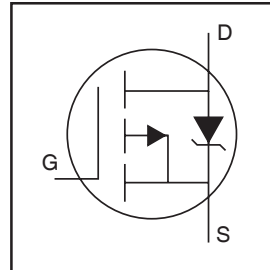


IRF9530NPbF

HEXFET® Power MOSFET

- Advanced Process Technology
- Dynamic dv/dt Rating
- 175°C Operating Temperature
- Fast Switching
- P-Channel
- Fully Avalanche Rated
- Lead-Free



$$V_{DS} = -100V$$

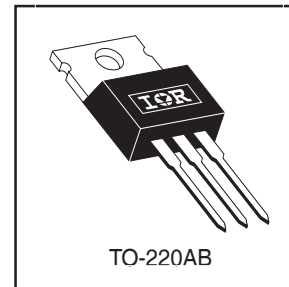
$$R_{DS(on)} = 0.20\Omega$$

$$I_D = -14A$$

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 TO-220 package is universally preferred for all commercial-industrial applications at power dissipation levels to approximately 50 watts. The low thermal resistance and low package cost of the TO-220 contribute to its wide acceptance throughout the industry.



Absolute Maximum Ratings

	Parameter	Max.	Units
I_D @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, V_{GS} @ -10V	-14	A
I_D @ $T_C = 100^\circ\text{C}$	Continuous Drain Current, V_{GS} @ -10V	-10	
I_{DM}	Pulsed Drain Current ①	-56	
P_D @ $T_C = 25^\circ\text{C}$	Power Dissipation	79	W
	Linear Derating Factor	0.53	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS}	Single Pulse Avalanche Energy②	250	mJ
I_{AR}	Avalanche Current①	-8.4	A
E_{AR}	Repetitive Avalanche Energy①	7.9	mJ
dv/dt	Peak Diode Recovery dv/dt ③	-5.0	V/ns
T_J	Operating Junction and	-55 to + 175	°C
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	
	Mounting torque, 6-32 or M3 screw	10 lbf•in (1.1N•m)	

Thermal Resistance

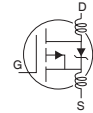
	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	1.9	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient	—	62	

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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	$V_{GS} = 0V$, $I_D = -250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	-0.11	—	V/ $^\circ\text{C}$	Reference to 25°C , $I_D = -1\text{mA}$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	—	0.20	Ω	$V_{GS} = -10V$, $I_D = -8.4A$ 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	3.2	—	—	S	$V_{DS} = -50V$, $I_D = -8.4A$
I_{DSS}	Drain-to-Source Leakage Current	—	—	-25	μA	$V_{DS} = -100V$, $V_{GS} = 0V$
		—	—	-250		$V_{DS} = -80V$, $V_{GS} = 0V$, $T_J = 150^\circ\text{C}$
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	—	—	58	nC	$I_D = -8.4A$
Q_{gs}	Gate-to-Source Charge	—	—	8.3		$V_{DS} = -80V$
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	—	32		$V_{GS} = -10V$, See Fig. 6 and 13 ④
$t_{d(on)}$	Turn-On Delay Time	—	15	—	ns	$V_{DD} = -50V$
t_r	Rise Time	—	58	—		$I_D = -8.4A$
$t_{d(off)}$	Turn-Off Delay Time	—	45	—		$R_G = 9.1\Omega$
t_f	Fall Time	—	46	—		$R_D = 6.2\Omega$, See Fig. 10 ④
L_D	Internal Drain Inductance	—	4.5	—	nH	Between lead, 6mm (0.25in.) from package and center of die contact
L_S	Internal Source Inductance	—	7.5	—		
C_{iss}	Input Capacitance	—	760	—	pF	$V_{GS} = 0V$
C_{oss}	Output Capacitance	—	260	—		$V_{DS} = -25V$
C_{rss}	Reverse Transfer Capacitance	—	170	—		$f = 1.0\text{MHz}$, See Fig. 5



Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	-14	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	-56		
V_{SD}	Diode Forward Voltage	—	—	-1.6	V	$T_J = 25^\circ\text{C}$, $I_S = -8.4A$, $V_{GS} = 0V$ ④
t_{rr}	Reverse Recovery Time	—	130	190	ns	$T_J = 25^\circ\text{C}$, $I_F = -8.4A$
Q_{rr}	Reverse Recovery Charge	—	650	970	nC	$di/dt = -100A/\mu s$ ④
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 $T_J = 25^\circ\text{C}$, $L = 7.0\text{mH}$
 $R_G = 25\Omega$, $I_{AS} = -8.4A$. (See Figure 12)

③ $I_{SD} \leq -8.4A$, $di/dt \leq -490A/\mu s$, $V_{DD} \leq V_{(BR)DSS}$,
 $T_J \leq 175^\circ\text{C}$

④ Pulse width $\leq 300\mu s$; duty cycle $\leq 2\%$.

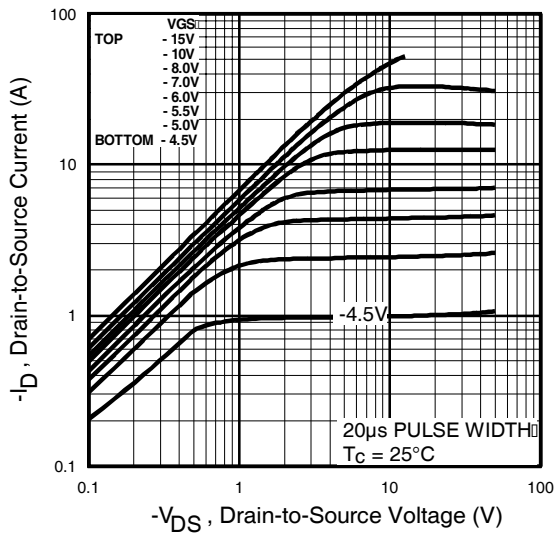


Fig 1. Typical Output Characteristics

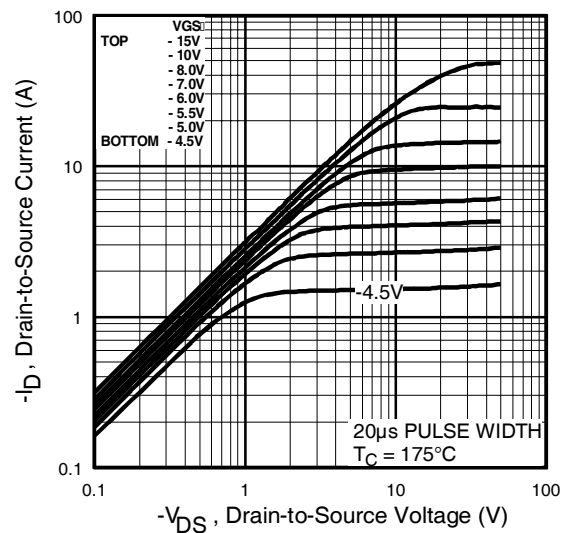


Fig 2. Typical Output Characteristics

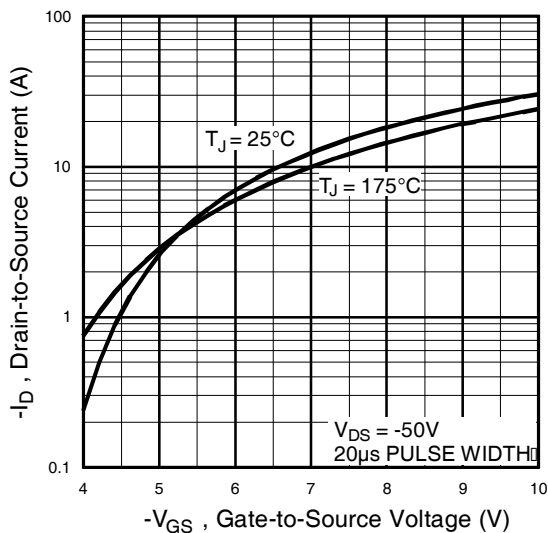


Fig 3. Typical Transfer Characteristics

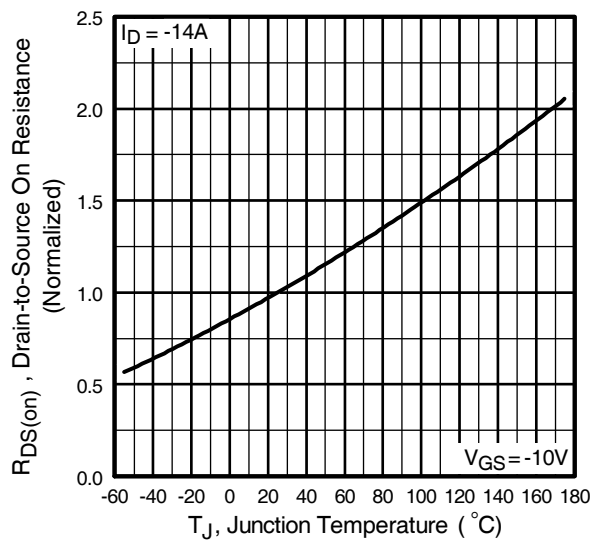


Fig 4. Normalized On-Resistance
Vs. Temperature

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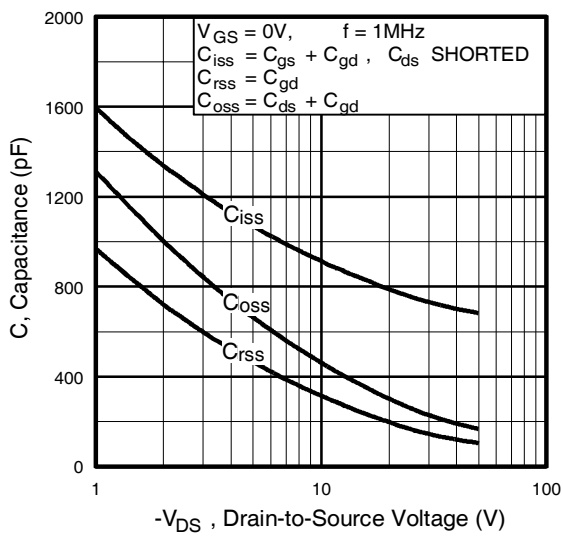


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

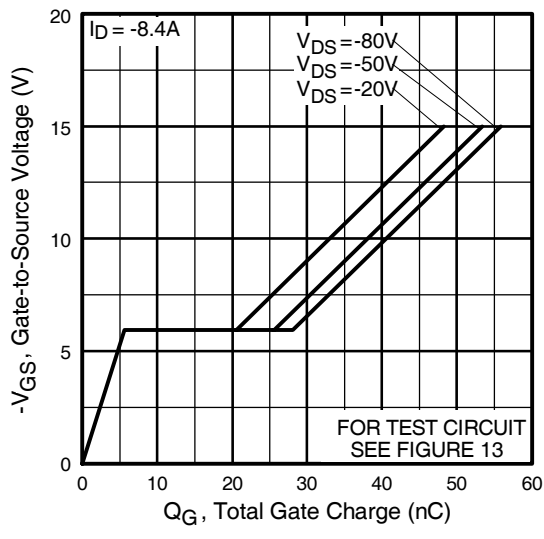


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

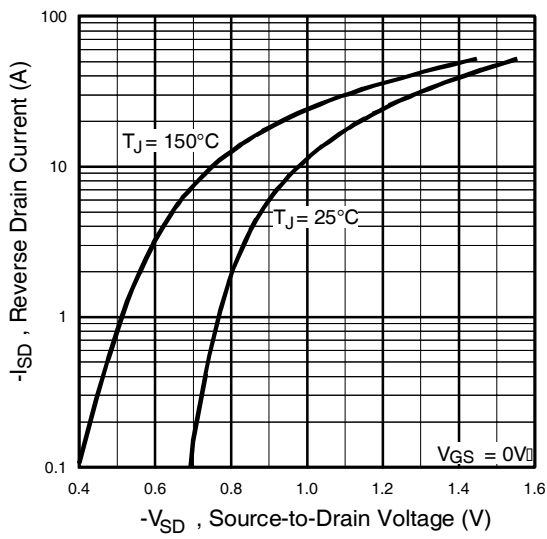


Fig 7. Typical Source-Drain Diode Forward Voltage

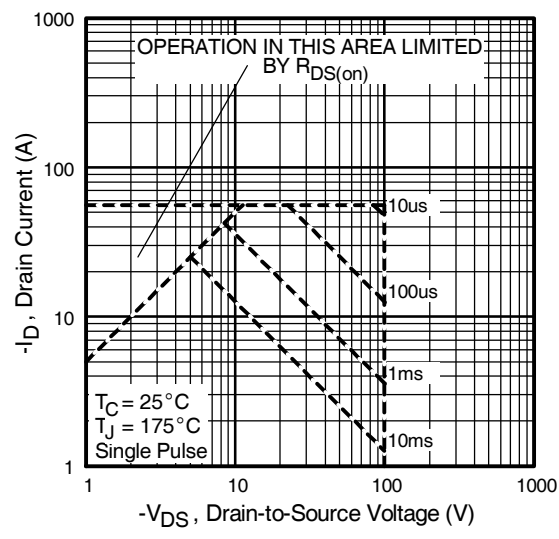


Fig 8. Maximum Safe Operating Area

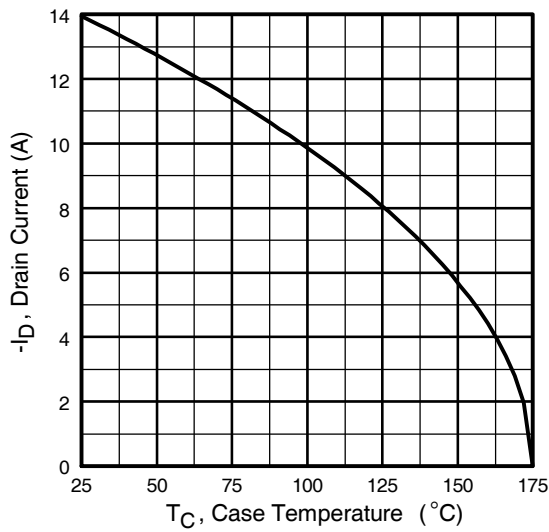


Fig 9. Maximum Drain Current Vs. Case Temperature

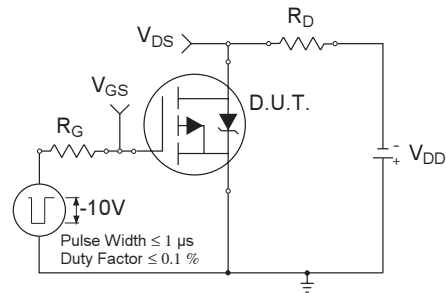


Fig 10a. Switching Time Test Circuit

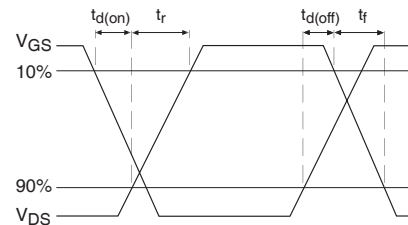


Fig 10b. Switching Time Waveforms

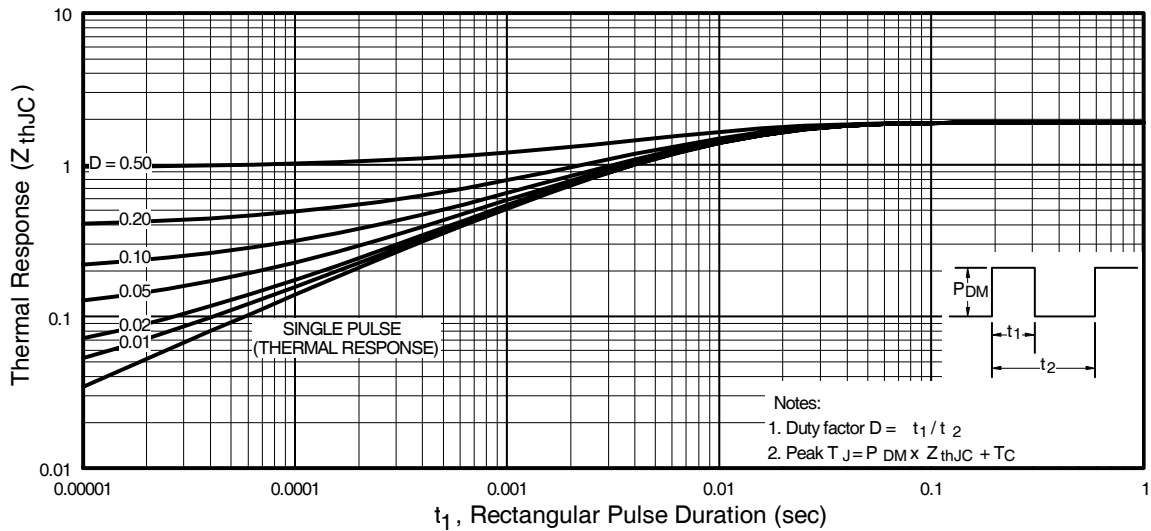


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

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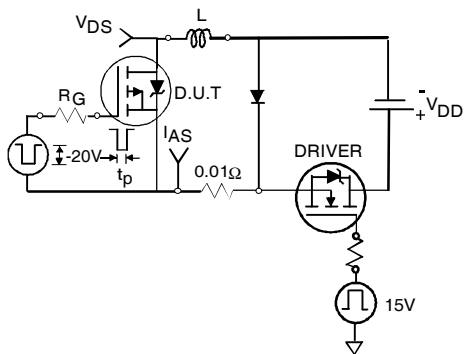


Fig 12a. Unclamped Inductive Test Circuit

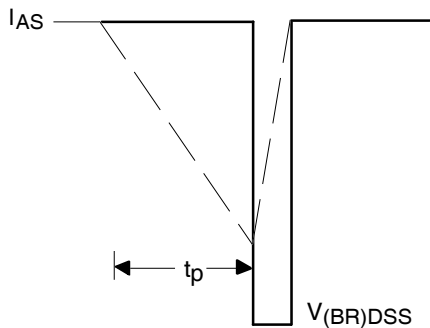


Fig 12b. Unclamped Inductive Waveforms

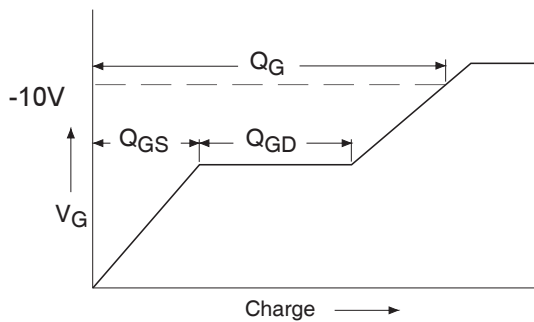


Fig 13a. Basic Gate Charge Waveform

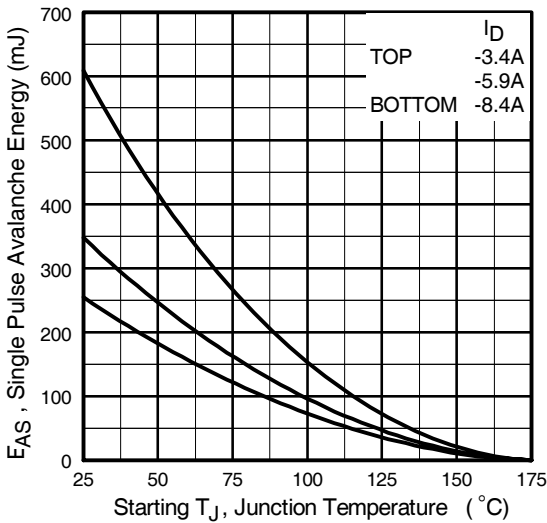


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

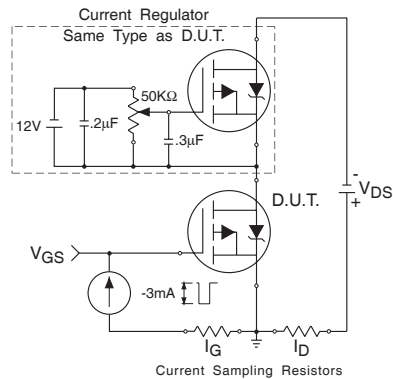


Fig 13b. Gate Charge Test Circuit

The diagram shows a Class-D power amplifier circuit. The input is a square wave voltage source V_{GS} (labeled 1) connected to the gate of a MOSFET through a gate resistor R_G . The MOSFET's source is grounded. The drain is connected to a transformer (labeled 2) and a second MOSFET (labeled 3). The second MOSFET's gate is driven by a transformer (labeled 4) and its source is grounded. The drain of the second MOSFET is connected to a load resistor and a DC supply V_{DD} . The load resistor is connected to ground. The output voltage is taken across the load resistor. The circuit is labeled with circled numbers 1 through 4.

Circuit Layout Considerations

- Low Stray Inductance
- Ground Plane
- Low Leakage Inductance

Current Transformer

- dv/dt controlled by R_G
- I_{SD} controlled by Duty Factor "D"
- D.U.T. - Device Under Test

① Driver Gate Drive

P.W. Period

$D = \frac{\text{P.W.}}{\text{Period}}$

$[V_{GS}=10V]$ ***

② D.U.T. I_{SD} Waveform

Reverse Recovery Current

Body Diode Forward Current

di/dt

③ D.U.T. V_{DS} Waveform

Diode Recovery dv/dt

Re-Applied Voltage

Body Diode Forward Drop

$[V_{DD}]$

④ Inductor Current

Ripple $\leq 5\%$

$[I_{SD}]$

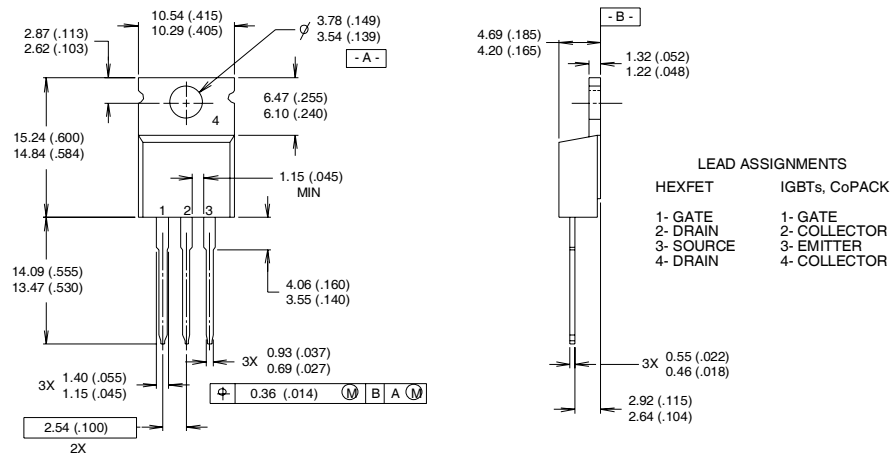
Fig 14. For P-Channel HEXFETS

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TO-220AB Package Outline

Dimensions are shown in millimeters (inches)



NOTES:

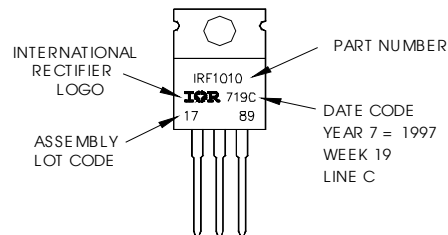
- 1 DIMENSIONING & TOLERANCING PER ANSI Y14.5M, 1982.
- 2 CONTROLLING DIMENSION : INCH

3 OUTLINE CONFORMS TO JEDEC OUTLINE TO-220AB.

4 HEATSINK & LEAD MEASUREMENTS DO NOT INCLUDE BURRS.

TO-220AB Part Marking Information

EXAMPLE: THIS IS AN IRF1010
LOT CODE 1789
ASSEMBLED ON WW 19, 1997
IN THE ASSEMBLY LINE "C"
Note: "P" in assembly line
position indicates "Lead-Free"



Data and specifications subject to change without notice.

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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.02/04

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

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