International
IOR Rectifier

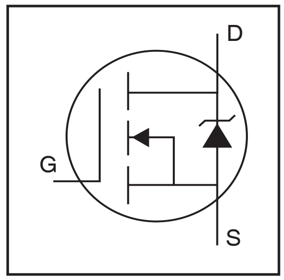
PDP SWITCH

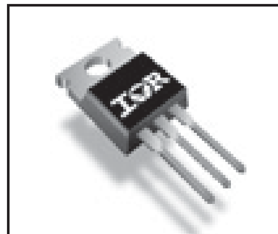
IRFB4233PbF

Features

- Advanced process technology
- Key parameters optimized for PDP Sustain, Energy Recovery and Pass Switch Applications
- Low E_{PULSE} rating to reduce power dissipation in PDP Sustain, Energy Recovery and Pass Switch Applications
- Low Q_G for fast response
- High repetitive peak current capability for reliable operation
- Short fall & rise times for fast switching
- 175°C operating junction temperature for improved ruggedness
- Repetitive avalanche capability for robustness and reliability

Key Parameters		
V_{DS} min	230	V
$V_{DS\ (Avalanche)}$ typ.	276	V
$R_{DS(ON)}$ typ. @ 10V	31	mΩ
I_{RP} max @ T_C= 100°C	114	A
T_J max	175	°C




TO-220AB

Description

This HEXFET® Power MOSFET is specifically designed for Sustain; Energy Recovery & Pass switch applications in Plasma Display Panels. This MOSFET utilizes the latest processing techniques to achieve low on-resistance per silicon area and low E_{PULSE} rating. Additional features of this MOSFET are 175°C operating junction temperature and high repetitive peak current capability. These features combine to make this MOSFET a highly efficient, robust and reliable device for PDP driving applications.

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{GS}	Gate-to-Source Voltage	±30	V
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V	56	A
I_D @ T_C = 100°C	Continuous Drain Current, V_{GS} @ 10V	39	
I_{DM}	Pulsed Drain Current ①	220	
I_{RP} @ T_C = 100°C	Repetitive Peak Current ⑤	114	
P_D @T_C = 25°C	Power Dissipation	370	W
P_D @T_C = 100°C	Power Dissipation	190	
	Linear Derating Factor	2.5	W/°C
T_J T_{STG}	Operating Junction and Storage Temperature Range	-40 to + 175	°C
	Soldering Temperature for 10 seconds	300	
	Mounting Torque, 6-32 or M3 Screw	10lb·in (1.1N·m)	N

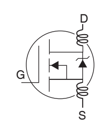
Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ④	—	0.402	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient ④	—	62	

Notes ① through ⑥ are on page 8

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
BV_{DSS}	Drain-to-Source Breakdown Voltage	230	——	——	V	V_{GS} = 0V, I_D = 250μA
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	——	200	——	mV/°C	Reference to 25°C, I_D = 1mA
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	——	31	37	mΩ	V_{GS} = 10V, I_D = 28A ③
$V_{GS(th)}$	Gate Threshold Voltage	3.0	——	5.0	V	V_{DS} = V_{GS}, I_D = 250μA
$\Delta V_{GS(th)}/\Delta T_J$	Gate Threshold Voltage Coefficient	——	-14	——	mV/°C	
I_{DSS}	Drain-to-Source Leakage Current	——	——	5.0	μA	V_{DS} = 184V, V_{GS} = 0V
		——	——	150		V_{DS} = 184V, 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
g_{fs}	Forward Transconductance	83	——	——	S	V_{DS} = 25V, I_D = 39A
Q_g	Total Gate Charge	——	120	170	nC	V_{DD} = 115V, I_D = 39A, V_{GS} = 10V③
Q_{gd}	Gate-to-Drain Charge	——	44	——		
$t_{d(on)}$	Turn-On Delay Time	——	31	——	ns	V_{DD} = 115V, V_{GS} = 10V ③
t_r	Rise Time	——	71	——		I_D = 39A
$t_{d(off)}$	Turn-Off Delay Time	——	51	——		R_G = 5Ω
t_f	Fall Time	——	41	——		See Fig. 22
t_{st}	Shoot Through Blocking Time	100	——	——	ns	V_{DD} = 184V, V_{GS} = 15V, R_G= 4.7Ω
E_{PULSE}	Energy per Pulse	——	460	——	μJ	L = 220nH, C= 0.4μF, V_{GS} = 15V V_{DS} = 184V, R_G= 4.7Ω, T_J = 25°C
		——	970	——		L = 220nH, C= 0.4μF, V_{GS} = 15V V_{DS} = 184V, R_G= 4.7Ω, T_J = 100°C
C_{iss}	Input Capacitance	——	5510	——	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	——	480	——		V_{DS} = 25V
C_{rss}	Reverse Transfer Capacitance	——	220	——		ƒ = 1.0MHz,
C_{oss} eff.	Effective Output Capacitance	——	340	——		V_{GS} = 0V, V_{DS} = 0V to 184V
L_D	Internal Drain Inductance	——	4.5	——	nH	Between lead, 6mm (0.25in.)
L_S	Internal Source Inductance	——	7.5	——		from package and center of die contact

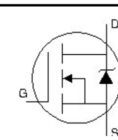


Avalanche Characteristics

	Parameter	Typ.	Max.	Units
E_{AS}	Single Pulse Avalanche Energy②	——	250	mJ
E_{AR}	Repetitive Avalanche Energy ①	——	39	mJ
$V_{DS(Avalanche)}$	Repetitive Avalanche Voltage ①	276	——	V
I_{AS}	Avalanche Current ②	——	39	A

Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S @ T_C = 25°C	Continuous Source Current (Body Diode)	——	——	56	A	MOSFET symbol showing the
I_{SM}	Pulsed Source Current (Body Diode) ①	——	——	220		integral reverse p-n junction diode.
V_{SD}	Diode Forward Voltage	——	——	1.0	V	T_J = 25°C, I_S = 39A, V_{GS} = 0V ③
t_{rr}	Reverse Recovery Time	——	190	280	ns	T_J = 25°C, I_F = 39A, V_{DD} = 50V
Q_{rr}	Reverse Recovery Charge	——	760	1140	nC	di/dt = 100A/μs ③



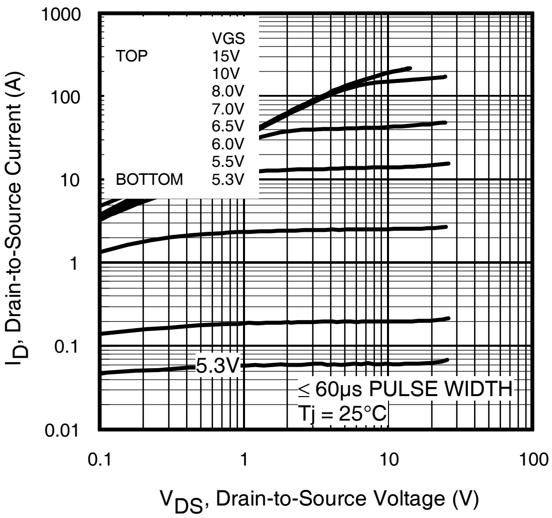


Fig 1. Typical Output Characteristics

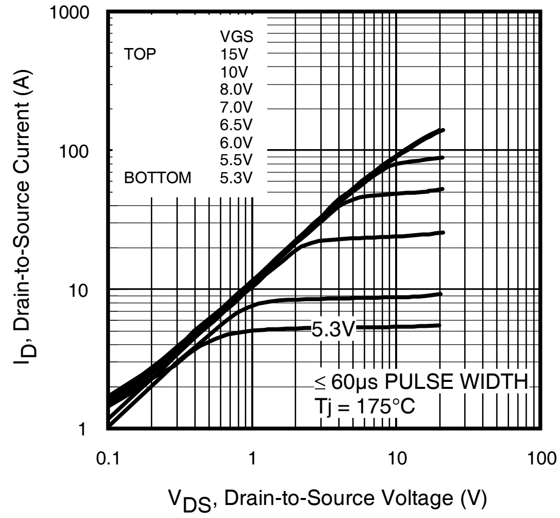


Fig 2. Typical Output Characteristics

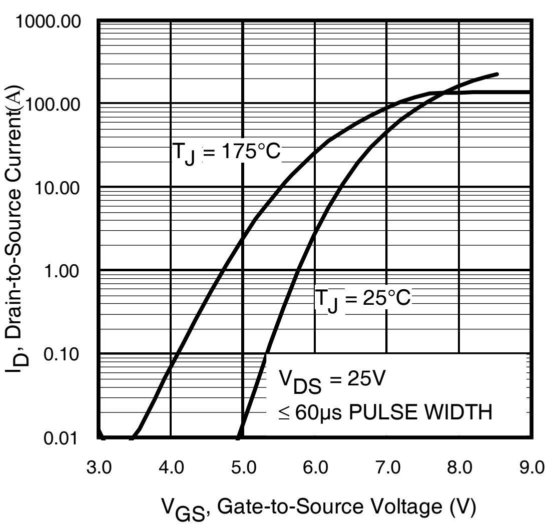


Fig 3. Typical Transfer Characteristics

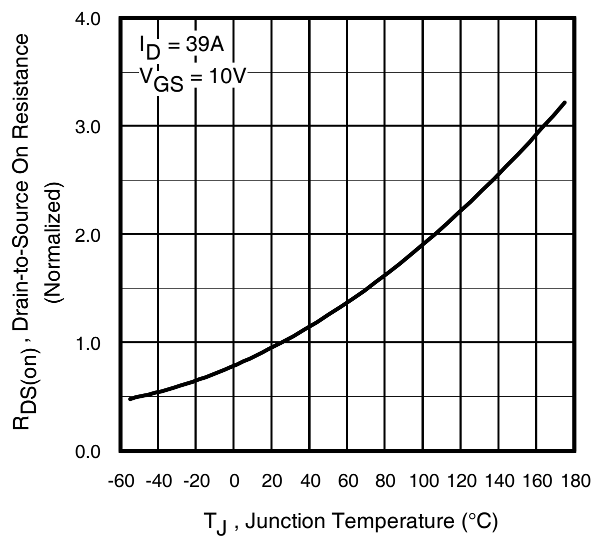


Fig 4. Normalized On-Resistance vs. Temperature

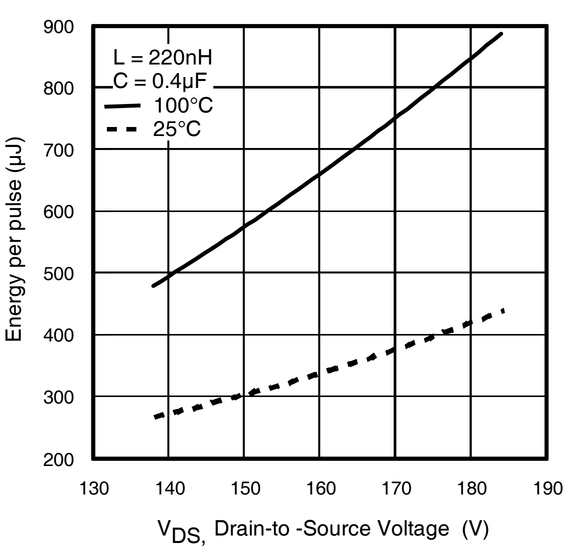


Fig 5. Typical E_{PULSE} vs. Drain-to-Source Voltage

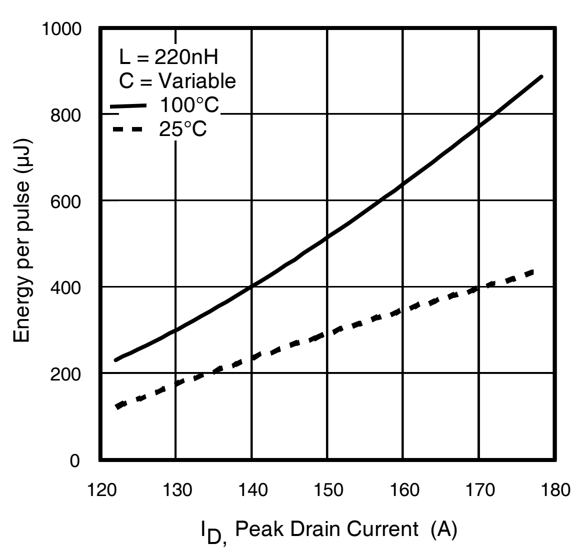


Fig 6. Typical E_{PULSE} vs. Drain Current

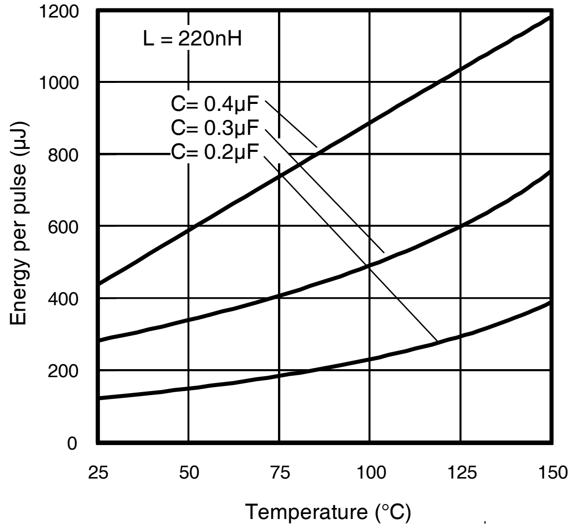


Fig 7. Typical E_{PULSE} vs.Temperature

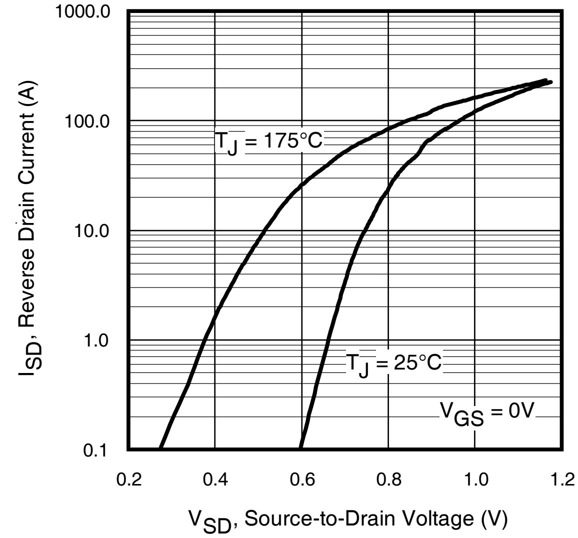


Fig 8. Typical Source-Drain Diode Forward Voltage

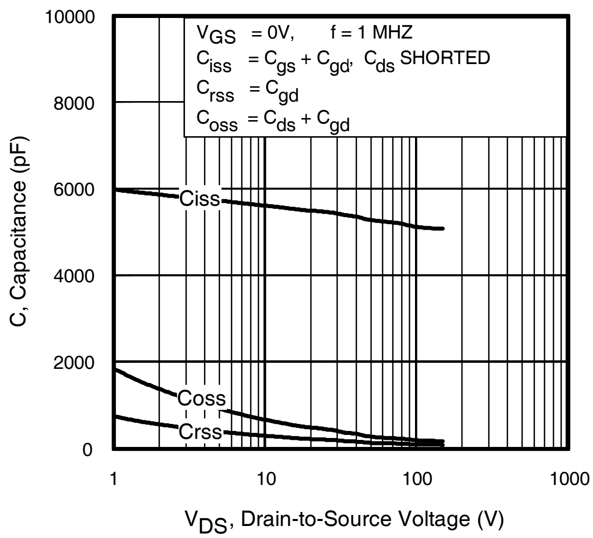


Fig 9. Typical Capacitance vs.Drain-to-Source Voltage

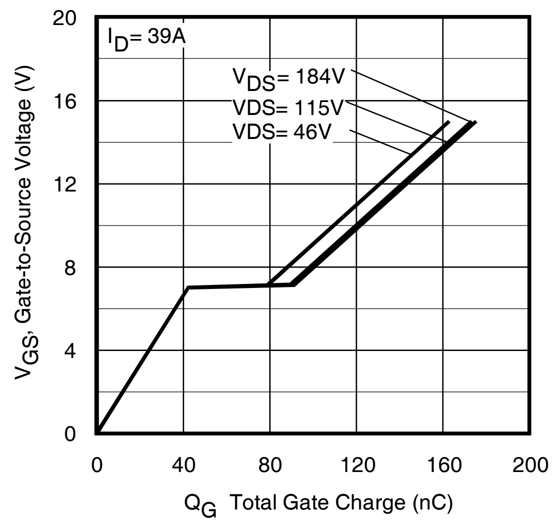


Fig 10. Typical Gate Charge vs.Gate-to-Source Voltage

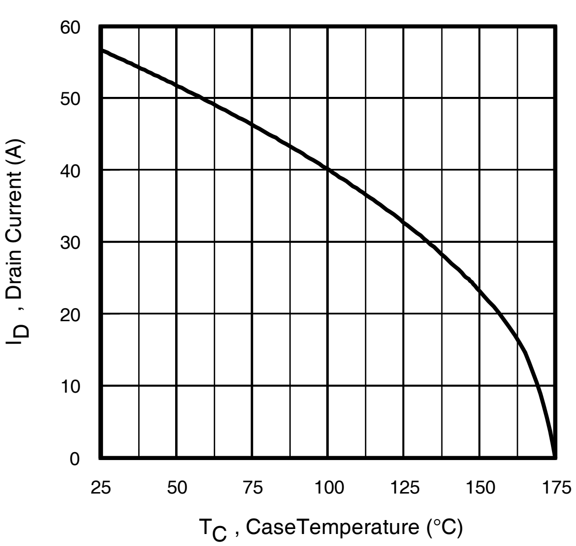


Fig 11. Maximum Drain Current vs. Case Temperature

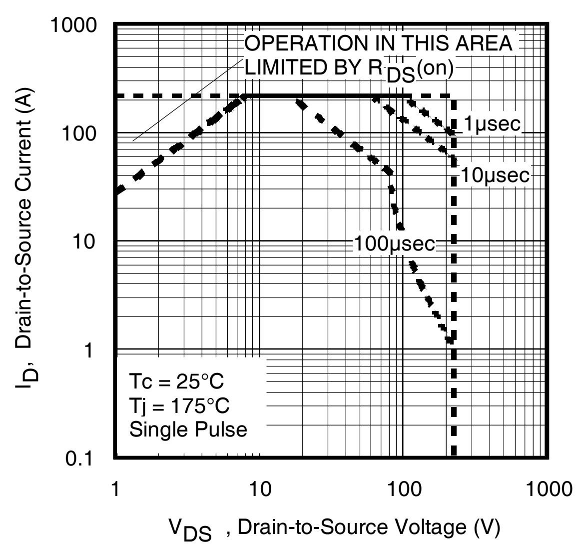


Fig 12. Maximum Safe Operating Area

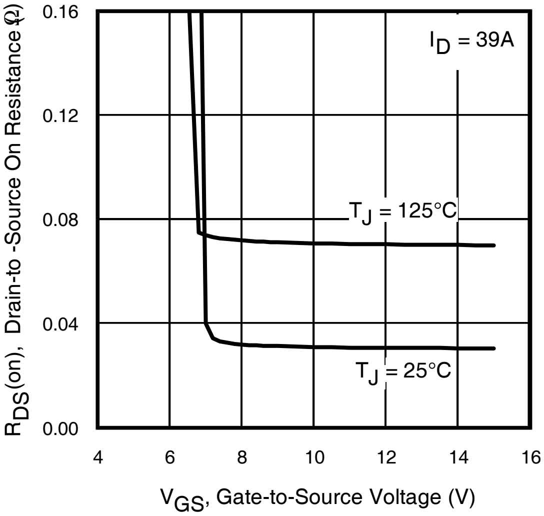


Fig 13. On-Resistance Vs. Gate Voltage

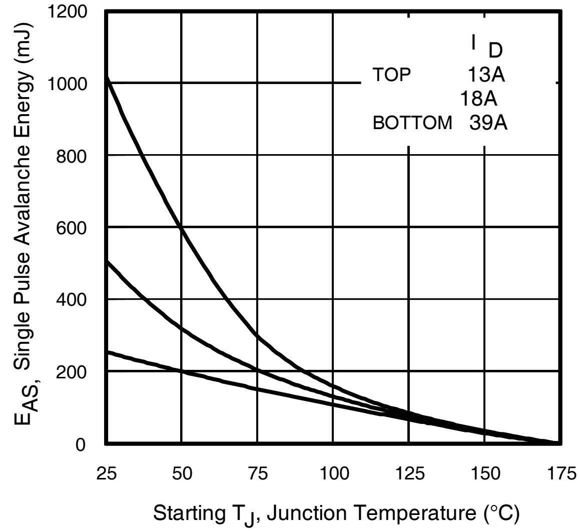


Fig 14. Maximum Avalanche Energy Vs. Temperature

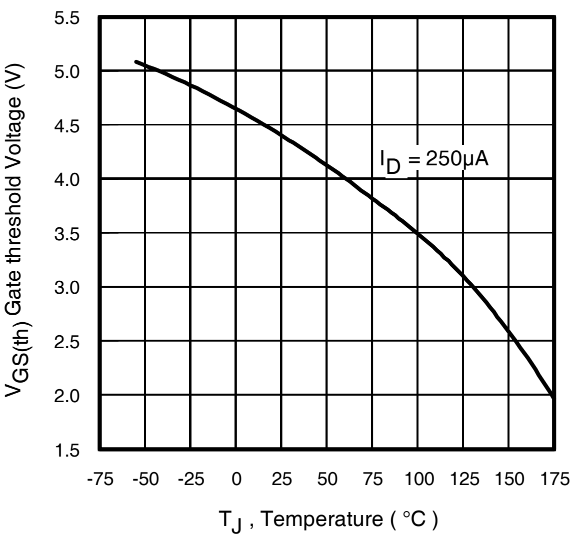


Fig 15. Threshold Voltage vs. Temperature

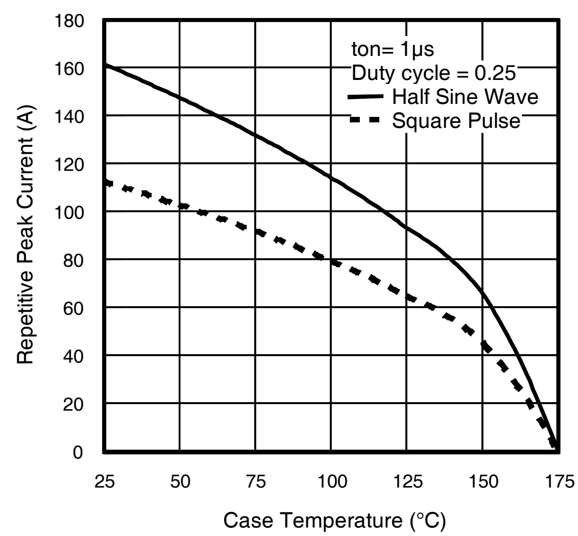


Fig 16. Typical Repetitive peak Current vs. Case temperature

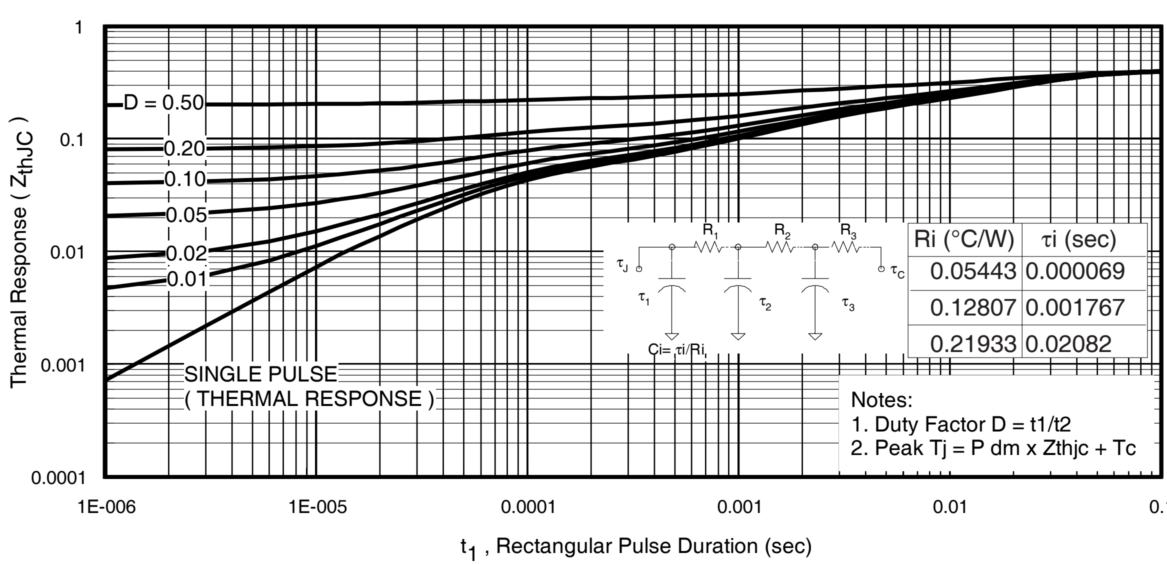


Fig 17. Maximum Effective Transient Thermal Impedance, Junction-to-Case

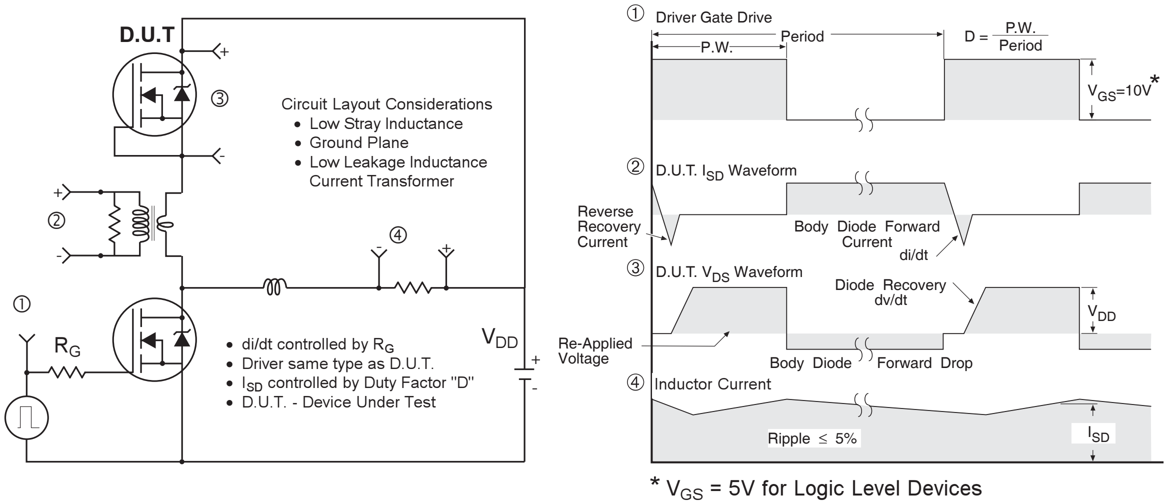


Fig 18. Diode Reverse Recovery Test Circuit for N-Channel HEXFET® Power MOSFETs

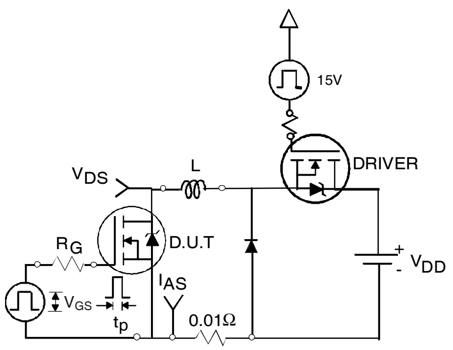


Fig 19a. Unclamped Inductive Test Circuit

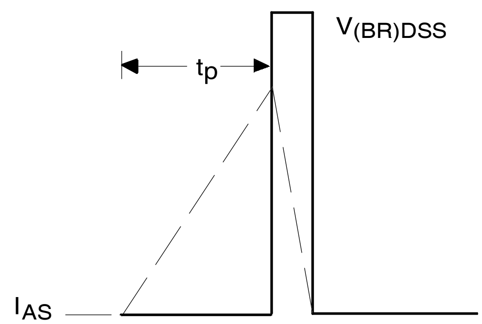


Fig 19b. Unclamped Inductive Waveforms

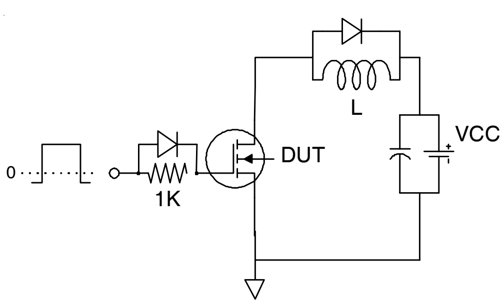


Fig 20a. Gate Charge Test Circuit

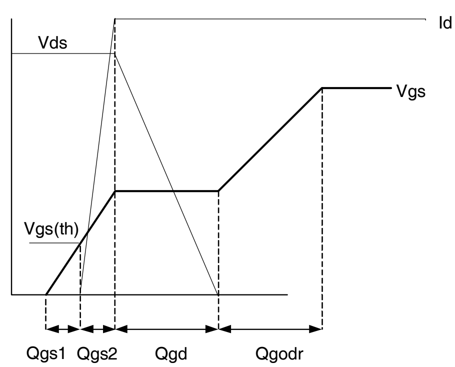


Fig 20b. Gate Charge Waveform

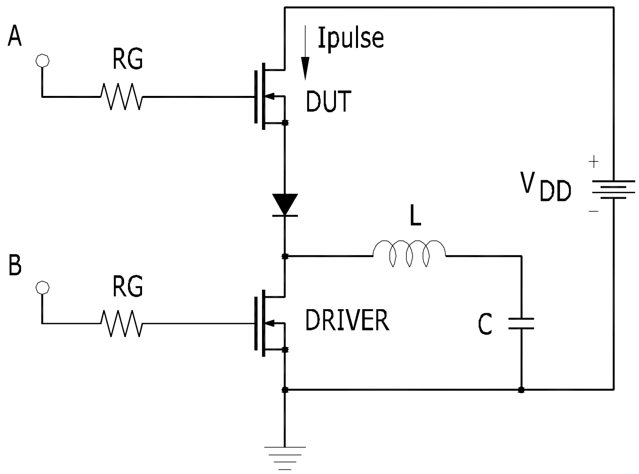


Fig 21a. t_{st} and E_{PULSE} Test Circuit

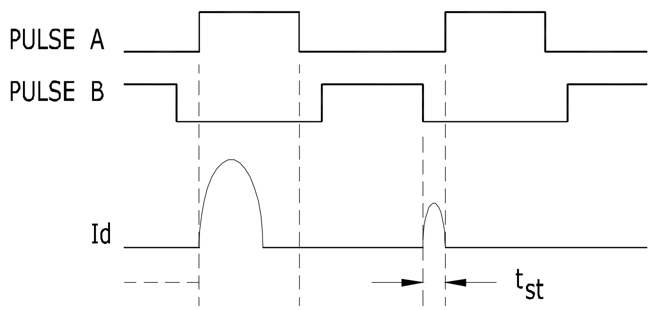


Fig 21b. t_{st} Test Waveforms

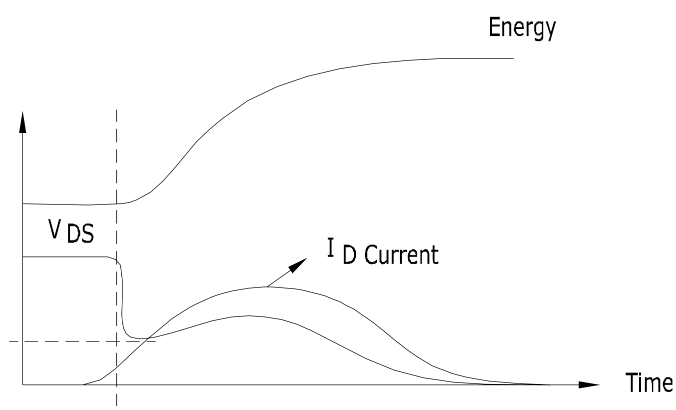


Fig 21c. E_{PULSE} Test Waveforms

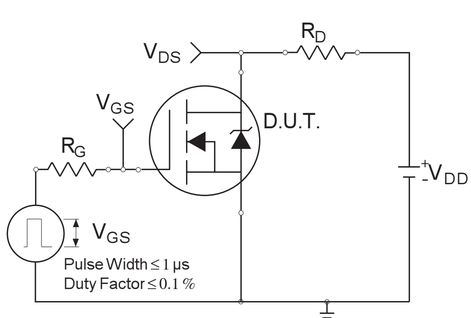


Fig 22a. Switching Time Test Circuit

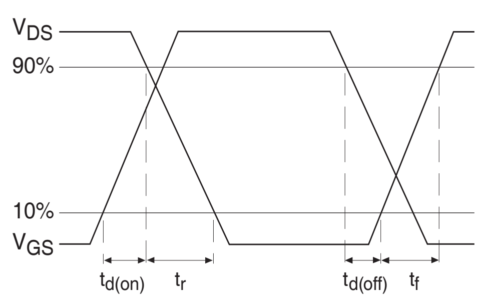
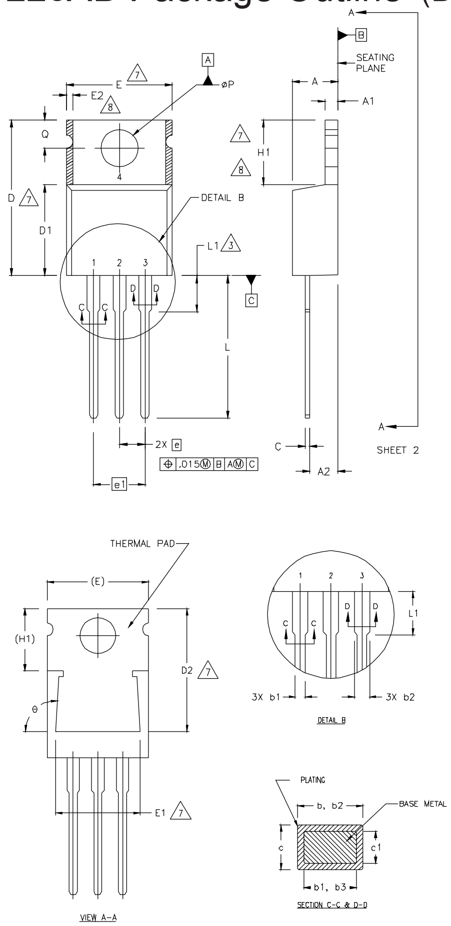


Fig 22b. Switching Time Waveforms

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



NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5 M- 1994.
2. DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS].
3. LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
4. DIMENSION D & 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 & 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 SINGULATION IRREGULARITIES ARE ALLOWED.

LEAD ASSIGNMENTS

HEXFET
1.- GATE
2.- DRAIN
3.- SOURCE

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

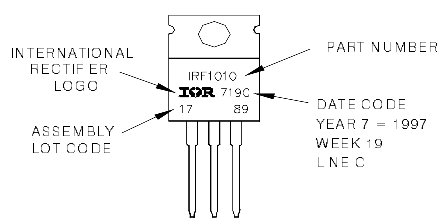
DIODES
1.- ANODE/OPEN
2.- CATHODE
3.- ANODE

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	3.56	4.82	.140	.190	
A1	0.51	1.40	.020	.055	
A2	2.04	2.92	.080	.115	
b	0.38	1.01	.015	.040	
b1	0.38	0.96	.015	.038	5
b2	1.15	1.77	.045	.070	
b3	1.15	1.73	.045	.068	
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	12.19	12.88	.480	.507	7
E	9.66	10.66	.380	.420	4,7
E1	8.38	8.89	.330	.350	7
e	2.54 BSC		.100 BSC		
e1	5.08		.200 BSC		
H1	5.85	6.55	.230	.270	7,8
L	12.70	14.73	.500	.580	
L1	–	6.35	–	.250	3
øP	3.54	4.08	.139	.161	
Q	2.54	3.42	.100	.135	
ø	90°-93°		90°-93°		

TO-220AB Part Marking Information

EXAMPLE: THIS IS AN IRF1010
LOT CODE 1789
ASSEMBLED ON WW 19, 1997
IN THE ASSEMBLY LINE "C"

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



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

Notes:

① Repetitive rating; pulse width limited by max. junction temperature.

② Starting T_J = 25°C, L = 0.34mH, R_G = 25Ω, I_{AS} = 39A.

③ Pulse width ≤ 400μs; duty cycle ≤ 2%.

④ R_θ is measured at T_J of approximately 90°C.

⑤ Half sine wave with duty cycle = 0.25, ton=1μsec.

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

Data and specifications subject to change without notice.
This product has been designed and qualified for the Industrial market.
Qualification Standards can be found on IR's Web site.

International IGR Rectifier

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