International
IOR Rectifier

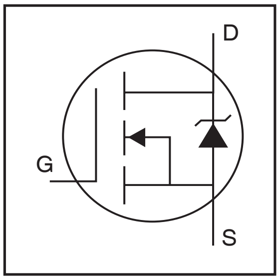
PDP SWITCH

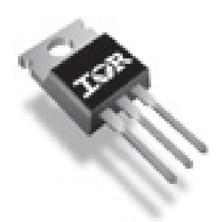
IRFB4233PbF

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

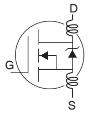
	Parameter	Max.	Units
V_{GS}	Gate-to-Source Voltage	±30	V
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V	56	A
I_D @ T_C = 100°C	Continuous Drain Current, V_{GS} @ 10V	39	
I_{DM}	Pulsed Drain Current ①	220	
I_{RP} @ T_C = 100°C	Repetitive Peak Current ⑤	114	
P_D @T_C = 25°C	Power Dissipation	370	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

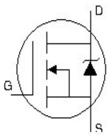
Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

	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_{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	——		f = 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.) from package and center of die contact 
L_S	Internal Source Inductance	——	7.5	——		

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 integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ①	——	——	220		
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

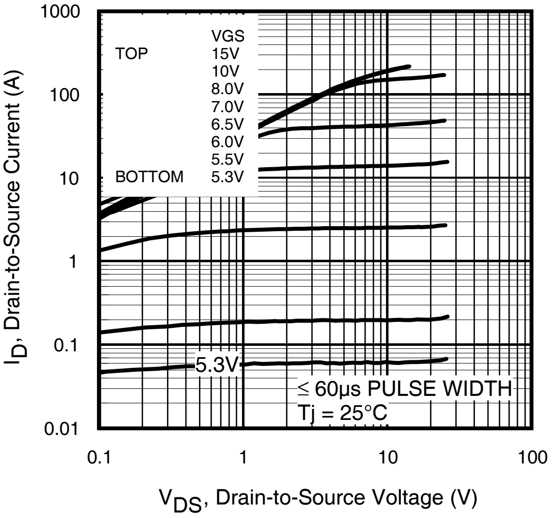


Fig 1. Typical Output Characteristics

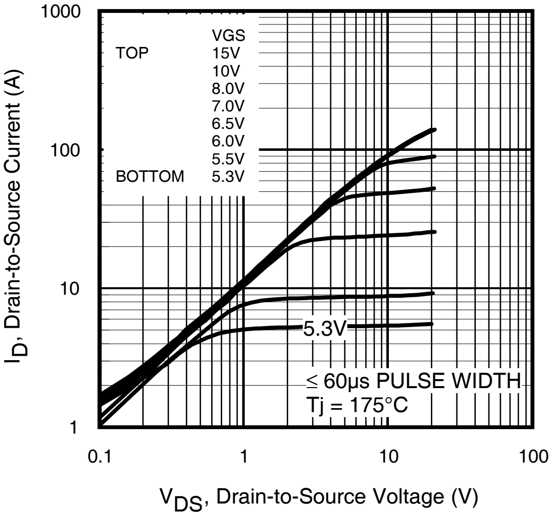


Fig 2. Typical Output Characteristics

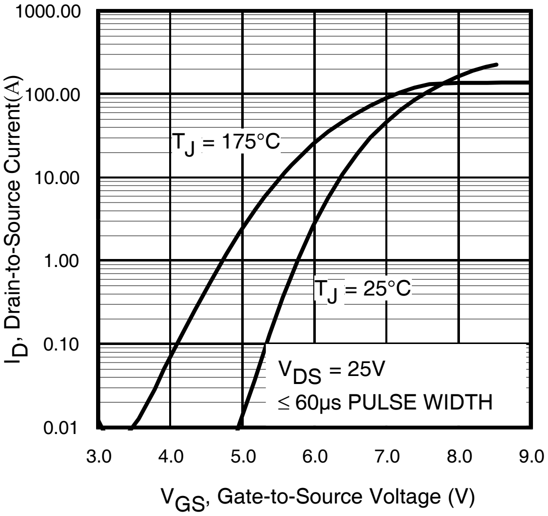


Fig 3. Typical Transfer Characteristics

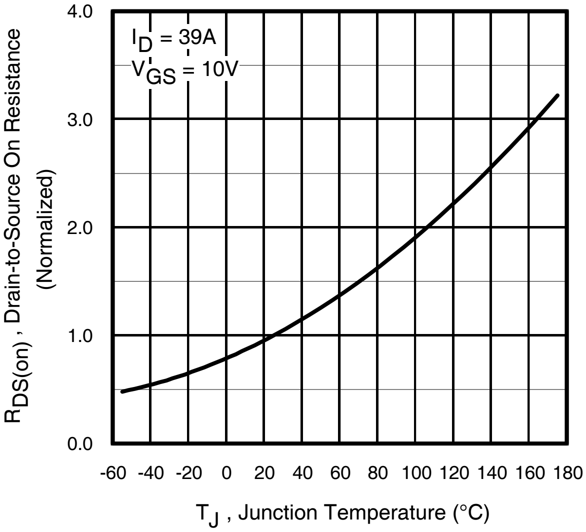


Fig 4. Normalized On-Resistance vs. Temperature

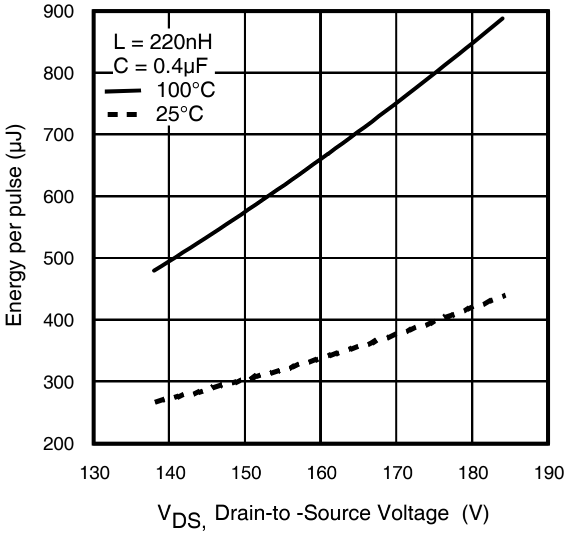


Fig 5. Typical E_{PULSE} vs. Drain-to-Source Voltage

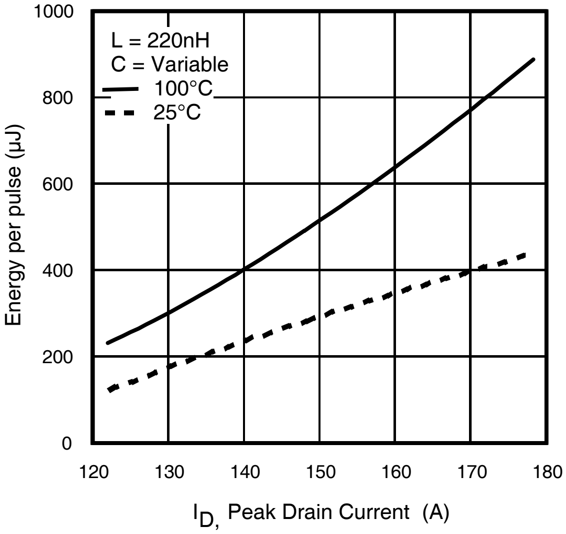


Fig 6. Typical E_{PULSE} vs. Drain Current

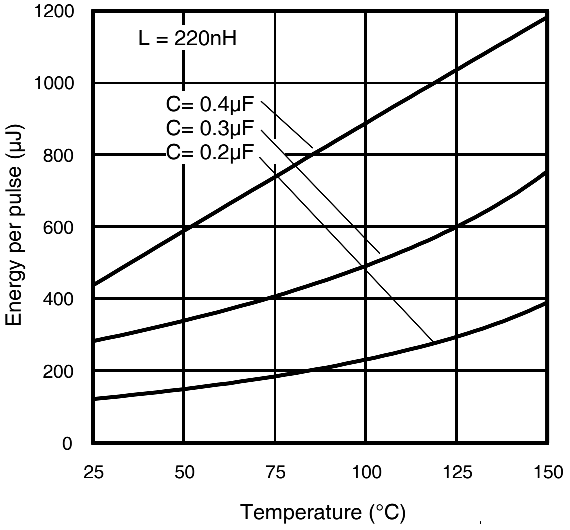


Fig 7. Typical E_{PULSE} vs.Temperature

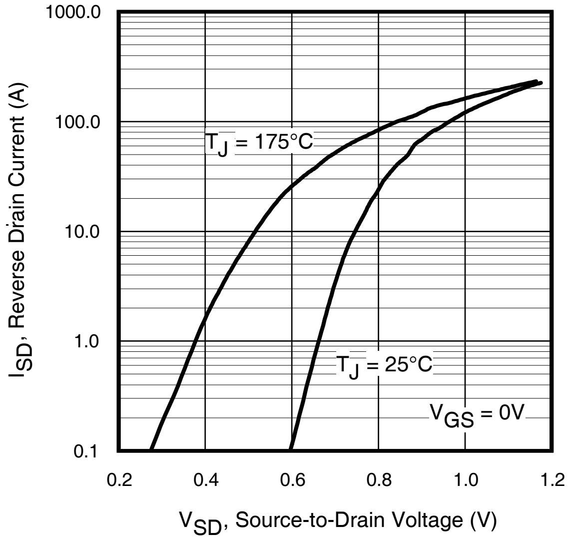


Fig 8. Typical Source-Drain Diode Forward Voltage

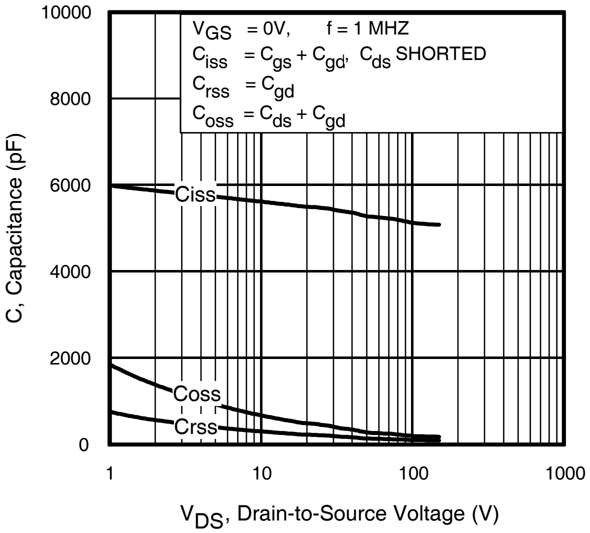


Fig 9. Typical Capacitance vs.Drain-to-Source Voltage

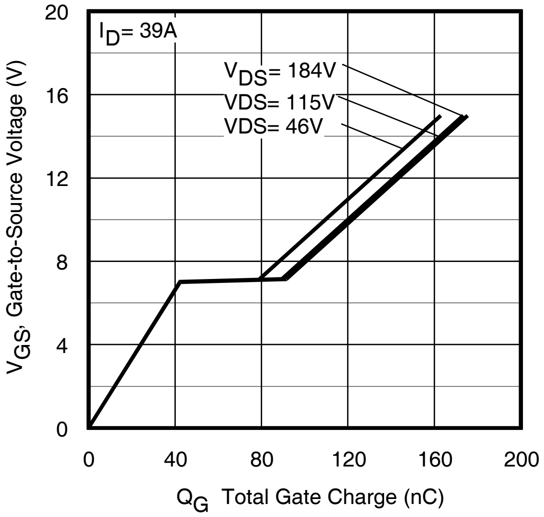


Fig 10. Typical Gate Charge vs.Gate-to-Source Voltage

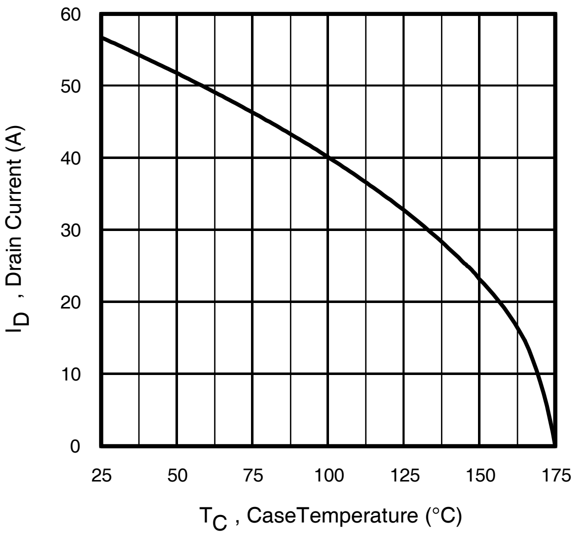


Fig 11. Maximum Drain Current vs. Case Temperature

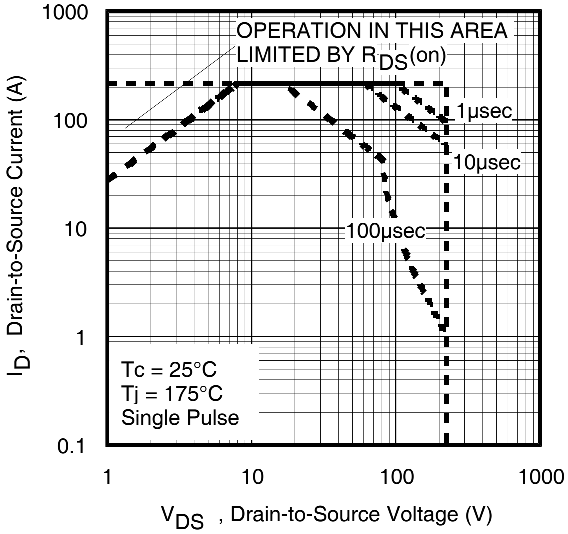


Fig 12. Maximum Safe Operating Area

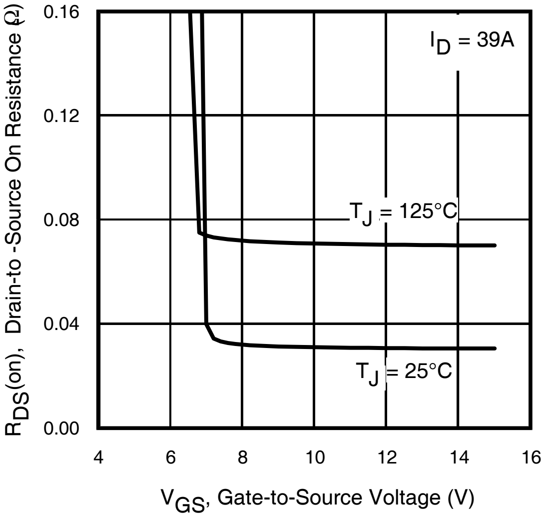


Fig 13. On-Resistance Vs. Gate Voltage

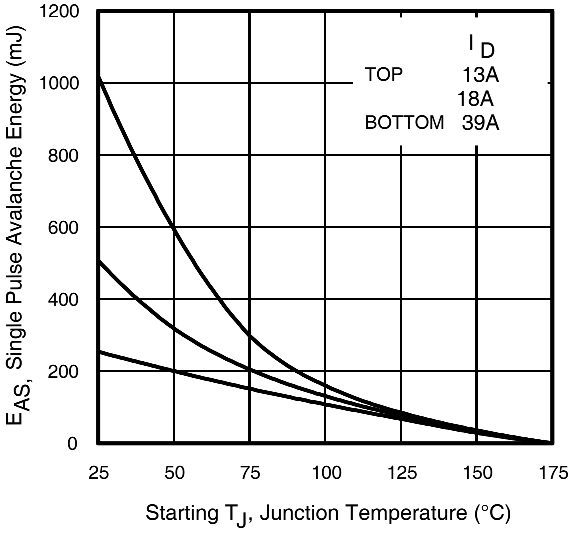


Fig 14. Maximum Avalanche Energy Vs. Temperature

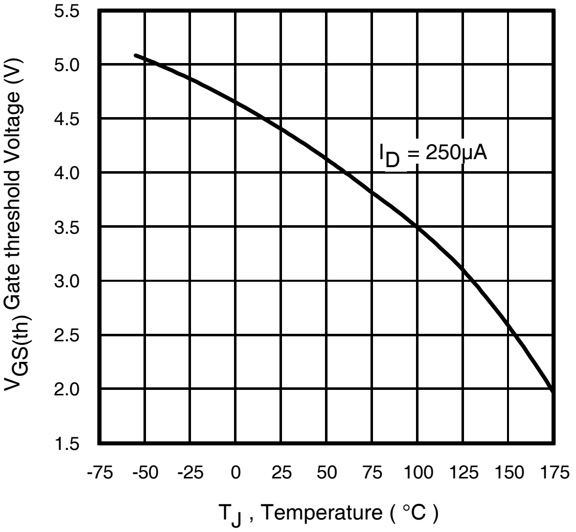


Fig 15. Threshold Voltage vs. Temperature

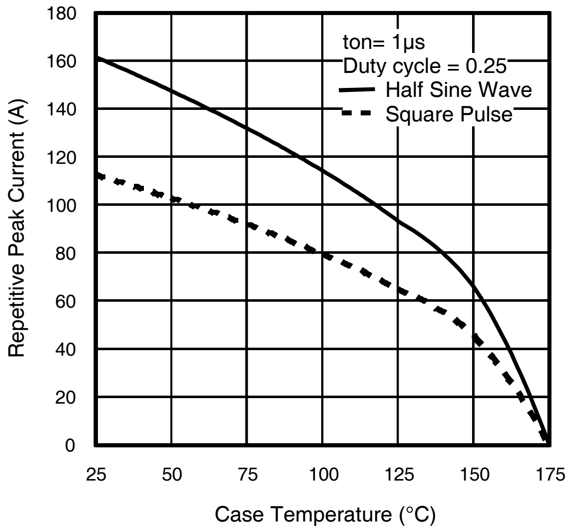
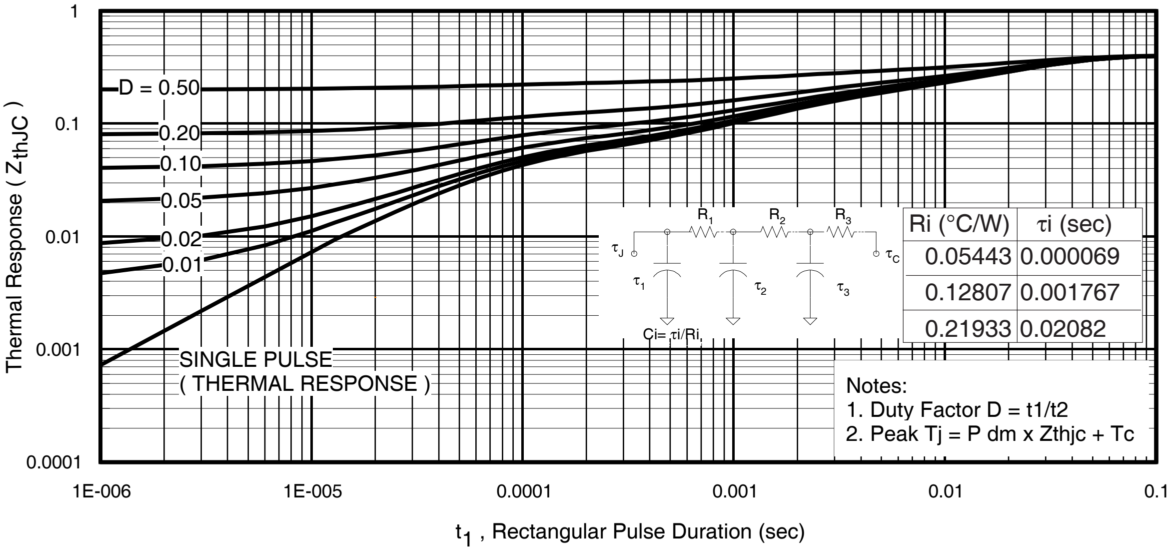


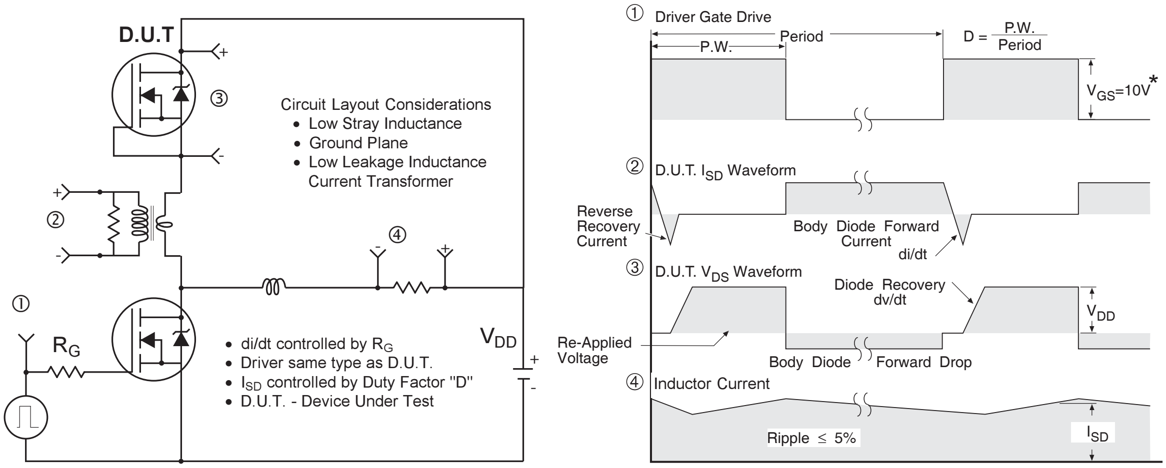
Fig 16. Typical Repetitive peak Current vs. Case temperature



Ri (°C/W)	τi (sec)
0.05443	0.000069
0.12807	0.001767
0.21933	0.02082

Notes:
1. Duty Factor D = t1/t2
2. Peak Tj = P dm x Zthjc + Tc

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



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

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

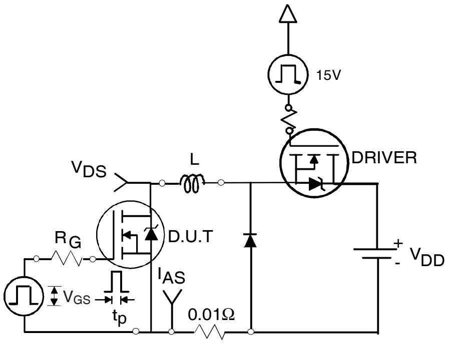


Fig 19a. Unclamped Inductive Test Circuit

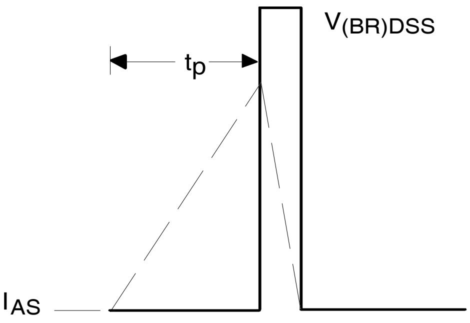


Fig 19b. Unclamped Inductive Waveforms

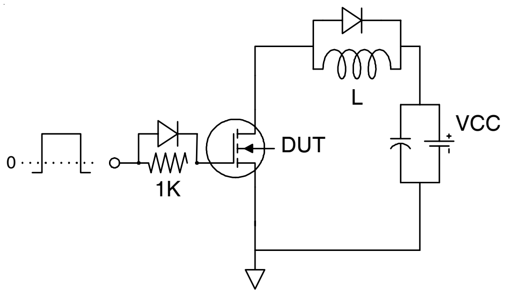


Fig 20a. Gate Charge Test Circuit

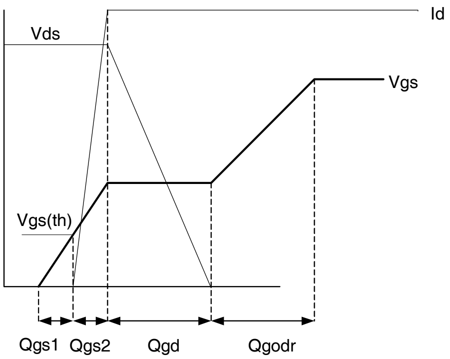


Fig 20b. Gate Charge Waveform

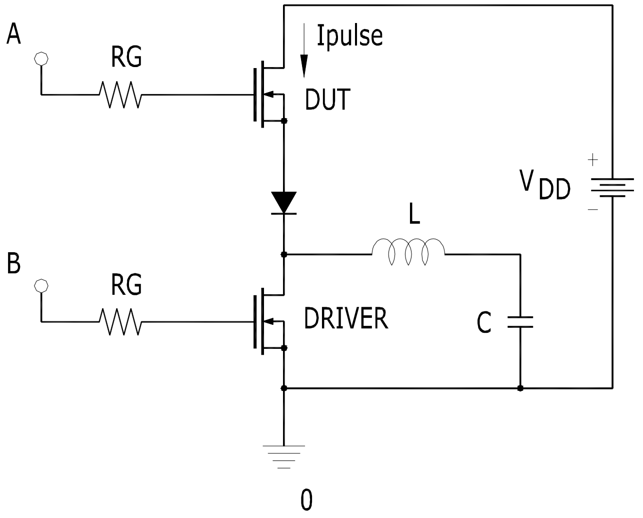


Fig 21a. t_{st} and E_{PULSE} Test Circuit

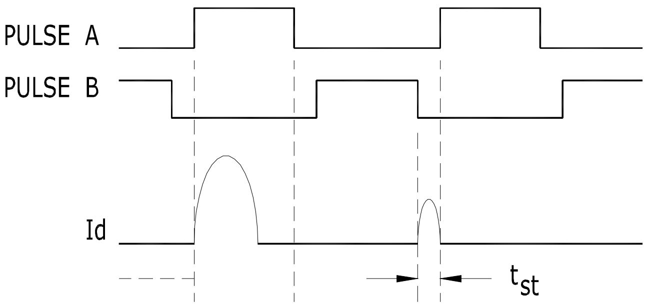


Fig 21b. t_{st} Test Waveforms

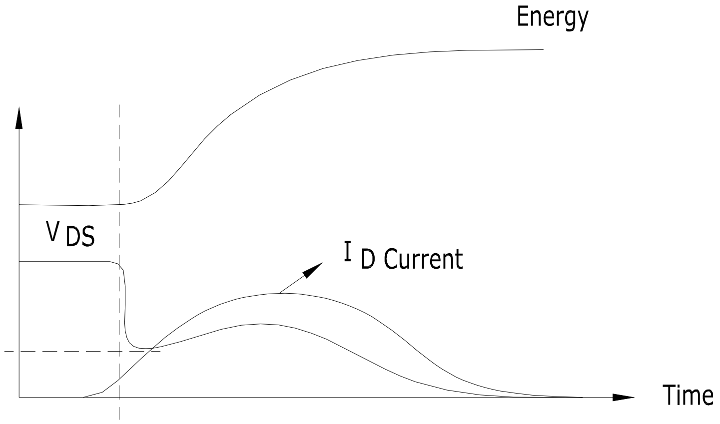
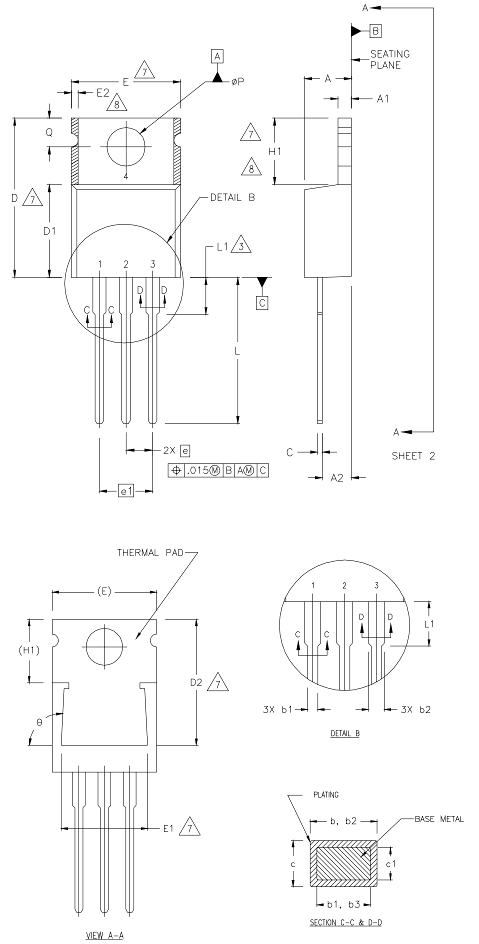


Fig 21c. E_{PULSE} Test Waveforms

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.

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°		

LEAD ASSIGNMENTS

HEXFET

1.– GATE
2.– DRAIN
3.– SOURCE

IGBTs, CoPACK

1.– GATE
2.– COLLECTOR
3.– EMITTER

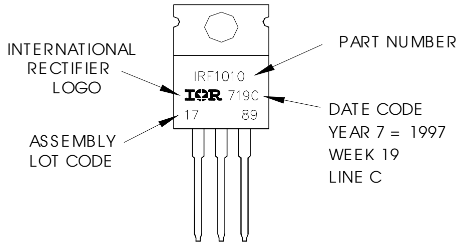
DIODES

1.– ANODE/OPEN
2.– CATHODE
3.– ANODE

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 $T_J = 25°C$, $L = 0.34mH$, $R_G = 25\Omega$, $I_{AS} = 39A$.
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.

This product has been designed and qualified for the Industrial market.
Qualification Standards can be found on IR's Web site.

International
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