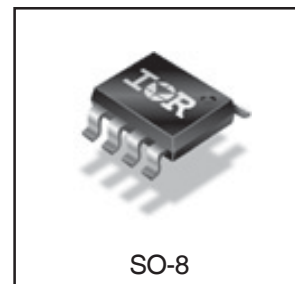
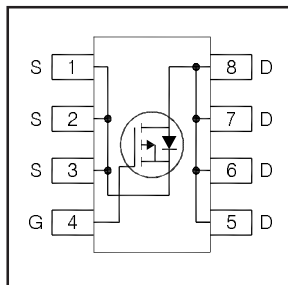


# IRF9321PbF

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>7.2</b>  | <b>mΩ</b> |
| <b>R<sub>DS(on)</sub> max</b><br>(@ V <sub>GS</sub> = -4.5V) | <b>11.2</b> | <b>mΩ</b> |
| <b>Q<sub>g</sub> (typical)</b>                               | <b>34</b>   | <b>nC</b> |
| <b>I<sub>D</sub></b><br>(@ T <sub>A</sub> = 25°C)            | <b>-15</b>  | <b>A</b>  |



## Applications

- Charge and Discharge Switch for Notebook PC Battery Application

## Features and Benefits

### Features

|  |
|--|
| Industry-Standard SO-8 Package                               |
| RoHS Compliant Containing no Lead, no Bromide and no Halogen |

results in  
⇒

### Resulting Benefits

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

| Orderable part number | Package Type | Standard Pack |          | Note |
|-----------------------|--------------|---------------|----------|------|
|                       |              | Form          | Quantity |      |
| IRF9321PbF            | SO8          | Tube/Bulk     | 95       |      |
| IRF9321TRPbF          | 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 | -15          | A     |
| I <sub>D</sub> @ T <sub>A</sub> = 70°C | Continuous Drain Current, V <sub>GS</sub> @ -10V | -12          |       |
| I <sub>DM</sub>                        | Pulsed Drain Current ①                           | -120         |       |
| 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                        |              |       |

Notes ① through ⑥ are on page 2

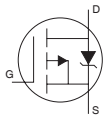
## Static @ T<sub>J</sub> = 25°C (unless otherwise specified)

|                                     | Parameter                            | Min. | Typ.  | Max. | Units | Conditions   |
|-------------------------------------|--------------------------------------|------|-------|------|-------|--|
| BV <sub>DSS</sub>                   | Drain-to-Source Breakdown Voltage    | -30  | —     | —    | V     | V <sub>GS</sub> = 0V, I <sub>D</sub> = -250μA                          |
| ΔBV <sub>DSS</sub> /ΔT <sub>J</sub> | Breakdown Voltage Temp. Coefficient  | —    | 0.021 | —    | V/°C  | Reference to 25°C, I <sub>D</sub> = -1mA                               |
| R <sub>DS(on)</sub>                 | Static Drain-to-Source On-Resistance | —    | 5.9   | 7.2  | mΩ    | V <sub>GS</sub> = -10V, I <sub>D</sub> = -15A ③                        |
|                                     |                                      | —    | 9.3   | 11.2 |       | V <sub>GS</sub> = -4.5V, I <sub>D</sub> = -12A ③                       |
| V <sub>GS(th)</sub>                 | Gate Threshold Voltage               | -1.3 | -1.8  | -2.4 | V     | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -50μA             |
| ΔV <sub>GS(th)</sub>                | Gate Threshold Voltage Coefficient   | —    | -5.9  | —    | mV/°C |  |
| I <sub>DSS</sub>                    | Drain-to-Source Leakage Current      | —    | —     | -1.0 | μA    | V <sub>DS</sub> = -24V, V <sub>GS</sub> = 0V                           |
|                                     |                                      | —    | —     | -150 |       | V <sub>DS</sub> = -24V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 125°C   |
| I <sub>GSS</sub>                    | Gate-to-Source Forward Leakage       | —    | —     | -100 | nA    | V <sub>GS</sub> = -20V   |
|                                     | Gate-to-Source Reverse Leakage       | —    | —     | 100  |       | V <sub>GS</sub> = 20V  |
| g <sub>fs</sub>                     | Forward Transconductance             | 30   | —     | —    | S     | V <sub>DS</sub> = -10V, I <sub>D</sub> = -12A                          |
| Q <sub>g</sub>                      | Total Gate Charge ⑥                  | —    | 34    | —    | nC    | V <sub>DS</sub> = -15V, V <sub>GS</sub> = -4.5V, I <sub>D</sub> = -12A |
| Q <sub>g</sub>                      | Total Gate Charge ⑥                  | —    | 65    | 98   | nC    | V <sub>GS</sub> = -10V   |
| Q <sub>gs</sub>                     | Gate-to-Source Charge ⑥              | —    | 10    | —    |       | V <sub>DS</sub> = -15V   |
| Q <sub>gd</sub>                     | Gate-to-Drain Charge ⑥               | —    | 16    | —    |       | I <sub>D</sub> = -12A  |
| R <sub>G</sub>                      | Gate Resistance ⑥                    | —    | 18    | —    | Ω     |  |
| t <sub>d(on)</sub>                  | Turn-On Delay Time                   | —    | 21    | —    | ns    | V <sub>DD</sub> = -30V, V <sub>GS</sub> = -4.5V ③                      |
| t <sub>r</sub>                      | Rise Time                            | —    | 79    | —    |       | I <sub>D</sub> = -1.0A   |
| t <sub>d(off)</sub>                 | Turn-Off Delay Time                  | —    | 185   | —    |       | R <sub>G</sub> = 6.8Ω  |
| t <sub>f</sub>                      | Fall Time                            | —    | 145   | —    |       | See Figs. 19a & 19b  |
| C <sub>iss</sub>                    | Input Capacitance                    | —    | 2590  | —    | pF    | V <sub>GS</sub> = 0V   |
| C <sub>oss</sub>                    | Output Capacitance                   | —    | 590   | —    |       | V <sub>DS</sub> = -25V   |
| C <sub>rss</sub>                    | Reverse Transfer Capacitance         | —    | 360   | —    |       | f = 1.0MHz   |

## Avalanche Characteristics

|                 | Parameter                       | Typ. | Max. | Units |
|-----------------|---------------------------------|------|------|-------|
| E <sub>AS</sub> | Single Pulse Avalanche Energy ② | —    | 310  | mJ    |
| I <sub>AR</sub> | Avalanche Current ①             | —    | -12  | A     |

## Diode Characteristics

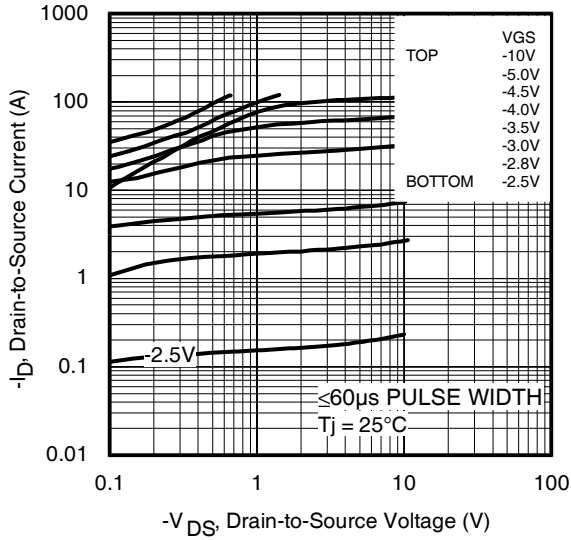
|                 | Parameter                              | Min. | Typ. | Max. | Units | Conditions   |
|-----------------|--|------|------|------|-------|--|
| I <sub>S</sub>  | Continuous Source Current (Body Diode) | —    | —    | -2.5 | A     | MOSFET symbol showing the integral reverse p-n junction diode.  |
| I <sub>SM</sub> | Pulsed Source Current (Body Diode) ①   | —    | —    | -120 |       |  |
| V <sub>SD</sub> | Diode Forward Voltage                  | —    | —    | -1.2 | V     | T <sub>J</sub> = 25°C, I <sub>S</sub> = -2.5A, V <sub>GS</sub> = 0V ③  |
| t <sub>rr</sub> | Reverse Recovery Time                  | —    | 38   | 57   | ns    | T <sub>J</sub> = 25°C, I <sub>F</sub> = -2.5A, V <sub>DD</sub> = -24V  |
| Q <sub>rr</sub> | Reverse Recovery Charge                | —    | 24   | 36   | nC    | di/dt = 100/μs ③   |

## Thermal Resistance

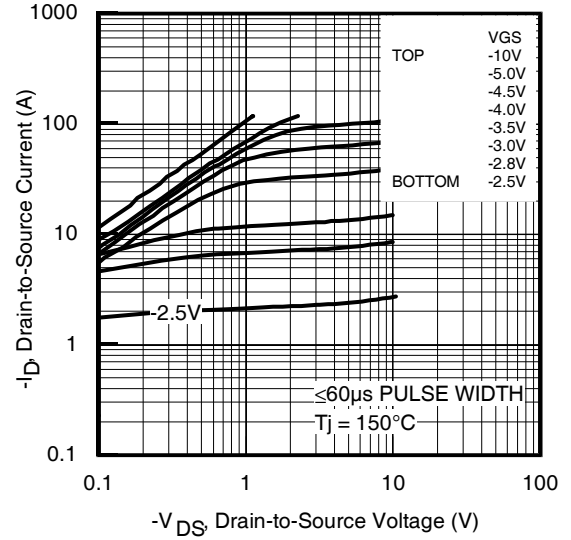
|                  | Parameter                | Typ. | Max. | Units |
|------------------|--------------------------|------|------|-------|
| R <sub>θJL</sub> | Junction-to-Drain Lead ⑤ | —    | 20   | °C/W  |
| R <sub>θJA</sub> | Junction-to-Ambient ④    | —    | 50   |       |

### Notes:

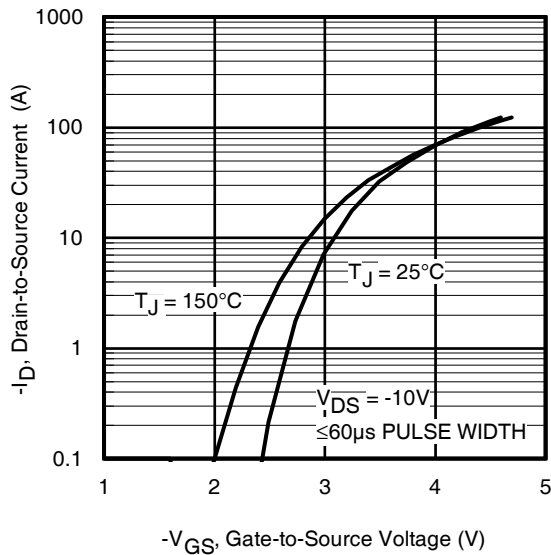
- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting T<sub>J</sub> = 25°C, L = 4.3mH, R<sub>G</sub> = 25Ω, I<sub>AS</sub> = -12A.
- ③ Pulse width ≤ 400μs; duty cycle ≤ 2%.
- ④ When mounted on 1 inch square copper board.
- ⑤ R<sub>θ</sub> is measured at T<sub>J</sub> of approximately 90°C.
- ⑥ For DESIGN AID ONLY, not subject to production testing.



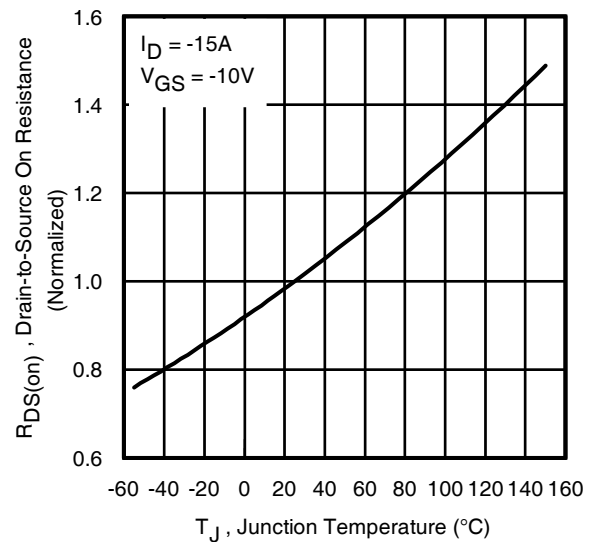
**Fig 1.** Typical Output Characteristics



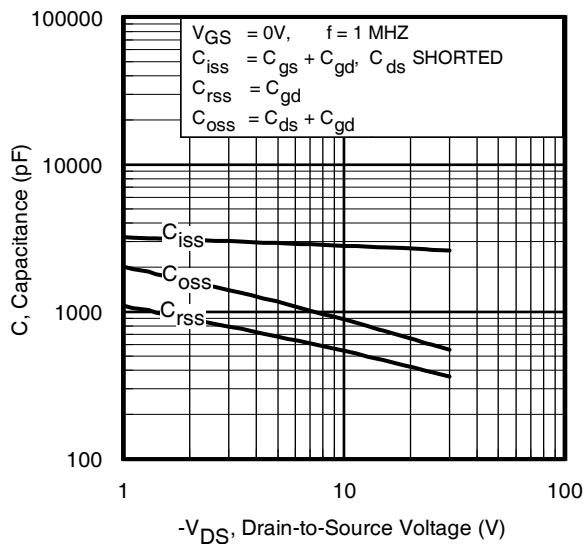
**Fig 2.** Typical Output Characteristics



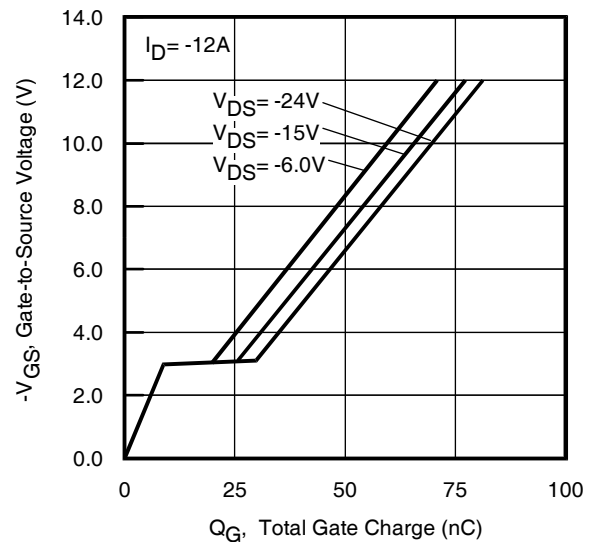
**Fig 3.** Typical Transfer Characteristics



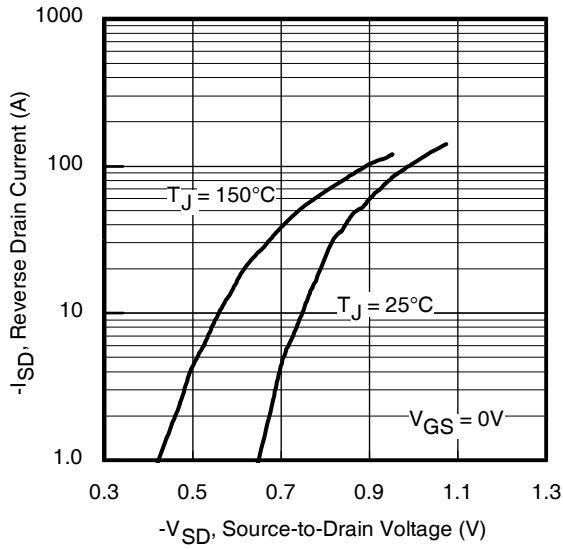
**Fig 4.** Normalized On-Resistance vs. Temperature



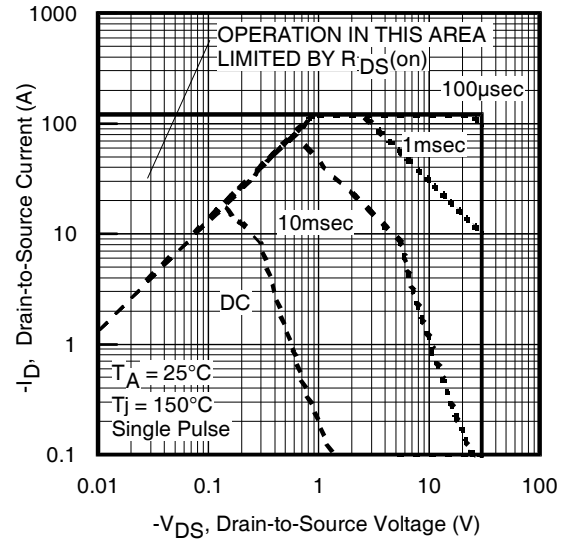
**Fig 5.** Typical Capacitance vs. Drain-to-Source Voltage  
[www.irf.com](http://www.irf.com)



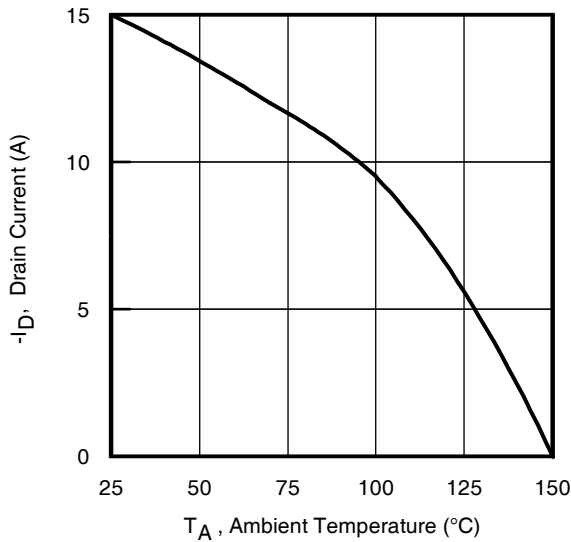
**Fig 6.** Typical Gate Charge vs. Gate-to-Source Voltage



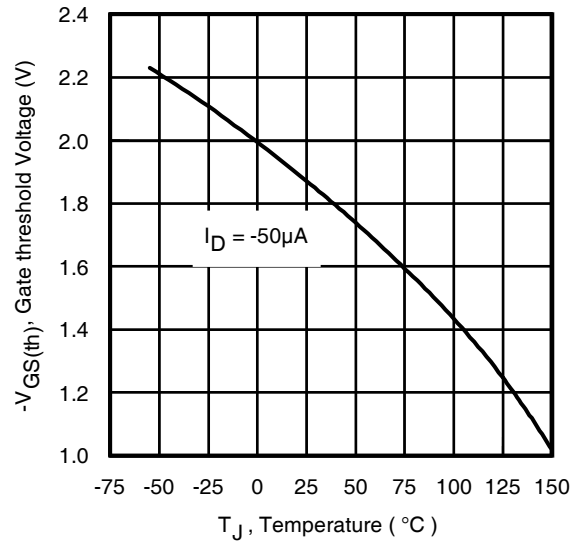
**Fig 7.** Typical Source-Drain Diode Forward Voltage



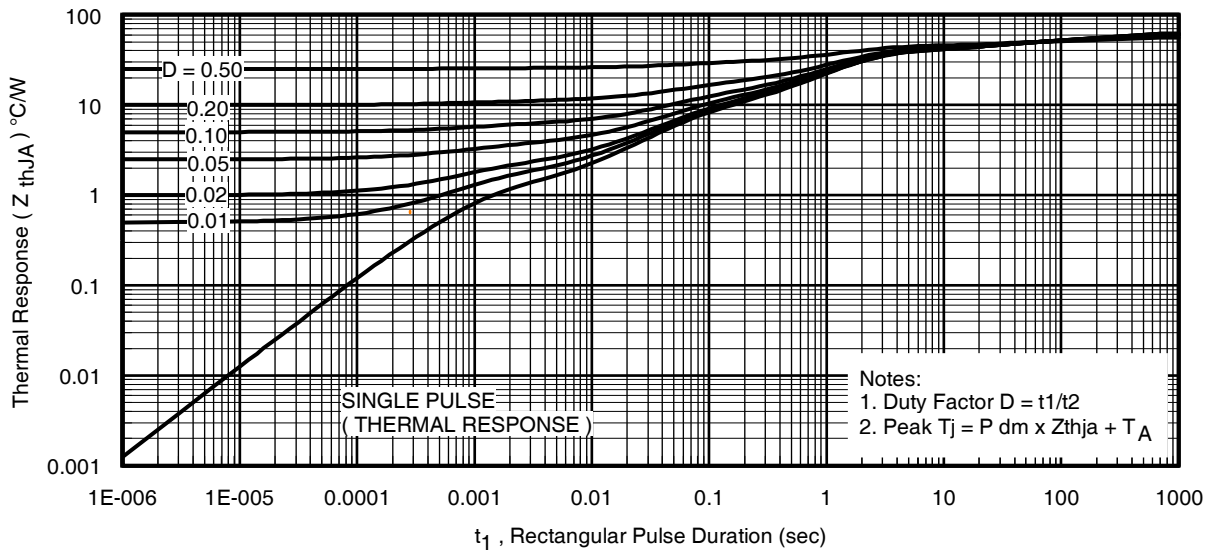
**Fig 8.** Maximum Safe Operating Area



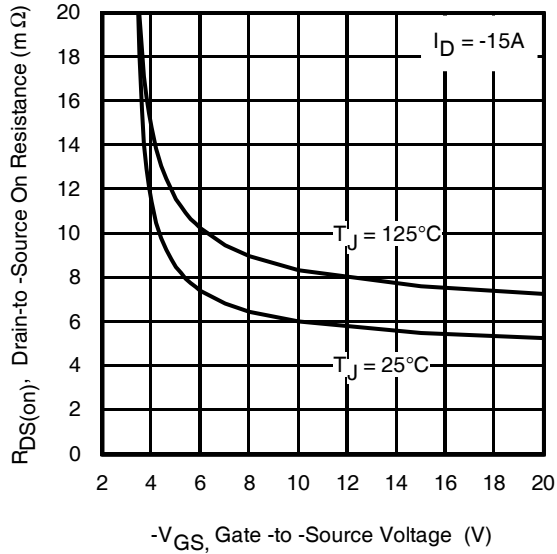
**Fig 9.** Maximum Drain Current vs. Ambient Temperature



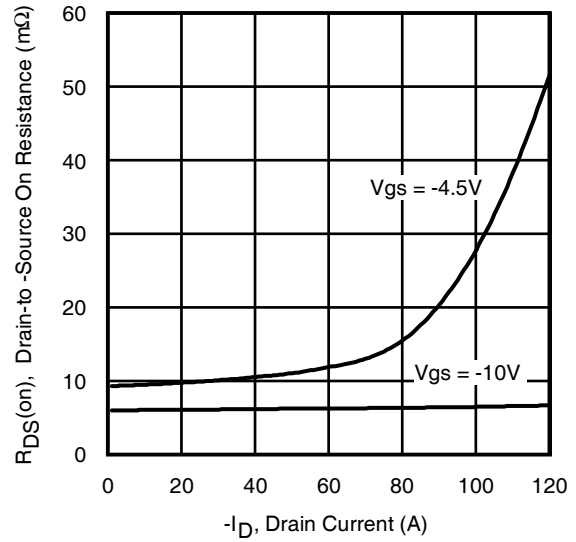
**Fig 10.** Threshold Voltage vs. Temperature



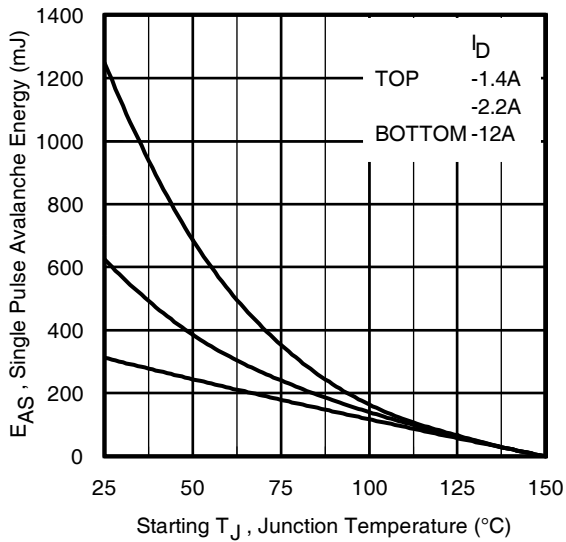
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Ambient



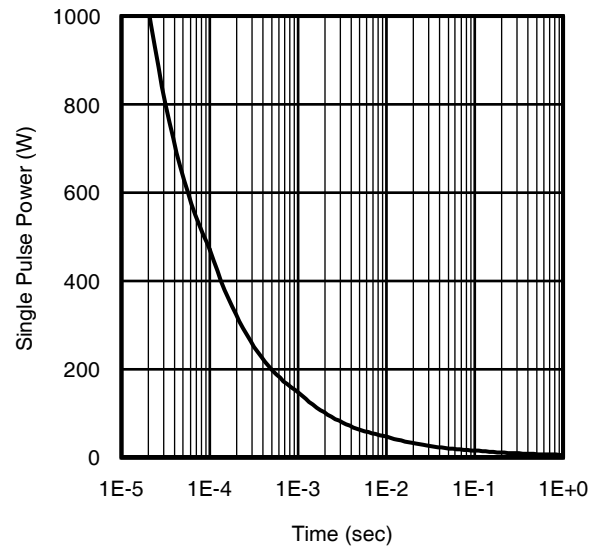
**Fig 12.** On-Resistance vs. Gate Voltage



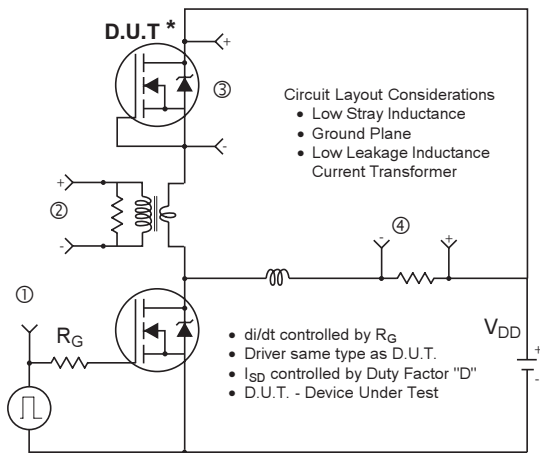
**Fig 13.** Typical On-Resistance vs. Drain Current



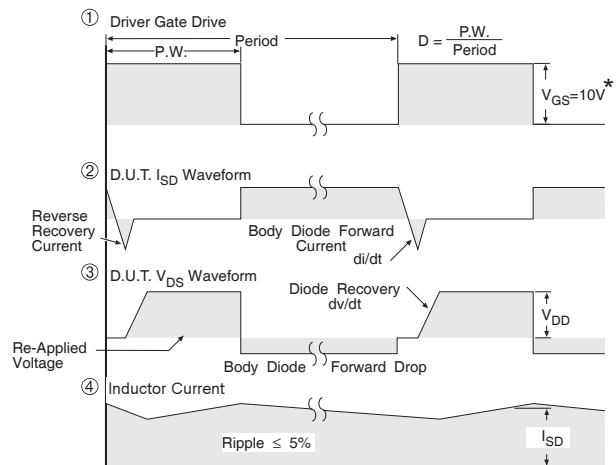
**Fig 14.** Maximum Avalanche Energy vs. Drain Current



**Fig 15.** Typical Power vs. Time

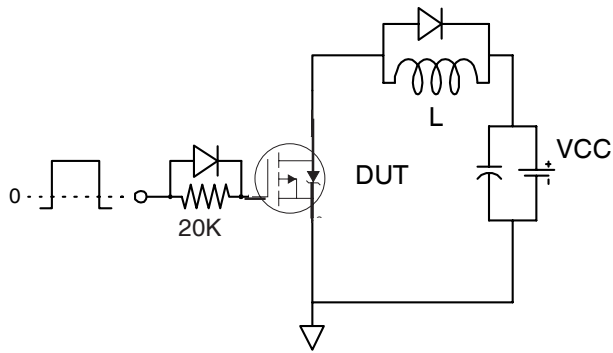


\* Reverse Polarity of D.U.T for P-Channel

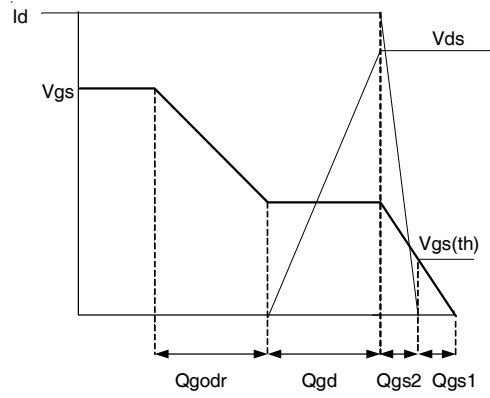


\*  $V_{GS} = 5V$  for Logic Level Devices

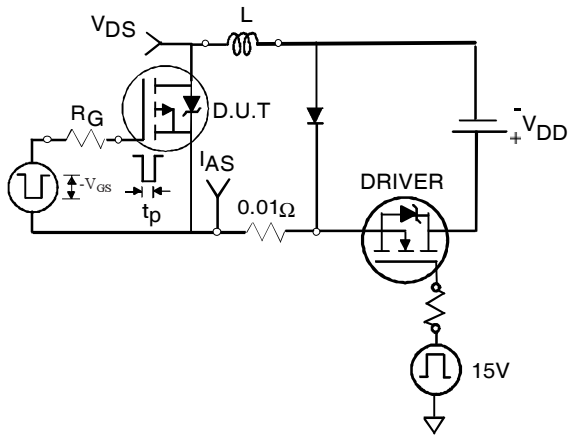
**Fig 16.** Diode Reverse Recovery Test Circuit for P-Channel HEXFET® Power MOSFETs



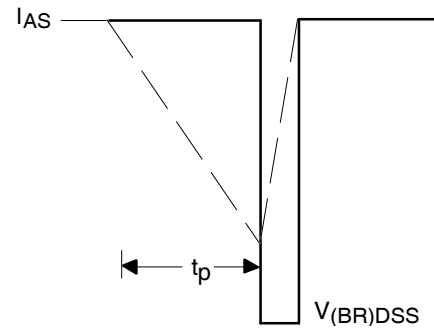
**Fig 17a.** Gate Charge Test Circuit



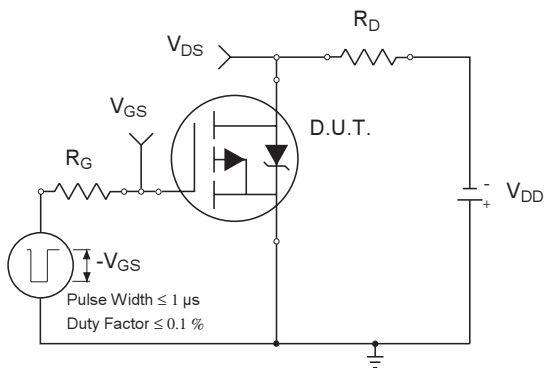
**Fig 17b.** Gate Charge Waveform



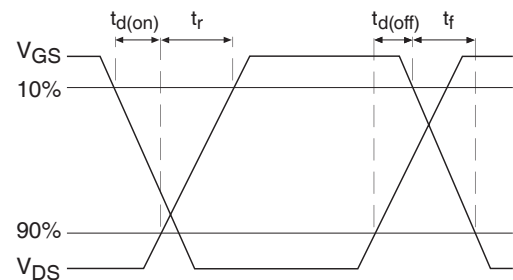
**Fig 18a.** Unclamped Inductive Test Circuit



**Fig 18b.** Unclamped Inductive Waveforms



**Fig 19a.** Switching Time Test Circuit



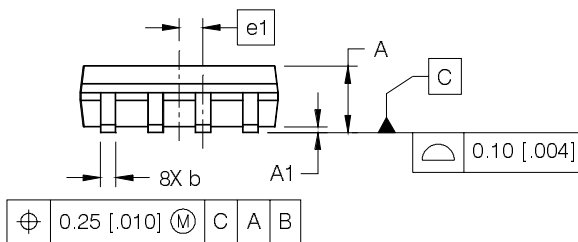
**Fig 19b.** Switching Time Waveforms

## 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

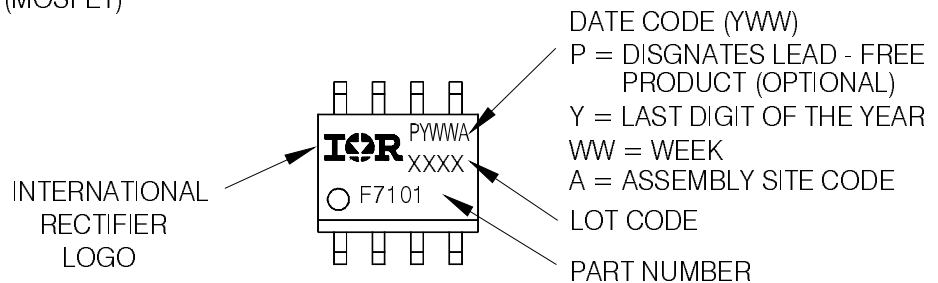


### NOTES:

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

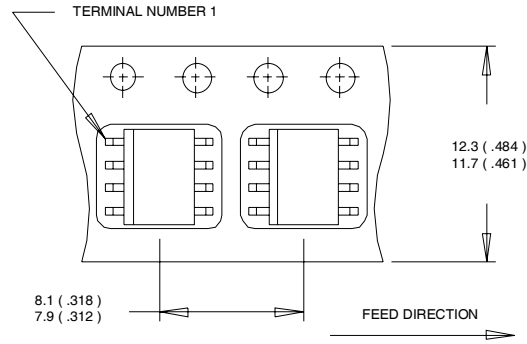
EXAMPLE: THIS IS AN IRF7101 (MOSFET)



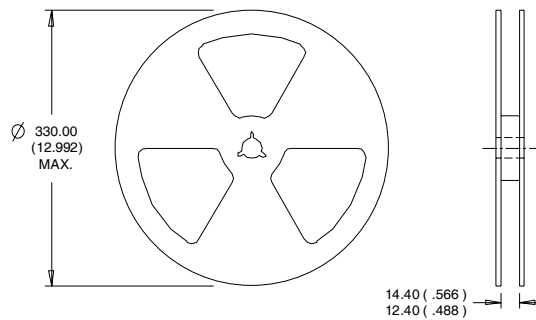
Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>

# IRF9321PbF

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



- 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†

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

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

†† 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/>

††† Applicable version of JEDEC standard at the time of product release.

Data and specifications subject to change without notice.