

HEXFET® Power MOSFET

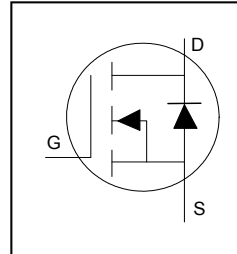
Applications

- High Efficiency Synchronous Rectification in SMPS
- Uninterruptible Power Supply
- High Speed Power Switching
- Hard Switched and High Frequency Circuits

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
- Halogen-Free

V_{DSS}	60V
R_{DS(on)} typ.	3.3mΩ
max.	4.2mΩ
I_D	71A



G	D	S
Gate	Drain	Source

Base Part Number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
IRFI3306GPbF	TO-220 Full-Pak	Tube	50	IRFI3306GPbF

Absolute Maximum Ratings

Symbol	Parameter	Max.	Units
I _D @ T _C = 25°C	Continuous Drain Current, V _{GS} @ 10V	71	A
I _D @ T _C = 100°C	Continuous Drain Current, V _{GS} @ 10V	50	
I _{DM}	Pulsed Drain Current ①	300	
P _D @ T _C = 25°C	Maximum Power Dissipation	46	W
	Linear Derating Factor	0.31	W/°C
V _{GS}	Gate-to-Source Voltage	± 20	V
E _{AS}	Single Pulse Avalanche Energy (Thermally Limited) ②	311	mJ
T _J	Operating Junction and Storage Temperature Range	-55 to + 175	°C
T _{STG}			
		Soldering Temperature, for 10 seconds (1.6mm from case)	
	Mounting torque, 6-32 or M3 screw	10lb•in (1.1N•m)	

Thermal Resistance

Symbol	Parameter	Typ.	Max.	Units
R _{θJC}	Junction-to-Case ④	—	3.23	°C/W
R _{θJA}	Junction-to-Ambient (PCB Mount) ④	—	65	

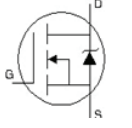
Static Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
V _{(BR)DSS}	Drain-to-Source Breakdown Voltage	60	—	—	V	V _{GS} = 0V, I _D = 250μA
ΔV _{(BR)DSS} /ΔT _J	Breakdown Voltage Temp. Coefficient	—	0.068	—	V/°C	Reference to 25°C, I _D = 5.0mA ^③
R _{DS(on)}	Static Drain-to-Source On-Resistance	—	3.3	4.2	mΩ	V _{GS} = 10V, I _D = 43A ^③
V _{GS(th)}	Gate Threshold Voltage	2.0	—	4.0	V	V _{DS} = V _{GS} , I _D = 150μA
I _{DSS}	Drain-to-Source Leakage Current	—	—	20	μA	V _{DS} = 60V, V _{GS} = 0V
		—	—	250		V _{DS} = 60V, 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(int)}	Internal Gate Resistance	—	0.72	—	Ω	

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

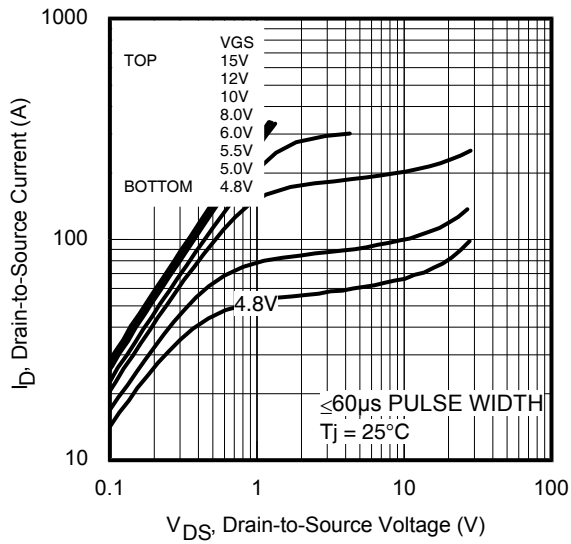
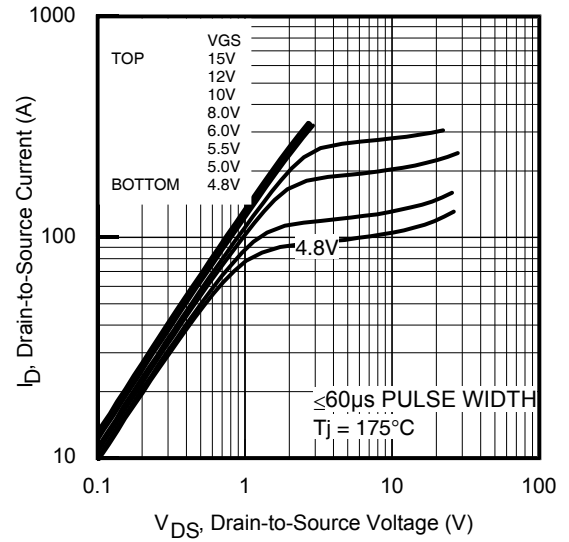
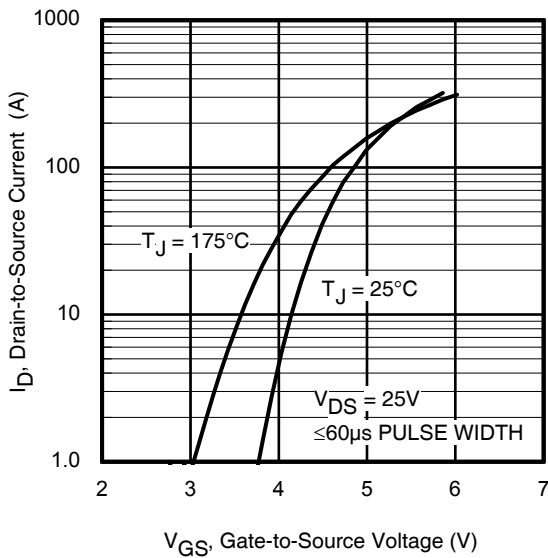
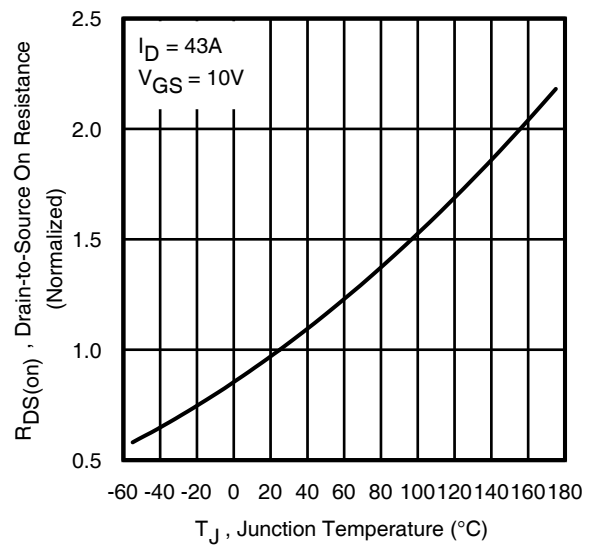
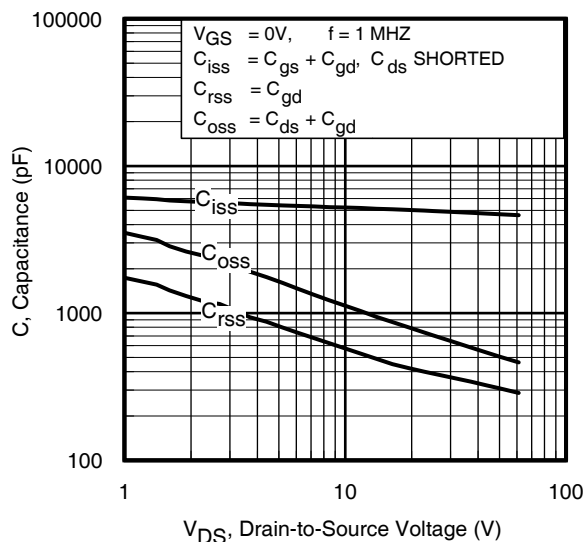
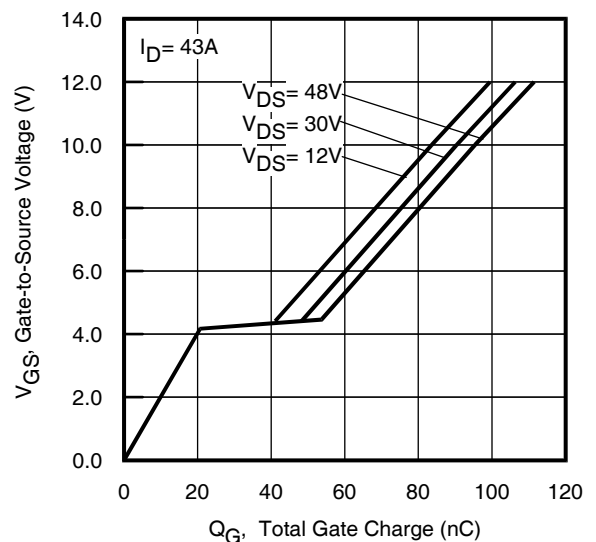
Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
g _{fs}	Forward Transconductance	89	—	—	S	V _{DS} = 25V, I _D = 43A
Q _g	Total Gate Charge	—	90	135	nC	I _D = 43A
Q _{gs}	Gate-to-Source Charge	—	22	—		V _{DS} = 30V
Q _{gd}	Gate-to-Drain ("Miller") Charge	—	26	—		V _{GS} = 10V ^③
Q _{sync}	Total Gate Charge Sync. (Q _g - Q _{gd})	—	116	—		I _D = 43A, V _{DS} = 0V, V _{GS} = 10V
t _{d(on)}	Turn-On Delay Time	—	15	—	ns	V _{DD} = 39V
t _r	Rise Time	—	30	—		I _D = 43A
t _{d(off)}	Turn-Off Delay Time	—	45	—		R _G = 2.7Ω
t _f	Fall Time	—	33	—		V _{GS} = 10V ^③
C _{iss}	Input Capacitance	—	4685	—	pF	V _{GS} = 0V
C _{oss}	Output Capacitance	—	506	—		V _{DS} = 50V
C _{rss}	Reverse Transfer Capacitance	—	310	—		f = 1.0 MHz
C _{oss eff. (ER)}	Effective Output Capacitance (Energy Related) ^⑥	—	733	—		V _{GS} = 0V, V _{DS} = 0V to 48V ^⑥
C _{oss eff. (TR)}	Effective Output Capacitance (Time Related) ^⑤	—	822	—		V _{GS} = 0V, V _{DS} = 0V to 48V ^⑤

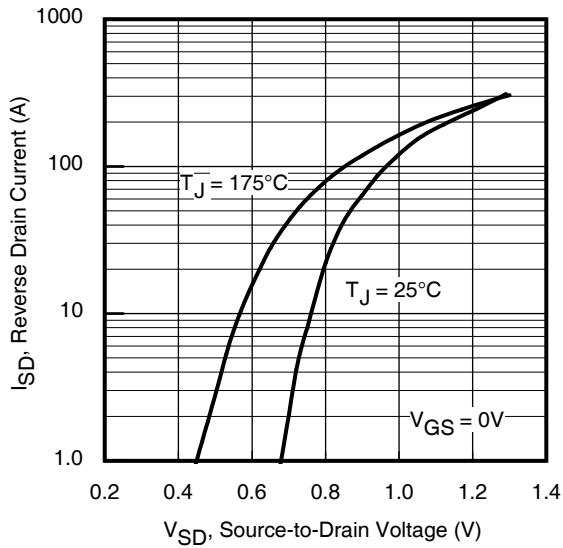
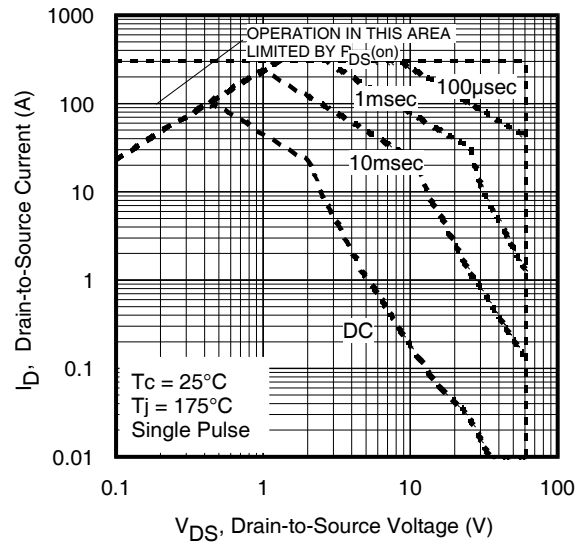
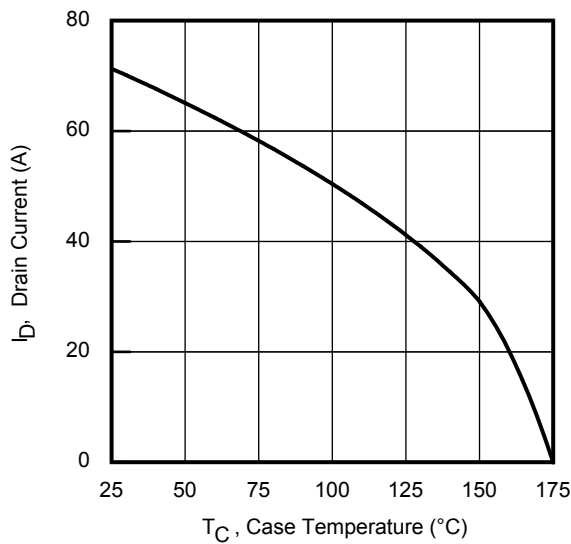
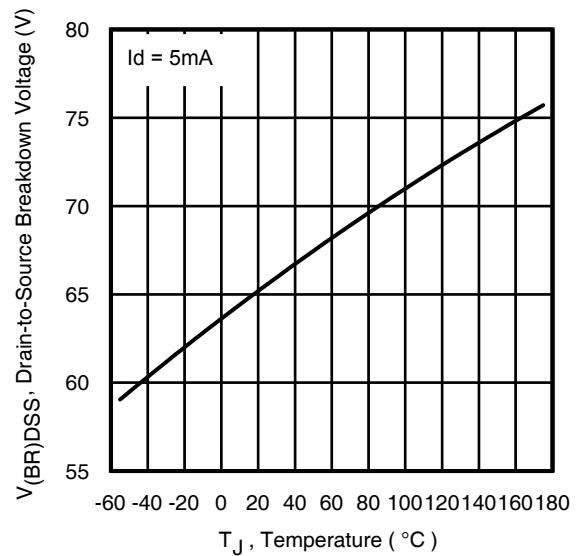
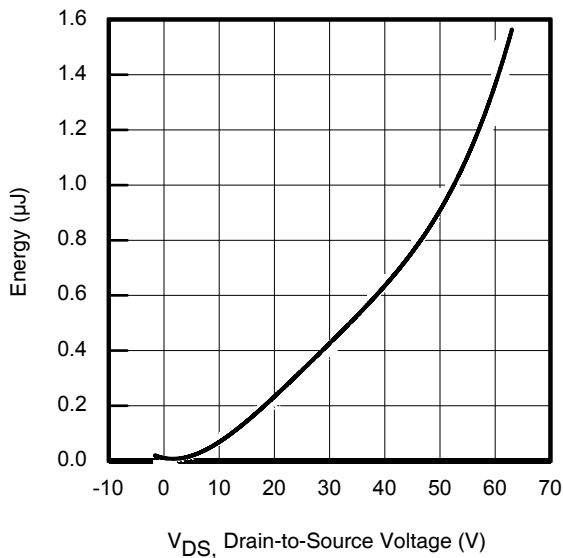
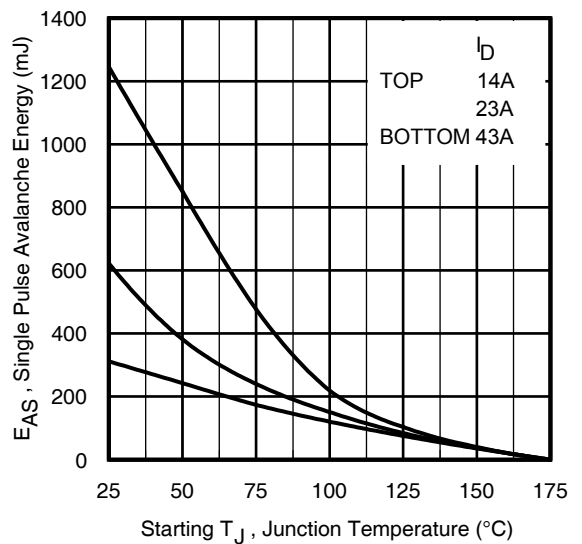
Diode Characteristics

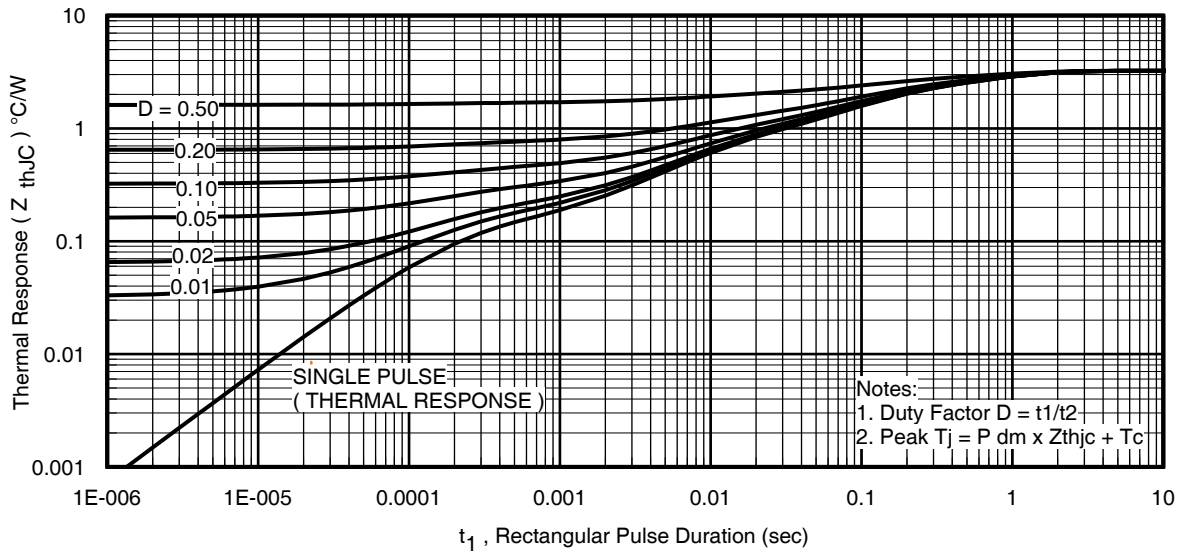
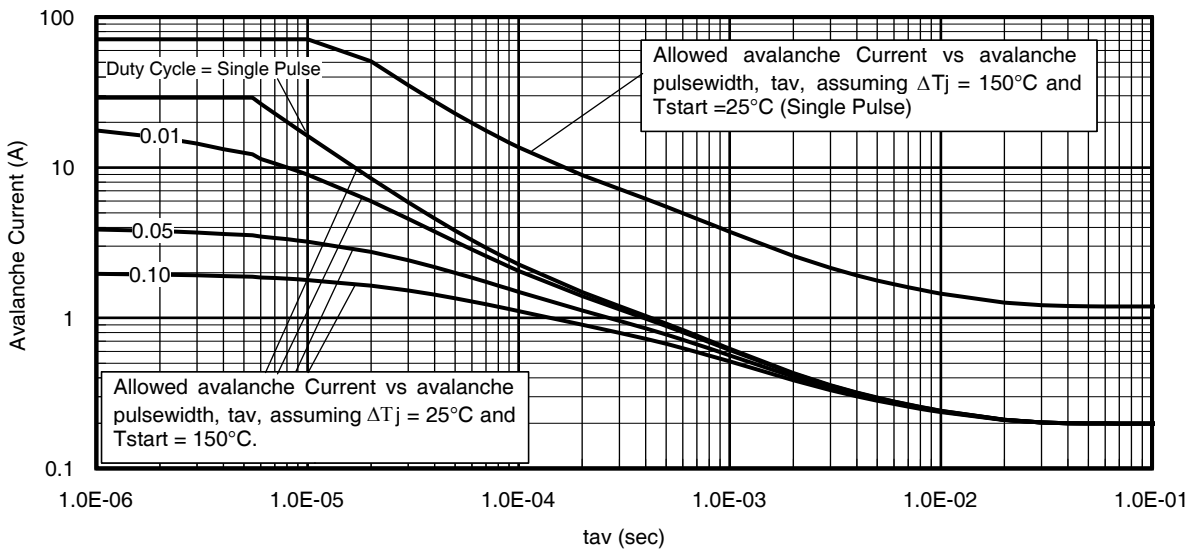
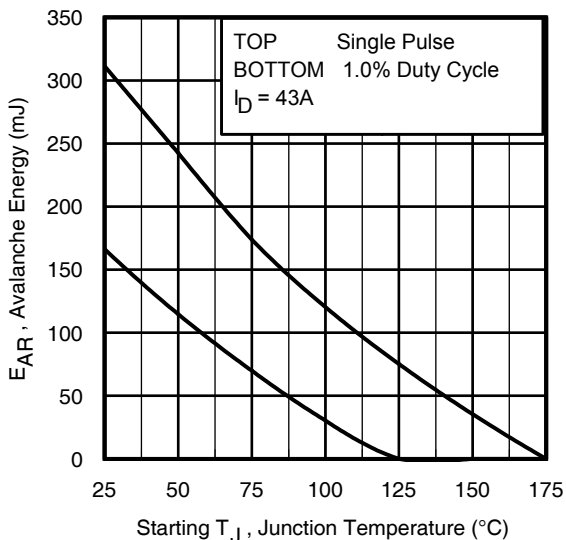
Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
I _S	Continuous Source Current (Body Diode)	—	—	71	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I _{SM}	Pulsed Source Current (Body Diode) ^②	—	—	300	A	
V _{SD}	Diode Forward Voltage	—	—	1.3	V	T _J = 25°C, I _S = 43A, V _{GS} = 0V ^③
dv/dt	Peak Diode Recovery ^④	—	2.3	—	V/ns	
t _{rr}	Reverse Recovery Time	—	43	—	ns	T _J = 25°C — V _R = 51V
		—	47	—		T _J = 125°C — I _F = 43A
Q _{rr}	Reverse Recovery Charge	—	63	—	nC	T _J = 25°C — di/dt = 100A/μs ^③
		—	78	—		T _J = 125°C
I _{RRM}	Reverse Recovery Current	—	2.5	—	A	T _J = 25°C

Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Limited by T_{Jmax}, starting T_J = 25°C, L = 0.34mH
R_G = 50Ω, I_{AS} = 43A, V_{GS} = 10V. Part not recommended for use above this value.
- ③ Pulse width ≤ 400μs; duty cycle ≤ 2%.
- ④ R_θ is measured at T_J approximately 90°C.
- ⑤ 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}.
- ⑥ 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}.


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-to-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. Typical Coss Stored Energy

Fig 12. Maximum Avalanche Energy vs. Drain Current


Fig 13. Maximum Effective Transient Thermal Impedance, Junction-to-Case

Fig 14. Typical Avalanche Current vs. Pulsewidth

Fig 15. Maximum Avalanche Energy vs. Temperature
**Notes on Repetitive Avalanche Curves, Figures 13, 14:
(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 16a, 16b.
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, 15).
 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)

$$P_{D(ave)} = 1/2 (1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$$

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

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

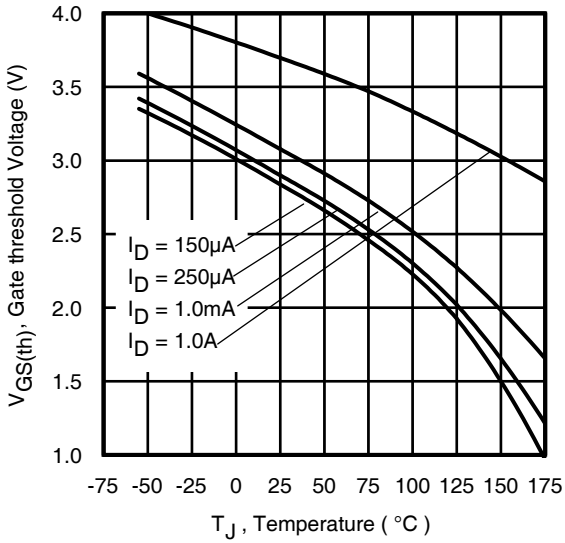


Fig 16. Threshold Voltage vs. Temperature

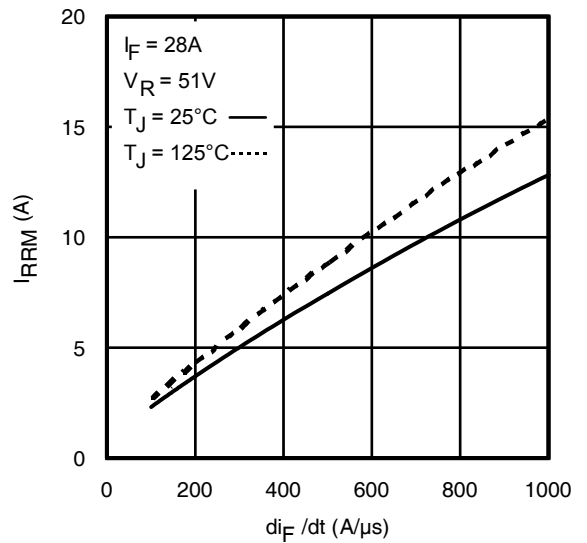


Fig 17. Typical Recovery Current vs. dif/dt

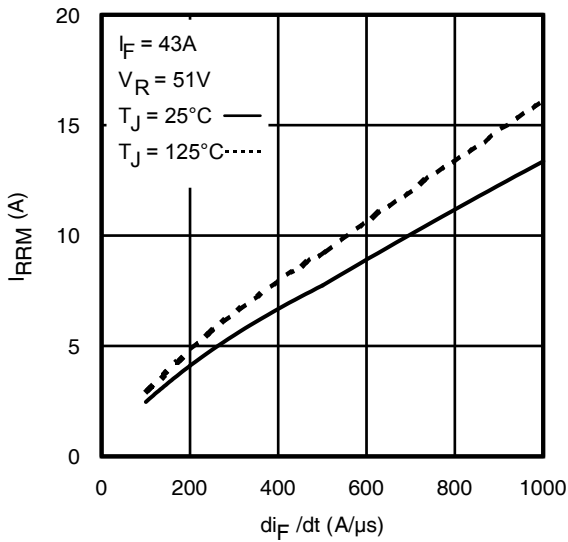


Fig. 18 - Typical Recovery Current vs. dif/dt

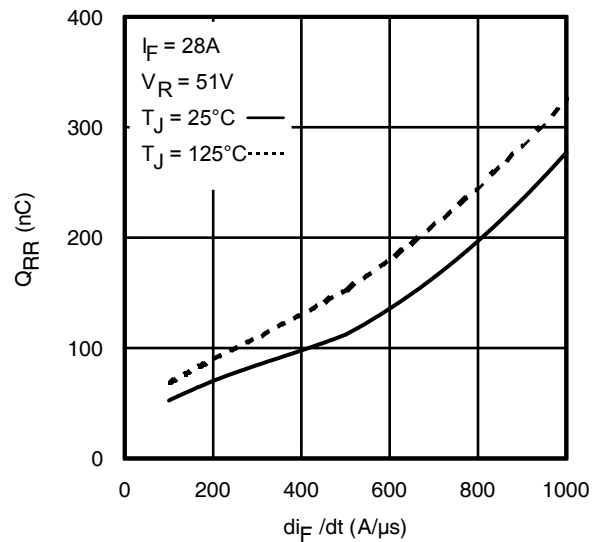


Fig. 19 - Typical Stored Charge vs. dif/dt

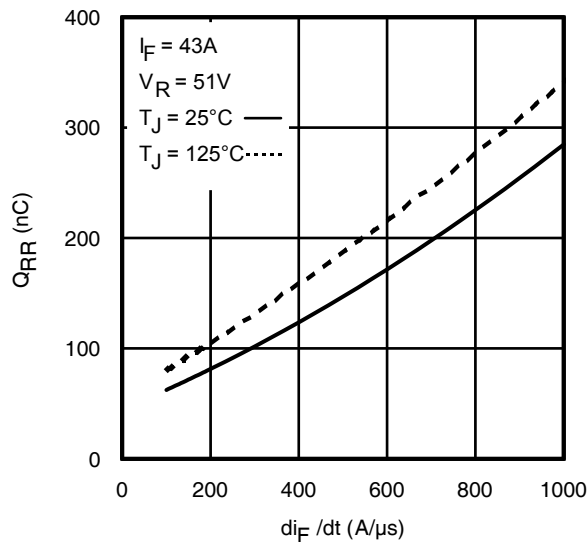
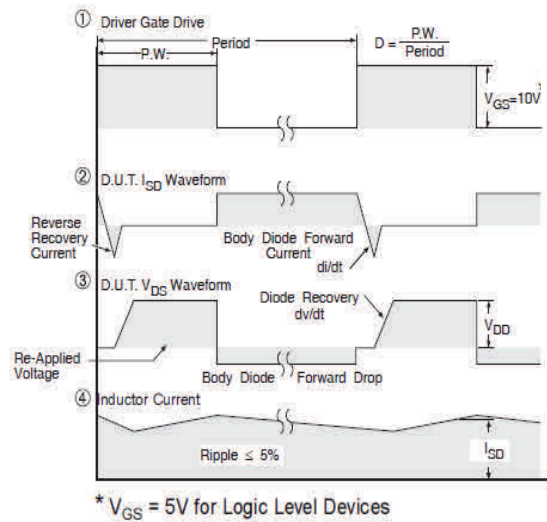
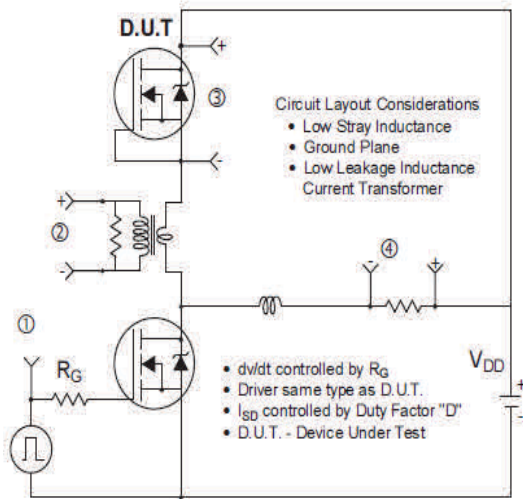
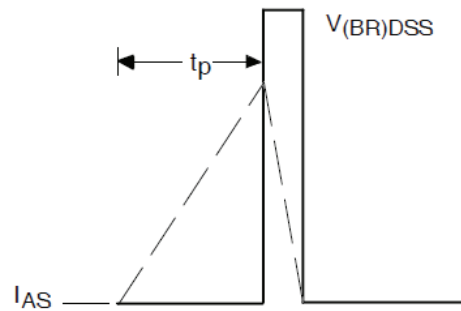
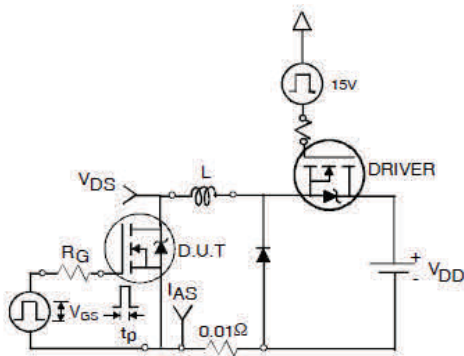
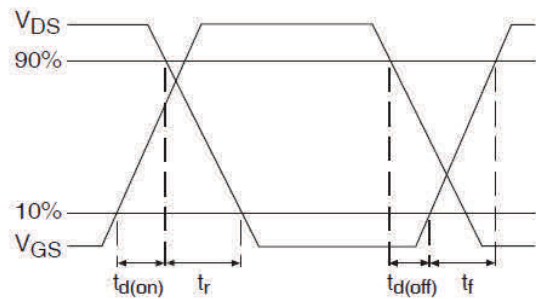
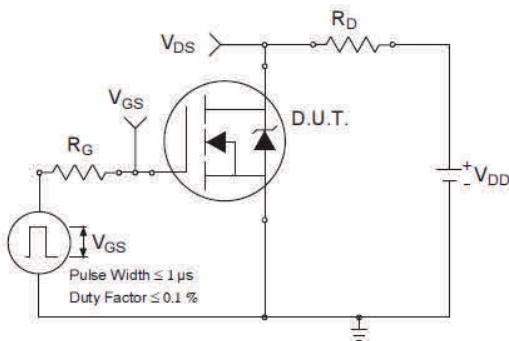
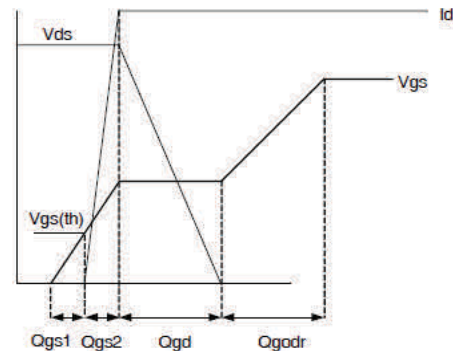
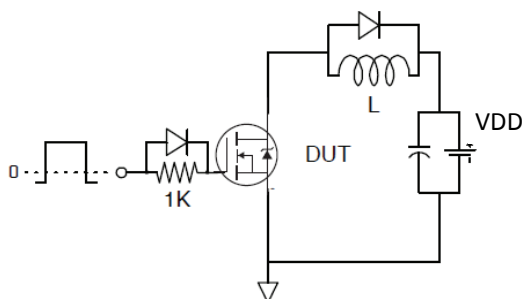
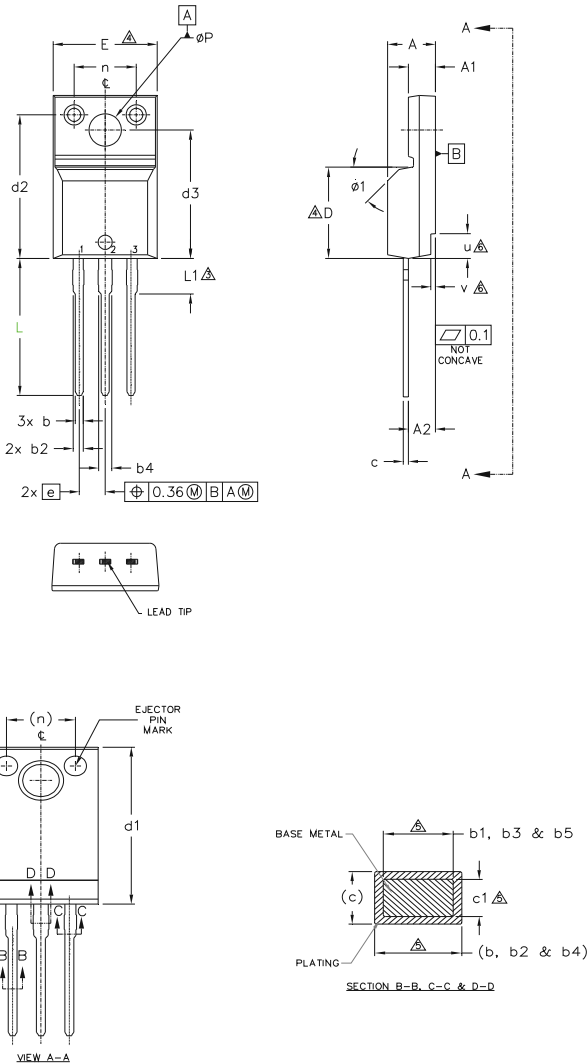


Fig. 20 - Typical Stored Charge vs. dif/dt


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

Fig 22a. Unclamped Inductive Test Circuit
Fig 22b. Unclamped Inductive Waveforms

Fig 23a. Switching Time Test Circuit
Fig 23b. Switching Time Waveforms

Fig 24a. Gate Charge Test Circuit
Fig 24b. Gate Charge Waveform

TO-220 Full-Pak Package Outline (Dimensions are shown in millimeters (inches))

NOTES:

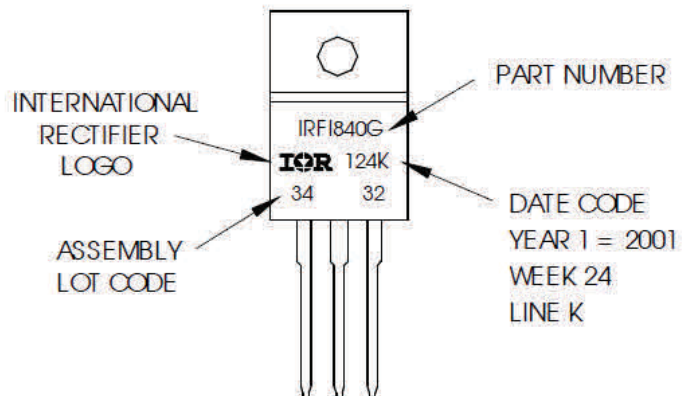
- 1.0 DIMENSIONING AND TOLERANCING AS PER ASME Y14.5 M- 1994.
- 2.0 DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
- 3.0 LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
- 4.0 DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTER MOST EXTREMES OF THE PLASTIC BODY.
- 5.0 DIMENSION b1, b3, b5 & c1 APPLY TO BASE METAL ONLY.
- 6.0 STEP OPTIONAL ON PLASTIC BODY DEFINED BY DIMENSIONS u & v.
- 7.0 CONTROLLING DIMENSION : INCHES.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.57	4.83	.180	.190	LEAD ASSIGNMENTS HEXFET 1.- GATE 2.- DRAIN 3.- SOURCE IGBTs, CoPACK 1.- GATE 2.- COLLECTOR 3.- EMITTER
A1	2.57	2.82	.101	.111	
A2	2.51	2.92	.099	.115	
b	0.61	0.94	.024	.037	
b1	0.61	0.89	.024	.035	
b2	0.76	1.27	.030	.050	
b3	0.76	1.22	.030	.048	
b4	1.02	1.52	.040	.060	
b5	1.02	1.47	.040	.058	
c	0.33	0.63	.013	.025	
c1	0.33	0.58	.013	.023	
D	8.66	9.80	.341	.386	
d1	15.80	16.13	.622	.635	
d2	13.97	14.22	.550	.560	
d3	12.29	12.93	.484	.509	
E	9.63	10.74	.379	.423	
e	2.54 BSC		.100 BSC		
L	13.21	13.72	.520	.540	
L1	3.10	3.68	.122	.145	
n	6.05	6.60	.238	.260	
ϕP	3.05	3.45	.120	.136	
u	2.39	2.49	.094	.098	
v	0.41	0.51	.016	.020	
$\phi 1$	-	45*	-	45*	

TO-220 Full-Pak Part Marking Information

EXAMPLE: THIS IS AN IRFI840G
 WITH ASSEMBLY
 LOT CODE 3432
 ASSEMBLED ON WW 24, 2001
 IN THE ASSEMBLY LINE "K"

Note: "P" in assembly line position
 indicates "Lead-Free"



TO-220AB Full-Pak packages are not recommended for Surface Mount Application.

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	TO-220 Full-Pak	N/A
		(per JEDEC J-STD-020D†)
RoHS compliant	Yes	

† Applicable version of JEDEC standard at the time of product release.

Revision History

Date	Comments
10/07/2013	<ul style="list-style-type: none"> Removed the “Silicon Limited” from the ID rating, on page 1.
04/27/2017	<ul style="list-style-type: none"> Changed datasheet with Infineon logo - all pages. Corrected Package Outline on page 8. Added disclaimer on last page.

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