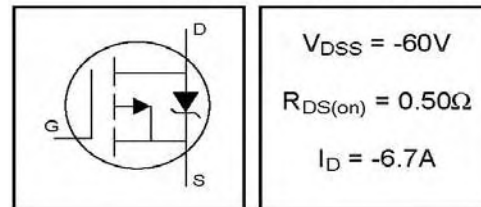


# IRF9Z14SPbF

# IRF9Z14LPbF

- Advanced Process Technology
- Surface Mount (IRF9Z14S)
- Low-profile through-hole (IRF9Z14L)
- 175°C Operating Temperature
- Fast Switching
- P- Channel
- Fully Avalanche Rated
- Lead-Free

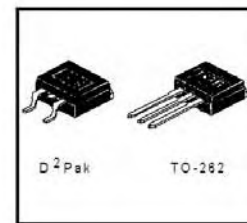
HEXFET® Power MOSFET



### Description

Third Generation HEXFETs from International Rectifier utilize advanced processing techniques to achieve extremely low on-resistance per silicon area. This benefit, combined with the fast switching speed and ruggedized device design that HEXFET Power MOSFETs are well known for, provides the designer with an extremely efficient and reliable device for use in a wide variety of applications.

The D<sup>2</sup>Pak is a surface mount power package capable of accommodating die sizes 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 is suitable for high current applications because of its low internal connection resistance and can dissipate up to 2.0W in a typical surface mount application. The through-hole version (IRF9Z14L) is available for low-profile applications.



### Absolute Maximum Ratings

	Parameter	Max.	Units
$I_D @ T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V} \textcircled{5}$	-6.7	A
$I_D @ T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V} \textcircled{5}$	-4.7	
$I_{DM}$	Pulsed Drain Current $\textcircled{1}\textcircled{5}$	-27	
$P_D @ T_A = 25^\circ\text{C}$	Power Dissipation	3.7	W
$P_D @ T_C = 25^\circ\text{C}$	Power Dissipation	43	W
	Linear Derating Factor	0.29	W/°C
$V_{GS}$	Gate-to-Source Voltage	$\pm 20$	V
$E_{AS}$	Single Pulse Avalanche Energy $\textcircled{2}\textcircled{5}$	140	mJ
$I_{AR}$	Avalanche Current $\textcircled{1}$	-6.7	A
$E_{AR}$	Repetitive Avalanche Energy $\textcircled{1}$	4.3	mJ
$dv/dt$	Peak Diode Recovery $dv/dt \textcircled{3}\textcircled{5}$	-4.5	V/ns
$T_J$	Operating Junction and	-55 to + 175	°C
$T_{STG}$	Storage Temperature Range		
	Soldering Temperature, for 10 seconds	300 (1.6mm from case )	

### Thermal Resistance

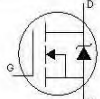
	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	3.5	°C/W
$R_{\theta JA}$	Junction-to-Ambient ( PCB Mounted, steady-state)**	—	40	

# IRF9Z14S/LPbF

## Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
V <sub>(BR)DSS</sub>	Drain-to-Source Breakdown Voltage	-60	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = -250μA
ΔV <sub>(BR)DSS/ΔT<sub>J</sub></sub>	Breakdown Voltage Temp. Coefficient	—	-0.06	—	V/°C	Reference to 25°C, I <sub>D</sub> = -1mA <sup>⑤</sup>
R <sub>DS(on)</sub>	Static Drain-to-Source On-Resistance	—	—	0.50	Ω	V <sub>GS</sub> = -10V, I <sub>D</sub> = -4.0A <sup>④</sup>
V <sub>GS(th)</sub>	Gate Threshold Voltage	-2.0	—	-4.0	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250μA
g <sub>fs</sub>	Forward Transconductance	1.4	—	—	S	V <sub>DS</sub> = -25V, I <sub>D</sub> = -4.0A <sup>⑤</sup>
I <sub>DSS</sub>	Drain-to-Source Leakage Current	—	—	-100	μA	V <sub>DS</sub> = -60V, V <sub>GS</sub> = 0V
		—	—	-500		V <sub>DS</sub> = -48V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 150°C
I <sub>GSS</sub>	Gate-to-Source Forward Leakage	—	—	-100	nA	V <sub>GS</sub> = -20V
	Gate-to-Source Reverse Leakage	—	—	100		V <sub>GS</sub> = 20V
Q <sub>g</sub>	Total Gate Charge	—	—	12	nC	I <sub>D</sub> = -6.7A
Q <sub>gs</sub>	Gate-to-Source Charge	—	—	3.8		V <sub>DS</sub> = -48V
Q <sub>gd</sub>	Gate-to-Drain ("Miller") Charge	—	—	5.1		V <sub>GS</sub> = -10V, See Fig. 6 and 13 <sup>④⑤</sup>
t <sub>d(on)</sub>	Turn-On Delay Time	—	11	—	ns	V <sub>DD</sub> = -30V
t <sub>r</sub>	Rise Time	—	63	—		I <sub>D</sub> = -6.7A
t <sub>d(off)</sub>	Turn-Off Delay Time	—	10	—		R <sub>G</sub> = 24Ω
t <sub>f</sub>	Fall Time	—	31	—		R <sub>D</sub> = 4.0Ω, See Fig. 10 <sup>④</sup>
L <sub>S</sub>	Internal Source Inductance	—	7.5	—	nH	Between lead, and center of die contact
C <sub>iSS</sub>	Input Capacitance	—	270	—	pF	V <sub>GS</sub> = 0V
C <sub>oSS</sub>	Output Capacitance	—	170	—		V <sub>DS</sub> = -25V
C <sub>rSS</sub>	Reverse Transfer Capacitance	—	31	—		f = 1.0MHz, See Fig. 5 <sup>⑤</sup>

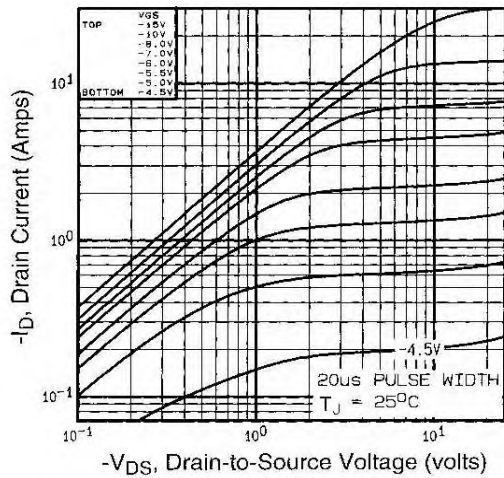
## Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I <sub>S</sub>	Continuous Source Current (Body Diode)	—	—	-6.7	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I <sub>SM</sub>	Pulsed Source Current (Body Diode) <sup>①</sup>	—	—	-27		
V <sub>SD</sub>	Diode Forward Voltage	—	—	-5.5	V	T <sub>J</sub> = 25°C, I <sub>S</sub> = -6.7A, V <sub>GS</sub> = 0V <sup>④</sup>
t <sub>rr</sub>	Reverse Recovery Time	—	80	160	ns	T <sub>J</sub> = 25°C, I <sub>F</sub> = -6.7A
Q <sub>rr</sub>	Reverse Recovery Charge	—	96	190	nC	di/dt = 100A/μs <sup>④⑤</sup>
t <sub>on</sub>	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by L <sub>S</sub> +L <sub>D</sub> )				

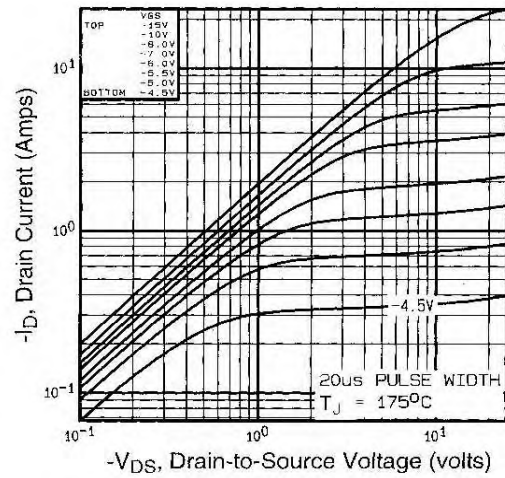
### Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. ( See fig. 11 )
- ② V<sub>DD</sub> = -25V, starting T<sub>J</sub> = 25°C, L = 3.6mH, R<sub>G</sub> = 25Ω, I<sub>AS</sub> = -6.7A. (See Figure 12)
- ③ I<sub>SD</sub> ≤ -6.7A, di/dt ≤ 90A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>J</sub> ≤ 175°C
- ④ Pulse width ≤ 300μs; duty cycle ≤ 2%.
- ⑤ Uses IRF9Z14 data and test conditions

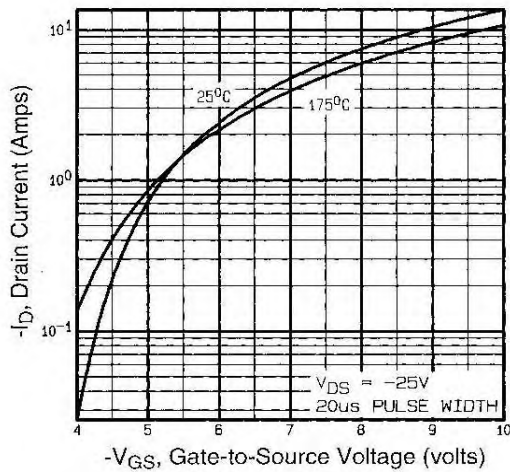
\*\* When mounted on 1" square PCB (FR-4 or G-10 Material ).  
 For recommended footprint and soldering techniques refer to application note #AN-994.



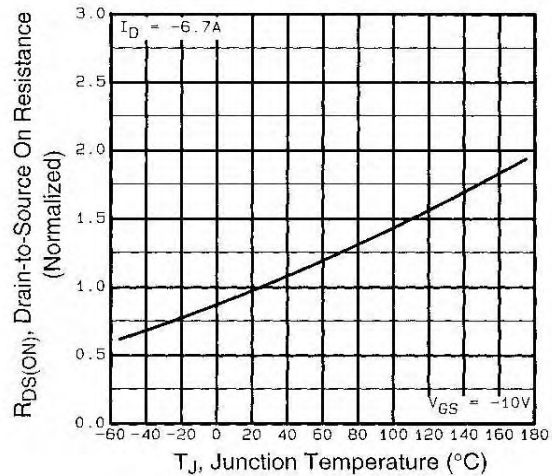
**Fig 1.** Typical Output Characteristics,



**Fig 2.** Typical Output Characteristics,

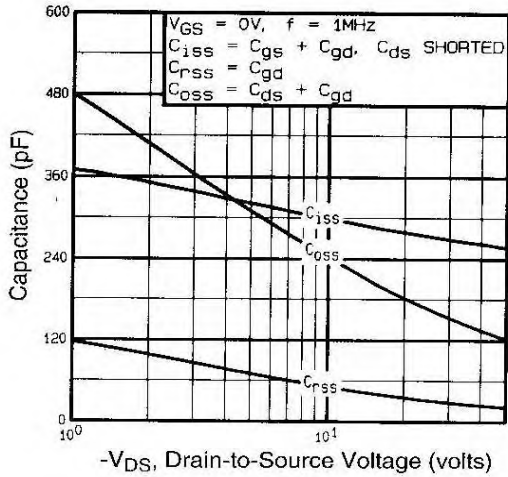


**Fig 3.** Typical Transfer Characteristics

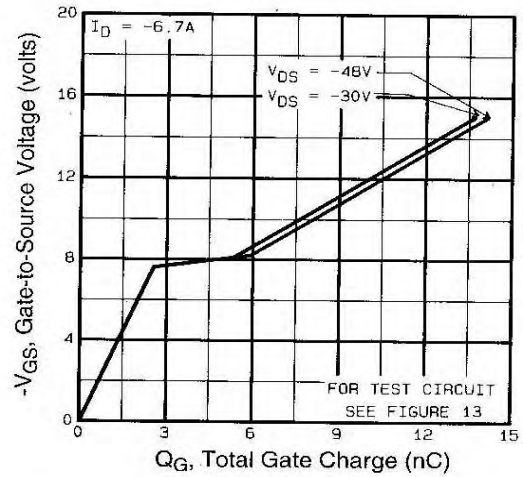


**Fig 4.** Normalized On-Resistance Vs. Temperature

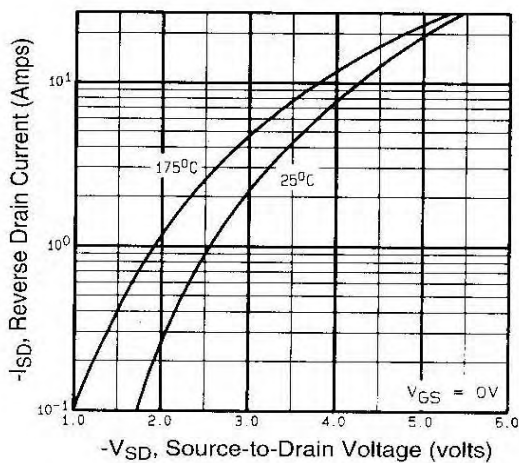
# IRF9Z14S/LPbF



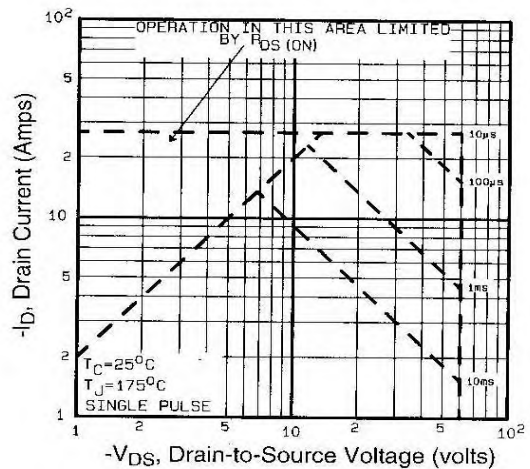
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



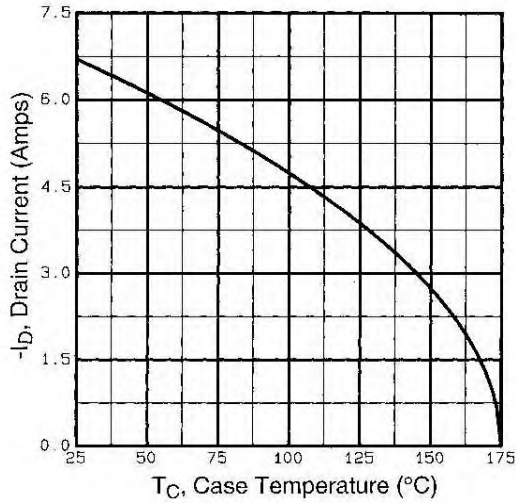
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



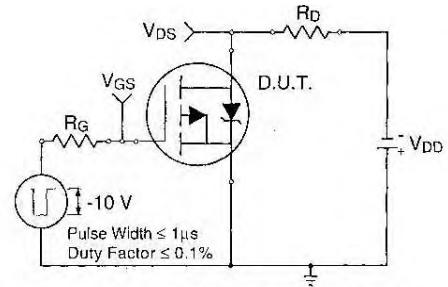
**Fig 7.** Typical Source-Drain Diode Forward Voltage



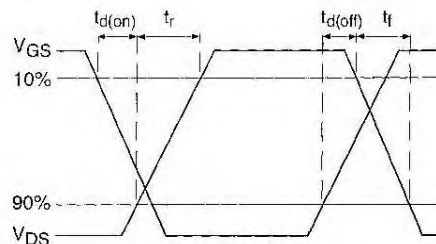
**Fig 8.** Maximum Safe Operating Area



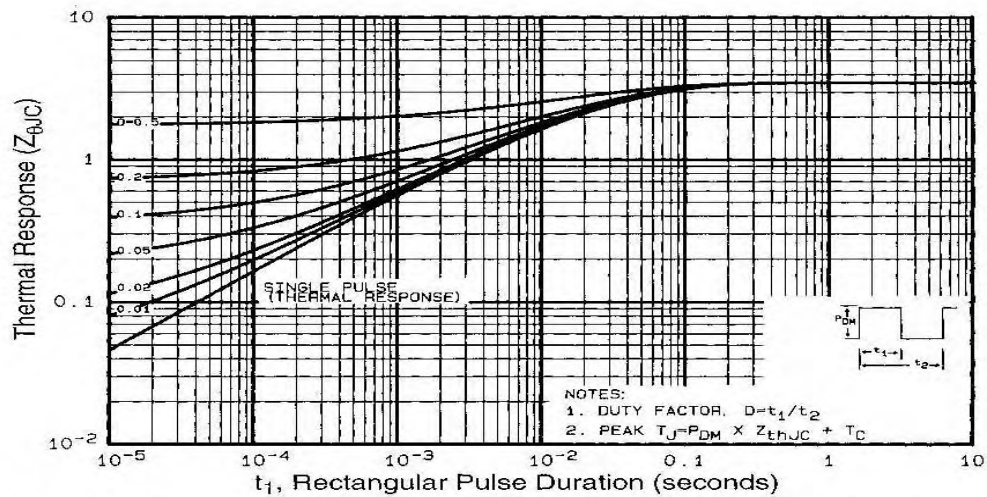
**Fig 9.** Maximum Drain Current Vs. Case Temperature



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

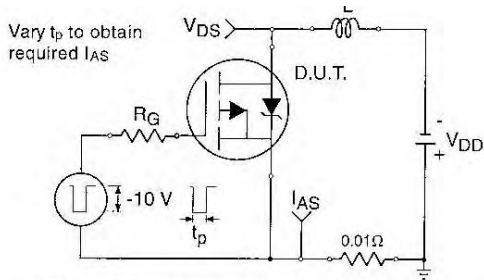


**Fig 10b.** Switching Time Waveforms

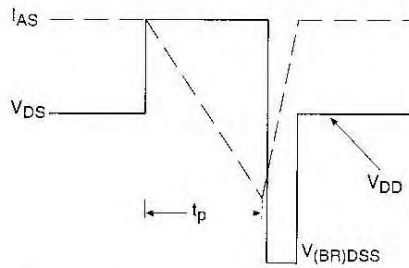


**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

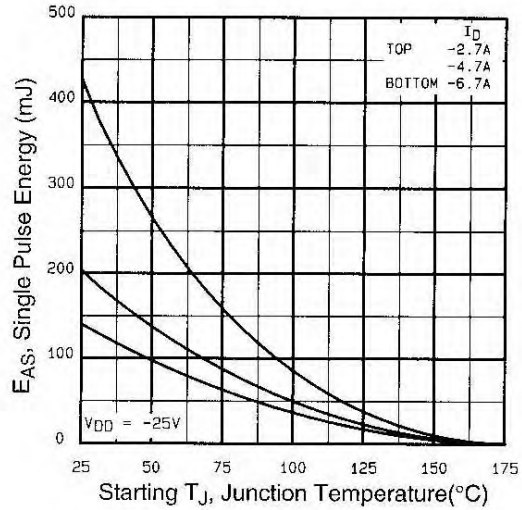
# IRF9Z14S/LPbF



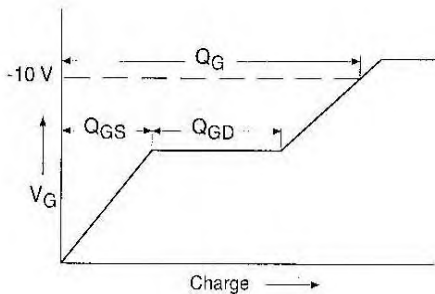
**Fig 12a.** Unclamped Inductive Test Circuit



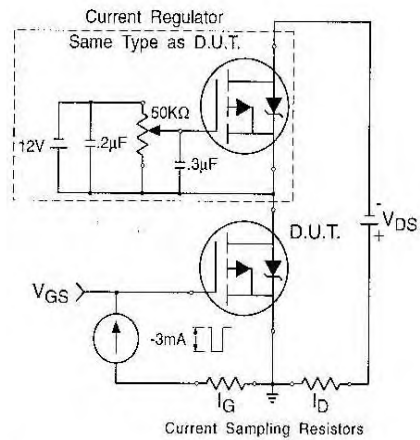
**Fig 12b.** Unclamped Inductive Waveforms



**Fig 12c.** Maximum Avalanche Energy Vs. Drain Current

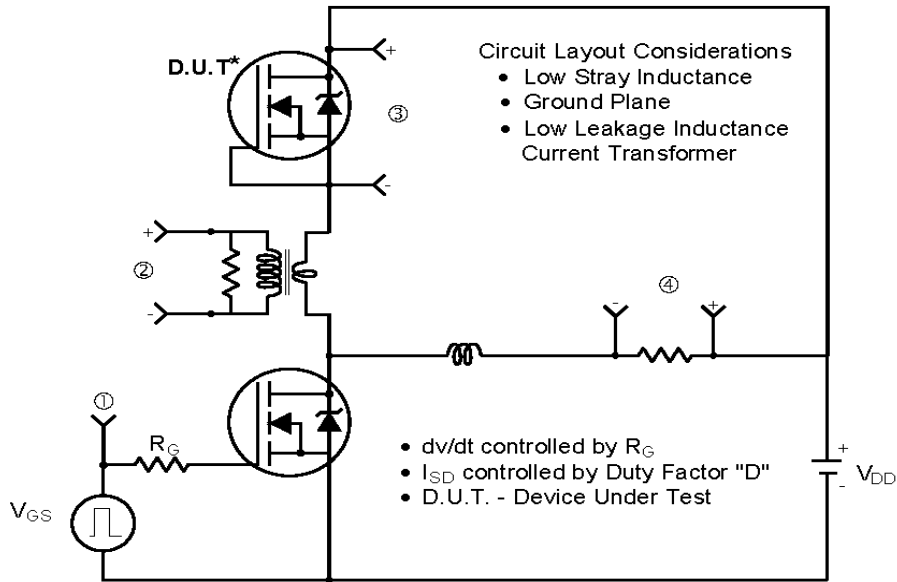


**Fig 13a.** Basic Gate Charge Waveform

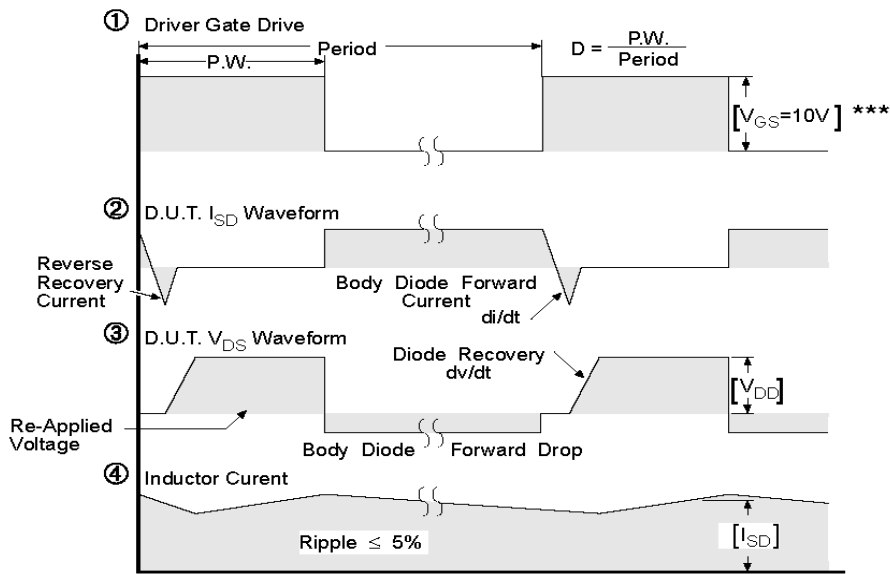


**Fig 13b.** Gate Charge Test Circuit

**Peak Diode Recovery dv/dt Test Circuit**



\* Reverse Polarity of D.U.T for P-Channel



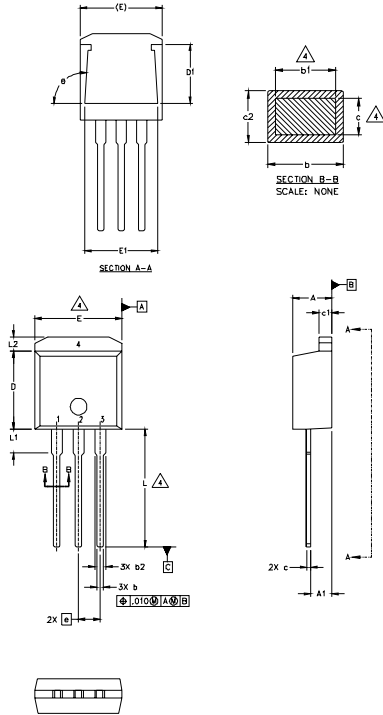
\*\*\*  $V_{GS} = 5.0V$  for Logic Level and 3V Drive Devices

**Fig 14.** For P-Channel HEXFETS

# IRF9Z14S/LPbF



## TO-262 Package Outline (Dimensions are shown in millimeters (inches))



SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	4
A1	2.03	2.92	.080	.115	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	4
b2	1.14	1.40	.045	.055	
c	0.38	0.63	.015	.025	4
c1	1.14	1.40	.045	.055	
c2	0.43	.063	.017	.029	3
D	8.51	9.65	.335	.380	
D1	5.33		.210		3
E	9.65	10.67	.380	.420	
E1	6.22		.245		3
e	2.54 BSC		.100 BSC		
L	13.46	14.09	.530	.555	3
L1	3.56	3.71	.140	.146	
L2		1.65		.065	

### LEAD ASSIGNMENTS

#### HEXFET

- 1.- GATE
- 2.- DRAIN
- 3.- SOURCE
- 4.- DRAIN

#### IGBT

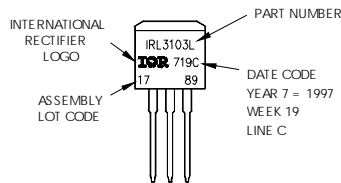
- 1 - GATE
- 2 - COLLECTOR
- 3 - EMITTER

#### NOTES:

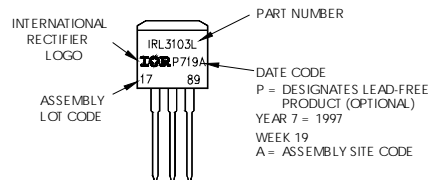
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [0.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
5. CONTROLLING DIMENSION: INCH.

## TO-262 Part Marking Information

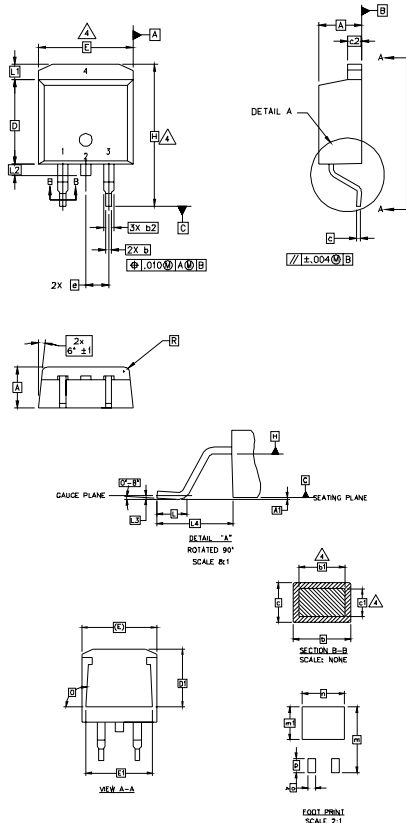
EXAMPLE: THIS IS AN IRL3103L  
 LOT CODE 1789  
 ASSEMBLED ON WW 19, 1997  
 IN THE ASSEMBLY LINE "C"  
 Note: "P" in assembly line  
 position indicates "Lead-Free"



OR



## D<sup>2</sup>Pak Package Outline (Dimensions are shown in millimeters (inches))



**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES]
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [0.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
5. CONTROLLING DIMENSION: INCH.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	4
A1	0.00	0.254	.000	.010	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	
b2	1.14	1.78	.045	.070	
c	0.38	0.74	.015	.029	
c1	0.38	0.58	.015	.023	
c2	1.14	1.65	.045	.065	
D	8.51	9.65	.335	.380	
D1	6.86		.270		
E	9.65	10.67	.380	.420	3
E1	6.22		.245		
e	2.54 BSC		.100 BSC		3
H	14.61	15.88	.575	.625	
L	1.78	2.79	.070	.110	
L1		1.65		.065	
L2	1.27	1.78	.050	.070	
L3	0.25 BSC		.010 BSC		
L4	4.78	5.28	.188	.208	
m	17.78		.700		
m1	8.89		.350		
n	11.43		.450		
o	2.08		.082		
p	3.81		.150		
R	0.51	0.71	.020	.028	
θ	90°	93°	90°	93°	

**LEAD ASSIGNMENTS**

**HEXFET**

- 1.- GATE
- 2, 4.- DRAIN
- 3.- SOURCE

**IGBTs, CoPACK**

- 1.- GATE
- 2, 4.- COLLECTOR
- 3.- EMITTER

**DIODES**

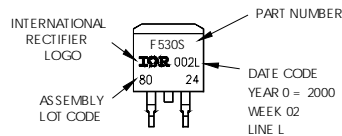
- 1.- ANODE \*
- 2, 4.- CATHODE
- 3.- ANODE

\* PART DEPENDENT.

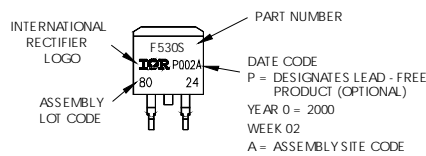
## D<sup>2</sup>Pak Part Marking Information

EXAMPLE: THIS IS AN IRF530S WITH LOT CODE 8024 ASSEMBLED ON WW02, 2000 IN THE ASSEMBLY LINE "L"

Note: "P" in assembly line position indicates "Lead - Free"



OR

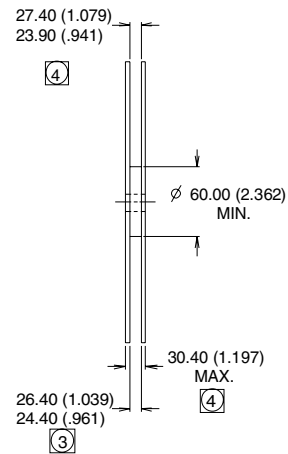
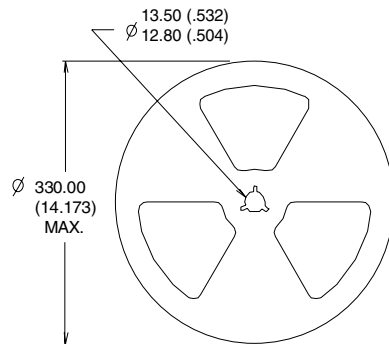
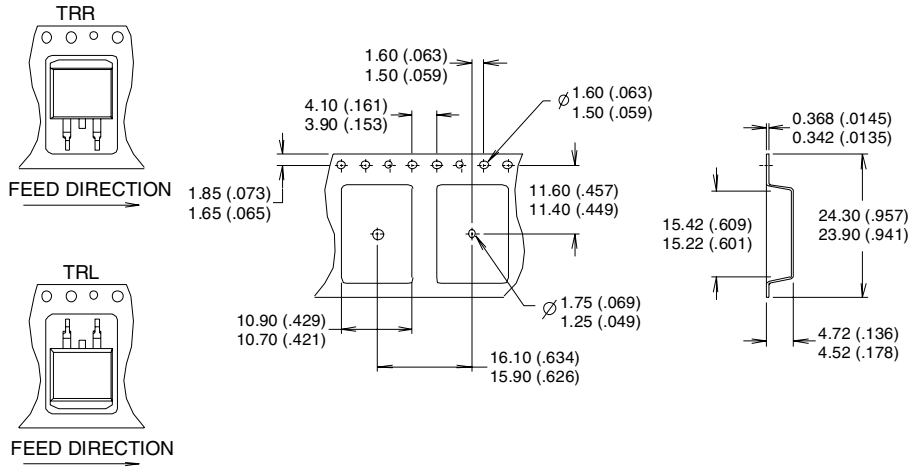


# IRF9Z14S/LPbF

International  
**IOR** Rectifier

## D<sup>2</sup>Pak Tape & Reel Information

Dimensions are shown in millimeters (inches)



- NOTES:
1. COMFORMS TO EIA-418.
  2. CONTROLLING DIMENSION: MILLIMETER.
  - ③ DIMENSION MEASURED @ HUB.
  - ④ INCLUDES FLANGE DISTORTION @ OUTER EDGE.

Data and specifications subject to change without notice.

International  
**IOR** Rectifier

IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105  
 TAC Fax: (310) 252-7903  
 06/05



### Notice

The products described herein were acquired by Vishay Intertechnology, Inc., as part of its acquisition of International Rectifier's Power Control Systems (PCS) business, which closed in April 2007. Specifications of the products displayed herein are pending review by Vishay and are subject to the terms and conditions shown below.

Specifications of the products displayed herein are subject to change without notice. Vishay Intertechnology, Inc., or anyone on its behalf, assumes no responsibility or liability for any errors or inaccuracies.

Information contained herein is intended to provide a product description only. No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document. Except as provided in Vishay's terms and conditions of sale for such products, Vishay assumes no liability whatsoever, and disclaims any express or implied warranty, relating to sale and/or use of Vishay products including liability or warranties relating to fitness for a particular purpose, merchantability, or infringement of any patent, copyright, or other intellectual property right.

The products shown herein are not designed for use in medical, life-saving, or life-sustaining applications. Customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Vishay for any damages resulting from such improper use or sale.

International Rectifier®, IR®, the IR logo, HEXFET®, HEXSense®, HEXDIP®, DOL®, INTERO®, and POWIRTRAIN® are registered trademarks of International Rectifier Corporation in the U.S. and other countries. All other product names noted herein may be trademarks of their respective owners.