

# IRF2805PbF

HEXFET® Power MOSFET

## Typical Applications

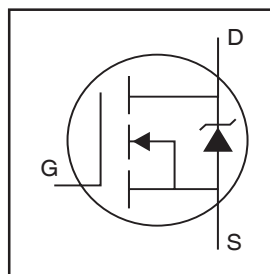
- Industrial Motor Drive

## Features

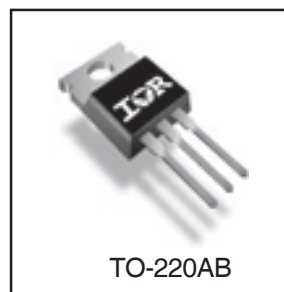
- Advanced Process Technology
- Ultra Low On-Resistance
- 175°C Operating Temperature
- Fast Switching
- Repetitive Avalanche Allowed up to  $T_{jmax}$
- Lead-Free

## Description

This HEXFET® Power MOSFET utilizes the latest processing techniques to achieve extremely low on-resistance per silicon area. Additional features of this design are a 175°C junction operating temperature, fast switching speed and improved repetitive avalanche rating. These features combine to make this design an extremely efficient and reliable device for use in a wide variety of applications.



|                           |
|---------------------------|
| $V_{DS} = 55V$            |
| $R_{DS(on)} = 4.7m\Omega$ |
| $I_D = 75A$               |



TO-220AB

## Absolute Maximum Ratings

|                            | Parameter                                                  | Max.                     | Units        |
|----------------------------|------------------------------------------------------------|--------------------------|--------------|
| $I_D @ T_C = 25^\circ C$   | Continuous Drain Current, $V_{GS} @ 10V$ (Silicon limited) | 175                      | A            |
| $I_D @ T_C = 100^\circ C$  | Continuous Drain Current, $V_{GS} @ 10V$ (See Fig.9)       | 120                      |              |
| $I_D @ T_C = 25^\circ C$   | Continuous Drain Current, $V_{GS} @ 10V$ (Package limited) | 75                       |              |
| $I_{DM}$                   | Pulsed Drain Current ①                                     | 700                      |              |
| $P_D @ T_C = 25^\circ C$   | Power Dissipation                                          | 330                      | W            |
|                            | Linear Derating Factor                                     | 2.2                      | W/°C         |
| $V_{GS}$                   | Gate-to-Source Voltage                                     | $\pm 20$                 | V            |
| $E_{AS}$                   | Single Pulse Avalanche Energy②                             | 450                      | mJ           |
| $E_{AS} (6 \text{ sigma})$ | Single Pulse Avalanche Energy Tested Value②                | 1220                     |              |
| $I_{AR}$                   | Avalanche Current③                                         | See Fig.12a, 12b, 15, 16 | A            |
| $E_{AR}$                   | Repetitive Avalanche Energy④                               |                          | mJ           |
| $T_J$                      | Operating Junction and                                     | -55 to + 175             | °C           |
| $T_{STG}$                  | Storage Temperature Range                                  |                          |              |
|                            | Soldering Temperature, for 10 seconds                      | 300 (1.6mm from case )   |              |
|                            | Mounting Torque, 6-32 or M3 screw                          | 1.1 (10)                 | N•m (lbf•in) |

## Thermal Resistance

|                 | Parameter                           | Typ. | Max. | Units |
|-----------------|-------------------------------------|------|------|-------|
| $R_{\theta JC}$ | Junction-to-Case                    | —    | 0.45 | °C/W  |
| $R_{\theta CS}$ | Case-to-Sink, Flat, Greased Surface | 0.50 | —    |       |
| $R_{\theta JA}$ | Junction-to-Ambient                 | —    | 62   |       |

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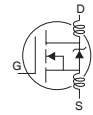
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# IRF2805PbF

International  
IR Rectifier

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

|                                 | Parameter                            | Min. | Typ. | Max. | Units               | Conditions                                                                  |
|---------------------------------|--------------------------------------|------|------|------|---------------------|-----------------------------------------------------------------------------|
| $V_{(BR)DSS}$                   | Drain-to-Source Breakdown Voltage    | 55   | —    | —    | V                   | $V_{GS} = 0V, I_D = 250\mu A$                                               |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient  | —    | 0.06 | —    | V/ $^\circ\text{C}$ | Reference to $25^\circ\text{C}$ , $I_D = 1mA$                               |
| $R_{DS(on)}$                    | Static Drain-to-Source On-Resistance | —    | 3.9  | 4.7  | m $\Omega$          | $V_{GS} = 10V, I_D = 104A$ ④                                                |
| $V_{GS(th)}$                    | Gate Threshold Voltage               | 2.0  | —    | 4.0  | V                   | $V_{DS} = 10V, I_D = 250\mu A$                                              |
| $g_{fs}$                        | Forward Transconductance             | 91   | —    | —    | S                   | $V_{DS} = 25V, I_D = 104A$                                                  |
| $I_{DSS}$                       | Drain-to-Source Leakage Current      | —    | —    | 20   | $\mu A$             | $V_{DS} = 55V, V_{GS} = 0V$                                                 |
|                                 |                                      | —    | —    | 250  |                     | $V_{DS} = 55V, V_{GS} = 0V, T_J = 125^\circ\text{C}$                        |
| $I_{GSS}$                       | Gate-to-Source Forward Leakage       | —    | —    | 200  | nA                  | $V_{GS} = 20V$                                                              |
|                                 | Gate-to-Source Reverse Leakage       | —    | —    | -200 |                     | $V_{GS} = -20V$                                                             |
| $Q_g$                           | Total Gate Charge                    | —    | 150  | 230  | nC                  | $I_D = 104A$                                                                |
| $Q_{gs}$                        | Gate-to-Source Charge                | —    | 38   | 57   |                     | $V_{DS} = 44V$                                                              |
| $Q_{gd}$                        | Gate-to-Drain ("Miller") Charge      | —    | 52   | 78   |                     | $V_{GS} = 10V$ ④                                                            |
| $t_{d(on)}$                     | Turn-On Delay Time                   | —    | 14   | —    | ns                  | $V_{DD} = 28V$                                                              |
| $t_r$                           | Rise Time                            | —    | 120  | —    |                     | $I_D = 104A$                                                                |
| $t_{d(off)}$                    | Turn-Off Delay Time                  | —    | 68   | —    |                     | $R_G = 2.5\Omega$                                                           |
| $t_f$                           | Fall Time                            | —    | 110  | —    |                     | $V_{GS} = 10V$ ④                                                            |
| $L_D$                           | Internal Drain Inductance            | —    | 4.5  | —    | nH                  | Between lead,<br>6mm (0.25in.)<br>from package<br>and center of die contact |
| $L_S$                           | Internal Source Inductance           | —    | 7.5  | —    |                     |                                                                             |
| $C_{iss}$                       | Input Capacitance                    | —    | 5110 | —    | pF                  | $V_{GS} = 0V$                                                               |
| $C_{oss}$                       | Output Capacitance                   | —    | 1190 | —    |                     | $V_{DS} = 25V$                                                              |
| $C_{rss}$                       | Reverse Transfer Capacitance         | —    | 210  | —    |                     | $f = 1.0MHz$ , See Fig. 5                                                   |
| $C_{oss}$                       | Output Capacitance                   | —    | 6470 | —    |                     | $V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0MHz$                                    |
| $C_{oss}$                       | Output Capacitance                   | —    | 860  | —    |                     | $V_{GS} = 0V, V_{DS} = 44V, f = 1.0MHz$                                     |
| $C_{oss \text{ eff.}}$          | Effective Output Capacitance ⑤       | —    | 1600 | —    |                     | $V_{GS} = 0V, V_{DS} = 0V \text{ to } 44V$                                  |



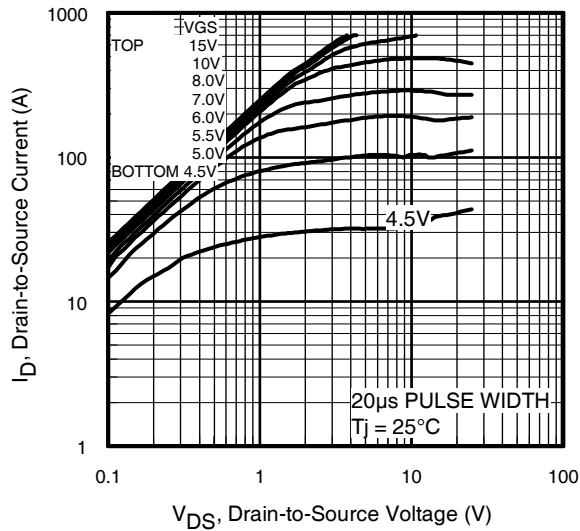
## Source-Drain Ratings and Characteristics

|          | Parameter                                 | Min.                                                                        | Typ. | Max. | Units | Conditions                                                              |
|----------|-------------------------------------------|-----------------------------------------------------------------------------|------|------|-------|-------------------------------------------------------------------------|
| $I_S$    | Continuous Source Current<br>(Body Diode) | —                                                                           | —    | 175  | A     | MOSFET symbol<br>showing the<br>integral reverse<br>p-n junction diode. |
| $I_{SM}$ | Pulsed Source Current<br>(Body Diode) ①   | —                                                                           | —    | 700  |       |                                                                         |
| $V_{SD}$ | Diode Forward Voltage                     | —                                                                           | —    | 1.3  | V     | $T_J = 25^\circ\text{C}, I_S = 104A, V_{GS} = 0V$ ④                     |
| $t_{rr}$ | Reverse Recovery Time                     | —                                                                           | 80   | 120  | ns    | $T_J = 25^\circ\text{C}, I_F = 104A$                                    |
| $Q_{rr}$ | Reverse Recovery Charge                   | —                                                                           | 290  | 430  | nC    | $di/dt = 100A/\mu s$ ④                                                  |
| $t_{on}$ | Forward Turn-On Time                      | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S + L_D$ ) |      |      |       |                                                                         |

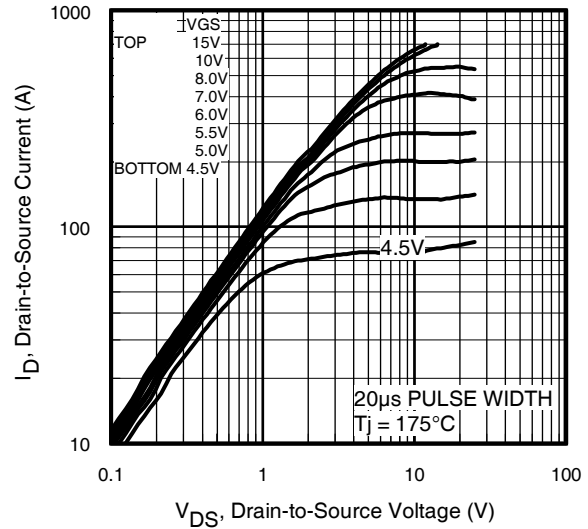
### Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11).
- ② Starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.08mH$   
 $R_G = 25\Omega$ ,  $I_{AS} = 104A$ . (See Figure 12).
- ③  $I_{SD} \leq 104A$ ,  $di/dt \leq 240A/\mu s$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  
 $T_J \leq 175^\circ\text{C}$
- ④ Pulse width  $\leq 400\mu s$ ; duty cycle  $\leq 2\%$ .

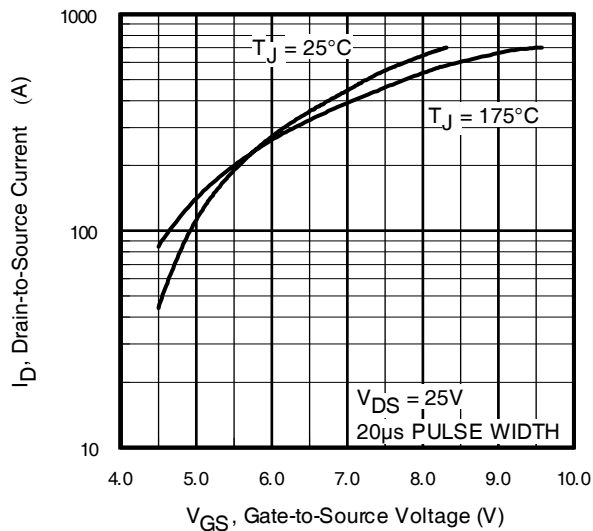
- ⑤  $C_{oss \text{ eff.}}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .
- ⑥ Limited by  $T_{Jmax}$ , see Fig.12a, 12b, 15, 16 for typical repetitive avalanche performance.
- ⑦ This value determined from sample failure population. 100% tested to this value in production.



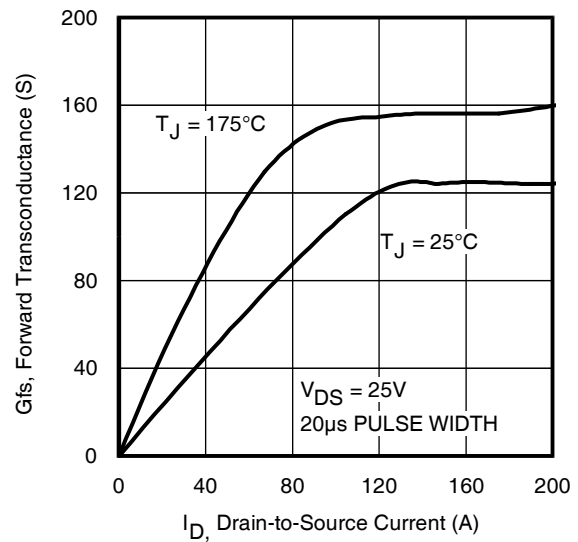
**Fig 1.** Typical Output Characteristics



**Fig 2.** Typical Output Characteristics



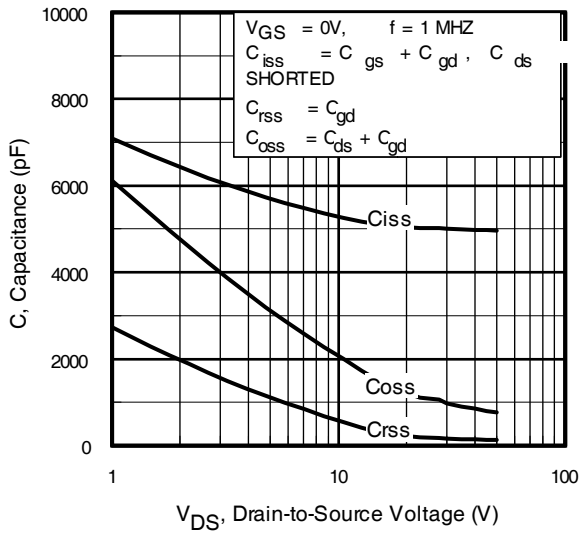
**Fig 3.** Typical Transfer Characteristics



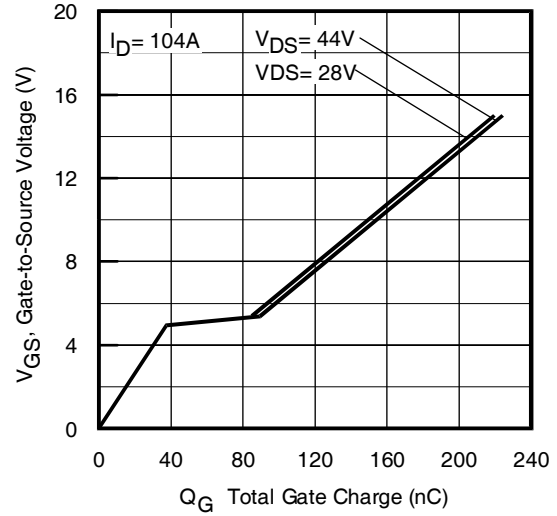
**Fig 4.** Typical Forward Transconductance Vs. Drain Current

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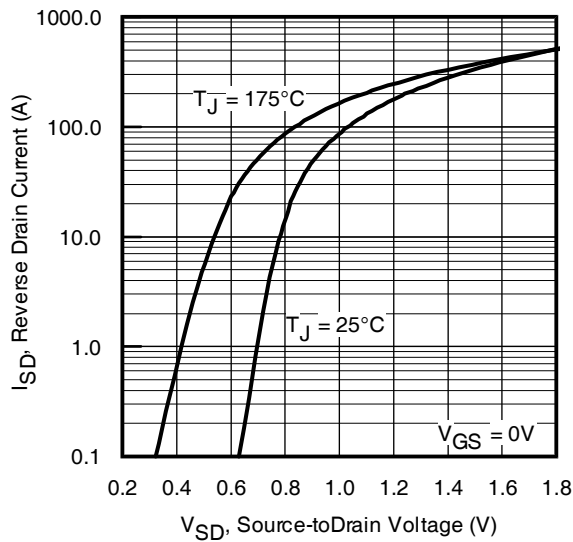
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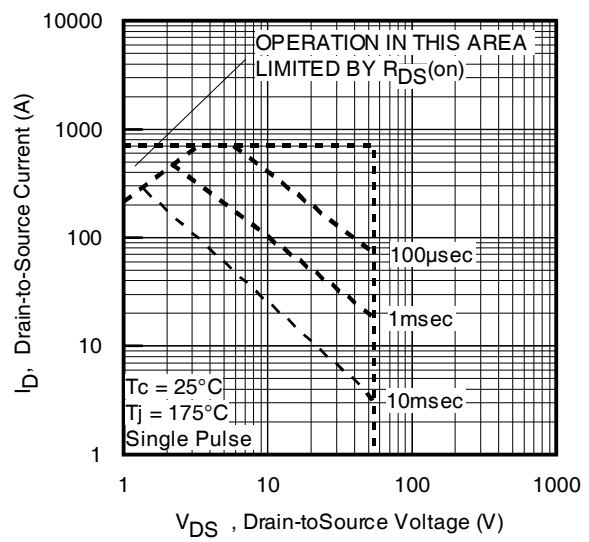
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



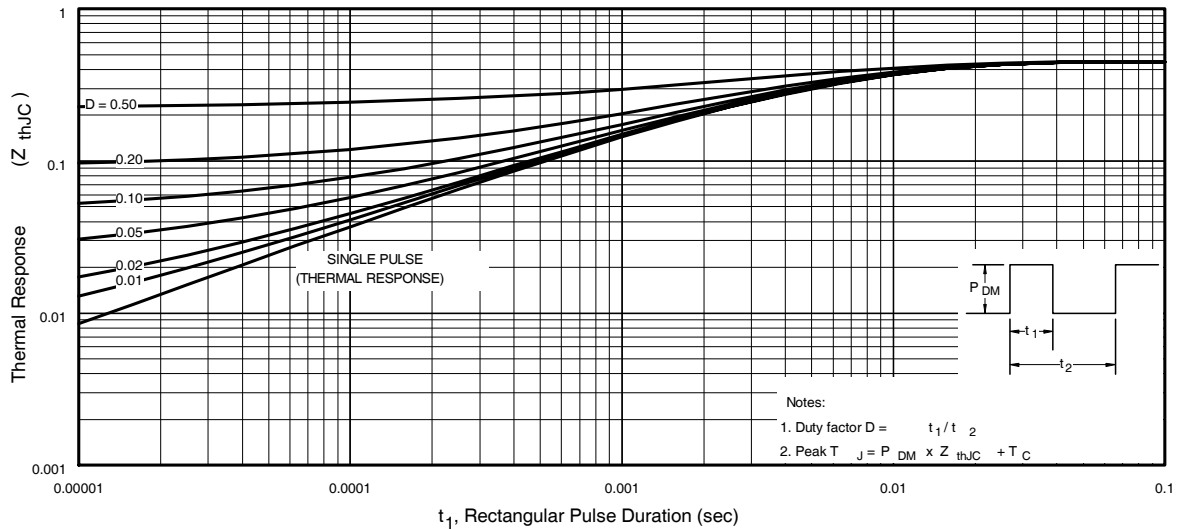
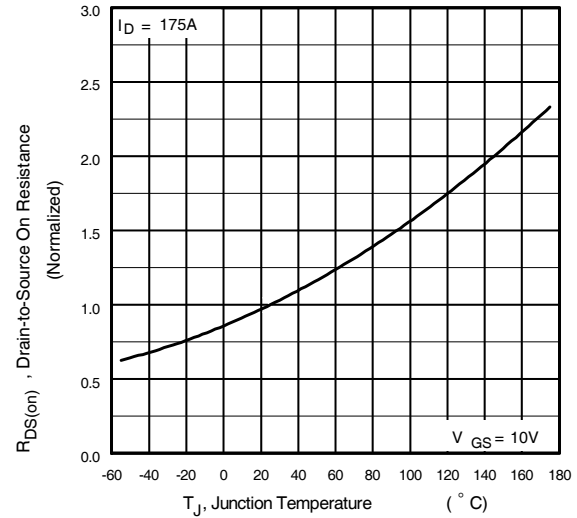
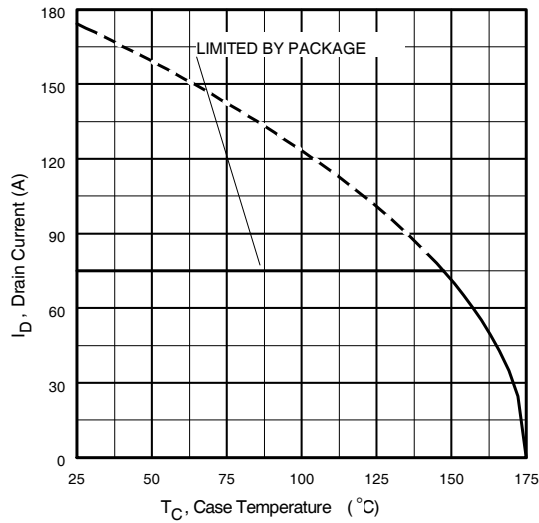
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



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

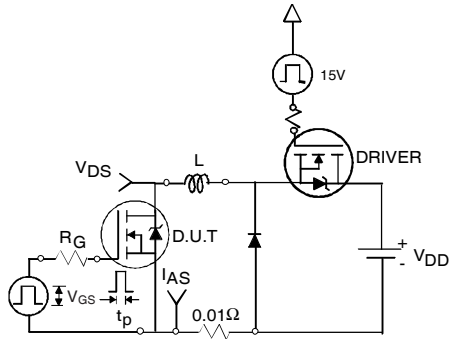


**Fig 8.** Maximum Safe Operating Area

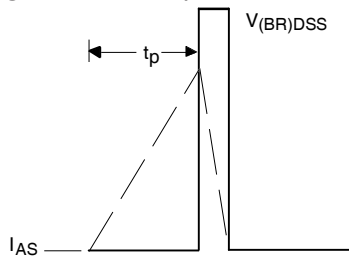


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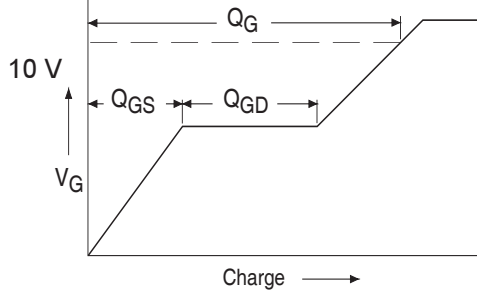
International  
**IR** Rectifier



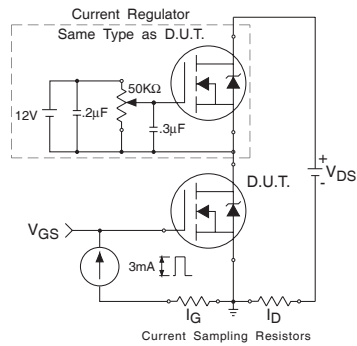
**Fig 12a.** Unclamped Inductive Test Circuit



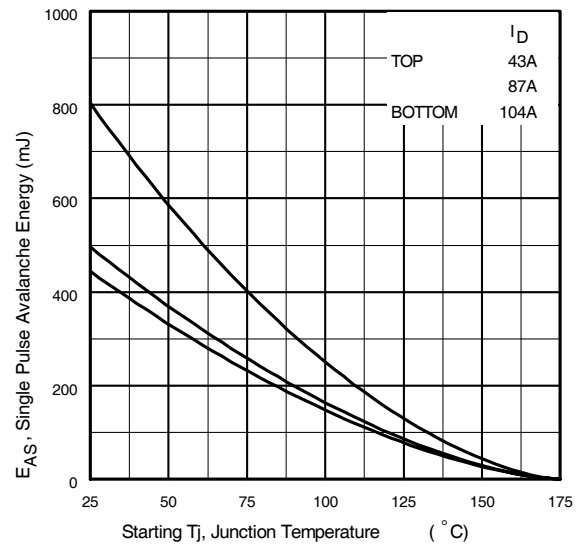
**Fig 12b.** Unclamped Inductive Waveforms



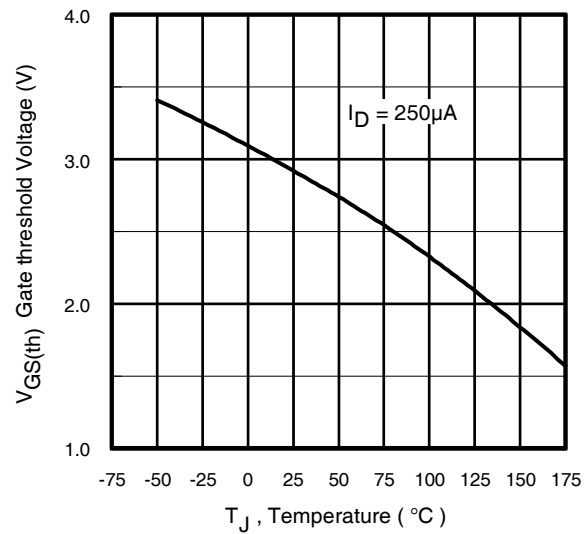
**Fig 13a.** Basic Gate Charge Waveform



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



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



**Fig 14.** Threshold Voltage Vs. Temperature

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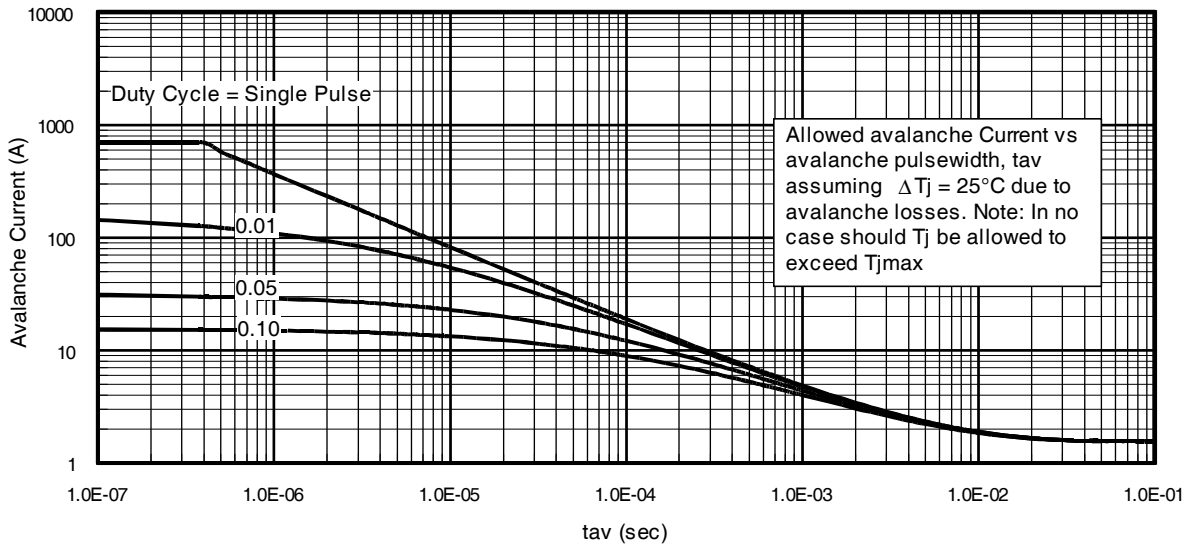


Fig 15. Typical Avalanche Current Vs. Pulsewidth

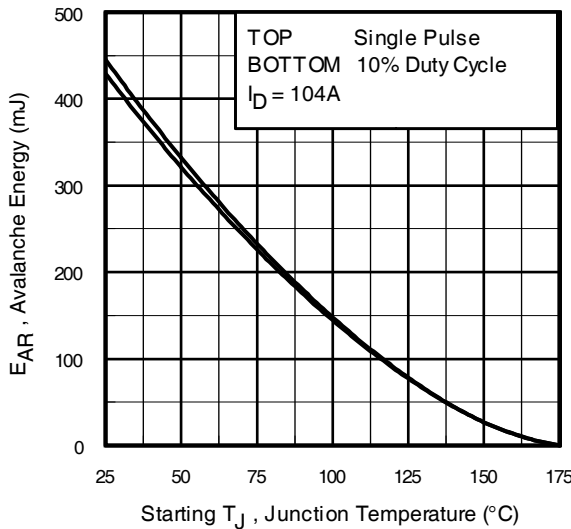


Fig 16. Maximum Avalanche Energy Vs. Temperature

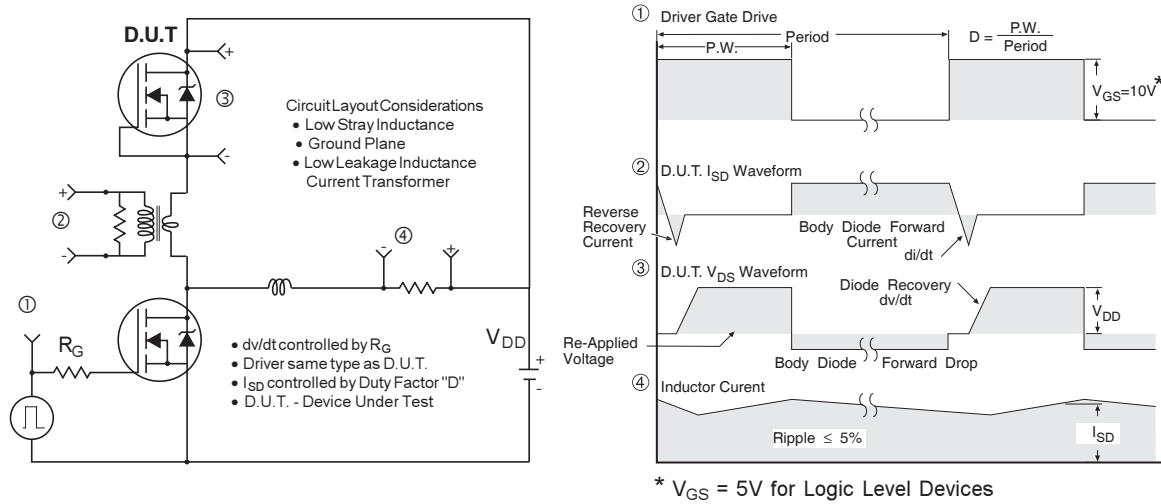
**Notes on Repetitive Avalanche Curves , Figures 15, 16:**  
(For further info, see AN-1005 at [www.irf.com](http://www.irf.com))

1. Avalanche failures assumption:  
Purely a thermal phenomenon and failure occurs at a temperature far in excess of  $T_{jmax}$ . This is validated for every part type.
2. Safe operation in Avalanche is allowed as long as  $T_{jmax}$  is not exceeded.
3. Equation below based on circuit and waveforms shown in Figures 12a, 12b.
4.  $P_{D(ave)}$  = Average power dissipation per single avalanche pulse.
5. BV = Rated breakdown voltage (1.3 factor accounts for voltage increase during avalanche).
6.  $I_{av}$  = Allowable avalanche current.
7.  $\Delta T$  = Allowable rise in junction temperature, not to exceed  $T_{jmax}$  (assumed as 25°C in Figure 15, 16).  
 $t_{av}$  = Average time in avalanche.  
 $D$  = Duty cycle in avalanche =  $t_{av} \cdot f$   
 $Z_{thJC}(D, t_{av})$  = Transient thermal resistance, see figure 11)

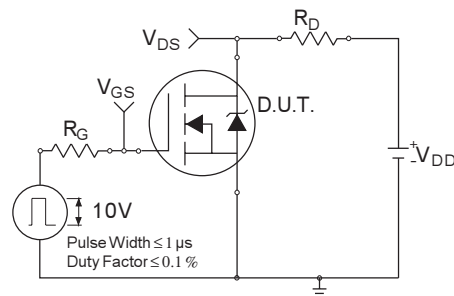
$$P_{D(ave)} = 1/2 (1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$$

$$I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{th}]$$

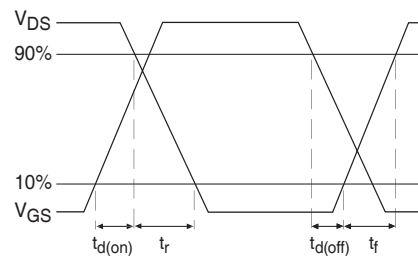
$$E_{AS(AR)} = P_{D(ave)} \cdot t_{av}$$



**Fig 17. Peak Diode Recovery  $dv/dt$  Test Circuit for N-Channel HEXFET® Power MOSFETs**



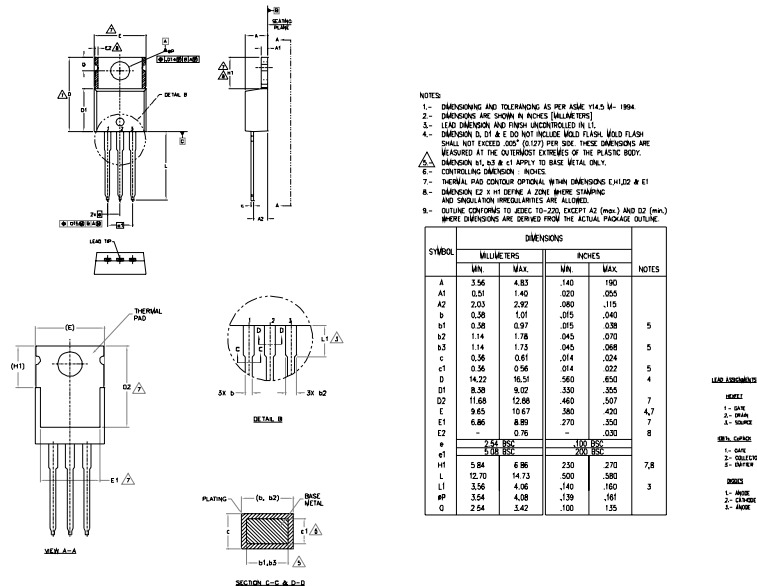
**Fig 18a. Switching Time Test Circuit**



**Fig 18b. Switching Time Waveforms**



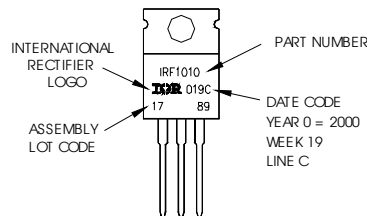
## TO-220AB Package Outline(Dimensions are shown in millimeters (inches))



## TO-220AB Part Marking Information

EXAMPLE: THIS IS AN IRF1010  
LOT CODE 1789  
ASSEMBLED ON WW 19, 2000  
IN THE ASSEMBLY LINE "C"

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



**TO-220AB package is not recommended for Surface Mount Application.**

### Notes:

1. For an Automotive Qualified version of this part please see <http://www.irf.com/product-info/auto/>
2. For the most current drawing please refer to IR website at <http://www.irf.com/package/>

Data and specifications subject to change without notice.  
This product has been designed and qualified for the Industrial market.  
Qualification Standards can be found on IR's Web site.

International  
**IR** Rectifier

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