

Automotive Dual N-Channel 20 V (D-S) 175 °C MOSFETs

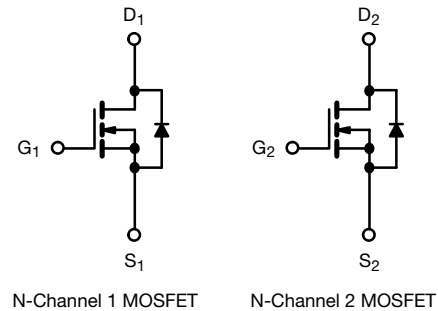
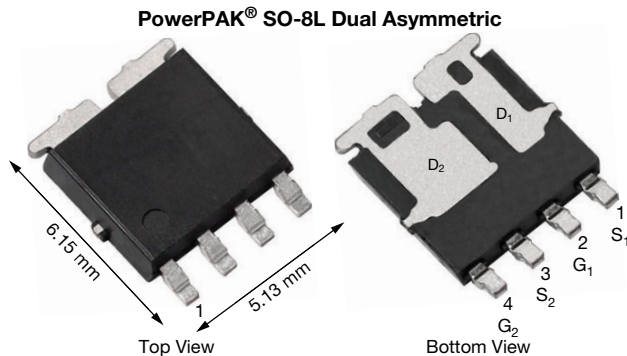
 AUTOMOTIVE
GRADE

RoHS
COMPLIANT
HALOGEN
FREE

PRODUCT SUMMARY		
	N-CHANNEL 1	N-CHANNEL 2
V_{DS} (V)	20	20
$R_{DS(on)}$ (Ω) at $V_{GS} = 10$ V	0.0088	0.0037
$R_{DS(on)}$ (Ω) at $V_{GS} = 4.5$ V	0.0124	0.0050
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



ABSOLUTE MAXIMUM RATINGS ($T_C = 25$ °C, unless otherwise noted)					
PARAMETER	SYMBOL	N-CHANNEL 1	N-CHANNEL 2	UNIT	
Drain-Source Voltage	V_{DS}	20	20	V	
Gate-Source Voltage	V_{GS}	± 20			
Continuous Drain Current ^a	I_D	$T_C = 25$ °C	20	60	A
		$T_C = 125$ °C	20	50	
Continuous Source Current (Diode Conduction)	I_S	20 ^a	44	mJ	
Pulsed Drain Current ^b	I_{DM}	80	180		
Single Pulse Avalanche Current	I_{AS}	L = 0.1 mH	22	40	mJ
Single Pulse Avalanche Energy			E_{AS}	24.2	
Maximum Power Dissipation ^b	P_D	$T_C = 25$ °C	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	R_{thJA}	85	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 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 ($T_C = 25\text{ }^\circ\text{C}$, unless otherwise noted)								
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT	
Static								
Drain-Source Breakdown Voltage	V_{DS}	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$		N-Ch 1	20	-	-	V
		$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$		N-Ch 2	20	-	-	
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$		N-Ch 1	1	1.5	2	
		$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$		N-Ch 2	1	1.5	2	
Gate-Source Leakage	I_{GSS}	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$		N-Ch 1	-	-	± 100	nA
				N-Ch 2	-	-	± 100	
Zero Gate Voltage Drain Current	I_{DSS}	$V_{GS} = 0\text{ V}$	$V_{DS} = 20\text{ V}$	N-Ch 1	-	-	1	μA
		$V_{GS} = 0\text{ V}$	$V_{DS} = 20\text{ V}$	N-Ch 2	-	-	1	
		$V_{GS} = 0\text{ V}$	$V_{DS} = 20\text{ V}, T_J = 125\text{ }^\circ\text{C}$	N-Ch 1	-	-	50	
		$V_{GS} = 0\text{ V}$	$V_{DS} = 20\text{ V}, T_J = 125\text{ }^\circ\text{C}$	N-Ch 2	-	-	50	
		$V_{GS} = 0\text{ V}$	$V_{DS} = 20\text{ V}, T_J = 175\text{ }^\circ\text{C}$	N-Ch 1	-	-	150	
		$V_{GS} = 0\text{ V}$	$V_{DS} = 20\text{ V}, T_J = 175\text{ }^\circ\text{C}$	N-Ch 2	-	-	150	
On-State Drain Current ^a	$I_{D(on)}$	$V_{GS} = 10\text{ V}$	$V_{DS} \geq 5\text{ V}$	N-Ch 1	20	-	-	A
		$V_{GS} = 10\text{ V}$	$V_{DS} \geq 5\text{ V}$	N-Ch 2	30	-	-	
Drain-Source On-State Resistance ^a	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	$I_D = 16\text{ A}$	N-Ch 1	-	0.0074	0.0088	Ω
		$V_{GS} = 10\text{ V}$	$I_D = 20\text{ A}$	N-Ch 2	-	0.0031	0.0037	
		$V_{GS} = 10\text{ V}$	$I_D = 16\text{ A}, T_J = 125\text{ }^\circ\text{C}$	N-Ch 1	-	0.0110	-	
		$V_{GS} = 10\text{ V}$	$I_D = 20\text{ A}, T_J = 125\text{ }^\circ\text{C}$	N-Ch 2	-	0.0036	-	
		$V_{GS} = 10\text{ V}$	$I_D = 16\text{ A}, T_J = 175\text{ }^\circ\text{C}$	N-Ch 1	-	0.0124	-	
		$V_{GS} = 10\text{ V}$	$I_D = 20\text{ A}, T_J = 175\text{ }^\circ\text{C}$	N-Ch 2	-	0.0063	-	
		$V_{GS} = 4.5\text{ V}$	$I_D = 14\text{ A}$	N-Ch 1	-	0.0095	0.0124	
		$V_{GS} = 4.5\text{ V}$	$I_D = 19\text{ A}$	N-Ch 2	-	0.0039	0.0050	
Forward Transconductance ^b	g_{fs}	$V_{DS} = 10\text{ V}, I_D = 10\text{ A}$		N-Ch 1	-	55	-	S
		$V_{DS} = 10\text{ V}, I_D = 10\text{ A}$		N-Ch 2	-	60	-	
Dynamic ^b								
Input Capacitance	C_{iss}	$V_{GS} = 0\text{ V}$	$V_{DS} = 10\text{ V}, f = 1\text{ MHz}$	N-Ch 1	-	723	975	pF
		$V_{GS} = 0\text{ V}$	$V_{DS} = 10\text{ V}, f = 1\text{ MHz}$	N-Ch 2	-	1937	2525	
Output Capacitance	C_{oss}	$V_{GS} = 0\text{ V}$	$V_{DS} = 10\text{ V}, f = 1\text{ MHz}$	N-Ch 1	-	269	675	
		$V_{GS} = 0\text{ V}$	$V_{DS} = 10\text{ V}, f = 1\text{ MHz}$	N-Ch 2	-	655	870	
Reverse Transfer Capacitance	C_{rss}	$V_{GS} = 0\text{ V}$	$V_{DS} = 10\text{ V}, f = 1\text{ MHz}$	N-Ch 1	-	112	340	
		$V_{GS} = 0\text{ V}$	$V_{DS} = 10\text{ V}, f = 1\text{ MHz}$	N-Ch 2	-	264	350	
Total Gate Charge ^c	Q_g	$V_{GS} = 10\text{ V}$	$V_{DS} = 10\text{ V}, I_D = 20\text{ A}$	N-Ch 1	-	12	18	nC
		$V_{GS} = 10\text{ V}$	$V_{DS} = 10\text{ V}, I_D = 60\text{ A}$	N-Ch 2	-	29	43	
Gate-Source Charge ^c	Q_{gs}	$V_{GS} = 10\text{ V}$	$V_{DS} = 10\text{ V}, I_D = 20\text{ A}$	N-Ch 1	-	1.6	-	
		$V_{GS} = 10\text{ V}$	$V_{DS} = 10\text{ V}, I_D = 60\text{ A}$	N-Ch 2	-	4.1	-	
Gate-Drain Charge ^c	Q_{gd}	$V_{GS} = 10\text{ V}$	$V_{DS} = 10\text{ V}, I_D = 20\text{ A}$	N-Ch 1	-	2.5	-	
		$V_{GS} = 10\text{ V}$	$V_{DS} = 10\text{ V}, I_D = 60\text{ A}$	N-Ch 2	-	6	-	
Gate Resistance	R_g	$f = 1\text{ MHz}$		N-Ch 1	1.1	2.3	3.5	Ω
				N-Ch 2	0.4	1	1.4	



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	-	4	6	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	-	7	9	
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	-	18	23	
		V _{DD} = 6 V, R _L = 0.1 Ω I _D ≅ 60 A, V _{GEN} = 10 V, R _g = 1 Ω	N-Ch 2	-	17	23	
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	-	13	17	
		V _{DD} = 6 V, R _L = 0.1 Ω I _D ≅ 60 A, V _{GEN} = 10 V, R _g = 1 Ω	N-Ch 2	-	19	25	
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	-	13	17	
		V _{DD} = 6 V, R _L = 0.1 Ω I _D ≅ 60 A, V _{GEN} = 10 V, R _g = 1 Ω	N-Ch 2	-	14	28	
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	

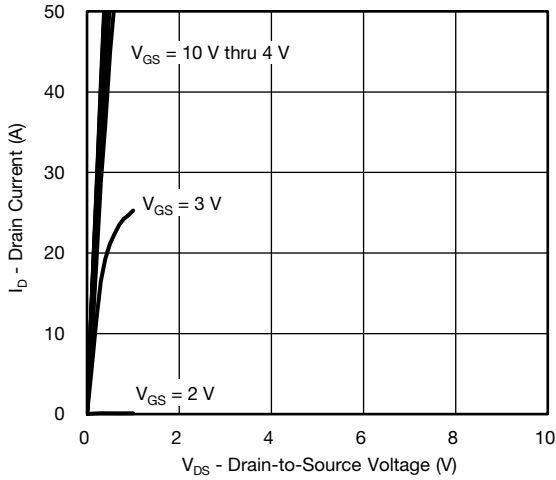
Notes

- a. Pulse test; pulse width ≤ 300 μs, duty cycle ≤ 2 %.
- b. Guaranteed by design, not subject to production testing.
- c. Independent of operating temperature.

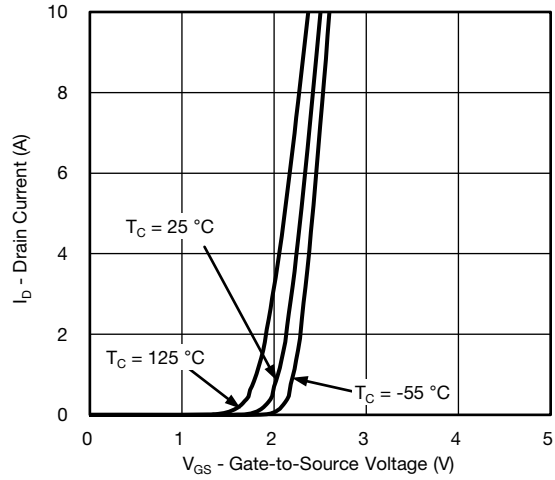
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



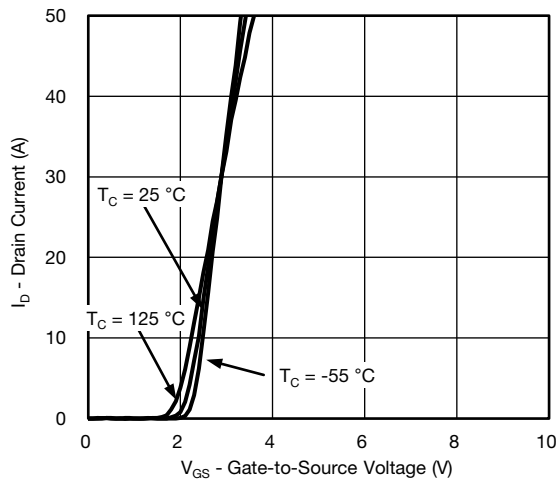
N-CHANNEL 1 TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^\circ\text{C}$, unless otherwise noted)



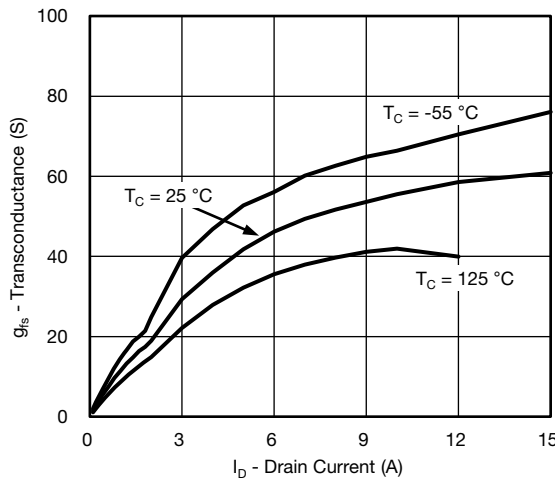
Output Characteristics



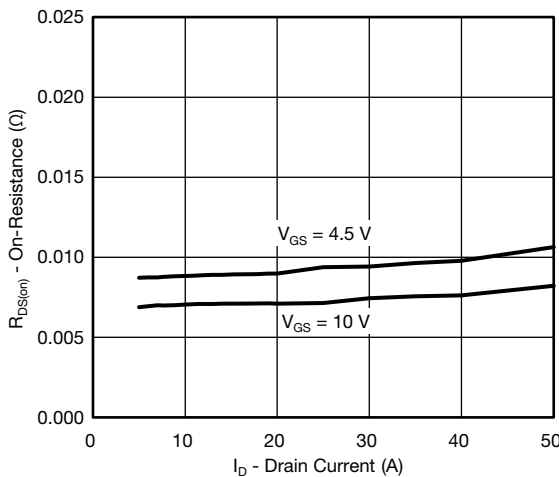
Transfer Characteristics



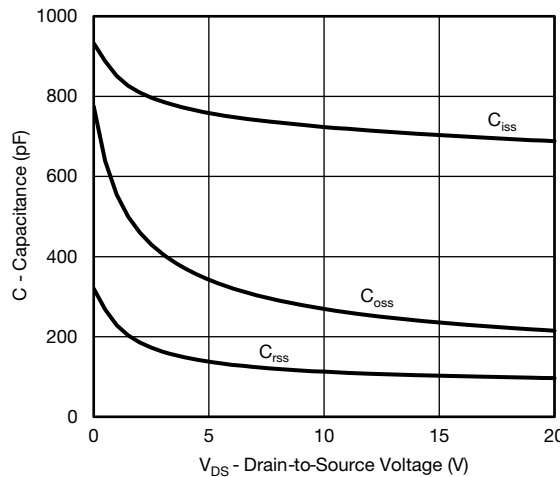
Transfer Characteristics



Transconductance



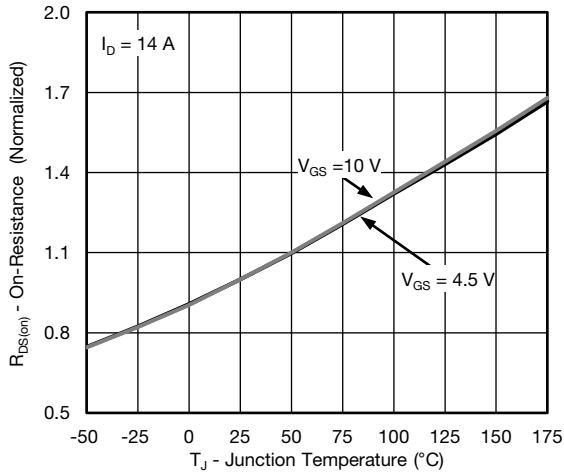
On-Resistance vs. Drain Current



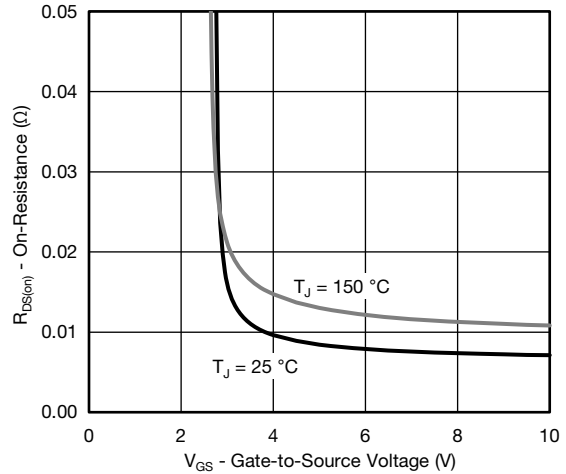
Capacitance



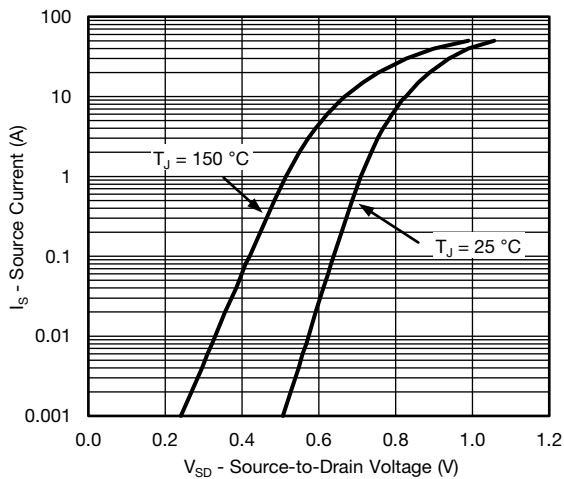
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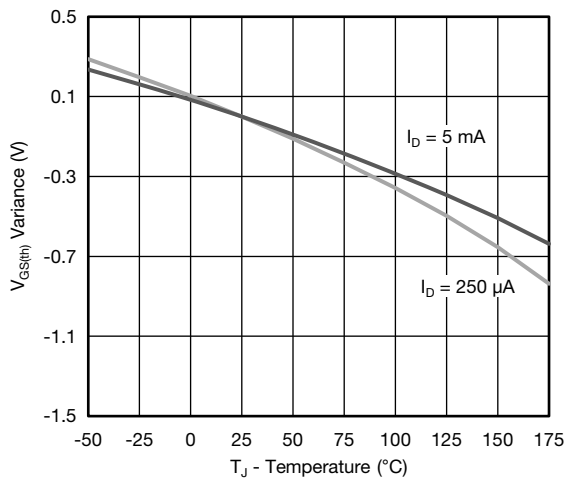
On-Resistance vs. Junction Temperature



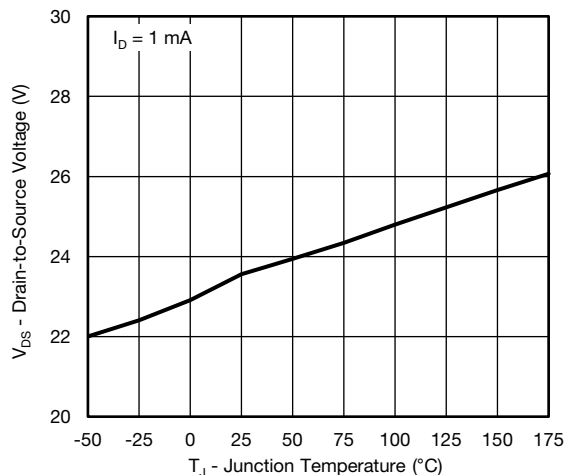
On-Resistance vs. Gate-to-Source Voltage



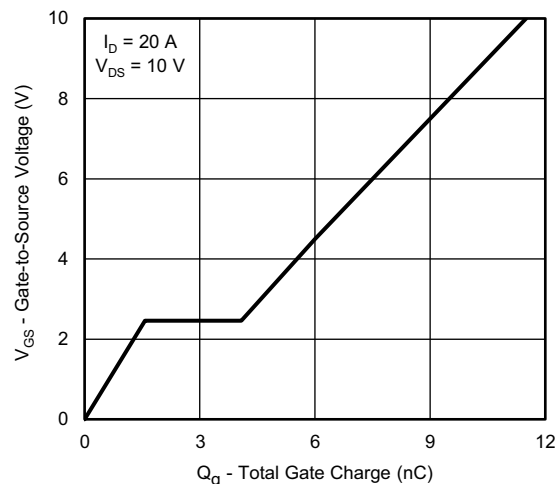
Source Drain Diode Forward Voltage



Threshold Voltage



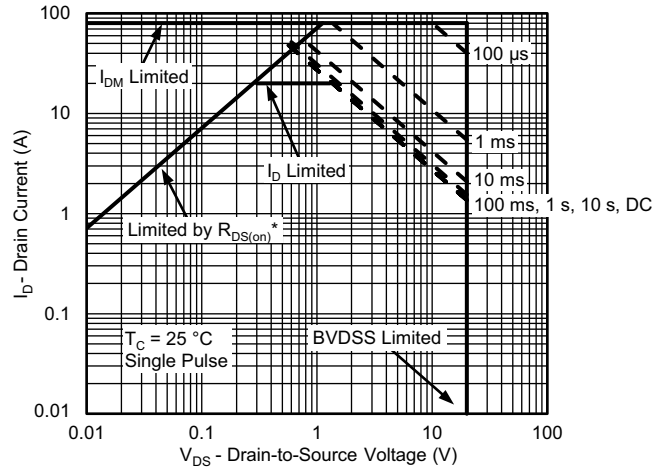
Drain Source Breakdown vs. Junction Temperature



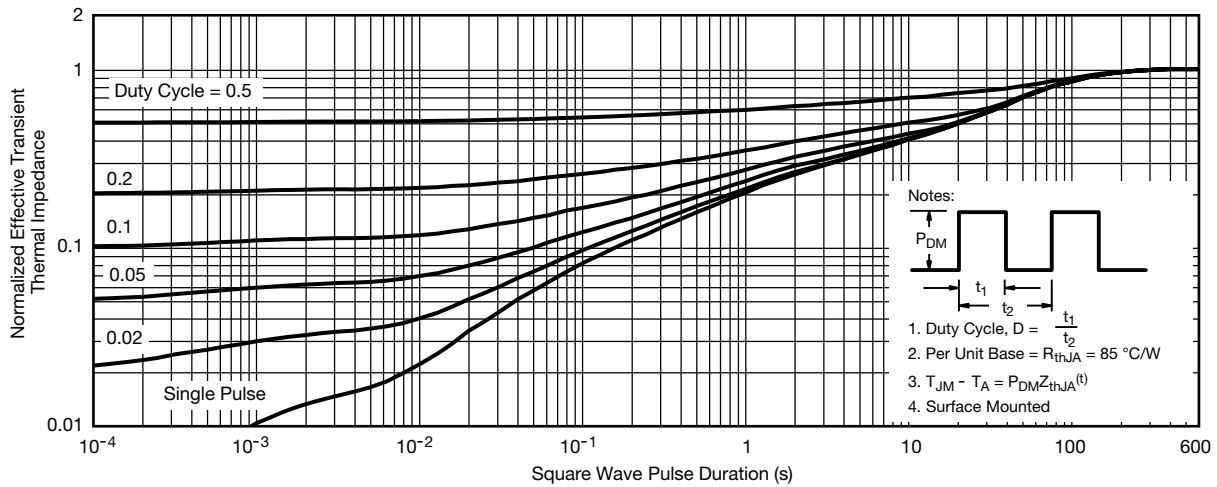
Gate Charge



N-CHANNEL 1 TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



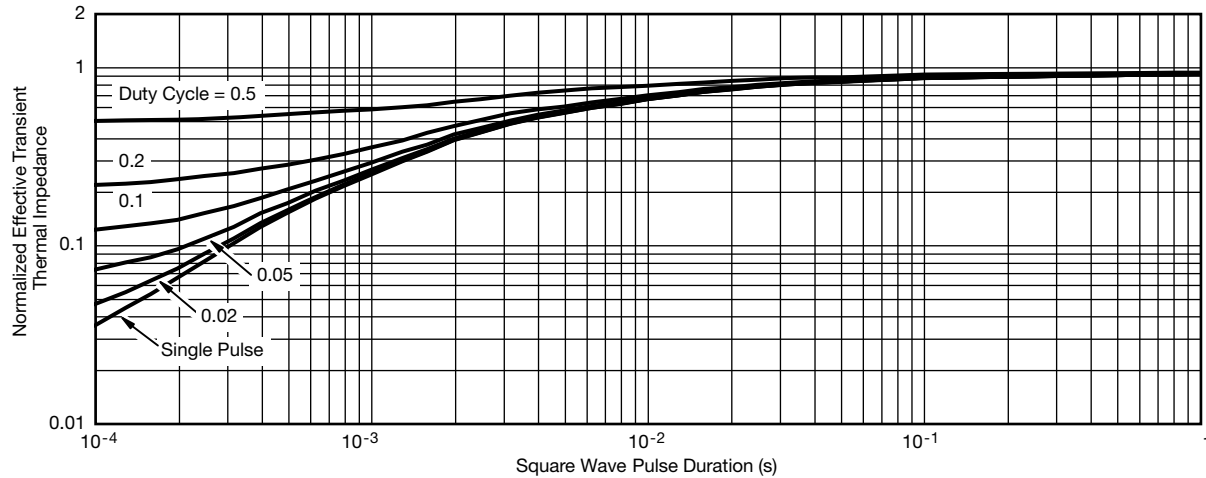
Safe Operating Area



Normalized Thermal Transient Impedance, Junction-to-Ambient



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



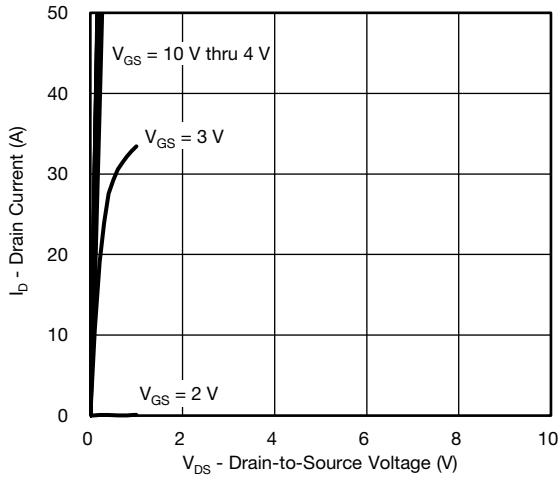
Normalized Thermal Transient Impedance, Junction-to-Case

Note

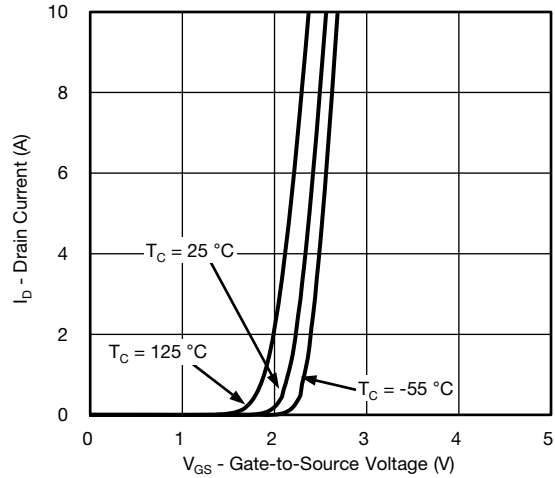
- The characteristics shown in the graph:
 - Normalized Transient Thermal Impedance Junction-to-Ambient ($25\text{ }^\circ\text{C}$) is given for general guidelines only to enable the user to get a “ball park” indication of part capabilities. The data are extracted from single pulse transient thermal 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.



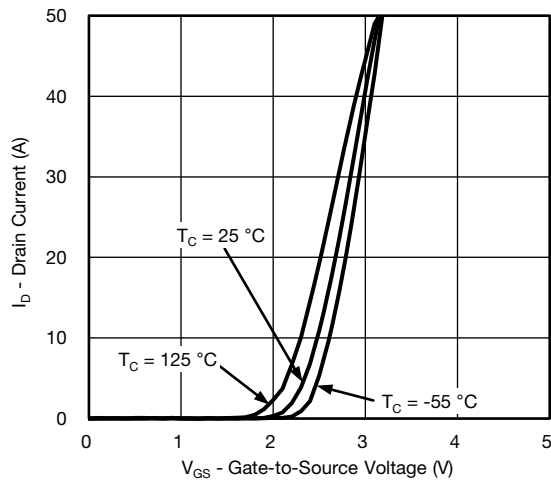
N-CHANNEL 2 TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^\circ\text{C}$, unless otherwise noted)



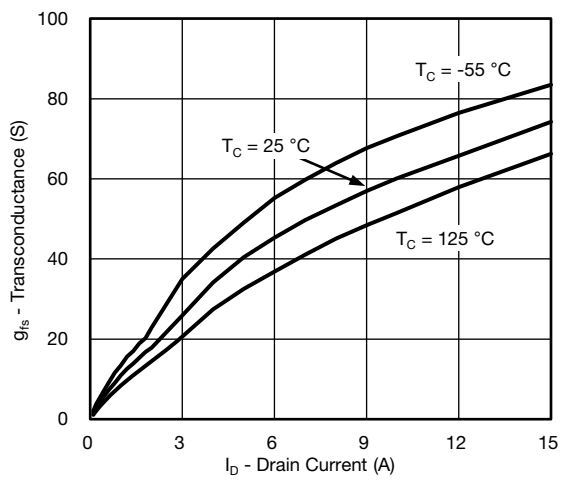
Output Characteristics



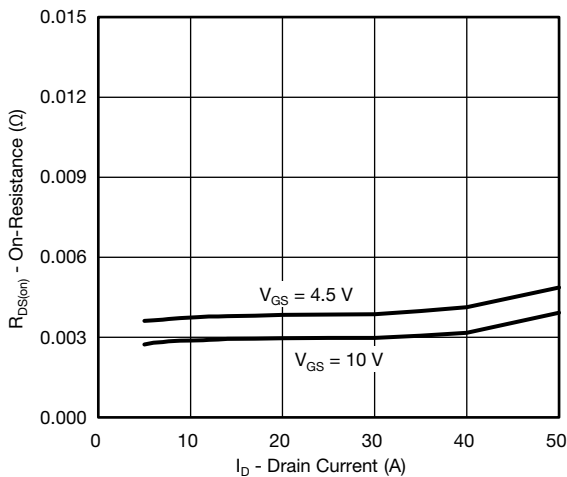
Transfer Characteristics



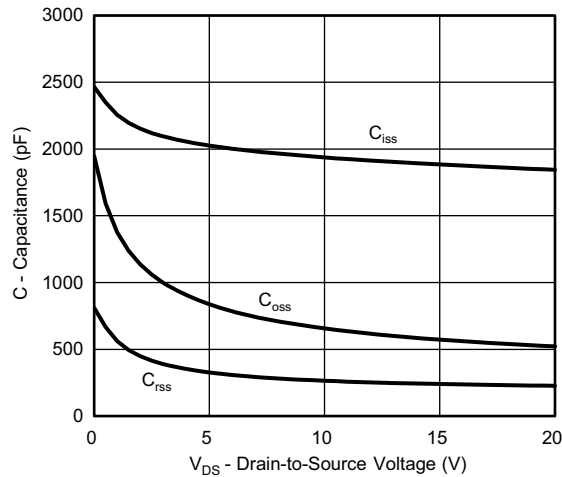
Transfer Characteristics



Transconductance



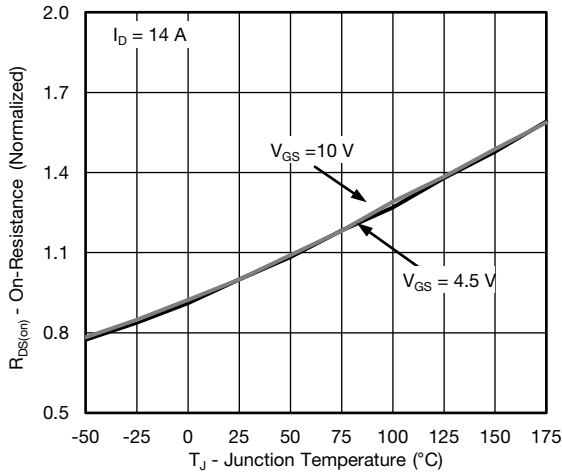
On-Resistance vs. Drain Current



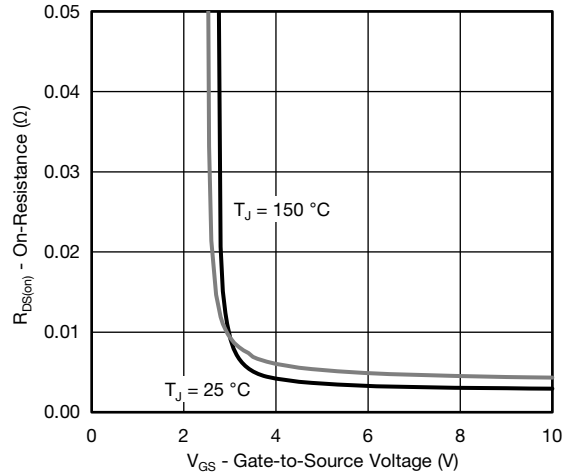
Capacitance



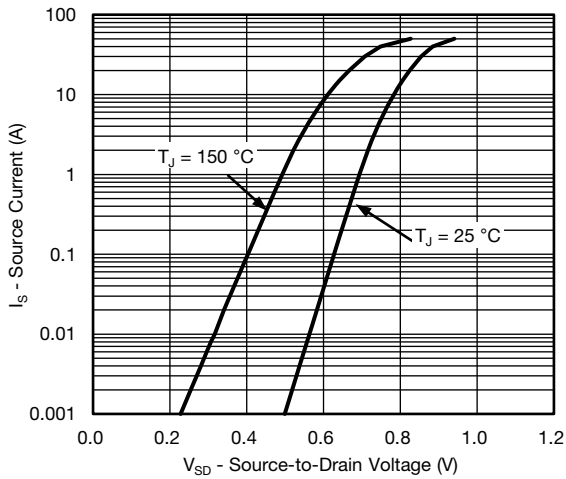
N-CHANNEL 2 TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^\circ\text{C}$, unless otherwise noted)



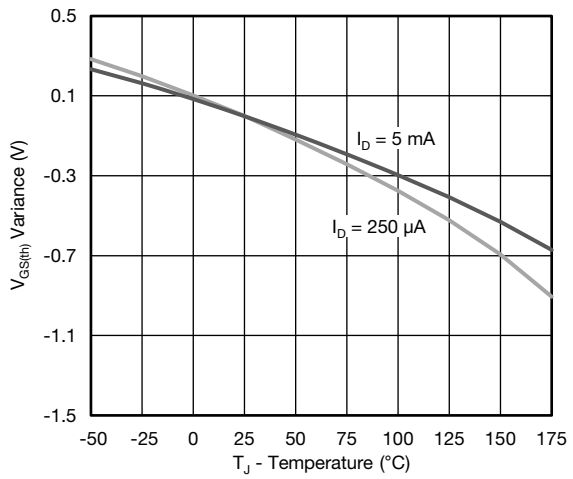
On-Resistance vs. Junction Temperature



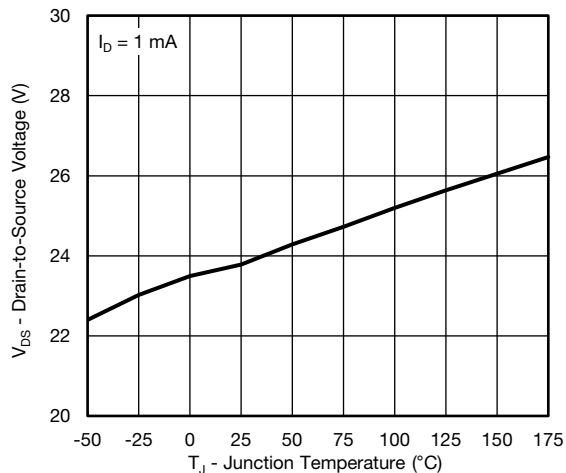
On-Resistance vs. Gate-to-Source Voltage



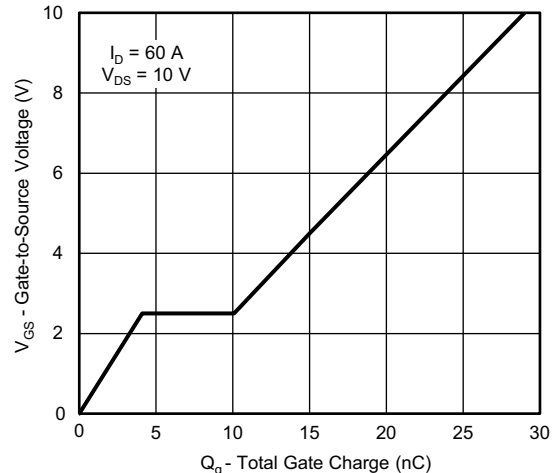
Source Drain Diode Forward Voltage



Threshold Voltage

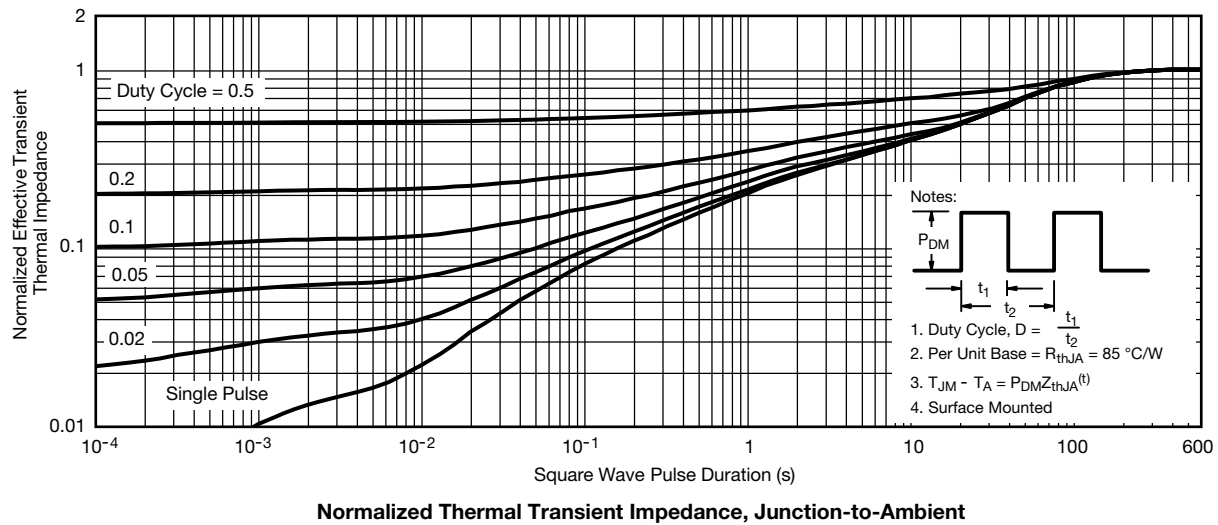
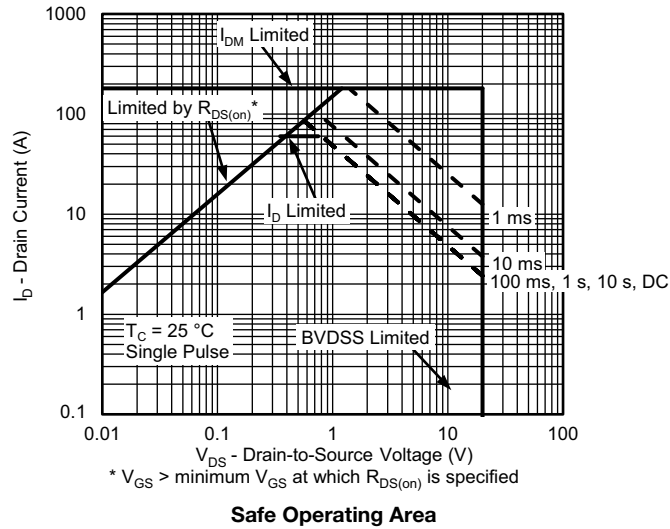


Drain Source Breakdown vs. Junction Temperature



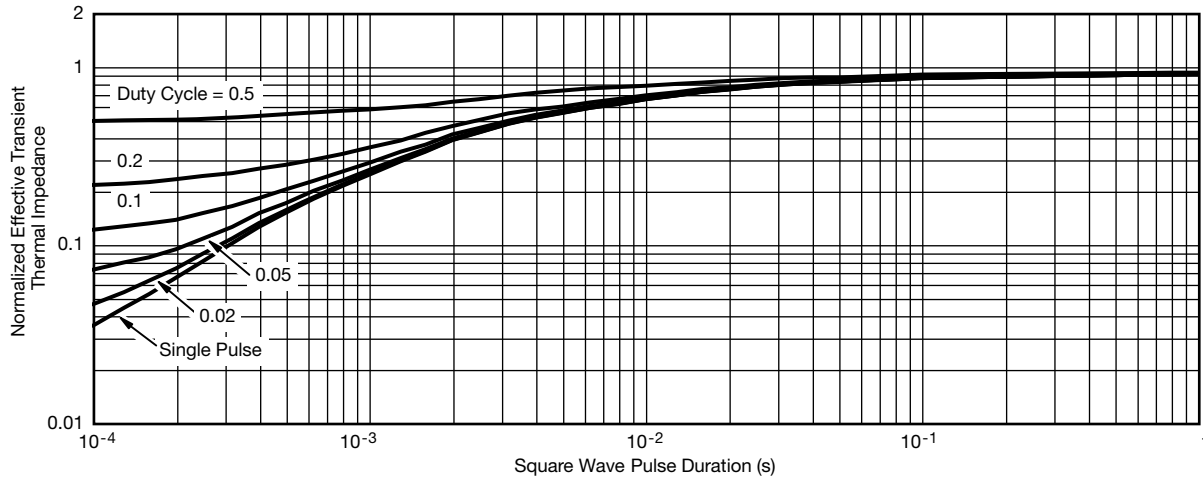
Gate Charge

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





N-CHANNEL 2 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 graph:
 - Normalized Transient Thermal Impedance Junction-to-Ambient (25 °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.

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?67774.



PowerPAK® SO-8L

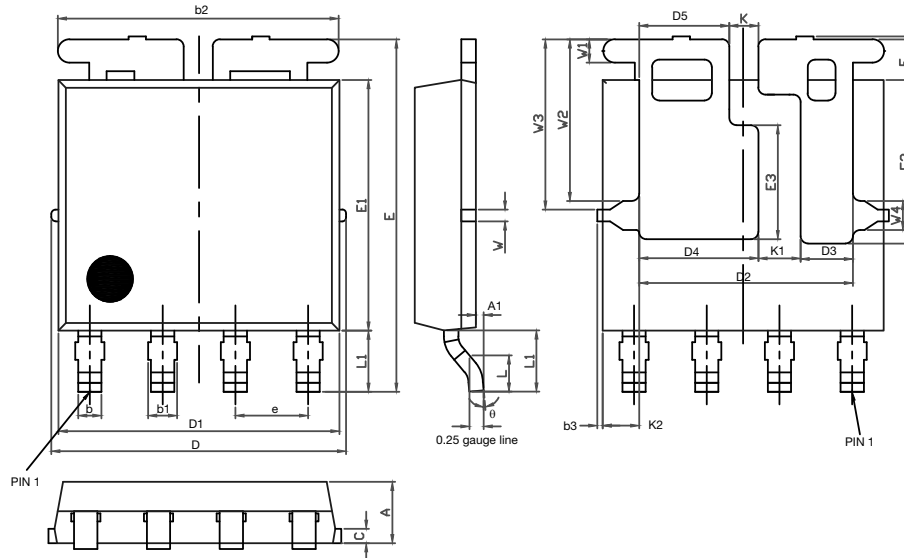
Ordering codes for the SQ rugged series power MOSFETs in the PowerPAK SO-8L package:

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
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SQJ459EP	-	SQJ459EP-T1_GE3
SQJ460AEP	-	SQJ460AEP-T1_GE3
SQJ461EP	SQJ461EP-T1-GE3	SQJ461EP-T1_GE3
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SQJ469EP	SQJ469EP-T1-GE3	SQJ469EP-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
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
SQJ956EP	SQJ956EP-T1-GE3	SQJ956EP-T1_GE3
SQJ960EP	SQJ960EP-T1-GE3	SQJ960EP-T1_GE3
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 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°

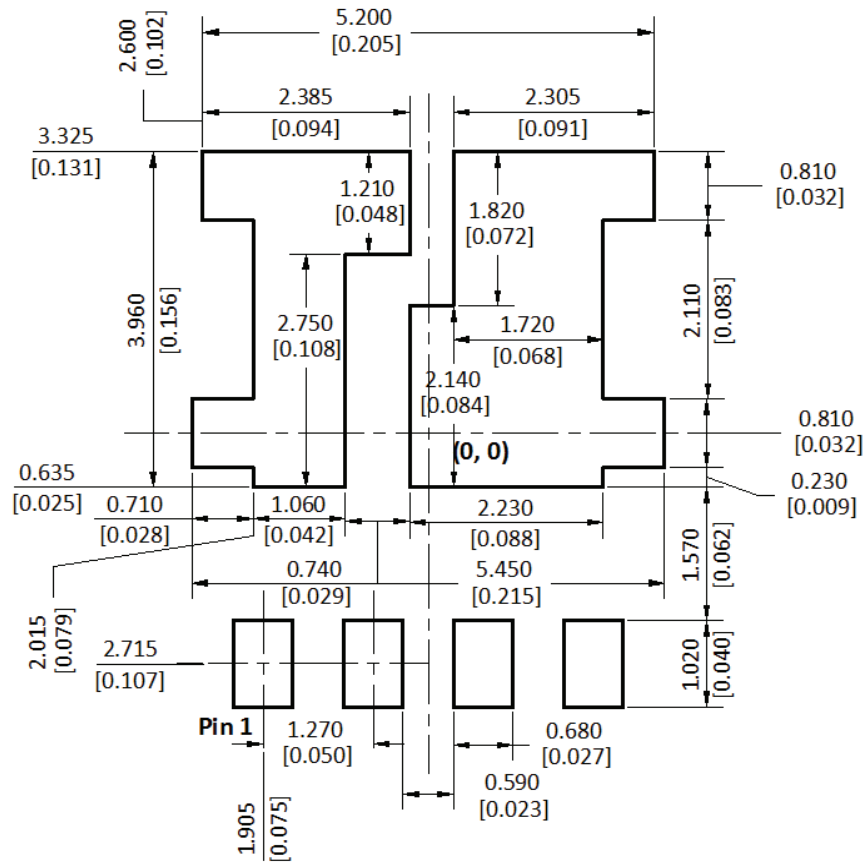
DWG: 6009

Note

- Millimeters will govern



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





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