

# International IR Rectifier

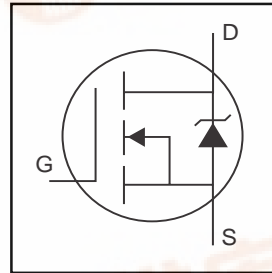
PD - 9.1611A

PRELIMINARY

# IRFI1310N

HEXFET® Power MOSFET

- Advanced Process Technology
- Isolated Package
- High Voltage Isolation = 2.5KV RMS ⑤
- Sink to Lead Creepage Dist. = 4.8mm
- Fully Avalanche Rated

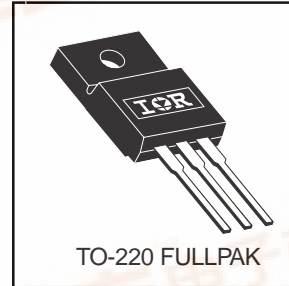


$V_{DS} = 100V$
$R_{DS(on)} = 0.036\Omega$
$I_D = 24A$

## 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 Fullpak eliminates the need for additional insulating hardware in commercial-industrial applications. The moulding compound used provides a high isolation capability and a low thermal resistance between the tab and external heatsink. This isolation is equivalent to using a 100 micron mica barrier with standard TO-220 product. The Fullpak is mounted to a heatsink using a single clip or by a single screw fixing.



## Absolute Maximum Ratings

	Parameter	Max.	Units
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$	24	A
$I_D @ T_C = 100^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$	17	
$I_{DM}$	Pulsed Drain Current ①⑥	140	
$P_D @ T_C = 25^\circ C$	Power Dissipation	56	W
	Linear Derating Factor	0.37	W/°C
$V_{GS}$	Gate-to-Source Voltage	$\pm 20$	V
$E_{AS}$	Single Pulse Avalanche Energy②⑥	420	mJ
$I_{AR}$	Avalanche Current①⑥	22	A
$E_{AR}$	Repetitive Avalanche Energy①	5.6	mJ
$d_v/d_t$	Peak Diode Recovery $dv/dt$ ③⑥	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	—	2.7	°C/W
$R_{\theta JA}$	Junction-to-Ambient	—	65	

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

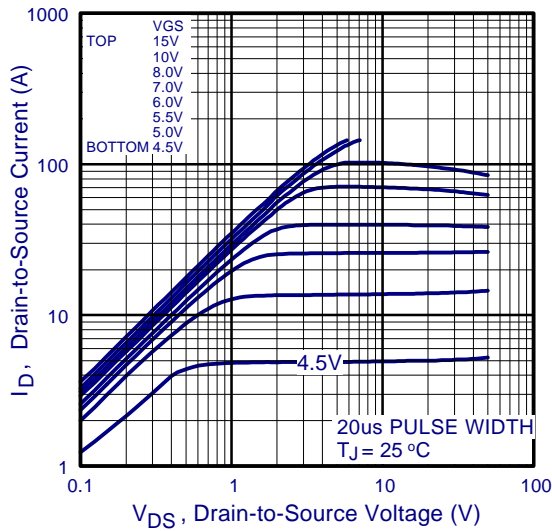
	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	100	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.11	—	V/ $^\circ\text{C}$	Reference to $25^\circ\text{C}$ , $I_D = 1\text{mA}$ ⑥
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	—	0.036	$\Omega$	$V_{GS} = 10V, I_D = 13A$ 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	14	—	—	S	$V_{DS} = 25V, I_D = 22A$ ⑥
$I_{DSS}$	Drain-to-Source Leakage Current	—	—	25	$\mu A$	$V_{DS} = 100V, V_{GS} = 0V$ $V_{DS} = 80V, V_{GS} = 0V, T_J = 150^\circ\text{C}$
$I_{GSS}$	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 20V$
	Gate-to-Source Reverse Leakage	—	—	-100	nA	$V_{GS} = -20V$
$Q_g$	Total Gate Charge	—	—	120	nC	$I_D = 22A$
$Q_{gs}$	Gate-to-Source Charge	—	—	15	nC	$V_{DS} = 80V$
$Q_{gd}$	Gate-to-Drain ("Miller") Charge	—	—	58	nC	$V_{GS} = 10V$ , See Fig. 6 and 13 ④⑥
$t_{d(on)}$	Turn-On Delay Time	—	11	—	ns	$V_{DD} = 50V$ $I_D = 22A$ $R_G = 3.6\Omega$ $R_D = 2.9\Omega$ , See Fig. 10 ④⑥
$t_r$	Rise Time	—	56	—		
$t_{d(off)}$	Turn-Off Delay Time	—	45	—		
$t_f$	Fall Time	—	40	—		
$L_D$	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	—	1900	—	pF	$V_{GS} = 0V$ $V_{DS} = 25V$ $f = 1.0\text{MHz}$ , See Fig. 5⑥
$C_{oss}$	Output Capacitance	—	450	—		
$C_{riss}$	Reverse Transfer Capacitance	—	230	—		
C	Drain to Sink Capacitance	—	12	—		

## Source-Drain Ratings and Characteristics

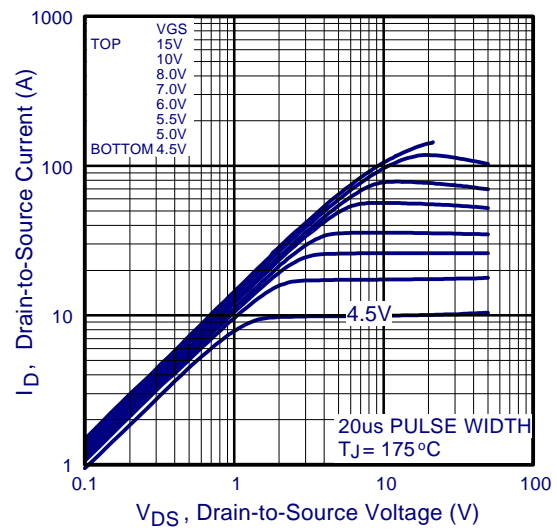
	Parameter	Min.	Typ.	Max.	Units	Conditions
$I_S$	Continuous Source Current (Body Diode)	—	—	24	A	MOSFET symbol showing the integral reverse p-n junction diode.
$I_{SM}$	Pulsed Source Current (Body Diode) ①⑥	—	—	140		
$V_{SD}$	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}, I_S = 13A, V_{GS} = 0V$ ④
$t_{rr}$	Reverse Recovery Time	—	180	270	ns	$T_J = 25^\circ\text{C}, I_F = 22A$
$Q_{rr}$	Reverse Recovery Charge	—	1.2	1.8	$\mu C$	$di/dt = 100A/\mu s$ ④⑥
$t_{on}$	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S+L_D$ )				

### Notes:

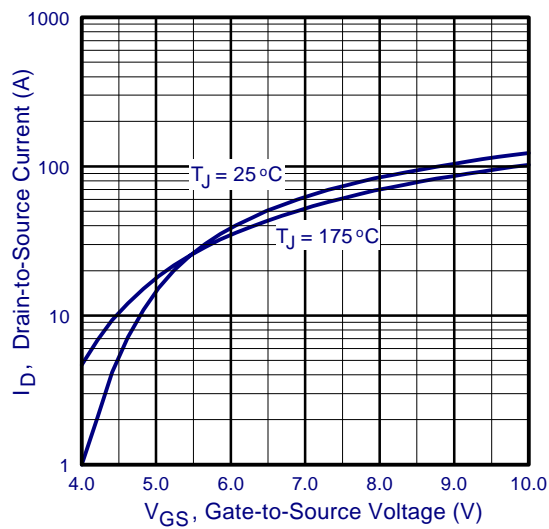
- ① Repetitive rating; pulse width limited by max. junction temperature. ( See fig. 11 )
- ② Starting  $T_J = 25^\circ\text{C}$ ,  $L = 1.0\text{mH}$   
 $R_G = 25\Omega, I_{AS} = 22A$ . (See Figure 12)
- ③  $I_{SD} \leq 22A, di/dt \leq 180A/\mu s, V_{DD} \leq V_{(BR)DSS}, T_J \leq 175^\circ\text{C}$
- ④ Pulse width  $\leq 300\mu s$ ; duty cycle  $\leq 2\%$ .
- ⑤  $t = 60s, f = 60\text{Hz}$
- ⑥ Uses IRF11310N data and test conditions



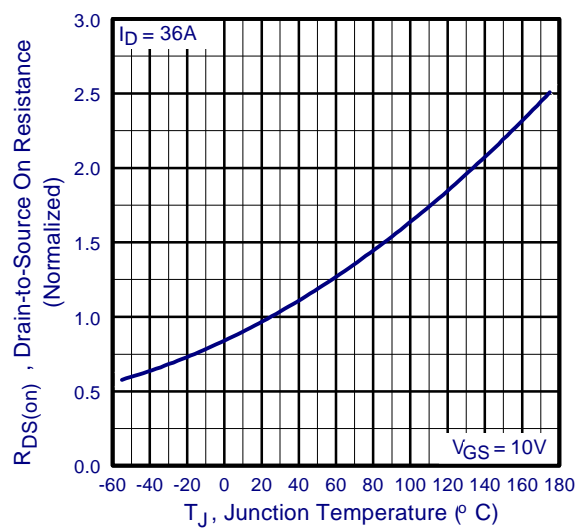
**Fig 1.** Typical Output Characteristics



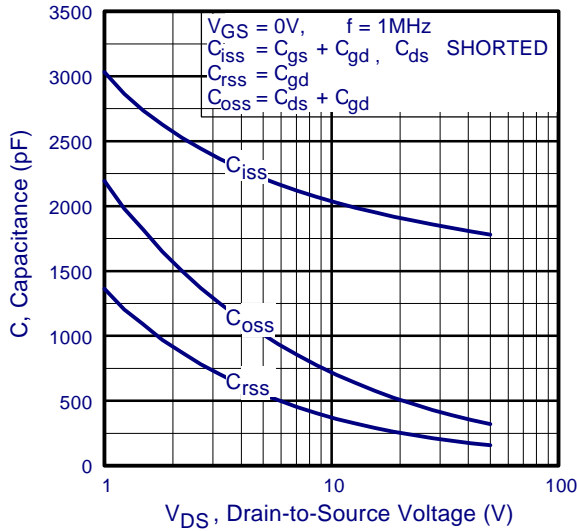
**Fig 2.** Typical Output Characteristics



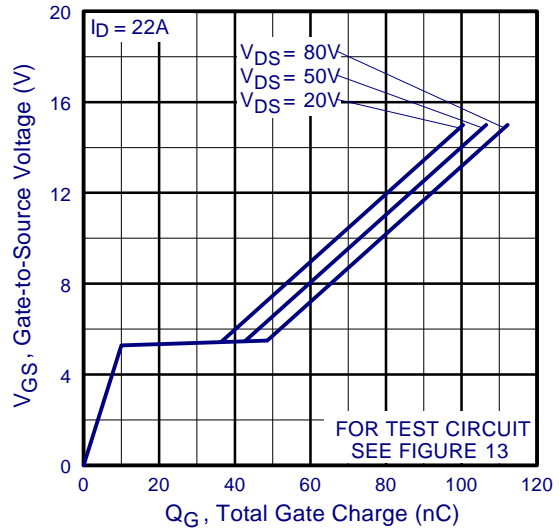
**Fig 3.** Typical Transfer Characteristics



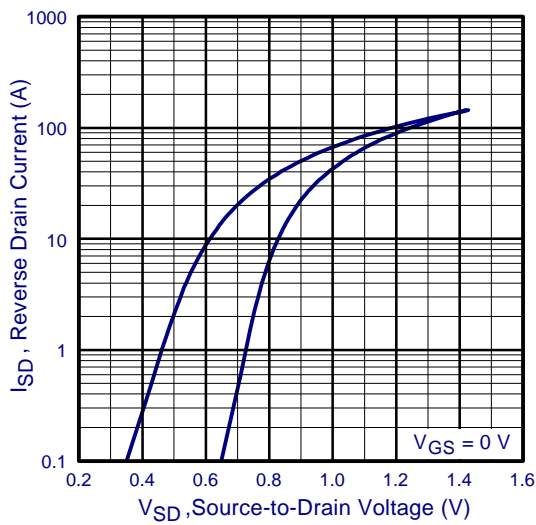
**Fig 4.** Normalized On-Resistance Vs. Temperature



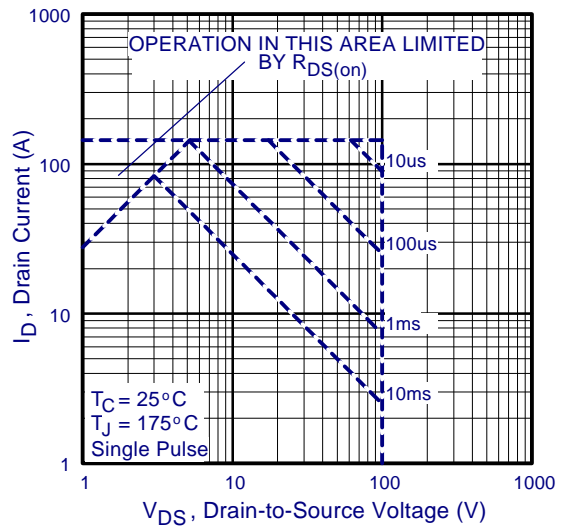
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



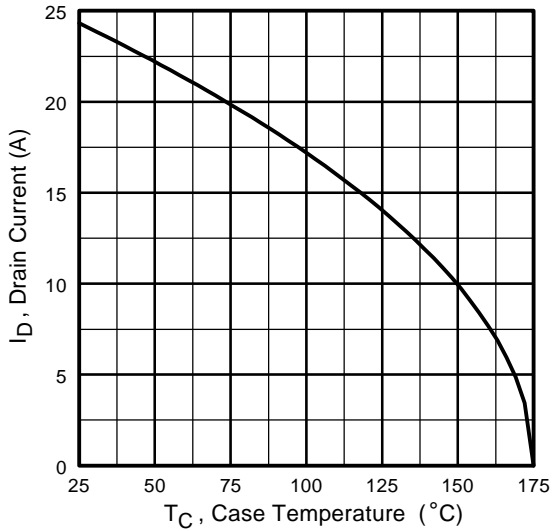
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



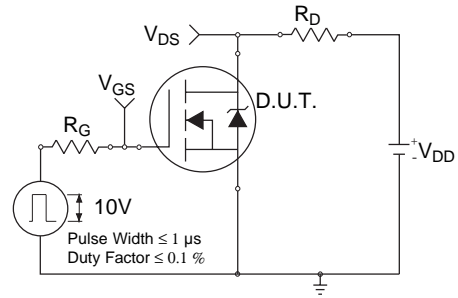
**Fig 7.** Typical Source-Drain Diode Forward Voltage



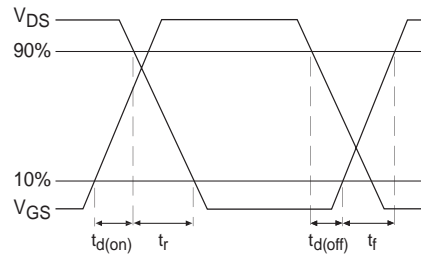
**Fig 8.** Maximum Safe Operating Area



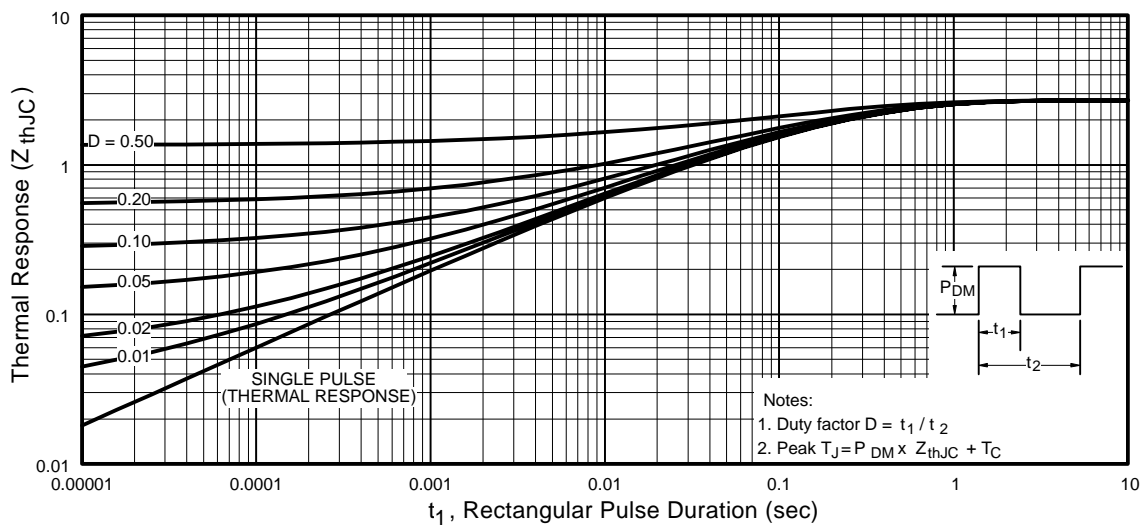
**Fig 9.** Maximum Drain Current Vs. Case Temperature



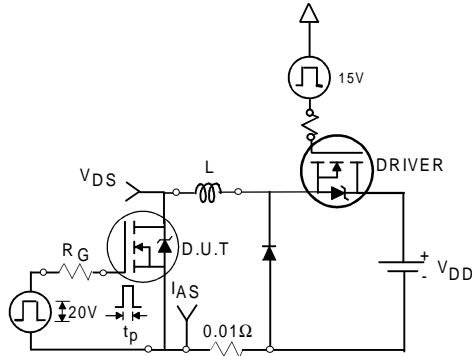
**Fig 10a.** Switching Time Test Circuit



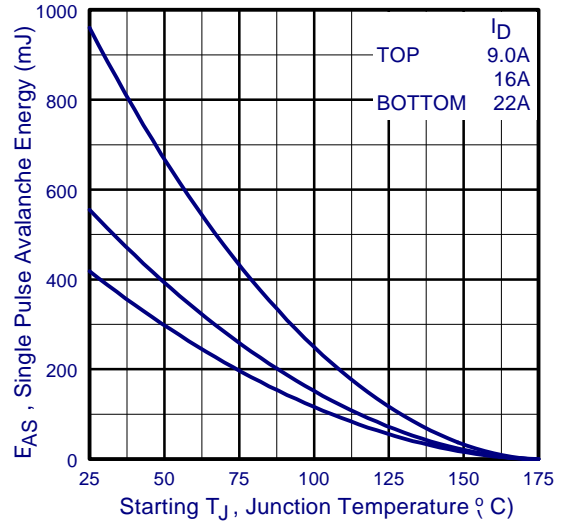
**Fig 10b.** Switching Time Waveforms



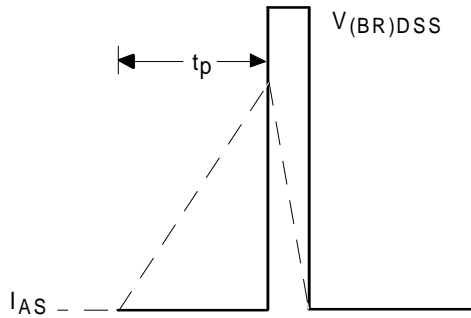
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case



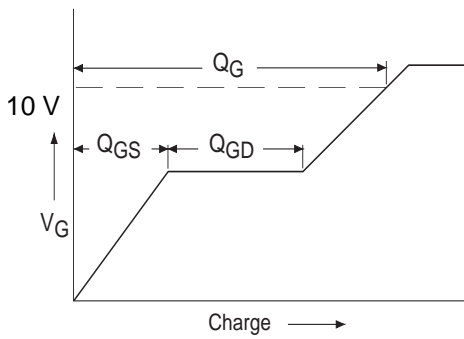
**Fig 12a.** Unclamped Inductive Test Circuit



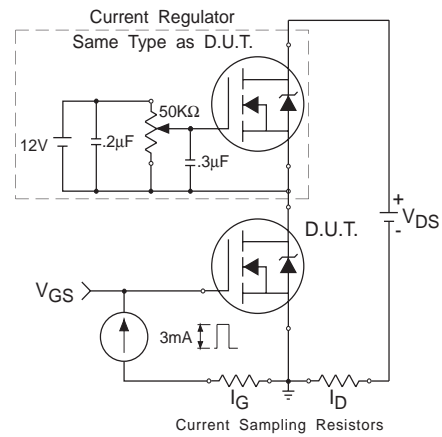
**Fig 12c.** Maximum Avalanche Energy Vs. Drain Current



**Fig 12b.** Unclamped Inductive Waveforms

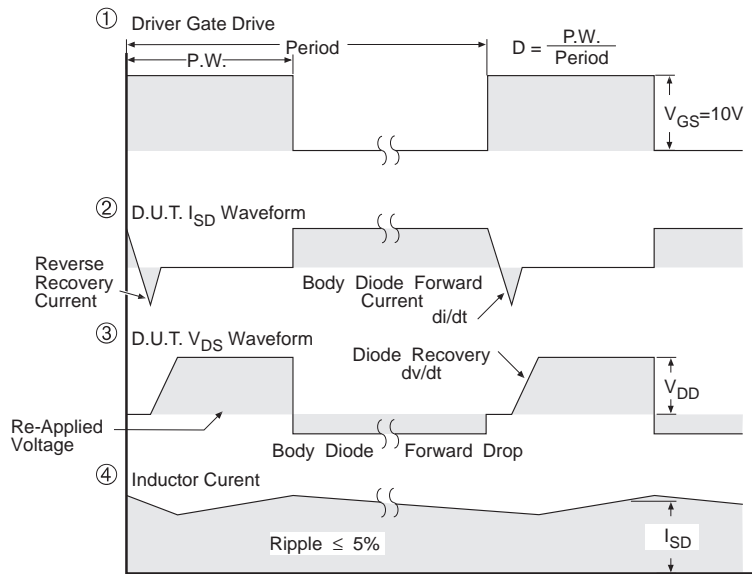
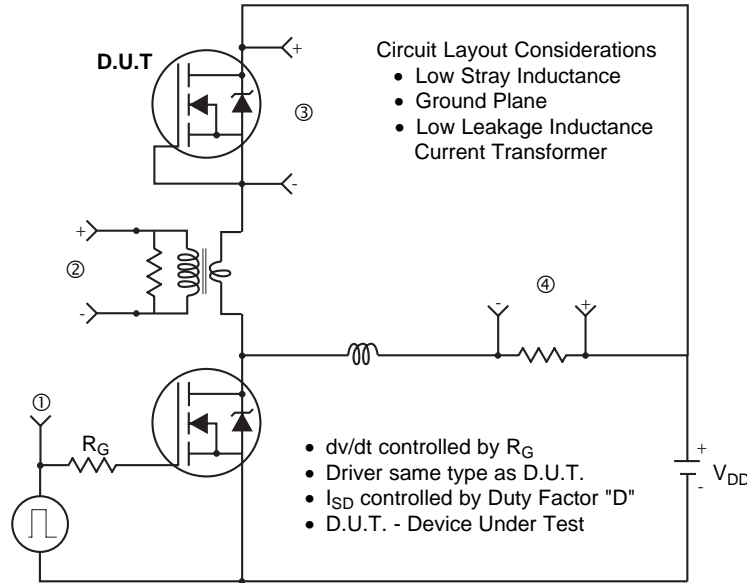


**Fig 13a.** Basic Gate Charge Waveform



**Fig 13b.** Gate Charge Test Circuit

**Peak Diode Recovery dv/dt Test Circuit**



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

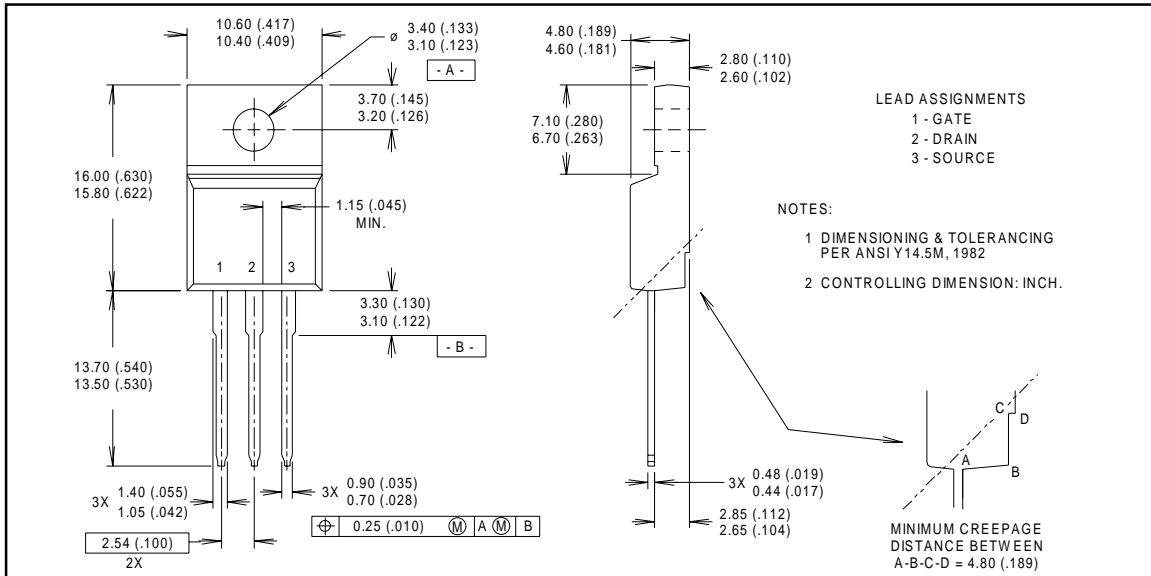
**Fig 14.** For N-Channel HEXFETS

# IRF11310N

International  
**IR** Rectifier

## Package Outline TO-220 Fullpak Outline

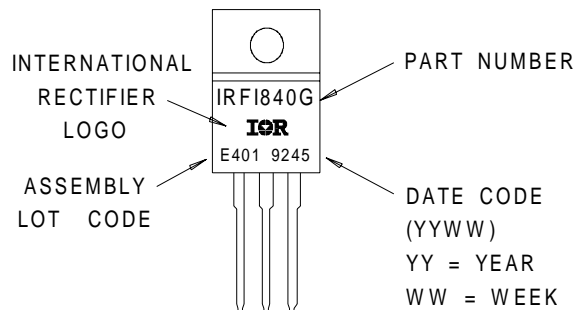
Dimensions are shown in millimeters (inches)



## Part Marking Information

### TO-220 Fullpak

EXAMPLE : THIS IS AN IRF1840G  
WITH ASSEMBLY  
LOT CODE E401



International  
**IR** Rectifier

**WORLD HEADQUARTERS:** 233 Kansas St., El Segundo, California 90245, Tel: (310) 322 3331  
**EUROPEAN HEADQUARTERS:** Hurst Green, Oxted, Surrey RH8 9BB, UK Tel: ++ 44 1883 732020  
**IR CANADA:** 7321 Victoria Park Ave., Suite 201, Markham, Ontario L3R 2Z8, Tel: (905) 475 1897  
**IR GERMANY:** Saalburgstrasse 157, 61350 Bad Homburg Tel: ++ 49 6172 96590  
**IR ITALY:** Via Liguria 49, 10071 Borgaro, Torino Tel: ++ 39 11 451 0111

**IR FAR EAST:** K&H Bldg., 2F, 30-4 Nishi-Ikebukuro 3-Chome, Toshima-Ku, Tokyo Japan 171 Tel: 81 3 3983 0086

**IR SOUTHEAST ASIA:** 315 Outram Road, #10-02 Tan Boon Liat Building, Singapore 0316 Tel: 65 221 8371

<http://www.irf.com/> Data and specifications subject to change without notice. 3/98