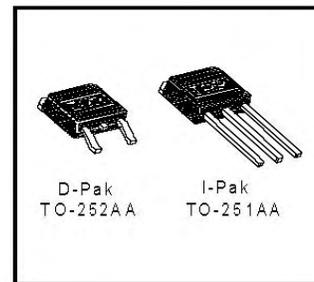
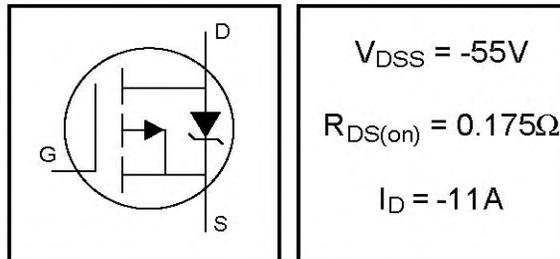


- Ultra Low On-Resistance
- P-Channel
- Surface Mount (IRFR9024N)
- Straight Lead (IRFU9024N)
- Advanced Process Technology
- Fast Switching
- Fully Avalanche Rated
- Lead-Free

HEXFET® Power MOSFET



Description

Fifth Generation HEXFETs from International Rectifier utilize advanced processing techniques to achieve extremely low 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 and reliable 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

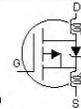
	Parameter	Max.	Units
$I_D @ T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ -10\text{V}$	-11	A
$I_D @ T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ -10\text{V}$	-8	
I_{DM}	Pulsed Drain Current ①	-44	
$P_D @ T_C = 25^\circ\text{C}$	Power Dissipation	38	W
	Linear Derating Factor	0.30	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS}	Single Pulse Avalanche Energy ②	62	mJ
I_{AR}	Avalanche Current ③	-6.6	A
E_{AR}	Repetitive Avalanche Energy ①	3.8	mJ
dv/dt	Peak Diode Recovery dv/dt ③	-10	V/ns
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 150	°C
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	3.3	°C/W
$R_{\theta JA}$	Junction-to-Ambient (PCB mount)**	—	50	
$R_{\theta JA}$	Junction-to-Ambient	—	110	

Electrical Characteristics @ T_J = 25°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 = -250μA
ΔV _{(BR)DSS/ΔT_J}	Breakdown Voltage Temp. Coefficient	—	-0.05	—	V/°C	Reference to 25°C, I _D = -1mA
R _{DS(on)}	Static Drain-to-Source On-Resistance	—	—	0.175	Ω	V _{GS} = -10V, I _D = -6.6A ④
V _{GS(th)}	Gate Threshold Voltage	-2.0	—	-4.0	V	V _{DS} = V _{GS} , I _D = -250μA
g _{fs}	Forward Transconductance	2.5	—	—	S	V _{DS} = -25V, I _D = -7.2A⑥
I _{DSS}	Drain-to-Source Leakage Current	—	—	-25	μA	V _{DS} = -55V, V _{GS} = 0V
		—	—	-250		V _{DS} = -44V, V _{GS} = 0V, T _J = 150°C
I _{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	V _{GS} = 20V
	Gate-to-Source Reverse Leakage	—	—	-100		V _{GS} = -20V
Q _g	Total Gate Charge	—	—	19	nC	I _D = -7.2A
Q _{gs}	Gate-to-Source Charge	—	—	5.1		V _{DS} = -44V
Q _{gd}	Gate-to-Drain ("Miller") Charge	—	—	10		V _{GS} = -10V, See Fig. 6 and 13 ④⑥
t _{d(on)}	Turn-On Delay Time	—	13	—	ns	V _{DD} = -28V
t _r	Rise Time	—	55	—		I _D = -7.2A
t _{d(off)}	Turn-Off Delay Time	—	23	—		R _G = 24Ω
t _f	Fall Time	—	37	—		R _D = 3.7Ω, See Fig. 10 ④⑥
L _D	Internal Drain Inductance	—	4.5	—	nH	Between lead, 6mm (0.25in.) from package and center of die contact⑤
L _S	Internal Source Inductance	—	7.5	—		
C _{iss}	Input Capacitance	—	350	—	pF	V _{GS} = 0V
C _{oss}	Output Capacitance	—	170	—		V _{DS} = -25V
C _{rss}	Reverse Transfer Capacitance	—	92	—		f = 1.0MHz, See Fig. 5⑥



Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I _S	Continuous Source Current (Body Diode)	—	—	-11	A	MOSFET symbol showing the integral reverse p-n junction diode.
I _{SM}	Pulsed Source Current (Body Diode) ①	—	—	-44		
V _{SD}	Diode Forward Voltage	—	—	-1.6	V	T _J = 25°C, I _S = -7.2A, V _{GS} = 0V ④
t _{rr}	Reverse Recovery Time	—	47	71	ns	T _J = 25°C, I _F = -7.2A
Q _{rr}	Reverse Recovery Charge	—	84	130	nC	di/dt = 100A/μs 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 Starting T_J = 25°C, L = 2.8mH
R_G = 25Ω, I_{AS} = -6.6A. (See Figure 12)

③ I_{SD} ≤ -6.6A, di/dt ≤ 240A/μs, V_{DD} ≤ V_{(BR)DSS},
T_J ≤ 150°C

④ Pulse width ≤ 300μs; duty cycle ≤ 2%.

⑤ This is applied for I-PAK, L_S of D-PAK is measured between lead and center of die contact

⑥ Uses IRF9Z24N 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

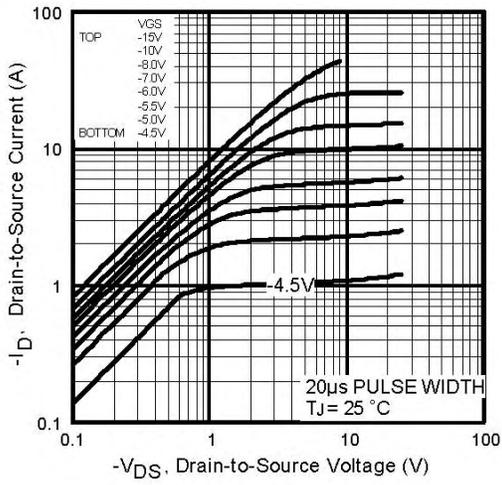


Fig 1. Typical Output Characteristics

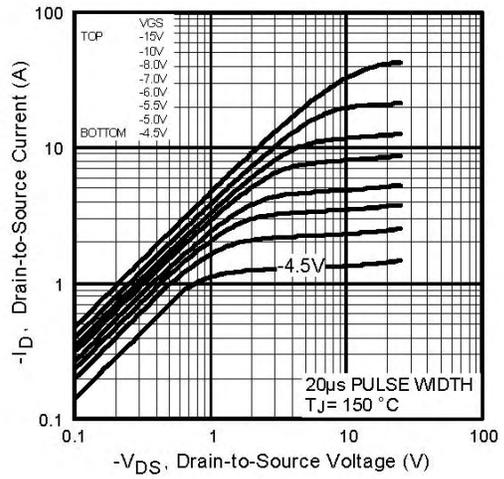


Fig 2. Typical Output Characteristics

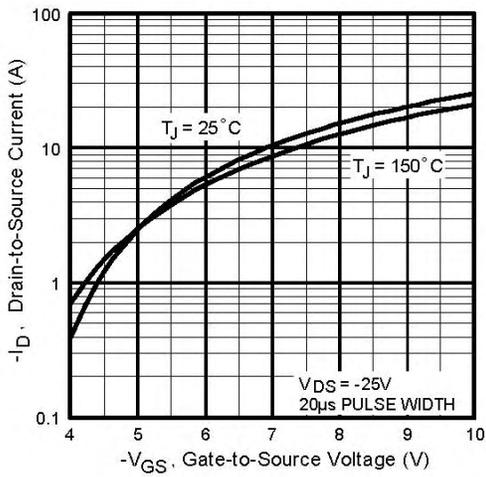


Fig 3. Typical Transfer Characteristics

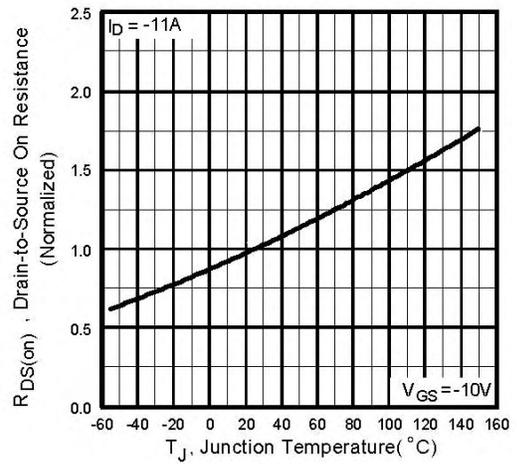


Fig 4. Normalized On-Resistance Vs. Temperature

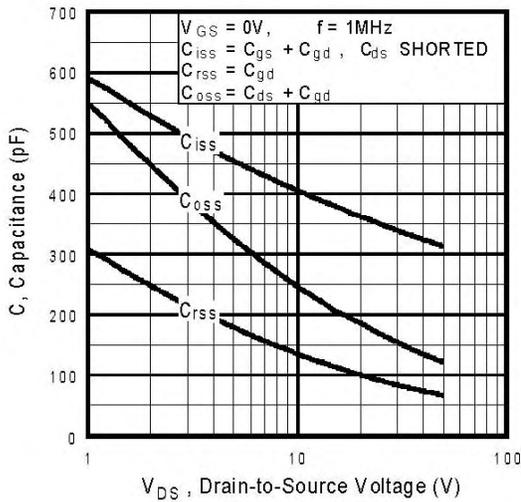


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

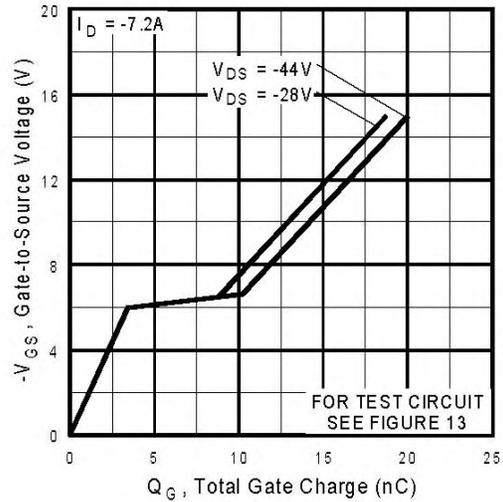


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

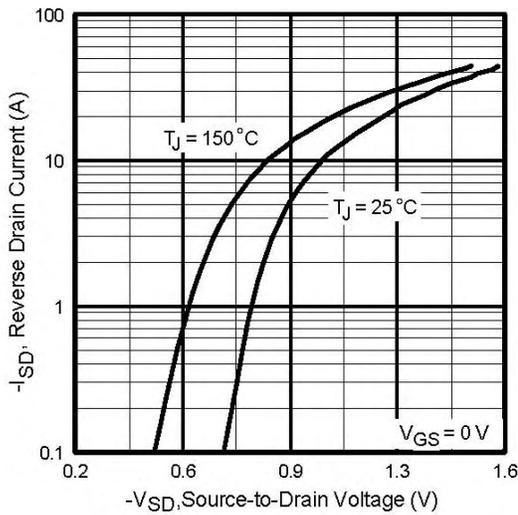


Fig 7. Typical Source-Drain Diode Forward Voltage

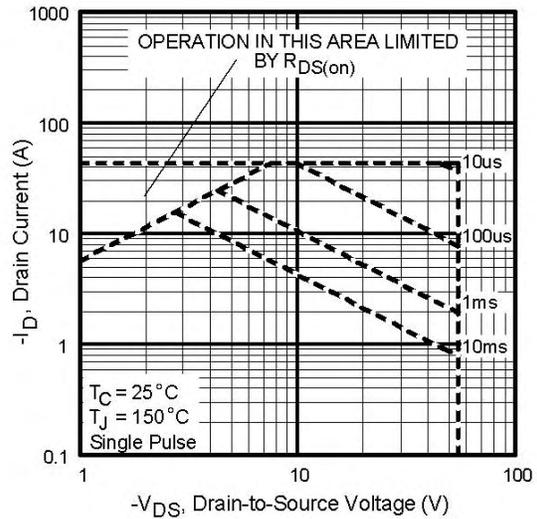


Fig 8. Maximum Safe Operating Area

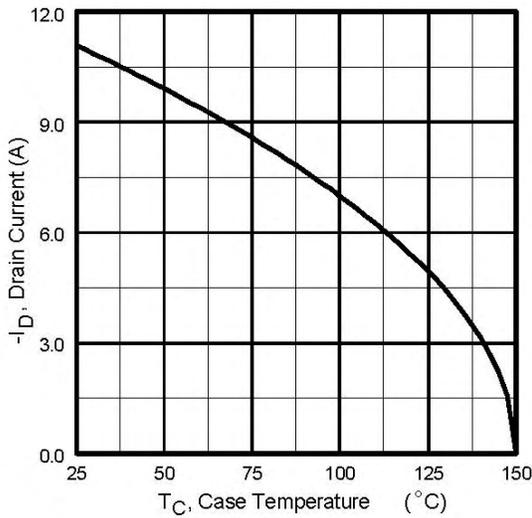


Fig 9. Maximum Drain Current Vs. Case Temperature

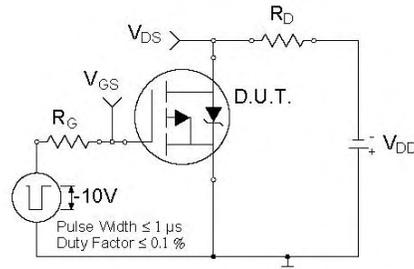


Fig 10a. Switching Time Test Circuit

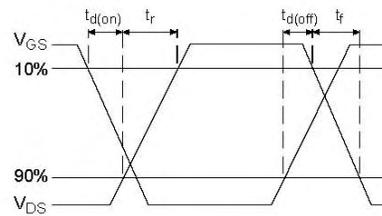


Fig 10b. Switching Time Waveforms

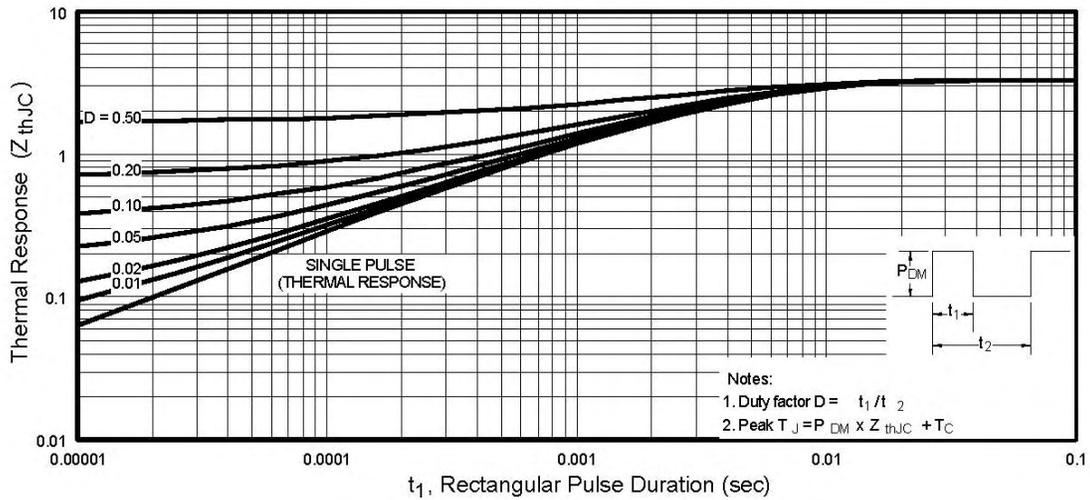


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

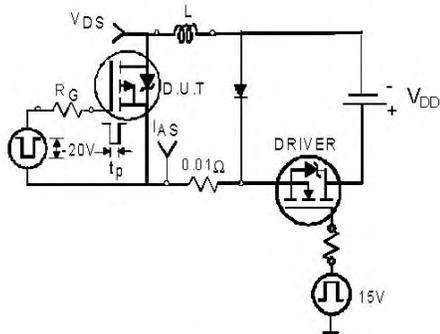


Fig 12a. Unclamped Inductive Test Circuit

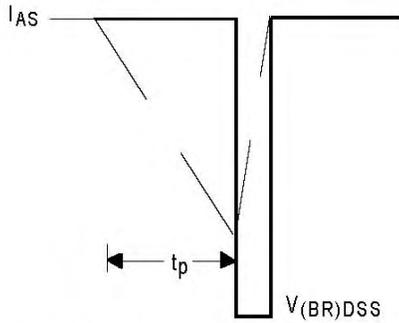


Fig 12b. Unclamped Inductive Waveforms

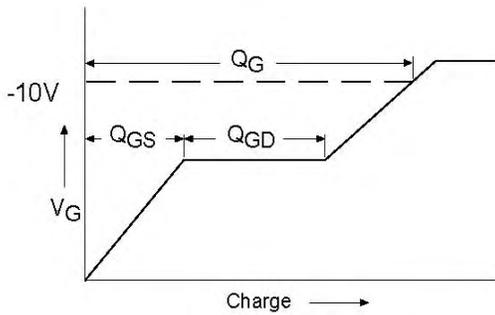


Fig 13a. Basic Gate Charge Waveform

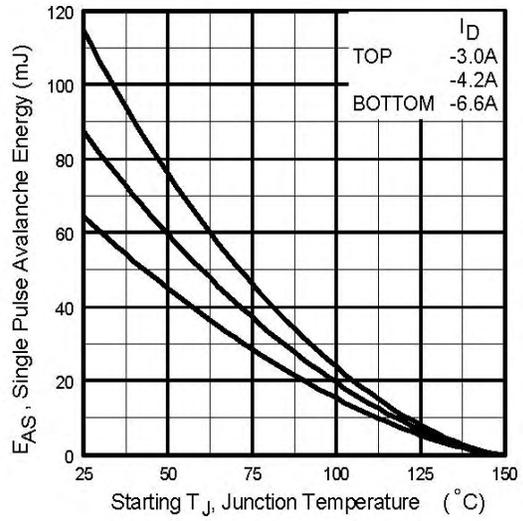


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

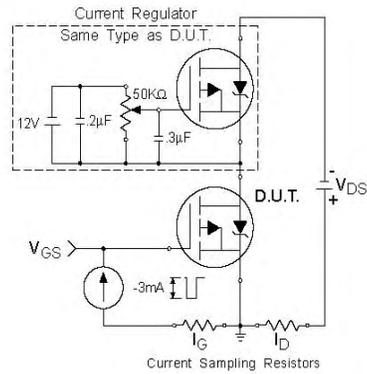
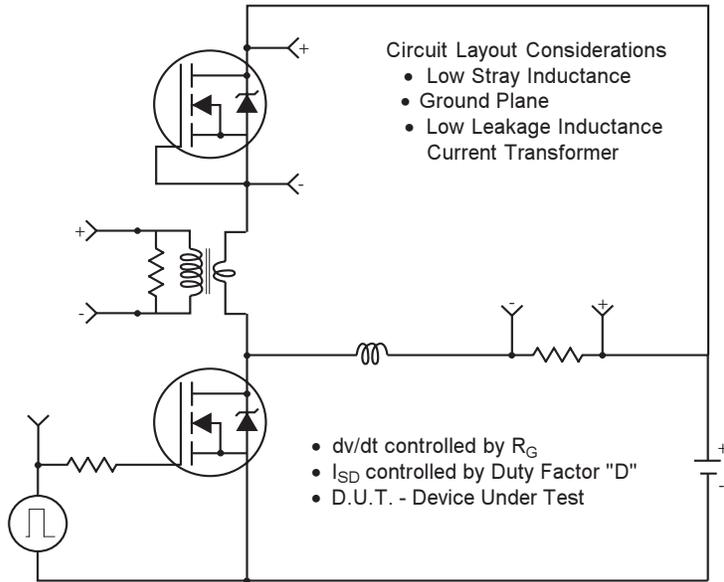


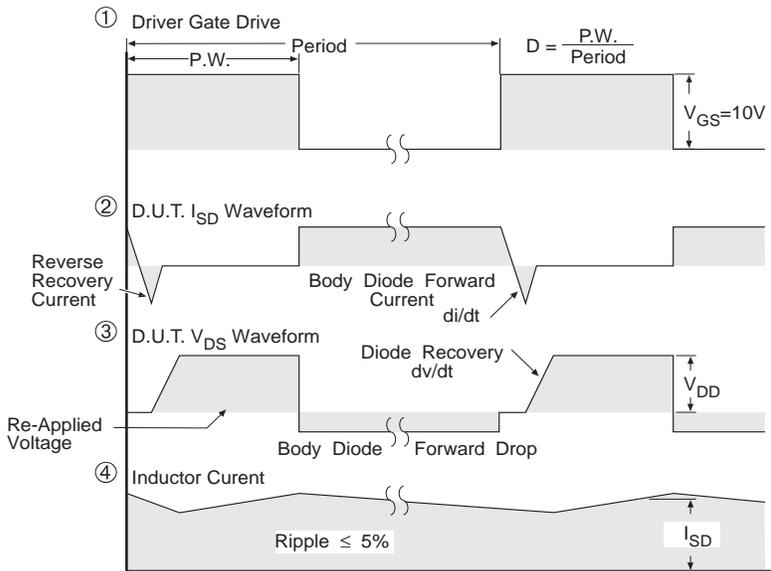
Fig 13b. Gate Charge Test Circuit

Peak Diode Recovery dv/dt Test Circuit



* Reverse Polarity for P-Channel

** Use P-Channel Driver for P-Channel Measurements



*** $V_{GS} = 5.0V$ for Logic Level and 3V Drive Devices

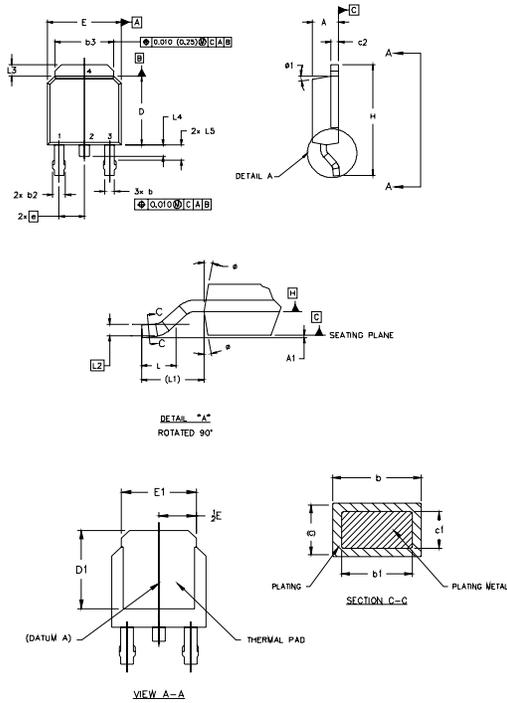
Fig 14 For P Channel HEXFETS

IRFR/U9024NPbF



D-Pak (TO-252AA) Package Outline

Dimensions are shown in millimeters (inches)



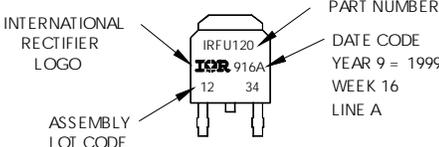
NOTES:
 1.0 DIMENSIONING AND TOLERANCING PER ASME Y14.5 M- 1994.
 2.0 DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS].
 3.0 LEAD DIMENSION UNCONTROLLED IN L5.
 4.0 DIMENSION D1 AND E1 ESTABLISH A MINIMUM MOUNTING SURFACE FOR THERMAL PAD.
 5.0 SECTION C-C DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN .005 [0.127] AND .010 [0.2540] FROM THE LEAD TIP.
 6.0 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.
 7.0 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	5
b1	0.64	0.70	.025	0.031	5
b2	0.76	1.14	.030	.045	
b3	4.95	5.46	.195	.215	
c	0.46	0.61	.018	.024	5
c1	0.41	0.56	.016	.022	5
c2	.046	0.89	.018	.035	5
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	-	.090 BSC	-	
H	9.40	10.41	.370	.410	
L	1.40	1.78	.055	.070	
L1	2.74 REF.	-	108 REF.	-	
L2	0.051 BSC	-	.020 BSC	-	
L3	0.89	1.27	.035	.050	
L4	1.02	1.02	.040	.040	
L5	1.14	1.52	.045	.060	3
φ	0"	10"	0"	10"	
φ1	0"	15"	0"	15"	

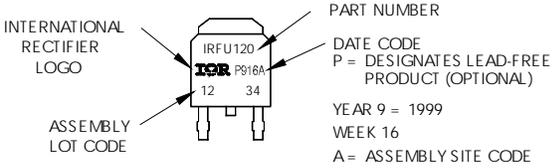
LEAD ASSIGNMENTS
 HEXFET
 1.- GATE
 2.- DRAIN
 3.- SOURCE
 4.- DRAIN
 IGBTs, CoPACK
 1.- GATE
 2.- COLLECTOR
 3.- EMITTER
 4.- COLLECTOR

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

EXAMPLE: THIS IS AN IRFR120 WITH ASSEMBLY LOT CODE 1234 ASSEMBLED ON VW 16, 1999 IN THE ASSEMBLY LINE "A"
 Note: "P" in assembly line position indicates "Lead-Free"

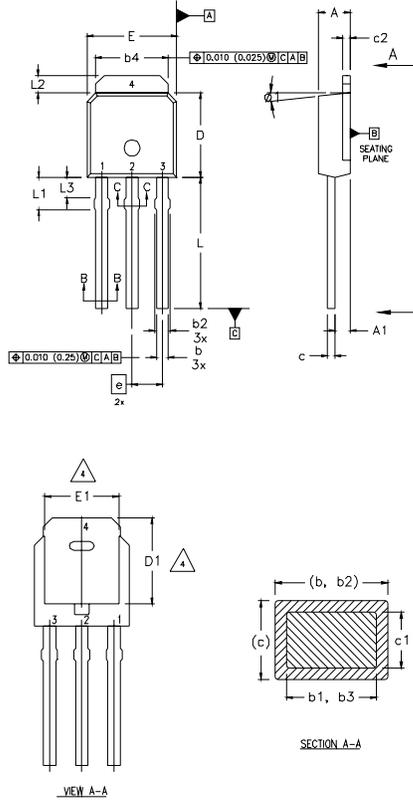


OR



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

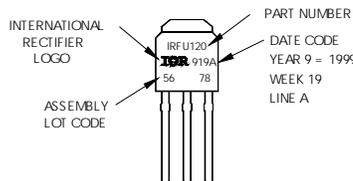
HEXFET

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

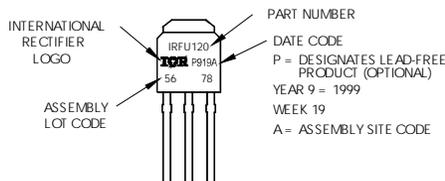
SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	2.18	2.39	0.086	.094	
A1	0.89	1.14	0.035	0.045	
b	0.64	0.89	0.025	0.035	
b1	0.64	0.79	0.025	0.031	4
b2	0.76	1.14	0.030	0.045	
b3	0.76	1.04	0.030	0.041	
b4	5.00	5.46	0.195	0.215	4
c	0.46	0.61	0.018	0.024	
c1	0.41	0.56	0.016	0.022	
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

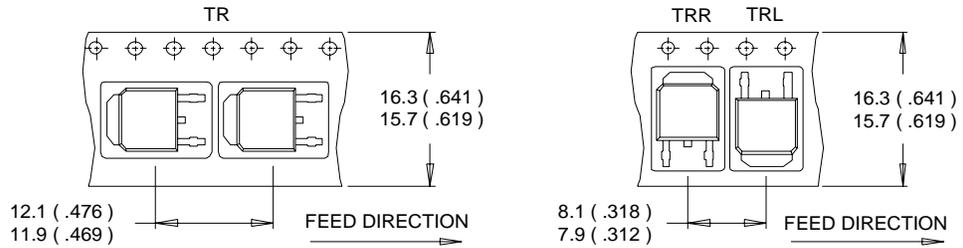


IRFR/U9024NPbF

International
IR Rectifier

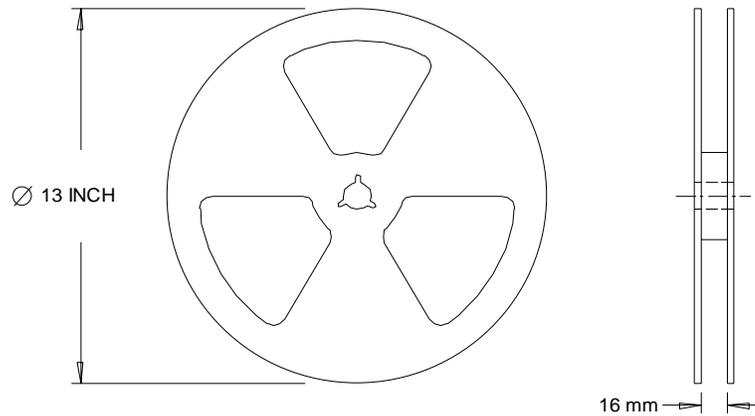
D-Pak (TO-252AA) Tape & Reel Information

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.

Data and specifications subject to change without notice.

International
IR Rectifier

IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105

TAC Fax: (310) 252-7903

Visit us at www.irf.com for sales contact information.12/04

www.irf.com

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



Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

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Факс: 8 (812) 320-02-42

Электронная почта: org@eplast1.ru

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