

# IRFR812TRPbF

HEXFET® Power MOSFET

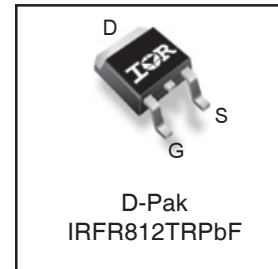
## Applications

- Zero Voltage Switching SMPS
- Uninterruptible Power Supplies
- Motor Control applications

| $V_{DSS}$ | $R_{DS(on)}$ typ. | $T_{rr}$ typ. | $I_D$ |
|-----------|-------------------|---------------|-------|
| 500V      | 1.85Ω             | 75ns          | 3.6A  |

## Features and Benefits

- Fast body diode eliminates the need for external diodes in ZVS applications.
- Lower Gate charge results in simpler drive requirements.
- Higher Gate voltage threshold offers improved noise immunity.



## Absolute Maximum Ratings

|                                   | Parameter                                | Max.                   | Units |
|-----------------------------------|------------------------------------------|------------------------|-------|
| $I_D$ @ $T_C = 25^\circ\text{C}$  | Continuous Drain Current, $V_{GS}$ @ 10V | 3.6                    | A     |
| $I_D$ @ $T_C = 100^\circ\text{C}$ | Continuous Drain Current, $V_{GS}$ @ 10V | 2.3                    |       |
| $I_{DM}$                          | Pulsed Drain Current ①                   | 14.4                   |       |
| $P_D$ @ $T_C = 25^\circ\text{C}$  | Power Dissipation                        | 78                     | W     |
|                                   | Linear Derating Factor                   | 0.63                   | W/°C  |
| $V_{GS}$                          | Gate-to-Source Voltage                   | ± 20                   | V     |
| $dv/dt$                           | Peak Diode Recovery $dv/dt$ ③            | 32                     | V/ns  |
| $T_J$                             | Operating Junction and                   | -55 to + 150           | °C    |
| $T_{STG}$                         | Storage Temperature Range                |                        |       |
|                                   | Soldering Temperature, for 10 seconds    | 300 (1.6mm from case ) |       |
|                                   | Mounting torque, 6-32 or M3 screw        | 10lb·in (1.1N·m)       |       |

## Diode Characteristics

| Symbol    | Parameter                                 | Min.                                                                 | Typ. | Max. | Units | Conditions                                                                                                   |
|-----------|-------------------------------------------|----------------------------------------------------------------------|------|------|-------|--------------------------------------------------------------------------------------------------------------|
| $I_S$     | Continuous Source Current<br>(Body Diode) | —                                                                    | —    | 3.6  | A     | MOSFET symbol showing the integral reverse p-n junction diode.                                               |
| $I_{SM}$  | Pulsed Source Current<br>(Body Diode) ①   | —                                                                    | —    | 14.4 |       |                                                                                                              |
| $V_{SD}$  | Diode Forward Voltage                     | —                                                                    | —    | 1.2  | V     | $T_J = 25^\circ\text{C}$ , $I_S = 3.6\text{A}$ , $V_{GS} = 0\text{V}$ ④                                      |
| $t_{rr}$  | Reverse Recovery Time                     | —                                                                    | 75   | 110  | ns    | $T_J = 25^\circ\text{C}$ , $I_F = 3.6\text{A}$                                                               |
|           |                                           | —                                                                    | 94   | 140  |       | $T_J = 125^\circ\text{C}$ , $di/dt = 100\text{A}/\mu\text{s}$ ④                                              |
| $Q_{rr}$  | Reverse Recovery Charge                   | —                                                                    | 135  | 200  | nC    | $T_J = 25^\circ\text{C}$ , $I_S = 3.6\text{A}$ , $V_{GS} = 0\text{V}$ ④                                      |
|           |                                           | —                                                                    | 220  | 330  |       | $T_J = 125^\circ\text{C}$ , $di/dt = 100\text{A}/\mu\text{s}$ ④                                              |
| $I_{RRM}$ | Reverse Recovery Current                  | —                                                                    | 3.2  | 4.8  | A     | $T_J = 25^\circ\text{C}$ , $I_S = 3.6\text{A}$ , $V_{GS} = 0\text{V}$ ④<br>$di/dt = 100\text{A}/\mu\text{s}$ |
| $t_{on}$  | Forward Turn-On Time                      | Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD) |      |      |       |                                                                                                              |

Notes ① through ⑦ are on page 2

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# IRFR812TRPbF

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## 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    | 500  | —    | —    | V                   | $V_{GS} = 0V, I_D = 250\mu A$                         |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient  | —    | 0.37 | —    | V/ $^\circ\text{C}$ | Reference to $25^\circ\text{C}, I_D = 250\mu A$       |
| $R_{DS(on)}$                    | Static Drain-to-Source On-Resistance | —    | 1.85 | 2.2  | $\Omega$            | $V_{GS} = 10V, I_D = 2.2A$ ④                          |
| $V_{GS(th)}$                    | Gate Threshold Voltage               | 3.0  | —    | 5.0  | V                   | $V_{DS} = V_{GS}, I_D = 250\mu A$                     |
| $I_{DSS}$                       | Drain-to-Source Leakage Current      | —    | —    | 25   | $\mu A$             | $V_{DS} = 500V, V_{GS} = 0V$                          |
|                                 |                                      | —    | —    | 2.0  | mA                  | $V_{DS} = 400V, V_{GS} = 0V, T_J = 125^\circ\text{C}$ |
| $I_{GSS}$                       | Gate-to-Source Forward Leakage       | —    | —    | 100  | nA                  | $V_{GS} = 20V$                                        |
|                                 | Gate-to-Source Reverse Leakage       | —    | —    | -100 | nA                  | $V_{GS} = -20V$                                       |

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

| Symbol                      | Parameter                                        | Min. | Typ. | Max. | Units | Conditions                                    |
|-----------------------------|--------------------------------------------------|------|------|------|-------|-----------------------------------------------|
| $g_{fs}$                    | Forward Transconductance                         | 7.6  | —    | —    | S     | $V_{DS} = 50V, I_D = 2.2A$                    |
| $Q_g$                       | Total Gate Charge                                | —    | —    | 20   | nC    | $I_D = 3.6A$                                  |
| $Q_{gs}$                    | Gate-to-Source Charge                            | —    | —    | 7.3  | nC    | $V_{DS} = 400V$                               |
| $Q_{gd}$                    | Gate-to-Drain ("Miller") Charge                  | —    | —    | 7.1  | nC    | $V_{GS} = 10V$ , See Fig. 14a & 14b ④         |
| $t_{d(on)}$                 | Turn-On Delay Time                               | —    | 14   | —    | ns    | $V_{DD} = 250V$                               |
| $t_r$                       | Rise Time                                        | —    | 22   | —    | ns    | $I_D = 3.6A$                                  |
| $t_{d(off)}$                | Turn-Off Delay Time                              | —    | 24   | —    | ns    | $R_G = 17\Omega$                              |
| $t_f$                       | Fall Time                                        | —    | 17   | —    | ns    | $V_{GS} = 10V$ , See Fig. 15a & 15b ④         |
| $C_{iss}$                   | Input Capacitance                                | —    | 810  | —    | pF    | $V_{GS} = 0V$                                 |
| $C_{oss}$                   | Output Capacitance                               | —    | 47   | —    | pF    | $V_{DS} = 25V$                                |
| $C_{rss}$                   | Reverse Transfer Capacitance                     | —    | 7.3  | —    | pF    | $f = 1.0MHz$ , See Fig. 5                     |
| $C_{oss}$                   | Output Capacitance                               | —    | 610  | —    | pF    | $V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0MHz$      |
| $C_{oss}$                   | Output Capacitance                               | —    | 16   | —    | pF    | $V_{GS} = 0V, V_{DS} = 400V, f = 1.0MHz$      |
| $C_{oss \text{ eff.}}$      | Effective Output Capacitance                     | —    | 5.9  | —    | pF    | $V_{GS} = 0V, V_{DS} = 0V \text{ to } 400V$ ⑤ |
| $C_{oss \text{ eff. (ER)}}$ | Effective Output Capacitance<br>(Energy Related) | —    | 37   | —    | pF    |                                               |

## Avalanche Characteristics

| Symbol   | Parameter                       | Typ. | Max. | Units |
|----------|---------------------------------|------|------|-------|
| $E_{AS}$ | Single Pulse Avalanche Energy ② | —    | 150  | mJ    |
| $I_{AR}$ | Avalanche Current ①             | —    | 1.8  | A     |
| $E_{AR}$ | Repetitive Avalanche Energy ①   | —    | 7.8  | mJ    |

## Thermal Resistance

| Symbol          | Parameter                           | Typ. | Max. | Units              |
|-----------------|-------------------------------------|------|------|--------------------|
| $R_{\theta JC}$ | Junction-to-Case ⑥                  | —    | 1.6  | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Junction-to-Ambient (PCB mount) ⑥ ⑦ | —    | 40   | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Junction-to-Ambient ⑥               | —    | 110  | $^\circ\text{C/W}$ |

### Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. (See Fig. 11)
- ② Starting  $T_J = 25^\circ\text{C}$ ,  $L = 93mH$ ,  $R_G = 25\Omega$ ,  $I_{AS} = 1.8A$ . (See Figure 13).
- ③  $I_{SD} = 3.6A$ ,  $di/dt \leq 520A/\mu s$ ,  $V_{DD} V_{(BR)DSS}$ ,  $T_J \leq 150^\circ\text{C}$ .

④ Pulse width  $\leq 300\mu s$ ; duty cycle  $\leq 2\%$ .

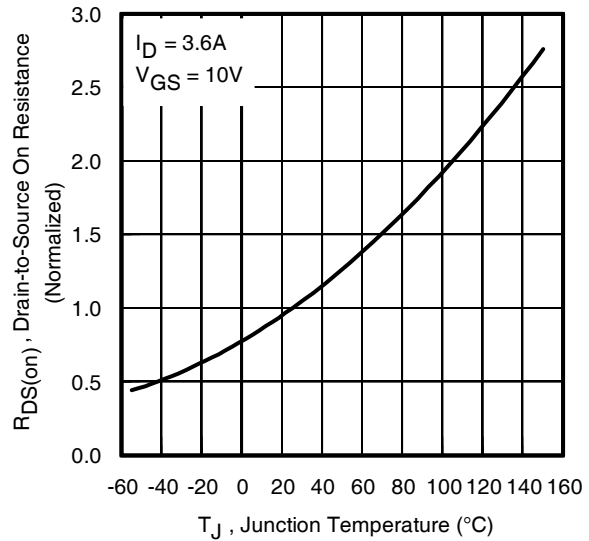
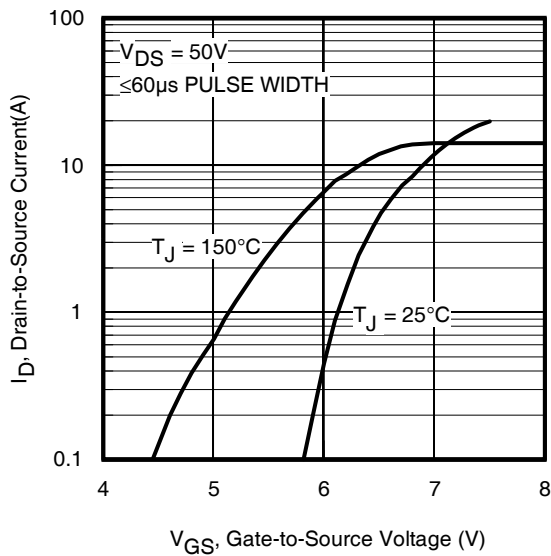
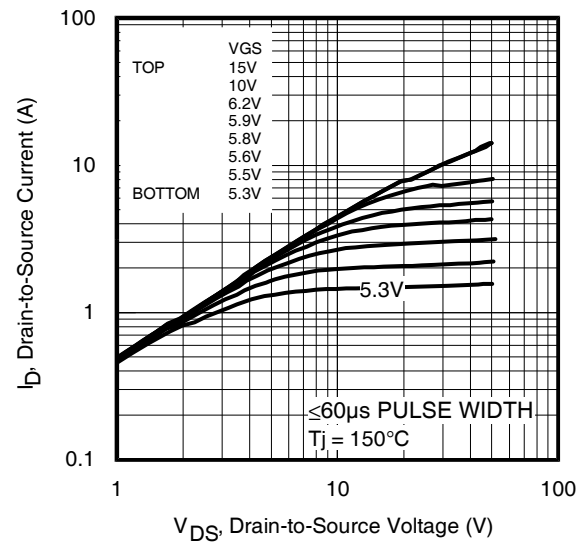
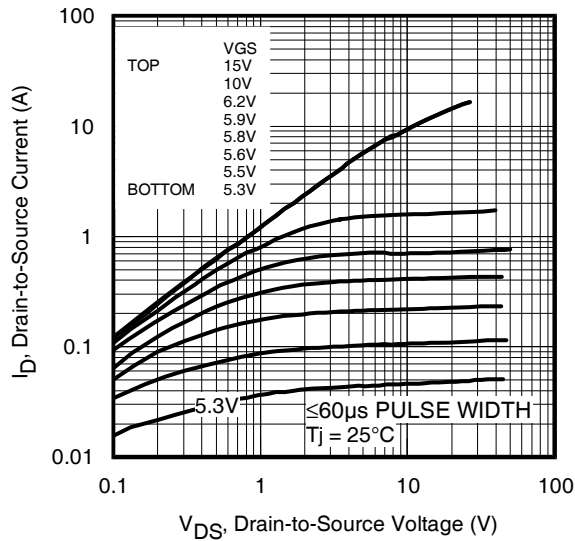
⑤  $C_{oss \text{ eff.}}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

$C_{oss \text{ eff. (ER)}}$  is a fixed capacitance that stores the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

⑥  $R_\theta$  is measured at  $T_J$  approximately  $90^\circ\text{C}$

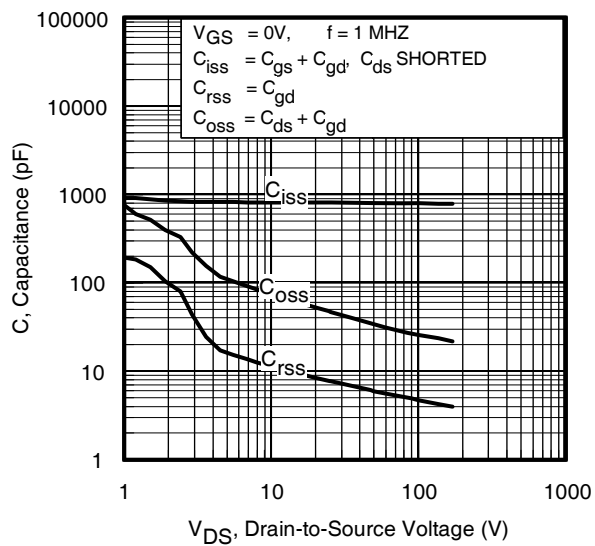
⑦ When mounted on 1" square PCB (FR-4 or G-10 Material)

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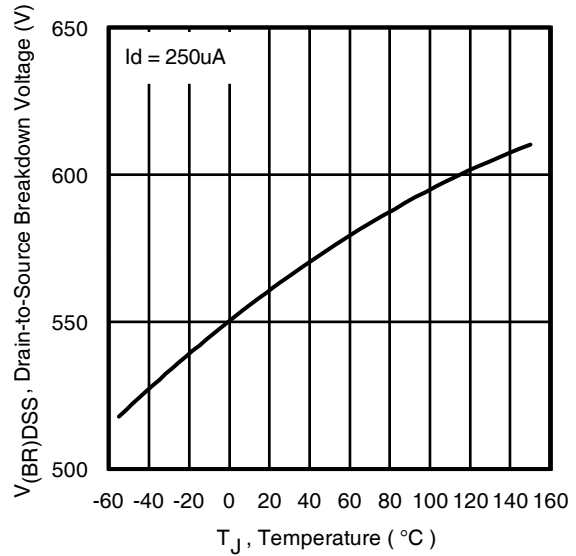


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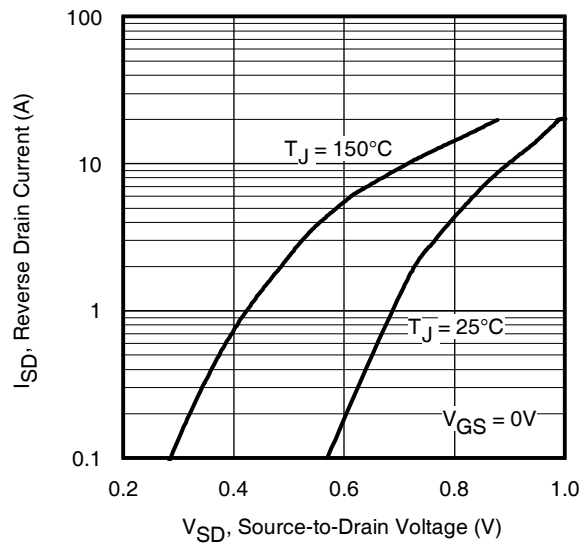
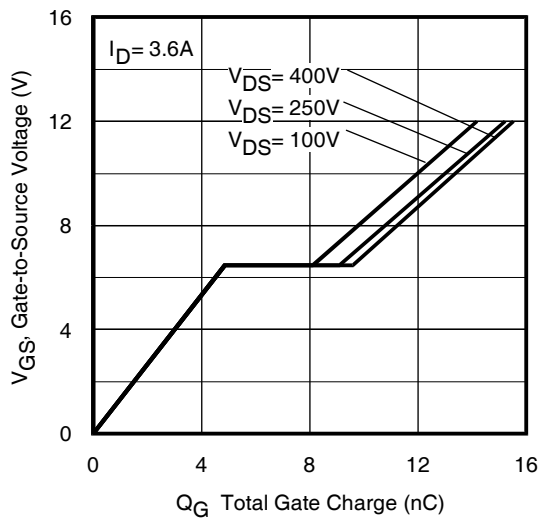
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**IR** Rectifier

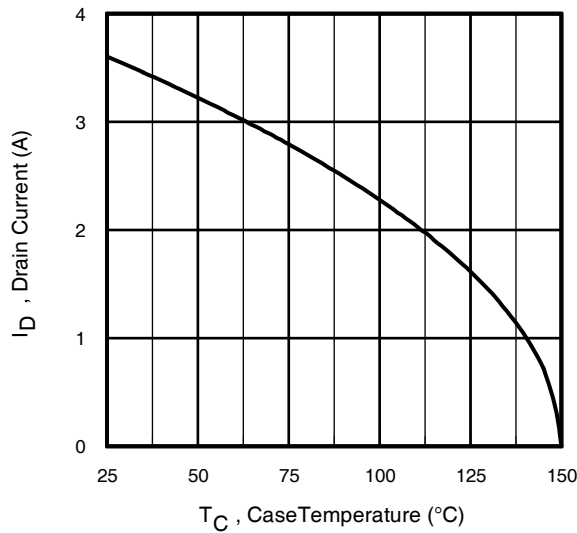


**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage

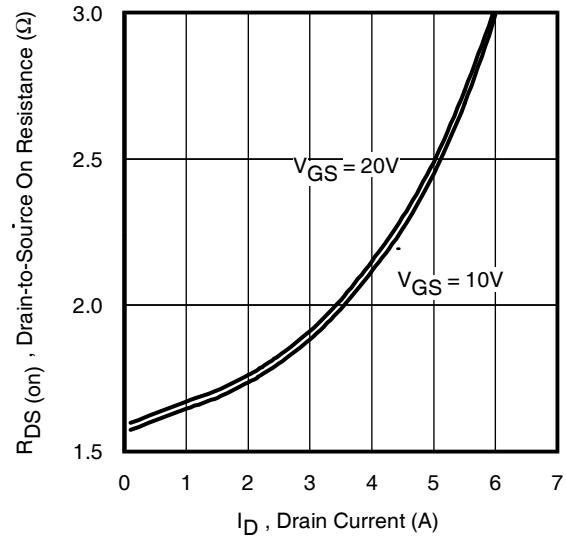


**Fig 6.** Typ. Breakdown Voltage vs. Temperature

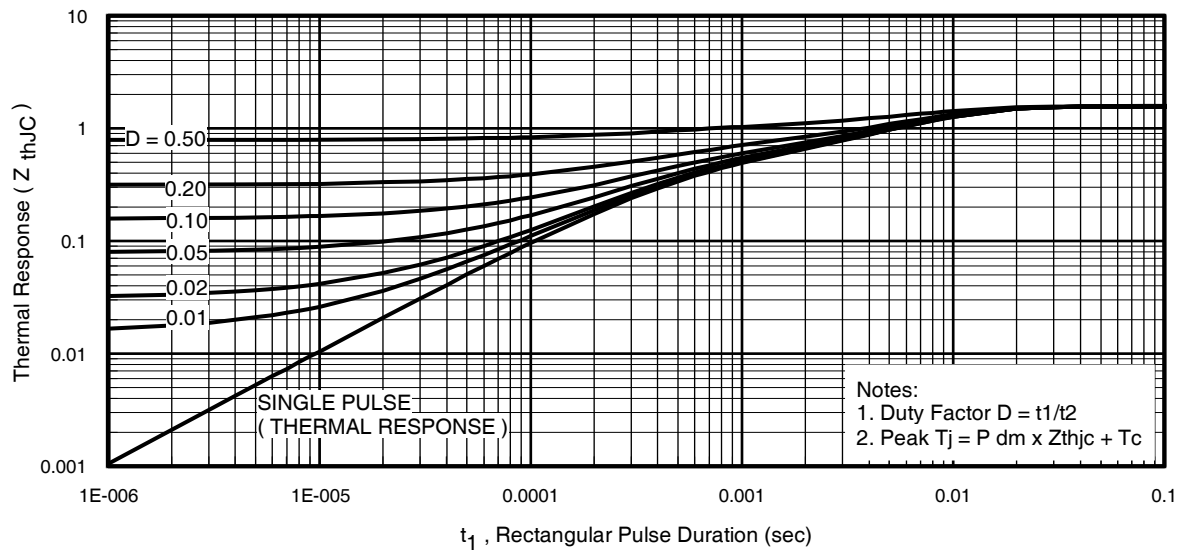




**Fig 9.** Maximum Drain Current Vs. Case Temperature



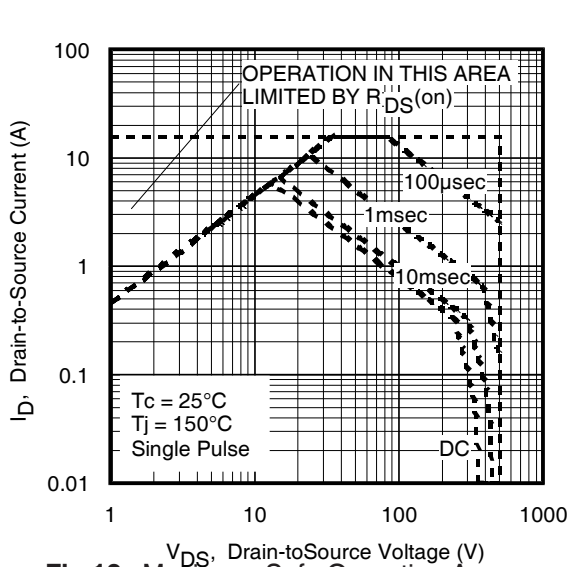
**Fig 9.** Typical  $R_{DS(on)}$  Vs. Drain Current



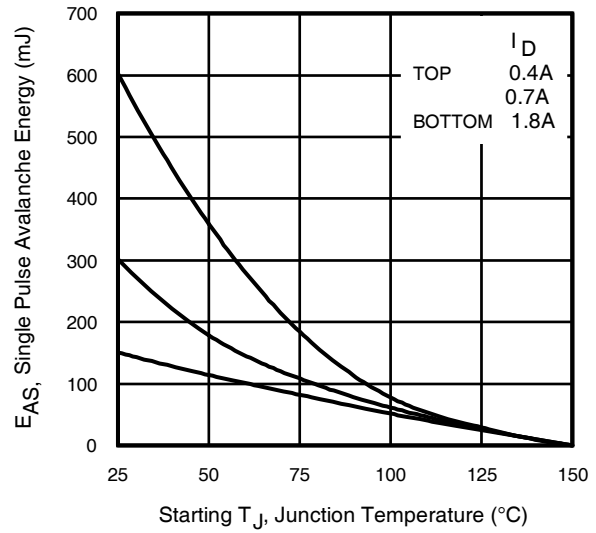
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

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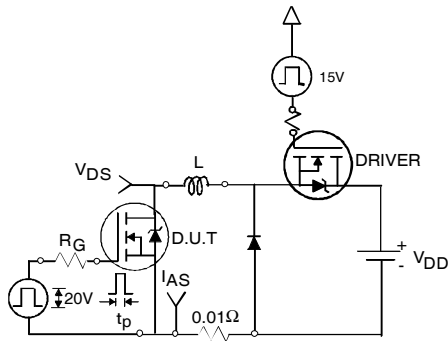
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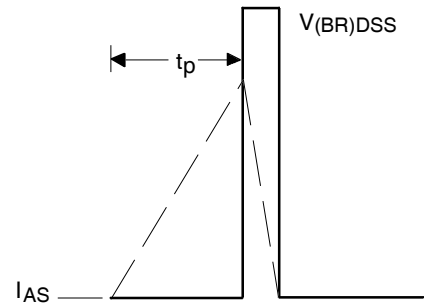
**Fig 12.** Maximum Safe Operating Area



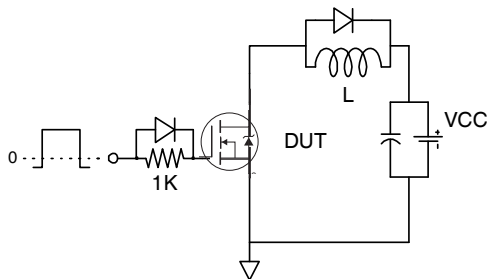
**Fig 13.** Maximum Avalanche Energy vs. Drain Current



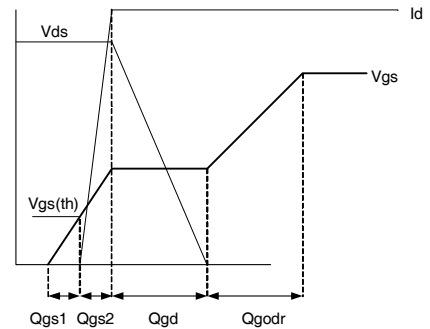
**Fig 13a.** Unclamped Inductive Test Circuit



**Fig 13b.** Unclamped Inductive Waveforms

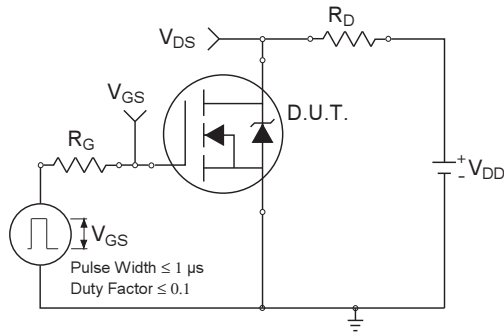


**Fig 14a.** Gate Charge Test Circuit

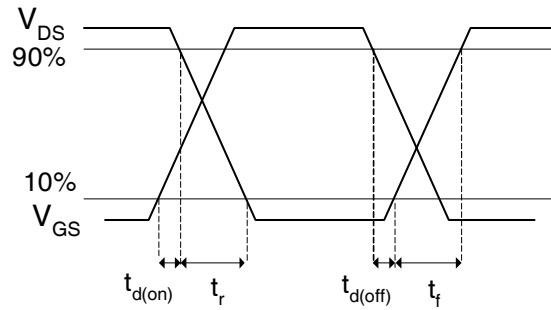


**Fig 14b.** Gate Charge Waveform

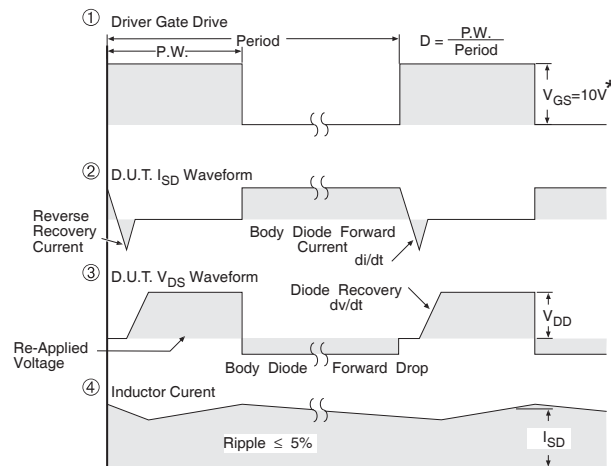
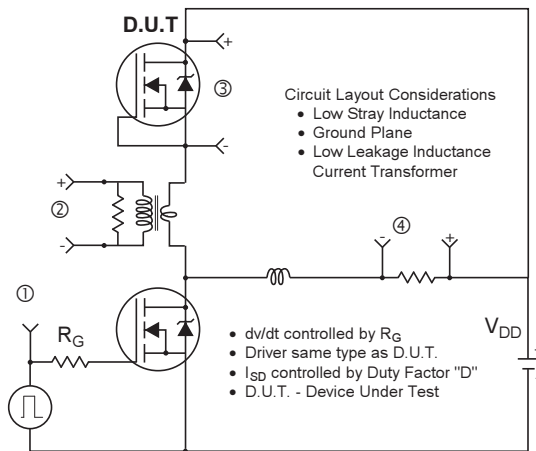
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**Fig 15a.** Switching Time Test Circuit



**Fig 15b.** Switching Time Waveforms



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

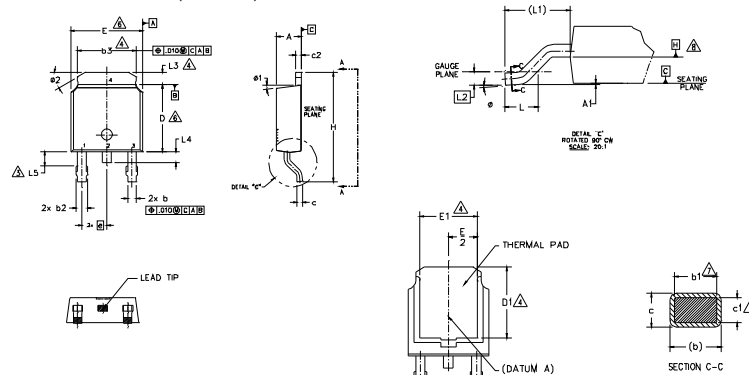
**Fig 16.** Peak Diode Recovery  $dv/dt$  Test Circuit for N-Channel HEXFET® Power MOSFETs

# IRFR812TRPbF

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## D-Pak (TO-252AA) Package Outline

Dimensions are shown in millimeters (inches)



- NOTES:
- 1.- DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
  - 2.- DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS]
  - 3.- LEAD DIMENSION UNCONTROLLED IN L5.
  - 4.- DIMENSION D1, E1, L3 & b5 ESTABLISH A MINIMUM MOUNTING SURFACE FOR THERMAL PAD.
  - 5.- SECTION C-C DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN .005 AND 0.10 [0.13 AND 0.25] FROM THE LEAD TIP.
  - 6.- DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005 [0.13] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
  - 7.- DIMENSION b1 & c1 APPLIED TO BASE METAL ONLY.
  - 8.- DATUM A & B TO BE DETERMINED AT DATUM PLANE H.
  - 9.- OUTLINE CONFORMS TO JEDEC OUTLINE TO-252AA.

| SYMBOL | DIMENSIONS  |       |          |      | NOTES |
|--------|-------------|-------|----------|------|-------|
|        | MILLIMETERS |       | INCHES   |      |       |
|        | MIN.        | MAX.  | MIN.     | MAX. |       |
| A      | 2.18        | 2.39  | .086     | .094 |       |
| A1     | —           | 0.13  | —        | .005 |       |
| b      | 0.64        | 0.89  | .025     | .035 |       |
| b1     | 0.65        | 0.79  | .025     | .031 | 7     |
| b2     | 0.76        | 1.14  | .030     | .045 |       |
| b3     | 4.95        | 5.46  | .190     | .215 | 4     |
| c      | 0.46        | 0.61  | .018     | .024 |       |
| c1     | 0.41        | 0.56  | .016     | .022 | 7     |
| c2     | 0.46        | 0.89  | .018     | .035 |       |
| D      | 5.97        | 6.22  | .235     | .245 | 6     |
| D1     | 5.21        | —     | .205     | —    | 4     |
| E      | 6.35        | 6.73  | .250     | .265 | 6     |
| E1     | 4.32        | —     | .170     | —    | 4     |
| e      | 2.29 BSC    | —     | .090 BSC | —    |       |
| H      | 9.40        | 10.41 | .370     | .410 |       |
| L      | 1.40        | 1.78  | .055     | .070 |       |
| L1     | 2.74 BSC    | —     | 1.08 REF | —    |       |
| L2     | 0.51 BSC    | —     | .020 BSC | —    | 4     |
| L3     | 0.89        | 1.27  | .035     | .050 |       |
| L4     | —           | 1.02  | —        | .040 |       |
| L5     | 1.14        | 1.52  | .045     | .060 | 3     |
| #      | 0°          | 10°   | 0°       | 10°  |       |
| #1     | 0°          | 15°   | 0°       | 15°  |       |
| #2     | 25°         | 35°   | 25°      | 35°  |       |

### LEAD ASSIGNMENTS

### HEXFEET

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

### IGBT & CbPAK

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

## D-Pak (TO-252AA) Part Marking Information

EXAMPLE: THIS IS AN IRFR120  
WITH ASSEMBLY  
LOT CODE 1234  
ASSEMBLED ON WW 16, 2001  
IN THE ASSEMBLY LINE "A"

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

"P" in assembly line position indicates  
"Lead-Free" qualification to the consumer-level

OR

INTERNATIONAL  
RECTIFIER  
LOGO

ASSEMBLY  
LOT CODE

INTERNATIONAL  
RECTIFIER  
LOGO

ASSEMBLY  
LOT CODE

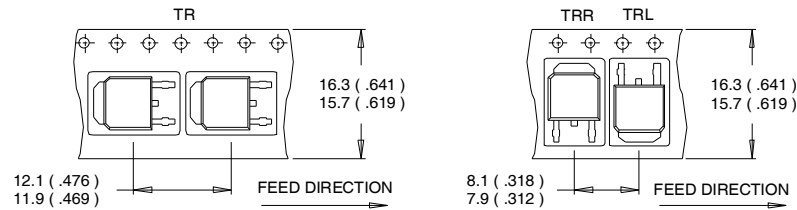
PART NUMBER  
DATE CODE  
P = DESIGNATES LEAD-FREE  
PRODUCT (OPTIONAL)  
P = DESIGNATES LEAD-FREE  
PRODUCT QUALIFIED TO THE  
CONSUMER LEVEL (OPTIONAL)  
YEAR 1 = 2001  
WEEK 16  
A = ASSEMBLY SITE CODE

D-Pak (TO-252AA) packages are not recommended for Surface Mount Application.

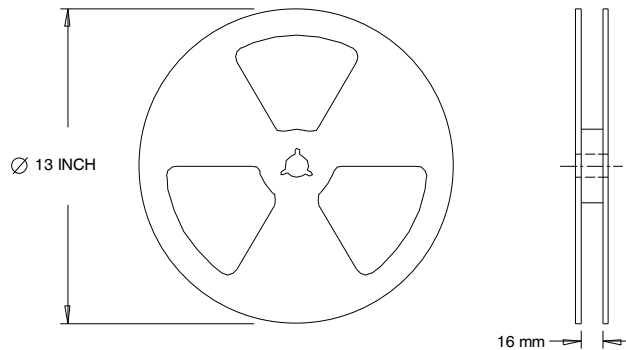
Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>

## D-Pak (TO-252AA) Tape & Reel Information

Dimensions are shown in millimeters (inches)



- NOTES :
1. CONTROLLING DIMENSION : MILLIMETER.
  2. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS ( INCHES ).
  3. OUTLINE CONFORMS TO EIA-481 & EIA-541.



- NOTES :
1. OUTLINE CONFORMS TO EIA-481.

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

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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