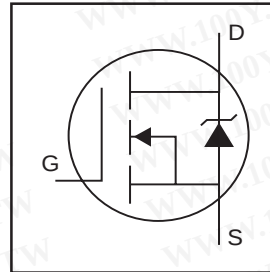


International IOR Rectifier

IRL1404

HEXFET® Power MOSFET

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

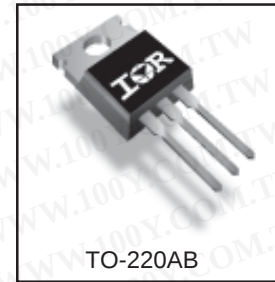


$V_{DS} = 40V$
 $R_{DS(on)} = 4.0m\Omega$
 $I_D = 160A\text{⑥}$

Description

Seventh Generation 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 @ $T_C = 25^\circ C$	Continuous Drain Current, V_{GS} @ 10V	160⑥	A
I_D @ $T_C = 100^\circ C$	Continuous Drain Current, V_{GS} @ 10V	110⑥	
I_{DM}	Pulsed Drain Current ①	640	
P_D @ $T_C = 25^\circ C$	Power Dissipation	200	W
	Linear Derating Factor	1.3	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS}	Single Pulse Avalanche Energy②	620	mJ
I_{AR}	Avalanche Current①	95	A
E_{AR}	Repetitive Avalanche Energy①	20	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

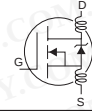
	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	0.75	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient (PCB Mounted)④	—	62	

IRL1404

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	40	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.038	—	V/°C	Reference to 25°C , $I_D = 1mA$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	—	4.0 5.9	mΩ	$V_{GS} = 10V, I_D = 95A$ ④ $V_{GS} = 4.3V, I_D = 40A$ ④
$V_{GS(th)}$	Gate Threshold Voltage	1.0	—	3.0	V	$V_{DS} = V_{GS}, I_D = 250\mu A$
g_{fs}	Forward Transconductance	93	—	—	S	$V_{DS} = 25V, I_D = 95A$
I_{DSS}	Drain-to-Source Leakage Current	—	—	20 250	μA	$V_{DS} = 40V, V_{GS} = 0V$ $V_{DS} = 32V, V_{GS} = 0V, T_J = 150^\circ\text{C}$
I_{GSS}	Gate-to-Source Forward Leakage Gate-to-Source Reverse Leakage	—	—	200 -200	nA	$V_{GS} = 20V$ $V_{GS} = -20V$
Q_g	Total Gate Charge	—	—	140	nC	$I_D = 95A$
Q_{gs}	Gate-to-Source Charge	—	—	48	nC	$V_{DS} = 32V$
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	—	60	nC	$V_{GS} = 5.0V$, See Fig. 6 ④
$t_{d(on)}$	Turn-On Delay Time	—	18	—	ns	$V_{DD} = 20V$
t_r	Rise Time	—	270	—	ns	$I_D = 95A$
$t_{d(off)}$	Turn-Off Delay Time	—	38	—	ns	$R_G = 2.5\Omega, V_{GS} = 4.5V$
t_f	Fall Time	—	37	—	ns	$R_D = 0.25\Omega$ 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	—	nH	
C_{iss}	Input Capacitance	—	6590	—	pF	$V_{GS} = 0V$
C_{oss}	Output Capacitance	—	1710	—	pF	$V_{DS} = 25V$
C_{rss}	Reverse Transfer Capacitance	—	350	—	pF	$f = 1.0MHz$, See Fig. 5
C_{oss}	Output Capacitance	—	6650	—	pF	$V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0MHz$
C_{oss}	Output Capacitance	—	1510	—	pF	$V_{GS} = 0V, V_{DS} = 32V, f = 1.0MHz$
$C_{oss \text{ eff.}}$	Effective Output Capacitance ⑤	—	1480	—	pF	$V_{GS} = 0V, V_{DS} = 0V \text{ to } 32V$



Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	160⑥	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	640	A	
V_{SD}	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}, I_S = 95A, V_{GS} = 0V$ ④
t_{rr}	Reverse Recovery Time	—	63	94	ns	$T_J = 25^\circ\text{C}, I_F = 95A$
Q_{rr}	Reverse Recovery Charge	—	170	250	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 $T_J = 25^\circ\text{C}$, $L = 0.35mH$
 $R_G = 25\Omega, I_{AS} = 95A$. (See Figure 12).
- ③ $I_{SD} \leq 95A, di/dt \leq 160A/\mu s, V_{DD} \leq V_{(BR)DSS}, T_J \leq 175^\circ\text{C}$.
- ④ Pulse width $\leq 300\mu s$; duty cycle $\leq 2\%$.

- ⑤ $C_{oss \text{ eff.}}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .
- ⑥ Calculated continuous current based on maximum allowable junction temperature; for recommended current-handing of the package refer to Design Tip # 93-4.
- ⑦ Calculated continuous current based on maximum allowable junction temperature. Package limitation current is 75A.

International
IR Rectifier

IRL1404

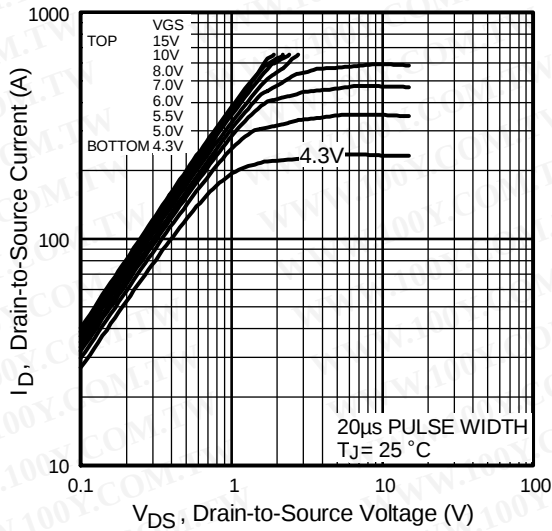


Fig 1. Typical Output Characteristics

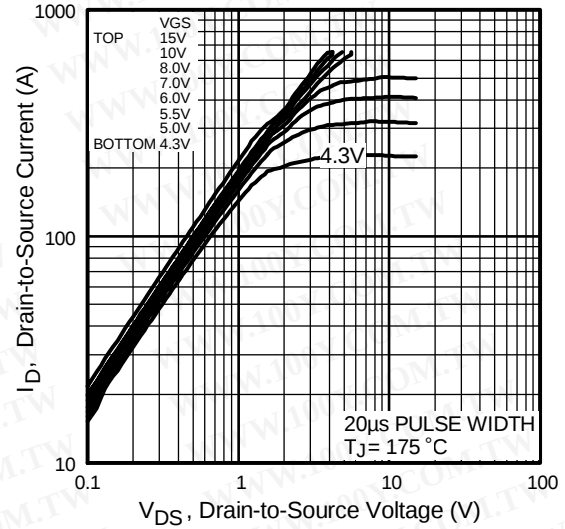


Fig 2. Typical Output Characteristics

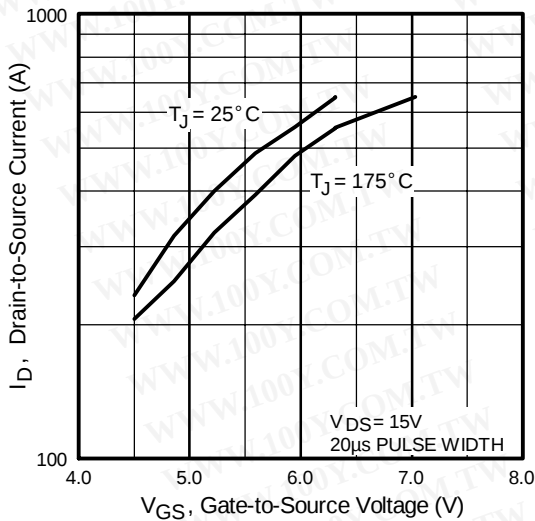


Fig 3. Typical Transfer Characteristics

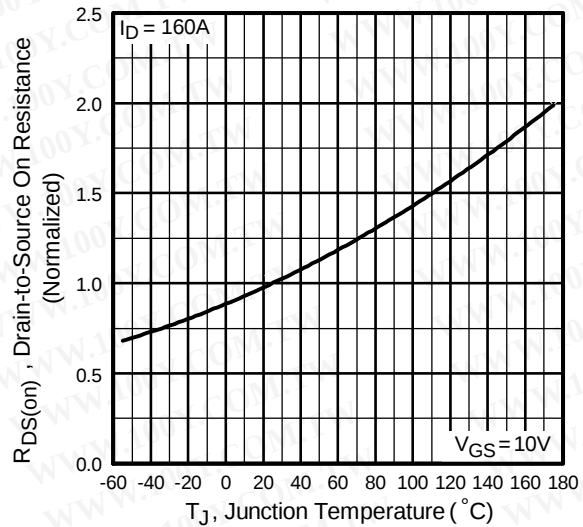
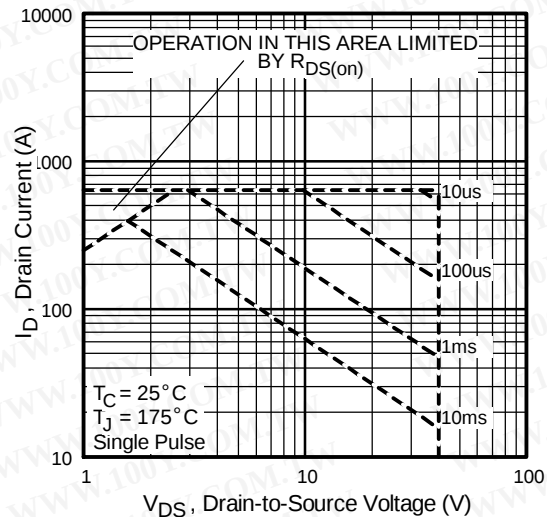
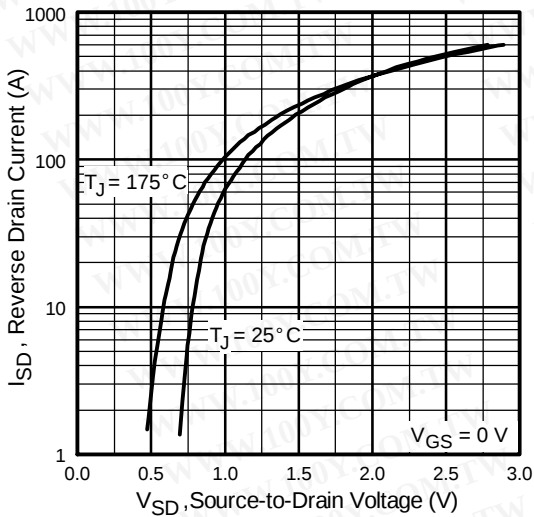
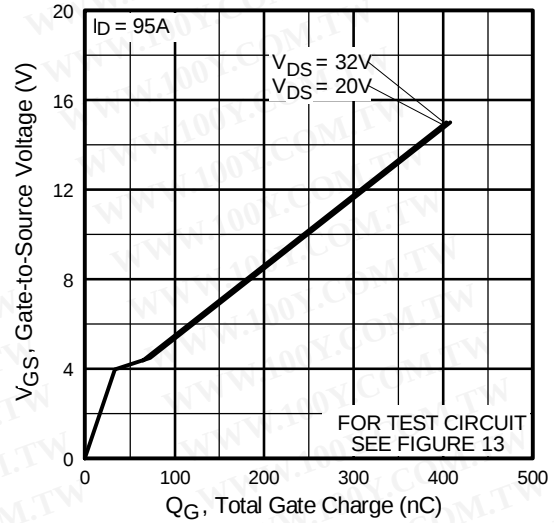
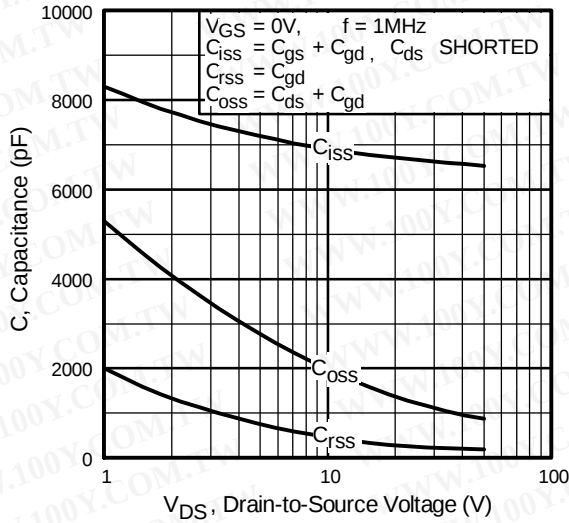


Fig 4. Normalized On-Resistance Vs. Temperature

IRL1404

International
IR Rectifier



International
IR Rectifier

IRL1404

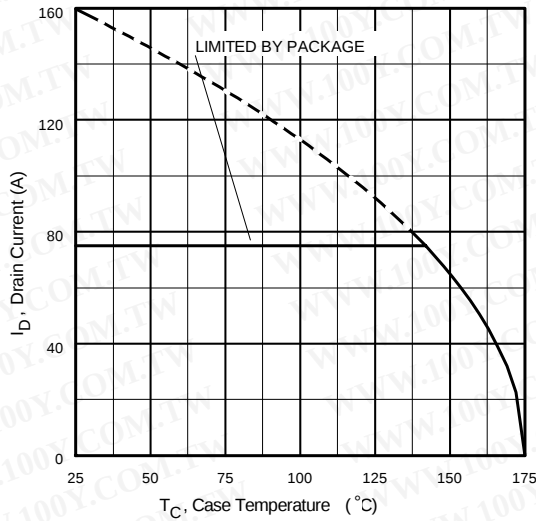


Fig 9. Maximum Drain Current Vs. Case Temperature

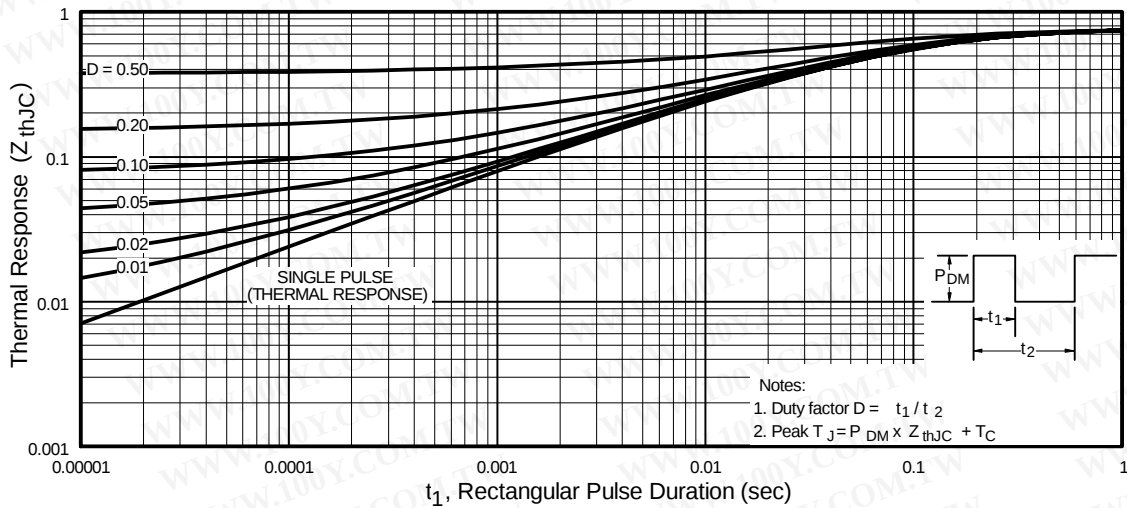
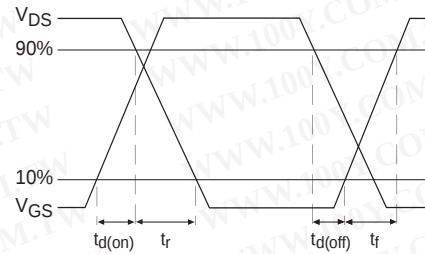
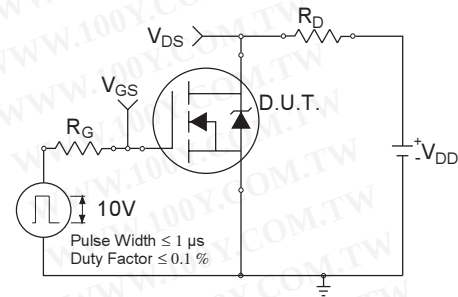


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

IRL1404

International
IR Rectifier

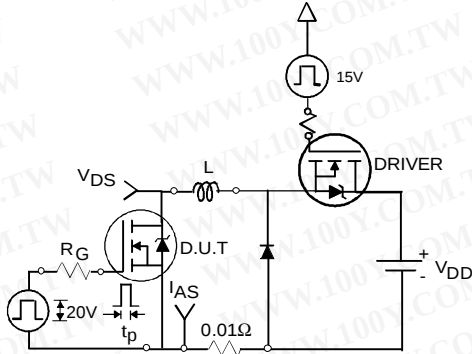


Fig 12a. Unclamped Inductive Test Circuit

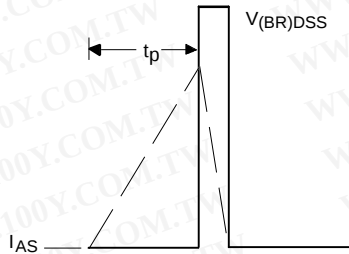


Fig 12b. Unclamped Inductive Waveforms

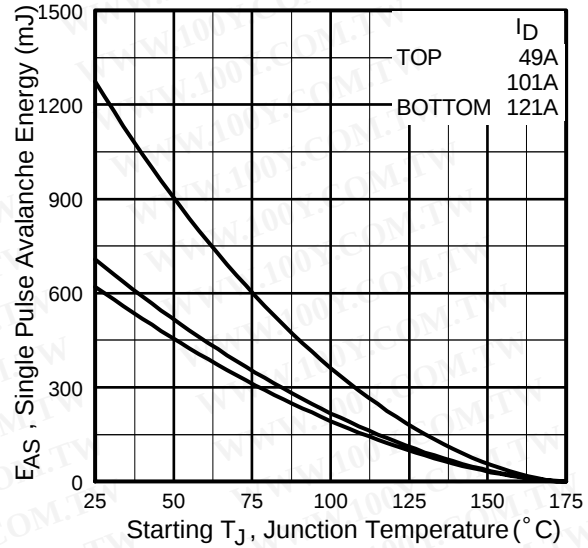


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

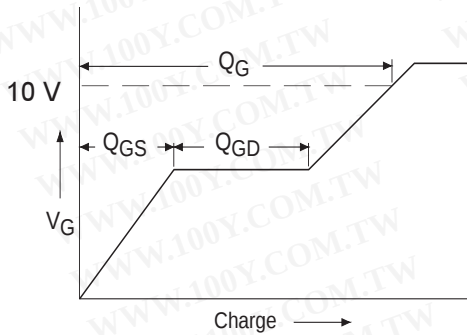


Fig 13a. Basic Gate Charge Waveform

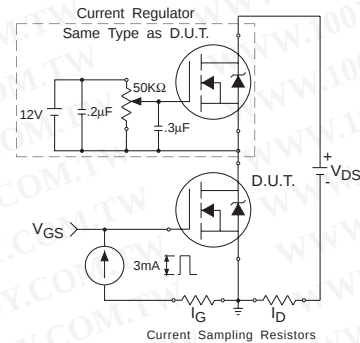
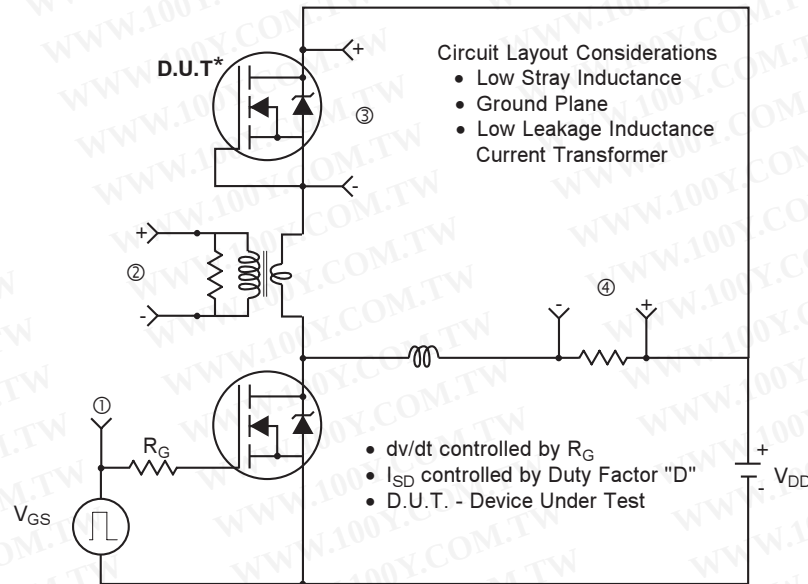
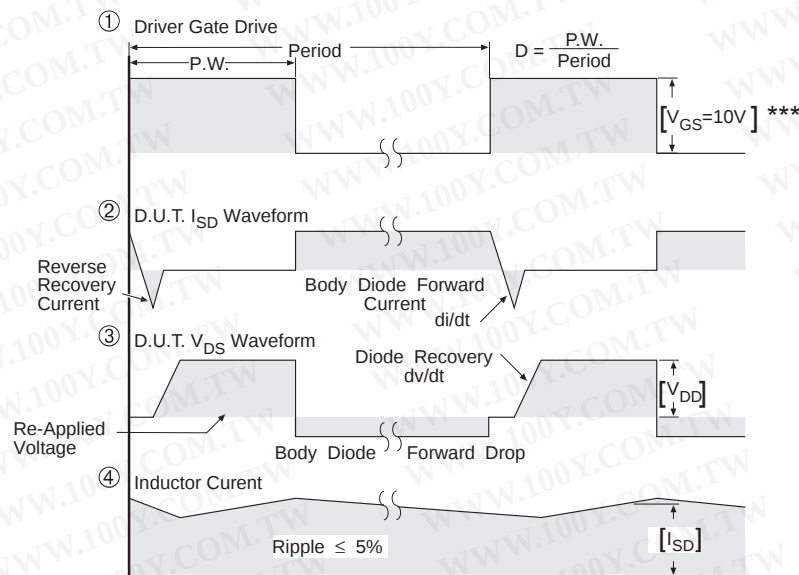


Fig 13b. Gate Charge Test Circuit

Peak Diode Recovery dv/dt Test Circuit



* Reverse Polarity 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

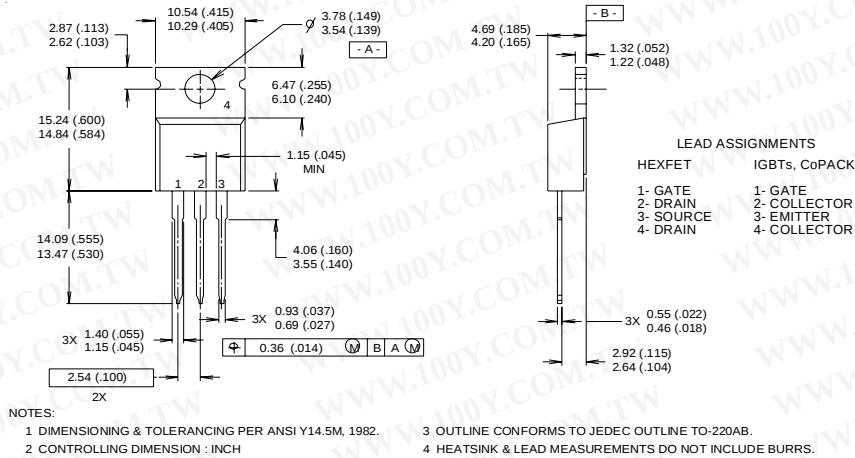
勝特力材料 886-3-5753170
 勝特力电子(上海) 86-21-54151736
 勝特力电子(深圳) 86-755-83298787
[Http://www.100y.com.tw](http://www.100y.com.tw)

IRL1404

International
IR Rectifier

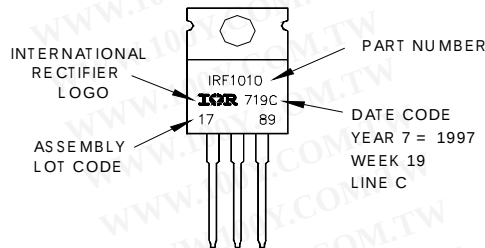
TO-220AB Package Outline

Dimensions are shown in millimeters (inches)



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.
 This product has been designed and qualified for the Automotive [Q101] market.
 Qualification Standards can be found on IR's Web site.

International
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.06/04

www.irf.com