International
IOR Rectifier

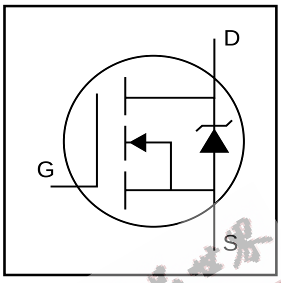
AUTOMOTIVE MOSFET

IRLL024NQ

HEXFET® Power MOSFET

Typical Applications

- Electronic Fuel Injection
- Active Suspension
- Power Doors, Windows & Seats
- Cruise Control
- Air Bags



V_{DSS} = 55V

$R_{DS(on)}$ = 0.065Ω

I_D = 3.1A

Benefits

- Advanced Process Technology
- Ultra Low On-Resistance
- 175°C Operating Temperature
- Repetitive Avalanche Allowed up to Tjmax
- Dynamic dv/dt Rating
- Automotive [Q101] Qualified

Description

Specifically designed for Automotive applications, this HEXFET® Power MOSFET in a SOT-223 package utilizes the lastest processing techniques to achieve extremely low on-resistance per silicon area. Additional features of this Automotive qualified HEXFET Power MOSFET are a 175°C junction operating temperature, fast switching speed and improved repetitive avalanche rating. These benefits combine to make this design an extremely efficient and reliable device for use in Automotive applications and a wide variety of other applications.

The efficient SOT-223 package is designed for surface mount and the enlarged tab provides improved thermal characteristics making it ideal in a variety of power applications. Power dissipation of 1.0W is possible in a typical surface mount application. Available in Tape & Reel.


SOT-223

Absolute Maximum Ratings

	Parameter	Max.	Units
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 4.5V	3.1	A
I_D @ T_C = 70°C	Continuous Drain Current, V_{GS} @ 4.5V	2.6	
I_{DM}	Pulsed Drain Current ①	12	
P_D @T_C = 25°C	Power Dissipation③	1.3	W
	Linear Derating Factor	8.3	mW/°C
V_{GS}	Gate-to-Source Voltage	±16	V
E_{AS}	Single Pulse Avalanche Energy④	87	mJ
I_{AR}	Avalanche Current①	See Fig.16c, 16d, 19, 20	A
E_{AR}	Repetitive Avalanche Energy⑥		mJ
dv/dt	Peak Diode Recovery dv/dt ⑤	9.9	V/ns
T_J, T_{STG}	Junction and Storage Temperature Range	-55 to + 175	°C

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{θJA}$	Junction-to-Amb. (PCB Mount, steady state)*	90	120	°C/W
$R_{θJA}$	Junction-to-Amb. (PCB Mount, steady state)**	50	60	

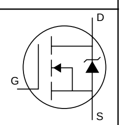
* When mounted on FR-4 board using minimum recommended footprint.
** When mounted on 1 inch square copper board, for comparison with other SMD devices.

03/16/01

Electrical Characteristics @ T_J = 25°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 = 250µA
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.057	—	V/°C	Reference to 25°C, I_D = 1mA
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	—	0.065	mΩ	V_{GS} = 10V, I_D = 3.1A ②
		—	—	0.080		V_{GS} = 5.0V, I_D = 2.5A ②
$V_{GS(th)}$	Gate Threshold Voltage	1.0	—	2.0	V	V_{DS} = V_{GS}, I_D = 250µA
g_{fs}	Forward Transconductance	4.5	—	—	S	V_{DS} = 25V, I_D = 1.9A
I_{DSS}	Drain-to-Source Leakage Current	—	—	25	µA	V_{DS} = 55V, V_{GS} = 0V
		—	—	250		V_{DS} = 44V, V_{GS} = 0V, T_J = 125°C
I_{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	V_{GS} = 16V
	Gate-to-Source Reverse Leakage	—	—	-100		V_{GS} = -16V
Q_g	Total Gate Charge	—	11	17	nC	I_D = 1.9A
Q_{gs}	Gate-to-Source Charge	—	1.9	—		V_{DS} = 44V
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	4.3	—		V_{GS} = 10V
$t_{d(on)}$	Turn-On Delay Time	—	12	—	ns	V_{DD} = 28V ②
t_r	Rise Time	—	41	—		I_D = 1.9A
$t_{d(off)}$	Turn-Off Delay Time	—	48	—		R_G = 24Ω
t_f	Fall Time	—	39	—		R_D = 15Ω
C_{iss}	Input Capacitance	—	508	—	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	—	141	—		V_{DS} = 25V
C_{rss}	Reverse Transfer Capacitance	—	62	—		f = 1.0MHz

Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	3.1	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	12		
V_{SD}	Diode Forward Voltage	—	—	1.0	V	T_J = 25°C, I_S = 1.9A, V_{GS} = 0V ②
t_{rr}	Reverse Recovery Time	—	40	60	ns	T_J = 25°C, I_F = 1.9A
Q_{rr}	Reverse Recovery Charge	—	65	97	nC	di/dt = 100A/µs ②

Notes:

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

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

③ Surface mounted on 1 in square Cu board

④ Starting T_J = 25°C, L = 18mH R_G = 25Ω, I_{AS} = 3.1A. (See Figure 12).

⑤ I_{SD} ≤ 1.9A, di/dt ≤ 197A/µs, V_{DD} ≤ $V_{(BR)DSS}$, T_J ≤ 175°C

⑥ Limited by T_{Jmax} , see Fig.16c, 16d, 19, 20 for typical repetitive avalanche performance.

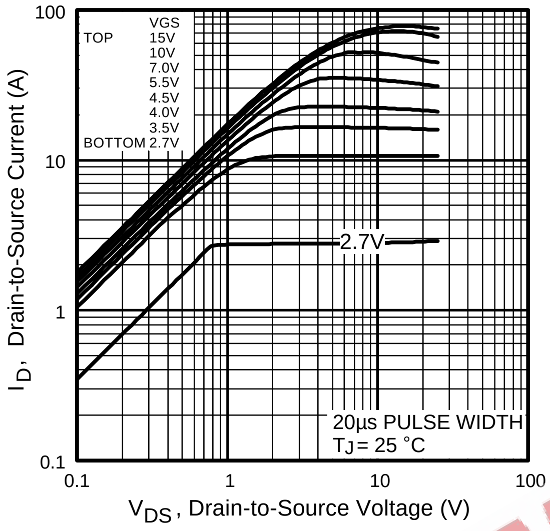


Fig 1. Typical Output Characteristics

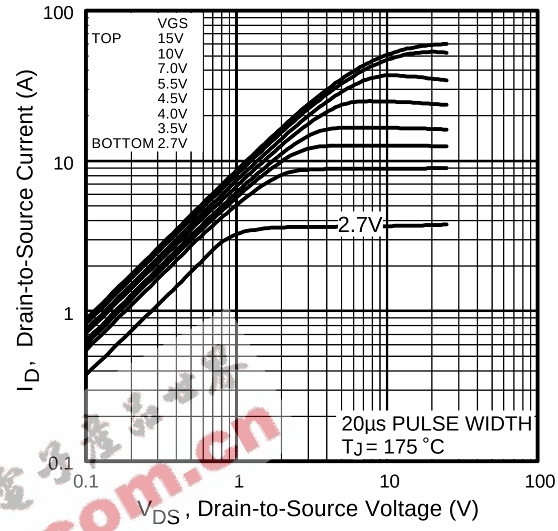


Fig 2. Typical Output Characteristics

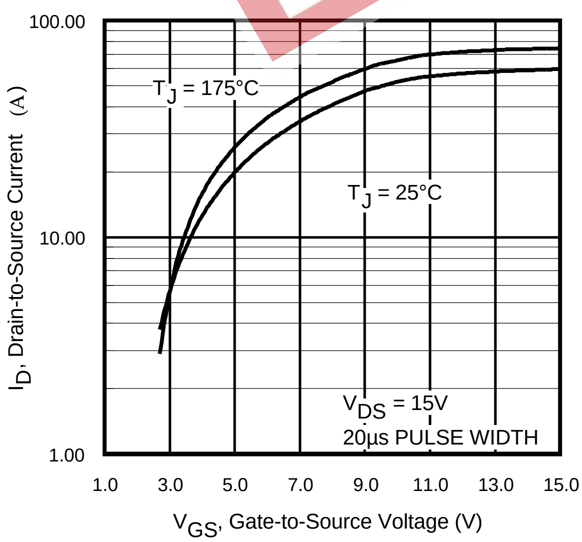


Fig 3. Typical Transfer Characteristics

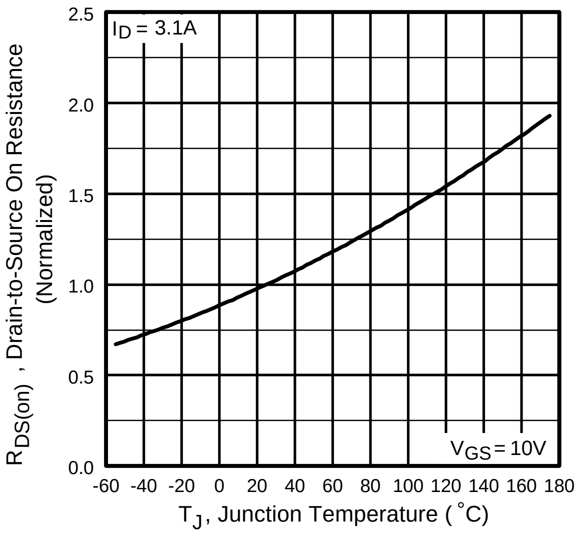


Fig 4. Normalized On-Resistance Vs. Temperature

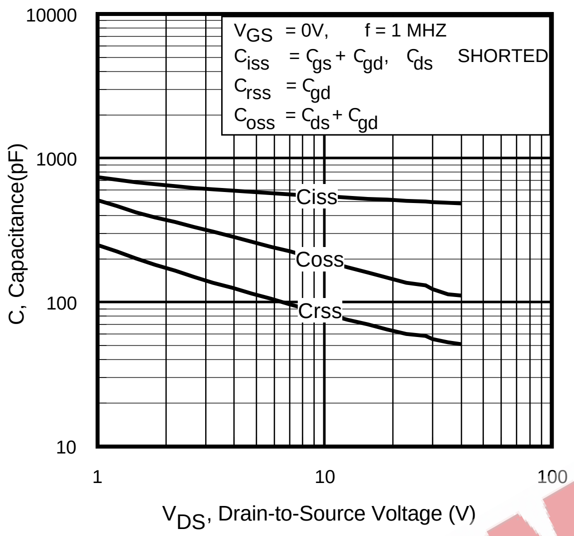


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

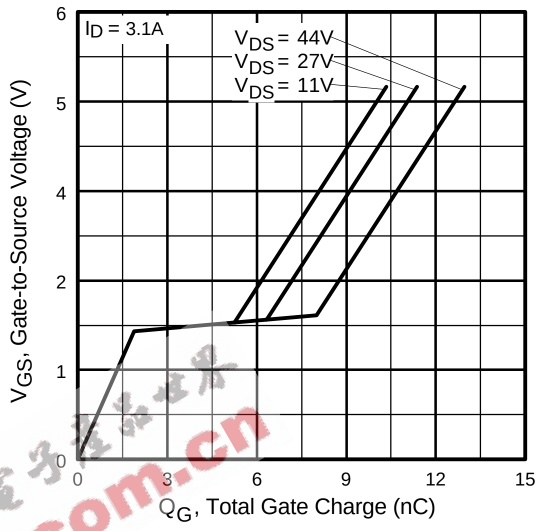


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

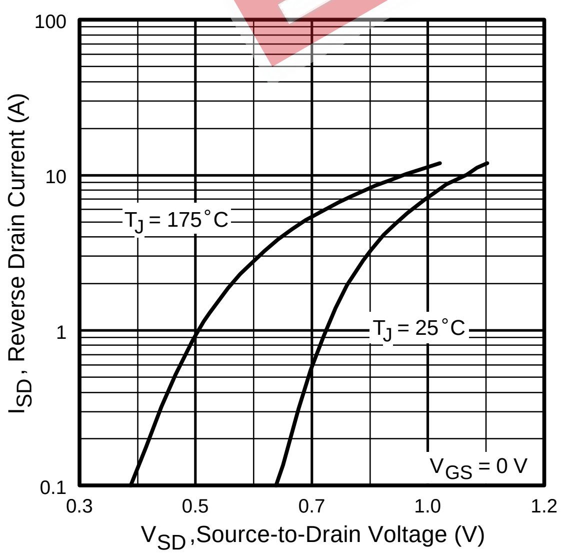


Fig 7. Typical Source-Drain Diode Forward Voltage

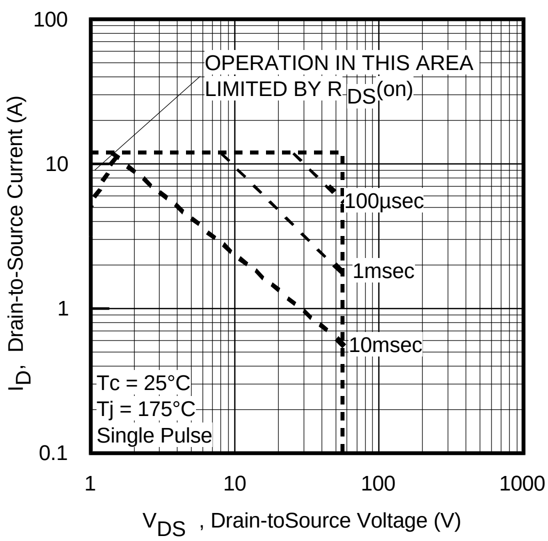


Fig 8. Maximum Safe Operating Area

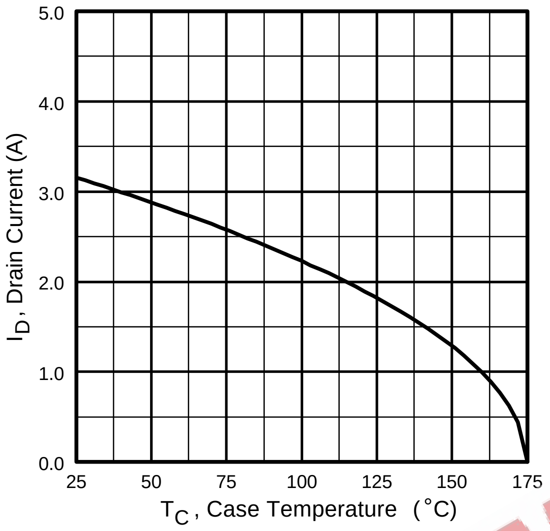


Fig 9. Maximum Drain Current Vs. Case Temperature

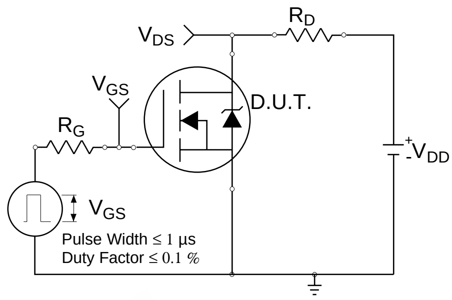


Fig 10a. Switching Time Test Circuit

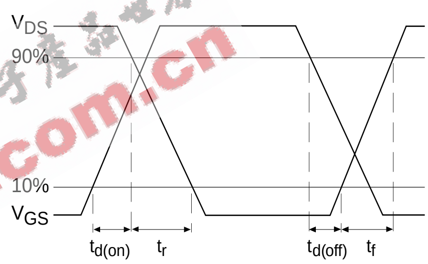


Fig 10b. Switching Time Waveforms

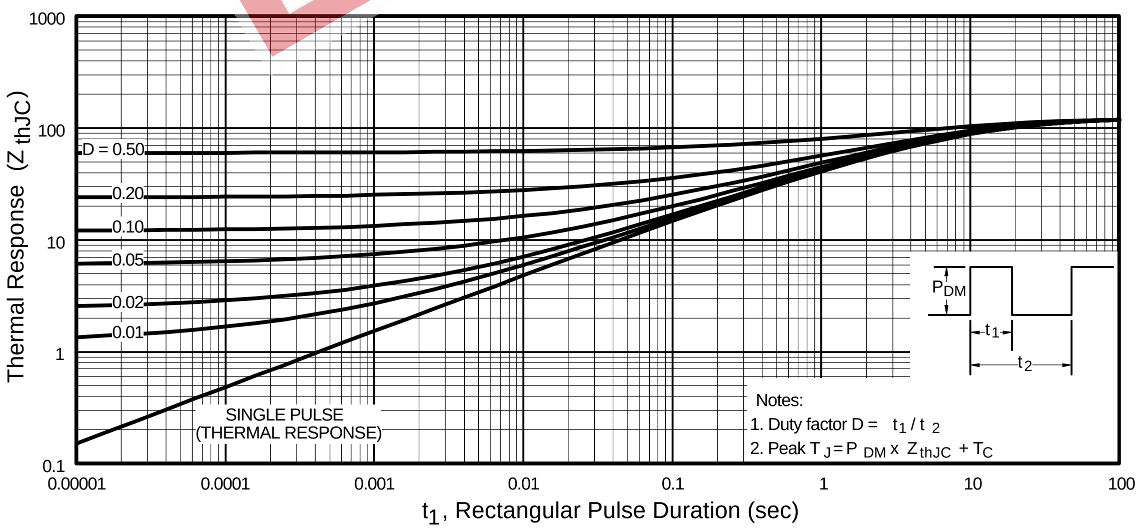


Fig 11. Typical Effective Transient Thermal Impedance, Junction-to-Ambient

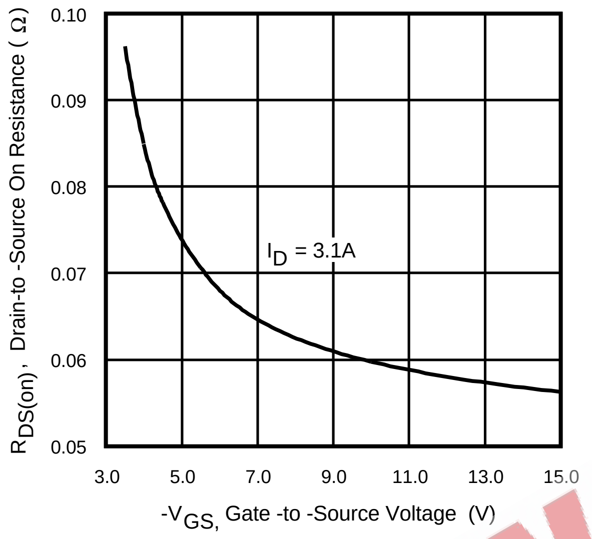


Fig 12. Typical On-Resistance Vs. Gate Voltage

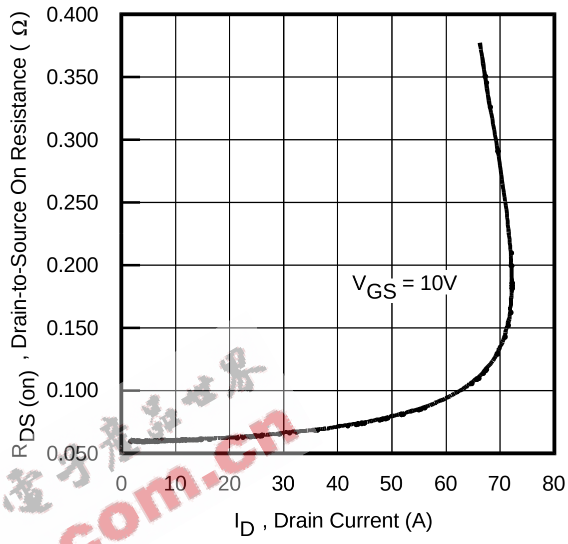


Fig 13. Typical On-Resistance Vs. Drain Current

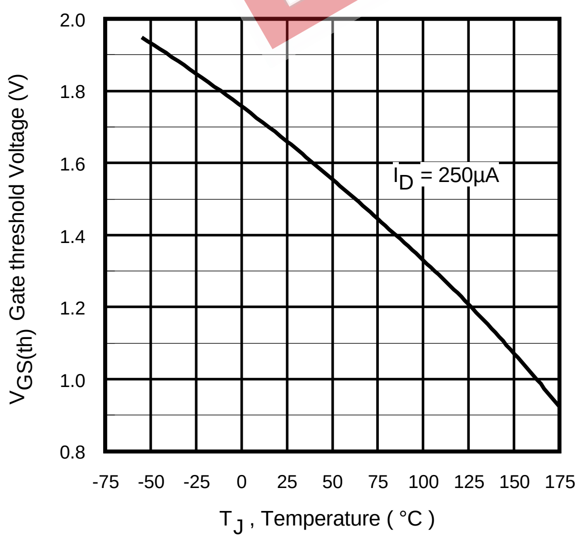


Fig 14. Typical Threshold Voltage Vs. Junction Temperature

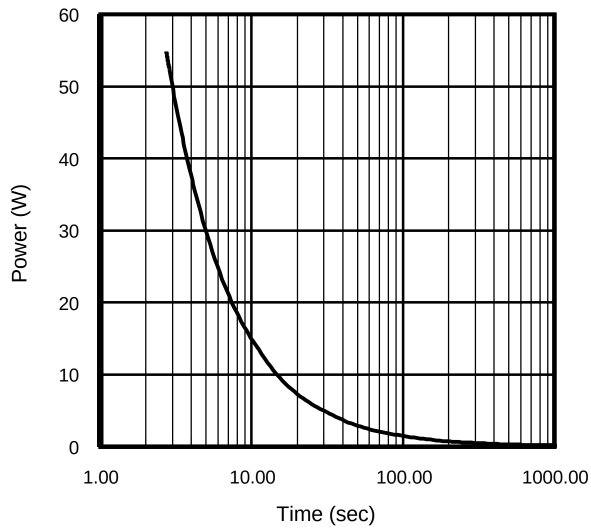


Fig 15. Typical Power Vs. Time

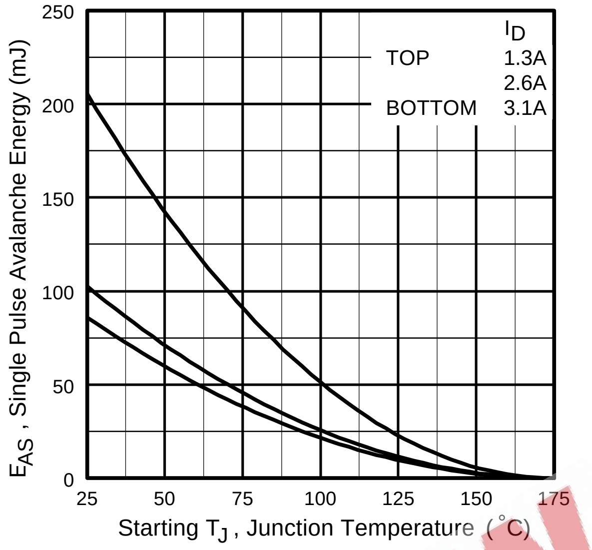


Fig 16a. Maximum Avalanche Energy Vs. Drain Current

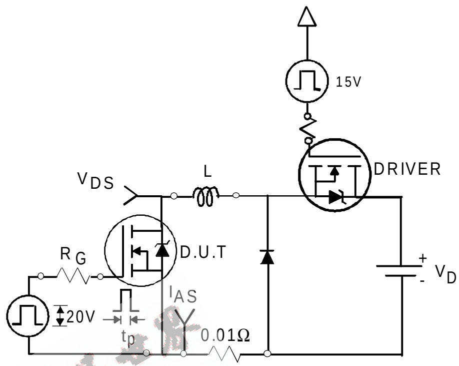


Fig 16c. Unclamped Inductive Test Circuit

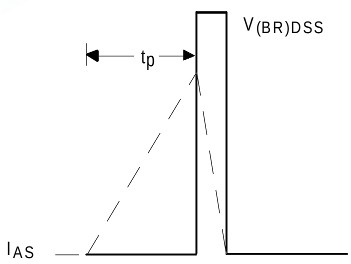


Fig 16d. Unclamped Inductive Waveforms

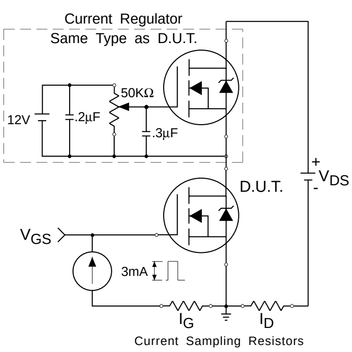


Fig 17. Gate Charge Test Circuit

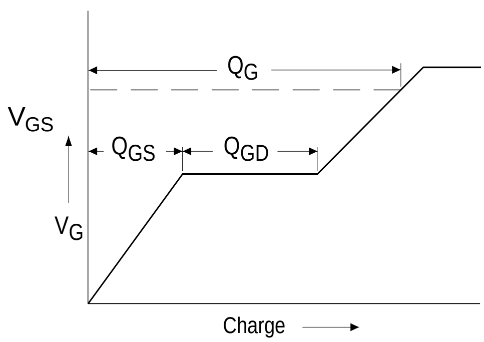


Fig 18. Basic Gate Charge Waveform

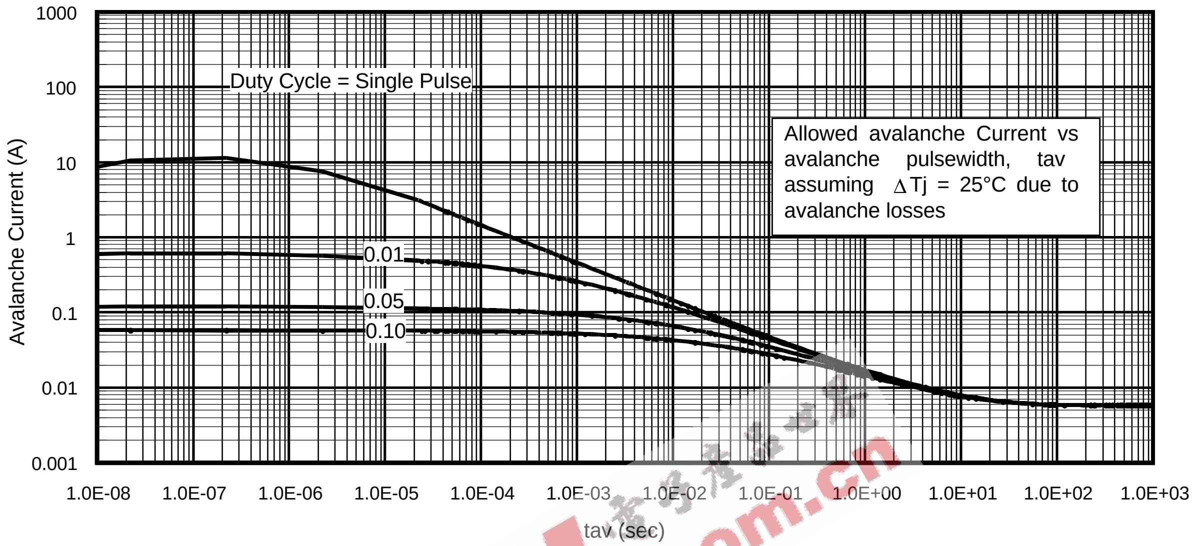


Fig 19. Typical Avalanche Current Vs.Pulsewidth

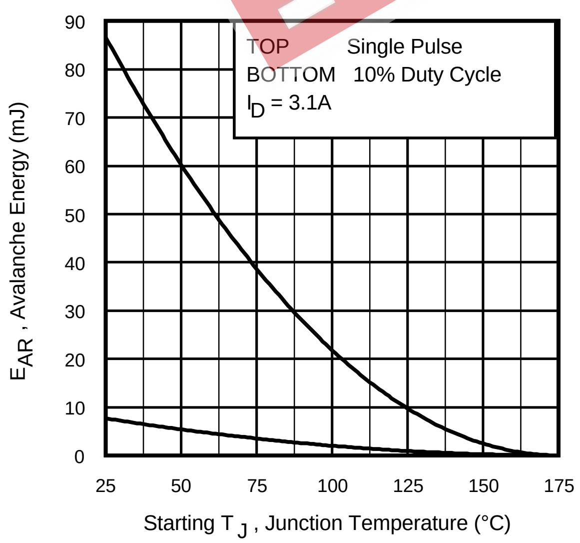


Fig 20. Maximum Avalanche Energy Vs. Temperature

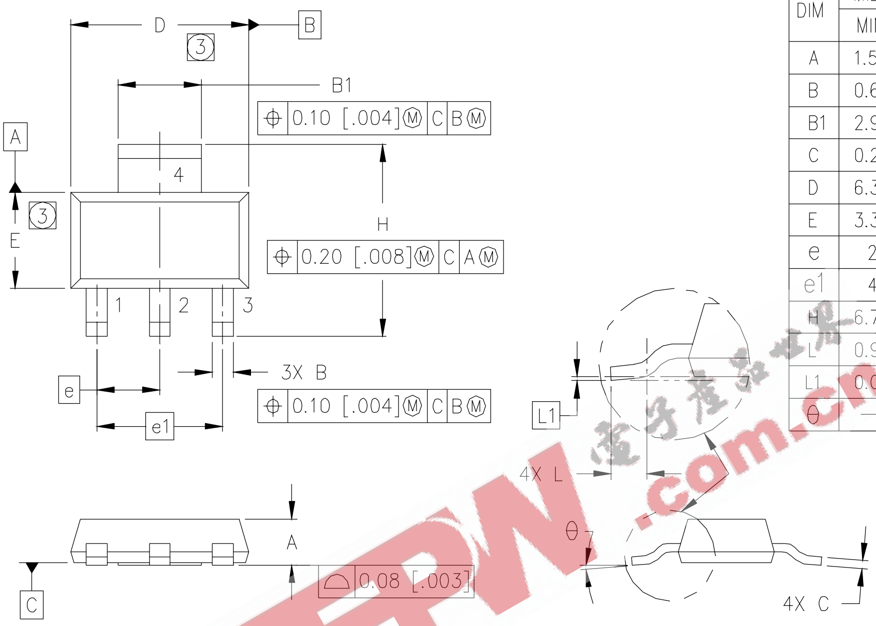
Notes on Repetitive Avalanche Curves , Figures 15, 16:
(For further info, see AN-1005 at www.irf.com)

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)

$$P_{D\ (ave)} = 1/2\ (1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$$
$$I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{th}]$$
$$E_{AS\ (AR)} = P_{D\ (ave)} \cdot t_{av}$$

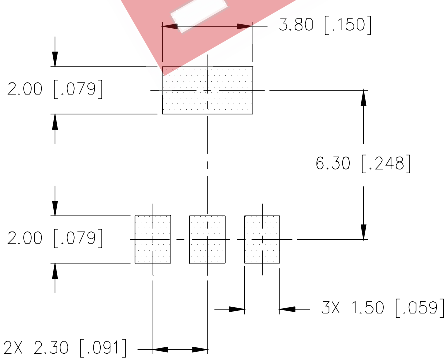
Package Outline

SOT-223



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.55	1.80	.061	.071
B	0.65	0.85	.026	.033
B1	2.95	3.15	.116	.124
C	0.25	0.35	.010	.014
D	6.30	6.70	.248	.264
E	3.30	3.70	.130	.146
e	2.30 BSC		.0905 BSC	
e1	4.60 BSC		.181 BSC	
H	6.71	7.29	.264	.287
L	0.91	—	.036	—
L1	0.061 BSC		.0024 BSC	
θ	—	10°	—	10°

MINIMUM RECOMMENDED FOOTPRINT



LEAD ASSIGNMENTS

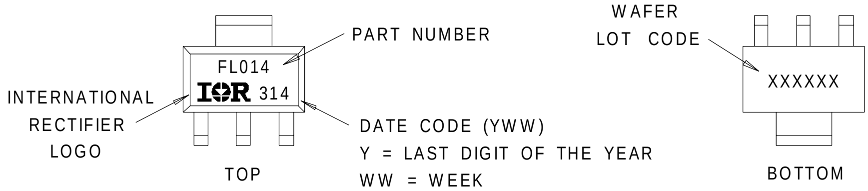
1 = GATE
2 = DRAIN
3 = SOURCE
4 = DRAIN

NOTES:
1. DIMENSIONING & TOLERANCING PER ASME Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSIONS DO NOT INCLUDE MOLD FLASH.
4. OUTLINE CONFORMS TO JEDEC OUTLINE TO-261AA.
5. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].

Part Marking Information

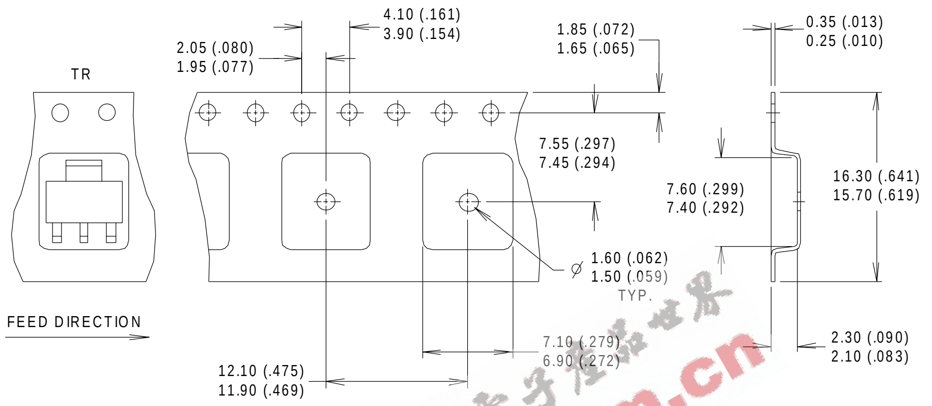
SOT-223

EXAMPLE : THIS IS AN IRFL014

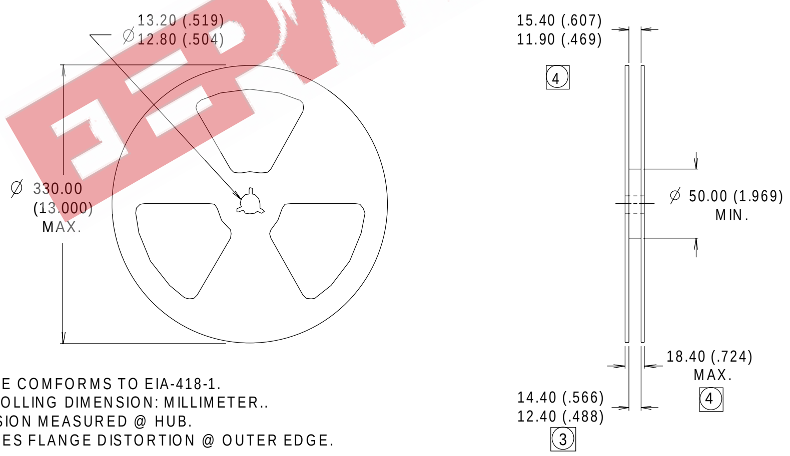


Tape & Reel Information

SOT-223



NOTES :
1. CONTROLLING DIMENSION: MILLIMETER.
2. OUTLINE CONFORMS TO EIA-481 & EIA-541.
3. EACH Ø330.00 (13.00) REEL CONTAINS 2,500 DEVICES.



NOTES :
1. OUTLINE CONFORMS 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 and qualified for the Automotive [Q101] market.
Qualification Standards can be found on IR's Web site.

International
IOR Rectifier

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