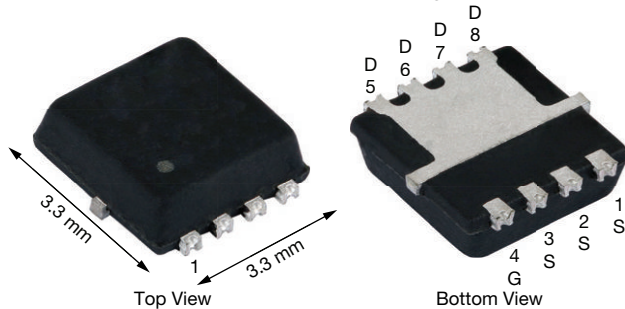


# Automotive P-Channel 60 V (D-S) 175 °C MOSFET

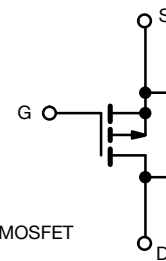
**PowerPAK® 1212-8W Single**

**Marking code: Q021**

PRODUCT SUMMARY	
$V_{DS}$ (V)	-60
$R_{DS(on)}$ ( $\Omega$ ) at $V_{GS} = -10$ V	0.065
$R_{DS(on)}$ ( $\Omega$ ) at $V_{GS} = -4.5$ V	0.090
$I_D$ (A)	-16
Configuration	Single
Package	PowerPAK 1212-8W

**FEATURES**

- TrenchFET® power MOSFET
- Low thermal resistance PowerPAK® 1212-8W package with 1.07 mm profile
- AEC-Q101 qualified
- Wettable flank terminals
- 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)

AUTOMOTIVE GRADE


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


P-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS ( $T_A = 25$ °C, unless otherwise noted)				
PARAMETER		SYMBOL	LIMIT	UNIT
Drain-source voltage		$V_{DS}$	-60	V
Gate-source voltage		$V_{GS}$	$\pm 20$	
Continuous drain current	$T_C = 25$ °C <sup>a</sup>	$I_D$	-16	A
	$T_C = 125$ °C		-11	
Continuous source current (diode conduction) <sup>a</sup>		$I_S$	-16	
Pulsed drain current <sup>b</sup>		$I_{DM}$	-64	
Single pulse avalanche current	L = 0.1 mH	$I_{AS}$	-23	
Single pulse avalanche energy		$E_{AS}$	26	
Maximum power dissipation <sup>b</sup>	$T_C = 25$ °C	$P_D$	53	W
	$T_C = 125$ °C		17	
Operating junction and storage temperature range		$T_J, T_{stg}$	-55 to +175	°C
Soldering recommendations (peak temperature) <sup>d</sup>			260	

THERMAL RESISTANCE RATINGS				
PARAMETER		SYMBOL	LIMIT	UNIT
Junction-to-ambient	PCB Mount <sup>c</sup>	$R_{thJA}$	81	°C/W
Junction-to-case (drain)		$R_{thJC}$	2.8	

**Notes**

- Package limited
- Pulse test; pulse width  $\leq 300$   $\mu$ s, duty cycle  $\leq 2$  %
- When mounted on 1" square PCB (FR4 material)
- 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
<b>Static</b>							
Drain-source breakdown voltage	$V_{DS}$	$V_{GS} = 0\text{ V}$ , $I_D = -250\text{ }\mu\text{A}$		-60	-	-	V
Gate-source threshold voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$ , $I_D = -250\text{ }\mu\text{A}$		-1.5	-2.0	-2.5	
Gate-source leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 20\text{ V}$		-	-	$\pm 100$	nA
Zero gate voltage drain current	$I_{DSS}$	$V_{GS} = 0\text{ V}$	$V_{DS} = -60\text{ V}$	-	-	-1	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$	$V_{DS} = -60\text{ V}$ , $T_J = 125\text{ }^\circ\text{C}$	-	-	-50	
		$V_{GS} = 0\text{ V}$	$V_{DS} = -60\text{ V}$ , $T_J = 175\text{ }^\circ\text{C}$	-	-	-150	
On-state drain current <sup>a</sup>	$I_{D(on)}$	$V_{GS} = -10\text{ V}$	$V_{DS} \leq -5\text{ V}$	-15	-	-	A
Drain-source on-state resistance <sup>a</sup>	$R_{DS(on)}$	$V_{GS} = -10\text{ V}$	$I_D = -5.7\text{ A}$	-	0.050	0.065	$\Omega$
		$V_{GS} = -10\text{ V}$	$I_D = -5.7\text{ A}$ , $T_J = 125\text{ }^\circ\text{C}$	-	-	0.112	
		$V_{GS} = -10\text{ V}$	$I_D = -5.7\text{ A}$ , $T_J = 175\text{ }^\circ\text{C}$	-	-	0.138	
		$V_{GS} = -4.5\text{ V}$	$I_D = -4.4\text{ A}$	-	0.070	0.090	
Forward transconductance <sup>b</sup>	$g_{fs}$	$V_{DS} = -15\text{ V}$ , $I_D = -5.7\text{ A}$		-	13	-	S
<b>Dynamic <sup>b</sup></b>							
Input capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}$	$V_{DS} = -25\text{ V}$ , $f = 1\text{ MHz}$	-	1108	1385	$\mu\text{F}$
Output capacitance	$C_{oss}$			-	132	165	
Reverse transfer capacitance	$C_{rss}$			-	84	105	
Total gate charge <sup>c</sup>	$Q_g$	$V_{GS} = -10\text{ V}$	$V_{DS} = -30\text{ V}$ , $I_D = -5.7\text{ A}$	-	25.5	38	nC
Gate-source charge <sup>c</sup>	$Q_{gs}$			-	3.6	-	
Gate-drain charge <sup>c</sup>	$Q_{gd}$			-	6.7	-	
Gate resistance	$R_g$	$f = 1\text{ MHz}$		3	6	9	$\Omega$
Turn-on delay time <sup>c</sup>	$t_{d(on)}$	$V_{DD} = -30\text{ V}$ , $R_L = 30\text{ }\Omega$ $I_D \cong -1\text{ A}$ , $V_{GEN} = -10\text{ V}$ , $R_g = 1\text{ }\Omega$		-	9	14	ns
Rise time <sup>c</sup>	$t_r$			-	9	14	
Turn-off delay time <sup>c</sup>	$t_{d(off)}$			-	37	56	
Fall time <sup>c</sup>	$t_f$			-	8	12	
<b>Source-drain diode ratings and characteristics <sup>b</sup></b>							
Pulsed current <sup>a</sup>	$I_{SM}$			-	-	-64	A
Forward voltage	$V_{SD}$	$I_F = -6\text{ A}$ , $V_{GS} = 0\text{ V}$		-	-0.85	-1.2	V

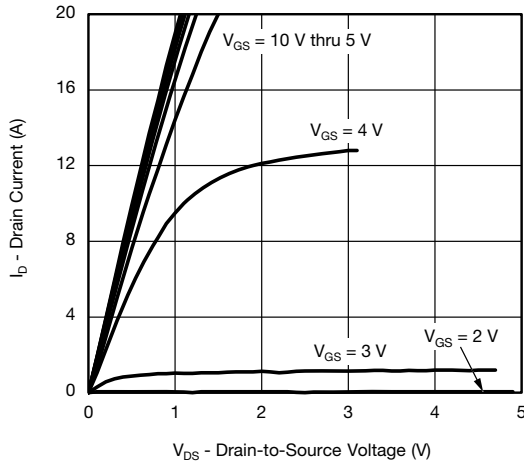
**Notes**

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

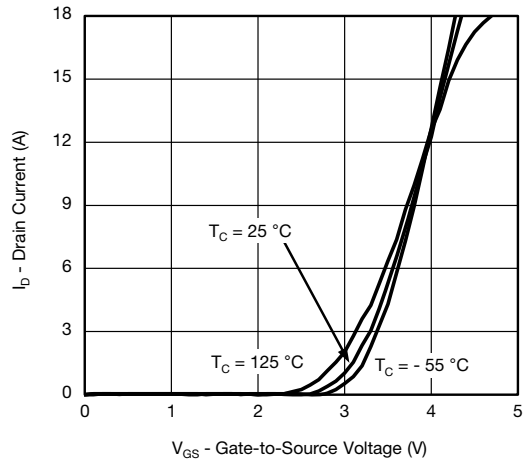
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



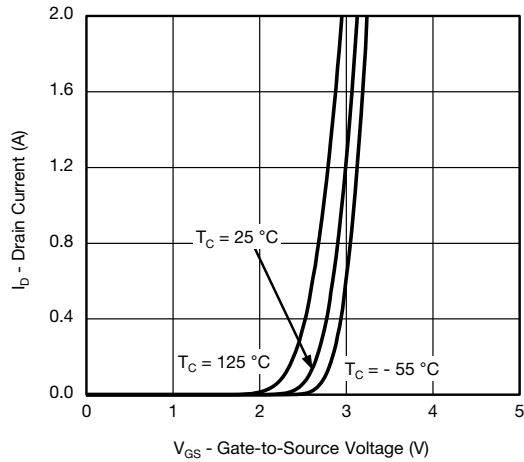
TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C, unless otherwise noted)



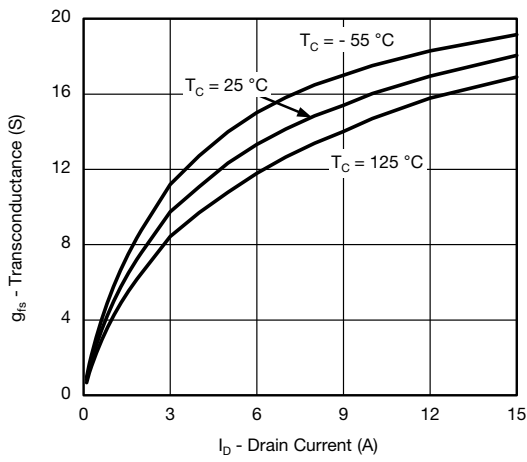
Output Characteristics



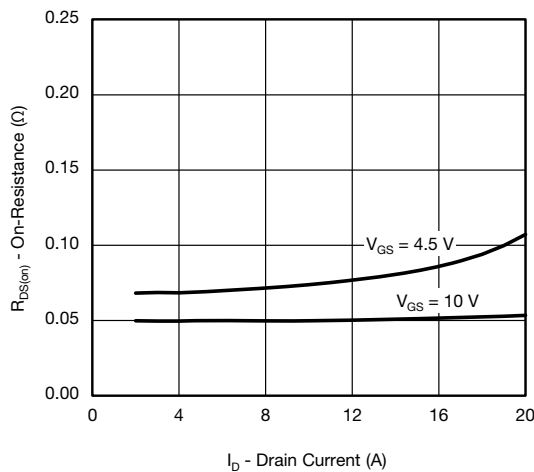
Transfer Characteristics



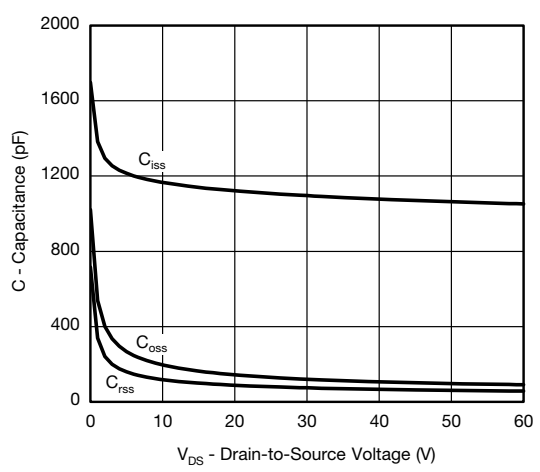
Transfer Characteristics



Transconductance



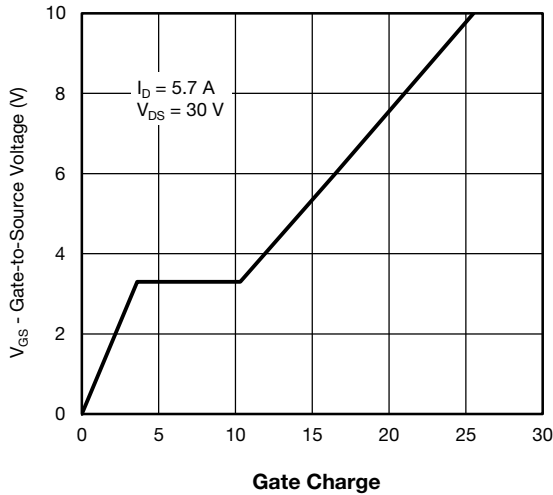
On-Resistance vs. Drain Current



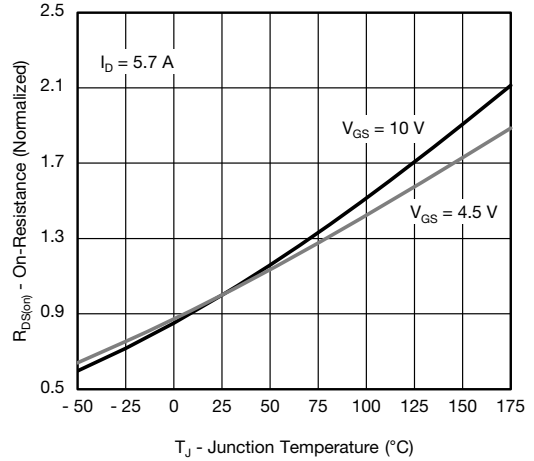
Capacitance



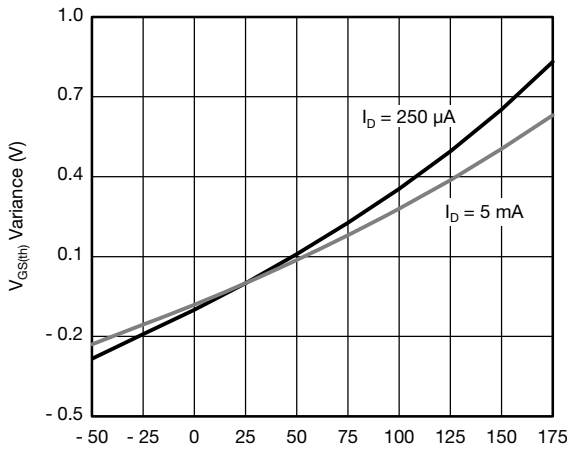
TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C, unless otherwise noted)



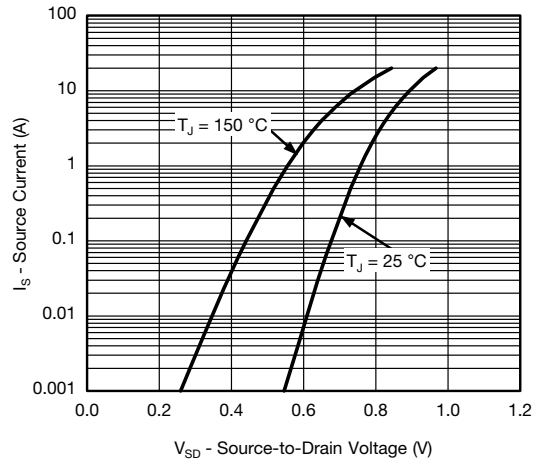
Gate Charge



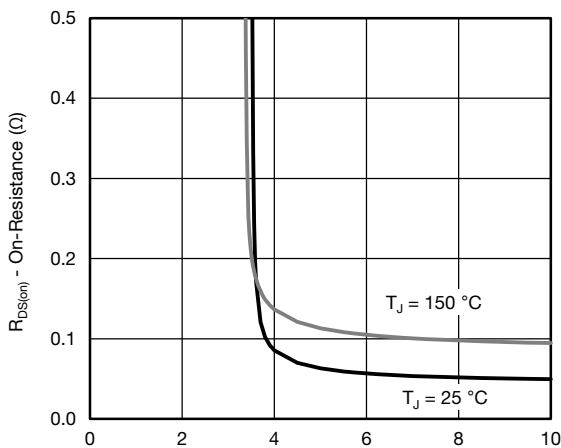
On-Resistance vs. Junction Temperature



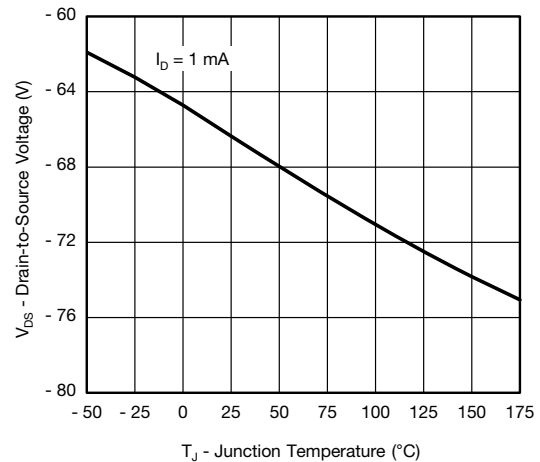
Threshold Voltage



Source Drain Diode Forward Voltage



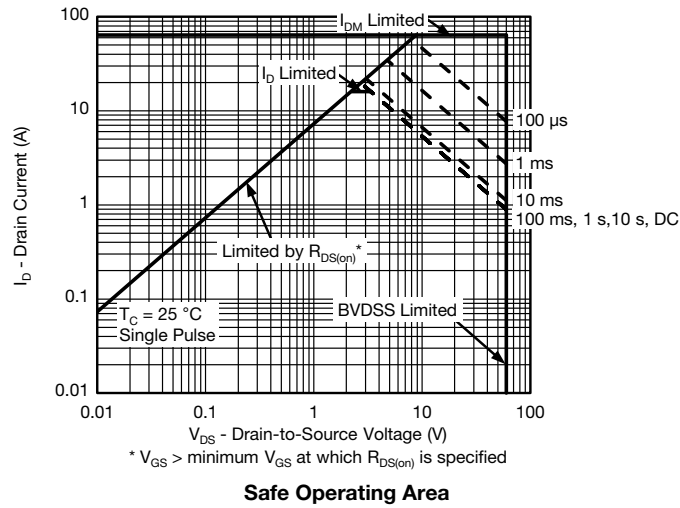
On-Resistance vs. Gate-to-Source Voltage



Drain Source Breakdown vs. Junction Temperature

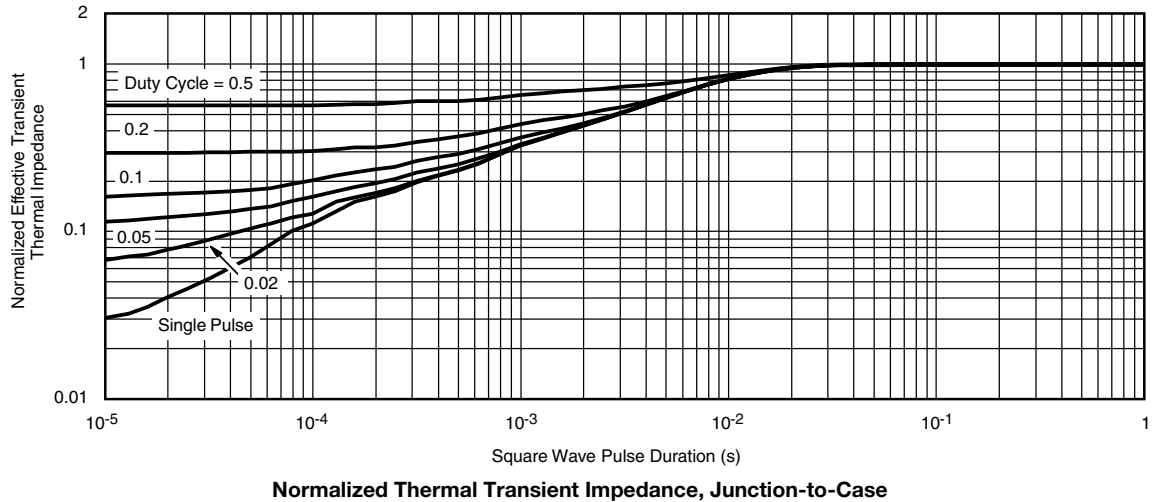
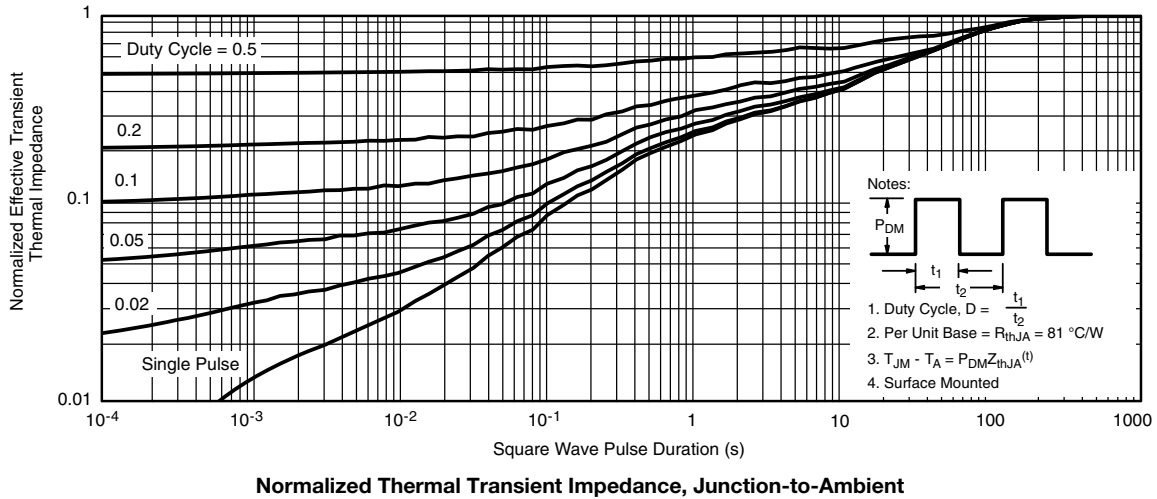


**THERMAL RATINGS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)





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



**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

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### PowerPAK® 1212-8W Case Outline



DIM.	MILLIMETERS			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.97	1.04	1.12	0.038	0.041	0.044
A1	0	-	0.05	0	-	0.002
A2	0	-	0.13	0	-	0.005
b	0.23	0.30	0.41	0.009	0.012	0.016
c	0.23	0.28	0.33	0.009	0.011	0.013
D	3.20	3.30	3.40	0.126	0.130	0.134
D1	2.95	3.05	3.15	0.116	0.120	0.124
D2	1.98	2.11	2.24	0.078	0.083	0.088
D4	0.47 typ.			0.0185 typ.		
D5	2.3 typ.			0.090 typ.		
E	3.20	3.30	3.40	0.126	0.130	0.134
E1	2.95	3.05	3.15	0.116	0.120	0.124
E2	1.47	1.60	1.73	0.058	0.063	0.068
E3	1.75	1.85	1.98	0.069	0.073	0.078
E4	0.34 typ.			0.013 typ.		
e	0.65 BSC.			0.026 BSC		
K	0.86 typ.			0.034 typ.		
H	0.30	0.41	0.51	0.012	0.016	0.020
L	0.30	0.43	0.56	0.012	0.017	0.022
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: C15-1530-Rev. B, 16-Nov-15						
DWG: 6032						

## RECOMMENDED MINIMUM PADS FOR PowerPAK® 1212-8 Single



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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