

# IRFP2907ZPbF

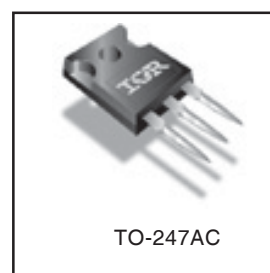
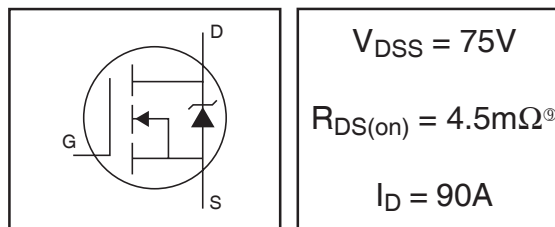
## Features

- 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.

## HEXFET® Power MOSFET



## Absolute Maximum Ratings

|                            | Parameter                                                  | Max.                  | Units |
|----------------------------|------------------------------------------------------------|-----------------------|-------|
| $I_D @ T_C = 25^{\circ}C$  | Continuous Drain Current, $V_{GS} @ 10V$ (Silicon Limited) | 170                   | 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) | 90                    |       |
| $I_{DM}$                   | Pulsed Drain Current ①                                     | 680                   |       |
| $P_D @ T_C = 25^{\circ}C$  | Maximum Power Dissipation                                  | 310                   | W     |
|                            | Linear Derating Factor                                     | 2.0                   | W/°C  |
| $V_{GS}$                   | Gate-to-Source Voltage                                     | $\pm 20$              | V     |
| $E_{AS}$                   | Single Pulse Avalanche Energy (Thermally Limited) ②        | 520                   | mJ    |
| $E_{AS} (tested)$          | Single Pulse Avalanche Energy Tested Value ②               | 690                   |       |
| $I_{AR}$                   | Avalanche Current ①                                        | See Fig.12a,12b,15,16 | A     |
| $E_{AR}$                   | Repetitive Avalanche Energy ③                              |                       | mJ    |
| $T_J$                      | Operating Junction and                                     | -55 to + 175          | °C    |
| $T_{STG}$                  | Storage Temperature Range                                  |                       |       |
|                            | Soldering Temperature, for 10 seconds                      |                       |       |
|                            | Mounting torque, 6-32 or M3 screw                          | 10 lbf•in (1.1N•m)    |       |

## Thermal Resistance

|                 | Parameter                             | Typ. | Max. | Units |
|-----------------|---------------------------------------|------|------|-------|
| $R_{\theta JC}$ | Junction-to-Case ③                    | —    | 0.49 | °C/W  |
| $R_{\theta CS}$ | Case-to-Sink, Flat, Greased Surface ③ | 0.24 | —    |       |
| $R_{\theta JA}$ | Junction-to-Ambient ③                 | —    | 40   |       |

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

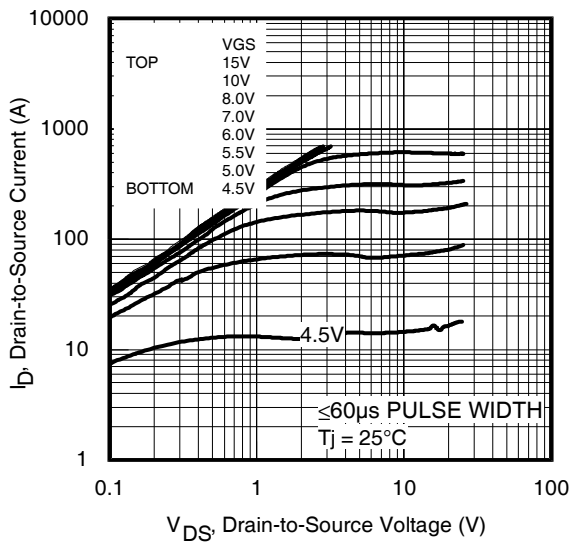
|                              | Parameter                            | Min. | Typ.  | Max. | Units              | Conditions                                                                  |
|------------------------------|--------------------------------------|------|-------|------|--------------------|-----------------------------------------------------------------------------|
| $V_{(BR)DSS}$                | Drain-to-Source Breakdown Voltage    | 75   | —     | —    | V                  | $V_{GS} = 0V, I_D = 250\mu A$                                               |
| $\Delta BV_{DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient  | —    | 0.069 | —    | $V/^\circ\text{C}$ | Reference to $25^\circ\text{C}$ , $I_D = 1\text{mA}$                        |
| $R_{DS(on)}$                 | Static Drain-to-Source On-Resistance | —    | 3.5   | 4.5  | $m\Omega$          | $V_{GS} = 10V, I_D = 90A$ 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             | 180  | —     | —    | S                  | $V_{DS} = 25V, I_D = 90A$                                                   |
| $I_{DSS}$                    | Drain-to-Source Leakage Current      | —    | —     | 20   | $\mu A$            | $V_{DS} = 75V, V_{GS} = 0V$                                                 |
|                              |                                      | —    | —     | 250  |                    | $V_{DS} = 75V, V_{GS} = 0V, T_J = 125^\circ\text{C}$                        |
| $I_{GSS}$                    | Gate-to-Source Forward Leakage       | —    | —     | 200  | nA                 | $V_{GS} = 20V$                                                              |
|                              | Gate-to-Source Reverse Leakage       | —    | —     | -200 |                    | $V_{GS} = -20V$                                                             |
| $Q_g$                        | Total Gate Charge                    | —    | 180   | 270  | nC                 | $I_D = 90A$                                                                 |
| $Q_{gs}$                     | Gate-to-Source Charge                | —    | 46    | —    |                    | $V_{DS} = 60V$                                                              |
| $Q_{gd}$                     | Gate-to-Drain ("Miller") Charge      | —    | 65    | —    |                    | $V_{GS} = 10V$ ④                                                            |
| $t_{d(on)}$                  | Turn-On Delay Time                   | —    | 19    | —    | ns                 | $V_{DD} = 38V$                                                              |
| $t_r$                        | Rise Time                            | —    | 140   | —    |                    | $I_D = 90A$                                                                 |
| $t_{d(off)}$                 | Turn-Off Delay Time                  | —    | 97    | —    |                    | $R_G = 2.5\Omega$                                                           |
| $t_f$                        | Fall Time                            | —    | 100   | —    |                    | $V_{GS} = 10V$ ④                                                            |
| $L_D$                        | Internal Drain Inductance            | —    | 5.0   | —    | nH                 | Between lead,<br>6mm (0.25in.)<br>from package<br>and center of die contact |
| $L_S$                        | Internal Source Inductance           | —    | 13    | —    |                    |                                                                             |
| $C_{iss}$                    | Input Capacitance                    | —    | 7500  | —    | pF                 | $V_{GS} = 0V$                                                               |
| $C_{oss}$                    | Output Capacitance                   | —    | 970   | —    |                    | $V_{DS} = 25V$                                                              |
| $C_{rss}$                    | Reverse Transfer Capacitance         | —    | 510   | —    |                    | $f = 1.0\text{MHz}$ , See Fig. 5                                            |
| $C_{oss}$                    | Output Capacitance                   | —    | 3640  | —    |                    | $V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0\text{MHz}$                             |
| $C_{oss}$                    | Output Capacitance                   | —    | 650   | —    |                    | $V_{GS} = 0V, V_{DS} = 60V, f = 1.0\text{MHz}$                              |
| $C_{oss \text{ eff.}}$       | Effective Output Capacitance         | —    | 1020  | —    |                    | $V_{GS} = 0V, V_{DS} = 0V \text{ to } 60V$                                  |

## Diode Characteristics

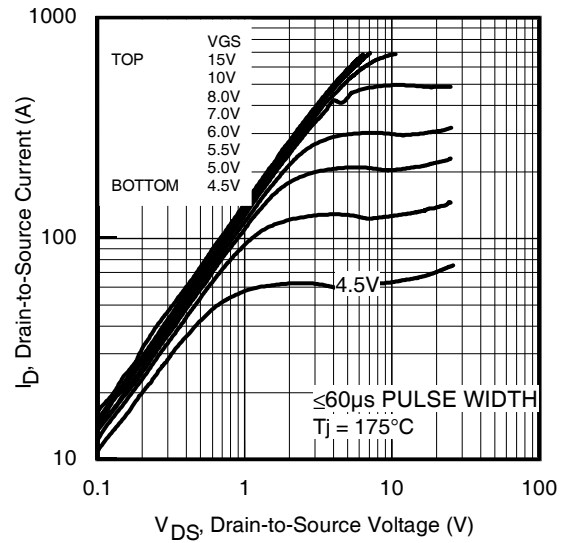
|          | Parameter                                 | Min.                                                                      | Typ. | Max. | Units | Conditions                                                              |
|----------|-------------------------------------------|---------------------------------------------------------------------------|------|------|-------|-------------------------------------------------------------------------|
| $I_S$    | Continuous Source Current<br>(Body Diode) | —                                                                         | —    | 90   | A     | MOSFET symbol<br>showing the<br>integral reverse<br>p-n junction diode. |
| $I_{SM}$ | Pulsed Source Current<br>(Body Diode) ①   | —                                                                         | —    | 680  |       |                                                                         |
| $V_{SD}$ | Diode Forward Voltage                     | —                                                                         | —    | 1.3  | V     | $T_J = 25^\circ\text{C}, I_S = 90A, V_{GS} = 0V$ ④                      |
| $t_{rr}$ | Reverse Recovery Time                     | —                                                                         | 41   | 61   | ns    | $T_J = 25^\circ\text{C}, I_F = 90A, V_{DD} = 38V$                       |
| $Q_{rr}$ | Reverse Recovery Charge                   | —                                                                         | 59   | 89   | 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:

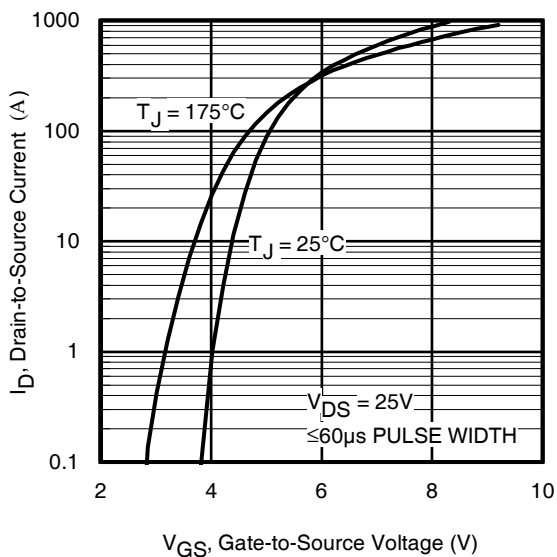
- ① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11).
- ② Limited by  $T_{Jmax}$ ; starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.13\text{mH}$ ,  $R_G = 25\Omega$ ,  $I_{AS} = 90A$ ,  $V_{GS} = 10V$ .  
Part not recommended for use above this value.
- ③  $I_{SD} \leq 90A$ ,  $di/dt \leq 340A/\mu s$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  $T_J \leq 175^\circ\text{C}$ .
- ④ Pulse width  $\leq 1.0\text{ms}$ ; 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.
- ⑧  $R_\theta$  is measured at  $T_J$  of approximately  $90^\circ\text{C}$ .



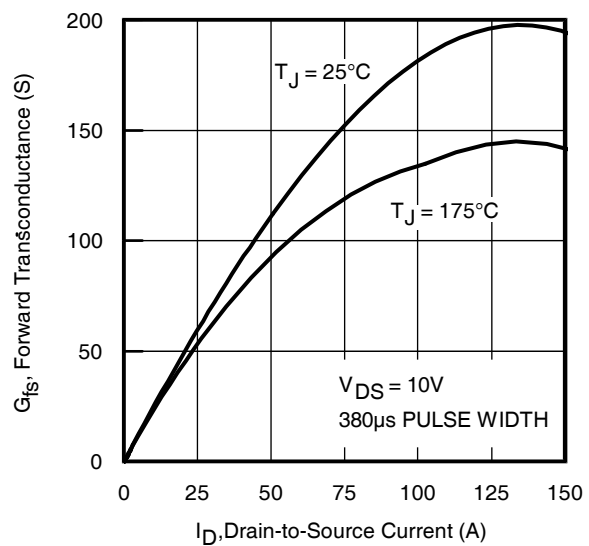
**Fig 1.** Typical Output Characteristics



**Fig 2.** Typical Output Characteristics

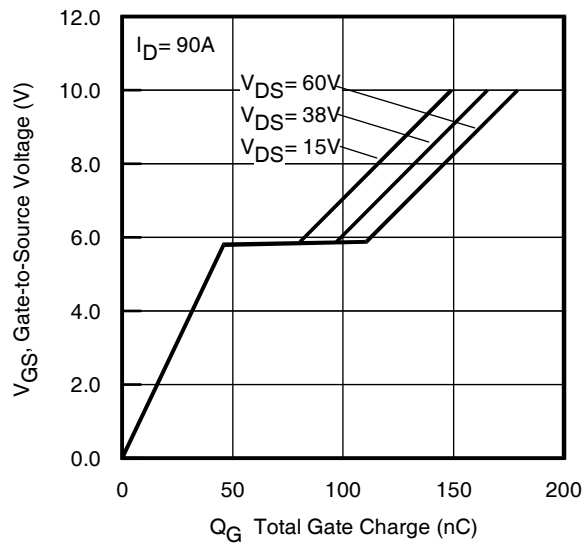


**Fig 3.** Typical Transfer Characteristics

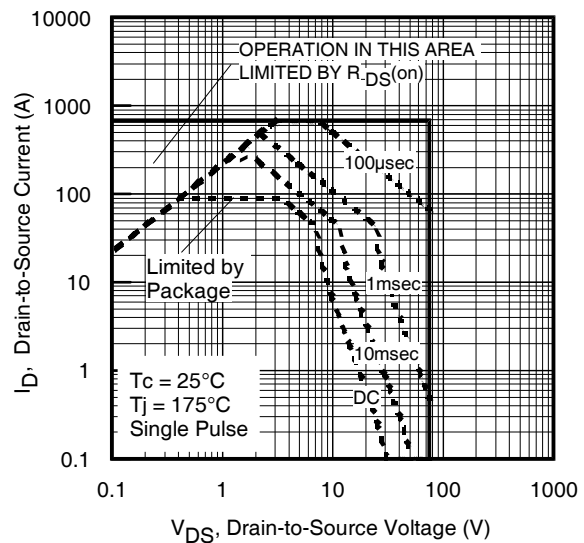


**Fig 4.** Typical Forward Transconductance vs. Drain Current

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



**Fig 8. Maximum Safe Operating Area**

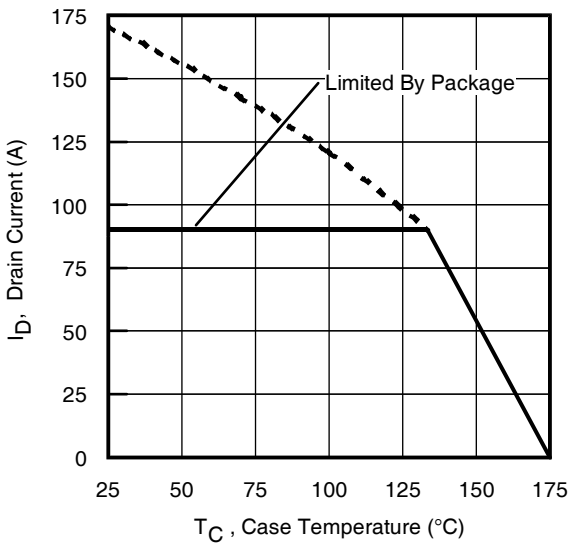


Fig 9. Maximum Drain Current vs. Case Temperature

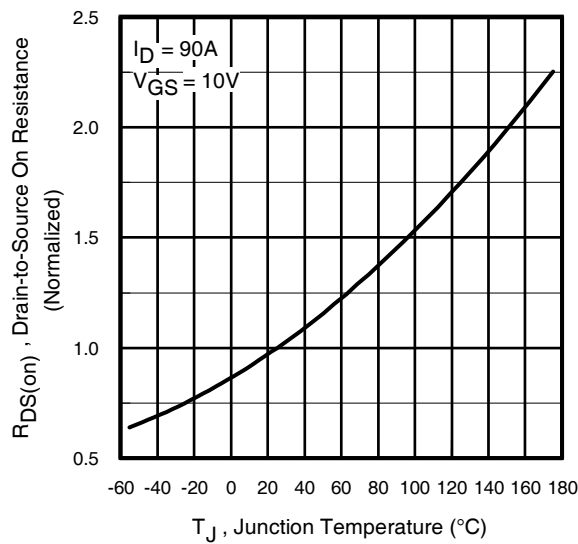


Fig 10. Normalized On-Resistance vs. Temperature

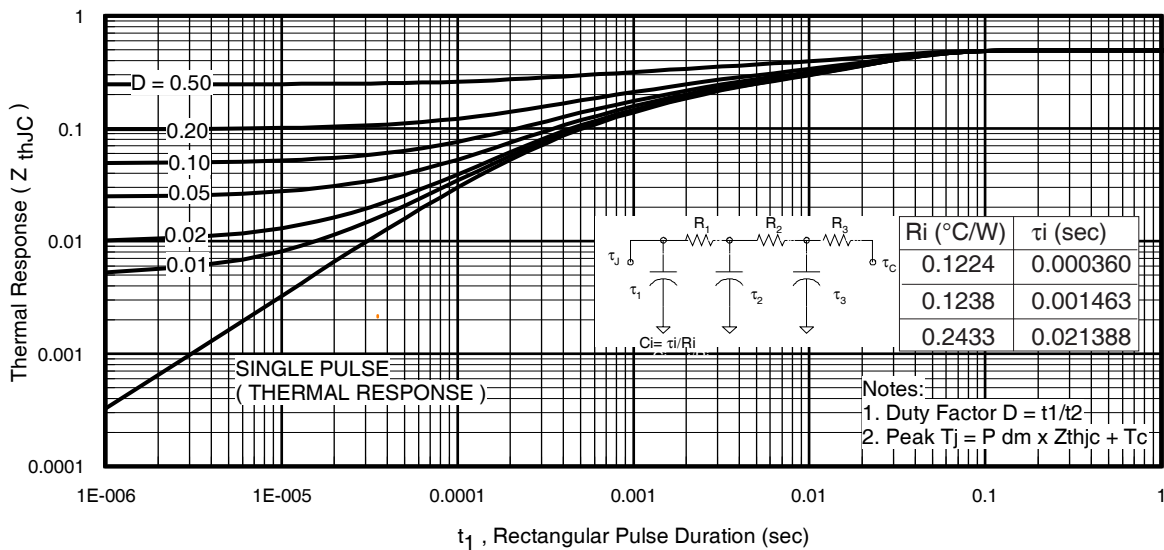
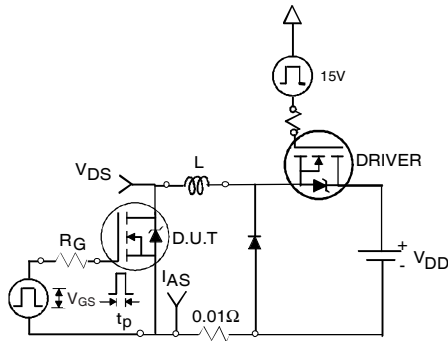
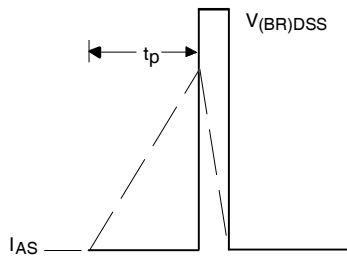


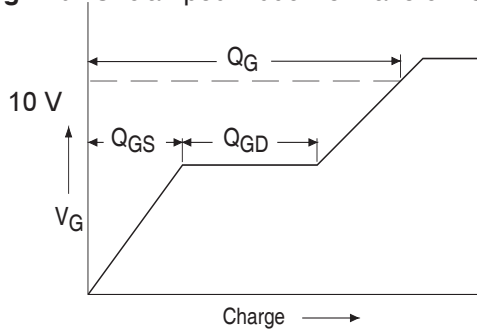
Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case



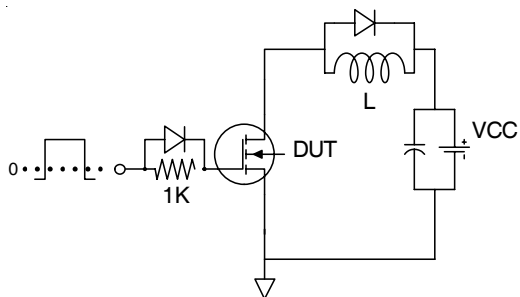
**Fig 12a.** Unclamped Inductive Test Circuit



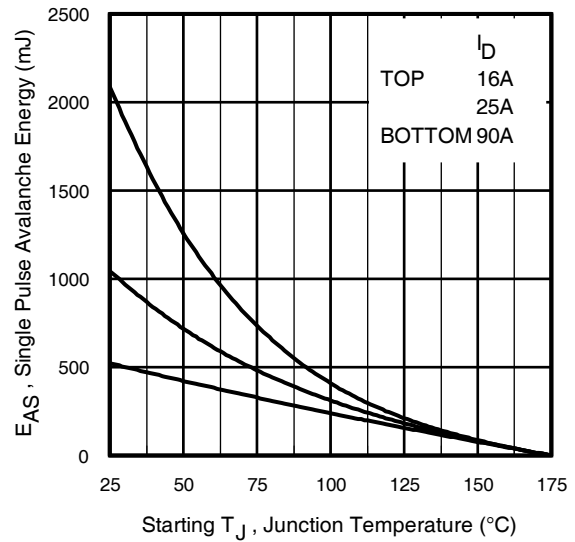
**Fig 12b.** Unclamped Inductive Waveforms



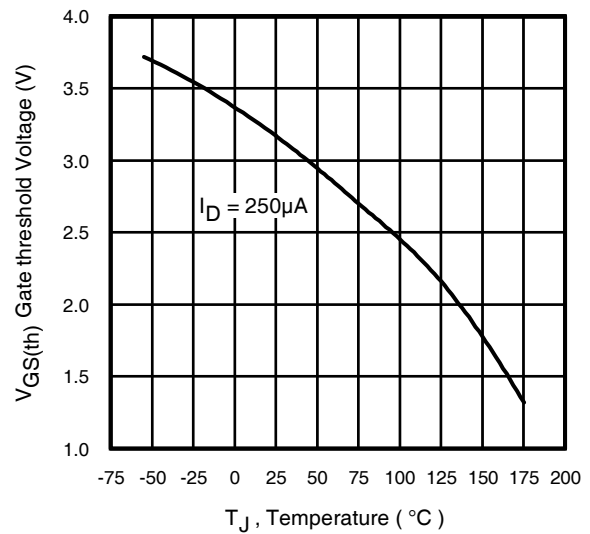
**Fig 13a.** Basic Gate Charge Waveform



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



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



**Fig 14.** Threshold Voltage vs. Temperature

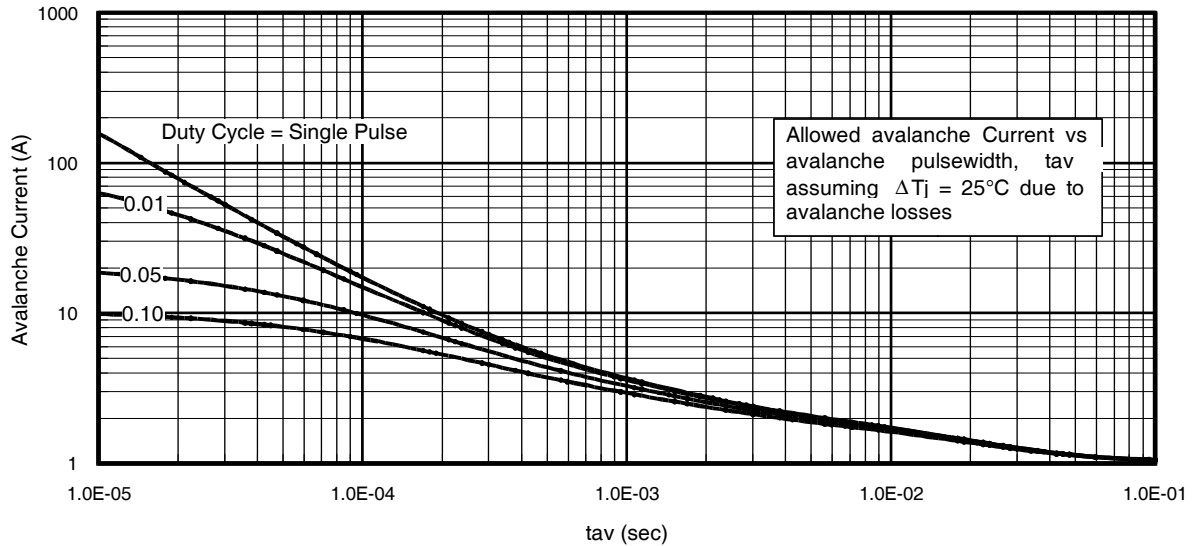


Fig 15. Typical Avalanche Current Vs. Pulsewidth

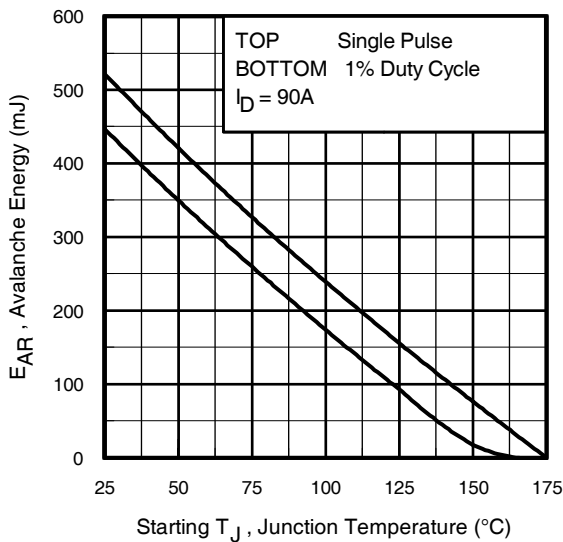


Fig 16. Maximum Avalanche Energy vs. Temperature

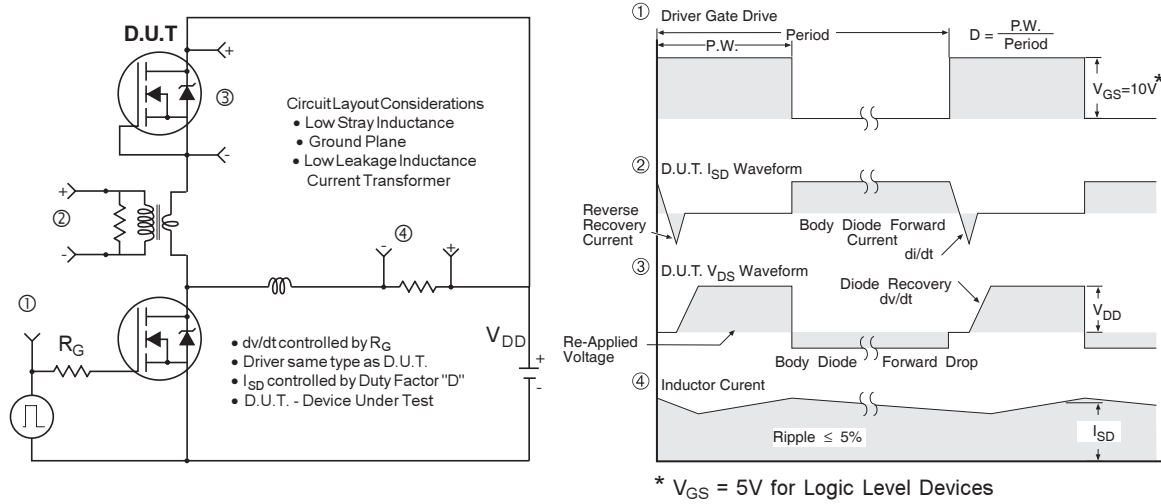
**Notes on Repetitive Avalanche Curves , Figures 15, 16:**  
(For further info, see AN-1005 at [www.irf.com](http://www.irf.com))

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  $25^\circ\text{C}$  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)

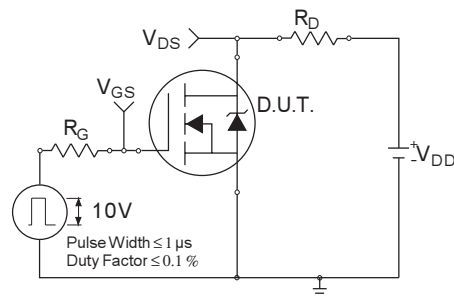
$$P_{D(ave)} = 1/2 (1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$$

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

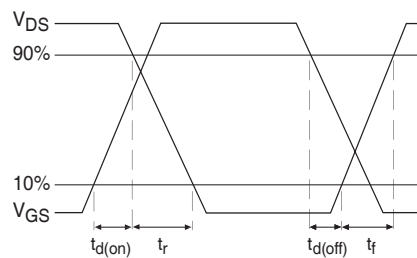
$$E_{AS(AR)} = P_{D(ave)} \cdot t_{av}$$



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



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

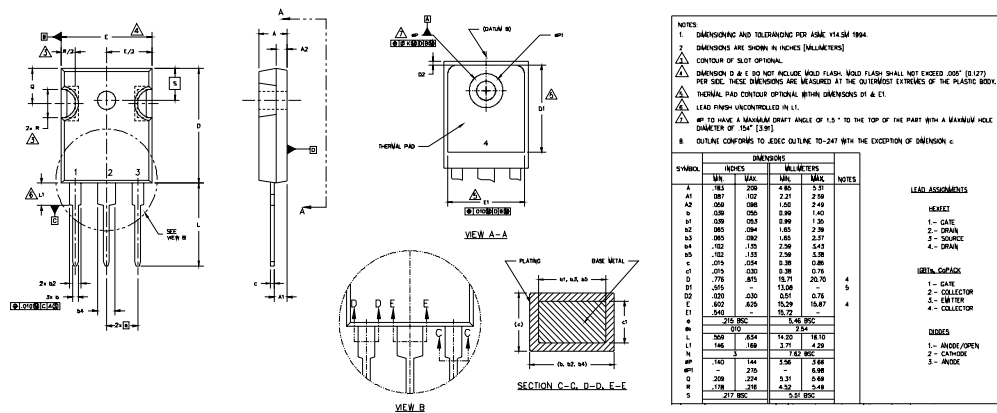


**Fig 18b. Switching Time Waveforms**



## TO-247AC Package Outline

Dimensions are shown in millimeters (inches)



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