

# International **IR** Rectifier

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

## 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-247 package is preferred for commercial-industrial applications where higher power levels preclude the use of TO-220 devices. The TO-247 is similar but superior to the earlier TO-218 package because of its isolated mounting hole.

## Absolute Maximum Ratings

	Parameter	Max.	Units
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$	53	
$I_D @ T_C = 100^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$	37	A
$I_{DM}$	Pulsed Drain Current ①⑤	180	
$P_D @ T_C = 25^\circ C$	Power Dissipation	120	W
	Linear Derating Factor	0.77	W/ $^\circ C$
$V_{GS}$	Gate-to-Source Voltage	$\pm 20$	V
$E_{AS}$	Single Pulse Avalanche Energy ②⑤	230	mJ
$I_{AR}$	Avalanche Current ①	28	A
$E_{AR}$	Repetitive Avalanche Energy ①	12	mJ
$dv/dt$	Peak Diode Recovery $dv/dt$ ③⑤	5.0	V/ns
$T_J$	Operating Junction and	-55 to + 175	$^\circ C$
$T_{STG}$	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	—	1.3	$^\circ C/W$
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.24	—	
$R_{\theta JA}$	Junction-to-Ambient	—	40	

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(\text{BR})\text{DSS}}$	Drain-to-Source Breakdown Voltage	55	—	—	V	$V_{\text{GS}} = 0\text{V}$ , $I_D = 250\mu\text{A}$
$\Delta V_{(\text{BR})\text{DSS}/\Delta T_J}$	Breakdown Voltage Temp. Coefficient	—	0.017	—	$\text{V}^\circ\text{C}$	Reference to $25^\circ\text{C}$ , $I_D = 1\text{mA}$ ③
$R_{\text{DS}(\text{on})}$	Static Drain-to-Source On-Resistance	—	—	0.020	$\Omega$	$V_{\text{GS}} = 10\text{V}$ , $I_D = 29\text{A}$ ④
$V_{\text{GS}(\text{th})}$	Gate Threshold Voltage	2.0	—	4.0	V	$V_{\text{DS}} = V_{\text{GS}}$ , $I_D = 250\mu\text{A}$
$g_{\text{fs}}$	Forward Transconductance	16	—	—	S	$V_{\text{DS}} = 25\text{V}$ , $I_D = 28\text{A}$ ⑤
$I_{\text{DSS}}$	Drain-to-Source Leakage Current	—	—	25	$\mu\text{A}$	$V_{\text{DS}} = 55\text{V}$ , $V_{\text{GS}} = 0\text{V}$
		—	—	250		$V_{\text{DS}} = 44\text{V}$ , $V_{\text{GS}} = 0\text{V}$ , $T_J = 150^\circ\text{C}$
$I_{\text{GSS}}$	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{\text{GS}} = 20\text{V}$
	Gate-to-Source Reverse Leakage	—	—	-100		$V_{\text{GS}} = -20\text{V}$
$Q_g$	Total Gate Charge	—	—	61	nC	$I_D = 28\text{A}$
$Q_{\text{gs}}$	Gate-to-Source Charge	—	—	13		$V_{\text{DS}} = 44\text{V}$
$Q_{\text{gd}}$	Gate-to-Drain ("Miller") Charge	—	—	24		$V_{\text{GS}} = 10\text{V}$ , See Fig. 6 and 13 ④⑤
$t_{\text{d}(\text{on})}$	Turn-On Delay Time	—	—	12	—	$V_{\text{DD}} = 28\text{V}$ $I_D = 28\text{A}$ $R_G = 12\Omega$ $R_D = 0.98\Omega$ , See Fig. 10 ④⑤
$t_r$	Rise Time	—	—	80	ns	
$t_{\text{d}(\text{off})}$	Turn-Off Delay Time	—	—	43	—	
$t_f$	Fall Time	—	—	52	—	
$L_D$	Internal Drain Inductance	—	—	5.0	nH	Between lead, 6mm (0.25in.) from package and center of die contact
$L_S$	Internal Source Inductance	—	—	13		
$C_{\text{iss}}$	Input Capacitance	—	—	1500	pF	$V_{\text{GS}} = 0\text{V}$
$C_{\text{oss}}$	Output Capacitance	—	—	450		$V_{\text{DS}} = 25\text{V}$
$C_{\text{rss}}$	Reverse Transfer Capacitance	—	—	160		$f = 1.0\text{MHz}$ , See Fig. 5 ⑤

## Source-Drain Ratings and Characteristics

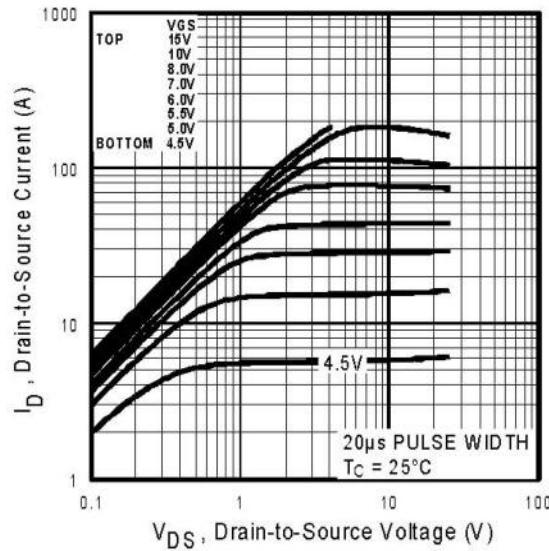
	Parameter	Min.	Typ.	Max.	Units	Conditions
$I_S$	Continuous Source Current (Body Diode)	—	—	53	A	MOSFET symbol showing the integral reverse p-n junction diode.
$I_{\text{SM}}$	Pulsed Source Current (Body Diode) ①	—	—	180		
$V_{\text{SD}}$	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}$ , $I_S = 29\text{A}$ , $V_{\text{GS}} = 0\text{V}$ ④
$t_{\text{rr}}$	Reverse Recovery Time	—	72	110	ns	$T_J = 25^\circ\text{C}$ , $I_F = 28\text{A}$
$Q_{\text{rr}}$	Reverse Recovery Charge	—	210	310	$\mu\text{C}$	$di/dt = -100\text{A}/\mu\text{s}$ ④⑤
$t_{\text{on}}$	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S + L_D$ )				

### Notes:

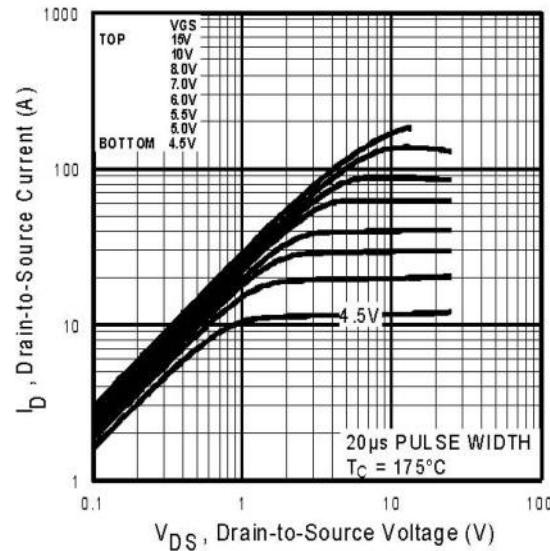
- ① Repetitive rating: pulse width limited by max. junction temperature. ( See fig. 11 )
- ②  $V_{\text{DD}} = 25\text{V}$ , starting  $T_J = 25^\circ\text{C}$ ,  $L = 410\mu\text{H}$   
 $R_G = 25\Omega$ ,  $I_{\text{AS}} = 28\text{A}$ . (See Figure 12)
- ③  $I_{\text{SD}} \leq 28\text{A}$ ,  $di/dt \leq 240\text{A}/\mu\text{s}$ ,  $V_{\text{DD}} \leq V_{(\text{BR})\text{DSS}}$ ,  $T_J \leq 175^\circ\text{C}$
- ④ Pulse width  $\leq 300\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- ⑤ Uses IRFZ46N data and test conditions

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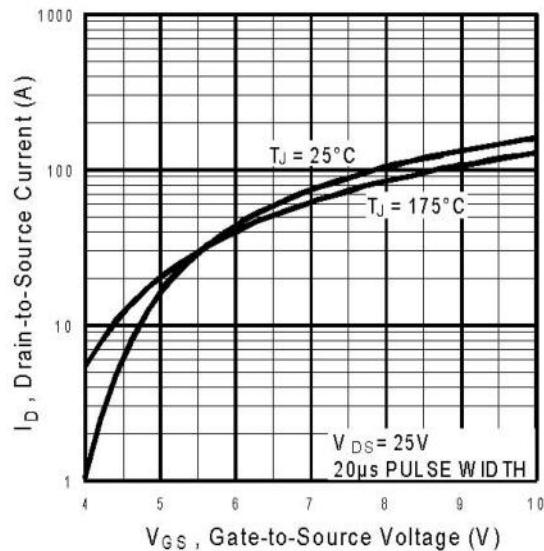
**IRFP044NPbF**



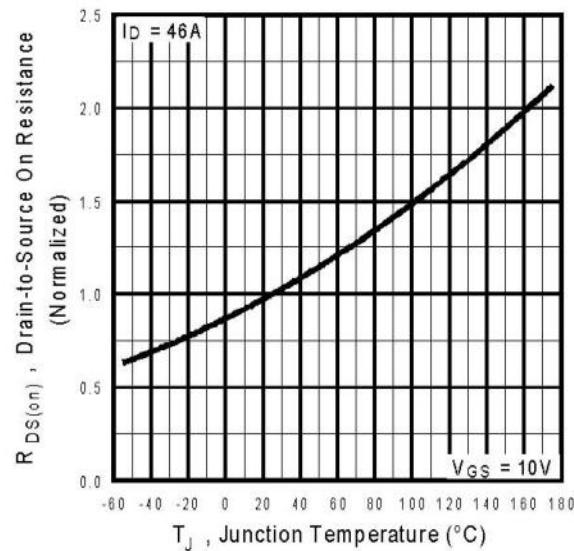
**Fig 1.** Typical Output Characteristics



**Fig 2.** Typical Output Characteristics



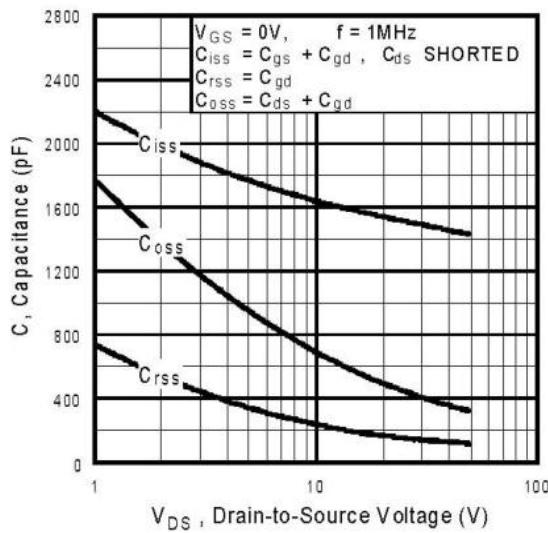
**Fig 3.** Typical Transfer Characteristics



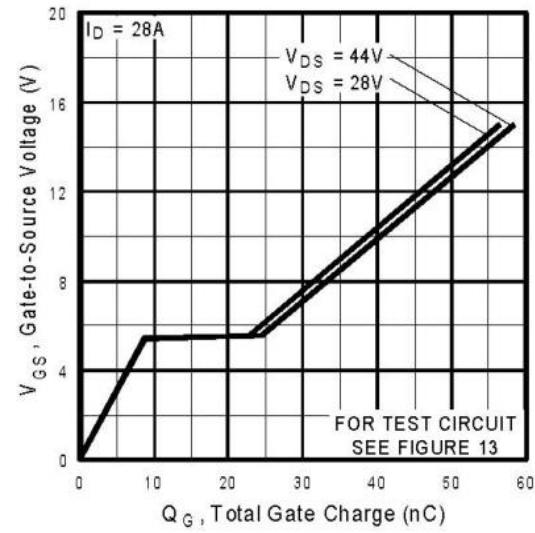
**Fig 4.** Normalized On-Resistance  
Vs. Temperature

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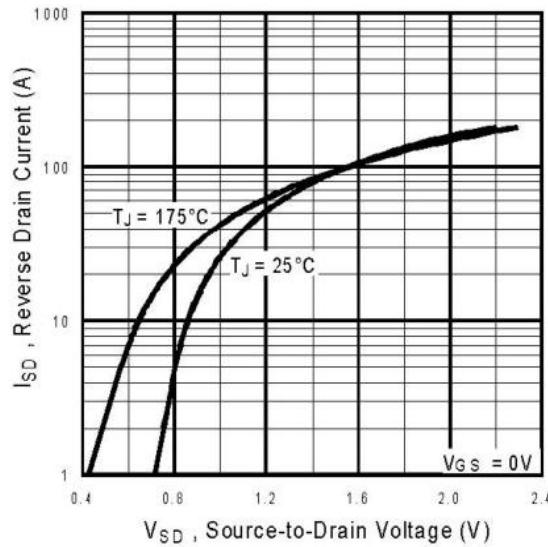
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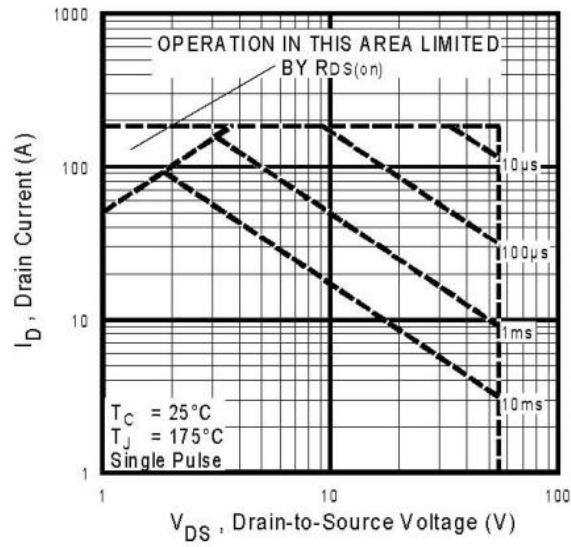
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



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

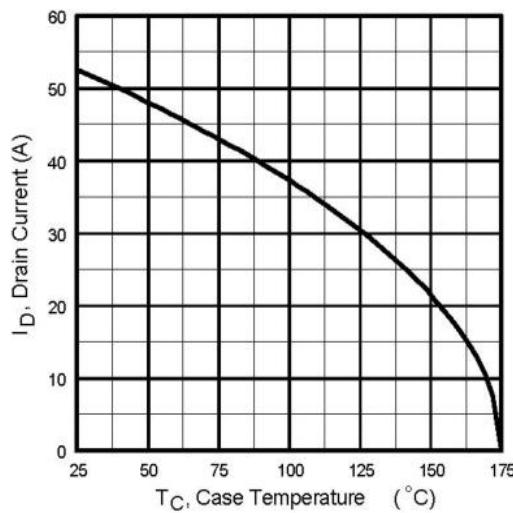


**Fig 7.** Typical Source-Drain Diode Forward Voltage



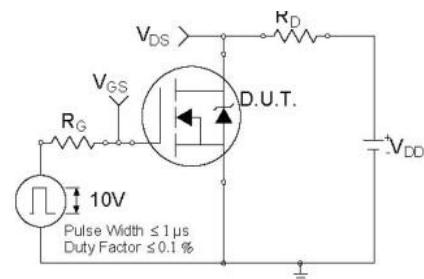
**Fig 8.** Maximum Safe Operating Area

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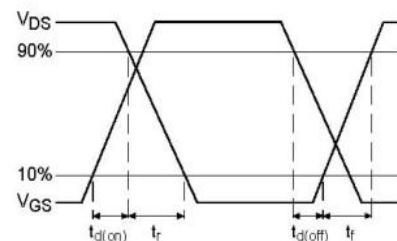


**Fig 9.** Maximum Drain Current Vs.  
Case Temperature

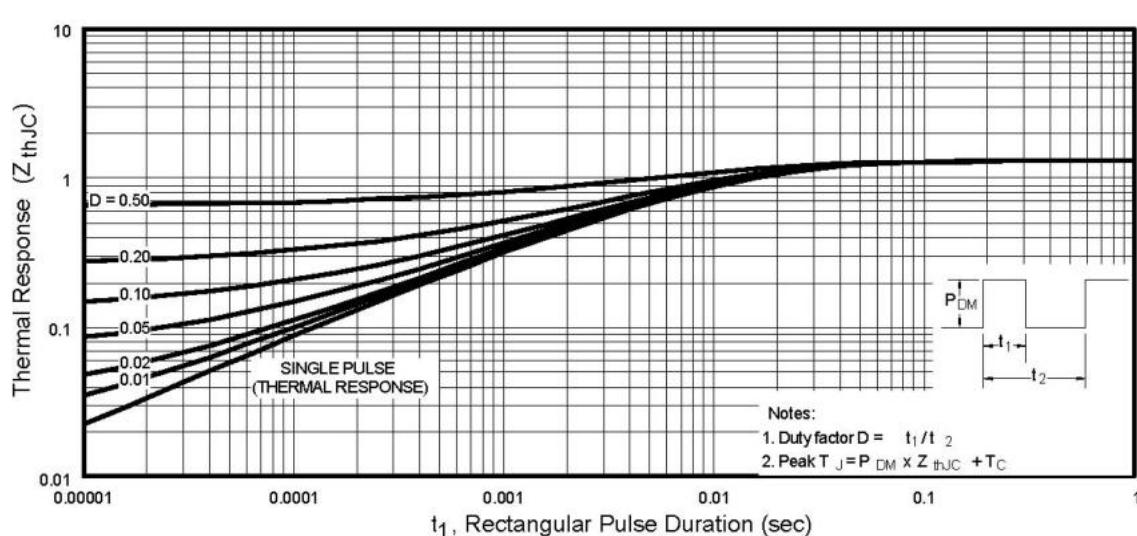
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**Fig 10a.** Switching Time Test Circuit



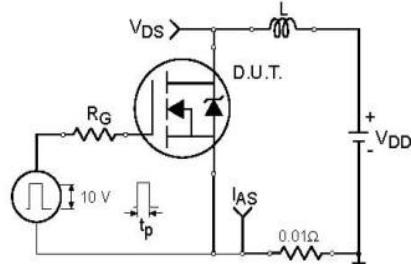
**Fig 10b.** Switching Time Waveforms



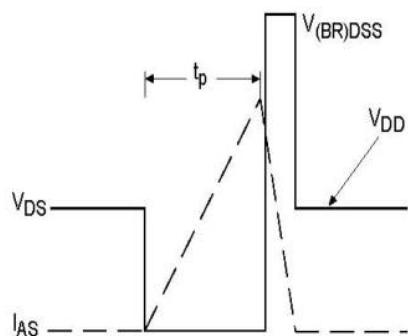
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

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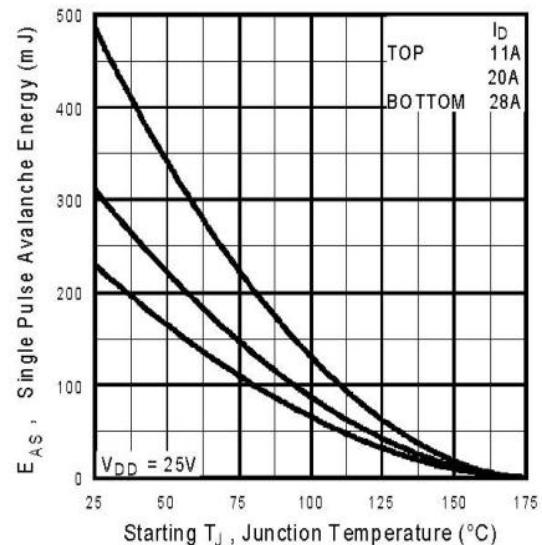
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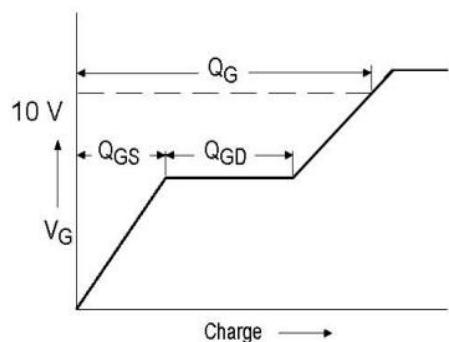
**Fig 12a.** Unclamped Inductive Test Circuit



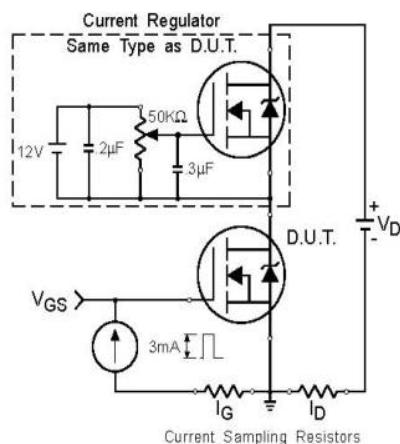
**Fig 12b.** Unclamped Inductive Waveforms



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

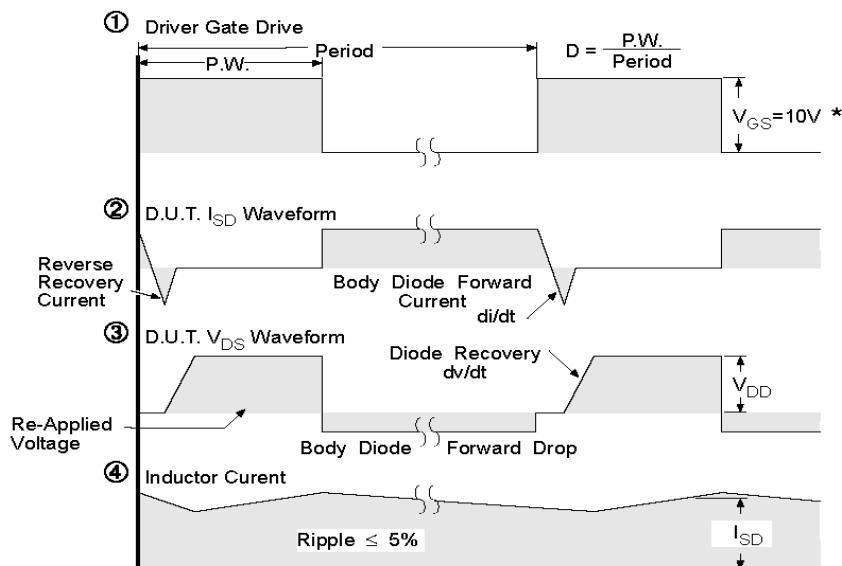
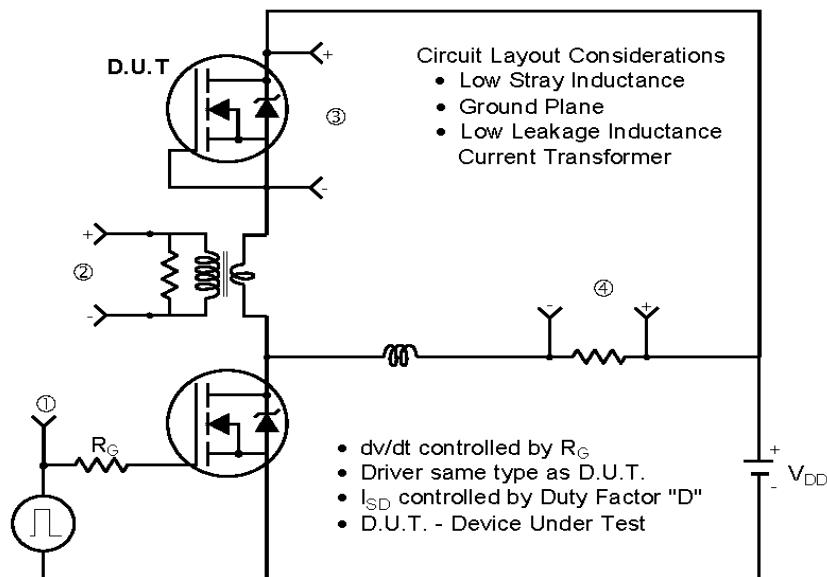


**Fig 13a.** Basic Gate Charge Waveform



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

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



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

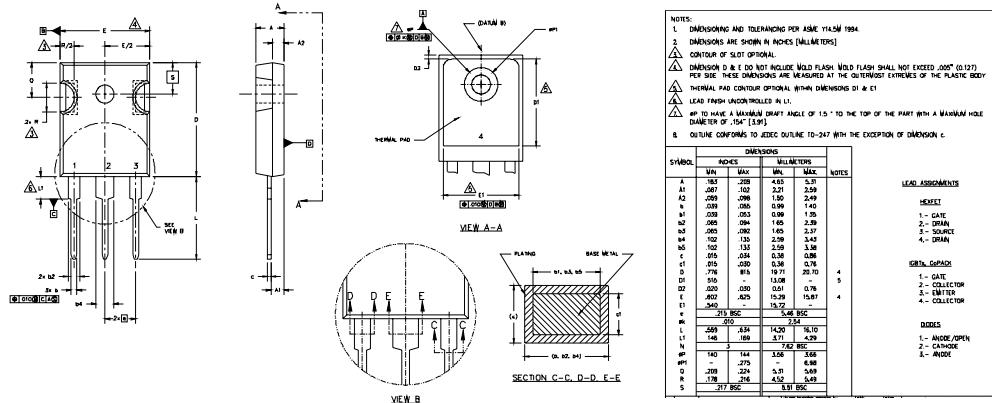
**Fig 14.** For N-Channel HEXFETS

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## TO-247AC Package Outline

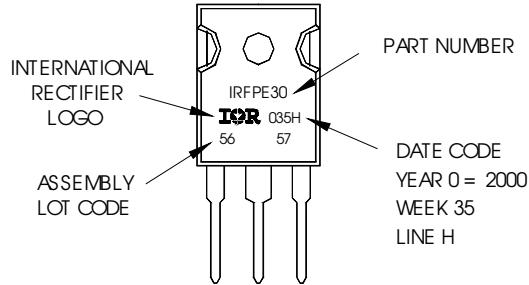
Dimensions are shown in millimeters (inches)



## TO-247AC Part Marking Information

EXAMPLE: THIS IS AN IRFPE30  
WITH ASSEMBLY  
LOT CODE 5657  
ASSEMBLED ON VW 35, 2000  
IN THE ASSEMBLY LINE "H"

**Note:** "P" in assembly line position indicates "Lead-Free"



Data and specifications subject to change without notice.

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TAC Fax: (310) 252-7903

Visit us at [www.irf.com](http://www.irf.com) for sales contact information. 06/04

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

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