

International IR Rectifier

PD-95413

IRF9610PbF

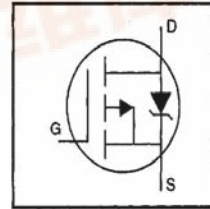
HEXFET® Power MOSFET

- Dynamic dv/dt Rating
- P-Channel
- Fast Switching
- Ease of Paralleling
- Simple Drive Requirements
- Lead-Free

Description

The HEXFET technology is the key to International Rectifier's advanced line of power MOSFET transistors. The efficient geometry and unique processing of the HEXFET design achieve very low on-state resistance combined with high transconductance and extreme device ruggedness.

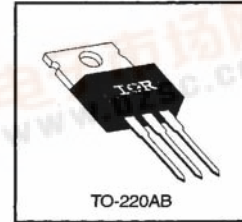
The TO-220 package is universally preferred for all commercial-industrial applications at power dissipation levels to approximately 50 watts. The low thermal resistance and low package cost of the TO-220 contribute to its wide acceptance throughout the industry.



$$V_{DSS} = -200V$$

$$R_{DS(on)} = 3.0\Omega$$

$$I_D = -1.8A$$



Absolute Maximum Ratings

	Parameter	Max.	Units
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ -10V$	-1.8	A
$I_D @ T_C = 100^\circ C$	Continuous Drain Current, $V_{GS} @ -10V$	-1.0	
I_{DM}	Pulsed Drain Current ①	-7.0	
$P_D @ T_C = 25^\circ C$	Power Dissipation	20	W
	Linear Derating Factor	0.16	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
I_{LM}	Inductive Current, Clamp	-7.0	A
dv/dt	Peak Diode Recovery dv/dt ③	-5.0	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)	
	Mounting Torque, 6-32 or M3 screw	10 lbf•in (1.1 N•m)	

Thermal Resistance

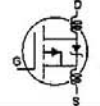
	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	—	6.4	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	—	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient	—	—	62	



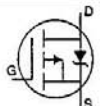
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Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Test Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	-200	—	—	V	$V_{GS}=0V, I_D=-250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	-0.23	—	V/ $^\circ\text{C}$	Reference to 25°C , $I_D=-1\text{mA}$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	—	3.0	Ω	$V_{GS}=-10V, I_D=-0.90A$ 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	0.90	—	—	S	$V_{DS}=-50V, I_D=-0.90A$ ④
I_{DSS}	Drain-to-Source Leakage Current	—	—	-100	μA	$V_{DS}=-200V, V_{GS}=0V$
		—	—	-500		$V_{DS}=-160V, V_{GS}=0V, T_J=125^\circ\text{C}$
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	—	—	11	nC	$I_D=-3.5A$
Q_{gs}	Gate-to-Source Charge	—	—	7.0		$V_{DS}=-160V$
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	—	4.0		$V_{GS}=-10V$ See Fig. 11 & 18 ④
$t_{d(on)}$	Turn-On Delay Time	—	8.0	—		ns
t_r	Rise Time	—	15	—	$I_D=-0.90A$	
$t_{d(off)}$	Turn-Off Delay Time	—	10	—	$R_G=50\Omega$	
t_f	Fall Time	—	8.0	—	$R_D=110\Omega$ See Figure 17 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	—	170	—	pF	$V_{GS}=0V$
C_{oss}	Output Capacitance	—	50	—		$V_{DS}=-25V$
C_{rss}	Reverse Transfer Capacitance	—	15	—		$f=1.0\text{MHz}$ See Figure 10

Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Test Conditions
I_S	Continuous Source Current (Body Diode)	—	—	-1.8	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	-7.0		
V_{SD}	Diode Forward Voltage	—	—	-5.8	V	$T_J=25^\circ\text{C}, I_S=-1.8A, V_{GS}=0V$ ④
t_{rr}	Reverse Recovery Time	—	240	360	ns	$T_J=25^\circ\text{C}, I_F=-1.8A$
Q_{rr}	Reverse Recovery Charge	—	1.7	2.6	μC	$di/dt=100A/\mu s$ 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 Figure 5)

③ $I_{SD} \leq -1.8A, di/dt \leq 70A/\mu s, V_{DD} \leq V_{(BR)DSS}, T_J \leq 150^\circ\text{C}$

② Not Applicable

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

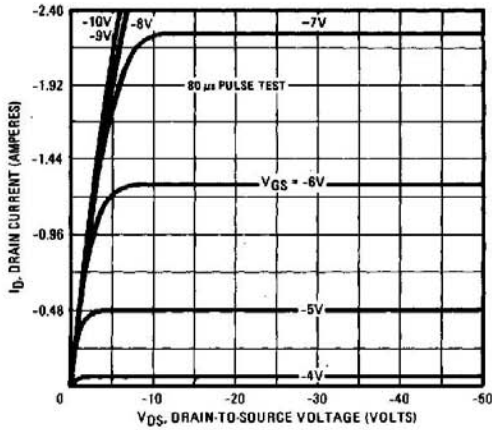


Fig. 1 — Typical Output Characteristics

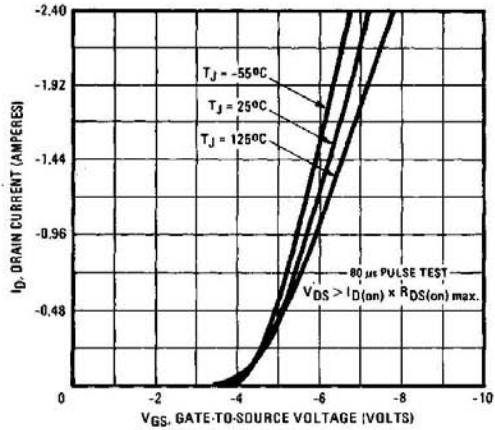


Fig. 2 — Typical Transfer Characteristics

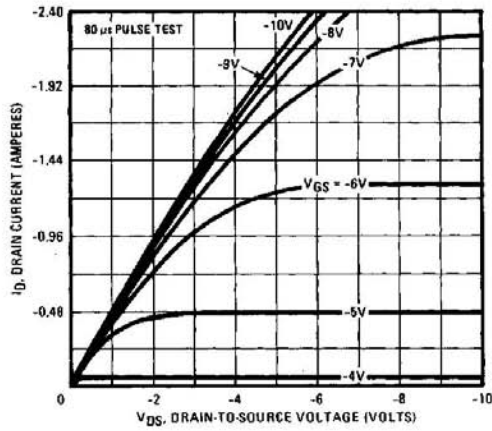


Fig. 3 — Typical Saturation Characteristics

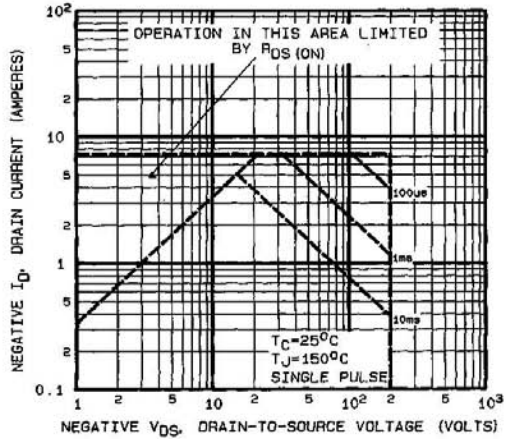


Fig. 4 — Maximum Safe Operating Area

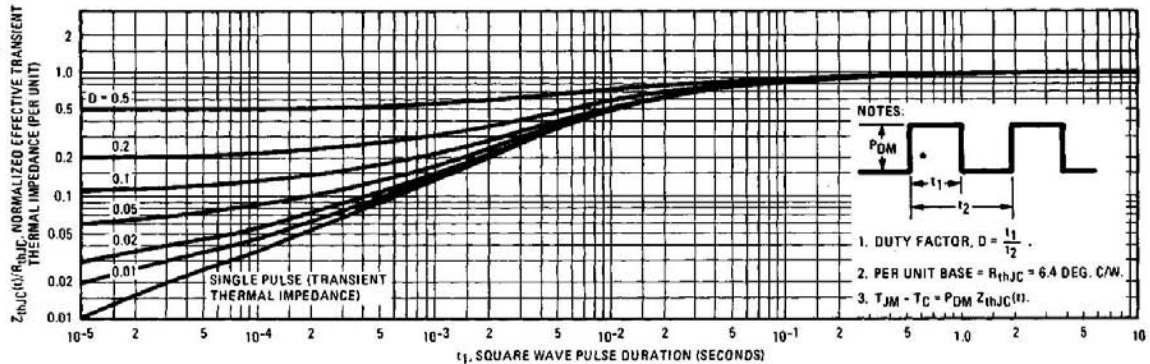


Fig. 5 — Maximum Effective Transient Thermal Impedance, Junction-to-Case Vs. Pulse Duration

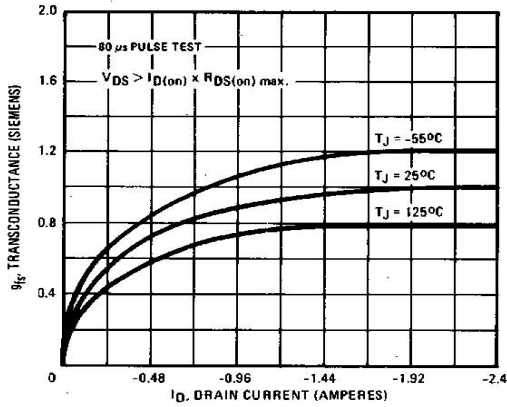


Fig. 6 — Typical Transconductance Vs. Drain Current

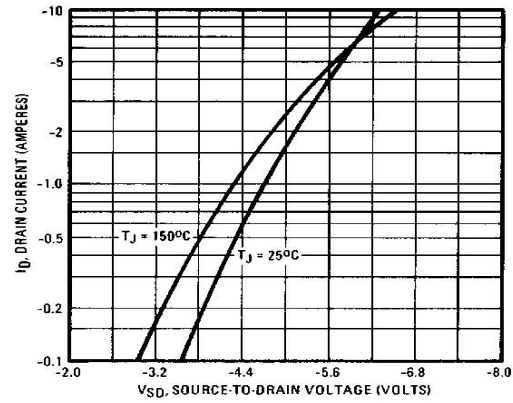


Fig. 7 — Typical Source-Drain Diode Forward Voltage

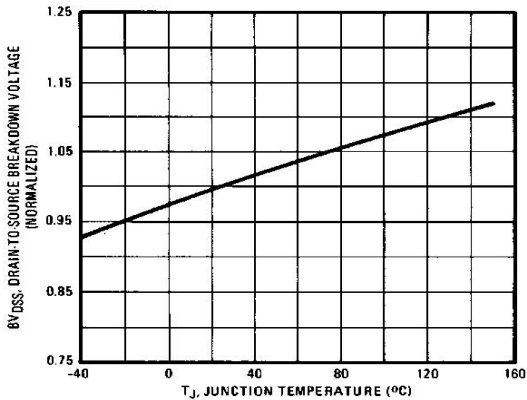


Fig. 8 — Breakdown Voltage Vs. Temperature

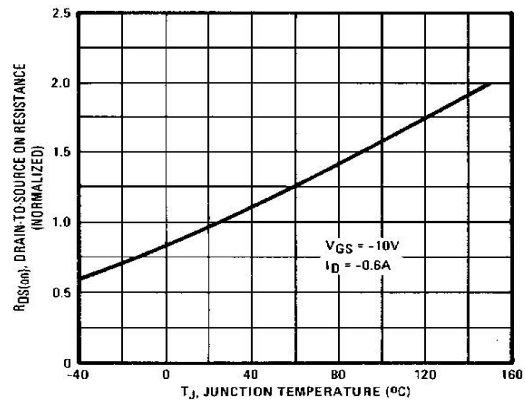


Fig. 9 — Normalized On-Resistance Vs. Temperature

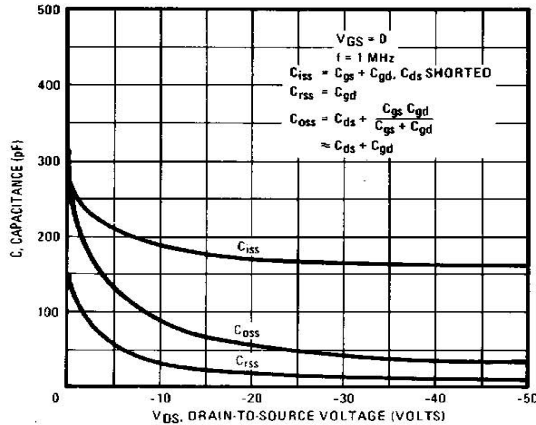


Fig. 10 — Typical Capacitance Vs. Drain-to-Source Voltage

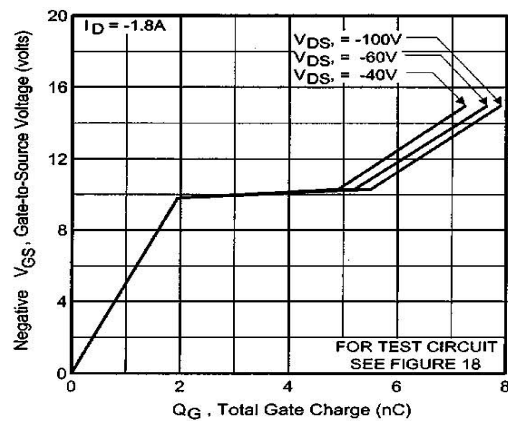


Fig. 11 — Typical Gate Charge Vs. Gate-to-Source Voltage

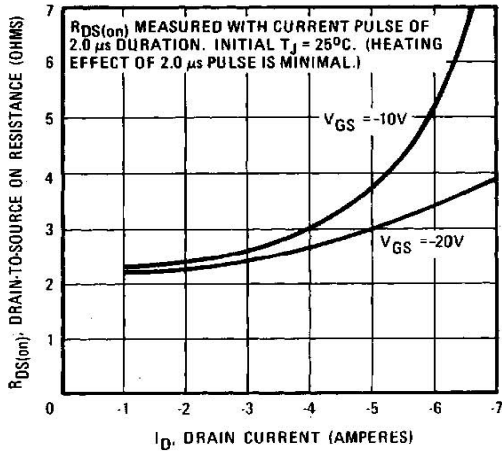


Fig. 12 — Typical On-Resistance Vs. Drain Current

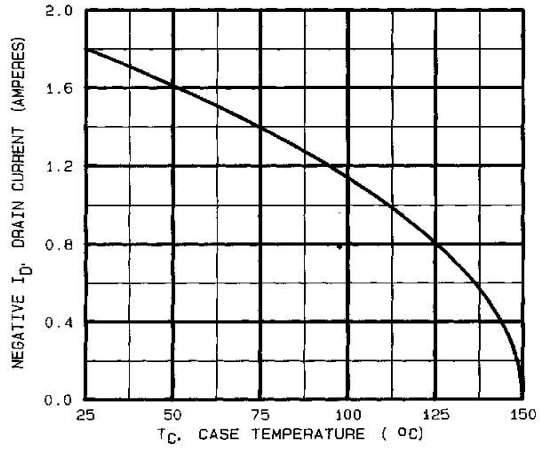


Fig. 13 — Maximum Drain Current Vs. Case Temperature

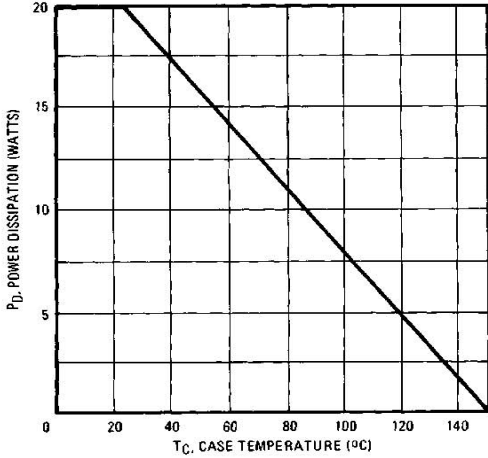


Fig. 14 — Power Vs. Temperature Derating Curve

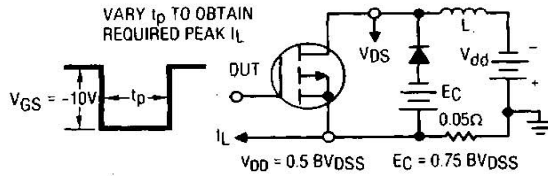


Fig. 15 — Clamped Inductive Test Circuit

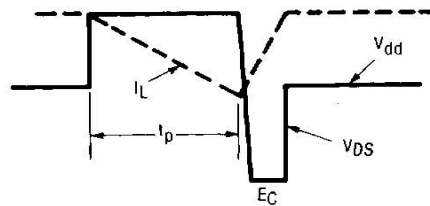


Fig. 16 — Clamped Inductive Waveforms

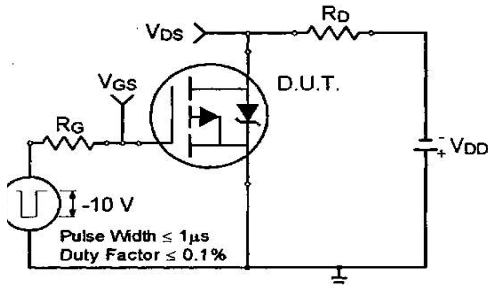


Fig. 17a — Switching Time Test Circuit

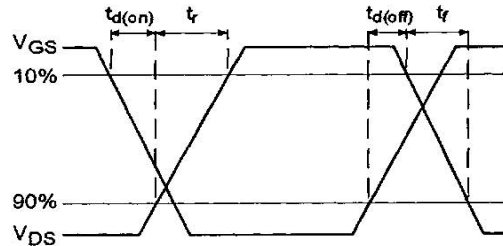


Fig. 17b — Switching Time Waveforms

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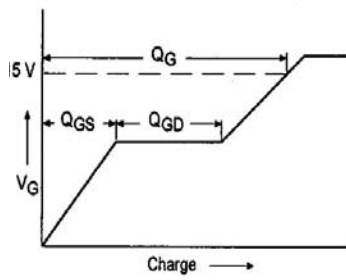


Fig. 18a — Basic Gate Charge Waveform

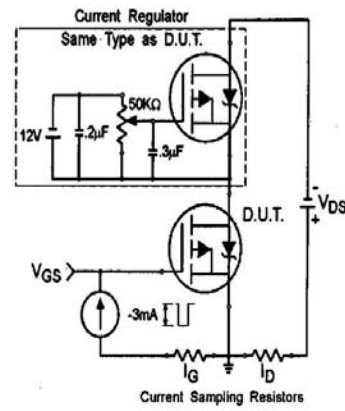
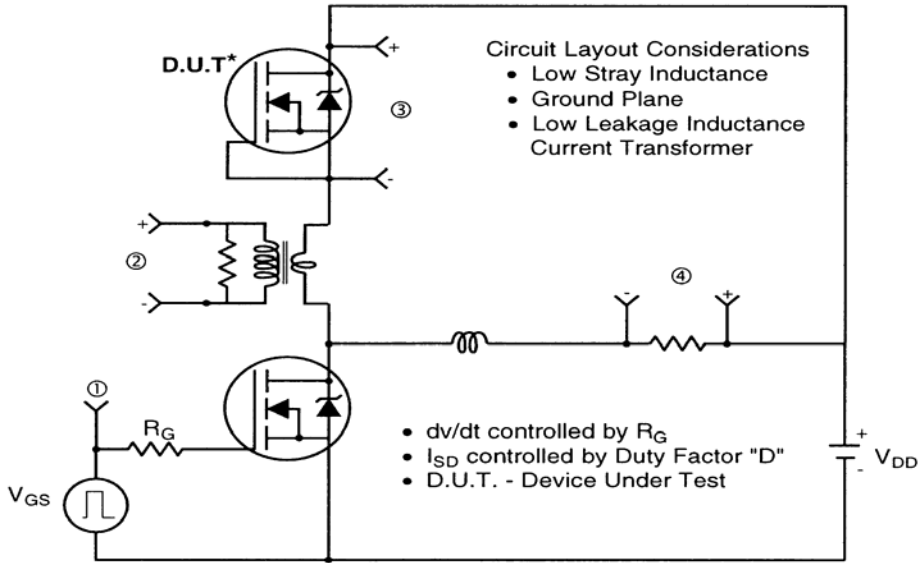
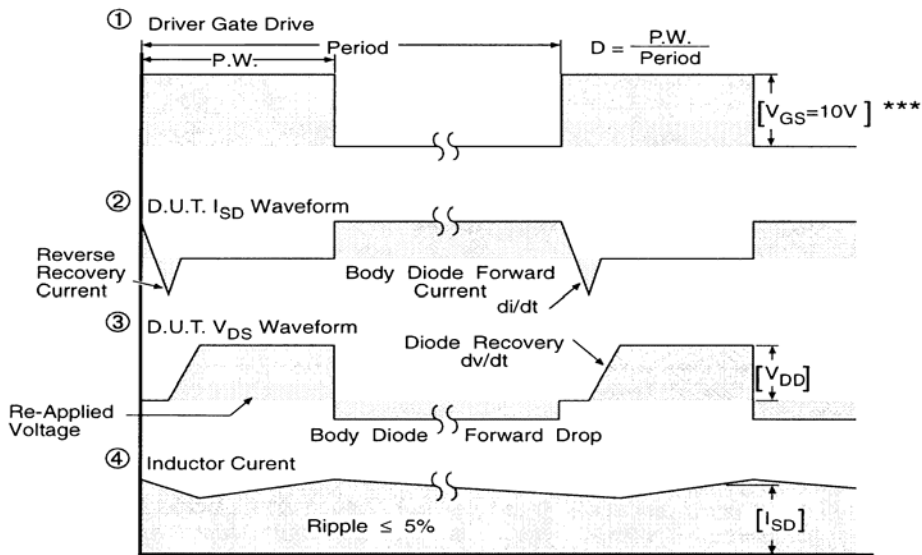


Fig. 18b — Gate Charge Test Circuit

Peak Diode Recovery dv/dt Test Circuit



* Reverse Polarity of D.U.T for P-Channel



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

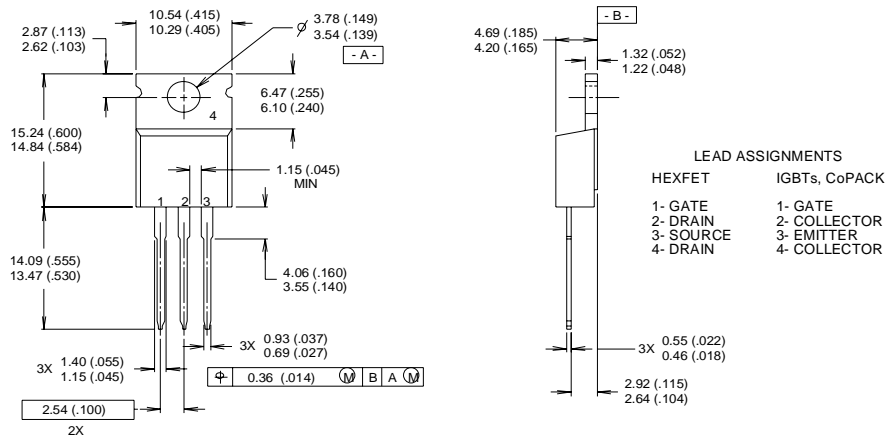
Fig 14. For P-Channel HEXFETS

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TO-220AB Package Outline

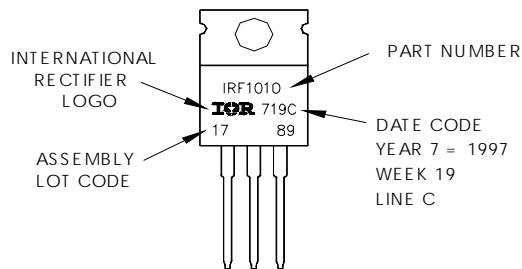
Dimensions are shown in millimeters (inches)



- 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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