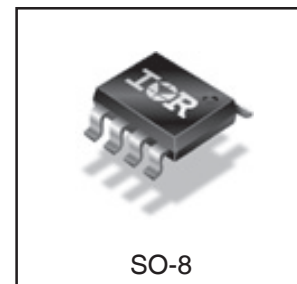
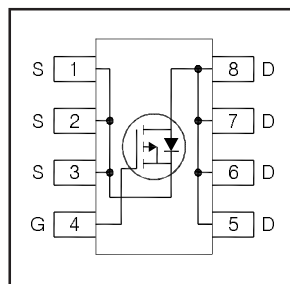


# IRF9333PbF

HEXFET® Power MOSFET

|                                                             |             |           |
|-------------------------------------------------------------|-------------|-----------|
| <b>V<sub>DS</sub></b>                                       | <b>-30</b>  | <b>V</b>  |
| <b>R<sub>DS(on)</sub> max</b><br>(@V <sub>GS</sub> = -10V)  | <b>19.4</b> | <b>mΩ</b> |
| <b>R<sub>DS(on)</sub> max</b><br>(@V <sub>GS</sub> = -4.5V) | <b>32.5</b> | <b>mΩ</b> |
| <b>Q<sub>g</sub> (typical)</b>                              | <b>14</b>   | <b>nC</b> |
| <b>I<sub>D</sub></b><br>(@T <sub>A</sub> = 25°C)            | <b>-9.2</b> | <b>A</b>  |



## Applications

- Charge and Discharge Switch for Notebook PC Battery Application

## Features and Benefits

### Features

|                                                              |
|--------------------------------------------------------------|
| Industry-Standard SO8 Package                                |
| RoHS Compliant Containing no Lead, no Bromide and no Halogen |

### Resulting Benefits

|                            |
|----------------------------|
| Multi-Vendor Compatibility |
| Environmentally Friendlier |

| Orderable part number | Package Type | Standard Pack |          | Note |
|-----------------------|--------------|---------------|----------|------|
|                       |              | Form          | Quantity |      |
| IRF9333PbF            | SO8          | Tube/Bulk     | 95       |      |
| IRF9333TRPbF          | SO8          | Tape and Reel | 4000     |      |

## Absolute Maximum Ratings

|                                        | Parameter                                       | Max.         | Units |
|----------------------------------------|-------------------------------------------------|--------------|-------|
| V <sub>DS</sub>                        | Drain-to-Source Voltage                         | -30          | V     |
| V <sub>GS</sub>                        | Gate-to-Source Voltage                          | ± 20         |       |
| I <sub>D</sub> @ T <sub>A</sub> = 25°C | Continuous Drain Current, V <sub>GS</sub> @ 10V | -9.2         | A     |
| I <sub>D</sub> @ T <sub>A</sub> = 70°C | Continuous Drain Current, V <sub>GS</sub> @ 10V | -7.3         |       |
| I <sub>DM</sub>                        | Pulsed Drain Current ①                          | -75          |       |
| P <sub>D</sub> @ T <sub>A</sub> = 25°C | Power Dissipation ④                             | 2.5          | W     |
| P <sub>D</sub> @ T <sub>A</sub> = 70°C | Power Dissipation ④                             | 1.6          |       |
|                                        | Linear Derating Factor                          | 0.02         | W/°C  |
| T <sub>J</sub>                         | Operating Junction and                          | -55 to + 150 | °C    |
| T <sub>STG</sub>                       | Storage Temperature Range                       |              |       |

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

|                              | Parameter                            | Min. | Typ.  | Max. | Units                | Conditions                                            |
|------------------------------|--------------------------------------|------|-------|------|----------------------|-------------------------------------------------------|
| $BV_{DSS}$                   | Drain-to-Source Breakdown Voltage    | -30  | —     | —    | V                    | $V_{GS} = 0V, I_D = -250\mu A$                        |
| $\Delta BV_{DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient  | —    | 0.019 | —    | V/ $^\circ\text{C}$  | Reference to $25^\circ\text{C}$ , $I_D = -1\text{mA}$ |
| $R_{DS(on)}$                 | Static Drain-to-Source On-Resistance | —    | 15.6  | 19.4 | $m\Omega$            | $V_{GS} = -10V, I_D = -9.2A$ ③                        |
|                              |                                      | —    | 25.6  | 32.5 |                      | $V_{GS} = -4.5V, I_D = -7.5A$ ③                       |
| $V_{GS(th)}$                 | Gate Threshold Voltage               | -1.3 | -1.8  | -2.4 | V                    | $V_{DS} = V_{GS}, I_D = -25\mu A$                     |
| $\Delta V_{GS(th)}$          | Gate Threshold Voltage Coefficient   | —    | -5.7  | —    | mV/ $^\circ\text{C}$ |                                                       |
| $I_{DSS}$                    | Drain-to-Source Leakage Current      | —    | —     | -1.0 | $\mu A$              | $V_{DS} = -24V, V_{GS} = 0V$                          |
|                              |                                      | —    | —     | -150 |                      | $V_{DS} = -24V, V_{GS} = 0V, T_J = 125^\circ\text{C}$ |
| $I_{GSS}$                    | Gate-to-Source Forward Leakage       | —    | —     | -100 | nA                   | $V_{GS} = -20V$                                       |
|                              | Gate-to-Source Reverse Leakage       | —    | —     | 100  |                      | $V_{GS} = 20V$                                        |
| $g_{fs}$                     | Forward Transconductance             | 13   | —     | —    | S                    | $V_{DS} = -10V, I_D = -7.5A$                          |
| $Q_g$                        | Total Gate Charge ⑥                  | —    | 14    | —    | nC                   | $V_{DS} = -15V, V_{GS} = -4.5V, I_D = -7.5A$          |
| $Q_g$                        | Total Gate Charge ⑥                  | —    | 25    | 38   | nC                   | $V_{GS} = -10V$                                       |
| $Q_{gs}$                     | Gate-to-Source Charge ⑥              | —    | 3.5   | —    |                      | $V_{DS} = -15V$                                       |
| $Q_{gd}$                     | Gate-to-Drain Charge ⑥               | —    | 6.4   | —    |                      | $I_D = -7.5A$                                         |
| $R_G$                        | Gate Resistance ⑥                    | —    | 15    | —    | $\Omega$             |                                                       |
| $t_{d(on)}$                  | Turn-On Delay Time                   | —    | 16    | —    | ns                   | $V_{DD} = -15V, V_{GS} = -4.5V$ ③                     |
| $t_r$                        | Rise Time                            | —    | 44    | —    |                      | $I_D = -1.0A$                                         |
| $t_{d(off)}$                 | Turn-Off Delay Time                  | —    | 55    | —    |                      | $R_G = 6.8\Omega$                                     |
| $t_f$                        | Fall Time                            | —    | 49    | —    |                      | See Figs. 20a & 20b                                   |
| $C_{iss}$                    | Input Capacitance                    | —    | 1110  | —    | pF                   | $V_{GS} = 0V$                                         |
| $C_{oss}$                    | Output Capacitance                   | —    | 230   | —    |                      | $V_{DS} = -25V$                                       |
| $C_{rss}$                    | Reverse Transfer Capacitance         | —    | 160   | —    |                      | $f = 1.0\text{MHz}$                                   |

## Avalanche Characteristics

|          | Parameter                       | Typ. | Max. | Units |
|----------|---------------------------------|------|------|-------|
| $E_{AS}$ | Single Pulse Avalanche Energy ② | —    | 100  | mJ    |
| $I_{AR}$ | Avalanche Current ①             | —    | -7.5 | A     |

## Diode Characteristics

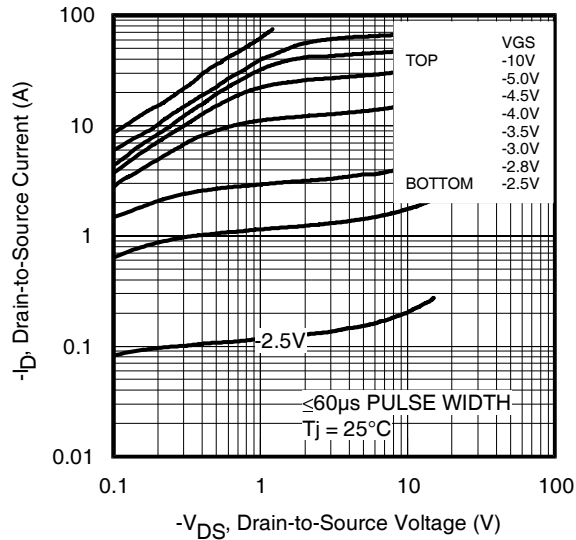
|          | Parameter                                 | Min. | Typ. | Max. | Units | Conditions                                                              |
|----------|-------------------------------------------|------|------|------|-------|-------------------------------------------------------------------------|
| $I_S$    | Continuous Source Current<br>(Body Diode) | —    | —    | -2.5 | A     | MOSFET symbol<br>showing the<br>integral reverse<br>p-n junction diode. |
| $I_{SM}$ | Pulsed Source Current<br>(Body Diode) ①   | —    | —    | -75  |       |                                                                         |
| $V_{SD}$ | Diode Forward Voltage                     | —    | —    | -1.2 | V     | $T_J = 25^\circ\text{C}, I_S = -2.5A, V_{GS} = 0V$ ③                    |
| $t_{rr}$ | Reverse Recovery Time                     | —    | 24   | 36   | ns    | $T_J = 25^\circ\text{C}, I_F = -2.5A, V_{DD} = -24V$                    |
| $Q_{rr}$ | Reverse Recovery Charge                   | —    | 15   | 23   | nC    | $di/dt = 100A/\mu s$ ③                                                  |

## Thermal Resistance

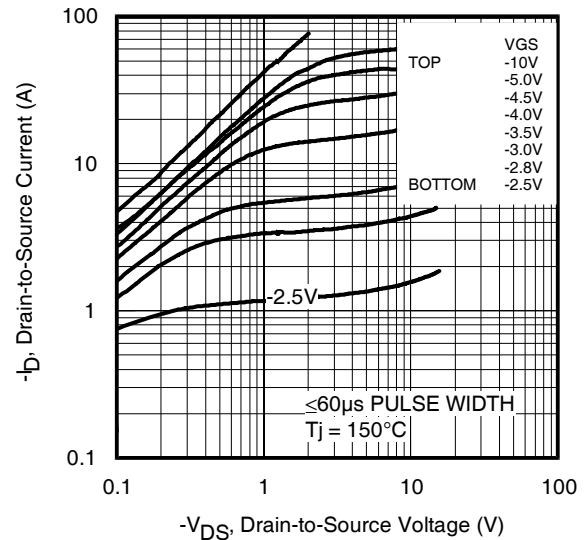
|                 | Parameter                | Typ. | Max. | Units              |
|-----------------|--------------------------|------|------|--------------------|
| $R_{\theta JL}$ | Junction-to-Drain Lead ⑤ | —    | 20   | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Junction-to-Ambient ④    | —    | 50   |                    |

### Notes:

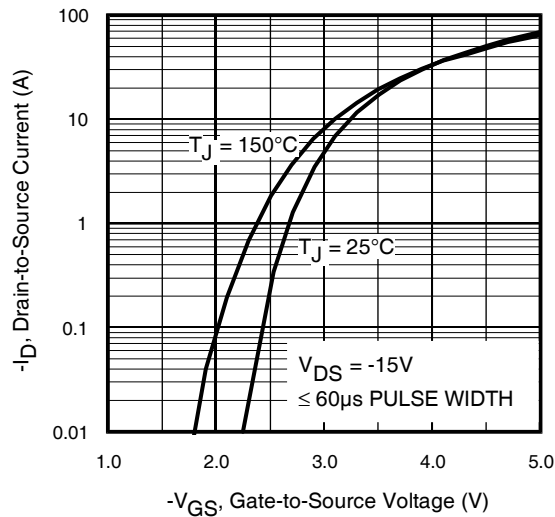
- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting  $T_J = 25^\circ\text{C}$ ,  $L = 3.5\text{mH}$ ,  $R_G = 25\Omega$ ,  $I_{AS} = -7.5A$ .
- ③ Pulse width  $\leq 400\mu s$ ; duty cycle  $\leq 2\%$ .
- ④ When mounted on 1 inch square copper board.
- ⑤  $R_\theta$  is measured at  $T_J$  of approximately  $90^\circ\text{C}$ .
- ⑥ For DESIGN AID ONLY, not subject to production testing.



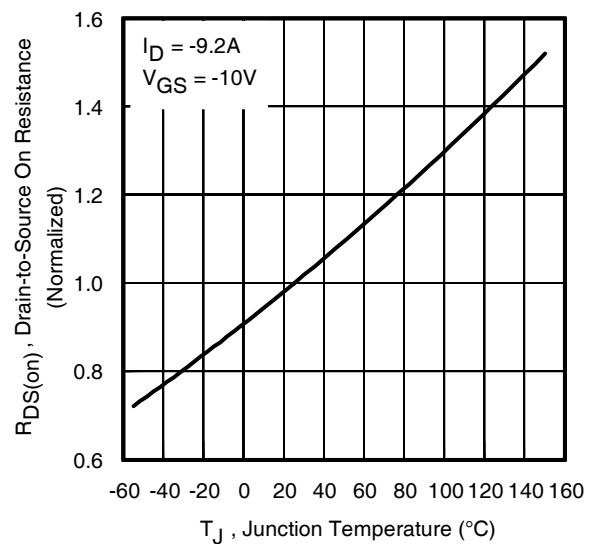
**Fig 1.** Typical Output Characteristics



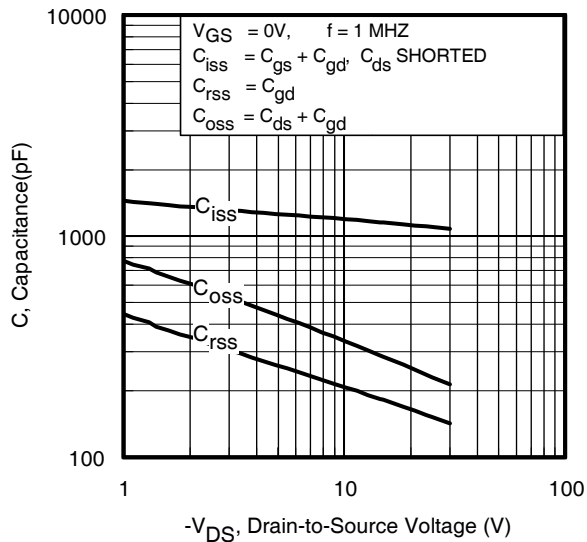
**Fig 2.** Typical Output Characteristics



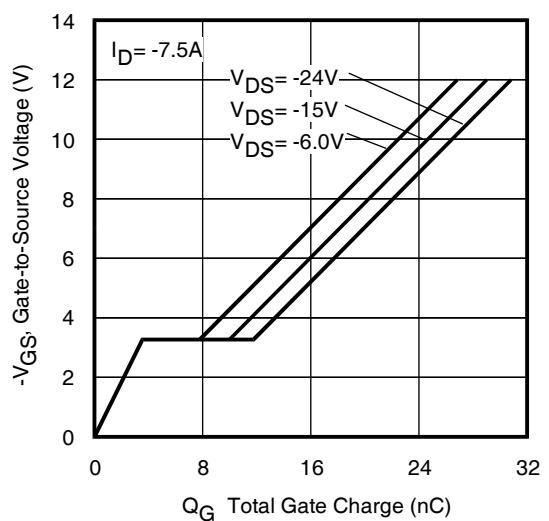
**Fig 3.** Typical Transfer Characteristics



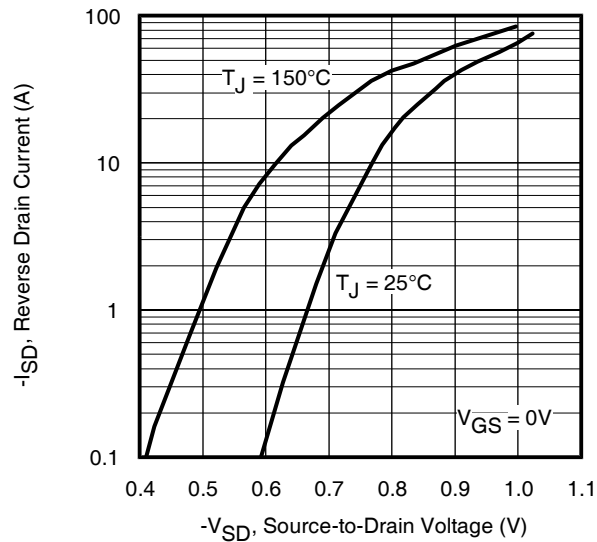
**Fig 4.** Normalized On-Resistance vs. Temperature



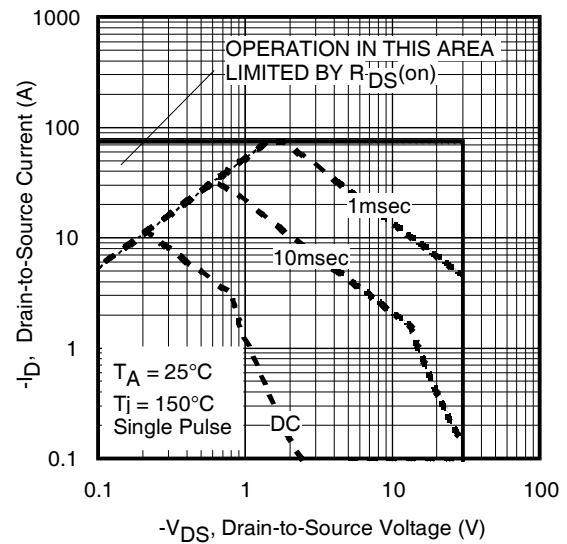
**Fig 5.** Typical Capacitance vs. Drain-to-Source Voltage  
www.irf.com



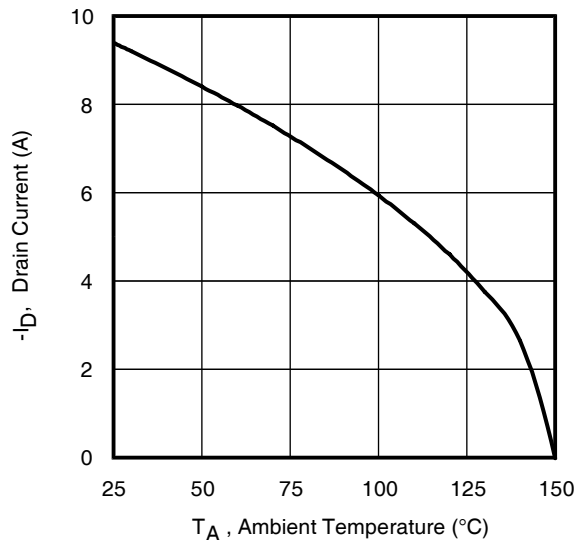
**Fig 6.** Typical Gate Charge vs. Gate-to-Source Voltage



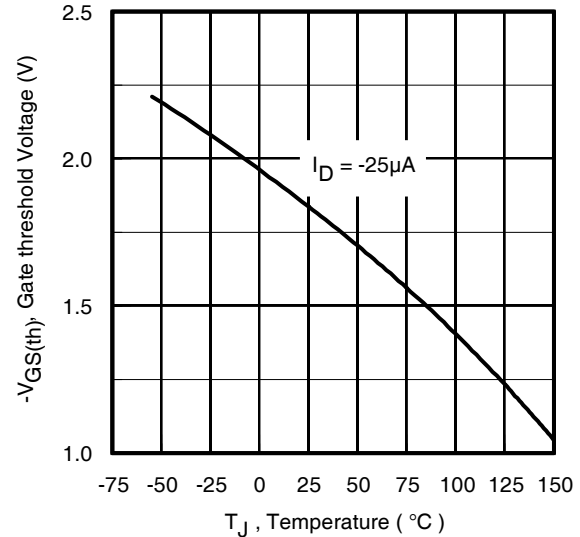
**Fig 7.** Typical Source-Drain Diode Forward Voltage



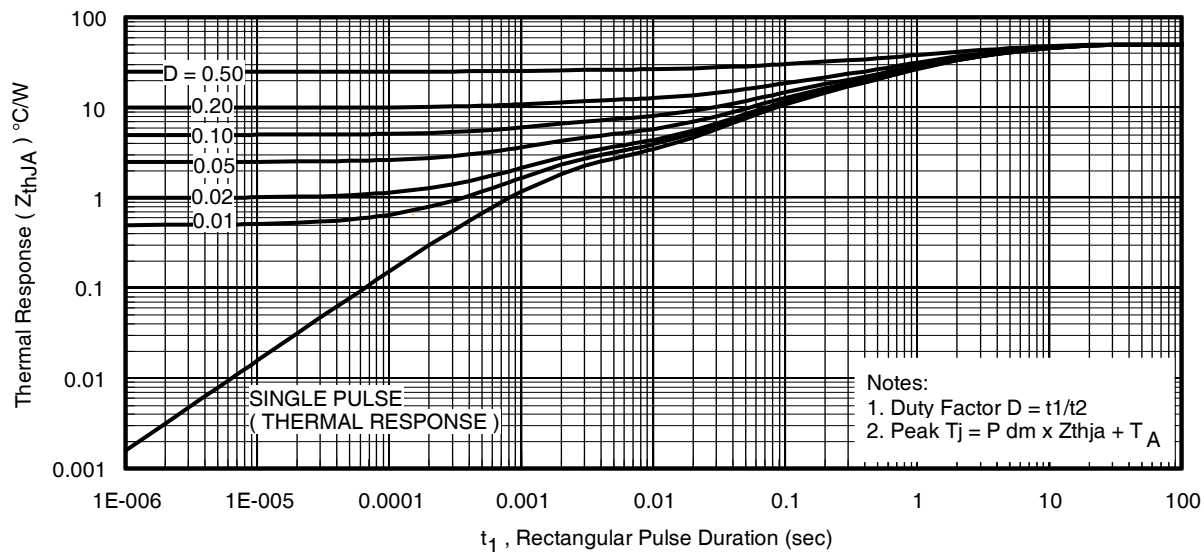
**Fig 8.** Maximum Safe Operating Area



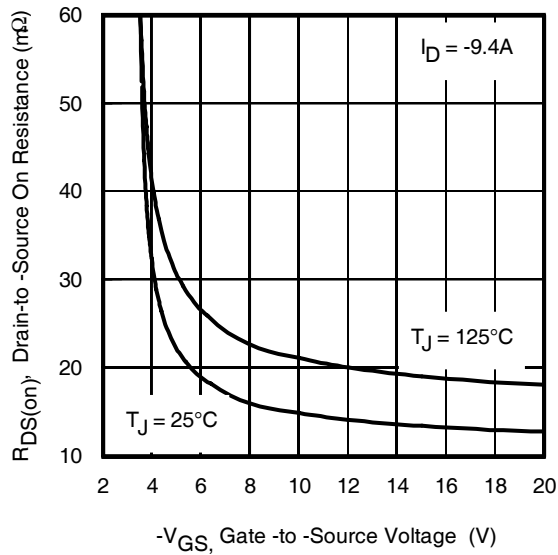
**Fig 9.** Maximum Drain Current vs. Ambient Temperature



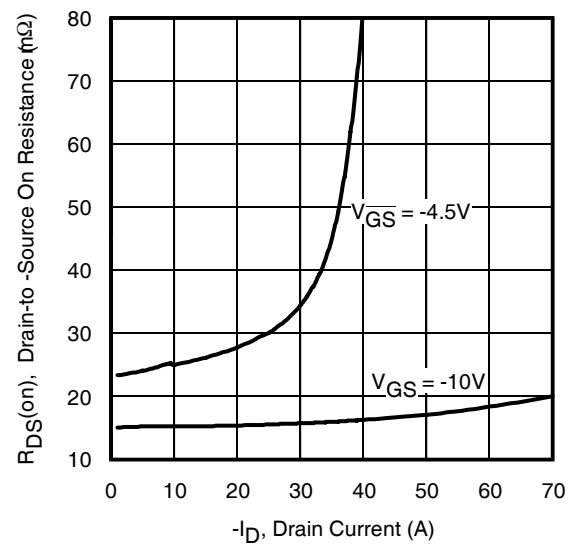
**Fig 10.** Threshold Voltage vs. Temperature



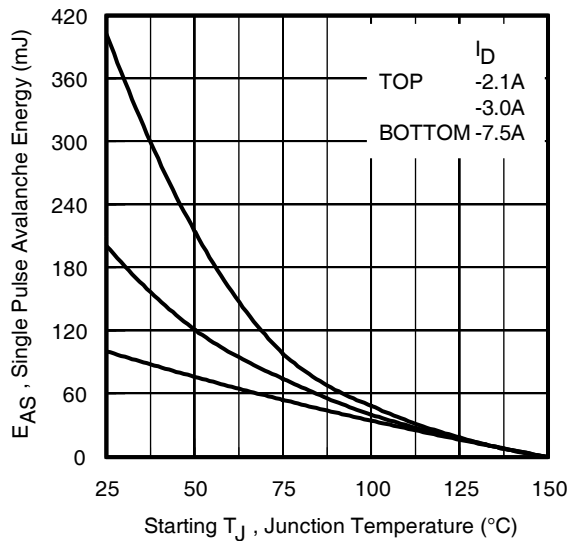
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Ambient



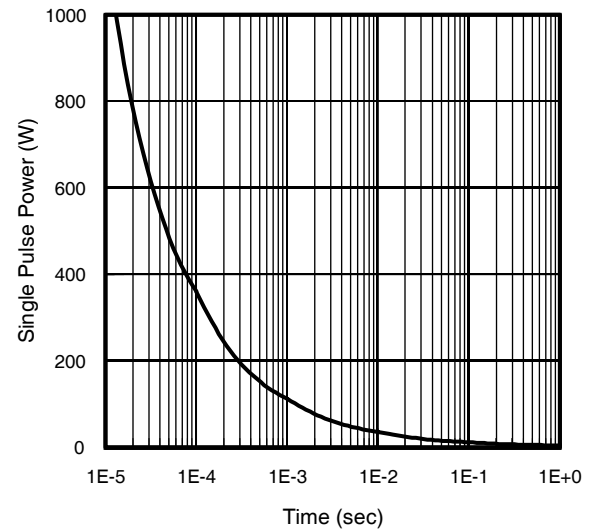
**Fig 12.** On-Resistance vs. Gate Voltage



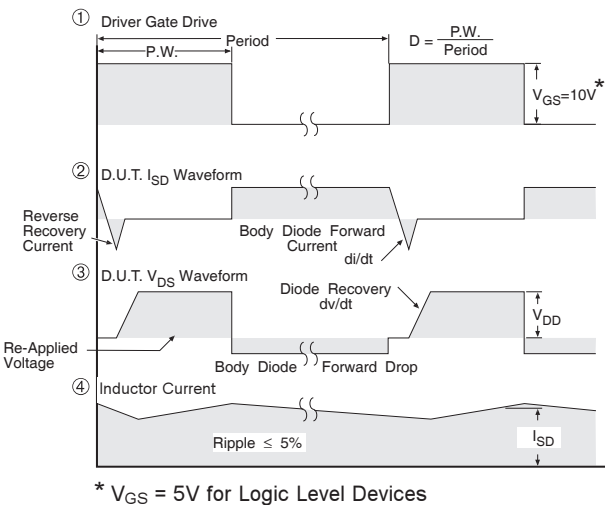
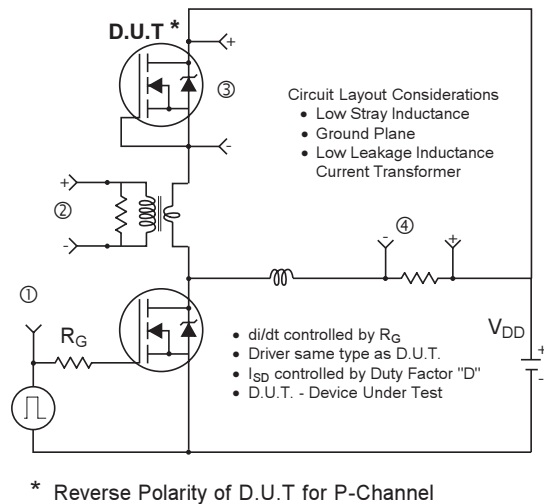
**Fig 13.** Typical On-Resistance vs. Drain Current



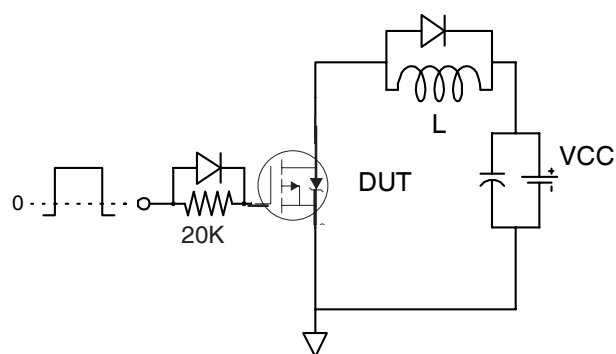
**Fig 14.** Maximum Avalanche Energy vs. Drain Current



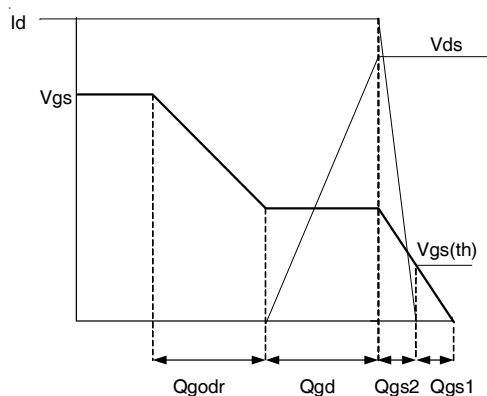
**Fig 16.** Typical Power vs. Time



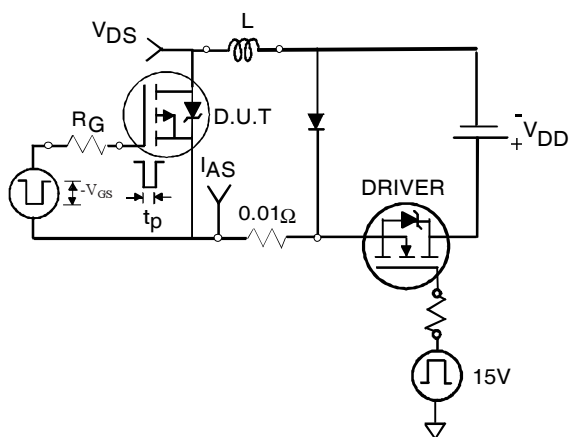
**Fig 17.** Diode Reverse Recovery Test Circuit for P-Channel HEXFET® Power MOSFETs



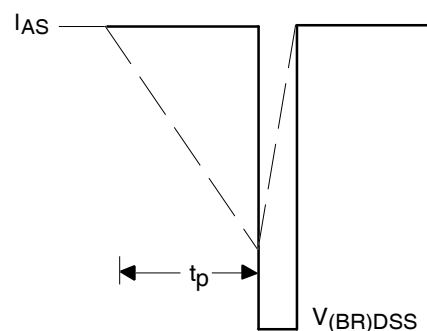
**Fig 18a.** Gate Charge Test Circuit



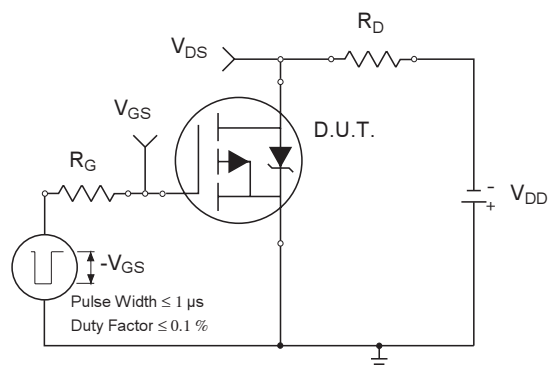
**Fig 18b.** Gate Charge Waveform



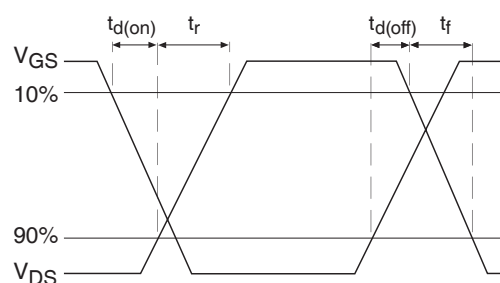
**Fig 19a.** Unclamped Inductive Test Circuit



**Fig 19b.** Unclamped Inductive Waveforms



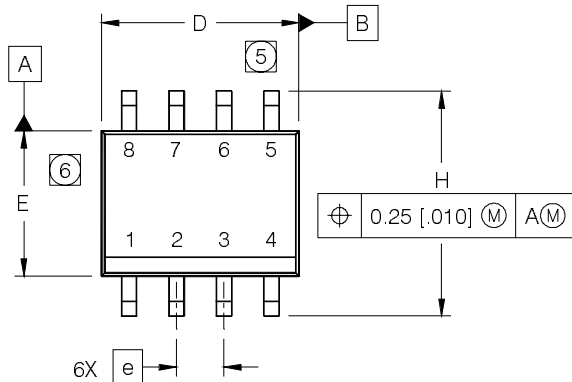
**Fig 20a.** Switching Time Test Circuit



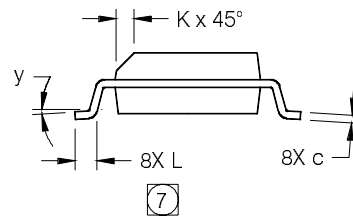
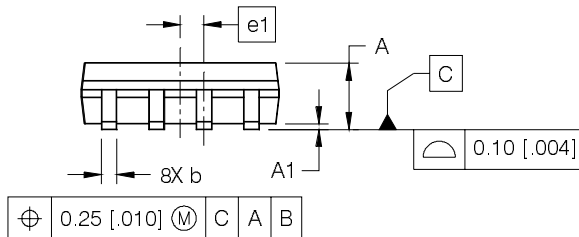
**Fig 20b.** Switching Time Waveforms

## SO-8 Package Outline (MOSFET & Fetky)

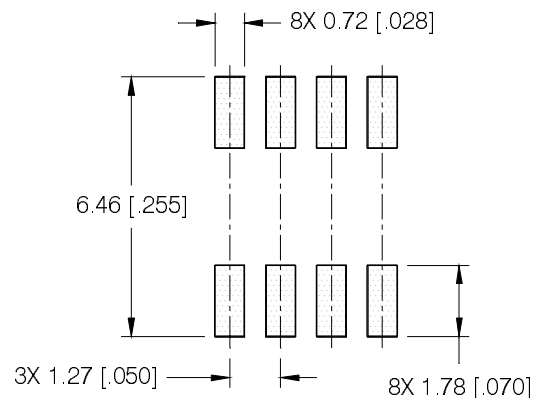
Dimensions are shown in millimeters (inches)



| DIM | INCHES     |       | MILLIMETERS |      |
|-----|------------|-------|-------------|------|
|     | MIN        | MAX   | MIN         | MAX  |
| A   | .0532      | .0688 | 1.35        | 1.75 |
| A1  | .0040      | .0098 | 0.10        | 0.25 |
| b   | .013       | .020  | 0.33        | 0.51 |
| c   | .0075      | .0098 | 0.19        | 0.25 |
| D   | .189       | .1968 | 4.80        | 5.00 |
| E   | .1497      | .1574 | 3.80        | 4.00 |
| e   | .050 BASIC |       | 1.27 BASIC  |      |
| e 1 | .025 BASIC |       | 0.635 BASIC |      |
| H   | .2284      | .2440 | 5.80        | 6.20 |
| K   | .0099      | .0196 | 0.25        | 0.50 |
| L   | .016       | .050  | 0.40        | 1.27 |
| y   | 0°         | 8°    | 0°          | 8°   |



### FOOTPRINT

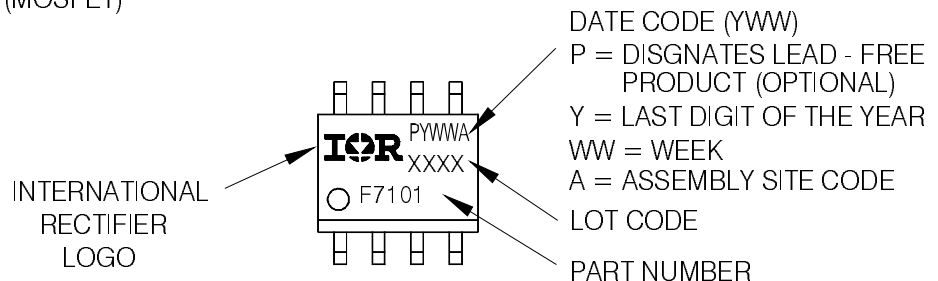


### NOTES:

1. DIMENSIONING & TOLERANCING PER ASME Y14.5M-1994.
2. CONTROLLING DIMENSION: MILLIMETER
3. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
4. OUTLINE CONFORMS TO JEDEC OUTLINE MS-012AA.
- ⑤ DIMENSION DOES NOT INCLUDE MOLD PROTRUSIONS. MOLD PROTRUSIONS NOT TO EXCEED 0.15 [0.006].
- ⑥ DIMENSION DOES NOT INCLUDE MOLD PROTRUSIONS. MOLD PROTRUSIONS NOT TO EXCEED 0.25 [0.010].
- ⑦ DIMENSION IS THE LENGTH OF LEAD FOR SOLDERING TO A SUBSTRATE.

## SO-8 Part Marking Information

EXAMPLE: THIS IS AN IRF7101 (MOSFET)

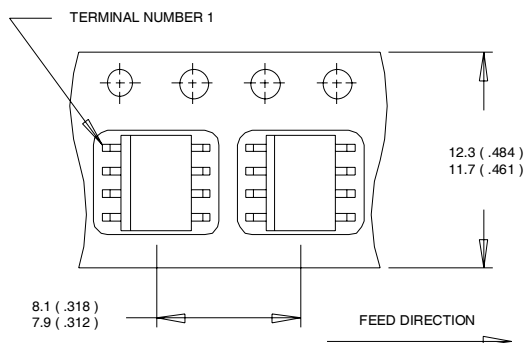


Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>

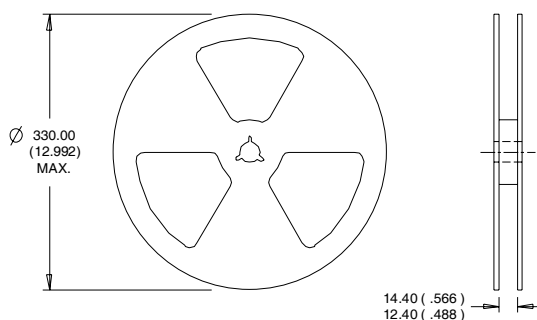
# IRF9333PbF

SO-8 Tape and Reel (Dimensions are shown in millimeters (inches))

International  
**IR** Rectifier



NOTES:  
1. CONTROLLING DIMENSION : MILLIMETER.  
2. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS(INCHES).  
3. OUTLINE CONFORMS TO EIA-481 & EIA-541.



NOTES :  
1. CONTROLLING DIMENSION : MILLIMETER.  
2. OUTLINE CONFORMS TO EIA-481 & EIA-541.

## Qualification Information<sup>†</sup>

| Qualification level        | Consumer <sup>††</sup>                        |                                                |
|----------------------------|-----------------------------------------------|------------------------------------------------|
|                            | (per JEDEC JESD47F <sup>†††</sup> guidelines) |                                                |
| Moisture Sensitivity Level | SO-8                                          | MSL1<br>(per JEDEC J-STD-020D <sup>†††</sup> ) |
| RoHS Compliant             | Yes                                           |                                                |

<sup>†</sup> Qualification standards can be found at International Rectifier's web site  
<http://www.irf.com/product-info/reliability>

<sup>††</sup> Higher qualification ratings may be available should the user have such requirements.  
Please contact your International Rectifier sales representative for further information:  
<http://www.irf.com/whoto-call/salesrep/>

<sup>†††</sup> Applicable version of JEDEC standard at the time of product release.

Data and specifications subject to change without notice.

International  
**IR** Rectifier

IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105  
TAC Fax: (310) 252-7903

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