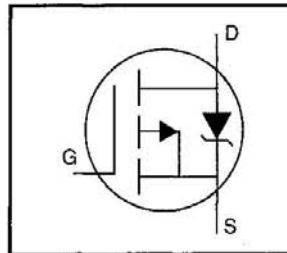


# IRFI9640GPbF

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



$$V_{DS} = -200V$$

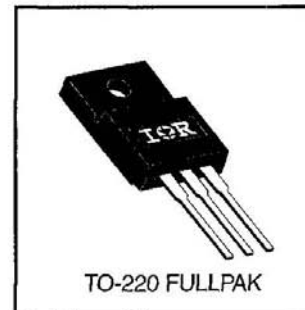
$$R_{DS(on)} = 0.50\Omega$$

$$I_D = -6.1A$$

## 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          | -6.1                  | A     |
| $I_D$ @ $T_C = 100^\circ C$ | Continuous Drain Current, $V_{GS}$ @ -10 V          | -3.9                  |       |
| $I_{DM}$                    | Pulsed Drain Current ①                              | -24                   |       |
| $P_D$ @ $T_C = 25^\circ C$  | Power Dissipation                                   | 40                    | W     |
|                             | Linear Derating Factor                              | 0.32                  | W/°C  |
| $V_{GS}$                    | Gate-to-Source Voltage                              | ±20                   | V     |
| $E_{AS}$                    | Single Pulse Avalanche Energy ②                     | 650                   | mJ    |
| $I_{AR}$                    | Avalanche Current ①                                 | -6.1                  | A     |
| $E_{AR}$                    | Repetitive Avalanche Energy ①                       | 4.0                   | mJ    |
| dv/dt                       | Peak Diode Recovery dv/dt ③                         | -5.0                  | V/ns  |
| $T_J$<br>$T_{STG}$          | Operating Junction and<br>Storage Temperature Range | -55 to +150           | °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   |       |

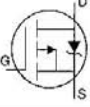
# IRFI9640GPbF

International  
IR Rectifier

## Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

|                                 | Parameter                            | Min. | Typ.  | Max. | Units               | Test Conditions                                                     |
|---------------------------------|--------------------------------------|------|-------|------|---------------------|---------------------------------------------------------------------|
| $V_{(BR)DSS}$                   | Drain-to-Source Breakdown Voltage    | -200 | —     | —    | V                   | $V_{GS}=0V$ , $I_D=-250\mu A$                                       |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient  | —    | -0.22 | —    | V/ $^\circ\text{C}$ | Reference to $25^\circ\text{C}$ , $I_D=-1mA$                        |
| $R_{DS(on)}$                    | Static Drain-to-Source On-Resistance | —    | —     | 0.50 | $\Omega$            | $V_{GS}=-10V$ , $I_D=-3.7A$ ④                                       |
| $V_{GS(th)}$                    | Gate Threshold Voltage               | -2.0 | —     | -4.0 | V                   | $V_{DS}=V_{GS}$ , $I_D=-250\mu A$                                   |
| $g_{fs}$                        | Forward Transconductance             | 3.4  | —     | —    | S                   | $V_{DS}=-50V$ , $I_D=-3.7A$ ④                                       |
| $I_{DSS}$                       | Drain-to-Source Leakage Current      | —    | —     | -100 | $\mu A$             | $V_{DS}=-200V$ , $V_{GS}=0V$                                        |
|                                 |                                      | —    | —     | -500 |                     | $V_{DS}=-160V$ , $V_{GS}=0V$ , $T_J=125^\circ\text{C}$              |
| $I_{GSS}$                       | Gate-to-Source Forward Leakage       | —    | —     | -100 | nA                  | $V_{GS}=-20V$                                                       |
|                                 | Gate-to-Source Reverse Leakage       | —    | —     | 100  |                     | $V_{GS}=20V$                                                        |
| $Q_g$                           | Total Gate Charge                    | —    | —     | 44   | nC                  | $I_D=-11A$                                                          |
| $Q_{gs}$                        | Gate-to-Source Charge                | —    | —     | 7.1  |                     | $V_{DS}=-160V$                                                      |
| $Q_{gd}$                        | Gate-to-Drain ("Miller") Charge      | —    | —     | 27   |                     | $V_{GS}=-10V$ See Fig. 6 and 13 ④                                   |
| $t_{d(on)}$                     | Turn-On Delay Time                   | —    | 14    | —    | ns                  | $V_{DD}=-100V$                                                      |
| $t_r$                           | Rise Time                            | —    | 43    | —    |                     | $I_D=-11A$                                                          |
| $t_{d(off)}$                    | Turn-Off Delay Time                  | —    | 39    | —    |                     | $R_G=9.1\Omega$                                                     |
| $t_f$                           | Fall Time                            | —    | 38    | —    |                     | $R_D=8.6\Omega$ See Figure 10 ④                                     |
| $L_D$                           | Internal Drain Inductance            | —    | 4.5   | —    | nH                  | Between lead, 6 mm (0.25in.) from package and center of die contact |
| $L_S$                           | Internal Source Inductance           | —    | 7.5   | —    |                     |                                                                     |
| $C_{iss}$                       | Input Capacitance                    | —    | 1200  | —    | pF                  | $V_{GS}=0V$                                                         |
| $C_{oss}$                       | Output Capacitance                   | —    | 370   | —    |                     | $V_{DS}=-25V$                                                       |
| $C_{rss}$                       | Reverse Transfer Capacitance         | —    | 80    | —    |                     | $f=1.0MHz$ See Figure 5                                             |
| $C$                             | Drain to Sink Capacitance            | —    | 12    | —    |                     | $f=1.0MHz$                                                          |

## Source-Drain Ratings and Characteristics

|          | Parameter                              | Min.                                                                      | Typ. | Max. | Units   | Test Conditions                                                                                                                                      |
|----------|----------------------------------------|---------------------------------------------------------------------------|------|------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| $I_S$    | Continuous Source Current (Body Diode) | —                                                                         | —    | -6.1 | A       | MOSFET symbol showing the integral reverse p-n junction diode.  |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ①   | —                                                                         | —    | -24  |         |                                                                                                                                                      |
| $V_{SD}$ | Diode Forward Voltage                  | —                                                                         | —    | -5.0 | V       | $T_J=25^\circ\text{C}$ , $I_S=-6.1A$ , $V_{GS}=0V$ ④                                                                                                 |
| $t_{rr}$ | Reverse Recovery Time                  | —                                                                         | 250  | 300  | ns      | $T_J=25^\circ\text{C}$ , $I_F=-11A$                                                                                                                  |
| $Q_{rr}$ | Reverse Recovery Charge                | —                                                                         | 2.9  | 3.6  | $\mu C$ | $di/dt=100A/\mu s$ ④                                                                                                                                 |
| $t_{on}$ | Forward Turn-On Time                   | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S+L_D$ ) |      |      |         |                                                                                                                                                      |

Notes:

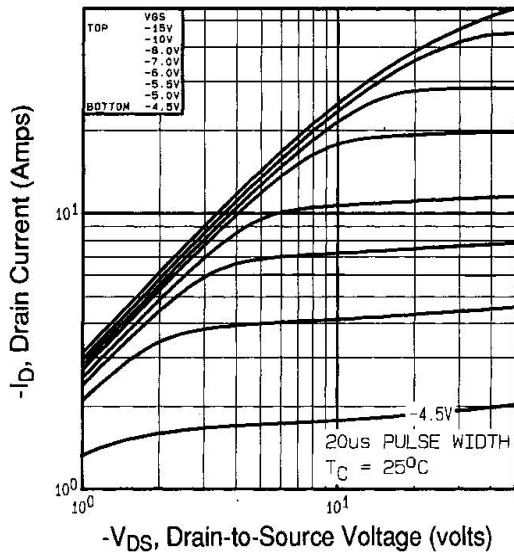
① Repetitive rating; pulse width limited by max. junction temperature (See Figure 11)

②  $V_{DD}=-50V$ , starting  $T_J=25^\circ\text{C}$ ,  $L=26mH$ ,  $R_G=25\Omega$ ,  $I_{AS}=-6.1A$  (See Figure 12)

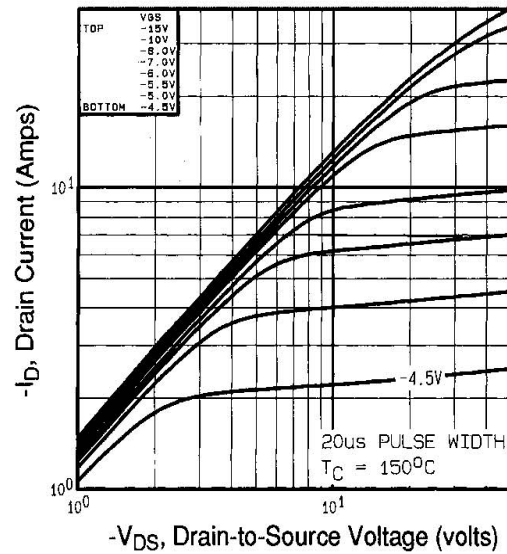
③  $I_{SD}\leq -11A$ ,  $di/dt\leq 150A/\mu s$ ,  $V_{DD}\leq V_{(BR)DSS}$ ,  $T_J\leq 150^\circ\text{C}$

④ Pulse width  $\leq 300\mu s$ ; duty cycle  $\leq 2\%$ .

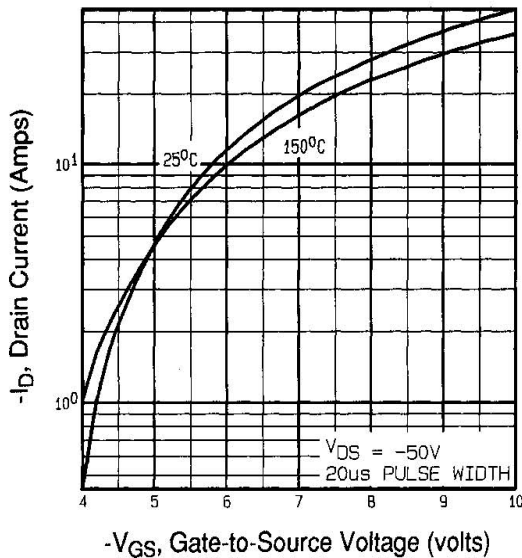
⑤  $t=60s$ ,  $f=60Hz$



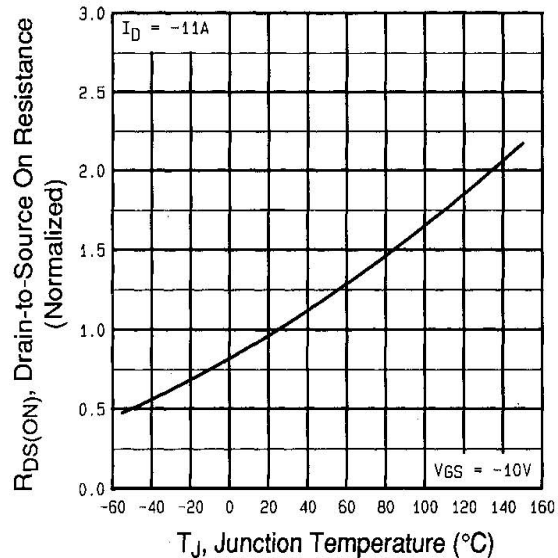
**Fig 1.** Typical Output Characteristics,  
 $T_C = 25^\circ\text{C}$



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



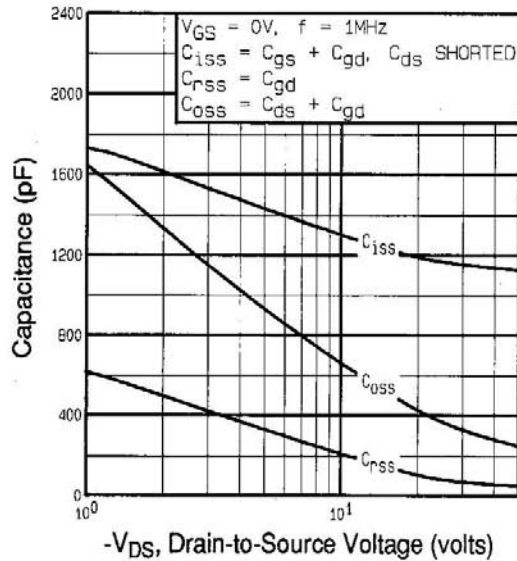
**Fig 3.** Typical Transfer Characteristics



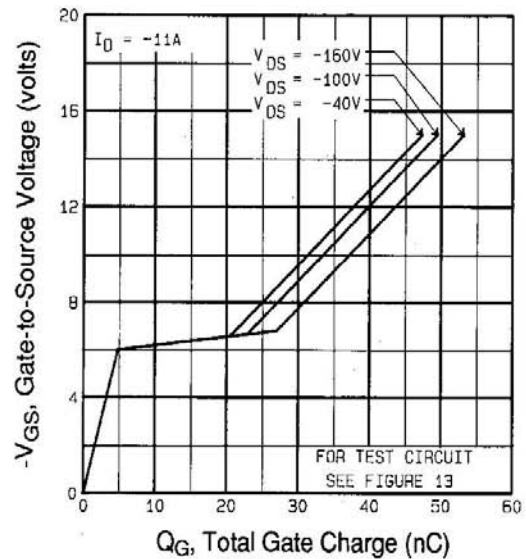
**Fig 4.** Normalized On-Resistance  
Vs. Temperature

# IRFI9640GPbF

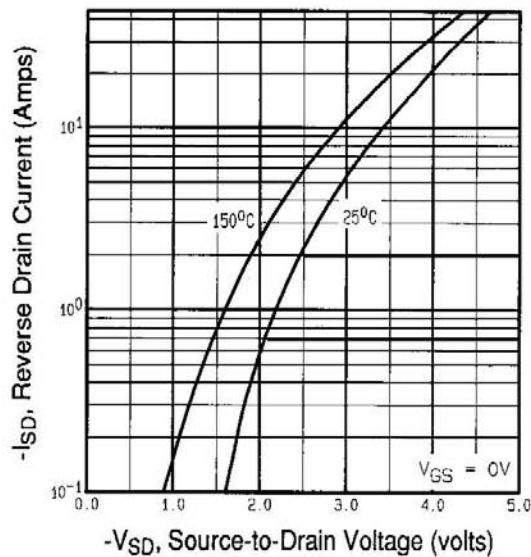
International  
IOR Rectifier



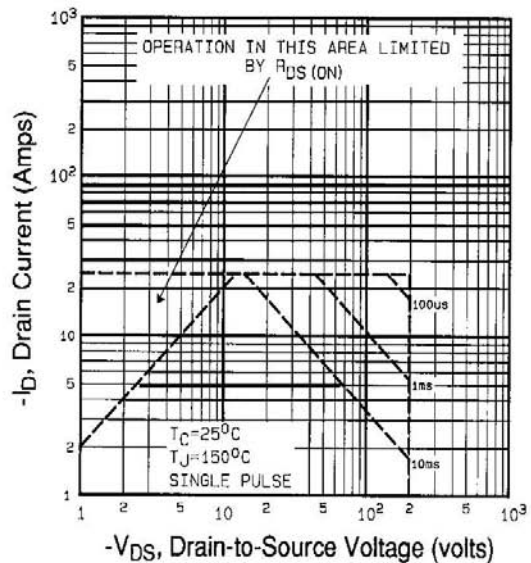
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



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

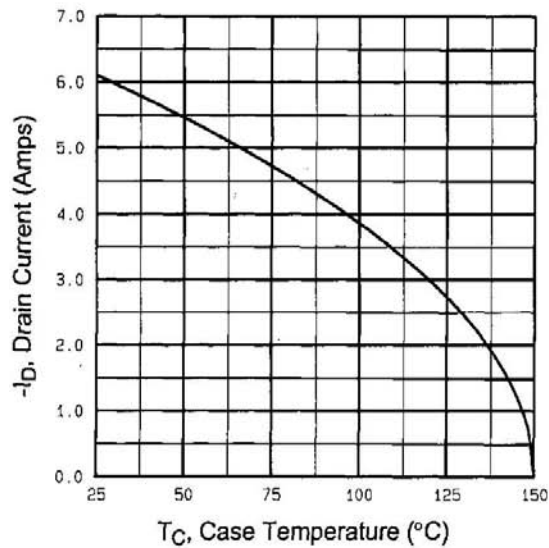


**Fig 7.** Typical Source-Drain Diode Forward Voltage

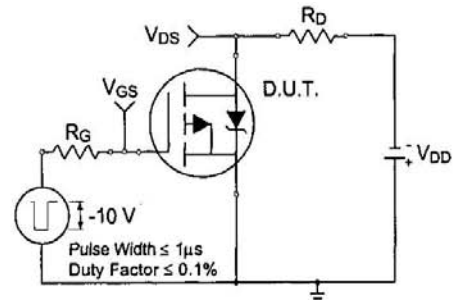


**Fig 8.** Maximum Safe Operating Area

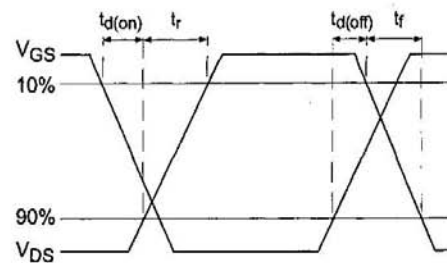




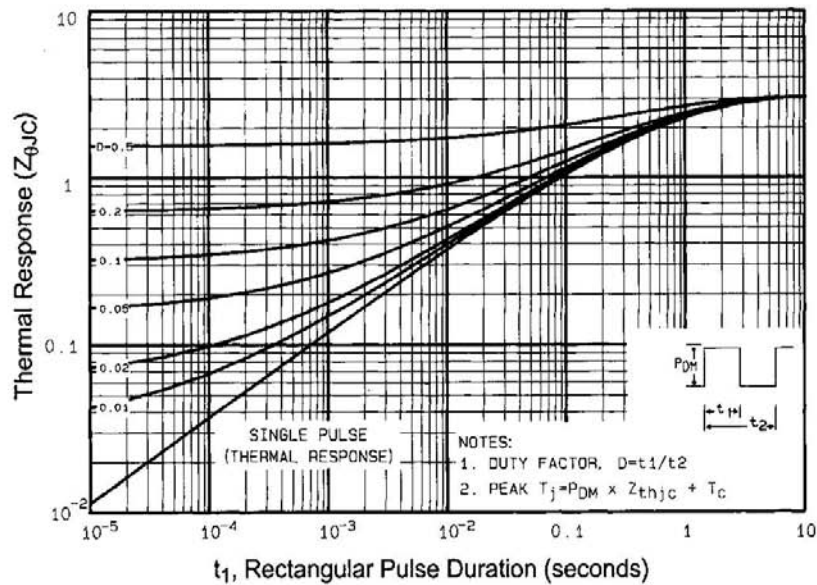
**Fig 9.** Maximum Drain Current Vs. Case Temperature



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



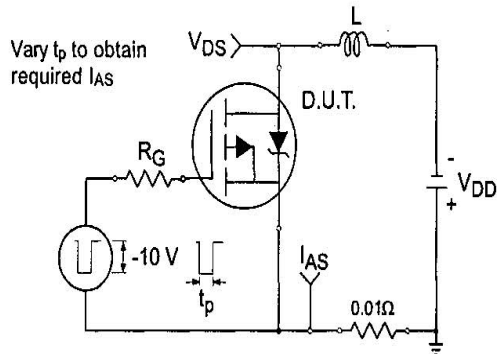
**Fig 10b.** Switching Time Waveforms



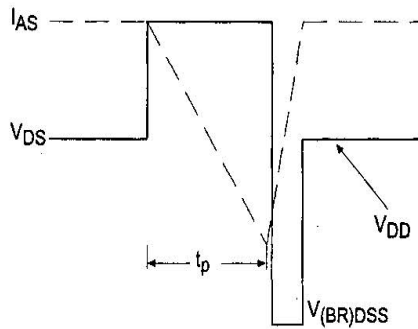
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

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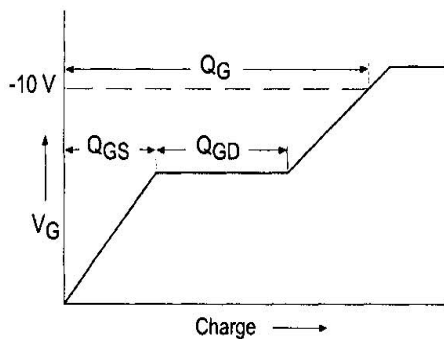
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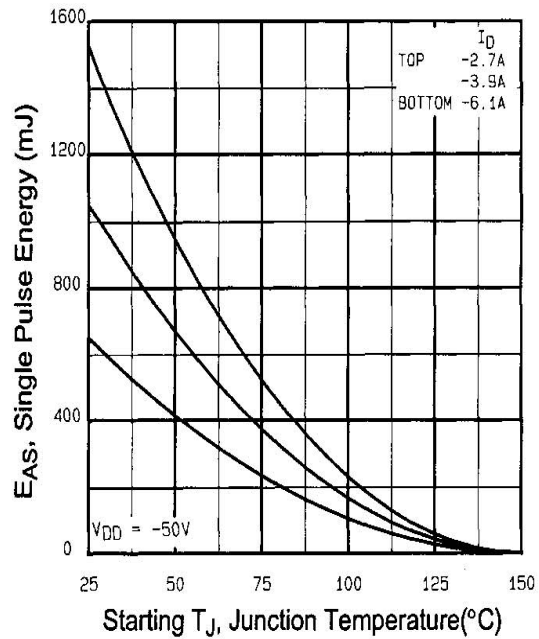
**Fig 12a.** Unclamped Inductive Test Circuit



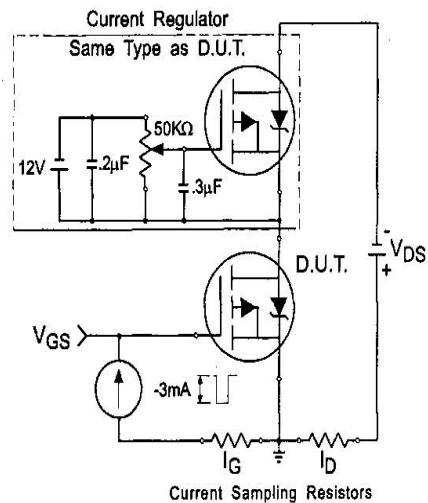
**Fig 12b.** Unclamped Inductive Waveforms



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

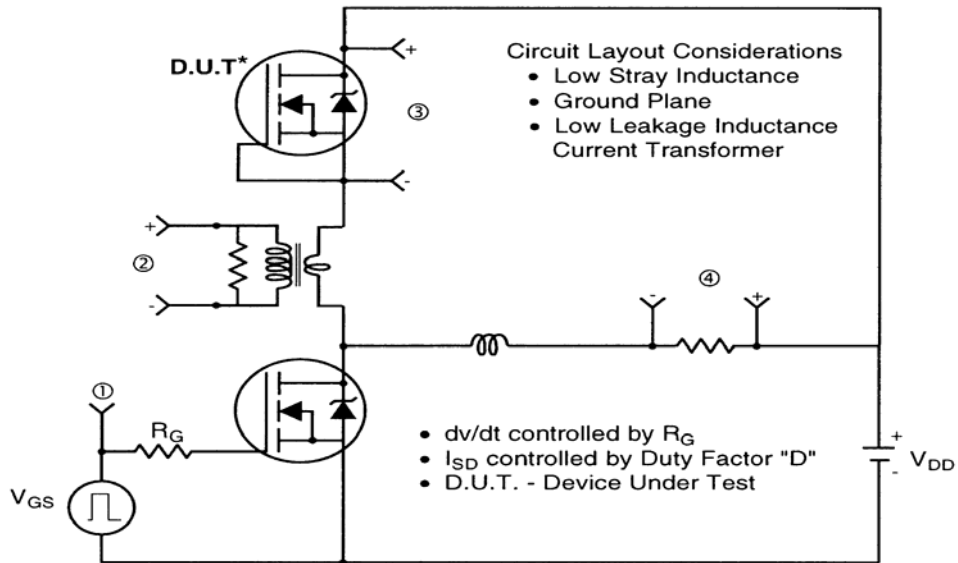


**Fig 12c.** Maximum Avalanche Energy Vs. Drain Current

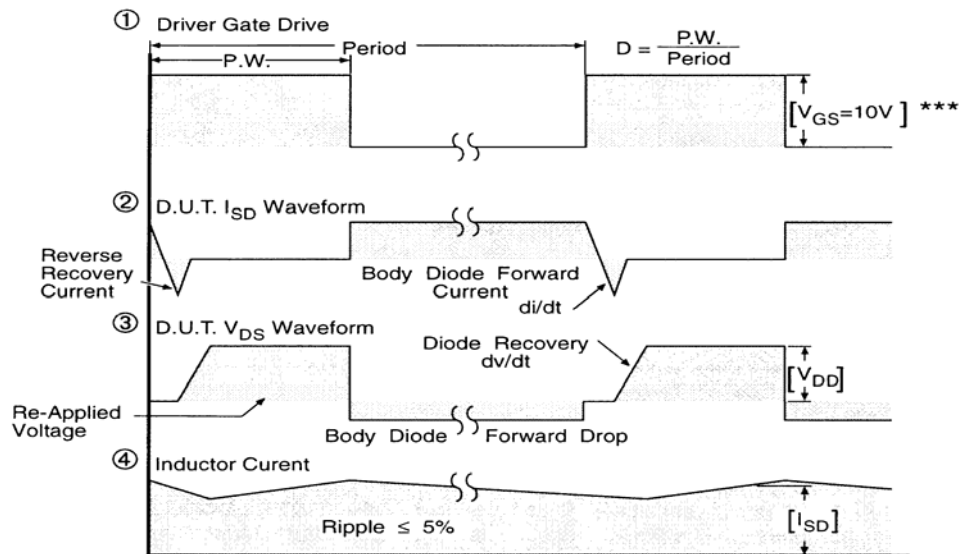


**Fig 13b.** Gate Charge Test Circuit

### Peak Diode Recovery $dv/dt$ Test Circuit



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



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

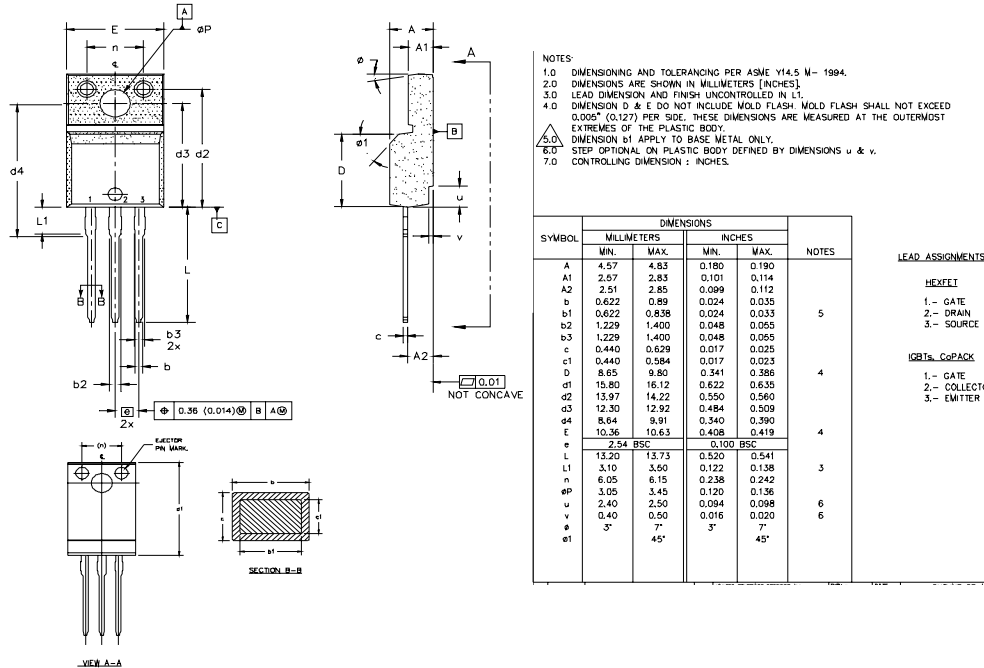
**Fig 14. For P-Channel HEXFETS**

# IRFI9640GPbF

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## TO-220 Full-Pak Package Outline

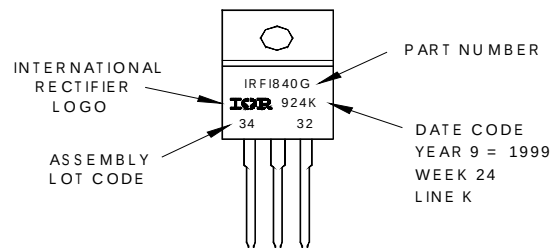
Dimensions are shown in millimeters (inches)



## 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

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TAC Fax: (310) 252-7903

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