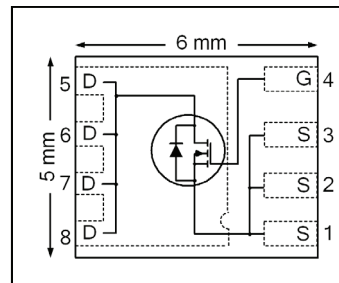


HEXFET® Power MOSFET

$V_{DSS}$	<b>25</b>	<b>V</b>
$R_{DS(on) \max}$ (@ $V_{GS} = 10V$ )	<b>0.95</b>	<b>mΩ</b>
(@ $V_{GS} = 4.5V$ )	<b>1.25</b>	
$Qg$ (typical)	<b>46.0</b>	<b>nC</b>
$I_D$ (@ $T_C(Bottom) = 25^\circ C$ )	<b>100</b> Ⓣ	<b>A</b>


**Applications**

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

**Features**

Low $R_{DS(on)}$ (<0.95 mΩ)
Low Thermal Resistance to PCB (<0.8°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	
IRFH4201PbF	PQFN 5mm x 6 mm	Tape and Reel	4000	IRFH4201TRPbF

**Absolute Maximum Ratings**

	Parameter	Max.	Units
$V_{GS}$	Gate-to-Source Voltage	± 20	V
$I_D @ T_A = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$	49	A
$I_D @ T_{C(Bottom)} = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$	326ⓉⓈ	
$I_D @ T_{C(Bottom)} = 100^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$	206ⓉⓈ	
$I_D @ T_{C(Bottom)} = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$ (Source Bonding Technology Limited)	100Ⓣ	
$I_{DM}$	Pulsed Drain Current ①	400	
$P_D @ T_A = 25^\circ C$	Power Dissipation ⑤	3.5	W
$P_D @ T_{C(Bottom)} = 25^\circ C$	Power Dissipation	156	
	Linear Derating Factor	0.028	W/°C
$T_J$ $T_{STG}$	Operating Junction and Storage Temperature Range	-55 to + 150	°C

Notes ① through ⑧ are on page 9

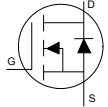
**Static @ T<sub>J</sub> = 25°C (unless otherwise specified)**

	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	—	20	—	mV/°C	Reference to 25°C, I <sub>D</sub> = 1mA	
R <sub>DS(on)</sub>	Static Drain-to-Source On-Resistance	—	0.70	0.95	mΩ	V <sub>GS</sub> = 10V, I <sub>D</sub> = 50A ③	
		—	0.97	1.25		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> = 150μA	
ΔV <sub>GS(th)</sub>	Gate Threshold Voltage Coefficient	—	-5.9	—	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	175	—	—	S	V <sub>DS</sub> = 13V, I <sub>D</sub> = 50A	
Q <sub>g</sub>	Total Gate Charge	—	94.0	—	nC	V <sub>GS</sub> = 10V, V <sub>DS</sub> = 13V, I <sub>D</sub> = 50A	
Q <sub>g</sub>	Total Gate Charge	—	46.0	69.0	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	—	11.0			—
	Q <sub>gs2</sub>	Post-V <sub>th</sub> Gate-to-Source Charge	—	6.4			—
	Q <sub>gd</sub>	Gate-to-Drain Charge	—	16.0			—
	Q <sub>godr</sub>	Gate Charge Overdrive	—	12.6			—
Q <sub>sw</sub>	Switch Charge (Q <sub>gs2</sub> + Q <sub>gd</sub> )	—	22.4	—			
Q <sub>oss</sub>	Output Charge	—	46.0	—	nC	V <sub>DS</sub> = 16V, V <sub>GS</sub> = 0V	
R <sub>G</sub>	Gate Resistance	—	0.9	2.7	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	—	43	—			
t <sub>d(off)</sub>	Turn-Off Delay Time	—	24	—			
t <sub>f</sub>	Fall Time	—	19	—			
C <sub>iss</sub>	Input Capacitance	—	6100	—	pF	V <sub>GS</sub> = 0V V <sub>DS</sub> = 13V f = 1.0MHz	
C <sub>oss</sub>	Output Capacitance	—	1700	—			
C <sub>rss</sub>	Reverse Transfer Capacitance	—	450	—			

**Avalanche Characteristics**

	Parameter	Typ.	Max.
E <sub>AS</sub>	Single Pulse Avalanche Energy ②	—	478
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)	—	—	100 ⑦	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	—	31	47	ns	T <sub>J</sub> = 25°C, I <sub>F</sub> = 50A, V <sub>DD</sub> = 13V
Q <sub>rr</sub>	Reverse Recovery Charge	—	84	126	nC	di/dt = 400A/μs ③

**Thermal Resistance**

	Parameter	Typ.	Max.	Units
R <sub>θJC</sub> (Bottom)	Junction-to-Case ④	—	0.8	°C/W
R <sub>θJC</sub> (Top)	Junction-to-Case ④	—	18	
R <sub>θJA</sub>	Junction-to-Ambient ⑤	—	36	
R <sub>θJA</sub> (<10s)	Junction-to-Ambient ⑤	—	22	

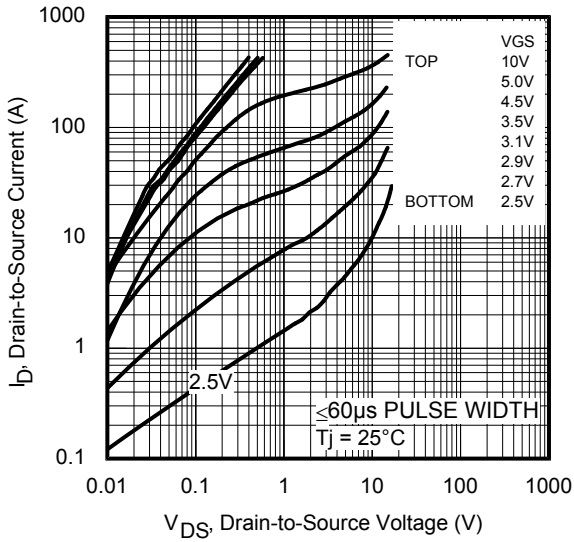


Fig 1. Typical Output Characteristics

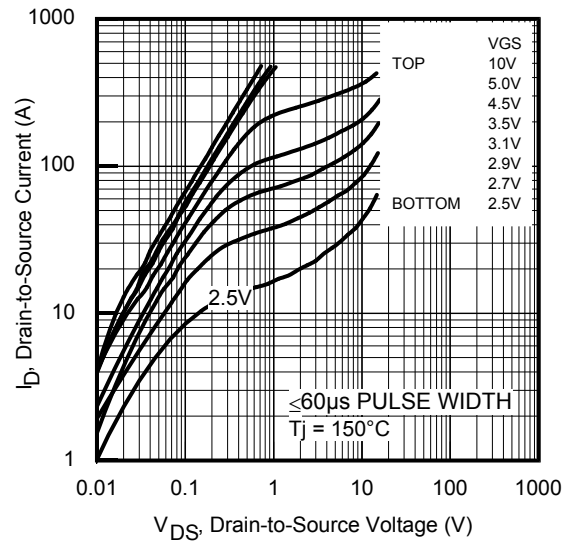


Fig 2. Typical Output Characteristics

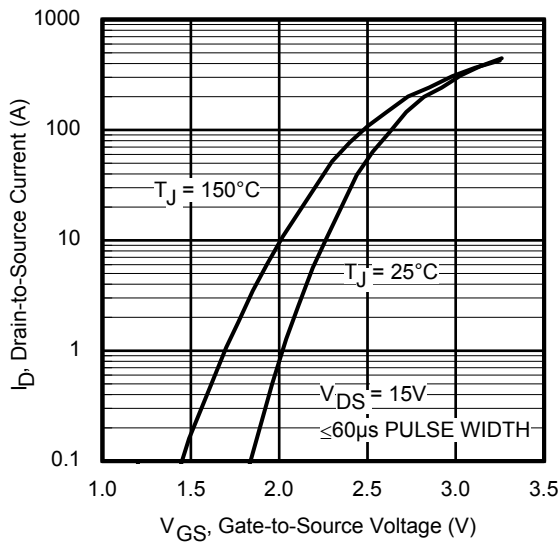


Fig 3. Typical Transfer Characteristics

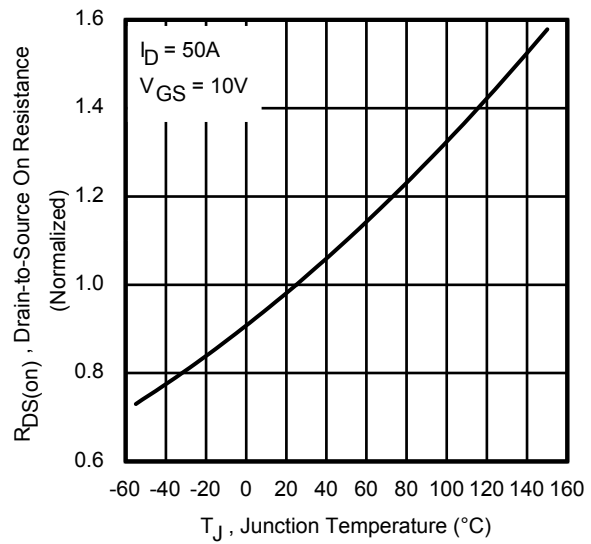


Fig 4. Normalized On-Resistance vs. Temperature

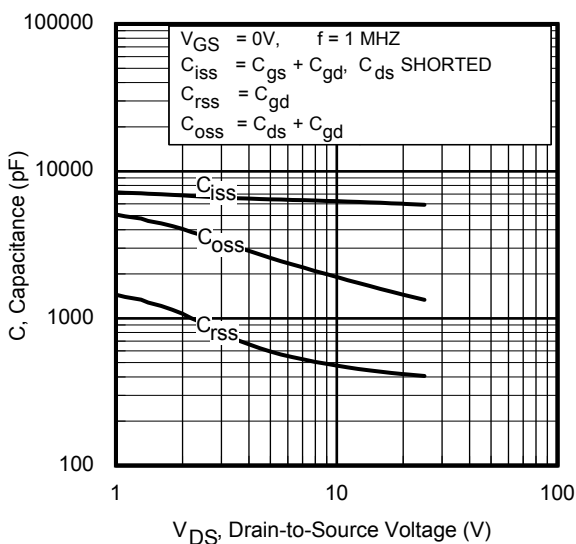


Fig 5. Typical Capacitance vs. Drain-to-Source Voltage

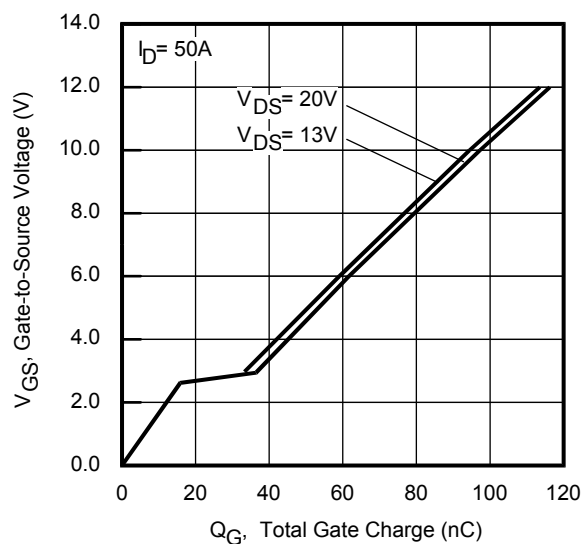


Fig 6. Typical Gate Charge vs. Gate-to-Source Voltage

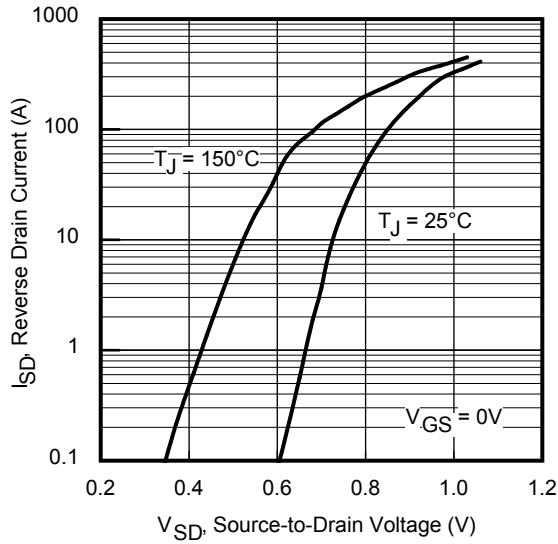


Fig 7. Typical Source-Drain Diode Forward Voltage

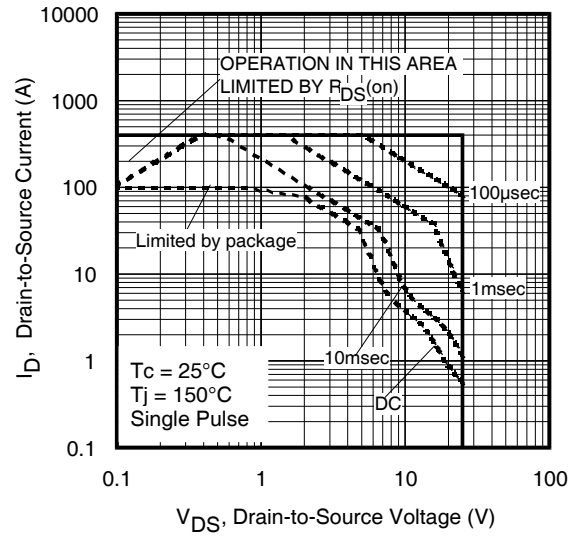


Fig 8. Maximum Safe Operating Area

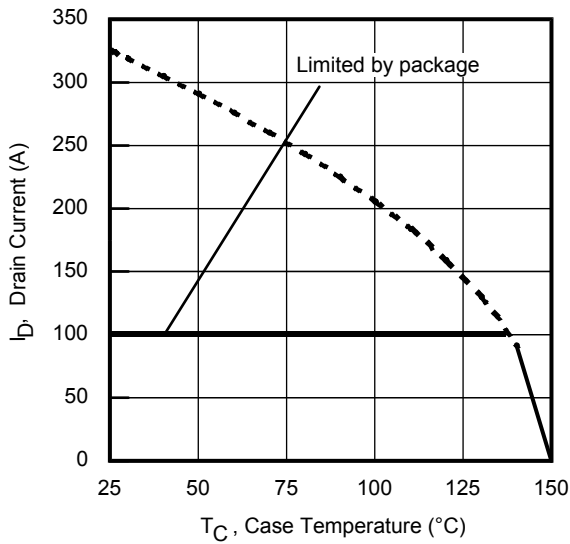


Fig 9. Maximum Drain Current vs. Case Temperature

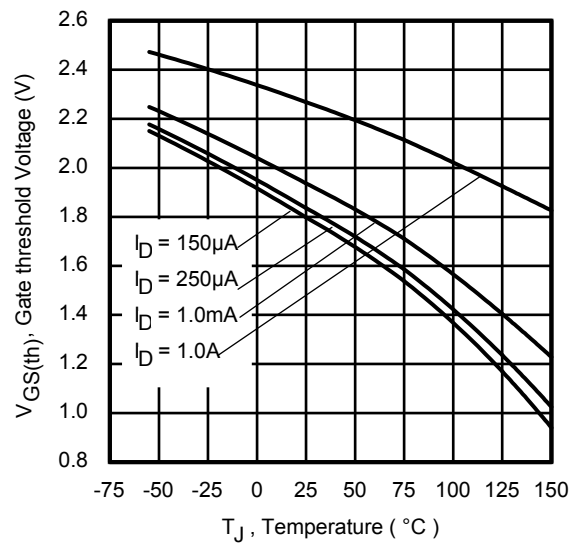


Fig 10. Drain-to-Source Breakdown Voltage

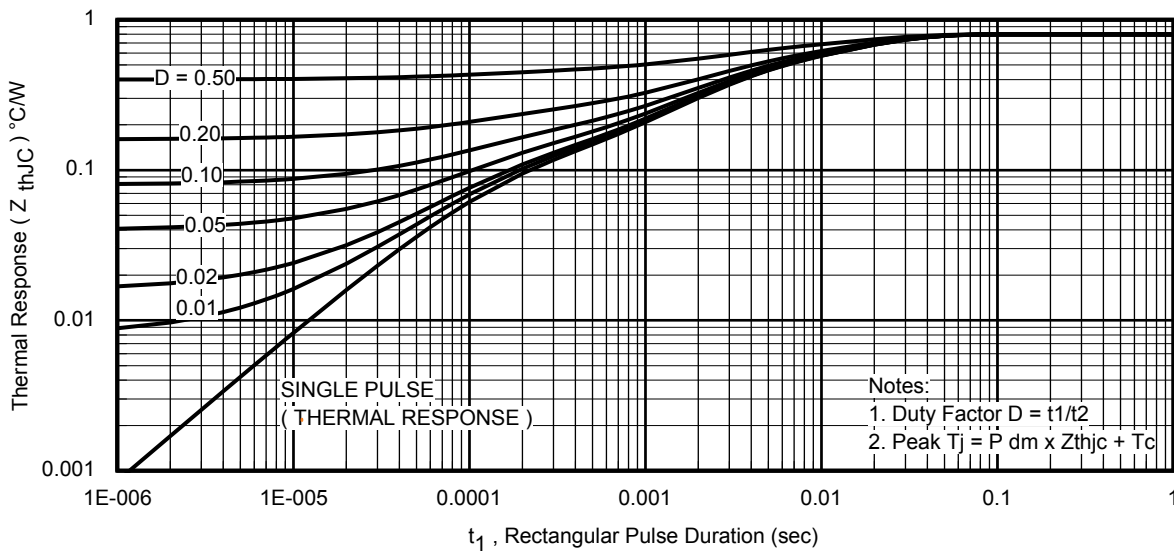


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

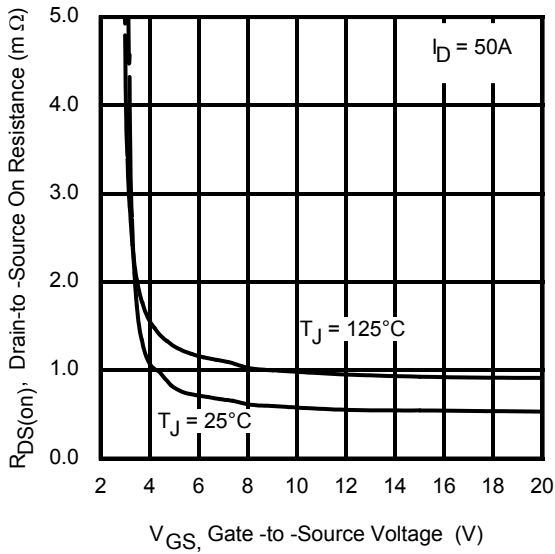


Fig 12. On- Resistance vs. Gate Voltage

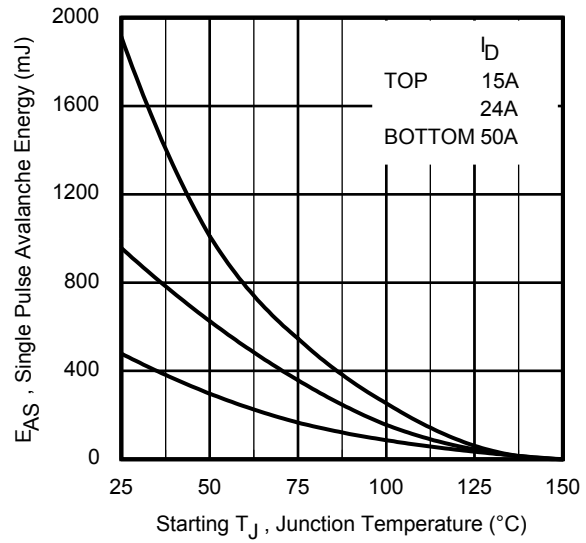


Fig 13. Maximum Avalanche Energy vs. Drain Current

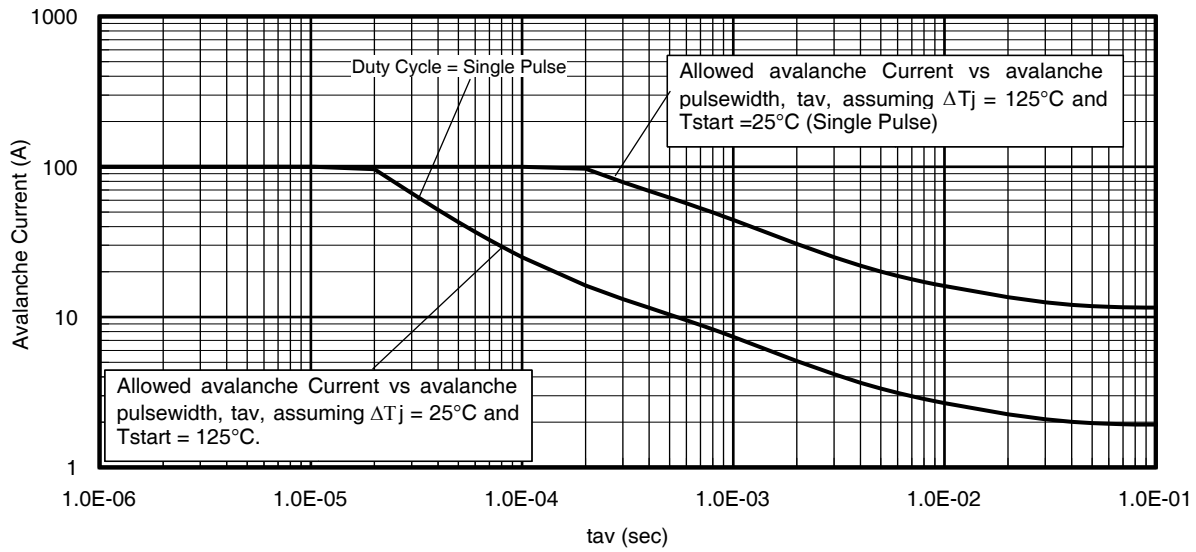
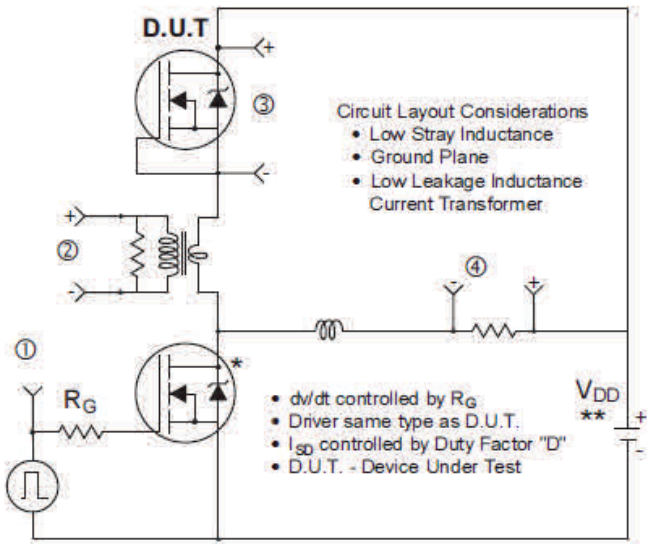


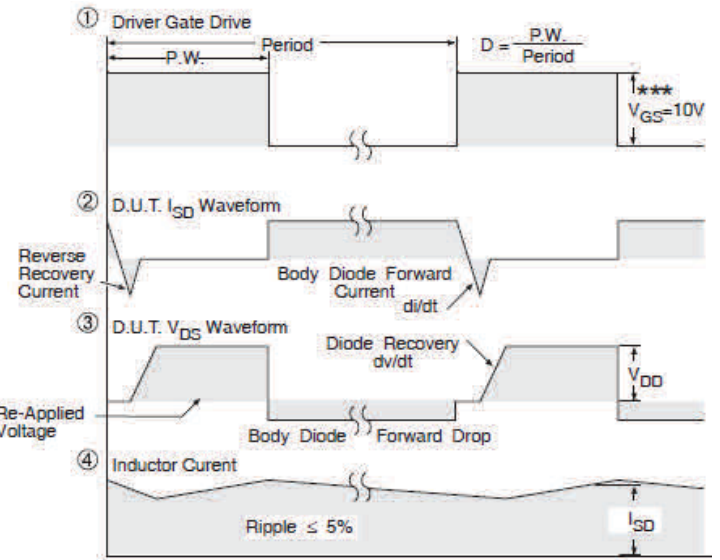
Fig 14. Typical Avalanche Current vs. Pulsewidth



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

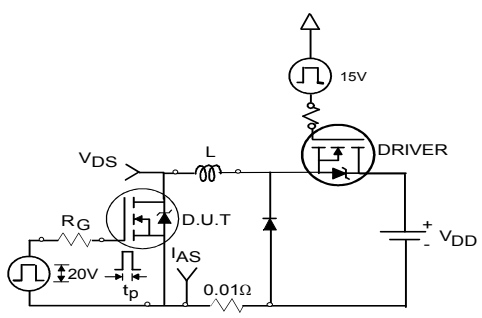
- $dv/dt$  controlled by  $R_G$
- Driver same type as D.U.T.
- $I_{SD}$  controlled by Duty Factor "D"
- D.U.T. - Device Under Test

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

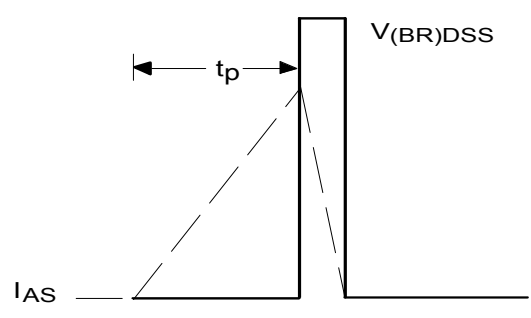


\*\*\*  $V_{GS} = 5V$  for Logic Level Devices

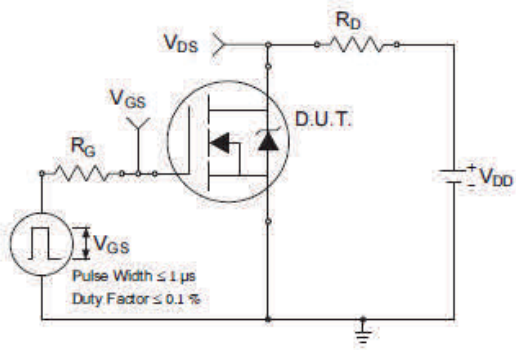
**Fig 15. Peak Diode Recovery  $dv/dt$  Test Circuit for N-Channel HEXFET® Power MOSFETs**



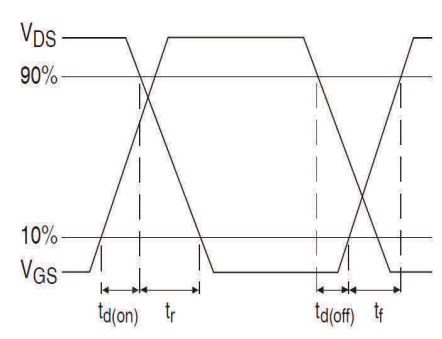
**Fig 16a. Unclamped Inductive Test Circuit**



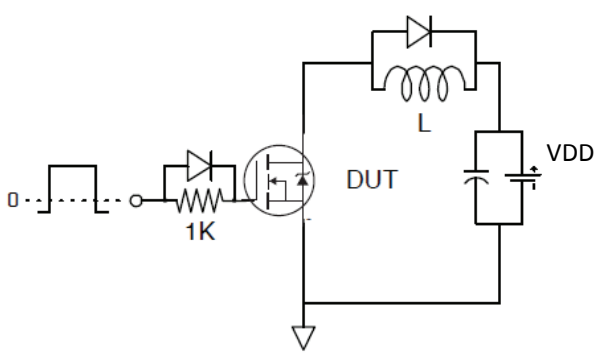
**Fig 16b. Unclamped Inductive Waveforms**



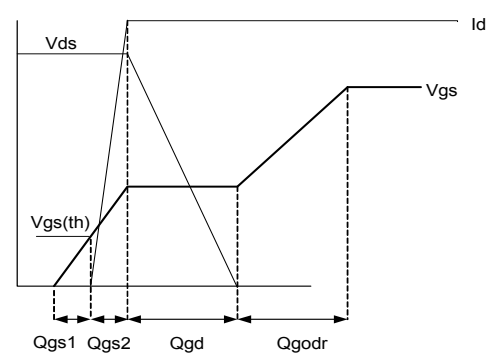
**Fig 17a. Switching Time Test Circuit**



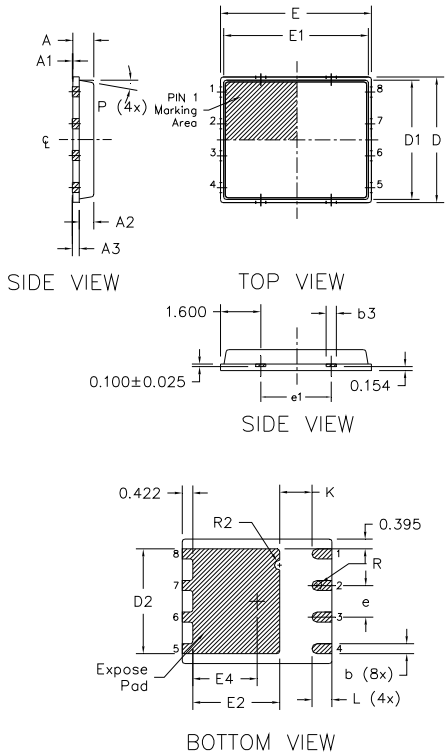
**Fig 17b. Switching Time Waveforms**



**Fig 18. Gate Charge Test Circuit**



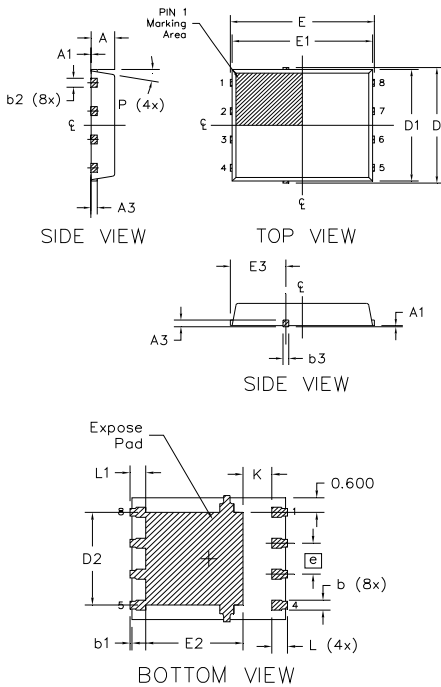
**Fig 19. Gate Charge Waveform**

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


DIM SYMBOL	MILLIMETERS		INCH	
	MIN	MAX	MIN	MAX
A	0.800	0.900	0.0315	0.0543
A1	0.000	0.050	0.0000	0.0020
A3	0.200	REF	0.0079	REF
b	0.350	0.470	0.0138	0.0185
b1	0.025	0.125	0.0010	0.0049
b2	0.210	0.410	0.0083	0.0161
b3	0.150	0.450	0.0059	0.0177
D	5.000	BSC	0.1969	BSC
D1	4.750	BSC	0.1870	BSC
D2	4.100	4.300	0.1614	0.1693
E	6.000	BSC	0.2362	BSC
E1	5.750	BSC	0.2264	BSC
E2	3.380	3.780	0.1331	0.1488
e	1.270	REF	0.0500	REF
e1	2.800	REF	0.1102	REF
K	1.200	1.420	0.0472	0.0559
L	0.710	0.900	0.0280	0.0354
P	0°	12°	0°	12°
R	0.200	REF	0.0079	REF
R2	0.150	0.200	0.0059	0.0079

**Note:**

1. Dimensions and tolerancing confirm to ASME Y14.5M-1994
2. Dimension L represents terminal full back from package edge up to 0.1mm is acceptable
3. Coplanarity applies to the expose Heat Slug as well as the terminal
4. Radius on terminal is Optional

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


DIM SYMBOL	MILLIMETERS		INCH	
	MIN.	MAX.	MIN.	MAX.
A	0.950	1.050	0.0374	0.0413
A1	0.000	0.050	0.0000	0.0020
A3	0.254	REF	0.0100	REF
b	0.310	0.510	0.0122	0.0201
b1	0.025	0.125	0.0010	0.0049
b2	0.210	0.410	0.0083	0.0161
b3	0.180	0.450	0.0071	0.0177
D	5.150	BSC	0.2028	BSC
D1	5.000	BSC	0.1969	BSC
D2	3.700	3.900	0.1457	0.1535
E	6.150	BSC	0.2421	BSC
E1	6.000	BSC	0.2362	BSC
E2	3.560	3.760	0.1402	0.1488
E3	2.270	2.470	0.0894	0.0972
e	1.27	REF	0.050	REF
K	0.830	1.400	0.0327	0.0551
L	0.510	0.710	0.0201	0.0280
L1	0.510	0.710	0.0201	0.0280
P	10 deg	12 deg	0 deg	12 deg

**Note:**

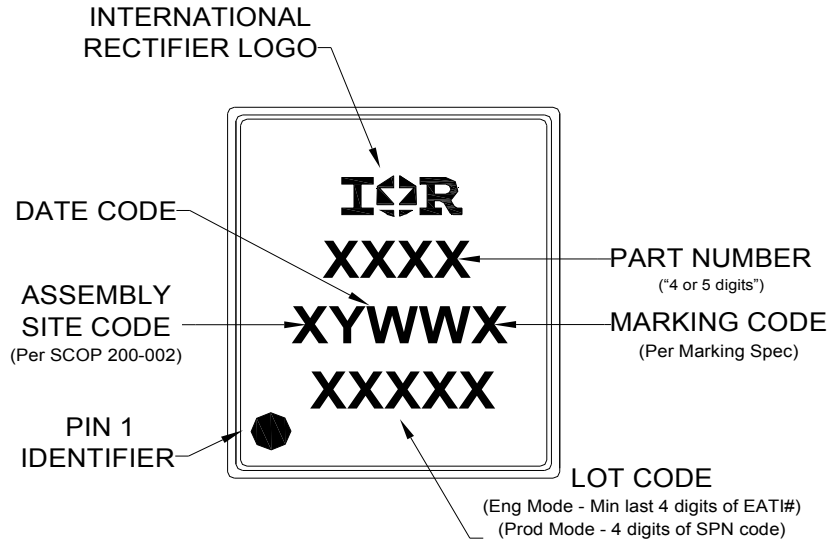
1. Dimensions and tolerancing confirm to ASME Y14.5M-1994
2. Dimension L represents terminal full back from package edge up to 0.1mm is acceptable
3. Coplanarity applies to the expose Heat Slug as well as the terminal
4. Radius on terminal is Optional

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

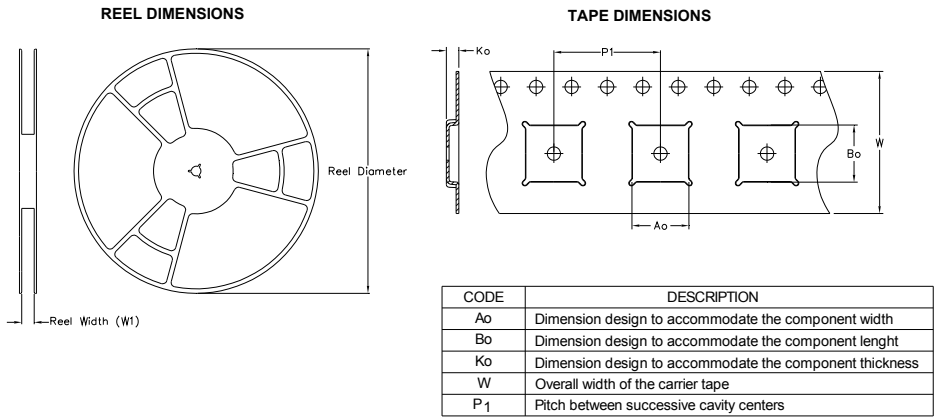
For more information on package inspection techniques, please refer to application note AN-1154: <http://www.infineon.com/technical-info/appnotes/an-1154.pdf>

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

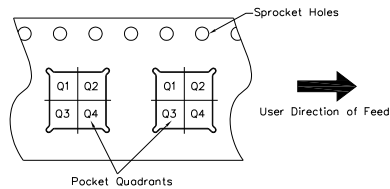
PQFN 5x6 Part Marking



PQFN 5x6 Tape and Reel



QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



Note: All dimension are nominal

Package Type	Reel Diameter (Inch)	QTY	Reel Width W1 (mm)	Ao (mm)	Bo (mm)	Ko (mm)	P1 (mm)	W (mm)	Pin 1 Quadrant
5 X 6 PQFN	13	4000	12.4	6.300	5.300	1.20	8.00	12	Q1

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



**Qualification Information<sup>†</sup>**

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

† Qualification standards can be found at International Rectifier's web site: <http://www.infineon.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  $T_J = 25^{\circ}\text{C}$ ,  $L = 0.38\text{mH}$ ,  $R_G = 50\Omega$ ,  $I_{AS} = 50\text{A}$ .
- 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.infineon.com/technical-info/appnotes/an-994.pdf>
- ⑥ Calculated continuous current based on maximum allowable junction temperature.
- ⑦ Current is limited to 100A by source bonding technology.

**Revision History**

<b>Date</b>	<b>Comments</b>
05/17/2013	<ul style="list-style-type: none"> <li>• Updated package 3D drawing, on page 1.</li> <li>• Added Continuous Drain Current limited by source bonding technology, on page 1.</li> <li>• Divided note 6 into note 6 &amp; 7, on page 8.</li> </ul>
01/15/2013	<ul style="list-style-type: none"> <li>• Release of final data sheet.</li> </ul>
03/16/2015	<ul style="list-style-type: none"> <li>• Updated package outline and tape and reel on pages 7 and 8.</li> </ul>
01/24/2017	<ul style="list-style-type: none"> <li>• Changed datasheet with Infineon logo - all pages</li> <li>• Added package outline for "option G" on page 7.</li> <li>• Added disclaimer on last page</li> </ul>

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