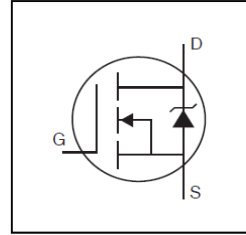


HEXFET® Power MOSFET

**Applications**

- Motion Control Applications
- High Efficiency Synchronous Rectification in SMPS
- Uninterruptible Power Supply
- Hard Switched and High Frequency Circuits



|                                |               |
|--------------------------------|---------------|
| <b>V<sub>DSS</sub></b>         | <b>150V</b>   |
| <b>R<sub>DS(on)</sub> typ.</b> | <b>12.2mΩ</b> |
| <b>R<sub>DS(on)</sub> max.</b> | <b>16mΩ</b>   |
| <b>I<sub>D</sub></b>           | <b>34A</b>    |

**Benefits**

- Low R<sub>DS(on)</sub> Reduces Losses
- Low Gate Charge Improves the Switching Performance
- Improved Diode Recovery Improves Switching & EMI Performance
- 30V Gate Voltage Rating Improves Robustness
- Fully Characterized Avalanche SOA



|          |          |          |
|----------|----------|----------|
| <b>G</b> | <b>D</b> | <b>S</b> |
| Gate     | Drain    | Source   |

| Base Part Number | Package Type    | Standard Pack |          | Orderable Part Number |
|------------------|-----------------|---------------|----------|-----------------------|
|                  |                 | Form          | Quantity |                       |
| IRFI4321PbF      | TO-220 Full-Pak | Tube          | 50       | IRFI4321PbF           |

**Absolute Maximum Ratings**

| Symbol                                  | Parameter                                               | Max.               | Units |
|-----------------------------------------|---------------------------------------------------------|--------------------|-------|
| I <sub>D</sub> @ T <sub>C</sub> = 25°C  | Continuous Drain Current, V <sub>GS</sub> @ 10V         | 34                 | A     |
| I <sub>D</sub> @ T <sub>C</sub> = 100°C | Continuous Drain Current, V <sub>GS</sub> @ 10V         | 21                 |       |
| I <sub>DM</sub>                         | Pulsed Drain Current ①                                  | 140                |       |
| P <sub>D</sub> @ T <sub>C</sub> = 25°C  | Maximum Power Dissipation                               | 46                 | W     |
|                                         | Linear Derating Factor                                  | 0.37               | W/°C  |
| V <sub>GS</sub>                         | Gate-to-Source Voltage                                  | ± 30               | V     |
| E <sub>AS</sub>                         | Single Pulse Avalanche Energy (Thermally Limited) ②     | 170                | mJ    |
| T <sub>J</sub>                          | Operating Junction and                                  | -55 to + 150       | °C    |
| T <sub>STG</sub>                        | Storage Temperature Range                               |                    |       |
|                                         | Soldering Temperature, for 10 seconds (1.6mm from case) | 300                |       |
|                                         | Mounting torque, 6-32 or M3 screw                       | 10 lbf•in (1.1N•m) |       |

**Thermal Resistance**

| Symbol           | Parameter                       | Typ. | Max. | Units |
|------------------|---------------------------------|------|------|-------|
| R <sub>θJC</sub> | Junction-to-Case ④              | —    | 2.73 | °C/W  |
| R <sub>θJA</sub> | Junction-to-Ambient (PCB Mount) | —    | 65   |       |

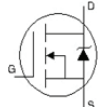
**Electrical Characteristics @  $T_J = 25^\circ\text{C}$  (unless otherwise specified)**

|                                 | Parameter                            | Min. | Typ. | Max. | Units | Conditions                                            |
|---------------------------------|--------------------------------------|------|------|------|-------|-------------------------------------------------------|
| $V_{(BR)DSS}$                   | Drain-to-Source Breakdown Voltage    | 150  | —    | —    | V     | $V_{GS} = 0V, I_D = 250\mu A$                         |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient  | —    | 190  | —    | mV/°C | Reference to $25^\circ\text{C}$ , $I_D = 1mA$ ③       |
| $R_{DS(on)}$                    | Static Drain-to-Source On-Resistance | —    | 12.2 | 16   | mΩ    | $V_{GS} = 10V, I_D = 20A$                             |
| $V_{GS(th)}$                    | Gate Threshold Voltage               | 3.0  | —    | 5.0  | V     | $V_{DS} = V_{GS}, I_D = 250\mu A$                     |
| $I_{DSS}$                       | Drain-to-Source Leakage Current      | —    | —    | 20   | μA    | $V_{DS} = 150V, V_{GS} = 0V$                          |
|                                 |                                      | —    | —    | 1.0  | mA    | $V_{DS} = 150V, V_{GS} = 0V, T_J = 125^\circ\text{C}$ |
| $I_{GSS}$                       | Gate-to-Source Forward Leakage       | —    | —    | 100  | nA    | $V_{GS} = 20V$                                        |
|                                 | Gate-to-Source Reverse Leakage       | —    | —    | -100 | nA    | $V_{GS} = -20V$                                       |
| $R_{G(int)}$                    | Internal Gate Resistance             | —    | 0.8  | —    | Ω     |                                                       |

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

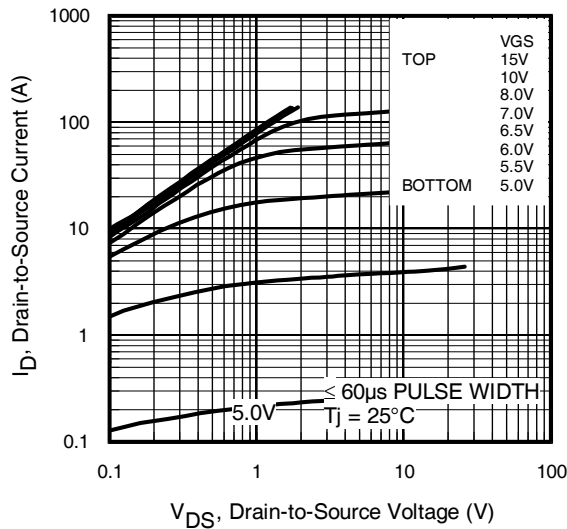
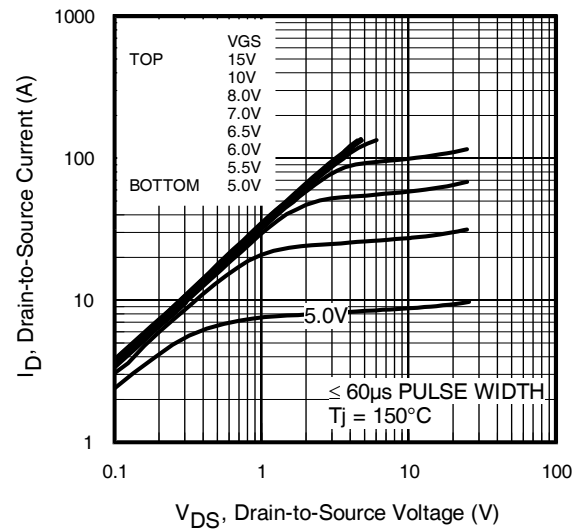
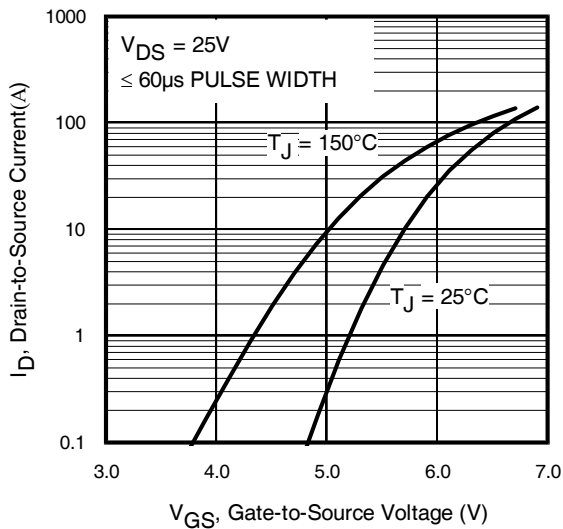
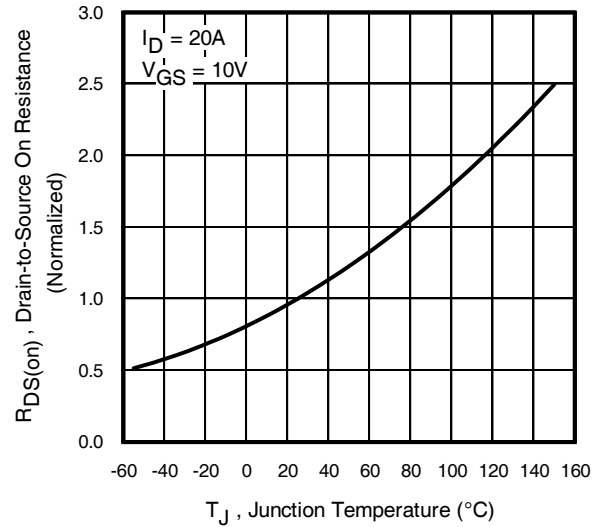
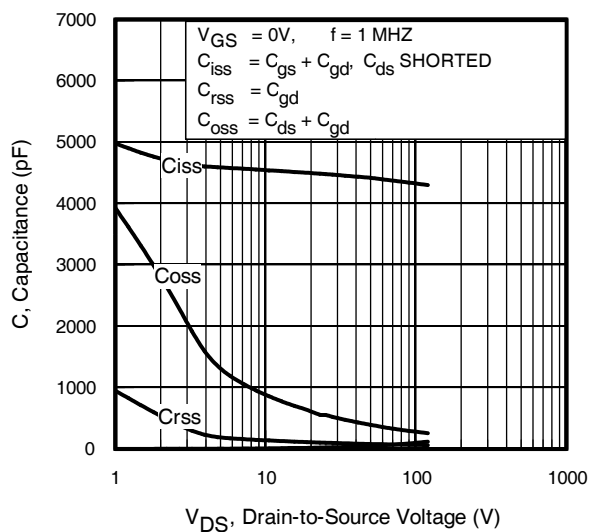
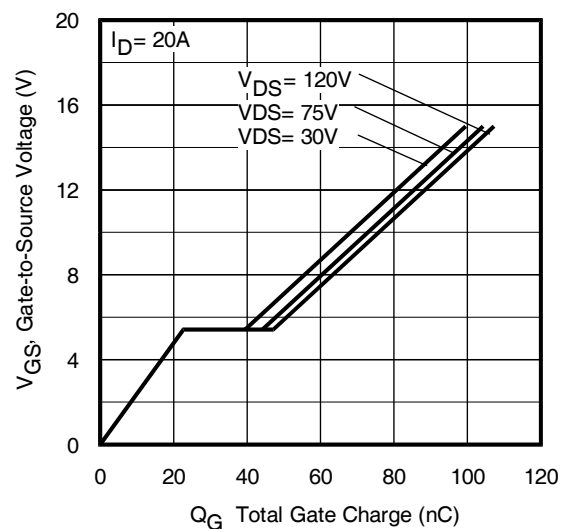
|              |                              |    |      |     |    |                           |
|--------------|------------------------------|----|------|-----|----|---------------------------|
| $g_{fs}$     | Forward Trans conductance    | 50 | —    | —   | S  | $V_{DS} = 50V, I_D = 20A$ |
| $Q_g$        | Total Gate Charge            | —  | 73   | 110 | nC | $I_D = 20A$               |
| $Q_{gs}$     | Gate-to-Source Charge        | —  | 24   | —   |    | $V_{DS} = 75V$            |
| $Q_{gd}$     | Gate-to-Drain Charge         | —  | 20   | —   |    | $V_{GS} = 10V$ ③          |
| $t_{d(on)}$  | Turn-On Delay Time           | —  | 18   | —   | ns | $V_{DD} = 75V$            |
| $t_r$        | Rise Time                    | —  | 29   | —   |    | $I_D = 20A$               |
| $t_{d(off)}$ | Turn-Off Delay Time          | —  | 27   | —   |    | $R_G = 2.5\Omega$         |
| $t_f$        | Fall Time                    | —  | 20   | —   |    | $V_{GS} = 10V$ ③          |
| $C_{iss}$    | Input Capacitance            | —  | 4440 | —   | pF | $V_{GS} = 0V$             |
| $C_{oss}$    | Output Capacitance           | —  | 390  | —   |    | $V_{DS} = 50V$            |
| $C_{rss}$    | Reverse Transfer Capacitance | —  | 84   | —   |    | $f = 1.0MHz$              |

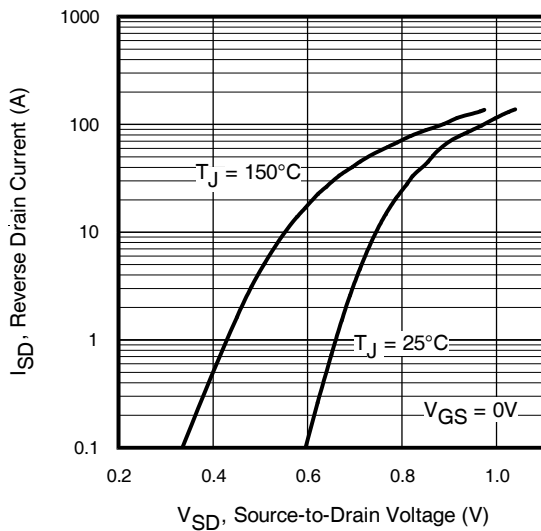
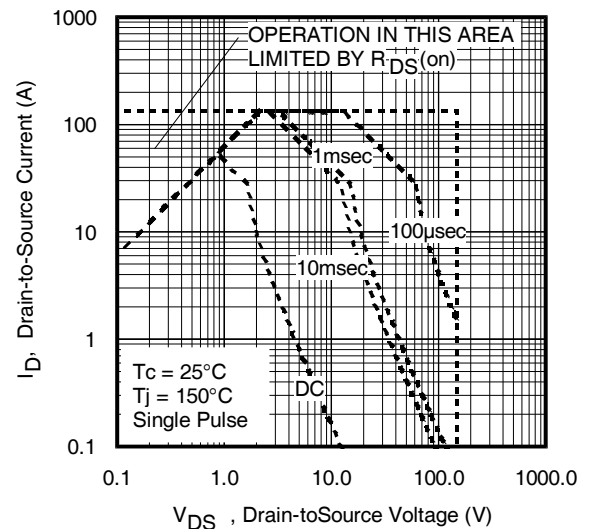
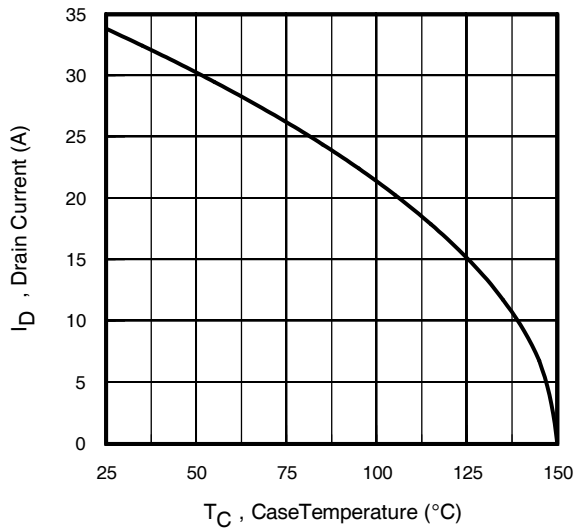
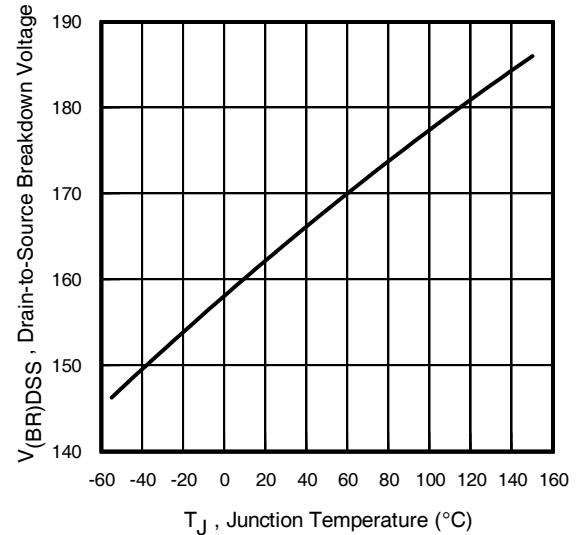
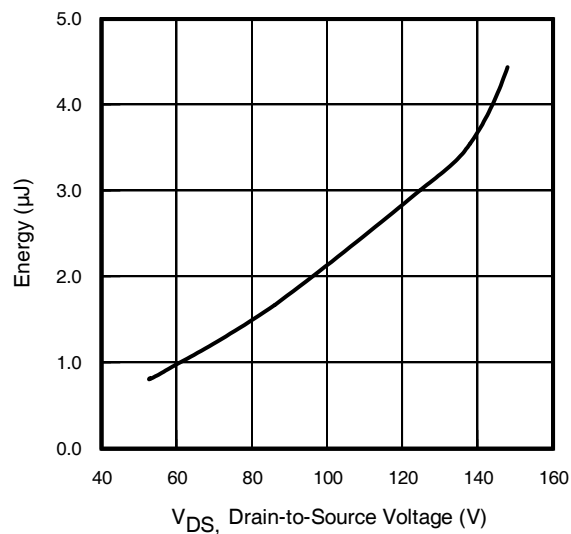
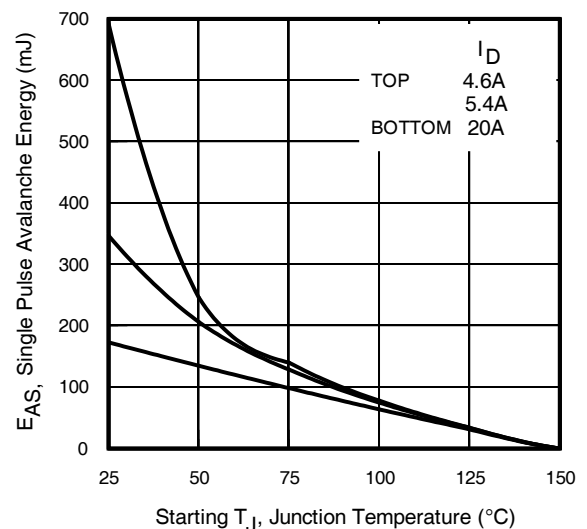
**Source-Drain Ratings and Characteristics**

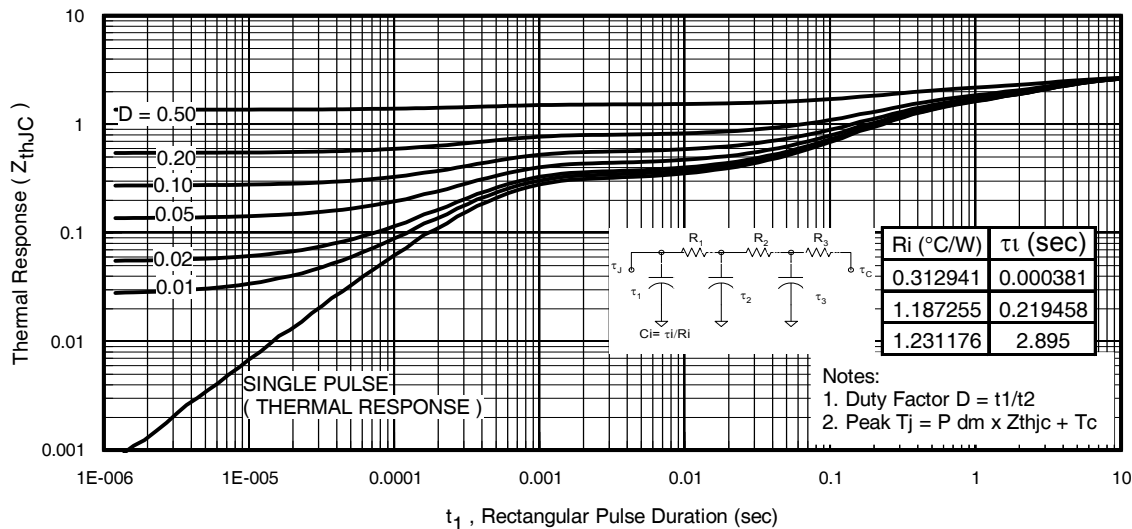
|           | Parameter                              | Min.                                                                        | Typ. | Max. | Units | Conditions                                                                                                                                           |
|-----------|----------------------------------------|-----------------------------------------------------------------------------|------|------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| $I_S$     | Continuous Source Current (Body Diode) | —                                                                           | —    | 34   | A     | MOSFET symbol showing the integral reverse p-n junction diode.  |
| $I_{SM}$  | Pulsed Source Current (Body Diode) ①   | —                                                                           | —    | 140  |       |                                                                                                                                                      |
| $V_{SD}$  | Diode Forward Voltage                  | —                                                                           | —    | 1.3  | V     | $T_J = 25^\circ\text{C}, I_S = 20A, V_{GS} = 0V$ ③                                                                                                   |
| $t_{rr}$  | Reverse Recovery Time                  | —                                                                           | 86   | 130  | ns    | $I_F = 20A$                                                                                                                                          |
| $Q_{rr}$  | Reverse Recovery Charge                | —                                                                           | 310  | 470  | nC    | $V_R = 128V$                                                                                                                                         |
| $I_{RRM}$ | Reverse Recovery Current               | —                                                                           | 6.7  | —    | A     | $di/dt = 100A/\mu s$ ③                                                                                                                               |
| $t_{on}$  | Forward Turn-On Time                   | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S + L_D$ ) |      |      |       |                                                                                                                                                      |

**Notes:**

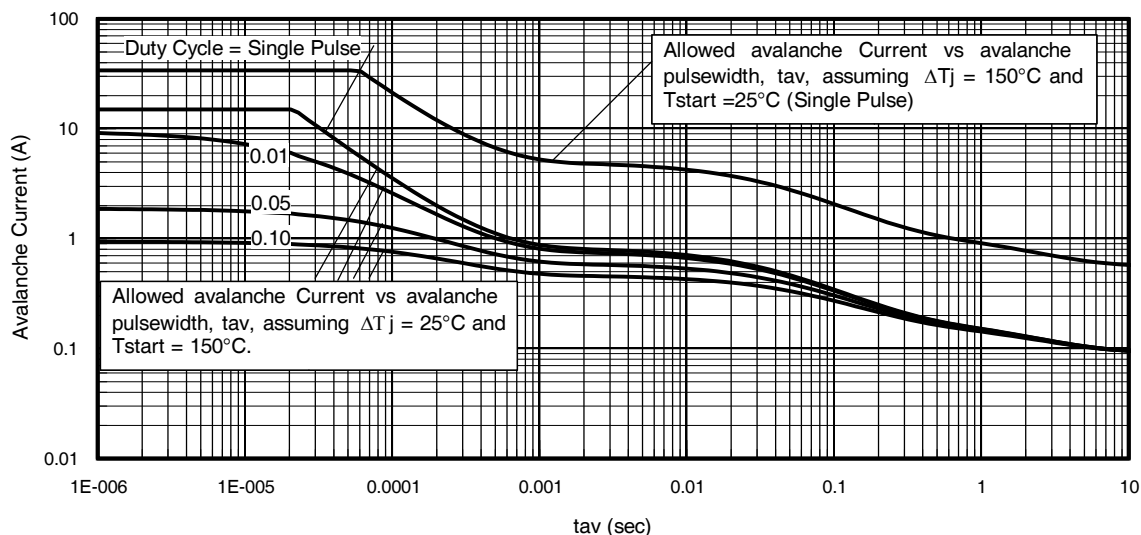
- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Limited by  $T_{Jmax}$ , starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.85mH$ ,  $R_G = 25\Omega$ ,  $I_{AS} = 20A$ ,  $V_{GS} = 10V$ . Part not recommended for use above this value.
- ③ Pulse width  $\leq 400\mu s$ ; duty cycle  $\leq 2\%$ .
- ④  $R_\theta$  is measured at  $T_J$  approximately  $90^\circ\text{C}$ .


**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

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

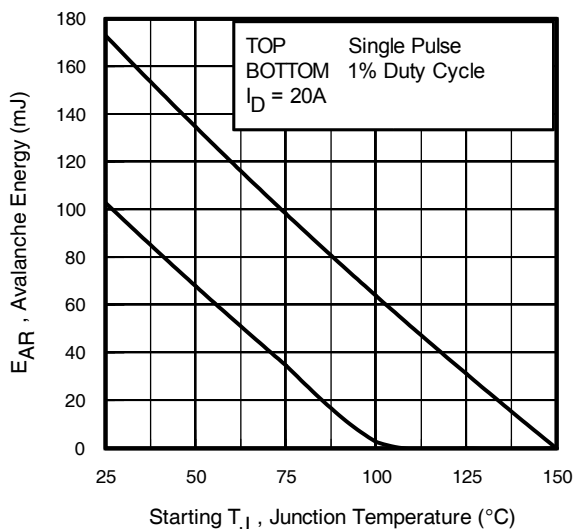

**Fig. 7. Typical Source-to-Drain Diode Forward Voltage**

**Fig. 8. Maximum Safe Operating Area**

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

**Fig. 10. Drain-to-Source Breakdown Voltage**

**Fig. 11. Typical  $C_{OSS}$  Stored Energy**

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



**Fig 13.** Maximum Effective Transient Thermal Impedance, Junction-to-Case



**Fig 14.** Single Avalanche Event: Pulse Current vs. Pulse Width



**Notes on Repetitive Avalanche Curves , Figures 14, 15:**  
 (For further info, see AN-1005 at [www.infineon.com](http://www.infineon.com))

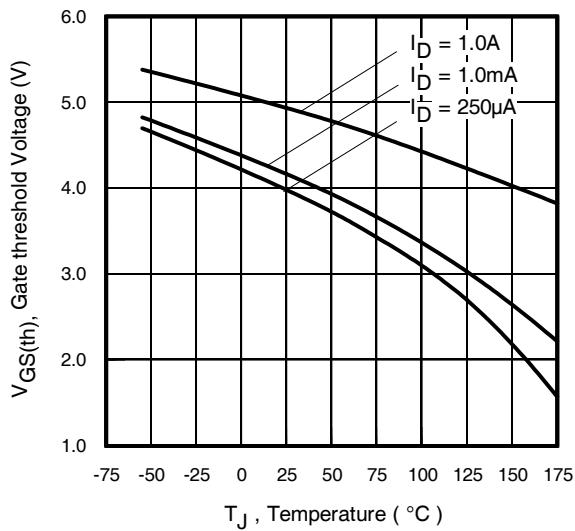
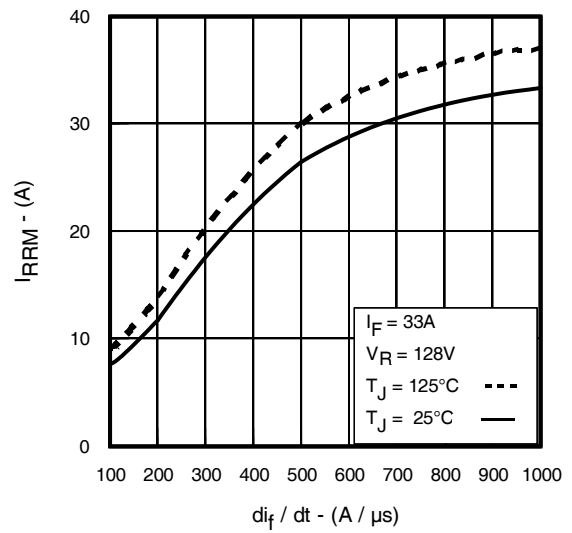
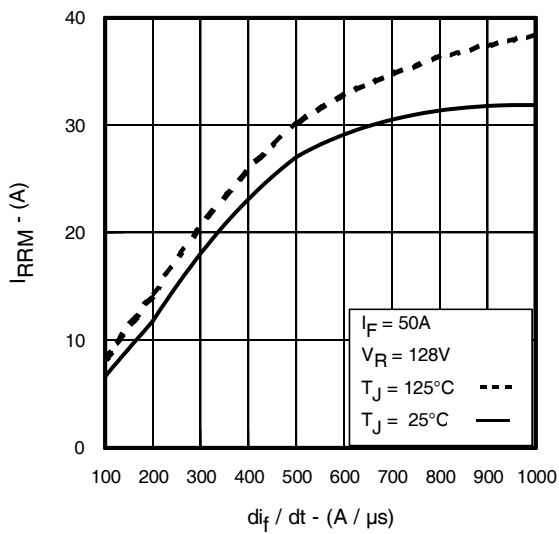
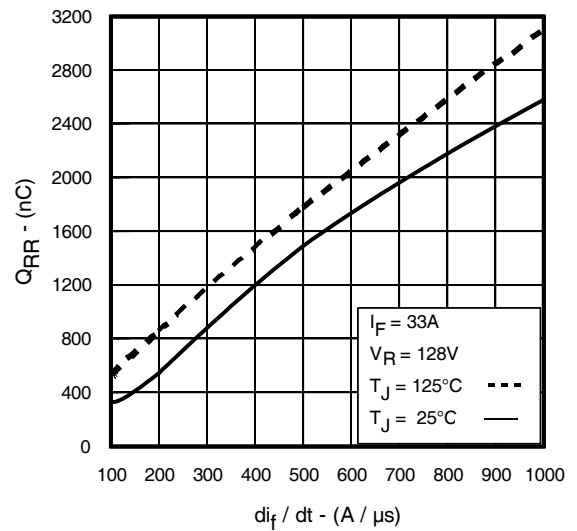
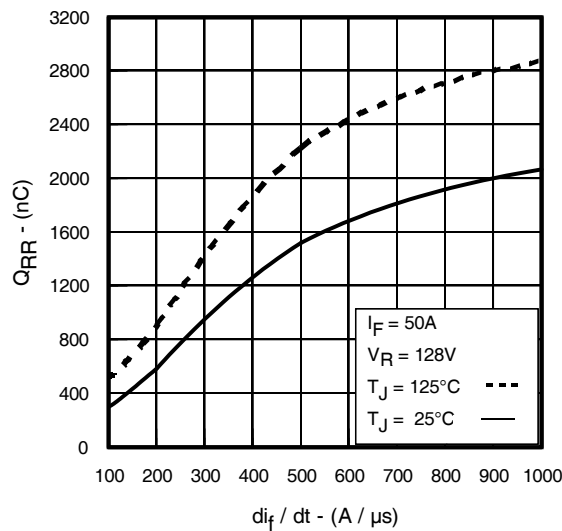
1. Avalanche failures assumption:  
Purely a thermal phenomenon and failure occurs at a temperature far in excess of  $T_{jmax}$ . This is validated for every part type.
2. Safe operation in Avalanche is allowed as long as  $T_{jmax}$  is not exceeded.
3. Equation below based on circuit and waveforms shown in Figures 16a, 16b.
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 14, 15).  
 $t_{av}$  = Average time in avalanche.  
 $D$  = Duty cycle in avalanche =  $t_{av} \cdot f$   
 $Z_{thJC}(D, t_{av})$  = Transient thermal resistance, see Figures 13)

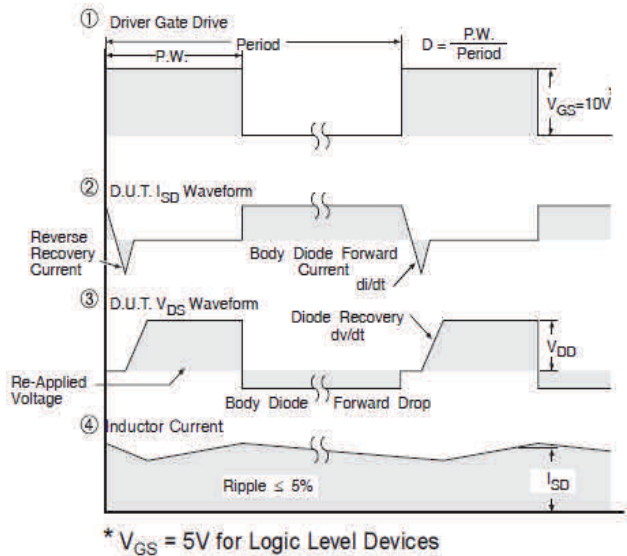
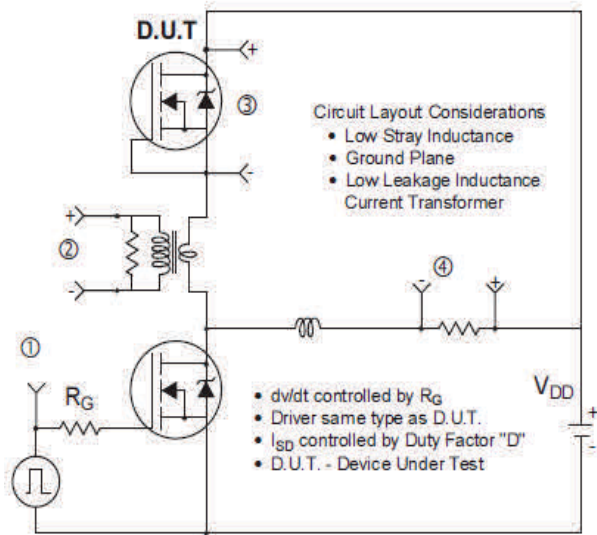
$$P_{D(ave)} = 1/2 (1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$$

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

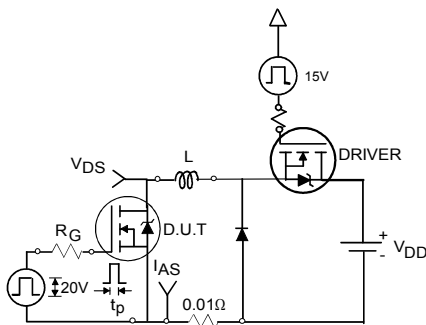
$$E_{AS(AR)} = P_{D(ave)} \cdot t_{av}$$

**Fig 15.** Maximum Avalanche Energy vs. Temperature

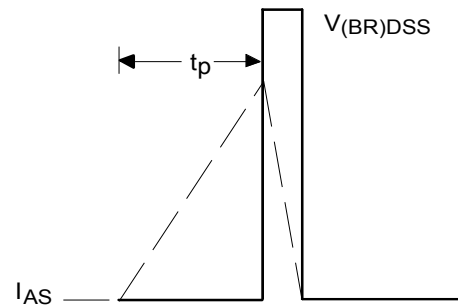

**Fig 16.** Threshold Voltage vs. Temperature

**Fig 17.** Typical Recovery Current vs.  $di_f/dt$ 

**Fig 18.** Typical Recovery Current vs.  $di_f/dt$ 

**Fig 19.** Typical Stored Charge vs.  $di_f/dt$ 

**Fig 20.** Typical Stored Charge vs.  $di_f/dt$



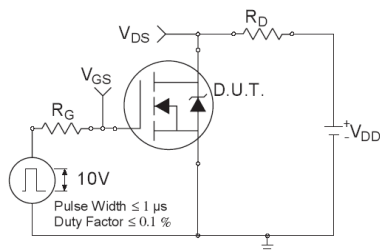
**Fig 21. Peak Diode Recovery  $dv/dt$  Test Circuit for N-Channel HEXFET® Power MOSFETs**



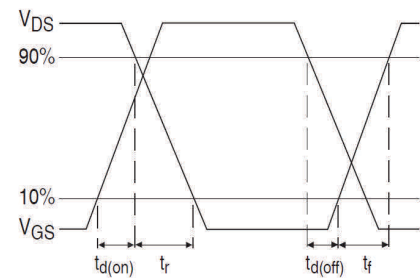
**Fig 22a. Unclamped Inductive Test Circuit**



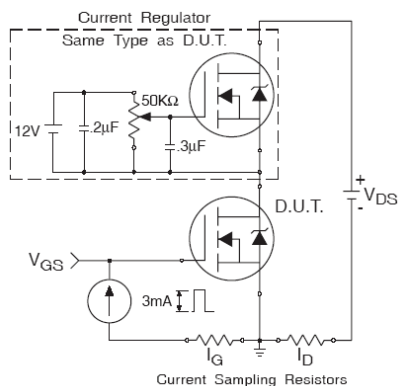
**Fig 22b. Unclamped Inductive Waveforms**



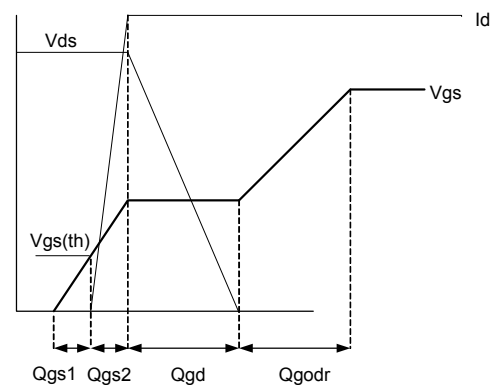
**Fig 23a. Switching Time Test Circuit**



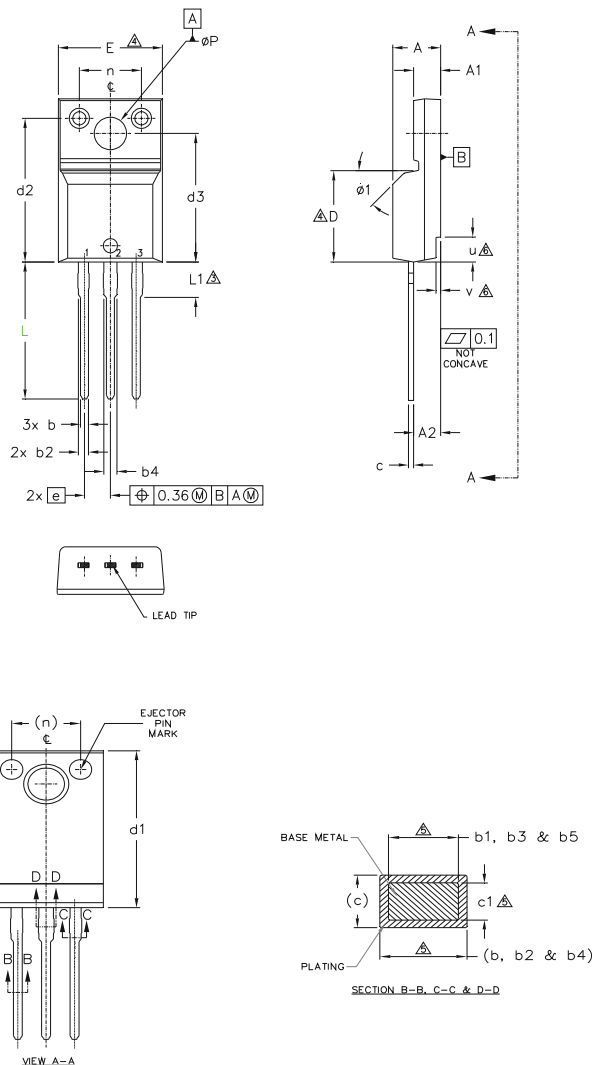
**Fig 23b. Switching Time Waveforms**



**Fig 24a. Gate Charge Test Circuit**



**Fig 24b. Gate Charge Waveform**

**TO-220 Full-Pak Package Outline** (Dimensions are shown in millimeters (inches))

**NOTES:**

- 1.0 DIMENSIONING AND TOLERANCING AS PER ASME Y14.5 M- 1994.
- 2.0 DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
- 3.0 LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
- 4.0 DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTER MOST EXTREMES OF THE PLASTIC BODY.
- 5.0 DIMENSION b1, b3, b5 & c1 APPLY TO BASE METAL ONLY.
- 6.0 STEP OPTIONAL ON PLASTIC BODY DEFINED BY DIMENSIONS u & v.
- 7.0 CONTROLLING DIMENSION : INCHES.

| S<br>Y<br>M<br>B<br>O<br>L | DIMENSIONS  |       |          |      | N<br>O<br>T<br>E<br>S |
|----------------------------|-------------|-------|----------|------|-----------------------|
|                            | MILLIMETERS |       | INCHES   |      |                       |
|                            | MIN.        | MAX.  | MIN.     | MAX. |                       |
| A                          | 4.57        | 4.83  | .180     | .190 | 5                     |
| A1                         | 2.57        | 2.82  | .101     | .111 |                       |
| A2                         | 2.51        | 2.92  | .099     | .115 |                       |
| b                          | 0.61        | 0.94  | .024     | .037 |                       |
| b1                         | 0.61        | 0.89  | .024     | .035 |                       |
| b2                         | 0.76        | 1.27  | .030     | .050 |                       |
| b3                         | 0.76        | 1.22  | .030     | .048 |                       |
| b4                         | 1.02        | 1.52  | .040     | .060 |                       |
| b5                         | 1.02        | 1.47  | .040     | .058 |                       |
| c                          | 0.33        | 0.63  | .013     | .025 |                       |
| c1                         | 0.33        | 0.58  | .013     | .023 | 5                     |
| D                          | 8.66        | 9.80  | .341     | .386 | 4                     |
| d1                         | 15.80       | 16.13 | .622     | .635 |                       |
| d2                         | 13.97       | 14.22 | .550     | .560 |                       |
| d3                         | 12.29       | 12.93 | .484     | .509 | 4                     |
| E                          | 9.63        | 10.74 | .379     | .423 |                       |
| e                          | 2.54 BSC    |       | .100 BSC |      | 3                     |
| L                          | 13.21       | 13.72 | .520     | .540 |                       |
| L1                         | 3.10        | 3.68  | .122     | .145 | 6                     |
| n                          | 6.05        | 6.60  | .238     | .260 |                       |
| øP                         | 3.05        | 3.45  | .120     | .136 | 6                     |
| u                          | 2.39        | 2.49  | .094     | .098 |                       |
| v                          | 0.41        | 0.51  | .016     | .020 | 6                     |
| ø1                         | —           | 45°   | —        | 45°  |                       |

**LEAD ASSIGNMENTS**
**HEXFET**

- 1.— GATE
- 2.— DRAIN
- 3.— SOURCE

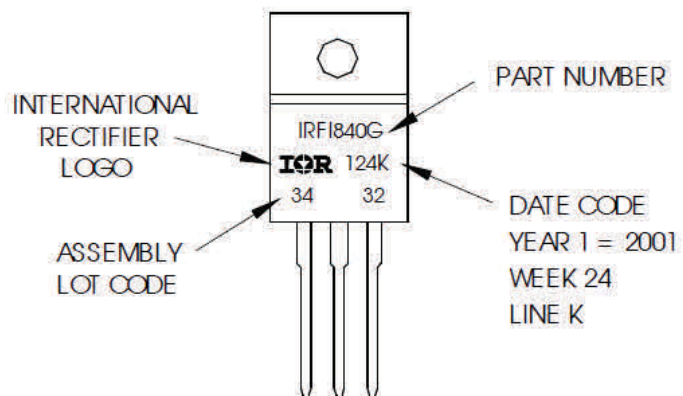
**IGBTs, CoPACK**

- 1.— GATE
- 2.— COLLECTOR
- 3.— EMITTER

**TO-220 Full-Pak Part Marking Information**

EXAMPLE: THIS IS AN IRFI840G  
WITH ASSEMBLY  
LOT CODE 3432  
ASSEMBLED ON WW 24, 2001  
IN THE ASSEMBLY LINE "K"

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



TO-220AB Full-Pak packages are not recommended for Surface Mount Application.

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



## Qualification Information

|                            |                                                |     |
|----------------------------|------------------------------------------------|-----|
| Qualification Level        | Industrial<br>(per JEDEC JESD47F) <sup>†</sup> |     |
| Moisture Sensitivity Level | TO-220 Full-Pak                                | N/A |
| RoHS Compliant             | Yes                                            |     |

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

## Revision History

| Date       | Comments                                                                                                                                                                                  |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 04/27/2017 | <ul style="list-style-type: none"> <li>Changed datasheet with Infineon logo - all pages.</li> <li>Corrected Package Outline on page 8.</li> <li>Added disclaimer on last page.</li> </ul> |

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