



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



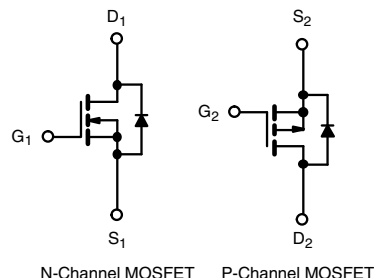
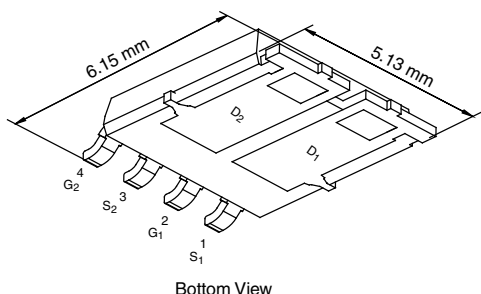
## PRODUCT SUMMARY

	N-CHANNEL	P-CHANNEL
$V_{DS}$ (V)	40	- 40
$R_{DS(on)}$ ( $\Omega$ ) at $V_{GS} = \pm 10$ V	0.014	0.028
$R_{DS(on)}$ ( $\Omega$ ) at $V_{GS} = \pm 4.5$ V	0.015	0.042
$I_D$ (A)	8	- 8
Configuration	N- and P-Pair	

## FEATURES

- TrenchFET® Power MOSFET
- AEC-Q101 Qualified<sup>d</sup>
- 100 %  $R_g$  and UIS Tested
- Material categorization:  
For definitions of compliance please see  
[www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

PowerPAK® SO-8L Dual



## ORDERING INFORMATION

Package	PowerPAK SO-8L
Lead (Pb)-free and Halogen-free	SQJ500EP-T1-GE3

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

PARAMETER		SYMBOL	N-CHANNEL	P-CHANNEL	UNIT
Drain-Source Voltage		V <sub>DS</sub>	40	- 40	V
Gate-Source Voltage		V <sub>GS</sub>	± 20		
Continuous Drain Current <sup>a</sup>	T <sub>C</sub> = 25 °C	I <sub>D</sub>	8	- 8	A
	T <sub>C</sub> = 125 °C		8	- 8	
Continuous Source Current (Diode Conduction) <sup>a</sup>		I <sub>S</sub>	8	- 8	
Pulsed Drain Current <sup>b</sup>		I <sub>DM</sub>	32	- 32	
Single Pulse Avalanche Current	L = 0.1 mH	I <sub>AS</sub>	30	- 30	mJ
Single Pulse Avalanche Energy		E <sub>AS</sub>	45	45	
Maximum Power Dissipation <sup>b</sup>	T <sub>C</sub> = 25 °C	P <sub>D</sub>	48	48	W
	T <sub>C</sub> = 125 °C		16	16	
Operating Junction and Storage Temperature Range		T <sub>J</sub> , T <sub>stg</sub>	- 55 to + 175		°C
Soldering Recommendations (Peak Temperature) <sup>e, f</sup>			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  $\leq 300$   $\mu$ s, duty cycle  $\leq 2$  %.
- When mounted on 1" square PCB (FR4 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.

**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 <sub>DS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA		N-Ch	40	-	-	V	
		V <sub>GS</sub> = 0 V, I <sub>D</sub> = - 250 μA		P-Ch	- 40	-	-		
Gate-Source Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA		N-Ch	1.3	1.8	2.3		
		V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = - 250 μA		P-Ch	- 1.5	- 2	- 2.5		
Gate-Source Leakage	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 20 V		N-Ch	-	-	± 100	nA	
				P-Ch	-	-	± 100		
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>GS</sub> = 0 V	V <sub>DS</sub> = 40 V	N-Ch	-	-	1	μA	
		V <sub>GS</sub> = 0 V	V <sub>DS</sub> = - 40 V	P-Ch	-	-	- 1		
		V <sub>GS</sub> = 0 V	V <sub>DS</sub> = 40 V, T <sub>J</sub> = 125 °C	N-Ch	-	-	50		
		V <sub>GS</sub> = 0 V	V <sub>DS</sub> = - 40 V, T <sub>J</sub> = 125 °C	P-Ch	-	-	- 50		
		V <sub>GS</sub> = 0 V	V <sub>DS</sub> = 40 V, T <sub>J</sub> = 175 °C	N-Ch	-	-	150		
		V <sub>GS</sub> = 0 V	V <sub>DS</sub> = - 40 V, T <sub>J</sub> = 175 °C	P-Ch	-	-	- 150		
On-State Drain Current <sup>a</sup>	I <sub>D(on)</sub>	V <sub>GS</sub> = 10 V	V <sub>DS</sub> ≥ 5 V	N-Ch	25	-	-	A	
		V <sub>GS</sub> = - 10 V	V <sub>DS</sub> ≤ 5 V	P-Ch	- 25	-	-		
Drain-Source On-State Resistance <sup>a</sup>	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10 V	I <sub>D</sub> = 8 A	N-Ch	-	0.011	0.014	Ω	
		V <sub>GS</sub> = - 10 V	I <sub>D</sub> = - 8 A	P-Ch	-	0.022	0.028		
		V <sub>GS</sub> = 10 V	I <sub>D</sub> = 8 A, T <sub>J</sub> = 125 °C	N-Ch	-	-	0.017		
		V <sub>GS</sub> = - 10 V	I <sub>D</sub> = - 8 A, T <sub>J</sub> = 125 °C	P-Ch	-	-	0.041		
		V <sub>GS</sub> = 10 V	I <sub>D</sub> = 8 A, T <sub>J</sub> = 175 °C	N-Ch	-	-	0.025		
		V <sub>GS</sub> = - 10 V	I <sub>D</sub> = - 8 A, T <sub>J</sub> = 175 °C	P-Ch	-	-	0.049		
		V <sub>GS</sub> = 4.5 V	I <sub>D</sub> = 6 A	N-Ch	-	0.012	0.015		
		V <sub>GS</sub> = - 4.5 V	I <sub>D</sub> = - 6 A	P-Ch	-	0.033	0.042		
Forward Transconductance <sup>b</sup>	g <sub>fs</sub>	V <sub>DS</sub> = 15 V, I <sub>D</sub> = 8 A		N-Ch	-	40	-	S	
		V <sub>DS</sub> = - 15 V, I <sub>D</sub> = - 8 A		P-Ch	-	18	-		
Dynamic <sup>b</sup>									
Input Capacitance	C <sub>iss</sub>	V <sub>GS</sub> = 0 V	V <sub>DS</sub> = 20 V, f = 1 MHz	N-Ch	-	1799	2248	pF	
		V <sub>GS</sub> = 0 V	V <sub>DS</sub> = - 20 V, f = 1 MHz	P-Ch	-	1756	2195		
Output Capacitance	C <sub>oss</sub>	V <sub>GS</sub> = 0 V	V <sub>DS</sub> = 20 V, f = 1 MHz	N-Ch	-	282	352		
		V <sub>GS</sub> = 0 V	V <sub>DS</sub> = - 20 V, f = 1 MHz	P-Ch	-	296	370		
Reverse Transfer Capacitance	C <sub>rss</sub>	V <sub>GS</sub> = 0 V	V <sub>DS</sub> = 20 V, f = 1 MHz	N-Ch	-	109	136		
		V <sub>GS</sub> = 0 V	V <sub>DS</sub> = - 20 V, f = 1 MHz	P-Ch	-	208	260		
Total Gate Charge <sup>c</sup>	Q <sub>g</sub>	V <sub>GS</sub> = 10 V	V <sub>DS</sub> = 20 V, I <sub>D</sub> = 10 A	N-Ch	-	31.5	48	nC	
		V <sub>GS</sub> = - 10 V	V <sub>DS</sub> = - 20 V, I <sub>D</sub> = - 10 A	P-Ch	-	41.5	63		
Gate-Source Charge <sup>c</sup>	Q <sub>gs</sub>	V <sub>GS</sub> = 10 V	V <sub>DS</sub> = 20 V, I <sub>D</sub> = 10 A	N-Ch	-	5.7	-		
		V <sub>GS</sub> = - 10 V	V <sub>DS</sub> = - 20 V, I <sub>D</sub> = - 10 A	P-Ch	-	5.5	-		
Gate-Drain Charge <sup>c</sup>	Q <sub>gd</sub>	V <sub>GS</sub> = 10 V	V <sub>DS</sub> = 20 V, I <sub>D</sub> = 10 A	N-Ch	-	4.8	-		
		V <sub>GS</sub> = - 10 V	V <sub>DS</sub> = - 20 V, I <sub>D</sub> = - 10 A	P-Ch	-	10.5	-		
Gate Resistance	R <sub>g</sub>	f = 1 MHz			N-Ch	2	4.11	6.2	Ω
					P-Ch	3.1	6.3	9.5	

**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.

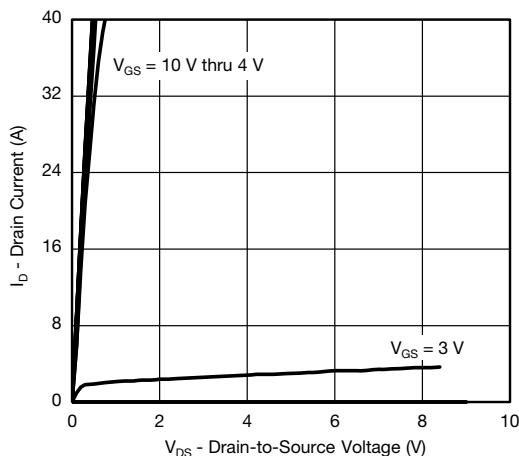
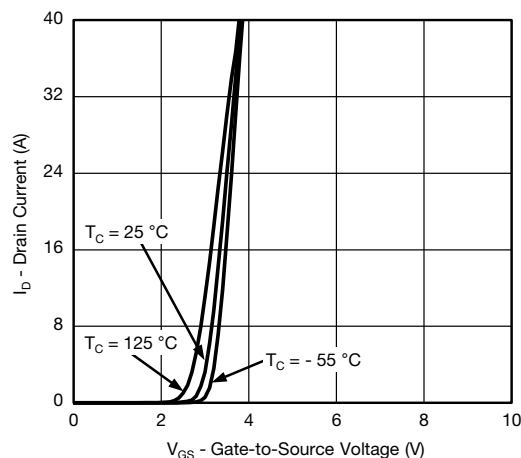
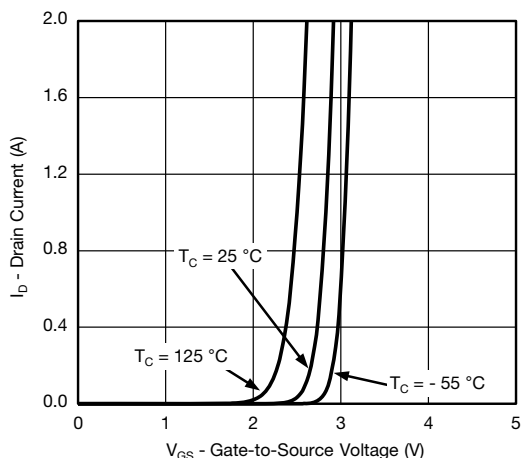
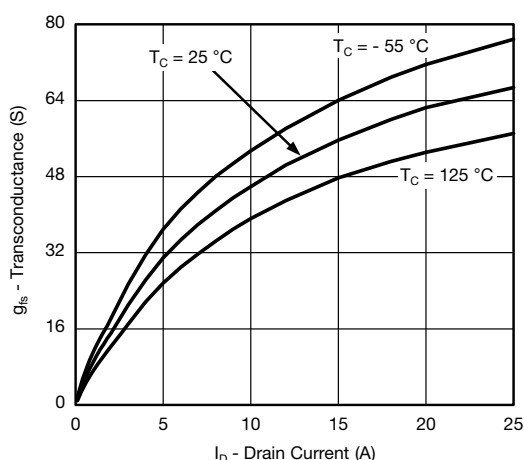
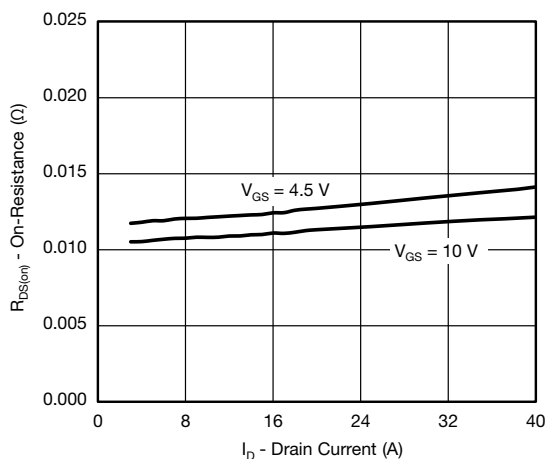
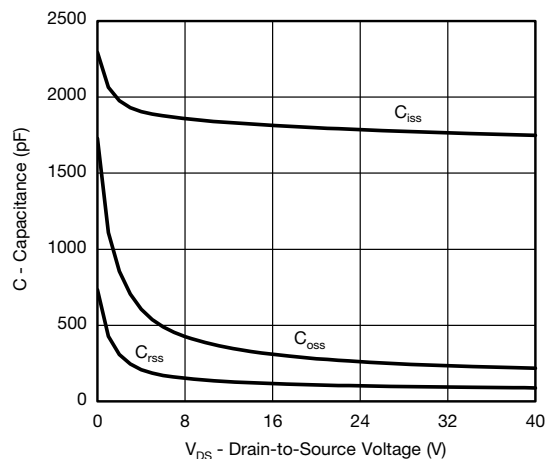


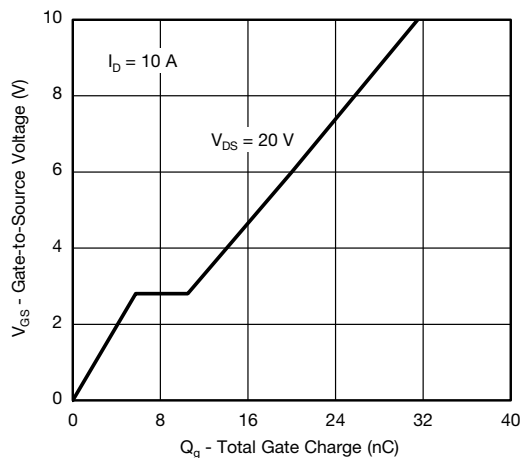
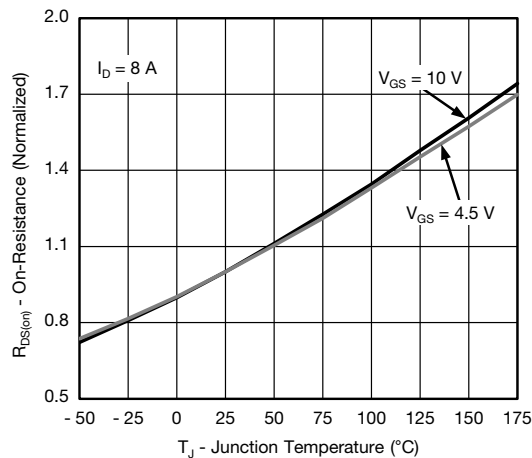
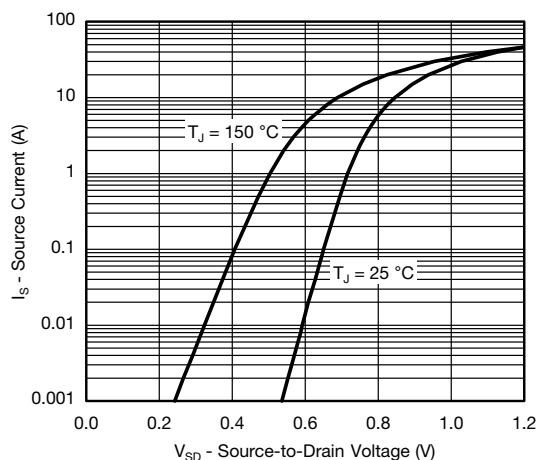
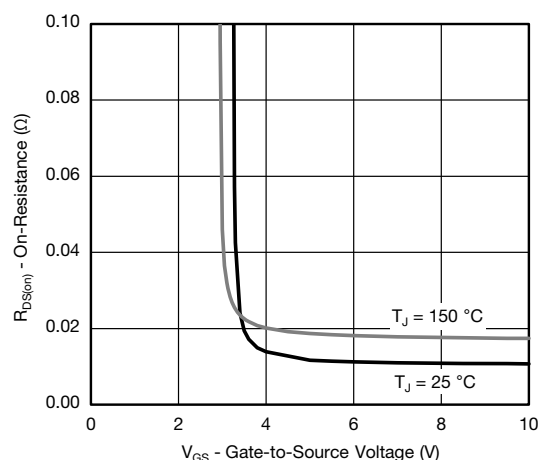
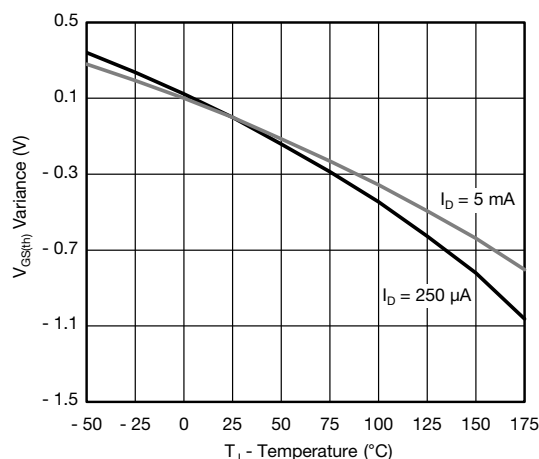
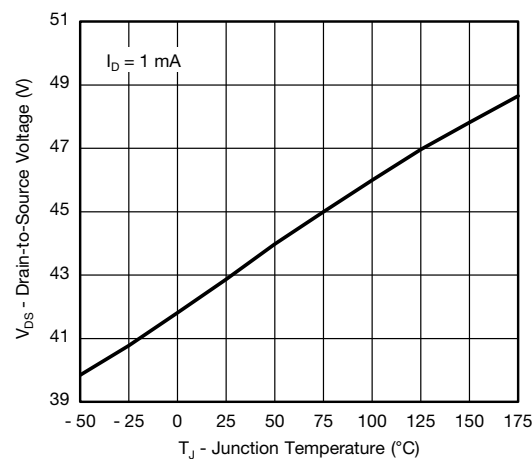
SPECIFICATIONS (T <sub>C</sub> = 25 °C, unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Turn-On Delay Time <sup>c</sup>	t <sub>d(on)</sub>	V <sub>DD</sub> = 20 V, R <sub>L</sub> = 2 Ω I <sub>D</sub> ≅ 10 A, V <sub>GEN</sub> = 10 V, R <sub>g</sub> = 1 Ω	N-Ch	-	7	11	ns
		V <sub>DD</sub> = - 20 V, R <sub>L</sub> = 2 Ω I <sub>D</sub> ≅ - 10 A, V <sub>GEN</sub> = - 10 V, R <sub>g</sub> = 1 Ω	P-Ch	-	11	17	
Rise Time <sup>c</sup>	t <sub>r</sub>	V <sub>DD</sub> = 20 V, R <sub>L</sub> = 2 Ω I <sub>D</sub> ≅ 10 A, V <sub>GEN</sub> = 10 V, R <sub>g</sub> = 1 Ω	N-Ch	-	21	32	
		V <sub>DD</sub> = - 20 V, R <sub>L</sub> = 2 Ω I <sub>D</sub> ≅ - 10 A, V <sub>GEN</sub> = - 10 V, R <sub>g</sub> = 1 Ω	P-Ch	-	9	14	
Turn-Off Delay Time <sup>c</sup>	t <sub>d(off)</sub>	V <sub>DD</sub> = 20 V, R <sub>L</sub> = 2 Ω I <sub>D</sub> ≅ 10 A, V <sub>GEN</sub> = 10 V, R <sub>g</sub> = 1 Ω	N-Ch	-	33	50	
		V <sub>DD</sub> = - 20 V, R <sub>L</sub> = 2 Ω I <sub>D</sub> ≅ - 10 A, V <sub>GEN</sub> = - 10 V, R <sub>g</sub> = 1 Ω	P-Ch	-	55	83	
Fall Time <sup>c</sup>	t <sub>f</sub>	V <sub>DD</sub> = 20 V, R <sub>L</sub> = 2 Ω I <sub>D</sub> ≅ 10 A, V <sub>GEN</sub> = 10 V, R <sub>g</sub> = 1 Ω	N-Ch	-	19	29	
		V <sub>DD</sub> = - 20 V, R <sub>L</sub> = 2 Ω I <sub>D</sub> ≅ - 10 A, V <sub>GEN</sub> = - 10 V, R <sub>g</sub> = 1 Ω	P-Ch	-	91	137	
Source-Drain Diode Ratings and Characteristics <sup>b</sup>							
Pulsed Current <sup>a</sup>	I <sub>SM</sub>		N-Ch	-	-	32	A
			P-Ch	-	-	- 32	
Forward Voltage	V <sub>SD</sub>	I <sub>S</sub> = 4 A	N-Ch	-	0.79	1.2	V
		I <sub>S</sub> = - 4 A	P-Ch	-	- 0.82	- 1.2	

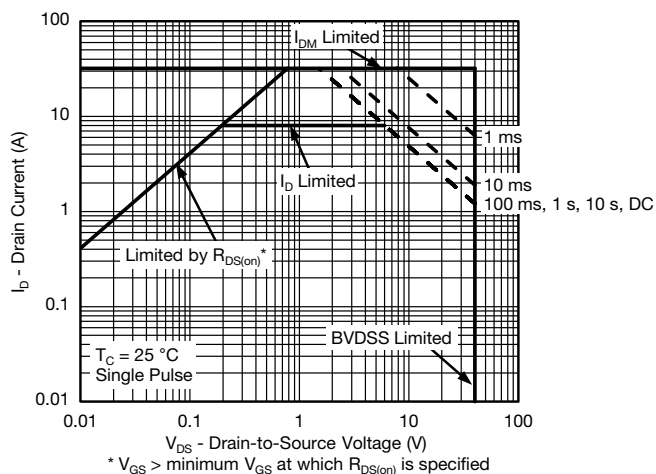
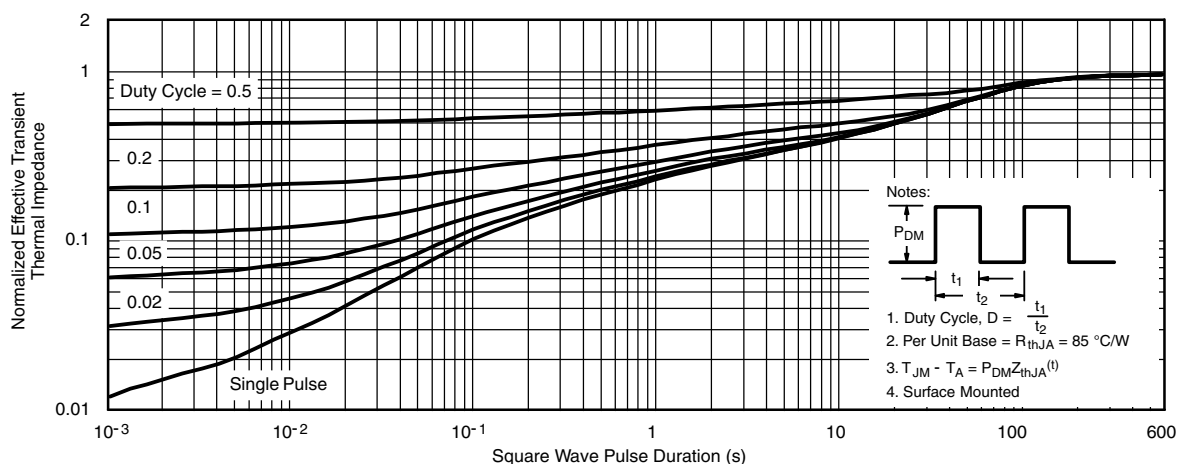
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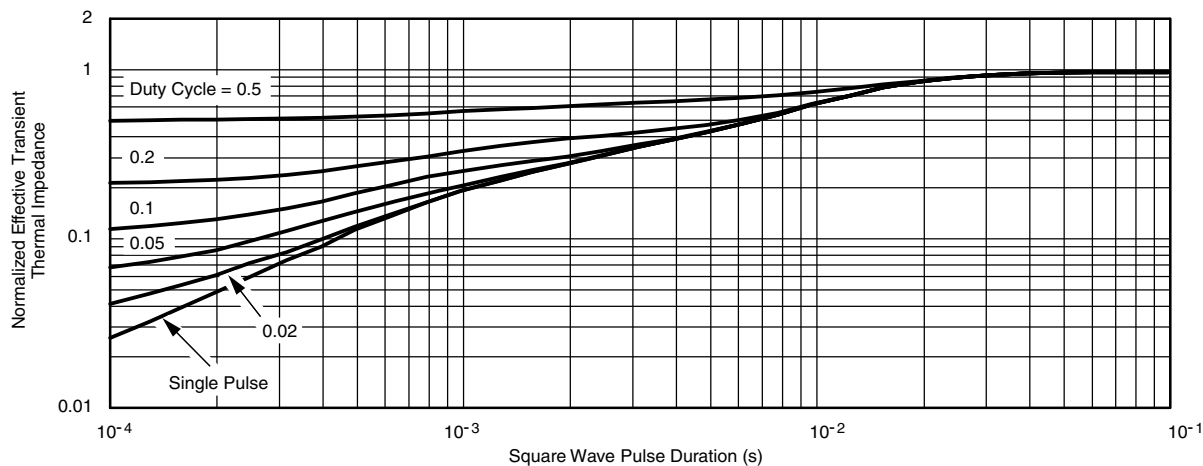
- a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .  
b. Guaranteed by design, not subject to production testing.  
c. Independent of operating temperature.

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

**Output Characteristics**

**Transfer Characteristics**

**Transfer Characteristics**

**Transconductance**

**On-Resistance vs. Drain Current**

**Capacitance**

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

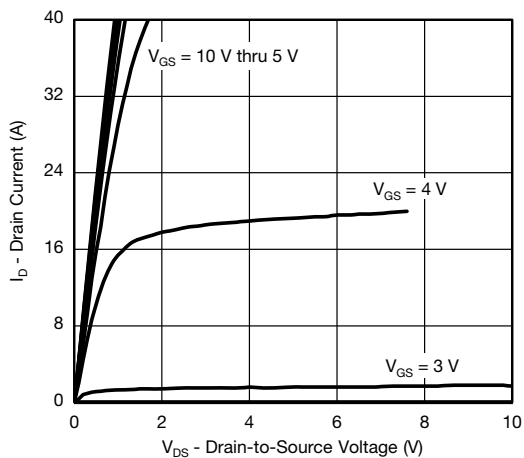
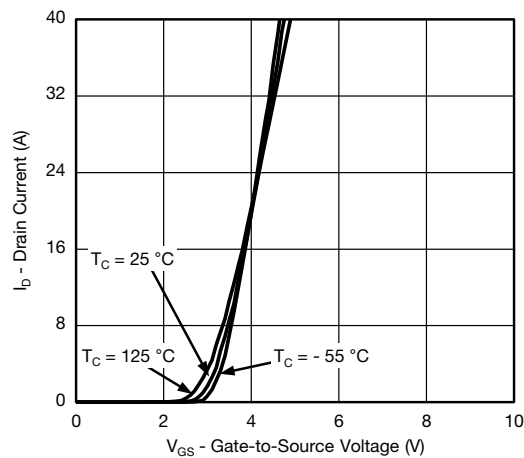
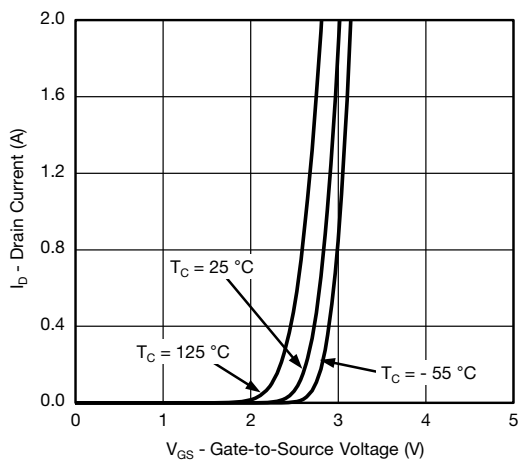
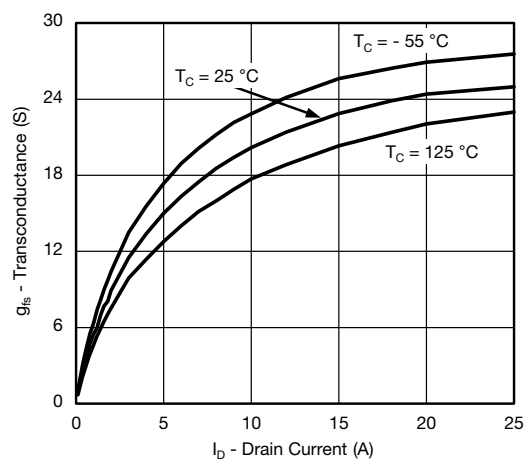
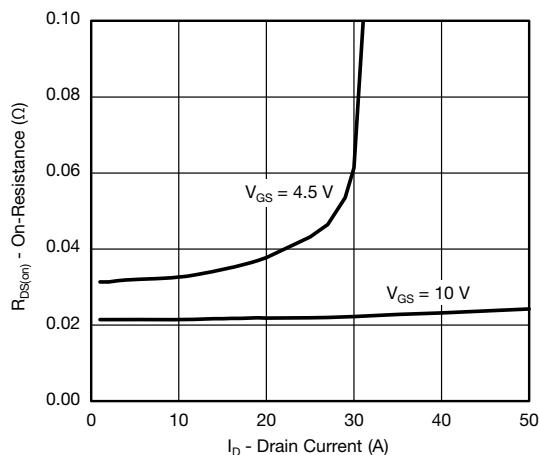
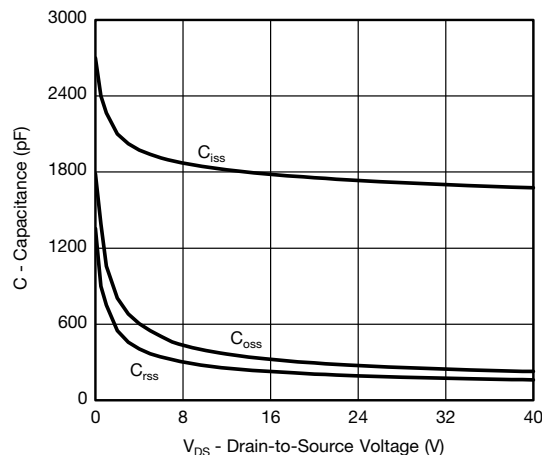
**N-CHANNEL TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

**Safe Operating Area**

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

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


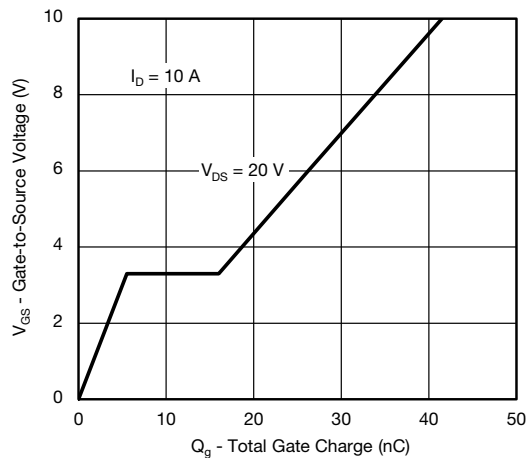
**Normalized Thermal Transient Impedance, Junction-to-Case**

**Note**

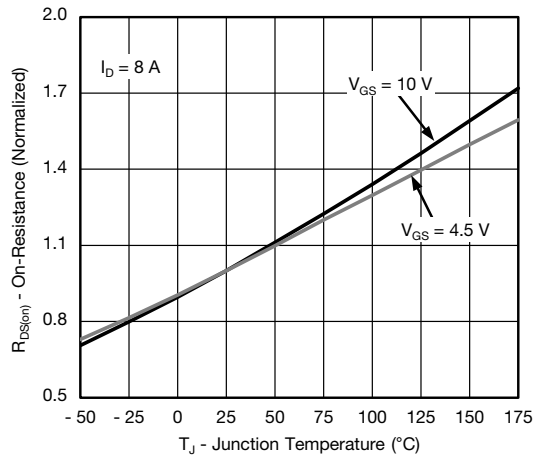
- The characteristics shown in the two graphs
  - Normalized Transient Thermal Impedance Junction-to-Ambient ( $25\text{ }^{\circ}\text{C}$ )
  - Normalized Transient Thermal Impedance Junction-to-Case ( $25\text{ }^{\circ}\text{C}$ )
 are given for general guidelines only to enable the user to get a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

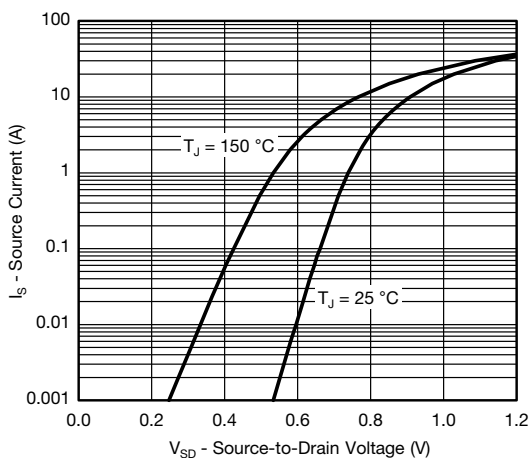


**P-CHANNEL TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)


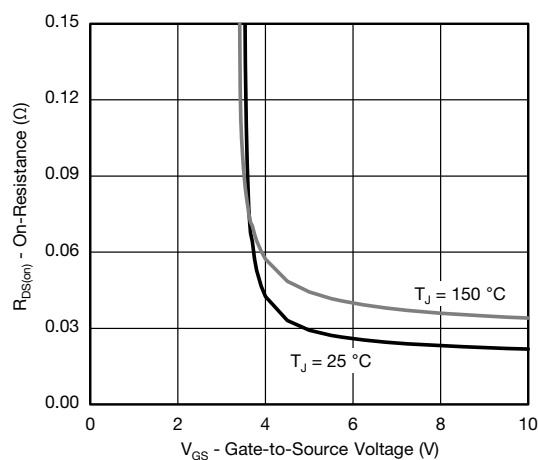
Gate Charge



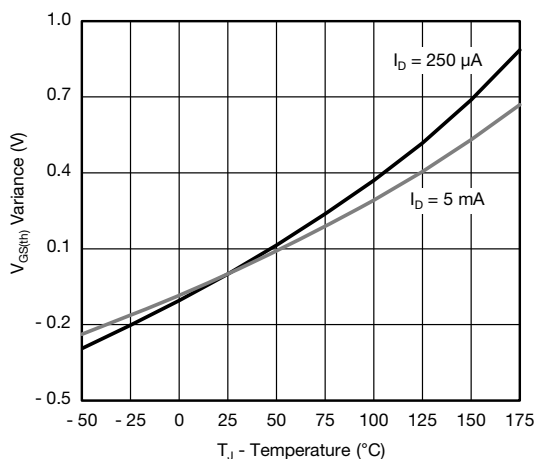
On-Resistance vs. Junction Temperature



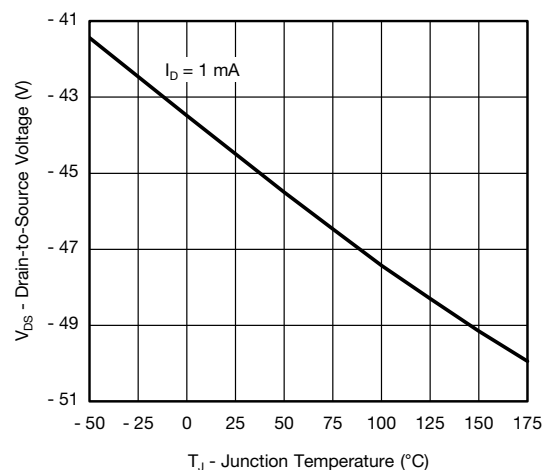
Source Drain Diode Forward Voltage



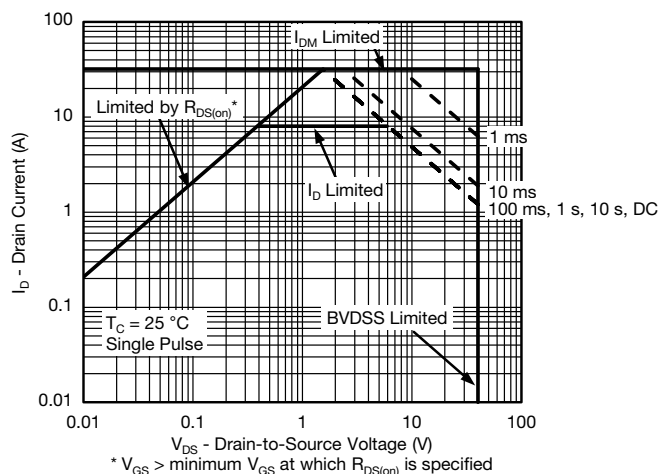
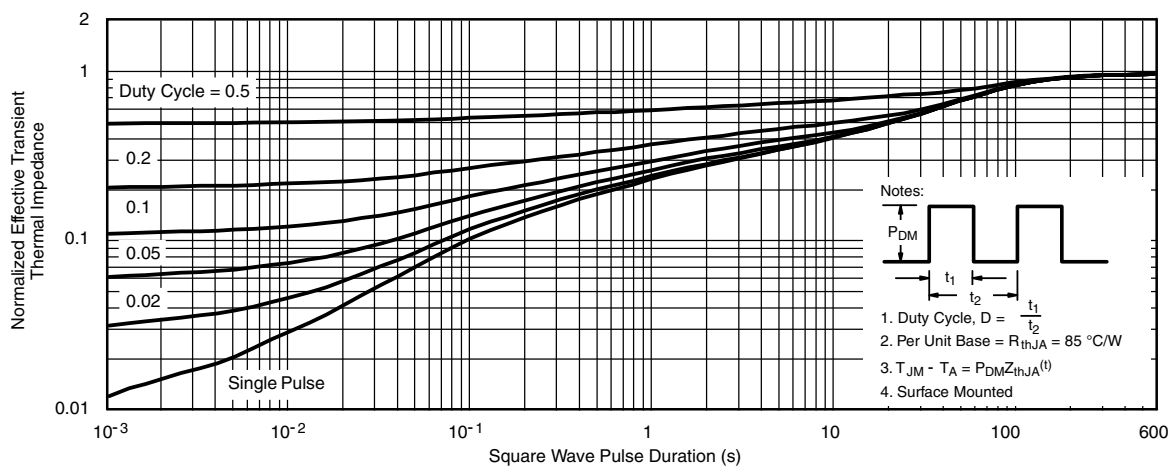
On-Resistance vs. Gate-to-Source Voltage

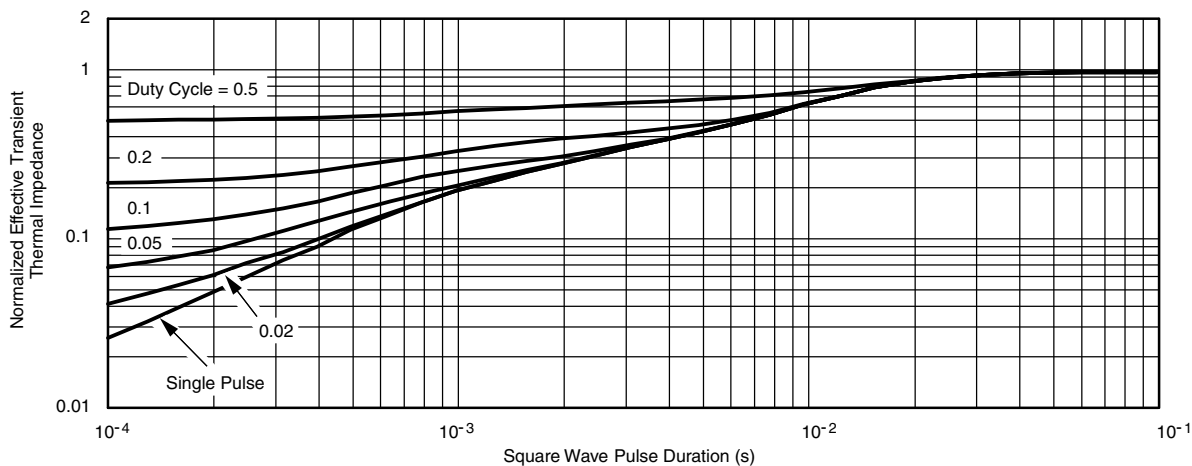


Threshold Voltage



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**

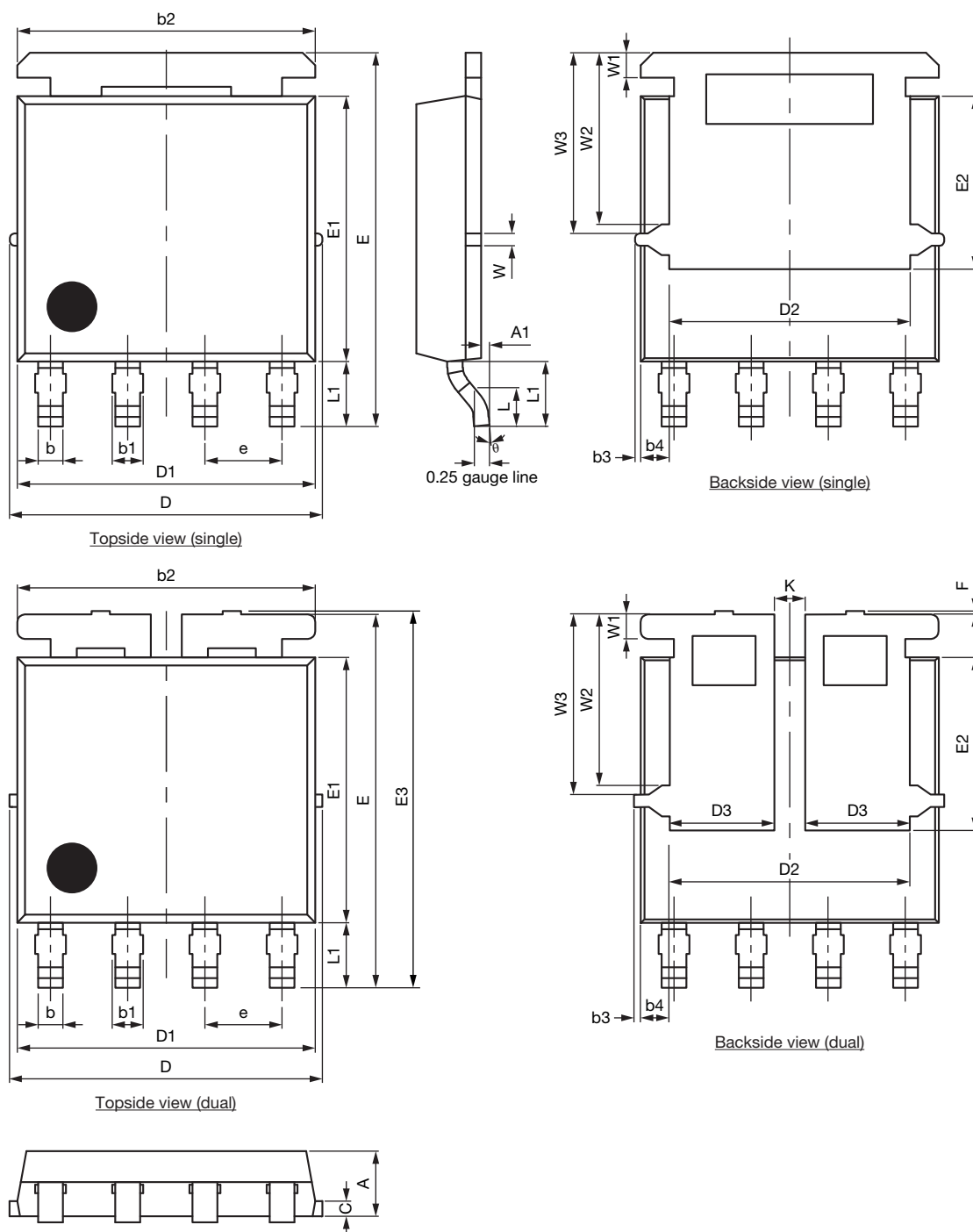
**Note**

- 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?67517](http://www.vishay.com/ppg?67517).



## PowerPAK® SO-8L Case Outline 2





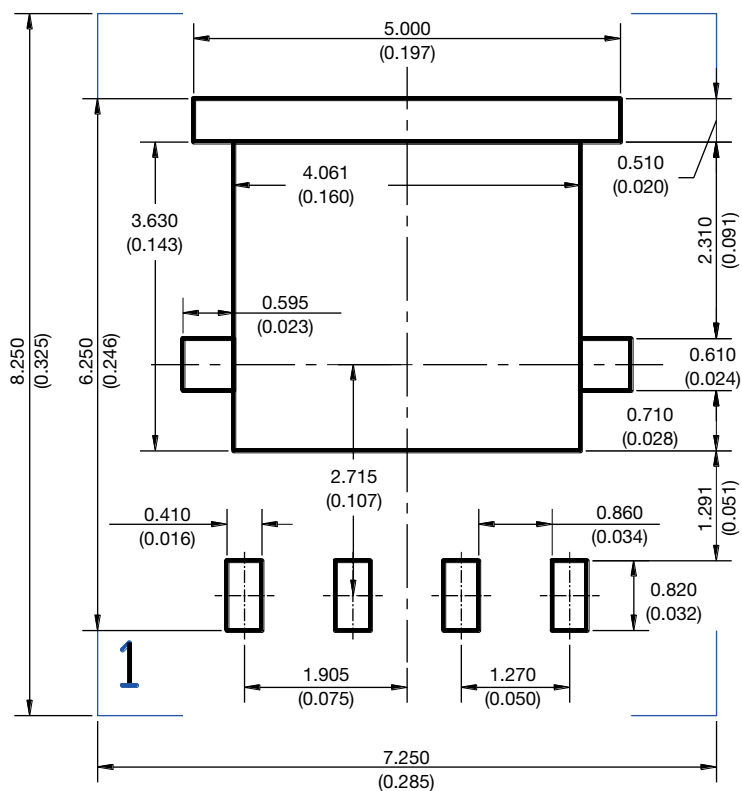
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	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	1.00	1.07	1.14	0.039	0.042	0.045
A1	0.00	-	0.127	0.00	-	0.005
b	0.33	0.41	0.48	0.013	0.016	0.019
b1	0.44	0.51	0.58	0.017	0.020	0.023
b2	4.80	4.90	5.00	0.189	0.193	0.197
b3	0.094			0.004		
b4	0.47			0.019		
c	0.20	0.25	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
E3	6.05	6.22	6.40	0.238	0.245	0.252
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: C23-1026-Rev. D, 25-Sep-2023 DWG: 6044						

**Note**

- Millimeters will govern



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



Recommended Minimum Pads  
Dimensions in mm (inches)



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