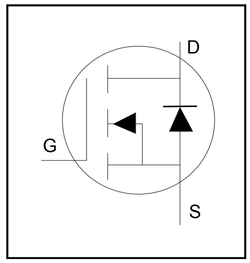
International
IOR Rectifier

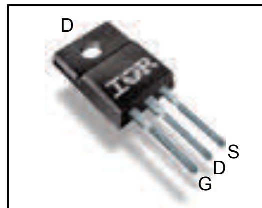
IRFI3306GPbF

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

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





TO-220 Full-Pak

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 T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 175	°C
	Soldering Temperature, for 10 seconds (1.6mm from case)	300	
	Mounting torque, 6-32 or M3 screw	10lb•in (1.1N•m)	

Thermal Resistance

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ④	——	3.23	°C/W
$R_{\theta JA}$	Junction-to-Ambient (PCB Mount) ④	——	65	

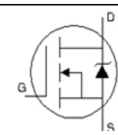
Static Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	60	–––	–––	V	V_{GS} = 0V, I_D = 250μA
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	–––	0.068	–––	V/°C	Reference to 25°C, I_D = 5.0mA③
$R_{DS(on)}$	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
gfs	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/μs③
		–––	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 TJmax, 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 Coss eff. (TR) is a fixed capacitance that gives the same charging time as Coss while VDS is rising from 0 to 80% VDSS.

⑥ Coss eff. (ER) is a fixed capacitance that gives the same energy as Coss while VDS is rising from 0 to 80% VDSS.

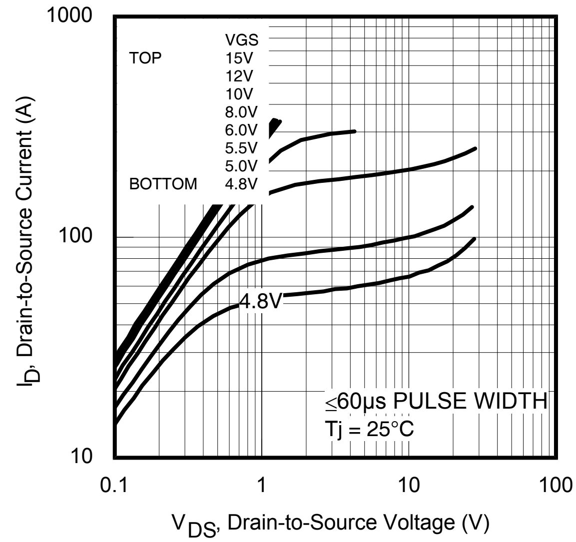


Fig. 1 Typical Output Characteristics

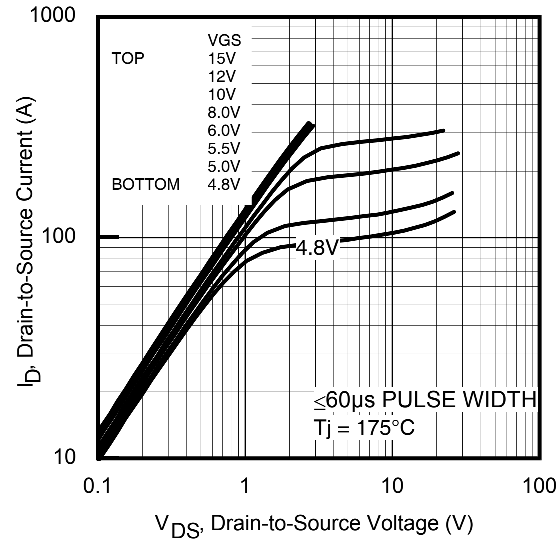


Fig. 2 Typical Output Characteristics

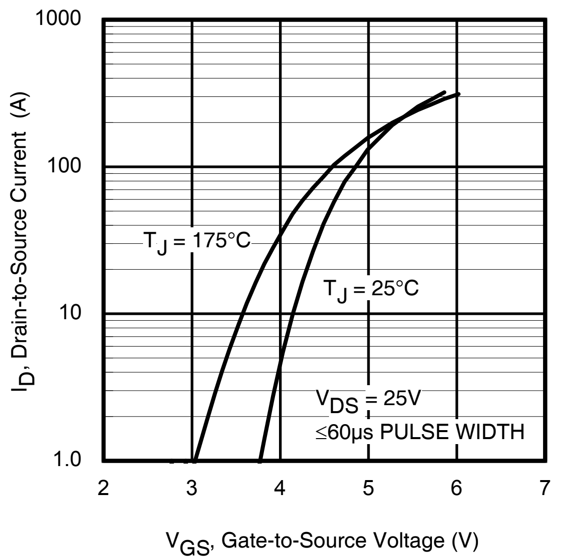


Fig. 3 Typical Transfer Characteristics

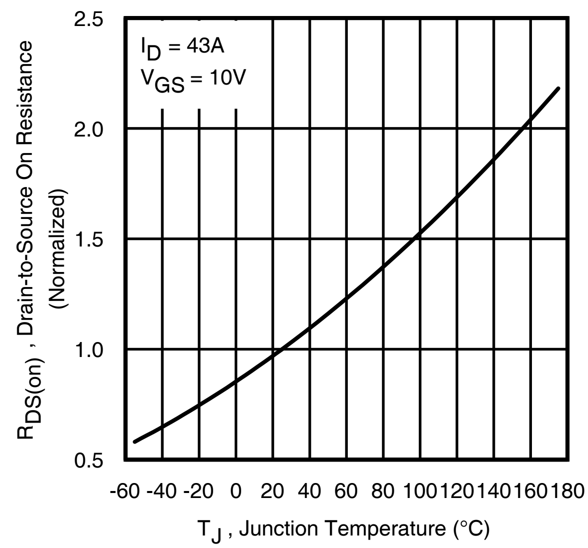


Fig. 4 Normalized On-Resistance vs. Temperature

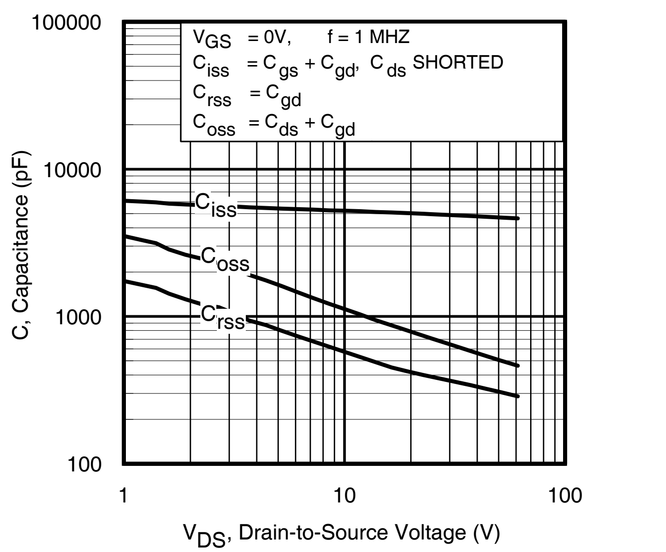


Fig 5. Typical Capacitance vs. Drain-to-Source Voltage

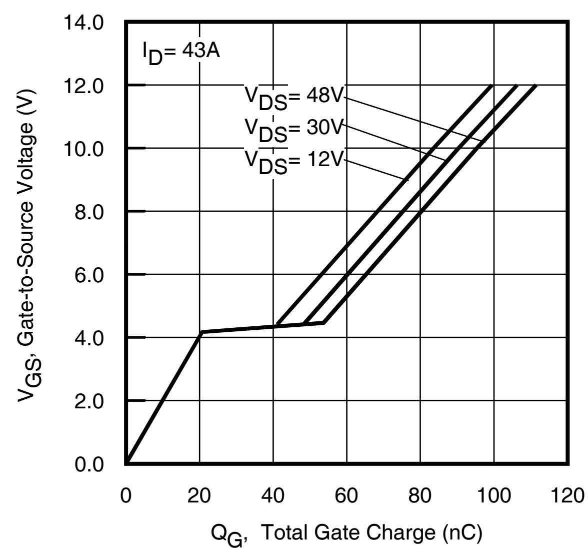


Fig 6. Typical Gate Charge vs. Gate-to-Source Voltage

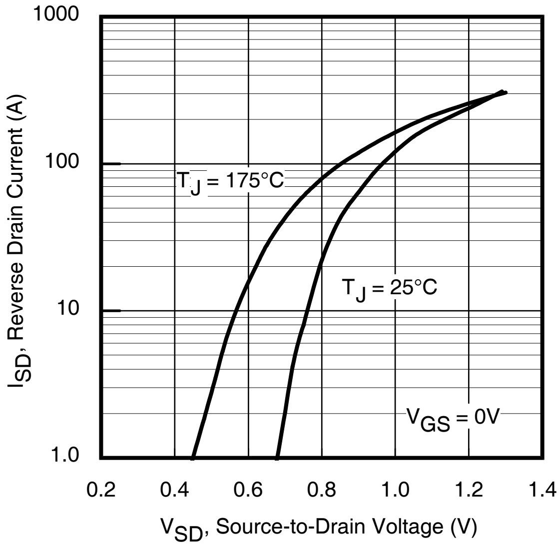


Fig. 7 Typical Source-to-Drain Diode Forward Voltage

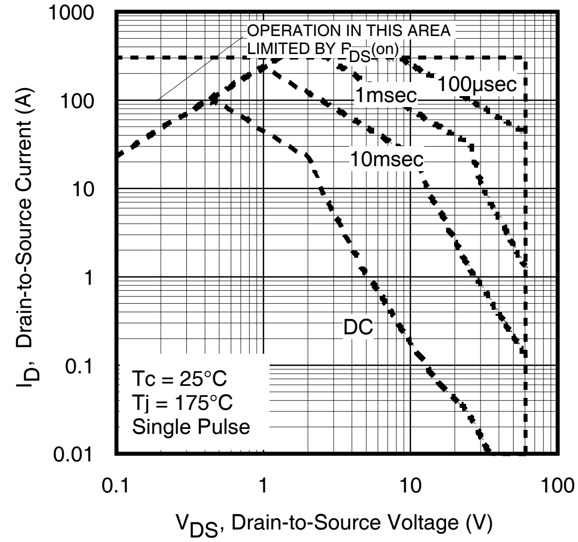


Fig 8. Maximum Safe Operating Area

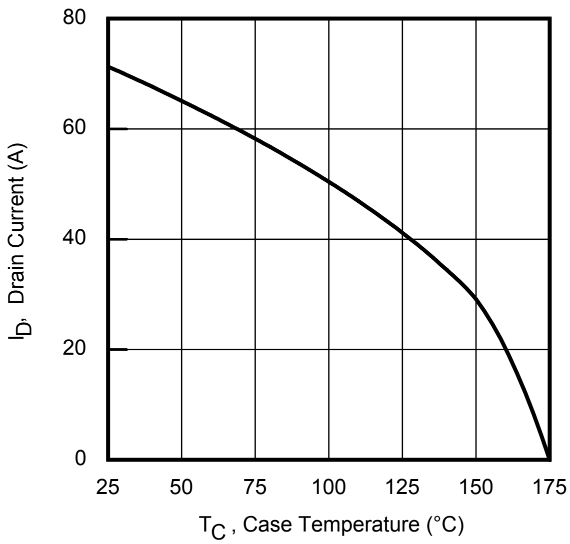


Fig 9. Maximum Drain Current vs. Case Temperature

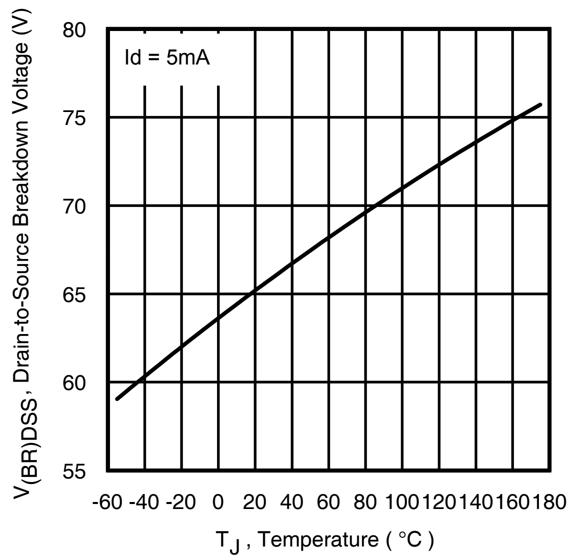


Fig 10. Drain-to-Source Breakdown Voltage

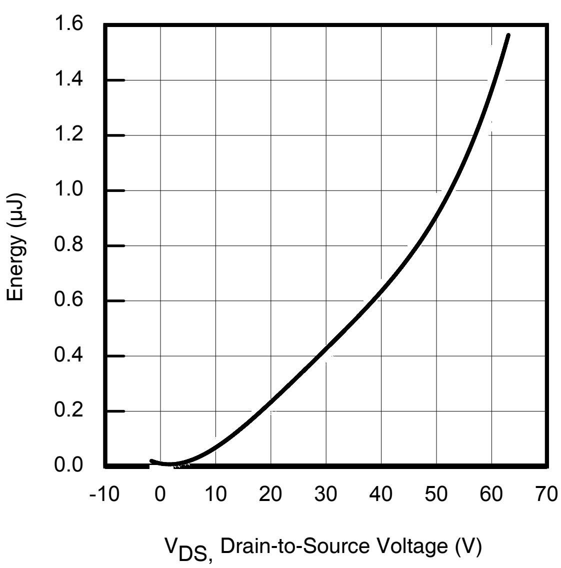


Fig 11. Typical Coss Stored Energy

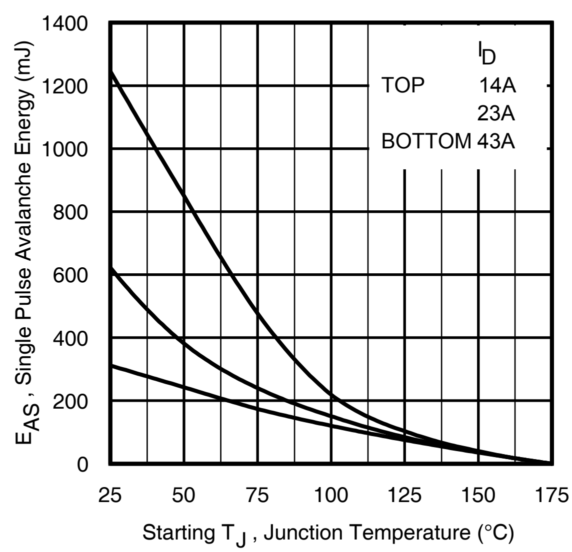


Fig 12. Maximum Avalanche Energy vs. Drain Current

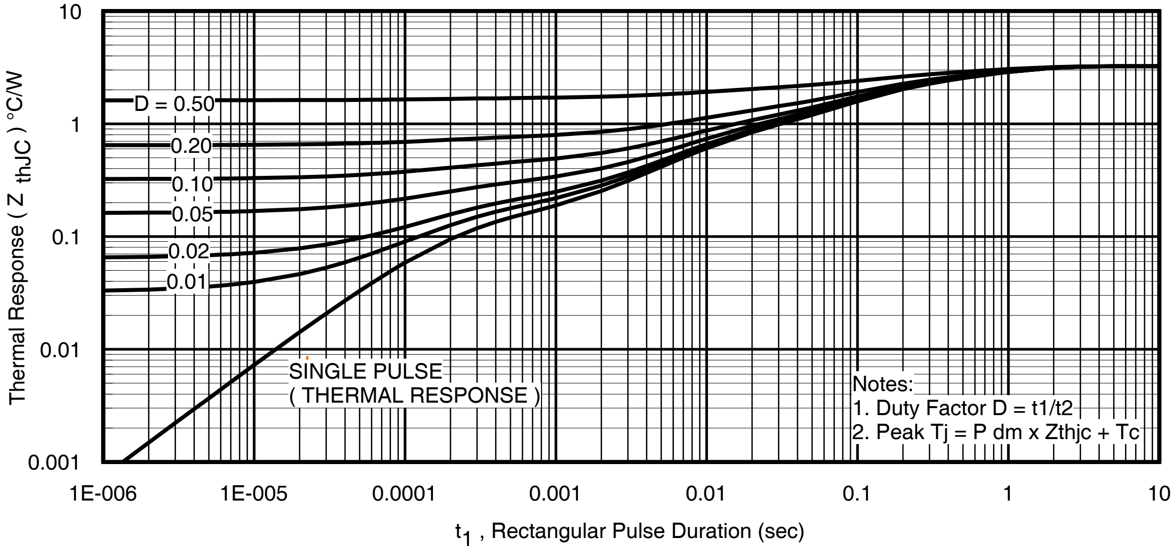


Fig 13. Maximum Effective Transient Thermal Impedance, Junction-to-Case

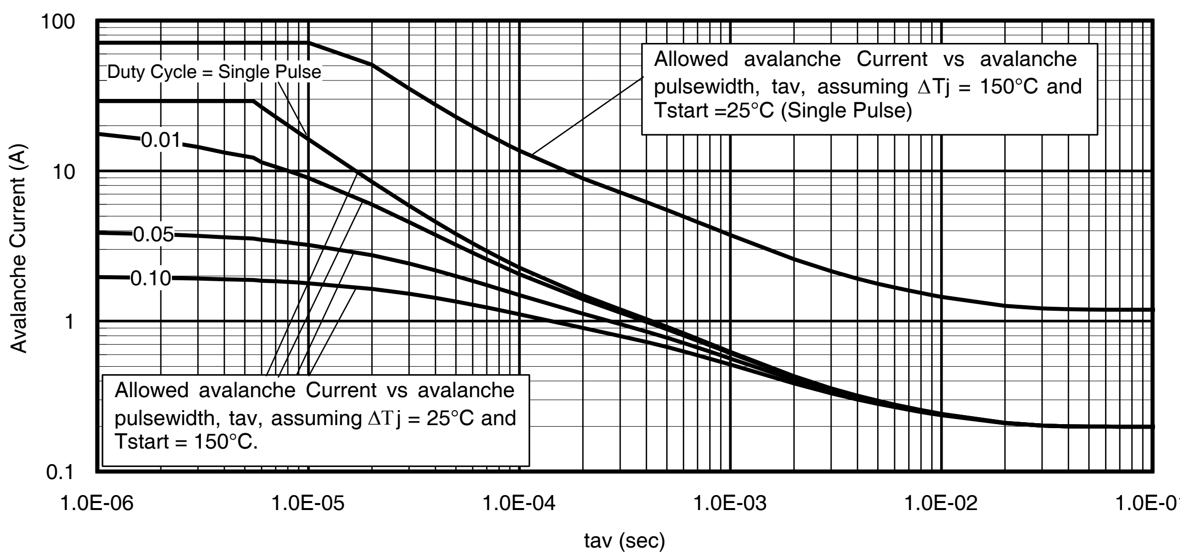


Fig 14. Typical Avalanche Current vs.Pulsewidth

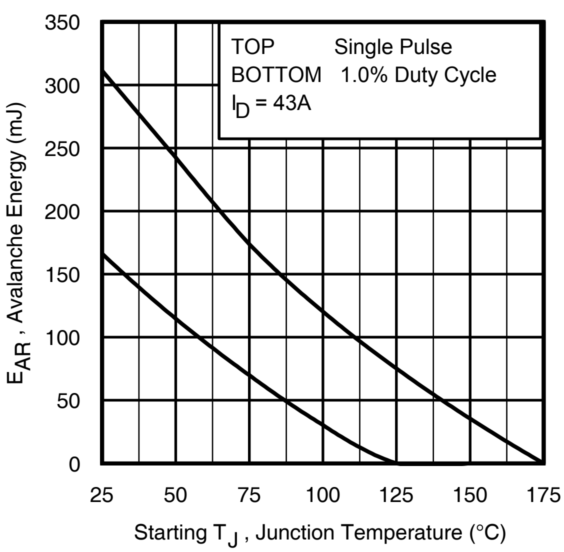


Fig 15. Maximum Avalanche Energy vs. Temperature

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)

$$P_{D\,(ave)} = 1/2\ (1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$$
$$I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{th}]$$
$$E_{AS\,(AR)} = P_{D\,(ave)} \cdot t_{av}$$

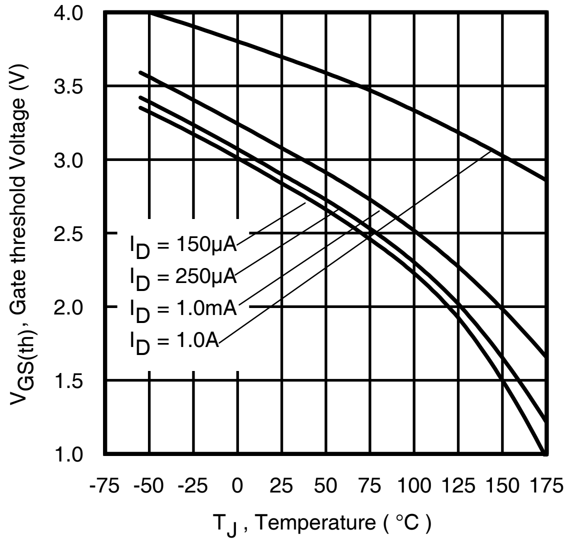


Fig 16. Threshold Voltage vs. Temperature

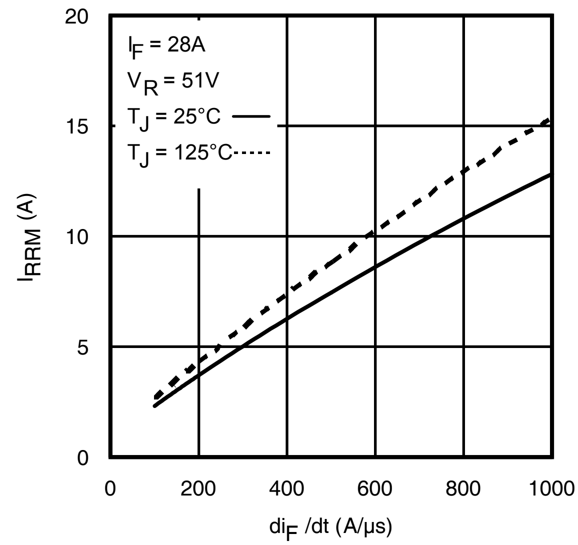


Fig 17. Typical Recovery Current vs. dif/dt

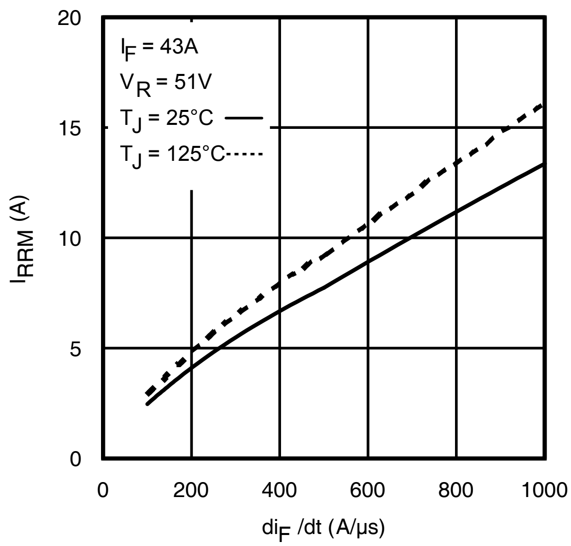


Fig. 18 - Typical Recovery Current vs. dif/dt

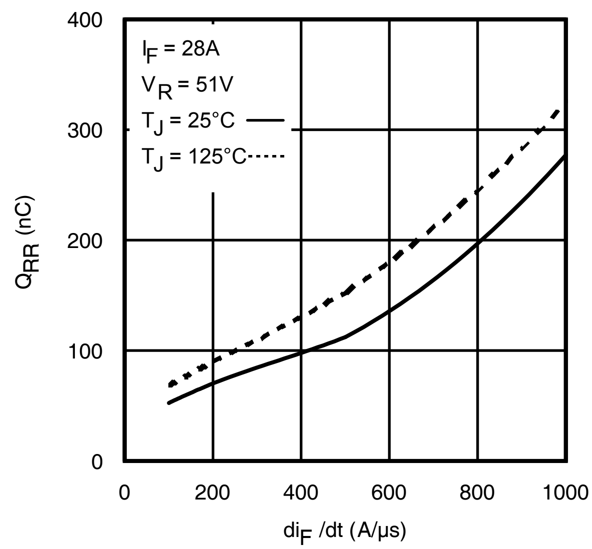


Fig. 19 - Typical Stored Charge vs. dif/dt

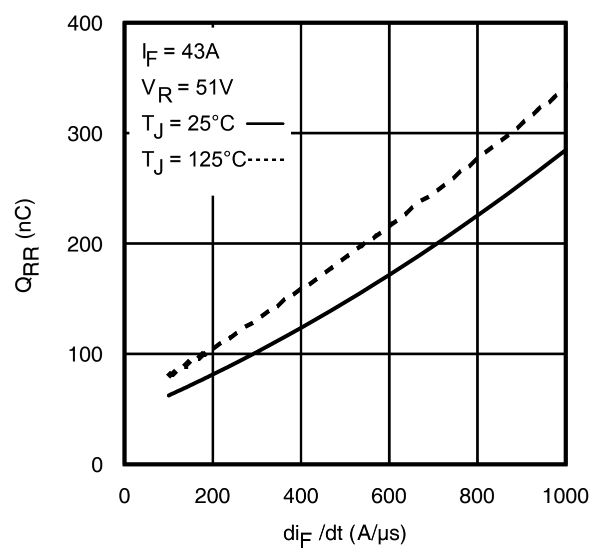


Fig. 20 - Typical Stored Charge vs. dif/dt

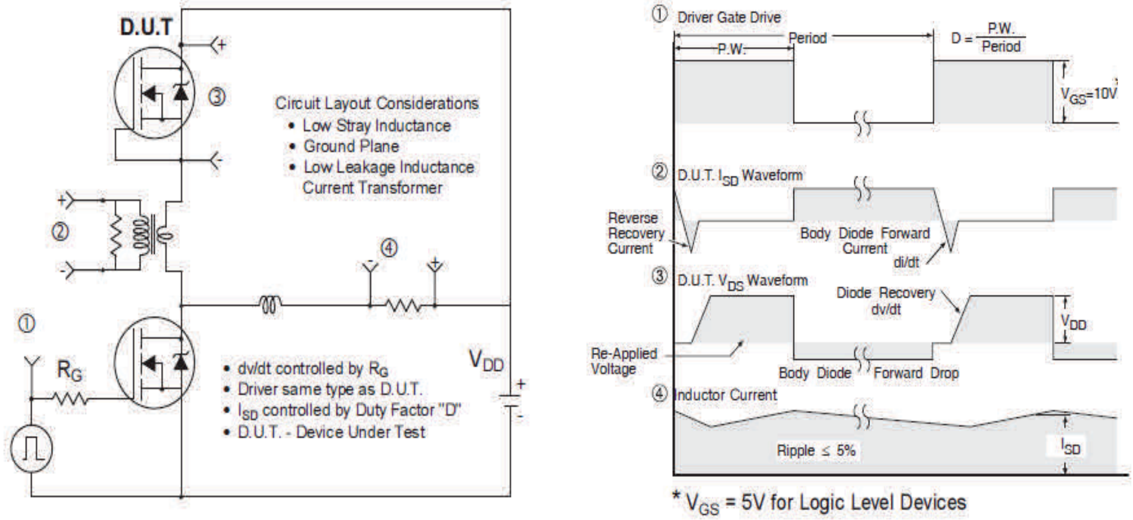


Fig 22. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

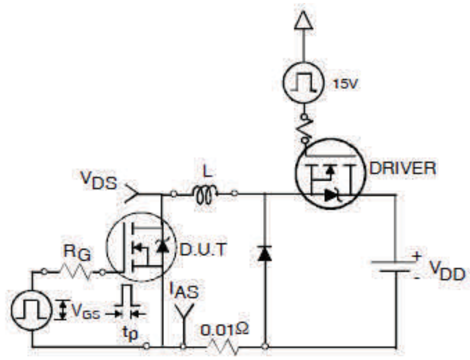


Fig 22a. Unclamped Inductive Test Circuit

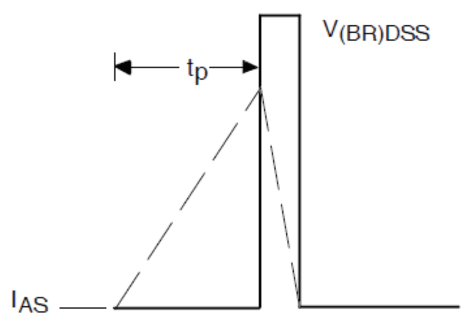


Fig 22b. Unclamped Inductive Waveforms

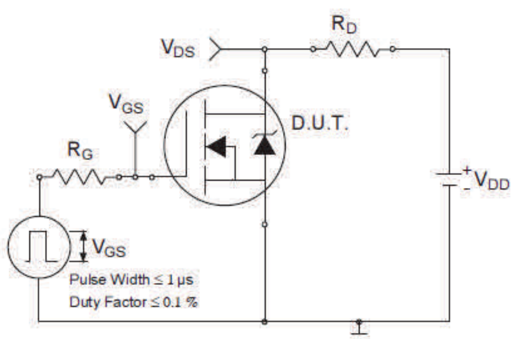


Fig 23a. Switching Time Test Circuit

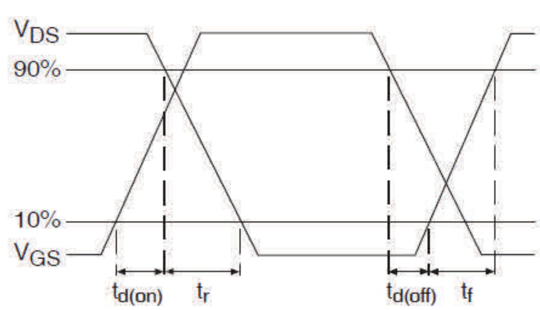


Fig 23b. Switching Time Waveforms

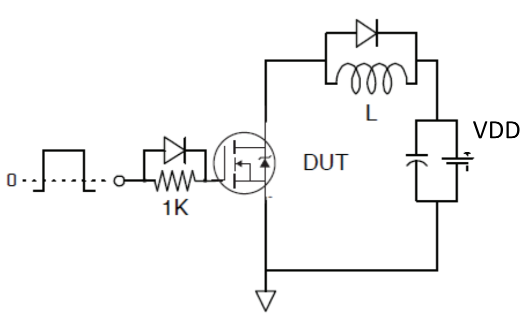


Fig 24a. Gate Charge Test Circuit

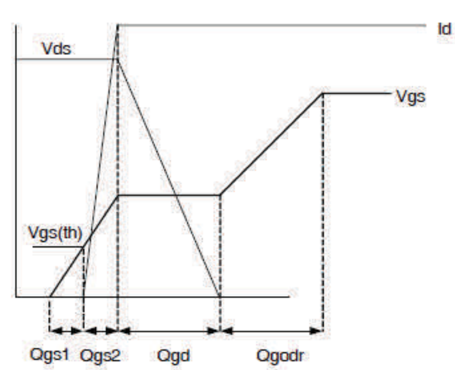
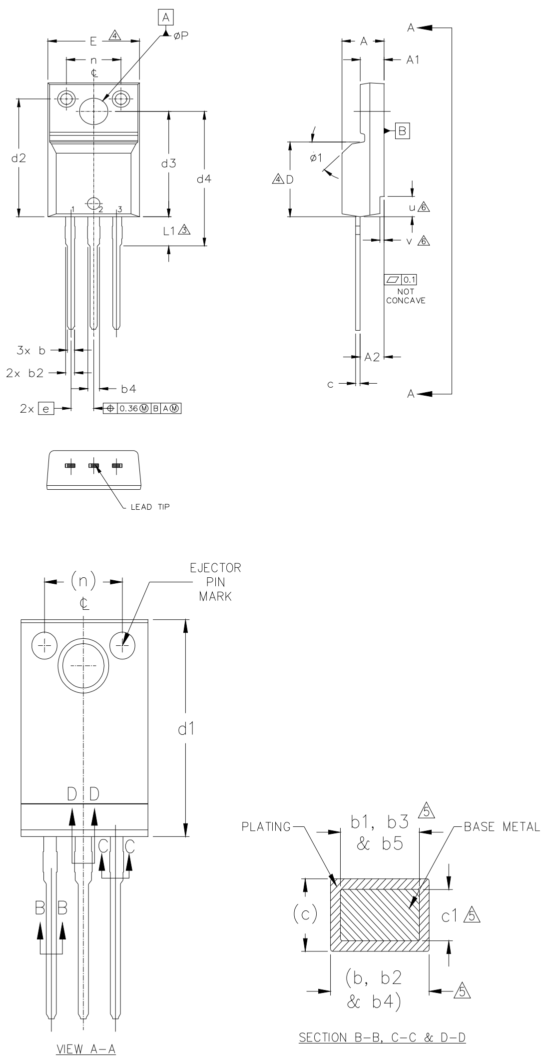


Fig 24b. Gate Charge Waveform

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	
A1	2.57	2.83	.101	.111	
A2	2.41	2.92	.095	.115	
b	0.62	.094	0.24	.037	
b1	0.62	0.89	.024	0.35	5
b2	0.76	1.27	.030	.050	
b3	0.76	1.22	.030	.048	5
b4	1.02	1.52	.040	.060	
b5	1.02	1.47	.040	.058	5
c	0.33	0.63	.013	.025	
c1	0.33	0.58	.013	.023	5
D	8.65	9.80	.341	.386	4
d1	15.80	16.12	.622	.635	
d2	13.97	14.22	.550	.560	
d3	12.30	12.92	.484	.509	
d4	8.64	9.91	.340	.390	
E	9.63	10.63	.379	.419	4
e	2.54 BSC		.100 BSC		
L	13.20	13.72	.520	.540	
L1	3.10	2.31	.122	.138	3
n	6.05	6.15	.238	.242	
øP	3.05	3.45	.120	.136	
u	2.40	2.50	.094	.098	6
v	0.40	0.50	.016	.020	6
ø1	–	45°	–	45°	

LEAD ASSIGNMENTS

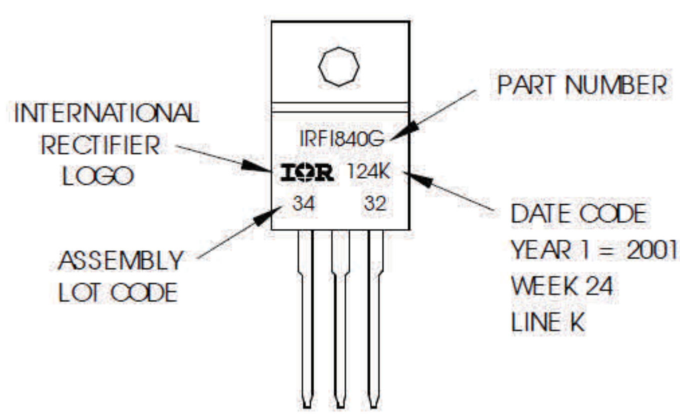
HEXFET
1.– GATE
2.– DRAIN
3.– SOURCE

IGBTs, CoPACK
1.– GATE
2.– COLLECTOR
3.– EMITTER

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	

† 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.

†††† Higher MSL ratings may be available for the specific package types listed here. Please contact your International Rectifier sales representative for further information: http://www.irf.com/whoto-call/salesrep/

Revision History

Date	Comments
10/07/2013	• Removed the "Silicon Limited" from the ID rating, on page 1.

International Rectifier

IR WORLD HEADQUARTERS: 101 N. Sepulveda Blvd., El Segundo, California 90245, USA

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

