

**Applications**

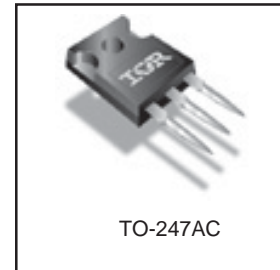
- Zero Voltage Switching SMPS
- Telecom and Server Power Supplies
- Uninterruptible Power Supplies
- Motor Control applications

HEXFET® Power MOSFET

$V_{DSS}$	$R_{DS(on)}$ typ.	$T_{rr}$ typ.	$I_D$
500V	0.15Ω	170ns	31A

**Features and Benefits**

- SuperFast body diode eliminates the need for external diodes in ZVS applications.
- Lower Gate charge results in simpler drive requirements.
- Enhanced dv/dt capabilities offer improved ruggedness.
- Higher Gate voltage threshold offers improved noise immunity.



**Absolute Maximum Ratings**

	Parameter	Max.	Units
$I_D$ @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS}$ @ 10V	31	A
$I_D$ @ $T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS}$ @ 10V	20	
$I_{DM}$	Pulsed Drain Current ①	124	
$P_D$ @ $T_C = 25^\circ\text{C}$	Power Dissipation	460	W
	Linear Derating Factor	3.7	W/°C
$V_{GS}$	Gate-to-Source Voltage	±30	V
dv/dt	Peak Diode Recovery dv/dt ③	16	V/ns
$T_J$ $T_{STG}$	Operating Junction and Storage Temperature Range	-55 to + 150	°C
	Soldering Temperature, for 10 seconds	300 (1.6mm from case )	
	Mounting torque, 6-32 or M3 screw	10lb-in (1.1N·m)	

**Diode Characteristics**

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$I_S$	Continuous Source Current (Body Diode)	—	—	31	A	MOSFET symbol showing the integral reverse p-n junction diode.
$I_{SM}$	Pulsed Source Current (Body Diode) ①	—	—	124		
$V_{SD}$	Diode Forward Voltage	—	—	1.5	V	$T_J = 25^\circ\text{C}$ , $I_S = 31\text{A}$ , $V_{GS} = 0\text{V}$ ④
$t_{rr}$	Reverse Recovery Time	—	170	250	ns	$T_J = 25^\circ\text{C}$ , $I_F = 31\text{A}$
		—	220	330		$T_J = 125^\circ\text{C}$ , $di/dt = 100\text{A}/\mu\text{s}$ ④
$Q_{rr}$	Reverse Recovery Charge	—	570	860	nC	$T_J = 25^\circ\text{C}$ , $I_S = 31\text{A}$ , $V_{GS} = 0\text{V}$ ④
		—	1.2	1.8		$T_J = 125^\circ\text{C}$ , $di/dt = 100\text{A}/\mu\text{s}$ ④
$I_{RRM}$	Reverse Recovery Current	—	7.9	12	A	$T_J = 25^\circ\text{C}$
$t_{on}$	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)				

# IRFP31N50L

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	500	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.28	—	V/°C	Reference to $25^\circ\text{C}, I_D = 1\text{mA}$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	0.15	0.18	$\Omega$	$V_{GS} = 10V, I_D = 19A$ 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	$\mu A$	$V_{DS} = 500V, V_{GS} = 0V$
		—	—	2.0	mA	$V_{DS} = 400V, V_{GS} = 0V, T_J = 125^\circ\text{C}$
$I_{GSS}$	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 30V$
	Gate-to-Source Reverse Leakage	—	—	-100	nA	$V_{GS} = -30V$
$R_G$	Internal Gate Resistance	—	1.1	—	$\Omega$	$f = 1\text{MHz}, \text{open drain}$

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

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$g_{fs}$	Forward Transconductance	15	—	—	S	$V_{DS} = 50V, I_D = 19A$
$Q_g$	Total Gate Charge	—	—	210	nC	$I_D = 31A$
$Q_{gs}$	Gate-to-Source Charge	—	—	58	nC	$V_{DS} = 400V$
$Q_{gd}$	Gate-to-Drain ("Miller") Charge	—	—	100	nC	$V_{GS} = 10V, \text{See Fig. 7 \& 15 } \text{④}$
$t_{d(on)}$	Turn-On Delay Time	—	28	—	ns	$V_{DD} = 250V$ $I_D = 31A$ $R_G = 4.3\Omega$ $V_{GS} = 10V, \text{See Fig. 14a \& 14b } \text{④}$
$t_r$	Rise Time	—	115	—		
$t_{d(off)}$	Turn-Off Delay Time	—	54	—		
$t_f$	Fall Time	—	53	—		
$C_{iss}$	Input Capacitance	—	5000	—	pF	$V_{GS} = 0V$ $V_{DS} = 25V$ $f = 1.0\text{MHz}, \text{See Fig. 5}$ $V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0\text{MHz}$ $V_{GS} = 0V, V_{DS} = 400V, f = 1.0\text{MHz}$ $V_{GS} = 0V, V_{DS} = 0V \text{ to } 400V \text{ } \text{⑤}$
$C_{oss}$	Output Capacitance	—	553	—		
$C_{rss}$	Reverse Transfer Capacitance	—	59	—		
$C_{oss}$	Output Capacitance	—	6630	—		
$C_{oss}$	Output Capacitance	—	155	—		
$C_{oss \text{ eff.}}$	Effective Output Capacitance	—	276	—		
$C_{oss \text{ eff. (ER)}}$	Effective Output Capacitance (Energy Related)	—	200	—		

## Avalanche Characteristics

Symbol	Parameter	Typ.	Max.	Units
$E_{AS}$	Single Pulse Avalanche Energy ②	—	460	mJ
$I_{AR}$	Avalanche Current ①	—	31	A
$E_{AR}$	Repetitive Avalanche Energy ①	—	46	mJ

## Thermal Resistance

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ⑥	—	0.26	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.24	—	
$R_{\theta JA}$	Junction-to-Ambient ⑥	—	40	

### Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. (See Fig. 11)
- ② Starting  $T_J = 25^\circ\text{C}$ ,  $L = 1\text{mH}$ ,  $R_G = 25\Omega$ ,  $I_{AS} = 31A$  (See Figure 12).
- ③  $I_{SD} = 31A$ ,  $di/dt \leq 630A/\mu s$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  $T_J \leq 150^\circ\text{C}$ .

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

⑤  $C_{oss \text{ eff.}}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

$C_{oss \text{ eff. (ER)}}$  is a fixed capacitance that stores the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

⑥  $R_{\theta}$  is measured at  $T_J$  approximately  $90^\circ\text{C}$

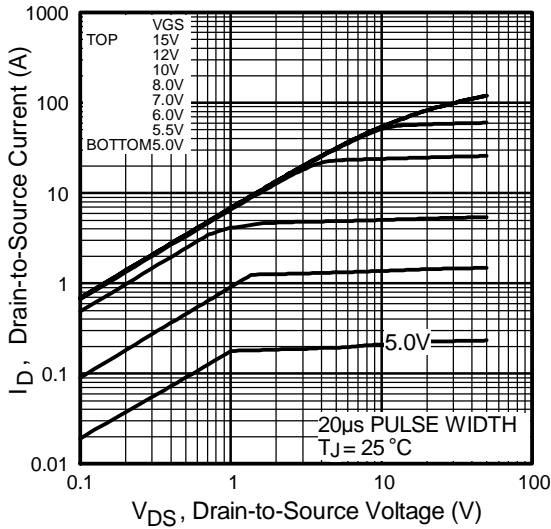


Fig 1. Typical Output Characteristics

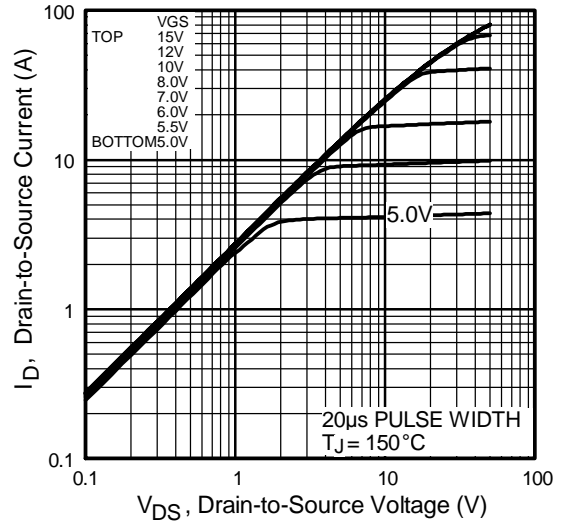


Fig 2. Typical Output Characteristics

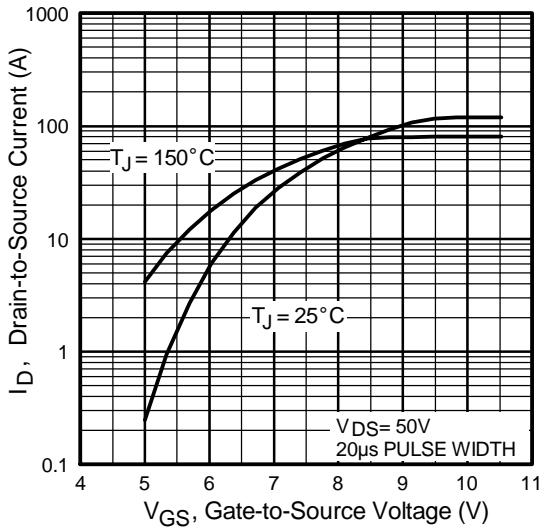


Fig 3. Typical Transfer Characteristics

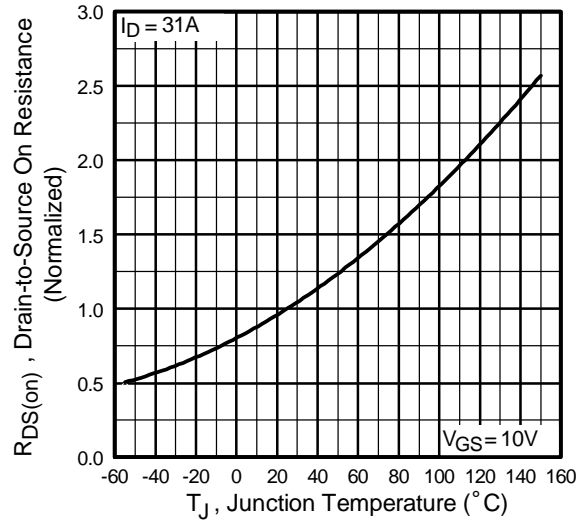
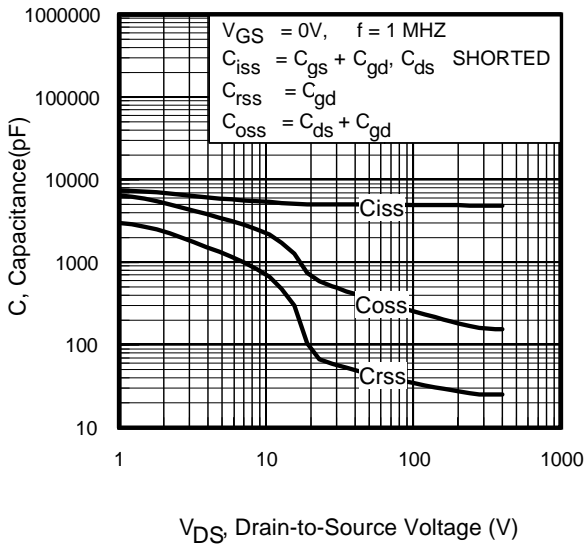
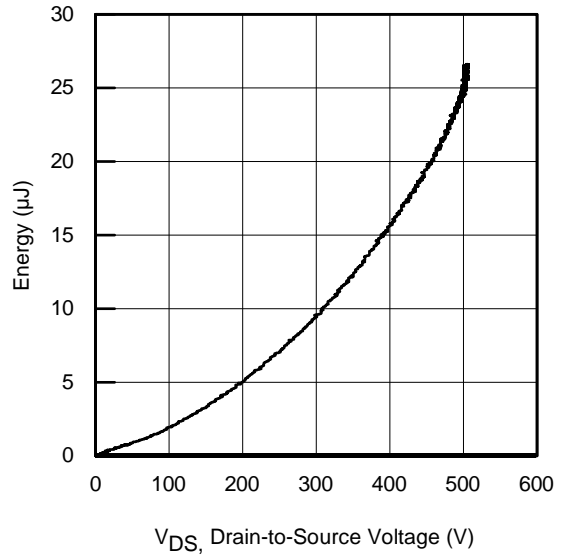


Fig 4. Normalized On-Resistance Vs. Temperature

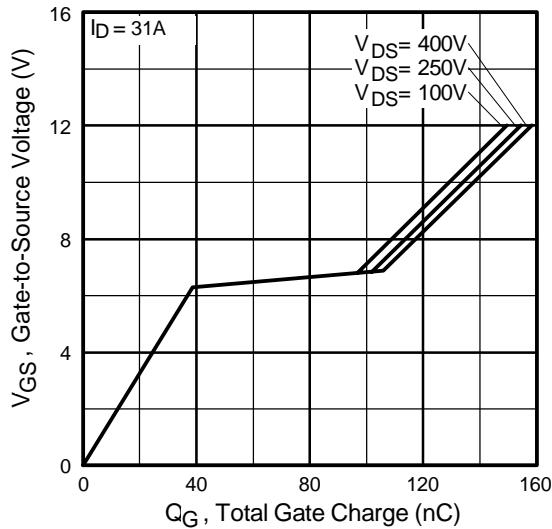
# IRFP31N50L



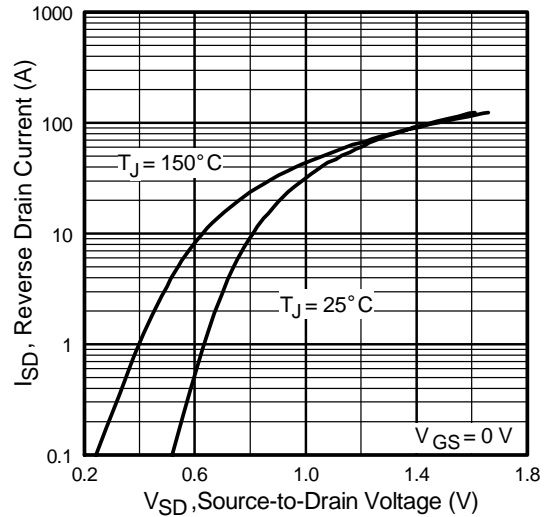
**Fig 5.** Typical Capacitance vs. Drain-to-Source Voltage



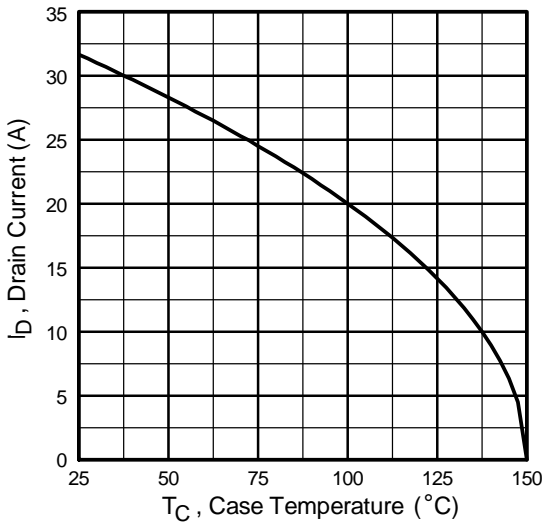
**Fig 6.** Typ. Output Capacitance Stored Energy vs.  $V_{DS}$



**Fig 7.** Typical Gate Charge vs. Gate-to-Source Voltage



**Fig 8.** Typical Source-Drain Diode Forward Voltage



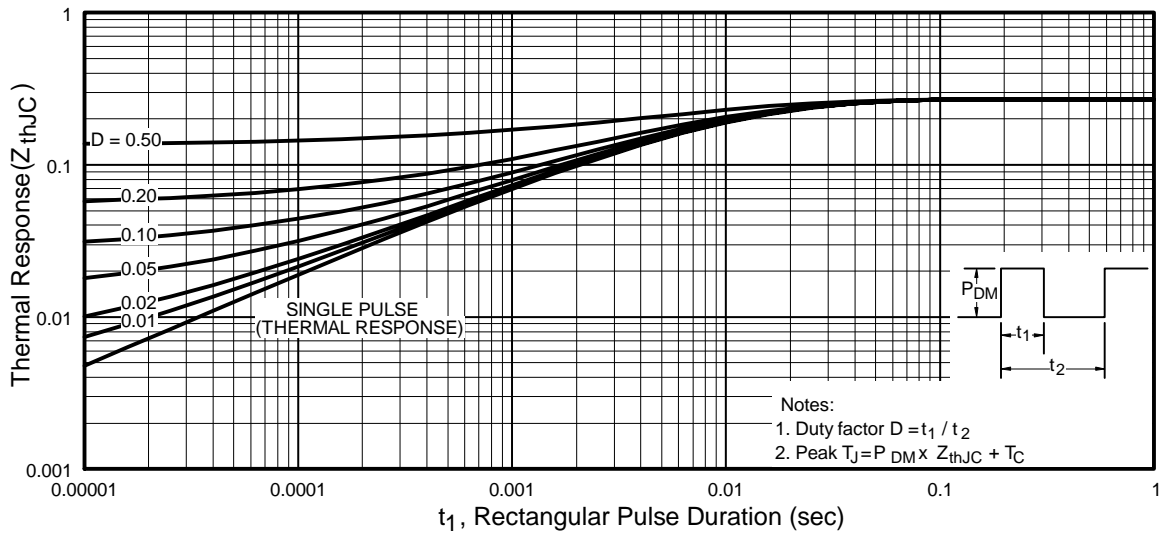
**Fig 9.** Maximum Drain Current vs. Case Temperature



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



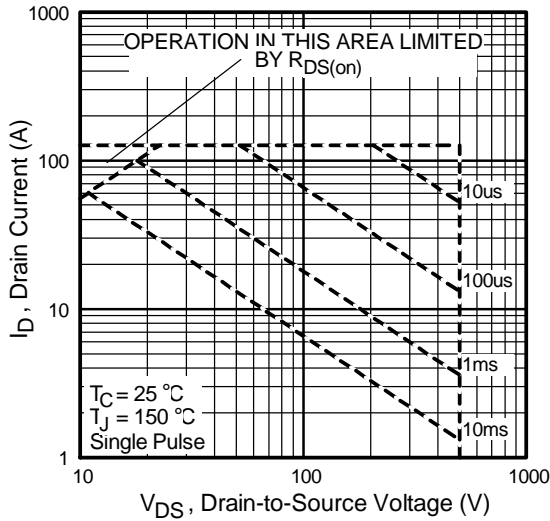
**Fig 10b.** Switching Time Waveforms



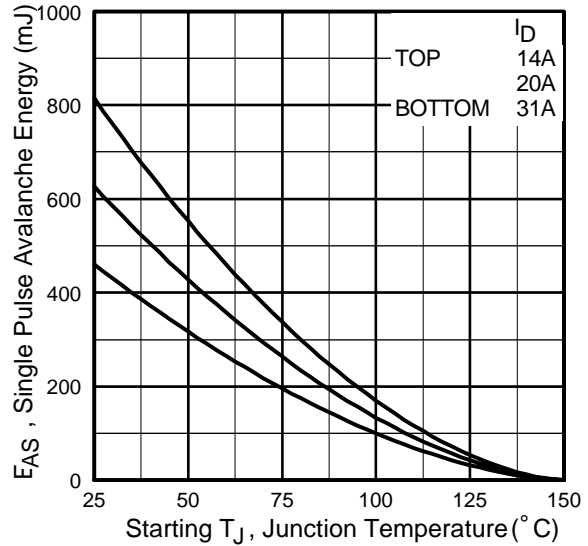
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

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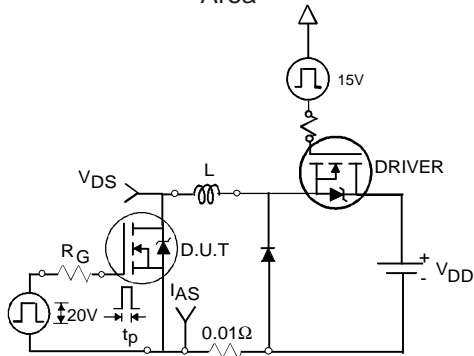
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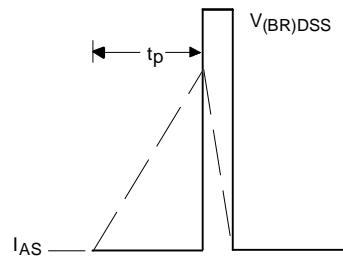
**Fig 12.** Maximum Safe Operating Area



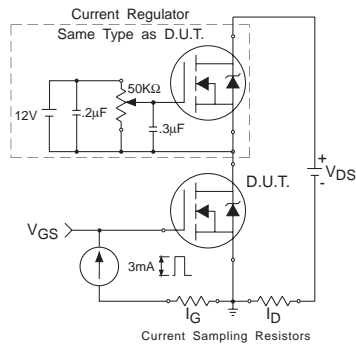
**Fig 13.** Maximum Avalanche Energy Vs. Drain Current



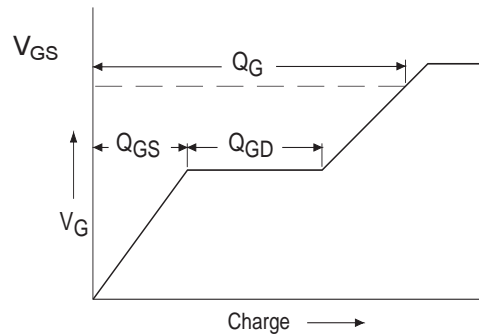
**Fig 14a.** Unclamped Inductive Test Circuit



**Fig 14b.** Unclamped Inductive Waveforms

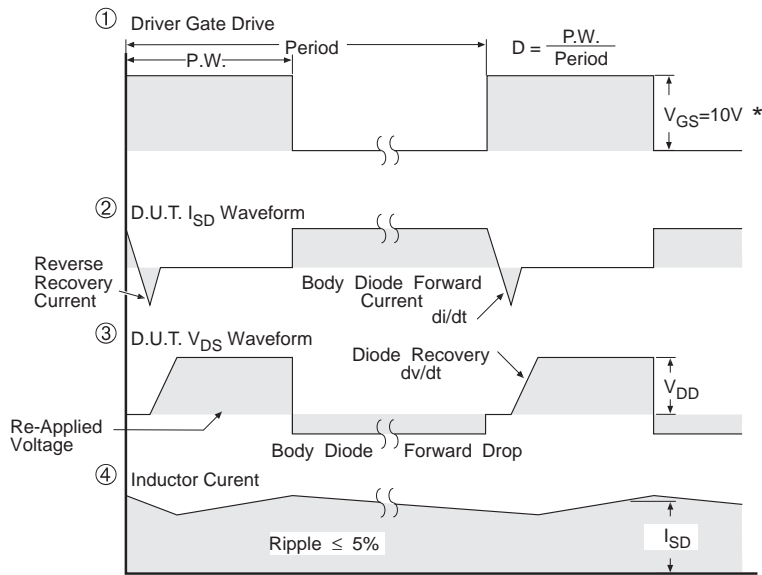
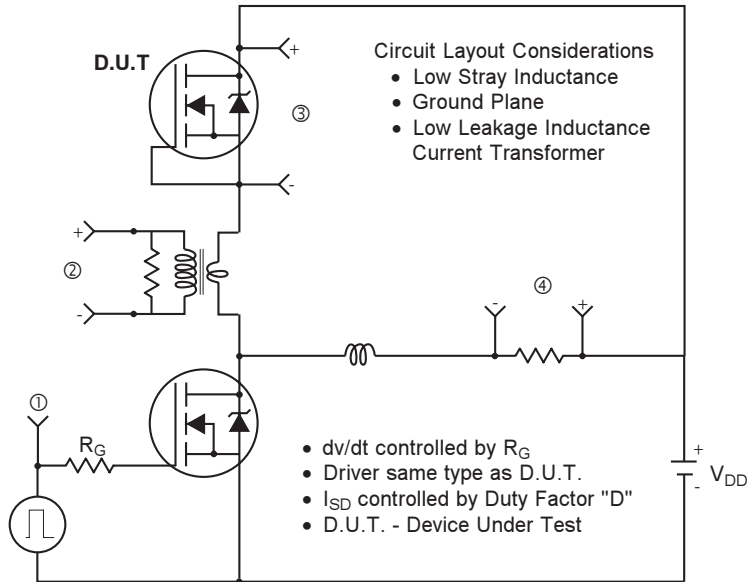


**Fig 15a.** Gate Charge Test Circuit



**Fig 15b.** Basic Gate Charge Waveform

## Peak Diode Recovery dv/dt Test Circuit



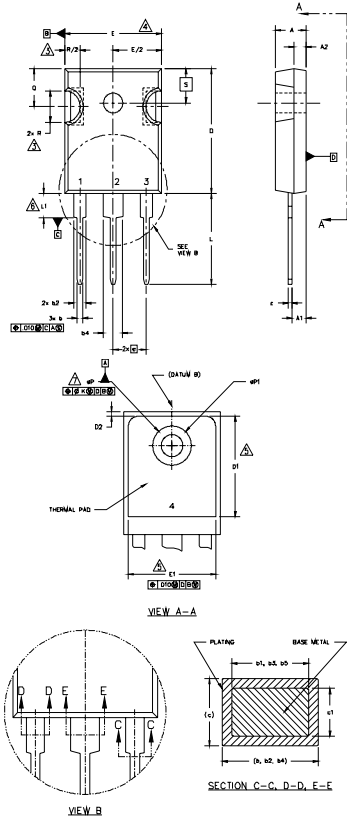
\*  $V_{GS} = 5V$  for Logic Level Devices

**Fig 16.** For N-Channel HEXFET® Power MOSFETs

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TO-247AC Package Outline Dimensions are shown in millimeters (inches)



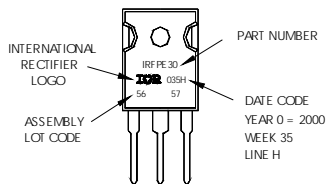
NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M 1994.
2. DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS]
3. CONTOUR OF SLOT OPTIONAL.
4. DIMENSION D & E DO NOT INCLUDE MOLD FLASH; MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
5. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS D1 & E1.
6. LEAD FINISH UNCONTROLLED IN L1.
7.  $\phi P$  TO HAVE A MAXIMUM DRAFT ANGLE OF 1.5° TO THE TOP OF THE PART WITH A MAXIMUM HOLE DIAMETER OF .154" [3.91].
8. B. OUTLINE CONFORMS TO JEDEC OUTLINE TO-247 WITH THE EXCEPTION OF DIMENSION e.

SYMBOL	DIMENSIONS				NOTES	LEAD ASSIGNMENTS
	INCHES		MILLIMETERS			
	MIN.	MAX.	MIN.	MAX.		
A	.183	.209	4.65	5.31		
A1	.067	.102	2.21	2.59		
A2	.059	.098	1.50	2.49		
b	.039	.055	0.99	1.40		<b>HEXFET</b>
b1	.039	.053	0.99	1.35		1.- GATE
b2	.065	.094	1.65	2.39		2.- DRAIN
b3	.065	.092	1.65	2.37		3.- SOURCE
b4	.102	.135	2.59	3.43		4.- DRAIN
b5	.102	.133	2.59	3.38		
c	.015	.034	0.38	0.86		<b>IGBTs, CoPACK</b>
e1	.015	.030	0.38	0.76	4	
D	.776	.815	19.71	20.70	5	1.- GATE
D1	.515	-	13.08	-		2.- COLLECTOR
D2	.020	.030	0.51	0.76		3.- EMITTER
E	.602	.625	15.29	15.87	4	4.- COLLECTOR
E1	.540	-	15.72	-		
e	.215 BSC		5.46 BSC			
ek	.010		2.54			<b>DIODES</b>
L	.559	.634	14.20	16.10		1.- ANODE/OPEN
L1	.146	.169	3.71	4.29		2.- CATHODE
N	3		7.62 BSC			3.- ANODE
$\phi P$	.140	.144	3.56	3.66		
$\phi P1$	-	.275	-	6.99		
Q	.209	.224	5.31	5.69		
R	.178	.216	4.52	5.49		
S	.217 BSC		5.51 BSC			

## TO-247AC Part Marking Information

EXAMPLE: THIS IS AN IRFPE30 WITH ASSEMBLY LOT CODE 5657 ASSEMBLED ON VWV 35, 2000 IN THE ASSEMBLY LINE "H"  
**Note:** "P" in assembly line position indicates "Lead-Free"



**TO-247AC package is not recommended for Surface Mount Application.**

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.

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**IR** Rectifier

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 TAC Fax: (310) 252-7903

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