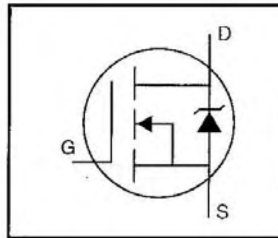
International
IOR Rectifier

PD - 95098A

IRFRC20PbF
IRFUC20PbF

HEXFET® Power MOSFET

- Dynamic dv/dt Rating
- Repetitive Avalanche Rated
- Surface Mount (IRFRC20)
- Straight Lead (IRFUC20)
- Available in Tape & Reel
- Fast Switching
- Ease of Paralleling
- Lead-Free



$V_{DSS} = 600V$

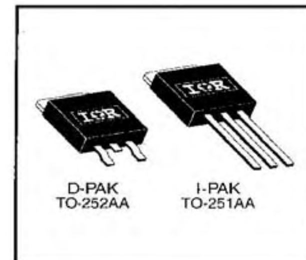
$R_{DS(on)} = 4.4\Omega$

$I_D = 2.0A$

Description

Third Generation HEXFETs from International Rectifier provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

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.



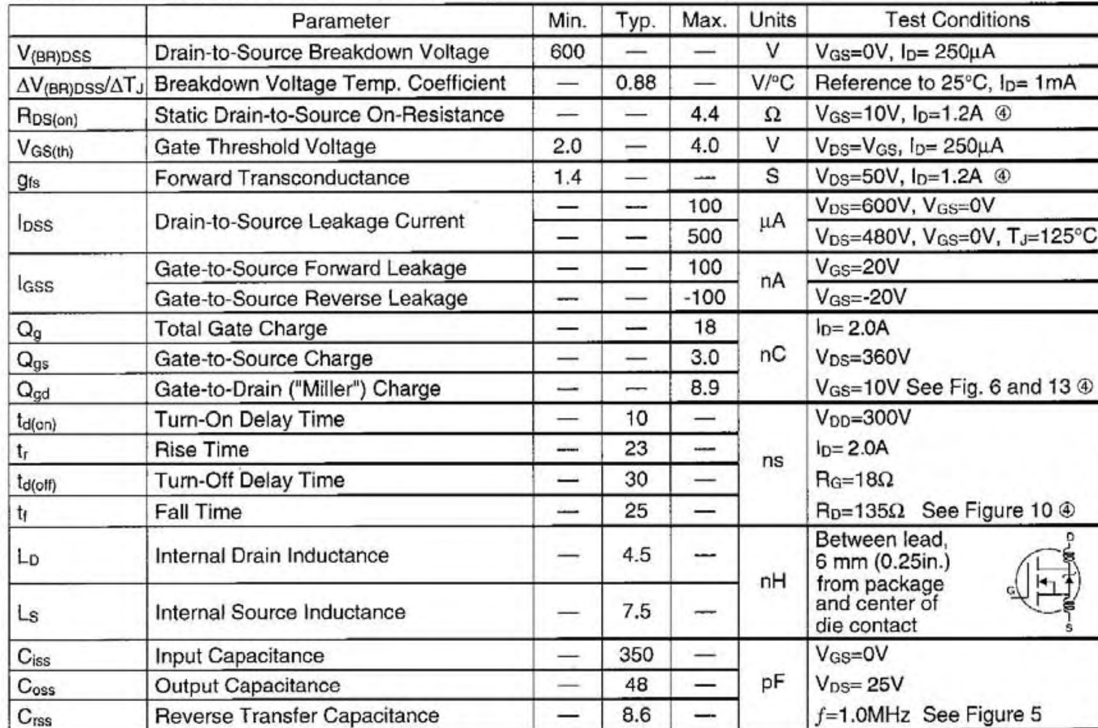
Absolute Maximum Ratings

	Parameter	Max.	Units
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10 V	2.0	A
I_D @ T_C = 100°C	Continuous Drain Current, V_{GS} @ 10 V	1.3	
I_{DM}	Pulsed Drain Current ①	8.0	
P_D @ T_C = 25°C	Power Dissipation	42	W
P_D @ T_A = 25°C	Power Dissipation (PCB Mount)**	2.5	
	Linear Derating Factor	0.33	W/°C
	Linear Derating Factor (PCB Mount)**	0.020	
V_{GS}	Gate-to-Source Voltage	±20	V
E_{AS}	Single Pulse Avalanche Energy ②	450	mJ
I_{AR}	Avalanche Current ①	2.0	A
E_{AR}	Repetitive Avalanche Energy ①	4.2	mJ
dv/dt	Peak Diode Recovery dv/dt ③	3.0	V/ns
T_J, T_{STG}	Junction and Storage Temperature Range	-55 to +150	°C
	Soldering Temperature, for 10 seconds	260 (1.6mm from case)	

Thermal Resistance

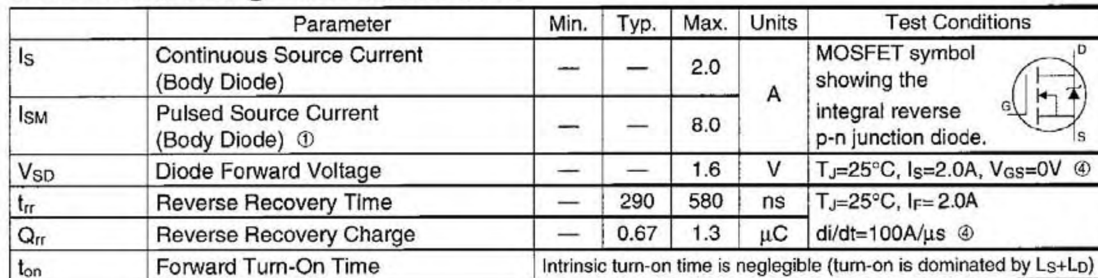
	Parameter	Min.	Typ.	Max.	Units
$R_{θJC}$	Junction-to-Case	—	—	3.0	°C/W
$R_{θJA}$	Junction-to-Ambient (PCB mount)**	—	—	50	
$R_{θJA}$	Junction-to-Ambient	—	—	110	

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



Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Test Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	600	—	—	V	V_{GS}=0V, I_D= 250μA
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.88	—	V/°C	Reference to 25°C, I_D= 1mA
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	—	4.4	Ω	V_{GS}=10V, I_D=1.2A ④
$V_{GS(th)}$	Gate Threshold Voltage	2.0	—	4.0	V	V_{DS}=V_{GS}, I_D= 250μA
g_{fs}	Forward Transconductance	1.4	—	—	S	V_{DS}=50V, I_D=1.2A ④
I_{DSS}	Drain-to-Source Leakage Current	—	—	100	μA	V_{DS}=600V, V_{GS}=0V
		—	—	500		V_{DS}=480V, V_{GS}=0V, T_J=125°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	—	—	18	nC	I_D= 2.0A
Q_{gs}	Gate-to-Source Charge	—	—	3.0		V_{DS}=360V
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	—	8.9		V_{GS}=10V See Fig. 6 and 13 ④
$t_{d(on)}$	Turn-On Delay Time	—	10	—	ns	V_{DD}=300V
t_r	Rise Time	—	23	—		I_D= 2.0A
$t_{d(off)}$	Turn-Off Delay Time	—	30	—		R_G=18Ω
t_f	Fall Time	—	25	—		R_D=135Ω See Figure 10 ④
L_D	Internal Drain Inductance	—	4.5	—	nH	Between lead, 6 mm (0.25in.) from package and center of die contact
L_S	Internal Source Inductance	—	7.5	—		
C_{iss}	Input Capacitance	—	350	—	pF	V_{GS}=0V
C_{oss}	Output Capacitance	—	48	—		V_{DS}= 25V
C_{rss}	Reverse Transfer Capacitance	—	8.6	—		f=1.0MHz See Figure 5



Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Test Conditions
I_S	Continuous Source Current (Body Diode)	—	—	2.0	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	8.0		
V_{SD}	Diode Forward Voltage	—	—	1.6	V	T_J=25°C, I_S=2.0A, V_{GS}=0V ④
t_{rr}	Reverse Recovery Time	—	290	580	ns	T_J=25°C, I_F= 2.0A
Q_{rr}	Reverse Recovery Charge	—	0.67	1.3	μC	di/dt=100A/μs ④
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is neglegible (turn-on is dominated by L_S+L_D)				

Notes:

① Repetitive rating; pulse width limited by max. junction temperature (See Figure 11)

② V_{DD}=50V, starting T_J=25°C, L=206mH R_G=25Ω, I_{AS}=2.0A (See Figure 12)

③ I_{SD}≤2.0A, di/dt≤40A/μs, V_{DD}≤$V_{(BR)DSS}$, T_J≤150°C

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

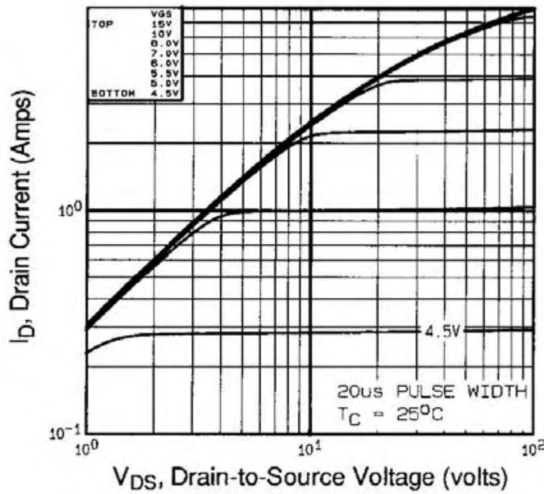


Fig 1. Typical Output Characteristics, T_C=25°C

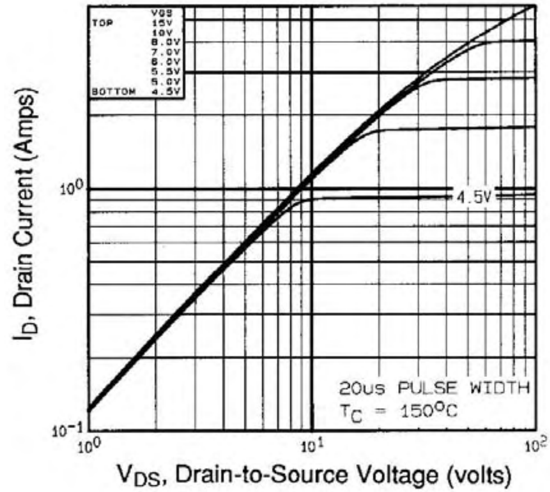


Fig 2. Typical Output Characteristics, T_C=150°C

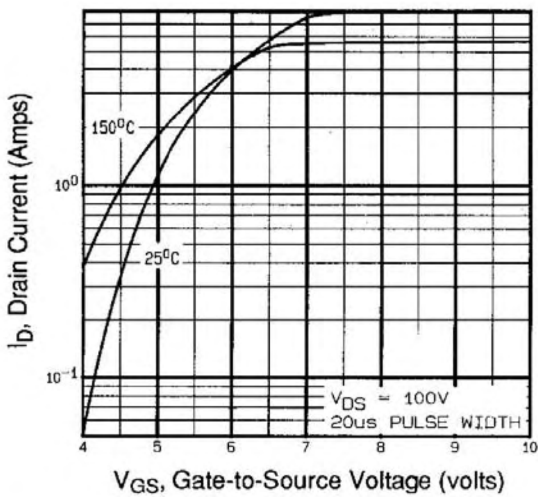


Fig 3. Typical Transfer Characteristics

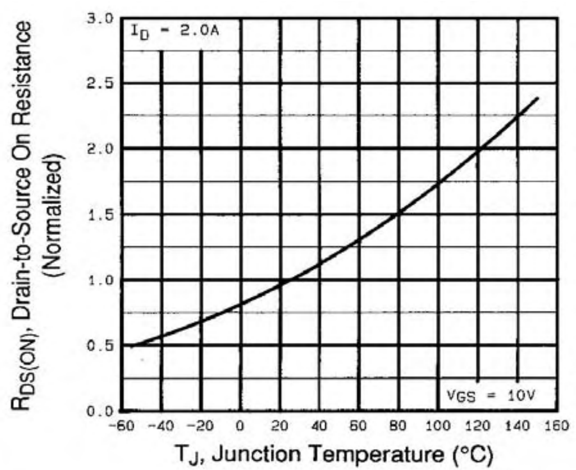


Fig 4. Normalized On-Resistance Vs. Temperature

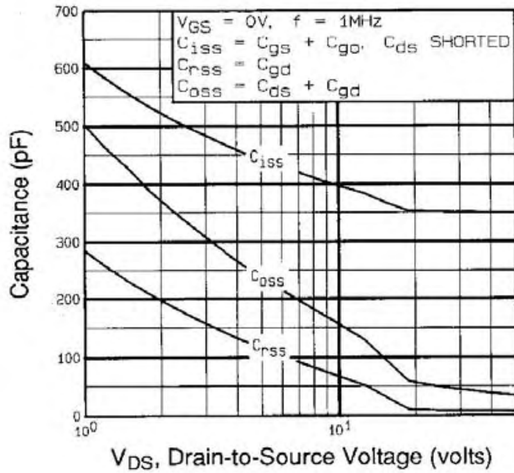


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

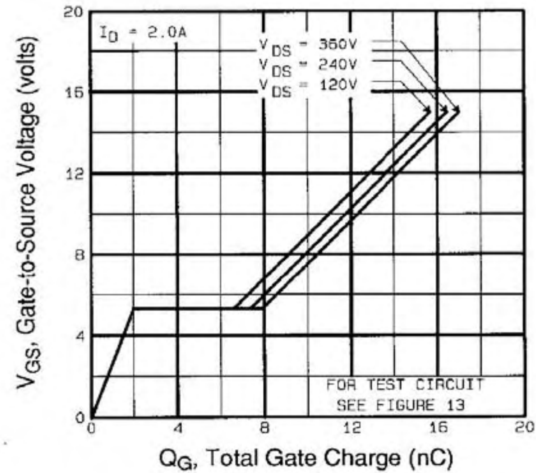


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

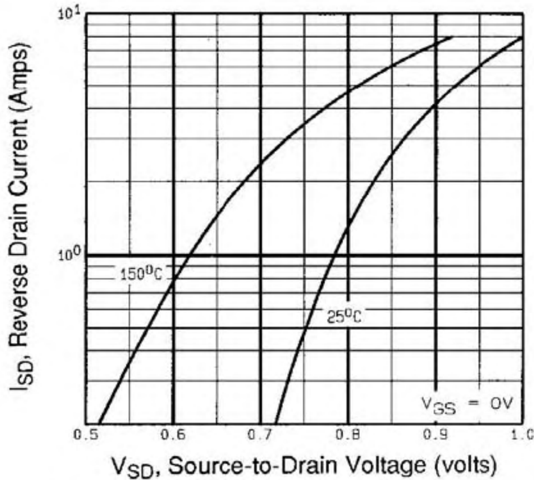


Fig 7. Typical Source-Drain Diode Forward Voltage

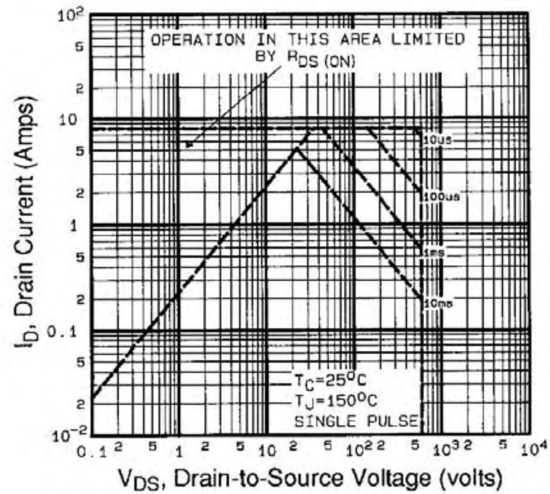


Fig 8. Maximum Safe Operating Area

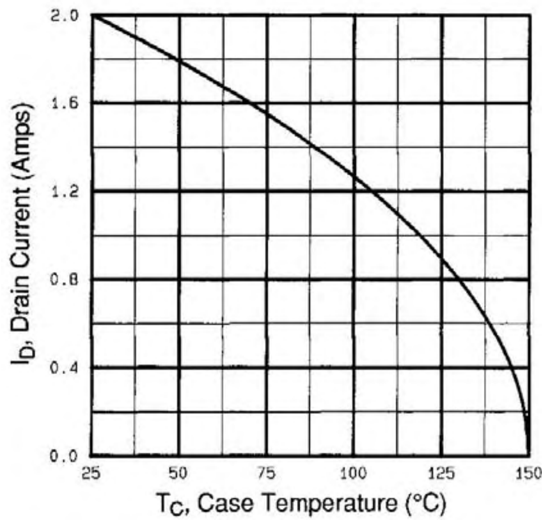


Fig 9. Maximum Drain Current Vs. Case Temperature

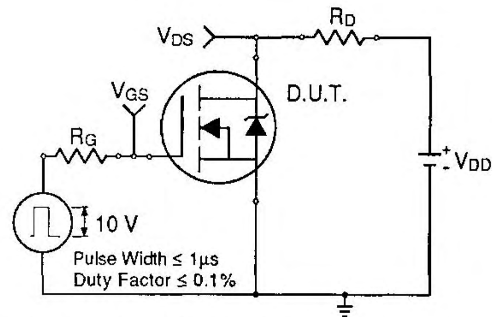


Fig 10a. Switching Time Test Circuit

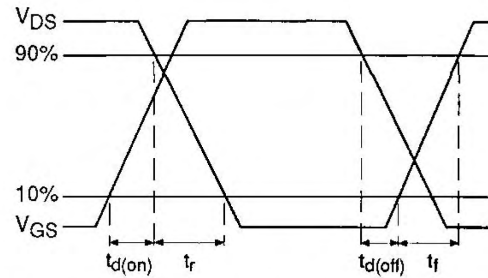


Fig 10b. Switching Time Waveforms

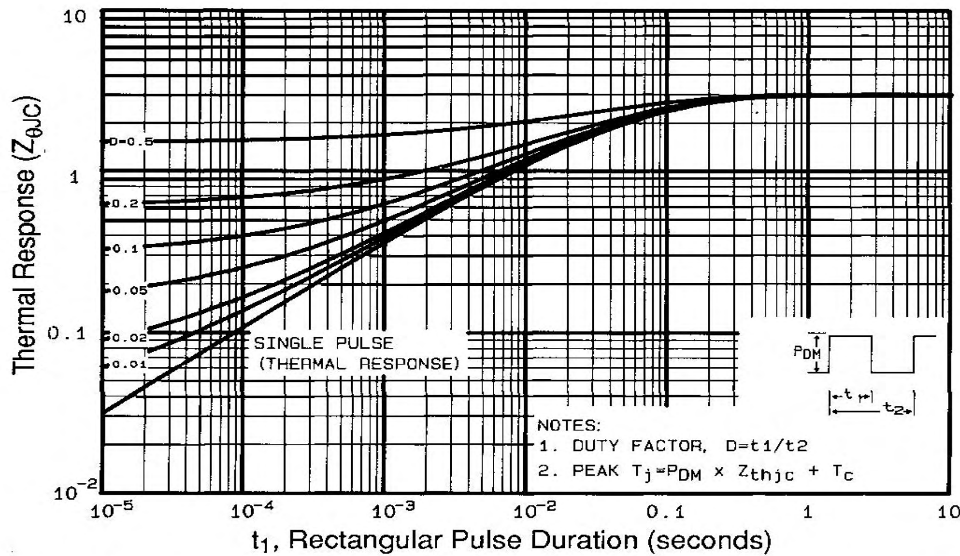


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

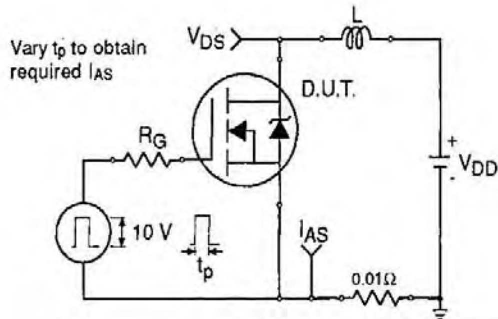


Fig 12a. Unclamped Inductive Test Circuit

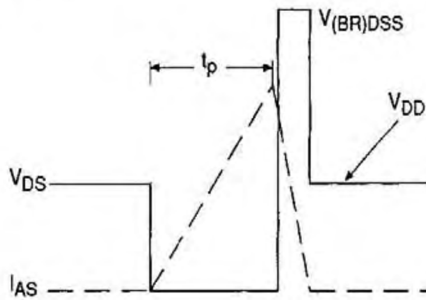


Fig 12b. Unclamped Inductive Waveforms

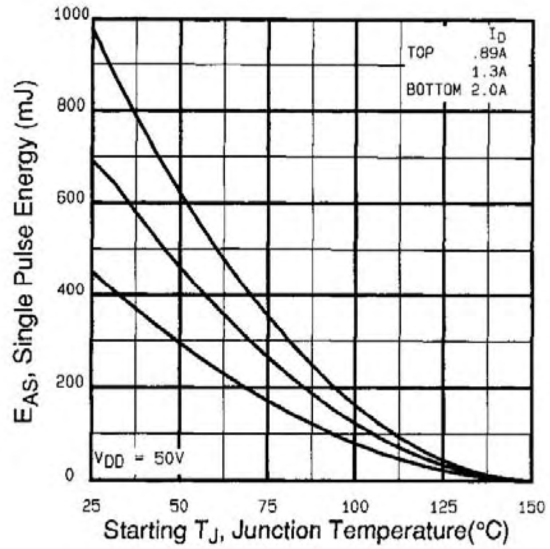


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

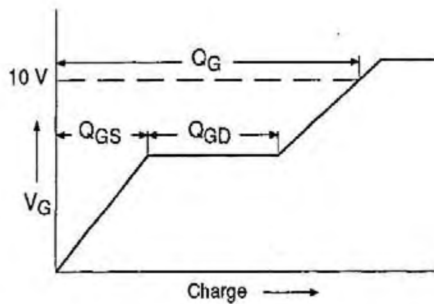


Fig 13a. Basic Gate Charge Waveform

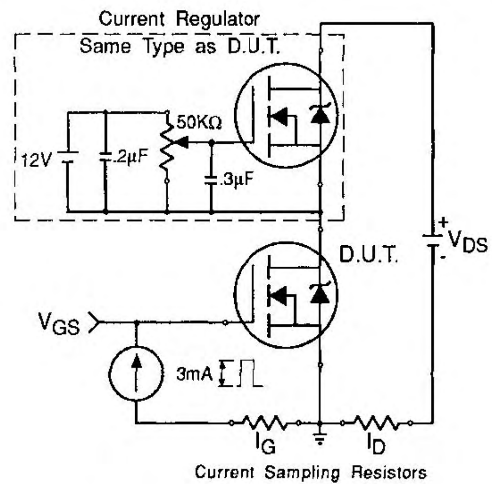
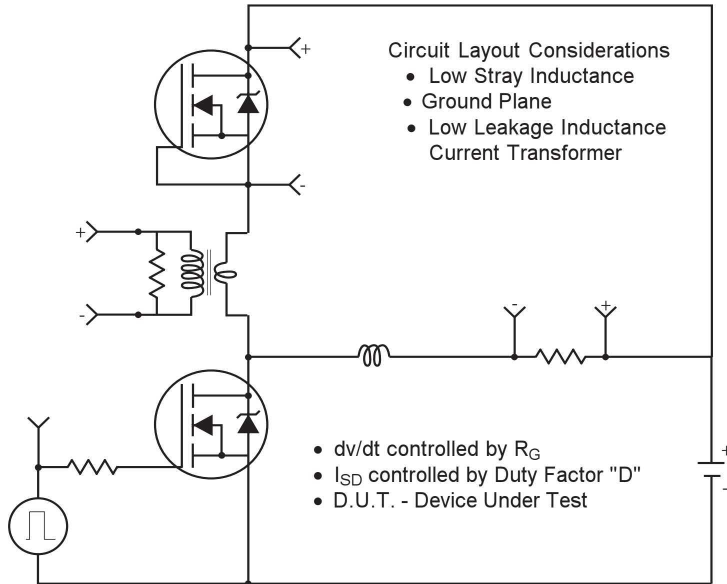


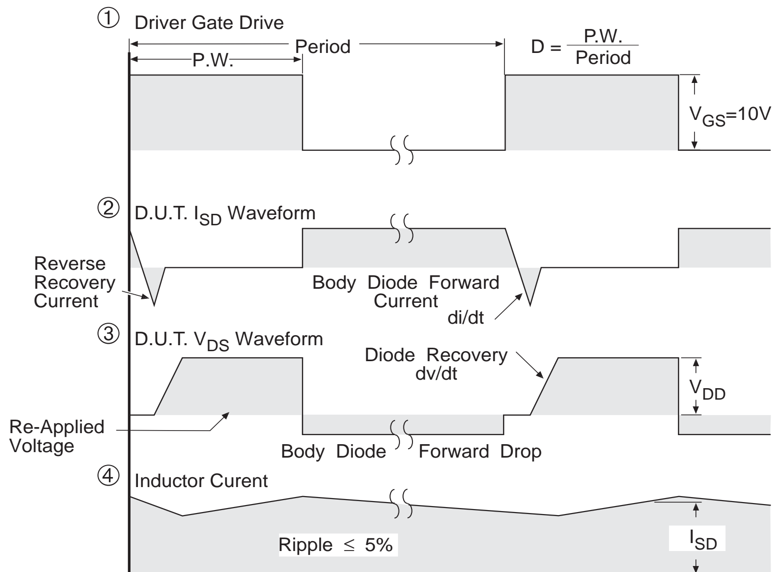
Fig 13b. Gate Charge Test Circuit

Peak Diode Recovery dv/dt Test Circuit



* Reverse Polarity for P-Channel

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

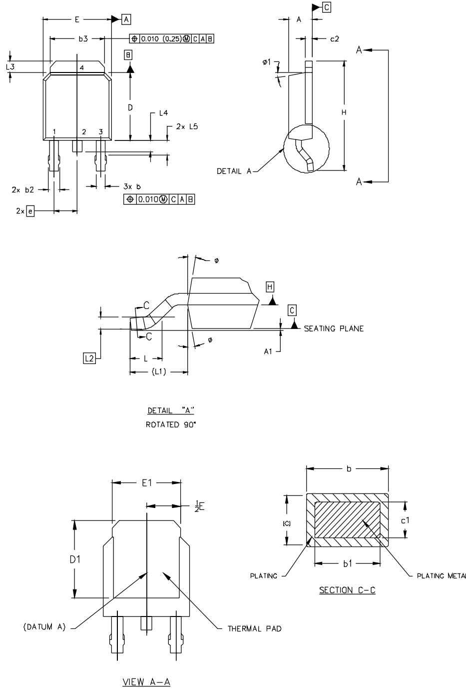


*** V_{GS} = 5.0V for Logic Level and 3V Drive Devices

Fig 14 For N Channel HEXFETS

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	0.79	.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		.040	
L5	1.14	1.52	.045	.060	3
ø	0°	10°	0°	10°	
ø1	0°	15°	0°	15°	

LEAD ASSIGNMENTS

HEXFET

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

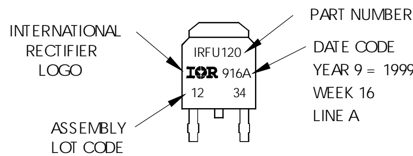
IGBTs, CoPACK

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

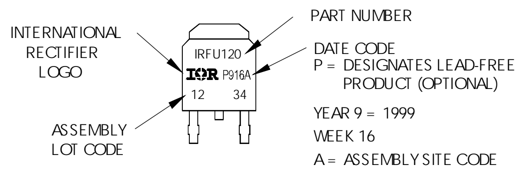
D-Pak (TO-252AA) Part Marking Information

EXAMPLE: THIS IS AN IRFR120
WITH ASSEMBLY
LOT CODE 1234
ASSEMBLED ON WW 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.

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	0°	15°	0°	15°	

LEAD ASSIGNMENTS

HEXFET

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

SECTION A-A

VIEW A-A

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"

INTERNATIONAL RECTIFIER LOGO

ASSEMBLY LOT CODE

PART NUMBER

DATE CODE
YEAR 9 = 1999
WEEK 19
LINE A

IRFU120
IOR 919A
56 78

OR

INTERNATIONAL RECTIFIER LOGO

ASSEMBLY LOT CODE

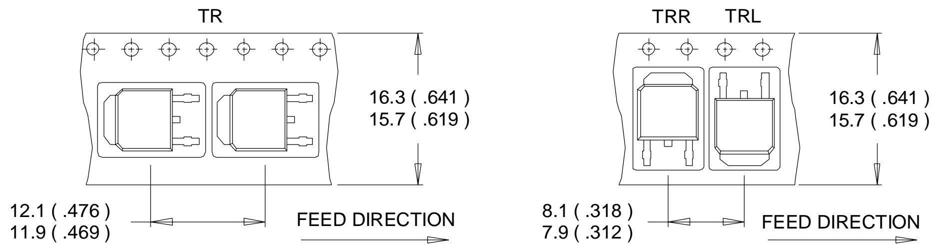
PART NUMBER

DATE CODE
P = DESIGNATES LEAD-FREE PRODUCT (OPTIONAL)
YEAR 9 = 1999
WEEK 19
A = ASSEMBLY SITE CODE

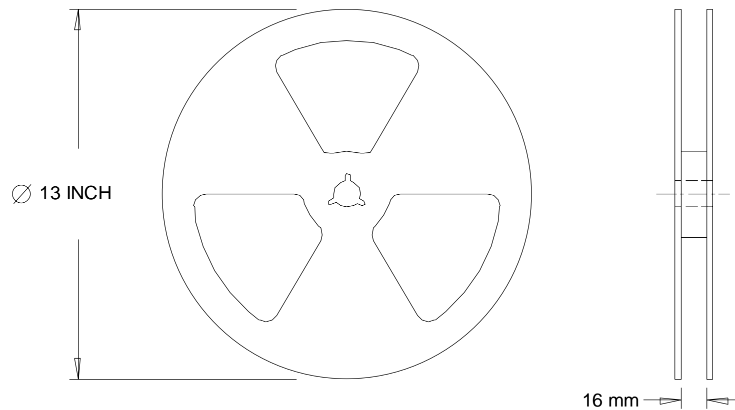
IRFU120
IOR P919A
56 78

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
IOR Rectifier

IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105
TAC Fax: (310) 252-7903
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