

### HEXFET® Power MOSFET

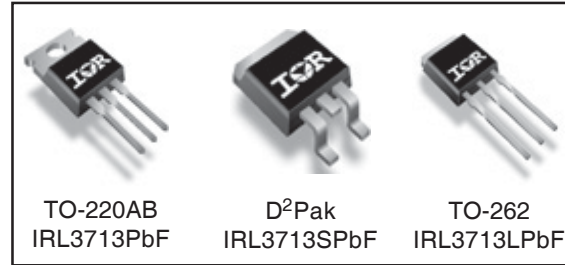
#### Applications

- High Frequency Isolated DC-DC Converters with Synchronous Rectification for Telecom and Industrial Use
- High Frequency Buck Converters for Computer Processor Power
- 100% R<sub>G</sub> Tested

#### Benefits

- Ultra-Low Gate Impedance
- Very Low R<sub>DS(on)</sub> at 4.5V V<sub>GS</sub>
- Fully Characterized Avalanche Voltage and Current
- Lead-Free

| V <sub>DSS</sub> | R <sub>DS(on)</sub> max (mΩ) | I <sub>D</sub>    |
|------------------|------------------------------|-------------------|
| 30V              | 3.0 @ V <sub>GS</sub> = 10V  | 260A <sup>⑥</sup> |



| Base Part Number | Package Type | Standard Pack       |          | Orderable Part Number |
|------------------|--------------|---------------------|----------|-----------------------|
|                  |              | Form                | Quantity |                       |
| IRL3713PbF       | TO-220       | Tube                | 50       | IRL3713PbF            |
| IRL3713SLPbF     | TO-262       | Tube                | 50       | IRL3713SLPbF          |
| IRL3713SPbF      | D²Pak        | Tube                | 50       | IRL3713SPbF           |
|                  |              | Tape and Reel Left  | 800      | IRL3713STRLPbF        |
|                  |              | Tape and Reel Right | 800      | IRL3713STRRPbF        |

#### Absolute Maximum Ratings

| Symbol                                  | Parameter                                       | Max               | Units |
|-----------------------------------------|-------------------------------------------------|-------------------|-------|
| V <sub>DS</sub>                         | Drain-Source Voltage                            | 30                | V     |
| V <sub>GS</sub>                         | Gate-to-Source Voltage                          | ± 20              | V     |
| I <sub>D</sub> @ T <sub>C</sub> = 25°C  | Continuous Drain Current, V <sub>GS</sub> @ 10V | 260 <sup>⑥</sup>  | A     |
| I <sub>D</sub> @ T <sub>C</sub> = 100°C | Continuous Drain Current, V <sub>GS</sub> @ 10V | 180 <sup>⑥</sup>  |       |
| I <sub>DM</sub>                         | Pulsed Drain Current <sup>①</sup>               | 1040 <sup>⑥</sup> |       |
| P <sub>D</sub> @ T <sub>C</sub> = 25°C  | Maximum Power Dissipation                       | 330               | W     |
| P <sub>D</sub> @ T <sub>C</sub> = 100°C | Maximum Power Dissipation                       | 170               |       |
|                                         | Linear Derating Factor                          | 2.2               | W/°C  |
| T <sub>J</sub> , T <sub>STG</sub>       | Junction and Storage Temperature Range          | -55 to +175       | °C    |

#### Thermal Resistance

| Symbol           | Parameter                                        | Typ  | Max   | Units |
|------------------|--------------------------------------------------|------|-------|-------|
| R <sub>θJC</sub> | Junction-to-Case <sup>②</sup>                    | —    | 0.45* | °C/W  |
| R <sub>qCS</sub> | Case-to-Sink, Flat, Greased Surface <sup>④</sup> | 0.50 | —     |       |
| R <sub>θJA</sub> | Junction-to-Ambient <sup>④⑦</sup>                | —    | 62    |       |
| R <sub>θJA</sub> | Junction-to-Ambient (PCB Mount) <sup>⑤⑦</sup>    | —    | 40    |       |

\* R<sub>θJC</sub> (end of life) for D²Pak and TO-262 = 0.50°C/W. This is the maximum measured value after 1000 temperature cycles from -55 to 150°C and is accounted for by the physical wearout of the die attach medium.

Notes <sup>①</sup> through <sup>⑦</sup> are on page 11

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

| Symbol                          | Parameter                            | Min | Typ   | Max  | Units               | Conditions                                           |
|---------------------------------|--------------------------------------|-----|-------|------|---------------------|------------------------------------------------------|
| $V_{(BR)DSS}$                   | Drain-to-Source Breakdown Voltage    | 30  | —     | —    | V                   | $V_{GS} = 0V, I_D = 250\mu A$                        |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient  | —   | 0.027 | —    | V/ $^\circ\text{C}$ | Reference to $25^\circ\text{C}$ , $I_D = 1\text{mA}$ |
| $R_{DS(on)}$                    | Static Drain-to-Source On-Resistance | —   | 2.6   | 3.0  | $m\Omega$           | $V_{GS} = 10V, I_D = 38A$ ③                          |
|                                 |                                      | —   | 3.3   | 4.0  |                     | $V_{GS} = 4.5V, I_D = 30A$ ③                         |
| $V_{GS(th)}$                    | Gate Threshold Voltage               | 1.0 | —     | 2.5  | V                   | $V_{DS} = V_{GS}, I_D = 250\mu A$                    |
| $I_{DSS}$                       | Drain-to-Source Leakage Current      | —   | —     | 50   | $\mu A$             | $V_{DS} = 30V, V_{GS} = 0V$                          |
|                                 |                                      | —   | —     | 20   |                     | $V_{DS} = 24V, V_{GS} = 0V$                          |
|                                 |                                      | —   | —     | 100  |                     | $V_{DS} = 24V, V_{GS} = 0V, T_J = 125^\circ\text{C}$ |
| $I_{GSS}$                       | Gate-to-Source Forward Leakage       | —   | —     | 200  | nA                  | $V_{GS} = 20V$                                       |
|                                 | Gate-to-Source Reverse Leakage       | —   | —     | -200 |                     | $V_{GS} = -20V$                                      |

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

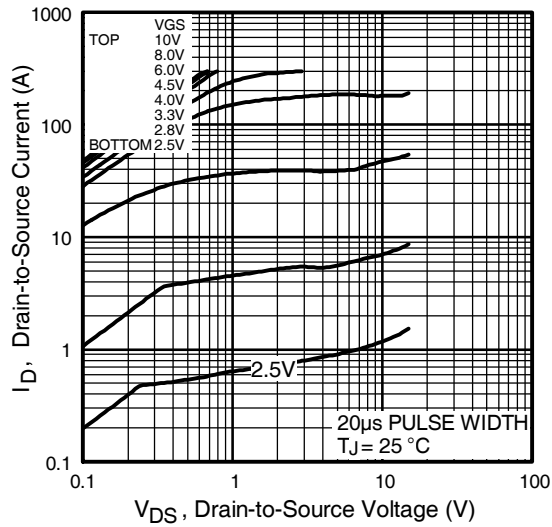
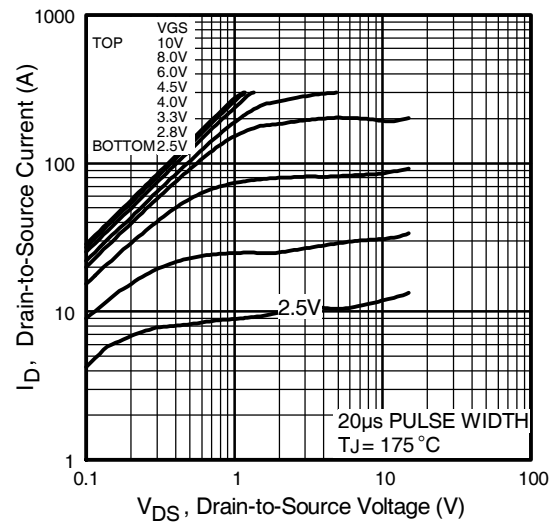
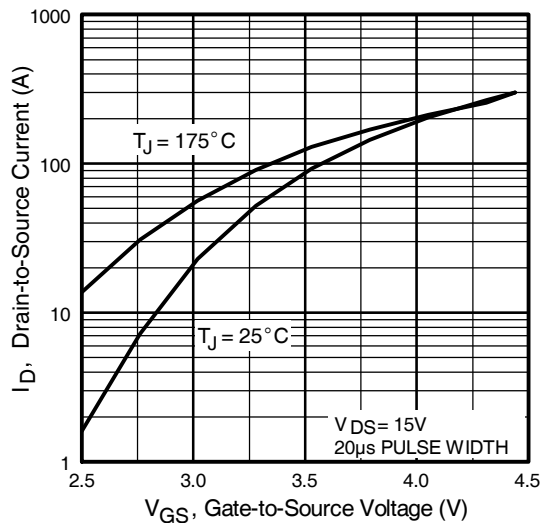
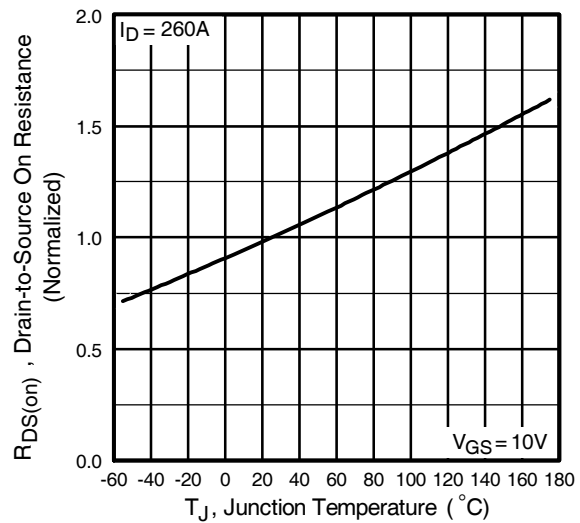
| Symbol       | Parameter                       | Min | Typ  | Max | Units    | Conditions                  |
|--------------|---------------------------------|-----|------|-----|----------|-----------------------------|
| $g_{fs}$     | Forward Transconductance        | 76  | —    | —   | S        | $V_{DS} = 15V, I_D = 30A$   |
| $Q_g$        | Total Gate Charge               | —   | 75   | 110 | nC       | $I_D = 30A$                 |
| $Q_{gs}$     | Gate-to-Source Charge           | —   | 24   | —   |          | $V_{DS} = 15V$              |
| $Q_{gd}$     | Gate-to-Drain ("Miller") Charge | —   | 37   | —   |          | $V_{GS} = 4.5V$ ④           |
| $Q_{OSS}$    | Output Gate Charge              | —   | 61   | 92  |          | $V_{GS} = 0V, V_{DS} = 15V$ |
| $R_G$        | Gate Resistance                 | 0.5 | —    | 3.4 | $\Omega$ |                             |
| $t_{d(on)}$  | Turn-On Delay Time              | —   | 16   | —   | ns       | $V_{DD} = 15V$              |
| $t_r$        | Rise Time                       | —   | 160  | —   |          | $I_D = 30A$                 |
| $t_{d(off)}$ | Turn-Off Delay Time             | —   | 40   | —   |          | $R_G = 1.8\Omega$           |
| $t_f$        | Fall Time                       | —   | 57   | —   |          | $V_{GS} = 4.5V$ ③           |
| $C_{iss}$    | Input Capacitance               | —   | 5890 | —   | pF       | $V_{GS} = 0V$               |
| $C_{oss}$    | Output Capacitance              | —   | 3130 | —   |          | $V_{DS} = 15V$              |
| $C_{rss}$    | Reverse Transfer Capacitance    | —   | 630  | —   |          | $f = 1.0\text{MHz}$         |

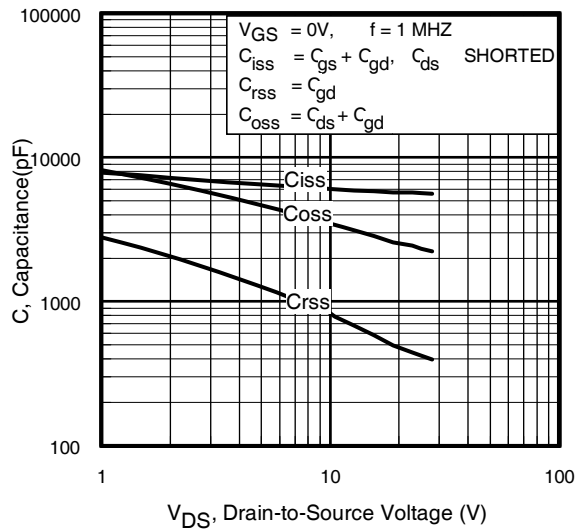
**Avalanche Characteristics**

| Symbol   | Parameter                       | Typ | Max  | Units |
|----------|---------------------------------|-----|------|-------|
| $E_{AS}$ | Single Pulse Avalanche Energy ② | —   | 1530 | mJ    |
| $I_{AR}$ | Avalanche Current ①             | —   | 46   | A     |

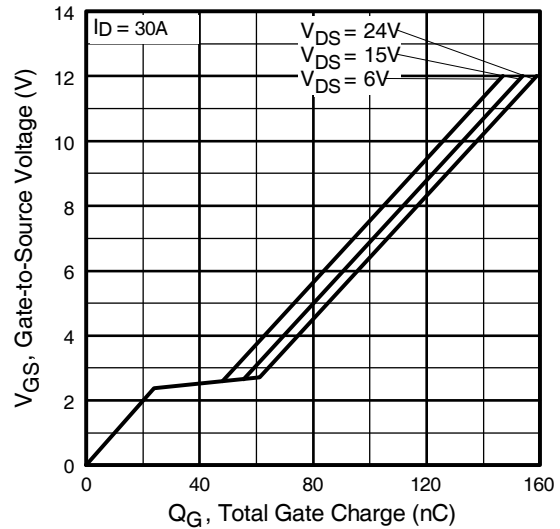
**Diode Characteristics**

| Symbol   | Parameter                              | Min | Typ  | Max  | Units | Conditions                                                     |
|----------|----------------------------------------|-----|------|------|-------|----------------------------------------------------------------|
| $I_S$    | Continuous Source Current (Body Diode) | —   | —    | 260  | A     | MOSFET symbol showing the integral reverse p-n junction diode. |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ①⑥  | —   | —    | 1040 |       |                                                                |
| $V_{SD}$ | Diode Forward Voltage                  | —   | 0.80 | 1.3  | V     | $T_J = 25^\circ\text{C}, I_S = 30A, V_{GS} = 0V$ ③             |
|          |                                        | —   | 0.68 | —    |       | $T_J = 125^\circ\text{C}, I_S = 30A, V_{GS} = 0V$ ③            |
| $t_{rr}$ | Reverse Recovery Time                  | —   | 75   | 110  | ns    | $T_J = 25^\circ\text{C}, I_F = 30A, V_R = 0V$                  |
| $Q_{rr}$ | Reverse Recovery Charge                | —   | 140  | 210  | nC    | $di/dt = 100A/\mu s$ ③                                         |
| $t_{rr}$ | Reverse Recovery Time                  | —   | 78   | 120  | ns    | $T_J = 125^\circ\text{C}, I_F = 30A, V_R = 20V$                |
| $Q_{rr}$ | Reverse Recovery Charge                | —   | 160  | 240  | nC    | $di/dt = 100A/\mu s$ ③                                         |

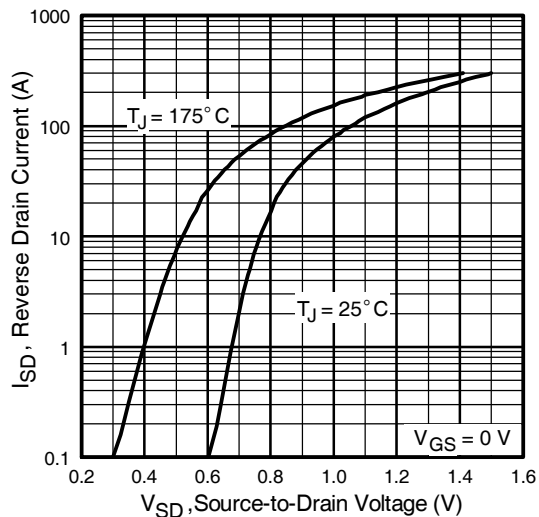

**Fig 1.** Typical Output Characteristics

**Fig 2.** Typical Output Characteristics

**Fig 3.** Typical Transfer Characteristics

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



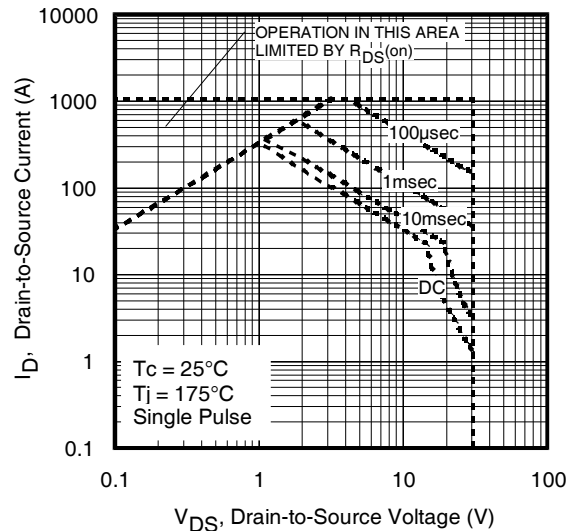
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



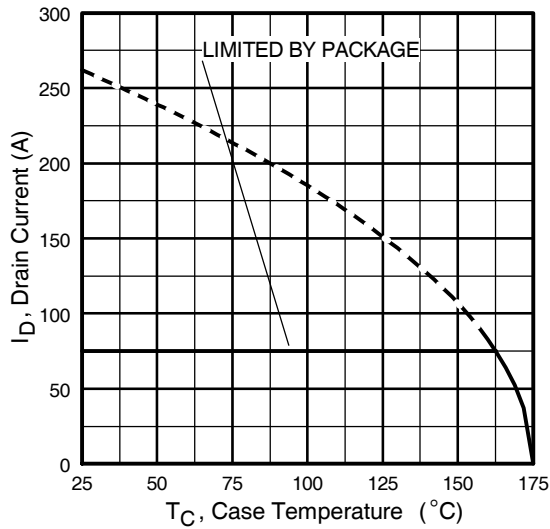
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



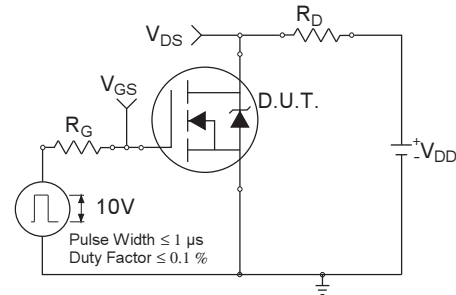
**Fig 7.** Typical Source-Drain Diode Forward Voltage



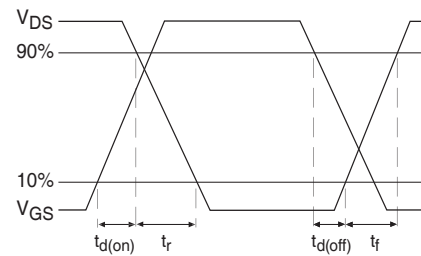
**Fig 8.** Maximum Safe Operating Area



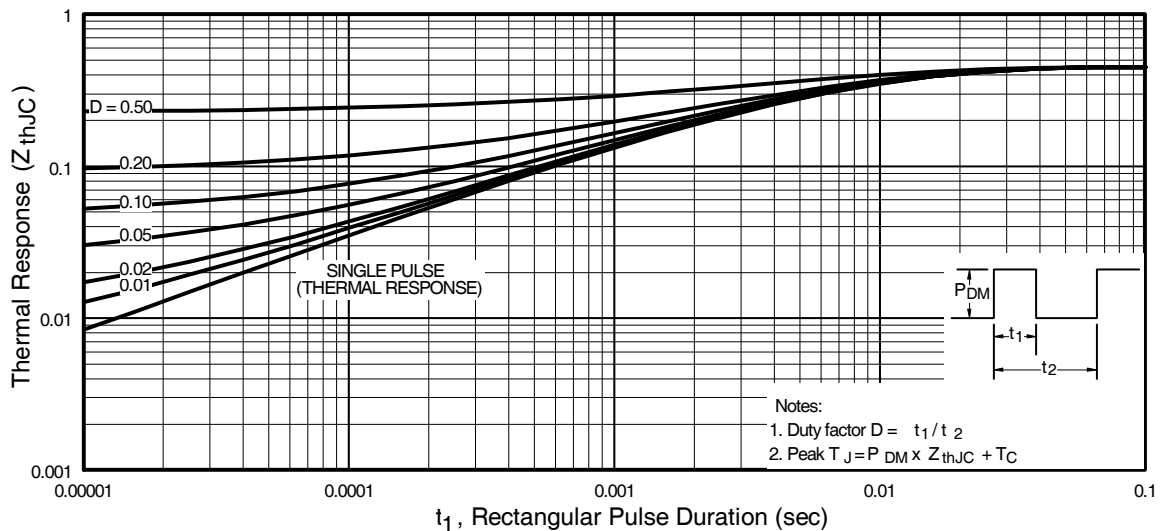
**Fig 9.** Maximum Drain Current Vs. Case Temperature



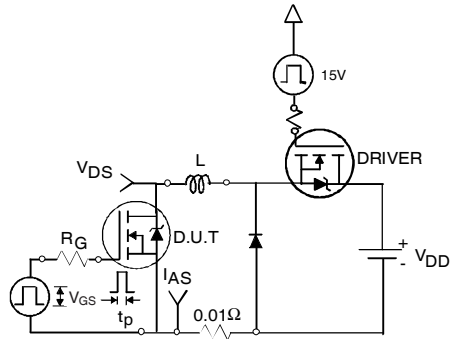
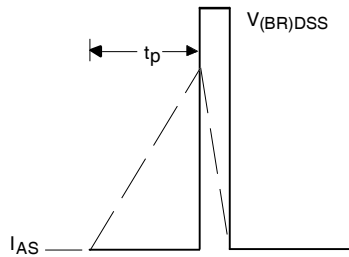
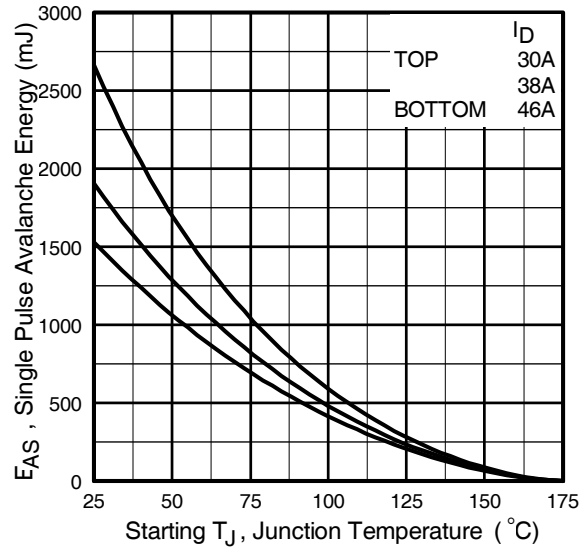
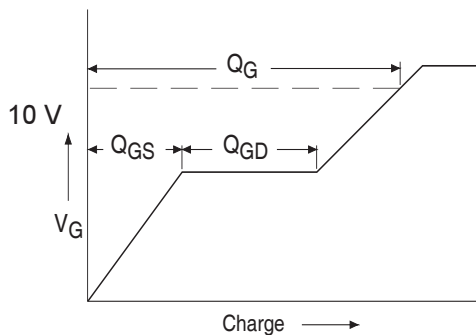
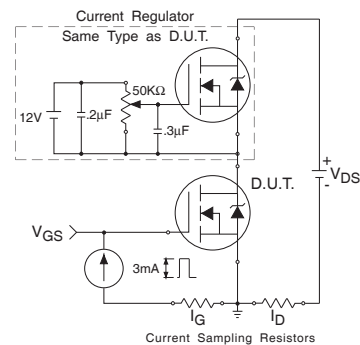
**Fig 10a.** Switching Time Test Circuit



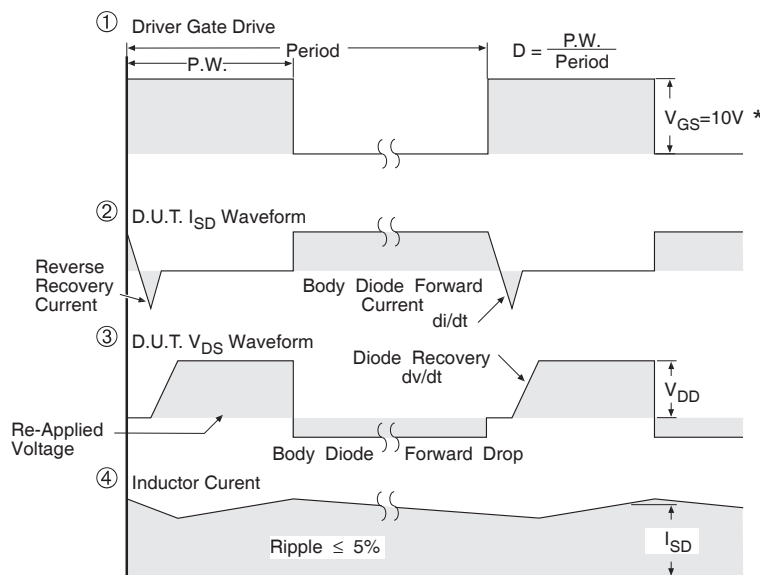
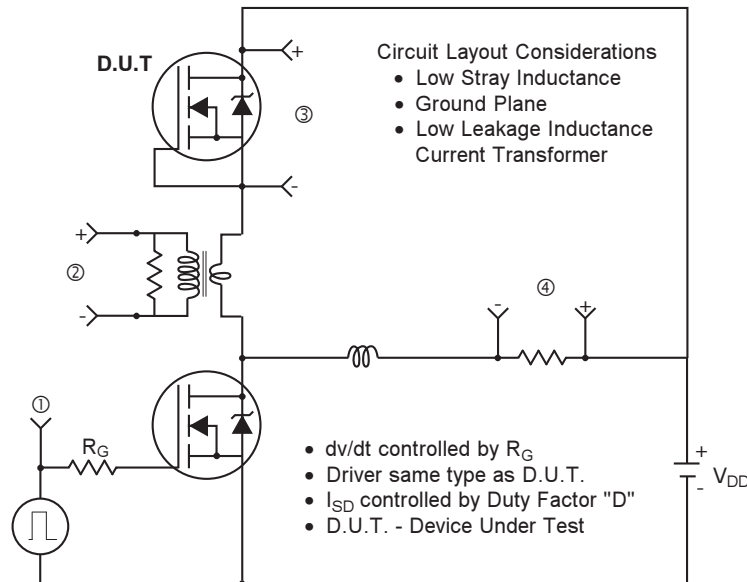
**Fig 10b.** Switching Time Waveforms



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


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

**Fig 12b.** Unclamped Inductive Waveforms

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

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

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

# Peak Diode Recovery dv/dt Test Circuit

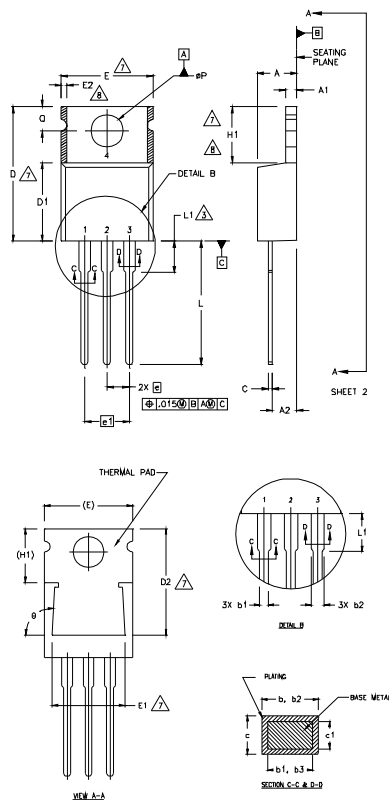


\*  $V_{GS} = 5V$  for Logic Level Devices

**Fig 14.** For N-Channel HEXFET® Power MOSFETs

## TO-220AB Package Outline

Dimensions are shown in millimeters (inches)



### NOTES:

- 1 DIMENSIONING AND TOLERANCING PER ASME Y14.5 M- 1994.
- 2 DIMENSIONS ARE SHOWN IN INCHES (MILLIMETERS).
- 3 LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
- 4 DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
- 5 DIMENSION b1 & c1 APPLY TO BASE METAL ONLY.
- 6 CONTROLLING DIMENSION : INCHES.
- 7 THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS E,H1,D2 & E1
- 8 DIMENSION E2 X H1 DEFINE A ZONE WHERE STAMPING AND SINGULATION IRREGULARITIES ARE ALLOWED.

### LEAD ASSIGNMENTS

#### HEXFEET

- 1 - GATE
- 2 - DRAIN
- 3 - SOURCE

#### KBITS - CoPACK

- 1 - GATE
- 2 - COLLECTOR
- 3 - EMITTER

#### DIODES

- 1 - ANODE/OPEN
- 2 - CATHODE
- 3 - ANODE

| SYMBOL | DIMENSIONS  |       |          |      | NOTES |
|--------|-------------|-------|----------|------|-------|
|        | MILLIMETERS |       | INCHES   |      |       |
|        | MIN.        | MAX.  | MIN.     | MAX. |       |
| A      | 3.56        | 4.82  | .140     | .190 |       |
| A1     | 0.51        | 1.40  | .020     | .055 |       |
| A2     | 2.04        | 2.92  | .080     | .115 |       |
| b      | 0.38        | 1.01  | .015     | .040 |       |
| b1     | 0.38        | 0.96  | .015     | .038 | 5     |
| b2     | 1.15        | 1.77  | .045     | .070 |       |
| b3     | 1.15        | 1.73  | .045     | .068 |       |
| c      | 0.36        | 0.61  | .014     | .024 |       |
| c1     | 0.36        | 0.56  | .014     | .022 | 5     |
| D      | 14.22       | 16.51 | .560     | .650 | 4     |
| D1     | 8.38        | 9.02  | .330     | .355 |       |
| D2     | 12.19       | 12.88 | .480     | .507 | 7     |
| E      | 9.66        | 10.66 | .380     | .420 | 4,7   |
| E1     | 8.38        | 8.89  | .330     | .350 | 7     |
| e      | 2.54 BSC    |       | .100 BSC |      |       |
| e1     | 5.08        |       | .200 BSC |      |       |
| H1     | 5.85        | 6.55  | .230     | .270 | 7,8   |
| L      | 12.70       | 14.73 | .500     | .580 |       |
| L1     | —           | 6.35  | —        | .250 | 3     |
| øP     | 3.54        | 4.08  | .139     | .161 |       |
| Q      | 2.54        | 3.42  | .100     | .135 |       |
| ø      | 90°-93°     |       | 90°-93°  |      |       |

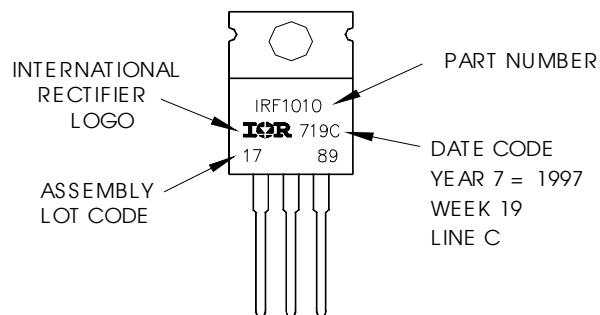
## TO-220AB Part Marking Information

EXAMPLE: THIS IS AN IRF1010

LOT CODE 1789

ASSEMBLED ON WW 19, 1997  
IN THE ASSEMBLY LINE "C"

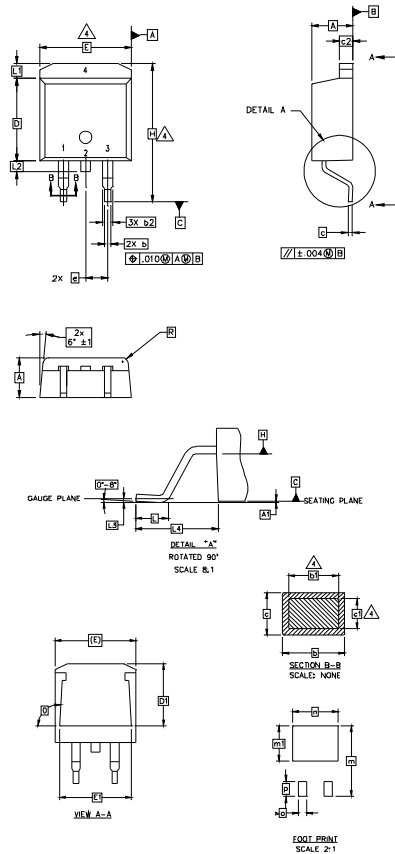
**Note:** "P" in assembly line  
position indicates "Lead-Free"



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

## D<sup>2</sup>Pak Package Outline

Dimensions are shown in millimeters (inches)



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES]
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [0.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
5. CONTROLLING DIMENSION: INCH.

| SYMBOL | DIMENSIONS  |       |        |      | NOTES |
|--------|-------------|-------|--------|------|-------|
|        | MILLIMETERS |       | INCHES |      |       |
|        | MIN.        | MAX.  | MIN.   | MAX. |       |
| A      | 4.06        | 4.83  | .160   | .190 |       |
| A1     | 0.00        | 0.254 | .000   | .010 |       |
| b      | 0.51        | 0.99  | .020   | .039 |       |
| b1     | 0.51        | 0.89  | .020   | .035 | 4     |
| b2     | 1.14        | 1.78  | .045   | .070 |       |
| c      | 0.38        | 0.74  | .015   | .029 |       |
| c1     | 0.38        | 0.58  | .015   | .023 | 4     |
| c2     | 1.14        | 1.65  | .045   | .065 |       |
| D      | 8.51        | 9.65  | .335   | .380 | 3     |
| D1     | 6.86        |       | .270   |      |       |
| E      | 9.65        | 10.67 | .380   | .420 | 3     |
| E1     | 6.22        |       | .245   |      |       |
| e      | 2.54        | BSC   | .100   | BSC  |       |
| H      | 14.61       | 15.88 | .575   | .625 |       |
| L      | 1.78        | 2.79  | .070   | .110 |       |
| L1     |             | 1.65  |        | .065 |       |
| L2     | 1.27        | 1.78  | .050   | .070 |       |
| L3     | 0.25        | BSC   | .010   | BSC  |       |
| L4     | 4.78        | 5.28  | .188   | .208 |       |
| m      | 17.78       |       | .700   |      |       |
| m1     | 8.89        |       | .350   |      |       |
| n      | 11.43       |       | .450   |      |       |
| o      | 2.08        |       | .082   |      |       |
| p      | 3.81        |       | .150   |      |       |
| R      | 0.51        | 0.71  | .020   | .028 |       |
| B      | 90°         | 93°   | 90°    | 93°  |       |

### LEAD ASSIGNMENTS

#### HEXFET

- 1.- GATE
- 2.- DRAIN
- 3.- SOURCE

#### IGBTs, CoPACK

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

#### DIODES

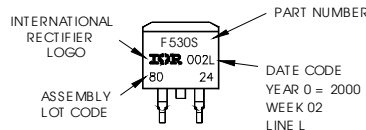
- 1.- ANODE \*
- 2.- CATHODE
- 3.- ANODE

\* PART DEPENDENT.

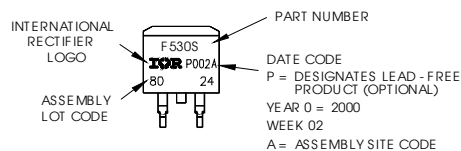
## D<sup>2</sup>Pak Part Marking Information

EXAMPLE: THIS IS AN IRL3713 WITH  
LOT CODE 8024  
ASSEMBLED ON WW 02, 2000  
IN THE ASSEMBLY LINE "L"

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



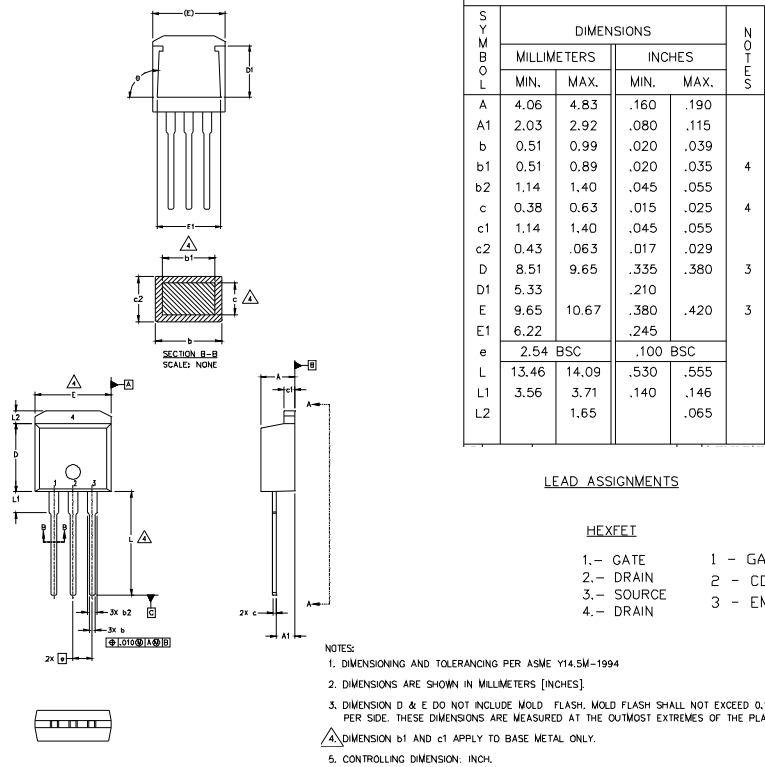
OR



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

## TO-262 Package Outline

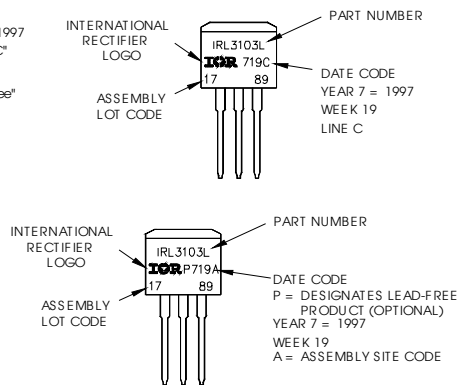
Dimensions are shown in millimeters (inches)



## TO-262 Part Marking Information

EXAMPLE: THIS IS AN IRL3103L  
 LOT CODE 1789  
 ASSEMBLED ON WW 19, 1997  
 IN THE ASSEMBLY LINE "C"  
 Note: "P" in assembly line position indicates "Lead-Free"

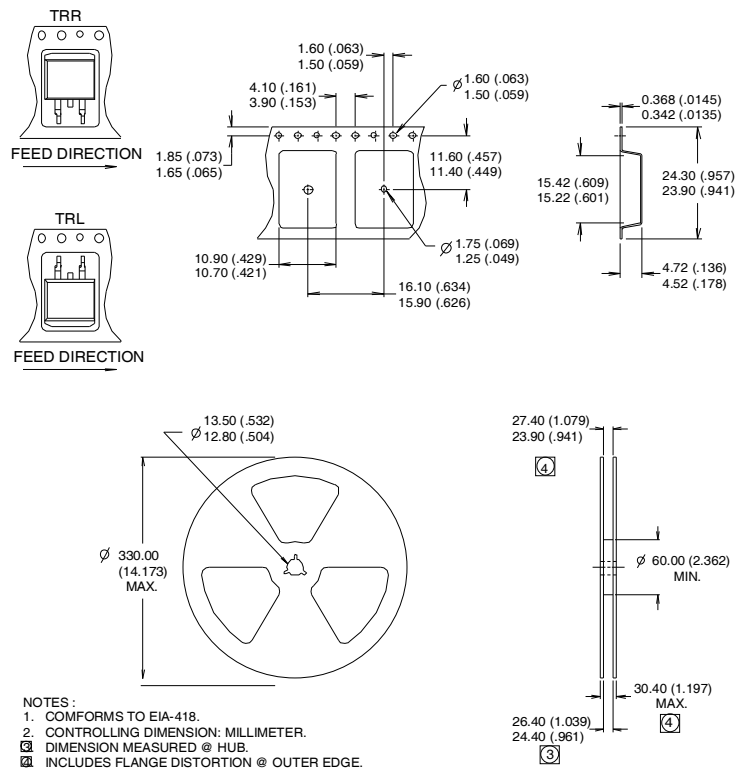
**OR**



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

## D<sup>2</sup>Pak Tape & Reel Information

Dimensions are shown in millimeters (inches)



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

### Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting  $T_J = 25^\circ\text{C}$ ,  $L = 1.4\text{mH}$ ,  $R_G = 25\Omega$ ,  $I_{AS} = 46\text{A}$ ,  $V_{GS} = 10\text{V}$ .
- ③ Pulse width  $\leq 400\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- ④ This is only applied to TO-220A package.
- ⑤ This is applied to D<sup>2</sup>Pak, when mounted on 1" square PCB (FR-4 or G-10 Material). For recommended footprint and soldering techniques refer to application note #AN-994.
- ⑥ Calculated continuous current based on maximum allowable junction temperature. Package limitation current is 75A.
- ⑦  $R_\theta$  is measured at  $T_J$  approximately  $90^\circ\text{C}$ .

**Qualification information<sup>†</sup>**

|                            |                                                            |                                               |
|----------------------------|------------------------------------------------------------|-----------------------------------------------|
| Qualification level        | Industrial<br>(per JEDEC JESD47F <sup>††</sup> guidelines) |                                               |
| Moisture Sensitivity Level | TO-220 PAK                                                 | N/A                                           |
|                            | TO-262 PAK                                                 |                                               |
|                            | D2-PAK                                                     | 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> Applicable version of JEDEC standard at the time of product release

**Revision History**

| Date      | Comments                                                                                                                                                      |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6/17/2013 | <ul style="list-style-type: none"> <li>• Updated ds with New IR Corporate Template</li> <li>• Updated Fig8-SOA curve with Spirito effect on page 4</li> </ul> |

International  
 Rectifier

**IR WORLD HEADQUARTERS:** 101 N. Sepulveda Blvd., El Segundo, California 90245, USA  
 To contact International Rectifier, please visit <http://www.irf.com/whoto-call/>

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