

**IRFZ44ZPbF**  
**IRFZ44ZSPbF**  
**IRFZ44ZLPbF**

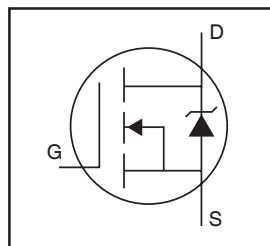
HEXFET® Power MOSFET

**Features**

- Advanced Process Technology
- Ultra Low On-Resistance
- Dynamic dv/dt Rating
- 175°C Operating Temperature
- Fast Switching
- Repetitive Avalanche Allowed up to  $T_{jmax}$
- Lead-Free

**Description**

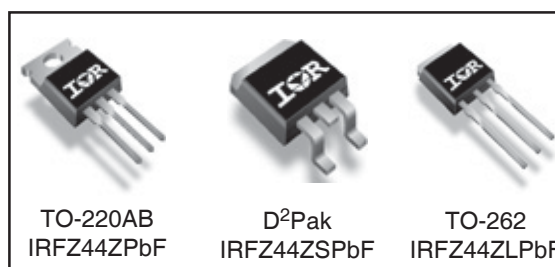
This HEXFET® Power MOSFET utilizes the latest processing techniques to achieve extremely low on-resistance per silicon area. Additional features of this design are a 175°C junction operating temperature, fast switching speed and improved repetitive avalanche rating. These features combine to make this design an extremely efficient and reliable device for use in a wide variety of applications.



$$V_{DSS} = 55V$$

$$R_{DS(on)} = 13.9m\Omega$$

$$I_D = 51A$$



**Absolute Maximum Ratings**

|                           | Parameter                                                  | Max.                      | Units |
|---------------------------|------------------------------------------------------------|---------------------------|-------|
| $I_D @ T_C = 25^\circ C$  | Continuous Drain Current, $V_{GS} @ 10V$ (Silicon Limited) | 51                        | A     |
| $I_D @ T_C = 100^\circ C$ | Continuous Drain Current, $V_{GS} @ 10V$ (See Fig. 9)      | 36                        |       |
| $I_{DM}$                  | Pulsed Drain Current ①                                     | 200                       |       |
| $P_D @ T_C = 25^\circ C$  | Maximum Power Dissipation                                  | 80                        | W     |
|                           | Linear Derating Factor                                     | 0.53                      | W/°C  |
| $V_{GS}$                  | Gate-to-Source Voltage                                     | $\pm 20$                  | V     |
| $E_{AS}$                  | Single Pulse Avalanche Energy (Thermally Limited) ②        | 86                        | mJ    |
| $E_{AS} (tested)$         | Single Pulse Avalanche Energy Tested Value ②               | 105                       |       |
| $I_{AR}$                  | Avalanche Current ①                                        | See Fig. 12a, 12b, 15, 16 | A     |
| $E_{AR}$                  | Repetitive Avalanche Energy ③                              |                           | mJ    |
| $T_J$                     | Operating Junction and                                     | -55 to + 175              | °C    |
| $T_{STG}$                 | Storage Temperature Range                                  |                           |       |
|                           | Soldering Temperature, for 10 seconds                      | 300 (1.6mm from case )    |       |
|                           | Mounting torque, 6-32 or M3 screw                          | 10 lbf•in (1.1N•m)        |       |

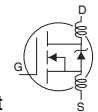
**Thermal Resistance**

|                 | Parameter                                      | Typ. | Max. | Units |
|-----------------|------------------------------------------------|------|------|-------|
| $R_{\theta JC}$ | Junction-to-Case                               | —    | 1.87 | °C/W  |
| $R_{\theta CS}$ | Case-to-Sink, Flat, Greased Surface            | 0.50 | —    |       |
| $R_{\theta JA}$ | Junction-to-Ambient                            | —    | 62   |       |
| $R_{\theta JA}$ | Junction-to-Ambient (PCB Mount, steady state)③ | —    | 40   |       |

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www.irf.com

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

|                              | Parameter                            | Min. | Typ.  | Max. | Units               | Conditions                                                                  |
|------------------------------|--------------------------------------|------|-------|------|---------------------|-----------------------------------------------------------------------------|
| $V_{(BR)DSS}$                | Drain-to-Source Breakdown Voltage    | 55   | —     | —    | V                   | $V_{GS} = 0V, I_D = 250\mu A$                                               |
| $\Delta BV_{DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient  | —    | 0.054 | —    | V/ $^\circ\text{C}$ | Reference to $25^\circ\text{C}$ , $I_D = 1mA$                               |
| $R_{DS(on)}$                 | Static Drain-to-Source On-Resistance | —    | 11.1  | 13.9 | m $\Omega$          | $V_{GS} = 10V, I_D = 31A$ ④                                                 |
| $V_{GS(th)}$                 | Gate Threshold Voltage               | 2.0  | —     | 4.0  | V                   | $V_{DS} = V_{GS}, I_D = 250\mu A$                                           |
| $g_{fs}$                     | Forward Transconductance             | 22   | —     | —    | S                   | $V_{DS} = 25V, I_D = 31A$                                                   |
| $I_{DSS}$                    | Drain-to-Source Leakage Current      | —    | —     | 20   | $\mu A$             | $V_{DS} = 55V, V_{GS} = 0V$                                                 |
|                              |                                      | —    | —     | 250  |                     | $V_{DS} = 55V, V_{GS} = 0V, T_J = 125^\circ\text{C}$                        |
| $I_{GSS}$                    | Gate-to-Source Forward Leakage       | —    | —     | 200  | nA                  | $V_{GS} = 20V$                                                              |
|                              | Gate-to-Source Reverse Leakage       | —    | —     | -200 |                     | $V_{GS} = -20V$                                                             |
| $Q_g$                        | Total Gate Charge                    | —    | 29    | 43   | nC                  | $I_D = 31A$                                                                 |
| $Q_{gs}$                     | Gate-to-Source Charge                | —    | 7.2   | 11   |                     | $V_{DS} = 44V$                                                              |
| $Q_{gd}$                     | Gate-to-Drain ("Miller") Charge      | —    | 12    | 18   |                     | $V_{GS} = 10V$ ④                                                            |
| $t_{d(on)}$                  | Turn-On Delay Time                   | —    | 14    | —    | ns                  | $V_{DD} = 28V$                                                              |
| $t_r$                        | Rise Time                            | —    | 68    | —    |                     | $I_D = 31A$                                                                 |
| $t_{d(off)}$                 | Turn-Off Delay Time                  | —    | 33    | —    |                     | $R_G = 15\Omega$                                                            |
| $t_f$                        | Fall Time                            | —    | 41    | —    |                     | $V_{GS} = 10V$ ④                                                            |
| $L_D$                        | Internal Drain Inductance            | —    | 4.5   | —    | nH                  | Between lead,<br>6mm (0.25in.)<br>from package<br>and center of die contact |
| $L_S$                        | Internal Source Inductance           | —    | 7.5   | —    |                     |                                                                             |
| $C_{iss}$                    | Input Capacitance                    | —    | 1420  | —    | pF                  | $V_{GS} = 0V$                                                               |
| $C_{oss}$                    | Output Capacitance                   | —    | 240   | —    |                     | $V_{DS} = 25V$                                                              |
| $C_{rss}$                    | Reverse Transfer Capacitance         | —    | 130   | —    |                     | $f = 1.0MHz$ , See Fig. 5                                                   |
| $C_{oss}$                    | Output Capacitance                   | —    | 830   | —    |                     | $V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0MHz$                                    |
| $C_{oss}$                    | Output Capacitance                   | —    | 190   | —    |                     | $V_{GS} = 0V, V_{DS} = 44V, f = 1.0MHz$                                     |
| $C_{oss \text{ eff.}}$       | Effective Output Capacitance         | —    | 300   | —    |                     | $V_{GS} = 0V, V_{DS} = 0V \text{ to } 44V$                                  |



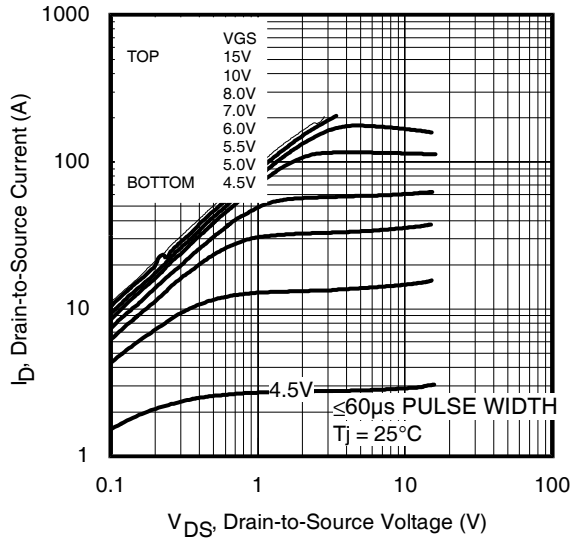
## Diode Characteristics

|          | Parameter                                 | Min.                                                                      | Typ. | Max. | Units | Conditions                                                              |
|----------|-------------------------------------------|---------------------------------------------------------------------------|------|------|-------|-------------------------------------------------------------------------|
| $I_S$    | Continuous Source Current<br>(Body Diode) | —                                                                         | —    | 51   | A     | MOSFET symbol<br>showing the<br>integral reverse<br>p-n junction diode. |
| $I_{SM}$ | Pulsed Source Current<br>(Body Diode) ①   | —                                                                         | —    | 200  |       |                                                                         |
| $V_{SD}$ | Diode Forward Voltage                     | —                                                                         | —    | 1.2  | V     | $T_J = 25^\circ\text{C}, I_S = 31A, V_{GS} = 0V$ ④                      |
| $t_{rr}$ | Reverse Recovery Time                     | —                                                                         | 23   | 35   | ns    | $T_J = 25^\circ\text{C}, I_F = 31A, V_{DD} = 28V$                       |
| $Q_{rr}$ | Reverse Recovery Charge                   | —                                                                         | 17   | 26   | nC    | $di/dt = 100A/\mu s$ ④                                                  |
| $t_{on}$ | Forward Turn-On Time                      | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S+L_D$ ) |      |      |       |                                                                         |

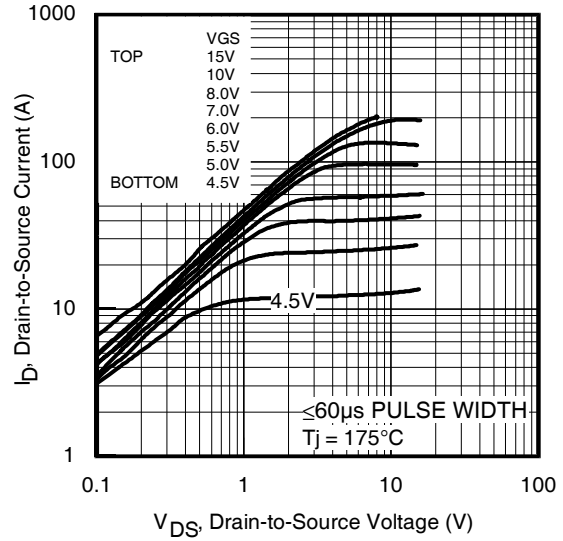
### Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11).
- ② Limited by  $T_{Jmax}$ , starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.18mH$ ,  $R_G = 25\Omega$ ,  $I_{AS} = 31A$ ,  $V_{GS} = 10V$ . Part not recommended for use above this value.
- ③  $I_{SD} \leq 31A$ ,  $di/dt \leq 840A/\mu s$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  $T_J \leq 175^\circ\text{C}$ .
- ④ Pulse width  $\leq 1.0ms$ ; duty cycle  $\leq 2\%$ .

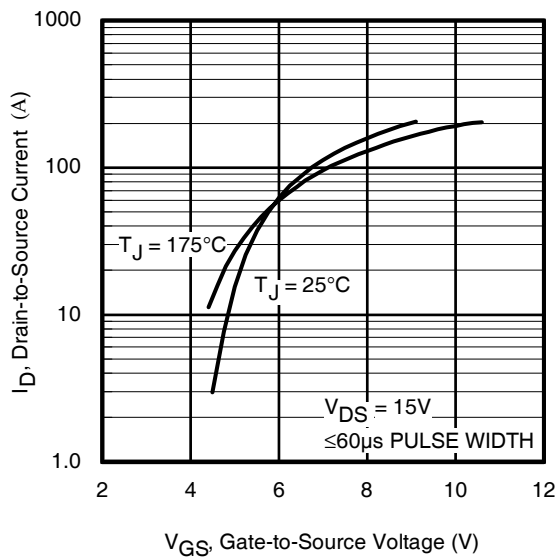
- ⑤  $C_{oss \text{ eff.}}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .
- ⑥ Limited by  $T_{Jmax}$ , see Fig.12a, 12b, 15, 16 for typical repetitive avalanche performance.
- ⑦ This value determined from sample failure population. 100% tested to this value in production.
- ⑧ 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.
- ⑨  $R_\theta$  is rated at  $T_J$  of approximately  $90^\circ\text{C}$ .



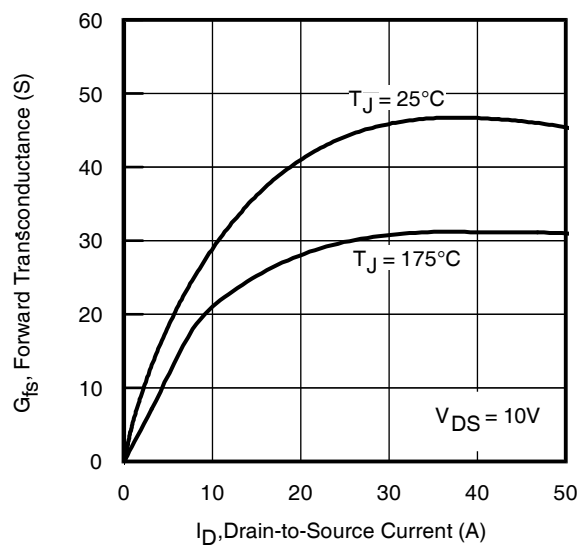
**Fig 1.** Typical Output Characteristics



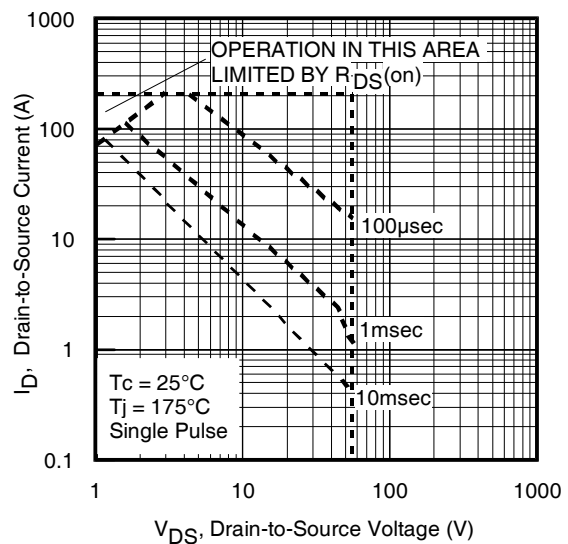
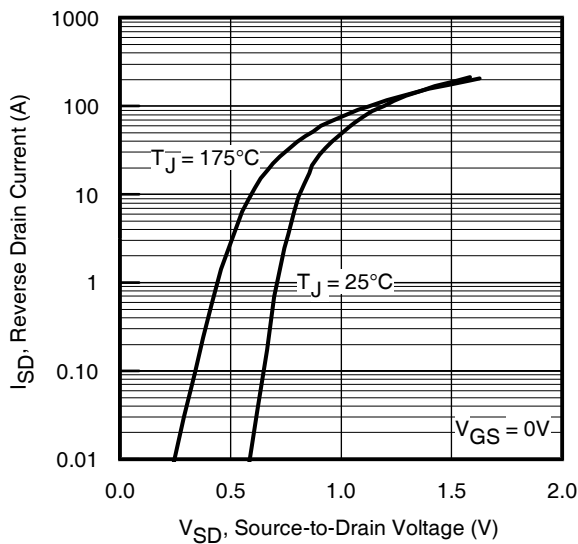
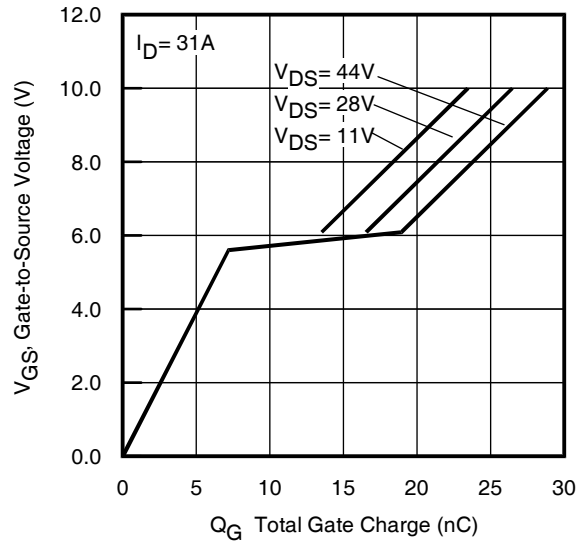
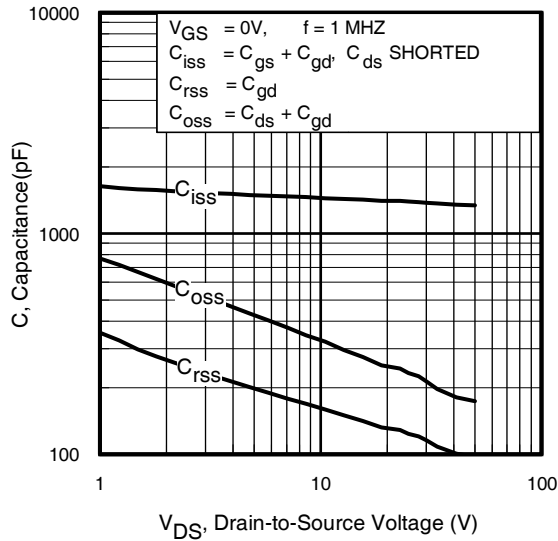
**Fig 2.** Typical Output Characteristics

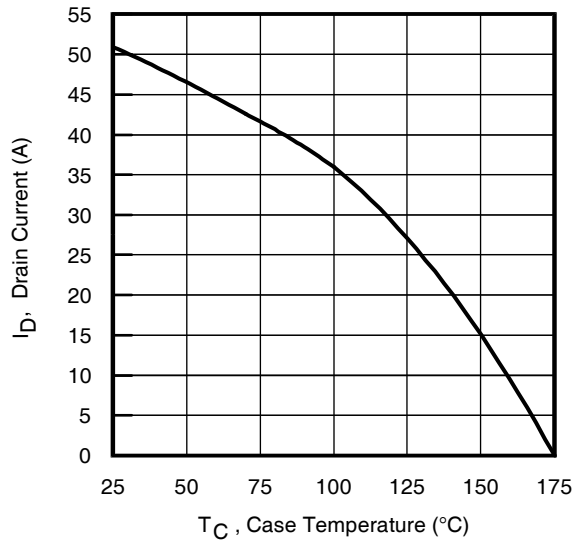


**Fig 3.** Typical Transfer Characteristics

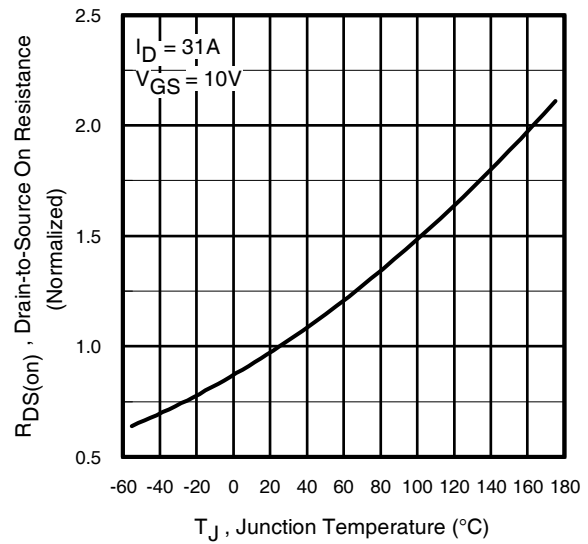


**Fig 4.** Typical Forward Transconductance vs. Drain Current

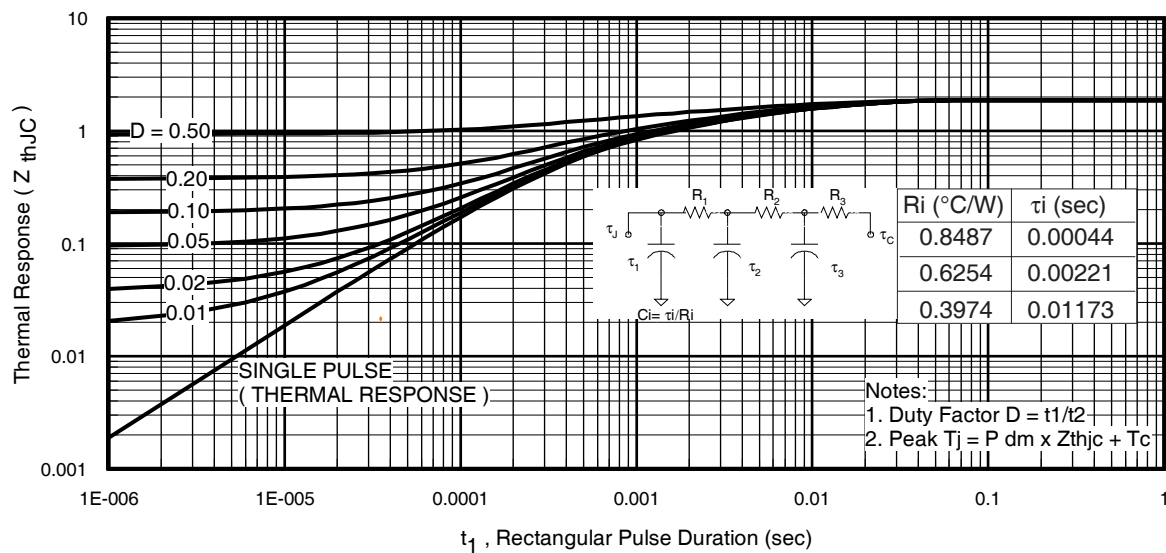




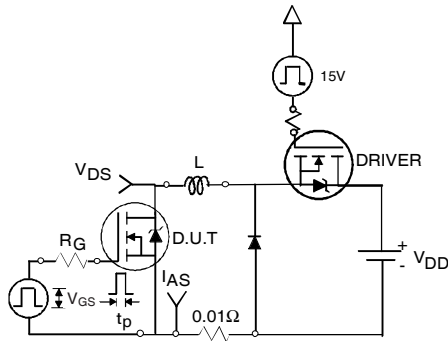
**Fig 9.** Maximum Drain Current vs. Case Temperature



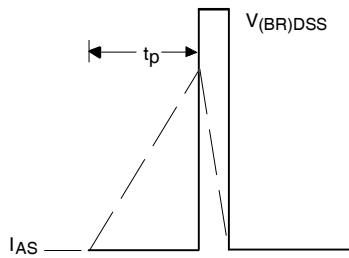
**Fig 10.** Normalized On-Resistance vs. Temperature



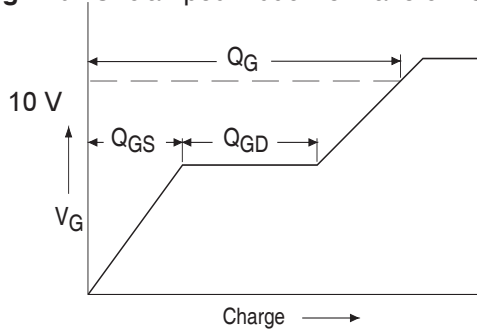
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case



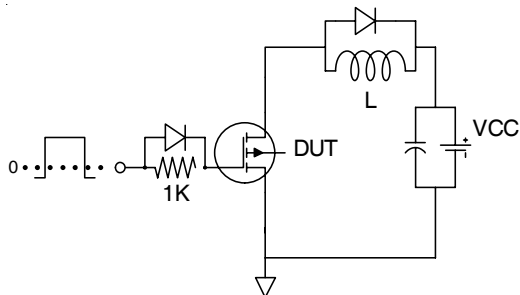
**Fig 12a.** Unclamped Inductive Test Circuit



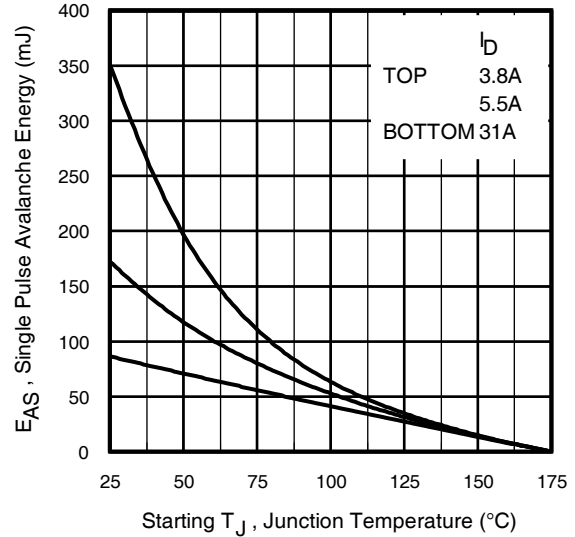
**Fig 12b.** Unclamped Inductive Waveforms



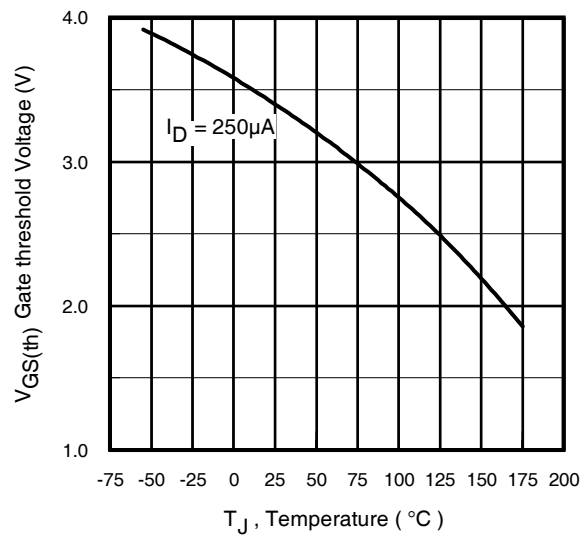
**Fig 13a.** Basic Gate Charge Waveform



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



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



**Fig 14.** Threshold Voltage vs. Temperature

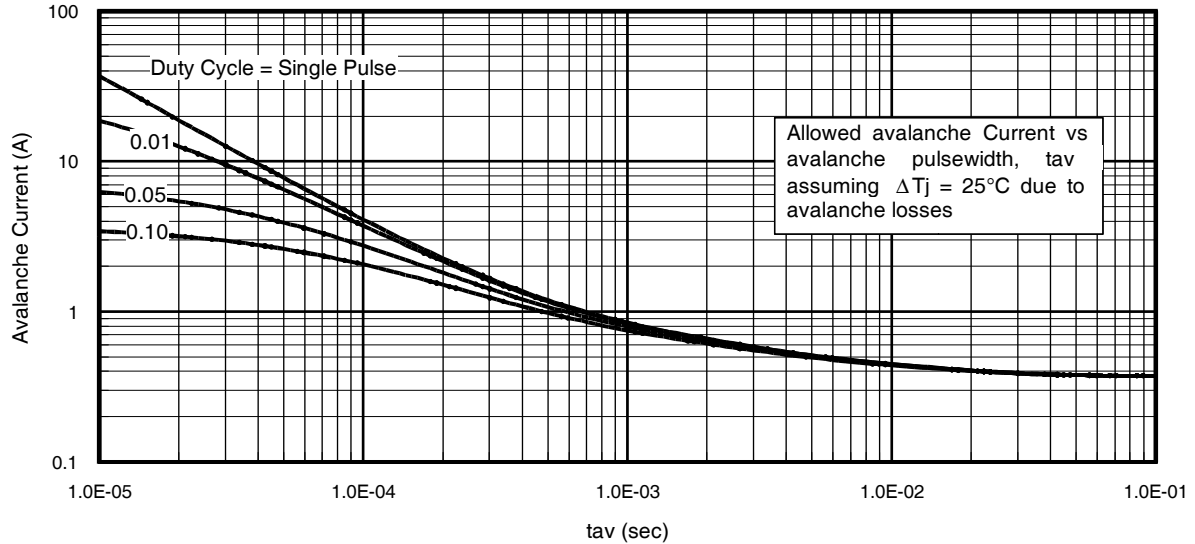


Fig 15. Typical Avalanche Current vs.Pulsewidth

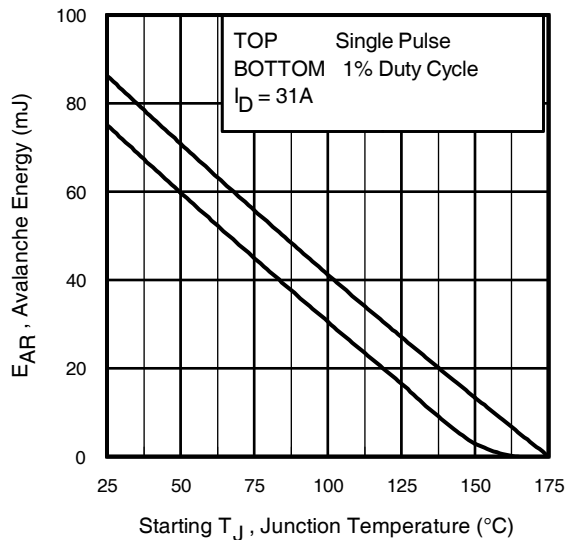


Fig 16. Maximum Avalanche Energy vs. Temperature

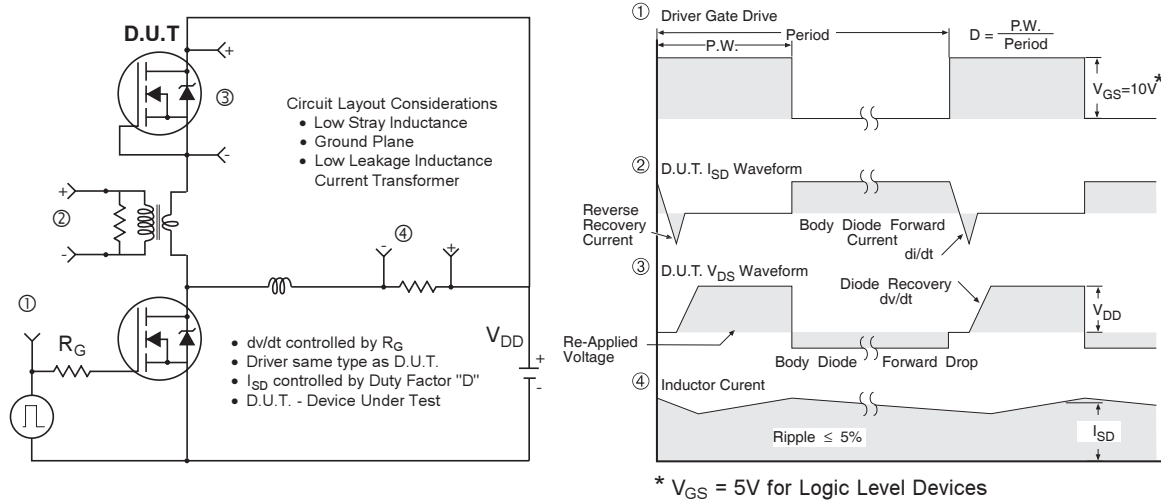
**Notes on Repetitive Avalanche Curves , Figures 15, 16:**  
(For further info, see AN-1005 at [www.irf.com](http://www.irf.com))

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 12a, 12b.
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°C in Figure 15, 16).  
 $t_{av}$  = Average time in avalanche.  
 $D$  = Duty cycle in avalanche =  $t_{av} \cdot f$   
 $Z_{thJC}(D, t_{av})$  = Transient thermal resistance, see figure 11)

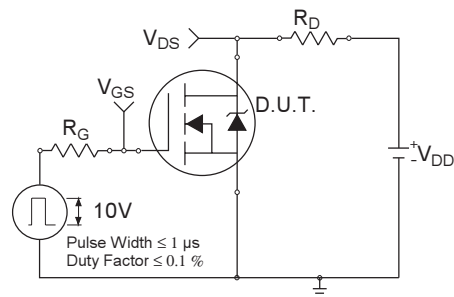
$$P_{D(ave)} = 1/2 (1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$$

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

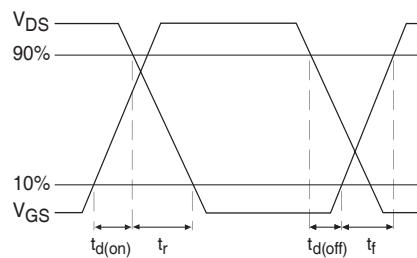
$$E_{AS(AR)} = P_{D(ave)} \cdot t_{av}$$



**Fig 17. Peak Diode Recovery  $dv/dt$  Test Circuit for N-Channel HEXFET® Power MOSFETs**



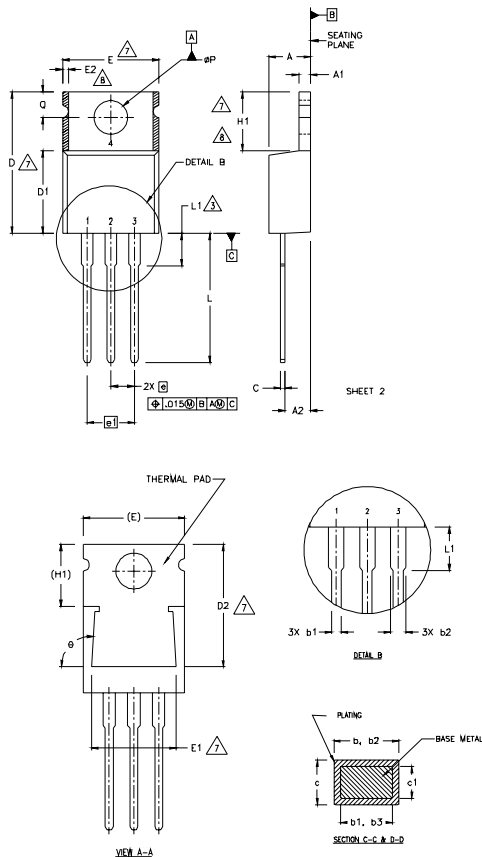
**Fig 18a. Switching Time Test Circuit**



**Fig 18b. Switching Time Waveforms**

## 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

#### HERMET

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

#### IRFZ44Z

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

#### DIODES

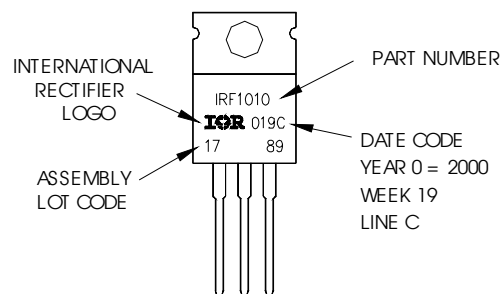
- 1 - ANODE/OPEN
- 2 - CATHODE
- 3 - ANODE

| SYMBOL | DIMENSIONS  |       |          |      | NOTES |
|--------|-------------|-------|----------|------|-------|
|        | MILLIMETERS |       | INCHES   |      |       |
|        | MIN.        | MAX.  | MIN.     | MAX. |       |
| A      | 3.56        | 4.82  | .140     | .190 | 5     |
| 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 |       |
| b2     | 1.15        | 1.77  | .045     | .070 | 5     |
| b3     | 1.15        | 1.73  | .045     | .068 |       |
| c      | 0.36        | 0.61  | .014     | .024 |       |
| c1     | 0.36        | 0.56  | .014     | .022 |       |
| D      | 14.22       | 16.51 | .560     | .650 | 4     |
| D1     | 8.38        | 9.02  | .330     | .355 | 7     |
| D2     | 12.19       | 12.88 | .480     | .507 |       |
| E      | 9.66        | 10.66 | .380     | .420 | 4,7   |
| E1     | 8.38        | 8.89  | .330     | .350 | 7     |
| e      | 2.54 BSC    |       | .100 BSC |      | 7,8   |
| e1     | 5.08        |       | .200 BSC |      |       |
| H1     | 5.85        | 6.55  | .230     | .270 |       |
| L      | 12.70       | 14.73 | .500     | .580 |       |
| L1     | —           | 6.35  | —        | .250 |       |
| ØP     | 3.54        | 4.08  | .139     | .161 | 3     |
| 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, 2000  
IN THE ASSEMBLY LINE "C"

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



### Notes:

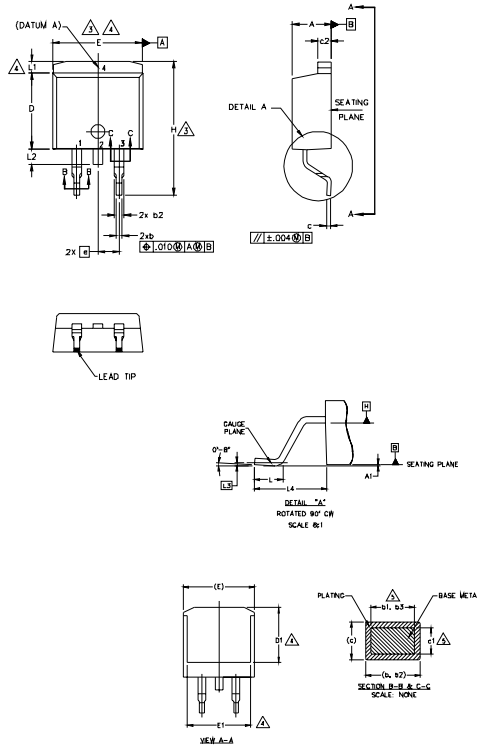
1. For an Automotive Qualified version of this part please see <http://www.irf.com/product-info/auto/>
2. For the most current drawing please refer to IR website at <http://www.irf.com/package/>

# IRFZ44Z/S/LPbF

International  
**IR** Rectifier

## D<sup>2</sup>Pak (TO-263AB) 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 AT DATUM H.
4. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E, L1, D1 & E1.
5. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
6. DATUM A & B TO BE DETERMINED AT DATUM PLANE H.
7. CONTROLLING DIMENSION: INCH.
8. OUTLINE CONFORMS TO JEDEC OUTLINE TO-263AB.

| 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 | 5     |
| b1     | 0.51        | 0.89  | .020     | .035 |       |
| b2     | 1.14        | 1.78  | .045     | .070 | 5     |
| b3     | 1.14        | 1.73  | .045     | .068 |       |
| c      | 0.38        | 0.74  | .015     | .029 |       |
| c1     | 0.38        | 0.58  | .015     | .023 | 5     |
| c2     | 1.14        | 1.65  | .045     | .065 |       |
| D      | 8.38        | 9.65  | .330     | .380 | 3     |
| D1     | 6.86        | —     | .270     | —    | 4     |
| E      | 9.65        | 10.67 | .380     | .420 | 3, 4  |
| 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  | —        | .066 | 4     |
| L2     | 1.27        | 1.78  | —        | .070 |       |
| L3     | 0.25 BSC    | —     | .010 BSC | —    |       |
| L4     | 4.78        | 5.28  | .188     | .208 |       |

### LEAD ASSIGNMENTS

#### HEXFET

1. GATE
2. DRAIN
3. SOURCE

#### IGBTs, CoPACK

1. GATE
2. 4. COLLECTOR
3. EMITTER

#### DIODES

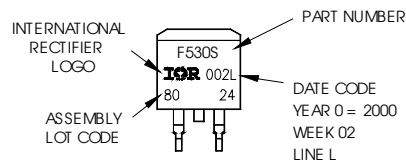
1. ANODE \*
2. 4. CATHODE
3. ANODE

\* PART DEPENDENT.

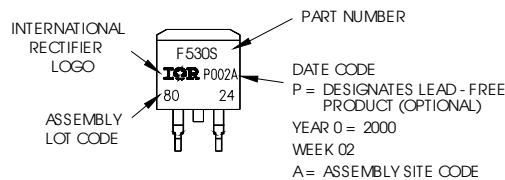
## D<sup>2</sup>Pak (TO-263AB) Part Marking Information

EXAMPLE: THIS IS AN IRF530S WITH  
LOT CODE 8024  
ASSEMBLED ON WW/02, 2000  
IN THE ASSEMBLY LINE "L"

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



OR

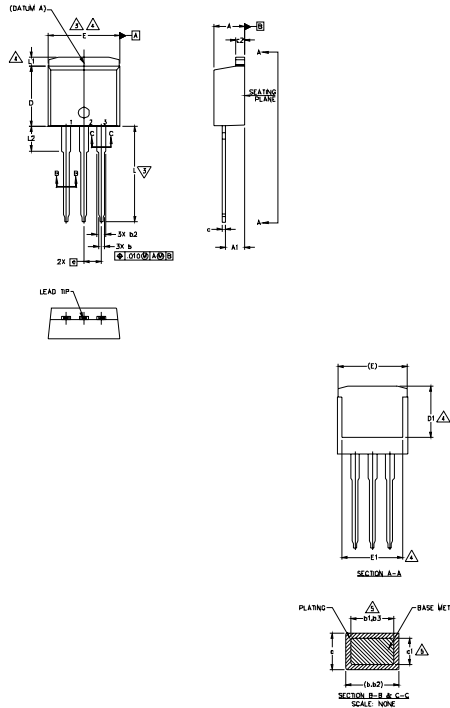


### Notes:

1. For an Automotive Qualified version of this part please see <http://www.irf.com/product-info/auto/>
2. 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)



### 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. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E, L1, D1 & E1.
5. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
6. CONTROLLING DIMENSION: INCH.
7. OUTLINE CONFORM TO JEDEC TO-262 EXCEPT A1(max.), b(min.) AND D1(min.) WHERE DIMENSIONS DERIVED THE ACTUAL PACKAGE OUTLINE.

| SYMBOL | DIMENSIONS  |       |        |      | NOTES |
|--------|-------------|-------|--------|------|-------|
|        | MILLIMETERS |       | INCHES |      |       |
|        | MIN.        | MAX.  | MIN.   | MAX. |       |
| A      | 4.06        | 4.83  | .160   | .190 |       |
| A1     | 2.03        | 3.02  | .080   | .119 |       |
| b      | 0.51        | 0.99  | .020   | .039 |       |
| b1     | 0.51        | 0.89  | .020   | .035 | 5     |
| b2     | 1.14        | 1.78  | .045   | .070 |       |
| b3     | 1.14        | 1.73  | .045   | .068 | 5     |
| c      | 0.38        | 0.74  | .015   | .029 |       |
| c1     | 0.38        | 0.58  | .015   | .023 | 5     |
| c2     | 1.14        | 1.65  | .045   | .065 |       |
| D      | 8.38        | 9.65  | .330   | .380 | 3     |
| D1     | 6.86        | —     | .270   | —    | 4     |
| E      | 9.65        | 10.67 | .380   | .420 | 3,4   |
| E1     | 6.22        | —     | .245   | —    | 4     |
| e      | 2.54        | BSC   | .100   | BSC  |       |
| L      | 13.46       | 14.10 | .530   | .555 |       |
| L1     | —           | 1.65  | —      | .065 | 4     |
| L2     | 3.56        | 3.71  | .140   | .146 |       |

### LEAD ASSIGNMENTS

#### HEXFET

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

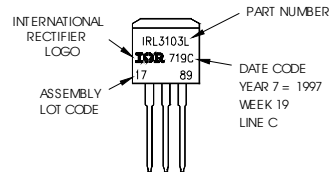
#### IGBTs, CoPACK

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

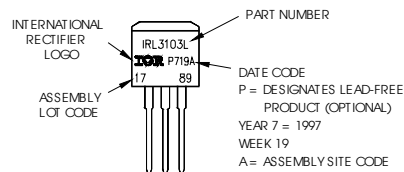
## TO-262 Part Marking Information

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



### Notes:

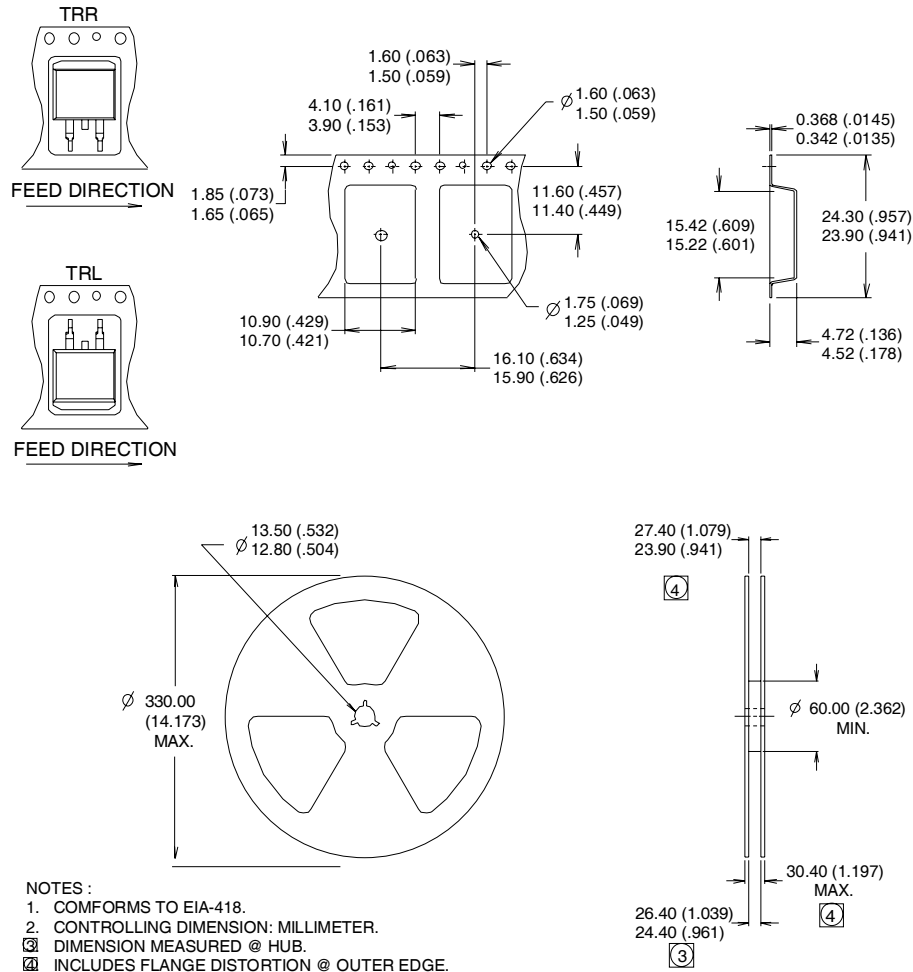
1. For an Automotive Qualified version of this part please see <http://www.irf.com/product-info/auto/>
2. For the most current drawing please refer to IR website at <http://www.irf.com/package/>

# IRFZ44Z/S/LPbF

International  
**IR** Rectifier

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

Dimensions are shown in millimeters (inches)



**TO-220AB package is not recommended for Surface Mount Application.**

Data and specifications subject to change without notice.  
This product has been designed and qualified for the Industrial market.  
Qualification Standards can be found on IR's Web site.

International  
**IR** Rectifier

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TAC Fax: (310) 252-7903

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