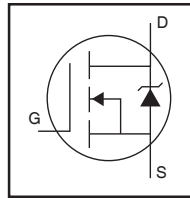


AUIRF2804WL

HEXFET® Power MOSFET

Features

- Advanced Process Technology
- Ultra Low On-Resistance
- 175°C Operating Temperature
- Fast Switching
- Repetitive Avalanche Allowed up to Tjmax
- Lead-Free, RoHS Compliant
- Automotive Qualified *



$V_{(BR)DSS}$	40V
$R_{DS(on)}$ max.	1.8mΩ
I_D (Silicon Limited)	295A
I_D (Package Limited)	240A

Description

Specifically designed for Automotive applications, 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 175°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 Automotive applications and a wide variety of other applications.



G	D	S
Gate	Drain	Source

Absolute Maximum Ratings

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only; and functional operation of the device at these or any other condition beyond those indicated in the specifications is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability. The thermal resistance and power dissipation ratings are measured under board mounted and still air conditions. Ambient temperature (T_A) is 25°C, unless otherwise specified.

	Parameter	Max.	Units
$I_D @ T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Silicon Limited)	295	A
$I_D @ T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Silicon Limited)	208	
$I_D @ T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Package Limited)	240	
I_{DM}	Pulsed Drain Current ①	1250	
$P_D @ T_C = 25^\circ\text{C}$	Maximum Power Dissipation	300	W
	Linear Derating Factor	2.0	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS}	Single Pulse Avalanche Energy (Thermally Limited) ②	420	mJ
$E_{AS}(\text{tested})$	Single Pulse Avalanche Energy Tested Value ③	640	
I_{AR}	Avalanche Current ④	See Fig.12a,12b,15,16	A
E_{AR}	Repetitive Avalanche Energy ⑤		mJ
T_J	Operating Junction and	-55 to + 175	°C
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 seconds (1.6mm from case)	300	
	Mounting torque, 6-32 or M3 screw	10 lbf•in (1.1N•m)	

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ⑦	—	0.50	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient	—	62	

HEXFET® is a registered trademark of International Rectifier.

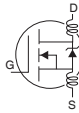
*Qualification standards can be found at <http://www.irf.com/>

Static 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	40	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.0297	—	V/ $^\circ\text{C}$	Reference to $25^\circ\text{C}, I_D = 1\text{mA}$
$R_{DS(on)}$ SMD	Static Drain-to-Source On-Resistance	—	1.57	1.8	m Ω	$V_{GS} = 10V, I_D = 187A$ ③
$V_{GS(th)}$	Gate Threshold Voltage	2.0	—	4.0	V	$V_{DS} = V_{GS}, I_D = 250\mu A$
gfs	Forward Transconductance	129	—	—	S	$V_{DS} = 10V, I_D = 187A$
I_{DSS}	Drain-to-Source Leakage Current	—	—	20	μA	$V_{DS} = 40V, V_{GS} = 0V$
		—	—	250		$V_{DS} = 40V, V_{GS} = 0V, T_J = 125^\circ\text{C}$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	200	nA	$V_{GS} = 20V$
	Gate-to-Source Reverse Leakage	—	—	-200		$V_{GS} = -20V$

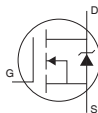
Dynamic Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
Q_g	Total Gate Charge	—	150	225	nC	$I_D = 187A$
Q_{gs}	Gate-to-Source Charge	—	42	—		$V_{DS} = 32V$
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	47	—		$V_{GS} = 10V$ ③
$t_{d(on)}$	Turn-On Delay Time	—	19	—	ns	$V_{DD} = 20V$
t_r	Rise Time	—	241	—		$I_D = 187A$
$t_{d(off)}$	Turn-Off Delay Time	—	71	—		$R_G = 2.6\Omega$
t_f	Fall Time	—	100	—		$V_{GS} = 10V$ ②
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	—		
C_{iss}	Input Capacitance	—	7978	—	pF	$V_{GS} = 0V$
C_{oss}	Output Capacitance	—	1693	—		$V_{DS} = 25V$
C_{rss}	Reverse Transfer Capacitance	—	934	—		$f = 1.0\text{MHz}$, See Fig. 5
C_{oss}	Output Capacitance	—	5422	—		$V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0\text{MHz}$
C_{oss}	Output Capacitance	—	1522	—		$V_{GS} = 0V, V_{DS} = 32V, f = 1.0\text{MHz}$
$C_{oss\ eff.}$	Effective Output Capacitance	—	2115	—		$V_{GS} = 0V, V_{DS} = 0V \text{ to } 32V$



Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	312	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	1250		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}, I_S = 187A, V_{GS} = 0V$ ③
t_{rr}	Reverse Recovery Time	—	29	44	ns	$T_J = 25^\circ\text{C}, I_F = 187A, V_{DD} = 20V$
Q_{rr}	Reverse Recovery Charge	—	68	102	nC	$di/dt = 100A/\mu s$ ③



Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11).
- ② Limited by T_{Jmax} , starting $T_J = 25^\circ\text{C}$, $L=0.024\text{mH}, R_G = 50\Omega, I_{AS} = 187A, V_{GS} = 10V$. Part not recommended for use above this value.
- ③ Pulse width $\leq 1.0\text{ms}$; duty cycle $\leq 2\%$.
- ④ $C_{oss\ eff.}$ 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 is determined from sample failure population, starting $T_J = 25^\circ\text{C}, L=0.024\text{mH}, R_G = 50\Omega, I_{AS} = 187A, V_{GS} = 10V$.
- ⑦ R_{θ} is measured at T_J of approximately 90°C .

Qualification Information[†]

Qualification Level		Automotive (per AEC-Q101) ^{††}	
		Comments: This part number(s) passed Automotive qualification. IR's Industrial and Consumer qualification level is granted by extension of the higher Automotive level.	
Moisture Sensitivity Level		TO-262 WideLead	N/A
ESD	Machine Model	Class M4 (+/- 425V) ^{†††} AEC-Q101-002	
	Human Body Model	Class H3A (+/- 4000V) ^{†††} AEC-Q101-001	
	Charged Device Model	Class C5 (+/- 1000V) ^{†††} AEC-Q101-005	
RoHS Compliant		Yes	

[†] Qualification standards can be found at International Rectifier's web site: <http://www.irf.com/>

^{††} Exceptions (if any) to AEC-Q101 requirements are noted in the qualification report.

^{†††} Highest passing voltage.

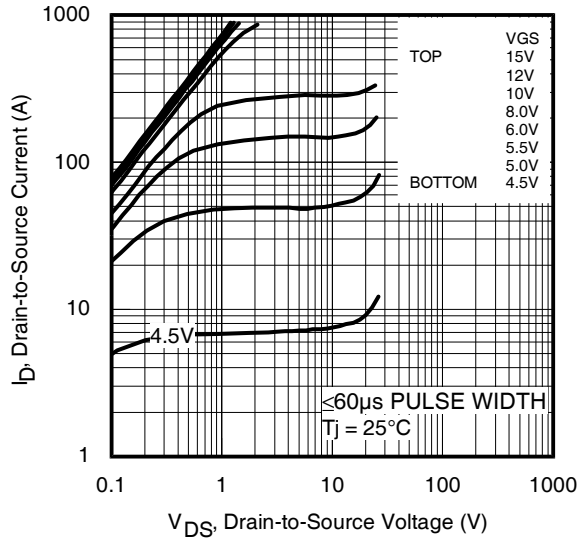


Fig 1. Typical Output Characteristics

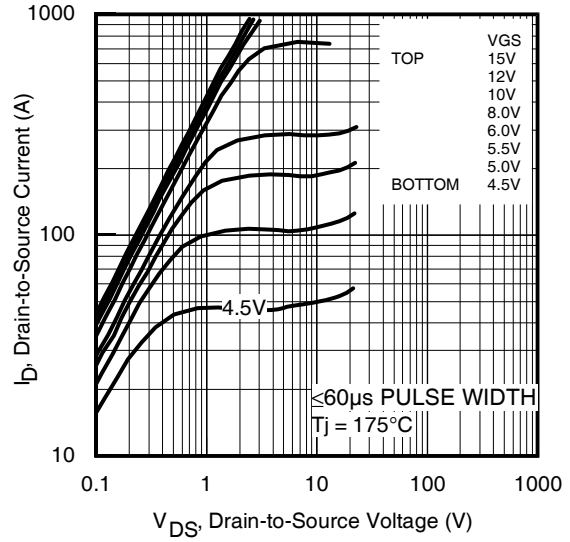


Fig 2. Typical Output Characteristics

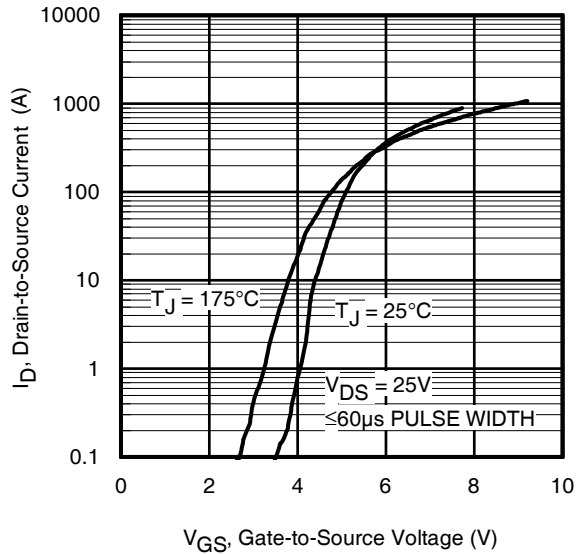


Fig 3. Typical Transfer Characteristics

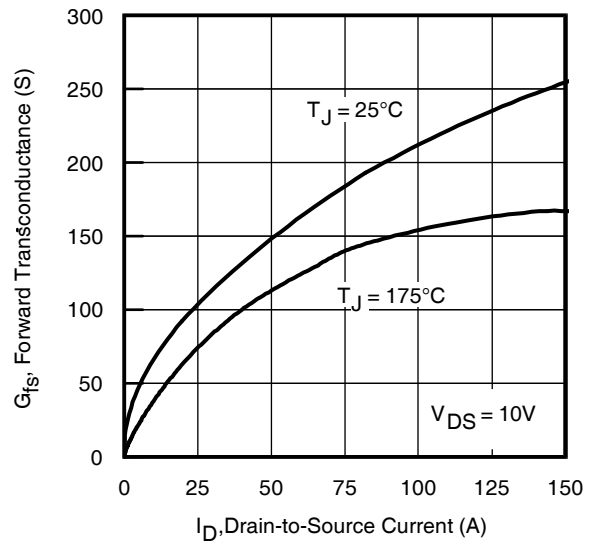


Fig 4. Typical Forward Transconductance vs. Drain Current

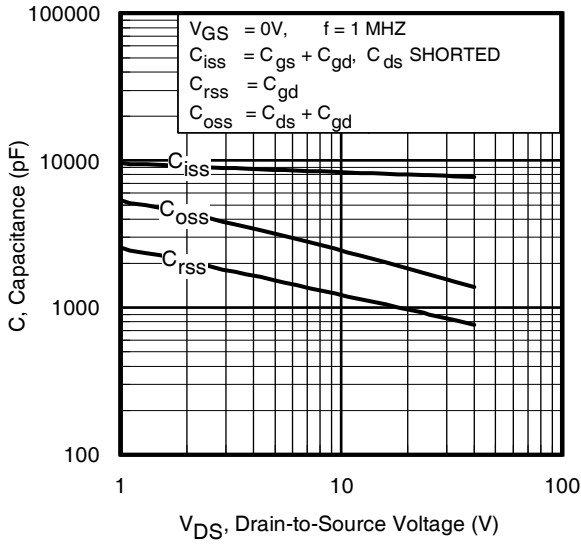


Fig 5. Typical Capacitance vs. Drain-to-Source Voltage



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

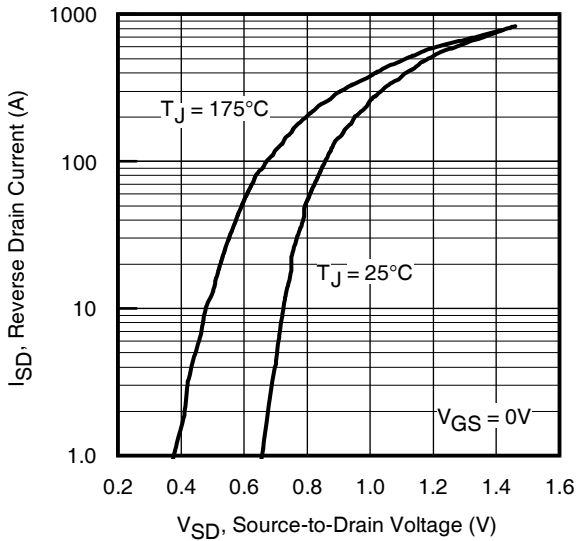


Fig 7. Typical Source-Drain Diode Forward Voltage

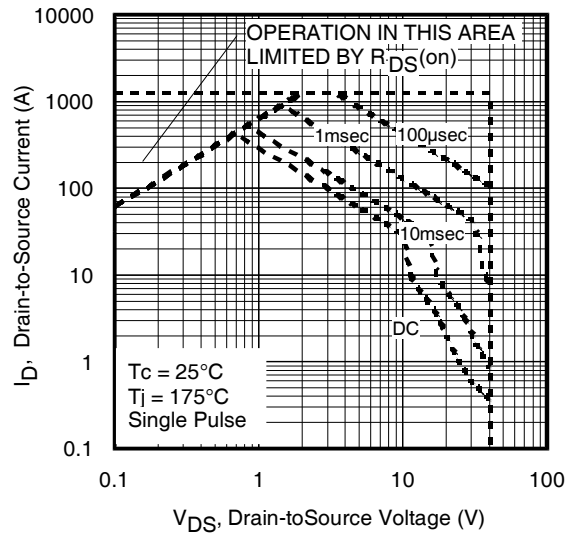


Fig 8. Maximum Safe Operating Area

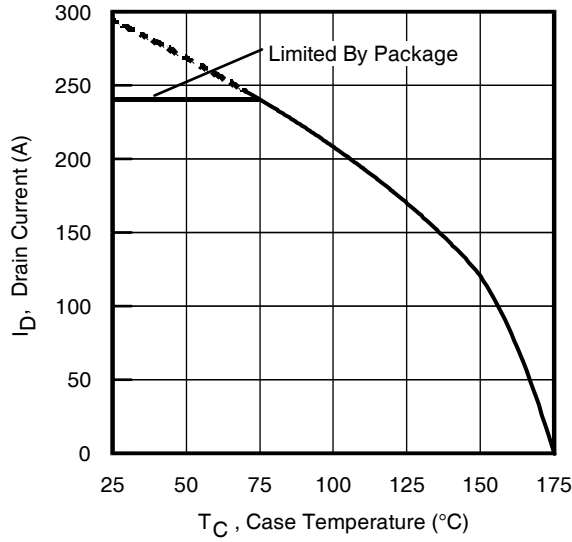


Fig 9. Maximum Drain Current vs. Case Temperature

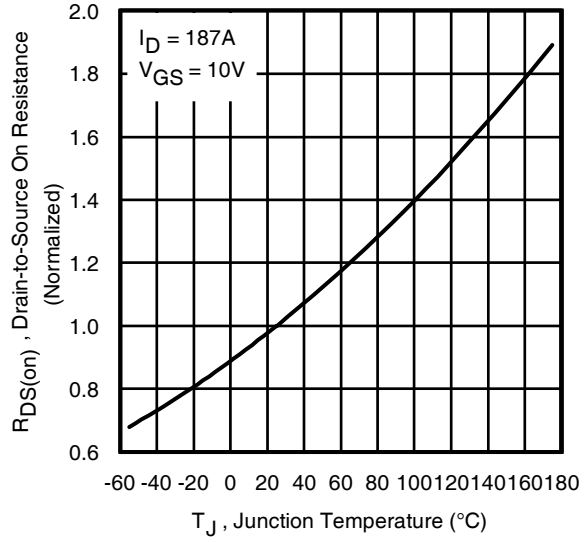


Fig 10. Normalized On-Resistance vs. Temperature

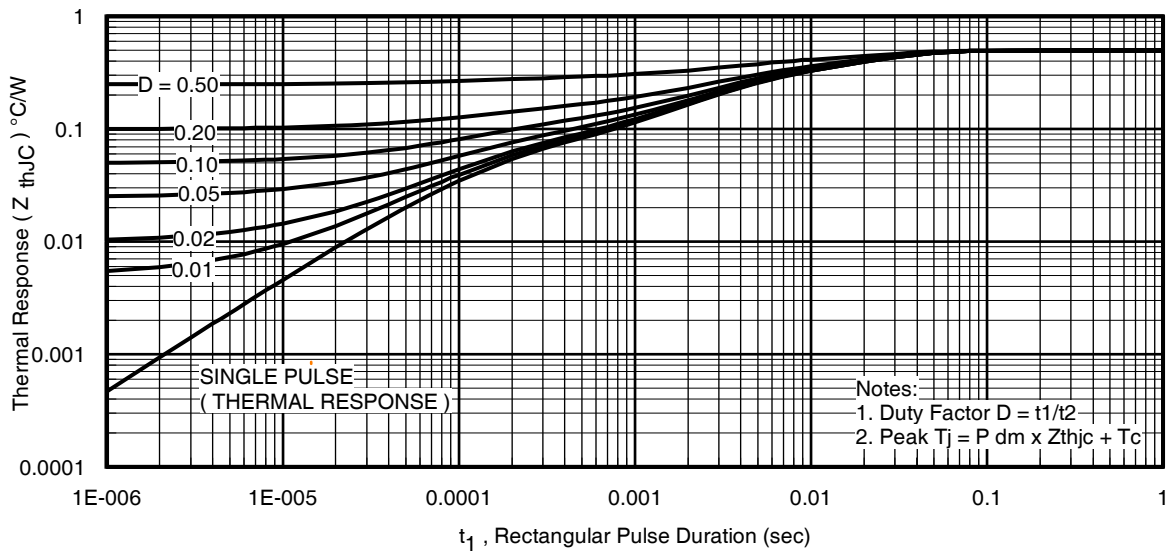


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

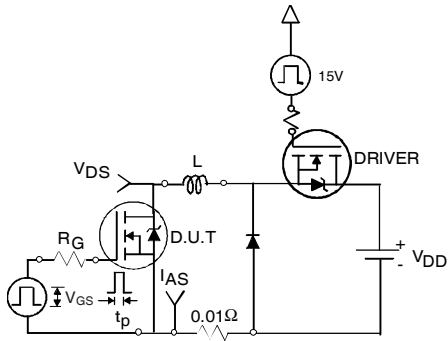


Fig 12a. Unclamped Inductive Test Circuit

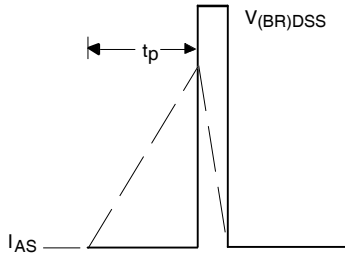


Fig 12b. Unclamped Inductive Waveforms

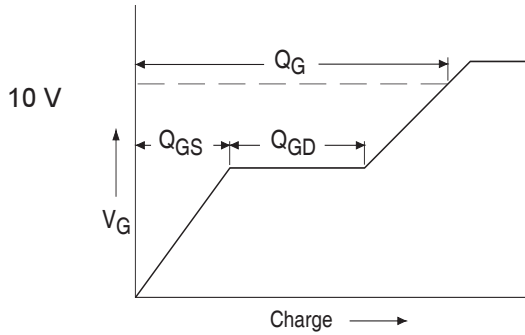


Fig 13a. Basic Gate Charge Waveform

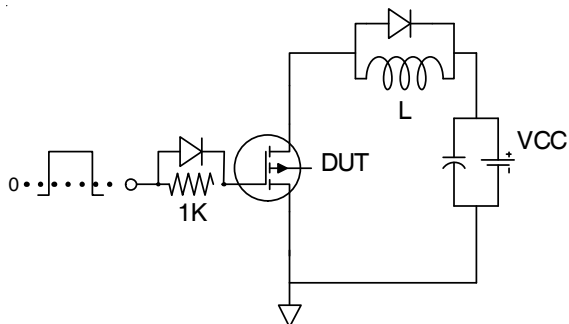


Fig 13b. Gate Charge Test Circuit
www.irf.com

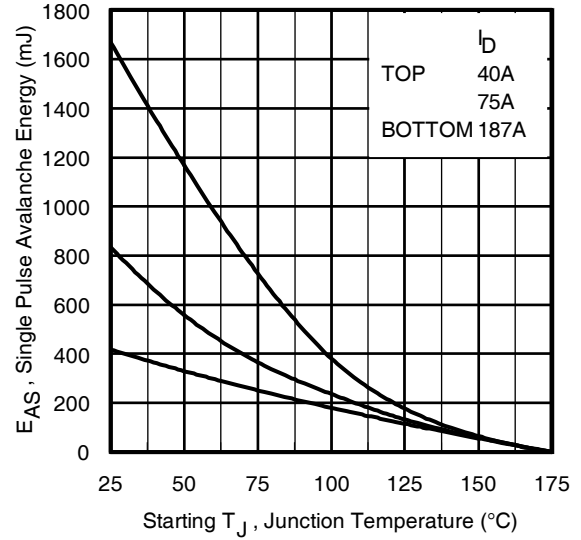


Fig 12c. Maximum Avalanche Energy vs. Drain Current

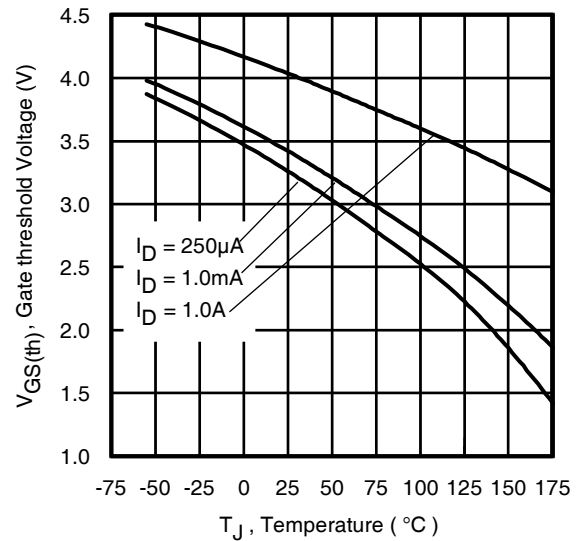


Fig 14. Threshold Voltage vs. Temperature

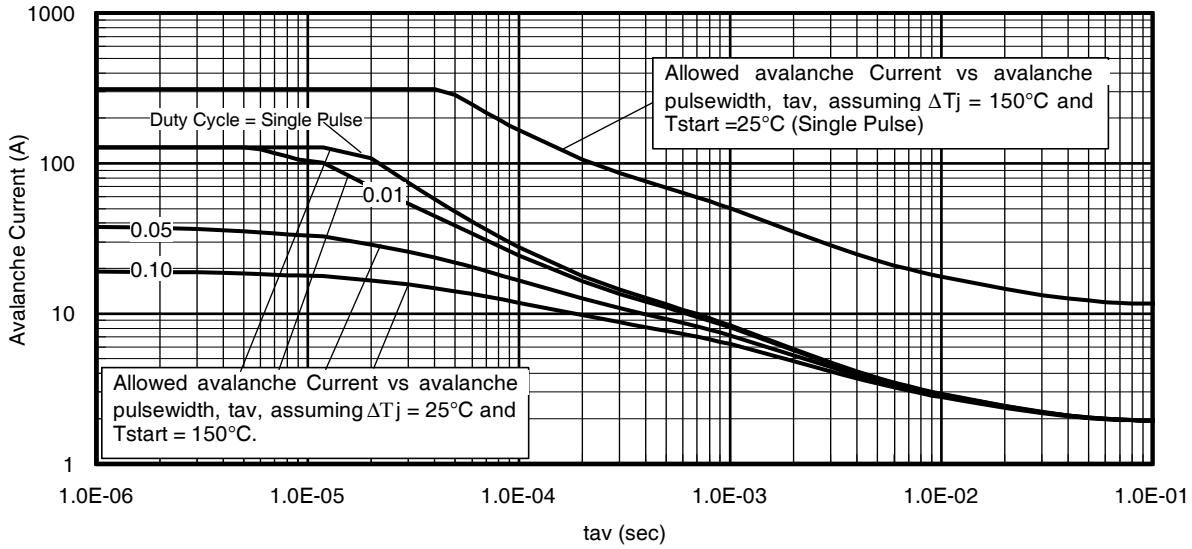


Fig 15. Typical Avalanche Current vs.Pulsewidth

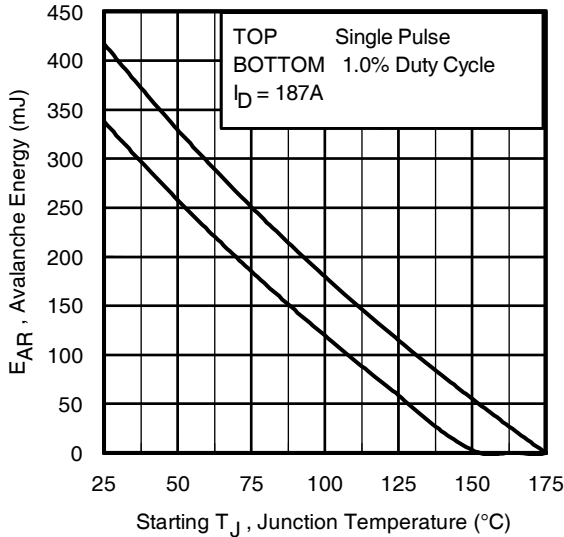


Fig 16. Maximum Avalanche Energy vs. Temperature

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 ΔT_{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)

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

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

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

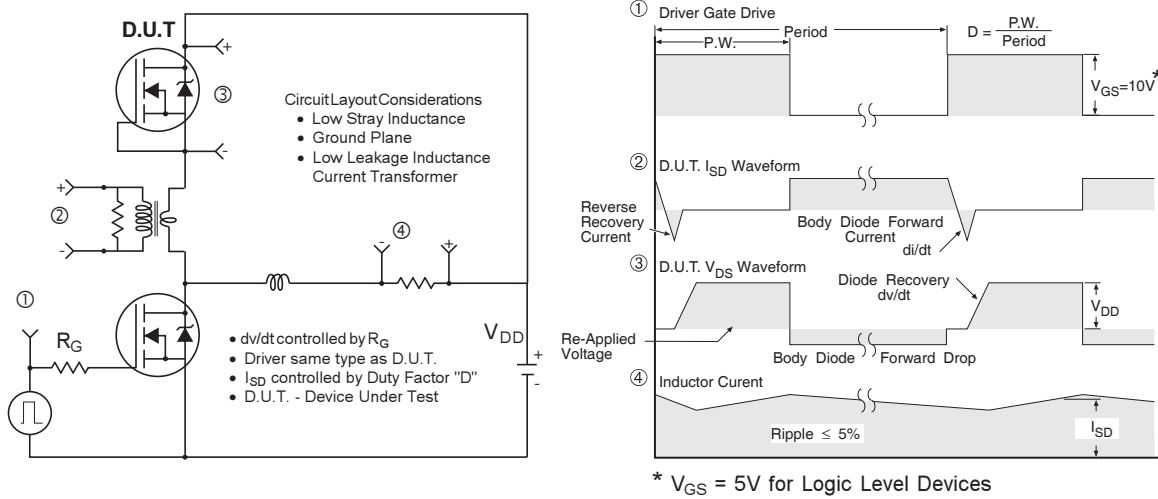


Fig 17. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

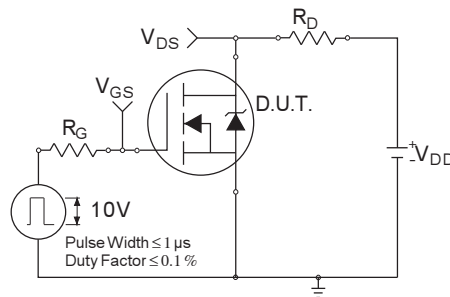


Fig 18a. Switching Time Test Circuit

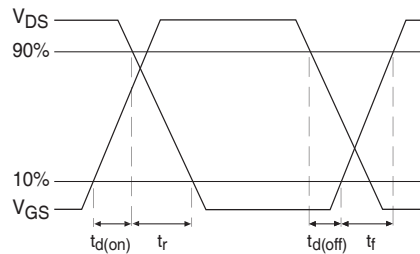
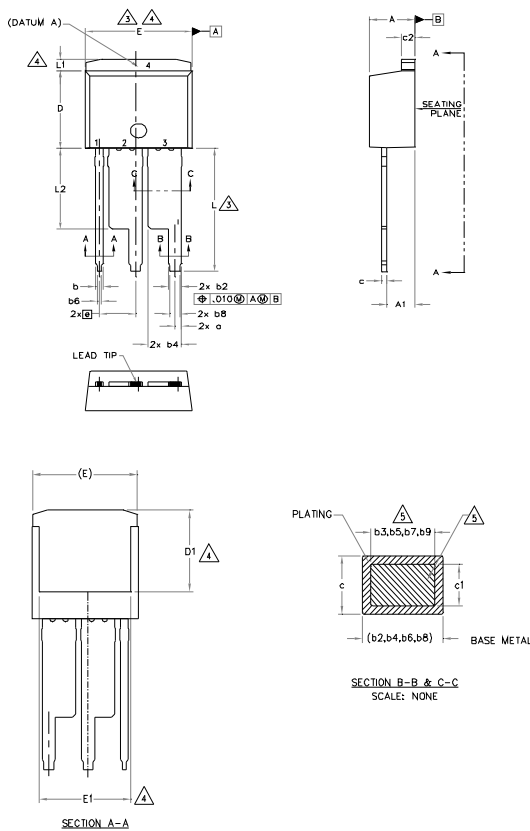


Fig 18b. Switching Time Waveforms

AUIRF2804WL

TO-262 WideLead Package Outline

Dimensions are shown in millimeters (inches)



SYMBOL	DIMENSIONS				SECTION
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	5
A1	2.03	3.02	.080	.119	
a	0.20	0.51	.008	.020	5
b	0.51	0.91	.020	.036	
b1	0.61	0.81	.020	.032	5
b2	1.07	1.47	0.42	.058	
b3	1.07	1.37	.042	.054	5
b4	3.05	3.45	.120	.136	
b5	3.05	3.35	.120	.132	5
b6	0.25	0.61	.010	.024	
b7	0.25	0.51	.010	.020	5
b8	0.76	1.17	.030	.046	
b9	0.76	1.07	.030	.022	5
c	0.38	0.74	.015	.029	
c1	0.38	0.58	.015	.023	5
c2	1.14	1.65	.045	.065	
D	8.51	9.65	.335	.380	3
D1	6.86	7.42	.270	.292	4
E	9.65	10.67	.380	.420	3,4
E1	6.22	8.48	.245	.334	4
e	3.81 BSC		.150 BSC		
L	13.46	14.10	.530	.555	4
L1	-	1.65	-	.065	
L2	8.64	9.40	.340	.370	

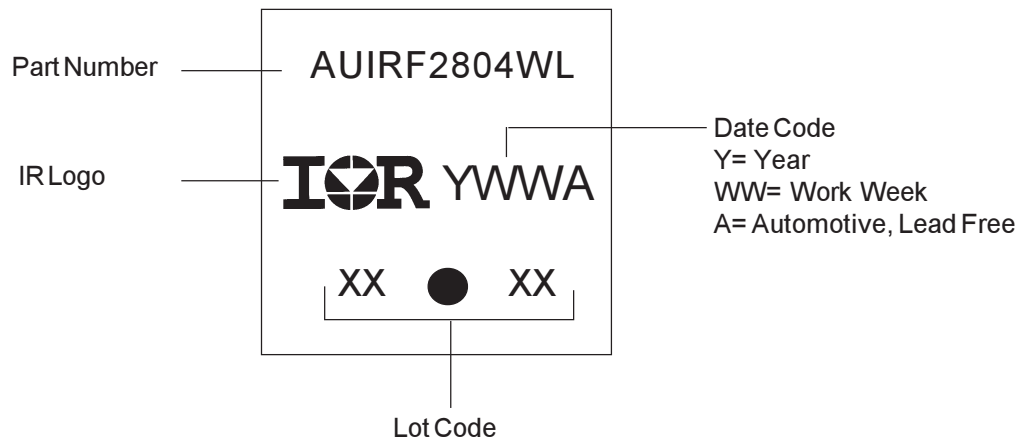
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
 2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES]
 3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [0.005] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
 4. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E, L1, D1 & E1.
 5. DIMENSION b3, b5, b7, b9 AND c1 APPLY TO BASE METAL ONLY.
 6. CONTROLLING DIMENSION: INCH.
 - 7.- OUTLINE CONFORM TO JEDEC TO-262 EXCEPT A1(max.), b(min.) AND D1(min.) WHERE DIMENSIONS DERIVED THE ACTUAL PACKAGE OUTLINE.

LEAD ASSIGNMENTS

HEXFET

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

TO-262 WideLead Part Marking Information



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

Ordering Information

Base part number	Package Type	Standard Pack		Complete Part Number
		Form	Quantity	
AUIRF2804WL	TO-262 WideLead	Tube	50	AUIRF2804WL

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