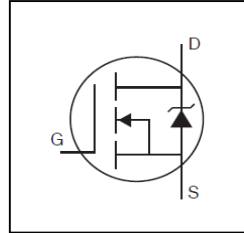


HEXFET® Power MOSFET

**Applications**

- High Efficiency Synchronous Rectification in SMPS
- Uninterruptible Power Supply
- High Speed Power Switching
- Hard Switched and High Frequency Circuits



|                                |              |
|--------------------------------|--------------|
| <b>V<sub>DSS</sub></b>         | <b>100V</b>  |
| <b>R<sub>DS(on)</sub> typ.</b> | <b>7.9mΩ</b> |
| <b>R<sub>DS(on)</sub> max.</b> | <b>9.3mΩ</b> |
| <b>I<sub>D</sub></b>           | <b>43A</b>   |

**Benefits**

- Improved Gate, Avalanche and Dynamic dV/dt Ruggedness
- Fully Characterized Capacitance and Avalanche SOA
- Enhanced body diode dV/dt and dI/dt Capability
- Lead-Free



TO-220 Full-Pak

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

| Base Part Number | Package Type    | Standard Pack |          | Orderable Part Number |
|------------------|-----------------|---------------|----------|-----------------------|
|                  |                 | Form          | Quantity |                       |
| IRFI4410ZPbF     | TO-220 Full-Pak | Tube          | 50       | IRFI4410ZPbF          |

**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     | 43                 | A     |
| I <sub>D</sub> @ T <sub>C</sub> = 100°C | Continuous Drain Current, V <sub>GS</sub> @ 10V     | 30                 |       |
| I <sub>DM</sub>                         | Pulsed Drain Current ①                              | 170                |       |
| P <sub>D</sub> @ T <sub>C</sub> = 25°C  | Maximum Power Dissipation                           | 47                 | W     |
|   | Linear Derating Factor                              | 0.3                | W/°C  |
| V <sub>GS</sub>                         | Gate-to-Source Voltage                              | ± 30               | V     |
| E <sub>AS</sub>                         | Single Pulse Avalanche Energy (Thermally Limited) ② | 310                | mJ    |
| T <sub>J</sub>                          | Operating Junction and Storage Temperature Range    | -55 to + 175       | °C    |
| T <sub>STG</sub>                        |   |                    |       |
|   |   |                    |       |
|   | 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               | —    | 3.2  | °C/W  |
| R <sub>θJA</sub> | Junction-to-Ambient (PCB Mount)④ | —    | 65   |       |

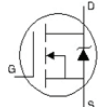
**Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)**

|  | Parameter                            | Min. | Typ. | Max. | Units | Conditions   |
|--|--------------------------------------|------|------|------|-------|--|
| V <sub>(BR)DSS</sub>                   | Drain-to-Source Breakdown Voltage    | 100  | —    | —    | V     | V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA                         |
| ΔV <sub>(BR)DSS</sub> /ΔT <sub>J</sub> | Breakdown Voltage Temp. Coefficient  | —    | 95   | —    | mV/°C | Reference to 25°C, I <sub>D</sub> = 5mA ①                            |
| R <sub>DS(on)</sub>                    | Static Drain-to-Source On-Resistance | —    | 7.9  | 9.3  | mΩ    | V <sub>GS</sub> = 10V, I <sub>D</sub> = 26A                          |
| V <sub>GS(th)</sub>                    | Gate Threshold Voltage               | 2.0  | —    | 4.0  | V     | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 150μA           |
| I <sub>DSS</sub>                       | Drain-to-Source Leakage Current      | —    | —    | 20   | μA    | V <sub>DS</sub> = 100V, V <sub>GS</sub> = 0V                         |
|  |                                      | —    | —    | 250  |       | V <sub>DS</sub> = 100V, 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   |
| R <sub>G</sub>                         | Internal Gate Resistance             | —    | 0.9  | —    | Ω     |  |

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

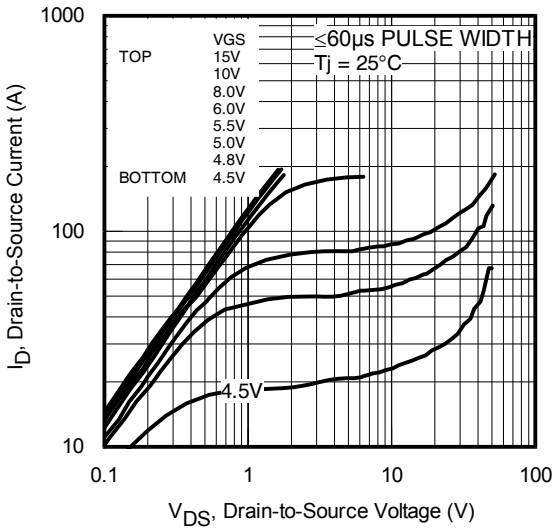
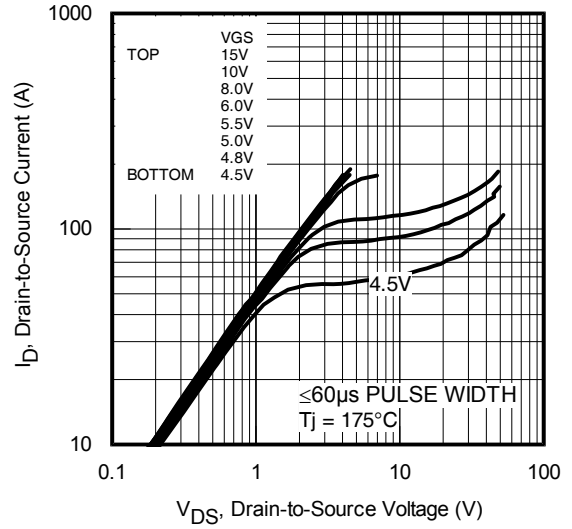
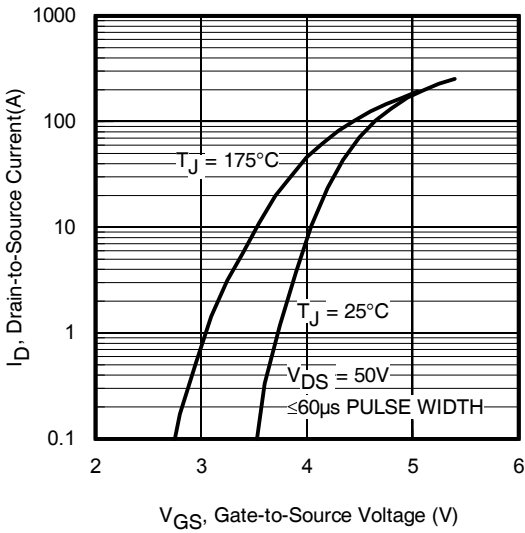
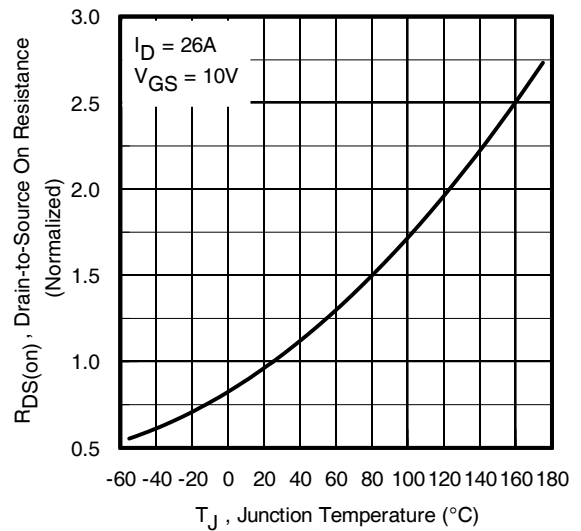
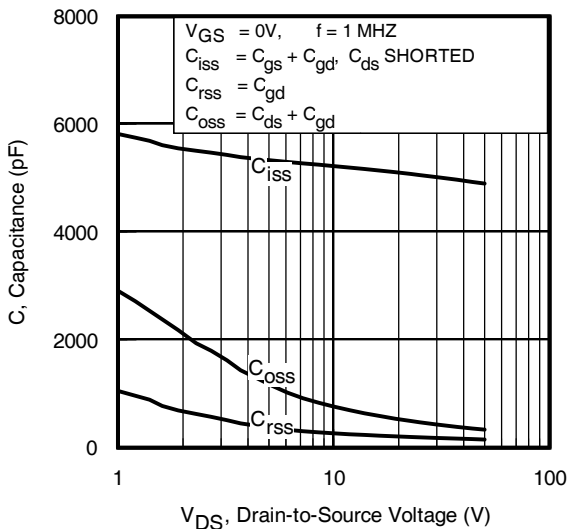
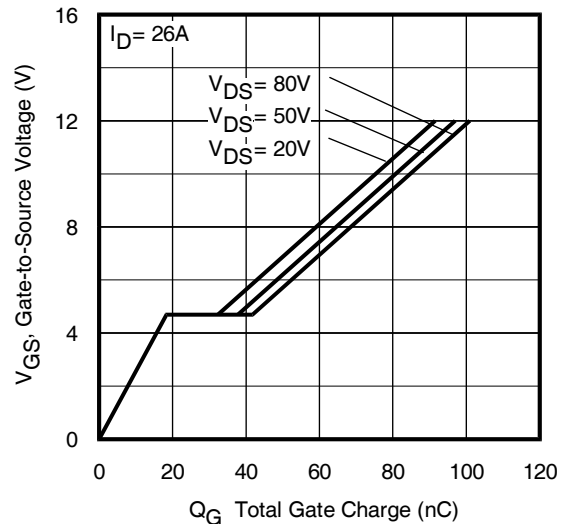
|                            |   |    |      |     |    |   |
|----------------------------|---|----|------|-----|----|---|
| g <sub>fs</sub>            | Forward Trans conductance                     | 80 | —    | —   | S  | V <sub>DS</sub> = 50V, I <sub>D</sub> = 26A                     |
| Q <sub>g</sub>             | Total Gate Charge                             | —  | 81   | 110 | nC | I <sub>D</sub> = 26A  |
| Q <sub>gs</sub>            | Gate-to-Source Charge                         | —  | 18   | —   |    | V <sub>DS</sub> = 50V   |
| Q <sub>gd</sub>            | Gate-to-Drain Charge                          | —  | 23   | —   |    | V <sub>GS</sub> = 10V ④   |
| t <sub>d(on)</sub>         | Turn-On Delay Time                            | —  | 15   | —   | ns | V <sub>DD</sub> = 65V   |
| t <sub>r</sub>             | Rise Time                                     | —  | 27   | —   |    | I <sub>D</sub> = 26A  |
| t <sub>d(off)</sub>        | Turn-Off Delay Time                           | —  | 43   | —   |    | R <sub>G</sub> = 2.7Ω   |
| t <sub>f</sub>             | Fall Time                                     | —  | 30   | —   |    | V <sub>GS</sub> = 10V ④   |
| C <sub>iss</sub>           | Input Capacitance                             | —  | 4910 | —   | pF | V <sub>GS</sub> = 0V  |
| C <sub>oss</sub>           | Output Capacitance                            | —  | 330  | —   |    | V <sub>DS</sub> = 50V   |
| C <sub>rss</sub>           | Reverse Transfer Capacitance                  | —  | 150  | —   |    | f = 1.0MHz  |
| C <sub>oss eff. (ER)</sub> | Effective Output Capacitance (Energy Related) | —  | 420  | —   |    | V <sub>GS</sub> = 0V, V <sub>DS</sub> = 0V to 80V ⑥ See Fig. 11 |
| C <sub>oss eff. (TR)</sub> | Effective Output Capacitance (Time Related)   | —  | 680  | —   |    | V <sub>GS</sub> = 0V, V <sub>DS</sub> = 0V to 80V ⑤             |

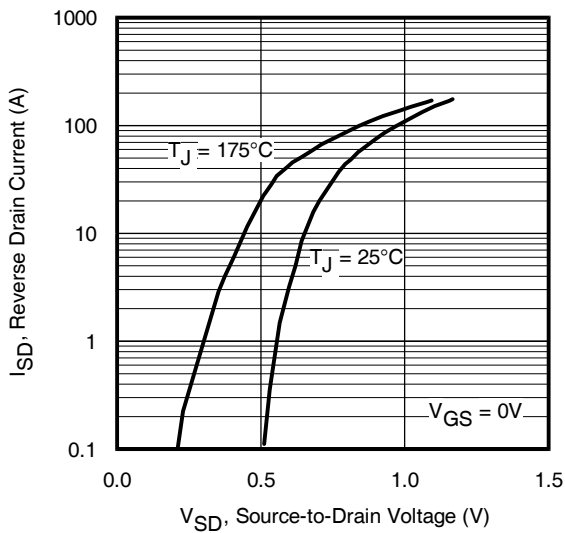
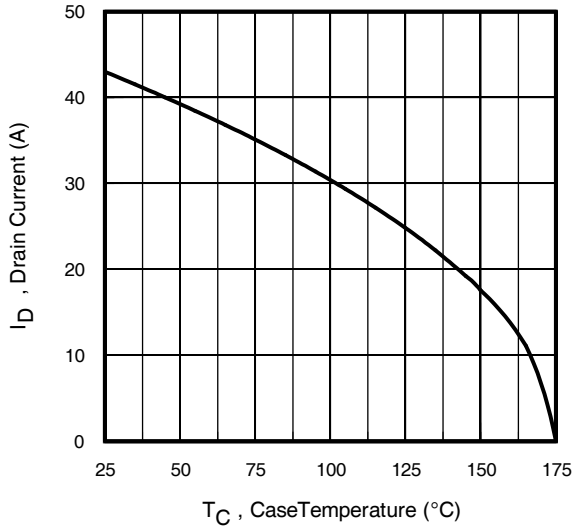
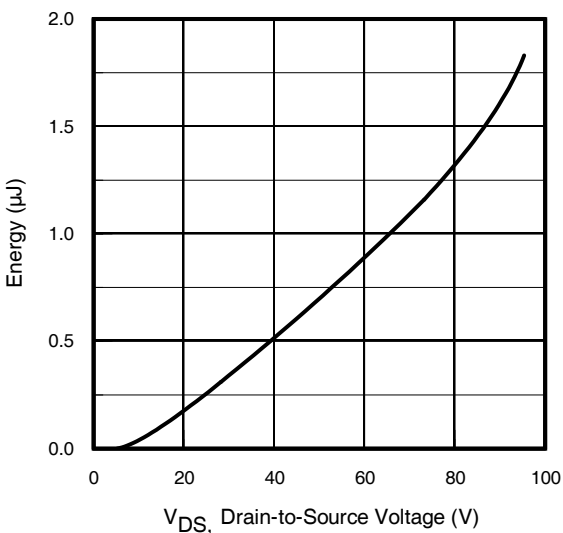
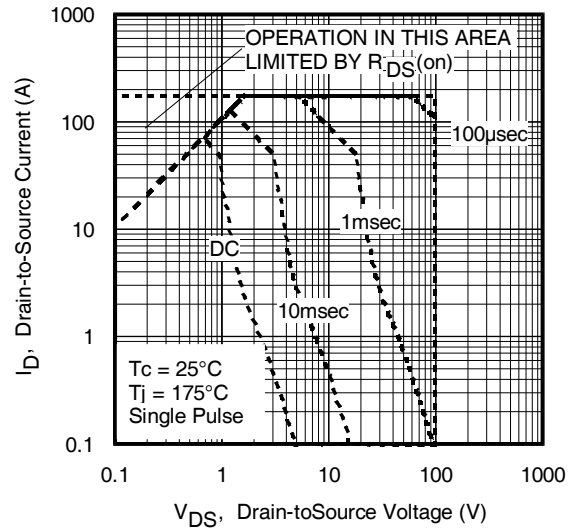
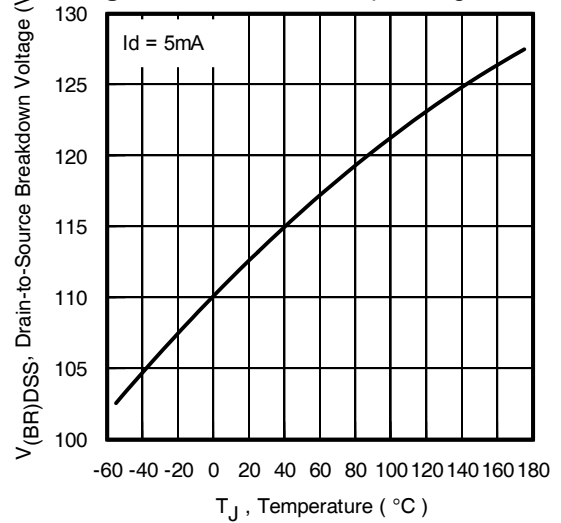
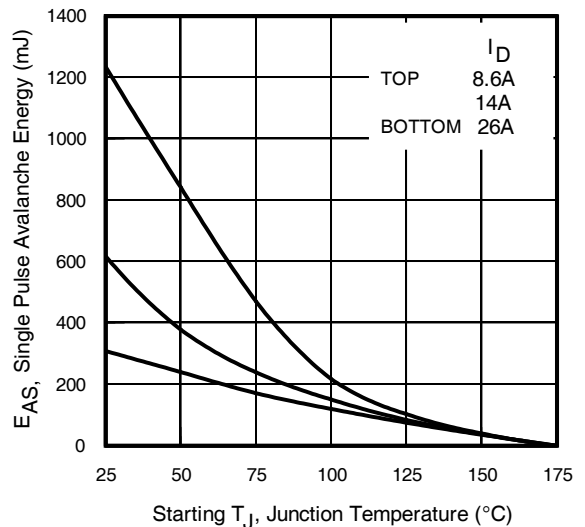
**Source-Drain Ratings and Characteristics**

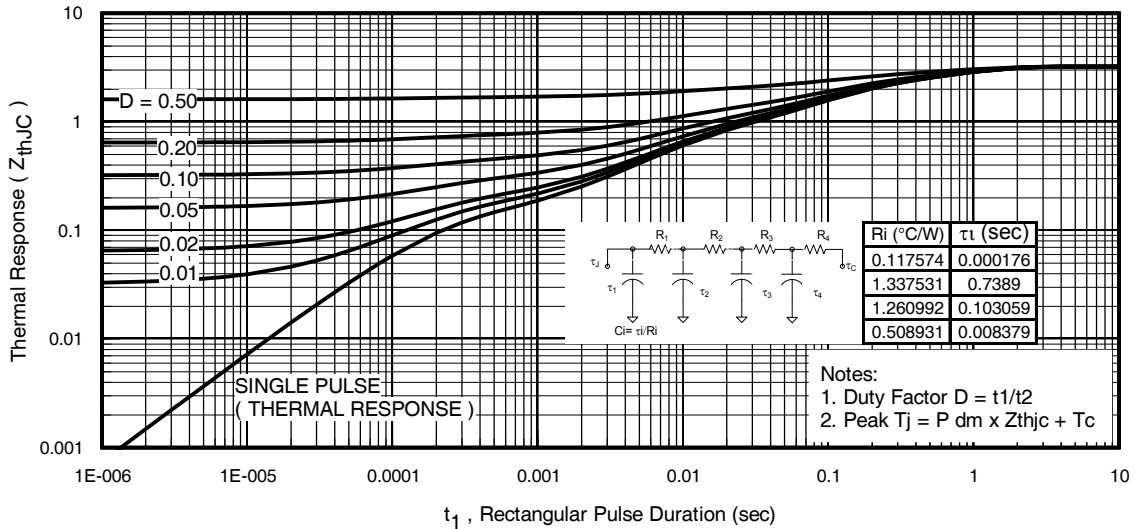
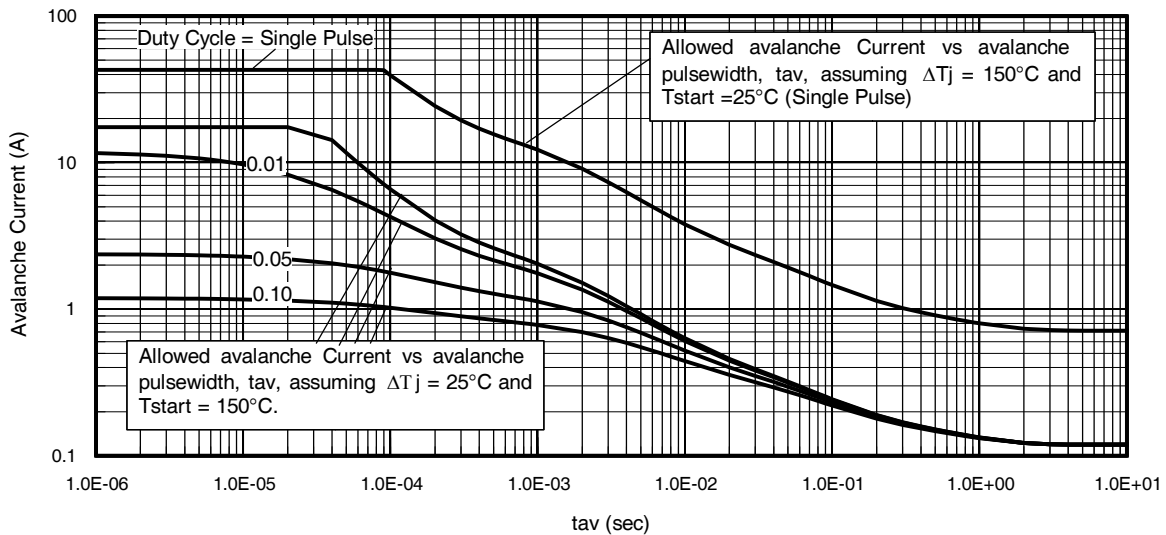
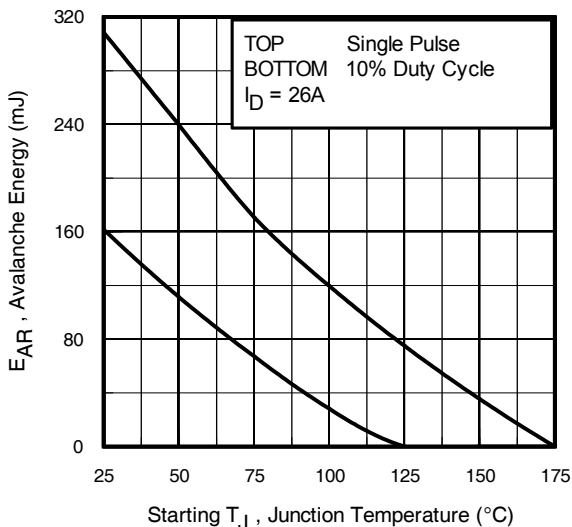
|                  | Parameter                              | Min.   | Typ. | Max. | Units | Conditions   |
|------------------|--|--|------|------|-------|--|
| I <sub>S</sub>   | Continuous Source Current (Body Diode) | —  | —    | 43   | A     | MOSFET symbol showing the integral reverse p-n junction diode.  |
| I <sub>SM</sub>  | Pulsed Source Current (Body Diode) ①   | —  | —    | 170  |       |  |
| V <sub>SD</sub>  | Diode Forward Voltage                  | —  | —    | 1.3  | V     | T <sub>J</sub> = 25°C, I <sub>S</sub> = 26A, V <sub>GS</sub> = 0V ④  |
| t <sub>rr</sub>  | Reverse Recovery Time                  | —  | 47   | 71   | ns    | T <sub>J</sub> = 25°C  |
|                  |  | —  | 54   | 81   |       | T <sub>J</sub> = 125°C   |
| Q <sub>rr</sub>  | Reverse Recovery Charge                | —  | 110  | 160  | nC    | T <sub>J</sub> = 25°C — V <sub>R</sub> = 85V   |
|                  |  | —  | 140  | 210  |       | T <sub>J</sub> = 125°C — I <sub>F</sub> = 26A  |
| I <sub>RRM</sub> | Reverse Recovery Current               | —  | 2.5  | —    | A     | T <sub>J</sub> = 25°C — di/dt = 100A/μs ④  |
| t <sub>on</sub>  | Forward Turn-On Time                   | Intrinsic turn-on time is negligible (turn-on is dominated by L <sub>S</sub> +L <sub>D</sub> ) |      |      |       |  |

**Notes:**

- ① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11)
- ② Limited by T<sub>Jmax</sub>, starting T<sub>J</sub> = 25°C, L = 0.91mH, R<sub>G</sub> = 25Ω, I<sub>AS</sub> = 26A, V<sub>GS</sub> = 10V. Part not recommended for use above this value.
- ③ Pulse width ≤ 400μs; duty cycle ≤ 2%.
- ④ R<sub>θ</sub> is measured at T<sub>J</sub> approximately 90°C.
- ⑤ C<sub>oss eff. (TR)</sub> is a fixed capacitance that gives the same charging time as C<sub>oss</sub> while V<sub>DS</sub> is rising from 0 to 80% V<sub>DSS</sub>.
- ⑥ C<sub>oss eff. (ER)</sub> is a fixed capacitance that gives the same energy as C<sub>oss</sub> while V<sub>DS</sub> is rising from 0 to 80% V<sub>DSS</sub>.


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

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

**Fig 8.** Maximum Safe Operating Area

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

**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)**

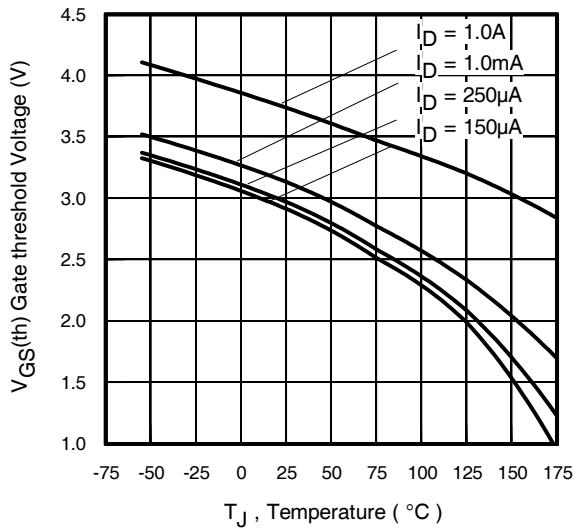
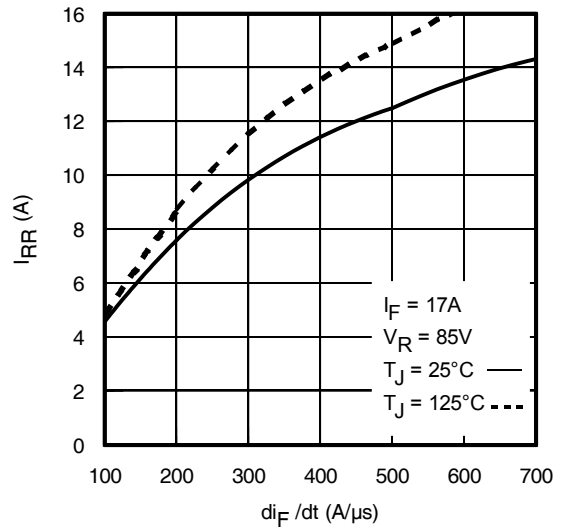
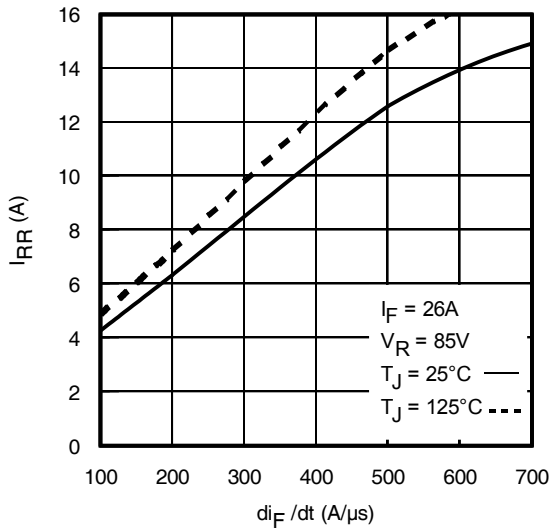
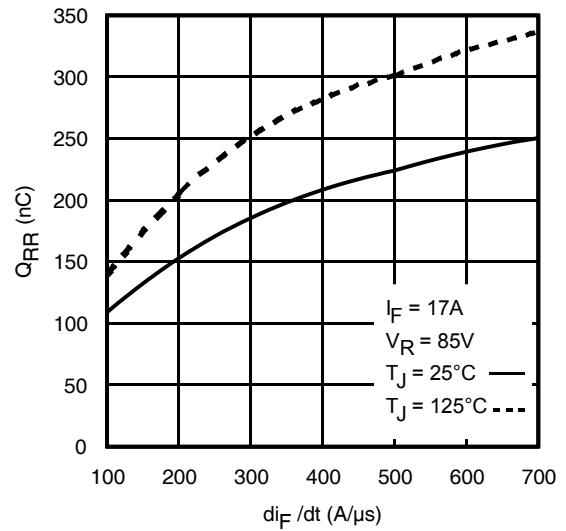
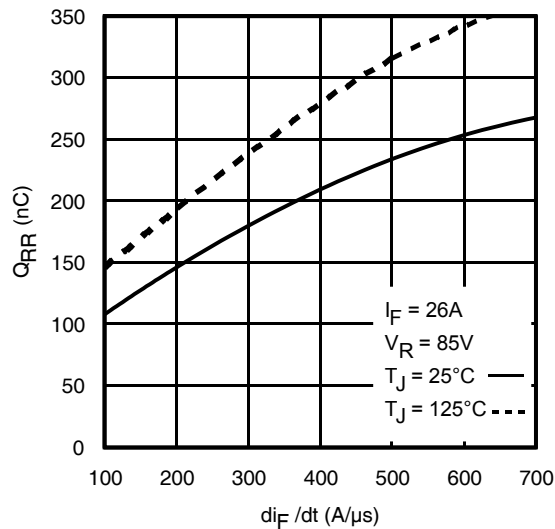
1. Avalanche failures assumption:  
Purely a thermal phenomenon and failure occurs at a temperature far in excess of  $T_{jmax}$ . This is validated for every part type.
2. Safe operation in Avalanche is allowed as long as  $T_{jmax}$  is not exceeded.
3. Equation below based on circuit and waveforms 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)

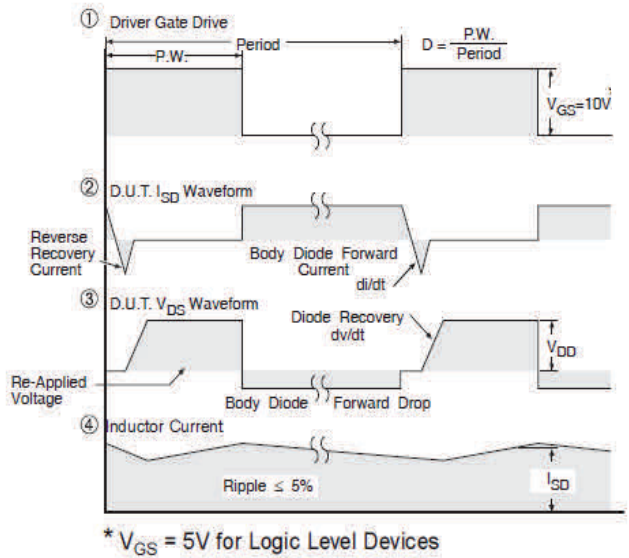
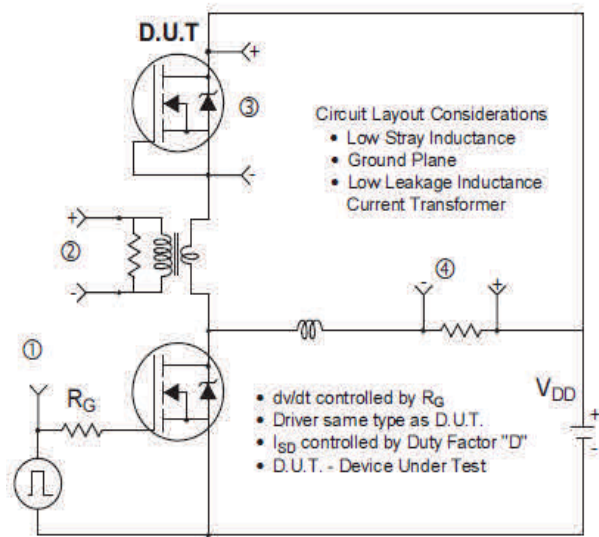
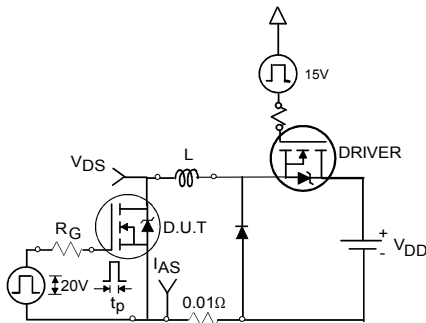
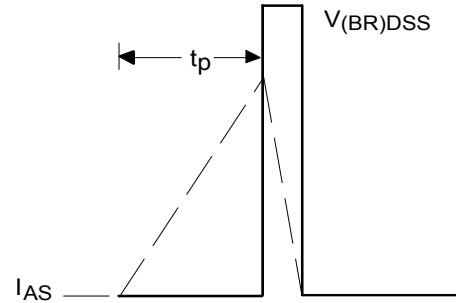
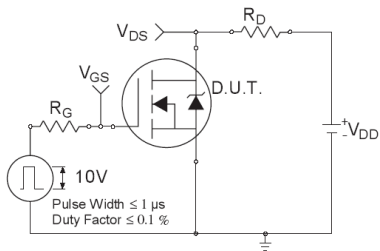
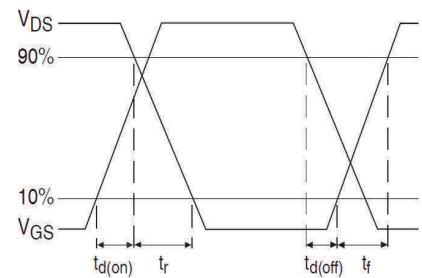
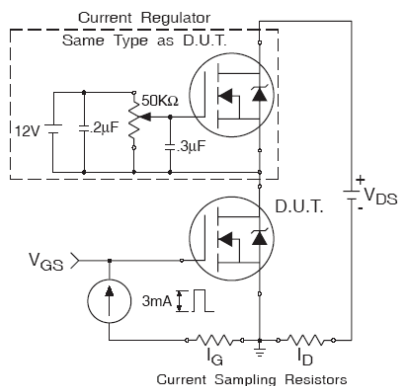
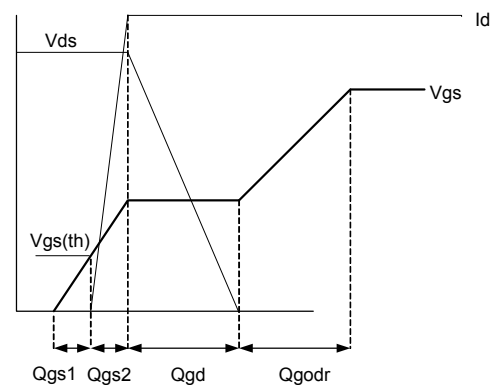
$$P_{D(ave)} = 1/2 (1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$$

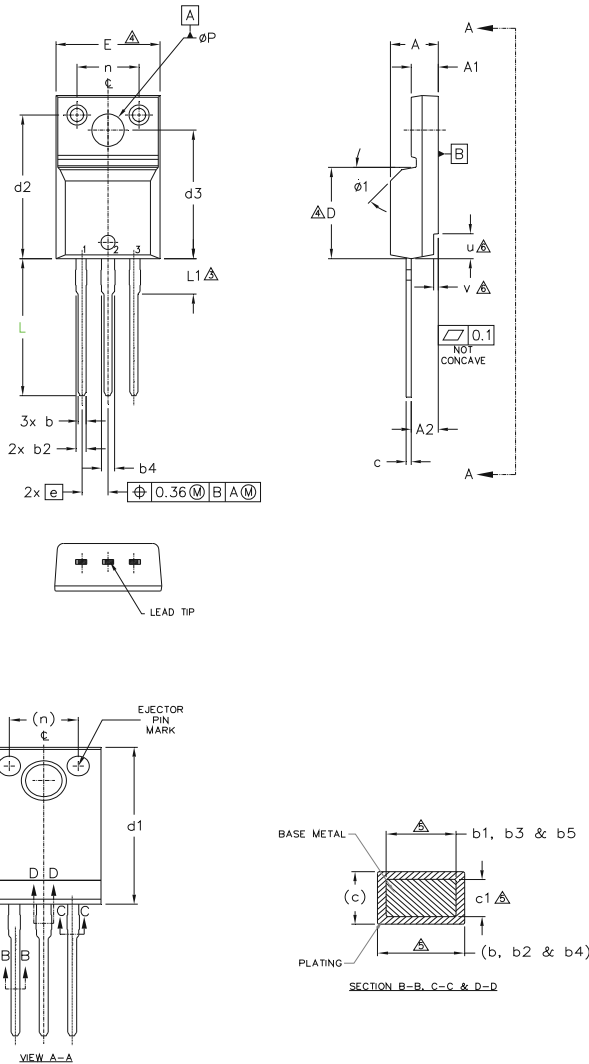
$$I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{th}]$$

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

**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:**

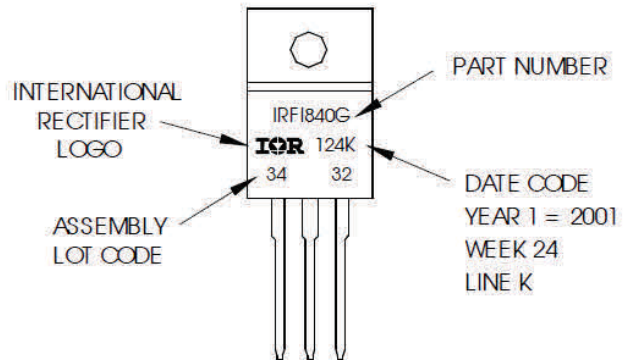
- 1.0 DIMENSIONING AND TOLERANCING AS PER ASME Y14.5 M- 1994.
- 2.0 DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
- 3.0 LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
- 4.0 DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE 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.

| SYMBOL | DIMENSIONS  |       |          |      | NOTES  |   |
|--------|-------------|-------|----------|------|--|---|
|        | MILLIMETERS |       | INCHES   |      |  |   |
|        | MIN.        | MAX.  | MIN.     | MAX. |  |   |
| A      | 4.57        | 4.83  | .180     | .190 | LEAD ASSIGNMENTS<br><br>HEXFET<br>1.- GATE<br>2.- DRAIN<br>3.- SOURCE<br><br>IGBTs, CoPACK<br>1.- GATE<br>2.- COLLECTOR<br>3.- EMITTER |   |
| 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 |  | 5 |
| b2     | 0.76        | 1.27  | .030     | .050 |  |   |
| b3     | 0.76        | 1.22  | .030     | .048 |  | 5 |
| b4     | 1.02        | 1.52  | .040     | .060 |  | 5 |
| b5     | 1.02        | 1.47  | .040     | .058 |  | 5 |
| 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 |  |   |
| E      | 9.63        | 10.74 | .379     | .423 | 4  |   |
| e      | 2.54 BSC    |       | .100 BSC |      |  |   |
| L      | 13.21       | 13.72 | .520     | .540 | 3  |   |
| L1     | 3.10        | 3.68  | .122     | .145 |  |   |
| n      | 6.05        | 6.60  | .238     | .260 |  |   |
| phi P  | 3.05        | 3.45  | .120     | .136 | 6  |   |
| u      | 2.39        | 2.49  | .094     | .098 | 6  |   |
| v      | 0.41        | 0.51  | .016     | .020 |  |   |
| phi 1  | -           | 45°   | -        | 45°  |  |   |

**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**

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

† 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>Corrected fig 19 &amp; 20 –Y axis title from “A” to “nC” on page 6.</li> <li>Added disclaimer on last page.</li> </ul> |

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