

**SMPS MOSFET**

**IRFR3704PbF**  
**IRFU3704PbF**

HEXFET® Power MOSFET

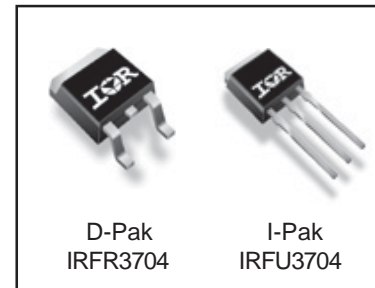
**Applications**

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

V <sub>DSS</sub>	R <sub>DS(on)</sub> max	I <sub>D</sub>
20V	9.5mΩ	75A

**Benefits**

- Ultra-Low R<sub>DS(on)</sub>
- Very Low Gate Impedance
- Fully Characterized Avalanche Voltage and Current



**Absolute Maximum Ratings**

Symbol	Parameter	Max	Units
V <sub>DS</sub>	Drain-Source Voltage	20	V
V <sub>GS</sub>	Gate-Source Voltage	± 20	
I <sub>D</sub> @ T <sub>C</sub> = 25°C	Continuous Drain Current, V <sub>GS</sub> @ 10V	75 ④	A
I <sub>D</sub> @ T <sub>C</sub> = 70°C	Continuous Drain Current, V <sub>GS</sub> @ 10V	63 ④	
I <sub>DM</sub>	Pulsed Drain Current ①	300	
P <sub>D</sub> @ T <sub>C</sub> = 25°C	Maximum Power Dissipation ③	90	W
P <sub>D</sub> @ T <sub>A</sub> = 70°C	Maximum Power Dissipation ③	62	
	Linear Derating Factor	0.58	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 ②	—	1.7	°C/W
R <sub>θJA</sub>	Junction-to-Ambient (PCB Mount) *⑤	—	50	
R <sub>θJA</sub>	Junction-to-Ambient ⑤	—	110	

\* When mounted on 1" square PCB (FR-4 or G-10 Material) .  
 For recommended footprint and soldering techniques refer to application note #AN-994

Notes ① through ⑤ are on page 9

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

Symbol	Parameter	Min	Typ	Max	Units	Conditions
V <sub>(BR)DSS</sub>	Drain-to-Source Breakdown Voltage	20	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA
ΔV <sub>(BR)DSS/ΔT<sub>J</sub></sub>	Breakdown Voltage Temp. Coefficient	—	0.021	—	V/°C	Reference to 25°C, I <sub>D</sub> = 1mA
R <sub>DS(on)</sub>	Static Drain-to-Source On-Resistance	—	7.3	9.5	mΩ	V <sub>GS</sub> = 10V, I <sub>D</sub> = 15A ③ V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 12A ③
V <sub>GS(th)</sub>	Gate Threshold Voltage	1.0	—	3.0	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA
I <sub>DSS</sub>	Drain-to-Source Leakage Current	—	—	10	μA	V <sub>DS</sub> = 20V, V <sub>GS</sub> = 0V V <sub>DS</sub> = 16V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 125°C
I <sub>GSS</sub>	Gate-to-Source Forward Leakage	—	—	200	nA	V <sub>GS</sub> = 16V
	Gate-to-Source Reverse Leakage	—	—	-200	nA	V <sub>GS</sub> = -16V

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

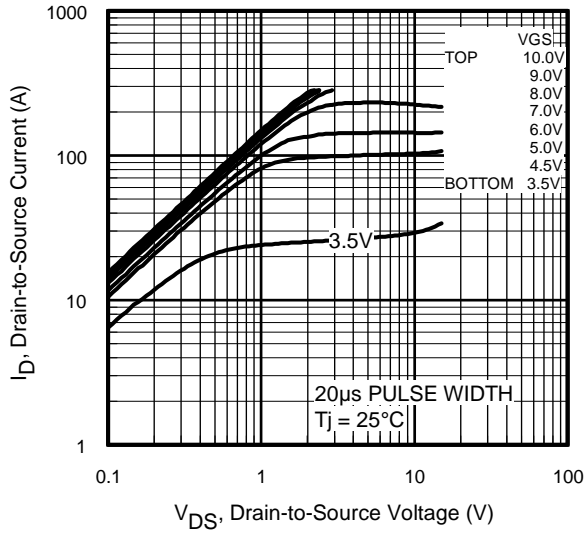
Symbol	Parameter	Min	Typ	Max	Units	Conditions
g <sub>fs</sub>	Forward Transconductance	42	—	—	S	V <sub>DS</sub> = 25V, I <sub>D</sub> = 57A
Q <sub>g</sub>	Total Gate Charge	—	19	—	nC	I <sub>D</sub> = 28.4A V <sub>DS</sub> = 10V V <sub>GS</sub> = 4.5V ③ V <sub>GS</sub> = 0V, V <sub>DS</sub> = 10V
Q <sub>gs</sub>	Gate-to-Source Charge	—	8.1	—		
Q <sub>gd</sub>	Gate-to-Drain ("Miller") Charge	—	6.4	—		
Q <sub>OSS</sub>	Output Gate Charge	—	16	24		
R <sub>G</sub>	Gate Resistance	0.3	—	3.2	Ω	
t <sub>d(on)</sub>	Turn-On Delay Time	—	8.4	—	ns	V <sub>DD</sub> = 10V I <sub>D</sub> = 28.4A R <sub>G</sub> = 1.8Ω V <sub>GS</sub> = 4.5V ③
t <sub>r</sub>	Rise Time	—	98	—		
t <sub>d(off)</sub>	Turn-Off Delay Time	—	12	—		
t <sub>f</sub>	Fall Time	—	5.0	—		
C <sub>iss</sub>	Input Capacitance	—	1996	—	pF	V <sub>GS</sub> = 0V V <sub>DS</sub> = 10V f = 1.0MHz
C <sub>OSS</sub>	Output Capacitance	—	1085	—		
C <sub>rss</sub>	Reverse Transfer Capacitance	—	155	—		

### Avalanche Characteristics

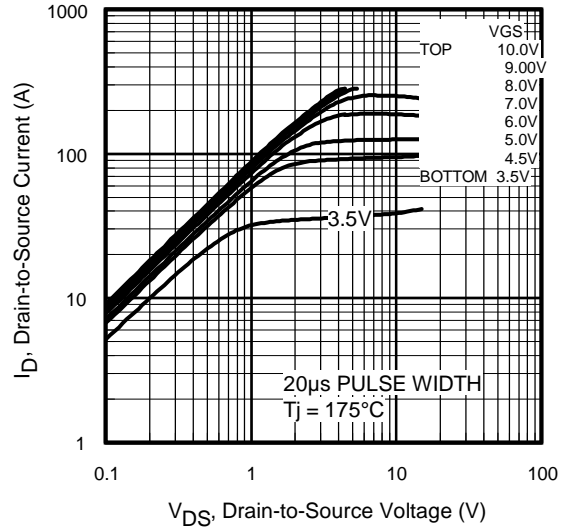
Symbol	Parameter	Typ	Max	Units
E <sub>AS</sub>	Single Pulse Avalanche Energy ②	—	216	mJ
I <sub>AR</sub>	Avalanche Current ①	—	71	A

### Diode Characteristics

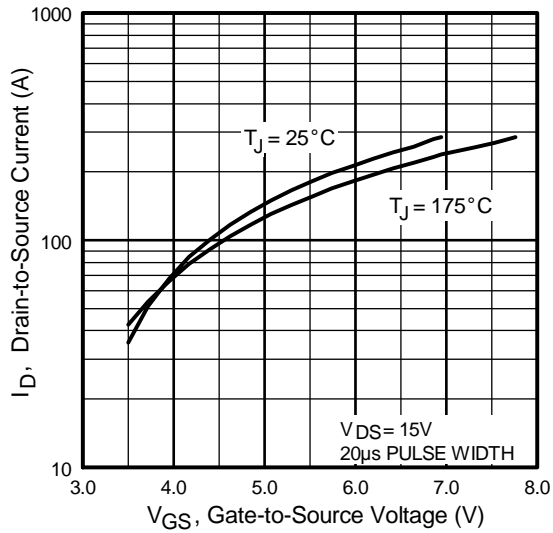
Symbol	Parameter	Min	Typ	Max	Units	Conditions
I <sub>S</sub>	Continuous Source Current (Body Diode)	—	—	75 ④	A	MOSFET symbol showing the integral reverse p-n junction diode.
I <sub>SM</sub>	Pulsed Source Current (Body Diode) ①	—	—	300		
V <sub>SD</sub>	Diode Forward Voltage	—	0.88	1.3	V	T <sub>J</sub> = 25°C, I <sub>S</sub> = 35.5A, V <sub>GS</sub> = 0V ③ T <sub>J</sub> = 125°C, I <sub>S</sub> = 35.5A, V <sub>GS</sub> = 0V ③
t <sub>rr</sub>	Reverse Recovery Time	—	38	57	ns	T <sub>J</sub> = 25°C, I <sub>F</sub> = 35.5A, V <sub>R</sub> = 20V
Q <sub>rr</sub>	Reverse Recovery Charge	—	45	68	nC	di/dt = 100A/μs ③
t <sub>rr</sub>	Reverse Recovery Time	—	41	62	ns	T <sub>J</sub> = 125°C, I <sub>F</sub> = 35.5A, V <sub>R</sub> = 20V
Q <sub>rr</sub>	Reverse Recovery Charge	—	50	75	nC	di/dt = 100A/μs ③



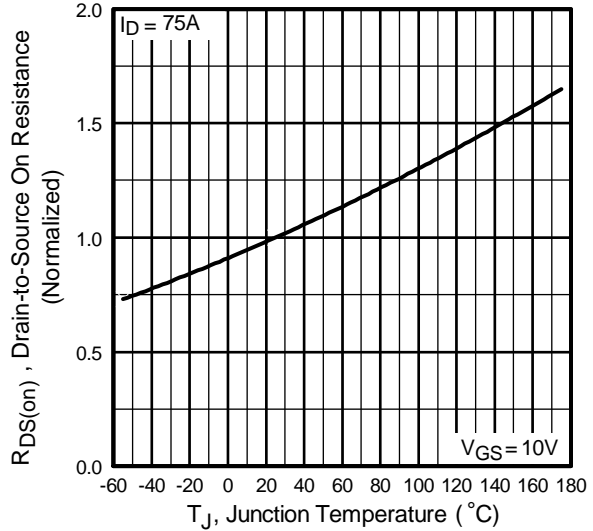
**Fig 1.** Typical Output Characteristics



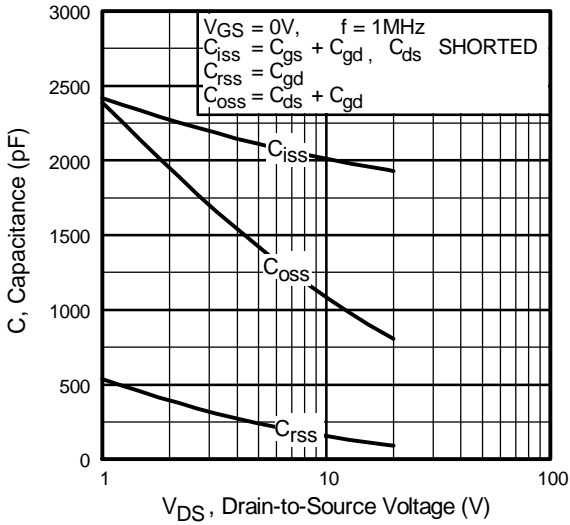
**Fig 2.** Typical Output Characteristics



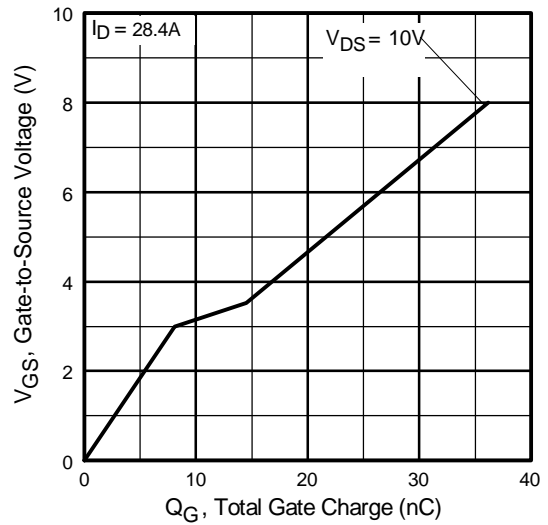
**Fig 3.** Typical Transfer Characteristics



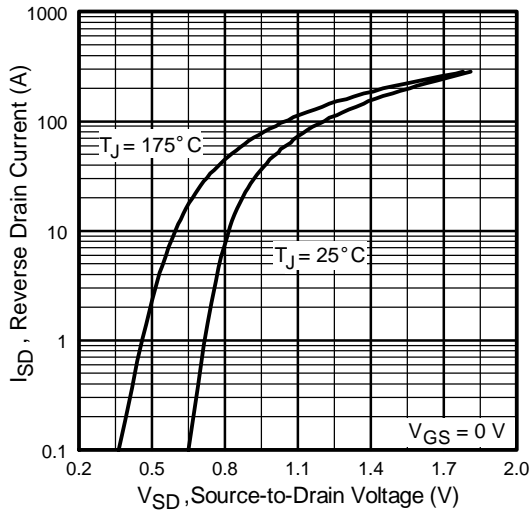
**Fig 4.** Normalized On-Resistance Vs. Temperature



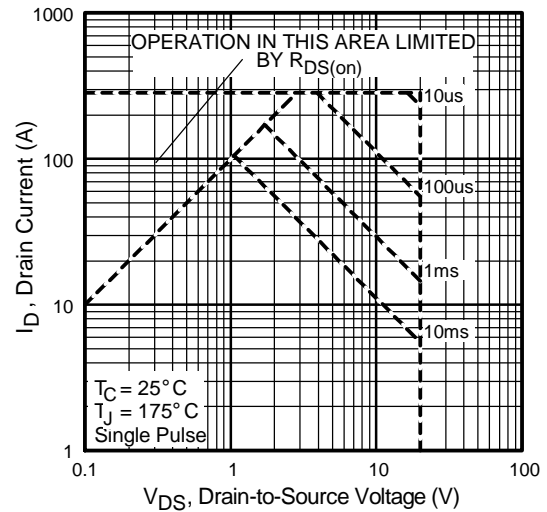
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



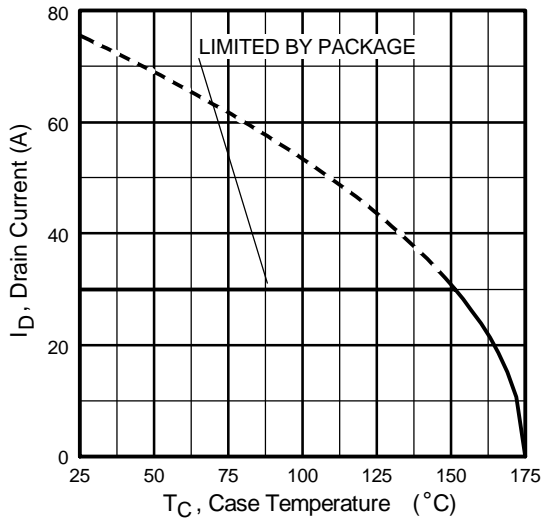
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



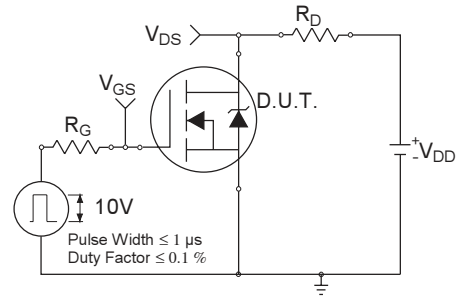
**Fig 7.** Typical Source-Drain Diode Forward Voltage



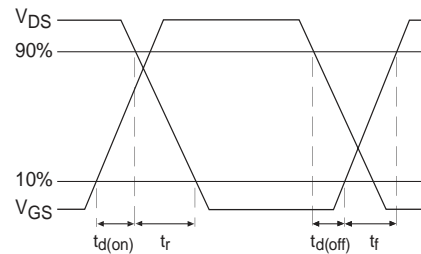
**Fig 8.** Maximum Safe Operating Area



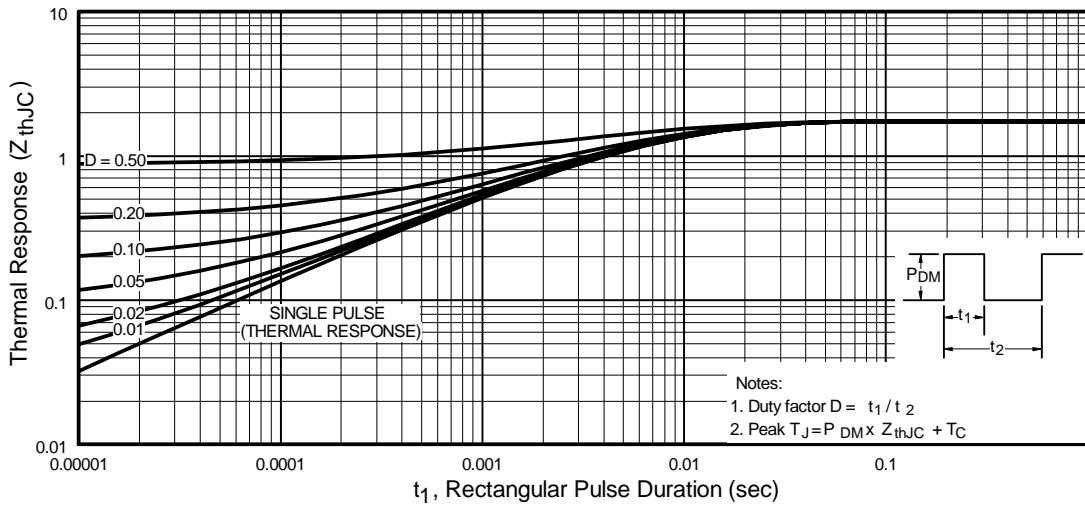
**Fig 9.** Maximum Drain Current Vs. Case Temperature



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



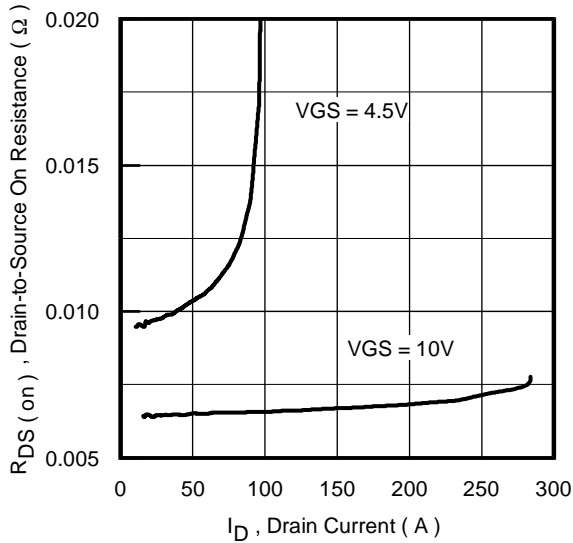
**Fig 10b.** Switching Time Waveforms



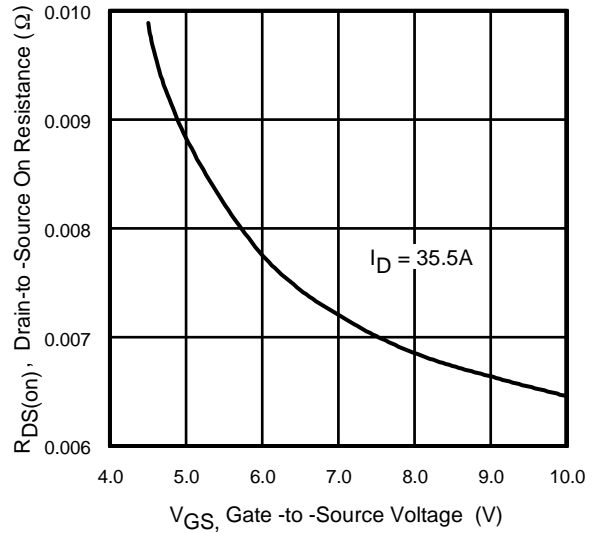
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

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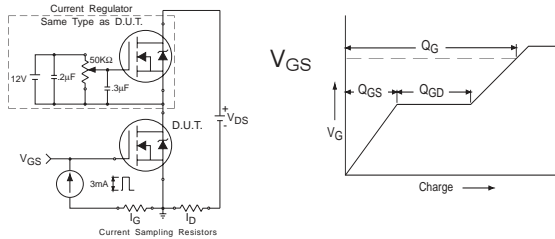
International  
**IR** Rectifier



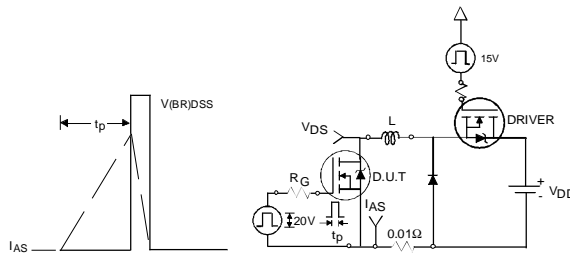
**Fig 12.** On-Resistance Vs. Drain Current



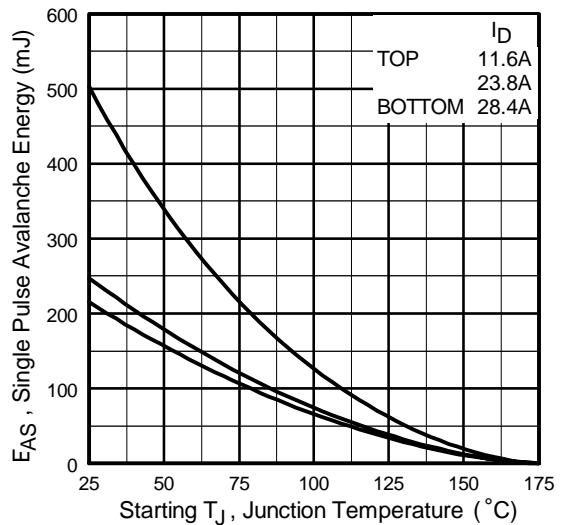
**Fig 13.** On-Resistance Vs. Gate Voltage



**Fig 14a&b.** Basic Gate Charge Test Circuit and Waveforms



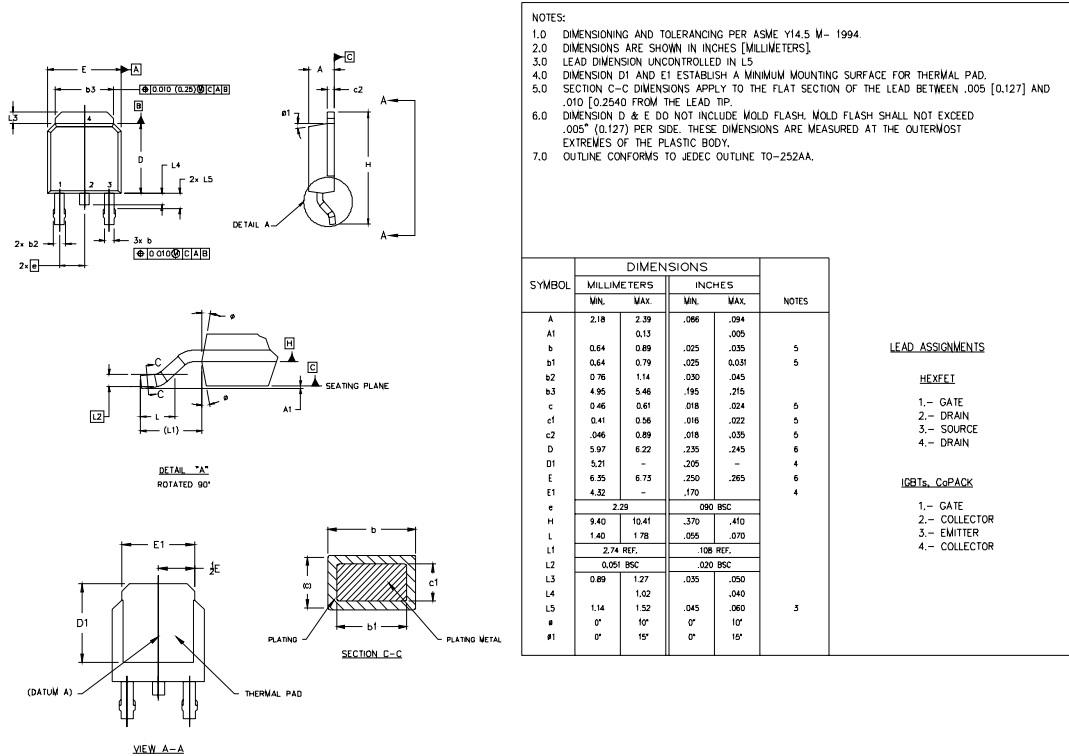
**Fig 15a&b.** Unclamped Inductive Test Circuit and Waveforms



**Fig 15c.** Maximum Avalanche Energy Vs. Drain Current

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

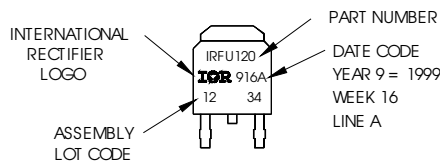
Dimensions are shown in millimeters (inches)



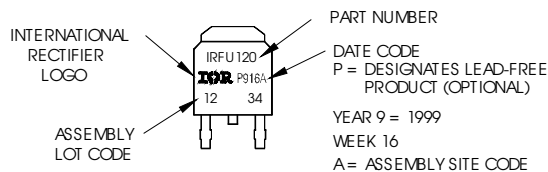
## D-Pak (TO-252AA) Part Marking Information

EXAMPLE: THIS IS AN IRFR120  
WITH ASSEMBLY  
LOT CODE 1234  
ASSEMBLED ON WW 16, 1999  
IN THE ASSEMBLY LINE "A"

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



OR

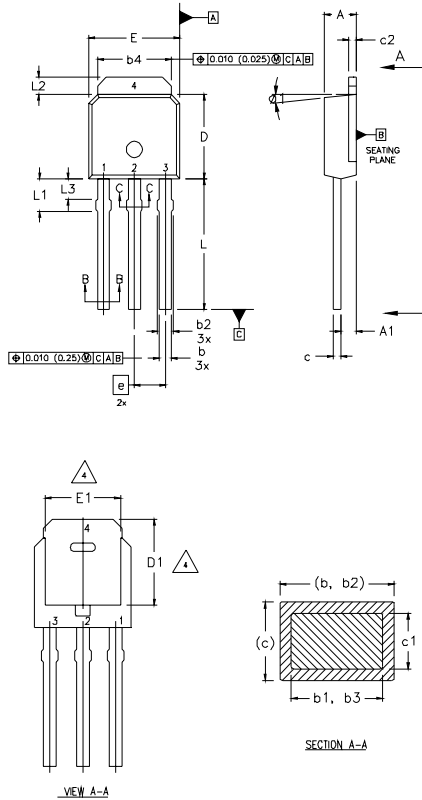


# IRFR/U3704PbF

International  
**IR** Rectifier

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

Dimensions are shown in millimeters (inches)



**NOTES:**

- 1 DIMENSIONING AND TOLERANCING PER ASME Y14.5 M- 1994.
- 2 DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).
- 3 DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
- 4 THERMAL PAD CONTOUR OPTION WITHIN DIMENSION b4, L2, E1 & D1.
- 5 LEAD DIMENSION UNCONTROLLED IN L3.
- 6 DIMENSION b1, b3 APPLY TO BASE METAL ONLY.
- 7 OUTLINE CONFORMS TO JEDEC OUTLINE TO-251AA.
- 8 CONTROLLING DIMENSION : INCHES.

**LEAD ASSIGNMENTS**

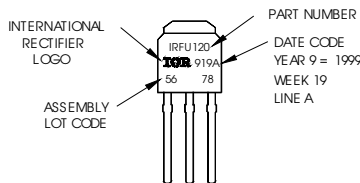
**HEXFEEET**

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

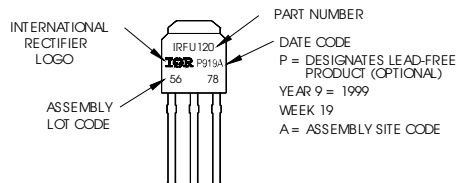
SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	2.18	2.39	0.086	.094	
A1	0.89	1.14	0.035	0.045	
b	0.64	0.89	0.025	0.035	
b1	0.64	0.79	0.025	0.031	4
b2	0.76	1.14	0.030	0.045	
b3	0.76	1.04	0.030	0.041	
b4	5.00	5.46	0.195	0.215	4
c	0.46	0.61	0.018	0.024	
c1	0.41	0.56	0.016	0.022	
c2	.046	0.86	0.018	0.035	
D	5.97	6.22	0.235	0.245	3, 4
D1	5.21	-	0.205	-	4
E	6.35	6.73	0.250	0.265	3, 4
E1	4.32	-	0.170	-	4
e	2.29		0.090 BSC		
L	8.89	9.60	0.350	0.380	
L1	1.91	2.29	0.075	0.090	
L2	0.89	1.27	0.035	0.050	4
L3	1.14	1.52	0.045	0.060	5
ø1	Ø	15'	Ø	15'	

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

EXAMPLE: THIS IS AN IRFU120 WITH ASSEMBLY LOT CODE 5678 ASSEMBLED ON WW 19, 1999 IN THE ASSEMBLY LINE 'A'  
**Note:** 'P' in assembly line position indicates 'Lead-Free'



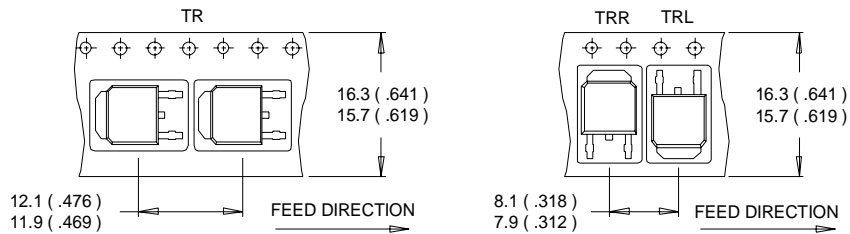
**OR**



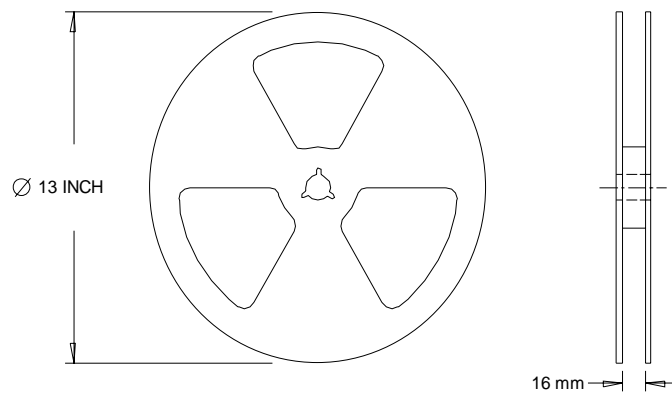


## D-Pak (TO-252AA) Tape & Reel Information

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  $T_J = 25^\circ\text{C}$ ,  $L = 0.5 \text{ mH}$   
 $R_G = 25\Omega$ ,  $I_{AS} = 28.4 \text{ A}$ .
- ③ Pulse width  $\leq 300\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- ④ Calculated continuous current based on maximum allowable junction temperature. Package limitation current is 30A
- ⑤  $R_\theta$  is measured at  $T_J$  approximately  $90^\circ\text{C}$

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.

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