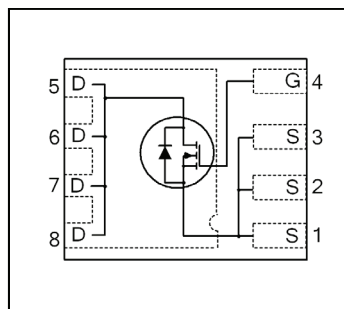


HEXFET® Power MOSFET

V_{DSS}	25	V
R_{DS(on)} max (@ V _{GS} = 10V)	3.4	mΩ
(@ V _{GS} = 4.5V)	4.6	
Qg (typical)	9.7	nC
I_D (@T _{C (Bottom)} = 25°C)	40 ⑦	A



Applications

- Control MOSFET for synchronous buck converter

Features

Low Charge (typical 9.7nC)
Low R _{DS(on)} (<3.4mΩ)
Low Thermal Resistance to PCB (<4.3°C/W)
Low Profile (<0.9mm)
Industry-Standard Pinout
Compatible with Existing Surface Mount Techniques
RoHS Compliant, Halogen-Free
MSL1, Industrial Qualification

results in



Benefits

Low Switching Losses
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	
IRFHM4231PbF	PQFN 3.3mm x 3.3mm	Tape and Reel	4000	IRFHM4231TRPbF

Absolute Maximum Ratings

	Parameter	Max.	Units
V _{GS}	Gate-to-Source Voltage	± 20	V
I _D @ T _A = 25°C	Continuous Drain Current, V _{GS} @ 10V	22	A
I _D @ T _{C(Bottom)} = 25°C	Continuous Drain Current, V _{GS} @ 10V	72⑥⑦	
I _D @ T _{C(Bottom)} = 100°C	Continuous Drain Current, V _{GS} @ 10V	46⑥	
I _D @ T _C = 25°C	Continuous Drain Current, V _{GS} @ 10V (Source Bonding Technology Limited)	40⑦	
I _{DM}	Pulsed Drain Current ①	288	
P _D @ T _A = 25°C	Power Dissipation ⑤	2.7	W
P _D @ T _{C(Bottom)} = 25°C	Power Dissipation	29	
	Linear Derating Factor	0.021	W/°C
T _J T _{STG}	Operating Junction and Storage Temperature Range	-55 to + 150	°C

Notes ① through ⑦ are on page 9

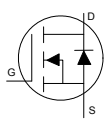
Static @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
BV_{DSS}	Drain-to-Source Breakdown Voltage	25	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	22	—	mV/ $^\circ\text{C}$	Reference to 25°C , $I_D = 1mA$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	2.7	3.4	m Ω	$V_{GS} = 10V, I_D = 30A$ ③
		—	3.7	4.6		$V_{GS} = 4.5V, I_D = 30A$ ③
$V_{GS(th)}$	Gate Threshold Voltage	1.1	1.6	2.1	V	$V_{DS} = V_{GS}, I_D = 35\mu A$
$\Delta V_{GS(th)}$	Gate Threshold Voltage Coefficient	—	-5.4	—	mV/ $^\circ\text{C}$	
I_{DSS}	Drain-to-Source Leakage Current	—	—	1.0	μA	$V_{DS} = 20V, V_{GS} = 0V$
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	120	—	—	S	$V_{DS} = 10V, I_D = 30A$
Q_g	Total Gate Charge	—	20	—	nC	$V_{GS} = 10V, V_{DS} = 13V, I_D = 30A$
Q_g	Total Gate Charge	—	9.7	15	nC	$V_{DS} = 13V$ $V_{GS} = 4.5V$ $I_D = 30A$
Q_{gs1}	Pre-Vth Gate-to-Source Charge	—	1.9	—		
Q_{gs2}	Post-Vth Gate-to-Source Charge	—	1.2	—		
Q_{gd}	Gate-to-Drain Charge	—	3.6	—		
Q_{godr}	Gate Charge Overdrive	—	3.0	—		
Q_{sw}	Switch Charge ($Q_{gs2} + Q_{gd}$)	—	4.8	—		
Q_{oss}	Output Charge	—	9.6	—	nC	$V_{DS} = 16V, V_{GS} = 0V$
R_G	Gate Resistance	—	1.4	—	Ω	
$t_{d(on)}$	Turn-On Delay Time	—	8.7	—	ns	$V_{DD} = 13V, V_{GS} = 4.5V$ $I_D = 30A$ $R_G = 1.8\Omega$
t_r	Rise Time	—	28	—		
$t_{d(off)}$	Turn-Off Delay Time	—	12	—		
t_f	Fall Time	—	5.9	—		
C_{iss}	Input Capacitance	—	1270	—	pF	$V_{GS} = 0V$ $V_{DS} = 13V$ $f = 1.0MHz$
C_{oss}	Output Capacitance	—	360	—		
C_{rss}	Reverse Transfer Capacitance	—	97	—		

Avalanche Characteristics

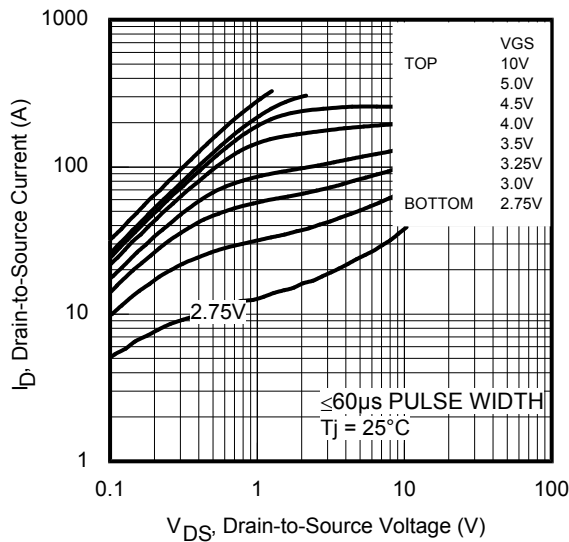
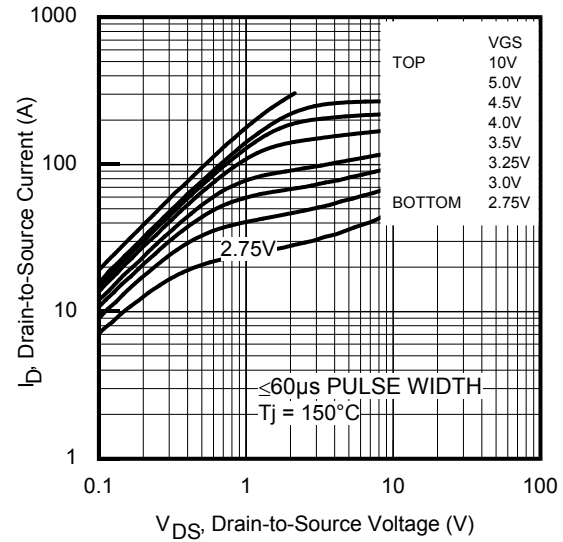
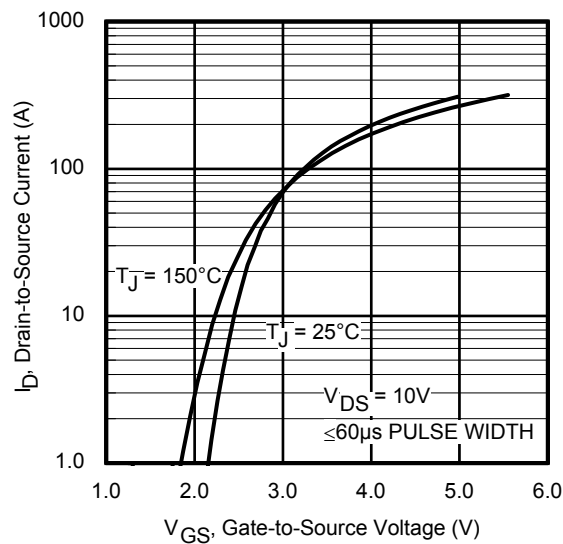
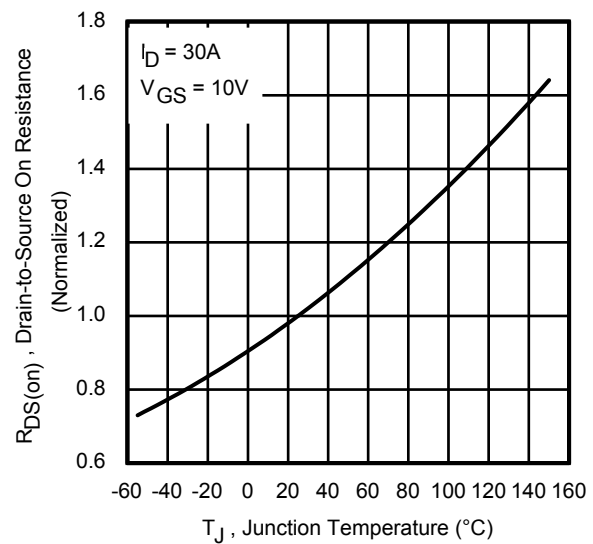
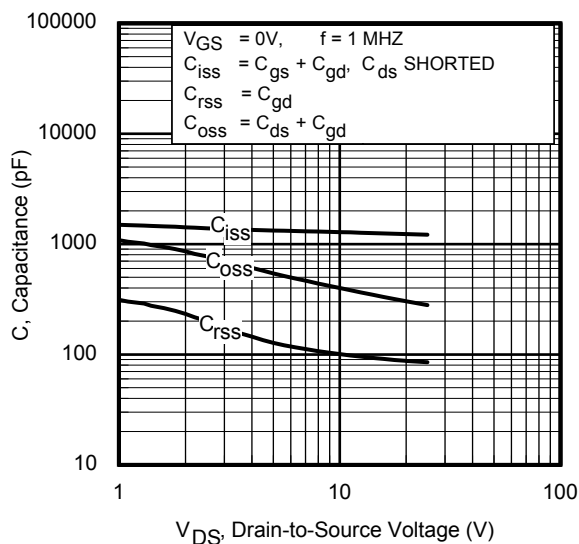
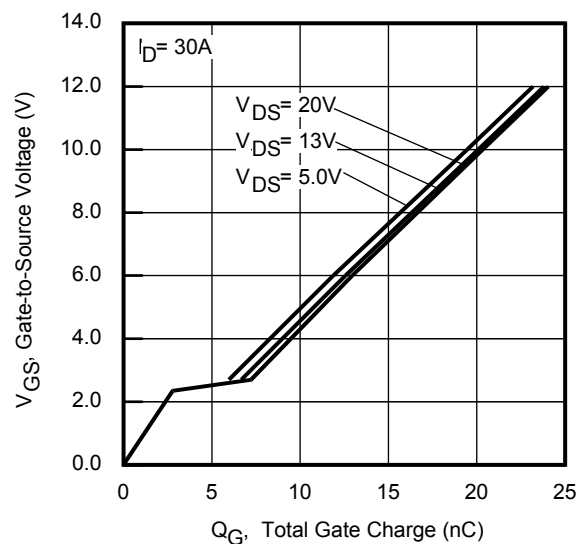
	Parameter	Typ.	Max.	Units
E_{AS}	Single Pulse Avalanche Energy ②	—	42	mJ
I_{AR}	Avalanche Current ①	—	30	A

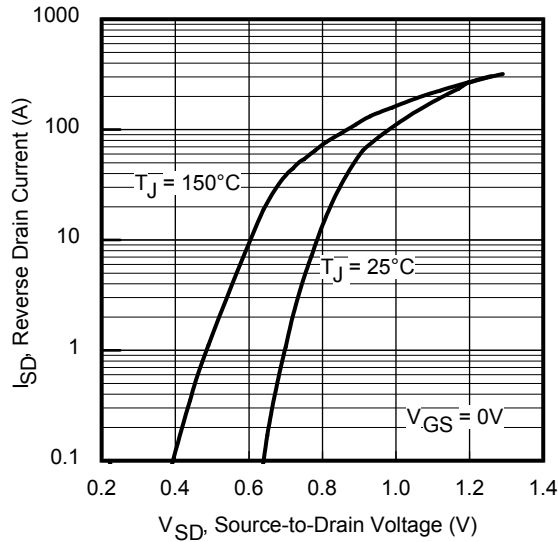
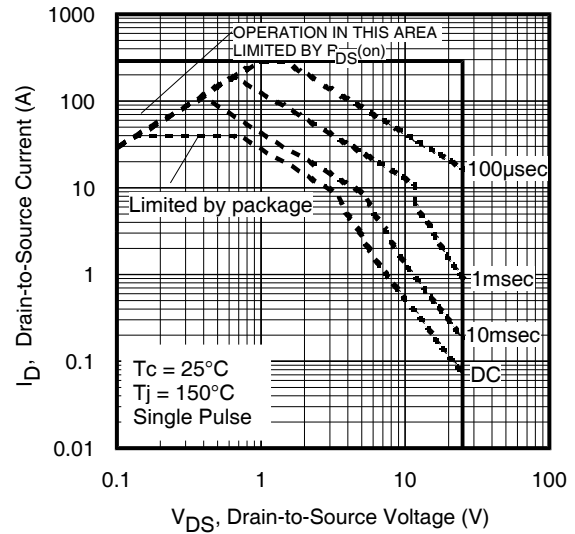
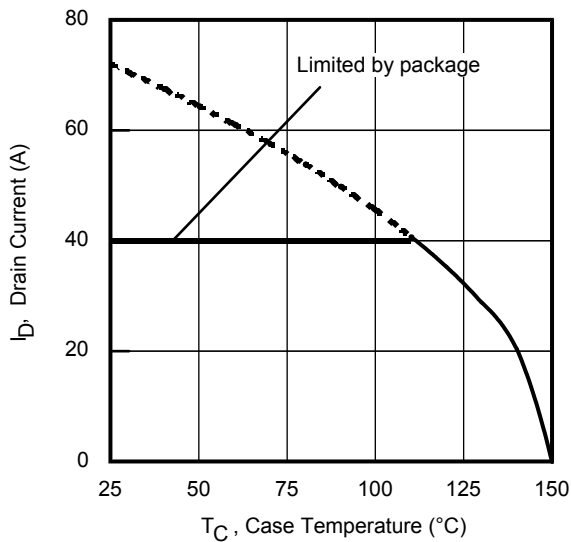
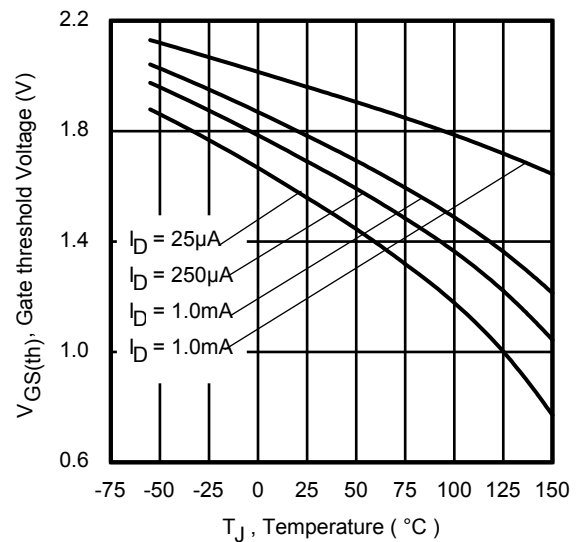
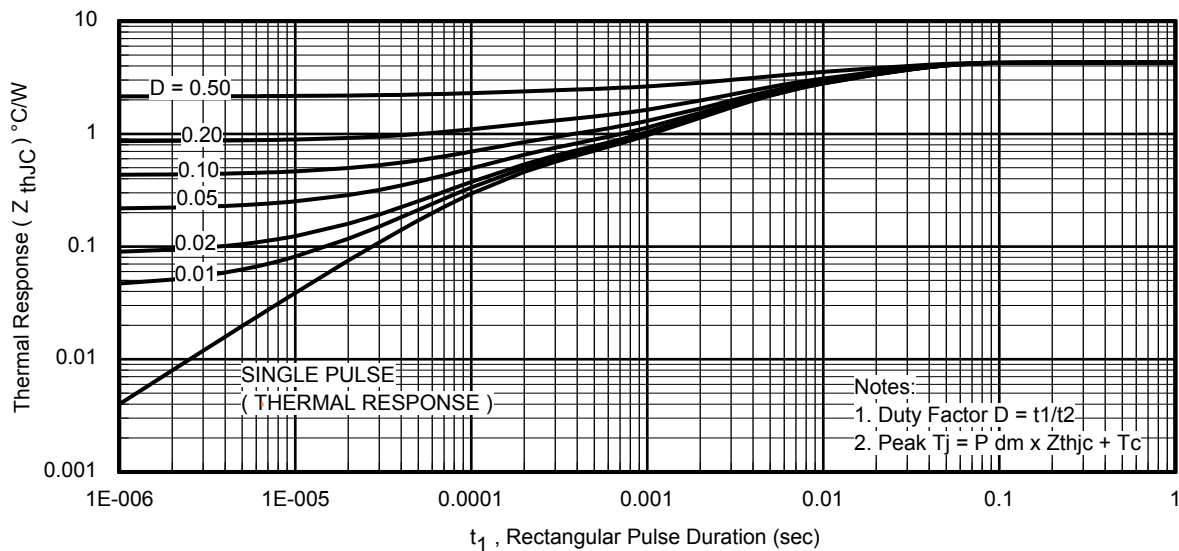
Diode Characteristics

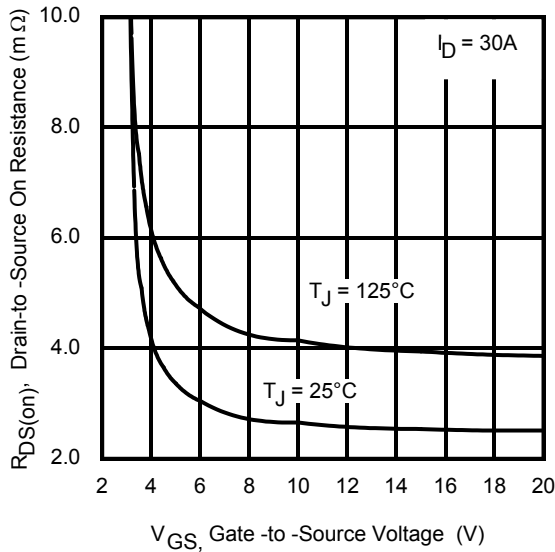
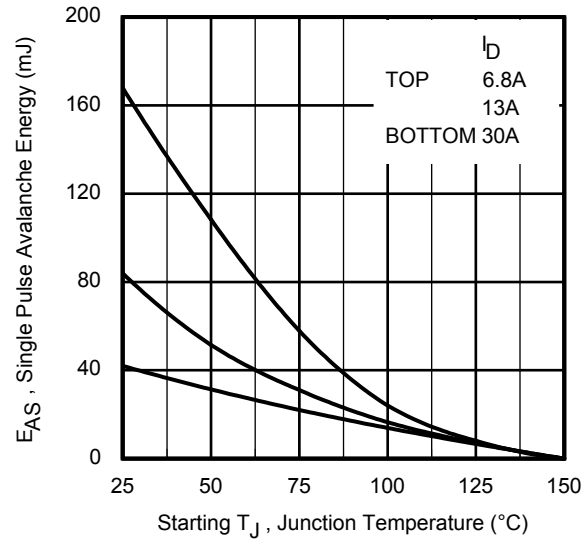
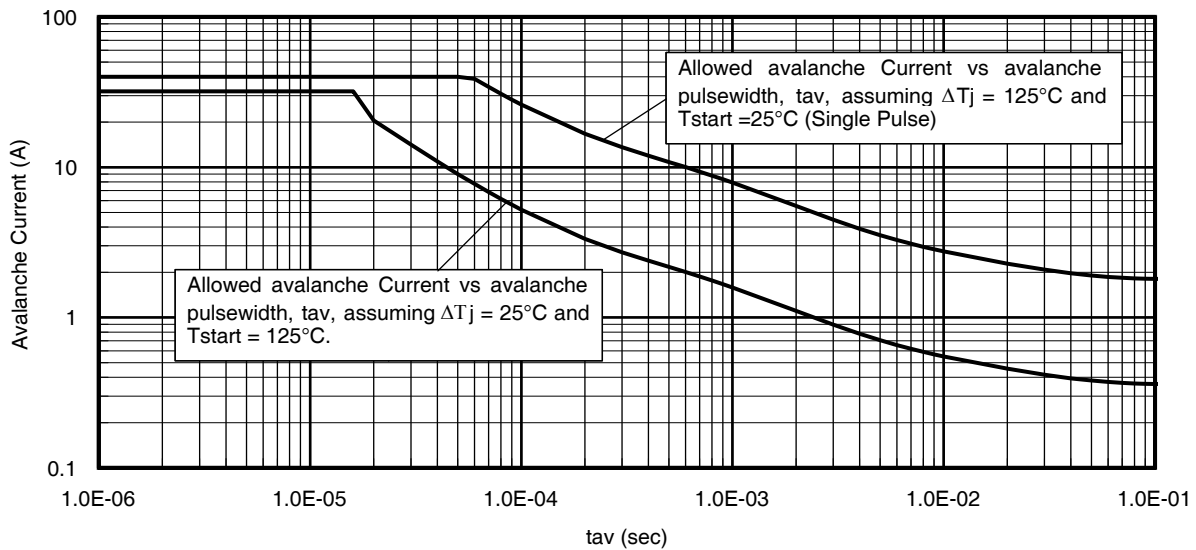
	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	40 ⑦	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	288		
V_{SD}	Diode Forward Voltage	—	—	1.0	V	$T_J = 25^\circ\text{C}, I_S = 30A, V_{GS} = 0V$ ③
t_{rr}	Reverse Recovery Time	—	16	24	ns	$T_J = 25^\circ\text{C}, I_F = 30A, V_{DD} = 13V$
Q_{rr}	Reverse Recovery Charge	—	13	20	nC	$di/dt = 280A/\mu s$ ③

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$ (Bottom)	Junction-to-Case ④	—	4.3	$^\circ\text{C/W}$
$R_{\theta JC}$ (Top)	Junction-to-Case ④	—	37	
$R_{\theta JA}$	Junction-to-Ambient ⑤	—	47	
$R_{\theta JA} (<10s)$	Junction-to-Ambient ⑤	—	31	


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. Pulse Width

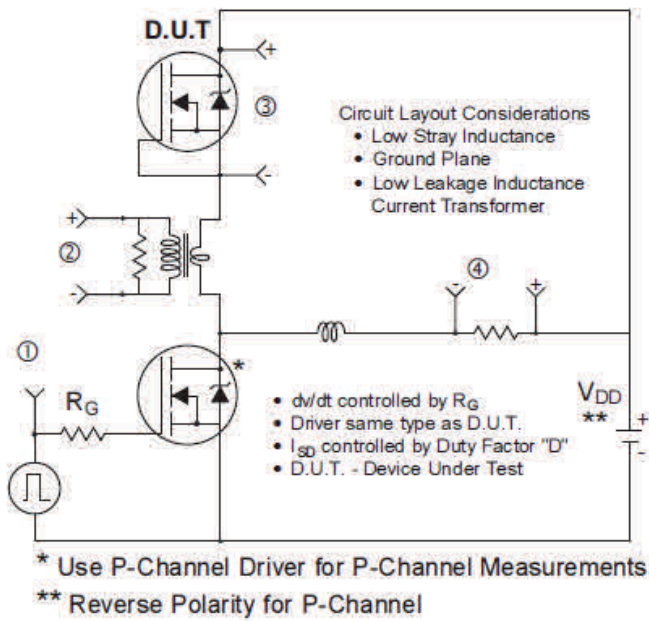


Fig 15. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

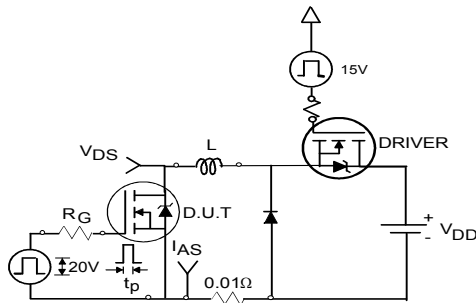


Fig 16a. Unclamped Inductive Test Circuit

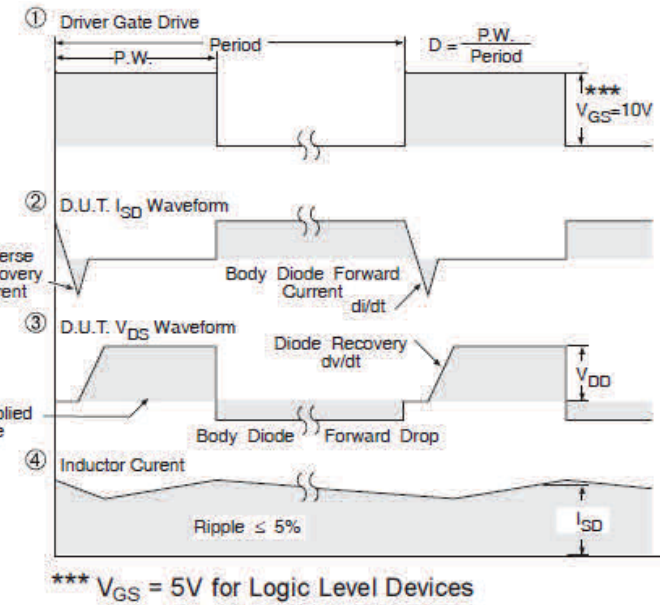


Fig 16b. Unclamped Inductive Waveforms

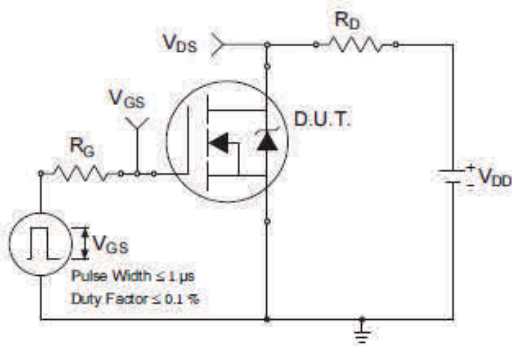


Fig 17a. Switching Time Test Circuit

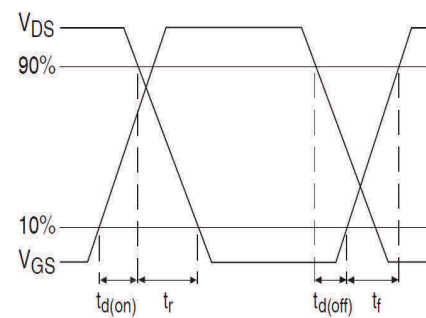


Fig 17b. Switching Time Waveforms

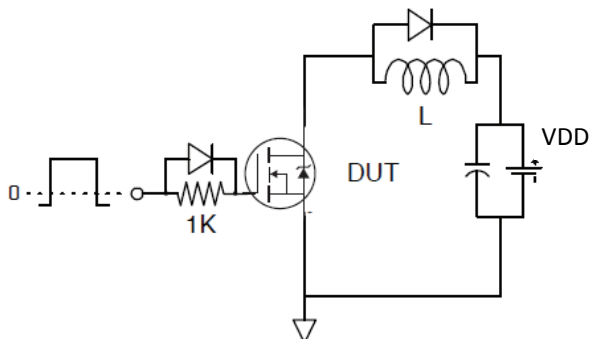


Fig 18. Gate Charge Test Circuit

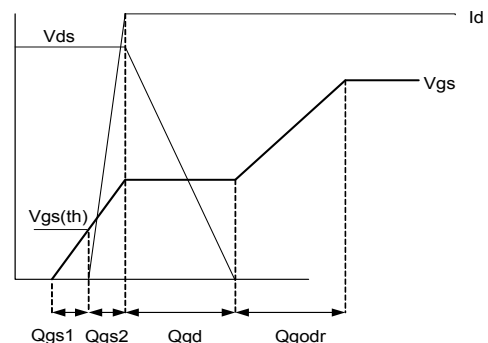
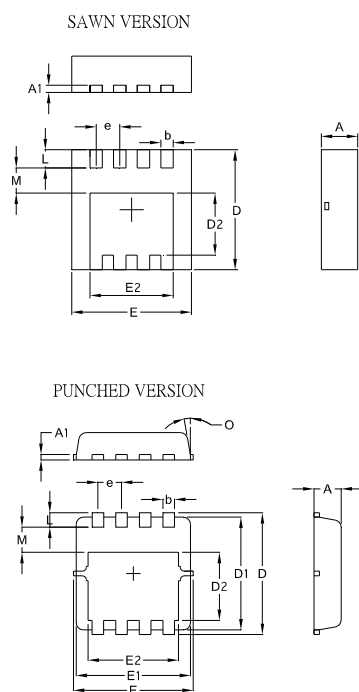


Fig 19. Gate Charge Waveform

PQFN 3.3 x 3.3 Package Details

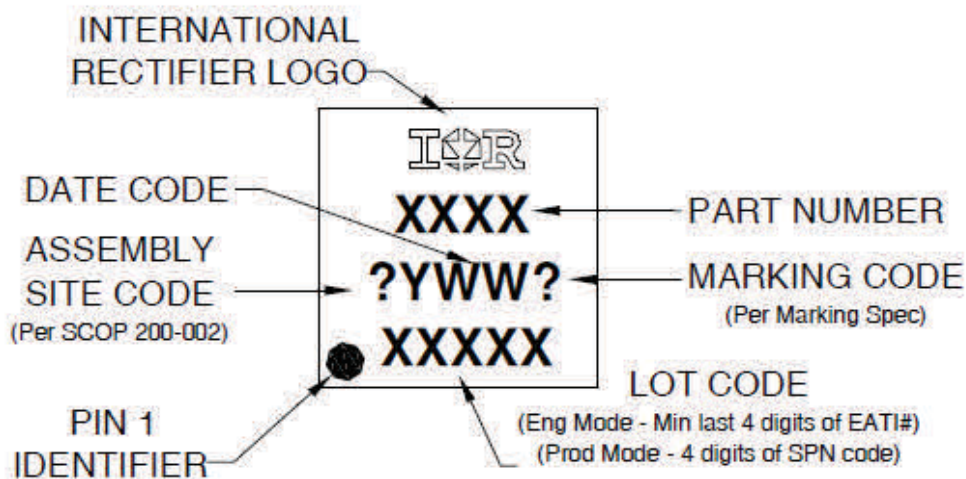


SYMBOL	COMMON			
	MM		INCH	
	MIN.	MAX.	MIN.	MAX.
A	0.70	1.05	0.0276	0.0413
A1	0.12	0.39	0.0047	0.0154
b	0.25	0.39	0.0098	0.0154
D	3.20	3.45	0.1260	0.1358
D1	3.00	3.20	0.1181	0.1417
D2	1.69	2.20	0.0665	0.0866
E	3.20	3.40	0.1260	0.1339
E1	3.00	3.20	0.1181	0.1417
E2	2.15	2.59	0.0846	0.1020
e	0.65 BSC		0.0256 BSC	
L	0.15	0.55	0.0059	0.0217
M	0.59	—	0.0232	—
O	9Deg	12Deg	9Deg	12Deg

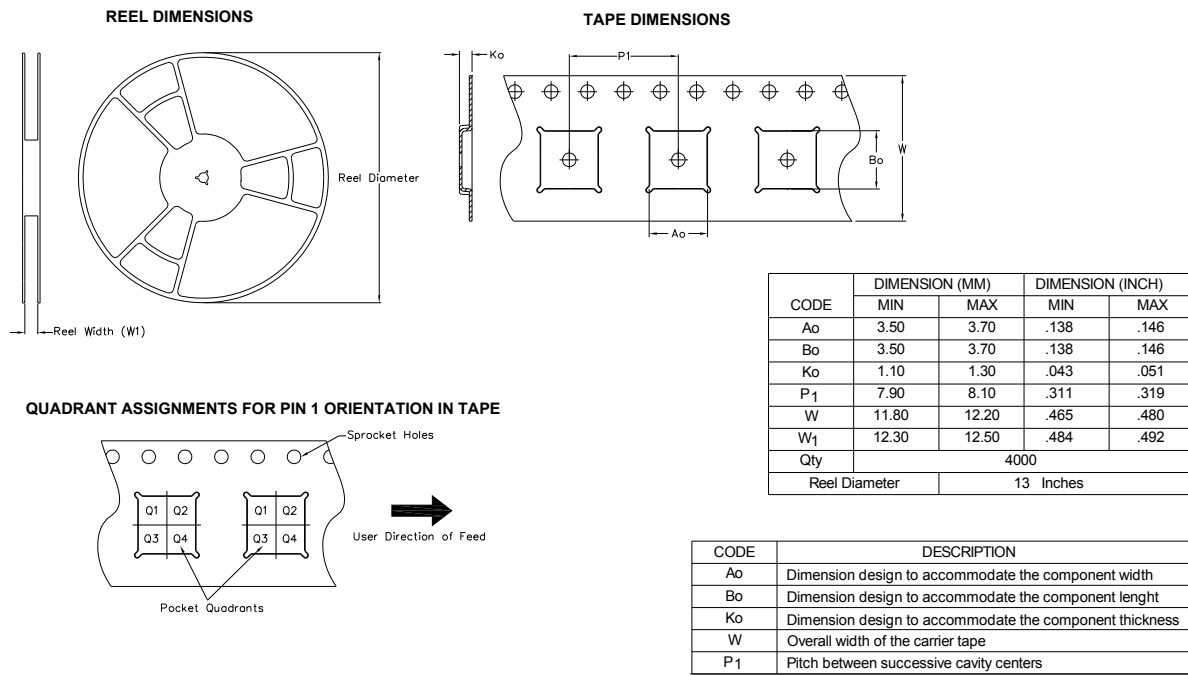
For more information on board mounting, including footprint and stencil recommendation, please refer to application note AN-1136: <http://www.irf.com/technical-info/appnotes/an-1136.pdf>

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 3.3 x 3.3 Part Marking



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

PQFN 3.3 x 3.3 Tape and Reel


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

Qualification Information[†]

Qualification Level	Industrial (per JEDEC JESD47F ^{††} guidelines)	
Moisture Sensitivity Level	PQFN 3.3mm x 3.3mm	MSL1 (per JEDEC J-STD-020D ^{††})
RoHS Compliant	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 $T_J = 25^{\circ}\text{C}$, $L = 0.093\text{mH}$, $R_G = 50\Omega$, $I_{AS} = 30\text{A}$.
- ③ Pulse width $\leq 400\mu\text{s}$; duty cycle $\leq 2\%$.
- ④ R_{θ} is measured at T_J of approximately 90°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.
- ⑦ Current is limited to 40A by source bonding technology.

Revision History

Date	Comments
6/5/14	• Updated schematic on page 1 • Updated tape and reel on page 9

International
 Rectifier

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