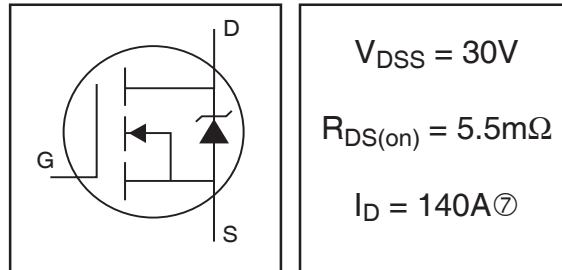


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HEXFET® Power MOSFET

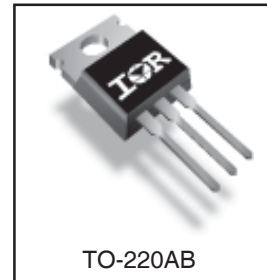
- Advanced Process Technology
- Ultra Low On-Resistance
- Dynamic dv/dt Rating
- 175°C Operating Temperature
- Fast Switching
- Fully Avalanche Rated
- Lead-Free



Description

Advanced HEXFET® Power MOSFETs 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, $V_{GS} @ 10\text{V}$	140 ⁽⁷⁾	A
$I_D @ T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$	110	
I_{DM}	Pulsed Drain Current ⁽¹⁾	470	
$P_D @ T_C = 25^\circ\text{C}$	Power Dissipation	200	W
	Linear Derating Factor	1.4	W/°C
V_{GS}	Gate-to-Source Voltage	± 16	V
I_{AR}	Avalanche Current ⁽¹⁾	71	A
E_{AR}	Repetitive Avalanche Energy ⁽¹⁾	20	mJ
dv/dt	Peak Diode Recovery dv/dt ⁽³⁾	5.0	V/ns
T_J	Operating Junction and Storage Temperature Range	-55 to + 175	°C
T_{STG}			
	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	—	0.74	°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	30	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.028	—	V/ $^\circ\text{C}$	Reference to $25^\circ\text{C}, I_D = 1\text{mA}$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	—	5.5	m Ω	$V_{GS} = 10V, I_D = 71A$ ④
		—	—	7.5		$V_{GS} = 4.5V, I_D = 59A$ ④
$V_{GS(th)}$	Gate Threshold Voltage	1.0	—	—	V	$V_{DS} = V_{GS}, I_D = 250\mu A$
g_{fs}	Forward Transconductance	82	—	—	S	$V_{DS} = 25V, I_D = 71A$ ④
I_{DSS}	Drain-to-Source Leakage Current	—	—	25	μA	$V_{DS} = 30V, V_{GS} = 0V$
		—	—	250		$V_{DS} = 24V, V_{GS} = 0V, T_J = 150^\circ\text{C}$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 16V$
	Gate-to-Source Reverse Leakage	—	—	-100		$V_{GS} = -16V$
Q_g	Total Gate Charge	—	—	76	nC	$I_D = 71A$
Q_{gs}	Gate-to-Source Charge	—	—	19		$V_{DS} = 24V$
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	—	35		$V_{GS} = 4.5V$, See Fig. 6 and 13
$t_{d(on)}$	Turn-On Delay Time	—	16	—	nH	$V_{DD} = 15V$ $I_D = 71A$ $R_G = 1.3\Omega$ $V_{GS} = 4.5V$, See Fig. 10 ④
t_r	Rise Time	—	180	—		
$t_{d(off)}$	Turn-Off Delay Time	—	29	—		
t_f	Fall Time	—	37	—		
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	—	3720	—	pF	$V_{GS} = 0V$ $V_{DS} = 25V$ $f = 1.0\text{MHz}$, See Fig. 5
C_{oss}	Output Capacitance	—	1480	—		
C_{rss}	Reverse Transfer Capacitance	—	270	—		
E_{AS}	Single Pulse Avalanche Energy ②	—	1560 ③	400 ⑥	mJ	$I_{AS} = 71A, L = 0.16\text{mH}$

Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	140 ⑦	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	470		
V_{SD}	Diode Forward Voltage	—	—	1.2	V	$T_J = 25^\circ\text{C}, I_S = 71A, V_{GS} = 0V$ ④
t_{rr}	Reverse Recovery Time	—	52	78	ns	$T_J = 25^\circ\text{C}, I_F = 71A$
Q_{rr}	Reverse Recovery Charge	—	91	140	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 $T_J = 25^\circ\text{C}$, $L = 160\mu H$
 $R_G = 25\Omega$, $I_{AS} = 71A$, $V_{GS} = 10V$ (See Figure 12)
- ③ $I_{SD} \leq 71A$, $di/dt \leq 110A/\mu s$, $V_{DD} \leq V_{(BR)DSS}$,
 $T_J \leq 175^\circ\text{C}$
- ④ Pulse width $\leq 400\mu s$; duty cycle $\leq 2\%$.
- ⑤ This is a typical value at device destruction and represents operation outside rated limits.
- ⑥ This is a calculated value limited to $T_J = 175^\circ\text{C}$.
- ⑦ Calculated continuous current based on maximum allowable junction temperature. Package limitation current is 75A.

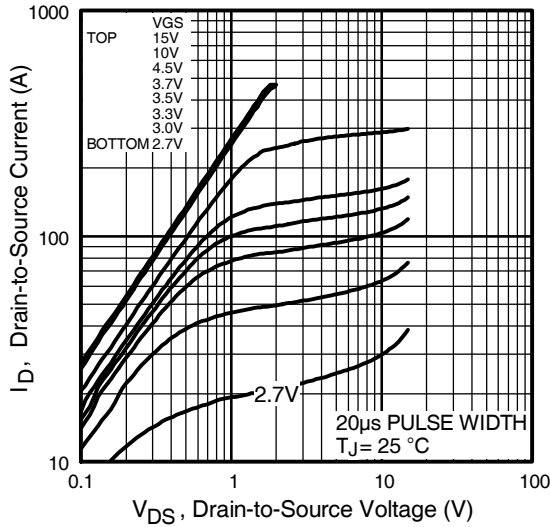


Fig 1. Typical Output Characteristics

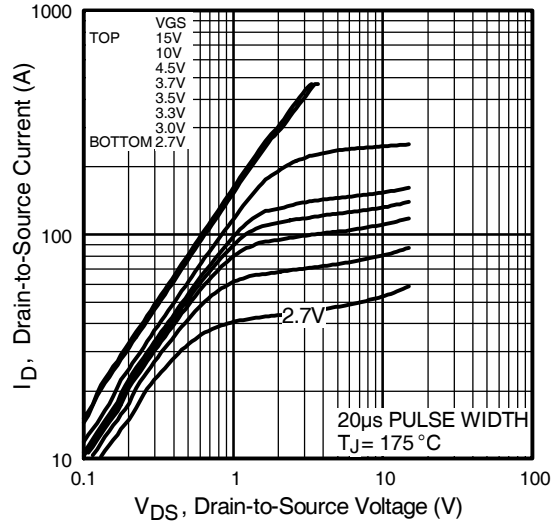


Fig 2. Typical Output Characteristics

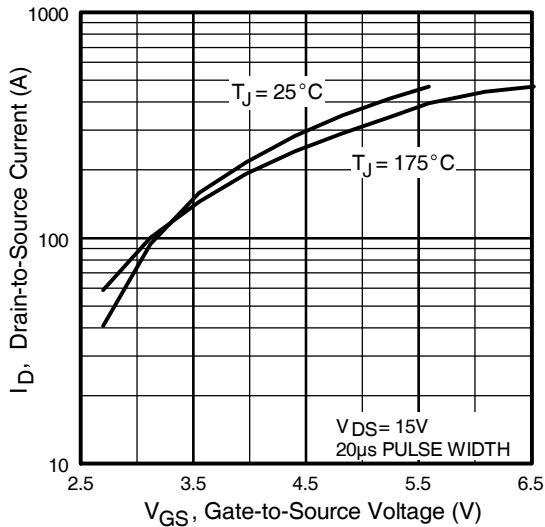


Fig 3. Typical Transfer Characteristics

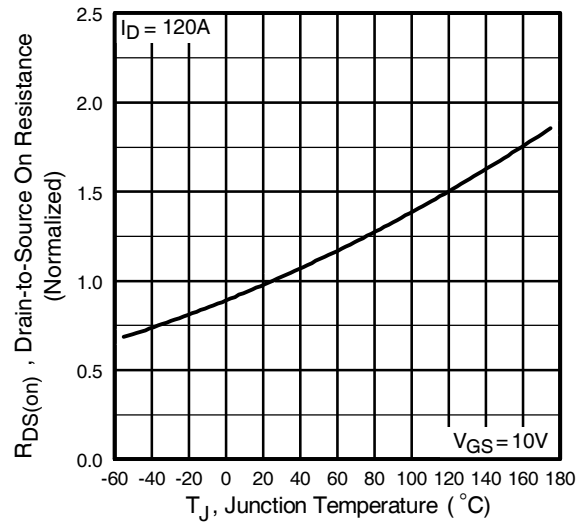


Fig 4. Normalized On-Resistance Vs. Temperature

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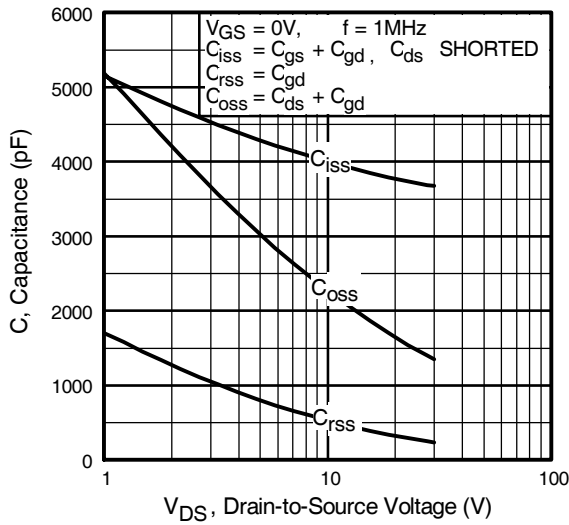


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

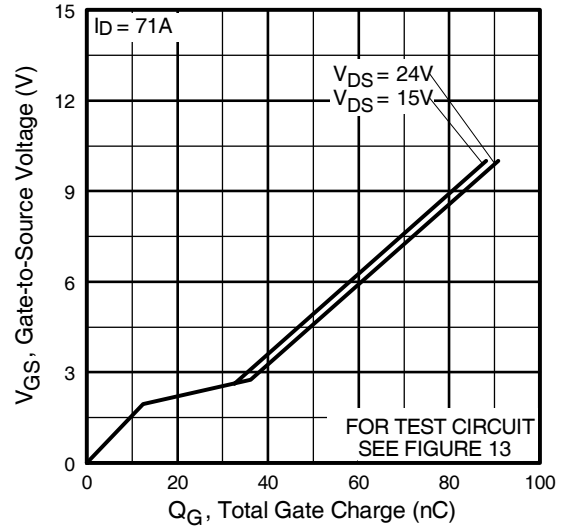


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

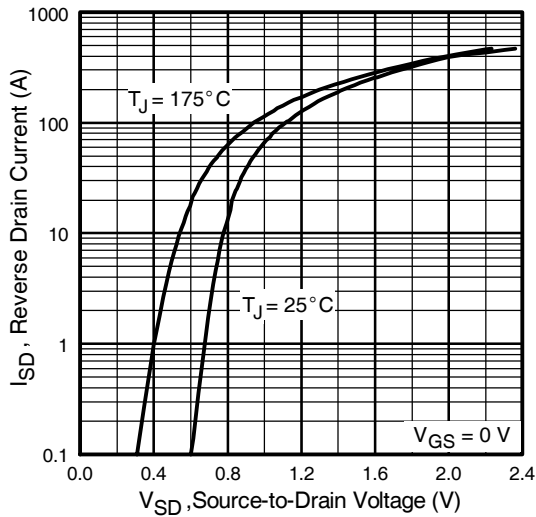


Fig 7. Typical Source-Drain Diode Forward Voltage

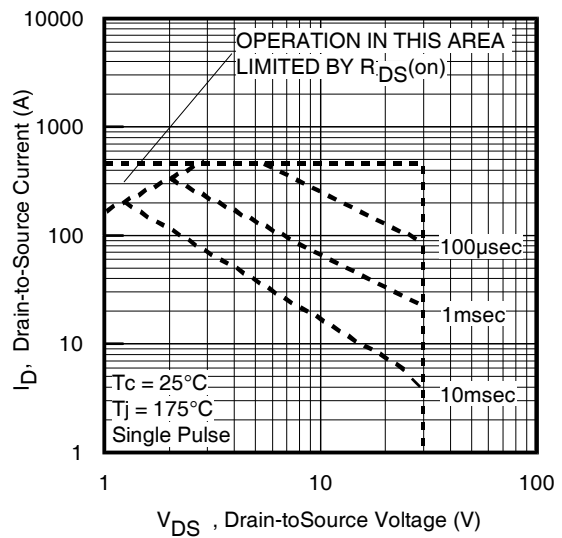


Fig 8. Maximum Safe Operating Area

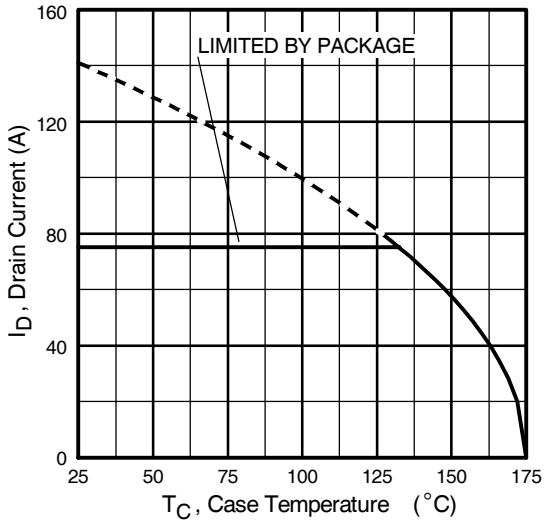


Fig 9. Maximum Drain Current Vs. Case Temperature



Fig 10a. Switching Time Test Circuit



Fig 10b. Switching Time Waveforms

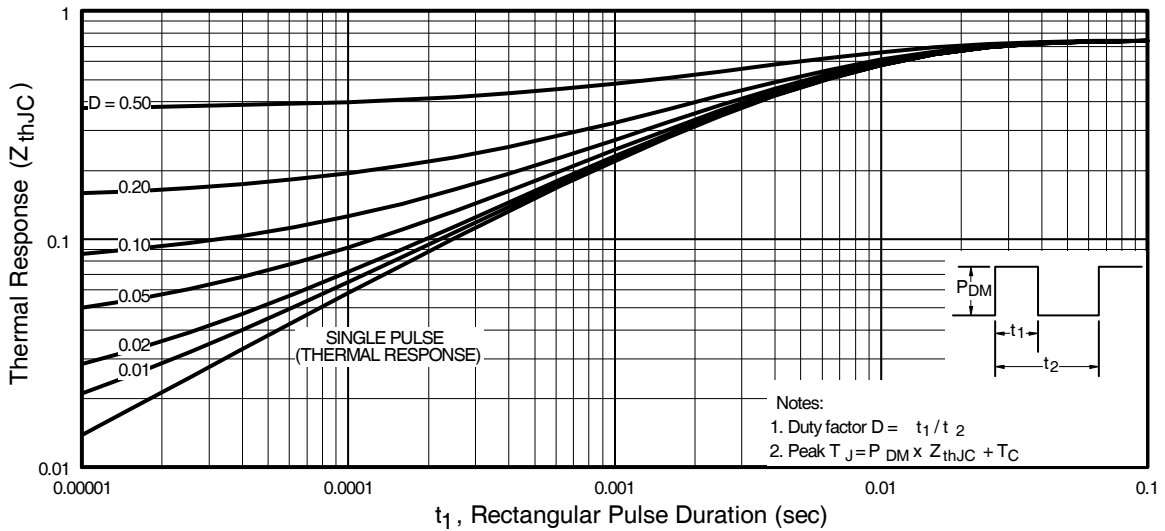


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

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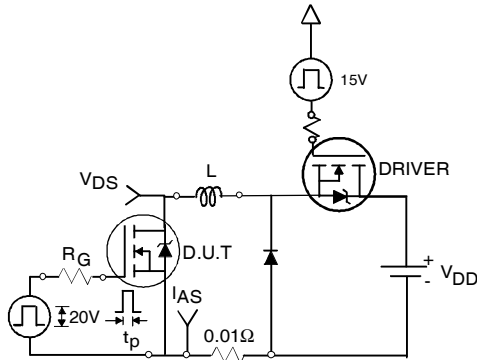


Fig 12a. Unclamped Inductive Test Circuit



Fig 12b. Unclamped Inductive Waveforms

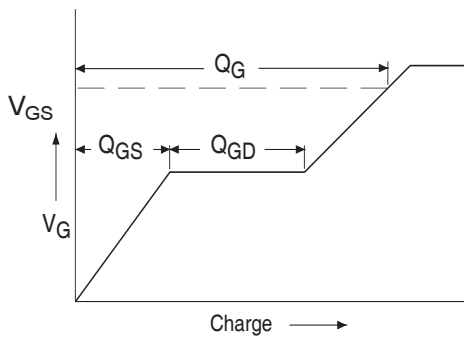


Fig 13a. Basic Gate Charge Waveform

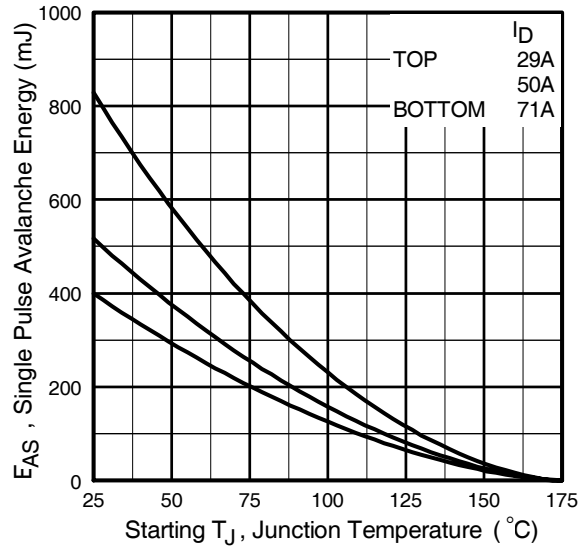


Fig 12c. Maximum Avalanche Energy Vs. Drain Current



Fig 13b. Gate Charge Test Circuit

Peak Diode Recovery dv/dt Test Circuit



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



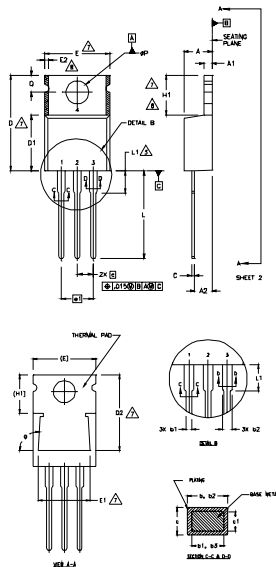
*** $V_{GS} = 5.0V$ for Logic Level and 3V Drive Devices

Fig 14. For N-channel HEXFET[®] power MOSFETs

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TO-220AB Package Outline



- NOTES:
- 1 DIMENSIONING AND TOLERANCING PER ASME Y14.5 M-1994.
 - 2 DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS].
 - 3 LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
 - 4 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.
 - 5 DIMENSION b1 & c1 APPLY TO BASE METAL ONLY.
 - 6 CONTROLLING DIMENSION: INCHES.
 - 7 THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS E*H1, D2 & E1.
 - 8 DIMENSION L2 IS HI DEFINE A ZONE WHERE STAMPING AND SINGULATION IRREGULARITIES ARE ALLOWED.

LEAD ASSIGNMENTS

- KEY:
- 1- GATE
 - 2- DIODE
 - 3- SOURCE

LEAD LENGTHS

- 1- GATE
- 2- COLLECTOR
- 3- EMITTER

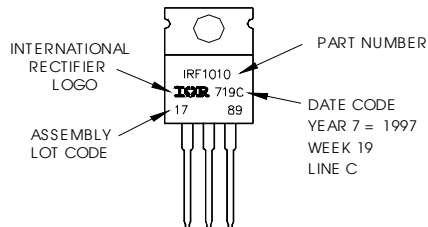
ROGERS

- 1- ANGLE/OPEN
- 2- OTHER
- 3- NONE

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	3.56	4.82	.140	.190	
A1	0.51	1.40	.020	.055	
A2	2.04	2.92	.080	.115	
b	0.38	1.01	.015	.040	
b1	0.38	0.96	.015	.038	5
b2	1.15	1.77	.045	.070	
b3	1.15	1.73	.045	.068	
c	0.36	0.61	.014	.024	
c1	0.36	0.56	.014	.022	5
D	14.22	16.51	.560	.650	4
D1	8.38	9.02	.330	.355	
D2	12.19	12.88	.480	.507	7
E	9.66	10.66	.380	.420	4,7
E1	8.38	8.89	.330	.350	7
e	2.54 BSC		.100 BSC		
e1	4.00		.150 BSC		
H1	5.85	6.55	.230	.270	7,8
L	12.70	14.73	.500	.580	
L1	-	6.35	-	.250	3
MP	3.54	4.08	.139	.161	
O	2.54	3.42	.100	.135	
Ø	.90-.93		.35-.37		

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"



TO-220AB package is not recommended for Surface Mount Application.

Data and specifications subject to change without notice.
 This product has been designed and qualified for the Industrial market.
 Qualification Standards can be found on IR's Web site.

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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/>

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[SSM6P54TU,LF](#) [SSM6P69NU,LF](#) [DMP22D4UFO-7B](#)