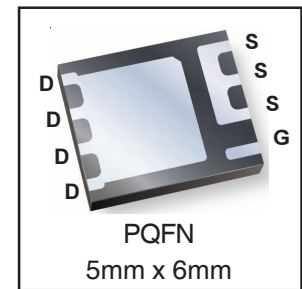
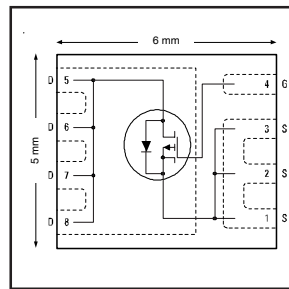


HEXFET® Power MOSFET

$V_{DS}$	<b>-30</b>	<b>V</b>
$R_{DS(on) \max}$ (@ $V_{GS} = 10V$ )	<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/ $^\circ C$
$T_J$	Operating Junction and	-55 to +150	$^\circ C$
$T_{STG}$	Storage Temperature Range		

Notes ① through ④ are on page 2


**Static @ T<sub>J</sub> = 25°C (unless otherwise specified)**

	Parameter	Min.	Typ.	Max.	Units	Conditions
BV <sub>DSS</sub>	Drain-to-Source Breakdown Voltage	-30	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = -250μA
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temp. Coefficient	—	0.020	—	V/°C	Reference to 25°C, I <sub>D</sub> = -1mA
R <sub>DS(on)</sub>	Static Drain-to-Source On-Resistance	—	3.7	4.6	mΩ	V <sub>GS</sub> = -10V, I <sub>D</sub> = -21A ③
		—	5.7	7.1		V <sub>GS</sub> = -4.5V, I <sub>D</sub> = -17A ③
V <sub>GS(th)</sub>	Gate Threshold Voltage	-1.3	-1.9	-2.4	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -100μA
ΔV <sub>GS(th)</sub>	Gate Threshold Voltage Coefficient	—	-5.8	—	mV/°C	
I <sub>DSS</sub>	Drain-to-Source Leakage Current	—	—	-1.0	μA	V <sub>DS</sub> = -24V, V <sub>GS</sub> = 0V
		—	—	-150		V <sub>DS</sub> = -24V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 125°C
I <sub>GSS</sub>	Gate-to-Source Forward Leakage	—	—	-100	nA	V <sub>GS</sub> = -20V
	Gate-to-Source Reverse Leakage	—	—	100		V <sub>GS</sub> = 20V
g <sub>fs</sub>	Forward Transconductance	39	—	—	S	V <sub>DS</sub> = -10V, I <sub>D</sub> = -17A
Q <sub>g</sub>	Total Gate Charge ⑥	—	58	—	nC	V <sub>DS</sub> = -15V, V <sub>GS</sub> = -4.5V, I <sub>D</sub> = -17A
Q <sub>g</sub>	Total Gate Charge ⑥	—	110	165	nC	V <sub>DS</sub> = -10V
Q <sub>gs</sub>	Gate-to-Source Charge ⑥	—	17	—		V <sub>DS</sub> = -15V
Q <sub>gd</sub>	Gate-to-Drain Charge ⑥	—	28	—		I <sub>D</sub> = -17A
R <sub>G</sub>	Gate Resistance ⑥	—	2.8	—	Ω	
t <sub>d(on)</sub>	Turn-On Delay Time	—	25	—	ns	V <sub>DD</sub> = -15V, V <sub>GS</sub> = -4.5V ③
t <sub>r</sub>	Rise Time	—	47	—		I <sub>D</sub> = -1.0A
t <sub>d(off)</sub>	Turn-Off Delay Time	—	65	—		R <sub>G</sub> = 1.8Ω
t <sub>f</sub>	Fall Time	—	70	—		See Figs. 19a & 19b
C <sub>iss</sub>	Input Capacitance	—	5250	—	pF	V <sub>GS</sub> = 0V
C <sub>oss</sub>	Output Capacitance	—	1300	—		V <sub>DS</sub> = -15V
C <sub>rss</sub>	Reverse Transfer Capacitance	—	880	—		f = 1.0MHz

**Avalanche Characteristics**

	Parameter	Typ.	Max.	Units
E <sub>AS</sub>	Single Pulse Avalanche Energy ②	—	170	mJ
I <sub>AR</sub>	Avalanche Current ①	—	-17	A

**Diode Characteristics**

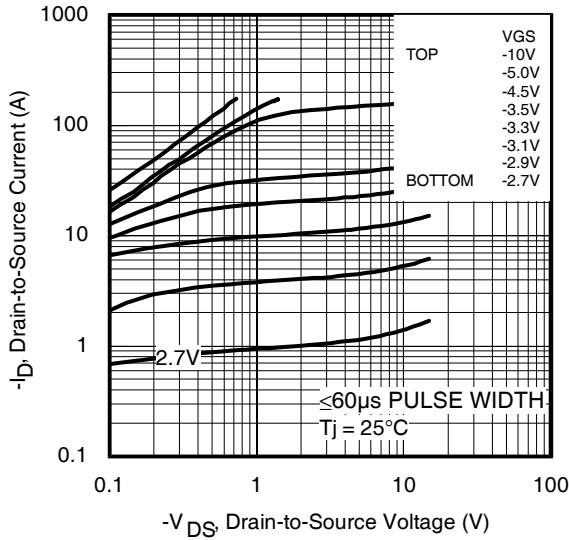
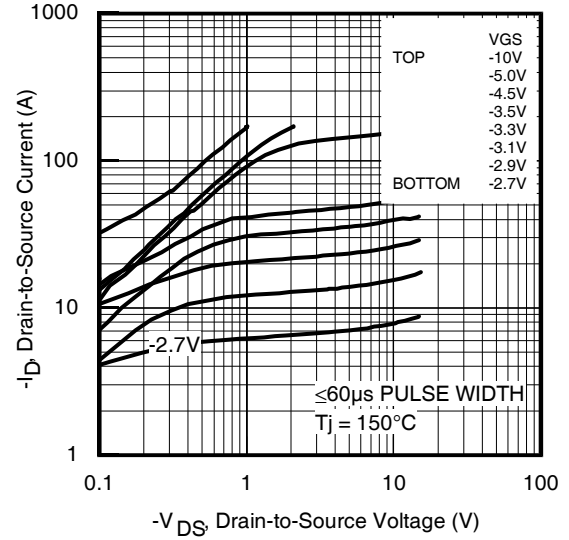
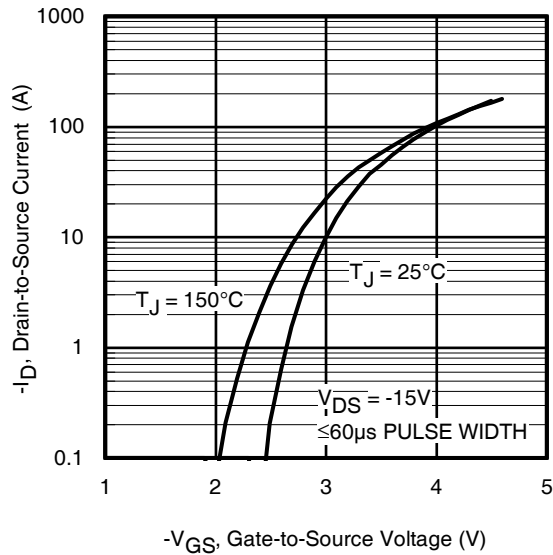
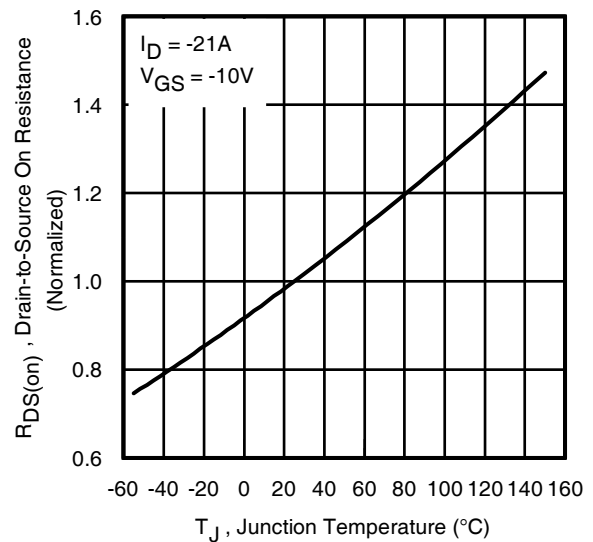
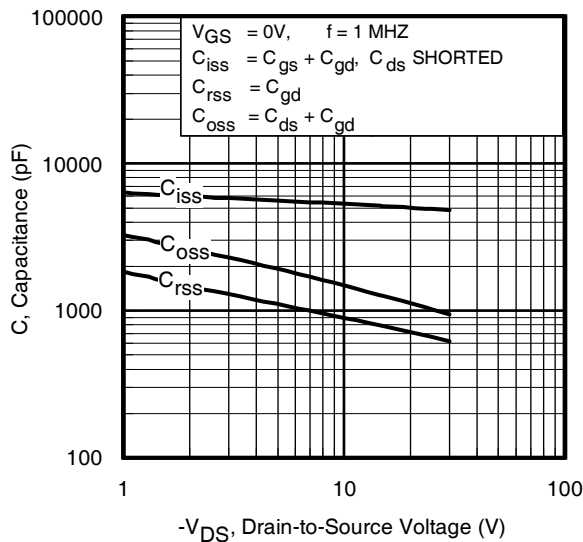
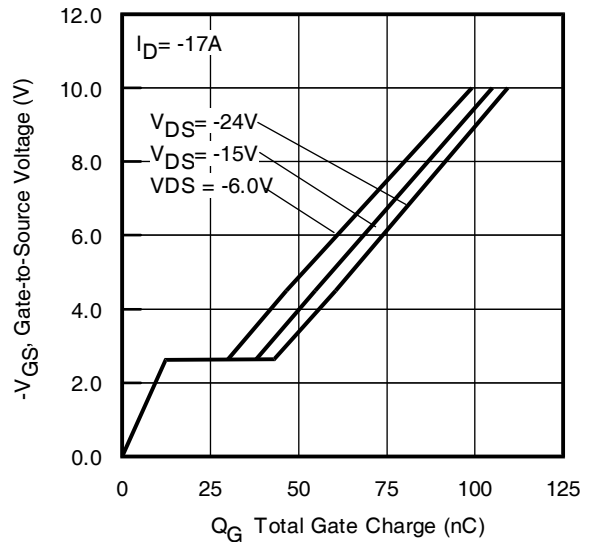
	Parameter	Min.	Typ.	Max.	Units	Conditions
I <sub>S</sub>	Continuous Source Current (Body Diode)	—	—	-3.1	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I <sub>SM</sub>	Pulsed Source Current (Body Diode) ①	—	—	-170		
V <sub>SD</sub>	Diode Forward Voltage	—	—	-1.2	V	T <sub>J</sub> = 25°C, I <sub>S</sub> = -3.1A, V <sub>GS</sub> = 0V ③
t <sub>rr</sub>	Reverse Recovery Time	—	42	63	ns	T <sub>J</sub> = 25°C, I <sub>F</sub> = -3.1A, V <sub>DD</sub> = -24V
Q <sub>rr</sub>	Reverse Recovery Charge	—	42	63	nC	di/dt = 100/μs ③

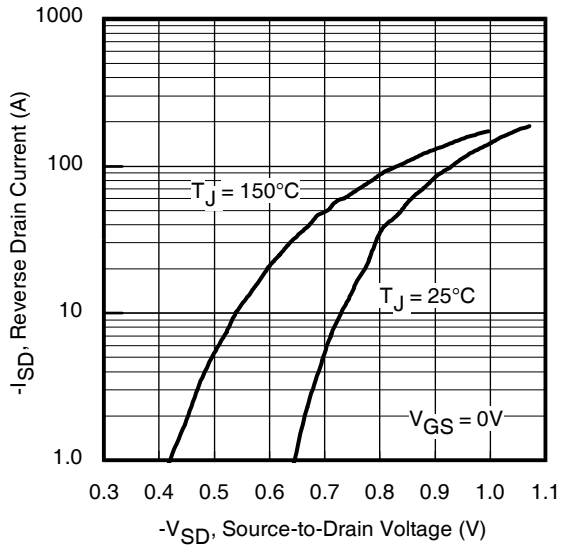
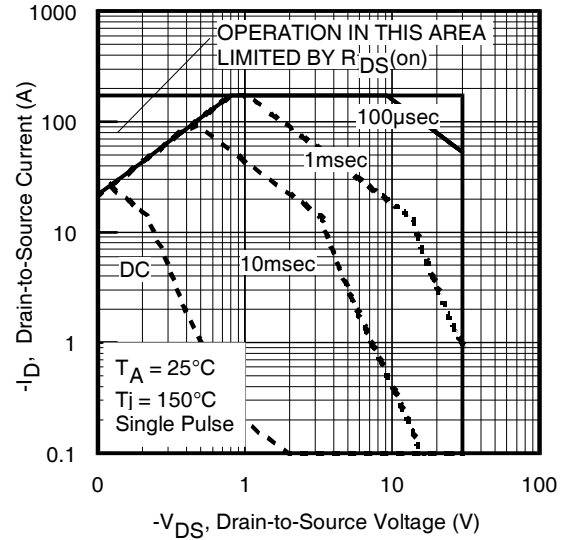
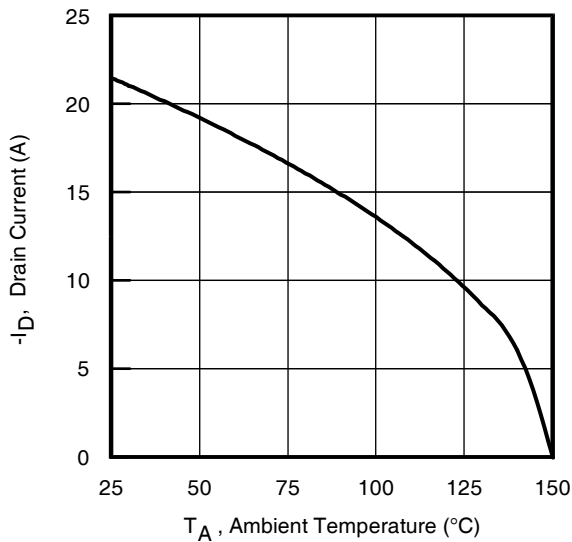
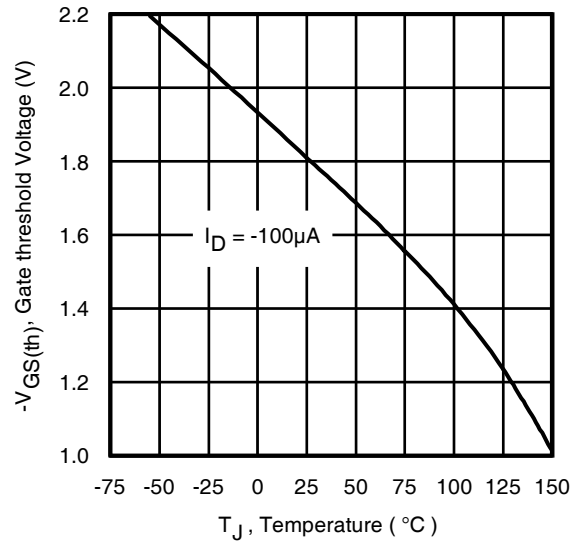
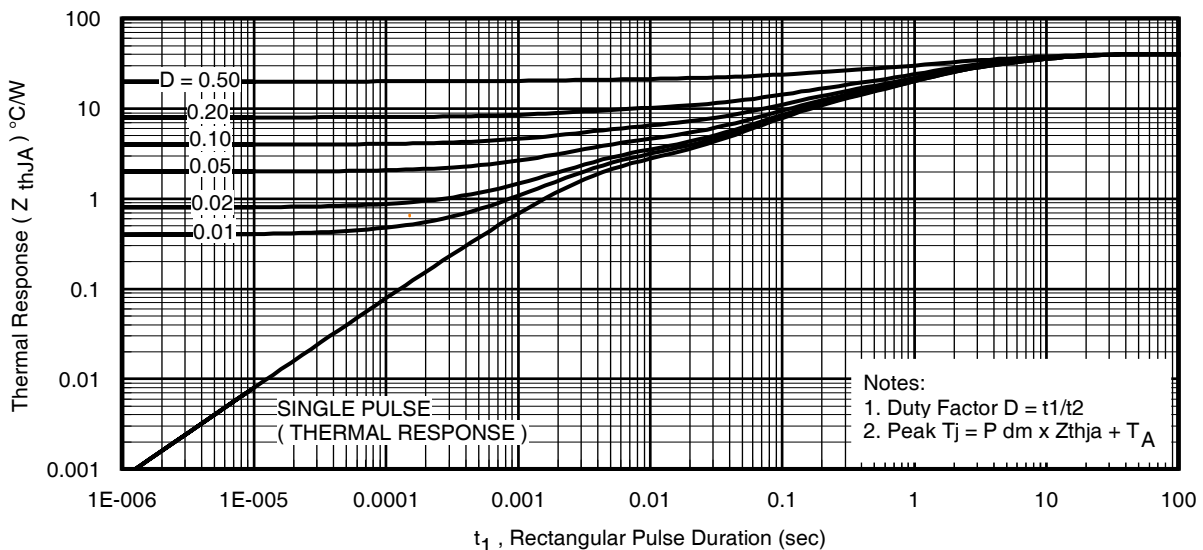
**Thermal Resistance**

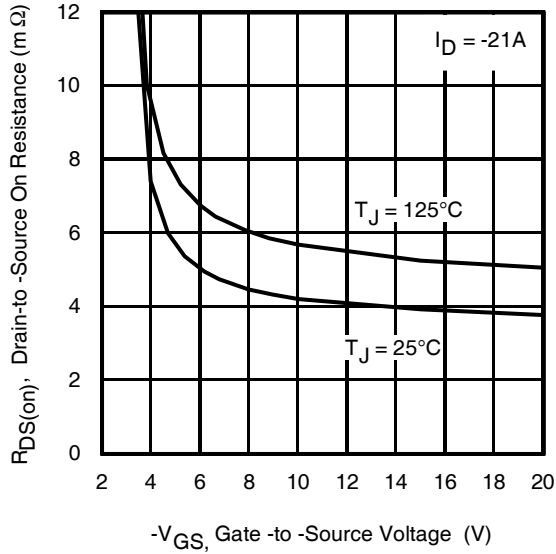
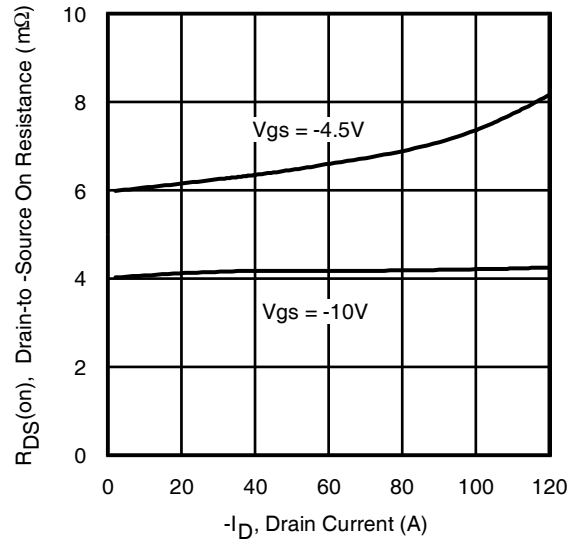
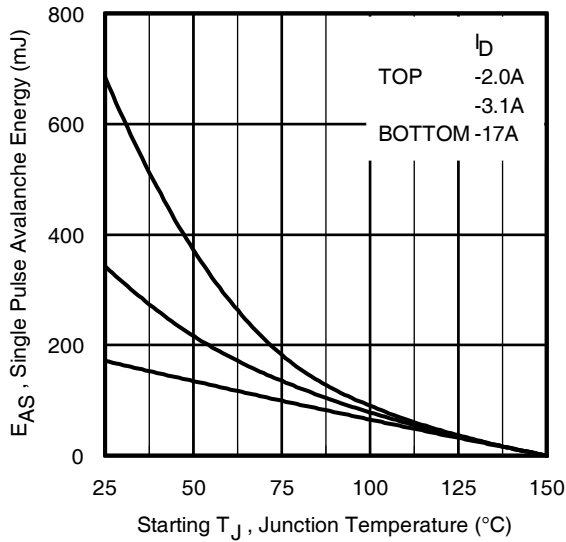
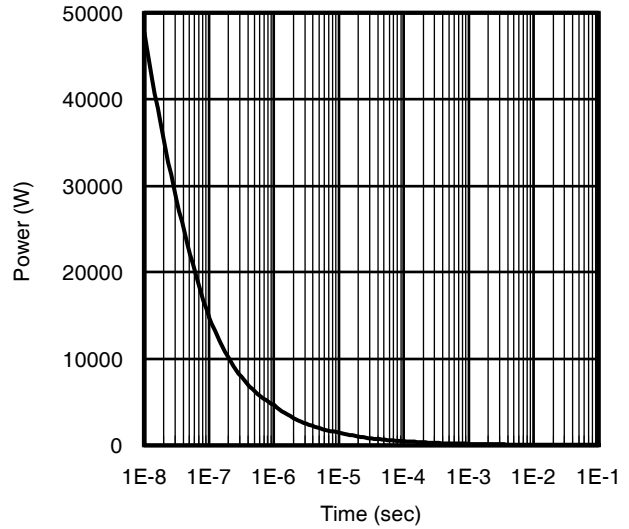
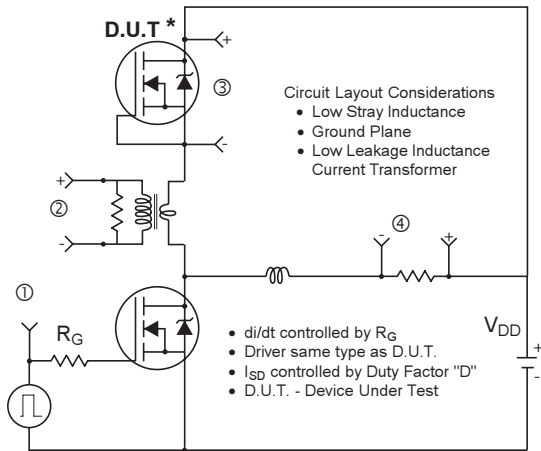
	Parameter	Typ.	Max.	Units
R <sub>θJC</sub>	Junction-to-Case ⑤	—	1.6	°C/W
R <sub>θJA</sub>	Junction-to-Ambient ④	—	40	
R <sub>θJA</sub>	Junction-to-Ambient (t < 10s) ④	—	35	

**Notes:**

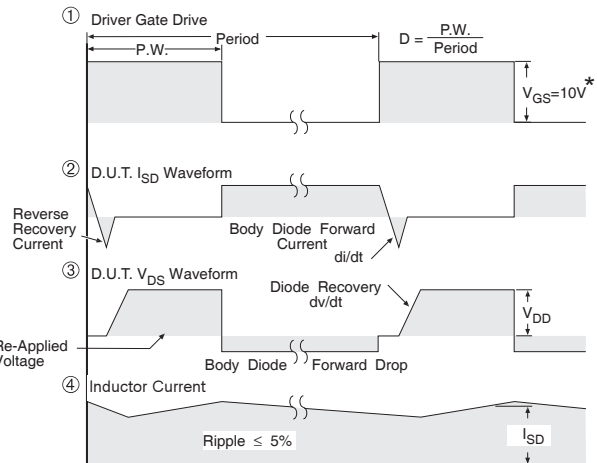
- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting T<sub>J</sub> = 25°C, L = 1.1mH, R<sub>G</sub> = 50Ω, I<sub>AS</sub> = -17A.
- ③ Pulse width ≤ 400μs; duty cycle ≤ 2%.
- ④ When mounted on 1 inch square copper board.
- ⑤ R<sub>θ</sub> is measured at T<sub>J</sub> of approximately 90°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

**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

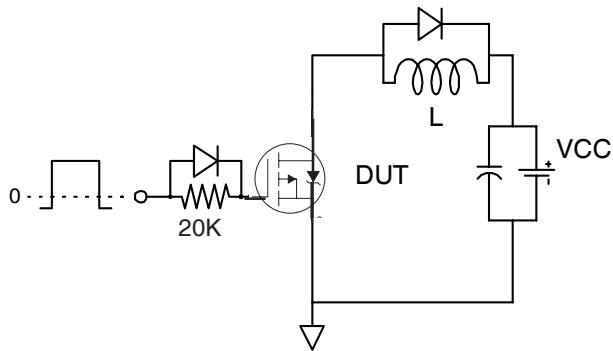

**Fig 12. On-Resistance vs. Gate Voltage**

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

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

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


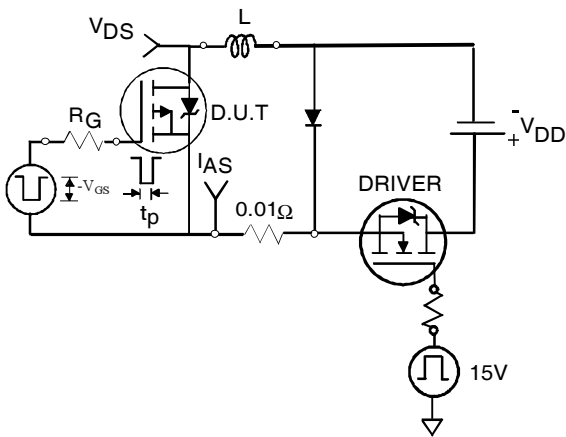
\* Reverse Polarity of D.U.T for P-Channel

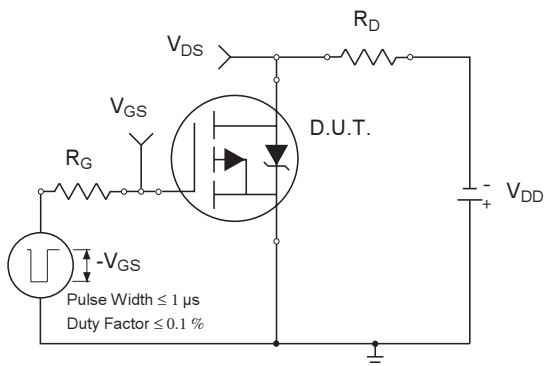
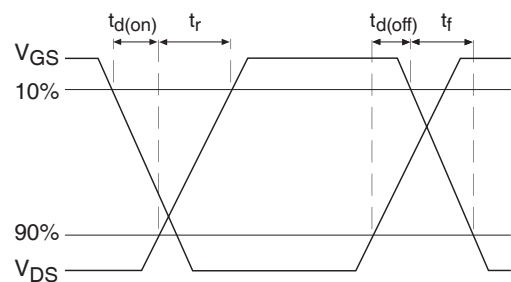


\*  $V_{GS} = 5V$  for Logic Level Devices

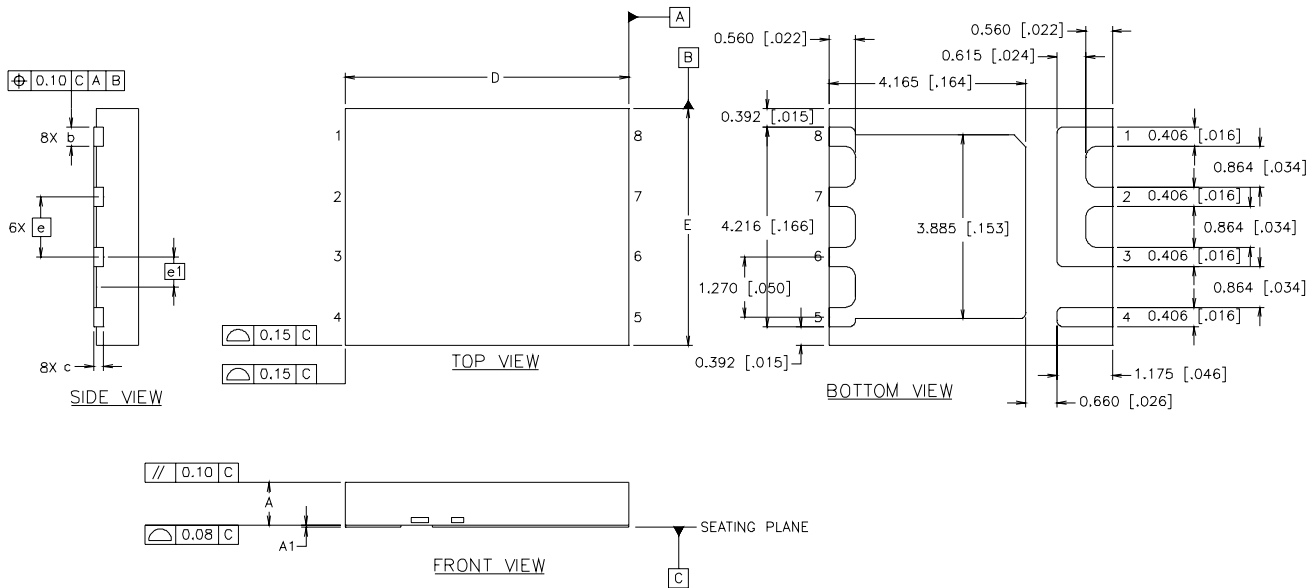
**Fig 16. Diode Reverse Recovery Test Circuit for P-Channel HEXFET<sup>®</sup> Power MOSFETs**


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

**Fig 17b. Gate Charge Waveform**

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

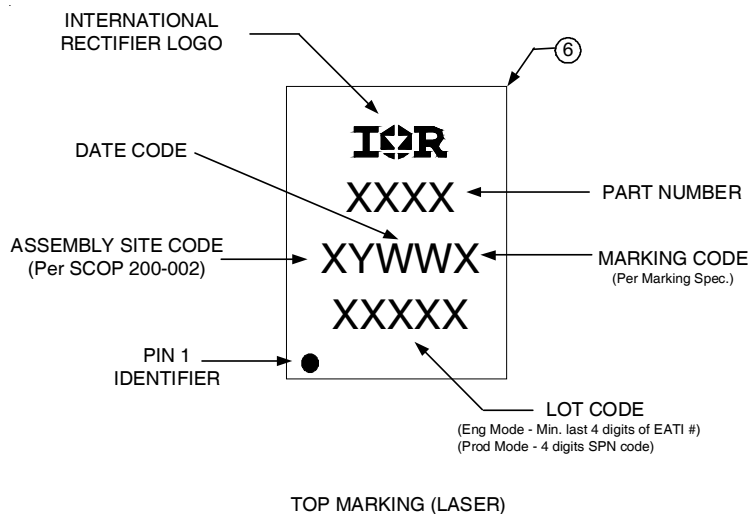
**Fig 18b. Unclamped Inductive Waveforms**

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

**Fig 19b. Switching Time Waveforms**

## PQFN Package Details



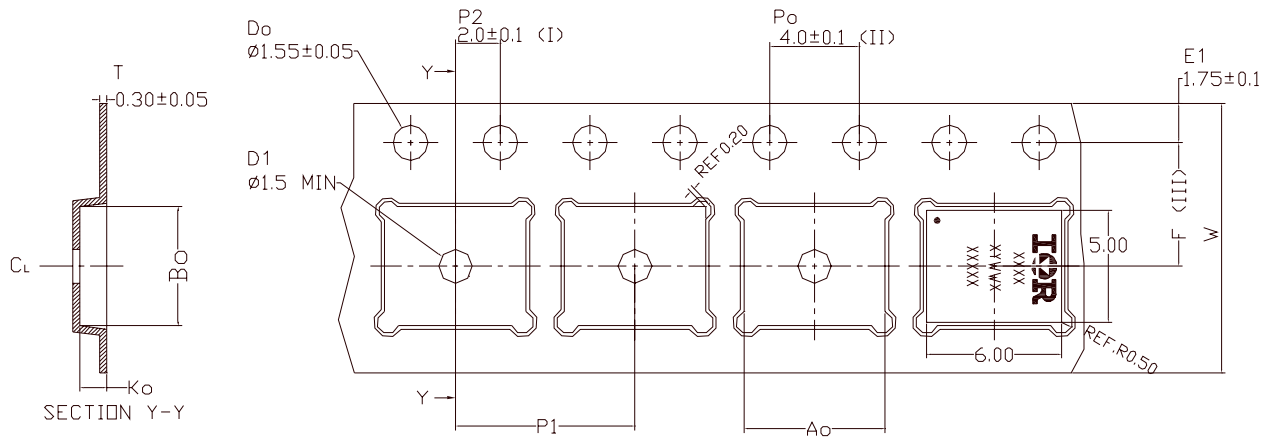
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.0315	.0394	0.800	1.000
A1	.0000	.0020	0.000	0.050
b	.0140	.0180	0.356	0.456
c	.0080 REF.		0.203 REF.	
D	.2362 BASIC		6.0 BASIC	
E	.1969 BASIC		5.0 BASIC	
e	.0500 BASIC		1.270 BASIC	
e1	.0250 BASIC		0.635 BASIC	

## PQFN Part Marking



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

## PQFN Tape and Reel



Ao	6.30 +/- 0.1
Bo	5.30 +/- 0.1
Ko	1.20 +/- 0.1
F	5.50 +/- 0.1
P1	8.00 +/- 0.1
W	12.00 +/- 0.3

(I) Measured from centerline of sprocket hole to centerline of pocket.

(II) Cumulative tolerance of 10 sprocket hole is  $\pm 0.20$ .

(III) Measured from centerline of sprocket hole to centerline of pocket.

(IV) Other material available.

(V) Typical SR of form tape Max  $10^9$  DHM/SQ.

ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE STATED.

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



**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	

† Qualification standards can be found at International Rectifier's web site

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

†† 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/>

††† Applicable version of JEDEC standard at the time of product release.

†††† 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/>

**Revision History**

Date	Comments
8/19/2014	<ul style="list-style-type: none"> <li>• Updated datasheet as per new IR Corporate Template</li> <li>• Updated data sheet with latest PQFN Tape and Reel Diagram.</li> </ul>