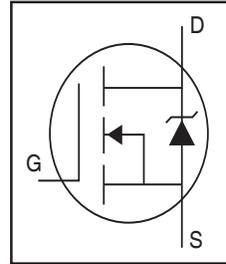


IRFB3256PbF

HEXFET® Power MOSFET

Applications

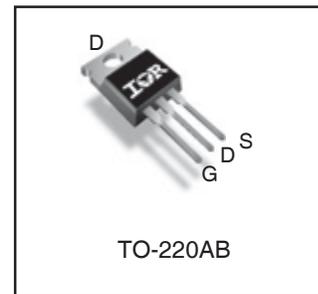
- High Efficiency Synchronous Rectification in SMPS
- Uninterruptible Power Supply
- High Speed Power Switching
- Hard Switched and High Frequency Circuits



V_{DSS}		60V
$R_{DS(on)}$	typ.	2.7mΩ
	max.	3.4mΩ
I_D (Silicon Limited)		206A
I_D (Package Limited)		75A

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



G	D	S
Gate	Drain	Source

Absolute Maximum Ratings

Symbol	Parameter	Max.	Units
$I_D @ T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Silicon Limited)	206	A
$I_D @ T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Silicon Limited)	172	
$I_D @ T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Package Limited)	75	
I_{DM}	Pulsed Drain Current ①	820	
$P_D @ T_C = 25^\circ\text{C}$	Maximum Power Dissipation	300	W
	Linear Derating Factor	2.0	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
dv/dt	Peak Diode Recovery ③	3.3	V/ns
T_J	Operating Junction and Storage Temperature Range	-55 to +175	°C
T_{STG}			
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	
	Mounting torque, 6-32 or M3 screw	10lbf·in (1.1N·m)	

Avalanche Characteristics

E_{AS}	Single Pulse Avalanche Energy (Thermally Limited) ②	340	mJ
I_{AR}	Avalanche Current ①	See Fig. 14, 15, 22a, 22b	A
E_{AR}	Repetitive Avalanche Energy ①		mJ

Thermal Resistance

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ⑦⑧	—	0.50	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat Greased Surface	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient	—	62	

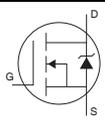
Static @ T_J = 25°C (unless otherwise specified)

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	—	29	—	mV/°C	Reference to 25°C, I _D = 1.0mA ^①
R _{DS(on)}	Static Drain-to-Source On-Resistance	—	2.7	3.4	mΩ	V _{GS} = 10V, I _D = 75A ^④
V _{GS(th)}	Gate Threshold Voltage	2.0	—	4.0	V	V _{DS} = V _{GS} , I _D = 150μA
g _{fs}	Forward Transconductance	88	—	—	S	V _{DS} = 25V, I _D = 75A
R _G	Internal Gate Resistance	—	0.79	—	Ω	
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

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

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
Q _g	Total Gate Charge	—	130	195	nC	I _D = 75A V _{DS} = 30V V _{GS} = 10V ^④ I _D = 75A, V _{DS} = 0V, V _{GS} = 10V
Q _{gs}	Gate-to-Source Charge	—	31	—		
Q _{gd}	Gate-to-Drain ("Miller") Charge	—	42	—		
Q _{sync}	Total Gate Charge Sync. (Q _g - Q _{gd})	—	88	—		
t _{d(on)}	Turn-On Delay Time	—	22	—	ns	V _{DD} = 39V I _D = 75A R _G = 2.7Ω V _{GS} = 10V ^④
t _r	Rise Time	—	77	—		
t _{d(off)}	Turn-Off Delay Time	—	55	—		
t _f	Fall Time	—	64	—		
C _{ISS}	Input Capacitance	—	6600	—	pF	V _{GS} = 0V V _{DS} = 48V f = 1.0 MHz, See Fig. 5 V _{GS} = 0V, V _{DS} = 0V to 48V ^⑥ , See Fig. 11 V _{GS} = 0V, V _{DS} = 0V to 48V ^⑤
C _{OSS}	Output Capacitance	—	720	—		
C _{rSS}	Reverse Transfer Capacitance	—	400	—		
C _{OSS} eff. (ER)	Effective Output Capacitance (Energy Related)	—	1080	—		
C _{OSS} eff. (TR)	Effective Output Capacitance (Time Related)	—	1400	—		

Diode Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
I _S	Continuous Source Current (Body Diode)	—	—	206	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I _{SM}	Pulsed Source Current (Body Diode) ^②	—	—	820	A	
V _{SD}	Diode Forward Voltage	—	—	1.3	V	T _J = 25°C, I _S = 75A, V _{GS} = 0V ^④
t _{rr}	Reverse Recovery Time	—	43	—	ns	T _J = 25°C V _R = 51V, T _J = 125°C I _F = 75A
Q _{rr}	Reverse Recovery Charge	—	58	—	nC	T _J = 25°C di/dt = 100A/μs ^④ T _J = 125°C
I _{RRM}	Reverse Recovery Current	—	2.4	—	A	T _J = 25°C
t _{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)				

Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Limited by T_{Jmax}, starting T_J = 25°C, L = 0.12mH
R_G = 50Ω, I_{AS} = 75A, V_{GS} = 10V. Part not recommended for use above this value.
- ③ I_{SD} ≤ 75A, di/dt ≤ 890A/μs, V_{DD} ≤ V_{(BR)DSS}, T_J ≤ 175°C.
- ④ Pulse width ≤ 400μs; duty cycle ≤ 2%.
- 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}.
- ⑦ R_θ is measured at T_J approximately 90°C.
- ⑧ R_{θJC} value shown is at time zero.

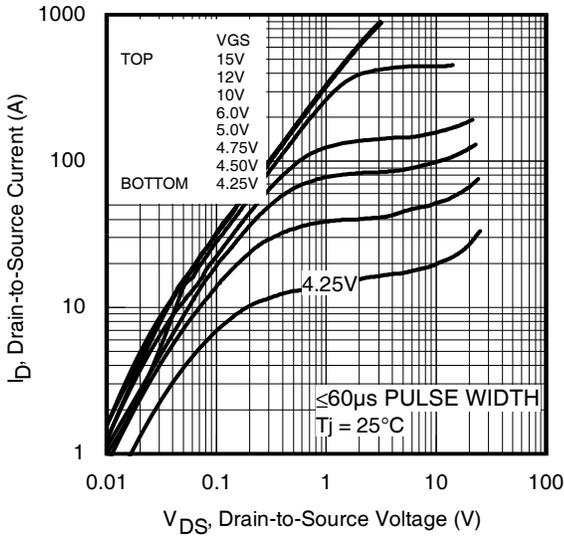


Fig 1. Typical Output Characteristics

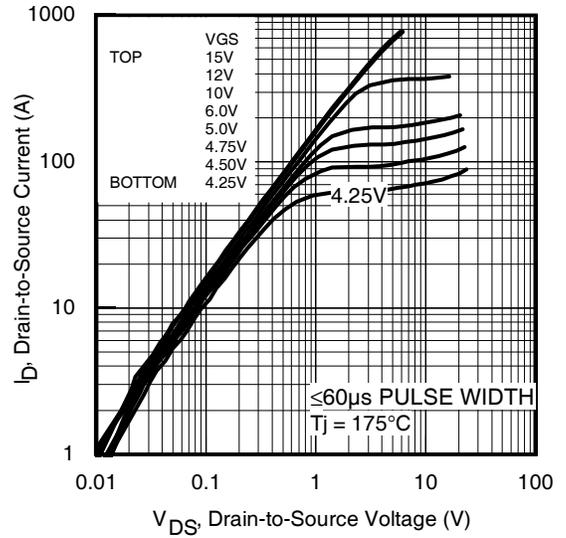


Fig 2. Typical Output Characteristics

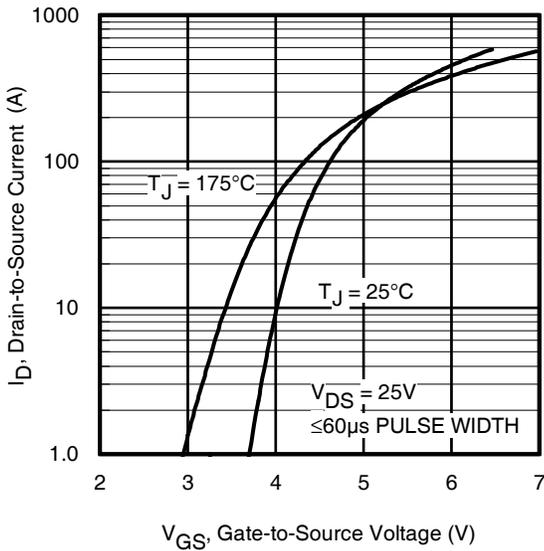


Fig 3. Typical Transfer Characteristics

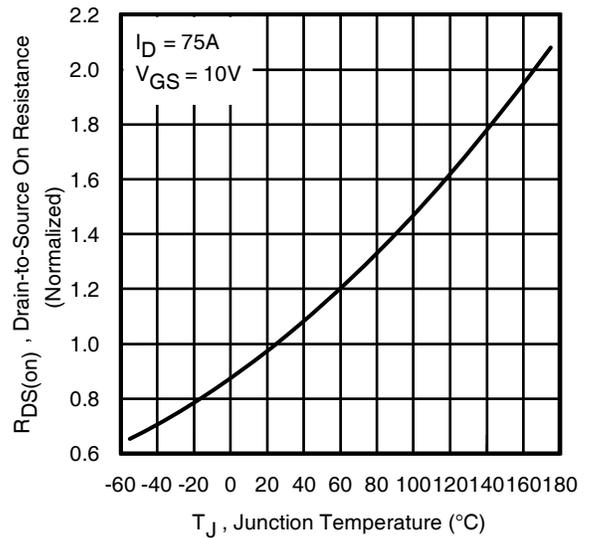


Fig 4. Normalized On-Resistance vs. Temperature

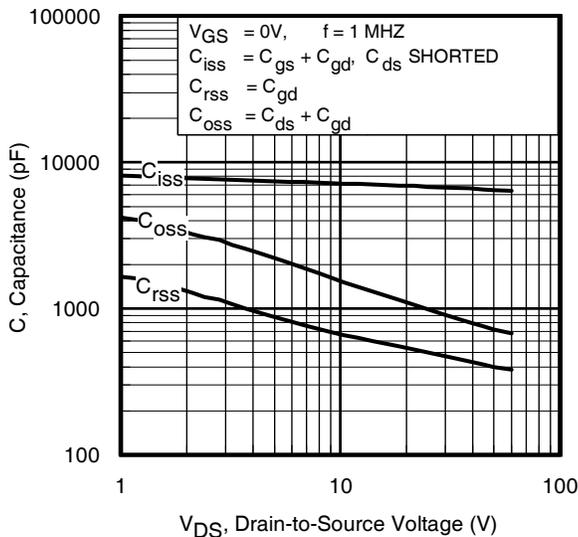


Fig 5. Typical Capacitance vs. Drain-to-Source Voltage

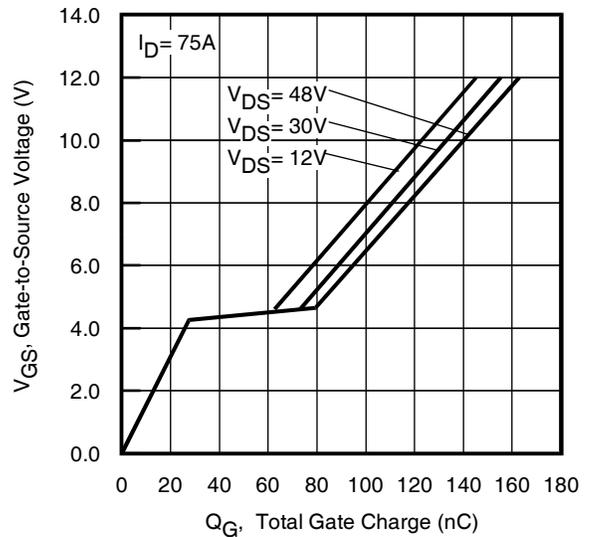


Fig 6. Typical Gate Charge vs. Gate-to-Source Voltage

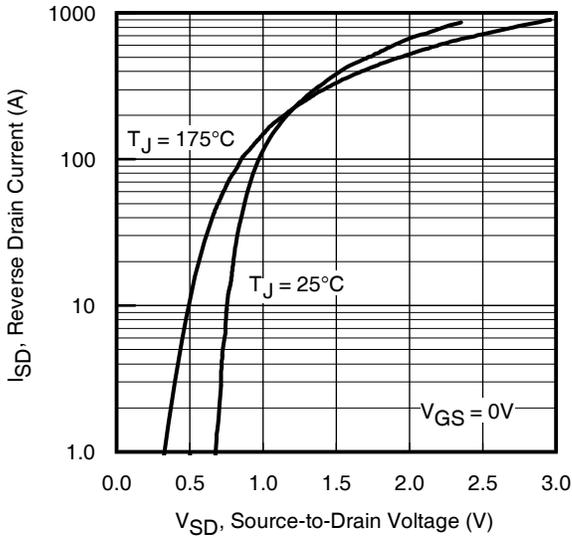


Fig 7. Typical Source-Drain Diode Forward Voltage

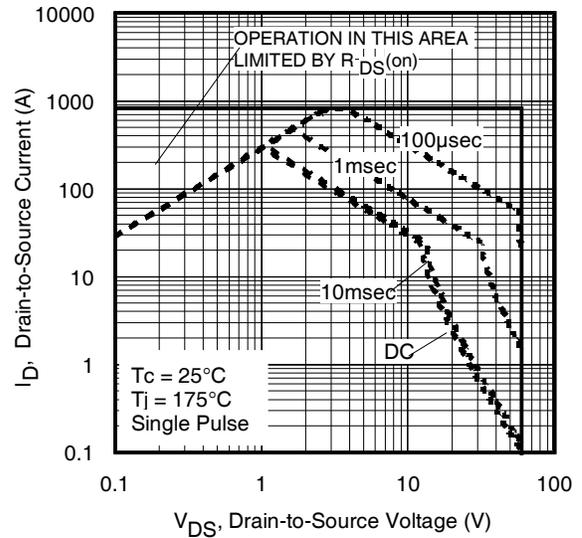


Fig 8. Maximum Safe Operating Area

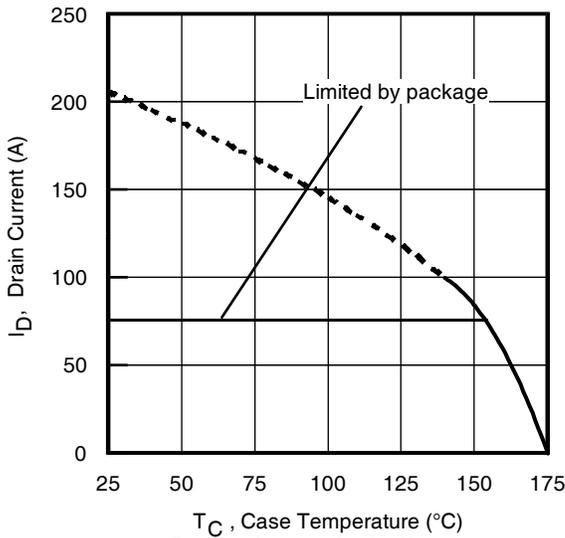


Fig 9. Maximum Drain Current vs. Case Temperature

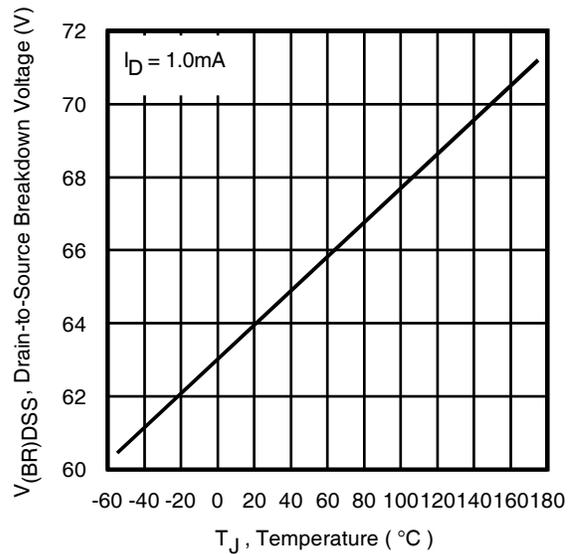


Fig 10. Drain-to-Source Breakdown Voltage

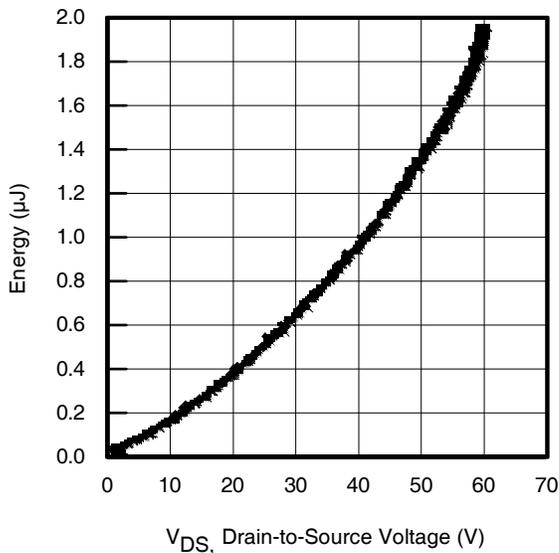


Fig 11. Typical C_{OSS} Stored Energy

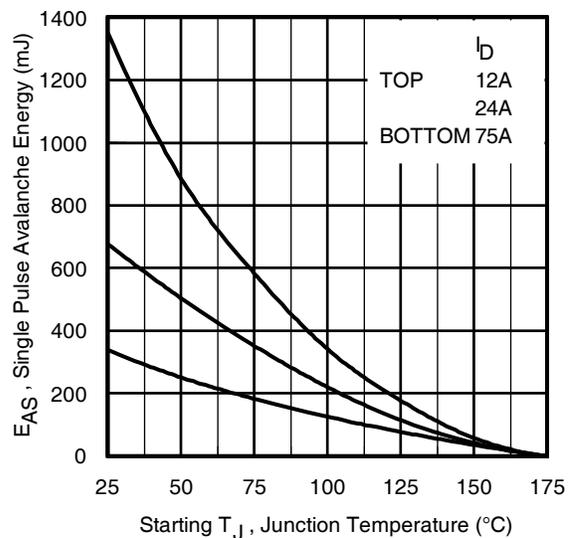


Fig 12. Maximum Avalanche Energy vs. Drain Current

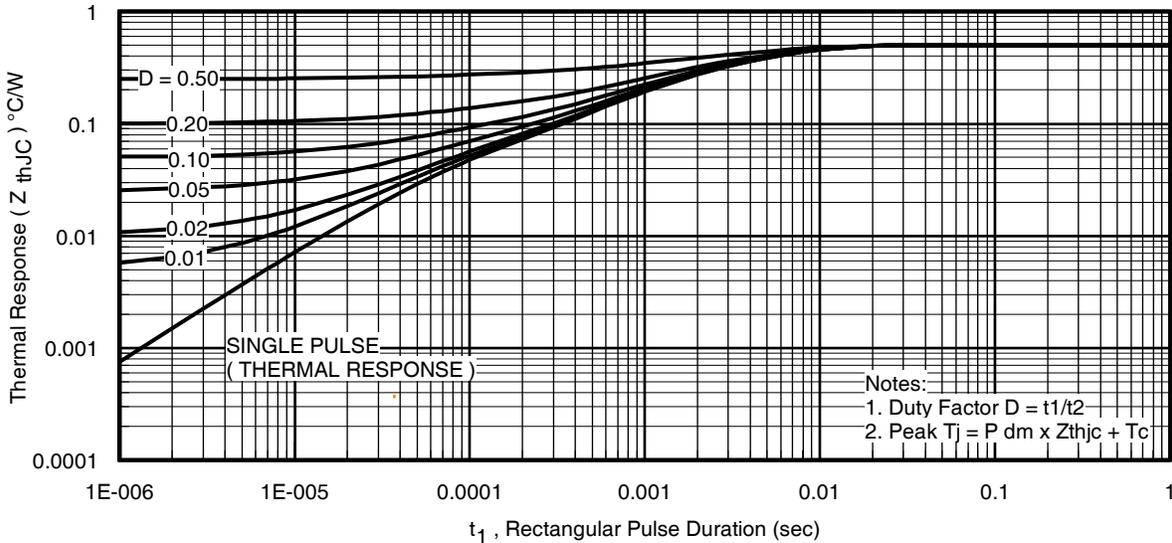


Fig 13. Maximum Effective Transient Thermal Impedance, Junction-to-Case

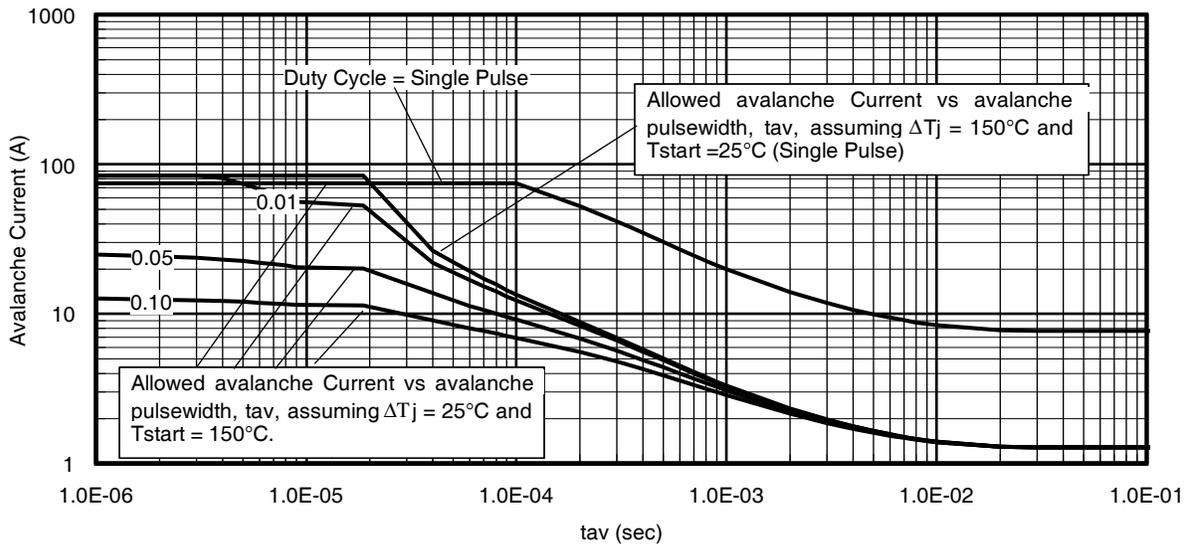


Fig 14. Typical Avalanche Current vs. Pulsewidth

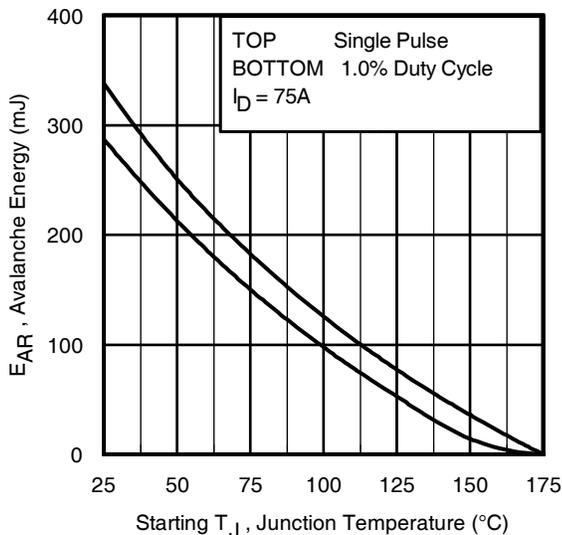


Fig 15. Maximum Avalanche Energy vs. Temperature

Notes on Repetitive Avalanche Curves , Figures 14, 15:
(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)

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

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

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

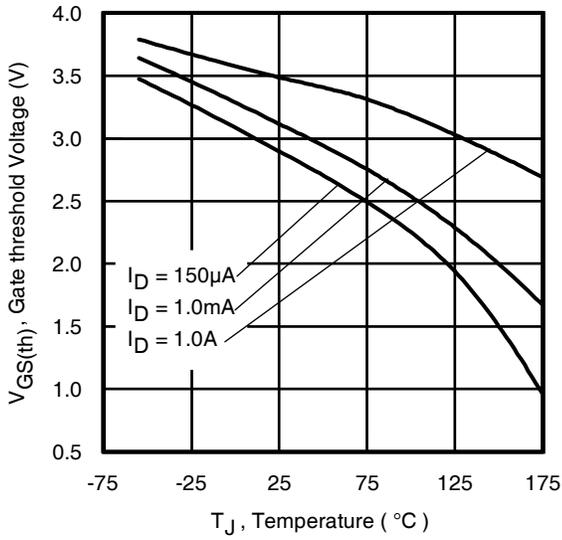


Fig 16. Threshold Voltage vs. Temperature

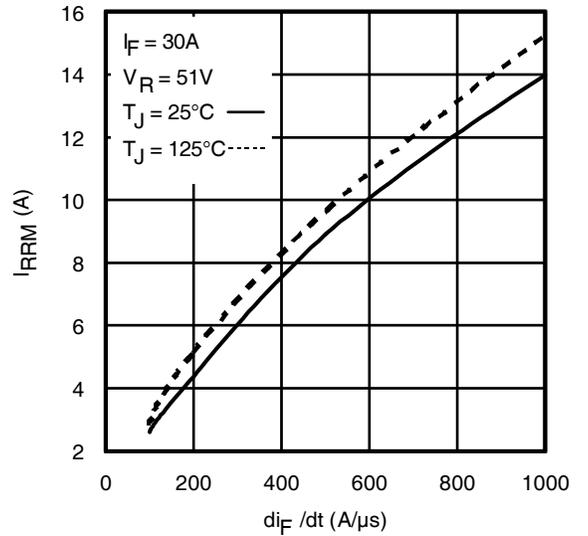


Fig. 17 - Typical Recovery Current vs. di_F/dt

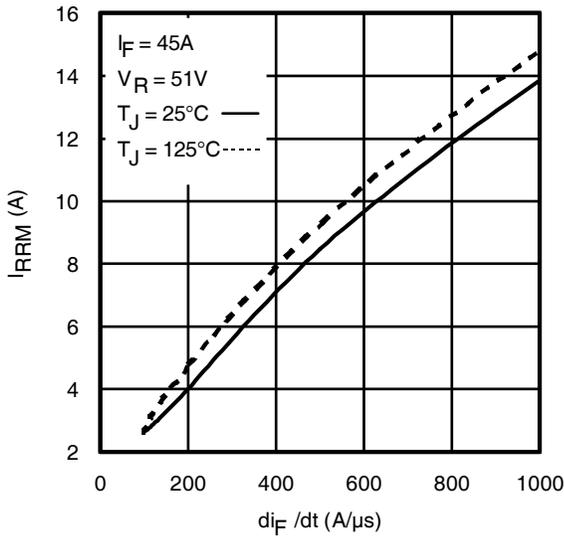


Fig. 18 - Typical Recovery Current vs. di_F/dt

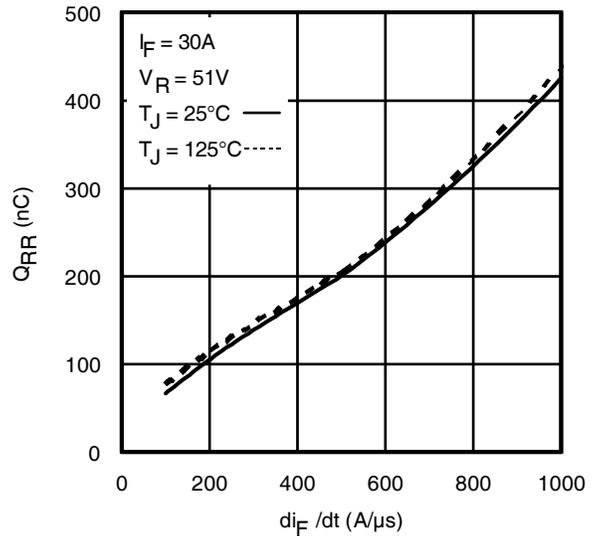


Fig. 19 - Typical Stored Charge vs. di_F/dt

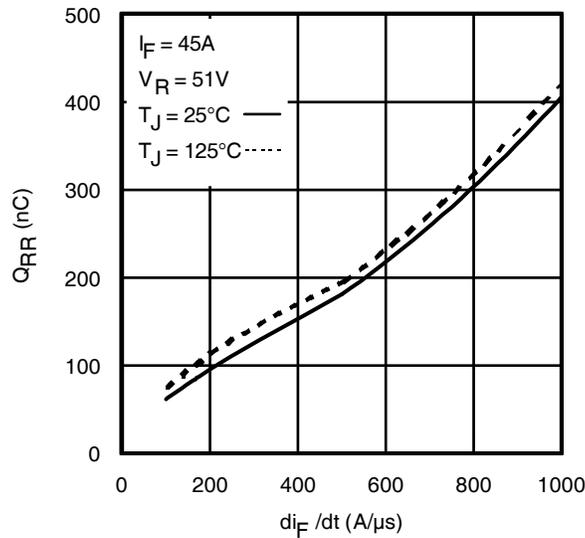


Fig. 20 - Typical Stored Charge vs. di_F/dt

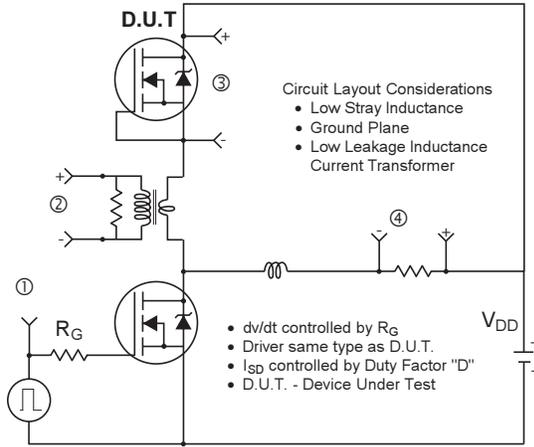
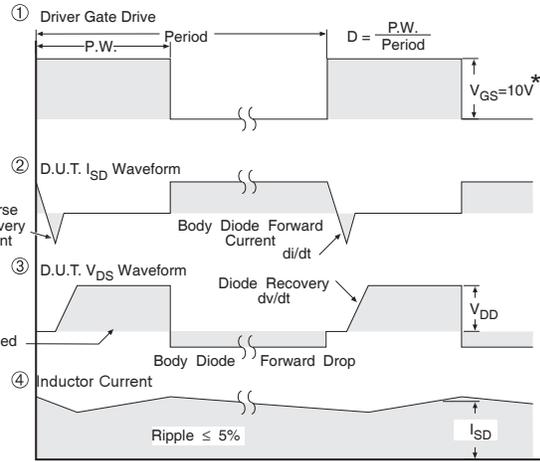


Fig 21. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs



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

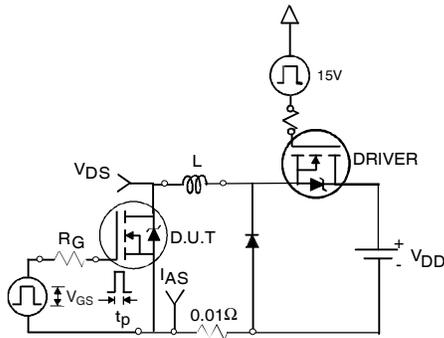


Fig 22a. Unclamped Inductive Test Circuit

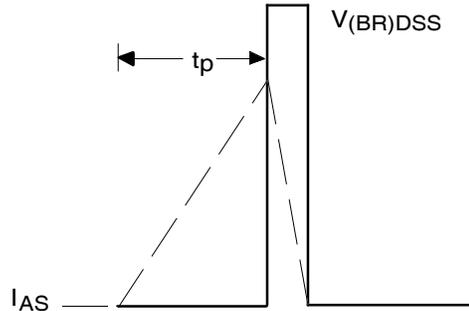


Fig 22b. Unclamped Inductive Waveforms

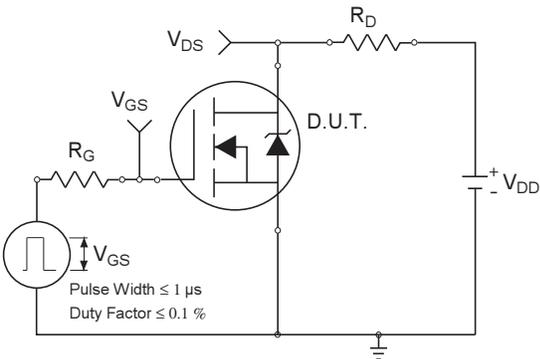


Fig 23a. Switching Time Test Circuit

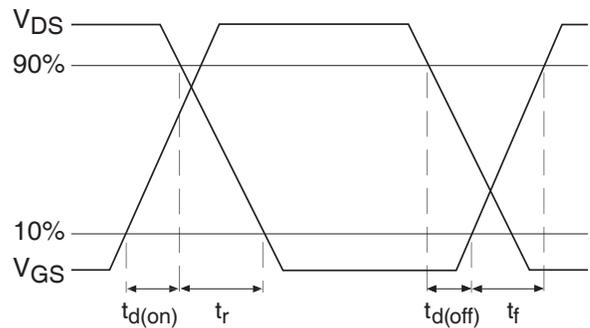


Fig 23b. Switching Time Waveforms

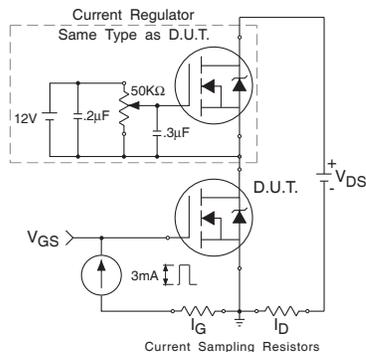


Fig 24a. Gate Charge Test Circuit

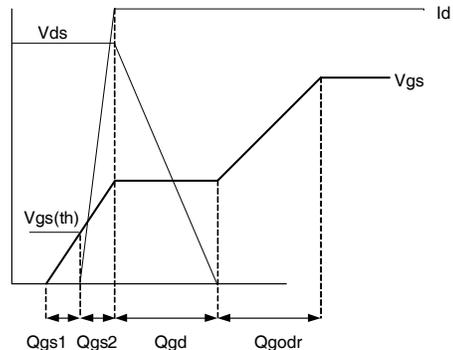
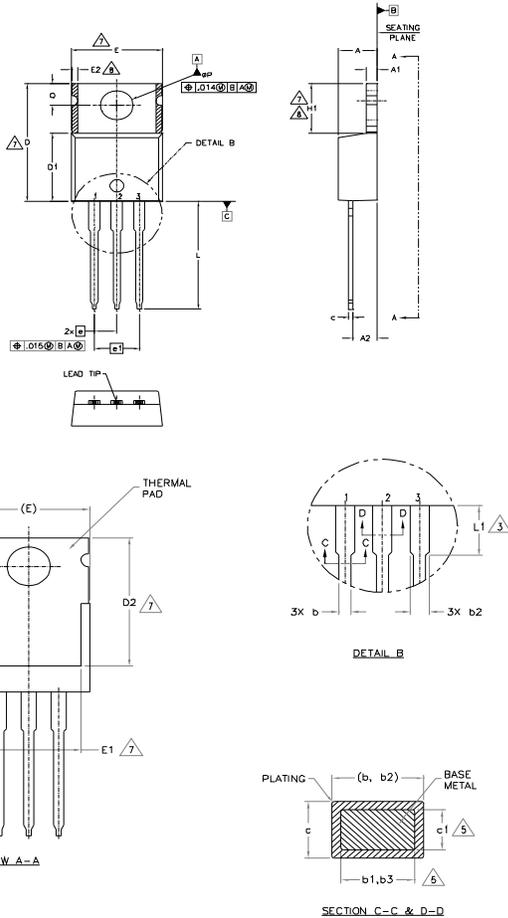


Fig 24b. Gate Charge Waveform

TO-220AB Package Outline

Dimensions are shown in millimeters (inches)



NOTES:

- 1.- DIMENSIONING AND TOLERANCING AS PER ASME Y14.5 M- 1994.
- 2.- DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS].
- 3.- LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
- 4.- DIMENSION D, D1 & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
- 5.- DIMENSION b1, b3 & c1 APPLY TO BASE METAL ONLY.
- 6.- CONTROLLING DIMENSION : INCHES.
- 7.- THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS E,H1,D2 & E1
- 8.- DIMENSION E2 X H1 DEFINE A ZONE WHERE STAMPING AND SINGULARITY IRREGULARITIES ARE ALLOWED.
- 9.- OUTLINE CONFORMS TO JEDEC TO-220, EXCEPT A2 (max.) AND D2 (min.) WHERE DIMENSIONS ARE DERIVED FROM THE ACTUAL PACKAGE OUTLINE.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	3.56	4.83	.140	.190	
A1	0.51	1.40	.020	.055	
A2	2.03	2.92	.080	.115	
b	0.38	1.01	.015	.040	
b1	0.38	0.97	.015	.038	5
b2	1.14	1.78	.045	.070	
b3	1.14	1.73	.045	.068	5
c	0.36	0.61	.014	.024	
c1	0.36	0.56	.014	.022	5
D	14.22	16.51	.560	.650	4
D1	8.38	9.02	.330	.355	
D2	11.68	12.88	.460	.507	7
E	9.65	10.67	.380	.420	4,7
E1	6.86	8.89	.270	.350	7
E2	-	0.76	-	.030	8
e	2.54 BSC		.100 BSC		
e1	5.08 BSC		.200 BSC		
H1	5.84	6.86	.230	.270	7,8
L	12.70	14.73	.500	.580	
L1	3.56	4.06	.140	.160	3
øP	3.54	4.08	.139	.161	
O	2.54	3.42	.100	.135	

LEAD ASSIGNMENTS

- HEXFET
 1- GATE
 2- DRAIN
 3- SOURCE

IGBTs, CoPACK

- 1- GATE
 2- COLLECTOR
 3- EMITTER

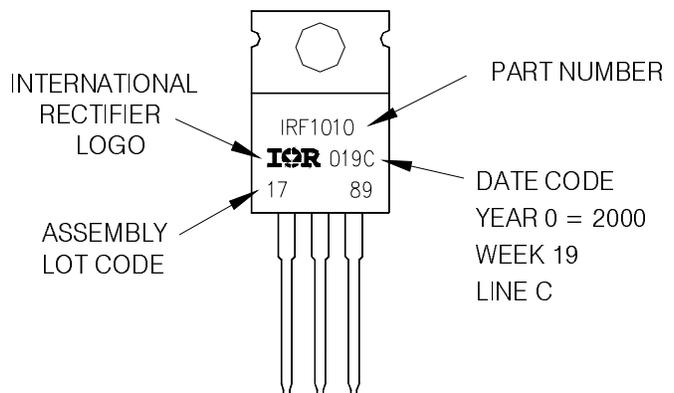
DIODES

- 1- ANODE
 2- CATHODE
 3- ANODE

TO-220AB Part Marking Information

EXAMPLE: THIS IS AN IRF1010
 LOT CODE 1789
 ASSEMBLED ON WW 19, 2000
 IN THE ASSEMBLY LINE "C"

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



TO-220AB 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	Consumer ^{††} (per JEDEC JESD47F ^{†††} guidelines)	
Moisture Sensitivity Level	TSOP-6	MSL1 (per IPC/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.

Data and specifications subject to change without notice.

International
IR Rectifier

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