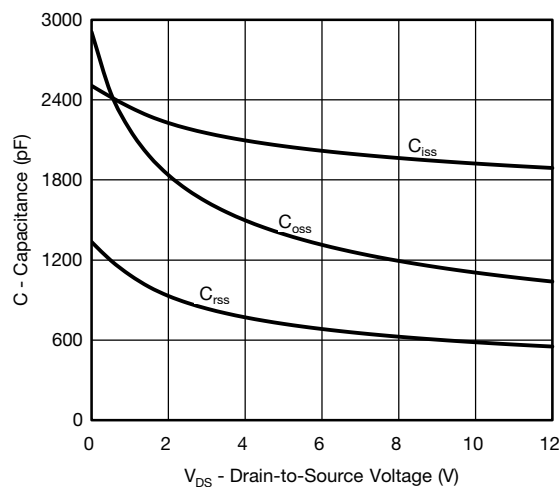
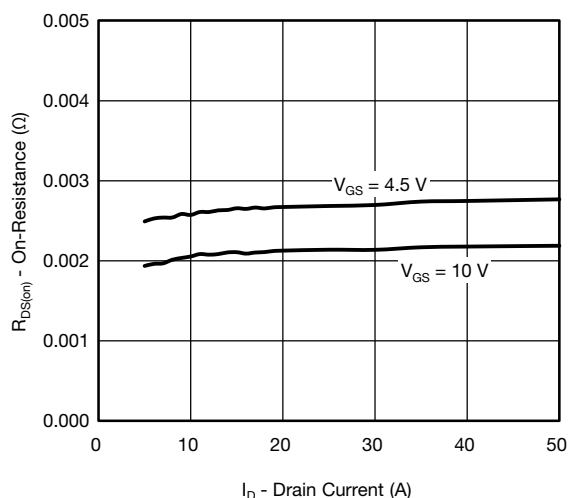
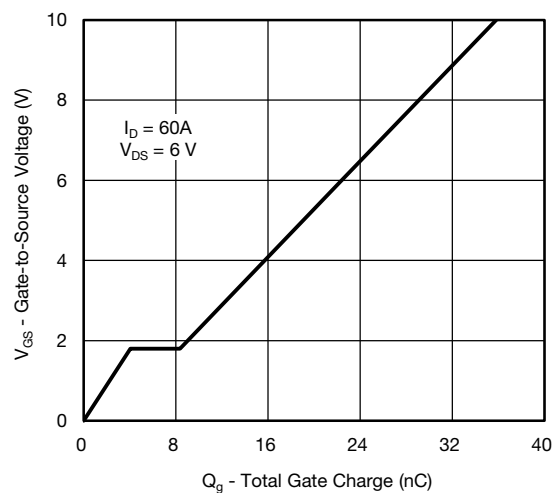
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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

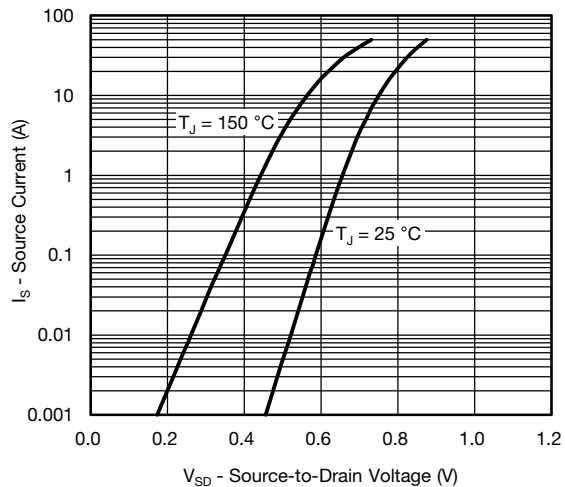
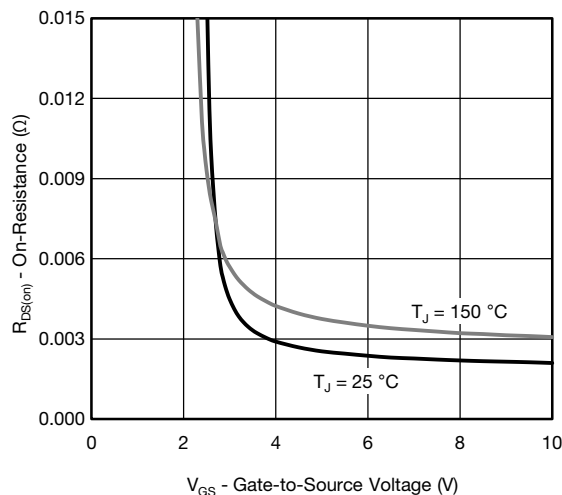
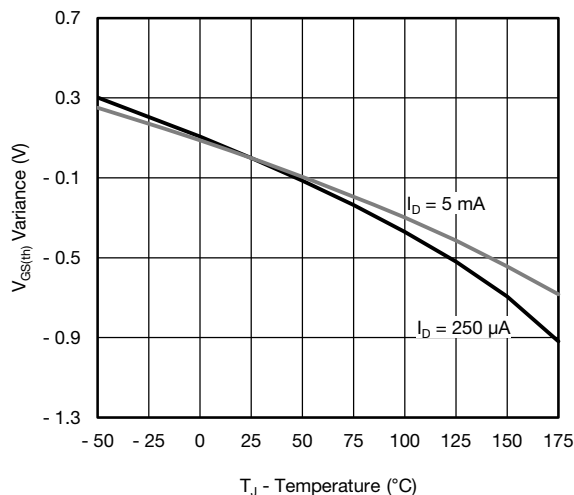
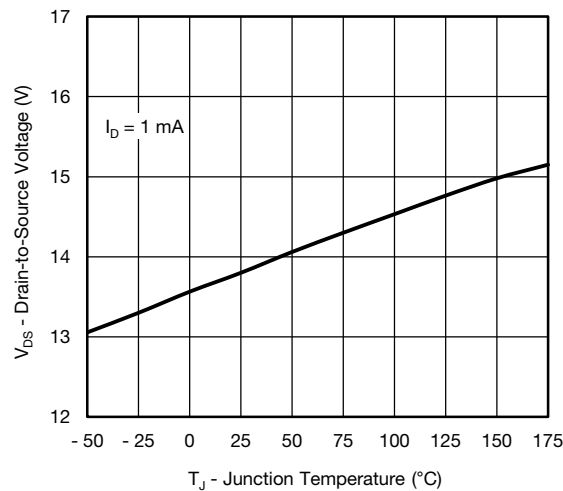
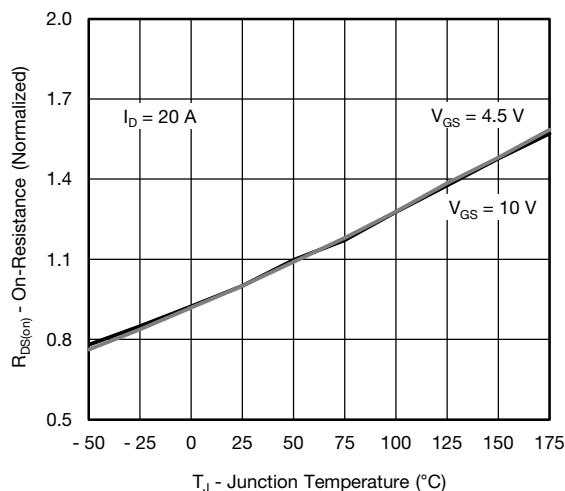
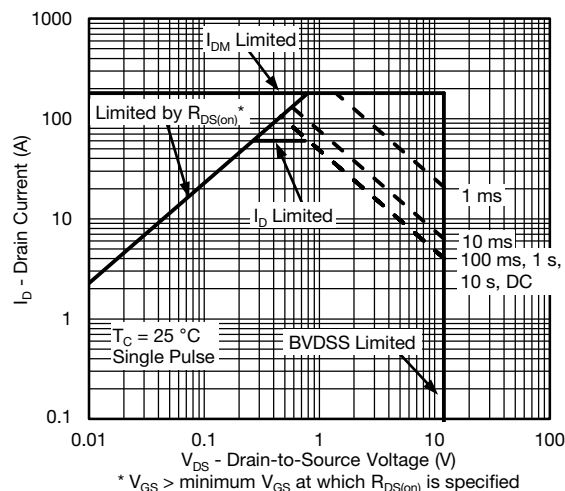
N-CHANNEL 1 TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)

Output Characteristics

Transconductance

Transfer Characteristics

Capacitance

On-Resistance vs. Drain Current

Gate Charge

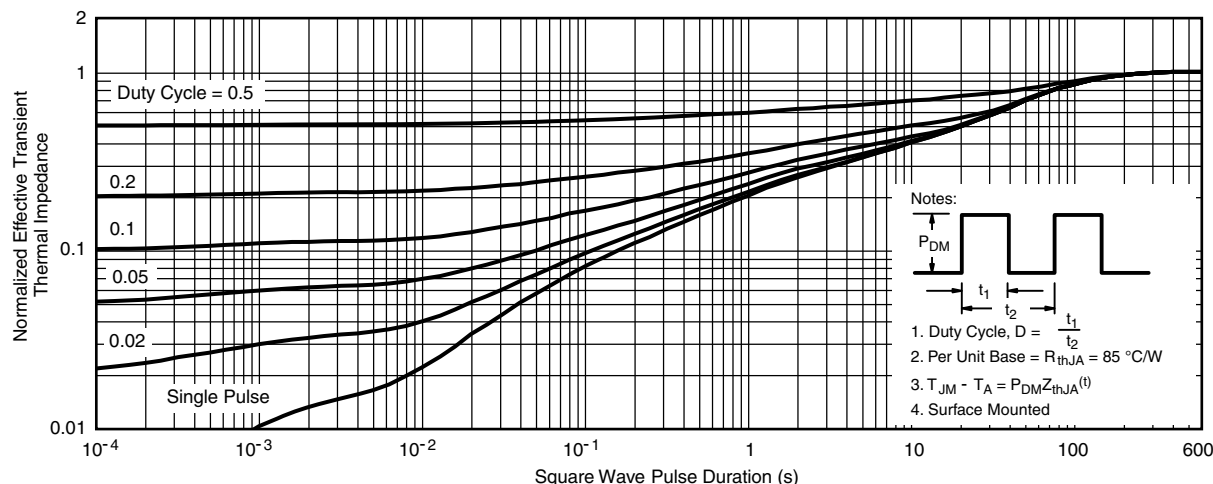
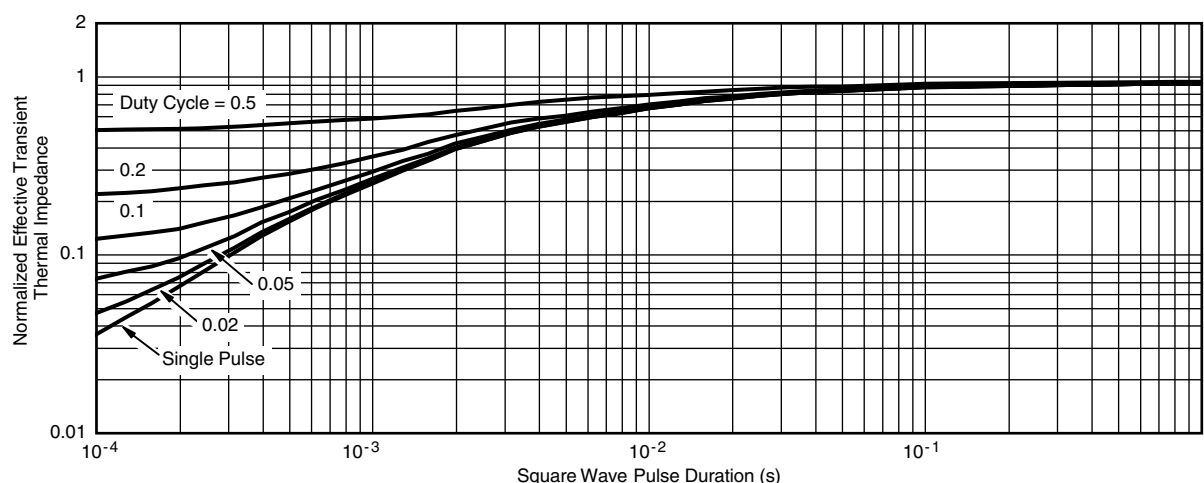
N-CHANNEL 1 TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)

Source Drain Diode Forward Voltage

On-Resistance vs. Gate-to-Source Voltage

Threshold Voltage

Drain Source Breakdown vs. Junction Temperature

On-Resistance vs. Junction Temperature

Safe Operating Area

N-CHANNEL 1 TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)

Normalized Thermal Transient Impedance, Junction-to-Ambient

Normalized Thermal Transient Impedance, Junction-to-Case
Note

- The characteristics shown in the graph:
 - Normalized Transient Thermal Impedance Junction-to-Ambient ($25\text{ }^{\circ}\text{C}$)
 is 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.

N-CHANNEL 2 TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)

Output Characteristics

Transconductance

Transfer Characteristics

Capacitance

On-Resistance vs. Drain Current

Gate Charge

N-CHANNEL 2 TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)

Source Drain Diode Forward Voltage

On-Resistance vs. Gate-to-Source Voltage

Threshold Voltage

Drain Source Breakdown vs. Junction Temperature

On-Resistance vs. Junction Temperature

Safe Operating Area

N-CHANNEL 2 TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)

Normalized Thermal Transient Impedance, Junction-to-Ambient

Normalized Thermal Transient Impedance, Junction-to-Case
Note

- The characteristics shown in the graph:
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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?62926.

**PowerPAK® SO-8L**

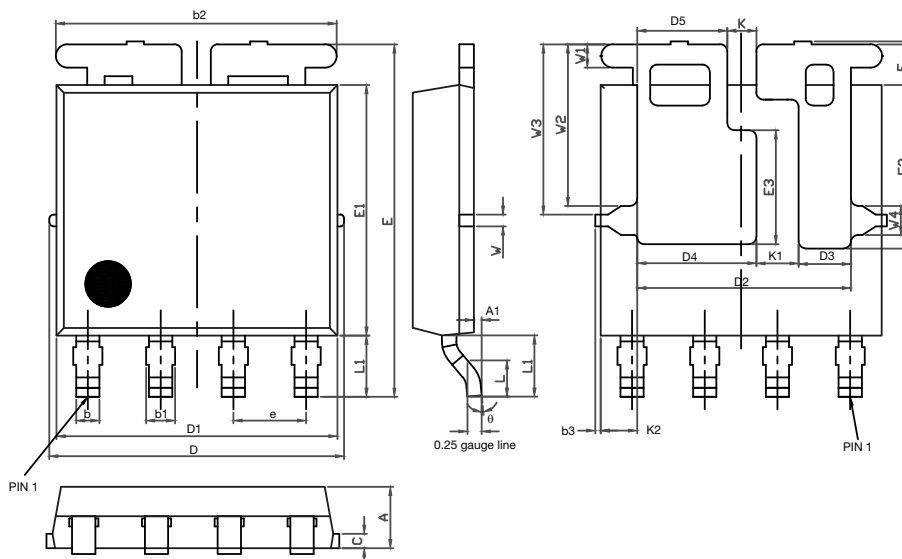
Ordering codes for the SQ rugged series power MOSFETs in the PowerPAK SO-8L package:

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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Note

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

PowerPAK® SO-8L Assymmetric Case Outline



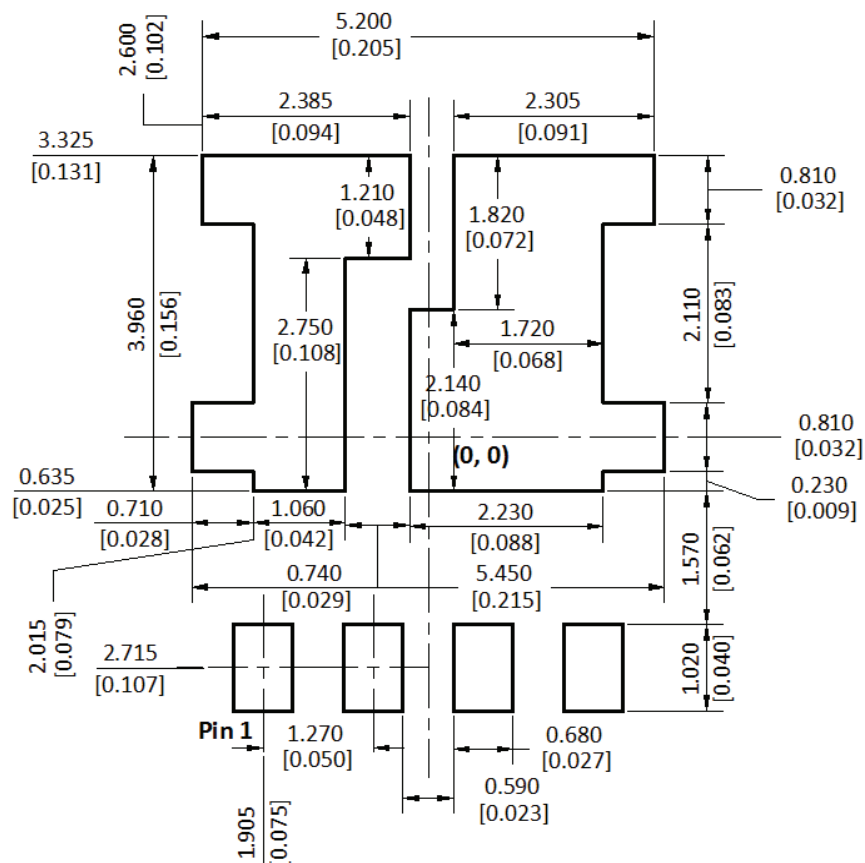
DIM.	MILLIMETERS			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	1.00	1.07	1.14	0.039	0.042	0.045
A1	0.00	0.06	0.13	0.000	0.003	0.005
b	0.33	0.41	0.48	0.013	0.016	0.019
b1	0.44	0.51	0.58	0.017	0.020	0.023
b2	4.80	4.90	5.00	0.189	0.193	0.197
b3	0.04	0.12	0.20	0.002	0.005	0.008
c	0.20	0.25	0.30	0.008	0.010	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	3.63	3.73	3.83	0.143	0.147	0.151
D3	0.81	0.91	1.01	0.032	0.036	0.040
D4	1.98	2.08	2.18	0.078	0.082	0.086
D5	1.47	1.57	1.67	0.058	0.062	0.066
e	1.20	1.27	1.34	0.047	0.050	0.053
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
E3	1.89	1.99	2.09	0.074	0.078	0.082
F	0.05	0.12	0.19	0.002	0.005	0.007
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	0.41	0.51	0.61	0.016	0.020	0.024
K1	0.64	0.74	0.84	0.025	0.029	0.033
K2	0.54	0.64	0.74	0.021	0.025	0.029
W	0.13	0.23	0.33	0.005	0.009	0.013
W1	0.31	0.41	0.51	0.012	0.016	0.020
W2	2.72	2.82	2.92	0.107	0.111	0.115
W3	2.86	2.96	3.06	0.113	0.117	0.120
W4	0.41	0.51	0.61	0.016	0.020	0.024
θ	5°	10°	12°	5°	10°	12°

DWG: 6009

Note

- Millimeters will govern

RECOMMENDED MINIMUM PADS FOR PowerPAK® SO-8L DUAL ASYMMETRIC



Recommended Minimum Pads
Dimensions in mm [inches]



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