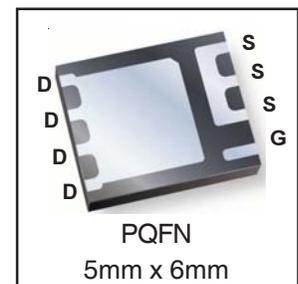
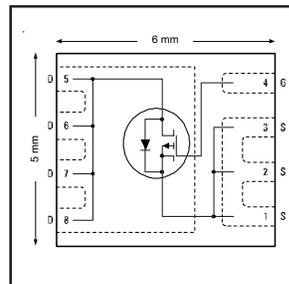


# IRFH9310PbF

HEXFET® Power MOSFET

$V_{DS}$	<b>-30</b>	<b>V</b>
$R_{DS(on) \text{ max}}$ (@ $V_{GS} = 10V$ )	<b>4.6</b>	<b>m<math>\Omega</math></b>
$Q_g$ (typical)	<b>110</b>	<b>nC</b>
$R_G$ (typical)	<b>2.8</b>	<b><math>\Omega</math></b>
$I_D$ (@ $T_A = 25^\circ C$ )	<b>-21</b>	<b>A</b>



## Applications

- Charge and Discharge Switch for Notebook PC Battery Application

## Features and Benefits

### Features

Low $R_{DS(on)}$ ( $\leq 4.6m\Omega$ )
Industry-Standard PQFN Package
RoHS Compliant Containing no Lead, no Bromide and no Halogen

results in  
⇒

### Resulting Benefits

Lower Conduction Losses
Multi-Vendor Compatibility
Environmentally Friendlier

Orderable part number	Package Type	Standard Pack		Note
		Form	Quantity	
IRFH9310TRPBF	PQFN 5mm x 6mm	Tape and Reel	4000	

## Absolute Maximum Ratings

	Parameter	Max.	Units
$V_{DS}$	Drain-to-Source Voltage	-30	V
$V_{GS}$	Gate-to-Source Voltage	$\pm 20$	
$I_D @ T_A = 25^\circ C$	Continuous Drain Current, $V_{GS} @ -10V$	-21	A
$I_D @ T_A = 70^\circ C$	Continuous Drain Current, $V_{GS} @ -10V$	-17	
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ -10V$ (Silicon Limited)	-107	
$I_D @ T_C = 70^\circ C$	Continuous Drain Current, $V_{GS} @ -10V$ (Silicon Limited)	-86	
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ -10V$ (Package Limited)	-40	
$I_{DM}$	Pulsed Drain Current ①	-170	
$P_D @ T_A = 25^\circ C$	Power Dissipation ④	3.1	W
$P_D @ T_A = 70^\circ C$	Power Dissipation ④	2.0	
	Linear Derating Factor	0.025	W/ $^\circ C$
$T_J$ $T_{STG}$	Operating Junction and Storage Temperature Range	-55 to +150	$^\circ C$

Notes ① through ④ are on page 2

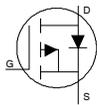
## Static @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	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	—	0.020	—	V/ $^\circ\text{C}$	Reference to $25^\circ\text{C}, I_D = -1\text{mA}$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	3.7	4.6	m $\Omega$	$V_{GS} = -10V, I_D = -21A$ ③
		—	5.7	7.1		$V_{GS} = -4.5V, I_D = -17A$ ③
$V_{GS(th)}$	Gate Threshold Voltage	-1.3	-1.9	-2.4	V	$V_{DS} = V_{GS}, I_D = -100\mu A$
$\Delta V_{GS(th)}$	Gate Threshold Voltage Coefficient	—	-5.8	—	mV/ $^\circ\text{C}$	
$I_{DSS}$	Drain-to-Source Leakage Current	—	—	-1.0	$\mu A$	$V_{DS} = -24V, V_{GS} = 0V$
		—	—	-150		$V_{DS} = -24V, V_{GS} = 0V, T_J = 125^\circ\text{C}$
$I_{GSS}$	Gate-to-Source Forward Leakage	—	—	-100	nA	$V_{GS} = -20V$
	Gate-to-Source Reverse Leakage	—	—	100		$V_{GS} = 20V$
$g_{fs}$	Forward Transconductance	39	—	—	S	$V_{DS} = -10V, I_D = -17A$
$Q_g$	Total Gate Charge ⑥	—	58	—	nC	$V_{DS} = -15V, V_{GS} = -4.5V, I_D = -17A$
$Q_g$	Total Gate Charge ⑥	—	110	165	nC	$V_{GS} = -10V$
$Q_{gs}$	Gate-to-Source Charge ⑥	—	17	—		$V_{DS} = -15V$
$Q_{gd}$	Gate-to-Drain Charge ⑥	—	28	—		$I_D = -17A$
$R_G$	Gate Resistance ⑥	—	2.8	—	$\Omega$	
$t_{d(on)}$	Turn-On Delay Time	—	25	—	ns	$V_{DD} = -15V, V_{GS} = -4.5V$ ③
$t_r$	Rise Time	—	47	—		$I_D = -1.0A$
$t_{d(off)}$	Turn-Off Delay Time	—	65	—		$R_G = 1.8\Omega$
$t_f$	Fall Time	—	70	—		See Figs. 19a & 19b
$C_{iss}$	Input Capacitance	—	5250	—	pF	$V_{GS} = 0V$
$C_{oss}$	Output Capacitance	—	1300	—		$V_{DS} = -15V$
$C_{rss}$	Reverse Transfer Capacitance	—	880	—		$f = 1.0\text{MHz}$

## Avalanche Characteristics

	Parameter	Typ.	Max.	Units
$E_{AS}$	Single Pulse Avalanche Energy ②	—	170	mJ
$I_{AR}$	Avalanche Current ①	—	-17	A

## Diode Characteristics

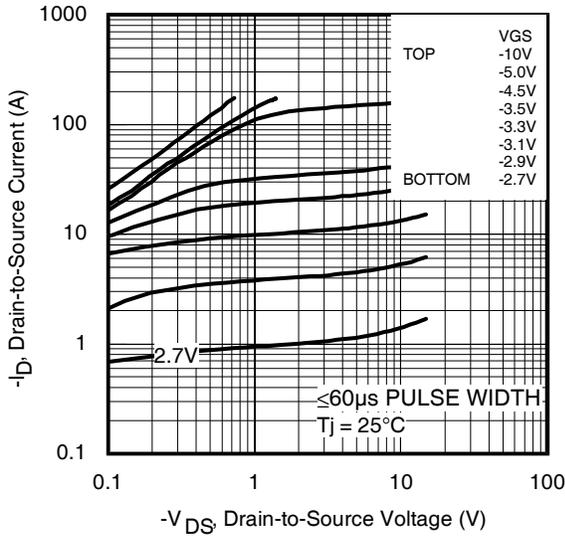
	Parameter	Min.	Typ.	Max.	Units	Conditions
$I_S$	Continuous Source Current (Body Diode)	—	—	-3.1	A	MOSFET symbol showing the integral reverse p-n junction diode. 
$I_{SM}$	Pulsed Source Current (Body Diode) ①	—	—	-170		
$V_{SD}$	Diode Forward Voltage	—	—	-1.2	V	$T_J = 25^\circ\text{C}, I_S = -3.1A, V_{GS} = 0V$ ③
$t_{rr}$	Reverse Recovery Time	—	42	63	ns	$T_J = 25^\circ\text{C}, I_F = -3.1A, V_{DD} = -24V$
$Q_{rr}$	Reverse Recovery Charge	—	42	63	nC	$di/dt = 100/\mu s$ ③

## Thermal Resistance

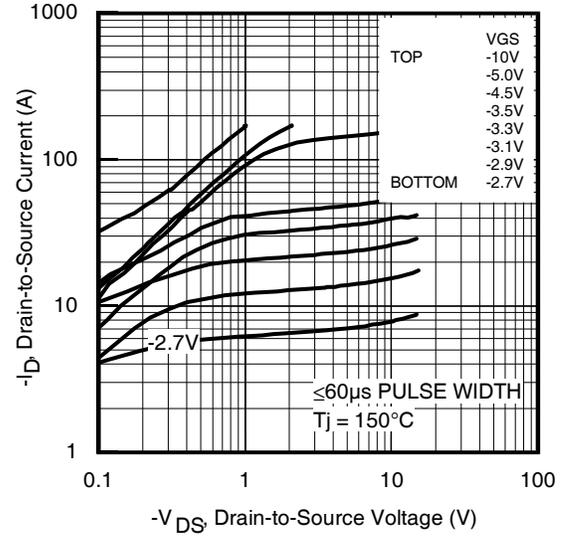
	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ⑤	—	1.6	$^\circ\text{C/W}$
$R_{\theta JA}$	Junction-to-Ambient ④	—	40	
$R_{\theta JA}$	Junction-to-Ambient ( $t < 10s$ ) ④	—	35	

### Notes:

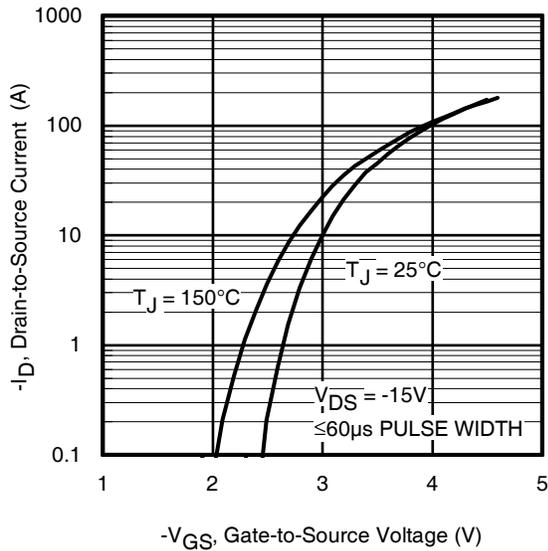
- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting  $T_J = 25^\circ\text{C}$ ,  $L = 1.1\text{mH}$ ,  $R_G = 50\Omega$ ,  $I_{AS} = -17A$ .
- ③ Pulse width  $\leq 400\mu s$ ; duty cycle  $\leq 2\%$ .
- ④ When mounted on 1 inch square copper board.
- ⑤  $R_{\theta}$  is measured at  $T_J$  of approximately  $90^\circ\text{C}$ .
- ⑥ For DESIGN AID ONLY, not subject to production testing.



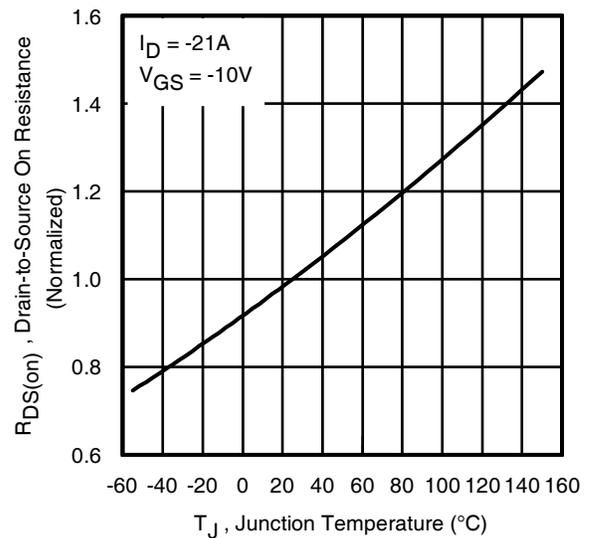
**Fig 1.** Typical Output Characteristics



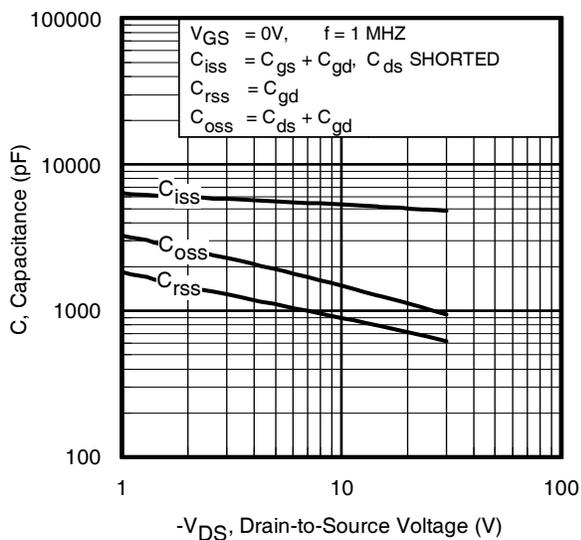
**Fig 2.** Typical Output Characteristics



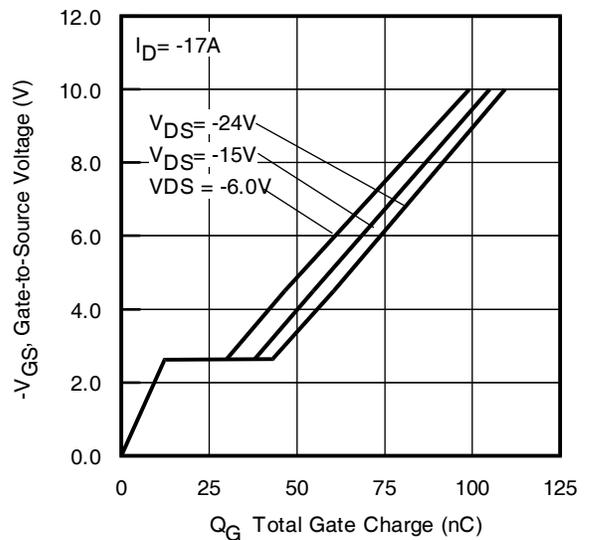
**Fig 3.** Typical Transfer Characteristics



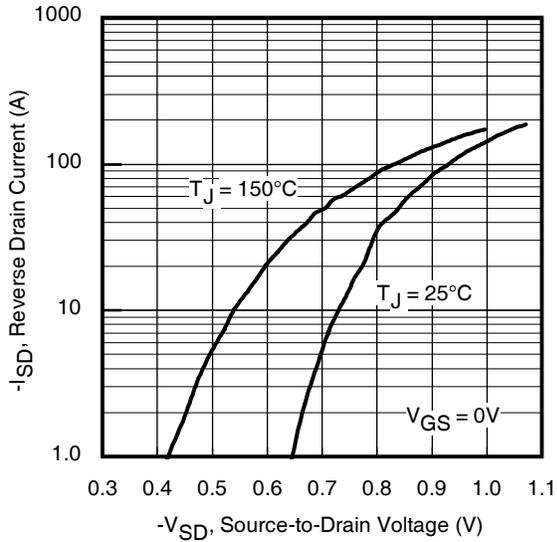
**Fig 4.** Normalized On-Resistance vs. Temperature



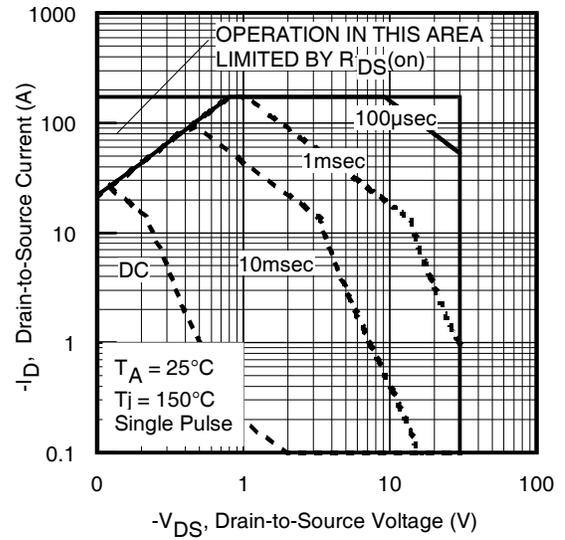
**Fig 5.** Typical Capacitance vs. Drain-to-Source Voltage  
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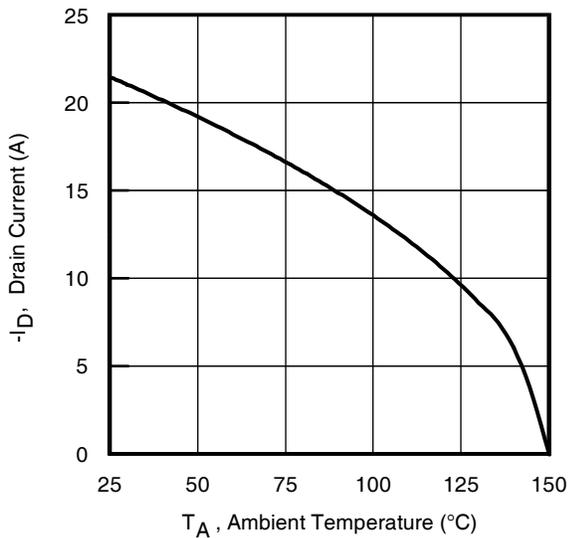
**Fig 6.** Typical Gate Charge vs. Gate-to-Source Voltage



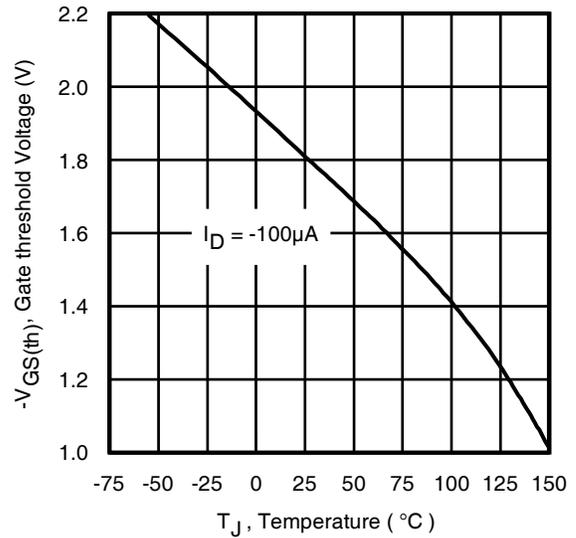
**Fig 7.** Typical Source-Drain Diode Forward Voltage



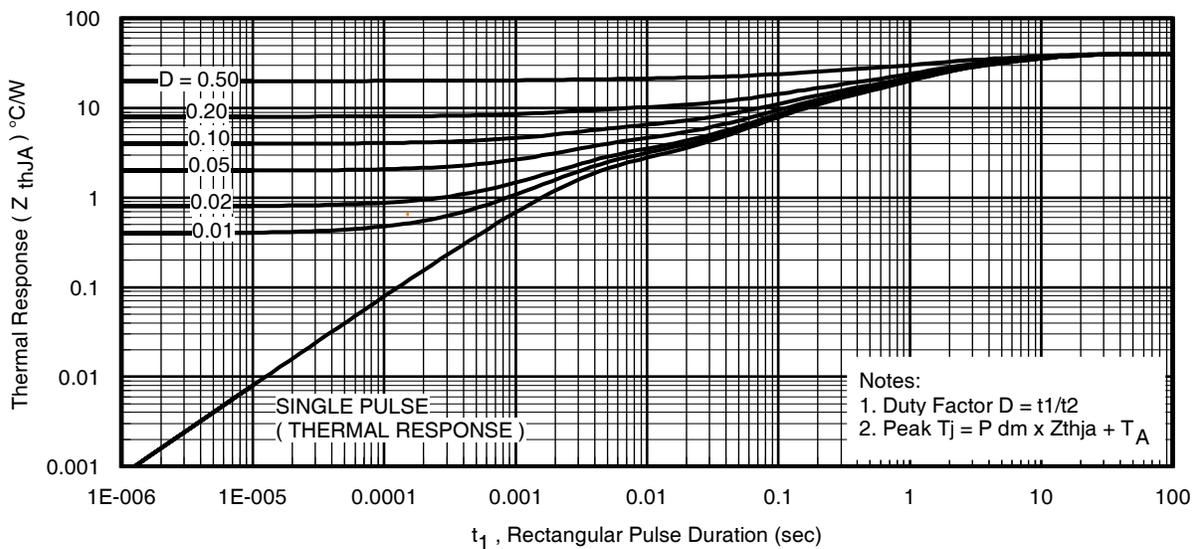
**Fig 8.** Maximum Safe Operating Area



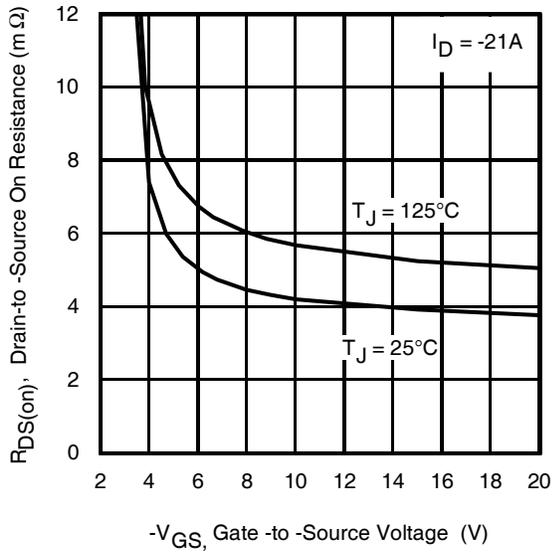
**Fig 9.** Maximum Drain Current vs. Ambient Temperature



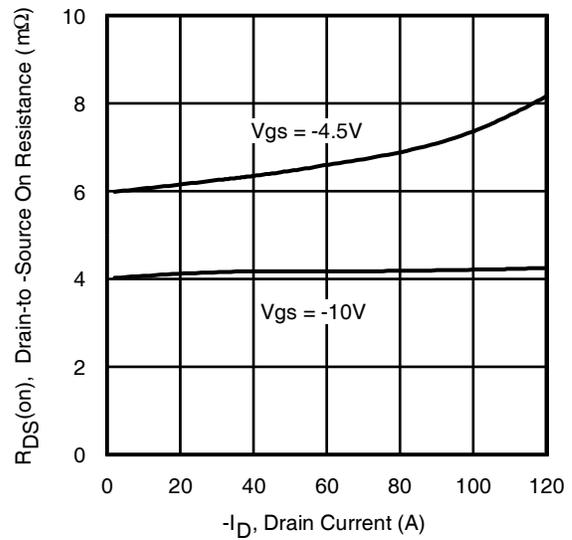
**Fig 10.** Threshold Voltage vs. Temperature



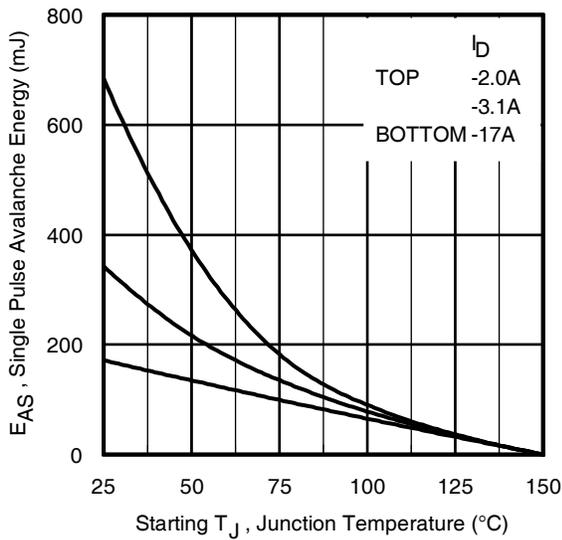
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Ambient



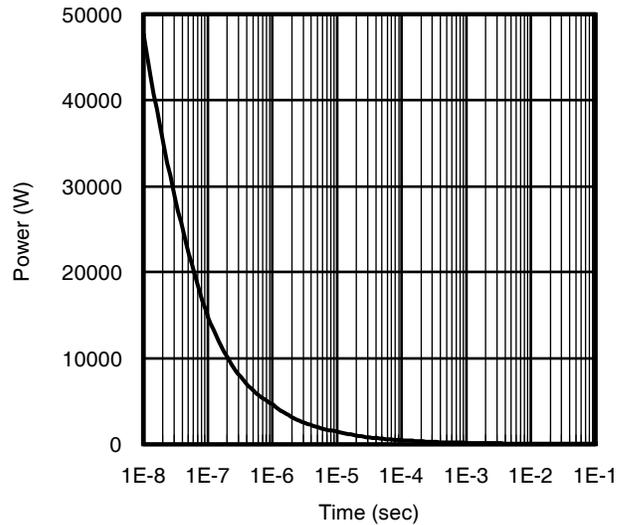
**Fig 12.** On-Resistance vs. Gate Voltage



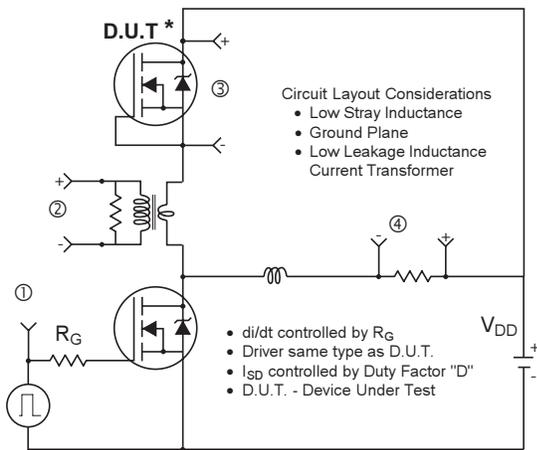
**Fig 13.** Typical On-Resistance vs. Drain Current



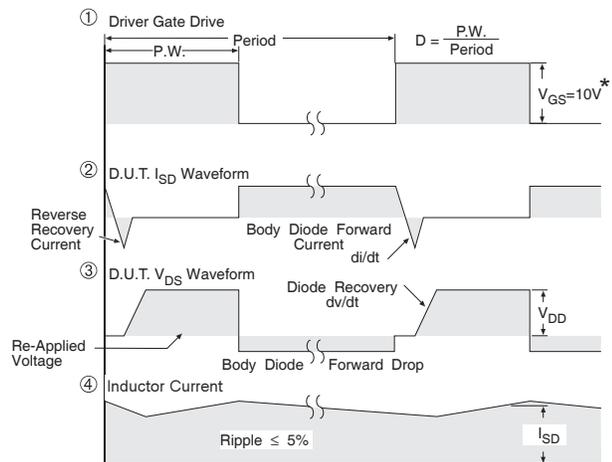
**Fig 14.** Maximum Avalanche Energy vs. Drain Current



**Fig 15.** Typical Power vs. Time

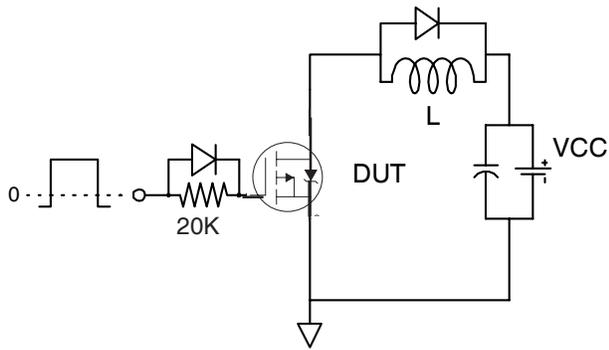


\* Reverse Polarity of D.U.T for P-Channel

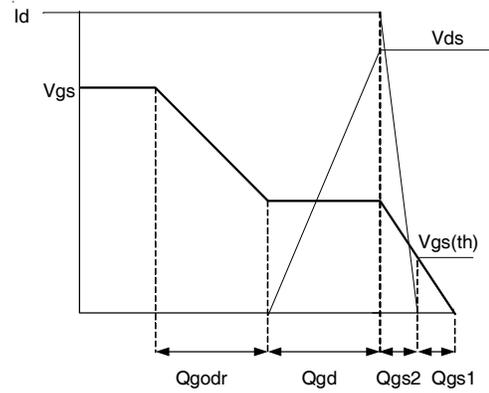


\*  $V_{GS} = 5V$  for Logic Level Devices

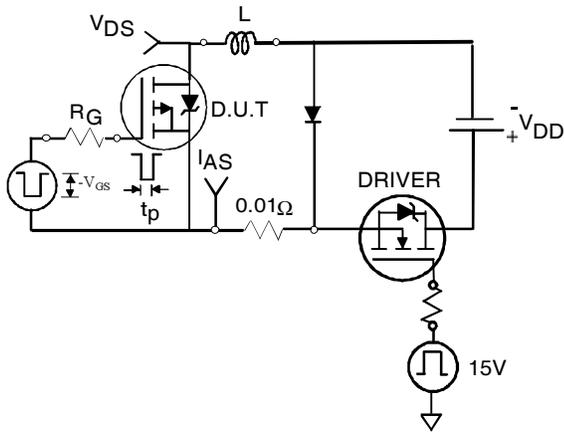
**Fig 16.** Diode Reverse Recovery Test Circuit for P-Channel HEXFET® Power MOSFETs



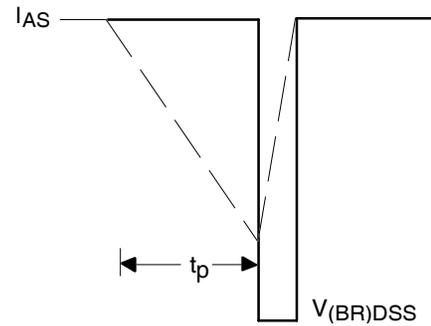
**Fig 17a.** Gate Charge Test Circuit



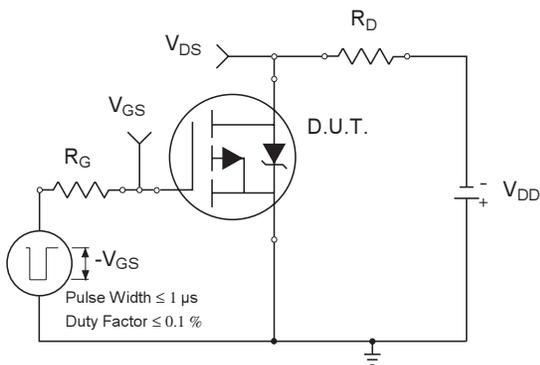
**Fig 17b.** Gate Charge Waveform



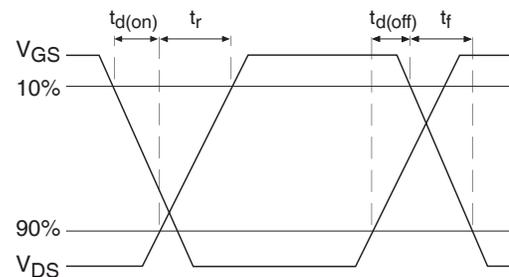
**Fig 18a.** Unclamped Inductive Test Circuit



**Fig 18b.** Unclamped Inductive Waveforms

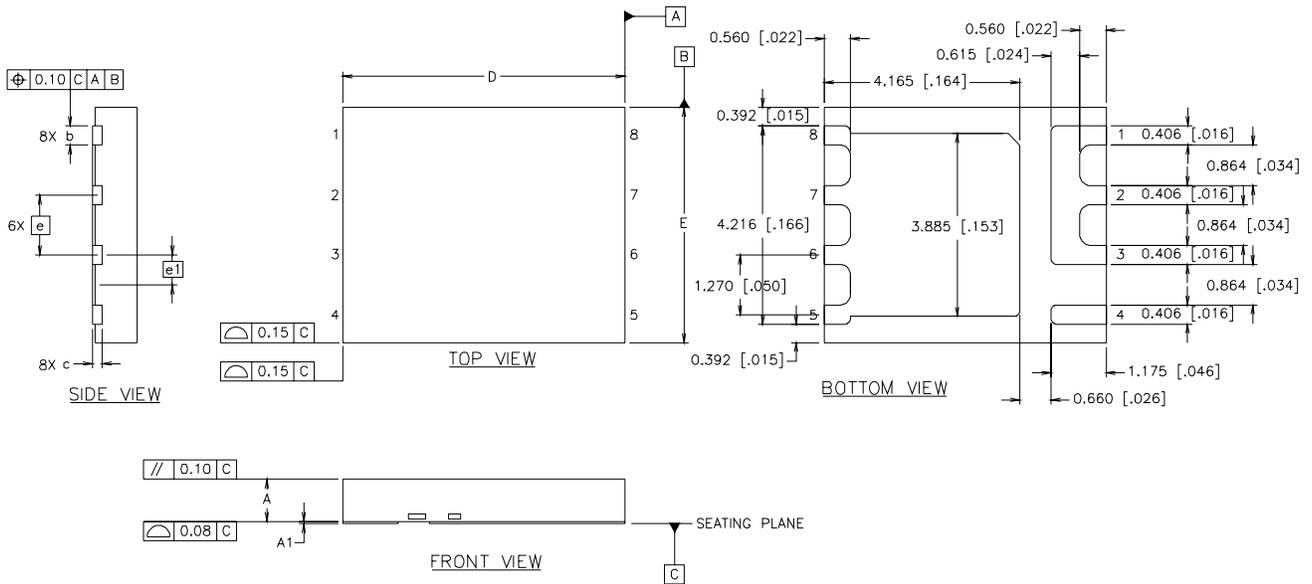


**Fig 19a.** Switching Time Test Circuit



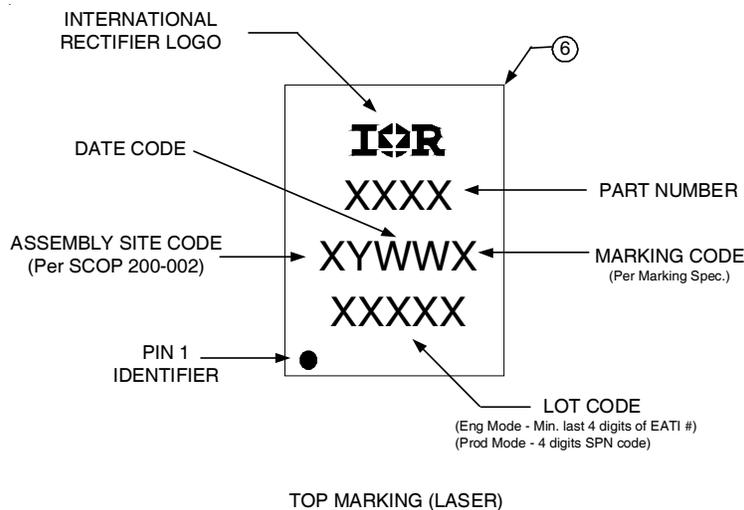
**Fig 19b.** Switching Time Waveforms

## PQFN Package Details



DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.0315	.0394	0.800	1.000
A1	.0000	.0020	0.000	0.050
b	.0140	.0180	0.356	0.456
c	.0080 REF.		0.203 REF.	
D	.2362 BASIC		6.0 BASIC	
E	.1969 BASIC		5.0 BASIC	
e	.0500 BASIC		1.270 BASIC	
e1	.0250 BASIC		0.635 BASIC	

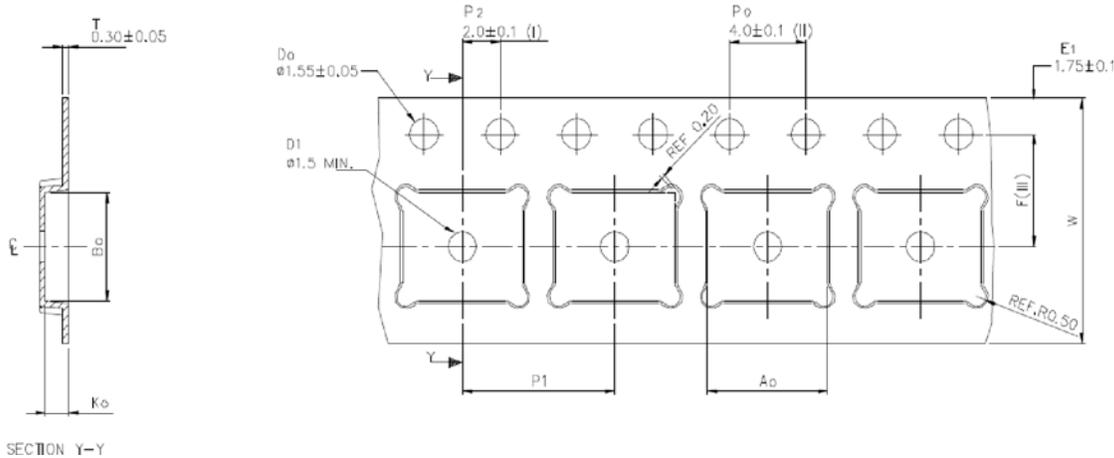
## PQFN Part Marking



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

# IRFH9310PbF

## PQFN Tape and Reel



A <sub>0</sub>	6.30 +/− 0.1
B <sub>0</sub>	5.30 +/− 0.1
K <sub>0</sub>	1.20 +/− 0.1
F	5.50 +/− 0.1
P <sub>1</sub>	8.00 +/− 0.1
W	12.00 +/− 0.3

- (I) Measured from centreline of sprocket hole to centreline of pocket.
- (II) Cumulative tolerance of 10 sprocket holes is ± 0.20 .
- (III) Measured from centreline of sprocket hole to centreline of pocket.
- (IV) Other material available.
- (V) Typical SR of form tape Max 10<sup>9</sup> OHM/SQ

ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED.

### Qualification Information<sup>†</sup>

Qualification level	Consumer <sup>††</sup>	
	(per JEDEC JESD47F <sup>†††</sup> guidelines)	
Moisture Sensitivity Level	PQFN 5mm x 6mm	MSL2 (per JEDEC J-STD-020D <sup>†††</sup> )
RoHS Compliant	Yes	

<sup>†</sup> Qualification standards can be found at International Rectifier's web site

<http://www.irf.com/product-info/reliability>

<sup>††</sup> Higher qualification ratings may be available should the user have such requirements.

Please contact your International Rectifier sales representative for further information:

<http://www.irf.com/whoto-call/salesrep/>

<sup>†††</sup> Applicable version of JEDEC standard at the time of product release.

<sup>††††</sup> Higher MSL ratings may be available for the specific package types listed here. Please contact your

International Rectifier sales representative for further information: <http://www.irf.com/whoto-call/salesrep/>

Data and specifications subject to change without notice.

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