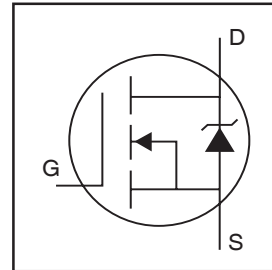


IRFZ24NS/LPbF

HEXFET® Power MOSFET

- Advanced Process Technology
- Surface Mount (IRFZ24NS)
- Low-profile through-hole (IRFZ24NL)
- 175°C Operating Temperature
- Fast Switching
- Fully Avalanche Rated
- Lead-Free



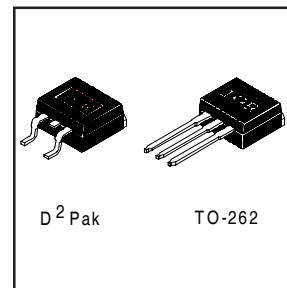
$V_{DS} = 55V$
 $R_{DS(on)} = 0.07\Omega$
 $I_D = 17A$

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 D²Pak is a surface mount power package capable of accommodating die sizes up to HEX-4. It provides the highest power capability and the lowest possible on-resistance in any existing surface mount package. The D²Pak is suitable for high current applications because of its low internal connection resistance and can dissipate up to 2.0W in a typical surface mount application.

The through-hole version (IRFZ24NL) is available for low-profile applications.



Absolute Maximum Ratings

	Parameter	Max.	Units
I_D @ $T_C = 25^\circ C$	Continuous Drain Current, V_{GS} @ 10V ^⑤	17	A
I_D @ $T_C = 100^\circ C$	Continuous Drain Current, V_{GS} @ 10V ^⑤	12	
I_{DM}	Pulsed Drain Current ^{① ⑤}	68	
P_D @ $T_A = 25^\circ C$	Power Dissipation	3.8	W
P_D @ $T_C = 25^\circ C$	Power Dissipation	45	W
	Linear Derating Factor	0.30	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS}	Single Pulse Avalanche Energy ^{② ⑤}	71	mJ
I_{AR}	Avalanche Current ^①	10	A
E_{AR}	Repetitive Avalanche Energy ^①	4.5	mJ
dv/dt	Peak Diode Recovery dv/dt ^{③ ⑤}	6.8	V/ns
T_J	Operating Junction and	-55 to + 175	°C
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 seconds		

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	3.3	°C/W
$R_{\theta JA}$	Junction-to-Ambient (PCB Mounted, steady-state)**	—	40	

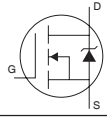
IRFZ24NS/LPbF

International
IR Rectifier

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	55	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.052	—	V/ $^\circ\text{C}$	Reference to 25°C , $I_D = 1\text{mA}$ ⑤
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	—	0.07	Ω	$V_{GS} = 10V, I_D = 10A$ ④
$V_{GS(th)}$	Gate Threshold Voltage	2.0	—	4.0	V	$V_{DS} = V_{GS}, I_D = 250\mu A$
g_{fs}	Forward Transconductance	4.5	—	—	S	$V_{DS} = 25V, I_D = 10A$ ⑤
I_{DSS}	Drain-to-Source Leakage Current	—	—	25	μA	$V_{DS} = 55V, V_{GS} = 0V$
		—	—	250		$V_{DS} = 44V, V_{GS} = 0V, T_J = 150^\circ\text{C}$
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	—	—	20	nC	$I_D = 10A$
Q_{gs}	Gate-to-Source Charge	—	—	5.3		$V_{DS} = 44V$
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	—	7.6		$V_{GS} = 10V$, See Fig. 6 and 13 ④ ⑤
$t_{d(on)}$	Turn-On Delay Time	—	4.9	—	ns	$V_{DD} = 28V$
t_r	Rise Time	—	34	—		$I_D = 10A$
$t_{d(off)}$	Turn-Off Delay Time	—	19	—		$R_G = 24\Omega$
t_f	Fall Time	—	27	—		$R_D = 2.6\Omega$, See Fig. 10 ④ ⑤
L_S	Internal Source Inductance	—	7.5	—	nH	Between lead, and center of die contact
C_{iss}	Input Capacitance	—	370	—	pF	$V_{GS} = 0V$
C_{oss}	Output Capacitance	—	140	—		$V_{DS} = 25V$
C_{rss}	Reverse Transfer Capacitance	—	65	—		$f = 1.0\text{MHz}$, See Fig. 5⑤

Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	17	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	68		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}, I_S = 10A, V_{GS} = 0V$ ④
t_{rr}	Reverse Recovery Time	—	56	83	ns	$T_J = 25^\circ\text{C}, I_F = 10A$
Q_{rr}	Reverse Recovery Charge	—	120	180	nC	$di/dt = 100A/\mu s$ ④ ⑤
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 $T_J = 25^\circ\text{C}$, $L = 1.0\text{mH}$
 $R_G = 25\Omega$, $I_{AS} = 10A$. (See Figure 12)
- ③ $I_{SD} \leq 10A$, $di/dt \leq 280A/\mu s$, $V_{DD} \leq V_{(BR)DSS}$,
 $T_J \leq 175^\circ\text{C}$
- ④ Pulse width $\leq 280\mu s$; duty cycle $\leq 2\%$.
- ⑤ Uses IRFZ24N 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.

IRFZ24NS/LPbF

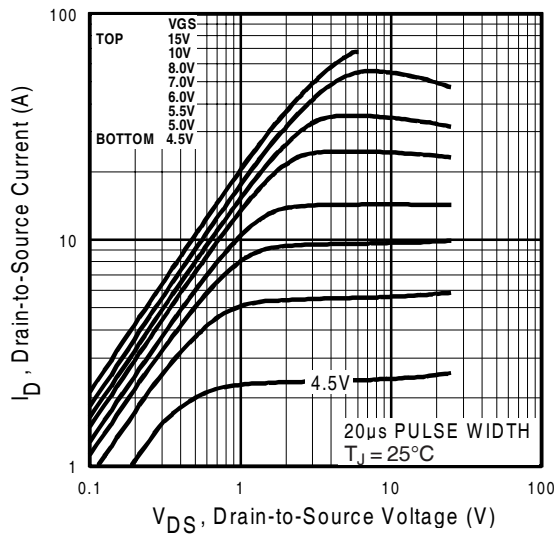


Fig 1. Typical Output Characteristics

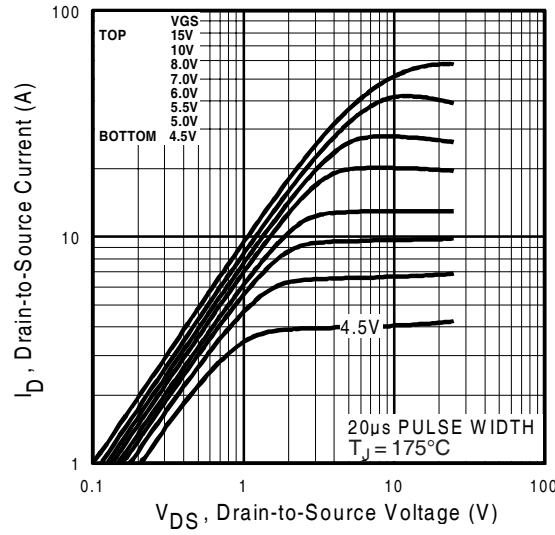


Fig 2. Typical Output Characteristics

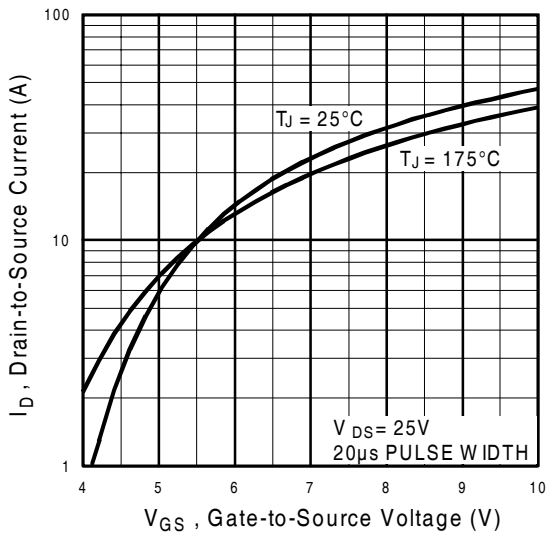


Fig 3. Typical Transfer Characteristics

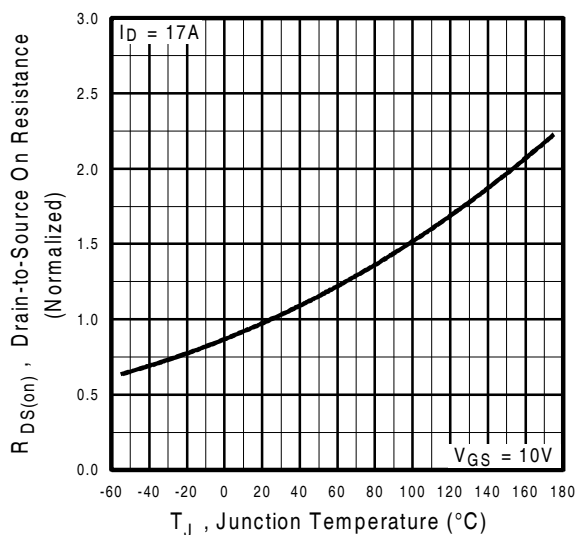


Fig 4. Normalized On-Resistance Vs. Temperature

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IR Rectifier

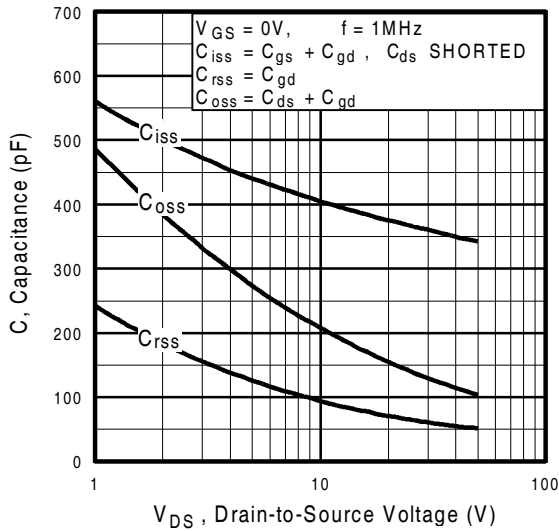


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

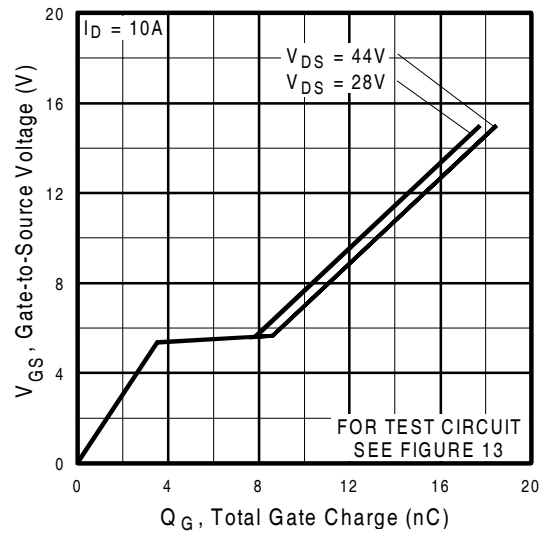


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

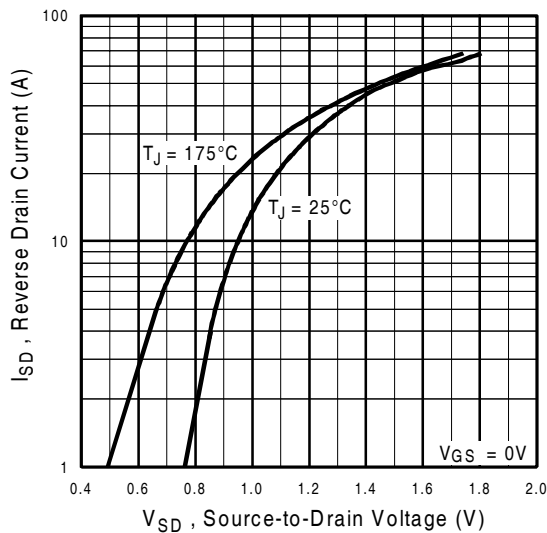


Fig 7. Typical Source-Drain Diode Forward Voltage

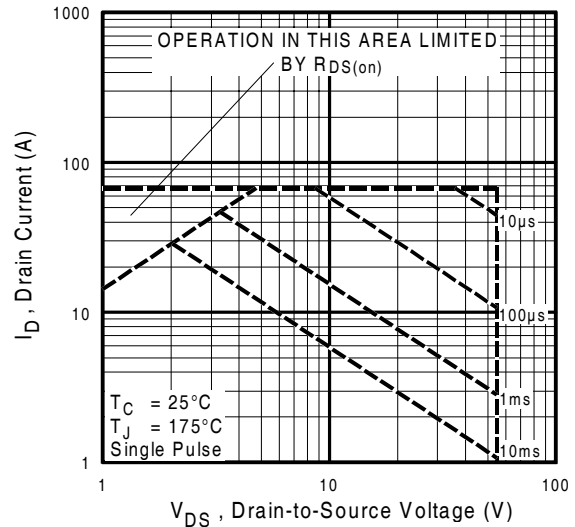


Fig 8. Maximum Safe Operating Area

IRFZ24NS/LPbF

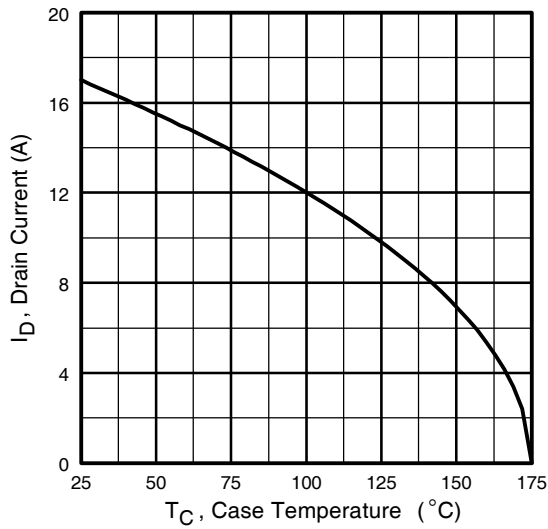


Fig 9. Maximum Drain Current Vs. Case Temperature

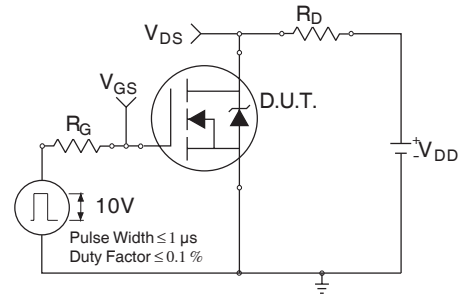


Fig 10a. Switching Time Test Circuit

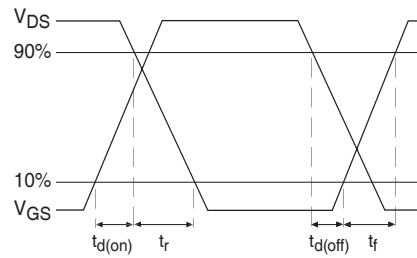


Fig 10b. Switching Time Waveforms

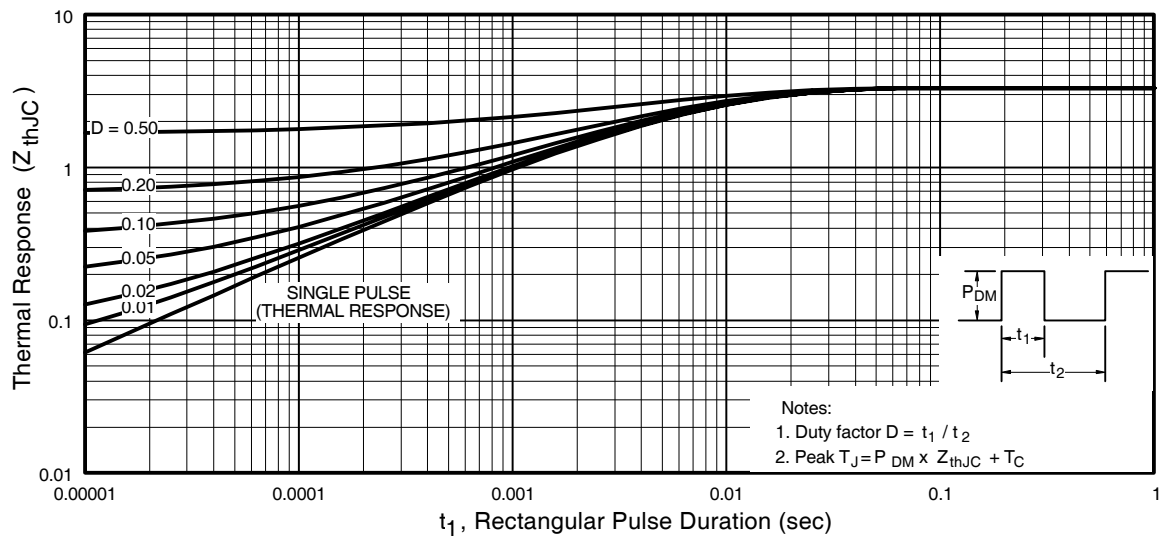


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

IRFZ24NS/LPbF

International
IOR Rectifier

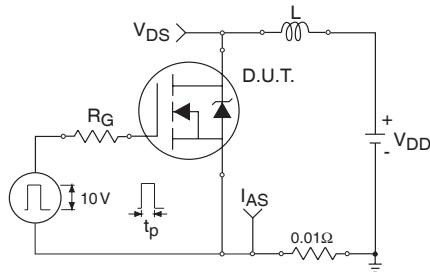


Fig 12a. Unclamped Inductive Test Circuit

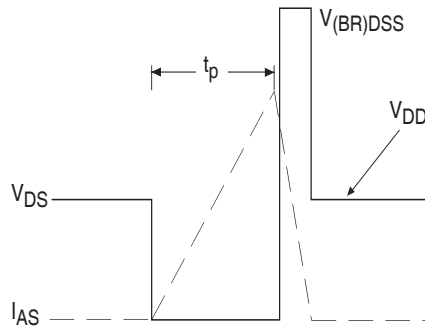


Fig 12b. Unclamped Inductive Waveforms

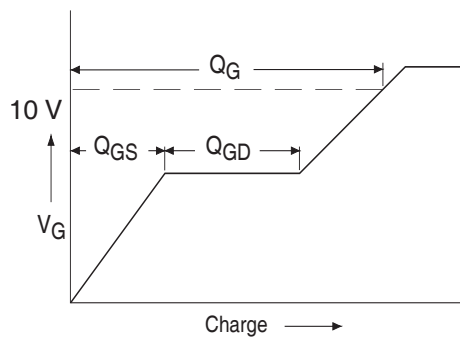


Fig 13a. Basic Gate Charge Waveform

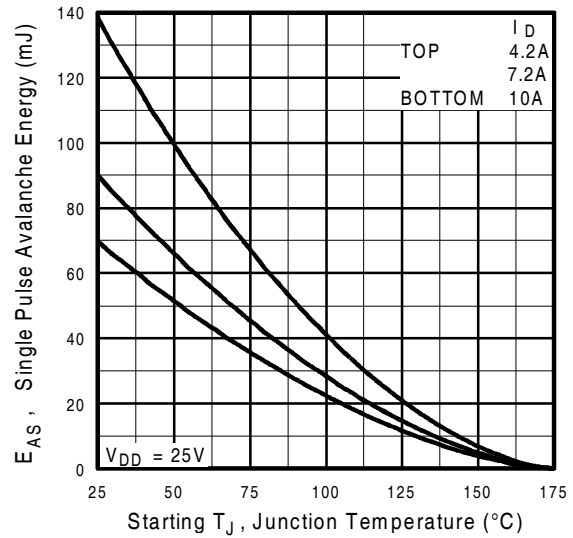


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

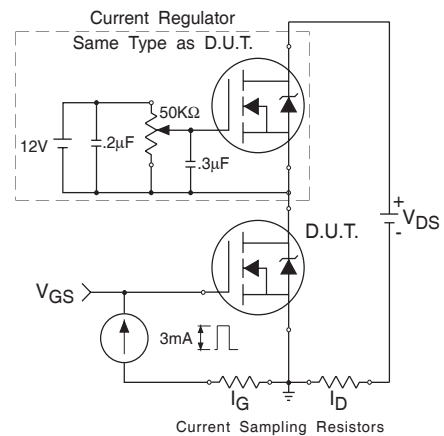
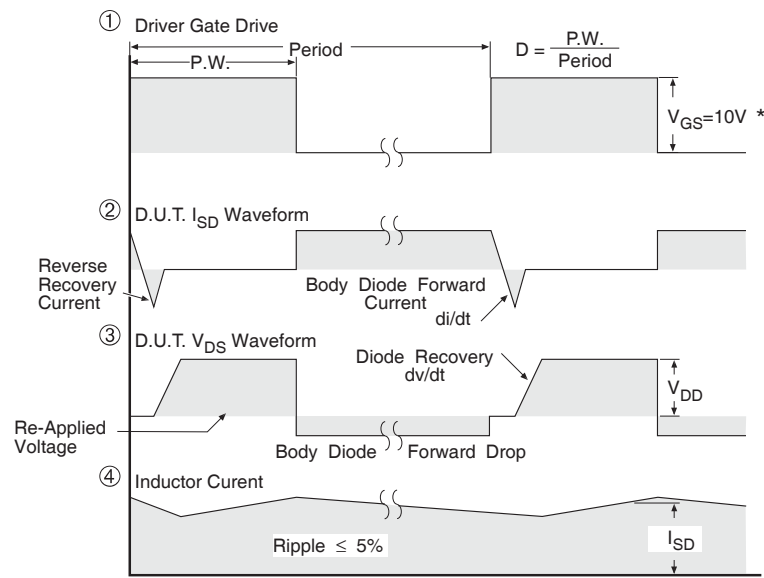
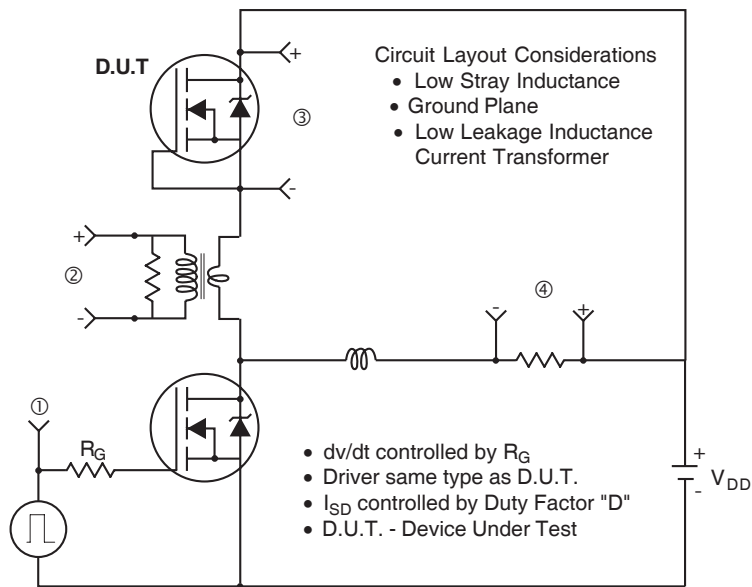


Fig 13b. Gate Charge Test Circuit

Peak Diode Recovery dv/dt Test Circuit



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

Fig 14. For N-Channel HEXFETS

International
IOR Rectifier

GAUGE PLANE

0°-8°

L4

L1

A1

SEATING PLANE

DETAIL "A-A"
ROTATED 90°
SCALE B:1

SECTION A-A

(E)

D1

E1

SECTION B-B
SCALE: NONE

(A)

b1

c

b

c1

n

m1

m

D

a-o

FOOT PRINT
SCALE 2:1

(B)

A

(C2)

DETAIL A

2X c

2X b

2X b2

2X a

1

2

3

D

L2

L

(A)

(C)

(D)

(E)

(F)

(G)

(H)

(I)

(J)

(K)

(L)

(M)

(N)

(O)

(P)

(Q)

(R)

(S)

(T)

(U)

(V)

(W)

(X)

(Y)

(Z)

NOTES:

1. DIMEN
2. DIMEN
3. DIMEN

PER

DIMEN

(A)

S Y M B O L	DIMENSIONS				N O T E S
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	
A1		0.127		.005	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	4
b2	1.14	1.40	.045	.055	
c	0.43	0.63	.017	.025	
c1	0.38	0.74	.015	.029	4
c2	1.14	1.40	.045	.055	
D	8.51	9.65	.335	.380	3
D1	5.33		.210		
E	9.65	10.67	.380	.420	3
E1	6.22		.245		
e	2.54 BSC		.100 BSC		
L	14.61	15.88	.575	.625	
L1	1.78	2.79	.070	.110	
L2		1.65		.065	
L3	1.27	1.78	.050	.070	
L4	0.25 BSC		.010 BSC		
m	17.78		.700		
m1	8.89		.350		
n	11.43		.450		
o	2.08		.082		
p	3.81		.150		
ø	90°	93°	90°	93°	

HEXFET	IGBTs, CoPACK	DIODES
1.— GATE	1.— GATE	1.— ANODE
2.— DRAIN	2.— COLLECTOR	2.— CATHODE
3.— SOURCE	3.— EMITTER	3.— ANODE

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 0.127 [.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
5. CONTROLLING DIMENSION: INCH.

EXAMPLE: THIS IS AN IRF530S WITH
LOT CODE 8024
ASSEMBLED ON WW 02, 2000
IN THE ASSEMBLY LINE "L"

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

Diagram illustrating the markings on an International Rectifier (IR) diode package (F530S):

- INTERNATIONAL RECTIFIER LOGO**: Points to the IR logo on the package.
- PART NUMBER**: Points to the F530S marking.
- DATE CODE**: Points to the 002L marking.
- YEAR 0 = 2000**: Explains the first digit of the date code.
- WEEK 02**: Explains the second digit of the date code.
- LINE L**: Explains the third digit of the date code.
- ASSEMBLY LOT CODE**: Points to the 80 marking.
- 24**: Points to the marking on the package.

OR

INTERNATIONAL RECTIFIER LOGO

PART NUMBER

DATE CODE

ASSEMBLY LOT CODE

F530S

100 P002A

80 24

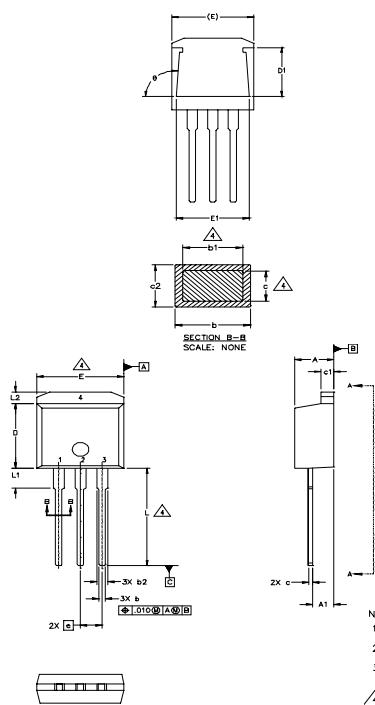
P = DESIGNATES LEAD-FREE PRODUCT (OPTIONAL)

YEAR 0 = 2000

WEEK 02

A = ASSEMBLY SITE CODE

TO-262 Package Outline



SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	4
A1	2.03	2.92	.080	.115	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	
b2	1.14	1.40	.045	.055	4
c	0.38	0.63	.015	.025	
c1	1.14	1.40	.045	.055	
c2	0.43	.063	.017	.029	
D	8.51	9.65	.335	.380	3
D1	5.33		.210		
E	9.65	10.67	.380	.420	3
E1	6.22		.245		
e	2.54	BSC	.100	BSC	
L	13.46	14.09	.530	.555	
L1	3.56	3.71	.140	.146	
L2		1.65		.065	

LEAD ASSIGNMENTS

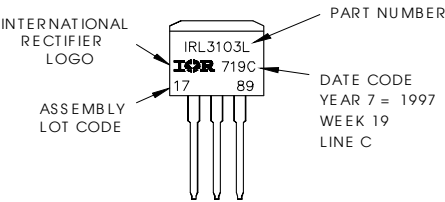
HEXFET	IGBT
1.- GATE	1 - GATE
2.- DRAIN	2 - COLLECTOR
3.- SOURCE	3 - EMITTER
4.- DRAIN	

- 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 0.127 [0.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
 4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
 5. CONTROLLING DIMENSION: INCH.

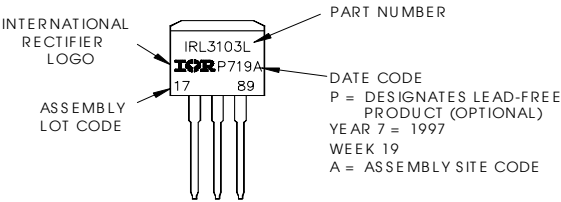
TO-262 Part Marking Information

EXAMPLE: THIS IS AN IRL3103L
LOT CODE 1789
ASSEMBLED ON WW 19, 1997
IN THE ASSEMBLY LINE "C"

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



OR



International
IOR Rectifier

TRR

FEED DIRECTION →

TRL

FEED DIRECTION →

1.60 (.063)
1.50 (.059)

4.10 (.161)
3.90 (.153)

1.85 (.073)
1.65 (.065)

11.60 (.457)
11.40 (.449)

1.60 (.063)
1.50 (.059)

0.368 (.0145)
0.342 (.0135)

15.42 (.609)
15.22 (.601)

24.30 (.957)
23.90 (.941)

10.90 (.429)
10.70 (.421)

1.75 (.069)
1.25 (.049)

16.10 (.634)
15.90 (.626)

4.72 (.136)
4.52 (.178)

13.50 (.532)
Ø 12.80 (.504)

Ø 330.00 (14.173)
MAX.

27.40 (1.079)
23.90 (.941)

Ø 60.00 (2.362)
MIN.

30.40 (1.197)
MAX.

26.40 (1.039)
24.40 (.961)

NOTES :

1. CONFORMS TO EIA-418.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION MEASURED @ HUB.
4. INCLUDES FLANGE DISTORTION @ OUTER EDGE.

International
IOR Rectifier

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TAC Fax: (310) 252-7903
Visit us at www.irf.com for sales contact information. 04/04