

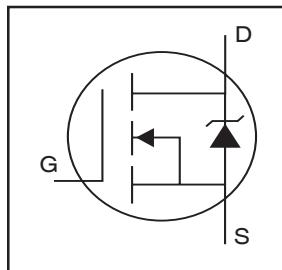
AUTOMOTIVE GRADE

AUIRF1324

HEXFET® Power MOSFET

Features

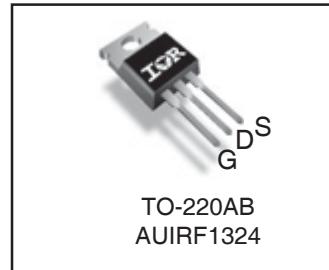
- Advanced Process Technology
- Ultra Low On-Resistance
- 175°C Operating Temperature
- Fast Switching
- Repetitive Avalanche Allowed up to T_{jmax}
- Lead-Free, RoHS Compliant
- Automotive Qualified *



V_{DSS}	24V
$R_{DS(on)}$	typ. 1.2mΩ
	max. 1.5mΩ
I_D (Silicon Limited)	353A①
I_D (Package Limited)	195A

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.

Symbol	Parameter	Max.	Units
I_D @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Silicon Limited)	353 ①	A
I_D @ $T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Silicon Limited)	249 ①	
I_D @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Package Limited)	195	
I_{DM}	Pulsed Drain Current ②	1412	
$P_D @ T_C = 25^\circ\text{C}$	Maximum Power Dissipation	300	W
	Linear Derating Factor	2.0	$\text{W}/^\circ\text{C}$
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS}	Single Pulse Avalanche Energy (Thermally Limited) ③	270	mJ
I_{AR}	Avalanche Current ②	See Fig. 14, 15, 22a, 22b	A
E_{AR}	Repetitive Avalanche Energy ③		mJ
dv/dt	Peak Diode Recovery ④	0.46	V/ns
T_J	Operating Junction and	-55 to + 175	$^\circ\text{C}$
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 seconds (1.6mm from case)		
	Mounting torque, 6-32 or M3 screw	10lb·in (1.1N·m)	

Thermal Resistance

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ⑧	—	0.50	$^\circ\text{C}/\text{W}$
$R_{\theta CS}$	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)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(\text{BR})\text{DSS}}$	Drain-to-Source Breakdown Voltage	24	—	—	V	$V_{\text{GS}} = 0\text{V}$, $I_D = 250\mu\text{A}$
$\Delta V_{(\text{BR})\text{DSS}}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	22	—	$\text{mV}/^\circ\text{C}$	Reference to 25°C , $I_D = 5.0\text{mA}$ ②
$R_{\text{DS}(\text{on})}$	Static Drain-to-Source On-Resistance	—	1.2	1.5	$\text{m}\Omega$	$V_{\text{GS}} = 10\text{V}$, $I_D = 195\text{A}$ ⑤
$V_{\text{GS}(\text{th})}$	Gate Threshold Voltage	2.0	—	4.0	V	$V_{\text{DS}} = V_{\text{GS}}$, $I_D = 250\mu\text{A}$
g_{fs}	Forward Transconductance	180	—	—	S	$V_{\text{DS}} = 10\text{V}$, $I_D = 195\text{A}$
R_G	Internal Gate Resistance	—	2.3	—	Ω	
I_{DSS}	Drain-to-Source Leakage Current	—	—	20	μA	$V_{\text{DS}} = 24\text{V}$, $V_{\text{GS}} = 0\text{V}$
		—	—	250	μA	$V_{\text{DS}} = 24\text{V}$, $V_{\text{GS}} = 0\text{V}$, $T_J = 125^\circ\text{C}$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	200	nA	$V_{\text{GS}} = 20\text{V}$
	Gate-to-Source Reverse Leakage	—	—	-200	nA	$V_{\text{GS}} = -20\text{V}$

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

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
Q_g	Total Gate Charge	—	160	240	nC	$I_D = 195\text{A}$
Q_{gs}	Gate-to-Source Charge	—	84	—		$V_{\text{DS}} = 12\text{V}$
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	49	—		$V_{\text{GS}} = 10\text{V}$ ⑤
Q_{sync}	Total Gate Charge Sync. ($Q_g - Q_{\text{gd}}$)	—	76	—		$I_D = 195\text{A}$, $V_{\text{DS}} = 0\text{V}$, $V_{\text{GS}} = 10\text{V}$
$t_{\text{d}(\text{on})}$	Turn-On Delay Time	—	17	—	ns	$V_{\text{DD}} = 16\text{V}$
t_r	Rise Time	—	190	—		$I_D = 195\text{A}$
$t_{\text{d}(\text{off})}$	Turn-Off Delay Time	—	83	—		$R_G = 2.7\Omega$
t_f	Fall Time	—	120	—		$V_{\text{GS}} = 10\text{V}$ ⑤
C_{iss}	Input Capacitance	—	7590	—	pF	$V_{\text{GS}} = 0\text{V}$
C_{oss}	Output Capacitance	—	3440	—		$V_{\text{DS}} = 24\text{V}$
C_{rss}	Reverse Transfer Capacitance	—	1960	—		$f = 1.0\text{ MHz}$, See Fig. 5
C_{oss} eff. (ER)	Effective Output Capacitance (Energy Related)	—	4700	—		$V_{\text{GS}} = 0\text{V}$, $V_{\text{DS}} = 0\text{V}$ to 19V ⑦, See Fig. 11
C_{oss} eff. (TR)	Effective Output Capacitance (Time Related)	—	4490	—		$V_{\text{GS}} = 0\text{V}$, $V_{\text{DS}} = 0\text{V}$ to 19V ⑥

Diode Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	353①	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode) ②	—	—	1412		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}$, $I_S = 195\text{A}$, $V_{\text{GS}} = 0\text{V}$ ⑤
t_{rr}	Reverse Recovery Time	—	46	—	ns	$T_J = 25^\circ\text{C}$ $V_R = 20\text{V}$,
		—	71	—		$T_J = 125^\circ\text{C}$ $I_F = 195\text{A}$
Q_{rr}	Reverse Recovery Charge	—	160	—	nC	$T_J = 25^\circ\text{C}$ $\text{di}/\text{dt} = 100\text{A}/\mu\text{s}$ ⑤
		—	430	—		$T_J = 125^\circ\text{C}$
I_{RRM}	Reverse Recovery Current	—	7.7	—	A	$T_J = 25^\circ\text{C}$
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)				

Notes:

① Calculated continuous current based on maximum allowable junction temperature Bond wire current limit is 195A. Note that current limitation arising from heating of the device leads may occur with some lead mounting arrangements.

② Repetitive rating; pulse width limited by max. junction temperature.

③ Limited by T_{Jmax} , starting $T_J = 25^\circ\text{C}$, $L = 0.014\text{mH}$
 $R_G = 25\Omega$, $I_{AS} = 195\text{A}$, $V_{\text{GS}} = 10\text{V}$. Part not recommended for use above this value.

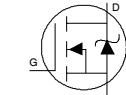
④ $I_{\text{SD}} \leq 195\text{A}$, $\text{di}/\text{dt} \leq 450\text{ A}/\mu\text{s}$, $V_{\text{DD}} \leq V_{(\text{BR})\text{DSS}}$, $T_J \leq 175^\circ\text{C}$.

⑤ Pulse width $\leq 400\mu\text{s}$; duty cycle $\leq 2\%$.

⑥ C_{oss} eff. (TR) is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .

⑦ C_{oss} eff. (ER) is a fixed capacitance that gives the same energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .

⑧ R_θ is measured at T_J approximately 90°C

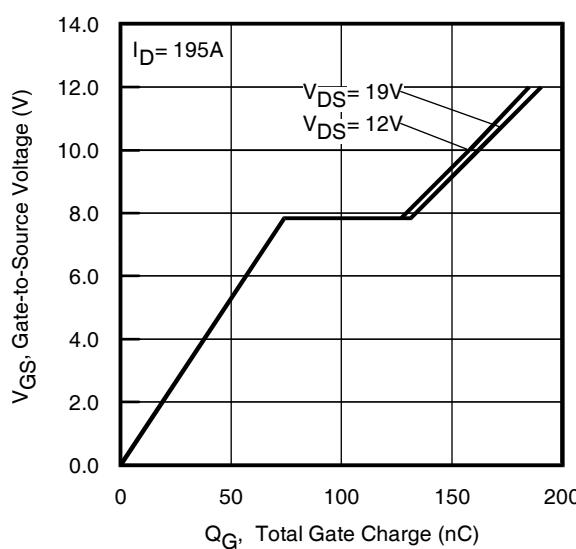
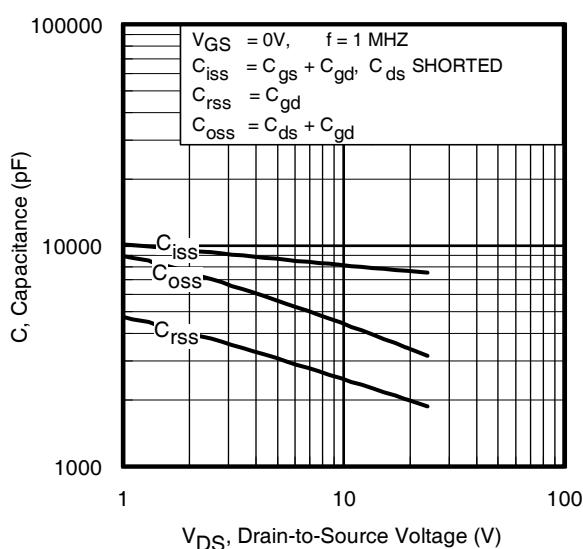
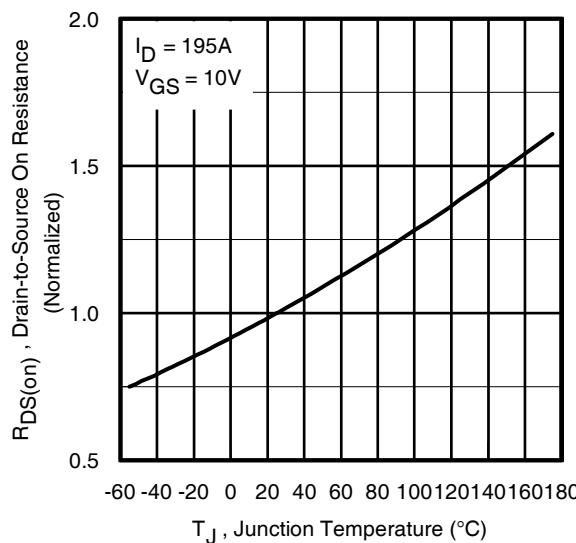
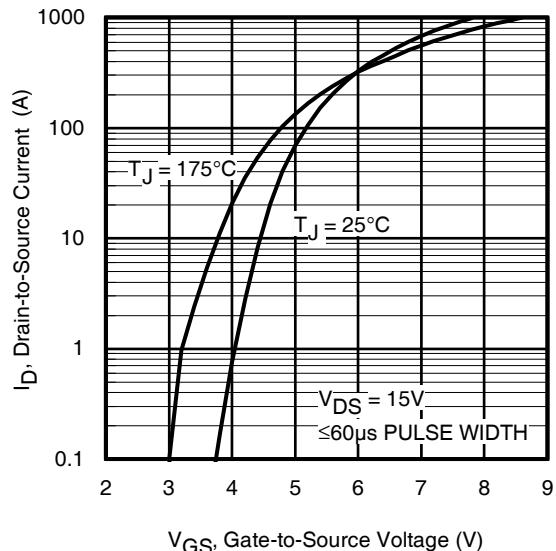
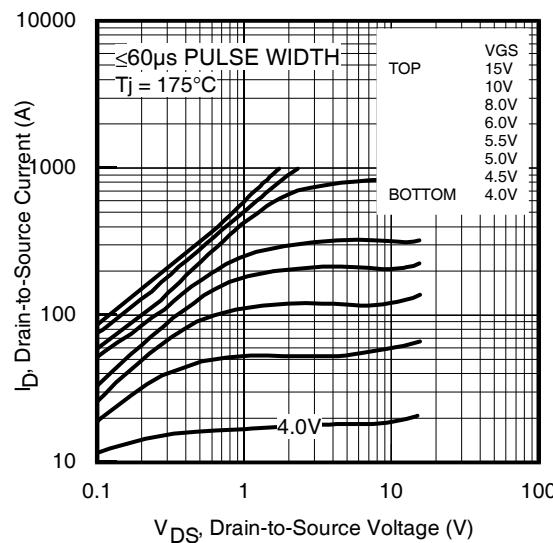
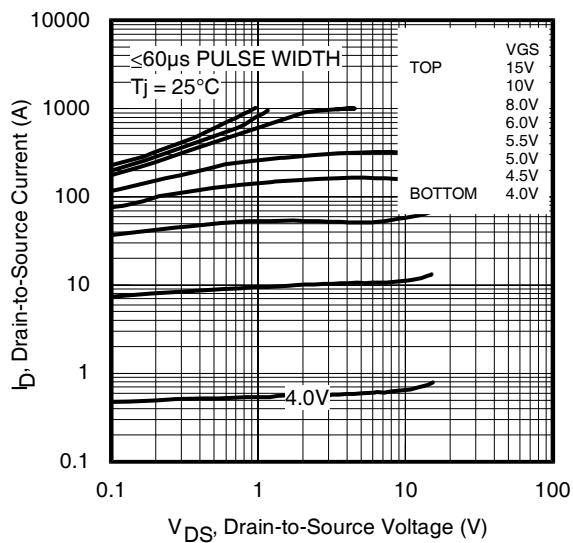


Qualification Information[†]

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	D2Pak	MSL1
	TO-262	N/A
ESD	Machine Model	Class M4 AEC-Q101-002
	Human Body Model	Class H3A AEC-Q101-001
	Charged Device Model	Class C5 AEC-Q101-005
RoHS Compliant		Yes

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

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



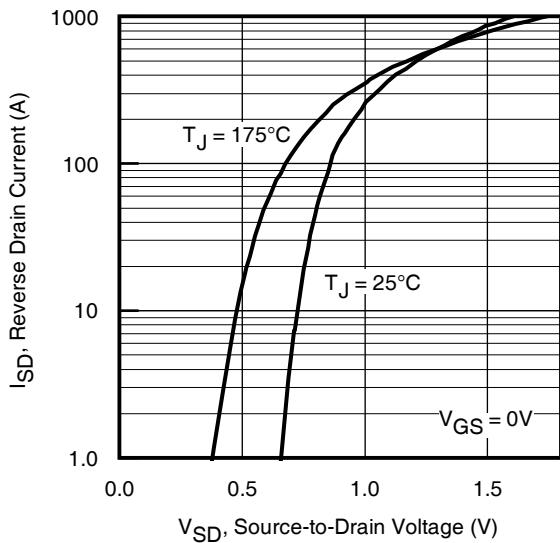


Fig 7. Typical Source-Drain Diode Forward Voltage

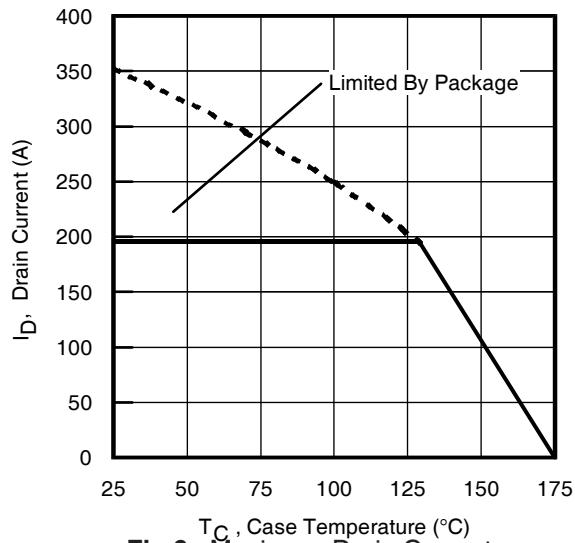


Fig 9. Maximum Drain Current vs. Case Temperature

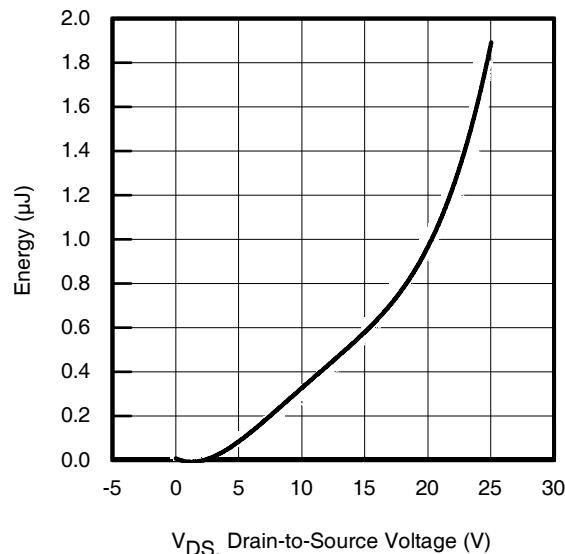


Fig 11. Typical Coss Stored Energy

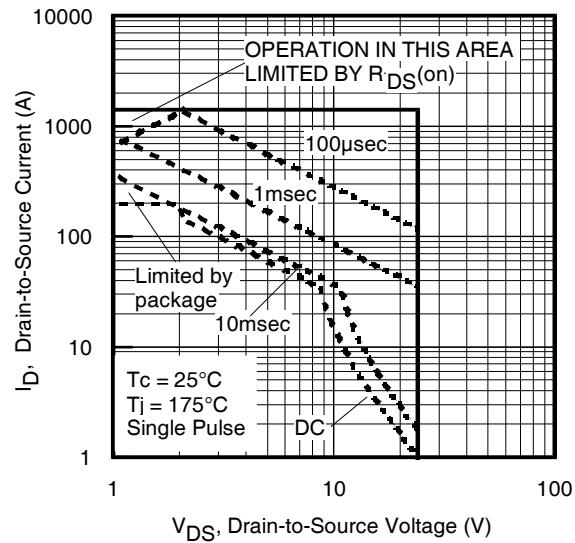


Fig 8. Maximum Safe Operating Area

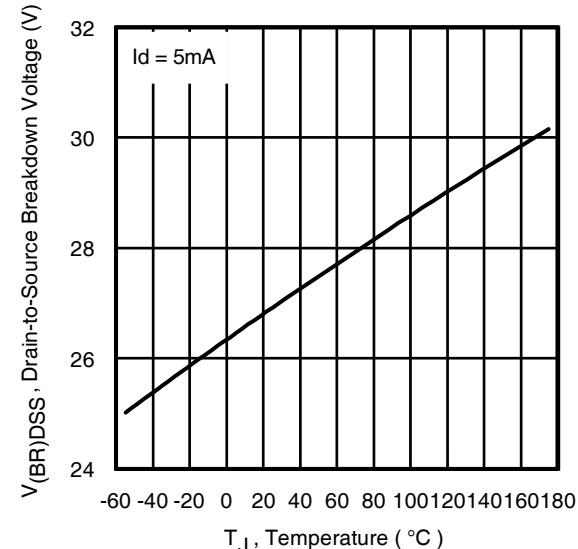


Fig 10. Drain-to-Source Breakdown Voltage

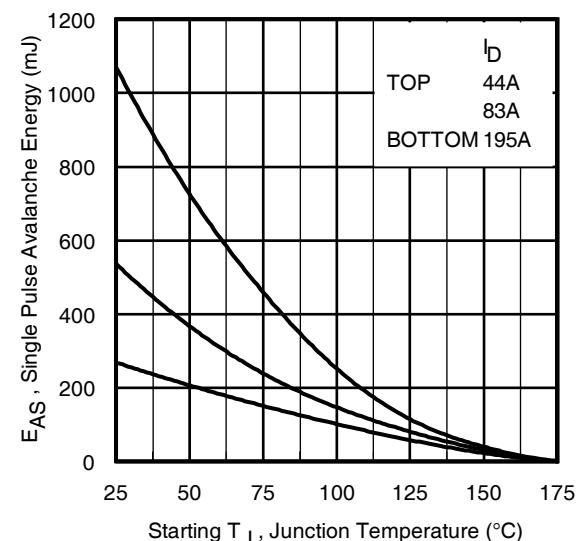


Fig 12. Maximum Avalanche Energy vs. Drain Current

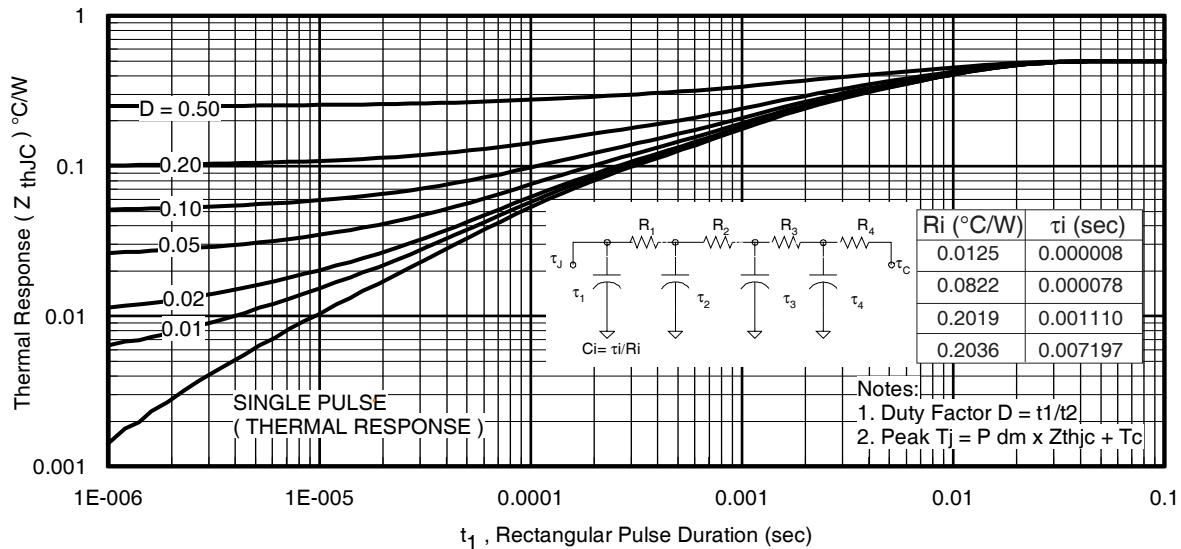


Fig 13. Maximum Effective Transient Thermal Impedance, Junction-to-Case

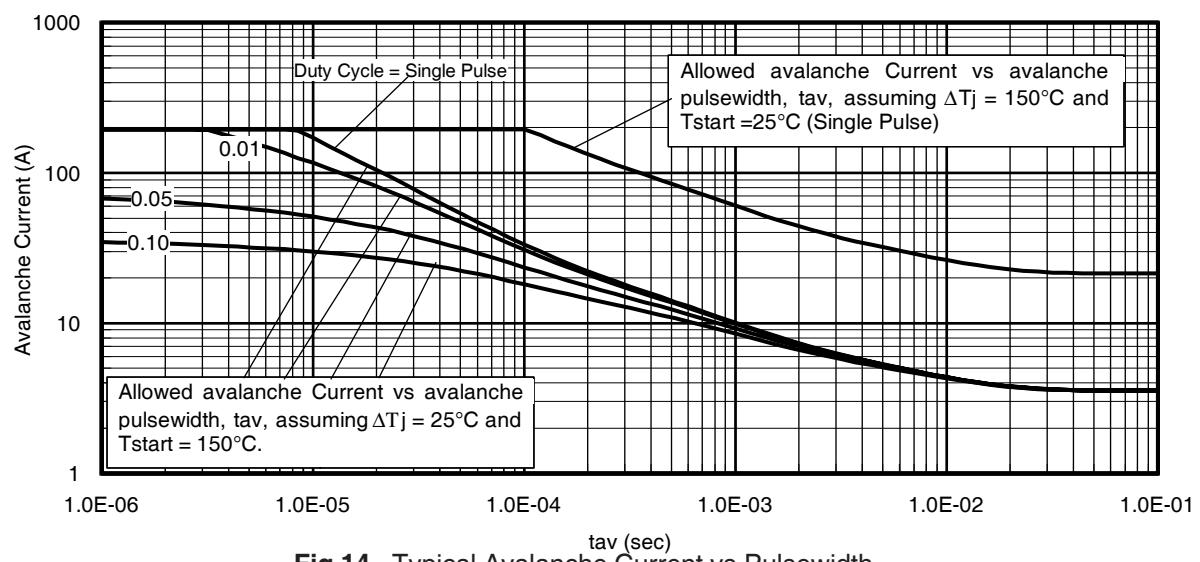


Fig 14. Typical Avalanche Current vs. Pulsewidth

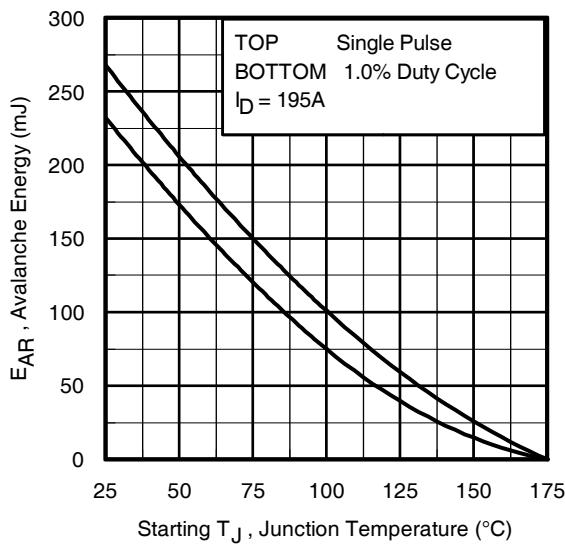


Fig 15. Maximum Avalanche Energy vs. Temperature

Notes on Repetitive Avalanche Curves , Figures 14, 15:
(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 16a, 16b.
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 14, 15).

t_{av} = Average time in avalanche.
 D = Duty cycle in avalanche = $t_{av} \cdot f$
 $Z_{thJC}(D, t_{av})$ = Transient thermal resistance, see Figures 13)

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

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

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

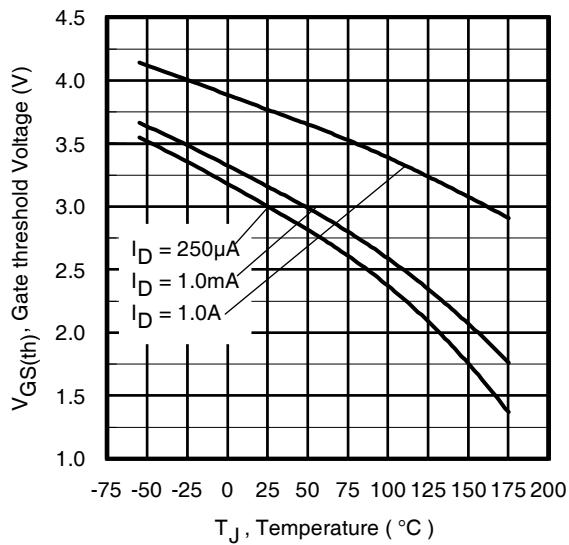


Fig 16. Threshold Voltage vs. Temperature

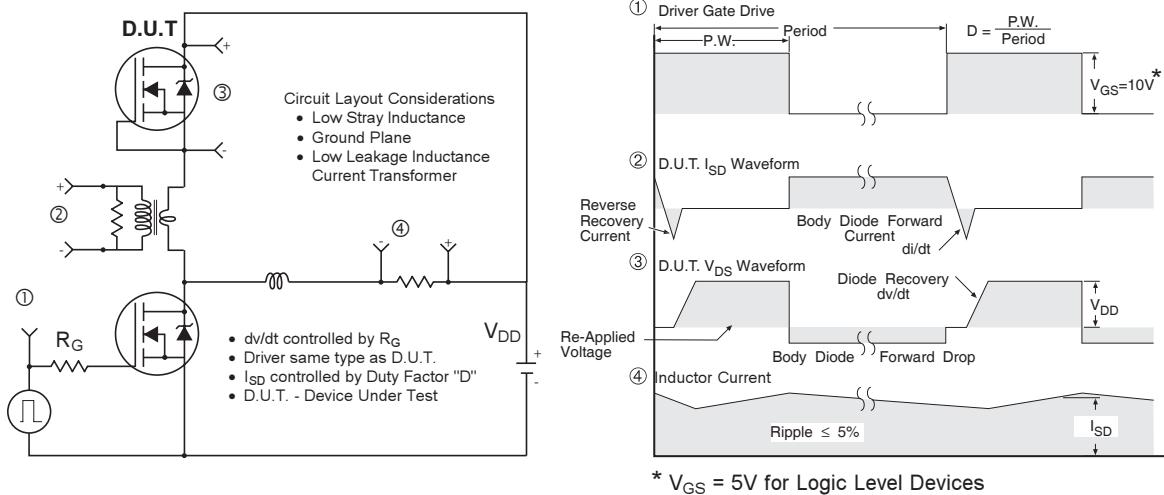


Fig 21. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

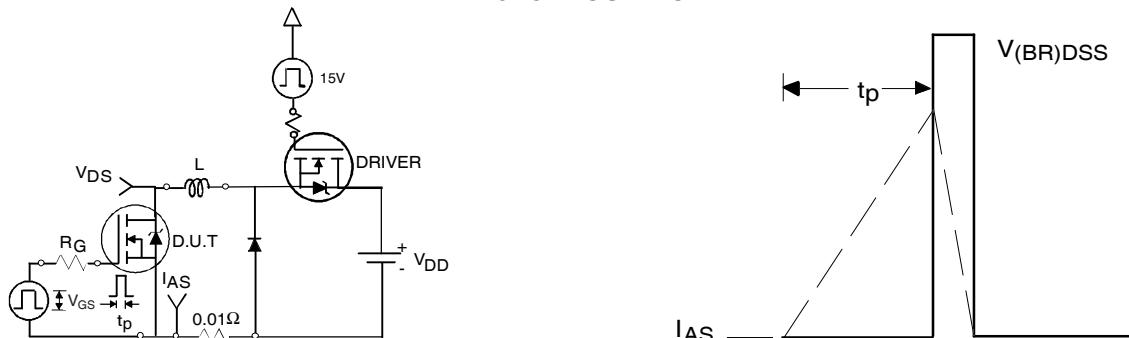


Fig 22a. Unclamped Inductive Test Circuit

Fig 22b. Unclamped Inductive Waveforms

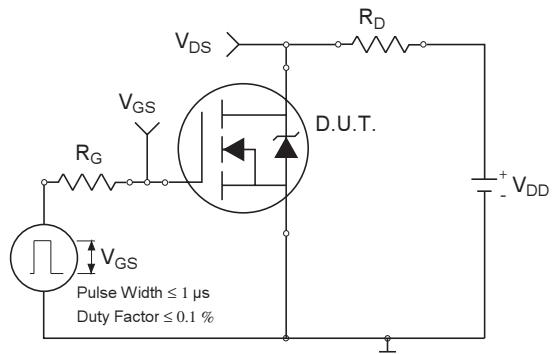


Fig 23a. Switching Time Test Circuit

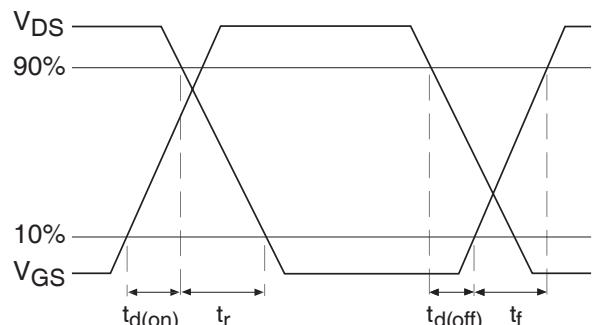


Fig 23b. Switching Time Waveforms

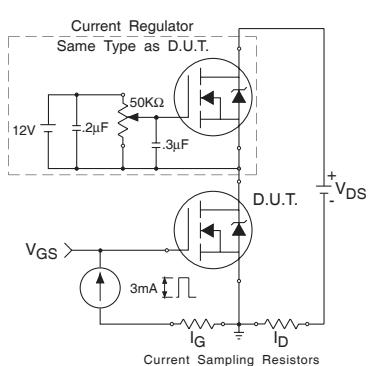


Fig 24a. Gate Charge Test Circuit

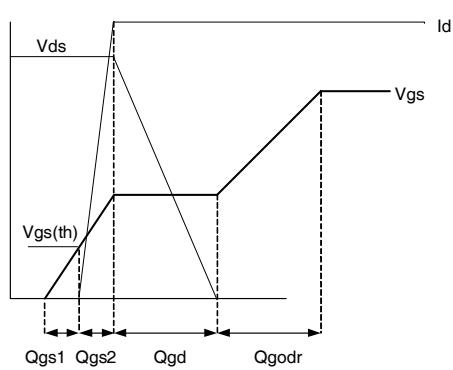
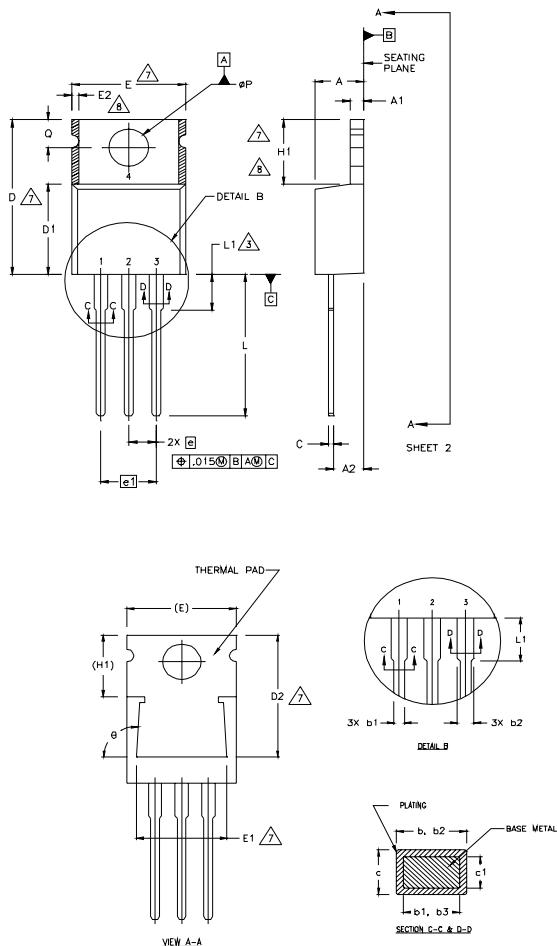


Fig 24b. Gate Charge Waveform

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" (.127) PER SIDE. THESE DIMENSIONS ARE
MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
DIMENSION b1 & c1 APPLY TO BASE METAL ONLY.
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.

LEAD ASSIGNMENTS

HEXFET

IGBTs, CoPACK

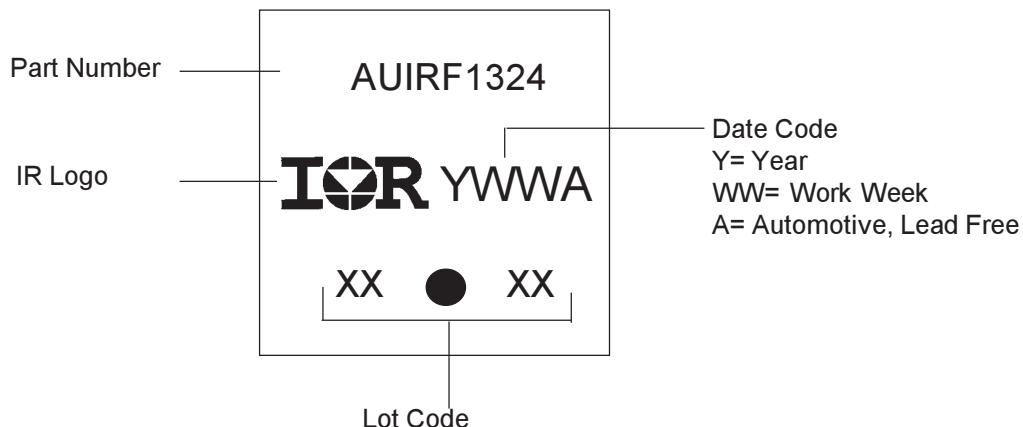
1. - GATE
2. - COLLECTOR
3. - Emitter

DIODES

- 1.- ANODE/OPEN
- 2.- CATHODE
- 3.- ANODE

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°			

TO-220AB Part Marking Information



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

Ordering Information

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