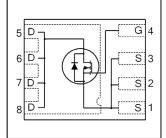




V _{DSS}	25	V
V _{GS} max	±20	V
$R_{DS(on)}$ max (@ V_{GS} = 10V)	7.7	mΩ
(@ V _{GS} = 4.5V)	13.4	
Qg (typical)	7.7	nC
I _D (@T _{C (Bottom)} = 25°C)	25⑦	A

HEXFET® Power MOSFET





Applications

• Control MOSFET for synchronous buck converter

Features

Low Thermal Resistance to PCB (<4.1°C/W)	
Low Profile (<1.05mm)	
Industry-Standard Pin out	results in
Compatible with Existing Surface Mount Techniqu	es ⇒
RoHS Compliant, Halogen-Free	
MSL1, Consumer Qualification	

Benefits

	Enable better Thermal Dissipation
	Increased Power Density
n	Multi-Vendor Compatibility
	Easier Manufacturing
	Environmentally Friendlier
	Increased Reliability

Base west womber Backene Toma		Standard P	ack	Orderable Part Number	
Base part number	Package Type	Form	Quantity	Orderable Part Number	
IRFHM8235PbF	PQFN 3.3 mm x 3.3 mm	Tape and Reel	4000	IRFHM8235TRPbF	

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	16	
I _D @ T _A = 70°C	Continuous Drain Current, V _{GS} @ 10V	13	
I _D @ T _{C(Bottom)} = 25°C	Continuous Drain Current, V _{GS} @ 10V	50 ©⑦	
I _D @ T _{C(Bottom)} = 100°C	Continuous Drain Current, V _{GS} @ 10V	32@⑦	Α
I _D @ T _C = 25°C Continuous Drain Current, V _{GS} @ 10V (Source Bonding Technology Limited)		25⑦	
I _{DM}	Pulsed Drain Current ①		
P _D @T _A = 25°C Power Dissipation ©		3.0	10/
P _D @T _{C(Bottom)} = 25°C	Power Dissipation ®	30	W
Linear Derating Factor ®		0.024	W/°C
TJ	Operating Junction and	-55 to + 150	°C
T _{STG}	Storage Temperature Range		°C

Notes ① through ® are on page 10

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Static @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Тур.	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		19		mV/°C	Reference to 25°C, I _D = 1.0mA
R _{DS(on)}	Static Drain-to-Source On-Resistance		6.2	7.7	*** O	$V_{GS} = 10V, I_D = 20A $ ③
			10.3	13.4	mΩ	$V_{GS} = 4.5V, I_D = 16A \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$
$V_{GS(th)}$	Gate Threshold Voltage	1.35	1.8	2.35	V	\\ -\\ -25\
$\Delta V_{GS(th)}$	Gate Threshold Voltage Coefficient		-5.9		mV/°C	$V_{DS} = V_{GS}, I_D = 25\mu A$
I _{DSS}	Drain-to-Source Leakage Current			1.0	μA	$V_{DS} = 20V, V_{GS} = 0V$
				150	μΑ	$V_{DS} = 20V, V_{GS} = 0V, T_{J} = 125^{\circ}C$
I_{GSS}	Gate-to-Source Forward Leakage			100	n ^	$V_{GS} = 20V$
	Gate-to-Source Reverse Leakage			-100	nA	$V_{GS} = -20V$
gfs	Forward Transconductance	43			S	$V_{DS} = 10V, I_{D} = 20A$
Q_g	Total Gate Charge		16		nC	$V_{GS} = 10V, V_{DS} = 13V, I_{D} = 20A$
Q_g	Total Gate Charge		7.7	12		
Q_{gs1}	Pre-Vth Gate-to-Source Charge		1.9			V _{DS} = 13V
Q_{gs2}	Post-Vth Gate-to-Source Charge		1.3		nC	V _{GS} = 4.5V
$Q_{\sf gd}$	Gate-to-Drain Charge		2.7		110	I _D = 20A
Q_{godr}	Gate Charge Overdrive		1.5			
Q_{sw}	Switch Charge (Q _{gs2} + Q _{gd})		4.0			
Q _{oss}	Output Charge		6.4		nC	$V_{DS} = 16V, V_{GS} = 0V$
R_G	Gate Resistance		1.6		Ω	
t _{d(on)}	Turn-On Delay Time		7.9			$V_{DD} = 13V, V_{GS} = 4.5V$
t _r	Rise Time		16]	I _D = 20A
$t_{d(off)}$	Turn-Off Delay Time		7.5		ns	$R_G=1.8\Omega$
t _f	Fall Time		5.2			
C _{iss}	Input Capacitance		1040			V _{GS} = 0V
Coss	Output Capacitance		300		pF	V _{DS} = 10V
C _{rss}	Reverse Transfer Capacitance		120			f = 1.0 MHz

Avalanche Characteristics

	Parameter	Тур.	Max.	Units
E _{AS}	Single Pulse Avalanche Energy ②		41	mJ

Diode Characteristics

	Parameter	Min.	Тур.	Max.	Units	Conditions
Is	Continuous Source Current (Body Diode)			25⑦		MOSFET symbol showing the
I _{SM}	Pulsed Source Current (Body Diode) ①			240®		integral reverse p-n junction diode.
V_{SD}	Diode Forward Voltage			1.0	٧	$T_J = 25^{\circ}C$, $I_S = 20A$, $V_{GS} = 0V$ ③
t _{rr}	Reverse Recovery Time		10	15	ns	$T_J = 25^{\circ}C$, $I_F = 20A$, $V_{DD} = 13V$
Qrr	Reverse Recovery Charge		4.9	7.4	nC	di/dt = 300A/µs ③

Thermal Resistance

	Parameter	Тур.	Max.	Units
$R_{\theta JC}$ (Bottom)	Junction-to-Case ④		4.1	
R _{θJC} (Top)	Junction-to-Case ④		42	°C/W
$R_{\theta JA}$	Junction-to-Ambient ©		42	C/VV
R _{θJA} (<10s)	Junction-to-Ambient ©		28	



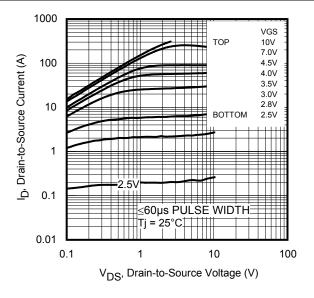


Fig 1. Typical Output Characteristics

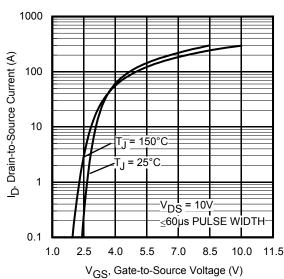


Fig 3. Typical Transfer Characteristics

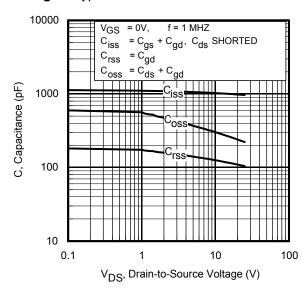


Fig 5. Typical Capacitance vs. Drain-to-Source Voltage

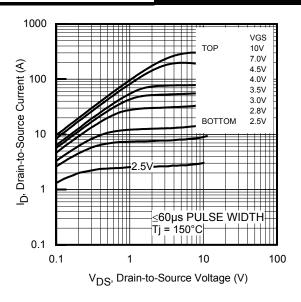


Fig 2. Typical Output Characteristics

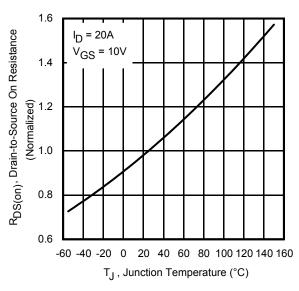


Fig 4. Normalized On-Resistance vs. Temperature

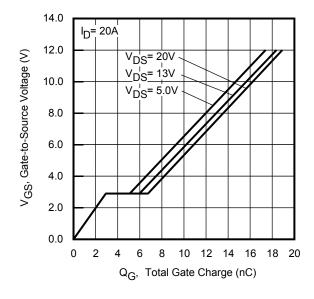


Fig 6. Typical Gate Charge vs. Gate-to-Source Voltage



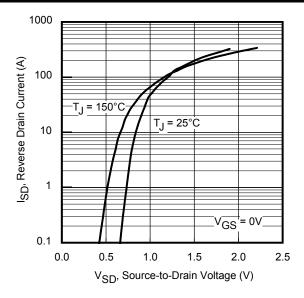


Fig 7. Typical Source-Drain Diode Forward Voltage

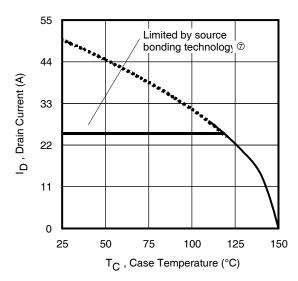


Fig 9. Maximum Drain Current vs. Case Temperature

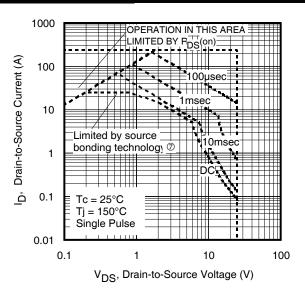


Fig 8. Maximum Safe Operating Area

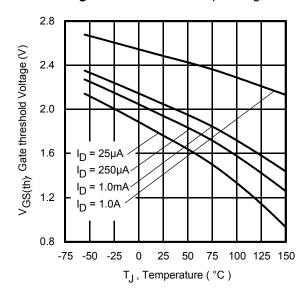


Fig 10. Threshold Voltage Vs. Temperature

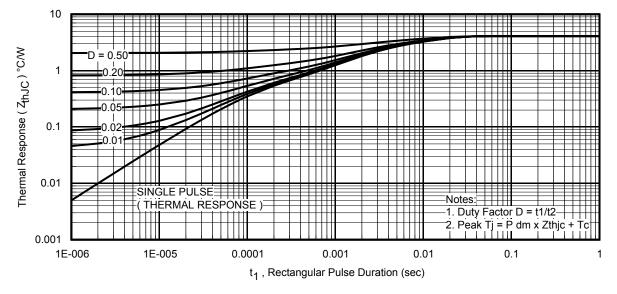
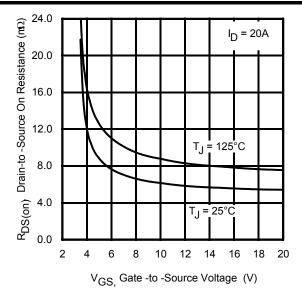


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

2016-2-23





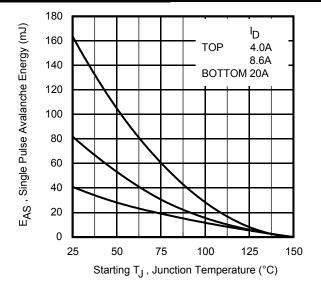


Fig 12. On-Resistance vs. Gate Voltage

Fig 13. Maximum Avalanche Energy vs. Drain Current

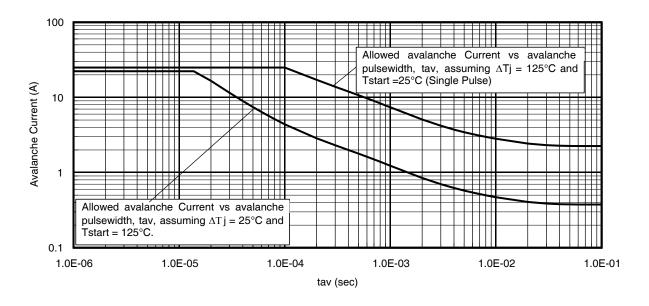


Fig 14. Single avalanche event: pulse current vs. pulse width



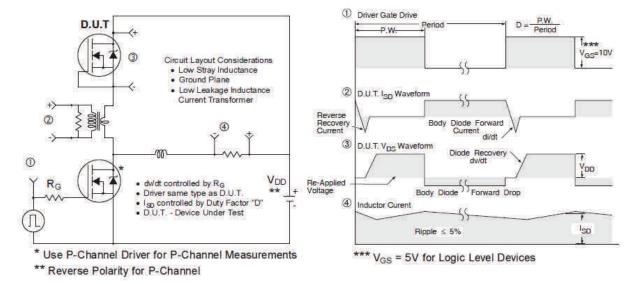


Fig 15. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

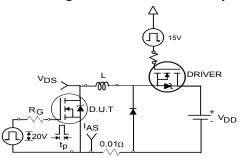


Fig 16a. Unclamped Inductive Test Circuit

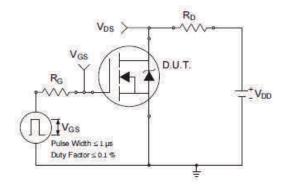


Fig 17a. Switching Time Test Circuit

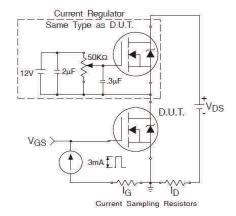


Fig 18a. Gate Charge Test Circuit

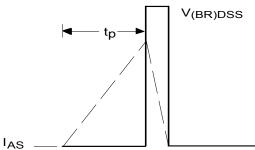


Fig 16b. Unclamped Inductive Waveforms

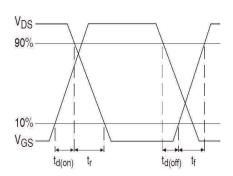


Fig 17b. Switching Time Waveforms

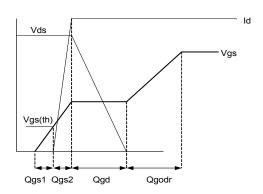


Fig 18b. Gate Charge Waveform

6



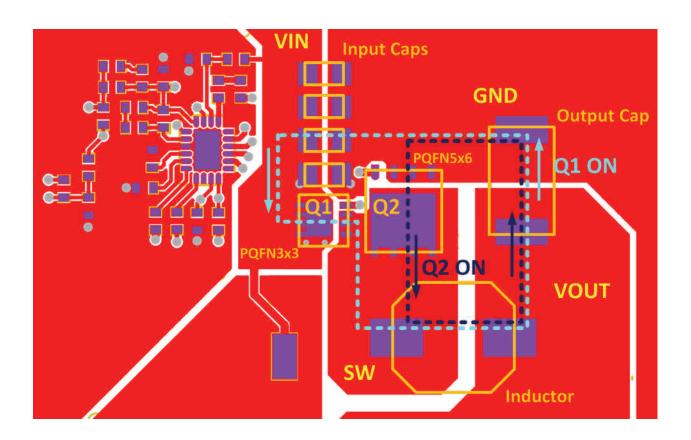
Placement and Layout Guidelines

The typical application topology for this product is the synchronous buck converter. These converters operate at high frequencies (typically around 400 kHz). During turn-on and turn-off switching cycles, the high di/dt currents circulating in the parasitic elements of the circuit induce high voltage ringing which may exceed the device rating and lead to undesirable effects. One of the major contributors to the increase in parasitics is the PCB power circuit inductance.

This section introduces a simple guideline that mitigates the effect of these parasitics on the performance of the circuit and provides reliable operation of the devices.

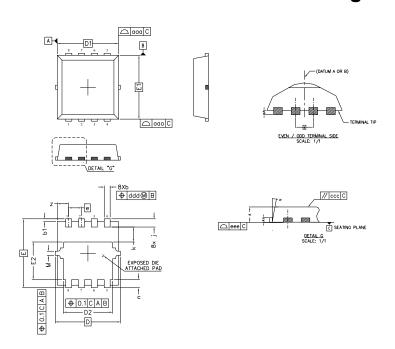
To reduce high frequency switching noise and the effects of Electromagnetic Interference (EMI) when the control MOSFET (Q1) is turned on, the layout shown in Figure 19 is recommended. The input bypass capacitors, control MOSFET and output capacitors are placed in a tight loop to minimize parasitic inductance which in turn lowers the amplitude of the switch node ringing, and minimizes exposure of the MOSFETs to repetitive avalanche conditions.

When the synchronous MOSFET (Q2) is turned on, high average DC current flows through the path indicated in Figure 19. Therefore, the Q2 turn-on path should be laid out with a tight loop and wide traces at both ends of the inductor to minimize loop resistance.



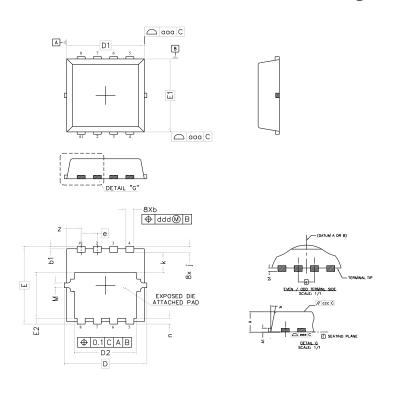


PQFN 3.3 x 3.3 Outline "C" Package Details



т				
DIM	MILLIMETERS		INCH	IES
DIM	MIN	MAX	MIN	MAX
A	0.70	0.80	.0276	.0315
A1	0.10	0.25	.0039	.0098
ь	0.25	0.35	.0098	.0138
ь1	0.05	0.15	.0020	.0059
D	3.20	3.40	.1260	.1339
D1	3.00	3.20	.1181	.1260
D2	2.39	2.59	.0941	.1020
E	3.25	3.45	.1280	.1358
E1	3.00	3.20	.1181	.1260
E2	1.78	1.98	.0701	.0780
е	0.65	BSC	.0255 BSC	
j	0.30	0.50	.0118	.0197
k	0.59	0.79	.0232	.0311
n	0.30	0.50	.0118	.0197
М	0.03	0.23	.0012	.0091
Р	10°	12*	10°	12*
z	0.50	0.70	.0197	.0276

PQFN 3.3 x 3.3 Outline "G" Package Details



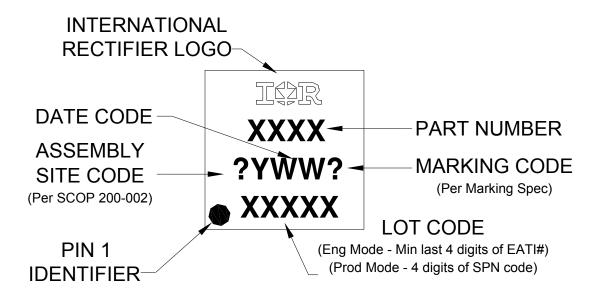
DIM	MILLIN	METERS	INCH	IES
DIM	MIN	MAX	MIN	MAX
А	0.80	0.90	.0315	.0354
Α1	0.12	0.22	.0047	.0086
Ь	0.22	0.42	.0087	.0165
b1	0.05	0.15	.0020	.0059
D	3.30	BSC	.1299	BSC
D1	3.10	BSC	.1220) BSC
D2	2.29	2.69	.0902	.1059
E	3.30	BSC	.1299 BSC	
E1	3.10	BSC	.1220 BSC	
E2	1.85	2.05	.0728	.0807
е	0.65	BSC	.0255	BSC
j	0.15	0.35	.0059	.0137
k	0.75	0.95	.0295	.0374
n	0.15	0.35	.0059	.0137
М	NOM.	0.20	NOM.	.0078
Р	9°	1 1°	9°	1 1°

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

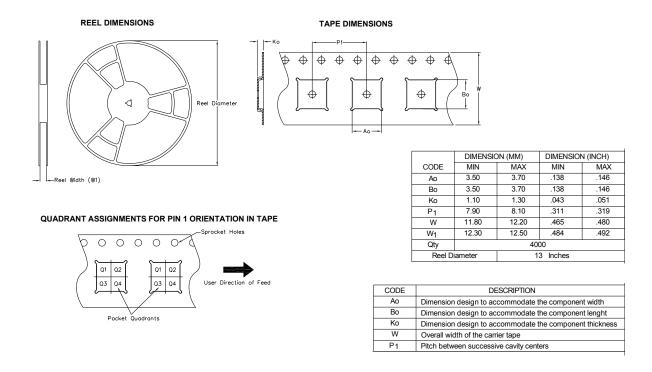


PQFN 3.3mm x 3.3mm Outline Part Marking



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

PQFN 3.3mm x 3.3mm Outline Tape and Reel



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



Qualification Information[†]

Qualification Level	Consumer ^{††} (per JEDEC JESD47F guidelines)			
Moisture Sensitivity Level	PQFN 3.3mm x 3.3mm (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/
- †† 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.

Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting $T_J = 25$ °C, L = 0.21mH, $R_G = 50\Omega$, $I_{AS} = 20$ A.
- 3 Pulse width \leq 400µs; duty cycle \leq 2%.
- 4 R_{θ} is measured at T_J of approximately 90°C.
- When mounted on 1 inch square 2 oz copper pad on 1.5x1.5 in. board of FR-4 material. Please refer to AN-994 for more details: http://www.irf.com/technical-info/appnotes/an-994.pdf
- © Calculated continuous current based on maximum allowable junction temperature.
- ② Current is limited to 25A by source bonding technology.
- Pulse drain current is limited to 100A by source bonding technology.



Revision History

Date	Comments
6/5/2014	 Updated schematic on page 1 Updated part marking on page 8 Updated tape and reel on page 9
6/30/2014	Remove "SAWN" package outline on page 8.
2/23/2016	 Updated datasheet with corporate template Updated package outline to reflect the PCN # (241-PCN30-Public) for "Option C" and "Option G" on page 8.

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