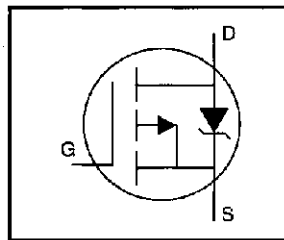


# IRFI9540GPbF

## HEXFET® Power MOSFET

- Isolated Package
- High Voltage Isolation= 2.5KVRMS ⑤
- Sink to Lead Creepage Dist.= 4.8mm
- P-Channel
- 175°C Operating Temperature
- Dynamic dv/dt Rating
- Low Thermal Resistance
- Lead-Free



$$V_{DSS} = -100V$$

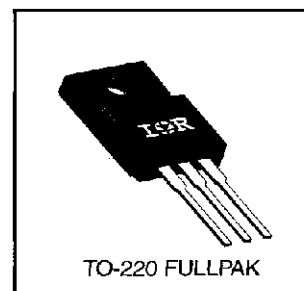
$$R_{DS(on)} = 0.20\Omega$$

$$I_D = -11A$$

### Description

Third Generation HEXFETs from International Rectifier provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

The TO-220 Fullpak eliminates the need for additional insulating hardware in commercial-industrial applications. The moulding compound used provides a high isolation capability and a low thermal resistance between the tab and external heatsink. This isolation is equivalent to using a 100 micron mica barrier with standard TO-220 product. The Fullpak is mounted to a heatsink using a single clip or by a single screw fixing.



### Absolute Maximum Ratings

	Parameter	Max.	Units
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ -10 V$	-11	A
$I_D @ T_C = 100^\circ C$	Continuous Drain Current, $V_{GS} @ -10 V$	-7.6	
$I_{DM}$	Pulsed Drain Current ①	-44	
$P_D @ T_C = 25^\circ C$	Power Dissipation	48	W
	Linear Derating Factor	0.32	W/°C
$V_{GS}$	Gate-to-Source Voltage	$\pm 20$	V
$E_{AS}$	Single Pulse Avalanche Energy ②	600	mJ
$I_{AR}$	Avalanche Current ③	-11	A
$E_{AR}$	Repetitive Avalanche Energy ①	4.8	mJ
dv/dt	Peak Diode Recovery dv/dt ④	-5.5	V/ns
$T_J$ $T_{STG}$	Operating Junction and Storage Temperature Range	-55 to +175	°C
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	
	Mounting Torque, 6-32 or M3 screw	10 lbf•in (1.1 N•m)	

### Thermal Resistance

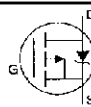
	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	—	3.1	°C/W
$R_{\theta JA}$	Junction-to-Ambient	—	—	65	

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

	Parameter	Min.	Typ.	Max.	Units	Test Conditions
V <sub>(BR)DSS</sub>	Drain-to-Source Breakdown Voltage	-100	—	—	V	V <sub>GS</sub> =0V, I <sub>D</sub> =-250μA
ΔV <sub>(BR)DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temp. Coefficient	—	-0.087	—	V/°C	Reference to 25°C, I <sub>D</sub> =-1mA
R <sub>DS(on)</sub>	Static Drain-to-Source On-Resistance	—	—	0.20	Ω	V <sub>GS</sub> =-10V, I <sub>D</sub> =-6.6A ④
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	5.4	—	—	S	V <sub>DS</sub> =-50V, I <sub>D</sub> =-6.6A ④
I <sub>DSS</sub>	Drain-to-Source Leakage Current	—	—	-100	μA	V <sub>DS</sub> =-100V, V <sub>GS</sub> =0V
		—	—	-500		V <sub>DS</sub> =-80V, 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	—	—	61	nC	I <sub>D</sub> =-19A
Q <sub>gs</sub>	Gate-to-Source Charge	—	—	14		V <sub>DS</sub> =-80V
Q <sub>gd</sub>	Gate-to-Drain ("Miller") Charge	—	—	29		V <sub>GS</sub> =-10V See Fig. 6 and 13 ④
t <sub>d(on)</sub>	Turn-On Delay Time	—	24	—	ns	V <sub>DD</sub> =-50V
t <sub>r</sub>	Rise Time	—	110	—		I <sub>D</sub> =-19A
t <sub>d(off)</sub>	Turn-Off Delay Time	—	51	—		R <sub>G</sub> =9.1Ω
t <sub>f</sub>	Fall Time	—	86	—		R <sub>D</sub> =7.4Ω See Figure 10 ④
L <sub>D</sub>	Internal Drain Inductance	—	4.5	—	nH	Between lead, 6 mm (0.25in.) from package and center of die contact
L <sub>S</sub>	Internal Source Inductance	—	7.5	—		
C <sub>iss</sub>	Input Capacitance	—	1400	—	pF	V <sub>GS</sub> =0V
C <sub>oss</sub>	Output Capacitance	—	590	—		V <sub>DS</sub> =-25V
C <sub>rss</sub>	Reverse Transfer Capacitance	—	140	—		f=1.0MHz See Figure 5
C	Drain to Sink Capacitance	—	12	—		f=1.0MHz



## Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Test Conditions
I <sub>S</sub>	Continuous Source Current (Body Diode)	—	—	-11	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I <sub>SM</sub>	Pulsed Source Current (Body Diode) ①	—	—	-44		
V <sub>SD</sub>	Diode Forward Voltage	—	—	-4.2	V	T <sub>J</sub> =25°C, I <sub>S</sub> =-11A, V <sub>GS</sub> =0V ④
t <sub>rr</sub>	Reverse Recovery Time	—	130	260	ns	T <sub>J</sub> =25°C, I <sub>F</sub> =-19A
Q <sub>rr</sub>	Reverse Recovery Charge	—	0.35	0.70	μC	di/dt=100A/μs ④
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:

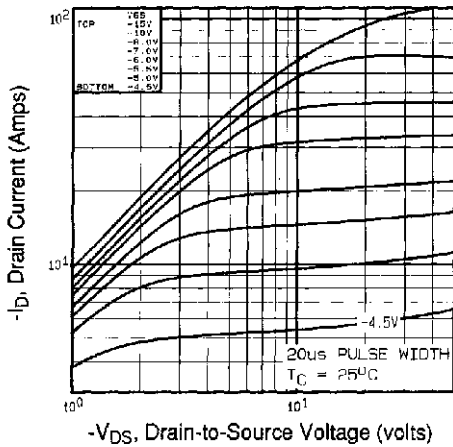
① Repetitive rating; pulse width limited by max. junction temperature (See Figure 11)

③ I<sub>SD</sub>≤-19A, di/dt≤170A/μs, V<sub>DD</sub>≤V<sub>(BR)DSS</sub>, T<sub>J</sub>≤175°C

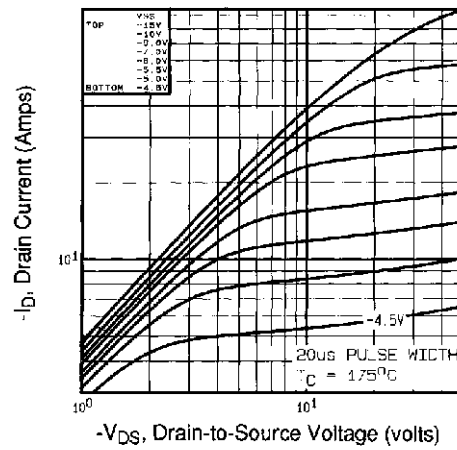
④ t=60s, f=60Hz

② V<sub>DD</sub>=-25V, starting T<sub>J</sub>=25°C, L=7.4mH R<sub>G</sub>=25Ω, I<sub>AS</sub>=-11A (See Figure 12)

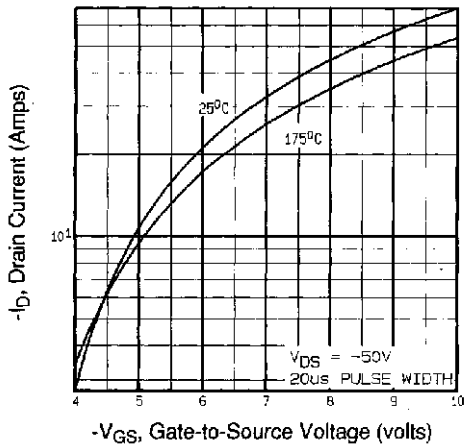
④ Pulse width ≤ 300 μs; duty cycle ≤2%.



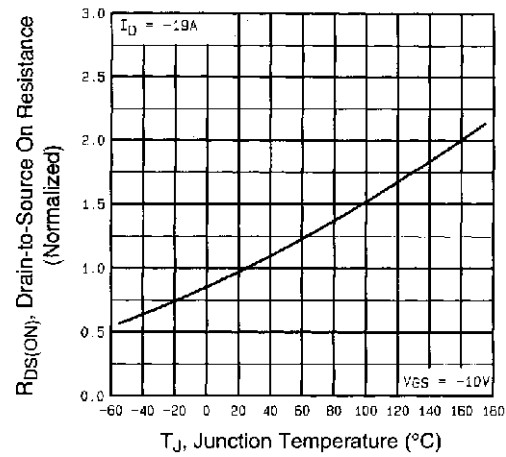
**Fig 1.** Typical Output Characteristics,  
 $T_C=25^\circ\text{C}$



**Fig 2.** Typical Output Characteristics,  
 $T_C=175^\circ\text{C}$



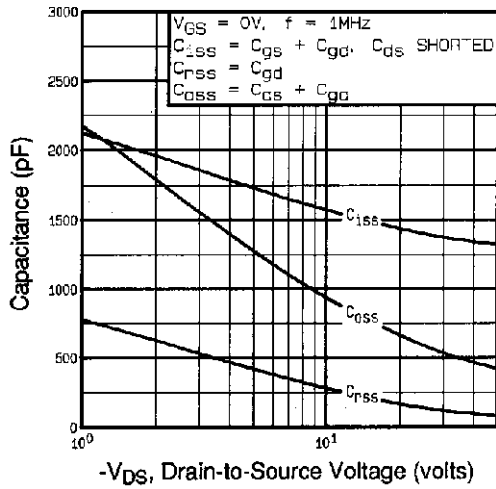
**Fig 3.** Typical Transfer Characteristics



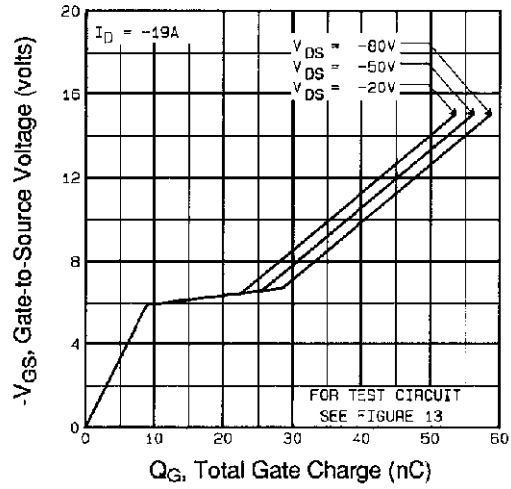
**Fig 4.** Normalized On-Resistance  
 Vs. Temperature

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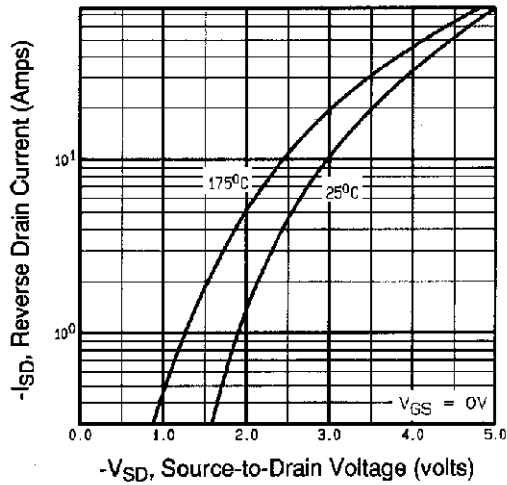
International  
**IR** Rectifier



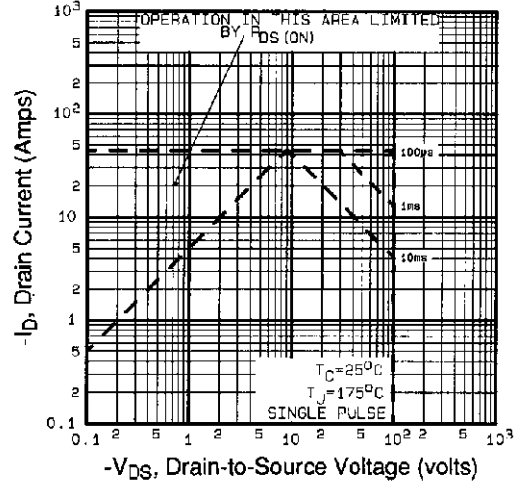
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



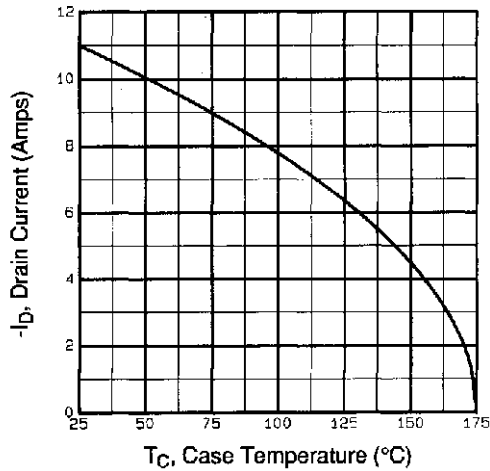
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



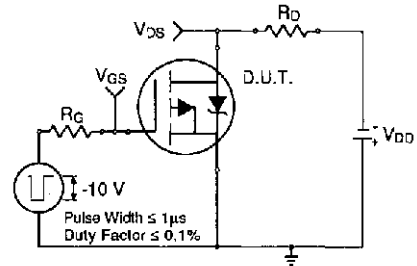
**Fig 7.** Typical Source-Drain Diode Forward Voltage



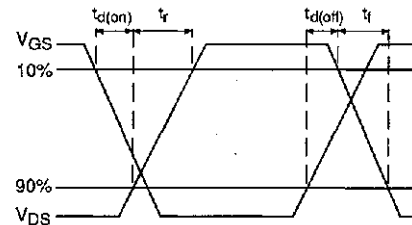
**Fig 8.** Maximum Safe Operating Area



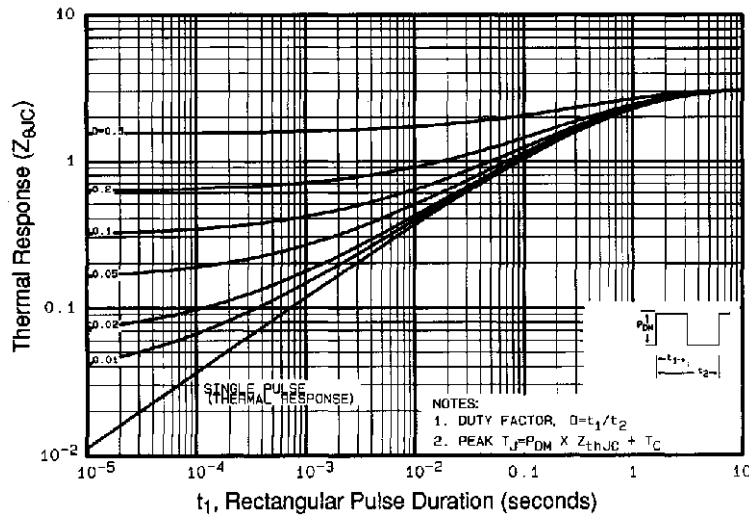
**Fig 9.** Maximum Drain Current Vs. Case Temperature



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



**Fig 10b.** Switching Time Waveforms



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

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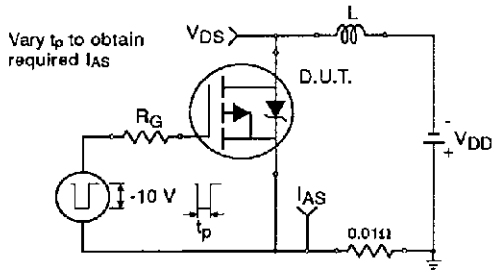


Fig 12a. Unclamped Inductive Test Circuit

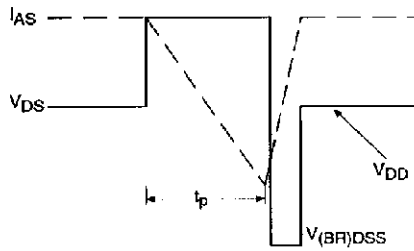


Fig 12b. Unclamped Inductive Waveforms

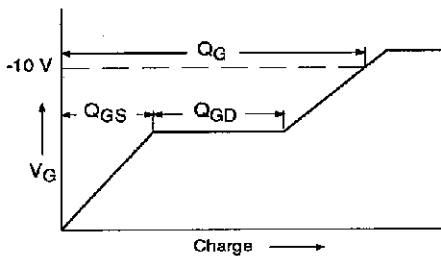


Fig 13a. Basic Gate Charge Waveform

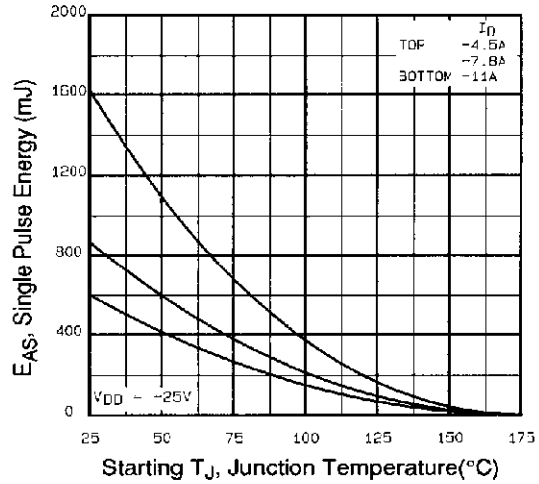


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

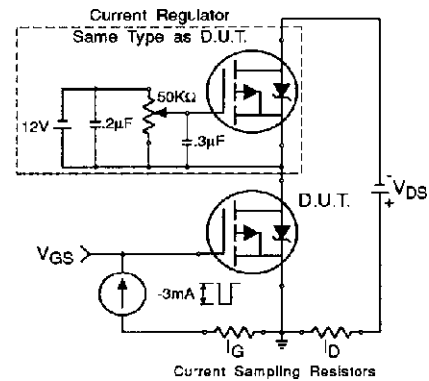
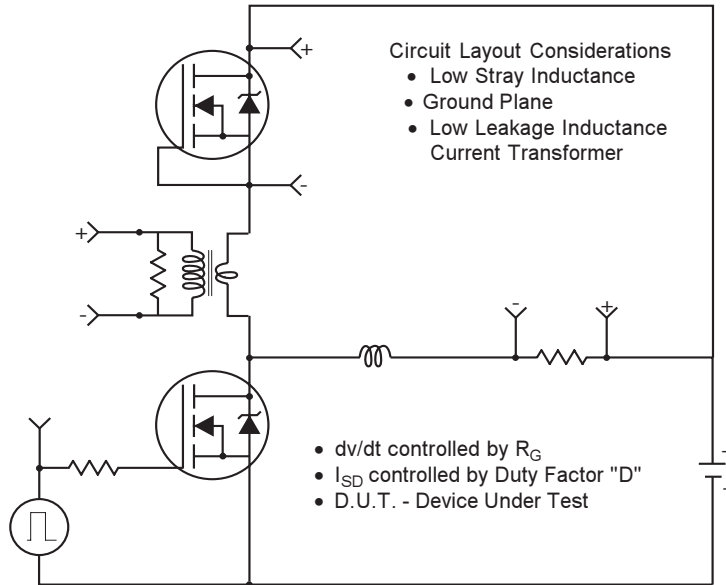


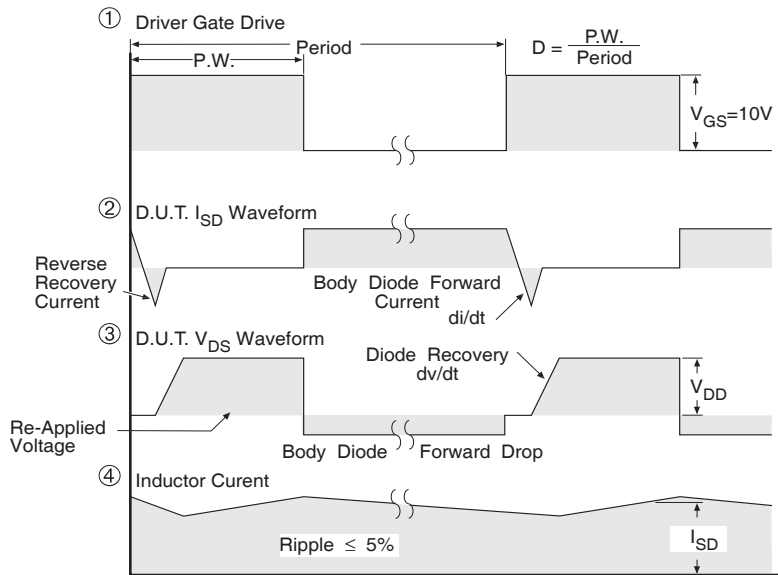
Fig 13b. Gate Charge Test Circuit

## Peak Diode Recovery dv/dt Test Circuit



\* Reverse Polarity for P-Channel

\*\* Use P-Channel Driver for P-Channel Measurements



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

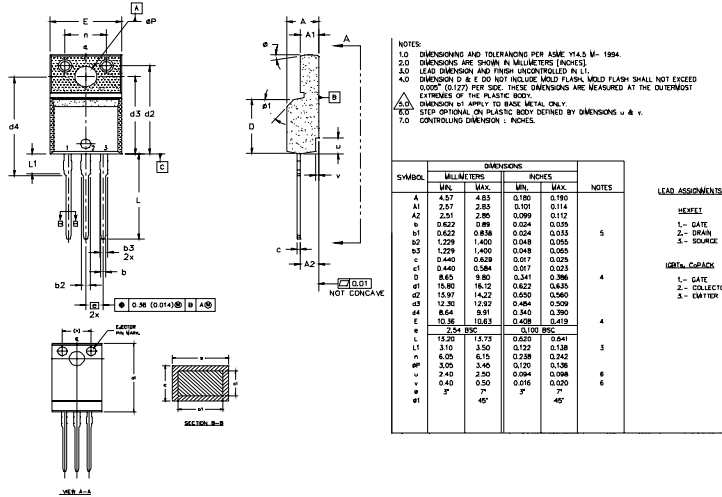
**Fig. 14** For N and P Channel HEXFETS

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International  
**IOR** Rectifier

## TO-220 Full-Pak Package Outline

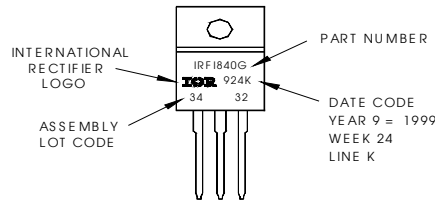
Dimensions are shown in millimeters (inches)



## TO-220 Full-Pak Part Marking Information

EXAMPLE: THIS IS AN IRFI840G  
WITH ASSEMBLY  
LOT CODE 3432  
ASSEMBLED ON WW 24 1999  
IN THE ASSEMBLY LINE "K"

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



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  
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