

### Applications

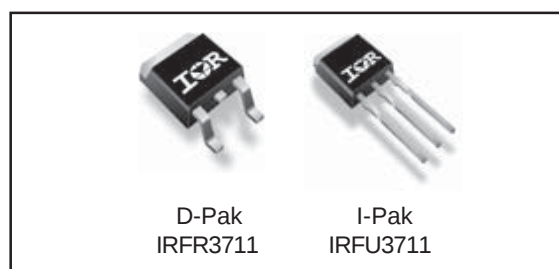
- High Frequency Isolated DC-DC Converters with Synchronous Rectification for Telecom and Industrial Use
- High Frequency Buck Converters for Server Processor Power Synchronous FET
- Optimized for Synchronous Buck Converters Including Capacitive Induced Turn-on Immunity
- 100%  $R_G$  Tested

### Benefits

- Ultra-Low Gate Impedance
- Very Low  $R_{DS(on)}$  at 4.5V  $V_{GS}$
- Fully Characterized Avalanche Voltage and Current

### HEXFET® Power MOSFET

| $V_{DS}$ | $R_{DS(on)}$ max | $I_D$             |
|----------|------------------|-------------------|
| 20V      | 6.5m $\Omega$    | 110A <sup>④</sup> |



### Absolute Maximum Ratings

| Symbol                            | Parameter                                | Max              | Units               |
|-----------------------------------|------------------------------------------|------------------|---------------------|
| $V_{DS}$                          | Drain-Source Voltage                     | 20               | V                   |
| $V_{GS}$                          | Gate-Source Voltage                      | $\pm 20$         |                     |
| $I_D$ @ $T_C = 25^\circ\text{C}$  | Continuous Drain Current, $V_{GS}$ @ 10V | 100 <sup>④</sup> | A                   |
| $I_D$ @ $T_C = 100^\circ\text{C}$ | Continuous Drain Current, $V_{GS}$ @ 10V | 69 <sup>④</sup>  |                     |
| $I_{DM}$                          | Pulsed Drain Current <sup>①</sup>        | 440              |                     |
| $P_D$ @ $T_A = 25^\circ\text{C}$  | Maximum Power Dissipation <sup>⑤</sup>   | 2.5              | W                   |
| $P_D$ @ $T_C = 25^\circ\text{C}$  | Maximum Power Dissipation                | 120              |                     |
|                                   | Linear Derating Factor                   | 0.96             | W/ $^\circ\text{C}$ |
| $T_J, T_{STG}$                    | Junction and Storage Temperature Range   | -55 to +150      | $^\circ\text{C}$    |

### Thermal Resistance

| Symbol          | Parameter                                     | Typ | Max  | Units              |
|-----------------|-----------------------------------------------|-----|------|--------------------|
| $R_{\theta JC}$ | Junction-to-Case <sup>⑥</sup>                 | —   | 1.04 | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Junction-to-Ambient (PCB Mount) <sup>⑤⑥</sup> | —   | 50   |                    |
| $R_{\theta JA}$ | Junction-to-Ambient <sup>⑥</sup>              | —   | 110  |                    |

Notes <sup>①</sup> through <sup>⑥</sup> are on page 10

# IRFR/U3711

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

International  
IR Rectifier

| Symbol                          | Parameter                            | Min | Typ   | Max  | Units               | Conditions                                           |
|---------------------------------|--------------------------------------|-----|-------|------|---------------------|------------------------------------------------------|
| $V_{(BR)DSS}$                   | Drain-to-Source Breakdown Voltage    | 20  | —     | —    | V                   | $V_{GS} = 0V, I_D = 250\mu A$                        |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient  | —   | 0.022 | —    | V/ $^\circ\text{C}$ | Reference to $25^\circ\text{C}, I_D = 1mA$           |
| $R_{DS(on)}$                    | Static Drain-to-Source On-Resistance | —   | 5.2   | 6.5  | $m\Omega$           | $V_{GS} = 10V, I_D = 15A$ ③                          |
|                                 |                                      | —   | 6.7   | 8.5  |                     | $V_{GS} = 4.5V, I_D = 12A$ ③                         |
| $V_{GS(th)}$                    | Gate Threshold Voltage               | 1.0 | —     | 3.0  | V                   | $V_{DS} = V_{GS}, I_D = 250\mu A$                    |
| $I_{DSS}$                       | Drain-to-Source Leakage Current      | —   | —     | 140  | $\mu A$             | $V_{DS} = 20V, V_{GS} = 0V$                          |
|                                 |                                      | —   | —     | 20   |                     | $V_{DS} = 16V, V_{GS} = 0V$                          |
|                                 |                                      | —   | —     | 100  |                     | $V_{DS} = 16V, V_{GS} = 0V, T_J = 125^\circ\text{C}$ |
| $I_{GSS}$                       | Gate-to-Source Forward Leakage       | —   | —     | 200  | nA                  | $V_{GS} = 20V$                                       |
|                                 | Gate-to-Source Reverse Leakage       | —   | —     | -200 |                     | $V_{GS} = -20V$                                      |

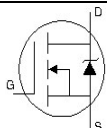
Dynamic @  $T_J = 25^\circ\text{C}$  (unless otherwise specified)

| Symbol       | Parameter                       | Min | Typ  | Max | Units    | Conditions                  |
|--------------|---------------------------------|-----|------|-----|----------|-----------------------------|
| $g_{fs}$     | Forward Transconductance        | 53  | —    | —   | S        | $V_{DS} = 16V, I_D = 30A$   |
| $Q_g$        | Total Gate Charge               | —   | 29   | 44  | nC       | $I_D = 15A$                 |
| $Q_{gs}$     | Gate-to-Source Charge           | —   | 7.3  | —   |          | $V_{DS} = 10V$              |
| $Q_{gd}$     | Gate-to-Drain ("Miller") Charge | —   | 8.9  | —   |          | $V_{GS} = 4.5V$ ③           |
| $Q_{oss}$    | Output Gate Charge              | —   | 33   | —   |          | $V_{GS} = 0V, V_{DS} = 10V$ |
| $R_G$        | Gate Resistance                 | 0.3 | —    | 2.5 | $\Omega$ |                             |
| $t_{d(on)}$  | Turn-On Delay Time              | —   | 12   | —   | ns       | $V_{DD} = 10V$              |
| $t_r$        | Rise Time                       | —   | 220  | —   |          | $I_D = 30A$                 |
| $t_{d(off)}$ | Turn-Off Delay Time             | —   | 17   | —   |          | $R_G = 1.8\Omega$           |
| $t_f$        | Fall Time                       | —   | 12   | —   |          | $V_{GS} = 4.5V$ ③           |
| $C_{iss}$    | Input Capacitance               | —   | 2980 | —   | pF       | $V_{GS} = 0V$               |
| $C_{oss}$    | Output Capacitance              | —   | 1770 | —   |          | $V_{DS} = 10V$              |
| $C_{rss}$    | Reverse Transfer Capacitance    | —   | 280  | —   |          | $f = 1.0MHz$                |

## Avalanche Characteristics

| Symbol   | Parameter                       | Typ | Max | Units |
|----------|---------------------------------|-----|-----|-------|
| $E_{AS}$ | Single Pulse Avalanche Energy ② | —   | 460 | mJ    |
| $I_{AR}$ | Avalanche Current ①             | —   | 30  | A     |

## Diode Characteristics

| Symbol   | Parameter                              | Min | Typ  | Max   | Units | Conditions                                                                                                                                           |
|----------|----------------------------------------|-----|------|-------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| $I_S$    | Continuous Source Current (Body Diode) | —   | —    | 110 ④ | A     | MOSFET symbol showing the integral reverse p-n junction diode.  |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ①   | —   | —    | 440   |       |                                                                                                                                                      |
| $V_{SD}$ | Diode Forward Voltage                  | —   | 0.88 | 1.3   | V     | $T_J = 25^\circ\text{C}, I_S = 30A, V_{GS} = 0V$ ③                                                                                                   |
|          |                                        | —   | 0.82 | —     |       | $T_J = 125^\circ\text{C}, I_S = 30A, V_{GS} = 0V$ ③                                                                                                  |
| $t_{rr}$ | Reverse Recovery Time                  | —   | 50   | 75    | ns    | $T_J = 25^\circ\text{C}, I_F = 16A, V_R = 10V$                                                                                                       |
| $Q_{rr}$ | Reverse Recovery Charge                | —   | 61   | 92    | nC    | $di/dt = 100A/\mu s$ ③                                                                                                                               |
| $t_{rr}$ | Reverse Recovery Time                  | —   | 48   | 72    | ns    | $T_J = 125^\circ\text{C}, I_F = 16A, V_R = 10V$                                                                                                      |
| $Q_{rr}$ | Reverse Recovery Charge                | —   | 65   | 98    | nC    | $di/dt = 100A/\mu s$ ③                                                                                                                               |

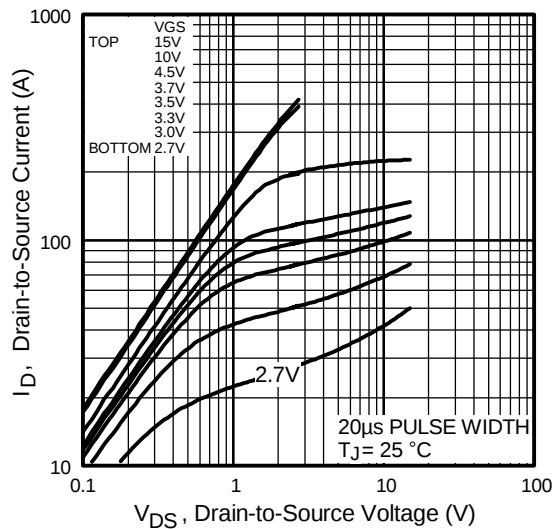


Fig 1. Typical Output Characteristics

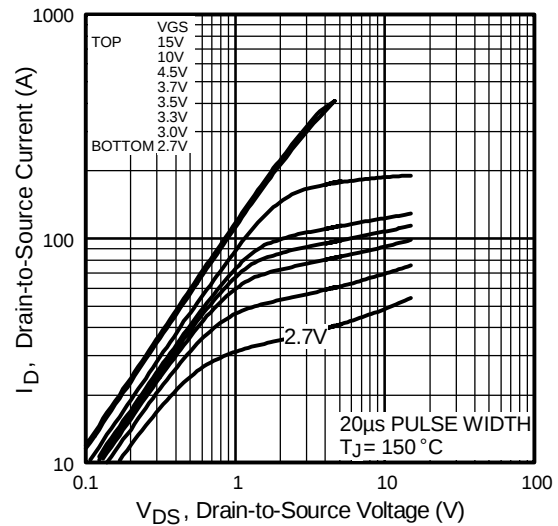


Fig 2. Typical Output Characteristics

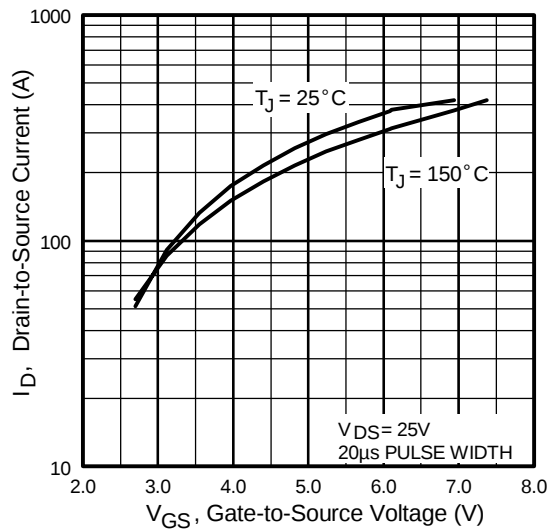


Fig 3. Typical Transfer Characteristics

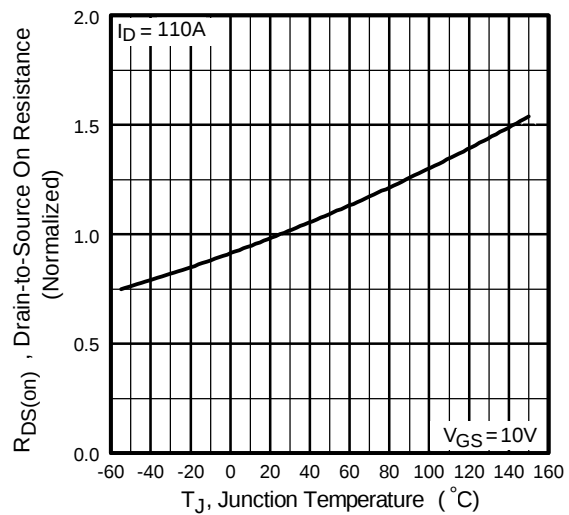
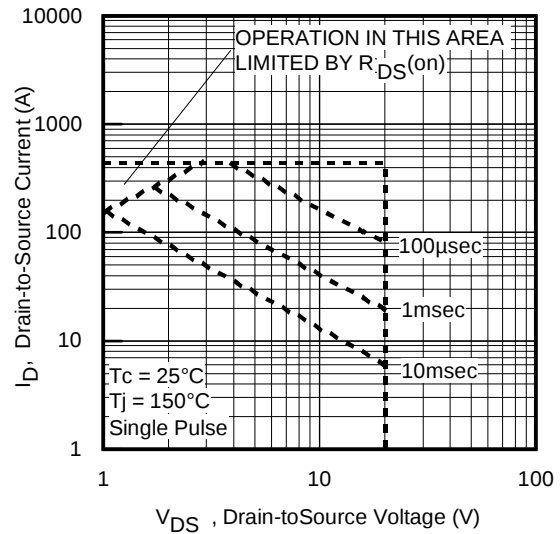
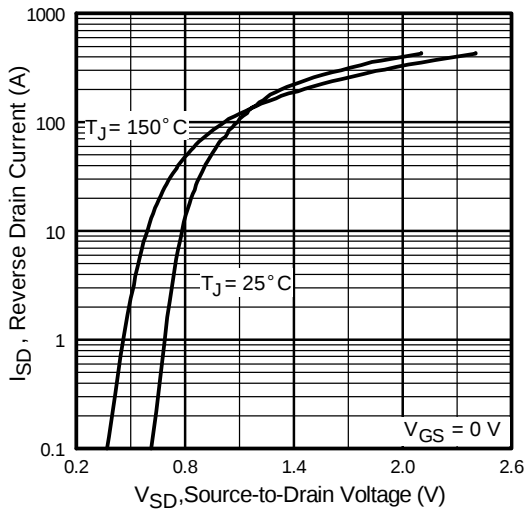
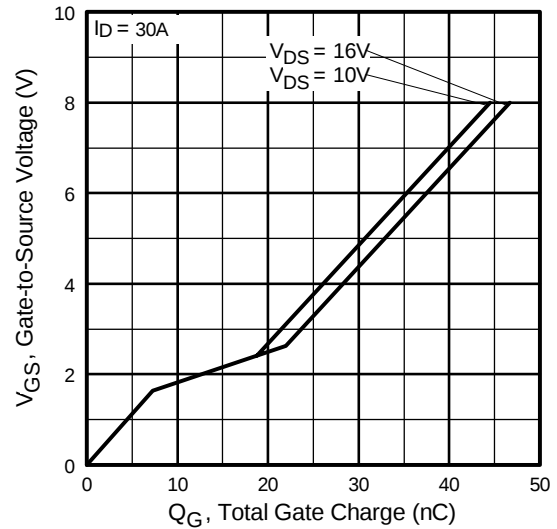
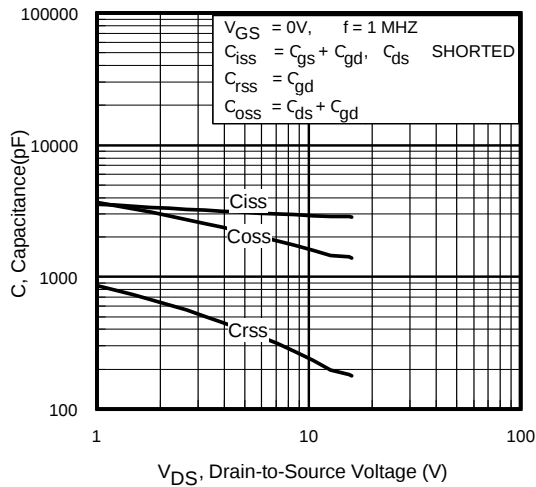
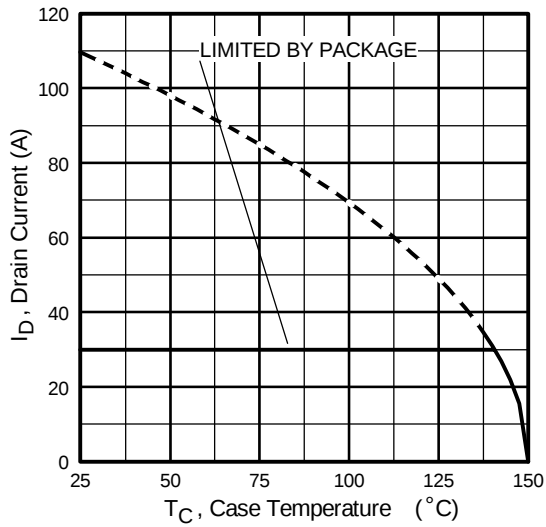
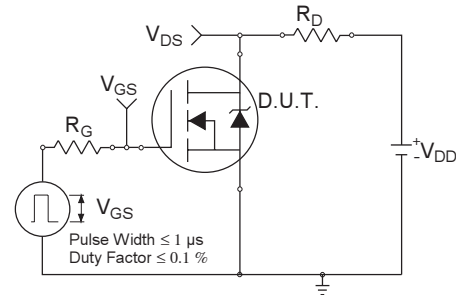


Fig 4. Normalized On-Resistance Vs. Temperature

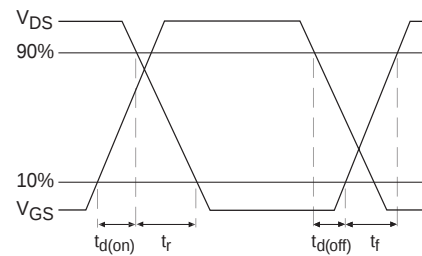




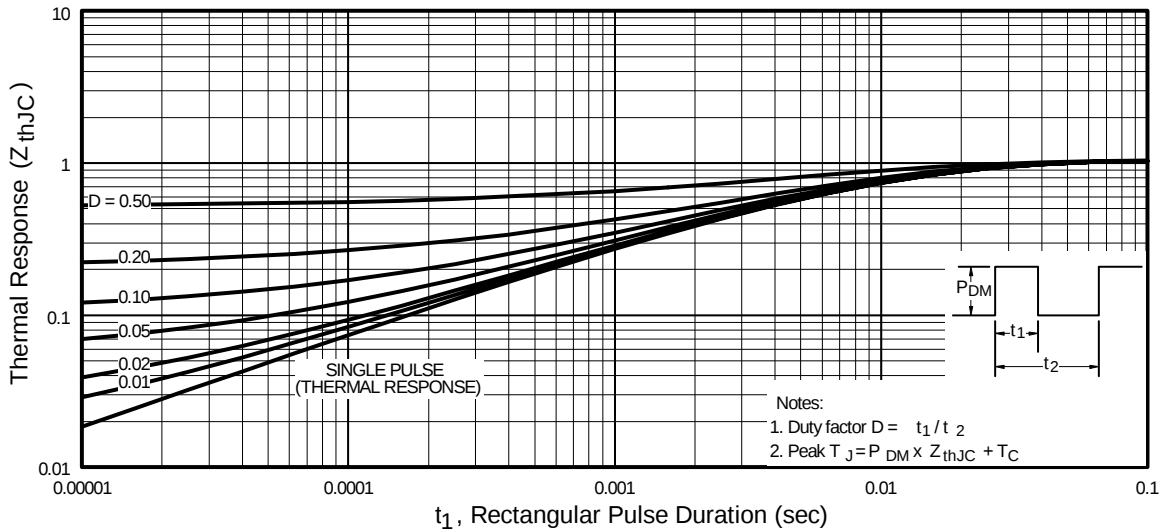
**Fig 9.** Maximum Drain Current Vs. Case Temperature



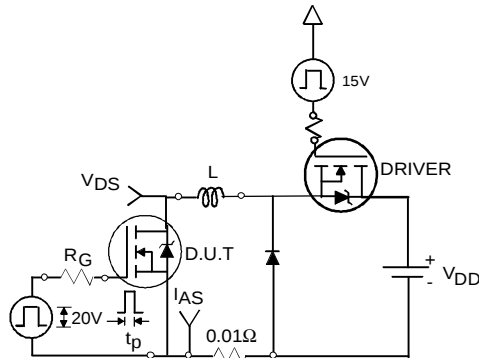
**Fig 10a.** Switching Time Test Circuit



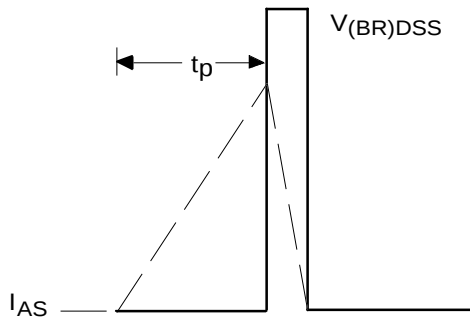
**Fig 10b.** Switching Time Waveforms



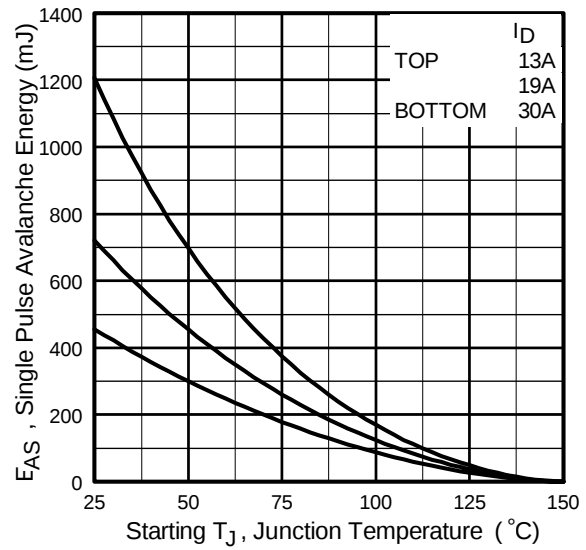
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case



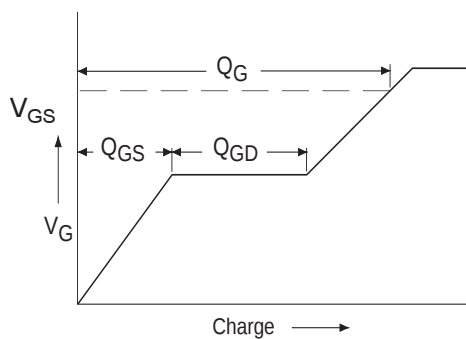
**Fig 12a.** Unclamped Inductive Test Circuit



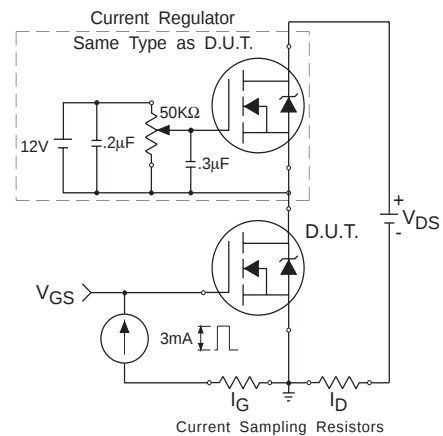
**Fig 12b.** Unclamped Inductive Waveforms



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

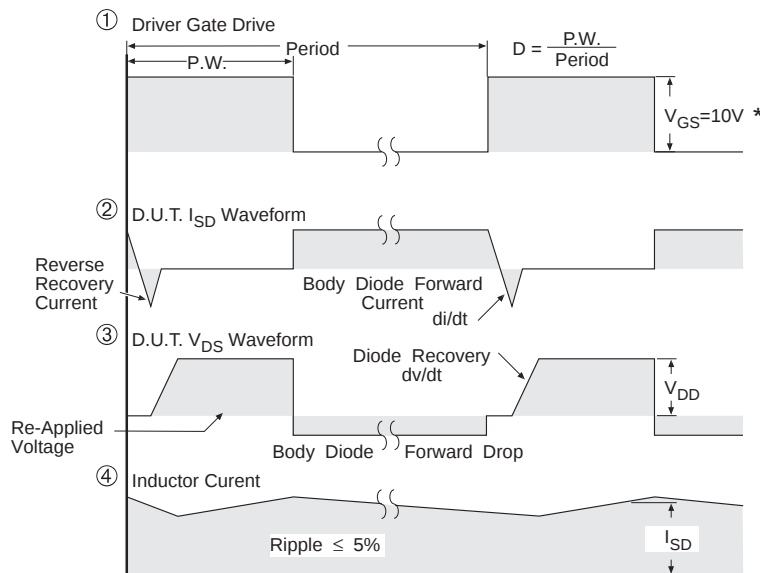
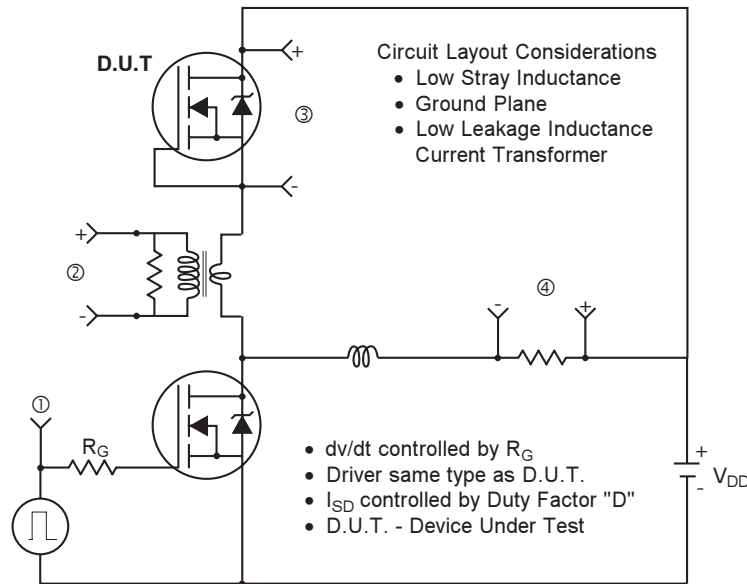


**Fig 13a.** Basic Gate Charge Waveform



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

### Peak Diode Recovery $dv/dt$ Test Circuit



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

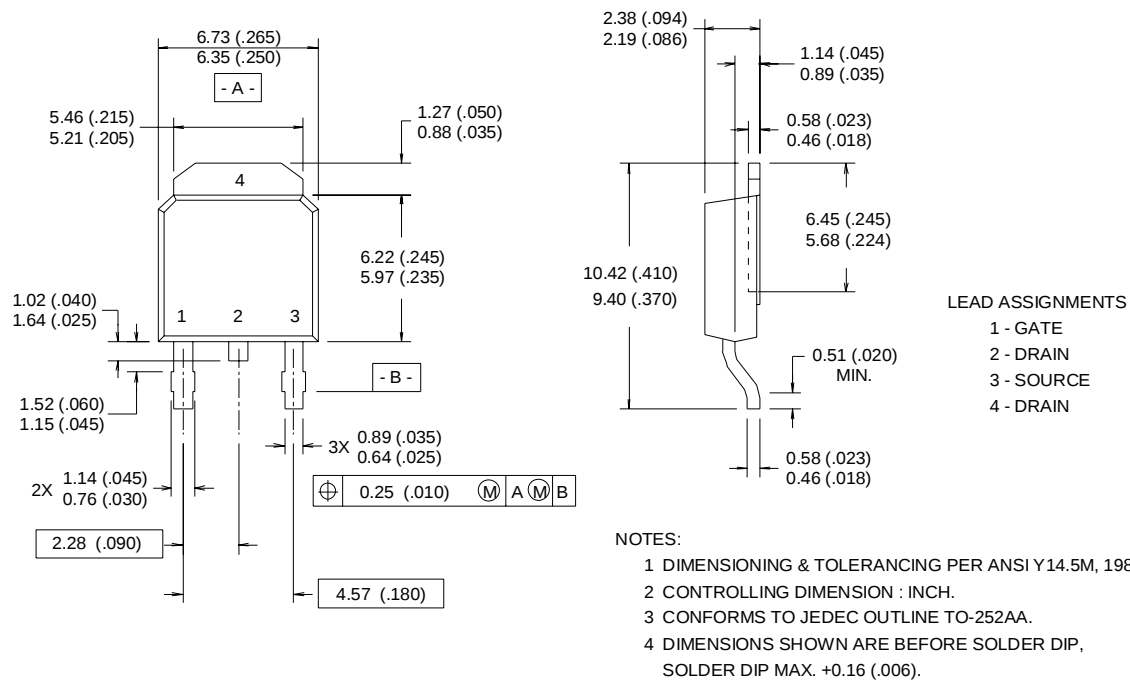
**Fig 14.** For N-Channel HEXFET® Power MOSFETs

# IRFR/U3711

International  
**IR** Rectifier

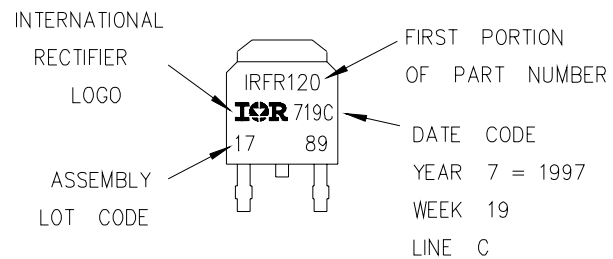
## D-Pak (TO-252AA) Package Outline

Dimensions are shown in millimeters (inches)



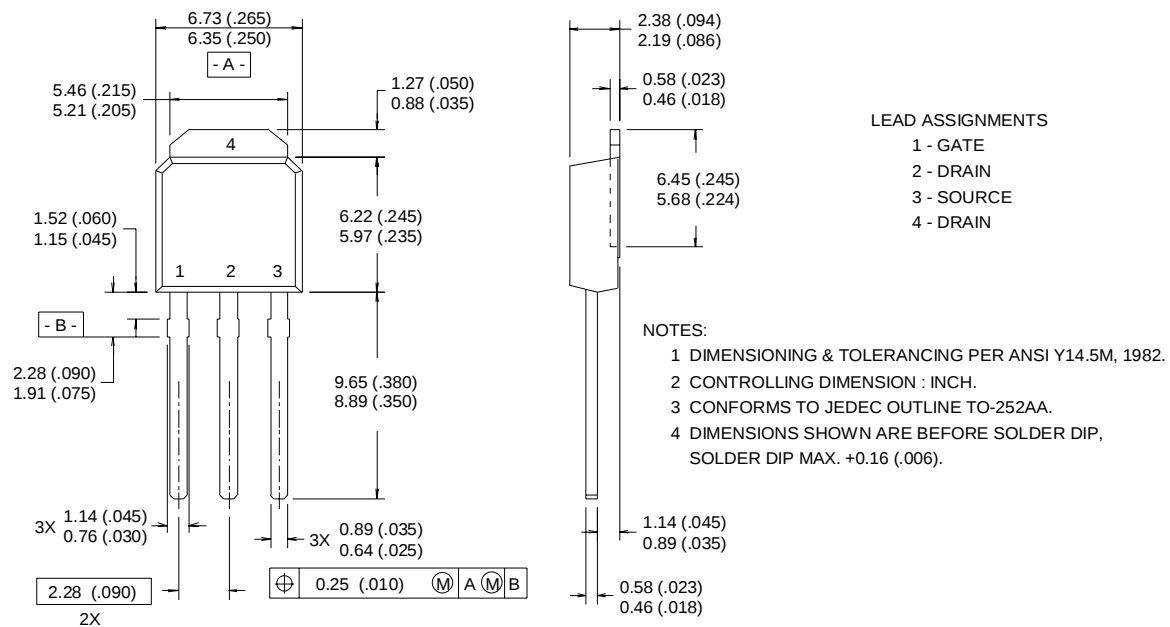
## D-Pak (TO-252AA) Part Marking Information

EXAMPLE: THIS IS AN IRFR120  
LOT CODE 1789  
ASSEMBLED ON WW 19, 1997  
IN THE ASSEMBLY LINE "C"



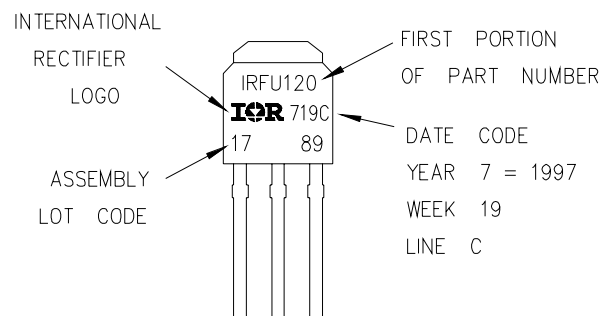
## I-Pak (TO-251AA) Package Outline

Dimensions are shown in millimeters (inches)



## I-Pak (TO-251AA) Part Marking Information

EXAMPLE: THIS IS AN IRFU120  
LOT CODE 1789  
ASSEMBLED ON WW 19, 1997  
IN THE ASSEMBLY LINE "C"

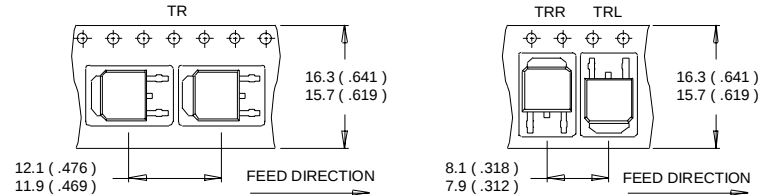


# IRFR/U3711

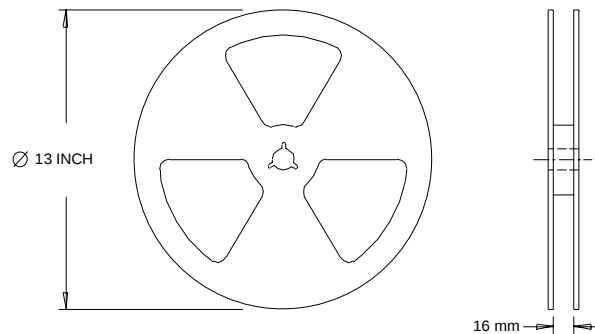
International  
**IR** Rectifier

## 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.

### Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting  $T_J = 25^\circ\text{C}$ ,  $L = 1.0\text{mH}$   
 $R_G = 25\Omega$ ,  $I_{AS} = 30\text{A}$ .
- ③ Pulse width  $\leq 400\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- ④ Calculated continuous current based on maximum allowable junction temperature. Package limitation current is 30A.
- ⑤ 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  $R_\theta$  is measured at  $T_J$  approximately at  $90^\circ\text{C}$

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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