

International **IR** Rectifier

- Ultra Low On-Resistance
- Surface Mount (IRFR3910)
- Straight Lead (IRFU3910)
- Advanced Process Technology
- Fast Switching
- Fully Avalanche Rated
- Lead-Free

Description

Fifth Generation HEXFETs from International Rectifier utilize advanced processing techniques to achieve the lowest possible on-resistance per silicon area. This benefit, combined with the fast switching speed and ruggedized device design that HEXFET Power MOSFETs are well known for, provides the designer with an extremely efficient device for use in a wide variety of applications.

The D-PAK is designed for surface mounting using vapor phase, infrared, or wave soldering techniques. The straight lead version (IRFU series) is for through-hole mounting applications. Power dissipation levels up to 1.5 watts are possible in typical surface mount applications.

Absolute Maximum Ratings

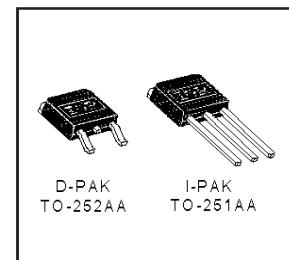
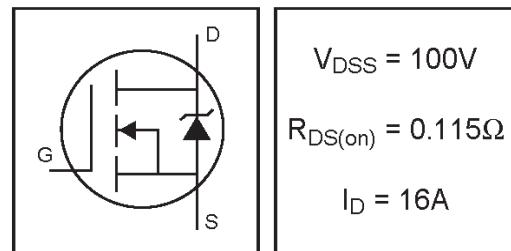
	Parameter	Max.	Units
$I_D @ T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$	16	A
$I_D @ T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$	12	
I_{DM}	Pulsed Drain Current ①⑥	60	
$P_D @ T_C = 25^\circ\text{C}$	Power Dissipation	79	W
	Linear Derating Factor	0.53	W/ $^\circ\text{C}$
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS}	Single Pulse Avalanche Energy ②⑥	150	mJ
I_{AR}	Avalanche Current ①⑥	9.0	A
E_{AR}	Repetitive Avalanche Energy ①⑥	7.9	mJ
dv/dt	Peak Diode Recovery dv/dt ③	5.0	V/ns
T_J	Operating Junction and	-55 to + 175	$^\circ\text{C}$
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	1.9	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Junction-to-Ambient (PCB mount) **	—	50	
$R_{\theta JA}$	Junction-to-Ambient	—	110	

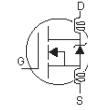
IRFR3910PbF IRFU3910PbF

HEXFET® Power MOSFET



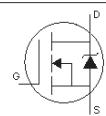
Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	100	—	—	V	$V_{GS} = 0\text{V}$, $I_D = 250\mu\text{A}$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.12	—	V/ $^\circ\text{C}$	Reference to 25°C , $I_D = 1\text{mA}$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	—	0.115		$V_{GS} = 10\text{V}$, $I_D = 10\text{A}$ ④
$V_{GS(th)}$	Gate Threshold Voltage	2.0	—	4.0	V	$V_{DS} = V_{GS}$, $I_D = 250\mu\text{A}$
g_{fs}	Forward Transconductance	6.4	—	—	S	$V_{DS} = 50\text{V}$, $I_D = 9.0\text{A}$ ⑥
I_{DSS}	Drain-to-Source Leakage Current	—	—	25	μA	$V_{DS} = 100\text{V}$, $V_{GS} = 0\text{V}$
		—	—	250		$V_{DS} = 80\text{V}$, $V_{GS} = 0\text{V}$, $T_J = 150^\circ\text{C}$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 20\text{V}$
	Gate-to-Source Reverse Leakage	—	—	-100		$V_{GS} = -20\text{V}$
Q_g	Total Gate Charge	—	—	44	nC	$I_D = 9.0\text{A}$
Q_{gs}	Gate-to-Source Charge	—	—	6.2		$V_{DS} = 80\text{V}$
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	—	21		$V_{GS} = 10\text{V}$, See Fig. 6 and 13 ④⑥
$t_{d(on)}$	Turn-On Delay Time	—	6.4	—	ns	$V_{DD} = 50\text{V}$
t_r	Rise Time	—	27	—		$I_D = 9.0\text{A}$
$t_{d(off)}$	Turn-Off Delay Time	—	37	—		$R_G = 12\Omega$
t_f	Fall Time	—	25	—		$R_D = 5.5\Omega$, See Fig. 10 ④⑥
L_D	Internal Drain Inductance	—	4.5	—	nH	Between lead, 6mm (0.25in.) from package and center of die contact ⑤
L_S	Internal Source Inductance	—	7.5	—		
C_{iss}	Input Capacitance	—	640	—	pF	$V_{GS} = 0\text{V}$
C_{oss}	Output Capacitance	—	160	—		$V_{DS} = 25\text{V}$
C_{rss}	Reverse Transfer Capacitance	—	88	—		$f = 1.0\text{MHz}$, See Fig. 5⑥



Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	16	A	MOSFET symbol showing the integral reverse p-n junction diode.
	Pulsed Source Current (Body Diode) ①⑥	—	—	60		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}$, $I_S = 9.0\text{A}$, $V_{GS} = 0\text{V}$ ④
t_{rr}	Reverse Recovery Time	—	130	190	ns	$T_J = 25^\circ\text{C}$, $I_F = 9.0\text{A}$
Q_{rr}	Reverse Recovery Charge	—	650	970	nC	$di/dt = 100\text{A}/\mu\text{s}$ ④⑥
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 $V_{DD} = 25\text{V}$, starting $T_J = 25^\circ\text{C}$, $L = 3.1\text{mH}$, $R_G = 25\Omega$, $I_{AS} = 9.0\text{A}$. (See Figure 12)
- ③ $I_{SD} \leq 9.0\text{A}$, $di/dt \leq 520\text{A}/\mu\text{s}$, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq 175^\circ\text{C}$
- ④ Pulse width $\leq 300\mu\text{s}$; duty cycle $\leq 2\%$
- ⑤ This is applied for I-PAK, L_S of D-PAK is measured between lead and center of die contact
- ⑥ Uses IRF530N data and test conditions

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

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IR Rectifier

IRFR/U3910PbF

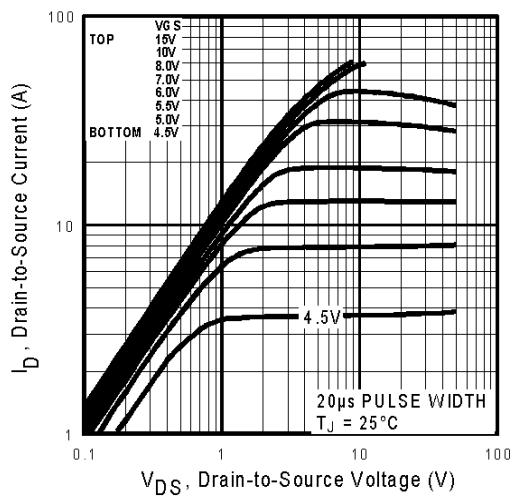


Fig 1. Typical Output Characteristics

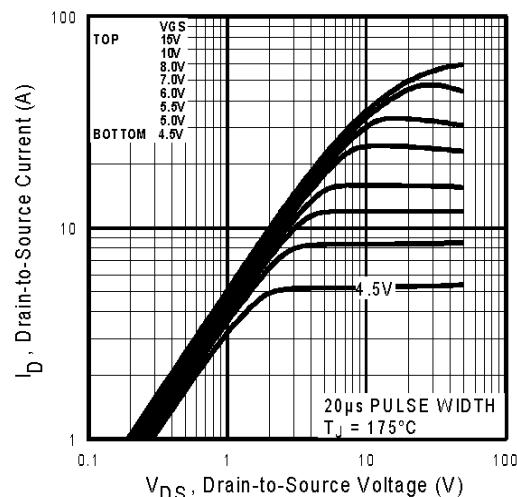


Fig 2. Typical Output Characteristics

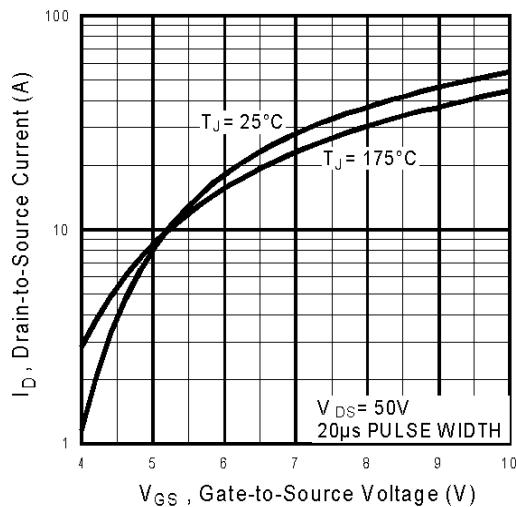


Fig 3. Typical Transfer Characteristics

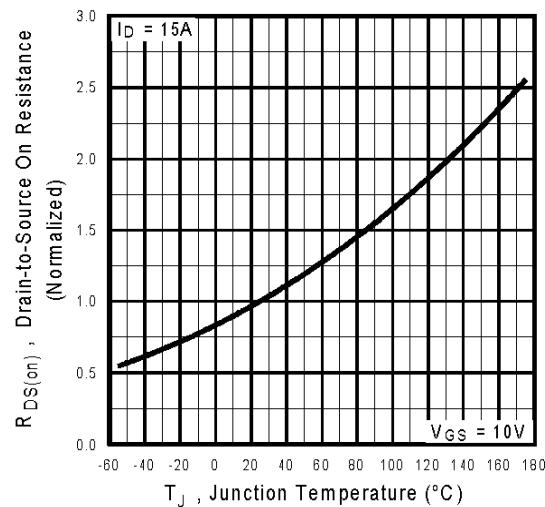


Fig 4. Normalized On-Resistance
Vs. Temperature

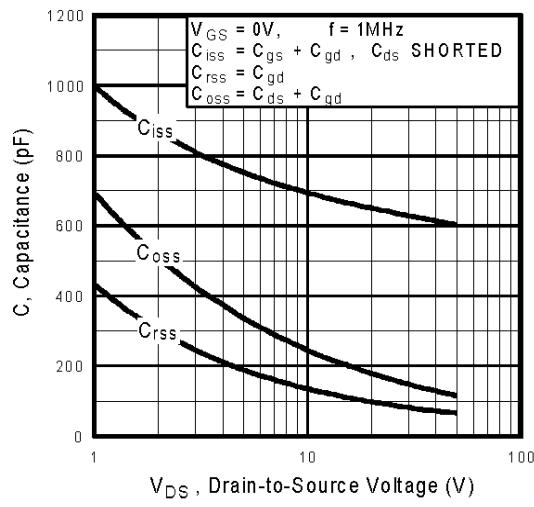


Fig 5. Typical Capacitance Vs.
Drain-to-Source Voltage

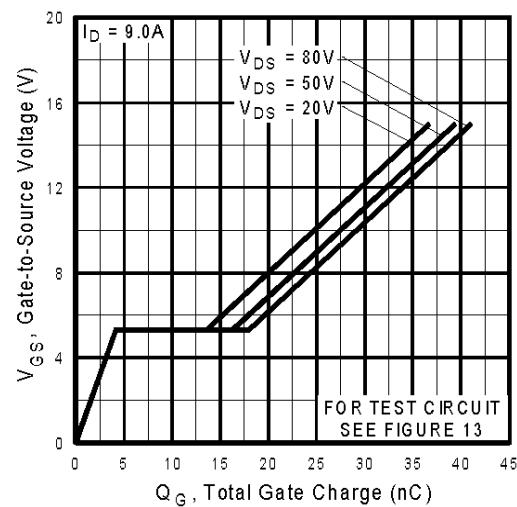


Fig 6. Typical Gate Charge Vs.
Gate-to-Source Voltage

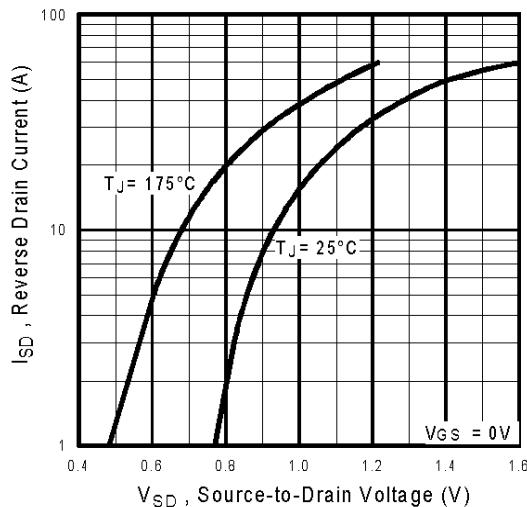


Fig 7. Typical Source-Drain Diode
Forward Voltage

4

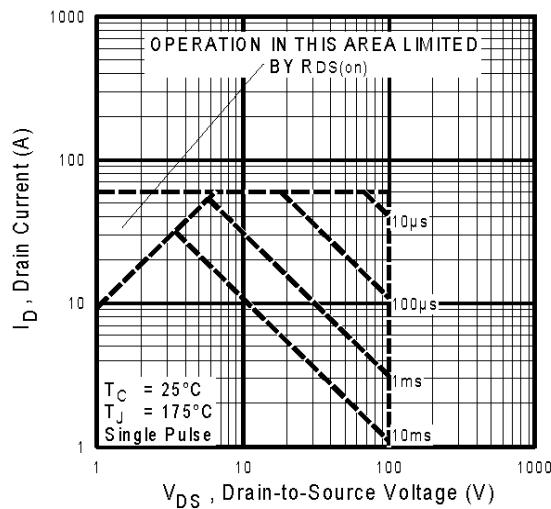


Fig 8. Maximum Safe Operating Area

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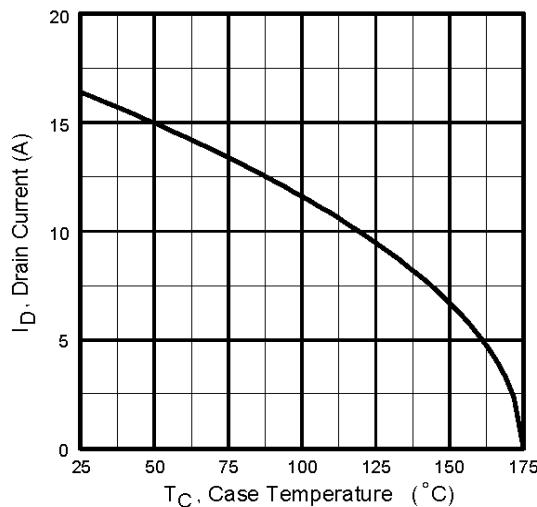


Fig 9. Maximum Drain Current Vs. Case Temperature

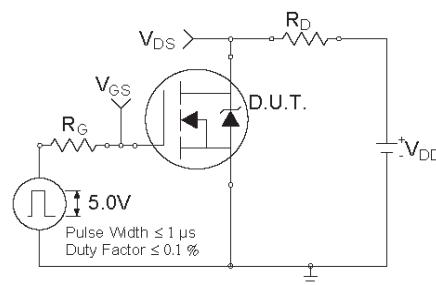


Fig 10a. Switching Time Test Circuit

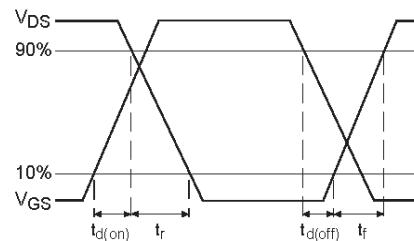


Fig 10b. Switching Time Waveforms

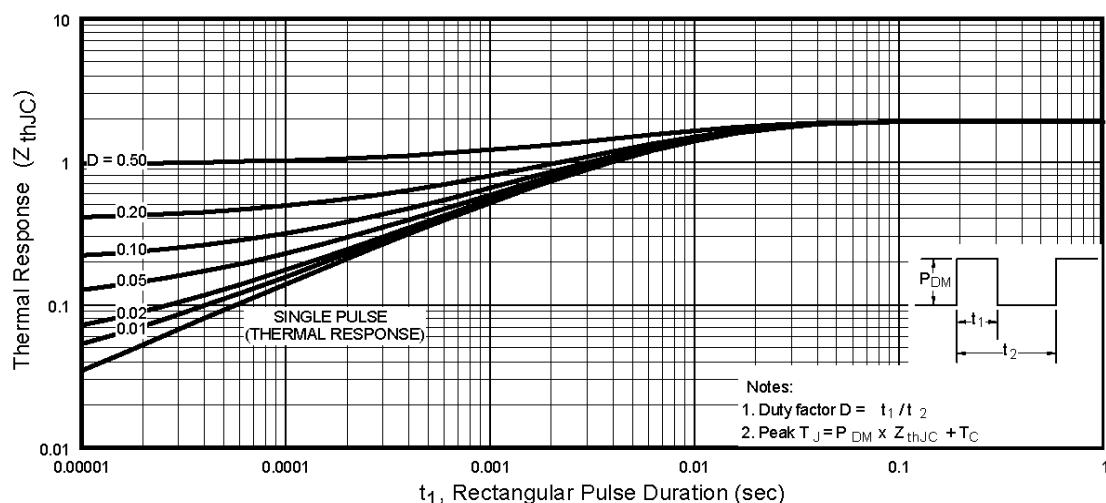


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

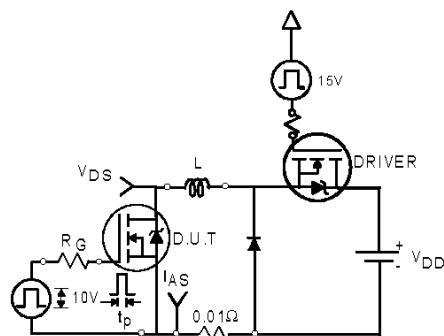


Fig 12a. Unclamped Inductive Test Circuit

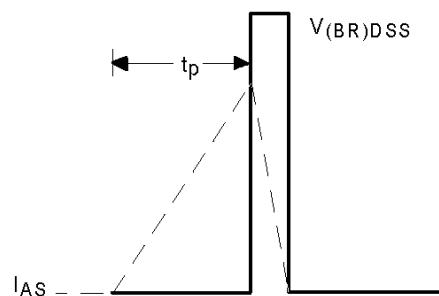


Fig 12b. Unclamped Inductive Waveforms

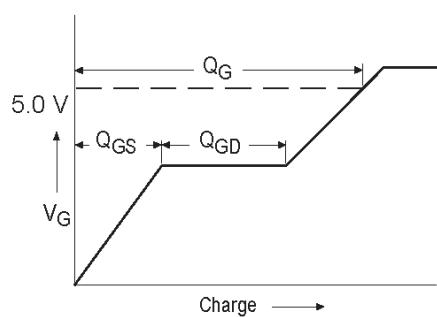


Fig 13a. Basic Gate Charge Waveform

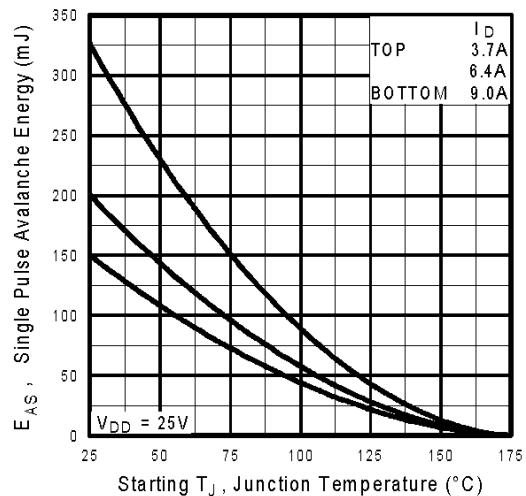


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

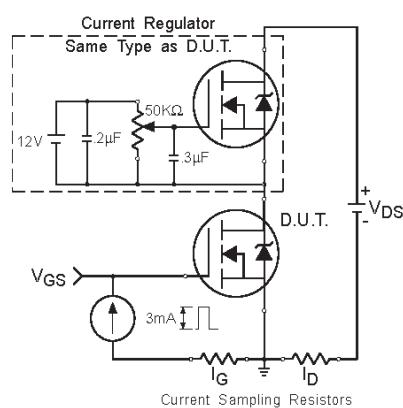
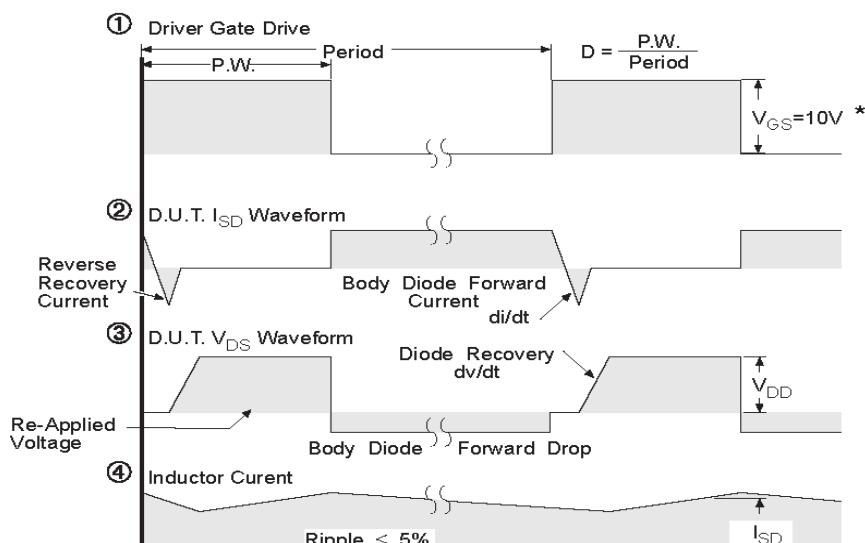
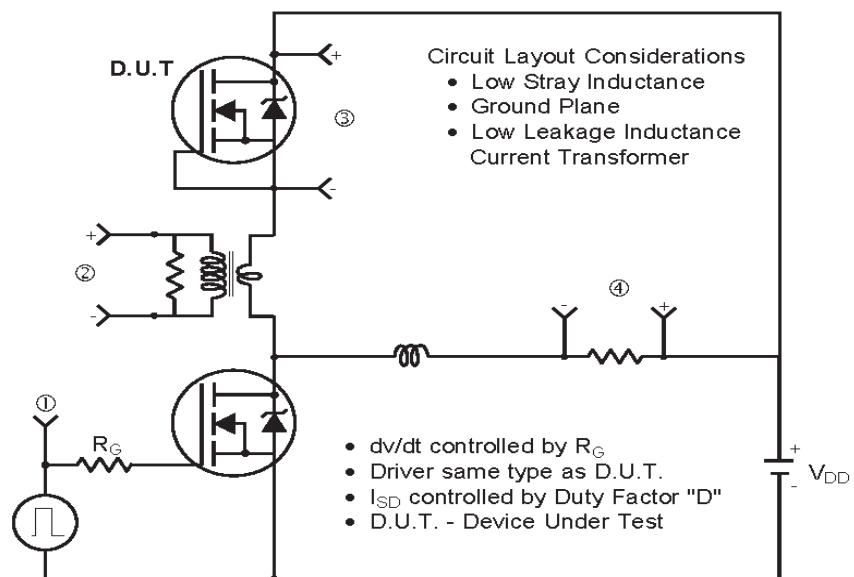


Fig 13b. Gate Charge Test Circuit

Peak Diode Recovery dv/dt Test Circuit

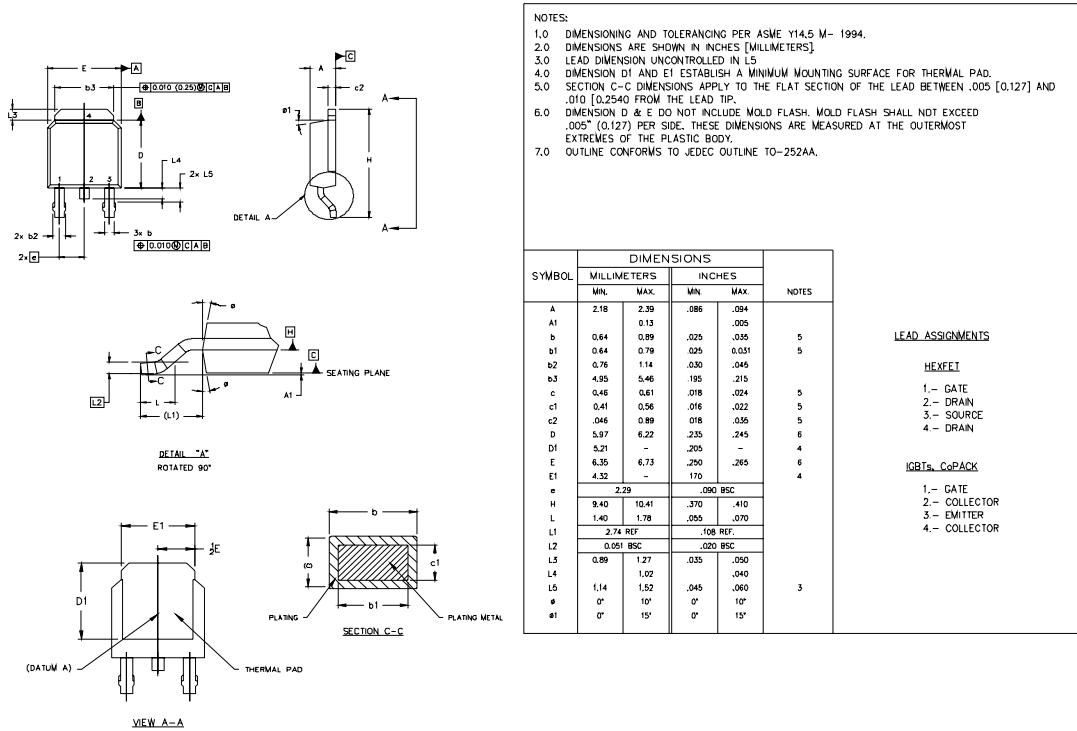


* $V_{GS} = 5V$ for Logic Level Devices

Fig 14. For N-Channel HEXFETs

D-Pak (TO-252AA) Package Outline

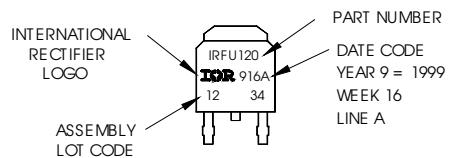
Dimensions are shown in millimeters (inches)



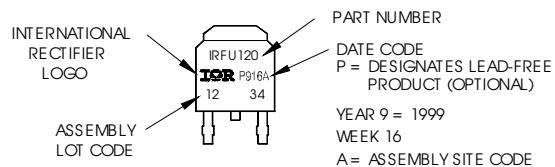
D-Pak (TO-252AA) Part Marking Information

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

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



OR

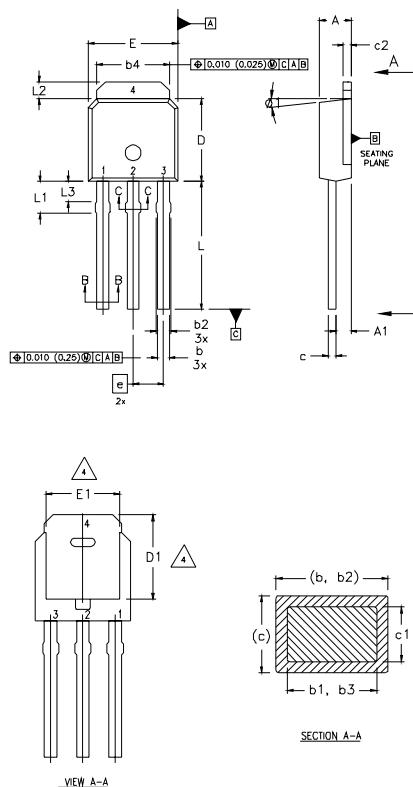


International
ICR Rectifier

IRFR/U3910PbF

I-Pak (TO-251AA) 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
0.005" (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

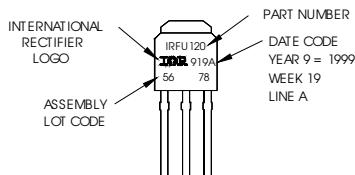
HEXFET

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

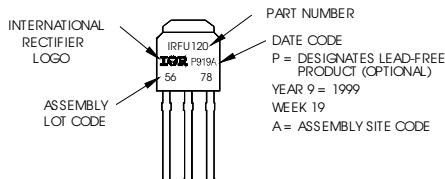
I-Pak (TO-251AA) Part Marking Information

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

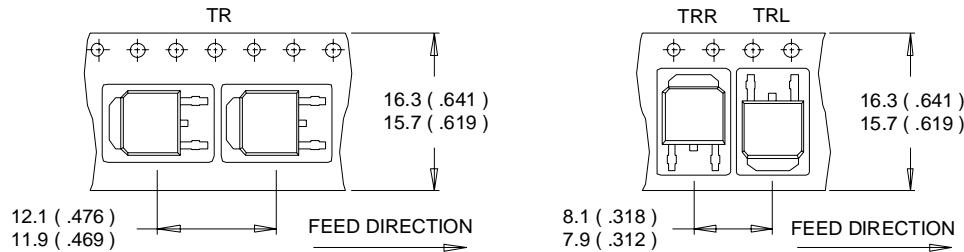


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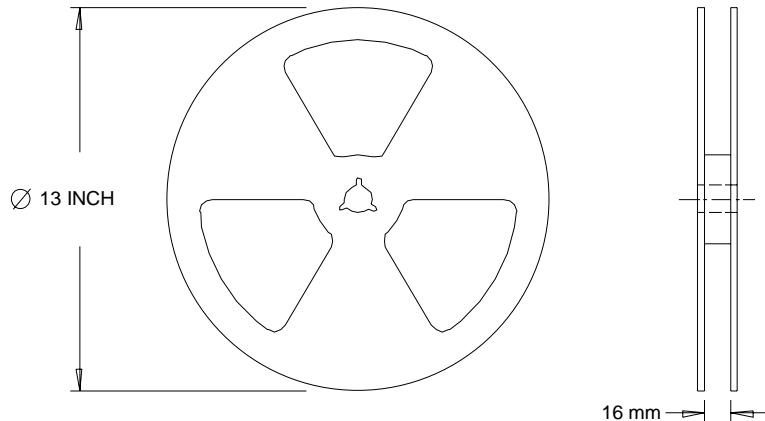
D-Pak (TO-252AA) Tape & Reel Information

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.

Data and specifications subject to change without notice.

International
IR Rectifier

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TAC Fax: (310) 252-7903

Visit us at www.irf.com for sales contact information.01/05

www.irf.com

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

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