

IRF4000

HEXFET® Power MOSFET

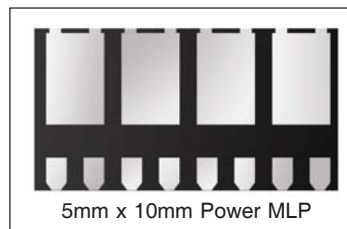
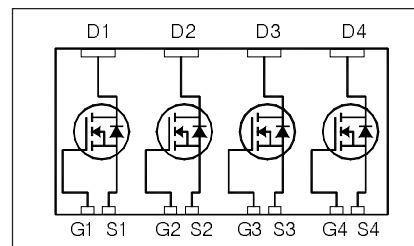
Applications

- IEEE 802.3af Compliant PoE Switch in Power Sourcing Equipment

Features

- Exceeds IEEE 802.3af PoE requirements
- Rugged planar technology with large SOA
- Very Low Leakage at 100V (1.5µA max)
- Fully characterized avalanche voltage and current
- Thermally enhanced
- Saves space: replaces 4 discrete MOSFETs

V_{DS}	$R_{DS(on)}$ max	I_D
100V	270mΩ @ $V_{GS} = 12V$	2.4A
	350mΩ @ $V_{GS} = 10V$	



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{DS}	Drain-to-Source Voltage	100	V
V_{GS}	Gate-to-Source Voltage	± 30	
I_D @ $T_A = 25^\circ C$	Continuous Drain Current, V_{GS} @ 10V	2.4	A
I_D @ $T_A = 70^\circ C$	Continuous Drain Current, V_{GS} @ 10V	1.9	
I_{DM}	Pulsed Drain Current ①	19	
P_D @ $T_A = 25^\circ C$	Maximum Power Dissipation	3.5	W
	Linear Derating Factor	0.028	W/°C
dv/dt	Peak Diode Recovery dv/dt	8.6	V/ns
T_J	Operating Junction and	-55 to + 150	°C
T_{STG}	Storage Temperature Range		

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JL}$	Junction-to-Drain Lead	—	1.5	°C/W
$R_{\theta JA}$	Junction-to-Ambient (PCB Mount) ④	—	36	

Notes ① through ⑤ are on page 7
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Static @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	100	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.19	—	V/°C	Reference to $25^\circ\text{C}, I_D = 1\text{mA}$ ③
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	230	270	m Ω	$V_{GS} = 12V, I_D = 2.4A$ ③
		—	270	350		$V_{GS} = 10V, I_D = 2.4A$ ③
$V_{GS(th)}$	Gate Threshold Voltage	3.5	—	5.7	V	$V_{DS} = V_{GS}, I_D = 250\mu A$
I_{DSS}	Drain-to-Source Leakage Current	—	—	1.5	μA	$V_{DS} = 100V, V_{GS} = 0V$
		—	—	10		$V_{DS} = 80V, V_{GS} = 0V, T_J = 125^\circ\text{C}$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 30V$
	Gate-to-Source Reverse Leakage	—	—	-100		$V_{GS} = -30V$

Dynamic @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
gfs	Forward Transconductance	1.6	—	—	S	$V_{DS} = 25V, I_D = 1.4A$
Q_g	Total Gate Charge	—	9.4	14	nC	$I_D = 1.4A$
Q_{gs}	Gate-to-Source Charge	—	2.8	4.2		$V_{DS} = 80V$
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	4.5	6.8		$V_{GS} = 10V$ ⑤
$t_{d(on)}$	Turn-On Delay Time	—	8.7	—	ns	$V_{DD} = 50V$
t_r	Rise Time	—	1.5	—		$I_D = 1.4A$
$t_{d(off)}$	Turn-Off Delay Time	—	13	—		$R_G = 6.2\Omega$
t_f	Fall Time	—	6.1	—		$V_{GS} = 10V$ ③
C_{iss}	Input Capacitance	—	330	—	pF	$V_{GS} = 0V$
C_{oss}	Output Capacitance	—	77	—		$V_{DS} = 25V$
C_{rss}	Reverse Transfer Capacitance	—	18	—		$f = 1.0\text{MHz}$
C_{oss}	Output Capacitance	—	410	—		$V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0\text{MHz}$
C_{oss}	Output Capacitance	—	45	—		$V_{GS} = 0V, V_{DS} = 80V, f = 1.0\text{MHz}$
$C_{oss\ eff.}$	Effective Output Capacitance	—	89	—		$V_{GS} = 0V, V_{DS} = 0V \text{ to } 80V$

Avalanche Characteristics

	Parameter	Typ.	Max.	Units
E_{AS}	Single Pulse Avalanche Energy ②	—	8.7	mJ
I_{AR}	Avalanche Current ①	—	1.4	A

Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	3.2	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	19		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}, I_S = 1.4A, V_{GS} = 0V$ ③
t_{rr}	Reverse Recovery Time	—	67	100	ns	$T_J = 25^\circ\text{C}, I_F = 1.4A, V_{DD} = 25V$
Q_{rr}	Reverse Recovery Charge	—	180	270	nC	$di/dt = 100A/\mu s$ ③
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)				

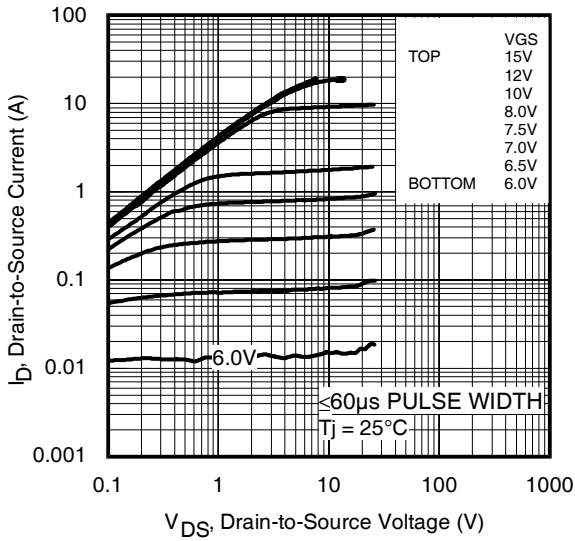


Fig 1. Typical Output Characteristics

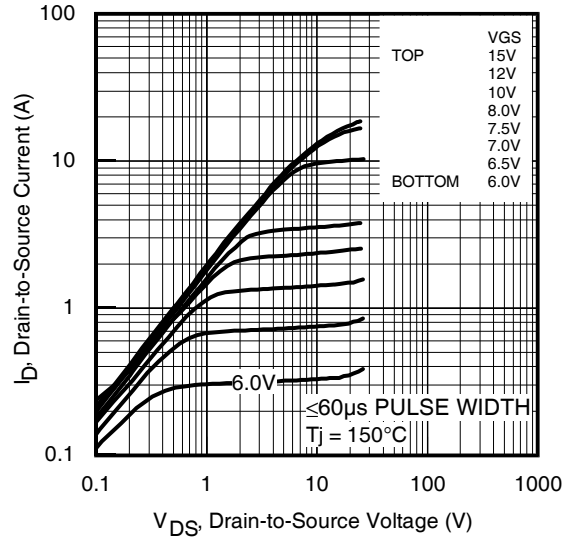


Fig 2. Typical Output Characteristics

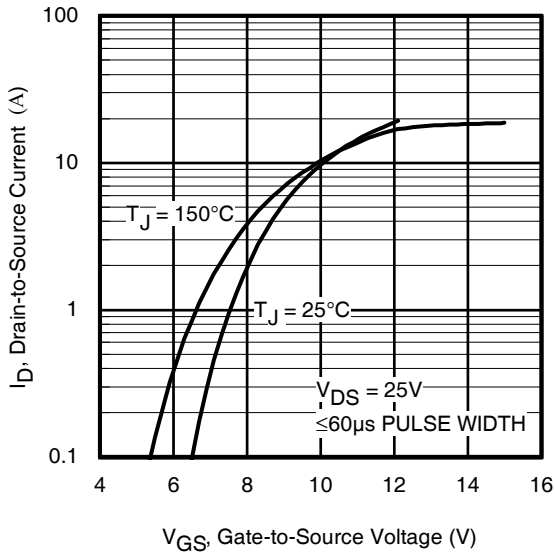


Fig 3. Typical Transfer Characteristics

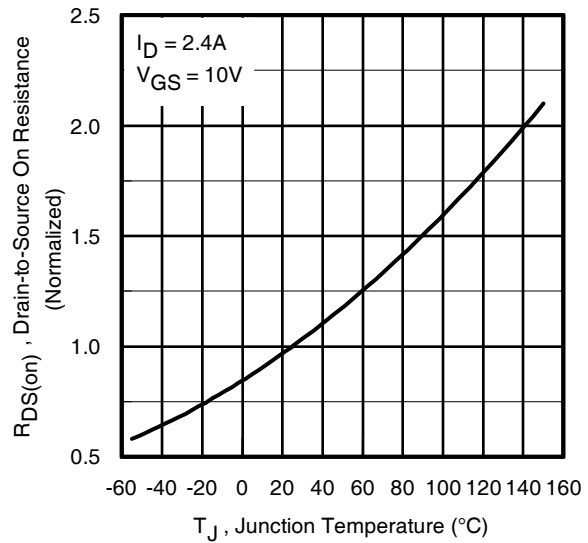


Fig 4. Normalized On-Resistance vs. Temperature

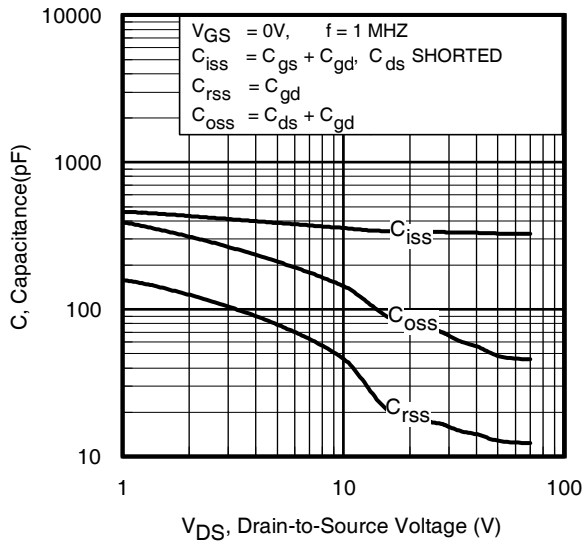


Fig 5. Typical Capacitance vs. Drain-to-Source Voltage

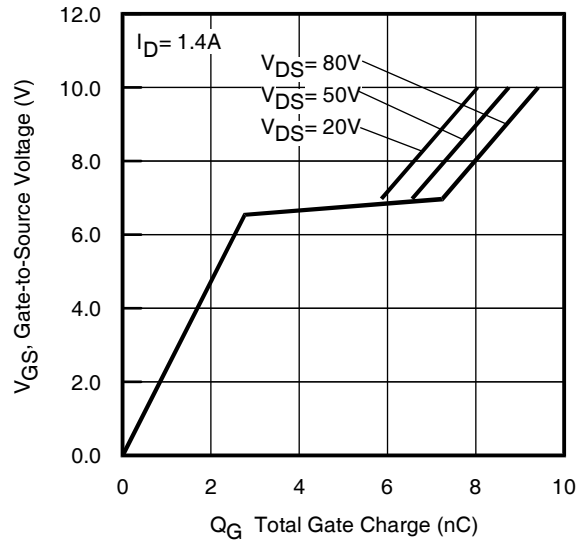


Fig 6. Typical Gate Charge vs. Gate-to-Source Voltage

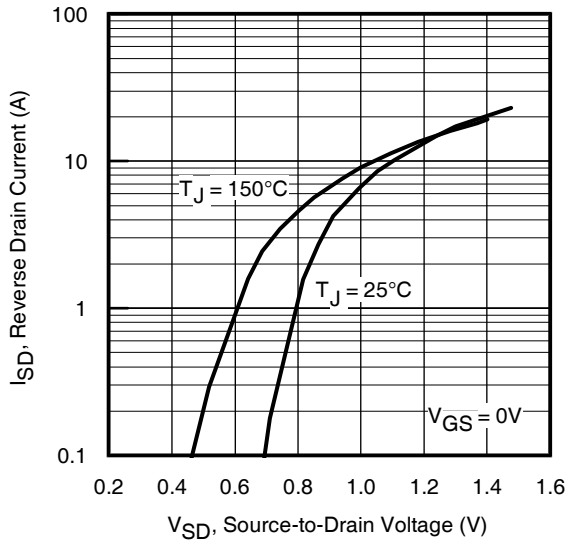


Fig 7. Typical Source-Drain Diode Forward Voltage

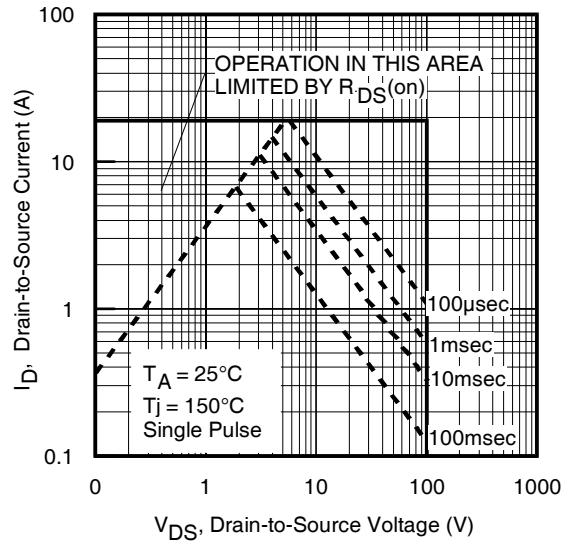


Fig 8. Maximum Safe Operating Area

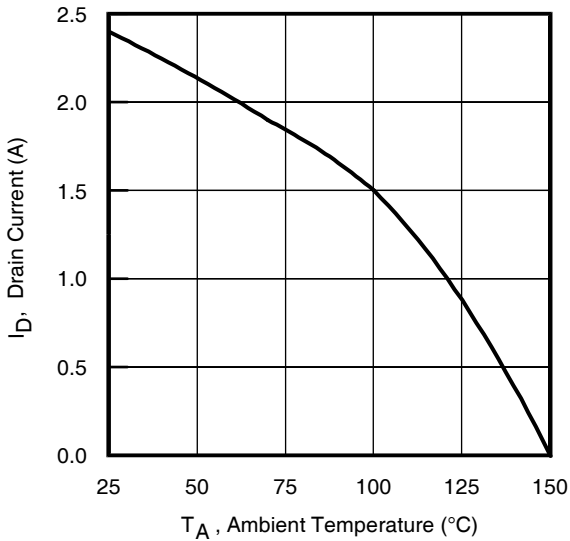


Fig 9. Maximum Drain Current vs. Ambient Temperature

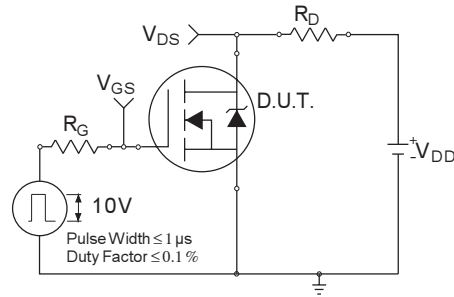


Fig 10a. Switching Time Test Circuit

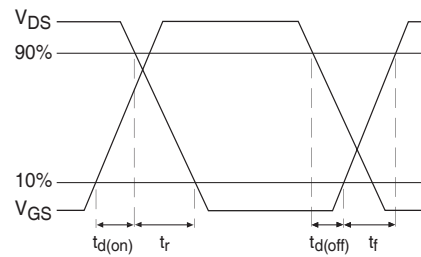


Fig 10b. Switching Time Waveforms

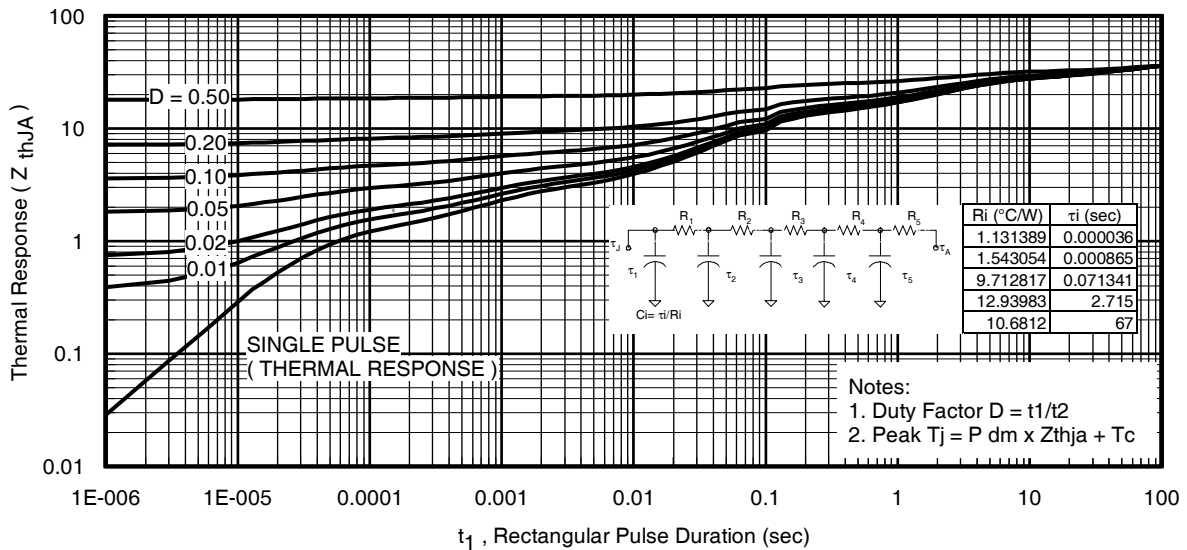


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

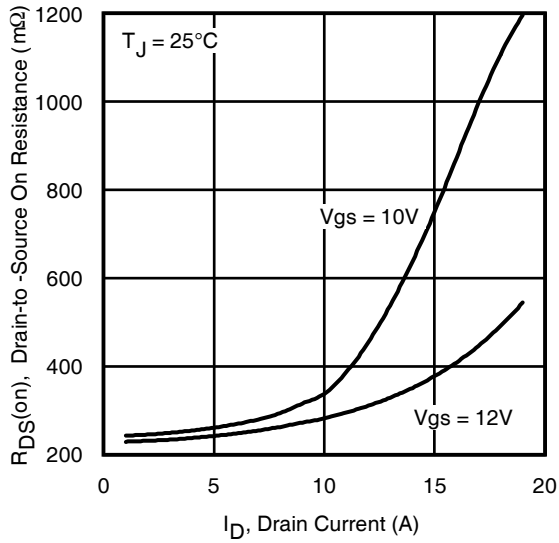


Fig 12. On-Resistance vs. Drain Current

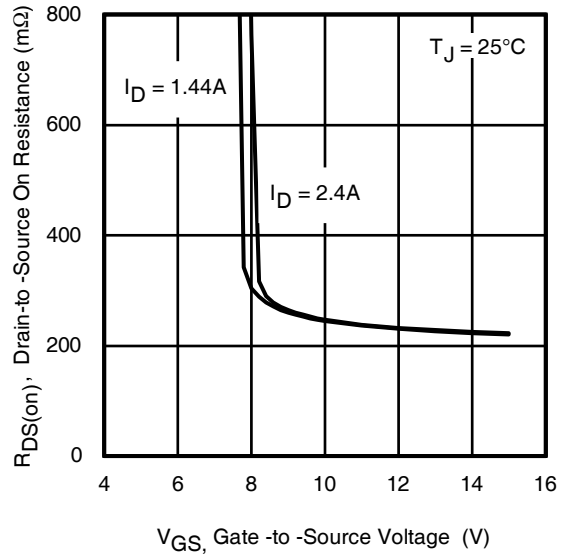


Fig 13. On-Resistance vs. Gate Voltage

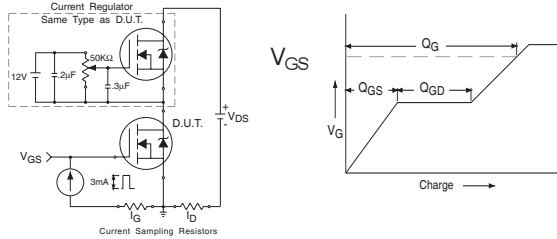


Fig 14a&b. Basic Gate Charge Test Circuit and Waveform

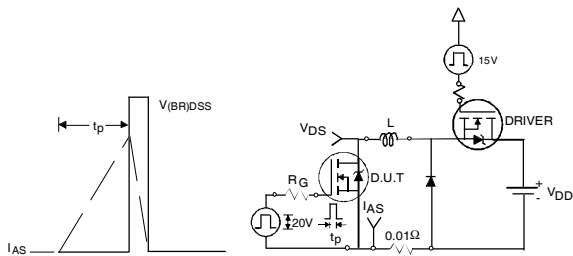


Fig 15a&b. Unclamped Inductive Test circuit and Waveforms

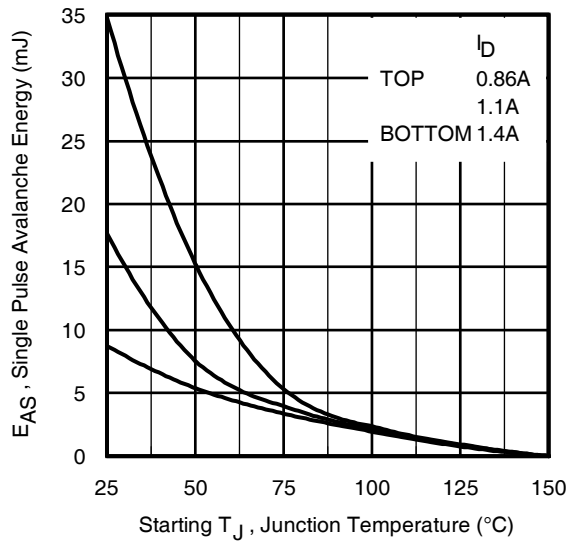
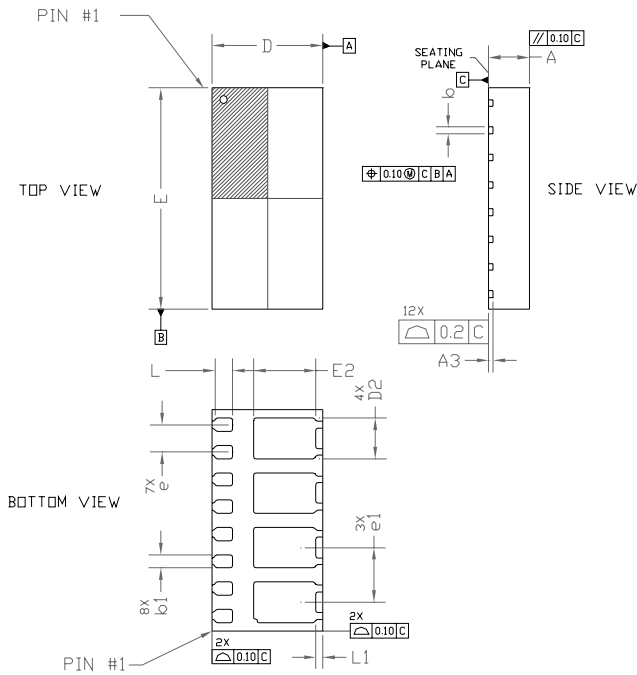


Fig 15c. Maximum Avalanche Energy vs. Drain Current

IRF4000 Power MLP Package Outline Drawing



SYMBOL	COMMON					
	DIMENSIONS MILLIMETER			DIMENSIONS INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	1.80	1.85	1.90	0.071	0.073	0.075
A3	0.20 BSC.			0.008 BSC.		
b	0.25	0.30	0.35	0.010	0.012	0.014
b1	0.55	0.60	0.65	0.022	0.024	0.026
D	5.00 BSC.			0.197 BSC.		
D2	1.785	1.835	1.885	0.070	0.072	0.074
E	10.00 BSC.			0.394 BSC.		
E2	2.755	2.805	2.855	0.108	0.110	0.112
e	1.235 BSC.			0.049 BSC.		
e1	2.47 BSC.			0.097 BSC.		
L	0.75	0.80	0.85	0.029	0.031	0.033
L1	0.261	0.311	0.361	0.010	0.012	0.014

NOTES:
 1. DIMENSION AND TOLERANCING CONFORM TO ASME Y14.5M-1994.
 2. CONTROLLING DIMENSIONS - MILLIMETER. CONVERTED INCH DIMENSIONS ARE NOT NECESSARILY EXACT.

Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting $T_J = 25^\circ\text{C}$, $L = 8.4\text{mH}$, $R_G = 25\Omega$, $I_{AS} = 1.4A$.
- ③ Pulse width $\leq 400\mu\text{s}$; duty cycle $\leq 2\%$.
- ④ When mounted on 1 inch square copper board.
- ⑤ Guarantee by Design.

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.