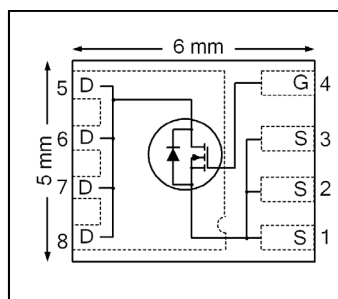


HEXFET® Power MOSFET

<b>V<sub>DSS</sub></b>	<b>25</b>	<b>V</b>
<b>R<sub>DS(on)</sub> max</b> (@ V <sub>GS</sub> = 10V)	<b>1.10</b>	<b>mΩ</b>
(@ V <sub>GS</sub> = 4.5V)	<b>1.35</b>	
<b>Qg</b> (typical)	<b>36</b>	<b>nC</b>
<b>I<sub>D</sub></b> (@T <sub>C (Bottom)</sub> = 25°C)	<b>245</b> Ⓢ	<b>A</b>



PQFN 5X6 mm

**Applications**

- Synchronous Rectifier MOSFET for Synchronous Buck Converters
- Secondary Synchronous Rectifier MOSFET for isolated DC-DC converters
- Active ORing and Hot Swap
- Battery Operated DC Motor Inverters

**Features**

Low R <sub>DS(on)</sub> (<1.10mΩ)
Low Thermal Resistance to PCB (<1.2°C/W)
Low Profile (<0.9 mm)
Industry-Standard Pinout
Compatible with Existing Surface Mount Techniques
RoHS Compliant, Halogen-Free
MSL1, Industrial Qualification

results in  
 ⇒

**Benefits**

Lower Conduction Losses
Enable better thermal dissipation
Increased Power Density
Multi-Vendor Compatibility
Easier Manufacturing
Environmentally Friendlier
Increased Reliability

Base part number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
IRFH4210PbF	PQFN 5mm x 6 mm	Tape and Reel	4000	IRFH4210TRPbF

**Absolute Maximum Ratings**

	Parameter	Max.	Units
V <sub>GS</sub>	Gate-to-Source Voltage	± 20	V
I <sub>D</sub> @ T <sub>A</sub> = 25°C	Continuous Drain Current, V <sub>GS</sub> @ 10V	45	A
I <sub>D</sub> @ T <sub>C(Bottom)</sub> = 25°C	Continuous Drain Current, V <sub>GS</sub> @ 10V	245Ⓢ	
I <sub>D</sub> @ T <sub>C(Bottom)</sub> = 100°C	Continuous Drain Current, V <sub>GS</sub> @ 10V	155Ⓢ	
I <sub>DM</sub>	Pulsed Drain Current ①	400	
P <sub>D</sub> @ T <sub>A</sub> = 25°C	Power Dissipation ⑤	3.6	W
P <sub>D</sub> @ T <sub>C(Bottom)</sub> = 25°C	Power Dissipation ⑤	104	
	Linear Derating Factor ⑤	0.029	W/°C
T <sub>J</sub> T <sub>STG</sub>	Operating Junction and Storage Temperature Range	-55 to + 150	°C

Notes ① through ⑤ are on page 8

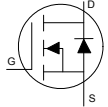
**Static @ T<sub>J</sub> = 25°C (unless otherwise specified)**

	Parameter	Min.	Typ.	Max.	Units	Conditions	
BV <sub>DSS</sub>	Drain-to-Source Breakdown Voltage	25	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA	
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temp. Coefficient	—	21	—	mV/°C	Reference to 25°C, I <sub>D</sub> = 1mA	
R <sub>DS(on)</sub>	Static Drain-to-Source On-Resistance	—	0.85	1.10	mΩ	V <sub>GS</sub> = 10V, I <sub>D</sub> = 50A ③	
		—	1.10	1.35		V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 50A ③	
V <sub>GS(th)</sub>	Gate Threshold Voltage	1.1	1.6	2.1	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 100μA	
ΔV <sub>GS(th)</sub>	Gate Threshold Voltage Coefficient	—	-6.0	—	mV/°C		
I <sub>DSS</sub>	Drain-to-Source Leakage Current	—	—	1.0	μA	V <sub>DS</sub> = 20V, V <sub>GS</sub> = 0V	
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	251	—	—	S	V <sub>DS</sub> = 10V, I <sub>D</sub> = 50A	
Q <sub>g</sub>	Total Gate Charge	—	74	—	nC	V <sub>GS</sub> = 10V, V <sub>DS</sub> = 13V, I <sub>D</sub> = 50A	
Q <sub>g</sub>	Total Gate Charge	—	36	54	nC	V <sub>DS</sub> = 13V V <sub>GS</sub> = 4.5V I <sub>D</sub> = 50A	
	Q <sub>gs1</sub>	Pre-V <sub>th</sub> Gate-to-Source Charge	—	9.4			—
	Q <sub>gs2</sub>	Post-V <sub>th</sub> Gate-to-Source Charge	—	4.6			—
	Q <sub>gd</sub>	Gate-to-Drain Charge	—	13			—
	Q <sub>godr</sub>	Gate Charge Overdrive	—	9.0			—
Q <sub>sw</sub>	Switch Charge (Q <sub>gs2</sub> + Q <sub>gd</sub> )	—	17.6	—			
Q <sub>oss</sub>	Output Charge	—	34	—	nC	V <sub>DS</sub> = 16V, V <sub>GS</sub> = 0V	
R <sub>G</sub>	Gate Resistance	—	1.2	—	Ω		
t <sub>d(on)</sub>	Turn-On Delay Time	—	20	—	ns	V <sub>DD</sub> = 13V, V <sub>GS</sub> = 4.5V I <sub>D</sub> = 50A R <sub>G</sub> = 1.8Ω	
t <sub>r</sub>	Rise Time	—	44	—			
t <sub>d(off)</sub>	Turn-Off Delay Time	—	24	—			
t <sub>f</sub>	Fall Time	—	15	—			
C <sub>iss</sub>	Input Capacitance	—	4760	—	pF	V <sub>GS</sub> = 0V V <sub>DS</sub> = 13V f = 1.0MHz	
C <sub>oss</sub>	Output Capacitance	—	1310	—			
C <sub>rss</sub>	Reverse Transfer Capacitance	—	370	—			

**Avalanche Characteristics**

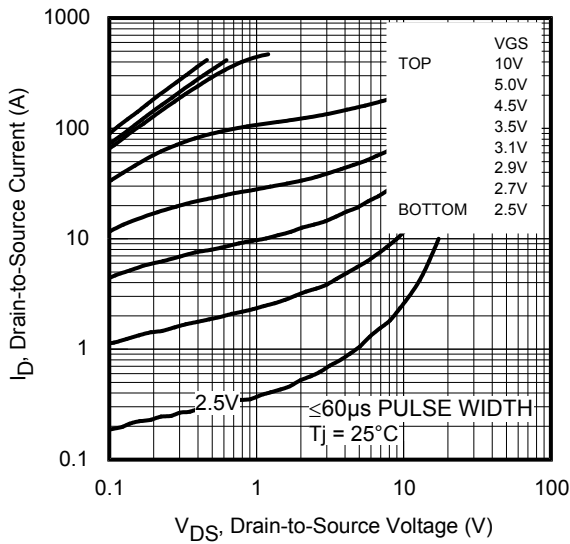
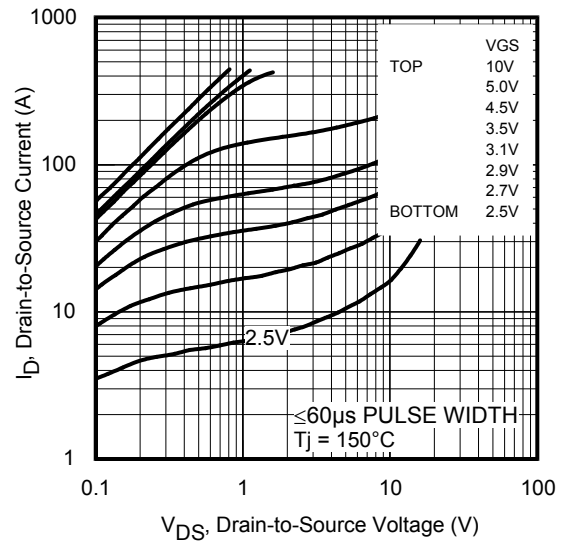
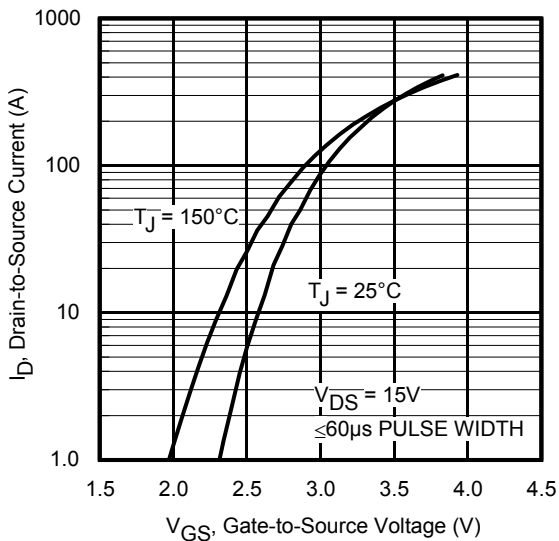
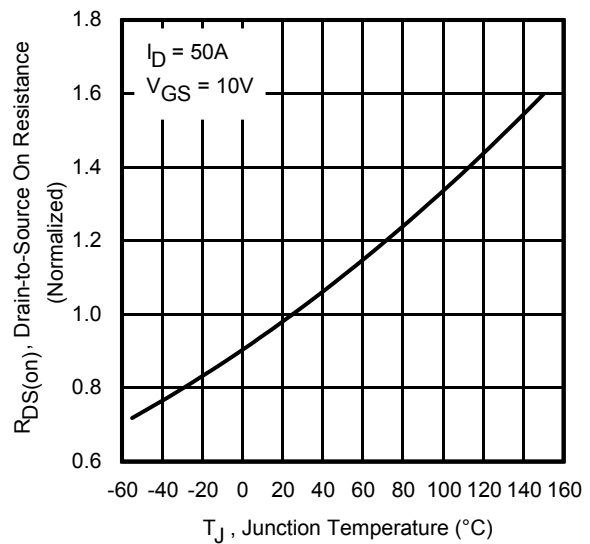
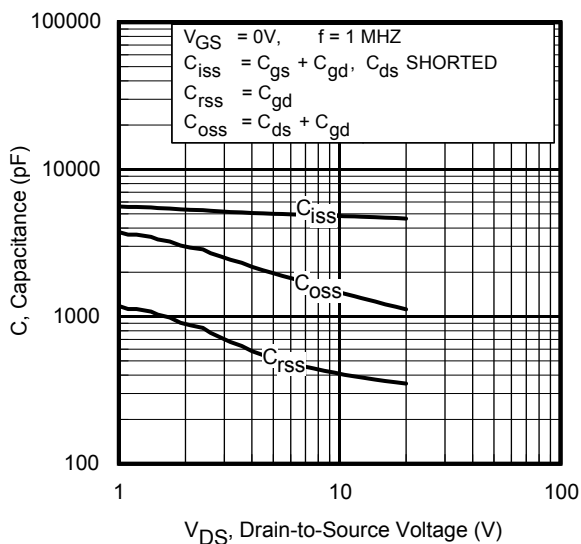
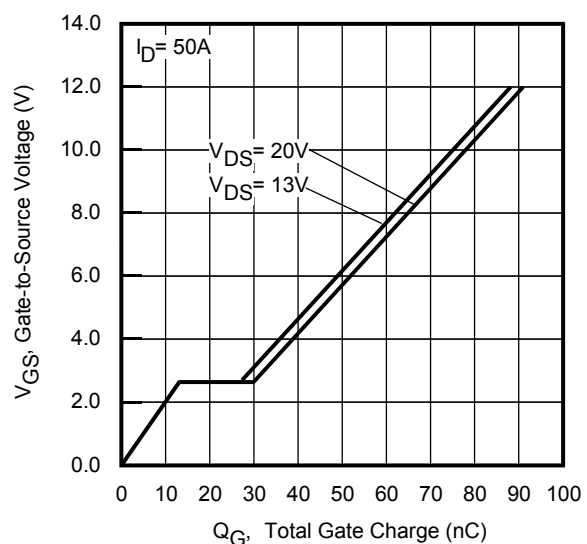
	Parameter	Typ.	Max.
E <sub>AS</sub>	Single Pulse Avalanche Energy ②	—	195
I <sub>AR</sub>	Avalanche Current ①	—	50

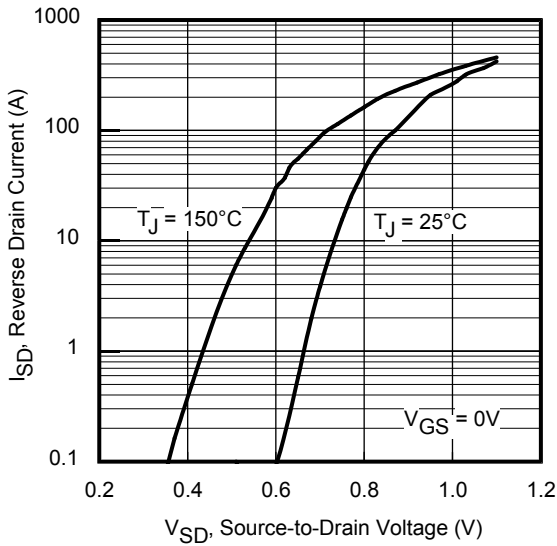
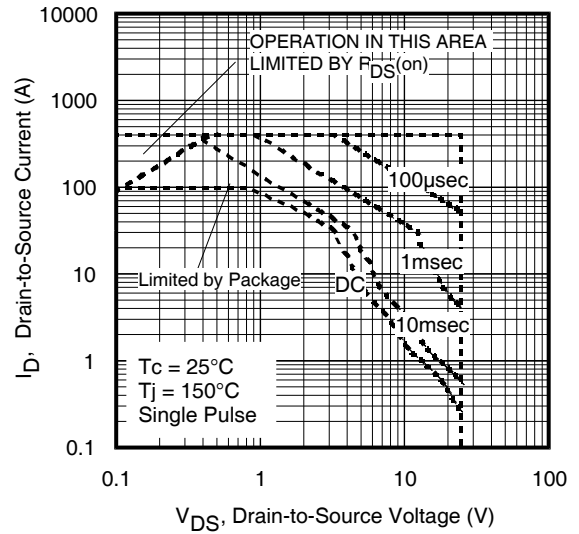
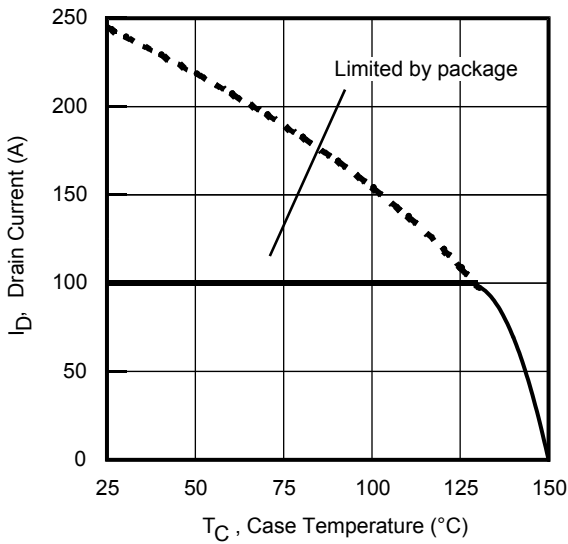
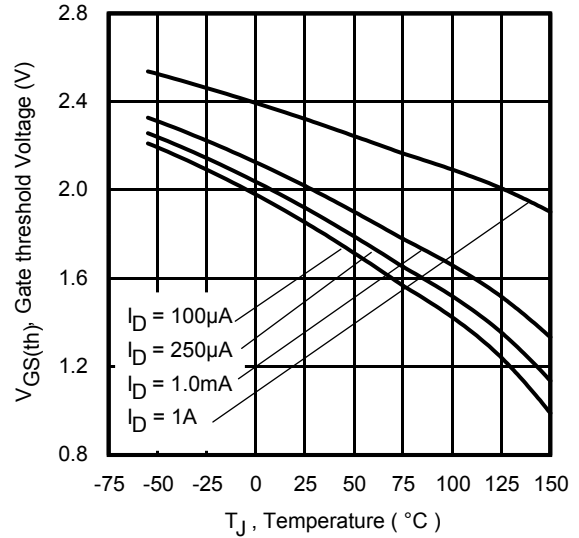
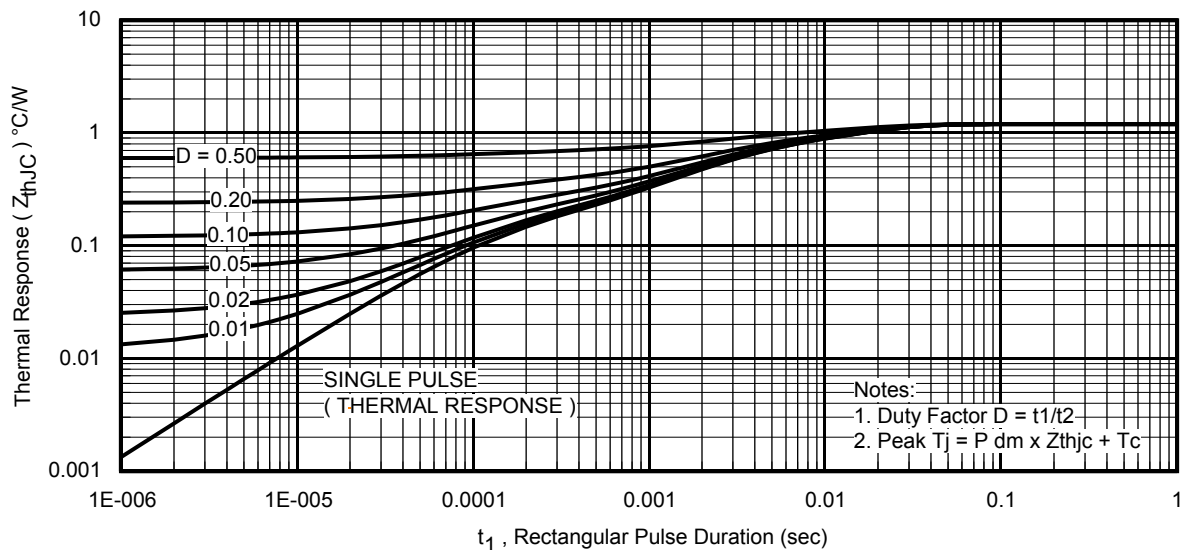
**Diode Characteristics**

	Parameter	Min.	Typ.	Max.	Units	Conditions
I <sub>S</sub>	Continuous Source Current (Body Diode)	—	—	245⑥	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I <sub>SM</sub>	Pulsed Source Current (Body Diode) ①	—	—	400		
V <sub>SD</sub>	Diode Forward Voltage	—	—	1.0	V	T <sub>J</sub> = 25°C, I <sub>S</sub> = 50A, V <sub>GS</sub> = 0V ③
t <sub>rr</sub>	Reverse Recovery Time	—	26	39	ns	T <sub>J</sub> = 25°C, I <sub>F</sub> = 50A, V <sub>DD</sub> = 13V
Q <sub>rr</sub>	Reverse Recovery Charge	—	51	77	nC	di/dt = 300A/μs ③

**Thermal Resistance**

	Parameter	Typ.	Max.	Units
R <sub>θJC</sub> (Bottom)	Junction-to-Case ④	—	1.2	°C/W
R <sub>θJC</sub> (Top)	Junction-to-Case ④	—	21	
R <sub>θJA</sub>	Junction-to-Ambient ⑤	—	35	
R <sub>θJA</sub> (<10s)	Junction-to-Ambient ⑤	—	21	


**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. Case Temperature**

**Fig 10. Threshold Voltage Vs. Temperature**

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

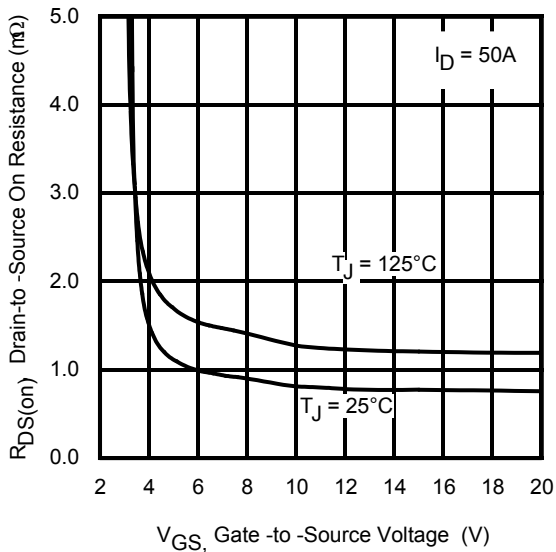


Fig 12. On- Resistance vs. Gate Voltage

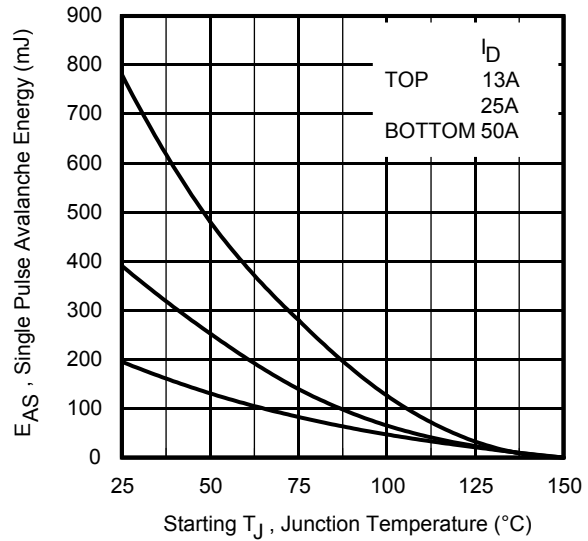


Fig 13. Maximum Avalanche Energy vs. Drain Current

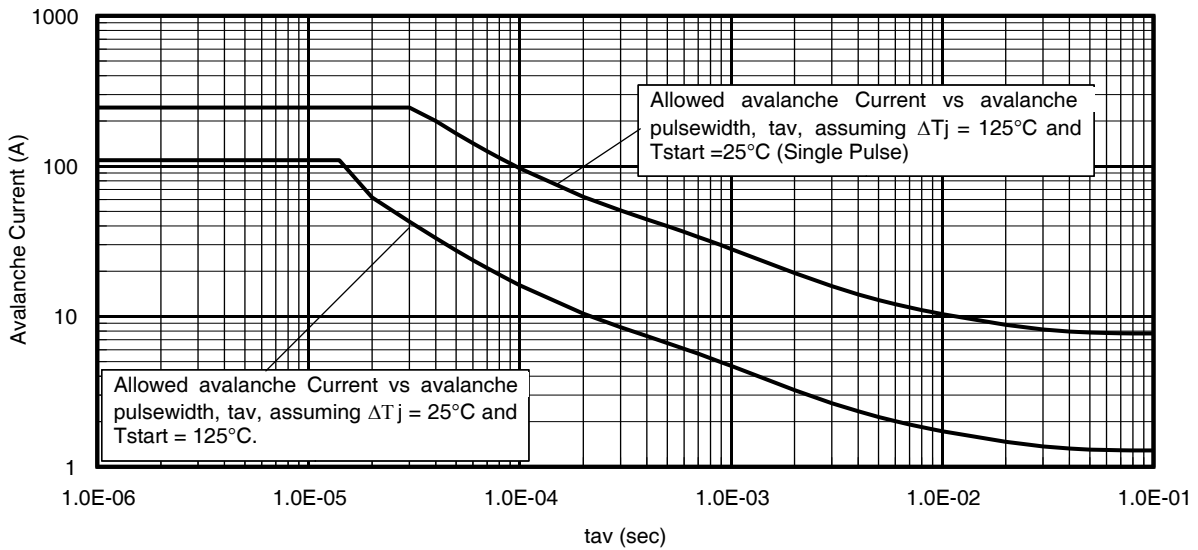
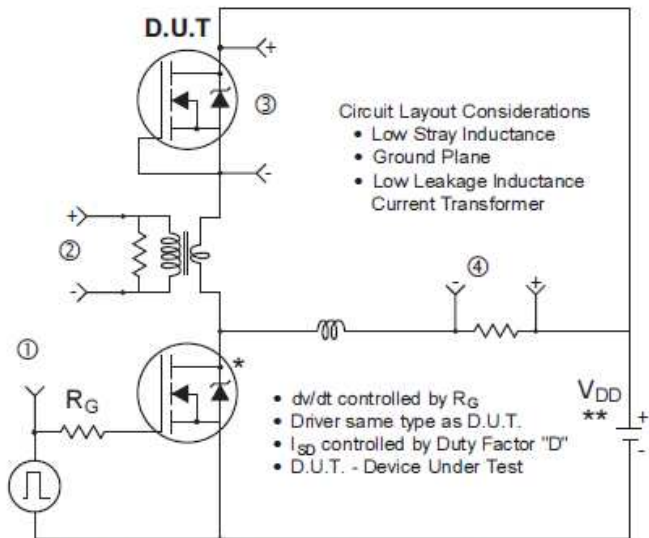


Fig 14. Typical Avalanche Current vs. Pulsewidth



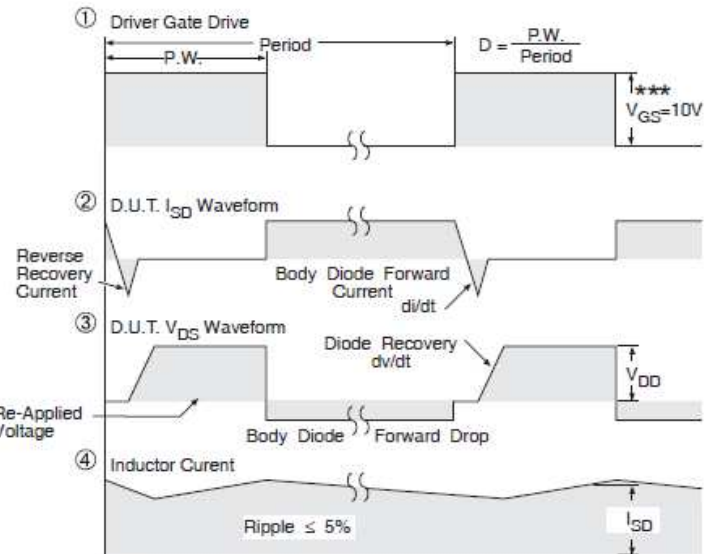
- Circuit Layout Considerations**
- Low Stray Inductance
  - Ground Plane
  - Low Leakage Inductance
  - Current Transformer

- $dv/dt$  controlled by  $R_G$
- Driver same type as D.U.T.
- $I_{SD}$  controlled by Duty Factor "D"
- D.U.T. - Device Under Test

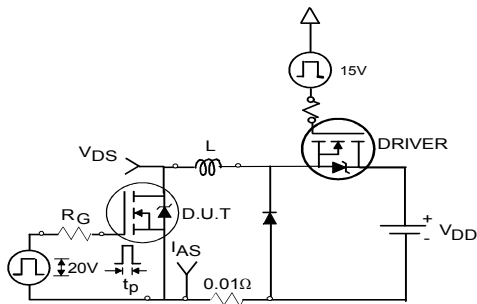
\* Use P-Channel Driver for P-Channel Measurements

\*\* Reverse Polarity for P-Channel

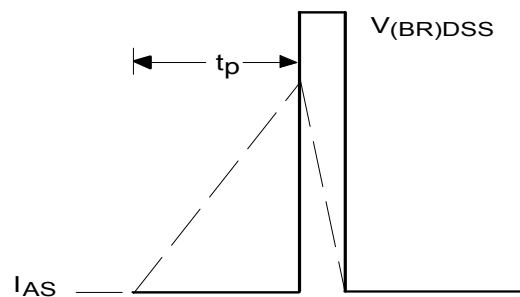
**Fig 15. Peak Diode Recovery  $dv/dt$  Test Circuit for N-Channel HEXFET<sup>®</sup> Power MOSFETs**



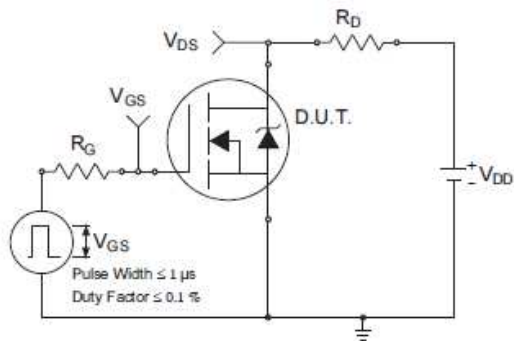
\*\*\*  $V_{GS} = 5V$  for Logic Level Devices



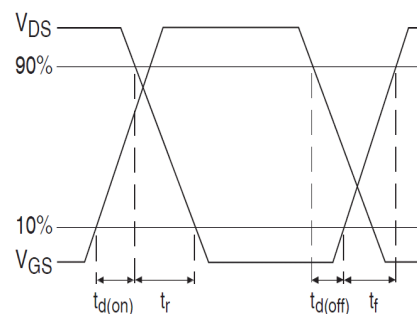
**Fig 16a. Unclamped Inductive Test Circuit**



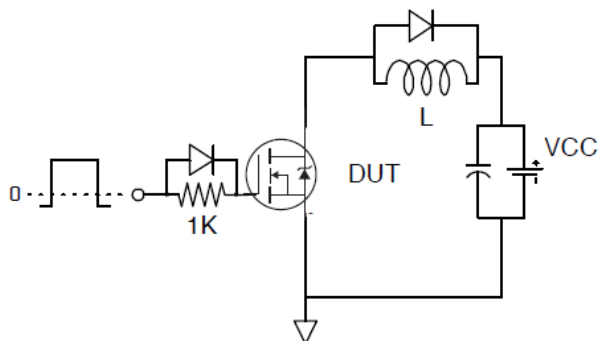
**Fig 16b. Unclamped Inductive Waveforms**



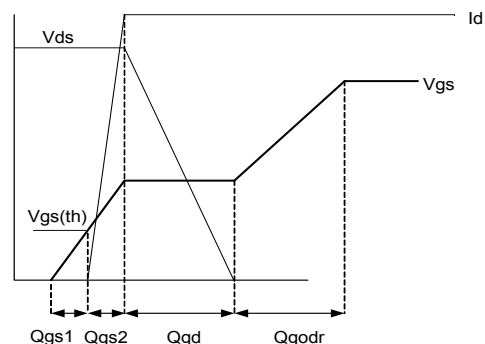
**Fig 17a. Switching Time Test Circuit**



**Fig 17b. Switching Time Waveforms**

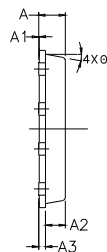


**Fig 18. Gate Charge Test Circuit**

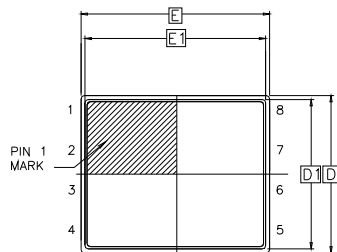


**Fig 19. Gate Charge Waveform**

**PQFN 5x6 Outline "B" Package Details**

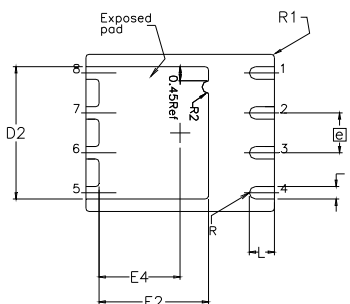


SIDE VIEW



TOP VIEW

DIM SYMBOL	MIN	NOM	MAX
A	0.800	0.830	1.05
A1	0.000	0.020	0.050
A2	0.580	0.630	0.680
A3		0.254 REF	
Ø	0"	10"	12"
b	0.350	0.400	0.470
D	4.850	5.000	5.150
D1	4.675	4.750	5.000
D2	3.700	4.210	4.300
e		1.270 BSC	
E	5.850	6.000	6.150
E1	5.675	5.750	6.000
E2	3.380	3.480	3.760
E4	2.480	2.580	2.680
L	0.550	0.800	0.900
R		0.200 REF	
R1		0.100 REF	
R2	0.150	0.200	0.250

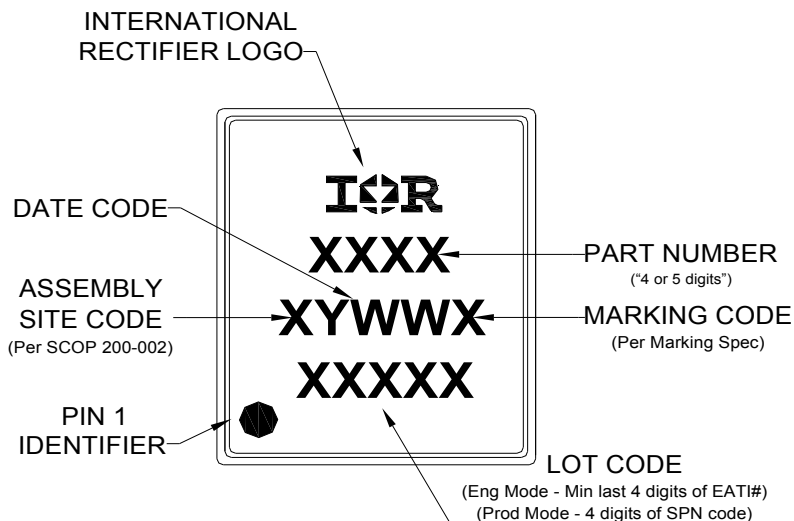


BOTTOM VIEW

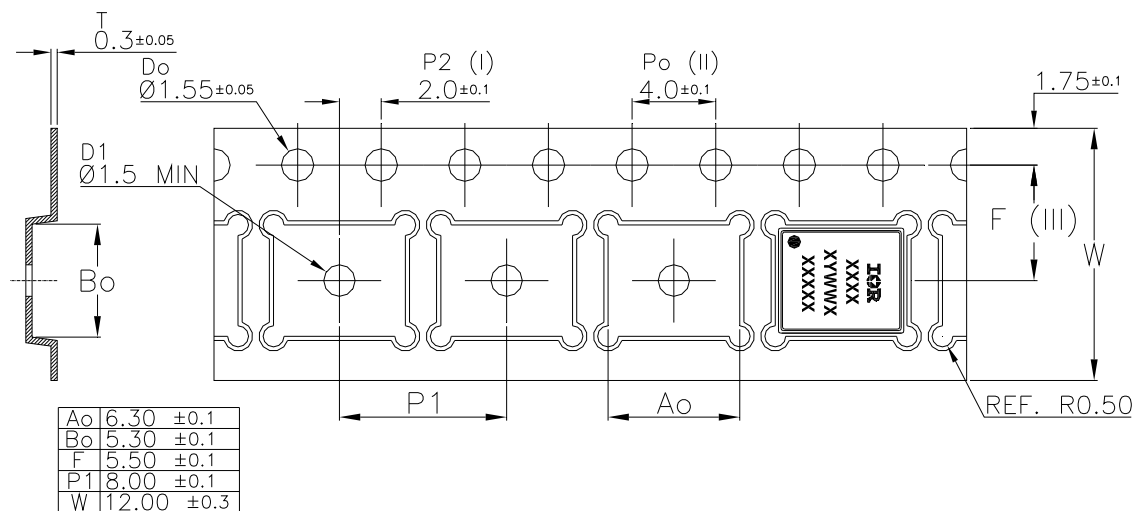
For more information on board mounting, including footprint and stencil recommendation, please refer to application note AN-1136: <http://www.irf.com/technical-info/appnotes/an-1136.pdf>

For more information on package inspection techniques, please refer to application note AN-1154: <http://www.irf.com/technical-info/appnotes/an-1154.pdf>

**PQFN 5x6 Outline "B" Part Marking**



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

**PQFN 5x6 Outline "B" Tape and Reel**


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

**Qualification Information†**

<b>Qualification Level</b>	Industrial† (per JEDEC JESD47F†† guidelines)	
<b>Moisture Sensitivity Level</b>	PQFN 5mm x 6mm	MSL1 (per JEDEC J-STD-020D††)
<b>RoHS Compliant</b>	Yes	

† Qualification standards can be found at International Rectifier's web site: <http://www.irf.com/product-info/reliability/>

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

**Notes:**

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.156\text{mH}$ ,  $R_G = 50\Omega$ ,  $I_{AS} = 50\text{A}$ .
- ③ Pulse width  $\leq 400\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- ④  $R_\theta$  is measured at  $T_J$  of approximately  $90^\circ\text{C}$ .
- ⑤ When mounted on 1 inch square PCB (FR-4). Please refer to AN-994 for more details: <http://www.irf.com/technical-info/appnotes/an-994.pdf>
- ⑥ Calculated continuous current based on maximum allowable junction temperature. Package is limited to 100A by production test capability.

**Revision History**

Date	Comments
05/13/2013	<ul style="list-style-type: none"> <li>• Updated package 3D drawing, on page 1.</li> <li>• Updated current rating based on max rating not limited by package, on pages 1 and 2.</li> </ul>
08/07/13	<ul style="list-style-type: none"> <li>• Added "Fast/RFET™" above part number on page 1</li> </ul>

International  
 Rectifier

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To contact International Rectifier, please visit <http://www.irf.com/whoto-call/>