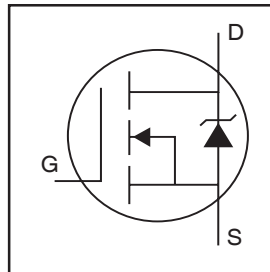


IRFL024ZPbF

HEXFET® Power MOSFET

Features

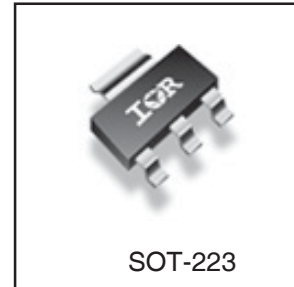
- Advanced Process Technology
- Ultra Low On-Resistance
- 150°C Operating Temperature
- Fast Switching
- Repetitive Avalanche Allowed up to Tjmax
- Lead-Free



$V_{DSS} = 55V$
$R_{DS(on)} = 57.5m\Omega$
$I_D = 5.1A$

Description

This HEXFET® Power MOSFET utilizes the latest processing techniques to achieve extremely low on-resistance per silicon area. Additional features of this design are a 150°C junction operating temperature, fast switching speed and improved repetitive avalanche rating. These features combine to make this design an extremely efficient and reliable device for use in a wide variety of applications.



Absolute Maximum Ratings

	Parameter	Max.	Units
$I_D @ T_A = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$ (Silicon Limited) ⑦	5.1	A
$I_D @ T_A = 70^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$ ⑦	4.1	
I_{DM}	Pulsed Drain Current ①	41	
$P_D @ T_A = 25^\circ C$	Power Dissipation ⑦	2.8	
$P_D @ T_A = 25^\circ C$	Power Dissipation ⑧	1.0	W
	Linear Derating Factor ⑦	0.02	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS} (Thermally limited)	Single Pulse Avalanche Energy ②	13	mJ
E_{AS} (Tested)	Single Pulse Avalanche Energy Tested Value ②	32	
I_{AR}	Avalanche Current ①	See Fig.12a, 12b, 15, 16	A
E_{AR}	Repetitive Avalanche Energy ⑤		mJ
T_J	Operating Junction and	-55 to + 150	°C
T_{STG}	Storage Temperature Range		

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JA}$	Junction-to-Ambient (PCB mount, steady state) ⑦	—	45	°C/W
$R_{\theta JA}$	Junction-to-Ambient (PCB mount, steady state) ⑧	—	120	

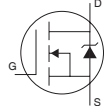
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Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	55	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.053	—	V/ $^\circ\text{C}$	Reference to $25^\circ\text{C}, I_D = 1\text{mA}$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	46.2	57.5	m Ω	$V_{GS} = 10V, I_D = 3.1A$ ③
$V_{GS(th)}$	Gate Threshold Voltage	2.0	—	4.0	V	$V_{DS} = V_{GS}, I_D = 250\mu A$
gfs	Forward Transconductance	6.2	—	—	S	$V_{DS} = 25V, I_D = 3.1A$
I_{DSS}	Drain-to-Source Leakage Current	—	—	20	μA	$V_{DS} = 55V, V_{GS} = 0V$
		—	—	250		$V_{DS} = 55V, V_{GS} = 0V, T_J = 125^\circ\text{C}$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	200	nA	$V_{GS} = 20V$
	Gate-to-Source Reverse Leakage	—	—	-200		$V_{GS} = -20V$
Q_g	Total Gate Charge	—	9.1	14	nC	$I_D = 3.1A$ $V_{DS} = 44V$ $V_{GS} = 10V$ ③
Q_{gs}	Gate-to-Source Charge	—	1.9	—		
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	3.9	—		
$t_{d(on)}$	Turn-On Delay Time	—	7.8	—	ns	$V_{DD} = 28V$ $I_D = 3.1A$ $R_G = 53\Omega$ $V_{GS} = 10V$ ③
t_r	Rise Time	—	21	—		
$t_{d(off)}$	Turn-Off Delay Time	—	30	—		
t_f	Fall Time	—	23	—		
C_{iss}	Input Capacitance	—	340	—	pF	$V_{GS} = 0V$ $V_{DS} = 25V$ $f = 1.0\text{MHz}$ $V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0\text{MHz}$ $V_{GS} = 0V, V_{DS} = 44V, f = 1.0\text{MHz}$ $V_{GS} = 0V, V_{DS} = 0V \text{ to } 44V$ ④
C_{oss}	Output Capacitance	—	68	—		
C_{rss}	Reverse Transfer Capacitance	—	39	—		
C_{oss}	Output Capacitance	—	210	—		
C_{oss}	Output Capacitance	—	55	—		
$C_{oss \text{ eff.}}$	Effective Output Capacitance	—	93	—		

Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	5.1	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	41		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}, I_S = 3.1A, V_{GS} = 0V$ ②
t_{rr}	Reverse Recovery Time	—	15	23	ns	$T_J = 25^\circ\text{C}, I_F = 3.1A, V_{DD} = 28V$
Q_{rr}	Reverse Recovery Charge	—	9.8	15	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)				

Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11).
- ② Limited by T_{Jmax} , starting $T_J = 25^\circ\text{C}$, $L = 2.8\text{mH}$
 $R_G = 25\Omega, I_{AS} = 3.1A, V_{GS} = 10V$.
Part not recommended for use above this value.
- ③ Pulse width $\leq 1.0\text{ms}$; duty cycle $\leq 2\%$.
- ④ $C_{oss \text{ eff.}}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .

- ⑤ Limited by T_{Jmax} , see Fig.12a, 12b, 15, 16 for typical repetitive avalanche performance.
- ⑥ This value determined from sample failure population. 100% tested to this value in production.
- ⑦ When mounted on 1 inch square copper board.
- ⑧ When mounted on FR-4 board using minimum recommended footprint.

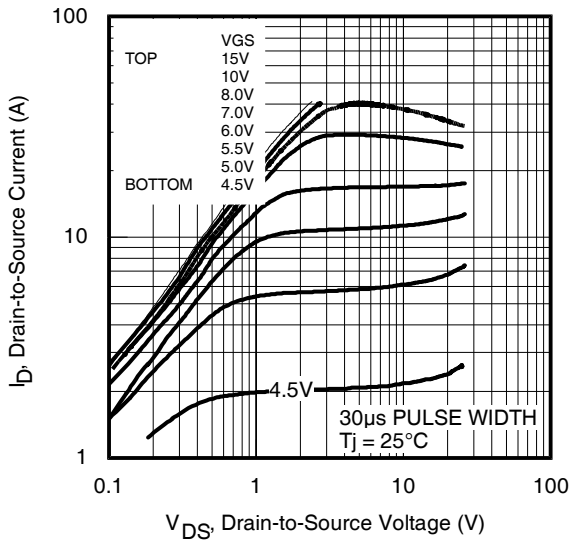


Fig 1. Typical Output Characteristics

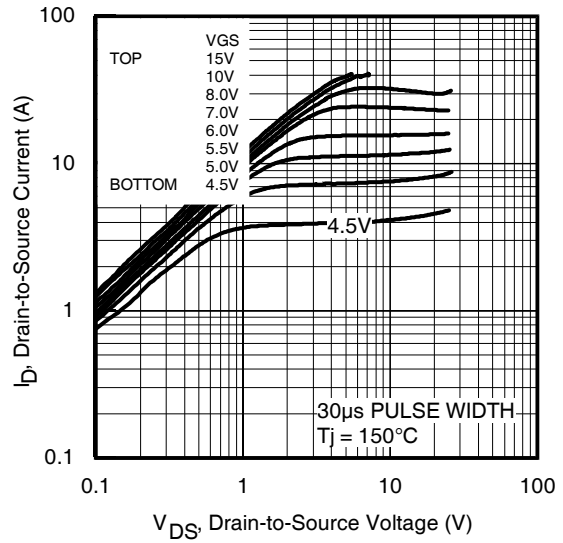


Fig 2. Typical Output Characteristics

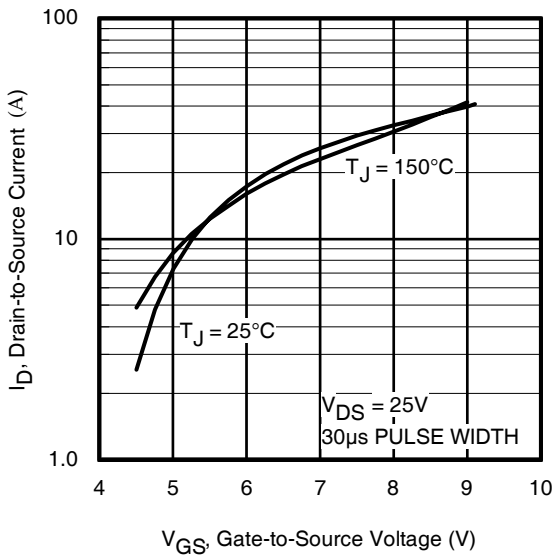


Fig 3. Typical Transfer Characteristics

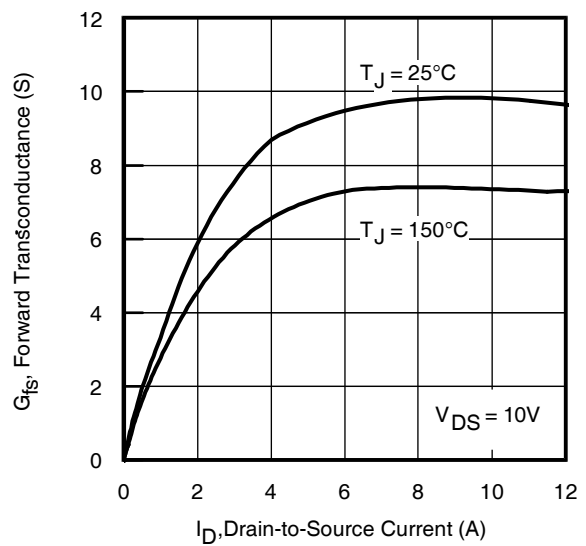


Fig 4. Typical Forward Transconductance vs. Drain Current

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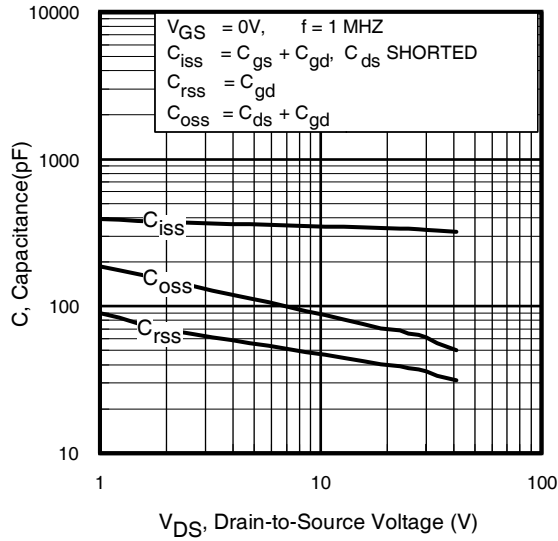


Fig 5. Typical Capacitance vs. Drain-to-Source Voltage

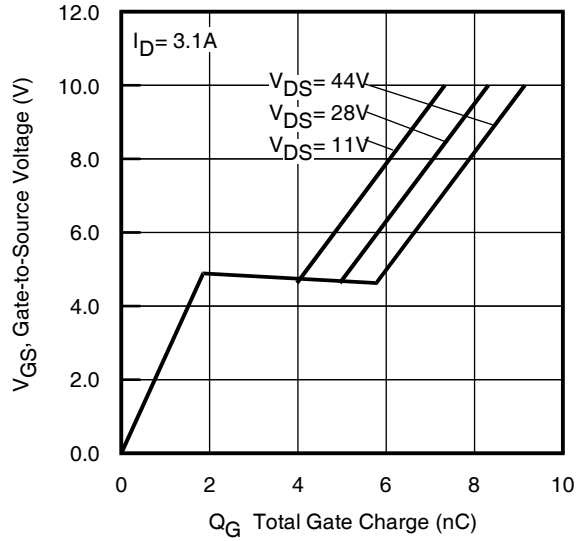


Fig 6. Typical Gate Charge vs. Gate-to-Source Voltage

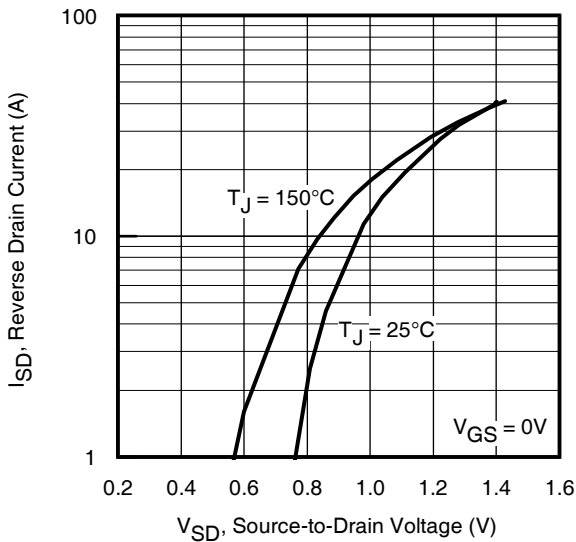


Fig 7. Typical Source-Drain Diode Forward Voltage

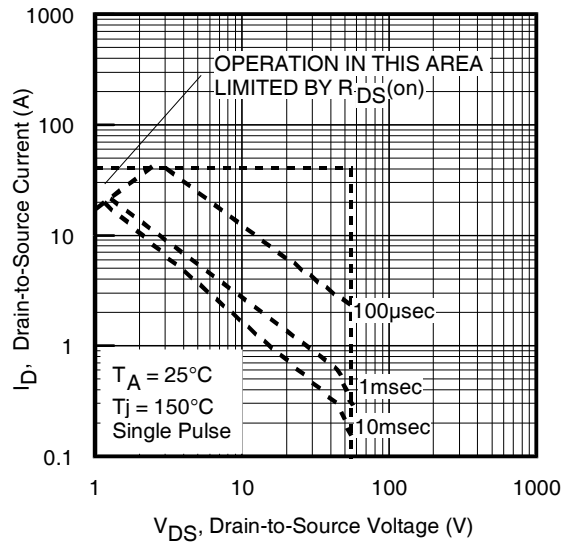


Fig 8. Maximum Safe Operating Area

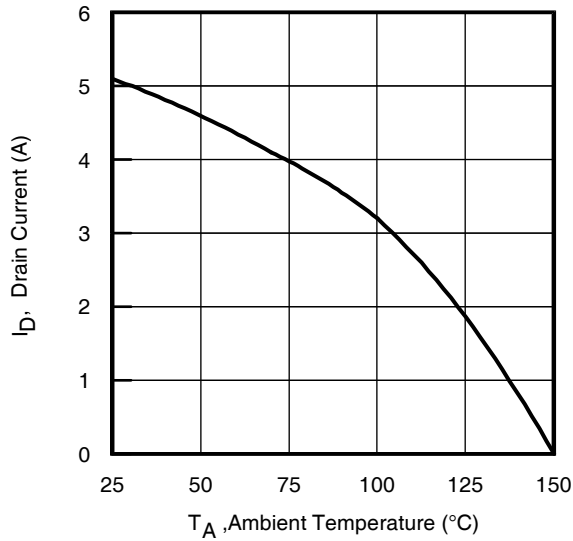


Fig 9. Maximum Drain Current vs. Ambient Temperature

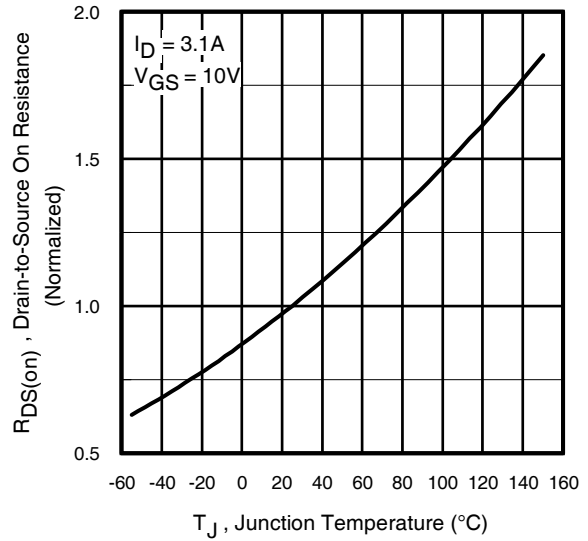


Fig 10. Normalized On-Resistance vs. Temperature

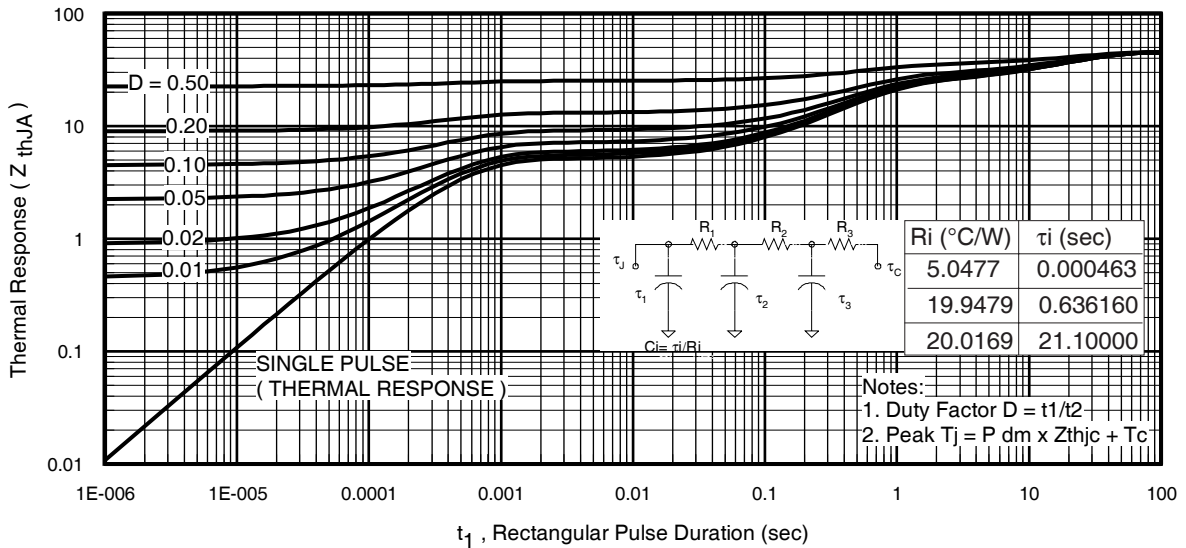


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

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Fig 12a. Unclamped Inductive Test Circuit



Fig 12b. Unclamped Inductive Waveforms



Fig 13a. Basic Gate Charge Waveform

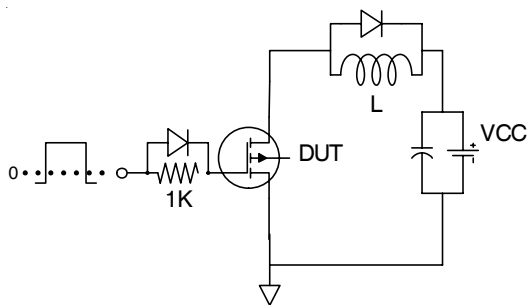


Fig 13b. Gate Charge Test Circuit

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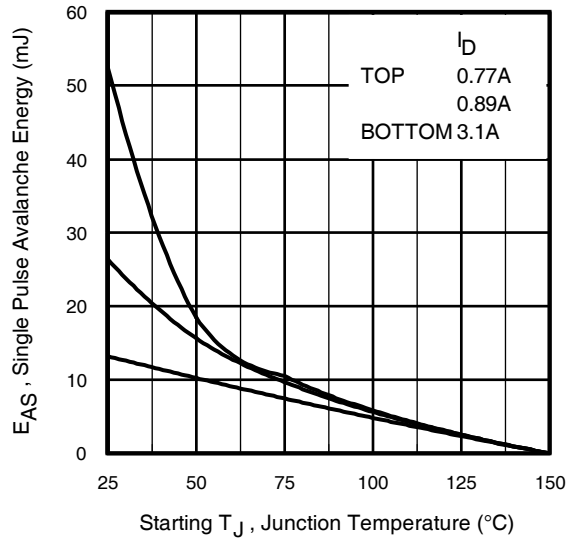


Fig 12c. Maximum Avalanche Energy vs. Drain Current

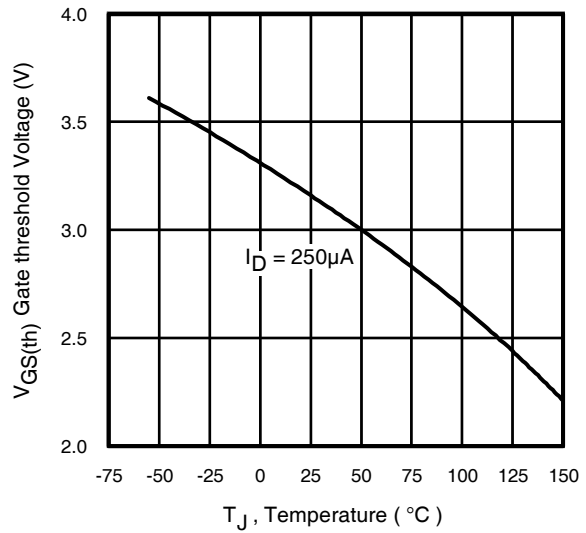


Fig 14. Threshold Voltage vs. Temperature

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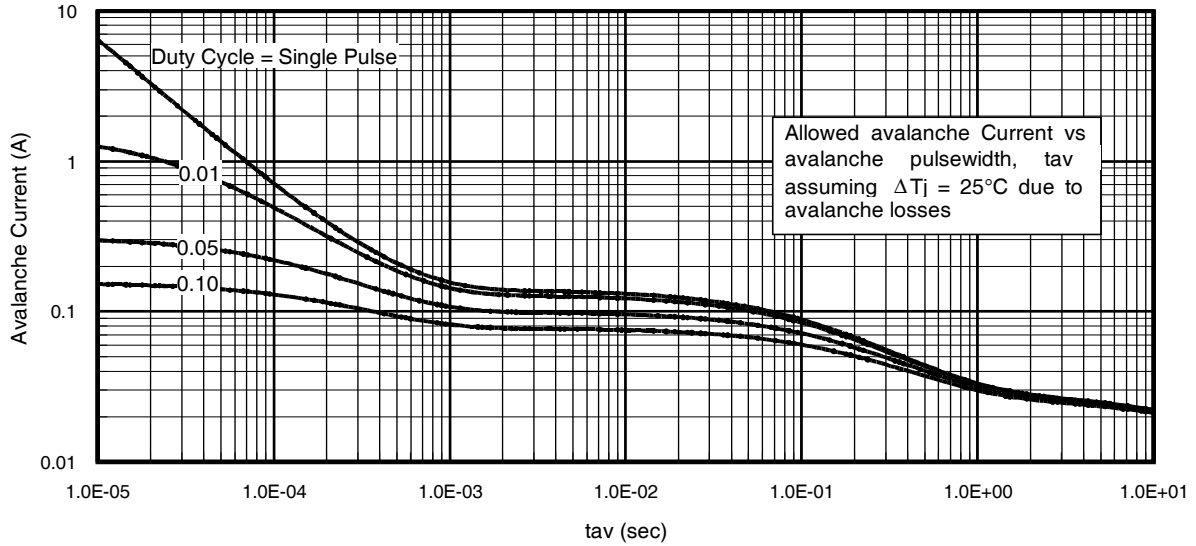


Fig 15. Typical Avalanche Current vs.Pulsewidth

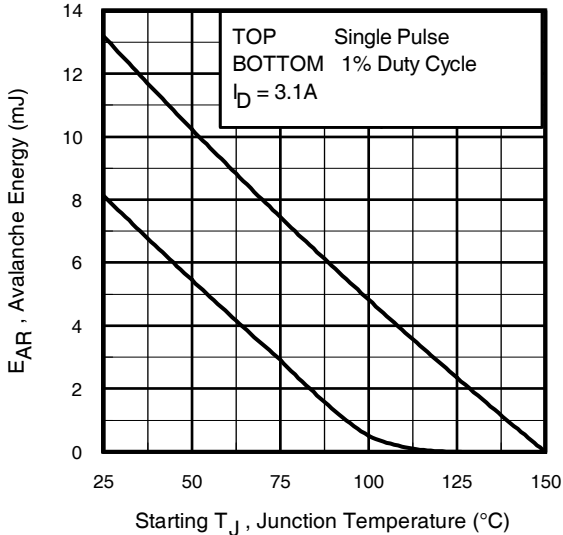


Fig 16. Maximum Avalanche Energy vs. Temperature

Notes on Repetitive Avalanche Curves , Figures 15, 16:
(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 12a, 12b.
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 15, 16).
 t_{av} = Average time in avalanche.
 D = Duty cycle in avalanche = $t_{av} \cdot f$
 $Z_{thJC}(D, t_{av})$ = Transient thermal resistance, see figure 11)

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

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

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



Fig 17. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs



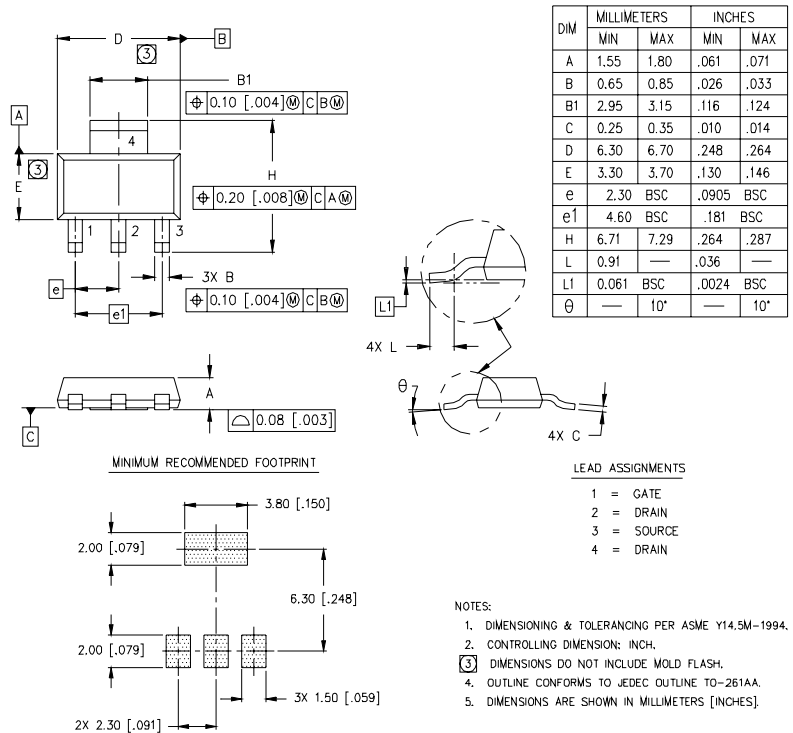
Fig 18a. Switching Time Test Circuit



Fig 18b. Switching Time Waveforms

SOT-223 (TO-261AA) Package Outline

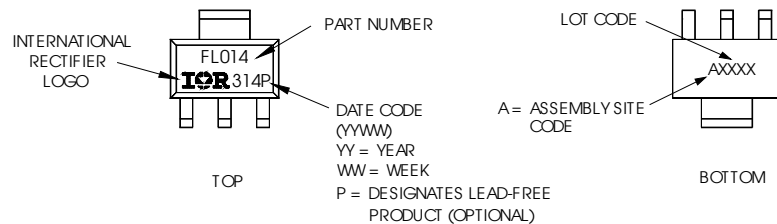
Dimensions are shown in millimeters (inches)



SOT-223 (TO-261AA) Part Marking Information

HEXFET PRODUCT MARKING

EXAMPLE: THIS IS AN IRFL014



Notes:

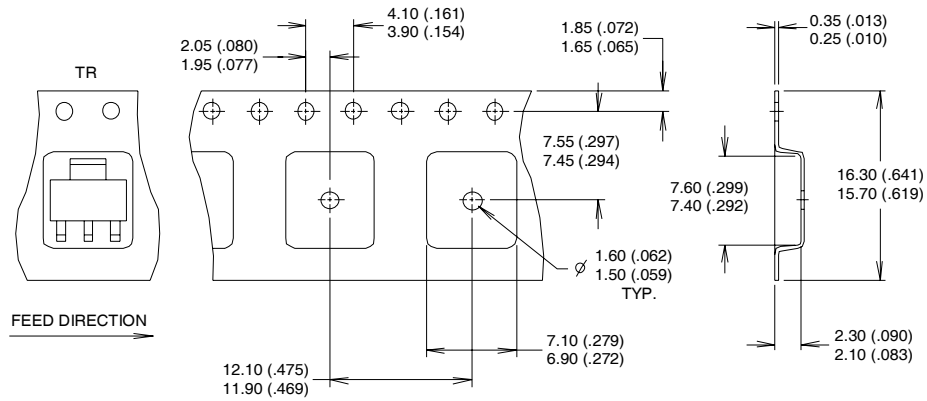
1. For an Automotive Qualified version of this part please see <http://www.irf.com/product-info/auto/>
2. For the most current drawing please refer to IR website at <http://www.irf.com/package/>

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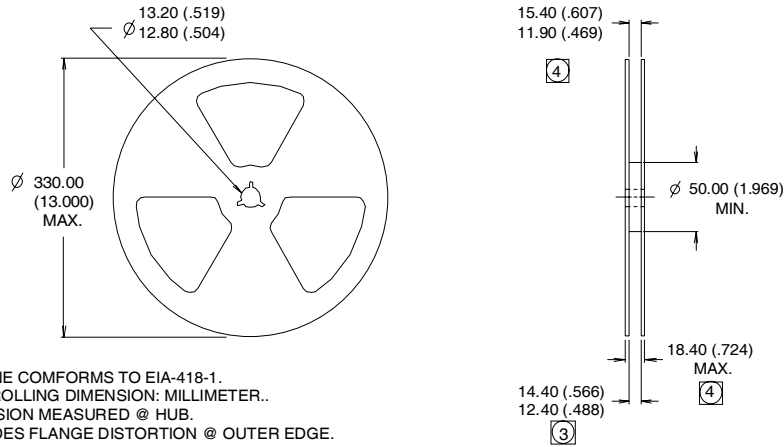
SOT-223 (TO-261AA) Tape & Reel Information

Dimensions are shown in millimeters (inches)



NOTES :

1. CONTROLLING DIMENSION: MILLIMETER.
2. OUTLINE CONFORMS TO EIA-481 & EIA-541.
3. EACH $\varnothing 330.00$ (13.00) REEL CONTAINS 2,500 DEVICES.



NOTES :

1. OUTLINE COMFORMS TO EIA-418-1.
2. CONTROLLING DIMENSION: MILLIMETER..
- ③ DIMENSION MEASURED @ HUB.
- ④ INCLUDES FLANGE DISTORTION @ OUTER EDGE.

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

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IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105
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