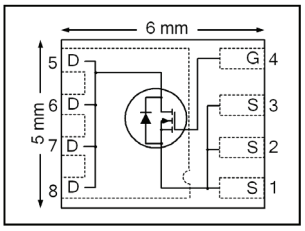
International
IOR Rectifier

StrongIRFET™
IRF40H210

HEXFET® Power MOSFET

Application

- Brushed Motor drive applications
- BLDC Motor drive applications
- Battery powered circuits
- Half-bridge and full-bridge topologies
- Synchronous rectifier applications
- Resonant mode power supplies
- OR-ing and redundant power switches
- DC/DC and AC/DC converters
- DC/AC Inverters



V_{DSS}	40V
$R_{DS(on)}$ typ.	1.4mΩ
max	1.7mΩ
$I_{D\ (Silicon\ Limited)}$	201A①
$I_{D\ (Package\ Limited)}$	100A

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

PQFN 5 x 6 mm

Base part number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
IRF40H210	PQFN 5mm x 6mm	Tape and Reel	4000	IRF40H210

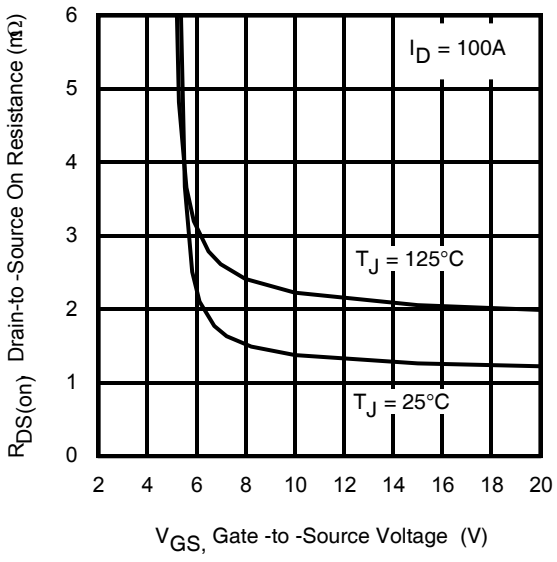


Fig 1. Typical On-Resistance vs. Gate Voltage

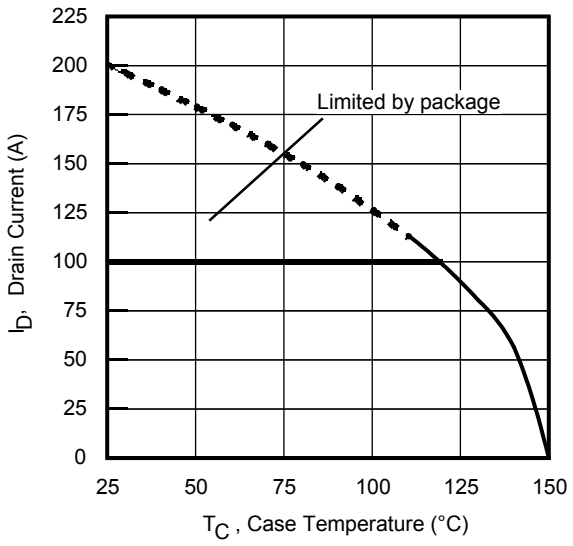


Fig 2. Maximum Drain Current vs. Case Temperature

Absolute Maximum Rating

Symbol	Parameter	Max.	Units
I_D @ $T_{C(Bottom)}$ = 25°C	Continuous Drain Current, V_{GS} @ 10V	201①	A
I_D @ $T_{C(Bottom)}$ = 100°C	Continuous Drain Current, V_{GS} @ 10V	127①	
I_D @ $T_{C(Bottom)}$ = 25°C	Continuous Drain Current, V_{GS} @ 10V(Wire Bond Limited)	100	
I_{DM}	Pulsed Drain Current ①	400*	
P_D @T_C = 25°C	Maximum Power Dissipation	125	W
	Linear Derating Factor	1.0	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 150	°C

Avalanche Characteristics

$E_{AS\ (Thermally\ limited)}$	Single Pulse Avalanche Energy ③	149	mJ
$E_{AS\ (Thermally\ limited)}$	Single Pulse Avalanche Energy ⑩	370	
I_{AR}	Avalanche Current ②	See Fig 15, 16, 23a, 23b	A
E_{AR}	Repetitive Avalanche Energy ②		mJ

Thermal Resistance

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$ (Bottom)	Junction-to-Case ⑧	——	1.0	°C/W
$R_{\theta JC}$ (Top)	Junction-to-Case ⑧	——	18	
$R_{\theta JA}$	Junction-to-Ambient ⑨	——	33	
$R_{\theta JA}$ (<10s)	Junction-to-Ambient ⑨	——	20	

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

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	40	——	——	V	V_{GS} = 0V, I_D = 250µA
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	——	42	——	mV/°C	Reference to 25°C, I_D = 1mA ②
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	——	1.4	1.7	mΩ	V_{GS} = 10V, I_D = 100A
		——	2.3	——		V_{GS} = 6.0V, I_D = 50A
$V_{GS(th)}$	Gate Threshold Voltage	2.2	——	3.7	V	V_{DS} = V_{GS}, I_D = 150µA
I_{DSS}	Drain-to-Source Leakage Current	——	——	1.0	µA	V_{DS} = 40 V, V_{GS} = 0V
		——	——	150		V_{DS} = 40V,V_{GS} = 0V,T_J =125°C
I_{GSS}	Gate-to-Source Forward Leakage	——	——	100	nA	V_{GS} = 20V
	Gate-to-Source Reverse Leakage	——	——	-100		V_{GS} = -20V
R_G	Gate Resistance	——	2.6	——	Ω	

Notes:

① Calculated continuous current based on maximum allowable junction temperature. Bond wire current limit is 100A by source bonding technology. Note that current limitations arising from heating of the device leads may occur with some lead mounting arrangements. (Refer to AN-1140)

② Repetitive rating; pulse width limited by max. junction temperature.

③ Limited by T_{Jmax}, starting T_J = 25°C, L = 0.030mH, R_G = 50Ω, I_{AS} = 100A, V_{GS} =10V.

④ $I_{SD} \le$ 100A, di/dt ≤ 1117A/µs, $V_{DD} \le V_{(BR)DSS}$, $T_J \le$ 150°C.

⑤ Pulse width ≤ 400µs; duty cycle ≤ 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 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

⑩ Limited by T_{Jmax}, starting T_J = 25°C, L = 1mH, R_G = 50Ω, I_{AS} = 27A, V_{GS} =10V.

* Pulse drain current is limited by source bonding technology.

Dynamic Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
gfs	Forward Transconductance	113	—	—	S	V_{DS} = 10V, I_D = 100A
Q_g	Total Gate Charge	—	101	152	nC	I_D = 100A
Q_{gs}	Gate-to-Source Charge	—	30	—		V_{DS} = 20V
Q_{gd}	Gate-to-Drain Charge	—	31	—		V_{GS} = 10V
Q_{sync}	Total Gate Charge Sync. (Qg – Qgd)	—	70	—		
$t_{d(on)}$	Turn-On Delay Time	—	9.2	—	ns	V_{DD} = 20V
t_r	Rise Time	—	25	—		I_D = 30A
$t_{d(off)}$	Turn-Off Delay Time	—	65	—		R_G= 2.7Ω
t_f	Fall Time	—	34	—		V_{GS} = 10V ⑤
C_{iss}	Input Capacitance	—	5406	—	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	—	805	—		V_{DS} = 25V
C_{rss}	Reverse Transfer Capacitance	—	518	—		f = 1.0MHz, See Fig.7
$C_{oss\ eff.(ER)}$	Effective Output Capacitance (Energy Related)	—	962	—		V_{GS} = 0V, VDS = 0V to 32V⑦
$C_{oss\ eff.(TR)}$	Output Capacitance (Time Related)	—	1179	—		V_{GS} = 0V, VDS = 0V to 32V⑥

Diode Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	100①	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	400*		
V_{SD}	Diode Forward Voltage	—	0.8	1.2	V	T_J = 25°C,I_S = 100A,V_{GS} = 0V ⑤
dv/dt	Peak Diode Recovery dv/dt④	—	6.2	—	V/ns	T_J = 150°C,I_S = 100A,V_{DS} = 40V
t_{rr}	Reverse Recovery Time	—	21	—	ns	T_J = 25°C
		—	22	—		T_J = 125°C
Q_{rr}	Reverse Recovery Charge	—	32	—	nC	T_J = 25°C
		—	38	—		T_J = 125°C
I_{RRM}	Reverse Recovery Current	—	1.0	—	A	T_J = 25°C

V_R = 34V, I_F = 100A di/dt = 100A/μs⑤

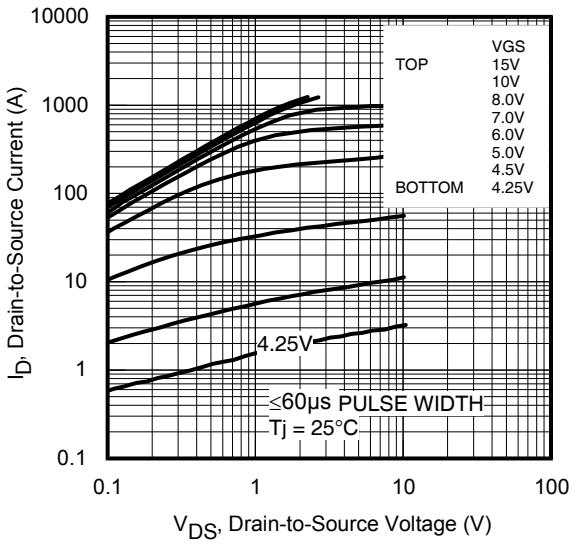


Fig 3. Typical Output Characteristics

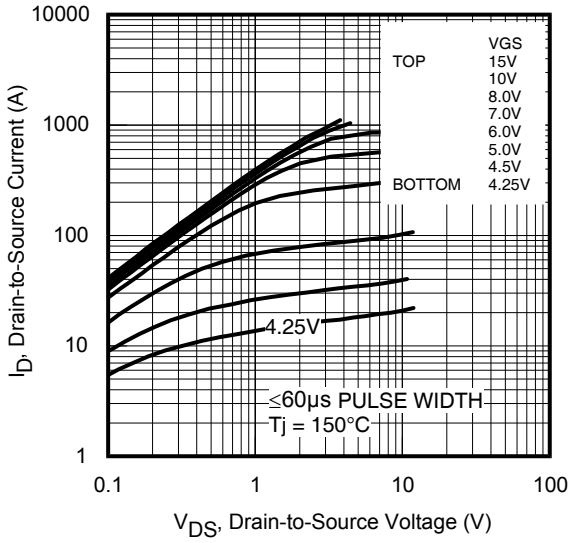


Fig 4. Typical Output Characteristics

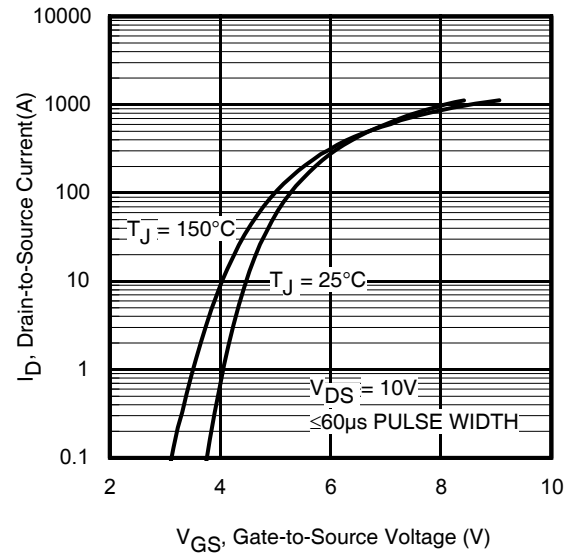


Fig 5. Typical Transfer Characteristics

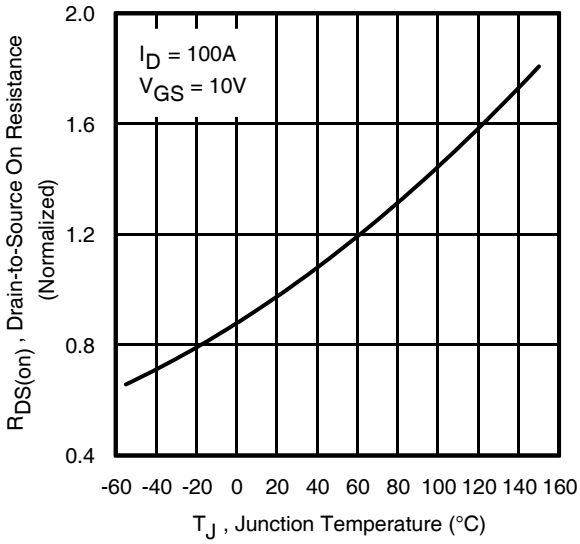


Fig 6. Normalized On-Resistance vs. Temperature

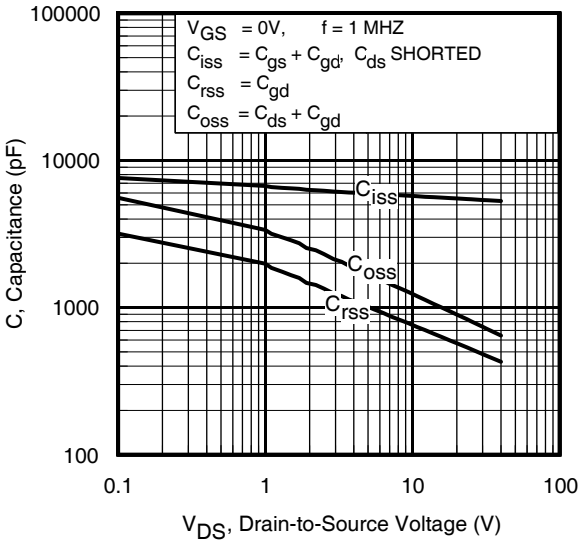


Fig 7. Typical Capacitance vs. Drain-to-Source Voltage

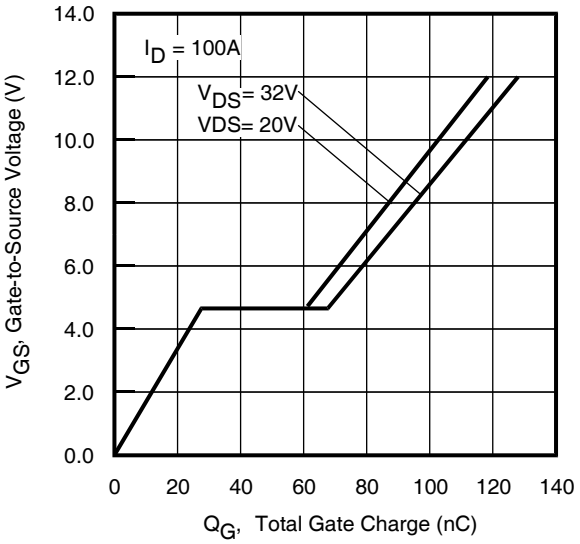


Fig 8. Typical Gate Charge vs. Gate-to-Source Voltage

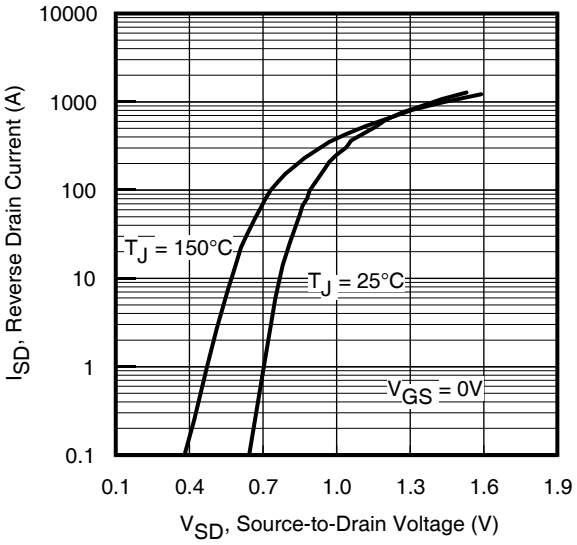


Fig 9. Typical Source-Drain Diode Forward Voltage

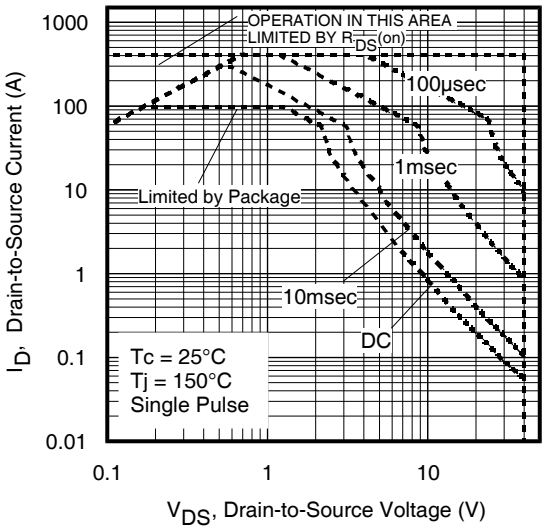


Fig 10. Maximum Safe Operating Area

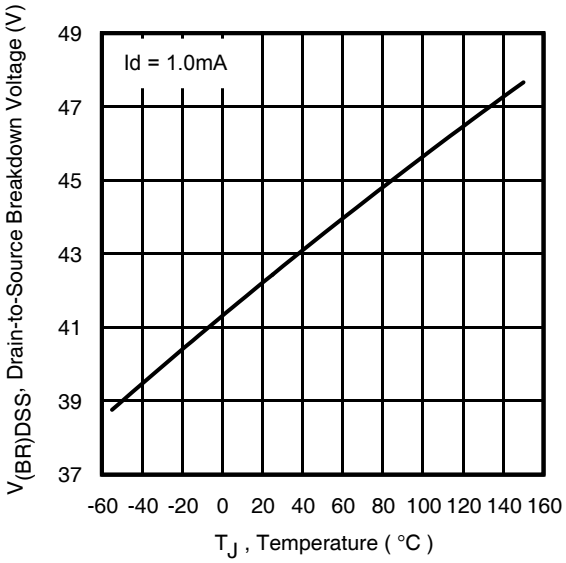


Fig 11. Drain-to-Source Breakdown Voltage

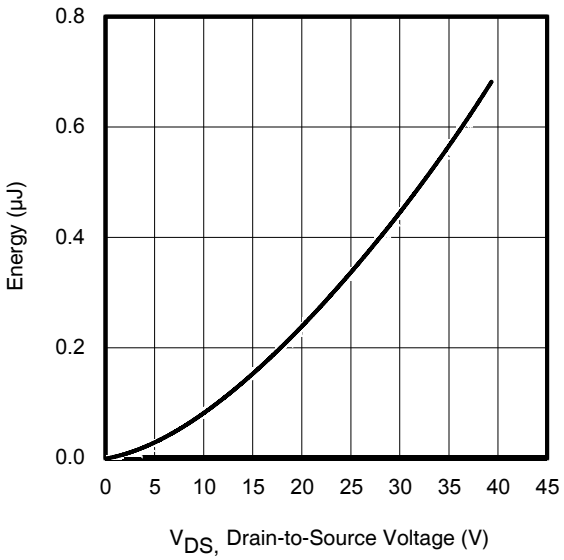


Fig 12. Typical C_{oss} Stored Energy

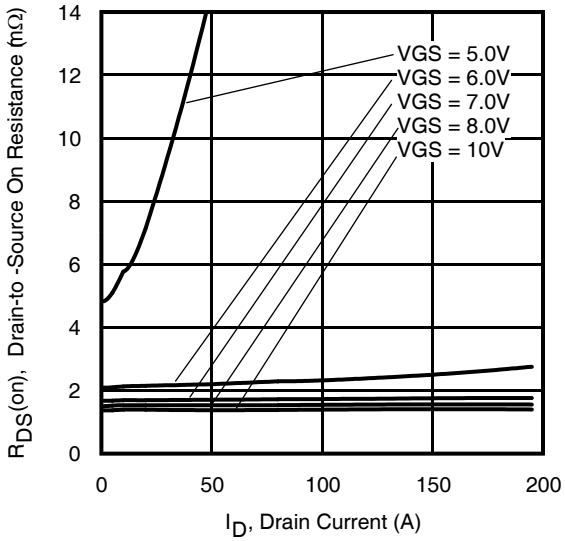


Fig 13. Typical On-Resistance vs. Drain Current

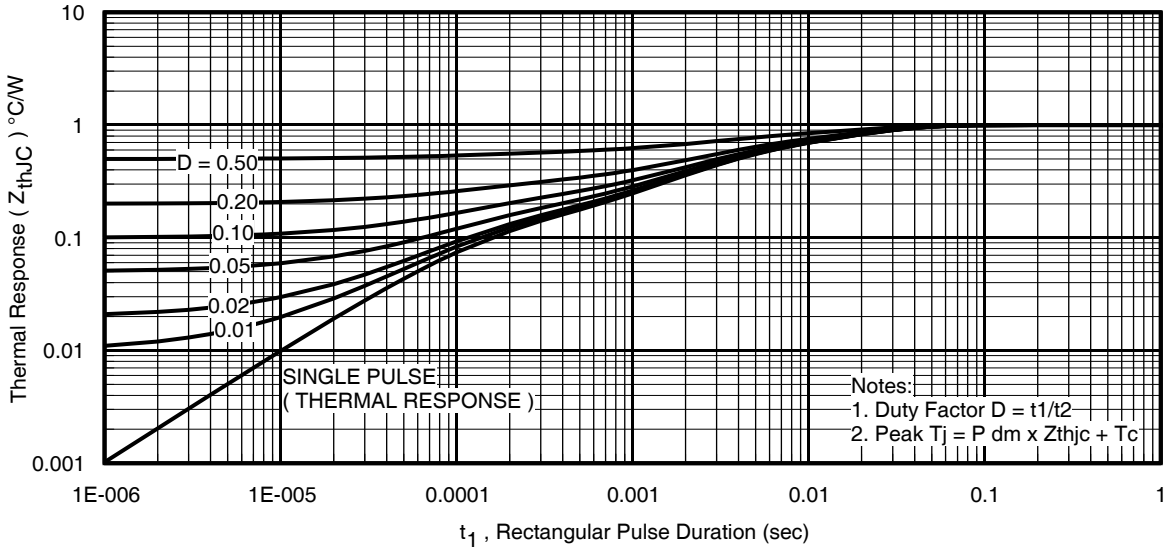


Fig 14. Maximum Effective Transient Thermal Impedance, Junction-to-Case

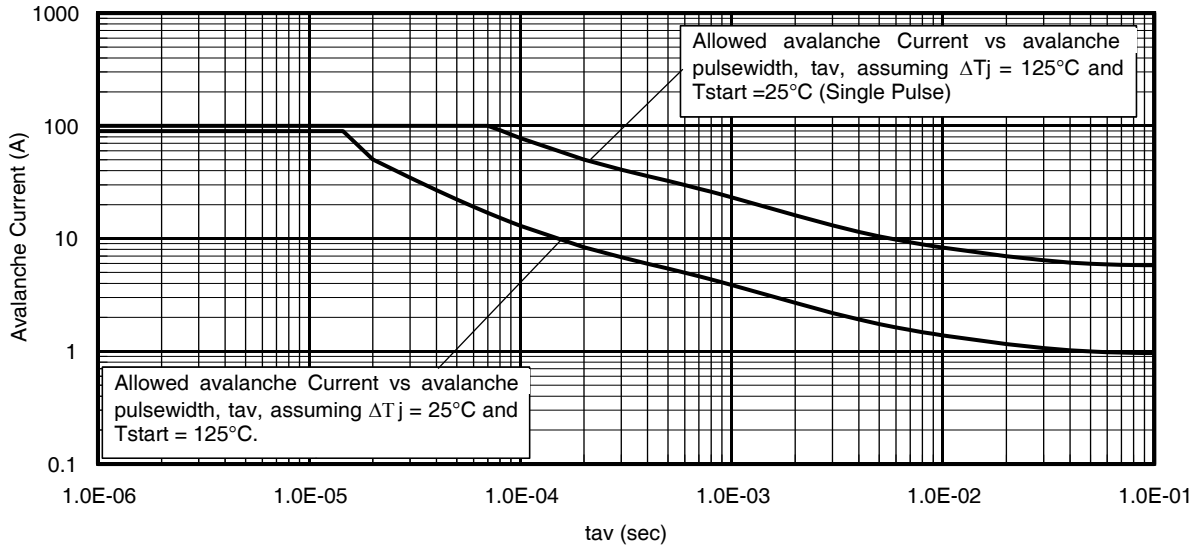


Fig 15. Avalanche Current vs. Pulse Width

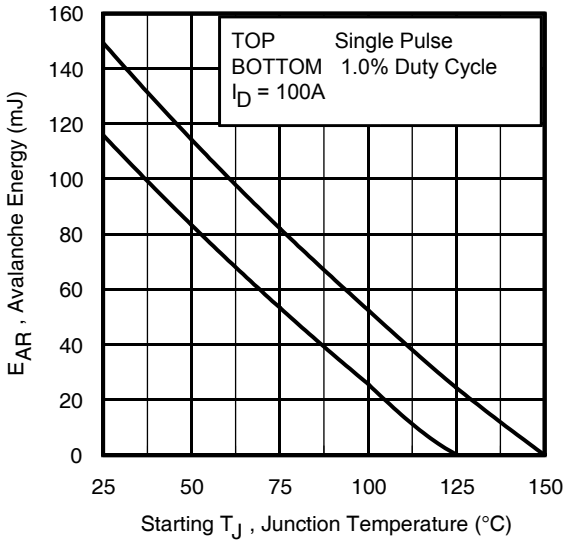


Fig 16. Maximum Avalanche Energy vs. Temperature

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 asT_{jmax} is not exceeded.

3. Equation below based on circuit and waveforms shown in Figures 23a, 23b.

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 15, 16).

t_{av} = Average time in avalanche.

D = Duty cycle in avalanche = tav ·f

$Z_{thJC}(D, t_{av})$ = Transient thermal resistance, see Figures 13)

PD (ave) = 1/2 (1.3·BV·I_{av}) = $\Delta T/ Z_{thJC}$

$I_{av} = 2\Delta T/ [1.3 \cdot BV \cdot Z_{th}]$

$E_{AS\ (AR)} = P_{D\ (ave)} \cdot t_{av}$

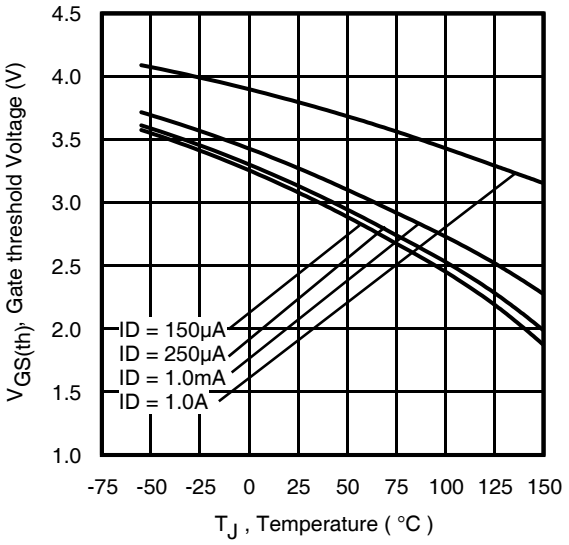


Fig 17. Threshold Voltage vs. Temperature

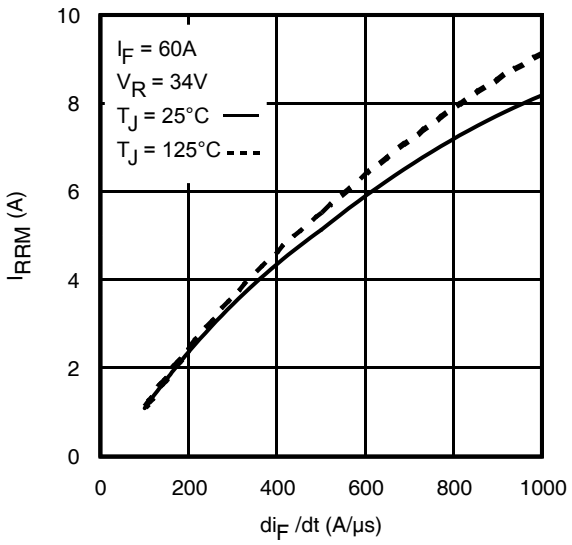


Fig 18. Typical Recovery Current vs. dif/dt

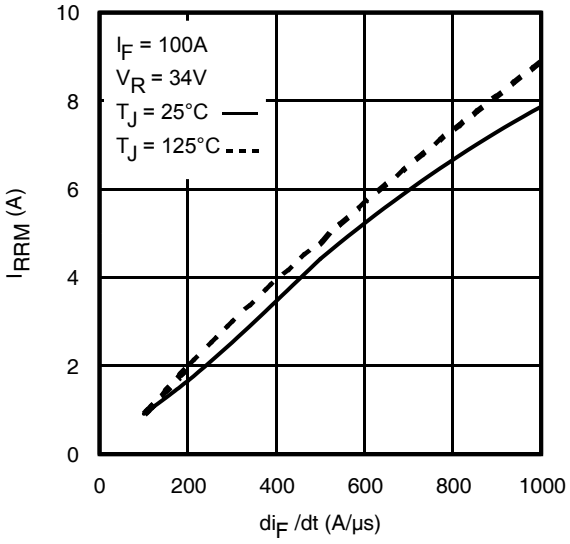


Fig 19. Typical Recovery Current vs. dif/dt

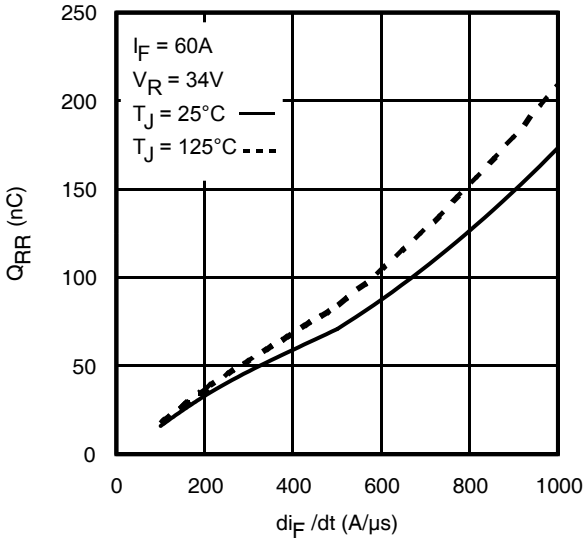


Fig 20. Typical Stored Charge vs. dif/dt

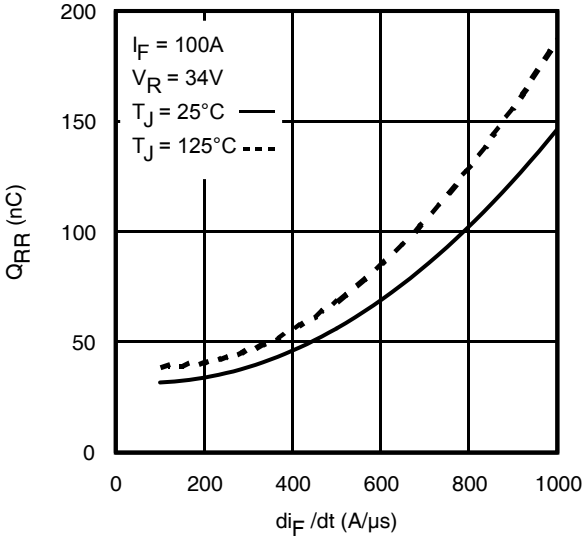


Fig 21. Typical Stored Charge vs. dif/dt

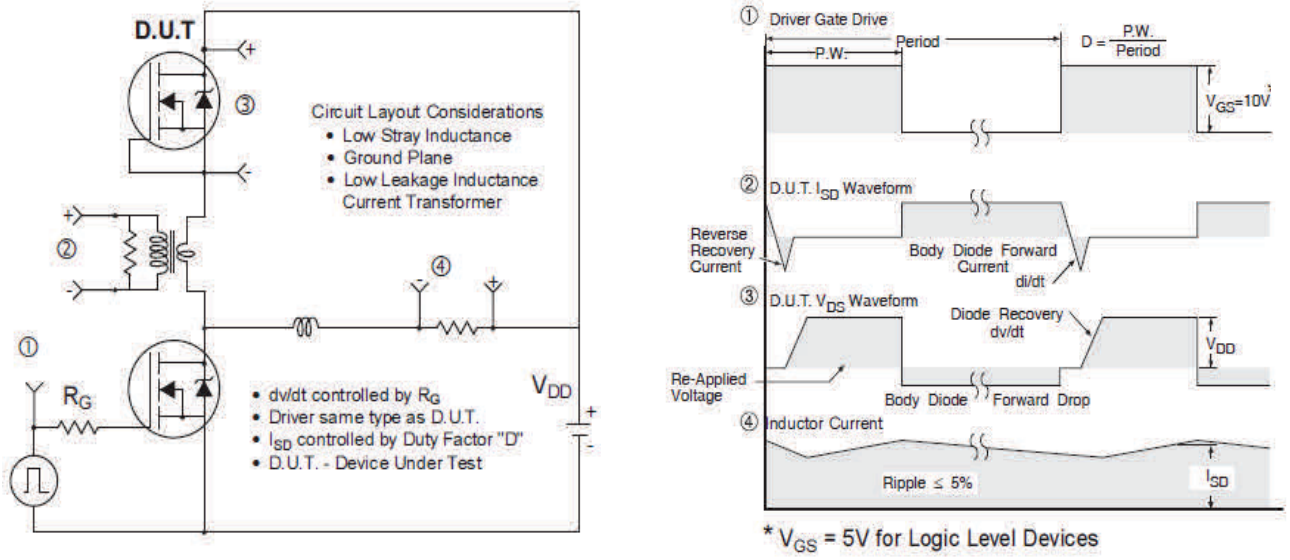


Fig 22. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

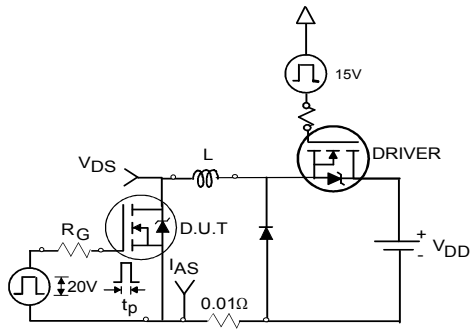


Fig 23a. Unclamped Inductive Test Circuit

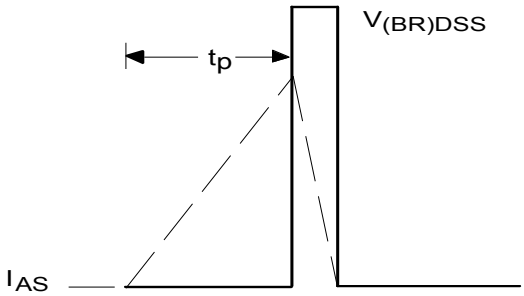


Fig 23b. Unclamped Inductive Waveforms

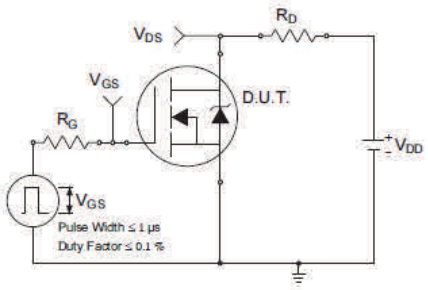


Fig 24a. Switching Time Test Circuit

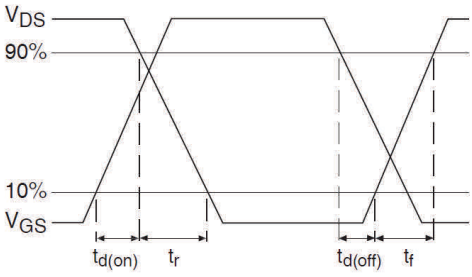


Fig 24b. Switching Time Waveforms

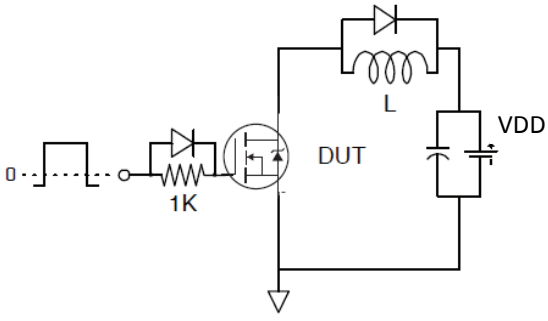


Fig 25a. Gate Charge Test Circuit

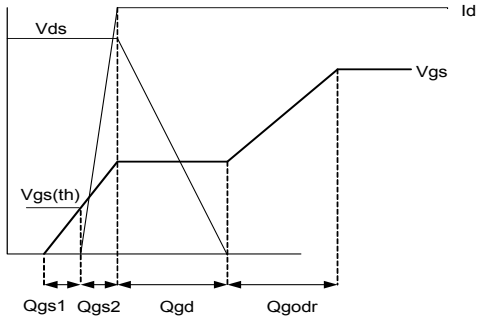
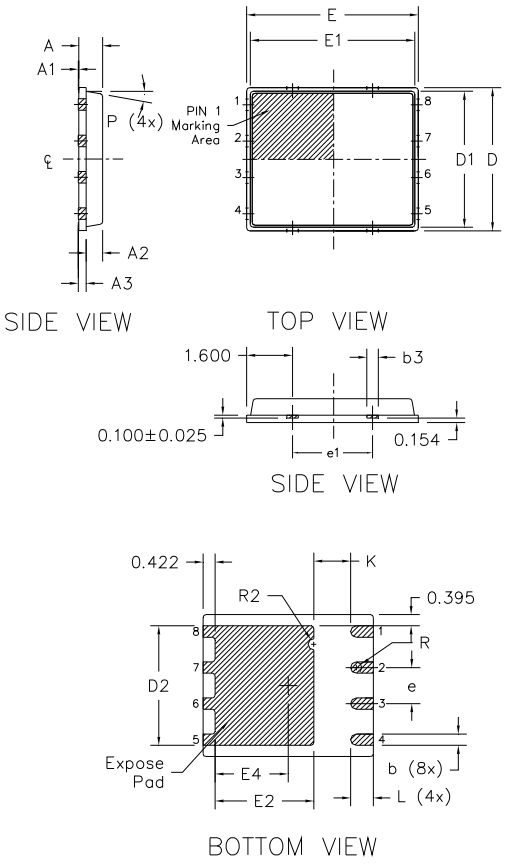


Fig 25b. Gate Charge Waveform

PQFN 5x6 Outline "B" Package Details



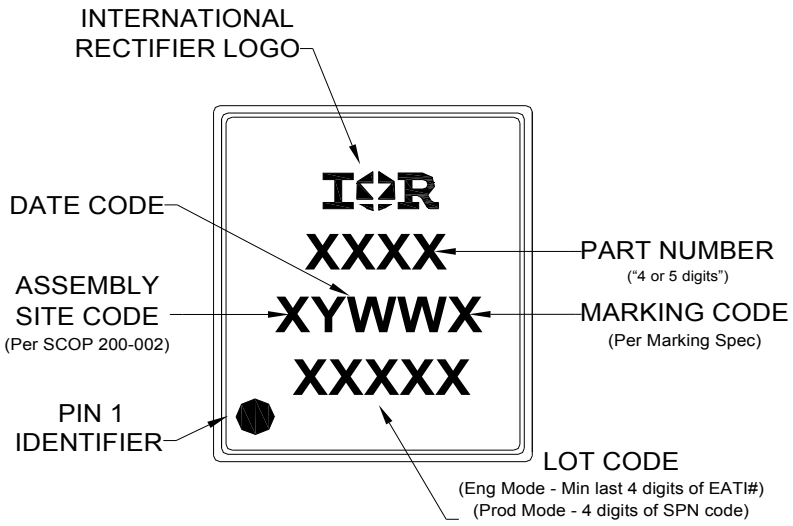
DIM / SYMBOL	MILLIMITERS MIN	MILLIMITERS MAX	INCH MIN	INCH MAX
A	0.800	0.900	0.0315	0.0543
A1	0.000	0.050	0.0000	0.0020
A3	0.200 REF		0.0079 REF	
b	0.350	0.470	0.0138	0.0185
b1	0.025	0.125	0.0010	0.0049
b2	0.210	0.410	0.0083	0.0161
b3	0.150	0.450	0.0059	0.0177
D	5.000 BSC		0.1969 BSC	
D1	4.750 BSC		0.1870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

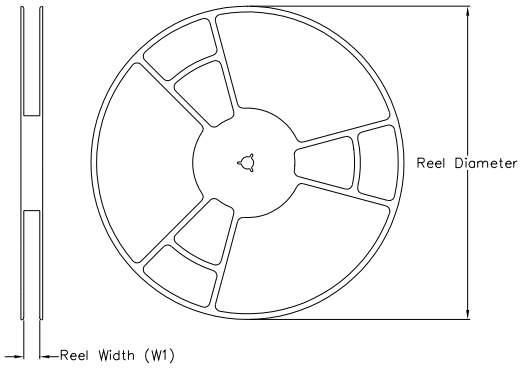
PQFN 5x6 Part Marking



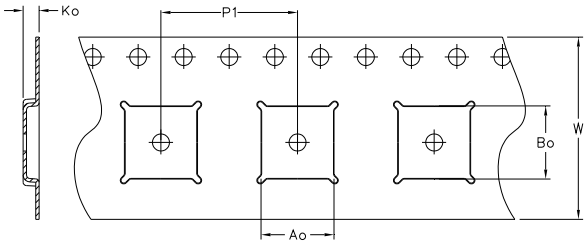
Note: For the most current drawing please refer to IR website at http://www.irf.com/package/

PQFN Tape and Reel

REEL DIMENSIONS

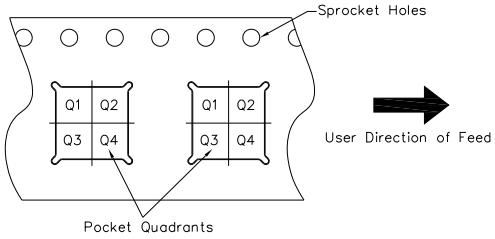


TAPE DIMENSIONS



CODE	DESCRIPTION
Ao	Dimension design to accommodate the component width
Bo	Dimension design to accommodate the component lenght
Ko	Dimension design to accommodate the component thickness
W	Overall width of the carrier tape
P_1	Pitch between successive cavity centers

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.

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