

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

Absolute Maximum Ratings

	Parameter	Max.	Units
$I_D @ T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$	81 ^⑥	A
$I_D @ T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$	57	
I_{DM}	Pulsed Drain Current ^{①⑤}	290	
$P_D @ T_C = 25^\circ\text{C}$	Power Dissipation	170	W
	Linear Derating Factor	1.1	W/ $^\circ\text{C}$
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS}	Single Pulse Avalanche Energy ^{②⑤}	360	mJ
I_{AR}	Avalanche Current ^①	43	A
E_{AR}	Repetitive Avalanche Energy ^①	17	mJ
dv/dt	Peak Diode Recovery dv/dt ^{③⑤}	5.0	V/ ns
T_J	Operating Junction and	-55 to $+175$	$^\circ\text{C}$
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 seconds		
	Mounting torque, 6-32 or M3 screw	300 (1.6mm from case)	
		10 lbf \cdot in (1.1N \cdot m)	

Thermal Resistance

	Parameter	Typ.	Max.	Units
R_{JC}	Junction-to-Case	—	0.90	$^\circ\text{C}/\text{W}$
R_{ECS}	Case-to-Sink, Flat, Greased Surface	0.24	—	
R_{EA}	Junction-to-Ambient	—	40	

IRFP054NPbF

International
Rectifier

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	—	0.06	—	V°C	Reference to 25°C , $I_D = 1\text{mA}$ ⑤
$R_{\text{DS}(\text{on})}$	Static Drain-to-Source On-Resistance	—	—	0.012	Ω	$V_{\text{GS}} = 10\text{V}$, $I_D = 43\text{A}$ 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_{fs}	Forward Transconductance	30	—	—	S	$V_{\text{DS}} = 25\text{V}$, $I_D = 43\text{A}$ ⑤
I_{DSS}	Drain-to-Source Leakage Current	—	—	25	μA	$V_{\text{DS}} = 55\text{V}$, $V_{\text{GS}} = 0\text{V}$
	—	—	—	250	μA	$V_{\text{DS}} = 44\text{V}$, $V_{\text{GS}} = 0\text{V}$, $T_J = 150^\circ\text{C}$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{\text{GS}} = 20\text{V}$
	Gate-to-Source Reverse Leakage	—	—	-100	nA	$V_{\text{GS}} = -20\text{V}$
Q_g	Total Gate Charge	—	—	130	nC	$I_D = 43\text{A}$
Q_{gs}	Gate-to-Source Charge	—	—	23	nC	$V_{\text{DS}} = 44\text{V}$
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	—	53	nC	$V_{\text{GS}} = 10\text{V}$, See Fig. 6 and 13 ④⑤
$t_{\text{d}(\text{on})}$	Turn-On Delay Time	—	11	—	ns	$V_{\text{DD}} = 28\text{V}$
t_r	Rise Time	—	66	—	ns	$I_D = 43\text{A}$
$t_{\text{d}(\text{off})}$	Turn-Off Delay Time	—	40	—	ns	$R_G = 3.6\Omega$
t_f	Fall Time	—	46	—	ns	$R_D = 0.62\Omega$, See Fig. 10④⑤
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	—	nH	
C_{iss}	Input Capacitance	—	2900	—	pF	$V_{\text{GS}} = 0\text{V}$
C_{oss}	Output Capacitance	—	880	—	pF	$V_{\text{DS}} = 25\text{V}$
C_{rss}	Reverse Transfer Capacitance	—	330	—	pF	$f = 1.0\text{MHz}$, See Fig. 5⑤

Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	81⑥	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	290		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}$, $I_S = 43\text{A}$, $V_{\text{GS}} = 0\text{V}$ ④
t_{rr}	Reverse Recovery Time	—	81	120	ns	$T_J = 25^\circ\text{C}$, $I_F = 43\text{A}$
Q_{rr}	Reverse Recovery Charge	—	240	370	nC	$di/dt = 100\text{A}/\mu\text{s}$ ④⑤

Notes:

① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11)

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

② $V_{\text{DD}} = 25\text{V}$, starting $T_J = 25^\circ\text{C}$, $L = 390\mu\text{H}$, $R_G = 25\Omega$, $I_{\text{AS}} = 43\text{A}$. (See Figure 12)

⑤ Uses IRF1010N data and test conditions

③ $I_{\text{SD}} \leq 43\text{A}$, $di/dt \leq 260\text{A}/\mu\text{s}$, $V_{\text{DD}} \leq V_{(\text{BR})\text{DSS}}$, $T_J \leq 175^\circ\text{C}$

⑥ Calculated continuous current based on maximum allowable junction temperature; for recommended current-handling of the package refer to Design Tip # 93-4

International
IR Rectifier

IRFP054NPbF

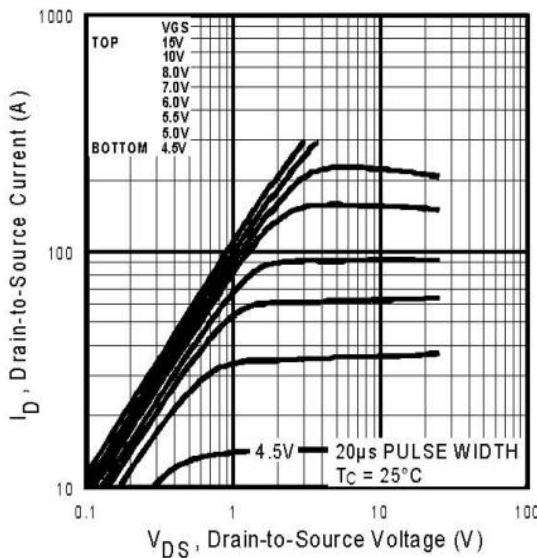


Fig 1. Typical Output Characteristics

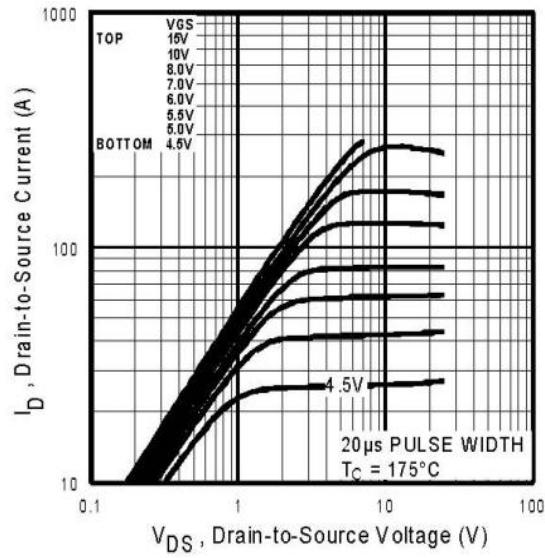


Fig 2. Typical Output Characteristics

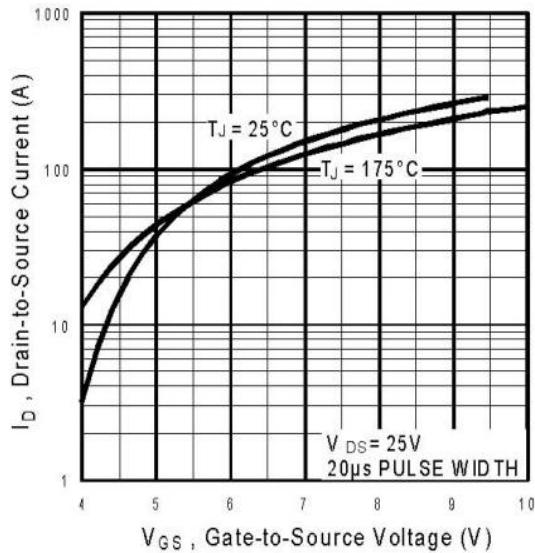


Fig 3. Typical Transfer Characteristics

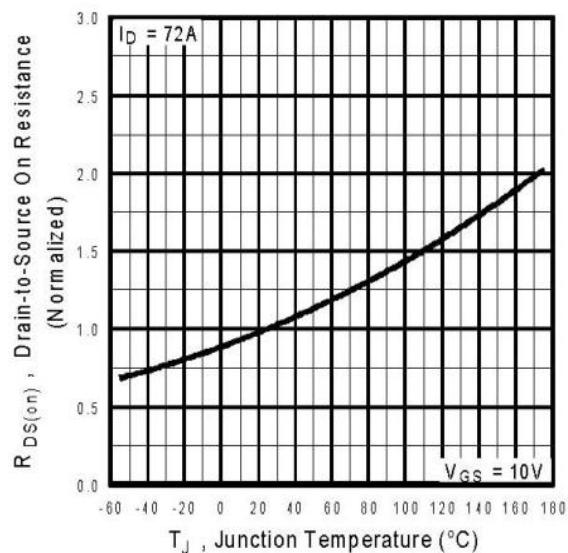


Fig 4. Normalized On-Resistance
Vs. Temperature

IRFP054NPbF

International
Rectifier

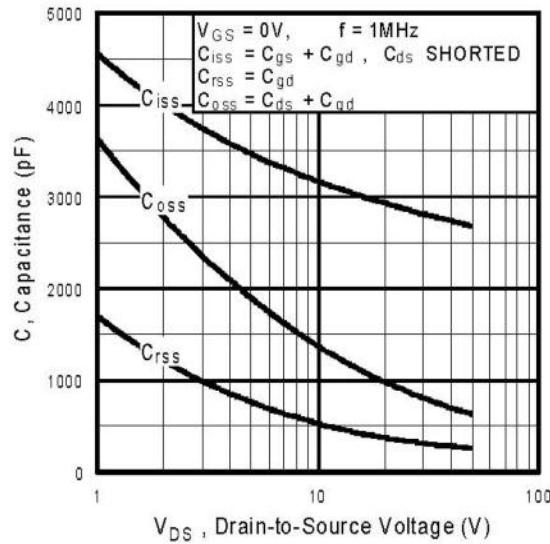


Fig 5. Typical Capacitance Vs.
Drain-to-Source Voltage

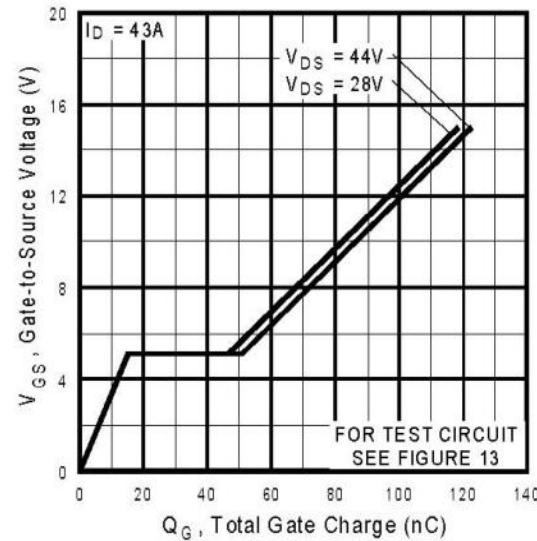


Fig 6. Typical Gate Charge Vs.
Gate-to-Source Voltage

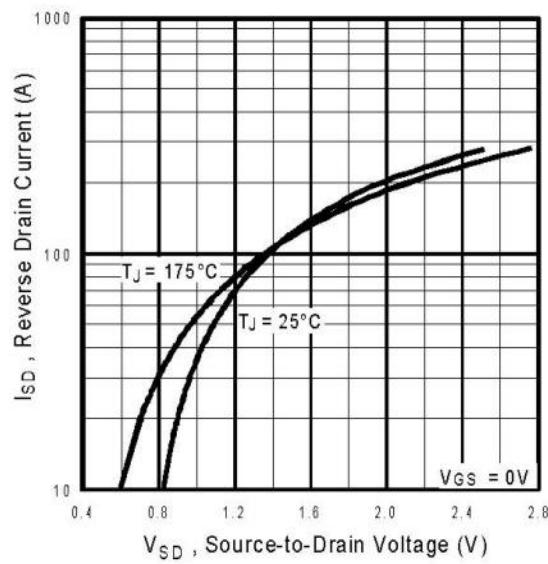


Fig 7. Typical Source-Drain Diode
Forward Voltage

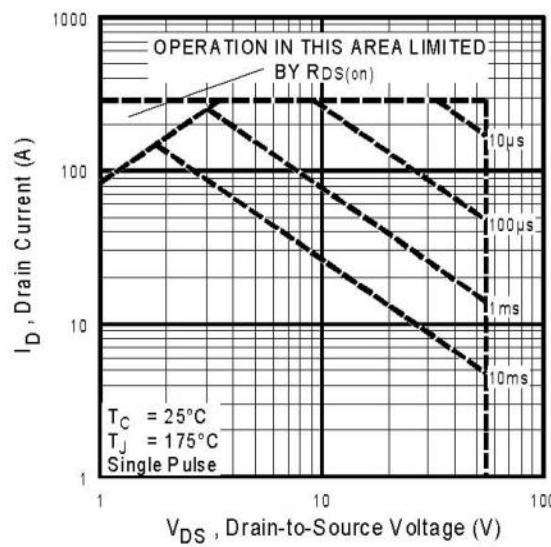


Fig 8. Maximum Safe Operating Area

International
IR Rectifier

IRFP054NPbF

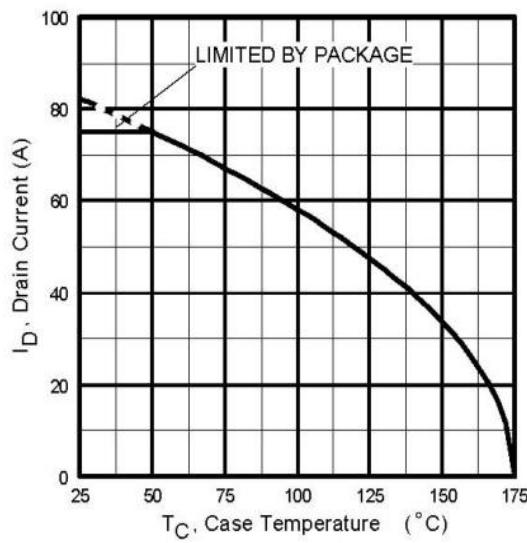


Fig 9. Maximum Drain Current Vs.
Case Temperature

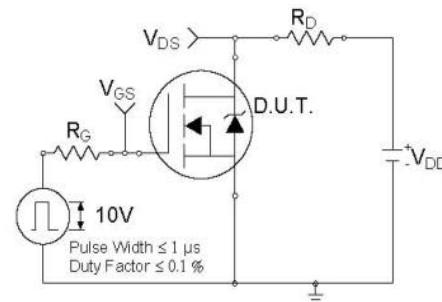


Fig 10a. Switching Time Test Circuit

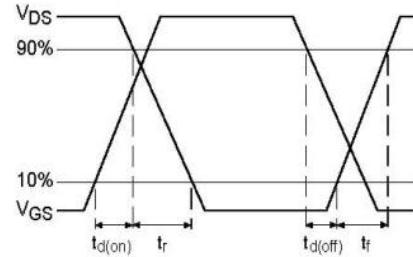


Fig 10b. Switching Time Waveforms

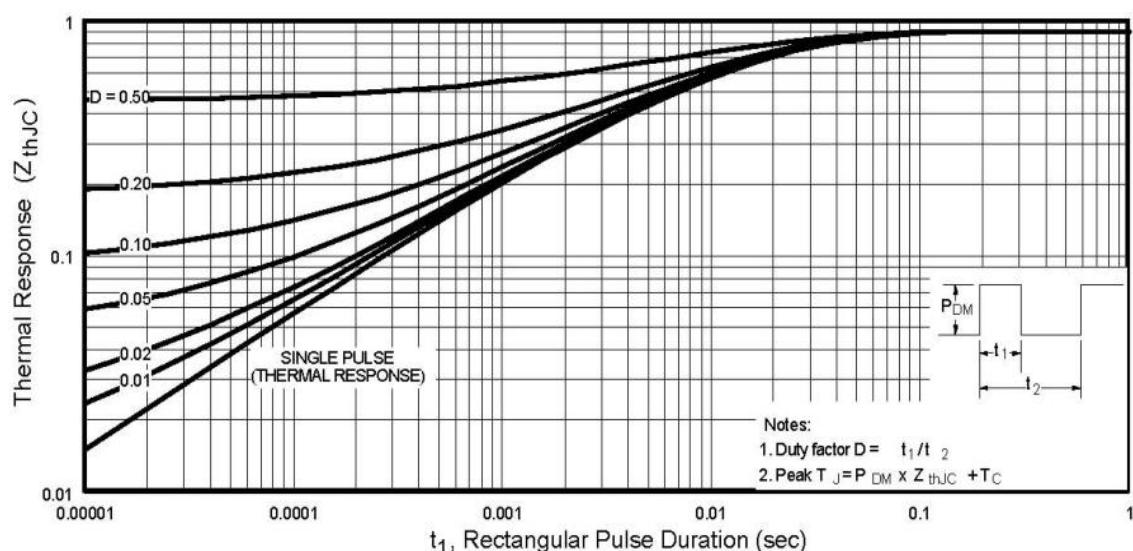


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

IRFP054NPbF

International
Rectifier

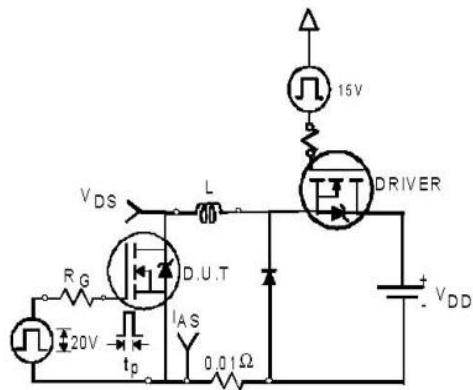


Fig 12a. Unclamped Inductive Test Circuit

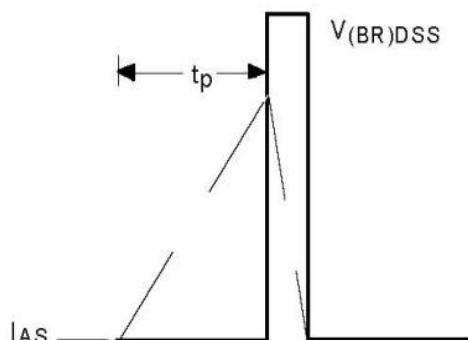


Fig 12b. Unclamped Inductive Waveforms

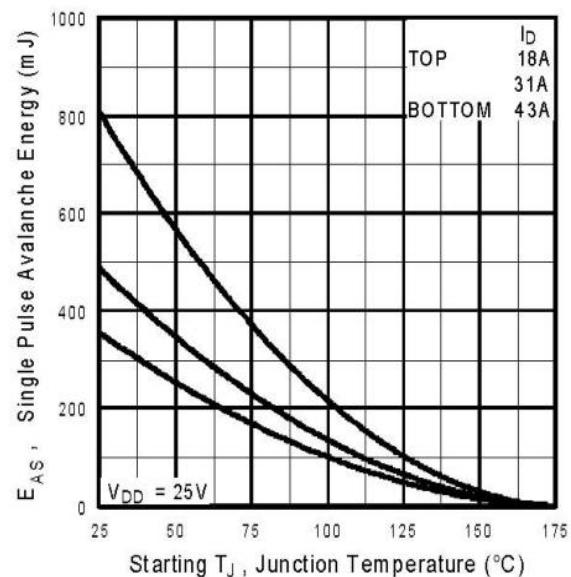


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

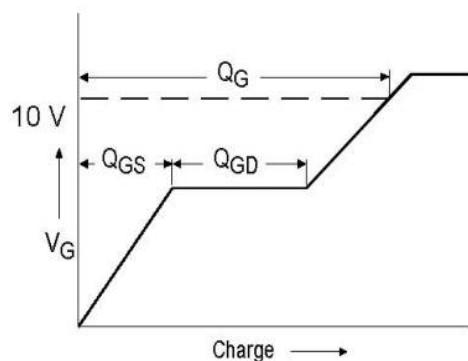


Fig 13a. Basic Gate Charge Waveform

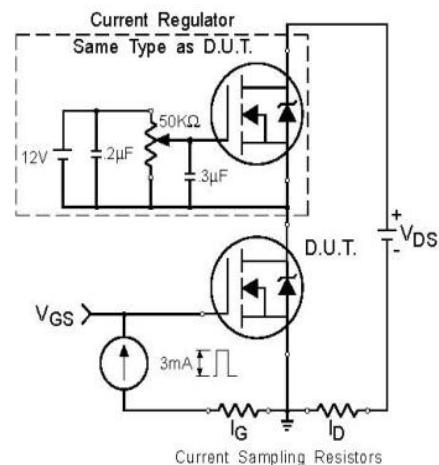


Fig 13b. Gate Charge Test Circuit

Peak Diode Recovery dv/dt Test Circuit

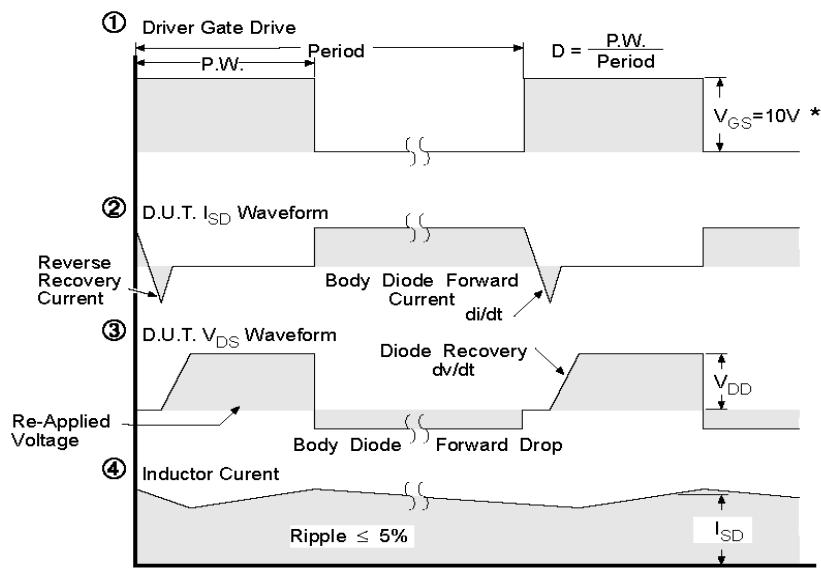
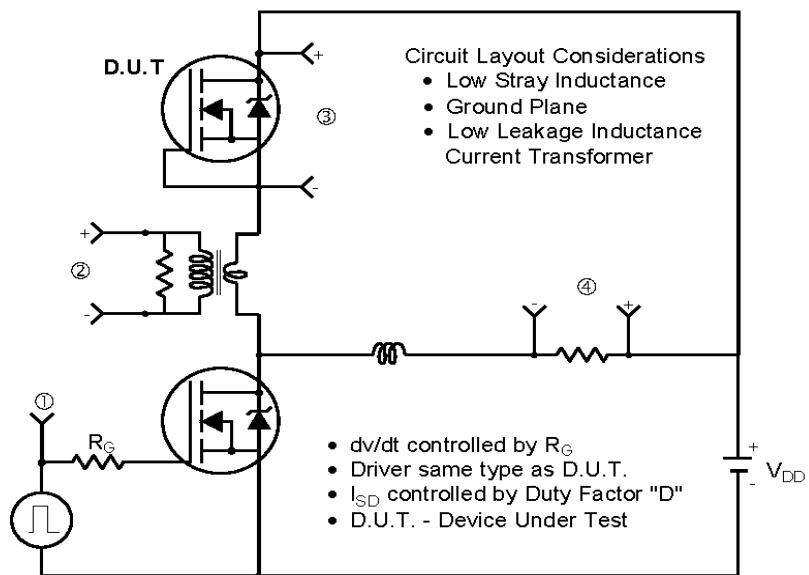


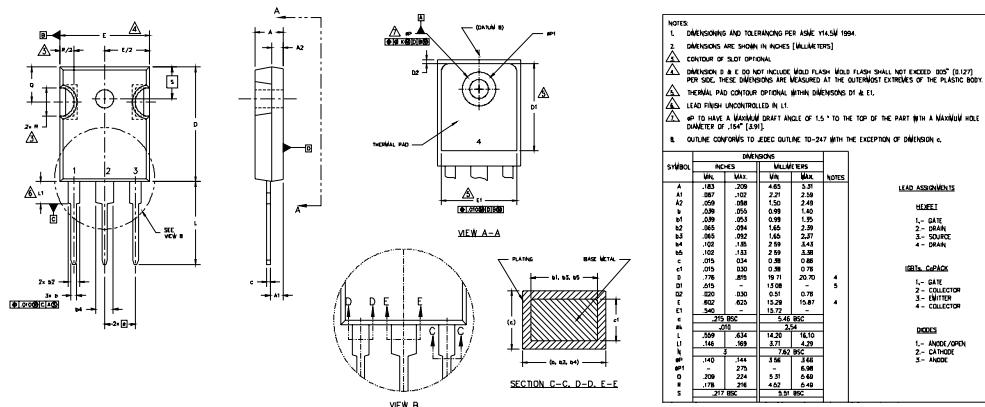
Fig 14. For N-Channel HEXFETs

IRFP054NPbF

International
IR Rectifier

TO-247AC Package Outline

Dimensions are shown in millimeters (inches)

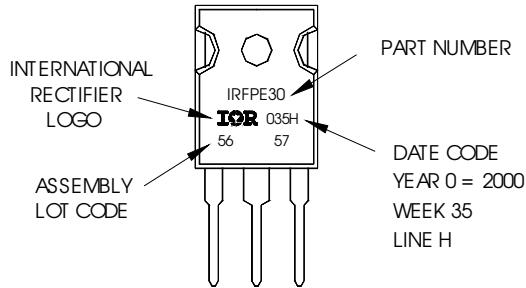


TO-247AC Part Marking Information

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

Note: "P" in assembly line
position indicates "Lead Free".

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



Data and specifications subject to change without notice.

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

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

IMPORTANT NOTICE

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics ("Beschaffenheitsgarantie").

With respect to any examples, hints or any typical values stated herein and/or any information regarding the application of the product, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

In addition, any information given in this document is subject to customer's compliance with its obligations stated in this document and any applicable legal requirements, norms and standards concerning customer's products and any use of the product of Infineon Technologies in customer's applications.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer's technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

For further information on the product, technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies office (www.infineon.com).

WARNINGS

Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.