

International  
**IR** Rectifier

PD - 94876

**IRFP22N60KPbF**

**SMPS MOSFET**

HEXFET® Power MOSFET

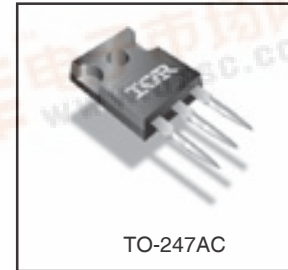
**Applications**

- Hard Switching Primary or PFS Switch
- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply
- High Speed Power Switching
- Motor Drive
- Lead-Free

<b>V<sub>DSS</sub></b>	<b>R<sub>DS(on) typ.</sub></b>	<b>I<sub>D</sub></b>
<b>600V</b>	<b>240mΩ</b>	<b>22A</b>

**Benefits**

- Low Gate Charge Qg results in Simple Drive Requirement
- Improved Gate, Avalanche and Dynamic dv/dt Ruggedness
- Fully Characterized Capacitance and Avalanche Voltage and Current
- Enhanced Body Diode dv/dt Capability



**Absolute Maximum Ratings**

	Parameter	Max.	Units
I <sub>D</sub> @ T <sub>C</sub> = 25°C	Continuous Drain Current, V <sub>GS</sub> @ 10V	22	A
I <sub>D</sub> @ T <sub>C</sub> = 100°C	Continuous Drain Current, V <sub>GS</sub> @ 10V	14	
I <sub>DM</sub>	Pulsed Drain Current ①	88	
P <sub>D</sub> @ T <sub>C</sub> = 25°C	Power Dissipation	370	W
	Linear Derating Factor	2.9	W/°C
V <sub>GS</sub>	Gate-to-Source Voltage	± 30	V
dv/dt	Peak Diode Recovery dv/dt ②	15	V/ns
T <sub>J</sub>	Operating Junction and Storage Temperature Range	-55 to + 150	°C
T <sub>STG</sub>			

**Avalanche Characteristics**

Symbol	Parameter	Typ.	Max.	Units
E <sub>AS</sub>	Single Pulse Avalanche Energy②	—	380	mJ
I <sub>AR</sub>	Avalanche Current①	—	22	A
E <sub>AR</sub>	Repetitive Avalanche Energy①	—	37	mJ

**Thermal Resistance**

Symbol	Parameter	Typ.	Max.	Units
R <sub>θJC</sub>	Junction-to-Case	—	0.34	°C/W
R <sub>θCS</sub>	Case-to-Sink, Flat, Greased Surface	0.24	—	
R <sub>θJA</sub>	Junction-to-Ambient	—	40	



# IRFP22N60KPbF

International  
IR Rectifier

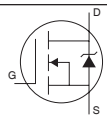
## Static @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	600	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.30	—	V/°C	Reference to $25^\circ\text{C}$ , $I_D = 1\text{mA}$ Ⓞ
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	240	280	mΩ	$V_{GS} = 10V, I_D = 13A$ ④
$V_{GS(th)}$	Gate Threshold Voltage	3.0	—	5.0	V	$V_{DS} = V_{GS}, I_D = 250\mu A$
$I_{DSS}$	Drain-to-Source Leakage Current	—	—	50	μA	$V_{DS} = 600V, V_{GS} = 0V$
		—	—	250	μA	$V_{DS} = 480V, V_{GS} = 0V, T_J = 125^\circ\text{C}$
$I_{GSS}$	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 30V$
	Gate-to-Source Reverse Leakage	—	—	-100	nA	$V_{GS} = -30V$

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

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$g_{fs}$	Forward Transconductance	11	—	—	S	$V_{DS} = 50V, I_D = 13A$
$Q_g$	Total Gate Charge	—	—	150	nC	$I_D = 22A$ $V_{DS} = 480V$ $V_{GS} = 10V$ ④
$Q_{gs}$	Gate-to-Source Charge	—	—	45		
$Q_{gd}$	Gate-to-Drain ("Miller") Charge	—	—	76		
$t_{d(on)}$	Turn-On Delay Time	—	26	—	ns	$V_{DD} = 300V$ $I_D = 22A$ $R_G = 6.2\ \Omega$ $V_{GS} = 10V$ ④
$t_r$	Rise Time	—	99	—		
$t_{d(off)}$	Turn-Off Delay Time	—	48	—		
$t_f$	Fall Time	—	37	—		
$C_{iss}$	Input Capacitance	—	3570	—	pF	$V_{GS} = 0V$ $V_{DS} = 25V$ $f = 1.0\text{MHz}$
$C_{oss}$	Output Capacitance	—	350	—		
$C_{rss}$	Reverse Transfer Capacitance	—	36	—		
$C_{oss}$	Output Capacitance	—	4710	—		
$C_{oss}$	Output Capacitance	—	92	—		
$C_{oss\ eff.}$	Effective Output Capacitance	—	180	—		

## Diode Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$I_S$	Continuous Source Current (Body Diode)	—	—	22	A	MOSFET symbol showing the integral reverse p-n junction diode. 
$I_{SM}$	Pulsed Source Current (Body Diode) ①	—	—	88		
$V_{SD}$	Diode Forward Voltage	—	—	1.5	V	$T_J = 25^\circ\text{C}, I_S = 22A, V_{GS} = 0V$ ④
$t_{rr}$	Reverse Recovery Time	—	590	890	ns	$T_J = 25^\circ\text{C}$ $I_F = 22A$
		—	670	1010		$T_J = 125^\circ\text{C}$ $di/dt = 100A/\mu s$ ④
$Q_{rr}$	Reverse Recovery Charge	—	7.2	11	μC	$T_J = 25^\circ\text{C}$
		—	8.5	13		$T_J = 125^\circ\text{C}$
$I_{RRM}$	Reverse Recovery Current	—	26	39	A	$T_J = 25^\circ\text{C}$
$t_{on}$	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.
- ② Starting  $T_J = 25^\circ\text{C}$ ,  $L = 1.5\text{mH}$ ,  $R_G = 25\ \Omega$ ,  $I_{AS} = 22A$
- ③  $I_{SD} \leq 22A$ ,  $di/dt \leq 360\ \text{A}/\mu s$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  $T_J \leq 150^\circ\text{C}$ .
- ④ Pulse width  $\leq 300\mu s$ ; duty cycle  $\leq 2\%$ .
- ⑤  $C_{oss\ eff.}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

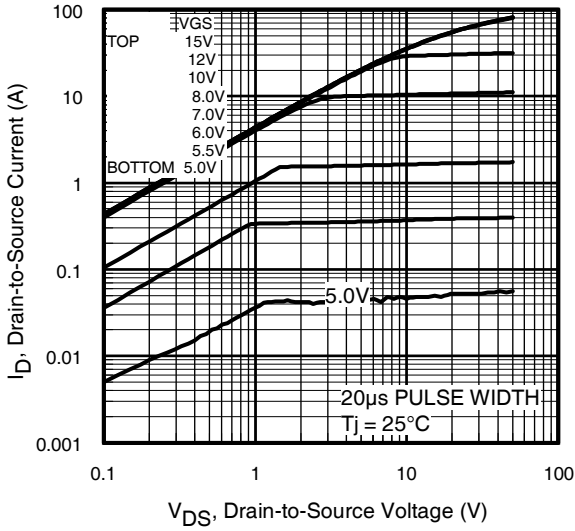


Fig 1. Typical Output Characteristics

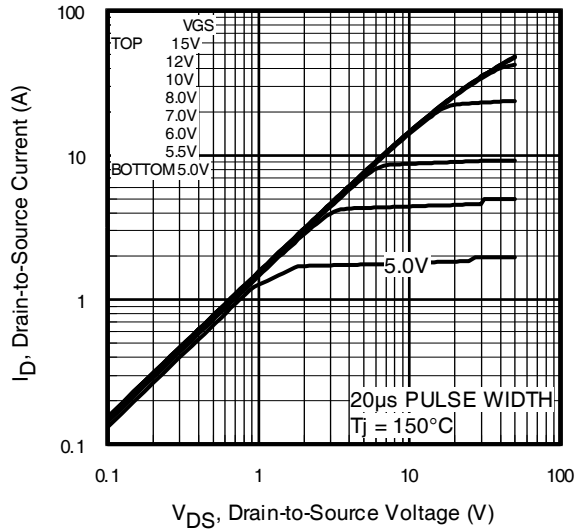


Fig 2. Typical Output Characteristics

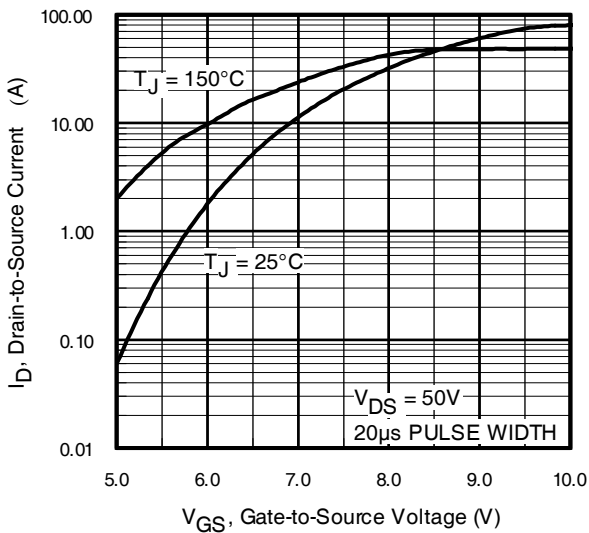


Fig 3. Typical Transfer Characteristics

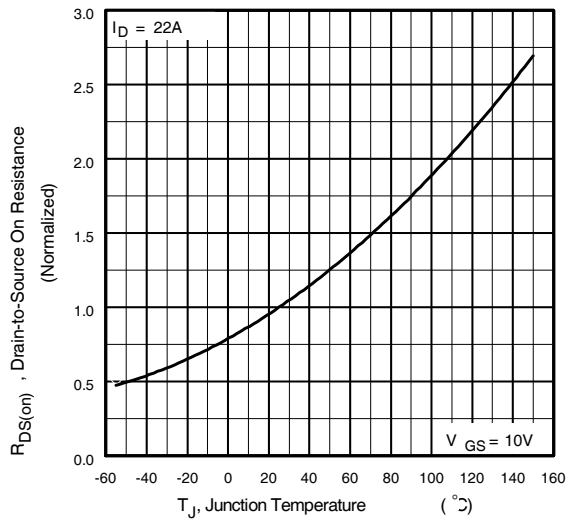
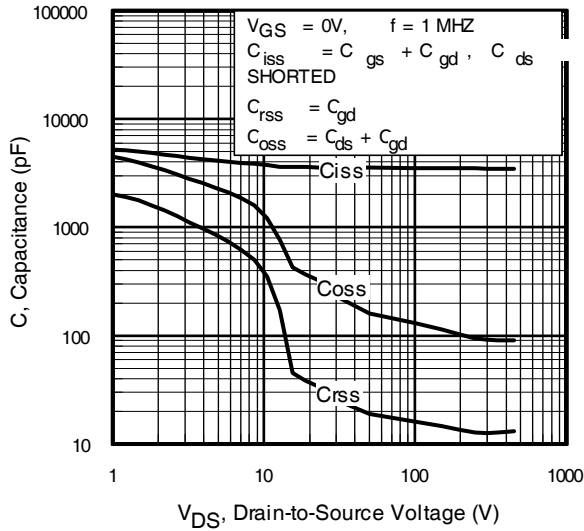


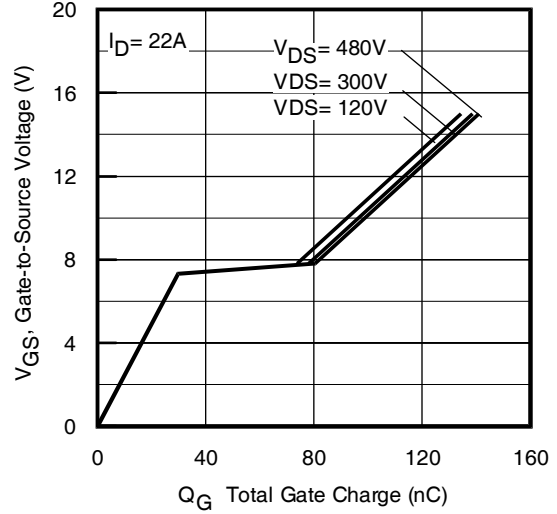
Fig 4. Normalized On-Resistance Vs. Temperature

# IRFP22N60KPbF

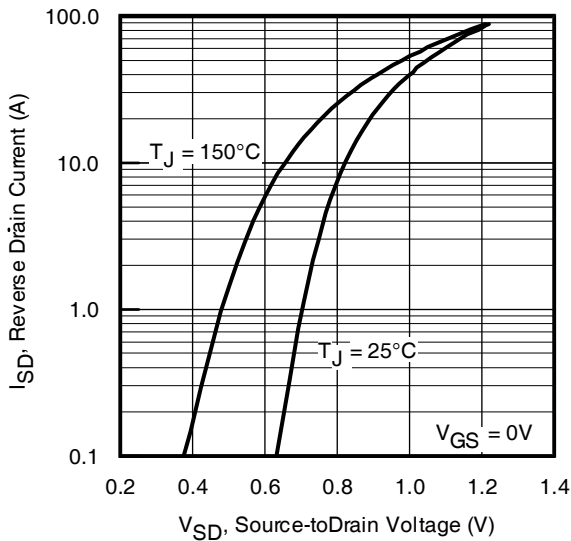
International  
**IR** Rectifier



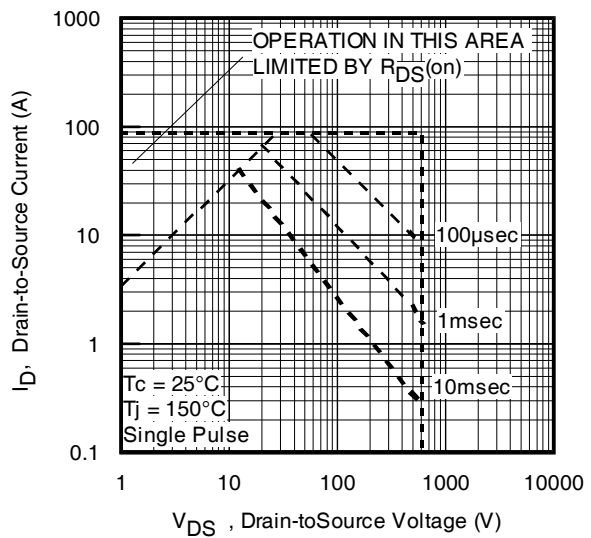
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



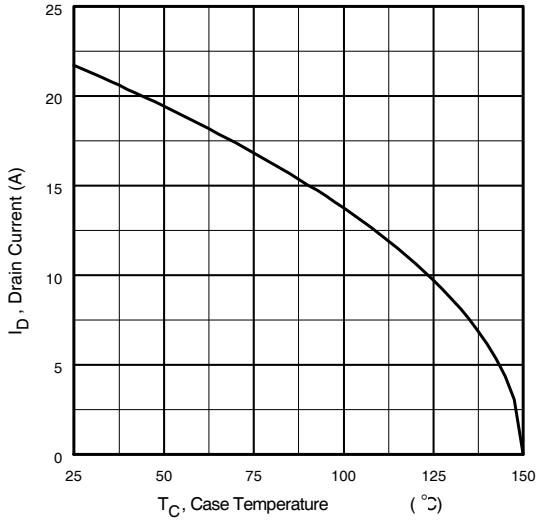
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



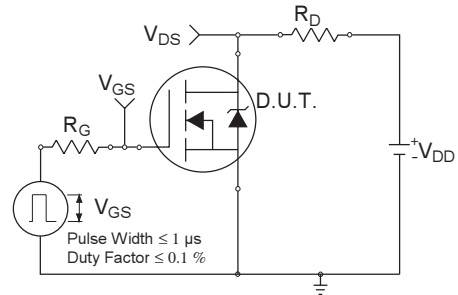
**Fig 7.** Typical Source-Drain Diode Forward Voltage



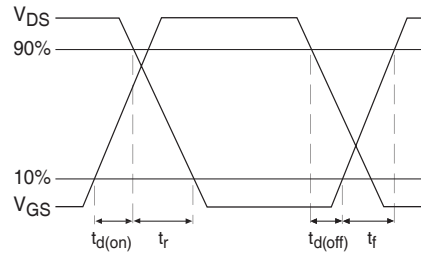
**Fig 8.** Maximum Safe Operating Area



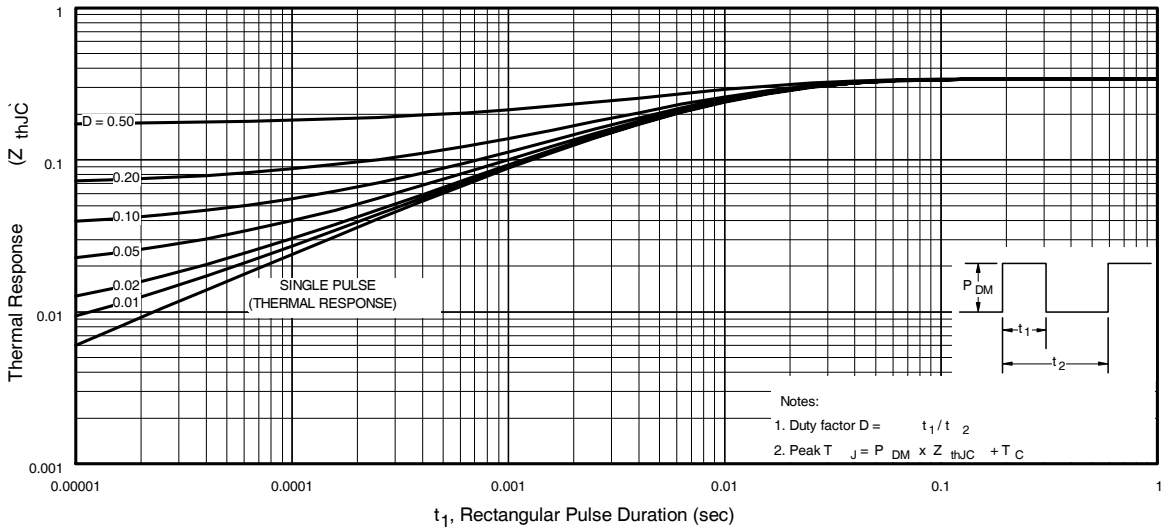
**Fig 9.** Maximum Drain Current Vs. Case Temperature



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



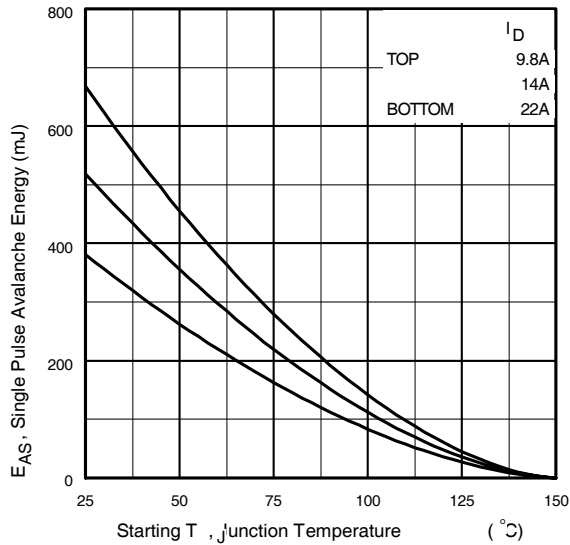
**Fig 10b.** Switching Time Waveforms



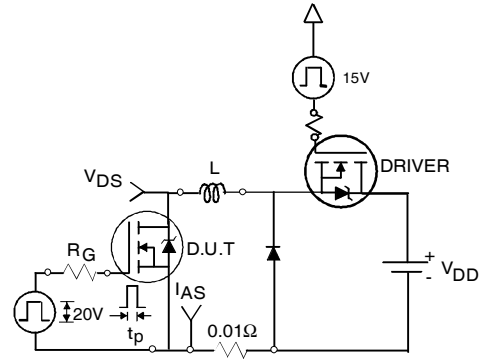
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

# IRFP22N60KPbF

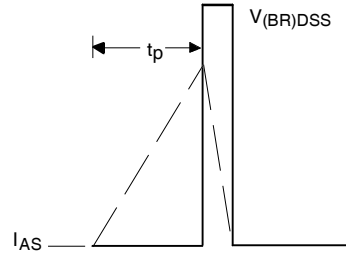
International  
**IR** Rectifier



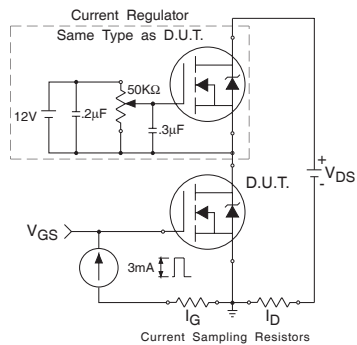
**Fig 12a.** Maximum Avalanche Energy Vs. Drain Current



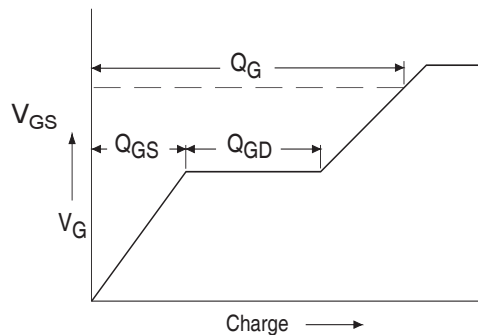
**Fig 12c.** Unclamped Inductive Test Circuit



**Fig 12d.** Unclamped Inductive Waveforms

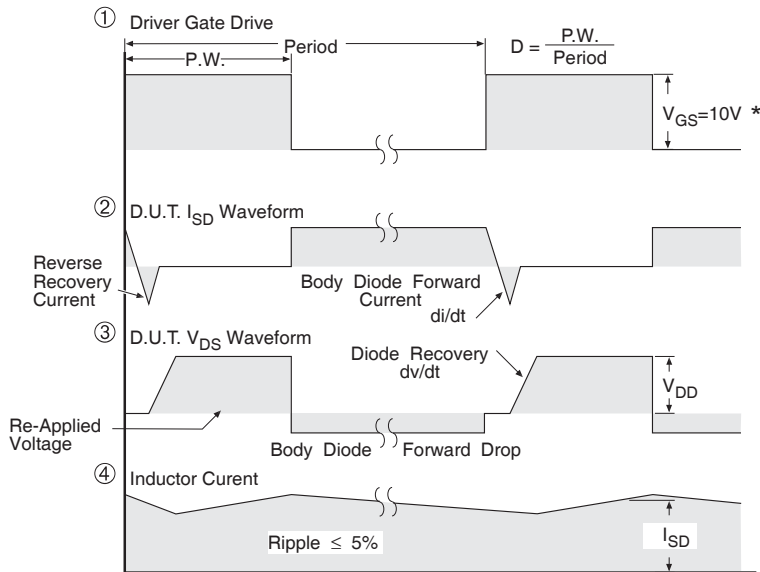
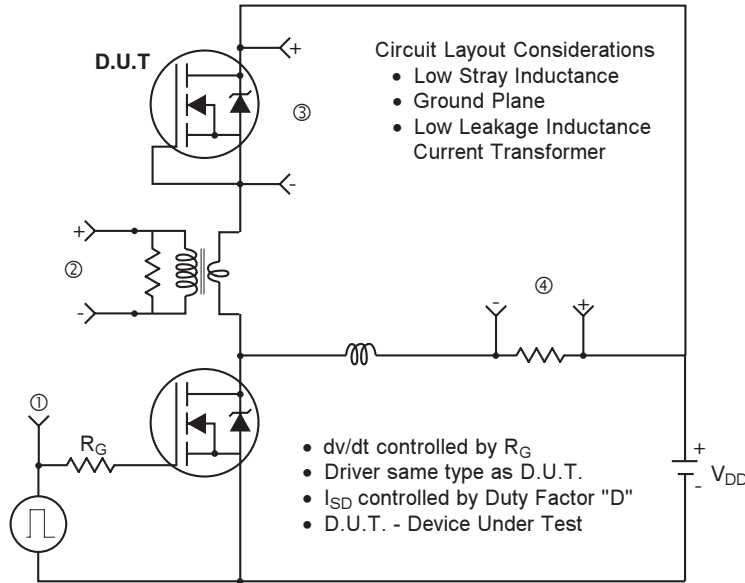


**Fig 13a.** Gate Charge Test Circuit



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

## Peak Diode Recovery dv/dt Test Circuit



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

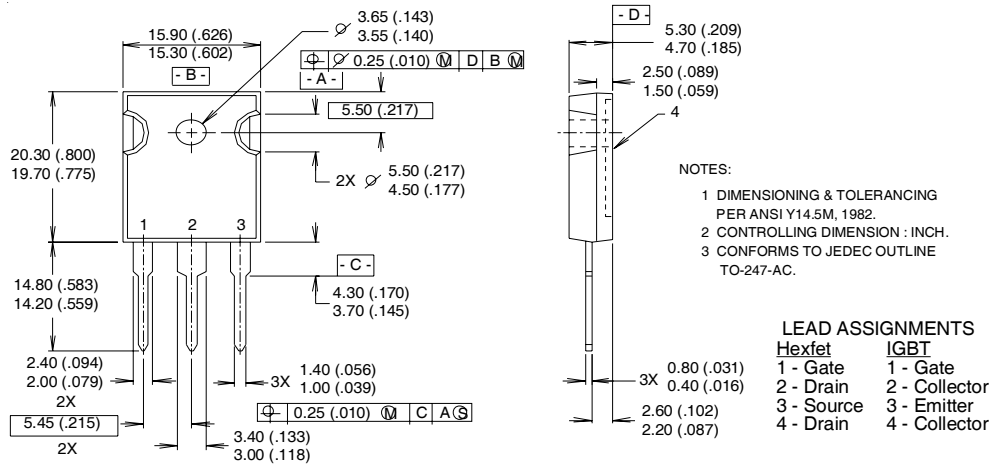
**Fig 14.** For N-Channel HEXFET® Power MOSFETs

# IRFP22N60KPbF

International  
**IR** Rectifier

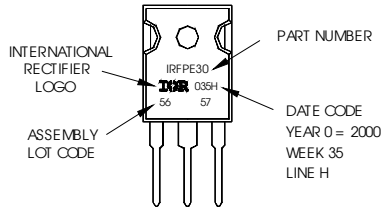
## TO-247AC Package Outline

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"



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.

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](http://www.irf.com) for sales contact information.12/03

[www.irf.com](http://www.irf.com)