

# IRFBC40APbF

HEXFET® Power MOSFET

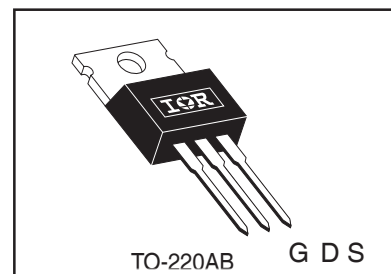
## Applications

- Switch Mode Power Supply ( SMPS )
- Uninterruptable Power Supply
- High speed power switching
- Lead-Free

## Benefits

- Low Gate Charge Qg results in Simple Drive Requirement
- Improved Gate, Avalanche and Dynamic dv/dt Ruggedness
- Fully Characterized Capacitance and Avalanche Voltage and Current
- Effective Coss Specified ( See AN 1001)

| $V_{DSS}$ | $R_{ds(on)} \text{ max}$ | $I_D$ |
|-----------|--------------------------|-------|
| 600V      | 1.2Ω                     | 6.2A  |



## Absolute Maximum Ratings

|                                 | Parameter                                       | Max.                   | Units |
|---------------------------------|-------------------------------------------------|------------------------|-------|
| $I_D @ T_C = 25^\circ\text{C}$  | Continuous Drain Current, $V_{GS} @ 10\text{V}$ | 6.2                    | A     |
| $I_D @ T_C = 100^\circ\text{C}$ | Continuous Drain Current, $V_{GS} @ 10\text{V}$ | 3.9                    |       |
| $I_{DM}$                        | Pulsed Drain Current ①                          | 25                     |       |
| $P_D @ T_C = 25^\circ\text{C}$  | Power Dissipation                               | 125                    | W     |
|                                 | Linear Derating Factor                          | 1.0                    | W/°C  |
| $V_{GS}$                        | Gate-to-Source Voltage                          | ± 30                   | V     |
| dv/dt                           | Peak Diode Recovery dv/dt ③                     | 6.0                    | V/ns  |
| $T_J$                           | Operating Junction and                          | -55 to + 150           | °C    |
| $T_{STG}$                       | Storage Temperature Range                       |                        |       |
|                                 | Soldering Temperature, for 10 seconds           | 300 (1.6mm from case ) |       |
|                                 | Mounting torque, 6-32 or M3 screw               | 10 lbf•in (1.1N•m)     |       |

## Typical SMPS Topologies:

- Single Transistor Forward

Notes ① through ⑤ are on page 8

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

International  
IOR Rectifier

|                                 | Parameter                            | Min. | Typ. | Max. | Units               | Conditions                                             |
|---------------------------------|--------------------------------------|------|------|------|---------------------|--------------------------------------------------------|
| $V_{(BR)DSS}$                   | Drain-to-Source Breakdown Voltage    | 600  | —    | —    | V                   | $V_{GS} = 0V, I_D = 250\mu A$                          |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient  | —    | 0.66 | —    | V/ $^\circ\text{C}$ | Reference to $25^\circ\text{C}$ , $I_D = 1\text{mA}$ ⑥ |
| $R_{DS(on)}$                    | Static Drain-to-Source On-Resistance | —    | —    | 1.2  | $\Omega$            | $V_{GS} = 10V, I_D = 3.7A$ ④                           |
| $V_{GS(th)}$                    | Gate Threshold Voltage               | 2.0  | —    | 4.0  | V                   | $V_{DS} = V_{GS}, I_D = 250\mu A$                      |
| $I_{DSS}$                       | Drain-to-Source Leakage Current      | —    | —    | 25   | $\mu A$             | $V_{DS} = 600V, V_{GS} = 0V$                           |
|                                 |                                      | —    | —    | 250  |                     | $V_{DS} = 480V, V_{GS} = 0V, T_J = 125^\circ\text{C}$  |
| $I_{GSS}$                       | Gate-to-Source Forward Leakage       | —    | —    | 100  | nA                  | $V_{GS} = 30V$                                         |
|                                 | Gate-to-Source Reverse Leakage       | —    | —    | -100 |                     | $V_{GS} = -30V$                                        |

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

|                        | Parameter                       | Min. | Typ. | Max. | Units | Conditions                                      |
|------------------------|---------------------------------|------|------|------|-------|-------------------------------------------------|
| $g_{fs}$               | Forward Transconductance        | 3.4  | —    | —    | S     | $V_{DS} = 50V, I_D = 3.7A$                      |
| $Q_g$                  | Total Gate Charge               | —    | —    | 42   | nC    | $I_D = 6.2A$                                    |
| $Q_{gs}$               | Gate-to-Source Charge           | —    | —    | 10   |       | $V_{DS} = 480V$                                 |
| $Q_{gd}$               | Gate-to-Drain ("Miller") Charge | —    | —    | 20   |       | $V_{GS} = 10V$ , See Fig. 6 and 13 ④            |
| $t_{d(on)}$            | Turn-On Delay Time              | —    | 13   | —    | ns    | $V_{DD} = 300V$                                 |
| $t_r$                  | Rise Time                       | —    | 23   | —    |       | $I_D = 6.2A$                                    |
| $t_{d(off)}$           | Turn-Off Delay Time             | —    | 31   | —    |       | $R_G = 9.1\Omega$                               |
| $t_f$                  | Fall Time                       | —    | 18   | —    |       | $R_D = 47\Omega$ , See Fig. 10 ④                |
| $C_{iss}$              | Input Capacitance               | —    | 1036 | —    | pF    | $V_{GS} = 0V$                                   |
| $C_{oss}$              | Output Capacitance              | —    | 136  | —    |       | $V_{DS} = 25V$                                  |
| $C_{rss}$              | Reverse Transfer Capacitance    | —    | 7.0  | —    |       | $f = 1.0\text{MHz}$ , See Fig. 5                |
| $C_{oss}$              | Output Capacitance              | —    | 1487 | —    |       | $V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0\text{MHz}$ |
| $C_{oss}$              | Output Capacitance              | —    | 36   | —    |       | $V_{GS} = 0V, V_{DS} = 480V, f = 1.0\text{MHz}$ |
| $C_{oss \text{ eff.}}$ | Effective Output Capacitance    | —    | 48   | —    |       | $V_{GS} = 0V, V_{DS} = 0V \text{ to } 480V$ ⑤   |

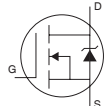
## Avalanche Characteristics

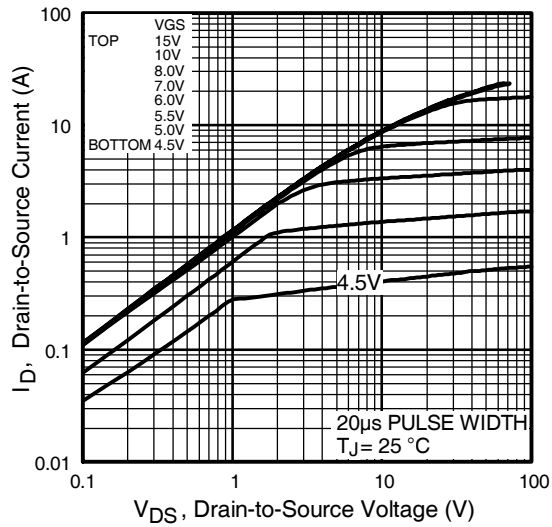
|          | Parameter                      | Typ. | Max. | Units |
|----------|--------------------------------|------|------|-------|
| $E_{AS}$ | Single Pulse Avalanche Energy② | —    | 570  | mJ    |
| $I_{AR}$ | Avalanche Current③             | —    | 6.2  | A     |
| $E_{AR}$ | Repetitive Avalanche Energy③   | —    | 13   | mJ    |

## Thermal Resistance

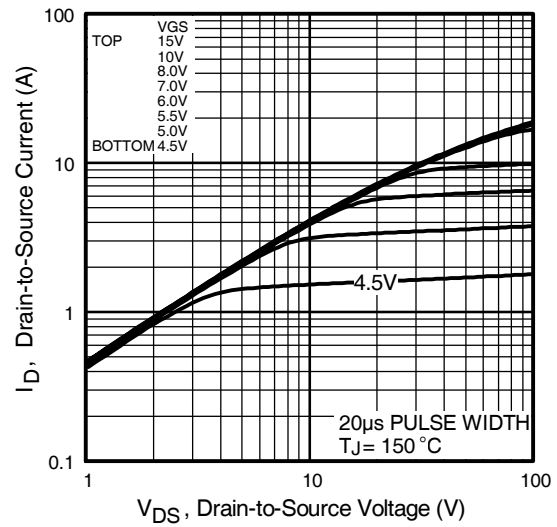
|                 | Parameter                           | Typ. | Max. | Units              |
|-----------------|-------------------------------------|------|------|--------------------|
| $R_{\theta JC}$ | Junction-to-Case                    | —    | 1.0  | $^\circ\text{C/W}$ |
| $R_{\theta CS}$ | Case-to-Sink, Flat, Greased Surface | 0.50 | —    |                    |
| $R_{\theta JA}$ | Junction-to-Ambient                 | —    | 62   |                    |

## Diode Characteristics

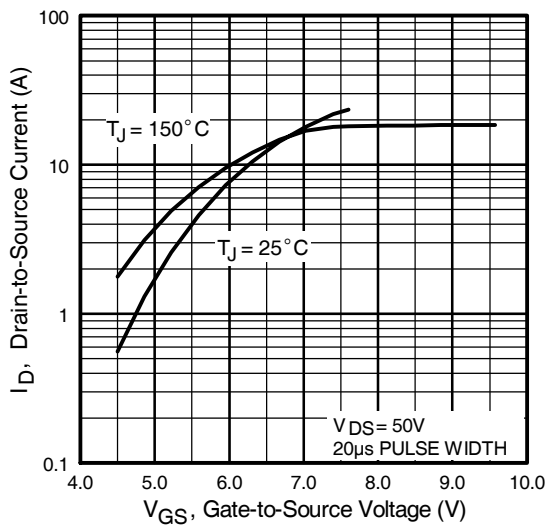
|          | Parameter                              | Min.                                                                        | Typ. | Max. | Units   | Conditions                                                                                                                                           |
|----------|----------------------------------------|-----------------------------------------------------------------------------|------|------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| $I_S$    | Continuous Source Current (Body Diode) | —                                                                           | —    | 6.2  | A       | MOSFET symbol showing the integral reverse p-n junction diode.  |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ①   | —                                                                           | —    | 25   |         |                                                                                                                                                      |
| $V_{SD}$ | Diode Forward Voltage                  | —                                                                           | —    | 1.5  | V       | $T_J = 25^\circ\text{C}, I_S = 6.2A, V_{GS} = 0V$ ④                                                                                                  |
| $t_{rr}$ | Reverse Recovery Time                  | —                                                                           | 431  | 647  | ns      | $T_J = 25^\circ\text{C}, I_F = 6.2A$                                                                                                                 |
| $Q_{rr}$ | Reverse Recovery Charge                | —                                                                           | 1.8  | 2.8  | $\mu C$ | $di/dt = 100A/\mu s$ ④                                                                                                                               |
| $t_{on}$ | Forward Turn-On Time                   | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S + L_D$ ) |      |      |         |                                                                                                                                                      |



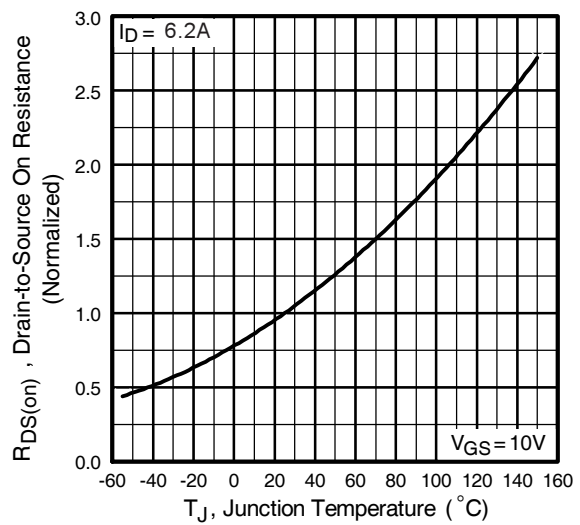
**Fig 1.** Typical Output Characteristics,



**Fig 2.** Typical Output Characteristics,



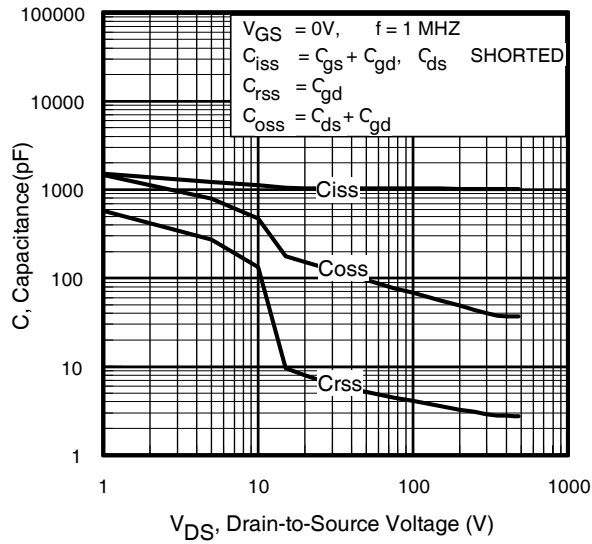
**Fig 3.** Typical Transfer Characteristics



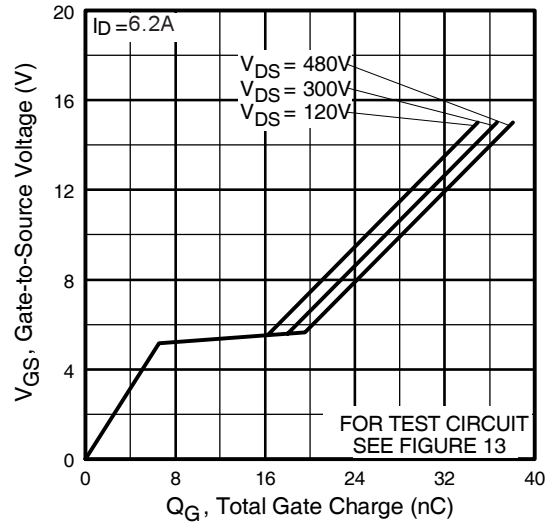
**Fig 4.** Normalized On-Resistance  
Vs. Temperature

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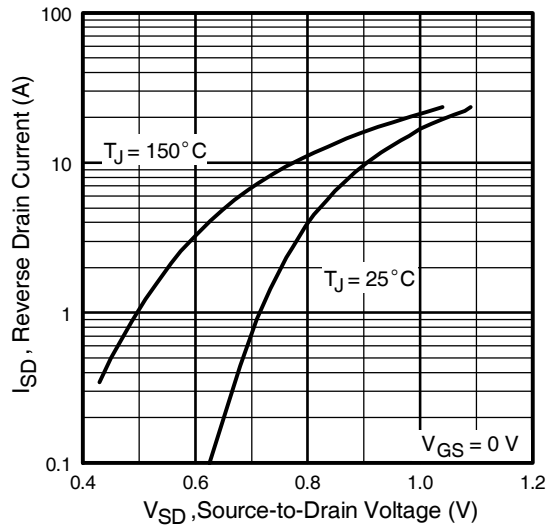
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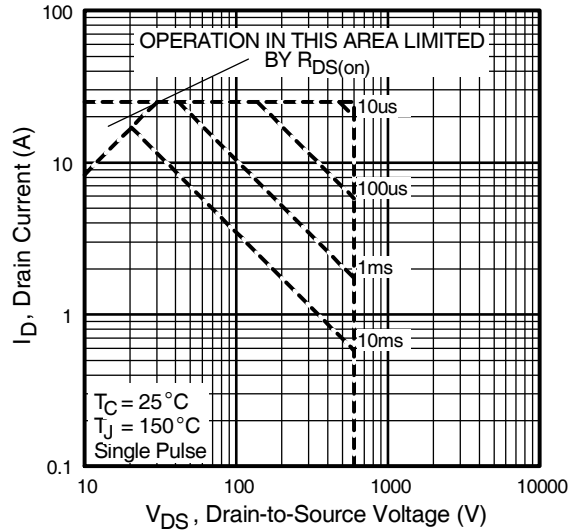
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



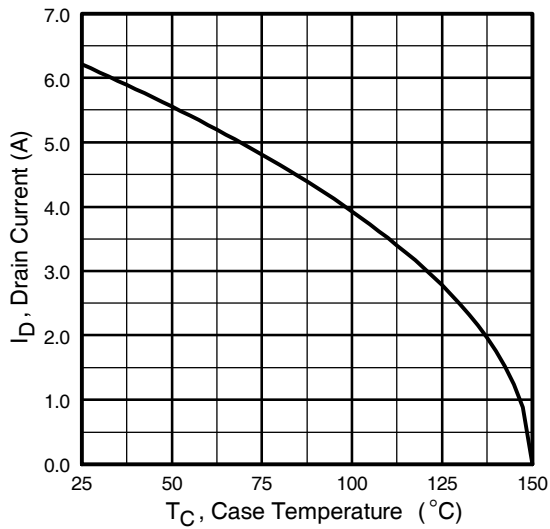
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



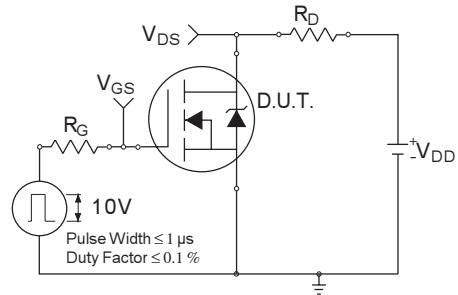
**Fig 7.** Typical Source-Drain Diode Forward Voltage



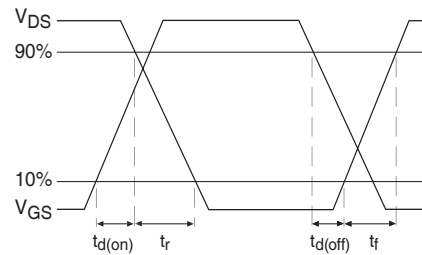
**Fig 8.** Maximum Safe Operating Area



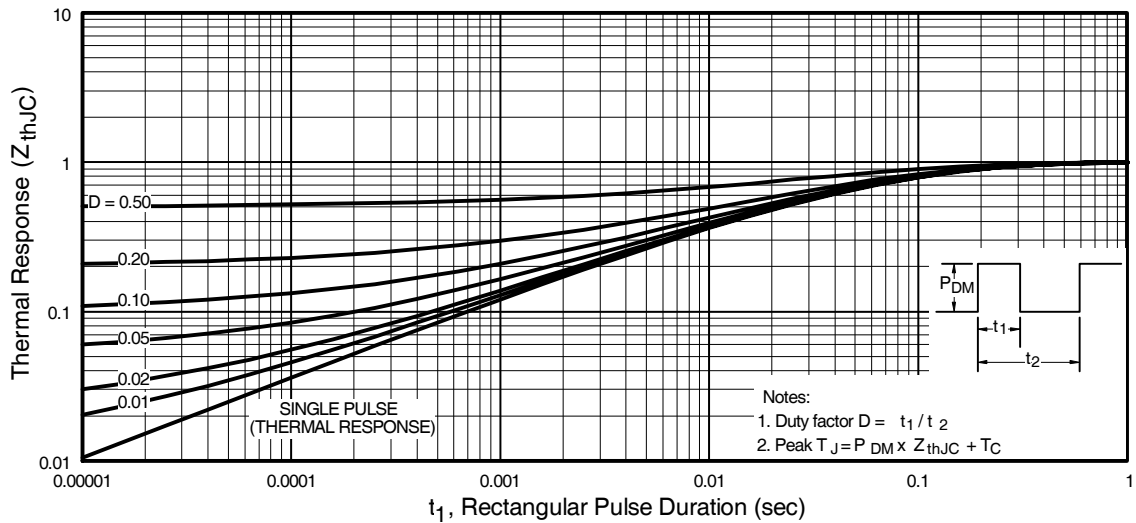
**Fig 9.** Maximum Drain Current Vs. Case Temperature



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



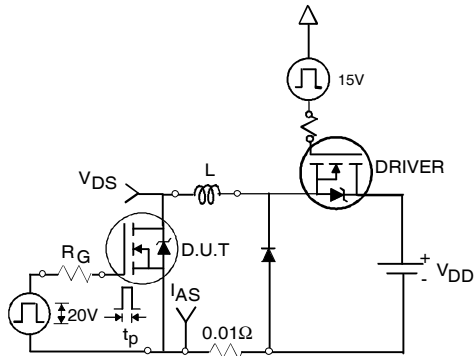
**Fig 10b.** Switching Time Waveforms



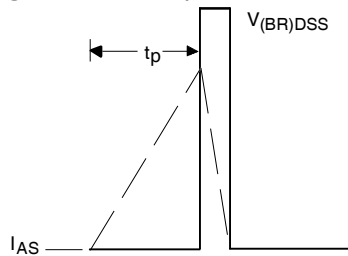
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

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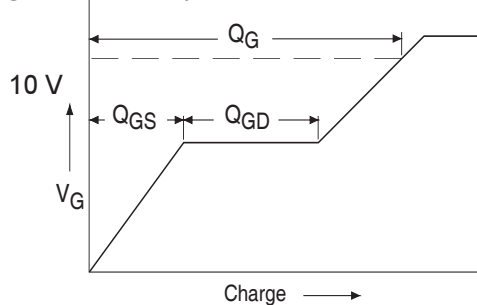
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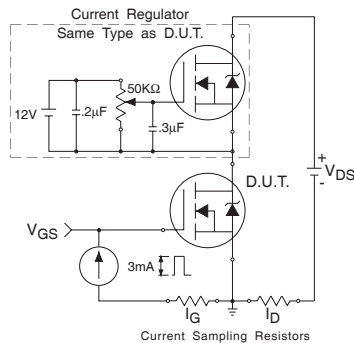
**Fig 12a.** Unclamped Inductive Test Circuit



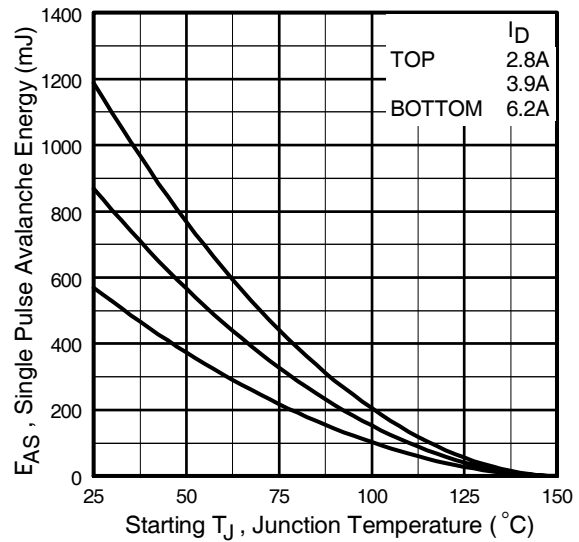
**Fig 12b.** Unclamped Inductive Waveforms



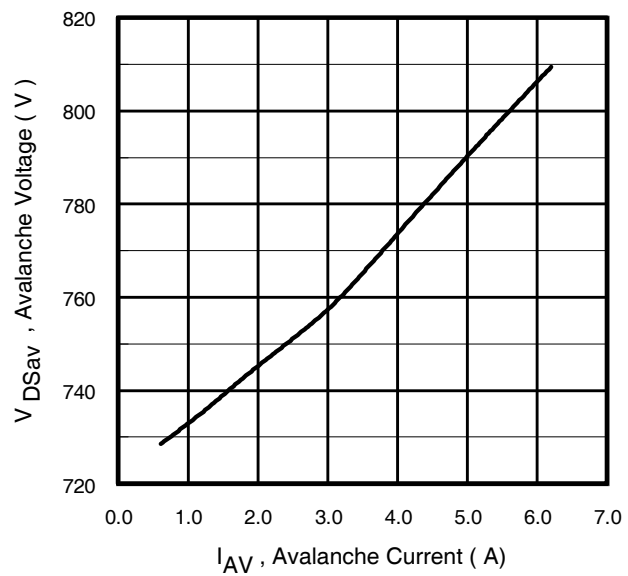
**Fig 13a.** Basic Gate Charge Waveform



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

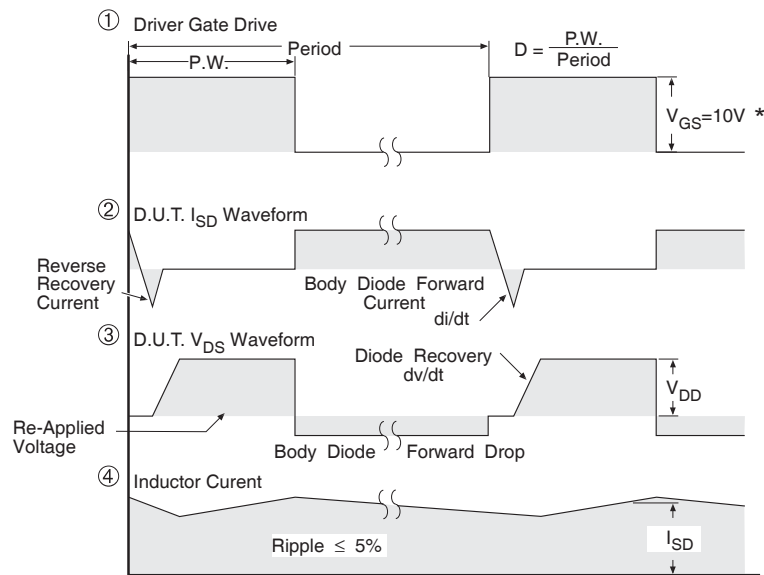
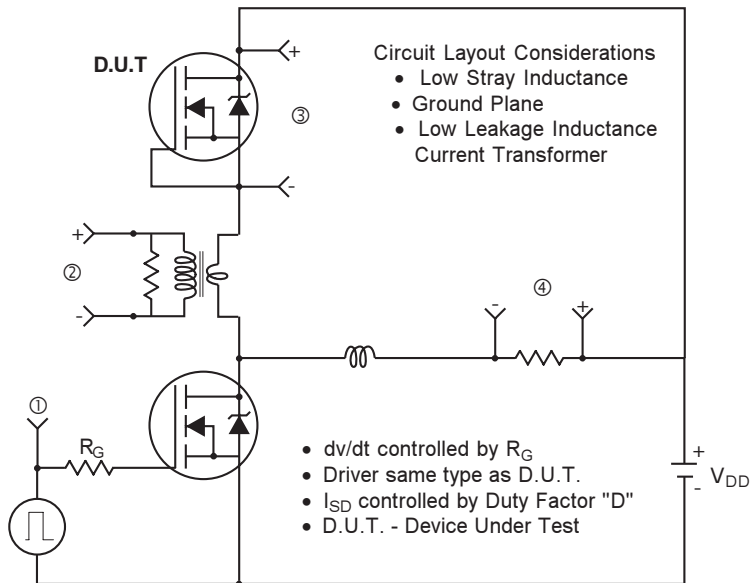


**Fig 12c.** Maximum Avalanche Energy Vs. Drain Current



**Fig 12d.** Typical Drain-to-Source Voltage Vs. Avalanche Current

## Peak Diode Recovery dv/dt Test Circuit



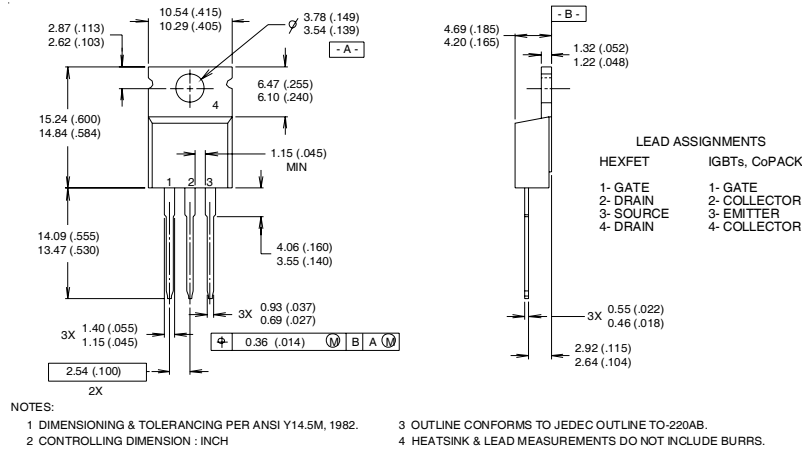
\*  $V_{GS} = 5V$  for Logic Level Devices

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

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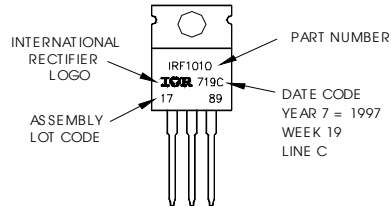
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**IR** Rectifier

## TO-220AB Package Outline



## TO-220AB Part Marking Information

EXAMPLE: THIS IS AN IRF1010  
LOT CODE 1789  
ASSEMBLED ON WW 19, 1997  
IN THE ASSEMBLY LINE "C"  
**Note:** "P" in assembly line  
position indicates "Lead-Free"



### Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. ( See fig. 11 )
- ② Starting  $T_J = 25^\circ\text{C}$ ,  $L = 29.6\text{mH}$   
 $R_G = 25\Omega$ ,  $I_{AS} = 6.2\text{A}$ . (See Figure 12)
- ③  $I_{SD} \leq 6.2\text{A}$ ,  $di/dt \leq 80\text{A}/\mu\text{s}$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  
 $T_J \leq 150^\circ\text{C}$
- ④ Pulse width  $\leq 300\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- ⑤  $C_{OSS}$  eff. is a fixed capacitance that gives the same charging time as  $C_{OSS}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$

Data and specifications subject to change without notice.

International  
**IR** Rectifier

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