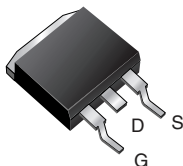


# Power MOSFET

**SMD-220**


N-Channel MOSFET

## FEATURES

- Surface-mount
- Available in tape and reel
- Dynamic dV/dt rating
- Repetitive avalanche rated
- Fast switching
- Ease of paralleling
- Simple drive requirements
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS\***  
Available  
**HALOGEN**  
**FREE**  
Available

## Note

\* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details

## DESCRIPTION

Third generation power MOSFETs from Vishay provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

The D<sup>2</sup>PAK (TO-263) is a surface-mount power package capable of accommodating die size up to HEX-4. It provides the highest power capability and the lowest possible on-resistance in any existing surface mount package. The D<sup>2</sup>PAK (TO-263) is suitable for high current applications because of its low internal connection resistance and can dissipate up to 2.0 W in a typical surface mount application.

## PRODUCT SUMMARY

V <sub>DS</sub> (V)	400	
R <sub>DS(on)</sub> (Ω)	V <sub>GS</sub> = 10 V	1.0
Q <sub>g</sub> max. (nC)	38	
Q <sub>gs</sub> (nC)	5.7	
Q <sub>gd</sub> (nC)	22	
Configuration	Single	

## ORDERING INFORMATION

Package	D <sup>2</sup> PAK (TO-263)	D <sup>2</sup> PAK (TO-263)	D <sup>2</sup> PAK (TO-263)
Lead (Pb)-free and Halogen-free	SiHF730S-GE3	SiHF730STRL-GE3 <sup>a</sup>	SiHF730STRR-GE3 <sup>a</sup>
Lead (Pb)-free	IRF730SPbF	IRF730STRLPbF <sup>a</sup>	IRF730STRRPbF

## Note

a. See device orientation

## ABSOLUTE MAXIMUM RATINGS (T<sub>C</sub> = 25 °C, unless otherwise noted)

PARAMETER	SYMBOL	LIMIT	UNIT
Drain-Source Voltage	V <sub>DS</sub>	400	V
Gate-Source Voltage	V <sub>GS</sub>	± 20	
Continuous Drain Current	V <sub>GS</sub> at 10 V	T <sub>C</sub> = 25 °C	A
		T <sub>C</sub> = 100 °C	
Pulsed Drain Current <sup>a</sup>	I <sub>DM</sub>	22	
Linear Derating Factor		0.59	W/°C
Linear Derating Factor (PCB mount) <sup>e</sup>		0.025	
Single Pulse Avalanche Energy <sup>b</sup>	E <sub>AS</sub>	290	mJ
Avalanche Current <sup>a</sup>	I <sub>AR</sub>	5.5	A
Repetitive Avalanche Energy <sup>a</sup>	E <sub>AR</sub>	7.4	mJ
Maximum Power Dissipation	P <sub>D</sub>	T <sub>C</sub> = 25 °C	W
Maximum Power Dissipation (PCB mount) <sup>e</sup>		T <sub>A</sub> = 25 °C	
Peak Diode Recovery dV/dt <sup>c</sup>	dV/dt	4.0	V/ns
Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	-55 to +150	°C
Soldering Recommendations (Peak temperature) <sup>d</sup>	For 10 s	300	

## Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
- V<sub>DD</sub> = 50 V, starting T<sub>J</sub> = 25 °C, L = 16 mH, R<sub>g</sub> = 25 Ω, I<sub>AS</sub> = 5.5 A (see fig. 12)
- I<sub>SD</sub> ≤ 5.5 A, dI/dt ≤ 90 A/μs, V<sub>DD</sub> ≤ V<sub>DS</sub>, T<sub>J</sub> ≤ 150 °C
- 1.6 mm from case
- When mounted on 1" square PCB (FR-4 or G-10 material)

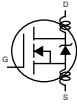

**THERMAL RESISTANCE RATINGS**

PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	62	°C/W
Maximum Junction-to-Ambient (PCB mount) <sup>a</sup>	$R_{thJA}$	-	40	
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	1.7	

**Note**

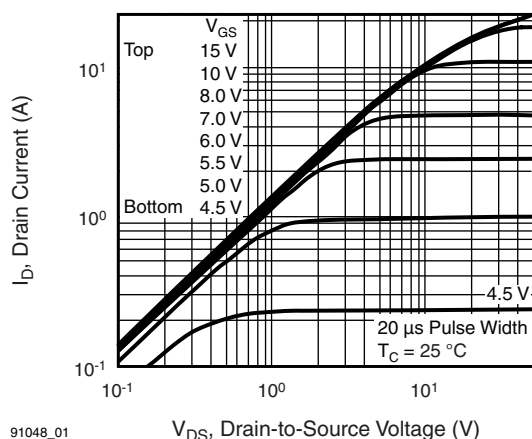
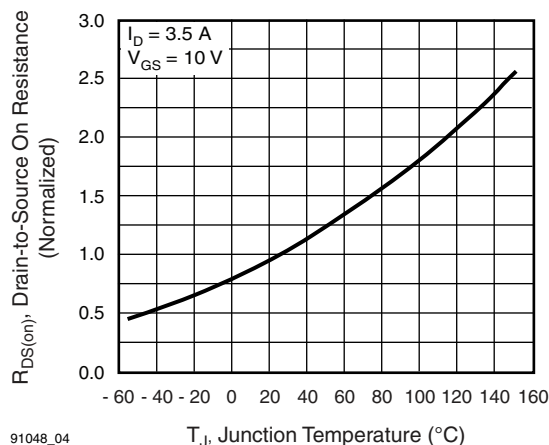
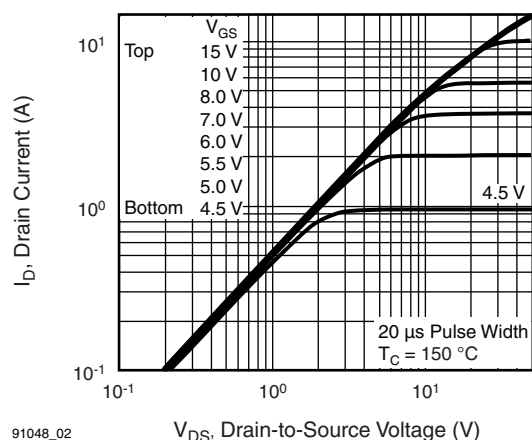
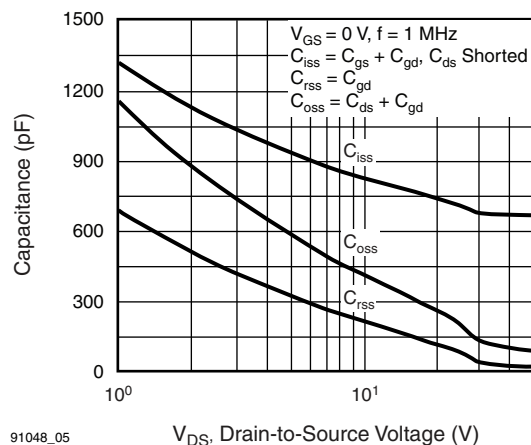
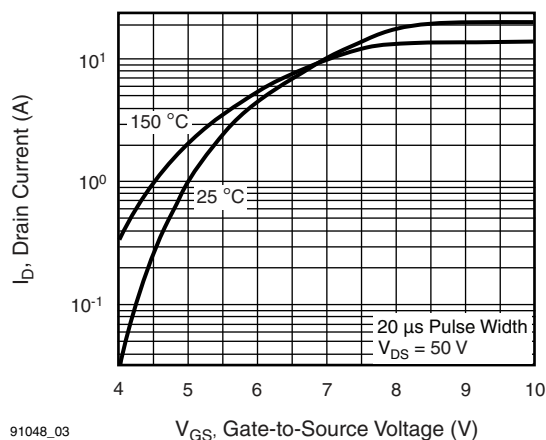
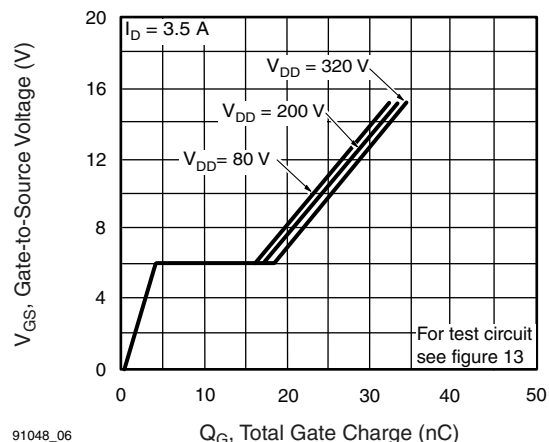
a. When mounted on 1" square PCB (FR-4 or G-10 material)

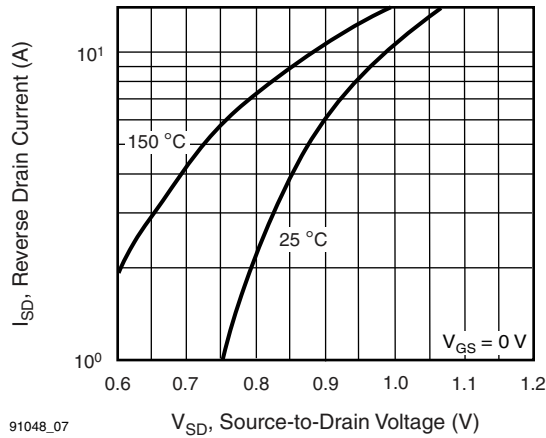
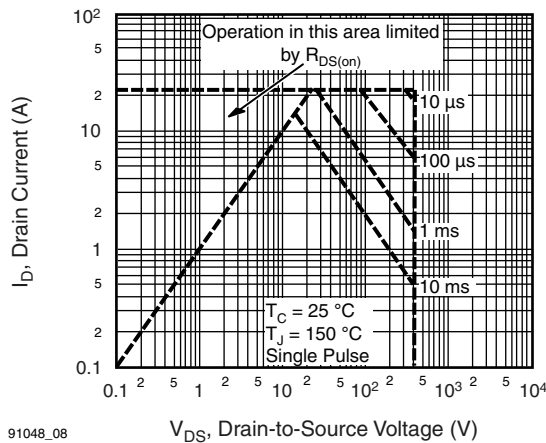
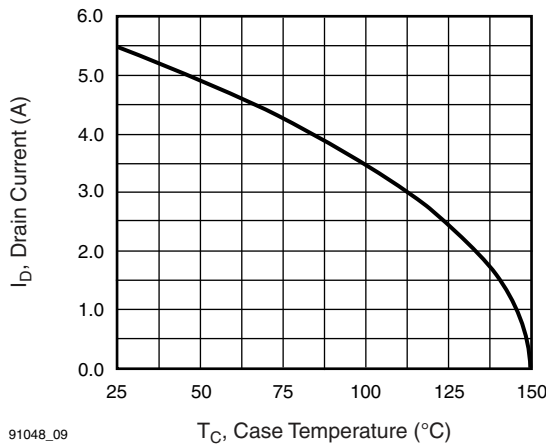
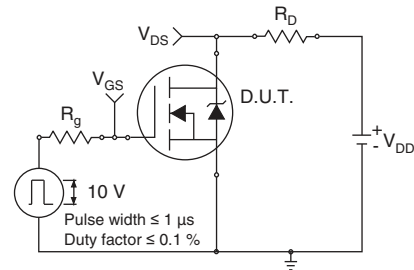
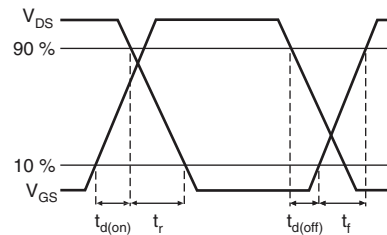
**SPECIFICATIONS** ( $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

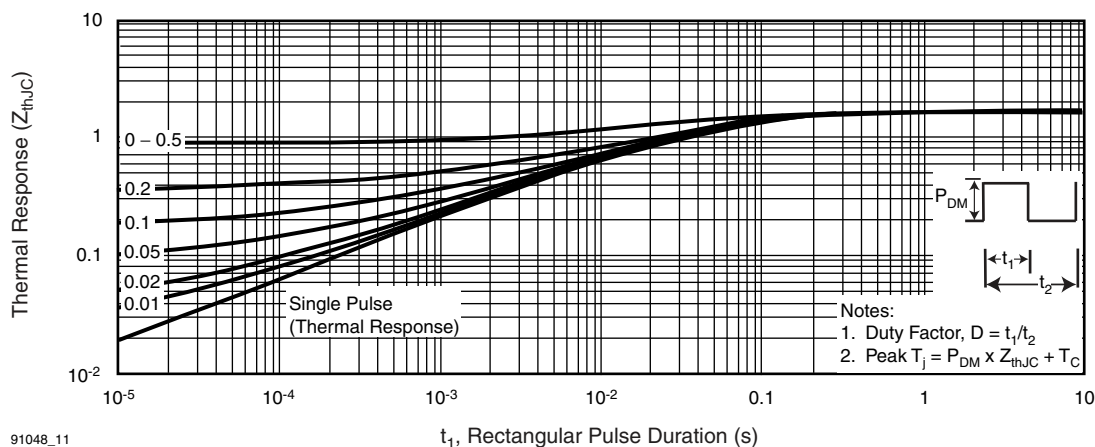
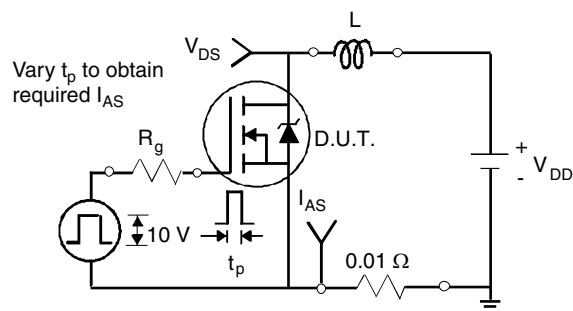
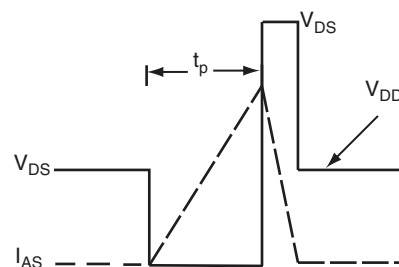
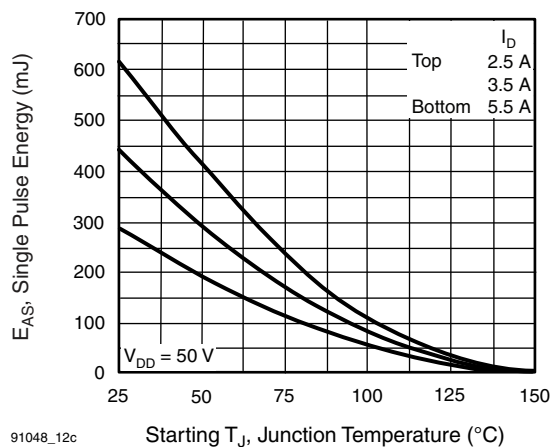
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-Source Breakdown Voltage	V <sub>DS</sub>	V <sub>GS</sub> = 0, I <sub>D</sub> = 250 μA		400	-	-	V
V <sub>DS</sub> Temperature Coefficient	ΔV <sub>DS</sub> /T <sub>J</sub>	Reference to 25 °C, I <sub>D</sub> = 1 mA		-	0.54	-	V/°C
Gate-Source Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA		2.0	-	4.0	V
Gate-Source Leakage	I <sub>GSS</sub>	V <sub>GS</sub> = ± 20 V		-	-	± 100	nA
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = 400 V, V <sub>GS</sub> = 0 V		-	-	25	μA
		V <sub>DS</sub> = 320 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 125 °C		-	-	250	
Drain-Source On-State Resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10 V	I <sub>D</sub> = 3.3 A <sup>b</sup>	-	-	1.0	Ω
Forward Transconductance	g <sub>fs</sub>	V <sub>DS</sub> = 50 V, I <sub>D</sub> = 3.3 A <sup>b</sup>		2.9	-	-	S
Dynamic							
Input Capacitance	C <sub>iss</sub>	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 25 V, f = 1.0 MHz, see fig. 5		-	700	-	pF
Output Capacitance	C <sub>oss</sub>			-	170	-	
Reverse Transfer Capacitance	C <sub>rss</sub>			-	64	-	
Total Gate Charge	Q <sub>g</sub>	V <sub>GS</sub> = 10 V	I <sub>D</sub> = 3.5 A, V <sub>DS</sub> = 320 V, see fig. 6 and 13 <sup>b</sup>	-	-	38	nC
Gate-Source Charge	Q <sub>gs</sub>			-	-	5.7	
Gate-Drain Charge	Q <sub>gd</sub>			-	-	22	
Turn-On Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = 200 V, I <sub>D</sub> = 3.5 A, R <sub>g</sub> = 12 Ω, R <sub>D</sub> = 57 Ω, see fig. 10 <sup>b</sup>		-	10	-	ns
Rise Time	t <sub>r</sub>			-	15	-	
Turn-Off Delay Time	t <sub>d(off)</sub>			-	38	-	
Fall Time	t <sub>f</sub>			-	14	-	
Gate Input Resistance	R <sub>g</sub>	f = 1 MHz, open drain		0.6	-	2.3	Ω
Internal Drain Inductance	L <sub>D</sub>	Between lead, 6 mm (0.25") from package and center of die contact 		-	4.5	-	nH
Internal Source Inductance	L <sub>S</sub>			-	7.5	-	
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I <sub>S</sub>	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	5.5	A
Pulsed Diode Forward Current <sup>a</sup>	I <sub>SM</sub>			-	-	22	
Body Diode Voltage	V <sub>SD</sub>	T <sub>J</sub> = 25 °C, I <sub>S</sub> = 5.5 A, V <sub>GS</sub> = 0 V <sup>b</sup>		-	-	1.6	V
Body Diode Reverse Recovery Time	t <sub>rr</sub>	T <sub>J</sub> = 25 °C, I <sub>F</sub> = 3.5 A, dI/dt = 100 A/μs <sup>b</sup>		-	270	530	ns
Body Diode Reverse Recovery Charge	Q <sub>rr</sub>			-	1.8	2.2	μC
Forward Turn-On Time	t <sub>on</sub>	Intrinsic turn-on time is negligible (turn-on is dominated by L <sub>S</sub> and L <sub>D</sub> )					

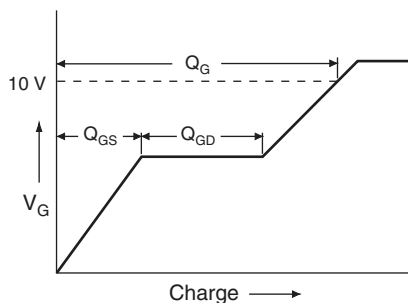
**Notes**

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).  
b. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$ .

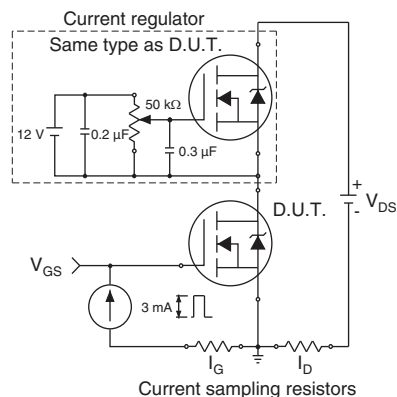
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

**Fig. 1 - Typical Output Characteristics,  $T_C = 25^\circ\text{C}$** 

**Fig. 4 - Normalized On-Resistance vs. Temperature**

**Fig. 2 - Typical Output Characteristics,  $T_C = 150^\circ\text{C}$** 

**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**

**Fig. 3 - Typical Transfer Characteristics**

**Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage**


**Fig. 7 - Typical Source-Drain Diode Forward Voltage**

**Fig. 8 - Maximum Safe Operating Area**

**Fig. 9 - Maximum Drain Current vs. Case Temperature**

**Fig. 10a - Switching Time Test Circuit**

**Fig. 10b - Switching Time Waveforms**

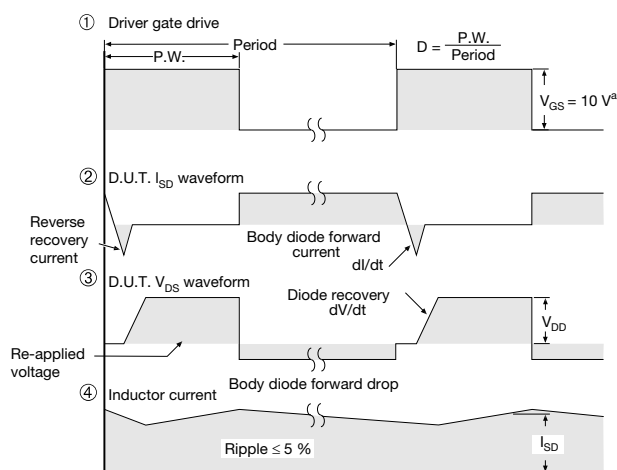
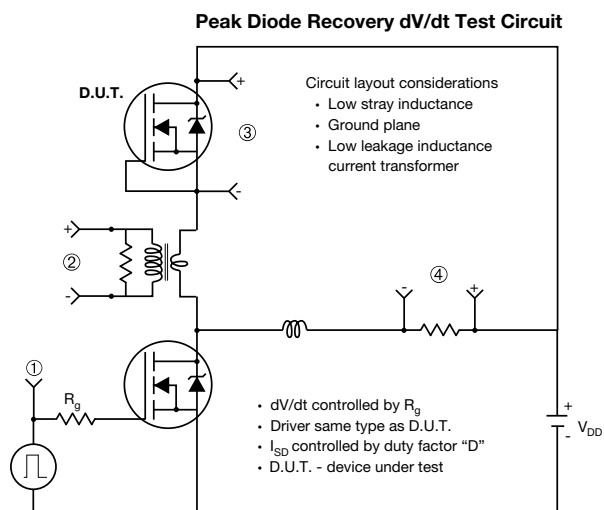

**Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case**

**Fig. 12a - Unclamped Inductive Test Circuit**

**Fig. 12b - Unclamped Inductive Waveforms**

**Fig. 12c - Maximum Avalanche Energy vs. Drain Current**



**Fig. 13a - Basic Gate Charge Waveform**



**Fig. 13b - Gate Charge Test Circuit**



**Note**  
a.  $V_{GS} = 5\text{ V}$  for logic level devices

**Fig. 14 - For N-Channel**

*Vishay Silconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silcon 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?91048](http://www.vishay.com/ppg?91048).*

	MILLIMETERS		INCHES	
DIM.	MIN.	MAX.	MIN.	MAX.
D1	6.86	-	0.270	-
E	9.65	10.67	0.380	0.420
E1	6.22	-	0.245	-
e	2.54 BSC		0.100 BSC	
H	14.61	15.88	0.575	0.625
L	1.78	2.79	0.070	0.110
L1	-	1.65	-	0.066
L2	-	1.78	-	0.070
L3	0.25 BSC		0.010 BSC	
L4	4.78	5.28	0.188	0.208

—

**RECOMMENDED MINIMUM PADS FOR D<sup>2</sup>PAK: 3-Lead**



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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