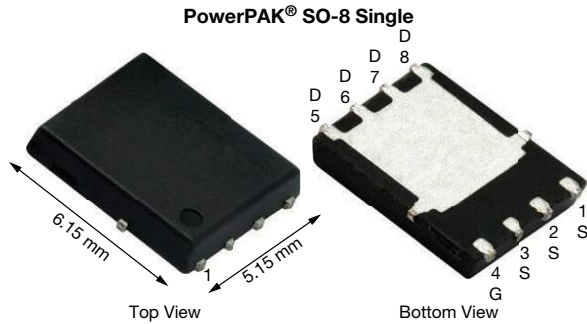


## N-Channel 20 V (D-S) MOSFET



### FEATURES

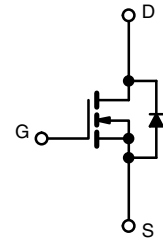
- TrenchFET® Gen IV power MOSFET
- Very low  $R_{DS(on)} \times Q_g$  figure-of-merit (FOM)
- Leadership  $R_{DS(on)}$  minimizes power loss from conduction
- 2.5 V ratings and operation at low voltage gate drive
- 100 %  $R_g$  and UIS tested
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

### APPLICATIONS

- Battery management
- DC/DC converters
- Load switch



N-Channel MOSFET

PRODUCT SUMMARY	
$V_{DS}$ (V)	20
$R_{DS(on)}$ max. ( $\Omega$ ) at $V_{GS} = 10$ V	0.0004
$R_{DS(on)}$ max. ( $\Omega$ ) at $V_{GS} = 4.5$ V	0.0005
$R_{DS(on)}$ max. ( $\Omega$ ) at $V_{GS} = 2.5$ V	0.0012
$Q_g$ typ. (nC)	95
$I_D$ (A) <sup>a</sup>	430
Configuration	Single

ORDERING INFORMATION	
Package	PowerPAK SO-8
Lead (Pb)-free and halogen-free	SiR178DP-T1-RE3

ABSOLUTE MAXIMUM RATINGS ( $T_A = 25$ °C, unless otherwise noted)			
PARAMETER	SYMBOL	LIMIT	UNIT
Drain-source voltage	$V_{DS}$	20	V
Gate-source voltage	$V_{GS}$	-8 / +12	V
Continuous drain current ( $T_J = 150$ °C)	$I_D$	$T_C = 25$ °C	430
		$T_C = 70$ °C	345
		$T_A = 25$ °C	100 <sup>b, c</sup>
		$T_A = 70$ °C	84.5 <sup>b, c</sup>
Pulsed drain current ( $t = 100$ $\mu$ s)	$I_{DM}$	500	A
Continuous source-drain diode current	$I_S$	$T_C = 25$ °C	94.5
		$T_A = 25$ °C	5.6 <sup>b, c</sup>
Single pulse avalanche current	$I_{AS}$	80	mJ
Single pulse avalanche energy	$E_{AS}$	320	
Maximum power dissipation	$P_D$	$T_C = 25$ °C	104
		$T_C = 70$ °C	67
		$T_A = 25$ °C	6.3 <sup>b, c</sup>
		$T_A = 70$ °C	4 <sup>b, c</sup>
Operating junction and storage temperature range	$T_J, T_{stg}$	-55 to +150	°C
Soldering recommendations (peak temperature) <sup>c</sup>		260	

THERMAL RESISTANCE RATINGS					
PARAMETER		SYMBOL	TYPICAL	MAXIMUM	UNIT
Maximum junction-to-ambient <sup>b</sup>	$t \leq 10$ s	$R_{thJA}$	15	20	°C/W
Maximum junction-to-case (drain)	Steady state	$R_{thJC}$	0.9	1.2	

### Notes

- $T_C = 25$  °C
- Surface mounted on 1" x 1" FR4 board
- $t = 10$  s
- See solder profile ([www.vishay.com/doc?73257](http://www.vishay.com/doc?73257)). The PowerPAK SO-8 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
- Maximum under steady state conditions is 54 °C/W



SPECIFICATIONS (T <sub>J</sub> = 25 °C, unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Static</b>						
Drain-source breakdown voltage	V <sub>DS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	20	-	-	V
V <sub>DS</sub> temperature coefficient	ΔV <sub>DS</sub> /T <sub>J</sub>	I <sub>D</sub> = 10 mA	-	14	-	mV/°C
V <sub>GS(th)</sub> temperature coefficient	ΔV <sub>GS(th)</sub> /T <sub>J</sub>	I <sub>D</sub> = 250 μA	-	-4.4	-	
Gate-source threshold voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	0.6	-	1.5	V
Gate-source leakage	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = -8 V / +12 V	-	-	± 150	nA
Zero gate voltage drain current	I <sub>DSS</sub>	V <sub>DS</sub> = 20 V, V <sub>GS</sub> = 0 V	-	-	1	μA
		V <sub>DS</sub> = 20 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 70 °C	-	-	15	
On-state drain current <sup>a</sup>	I <sub>D(on)</sub>	V <sub>DS</sub> ≥ 10 V, V <sub>GS</sub> = 10 V	20	-	-	A
Drain-source on-state resistance <sup>a</sup>	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 30 A	-	0.00031	0.0004	Ω
		V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 30 A	-	0.00038	0.0005	
		V <sub>GS</sub> = 2.5 V, I <sub>D</sub> = 30 A	-	0.00074	0.0012	
Forward transconductance <sup>a</sup>	g <sub>fs</sub>	V <sub>DS</sub> = 15 V, I <sub>D</sub> = 50 A	-	295	-	S
<b>Dynamic <sup>b</sup></b>						
Input capacitance	C <sub>ISS</sub>	V <sub>DS</sub> = 10 V, V <sub>GS</sub> = 0 V, f = 1 MHz	-	12 430	-	pF
Output capacitance	C <sub>OSS</sub>		-	4070	-	
Reverse transfer capacitance	C <sub>RSS</sub>		-	740	-	
Total gate charge	Q <sub>g</sub>	V <sub>DS</sub> = 10 V, V <sub>GS</sub> = 10 V, I <sub>D</sub> = 20 A	-	207	310	nC
		V <sub>DS</sub> = 10 V, V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 20 A	-	95	143	
Gate-source charge	Q <sub>gs</sub>		-	26.6	-	
Gate-drain charge	Q <sub>gd</sub>		-	18.219	-	
Output charge	Q <sub>OSS</sub>	V <sub>DS</sub> = 10 V, V <sub>GS</sub> = 0 V	-	62	-	
Gate resistance	R <sub>g</sub>	f = 1 MHz	0.2	0.94	1.9	Ω
Turn-on delay time	t <sub>d(on)</sub>	V <sub>DD</sub> = 10 V, R <sub>L</sub> = 1 Ω, I <sub>D</sub> ≅ 10 A, V <sub>GEN</sub> = 10 V, R <sub>g</sub> = 1 Ω	-	17	40	ns
Rise time	t <sub>r</sub>		-	10	20	
Turn-off delay time	t <sub>d(off)</sub>		-	83	170	
Fall time	t <sub>f</sub>		-	14	30	
Turn-on delay time	t <sub>d(on)</sub>	V <sub>DD</sub> = 10 V, R <sub>L</sub> = 1 Ω, I <sub>D</sub> ≅ 10 A, V <sub>GEN</sub> = 4.5 V, R <sub>g</sub> = 1 Ω	-	44	90	
Rise time	t <sub>r</sub>		-	64	130	
Turn-off delay time	t <sub>d(off)</sub>		-	128	260	
Fall time	t <sub>f</sub>		-	39	80	
<b>Drain-Source Body Diode Characteristics</b>						
Continuous source-drain diode current	I <sub>S</sub>	T <sub>C</sub> = 25 °C	-	-	100	A
Pulse diode forward current	I <sub>SM</sub>		-	-	300	
Body diode voltage	V <sub>SD</sub>	I <sub>S</sub> = 10 A, V <sub>GS</sub> = 0 V	-	0.7	1.1	V
Body diode reverse recovery time	t <sub>rr</sub>	I <sub>F</sub> = 10 A, di/dt = 100 A/μs, T <sub>J</sub> = 25 °C	-	46	90	ns
Body diode reverse recovery charge	Q <sub>rr</sub>		-	55	110	nC
Reverse recovery fall time	t <sub>a</sub>		-	27	-	ns
Reverse recovery rise time	t <sub>b</sub>		-	19	-	

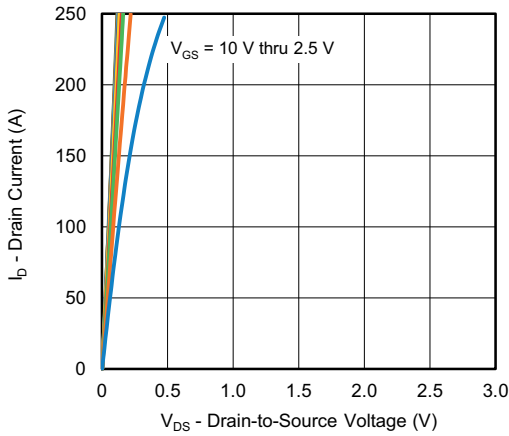
**Notes**

- g. Pulse test; pulse width ≤ 300 μs, duty cycle ≤ 2 %
- h. Guaranteed by design, not subject to production testing

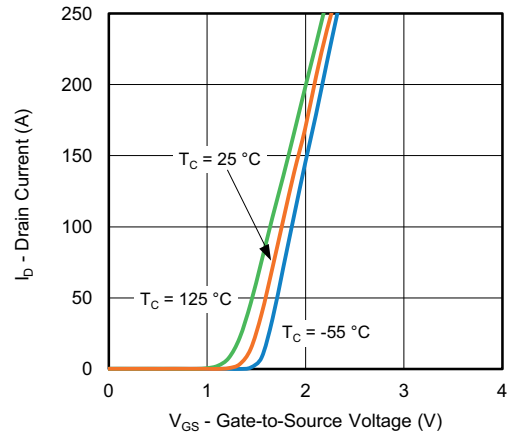
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



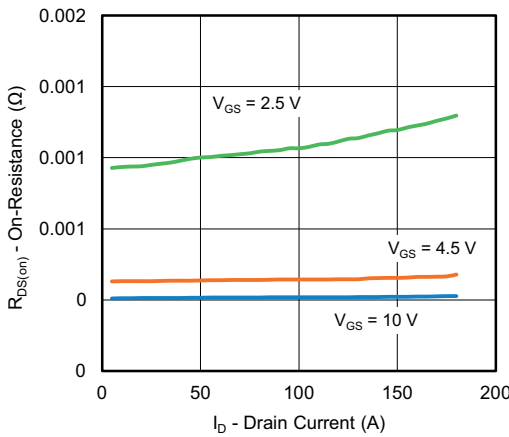
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



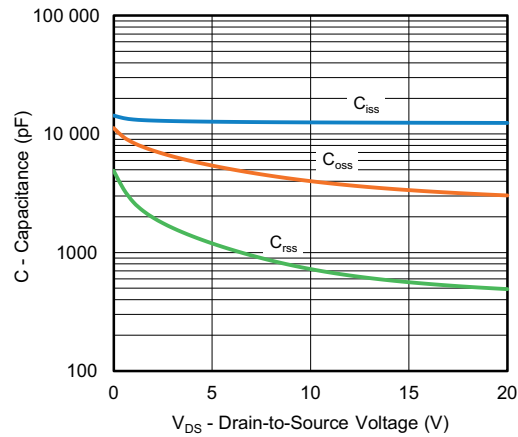
Output Characteristics



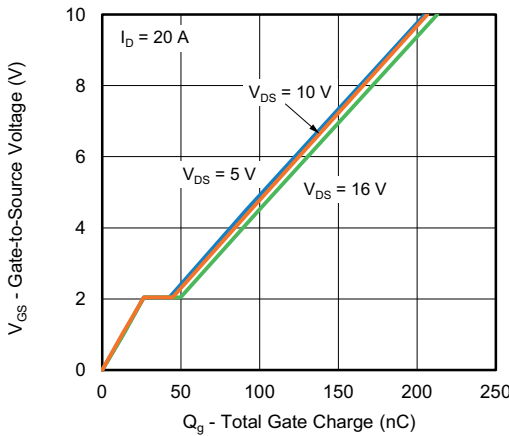
Transfer Characteristics



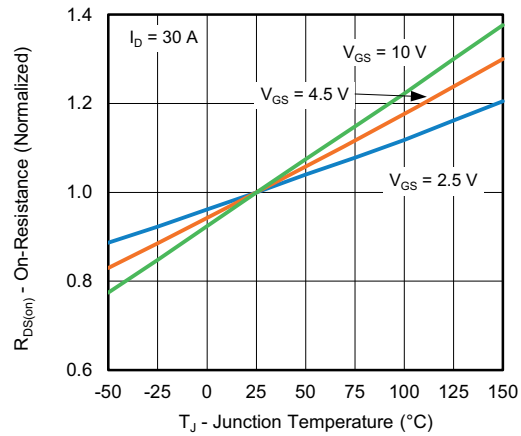
On-Resistance vs. Drain Current and Gate Voltage



Capacitance



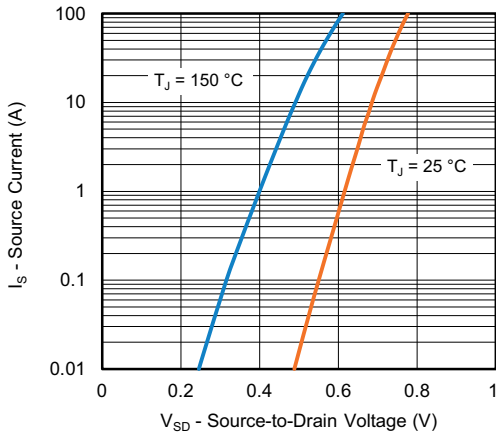
Gate Charge



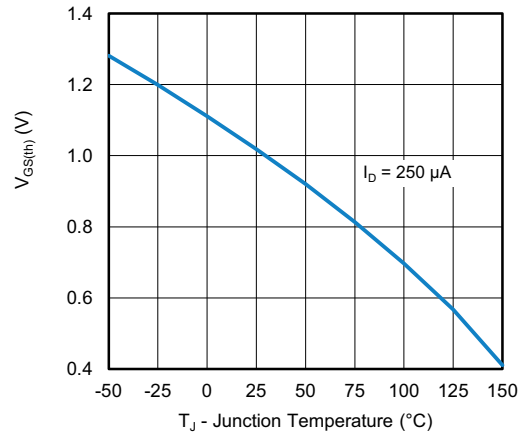
On-Resistance vs. Junction Temperature



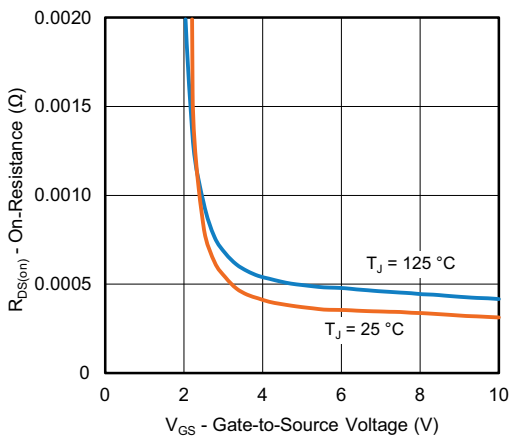
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



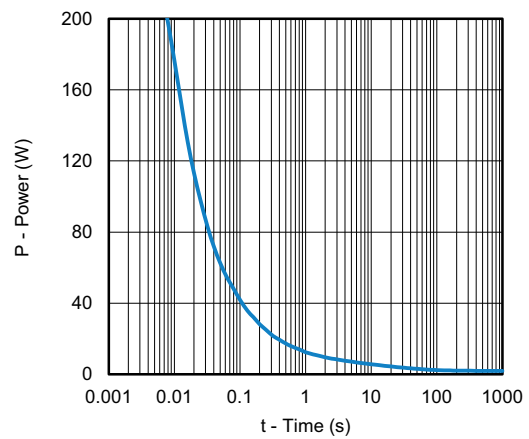
Source-Drain Diode Forward Voltage



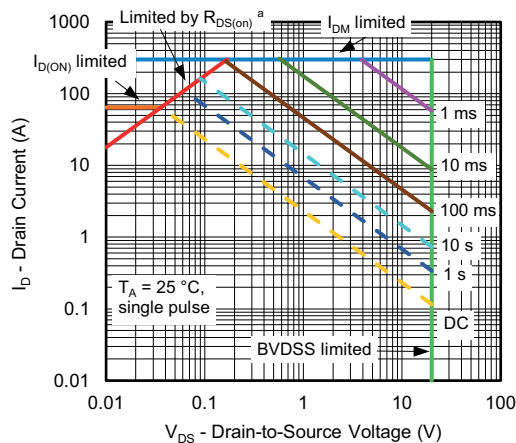
Threshold Voltage



On-Resistance vs. Gate-to-Source Voltage



Single Pulse Power, Junction-to-Ambient



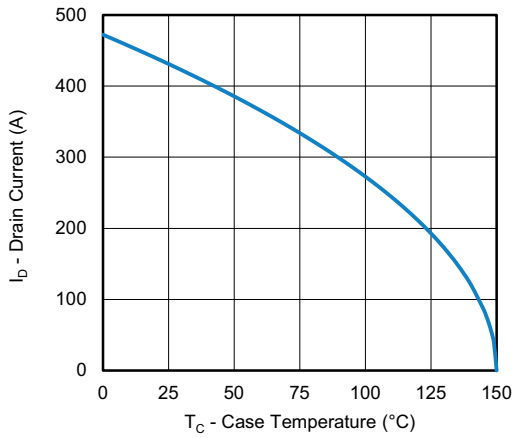
Safe Operating Area, Junction-to-Ambient

Note

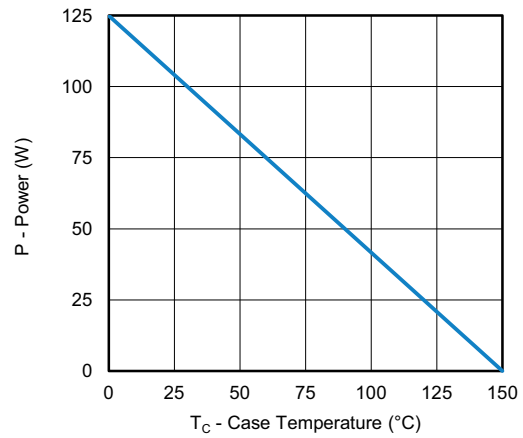
a.  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified



**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



**Current Derating <sup>a</sup>**



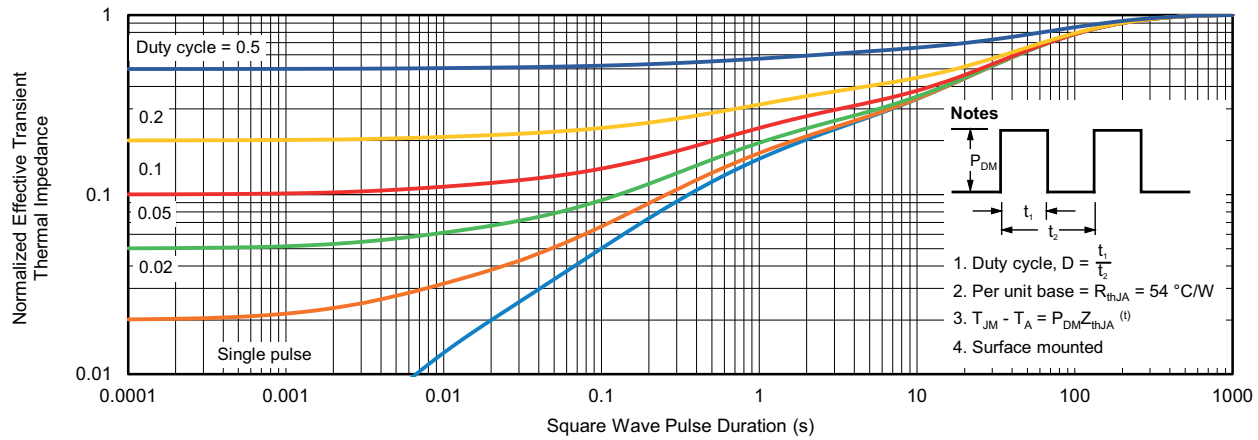
**Power, Junction-to-Case**

**Note**

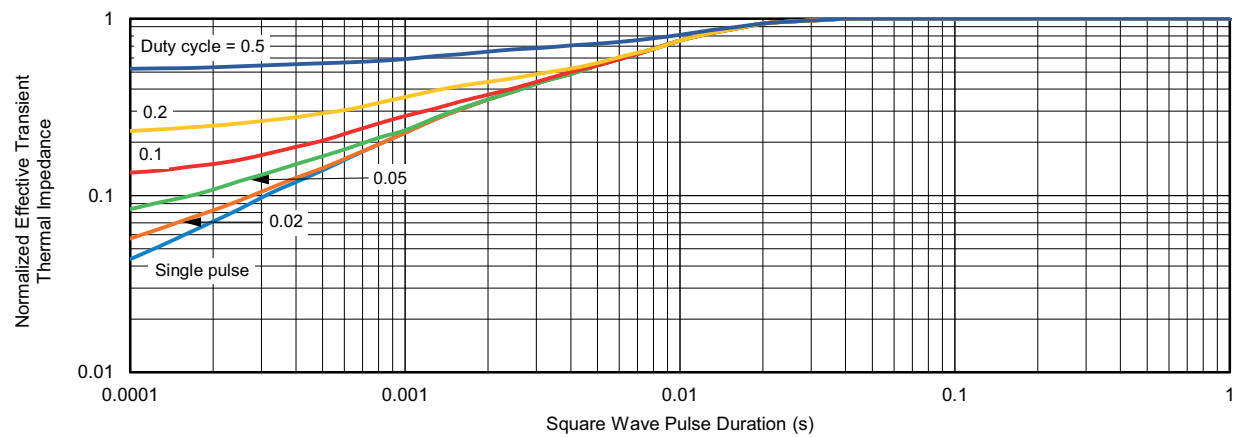
- a. The power dissipation  $P_D$  is based on  $T_{J \text{ max.}} = 150 \text{ °C}$ , using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit



TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



Normalized Thermal Transient Impedance, Junction-to-Ambient



Normalized Thermal Transient Impedance, Junction-to-Case

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# PowerPAK<sup>®</sup> SO-8, (Single/Dual)



- Notes**
1. Inch will govern.
  2. Dimensions exclusive of mold gate burrs.
  3. Dimensions exclusive of mold flash and cutting burrs.

DIM.	MILLIMETERS			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.97	1.04	1.12	0.038	0.041	0.044
A1		-	0.05	0	-	0.002
b	0.33	0.41	0.51	0.013	0.016	0.020
c	0.23	0.28	0.33	0.009	0.011	0.013
D	5.05	5.15	5.26	0.199	0.203	0.207
D1	4.80	4.90	5.00	0.189	0.193	0.197
D2	3.56	3.76	3.91	0.140	0.148	0.154
D3	1.32	1.50	1.68	0.052	0.059	0.066
D4	0.57 typ.			0.0225 typ.		
D5	3.98 typ.			0.157 typ.		
E	6.05	6.15	6.25	0.238	0.242	0.246
E1	5.79	5.89	5.99	0.228	0.232	0.236
E2	3.48	3.66	3.84	0.137	0.144	0.151
E3	3.68	3.78	3.91	0.145	0.149	0.154
E4	0.75 typ.			0.030 typ.		
e	1.27 BSC			0.050 BSC		
K	1.27 typ.			0.050 typ.		
K1	0.56	-	-	0.022	-	-
H	0.51	0.61	0.71	0.020	0.024	0.028
L	0.51	0.61	0.71	0.020	0.024	0.028
L1	0.06	0.13	0.20	0.002	0.005	0.008
θ	0°	-	12°	0°	-	12°
W	0.15	0.25	0.36	0.006	0.010	0.014
M	0.125 typ.			0.005 typ.		
ECN: S17-0173-Rev. L, 13-Feb-17						
DWG: 5881						

## RECOMMENDED MINIMUM PADS FOR PowerPAK® SO-8 Single



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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