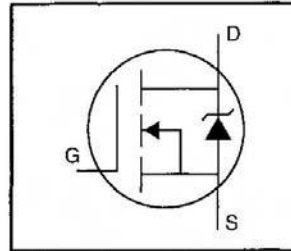


# IRFIBE20GPbF

HEXFET® Power MOSFET

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



$$V_{DSS} = 800V$$

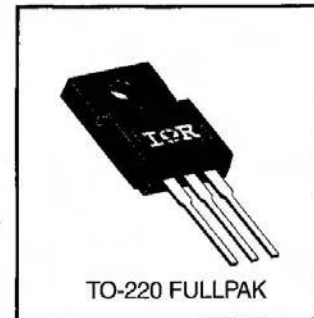
$$R_{DS(on)} = 6.5\Omega$$

$$I_D = 1.4A$$

## 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           | 1.4                   | A     |
| $I_D$ @ $T_C = 100^\circ C$ | Continuous Drain Current, $V_{GS}$ @ 10 V           | 0.86                  |       |
| $I_{DM}$                    | Pulsed Drain Current ①                              | 5.6                   |       |
| $P_D$ @ $T_C = 25^\circ C$  | Power Dissipation                                   | 30                    | W     |
|                             | Linear Derating Factor                              | 0.24                  | W/°C  |
| $V_{GS}$                    | Gate-to-Source Voltage                              | ±20                   | V     |
| $E_{AS}$                    | Single Pulse Avalanche Energy ②                     | 180                   | mJ    |
| $I_{AR}$                    | Avalanche Current ①                                 | 1.4                   | A     |
| $E_{AR}$                    | Repetitive Avalanche Energy ①                       | 3.0                   | mJ    |
| dv/dt                       | Peak Diode Recovery dv/dt ③                         | 2.0                   | 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

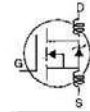
|                 | Parameter           | Min. | Typ. | Max. | Units |
|-----------------|---------------------|------|------|------|-------|
| $R_{\theta JC}$ | Junction-to-Case    | —    | —    | 4.1  | °C/W  |
| $R_{\theta JA}$ | Junction-to-Ambient | —    | —    | 65   |       |

# IRFIBE20GPbF

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## 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    | 800  | —    | —    | V                   | $V_{GS}=0V$ , $I_D=250\mu A$                                        |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient  | —    | 0.98 | —    | V/ $^\circ\text{C}$ | Reference to $25^\circ\text{C}$ , $I_D=1\text{mA}$                  |
| $R_{DS(on)}$                    | Static Drain-to-Source On-Resistance | —    | —    | 6.5  | $\Omega$            | $V_{GS}=10V$ , $I_D=0.84A$ 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             | 1.0  | —    | —    | S                   | $V_{DS}=10V$ , $I_D=0.84A$ ④                                        |
| $I_{DSS}$                       | Drain-to-Source Leakage Current      | —    | —    | 100  | $\mu A$             | $V_{DS}=800V$ , $V_{GS}=0V$                                         |
|                                 |                                      | —    | —    | 500  |                     | $V_{DS}=640V$ , $V_{GS}=0V$ , $T_J=125^\circ\text{C}$               |
| $I_{GSS}$                       | Gate-to-Source Forward Leakage       | —    | —    | 100  | nA                  | $V_{GS}=20V$                                                        |
|                                 | Gate-to-Source Reverse Leakage       | —    | —    | -100 |                     | $V_{GS}=-20V$                                                       |
| $Q_g$                           | Total Gate Charge                    | —    | —    | 38   | nC                  | $I_D=1.8A$                                                          |
| $Q_{gs}$                        | Gate-to-Source Charge                | —    | —    | 5.0  |                     | $V_{DS}=400V$                                                       |
| $Q_{gd}$                        | Gate-to-Drain ("Miller") Charge      | —    | —    | 21   |                     | $V_{GS}=10V$ See Fig. 6 and 13 ④                                    |
| $t_{d(on)}$                     | Turn-On Delay Time                   | —    | 8.2  | —    | ns                  | $V_{DD}=400V$                                                       |
| $t_r$                           | Rise Time                            | —    | 17   | —    |                     | $I_D=1.8A$                                                          |
| $t_{d(off)}$                    | Turn-Off Delay Time                  | —    | 58   | —    |                     | $R_G=18\Omega$                                                      |
| $t_f$                           | Fall Time                            | —    | 27   | —    |                     | $R_D=230\Omega$ 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                    | —    | 530  | —    | pF                  | $V_{GS}=0V$                                                         |
| $C_{oss}$                       | Output Capacitance                   | —    | 150  | —    |                     | $V_{DS}=25V$                                                        |
| $C_{rss}$                       | Reverse Transfer Capacitance         | —    | 90   | —    |                     | $f=1.0\text{MHz}$ See Figure 5                                      |
| $C$                             | Drain to Sink Capacitance            | —    | 12   | —    | pF                  | $f=1.0\text{MHz}$                                                   |



## Source-Drain Ratings and Characteristics

|          | Parameter                              | Min.                                                                      | Typ. | Max. | Units   | Test Conditions                                                |
|----------|----------------------------------------|---------------------------------------------------------------------------|------|------|---------|----------------------------------------------------------------|
| $I_S$    | Continuous Source Current (Body Diode) | —                                                                         | —    | 1.4  | A       | MOSFET symbol showing the integral reverse p-n junction diode. |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ①   | —                                                                         | —    | 5.6  |         |                                                                |
| $V_{SD}$ | Diode Forward Voltage                  | —                                                                         | —    | 1.4  | V       | $T_J=25^\circ\text{C}$ , $I_S=1.4A$ , $V_{GS}=0V$ ④            |
| $t_{rr}$ | Reverse Recovery Time                  | —                                                                         | 380  | 570  | ns      | $T_J=25^\circ\text{C}$ , $I_F=1.8A$                            |
| $Q_{rr}$ | Reverse Recovery Charge                | —                                                                         | 0.94 | 1.4  | $\mu C$ | $di/dt=100A/\mu s$ 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)

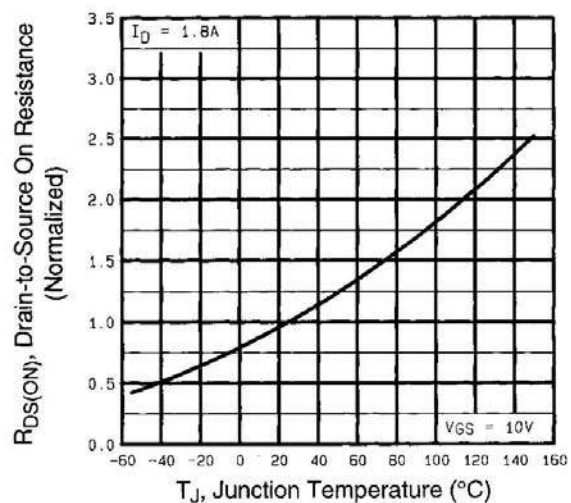
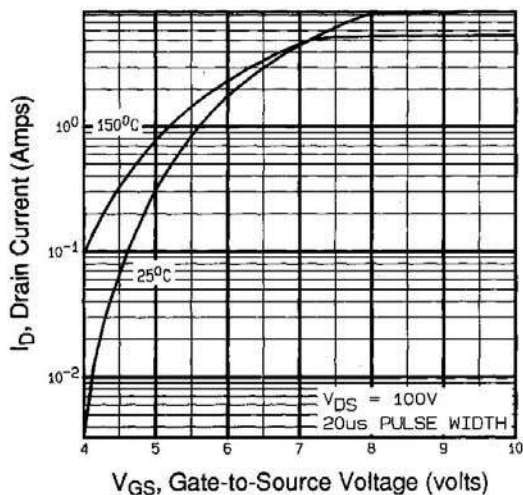
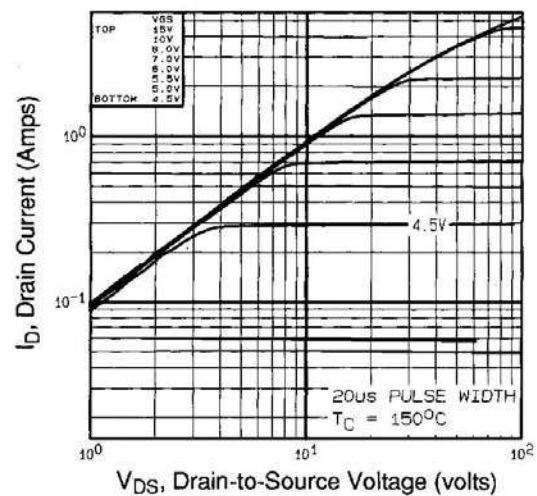
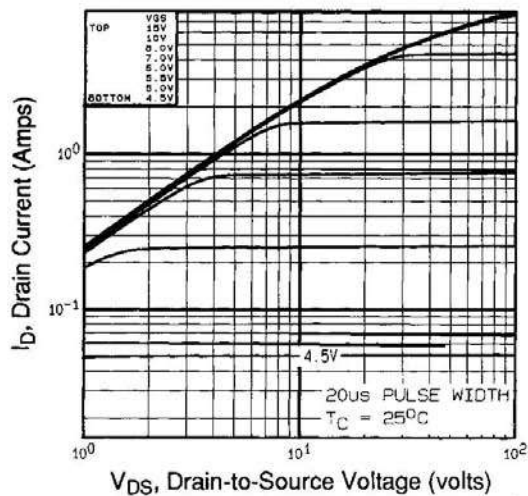
③  $I_{SD} \leq 1.8A$ ,  $di/dt \leq 80A/\mu s$ ,  $V_{DD} \leq 600$ ,  $T_J \leq 150^\circ\text{C}$

⑤  $t=60s$ ,  $f=60\text{Hz}$

②  $V_{DD}=50V$ , starting  $T_J=25^\circ\text{C}$ ,  $L=172\text{mH}$ ,  $R_G=25\Omega$ ,  $I_{AS}=1.4A$  (See Figure 12)

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

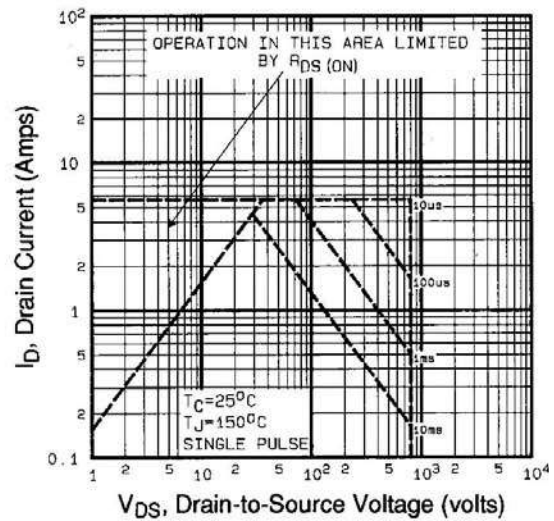
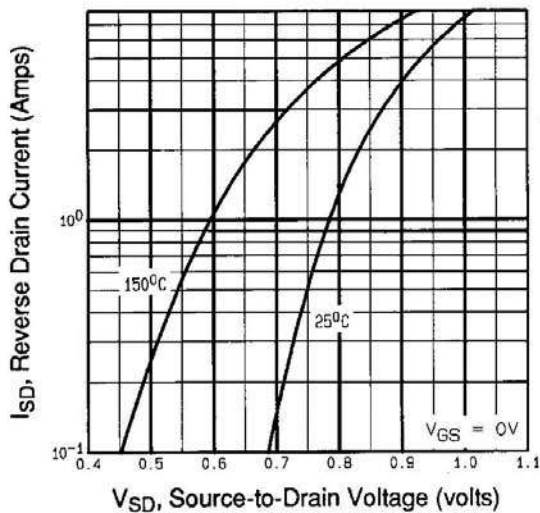
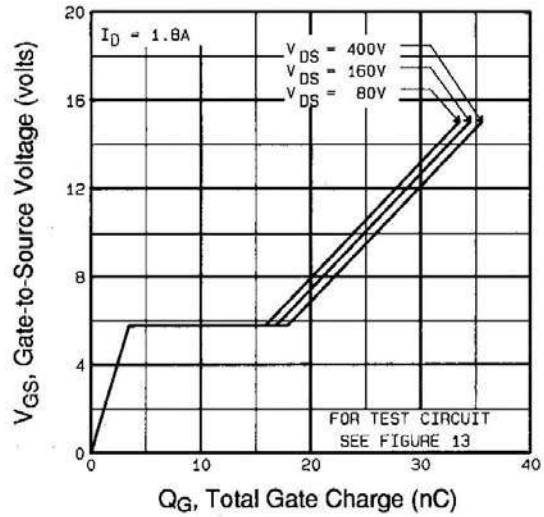
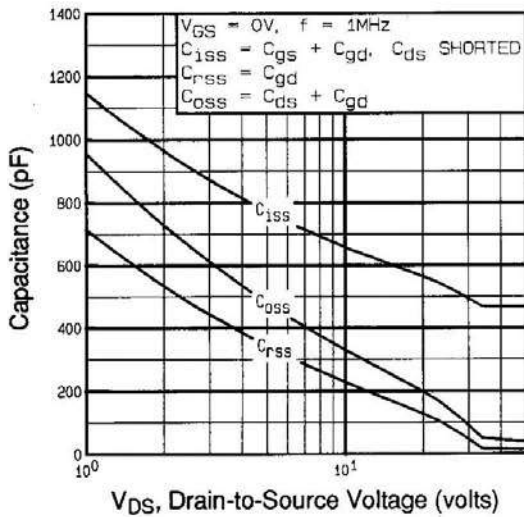
# IRFIBE20GPbF

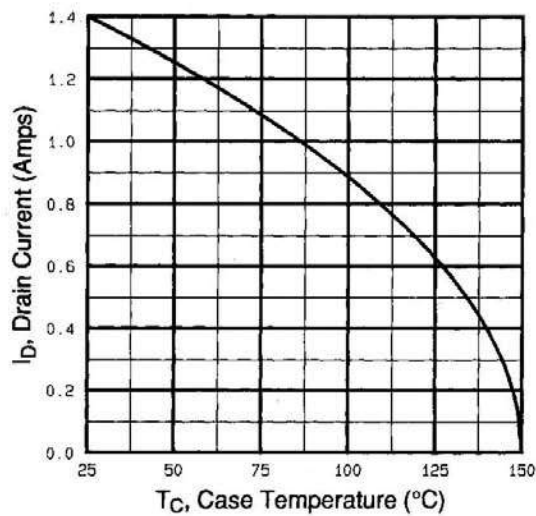




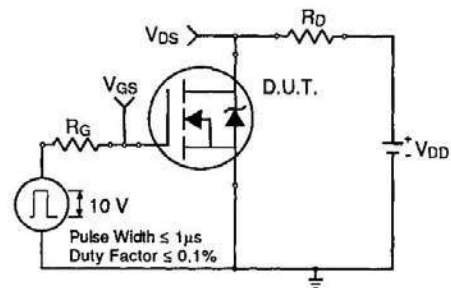
# IRFIBE20GPbF

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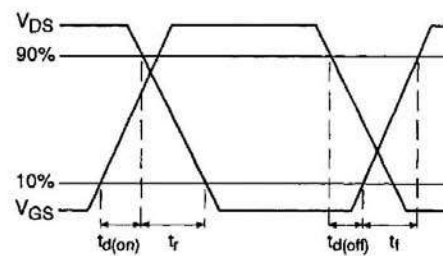




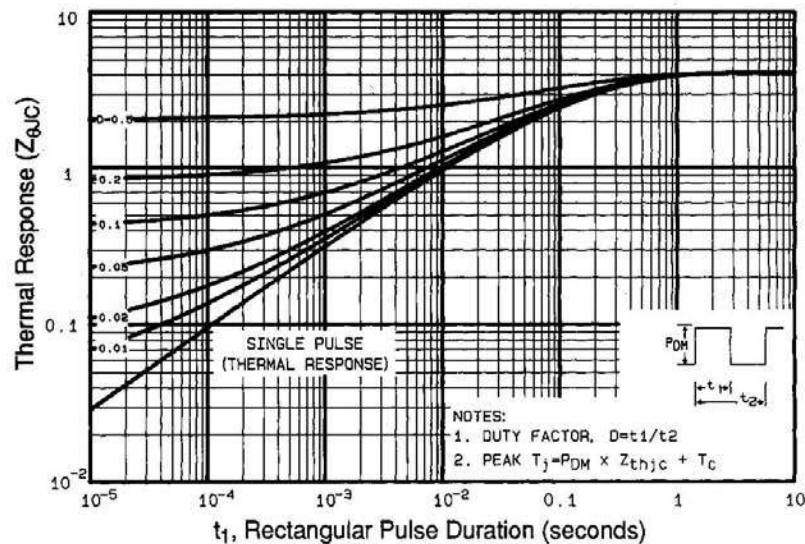
**Fig 9.** Maximum Drain Current Vs. Case Temperature



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



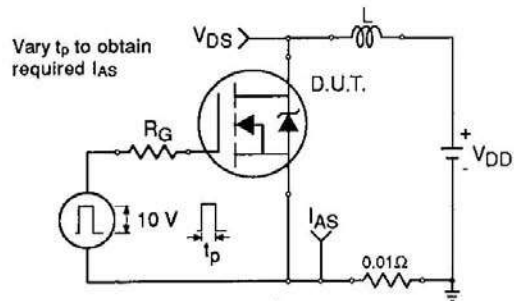
**Fig 10b.** Switching Time Waveforms



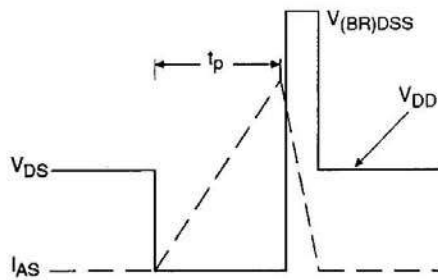
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

# IRFIBE20GPbF

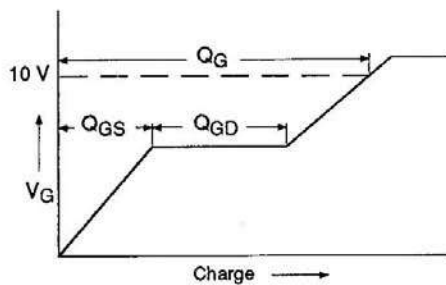
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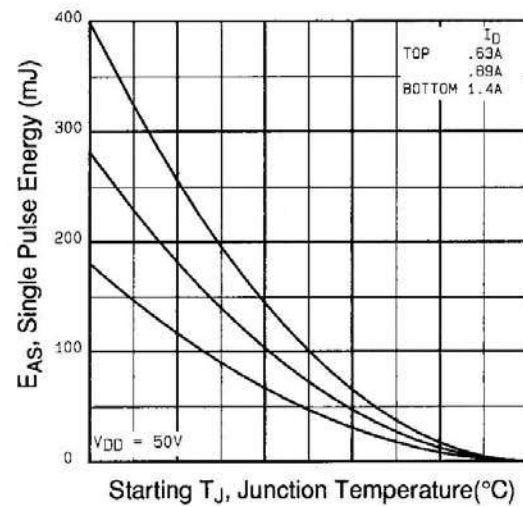
**Fig 12a.** Unclamped Inductive Test Circuit



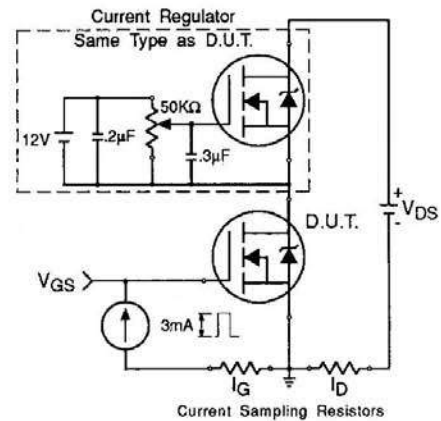
**Fig 12b.** Unclamped Inductive Waveforms



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

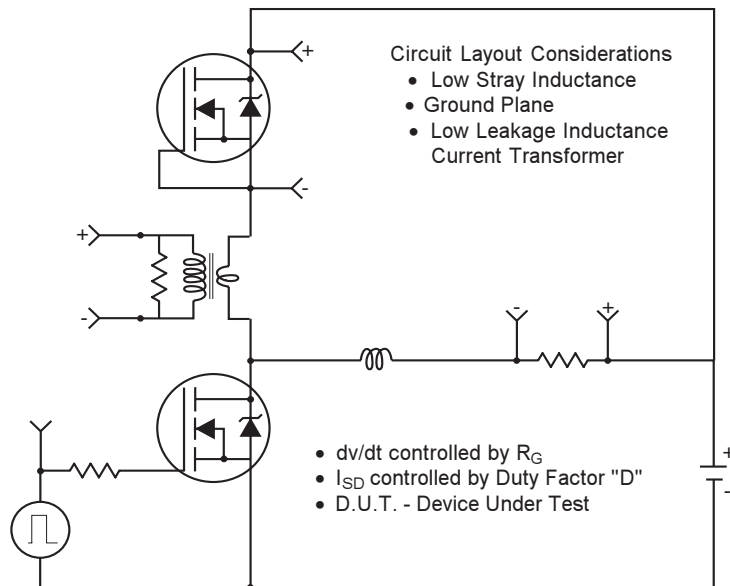


**Fig 12c.** Maximum Avalanche Energy Vs. Drain Current



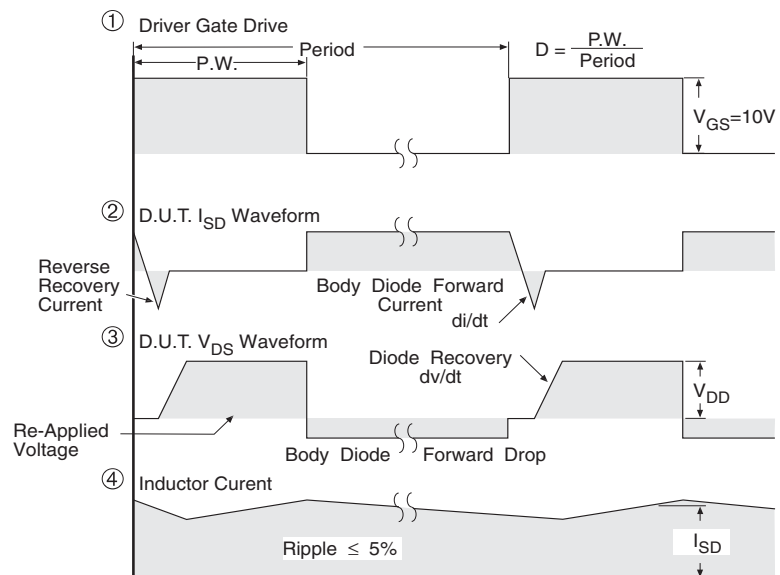
**Fig 13b.** Gate Charge Test Circuit

## 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

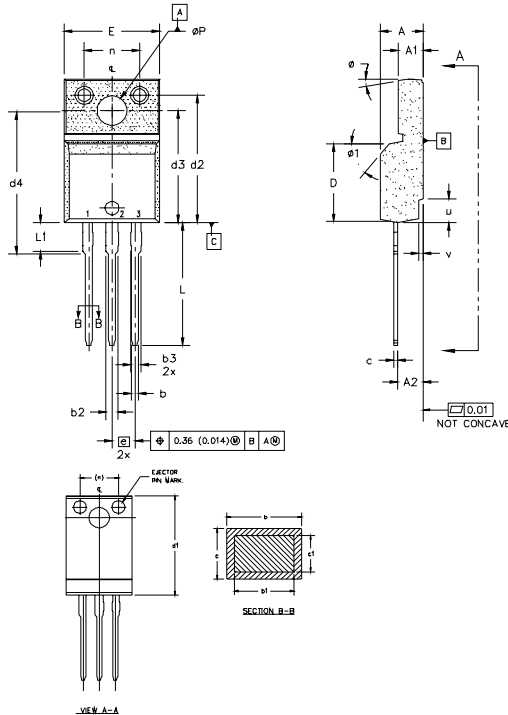
**Fig -14** For N Channel HEXFETS

# IRFIBE20GPbF

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## TO-220 Full-Pak Package Outline

Dimensions are shown in millimeters (inches)



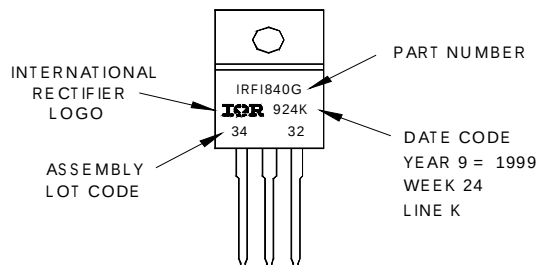
- NOTES:
- 1.0 DIMENSIONING AND TOLERANCING PER ASME Y14.5 M- 1994.
  - 2.0 DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).
  - 3.0 LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
  - 4.0 DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
  - 5.0 DIMENSION b1 APPLY TO BASE METAL ONLY.
  - 6.0 STEP OPTIONAL ON PLASTIC BODY DEFINED BY DIMENSIONS u & v.
  - 7.0 CONTROLLING DIMENSION : INCHES.

| SYMBOL | DIMENSIONS  |       |           |       | NOTES | LEAD ASSIGNMENTS |
|--------|-------------|-------|-----------|-------|-------|------------------|
|        | MILLIMETERS |       | INCHES    |       |       |                  |
|        | MIN.        | MAX.  | MIN.      | MAX.  |       |                  |
| A      | 4.57        | 4.83  | 0.180     | 0.190 |       |                  |
| A1     | 2.57        | 2.83  | 0.101     | 0.114 |       |                  |
| A2     | 2.51        | 2.85  | 0.099     | 0.112 |       | HEXFLET          |
| b      | 0.622       | 0.89  | 0.024     | 0.035 |       | 1. - GATE        |
| b1     | 0.622       | 0.838 | 0.024     | 0.033 | 5     | 2. - DRAIN       |
| b2     | 1.229       | 1.400 | 0.048     | 0.055 |       | 3. - SOURCE      |
| b3     | 1.229       | 1.400 | 0.048     | 0.055 |       |                  |
| c      | 0.440       | 0.629 | 0.017     | 0.025 |       |                  |
| d      | 0.440       | 0.584 | 0.017     | 0.023 |       | IGBTs, CoPACK    |
| d1     | 8.65        | 9.80  | 0.341     | 0.386 | 4     | 1. - GATE        |
| d2     | 15.80       | 16.12 | 0.622     | 0.365 |       | 2. - COLLECTOR   |
| d3     | 13.97       | 14.22 | 0.550     | 0.560 |       | 3. - EMITTER     |
| d4     | 12.30       | 12.92 | 0.484     | 0.509 |       |                  |
| d5     | 8.64        | 9.91  | 0.340     | 0.390 |       |                  |
| E      | 10.36       | 10.63 | 0.408     | 0.419 | 4     |                  |
| e      | 2.54 BSC    |       | 0.100 BSC |       |       |                  |
| L      | 13.20       | 13.73 | 0.520     | 0.541 |       |                  |
| L1     | 3.10        | 3.50  | 0.122     | 0.138 | 3     |                  |
| n      | 6.05        | 6.15  | 0.238     | 0.242 |       |                  |
| p      | 3.05        | 3.46  | 0.120     | 0.136 |       |                  |
| u      | 2.40        | 2.50  | 0.094     | 0.098 | 6     |                  |
| v      | 0.40        | 0.50  | 0.016     | 0.020 | 6     |                  |
| w      | 3"          | 7"    | 3"        | 7"    |       |                  |
| x      |             | 45°   |           | 45°   |       |                  |

## TO-220 Full-Pak Part Marking Information

EXAMPLE: THIS IS AN IRF1840G  
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

07/04





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