

### Applications

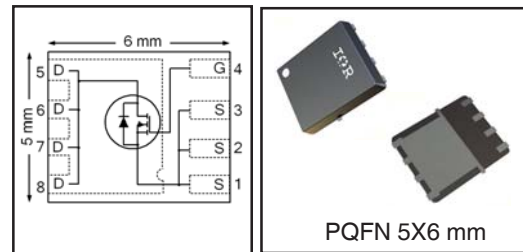
- Synchronous MOSFET for Notebook Processor Power
- Synchronous Rectifier MOSFET for Isolated DC-DC Converters in Networking Systems

### HEXFET® Power MOSFET

$V_{DS}$	$R_{DS(on)}$ max	Qg
30V	4.8m $\Omega$ @ $V_{GS} = 10V$	17nC

### Benefits

- Very low  $R_{DS(ON)}$  at 4.5V  $V_{GS}$
- Low Gate Charge
- Fully Characterized Avalanche Voltage and Current
- 100% Tested for  $R_G$
- Lead-Free (Qualified up to 260°C Reflow)
- RoHS compliant (Halogen Free)
- Low Thermal Resistance
- Large Source Lead for more reliable Soldering



### Absolute Maximum Ratings

	Parameter	Max.	Units
$V_{DS}$	Drain-to-Source Voltage	30	V
$V_{GS}$	Gate-to-Source Voltage	$\pm 20$	
$I_D @ T_A = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$	20	A
$I_D @ T_A = 70^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$	16	
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$	54	
$I_{DM}$	Pulsed Drain Current ①	160	
$P_D @ T_A = 25^\circ C$	Power Dissipation ⑤	3.1	W
$P_D @ T_A = 70^\circ C$	Power Dissipation ⑤	2.0	
	Linear Derating Factor ⑤	0.025	W/°C
$T_J$	Operating Junction and	-55 to + 150	°C
$T_{STG}$	Storage Temperature Range		

### Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ⑤	—	5.6	°C/W
$R_{\theta JA}$	Junction-to-Ambient ⑤	—	40	

Notes ① through ⑤ are on page 9

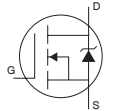
**Static @ T<sub>J</sub> = 25°C (unless otherwise specified)**

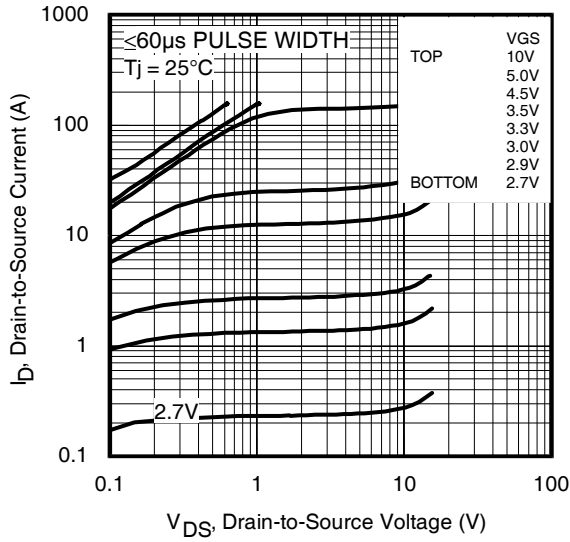
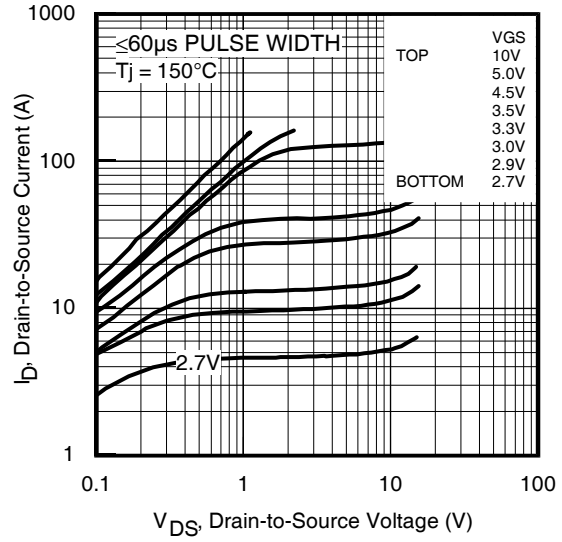
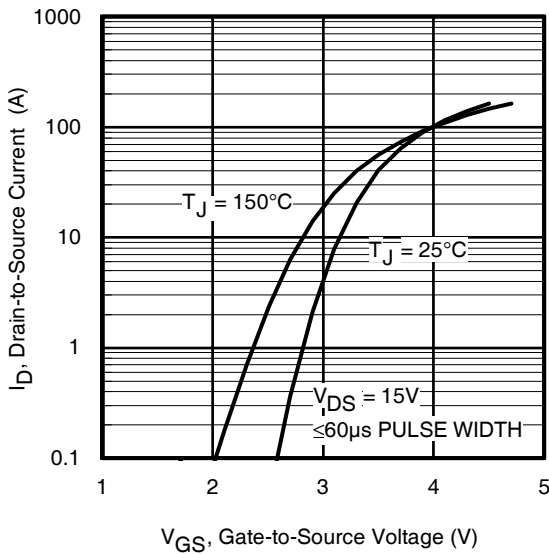
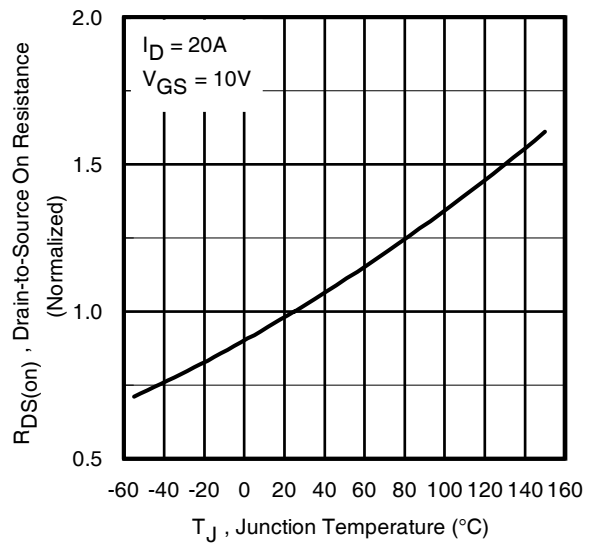
	Parameter	Min.	Typ.	Max.	Units	Conditions
BV <sub>DSS</sub>	Drain-to-Source Breakdown Voltage	30	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temp. Coefficient	—	0.022	—	V/°C	Reference to 25°C, I <sub>D</sub> = 1mA
R <sub>DS(on)</sub>	Static Drain-to-Source On-Resistance	—	4.1	4.8	mΩ	V <sub>GS</sub> = 10V, I <sub>D</sub> = 20A ③
		—	6.0	6.8		V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 16A ③
V <sub>GS(th)</sub>	Gate Threshold Voltage	1.35	1.8	2.35	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 50μA
ΔV <sub>GS(th)</sub>	Gate Threshold Voltage Coefficient	—	-6.3	—	mV/°C	
I <sub>DSS</sub>	Drain-to-Source Leakage Current	—	—	1.0	μA	V <sub>DS</sub> = 24V, V <sub>GS</sub> = 0V
		—	—	150		V <sub>DS</sub> = 24V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 125°C
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	48	—	—	S	V <sub>DS</sub> = 15V, I <sub>D</sub> = 16A
Q <sub>g</sub>	Total Gate Charge	—	17	26	nC	V <sub>DS</sub> = 15V V <sub>GS</sub> = 4.5V I <sub>D</sub> = 16A See Fig.17 & 18
Q <sub>gs1</sub>	Pre-V <sub>th</sub> Gate-to-Source Charge	—	4.5	—		
Q <sub>gs2</sub>	Post-V <sub>th</sub> Gate-to-Source Charge	—	2.0	—		
Q <sub>gd</sub>	Gate-to-Drain Charge	—	5.5	—		
Q <sub>godr</sub>	Gate Charge Overdrive	—	5.0	—		
Q <sub>sw</sub>	Switch Charge (Q <sub>gs2</sub> + Q <sub>gd</sub> )	—	7.5	—		
Q <sub>oss</sub>	Output Charge	—	9.0	—	nC	V <sub>DS</sub> = 16V, V <sub>GS</sub> = 0V
R <sub>G</sub>	Gate Resistance	—	1.5	2.3	Ω	
t <sub>di(on)</sub>	Turn-On Delay Time	—	17	—	ns	V <sub>DD</sub> = 15V, V <sub>GS</sub> = 4.5V I <sub>D</sub> = 16A R <sub>G</sub> = 1.8Ω See Fig.15
t <sub>r</sub>	Rise Time	—	12	—		
t <sub>di(off)</sub>	Turn-Off Delay Time	—	19	—		
t <sub>f</sub>	Fall Time	—	7.0	—		
C <sub>iss</sub>	Input Capacitance	—	2360	—	pF	V <sub>GS</sub> = 0V V <sub>DS</sub> = 15V f = 1.0MHz
C <sub>oss</sub>	Output Capacitance	—	450	—		
C <sub>rss</sub>	Reverse Transfer Capacitance	—	210	—		

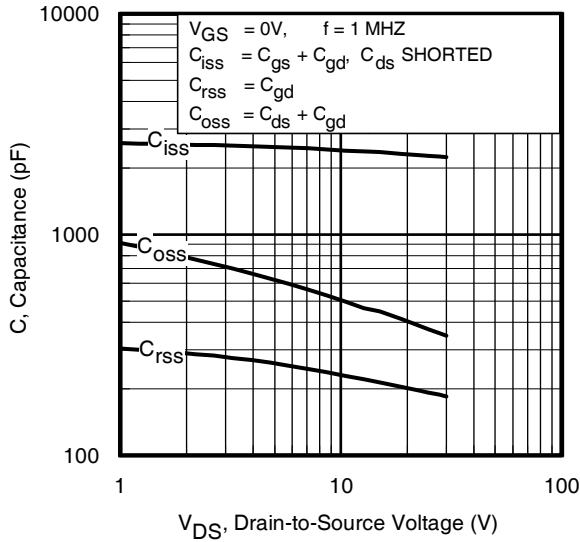
**Avalanche Characteristics**

	Parameter	Typ.	Max.	Units
E <sub>AS</sub>	Single Pulse Avalanche Energy ②	—	28	mJ
I <sub>AR</sub>	Avalanche Current ①	—	16	A

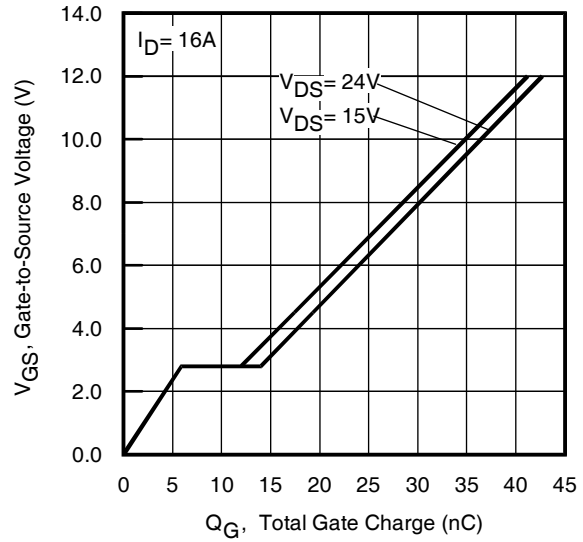
**Diode Characteristics**

	Parameter	Min.	Typ.	Max.	Units	Conditions
I <sub>S</sub>	Continuous Source Current (Body Diode)	—	—	3.9	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I <sub>SM</sub>	Pulsed Source Current (Body Diode) ①	—	—	160		
V <sub>SD</sub>	Diode Forward Voltage	—	—	1.0	V	T <sub>J</sub> = 25°C, I <sub>S</sub> = 16A, V <sub>GS</sub> = 0V ③
t <sub>rr</sub>	Reverse Recovery Time	—	14	21	ns	T <sub>J</sub> = 25°C, I <sub>F</sub> = 16A, V <sub>DD</sub> = 15V
Q <sub>rr</sub>	Reverse Recovery Charge	—	15	23	nC	di/dt = 300A/μs ③ See Fig.16
t <sub>on</sub>	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)				

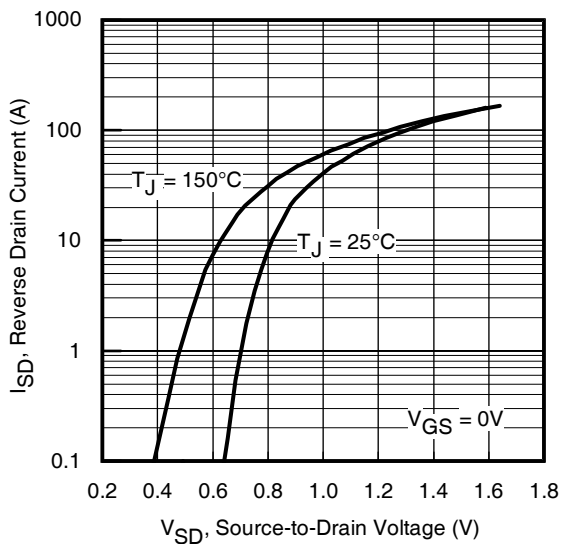

**Fig 1.** Typical Output Characteristics

**Fig 2.** Typical Output Characteristics

**Fig 3.** Typical Transfer Characteristics

**Fig 4.** Normalized On-Resistance vs. Temperature



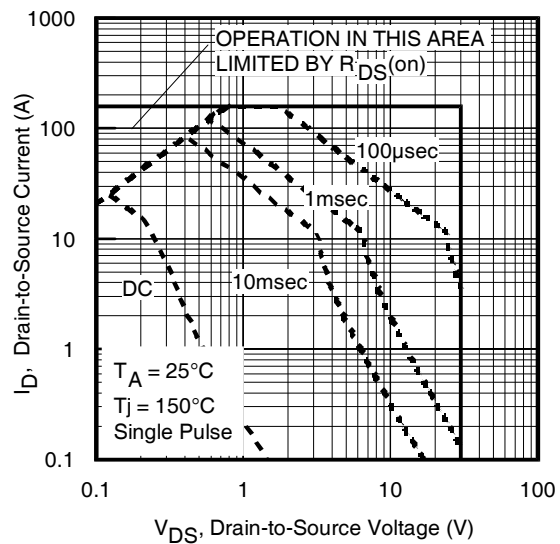
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



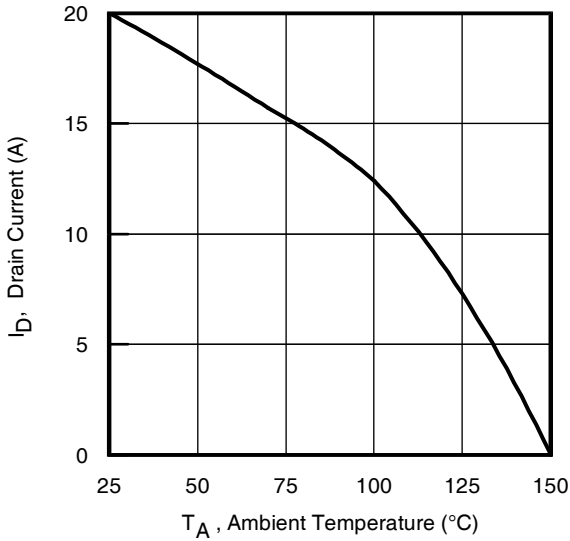
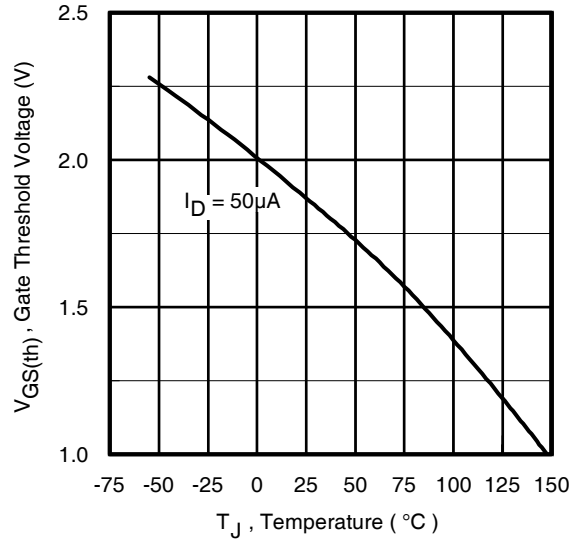
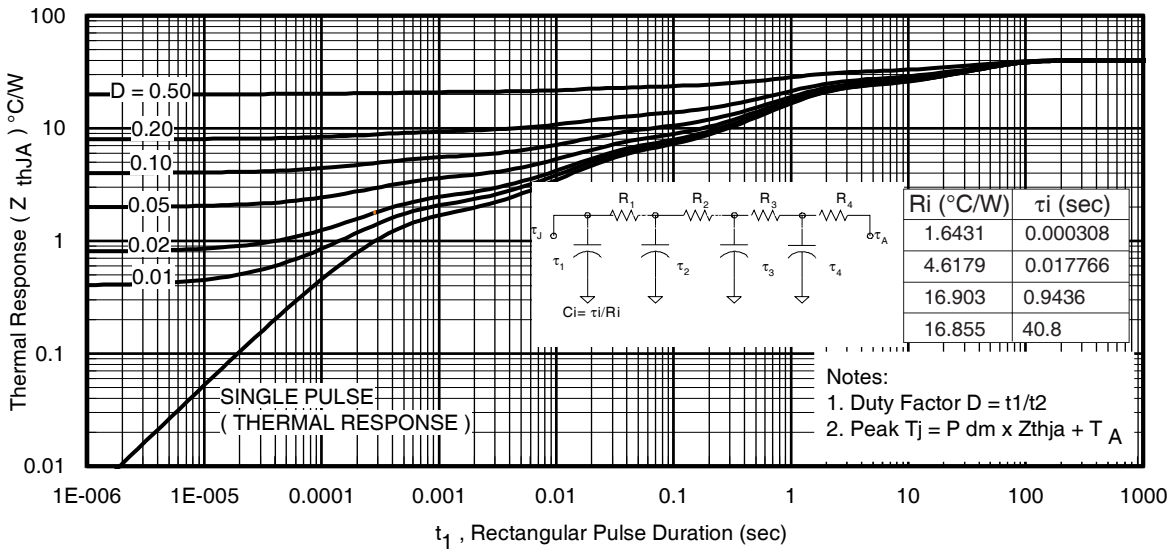
**Fig 6.** Typical Gate Charge vs. Gate-to-Source Voltage

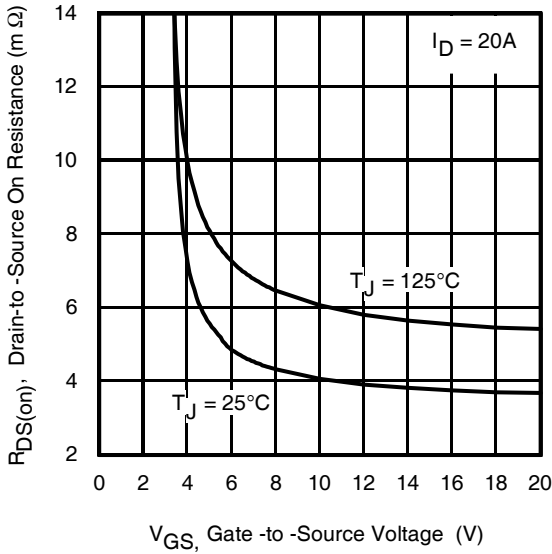
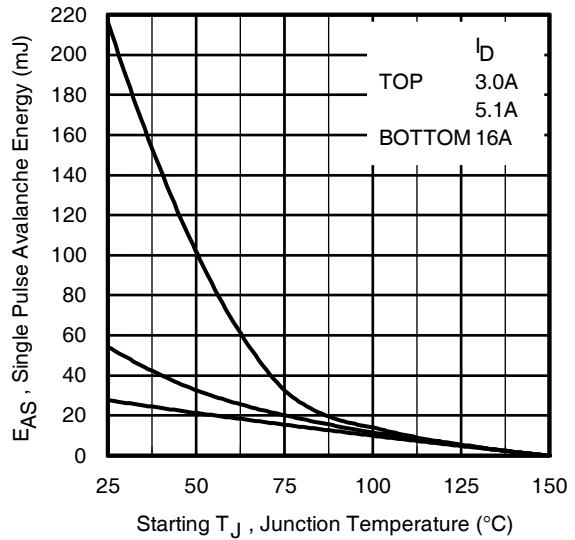
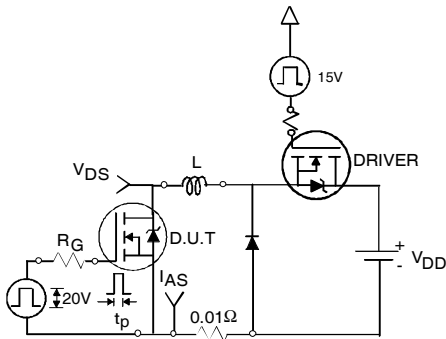
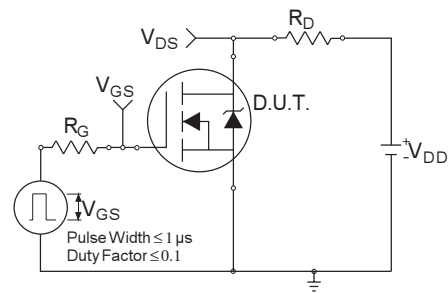
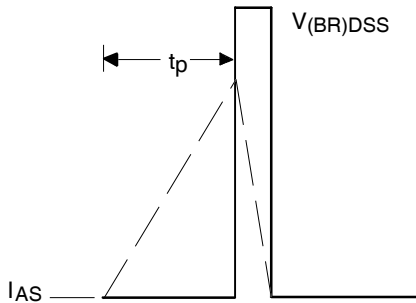
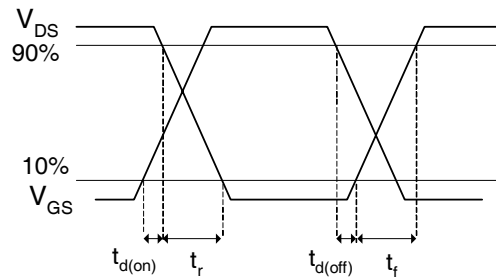


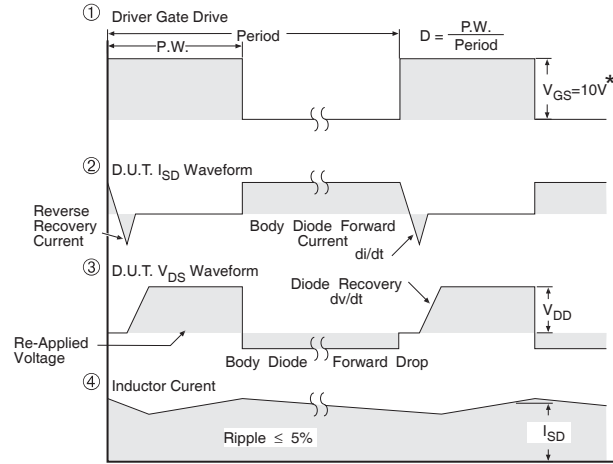
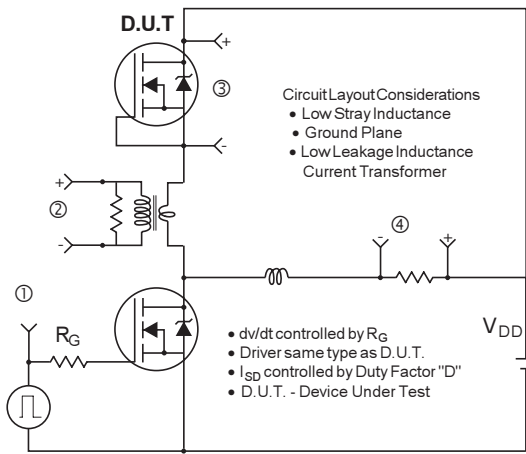
**Fig 7.** Typical Source-Drain Diode Forward Voltage



**Fig 8.** Maximum Safe Operating Area

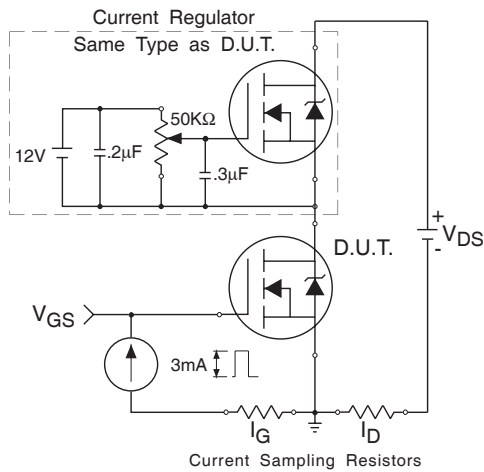

**Fig 9.** Maximum Drain Current vs. Ambient Temperature

**Fig 10.** Threshold Voltage vs. Temperature

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


**Fig 12. On-Resistance vs. Gate Voltage**

**Fig 13. Maximum Avalanche Energy vs. Drain Current**

**Fig 14a. Unclamped Inductive Test Circuit**

**Fig 15a. Switching Time Test Circuit**

**Fig 14b. Unclamped Inductive Waveforms**

**Fig 15b. Switching Time Waveforms**

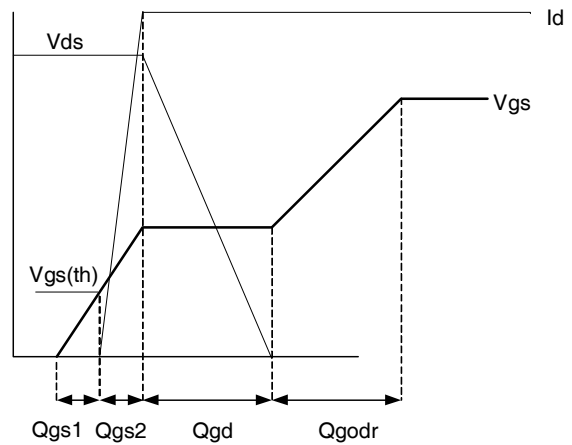


\*  $V_{GS} = 5V$  for Logic Level Devices

**Fig 16. Peak Diode Recovery  $dv/dt$  Test Circuit for N-Channel HEXFET® Power MOSFETs**

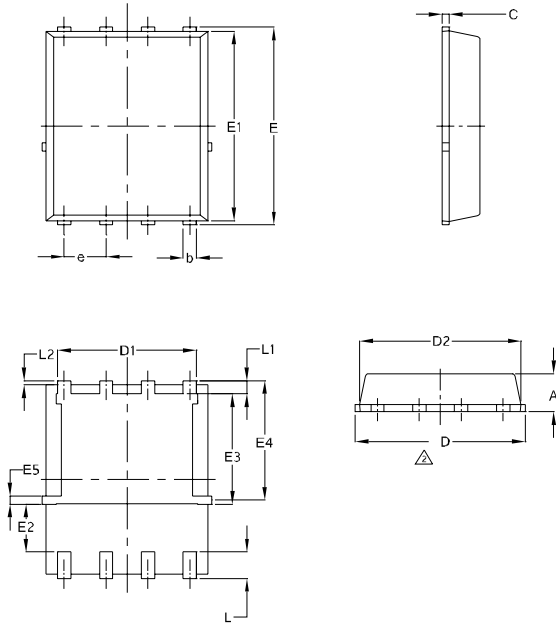


**Fig 17. Gate Charge Test Circuit**



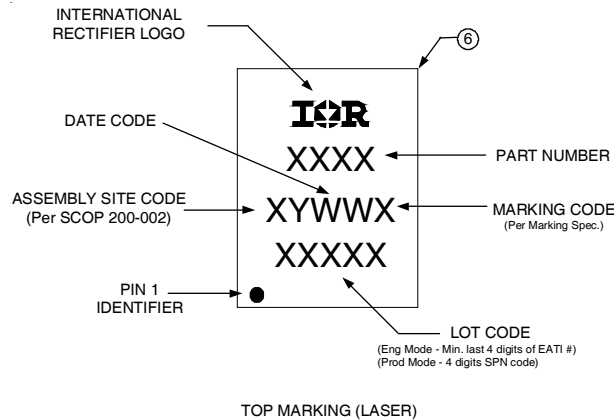
**Fig 18. Gate Charge Waveform**

## PQFN 5x6 Option "E" Package Details



SYMBOL	COMMON			
	MM		INCH	
	MIN.	MAX.	MIN.	MAX.
A	0.90	1.17	0.0354	0.0461
b	0.31	0.51	0.0130	0.0189
C	0.195	0.300	0.0077	0.0118
D	4.80	5.25	0.1890	0.2028
D1	3.91	4.31	0.1539	0.1697
D2	4.80	5.10	0.1890	0.1968
E	5.90	6.25	0.2323	0.2421
E1	5.65	6.15	0.2224	0.2362
E2	1.10	—	0.0594	—
E3	3.32	3.78	0.1307	0.1480
E4	3.52	3.72	0.1346	0.1409
E5	0.13	0.32	0.0071	0.0126
e	1.27	BSC	0.050	BSC
L	0.51	0.86	0.0020	0.0098
L1	0.38	0.71	0.0150	0.0260
L2	0.05	0.25	0.0201	0.0339
I	0	0.18	0	0.0071

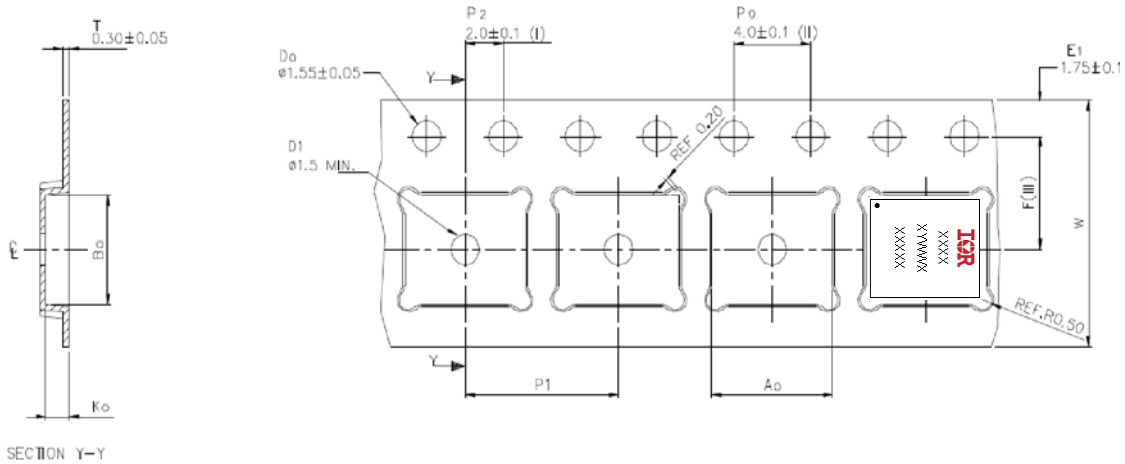
## PQFN Part Marking



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



## PQFN Tape and Reel



$A_0$	6.30 +/− 0.1
$B_0$	5.30 +/− 0.1
$K_0$	1.20 +/− 0.1
$F$	5.50 +/− 0.1
$P_1$	8.00 +/− 0.1
$W$	12.00 +/− 0.3

- (I) Measured from centreline of sprocket hole to centreline of pocket.
- (II) Cumulative tolerance of 10 sprocket holes is ± 0.20 .
- (III) Measured from centreline of sprocket hole to centreline of pocket.
- (IV) Other material available.
- (V) Typical SR of form tape Max  $10^9$  OHM/SQ

ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED

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

### Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.22\text{mH}$ ,  $R_G = 25\Omega$ ,  $I_{AS} = 16\text{A}$ .
- ③ Pulse width ≤ 400µs; duty cycle ≤ 2%.
- ④  $R_{thjc}$  is guaranteed by design
- ⑤ When mounted on 1 inch square 2 oz copper pad on 1.5x1.5 in. board of FR-4 material.

### Revision History

Date	Comments
08/08/2013	<ul style="list-style-type: none"> <li>• Updated the package drawing, on page 1.</li> <li>• Updated the package outline drawing, on page 8.</li> <li>• This drawing change is related to PCN "Hana-GTBF-GEM 5x6 PQFN Public."</li> </ul>

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