

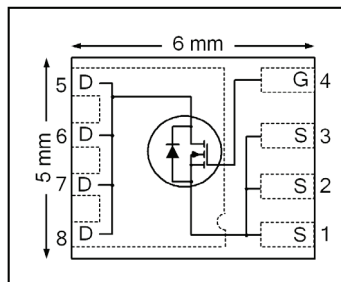
HEXFET® Power MOSFET

Application

- Half-bridge and full-bridge topologies
- Synchronous rectifier applications
- Resonant mode power supplies
- DC/DC converters
- DC/AC Inverters

Benefits

- Improved Gate, Avalanche and Dynamic dV/dt Ruggedness
- Fully Characterized Capacitance and Avalanche SOA
- Enhanced body diode dV/dt and dI/dt Capability
- Lead-Free, RoHS Compliant



V_{DS}	60V
$R_{DS(on)}$ typ. max	2.6mΩ
	3.2mΩ
I_D (Silicon Limited)	147A①
I_D (Package Limited)	100A①



Base part number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
IRFH7085PbF	PQFN 5mm x 6mm	Tape and Reel	4000	IRFH7085TRPbF

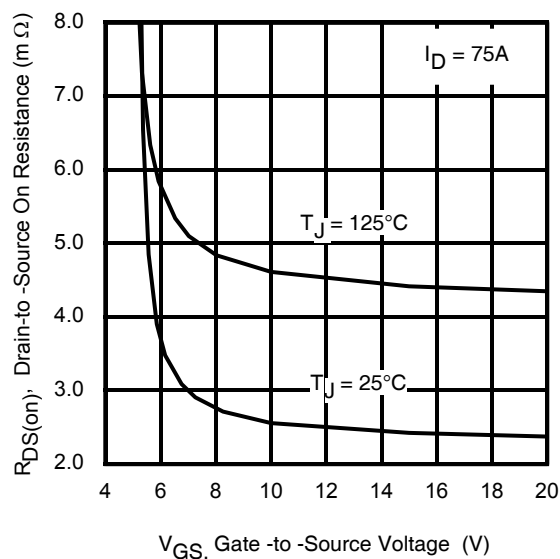


Fig 1. Typical On-Resistance vs. Gate Voltage

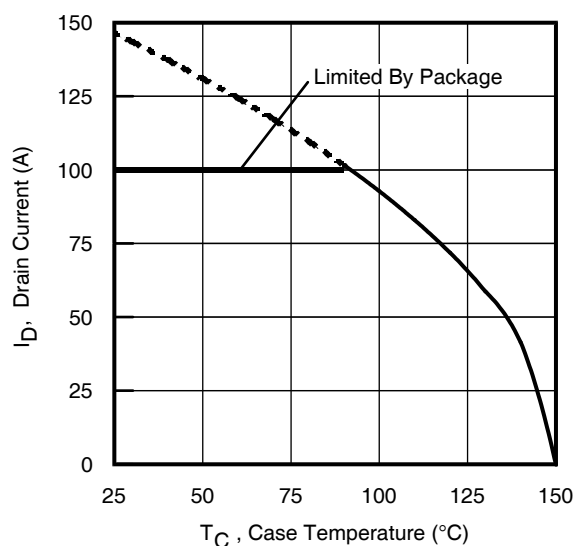


Fig 2. Maximum Drain Current vs. Case Temperature

Absolute Maximum Rating

Symbol	Parameter	Max.	Units
$I_D @ T_A = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$	23	A
$I_D @ T_{C(\text{Bottom})} = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Silicon Limited)	147 ^①	
$I_D @ T_{C(\text{Bottom})} = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$	93	
$I_D @ T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Package Limited)	100 ^①	
I_{DM}	Pulsed Drain Current ^②	590	A
$P_D @ T_C = 25^\circ\text{C}$	Maximum Power Dissipation	156	W
	Linear Derating Factor	1.25	W/ $^\circ\text{C}$
V_{GS}	Gate-to-Source Voltage	± 20	V
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 150	$^\circ\text{C}$

Avalanche Characteristics

Symbol	Parameter	Max.	Units
E_{AS} (Thermally limited)	Single Pulse Avalanche Energy ^③	319	mJ
E_{AS} (Thermally limited)	Single Pulse Avalanche Energy ^④	554	
I_{AR}	Avalanche Current ^②	See Fig 15, 16, 23a, 23b	A
E_{AR}	Repetitive Avalanche Energy ^②		mJ

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$ (Bottom)	Junction-to-Case ^⑧	0.5	0.8	$^\circ\text{C/W}$
$R_{\theta JC}$ (Top)	Junction-to-Case ^⑧	—	20	
$R_{\theta JA}$	Junction-to-Ambient ^⑩	—	34	
$R_{\theta JA}$ (<10s)	Junction-to-Ambient	—	22	

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

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	60	—	—	V	$V_{GS} = 0\text{V}$, $I_D = 250\mu\text{A}$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	43	—	mV/ $^\circ\text{C}$	Reference to 25°C , $I_D = 1.0\text{mA}$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	2.6	3.2	m Ω	$V_{GS} = 10\text{V}$, $I_D = 75\text{A}$
		—	3.6	—		$V_{GS} = 6.0\text{V}$, $I_D = 38\text{A}$
$V_{GS(th)}$	Gate Threshold Voltage	2.1	—	3.7	V	$V_{DS} = V_{GS}$, $I_D = 150\mu\text{A}$
I_{DSS}	Drain-to-Source Leakage Current	—	—	1.0	μA	$V_{DS} = 60\text{V}$, $V_{GS} = 0\text{V}$
		—	—	150		$V_{DS} = 60\text{V}$, $V_{GS} = 0\text{V}$, $T_J = 125^\circ\text{C}$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 20\text{V}$
	Gate-to-Source Reverse Leakage	—	—	-100		$V_{GS} = -20\text{V}$
R_G	Gate Resistance	—	1.4	—	Ω	

Notes:

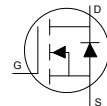
- ① Calculated continuous current based on maximum allowable junction temperature. Package is limited to 100A by production test capability.
- ② Repetitive rating; pulse width limited by max. junction temperature.
- ③ Limited by T_{Jmax} , starting $T_J = 25^\circ\text{C}$, $L = 113\mu\text{H}$, $R_G = 50\Omega$, $I_{AS} = 75\text{A}$, $V_{GS} = 10\text{V}$.
- ④ $I_{SD} \leq 75\text{A}$, $di/dt \leq 1280\text{A}/\mu\text{s}$, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq 150^\circ\text{C}$.
- ⑤ Pulse width $\leq 400\mu\text{s}$; duty cycle $\leq 2\%$.
- ⑥ C_{oss} eff. (TR) is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .
- ⑦ C_{oss} eff. (ER) is a fixed capacitance that gives the same energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .
- ⑧ R_{θ} is measured at T_J approximately 90°C .
- ⑨ Limited by T_{Jmax} , starting $T_J = 25^\circ\text{C}$, $L = 1\text{mH}$, $R_G = 50\Omega$, $I_{AS} = 33\text{A}$, $V_{GS} = 10\text{V}$.
- ⑩ When mounted on 1 inch square PCB (FR-4). Please refer to AN-994 for more details:

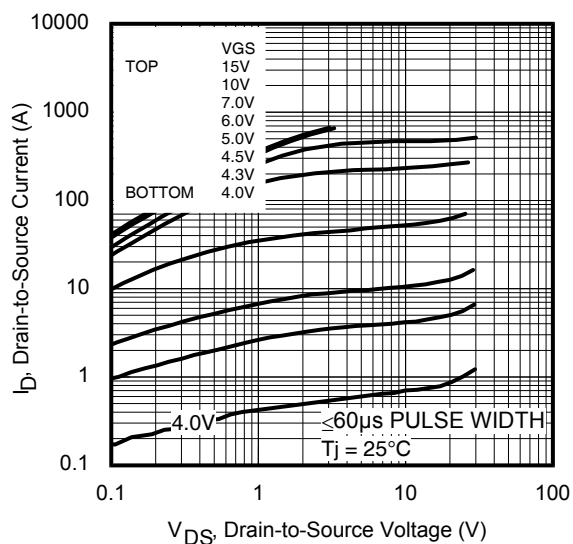
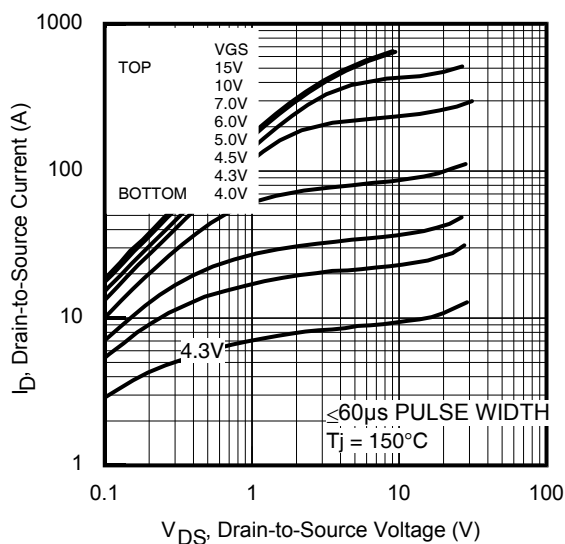
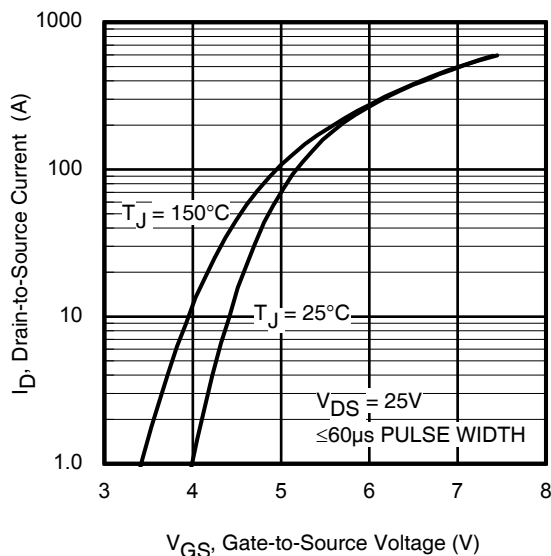
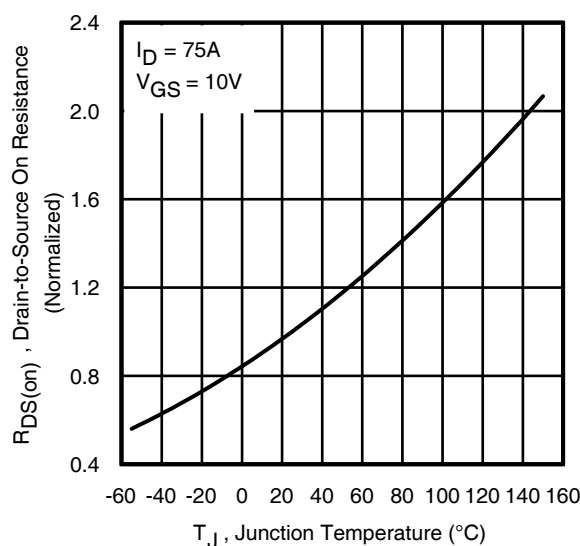
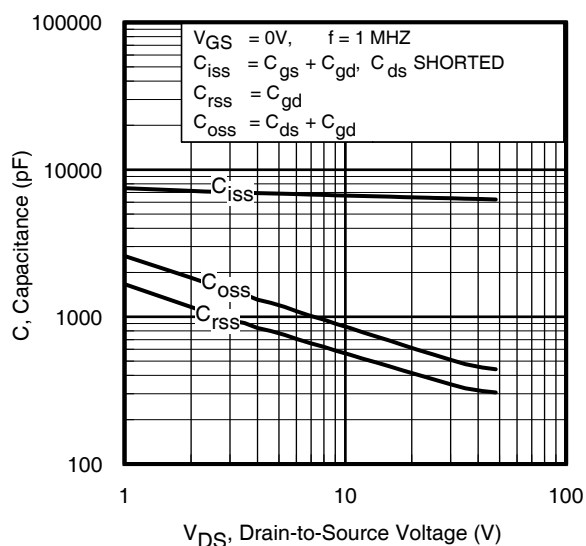
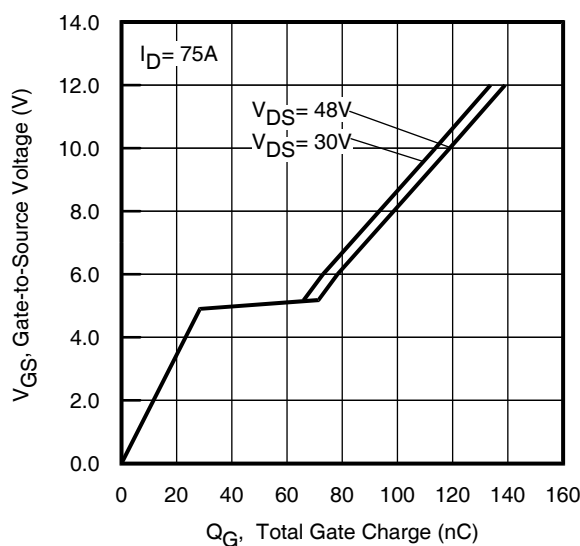
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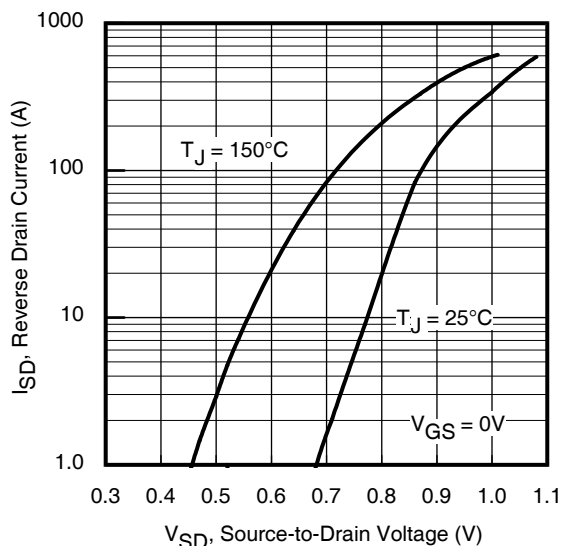
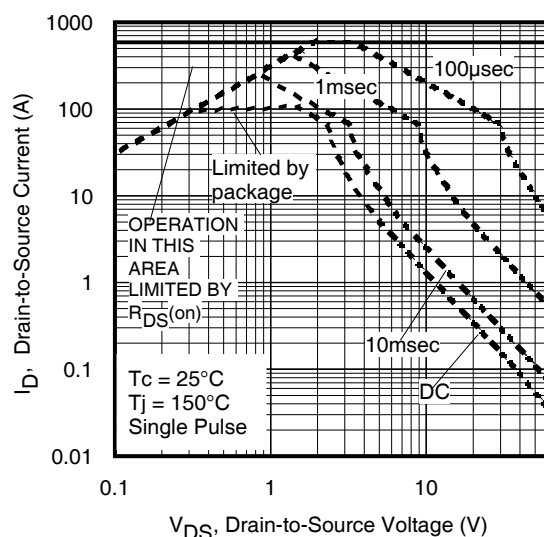
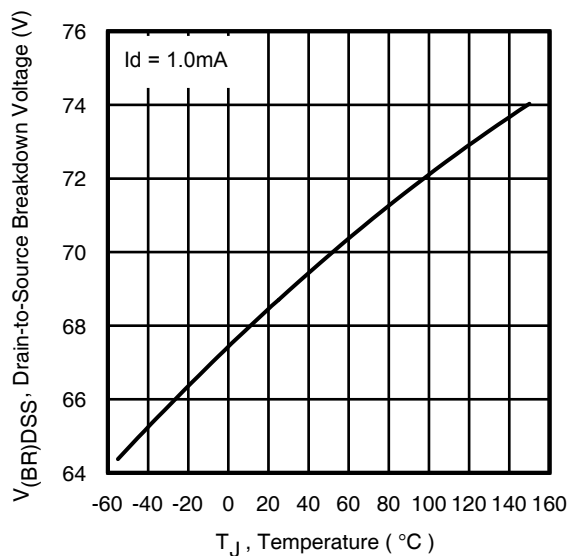
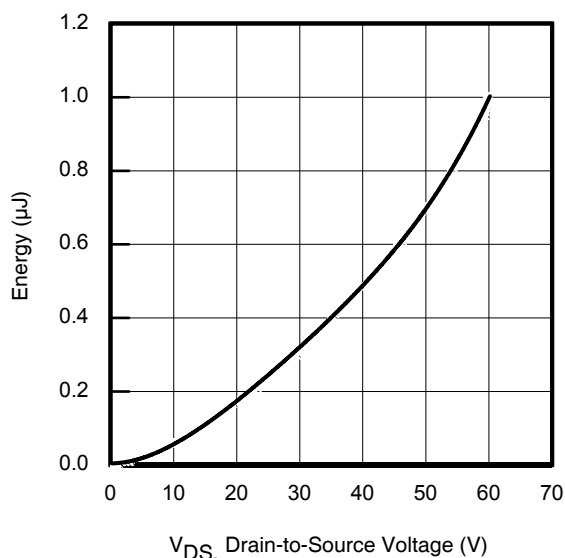
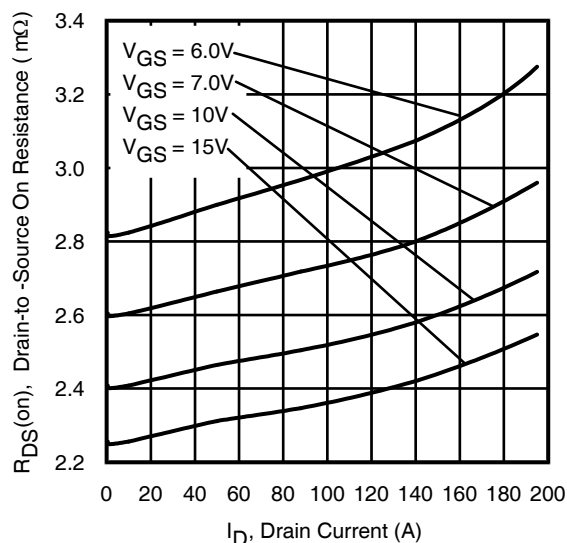
Dynamic Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
g_{fs}	Forward Transconductance	140	—	—	S	$V_{DS} = 10\text{V}$, $I_D = 75\text{A}$
Q_g	Total Gate Charge	—	110	165	nC	$I_D = 75\text{A}$ $V_{DS} = 30\text{V}$ $V_{GS} = 10\text{V}$
Q_{gs}	Gate-to-Source Charge	—	30	—		
Q_{gd}	Gate-to-Drain Charge	—	36	—		
Q_{sync}	Total Gate Charge Sync. ($Q_g - Q_{gd}$)	—	74	—		
$t_{d(on)}$	Turn-On Delay Time	—	13	—	ns	$V_{DD} = 30\text{V}$ $I_D = 30\text{A}$ $R_G = 2.7\Omega$ $V_{GS} = 10\text{V}^{(5)}$
t_r	Rise Time	—	25	—		
$t_{d(off)}$	Turn-Off Delay Time	—	63	—		
t_f	Fall Time	—	23	—		
C_{iss}	Input Capacitance	—	6460	—	pF	$V_{GS} = 0\text{V}$
C_{oss}	Output Capacitance	—	560	—		$V_{DS} = 25\text{V}$
C_{rss}	Reverse Transfer Capacitance	—	380	—		$f = 1.0\text{MHz}$
$C_{oss\text{ eff.}(ER)}$	Effective Output Capacitance (Energy Related)	—	570	—		$V_{GS} = 0\text{V}$, $V_{DS} = 0\text{V}$ to $48\text{V}^{(7)}$
$C_{oss\text{ eff.}(TR)}$	Output Capacitance (Time Related)	—	715	—		$V_{GS} = 0\text{V}$, $V_{DS} = 0\text{V}$ to $48\text{V}^{(6)}$

Diode Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	147 ⁽¹⁾	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ⁽²⁾	—	—	590		
V_{SD}	Diode Forward Voltage	—	—	1.2	V	$T_J = 25^\circ\text{C}$, $I_S = 75\text{A}$, $V_{GS} = 0\text{V}$ ⁽⁵⁾
dv/dt	Peak Diode Recovery dv/dt ⁽⁴⁾	—	3.0	—	V/ns	$T_J = 150^\circ\text{C}$, $I_S = 75\text{A}$, $V_{DS} = 60\text{V}^{(5)}$
t_{rr}	Reverse Recovery Time	—	31 30	—	ns	$T_J = 25^\circ\text{C}$ $V_{DD} = 51\text{V}$ $T_J = 125^\circ\text{C}$ $I_F = 75\text{A}$, $T_J = 25^\circ\text{C}$ $di/dt = 100\text{A}/\mu\text{s}$ ⁽⁵⁾ $T_J = 125^\circ\text{C}$
Q_{rr}	Reverse Recovery Charge	—	39 33	—		
I_{RRM}	Reverse Recovery Current	—	1.9	—	A	$T_J = 25^\circ\text{C}$


Fig 3. Typical Output Characteristics

Fig 4. Typical Output Characteristics

Fig 5. Typical Transfer Characteristics

Fig 6. Normalized On-Resistance vs. Temperature

Fig 7. Typical Capacitance vs. Drain-to-Source Voltage

Fig 8. Typical Gate Charge vs. Gate-to-Source Voltage


Fig 9. Typical Source-Drain Diode Forward Voltage

Fig 10. Maximum Safe Operating Area

Fig 11. Drain-to-Source Breakdown Voltage

Fig 12. Typical C_{OSS} Stored Energy

Fig 13. Typical On-Resistance vs. Drain Current

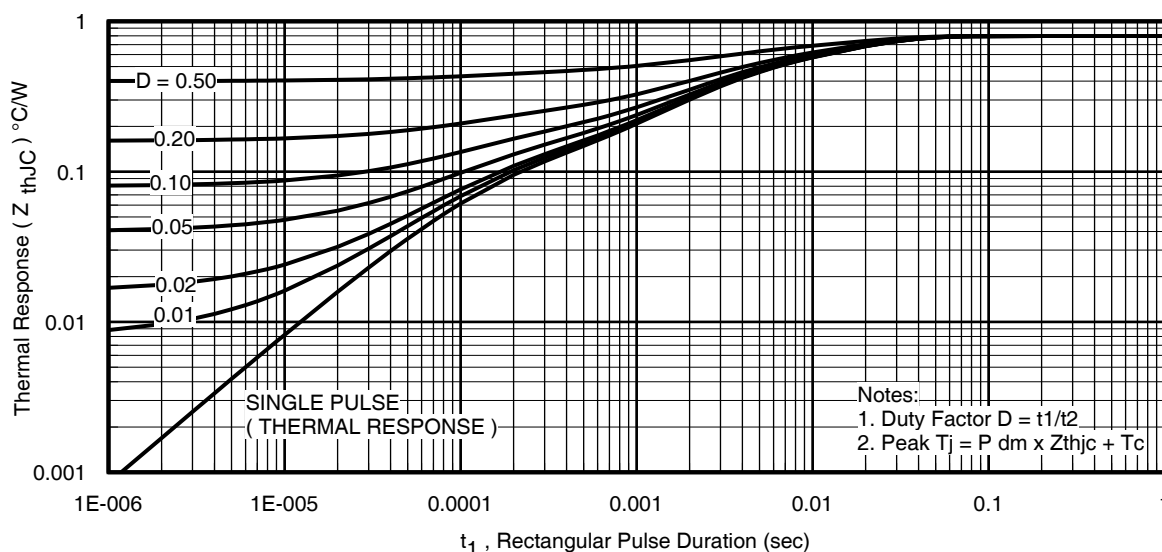


Fig 14. Maximum Effective Transient Thermal Impedance, Junction-to-Case

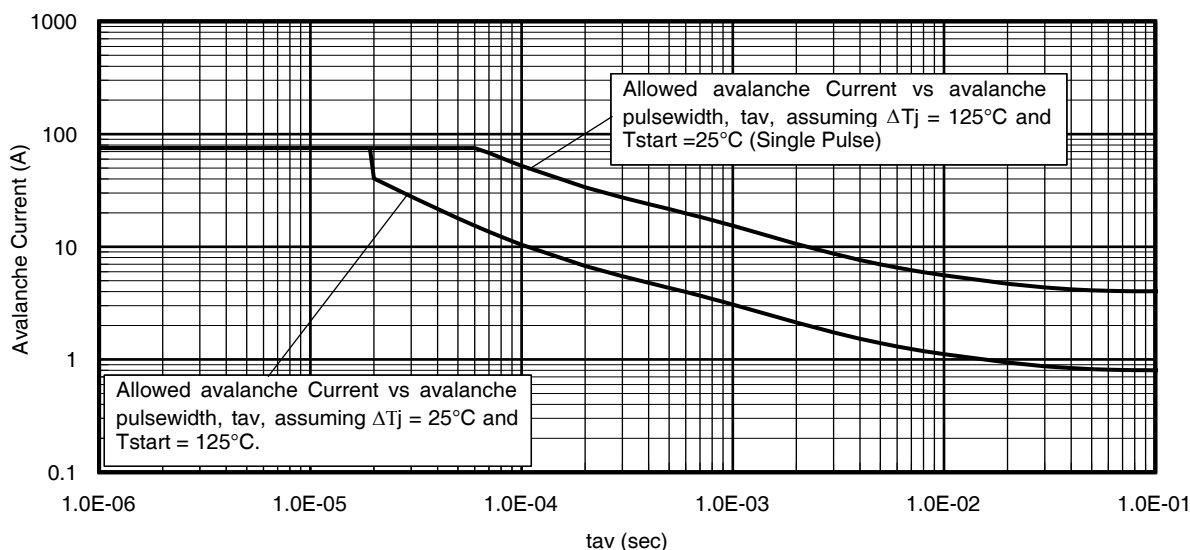


Fig 15. Typical Avalanche Current vs. Pulse Width

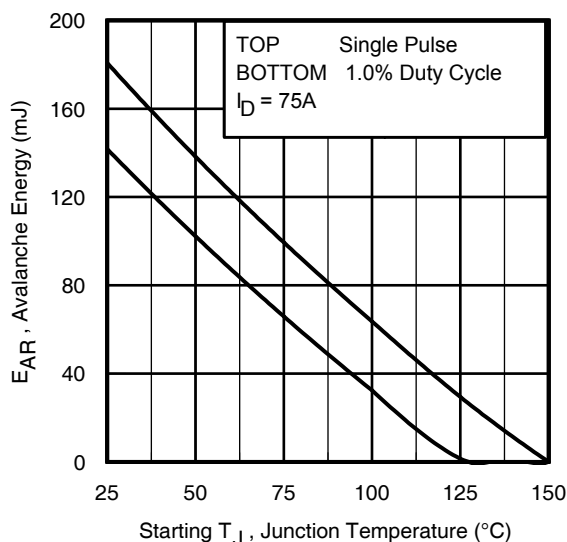
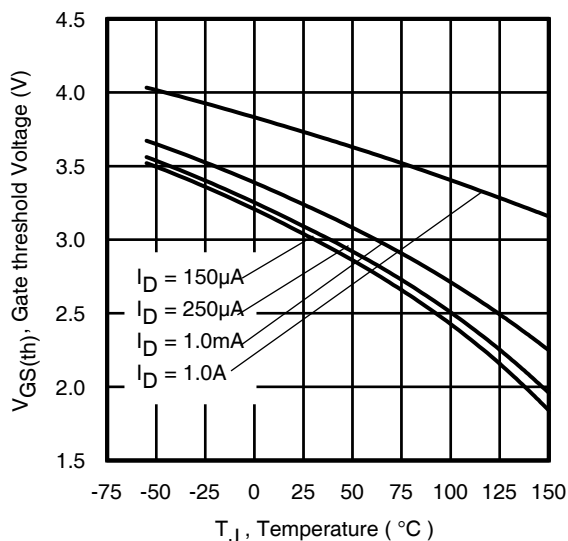
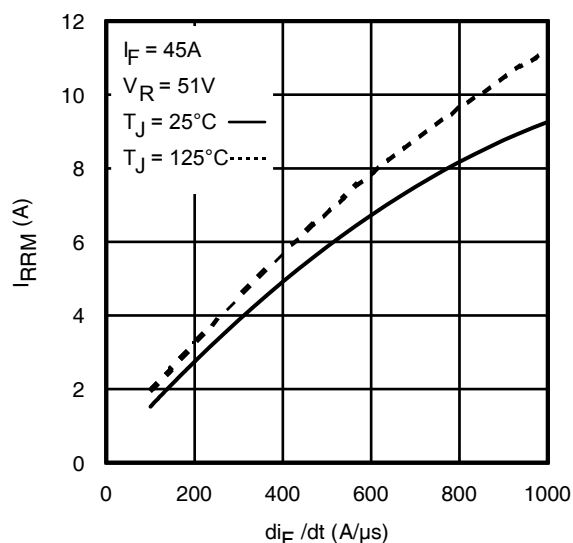
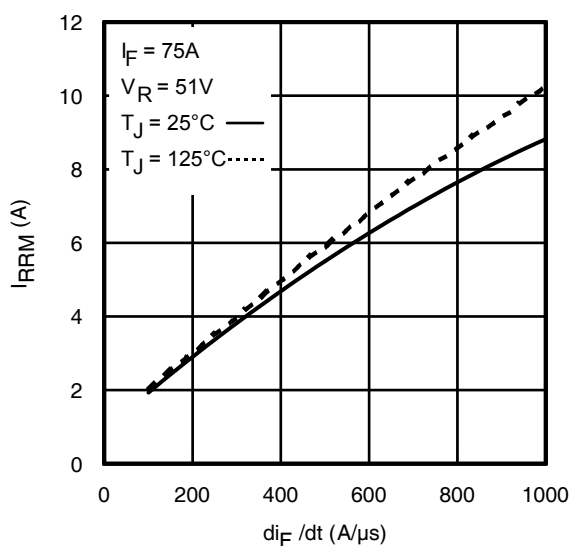
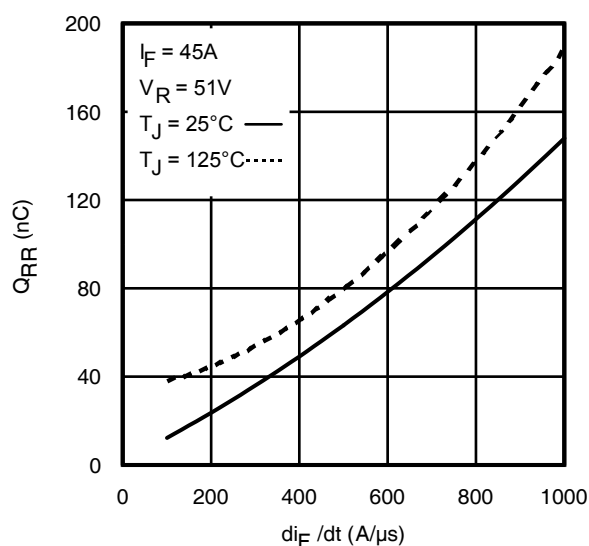
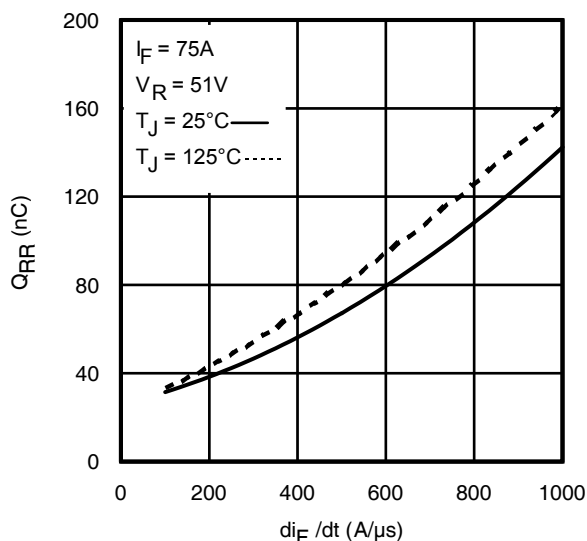


Fig 16. Maximum Avalanche Energy vs. Temperature

Notes on Repetitive Avalanche Curves , Figures 15, 16:
(For further info, see AN-1005 at www.irf.com)

1. Avalanche failures assumption:
Purely a thermal phenomenon and failure occurs at a temperature far in excess of T_{jmax} . This is validated for every part type.
2. Safe operation in Avalanche is allowed as long as T_{jmax} is not exceeded.
3. Equation below based on circuit and waveforms shown in Figures 22a, 22b.
4. $P_{D(ave)}$ = Average power dissipation per single avalanche pulse.
5. BV = Rated breakdown voltage (1.3 factor accounts for voltage increase during avalanche).
6. I_{av} = Allowable avalanche current.
7. ΔT = Allowable rise in junction temperature, not to exceed T_{jmax} (assumed as 25°C in Figure 14, 16).
 t_{av} = Average time in avalanche.
 D = Duty cycle in avalanche = $t_{av} \cdot f$
 $Z_{thJC}(D, t_{av})$ = Transient thermal resistance, see Figures 13)
 $PD(ave) = 1/2 (1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$
 $I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{th}]$
 $E_{AS(AR)} = P_{D(ave)} \cdot t_{av}$


Fig 17. Threshold Voltage vs. Temperature

Fig 18. Typical Recovery Current vs. di_F/dt

Fig 19. Typical Recovery Current vs. di_F/dt

Fig 20. Typical Stored Charge vs. di_F/dt

Fig 21. Typical Stored Charge vs. di_F/dt

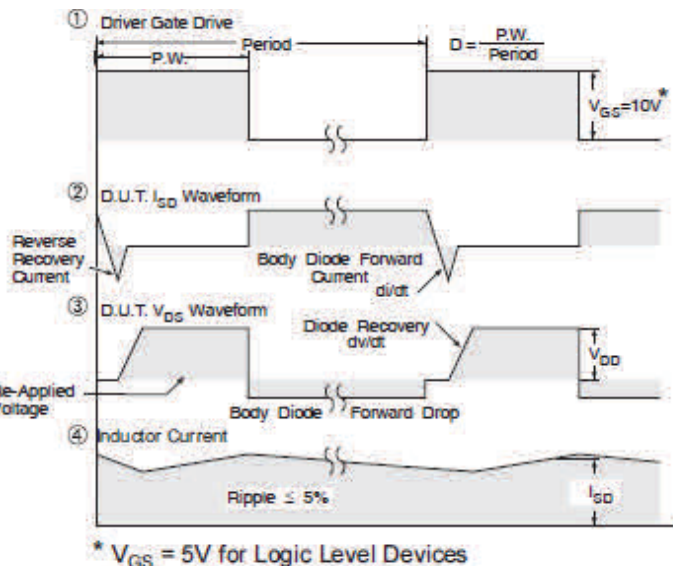
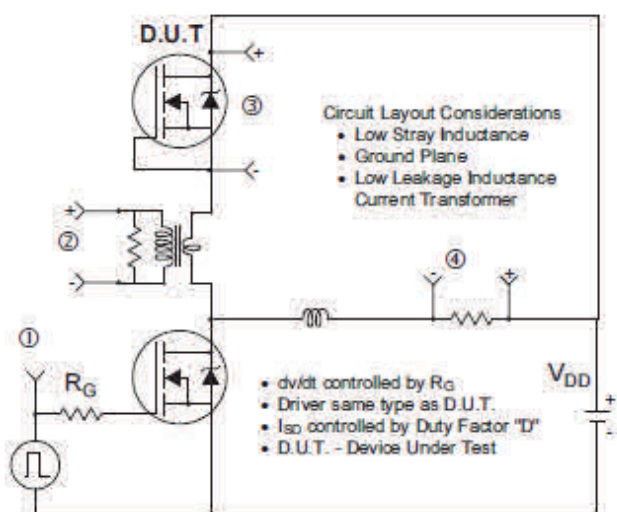


Fig 22. Peak Diode Recovery dV/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

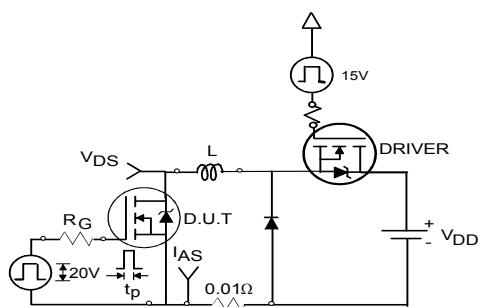


Fig 23a. Unclamped Inductive Test Circuit

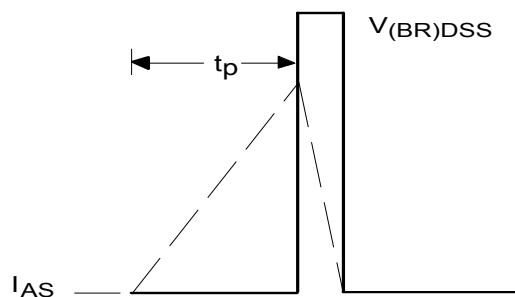


Fig 23b. Unclamped Inductive Waveforms

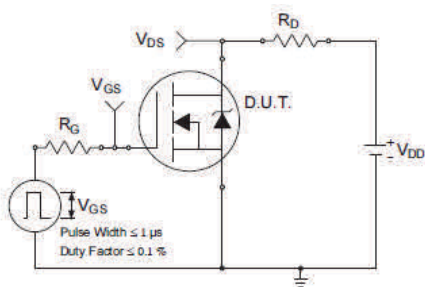


Fig 24a. Switching Time Test Circuit

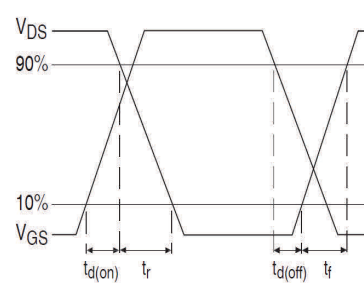


Fig 24b. Switching Time Waveforms

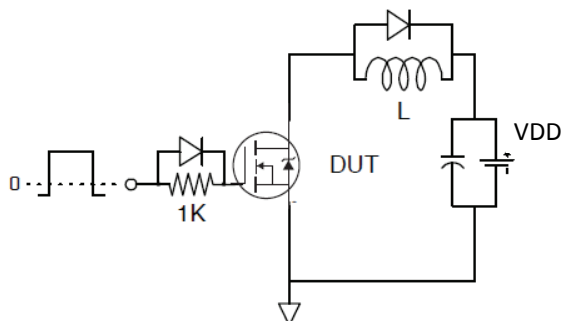


Fig 25a. Gate Charge Test Circuit

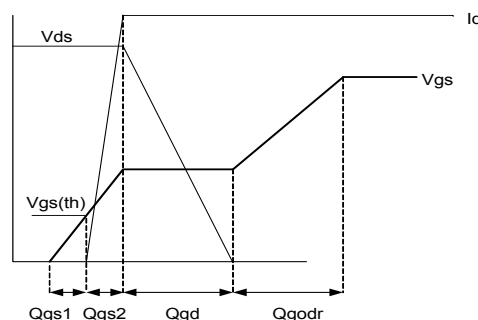
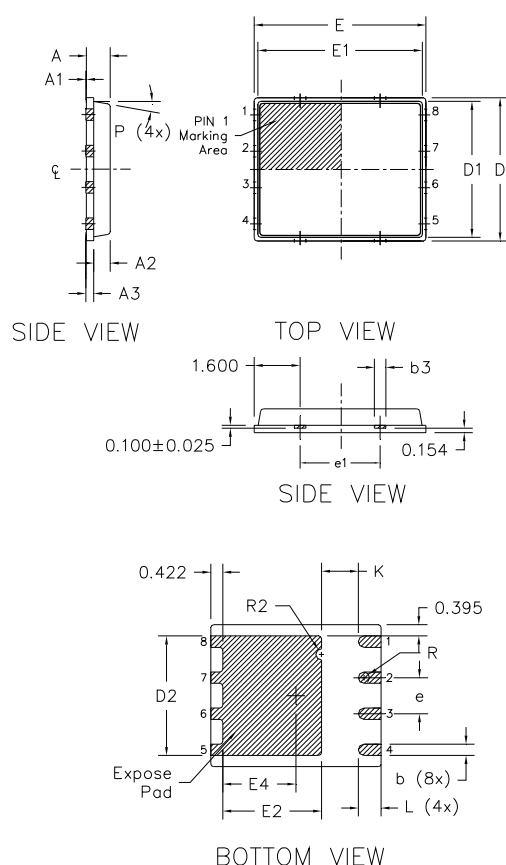


Fig 25b. Gate Charge Waveform

PQFN 5x6 Outline "B" Package Details


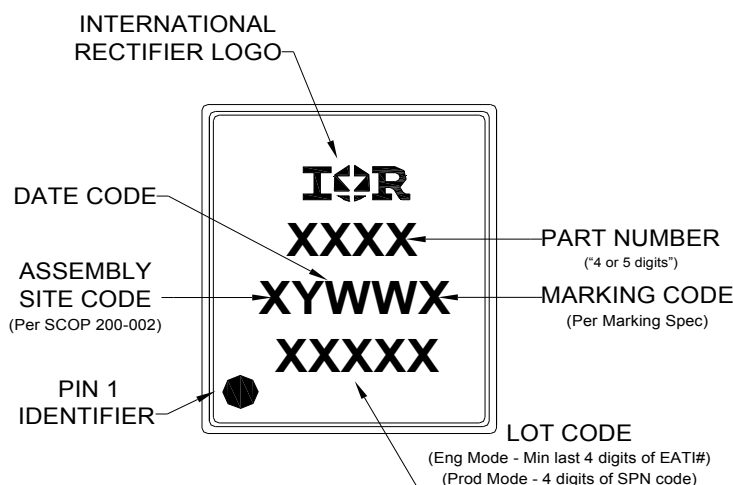
DIM SYMBOL	MILLIMETERS		INCH	
	MIN	MAX	MIN	MAX
A	0.800	0.900	0.0315	0.0543
A1	0.000	0.050	0.0000	0.0020
A3	0.200	REF	0.0079	REF
b	0.350	0.470	0.0138	0.0185
b1	0.025	0.125	0.0010	0.0049
b2	0.210	0.410	0.0083	0.0161
b3	0.150	0.450	0.0059	0.0177
D	5.000	BSC	0.1969	BSC
D1	4.750	BSC	0.1870	BSC
D2	4.100	4.300	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

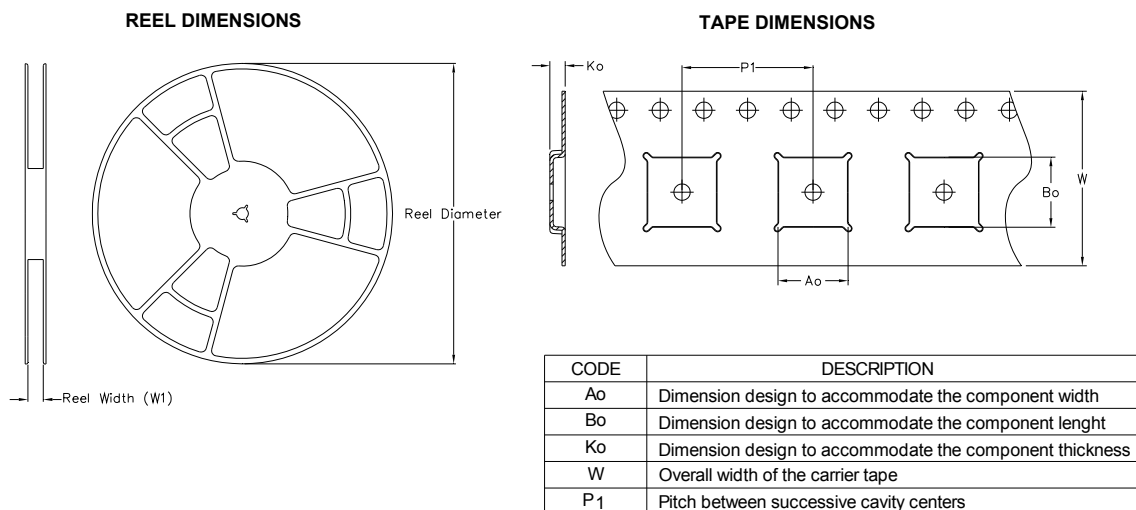
For more information on board mounting, including footprint and stencil recommendation, please refer to application note AN-1136: <http://www.irf.com/technical-info/appnotes/an-1136.pdf>

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

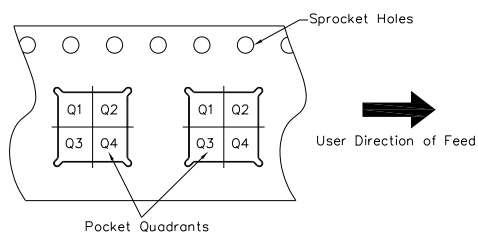
PQFN 5x6 Part Marking


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

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.irf.com/package/>

Qualification Information[†]

Qualification level	Industrial (per JEDEC JESD47F ^{††} guidelines)	
Moisture Sensitivity Level	PQFN 5mm x 6mm	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.

Revision History

Date	Comments
11/7/2014	- Added $E_{AS} (L = 1mH) = 554mJ$ on page 2 - Added note 9 "Limited by T_{Jmax}, starting $T_J = 25^{\circ}C$, $L = 1mH$, $R_G = 50\Omega$, $I_{AS} = 33A$, $V_{GS} = 10V$". on page 2 - Added $P_d @ T_c = 25^{\circ}C$ on Absolute Max Rating table on page 2
3/17/2015	Updated package outline and tape and reel on pages 9 and 10.

International
 Rectifier

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