

# IRLB3813PbF

## Applications

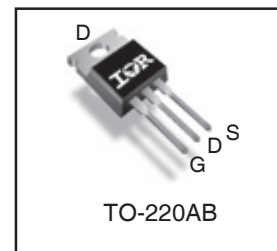
- Optimized for UPS/Inverter Applications
- High Frequency Isolated DC-DC Converters with Synchronous Rectification for Telecom and Industrial Use
- Power Tools

## Benefits

- Very Low  $R_{DS(on)}$  at 4.5V  $V_{GS}$
- Ultra-Low Gate Impedance
- Fully Characterized Avalanche Voltage and Current
- Lead-Free

HEXFET® Power MOSFET

$V_{DSS}$	$R_{DS(on)}$ max	Qg (typ.)
30V	1.95m $\Omega$ @ $V_{GS} = 10V$	57nC



G	D	S
Gate	Drain	Source

## Absolute Maximum Ratings

	Parameter	Max.	Units
$V_{DS}$	Drain-to-Source Voltage	30	V
$V_{GS}$	Gate-to-Source Voltage	$\pm 20$	
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$	260 <sup>Ⓒ</sup>	A
$I_D @ T_C = 100^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$	190 <sup>Ⓒ</sup>	
$I_{DM}$	Pulsed Drain Current <sup>Ⓓ</sup>	1050	W
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation <sup>Ⓔ</sup>	230	
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation <sup>Ⓔ</sup>	120	
	Linear Derating Factor	1.6	
$T_J$ $T_{STG}$	Operating Junction and Storage Temperature Range	-55 to + 175	°C
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	
	Mounting torque, 6-32 or M3 screw	10lb·in (1.1N·m)	

## Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case <sup>Ⓔ</sup>	—	0.64	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat Greased Surface	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient <sup>Ⓔ</sup>	—	62	

Notes <sup>Ⓓ</sup> through <sup>Ⓔ</sup> are on page 9

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

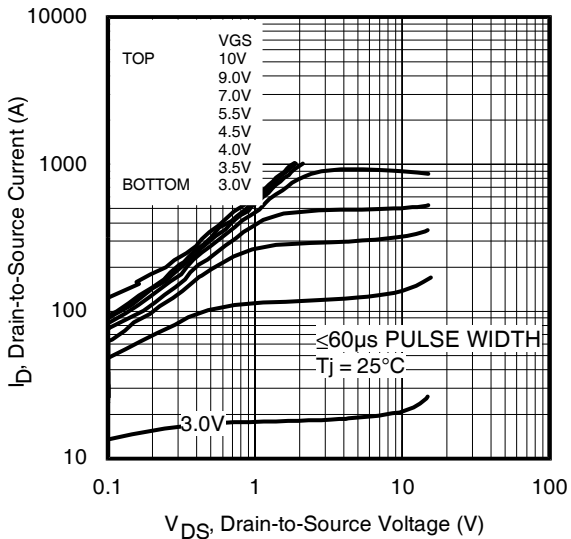
	Parameter	Min.	Typ.	Max.	Units	Conditions
$BV_{DSS}$	Drain-to-Source Breakdown Voltage	30	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	11	—	mV/°C	Reference to $25^\circ\text{C}, I_D = 1.0\text{mA}$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	1.60	1.95	m $\Omega$	$V_{GS} = 10V, I_D = 60A$ ③
		—	2.00	2.60		$V_{GS} = 4.5V, I_D = 48A$ ③
$V_{GS(th)}$	Gate Threshold Voltage	1.35	1.90	2.35	V	$V_{DS} = V_{GS}, I_D = 150\mu A$
$\Delta V_{GS(th)}/\Delta T_J$	Gate Threshold Voltage Coefficient	—	-7.8	—	mV/°C	
$I_{DSS}$	Drain-to-Source Leakage Current	—	—	1.0	$\mu A$	$V_{DS} = 24V, V_{GS} = 0V$
		—	—	100		$V_{DS} = 24V, V_{GS} = 0V, T_J = 125^\circ\text{C}$
$I_{GSS}$	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 20V$
	Gate-to-Source Reverse Leakage	—	—	-100		$V_{GS} = -20V$
$g_{fs}$	Forward Transconductance	140	—	—	S	$V_{DS} = 15V, I_D = 48A$
$Q_g$	Total Gate Charge	—	57	86	nC	$V_{DS} = 15V$ $V_{GS} = 4.5V$ $I_D = 48A$ See Fig. 16
$Q_{gs1}$	Pre-Vth Gate-to-Source Charge	—	16	—		
$Q_{gs2}$	Post-Vth Gate-to-Source Charge	—	6.7	—		
$Q_{gd}$	Gate-to-Drain Charge	—	19	—		
$Q_{godr}$	Gate Charge Overdrive	—	15	—		
$Q_{sw}$	Switch Charge ( $Q_{gs2} + Q_{gd}$ )	—	25.7	—		
$Q_{oss}$	Output Charge	—	35	—	nC	$V_{DS} = 16V, V_{GS} = 0V$
$R_G$	Gate Resistance	—	0.87	1.3	$\Omega$	
$t_{d(on)}$	Turn-On Delay Time	—	36	—	ns	$V_{DD} = 15V, V_{GS} = 4.5V$ ③ $I_D = 48A$ $R_G = 1.8\Omega$ See Fig. 14
$t_r$	Rise Time	—	170	—		
$t_{d(off)}$	Turn-Off Delay Time	—	33	—		
$t_f$	Fall Time	—	60	—		
$C_{iss}$	Input Capacitance	—	8420	—	pF	$V_{GS} = 0V$ $V_{DS} = 15V$ $f = 1.0\text{MHz}$
$C_{oss}$	Output Capacitance	—	1620	—		
$C_{riss}$	Reverse Transfer Capacitance	—	650	—		

## Avalanche Characteristics

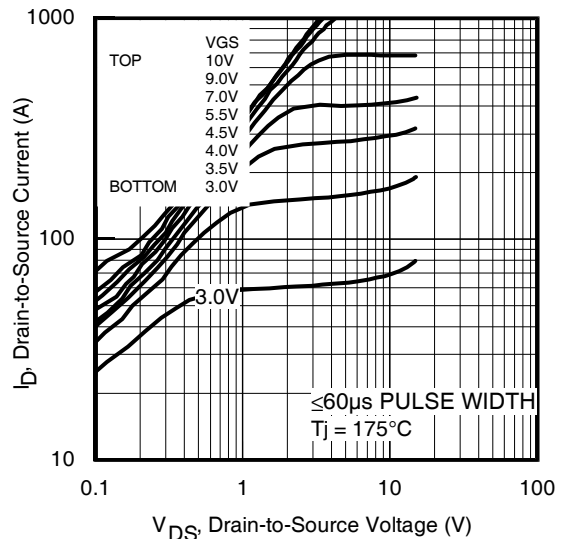
	Parameter	Typ.	Max.	Units
$E_{AS}$	Single Pulse Avalanche Energy ②	—	520	mJ
$I_{AR}$	Avalanche Current ①	—	48	A

## Diode Characteristics

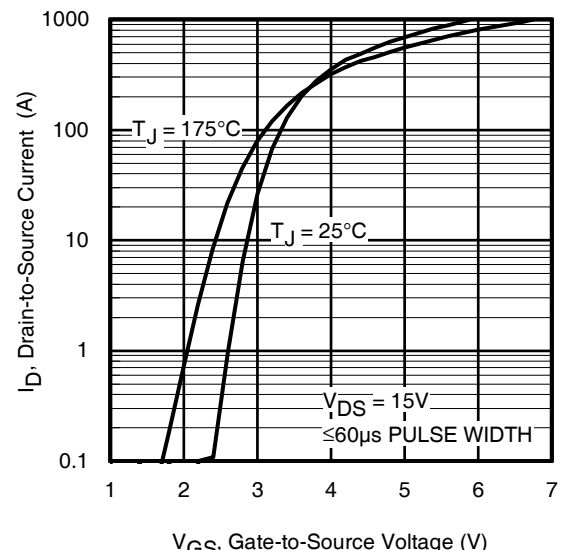
	Parameter	Min.	Typ.	Max.	Units	Conditions
$I_S$	Continuous Source Current (Body Diode)	—	—	260	A	MOSFET symbol showing the integral reverse p-n junction diode.
$I_{SM}$	Pulsed Source Current (Body Diode) ①	—	—	1050		
$V_{SD}$	Diode Forward Voltage	—	—	1.0	V	$T_J = 25^\circ\text{C}, I_S = 48A, V_{GS} = 0V$ ③
$t_{rr}$	Reverse Recovery Time	—	24	36	ns	$T_J = 25^\circ\text{C}, I_F = 48A, V_{DD} = 15V$
$Q_{rr}$	Reverse Recovery Charge	—	22	33	nC	$di/dt = 244A/\mu s$ ③



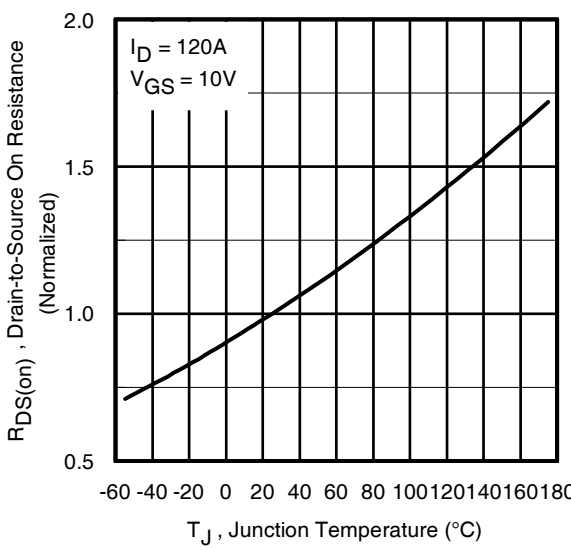
**Fig 1.** Typical Output Characteristics



**Fig 2.** Typical Output Characteristics

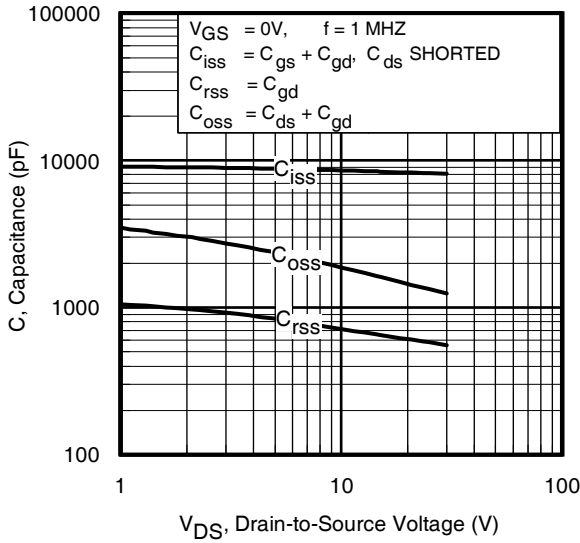


**Fig 3.** Typical Transfer Characteristics

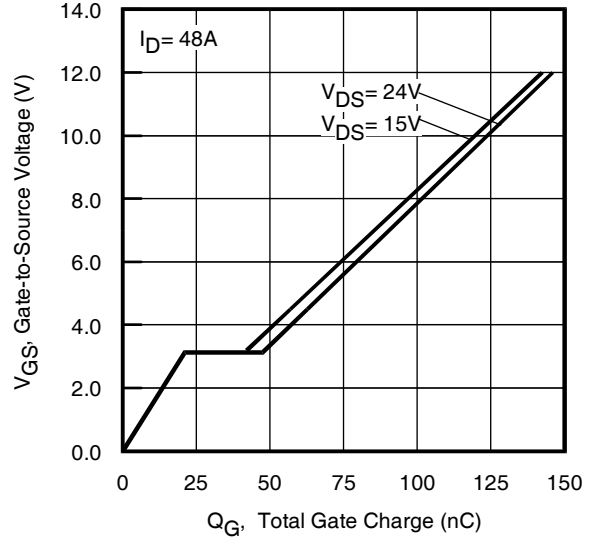


**Fig 4.** Normalized On-Resistance vs. Temperature

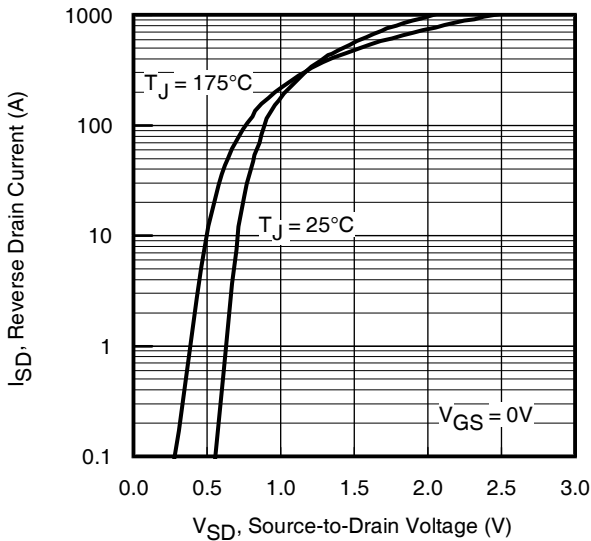
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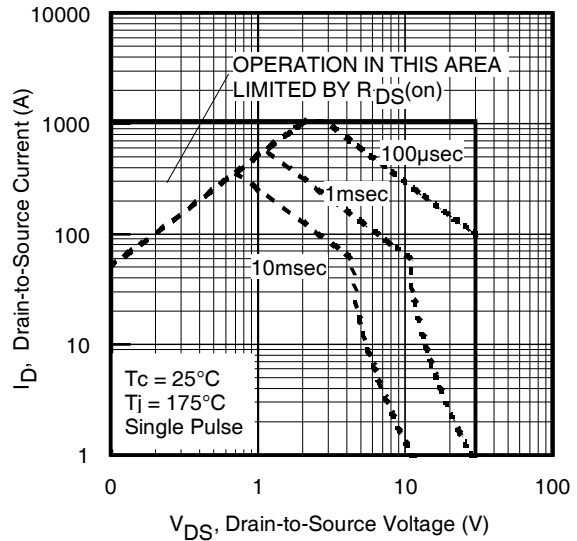
**Fig 5.** Typical Capacitance vs. Drain-to-Source Voltage



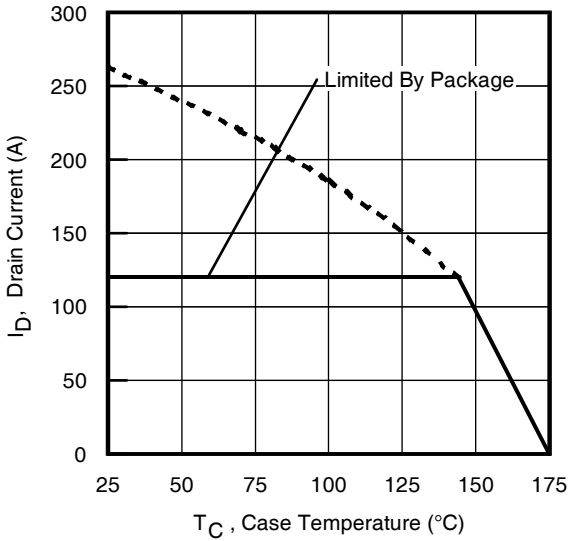
**Fig 6.** Typical Gate Charge vs. Gate-to-Source Voltage



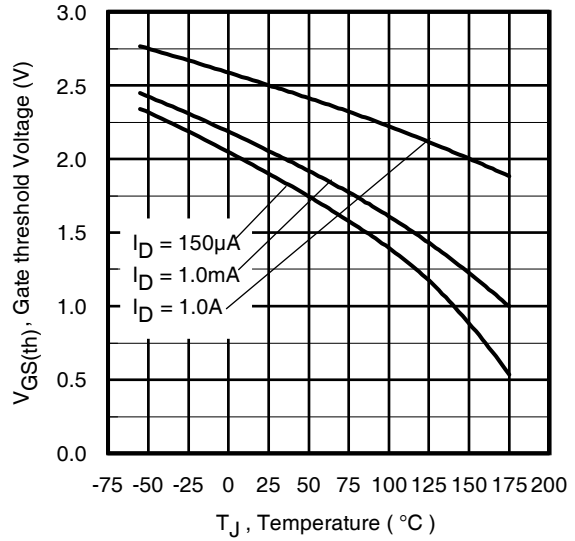
**Fig 7.** Typical Source-Drain Diode Forward Voltage



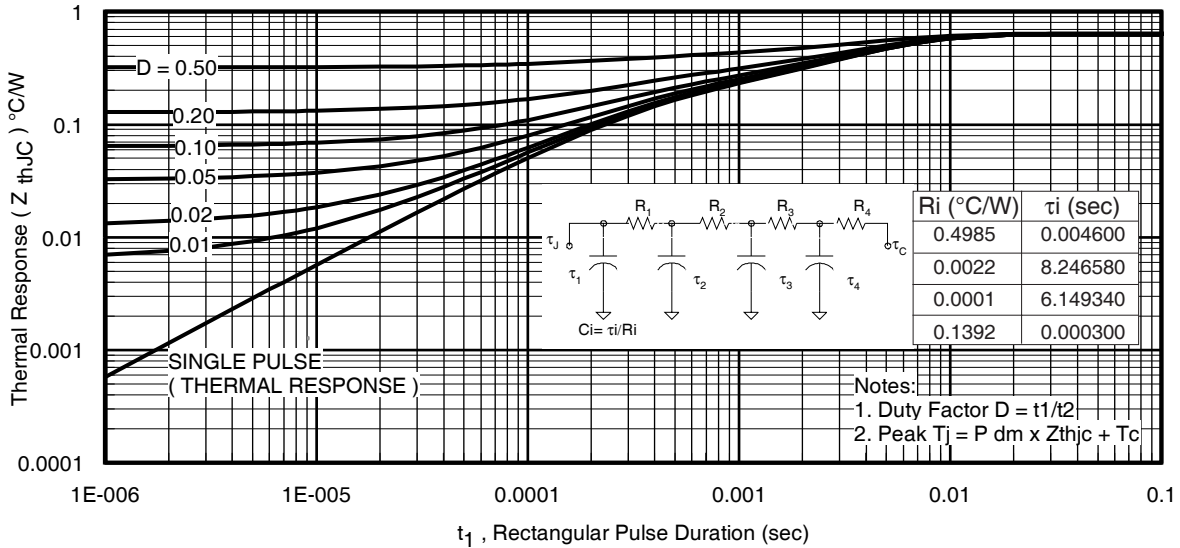
**Fig 8.** Maximum Safe Operating Area



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



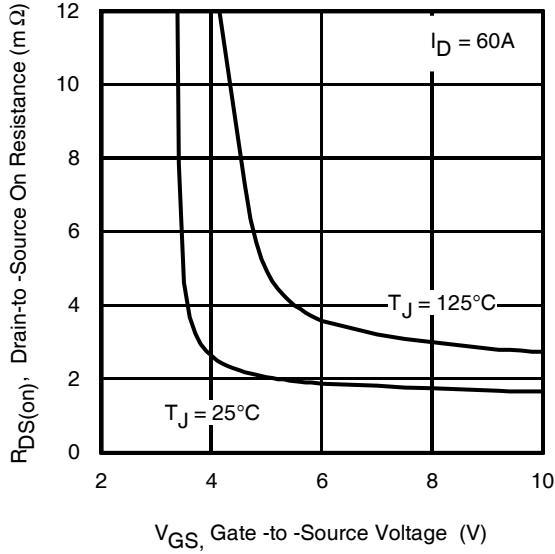
**Fig 10.** Threshold Voltage vs. Temperature



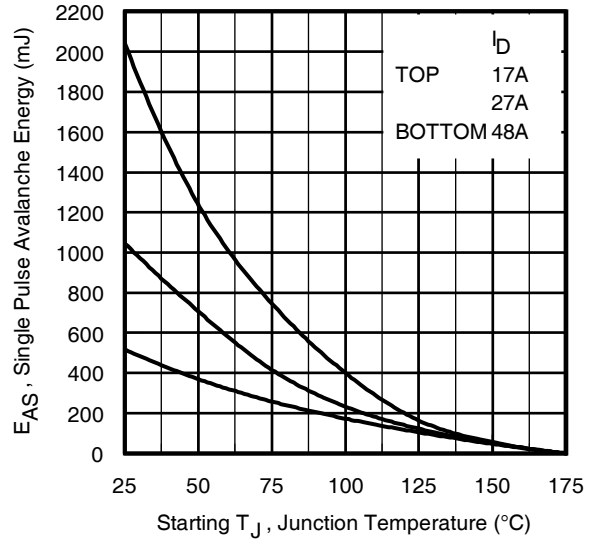
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

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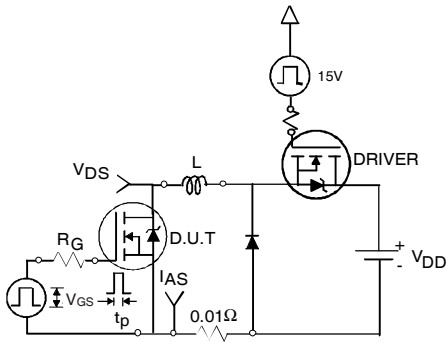
International  
**IR** Rectifier



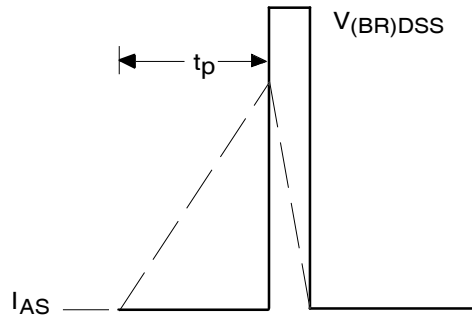
**Fig 12.** On-Resistance vs. Gate Voltage



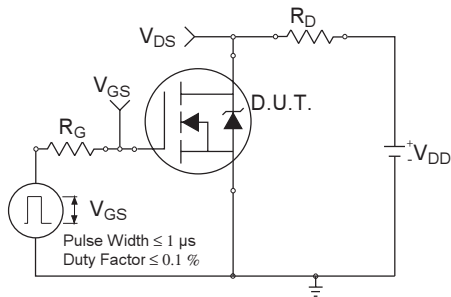
**Fig 13a.** Maximum Avalanche Energy vs. Drain Current



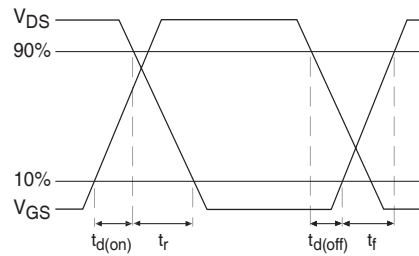
**Fig 13b.** Unclamped Inductive Test Circuit



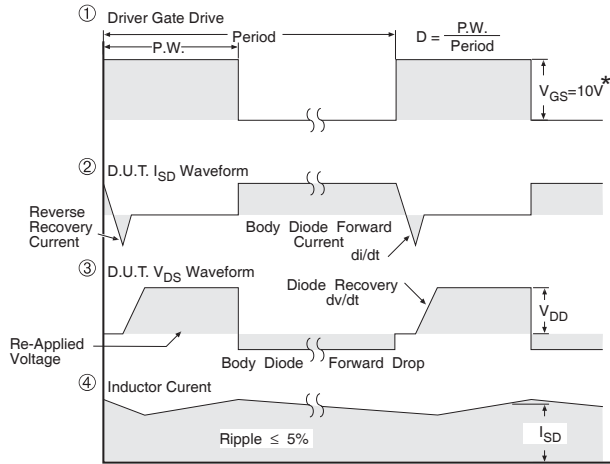
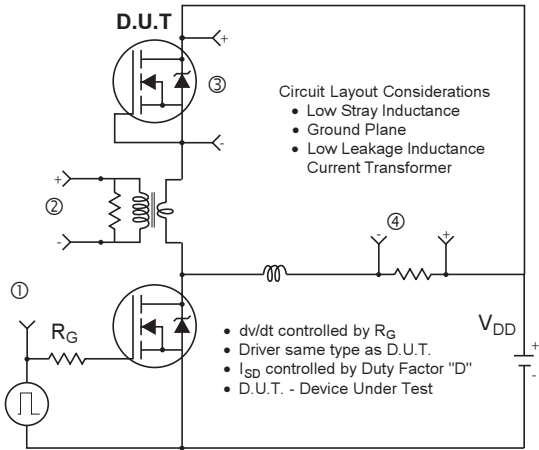
**Fig 13c.** Unclamped Inductive Waveforms



**Fig 14a.** Switching Time Test Circuit

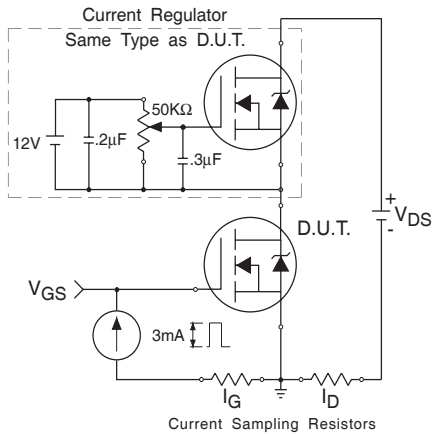


**Fig 14b.** Switching Time Waveforms

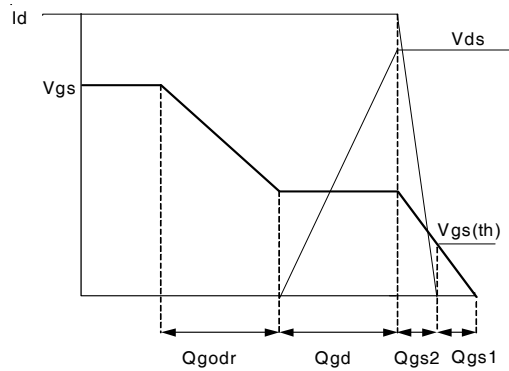


\*  $V_{GS} = 5V$  for Logic Level Devices

**Fig 15. Peak Diode Recovery  $dv/dt$  Test Circuit for N-Channel HEXFET<sup>®</sup> Power MOSFETs**



**Fig 16a. Gate Charge Test Circuit**

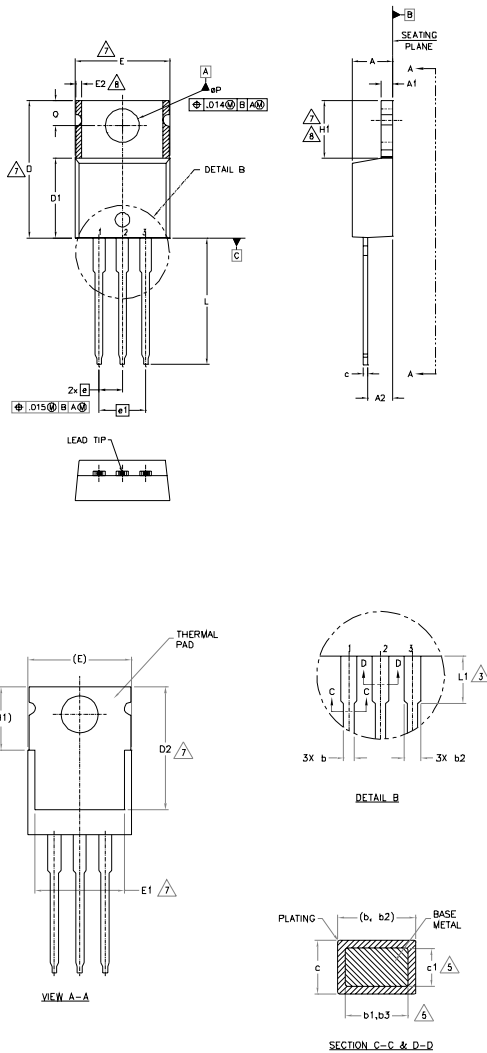


**Fig 16b. Gate Charge Waveform**

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International  
**IR** Rectifier

TO-220AB Package Outline (Dimensions are shown in millimeters (inches))



**NOTES:**

- 1.- DIMENSIONING AND TOLERANCING AS PER ASME Y14.5 M- 1994.
- 2.- DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS].
- 3.- LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
- 4.- DIMENSION D, D1 & 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.- DIMENSION b1, b3 & c1 APPLY TO BASE METAL ONLY.
- 6.- CONTROLLING DIMENSION : INCHES.
- 7.- THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS E,H1,D2 & E1
- 8.- DIMENSION E2 X H1 DEFINE A ZONE WHERE STAMPING AND SINGULATION IRREGULARITIES ARE ALLOWED.
- 9.- OUTLINE CONFORMS TO JEDEC TO-220, EXCEPT A2 (max.) AND D2 (min.) WHERE DIMENSIONS ARE DERIVED FROM THE ACTUAL PACKAGE OUTLINE.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	3.56	4.83	.140	.190	
A1	0.51	1.40	.020	.055	
A2	2.03	2.92	.080	.115	
b	0.38	1.01	.015	.040	
b1	0.38	0.97	.015	.038	5
b2	1.14	1.78	.045	.070	
b3	1.14	1.73	.045	.068	5
c	0.36	0.61	.014	.024	
c1	0.36	0.56	.014	.022	5
D	14.22	16.51	.560	.650	4
D1	8.38	9.02	.330	.356	
D2	11.68	12.88	.460	.507	7
E	9.65	10.67	.380	.420	4,7
E1	6.86	8.89	.270	.350	7
E2	-	0.76	-	.030	8
e	2.54 BSC		.100 BSC		
e1	5.08 BSC		.200 BSC		
H1	5.84	6.86	.230	.270	7,8
L	12.70	14.73	.500	.580	
L1	3.56	4.06	.140	.160	3
ØP	3.54	4.08	.139	.161	
Q	2.54	3.42	.100	.135	

**LEAD ASSIGNMENTS**

**HEFET**

- 1.- GATE
- 2.- DRAIN
- 3.- SOURCE

**IGBTs, CoPACK**

- 1.- GATE
- 2.- COLLECTOR
- 3.- EMITTER

**DIODES**

- 1.- ANODE
- 2.- CATHODE
- 3.- ANODE

TO-220AB packages are not recommended for Surface Mount Application.

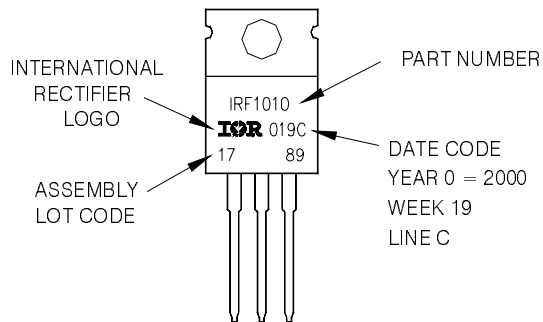
Note: For the most current drawing please refer to IR website at: <http://www.irf.com/package/>



## TO-220AB Part Marking Information

EXAMPLE: THIS IS AN IRF1010  
LOT CODE 1789  
ASSEMBLED ON WW 19, 2000  
IN THE ASSEMBLY LINE "C"

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



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

### Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.45\text{mH}$ ,  $R_G = 25\Omega$ ,  $I_{AS} = 48\text{A}$ .
- ③ Pulse width  $\leq 400\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- ④ When mounted on 1" square PCB (FR-4 or G-10 Material). For recommended footprint and soldering techniques refer to application note #AN-994.
- ⑤  $R_\theta$  is measured at  $T_J$  approximately  $90^\circ\text{C}$ .
- ⑥ Calculated continuous current based on maximum allowable junction temperature. Package limitation current is 120A.

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

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