

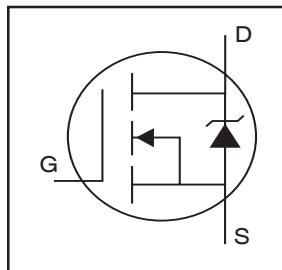
AUTOMOTIVE GRADE

**AUIRF1324**

HEXFET® Power MOSFET

**Features**

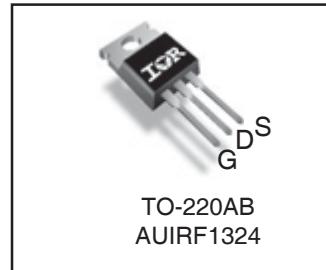
- Advanced Process Technology
- Ultra Low On-Resistance
- 175°C Operating Temperature
- Fast Switching
- Repetitive Avalanche Allowed up to  $T_{jmax}$
- Lead-Free, RoHS Compliant
- Automotive Qualified \*



$V_{DSS}$	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
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$ (Silicon Limited)	353 ①	A
$I_D @ T_C = 100^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$ (Silicon Limited)	249 ①	
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$ (Package Limited)	195	
$I_{DM}$	Pulsed Drain Current ②	1412	
$P_D @ T_C = 25^\circ C$	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) 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	°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	°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)**

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

**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	—		$V_{DS} = 12V$
$Q_{gd}$	Gate-to-Drain ("Miller") Charge	—	49	—		$V_{GS} = 10V$ ⑤
$Q_{\text{sync}}$	Total Gate Charge Sync. ( $Q_g - Q_{gd}$ )	—	76	—		$I_D = 195\text{A}, V_{DS} = 0V, V_{GS} = 10V$
$t_{d(on)}$	Turn-On Delay Time	—	17	—	ns	$V_{DD} = 16V$
$t_r$	Rise Time	—	190	—		$I_D = 195\text{A}$
$t_{d(off)}$	Turn-Off Delay Time	—	83	—		$R_G = 2.7\Omega$
$t_f$	Fall Time	—	120	—		$V_{GS} = 10V$ ⑤
$C_{iss}$	Input Capacitance	—	7590	—	pF	$V_{GS} = 0V$
$C_{oss}$	Output Capacitance	—	3440	—		$V_{DS} = 24V$
$C_{rss}$	Reverse Transfer Capacitance	—	1960	—		$f = 1.0 \text{ MHz, See Fig. 5}$
$C_{oss \text{ eff. (ER)}}$	Effective Output Capacitance (Energy Related)	—	4700	—		$V_{GS} = 0V, V_{DS} = 0V \text{ to } 19V$ ⑦, See Fig. 11
$C_{oss \text{ eff. (TR)}}$	Effective Output Capacitance (Time Related)	—	4490	—		$V_{GS} = 0V, V_{DS} = 0V \text{ to } 19V$ 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	$T_J = 25^\circ\text{C}, I_S = 195\text{A}, V_{GS} = 0V$ ⑤
$t_{rr}$	Reverse Recovery Time	—	46	—	ns	$T_J = 25^\circ\text{C}$ $V_R = 20V$ , $I_F = 195\text{A}$
		—	71	—		$T_J = 125^\circ\text{C}$
$Q_{rr}$	Reverse Recovery Charge	—	160	—	nC	$T_J = 25^\circ\text{C}$ $\text{di/dt} = 100\text{A}/\mu\text{s}$ 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:**

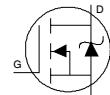
- ① Calculated continuous current based on maximum allowable junction temperature Bond wire current limit is 195A. Note that current limitation arising from heating of the device leads may occur with some lead mounting arrangements.
- ② Repetitive rating; pulse width limited by max. junction temperature.
- ③ Limited by  $T_{J\text{max}}$ , starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.014\text{mH}$   $R_G = 25\Omega$ ,  $I_{AS} = 195\text{A}$ ,  $V_{GS} = 10V$ . Part not recommended for use above this value .
- ④  $I_{SD} \leq 195\text{A}$ ,  $\text{di/dt} \leq 450 \text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{(\text{BR})\text{DSS}}$ ,  $T_J \leq 175^\circ\text{C}$ .

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

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

⑧  $R_\theta$  is measured at  $T_J$  approximately  $90^\circ\text{C}$

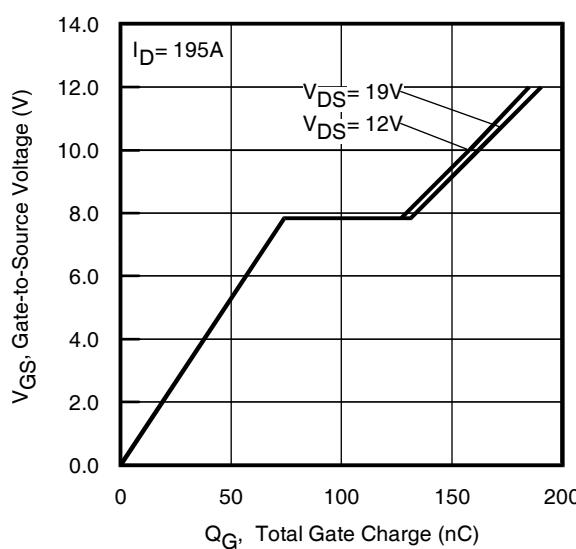
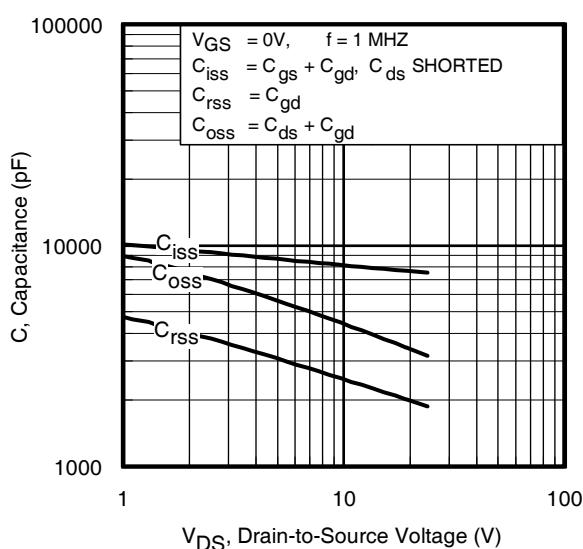
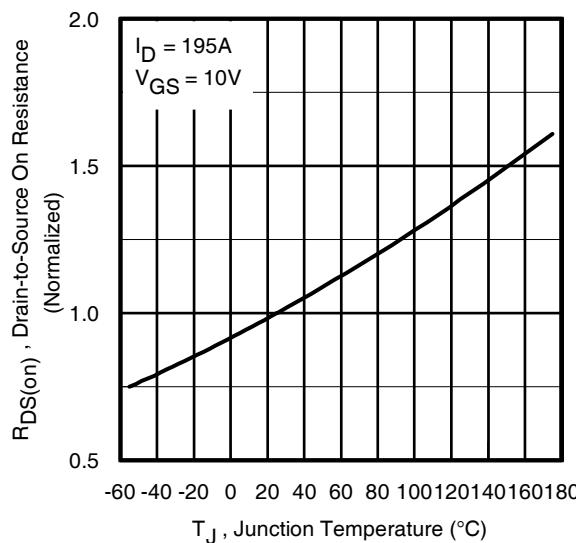
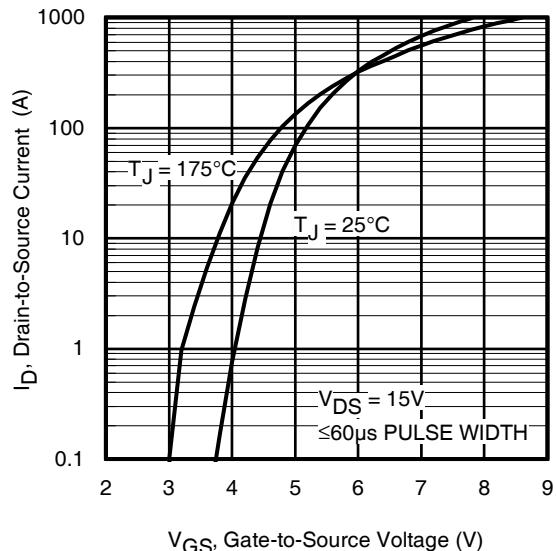
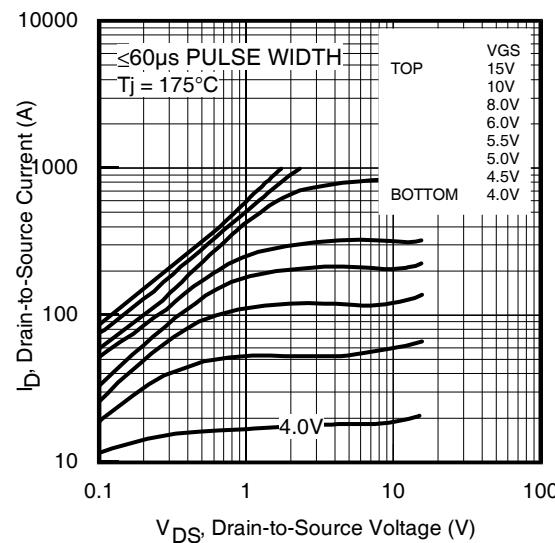
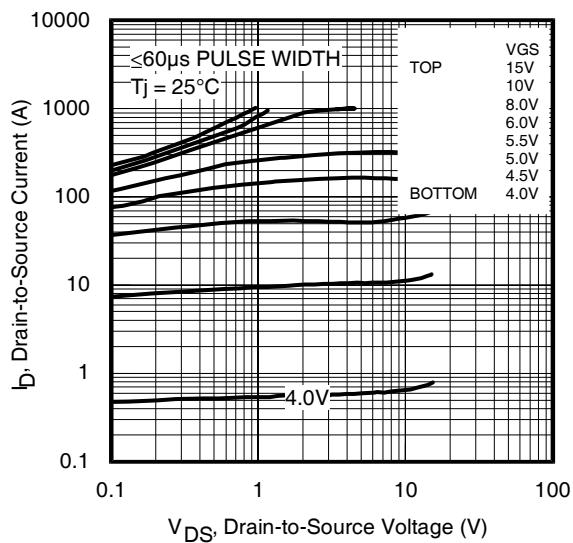


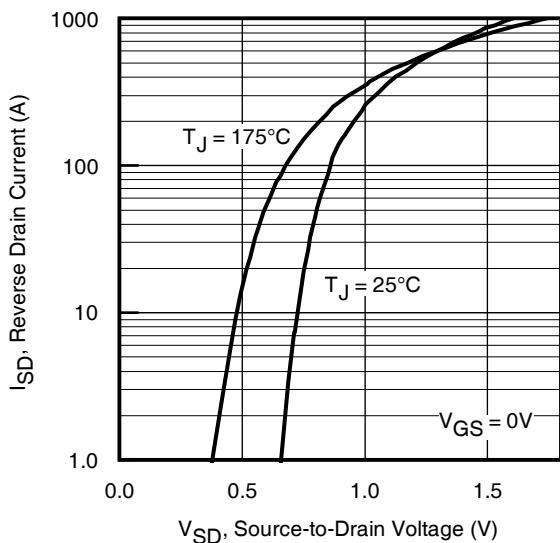
**Qualification Information<sup>†</sup>**

		Automotive (per AEC-Q101) <sup>††</sup>	
<b>Qualification Level</b>		Comments: This part number(s) passed Automotive qualification. IR's Industrial and Consumer qualification level is granted by extension of the higher Automotive level.	
<b>Moisture Sensitivity Level</b>	D2Pak	MSL1	
	TO-262	N/A	
<b>ESD</b>	Machine Model	Class M4 AEC-Q101-002	
	Human Body Model	Class H3A AEC-Q101-001	
	Charged Device Model	Class C5 AEC-Q101-005	
<b>RoHS Compliant</b>		Yes	

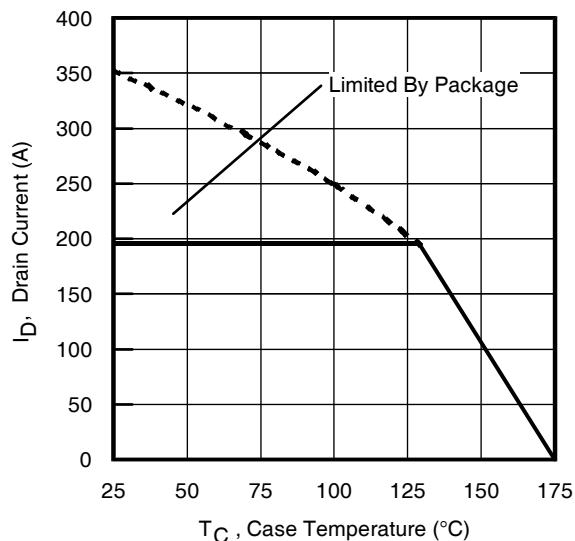
<sup>†</sup> Qualification standards can be found at International Rectifier's web site: <http://www.irf.com/>

<sup>††</sup> Exceptions to AEC-Q101 requirements are noted in the qualification report.

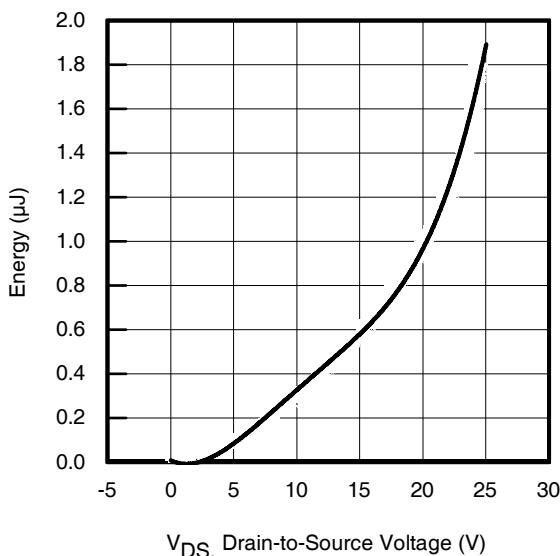




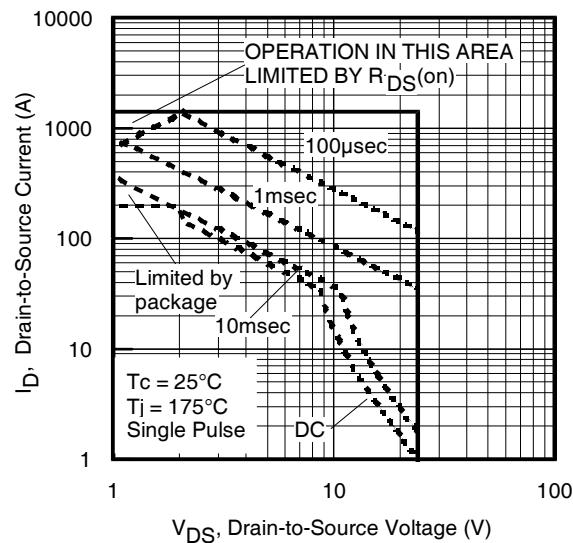
**Fig 7.** Typical Source-Drain Diode Forward Voltage



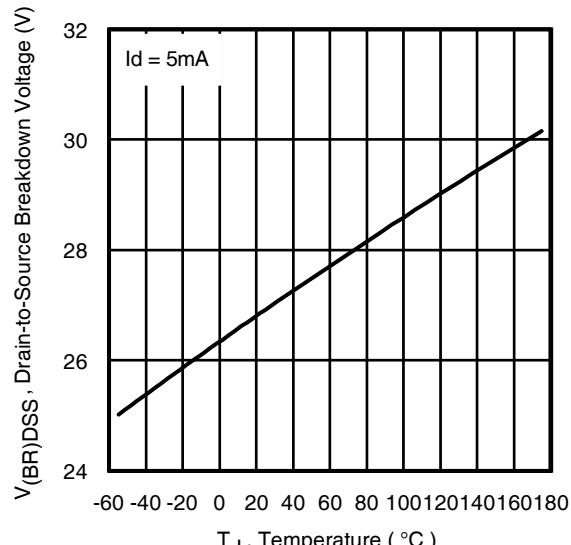
**Fig 9.** Maximum Drain Current vs. Case Temperature



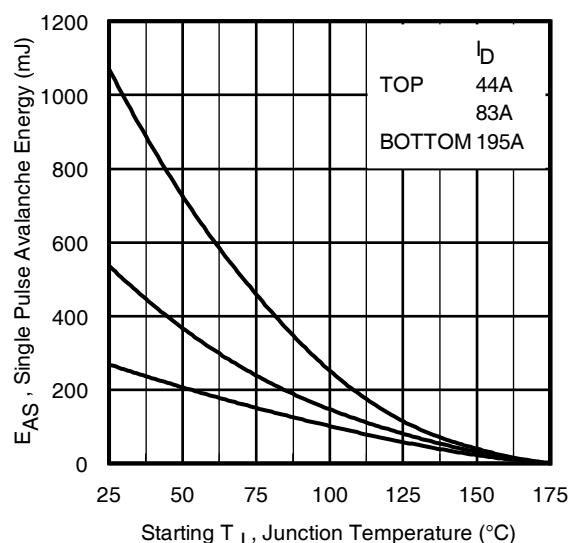
**Fig 11.** Typical Coss Stored Energy



**Fig 8.** Maximum Safe Operating Area



**Fig 10.** Drain-to-Source Breakdown Voltage



**Fig 12.** Maximum Avalanche Energy vs. Drain Current

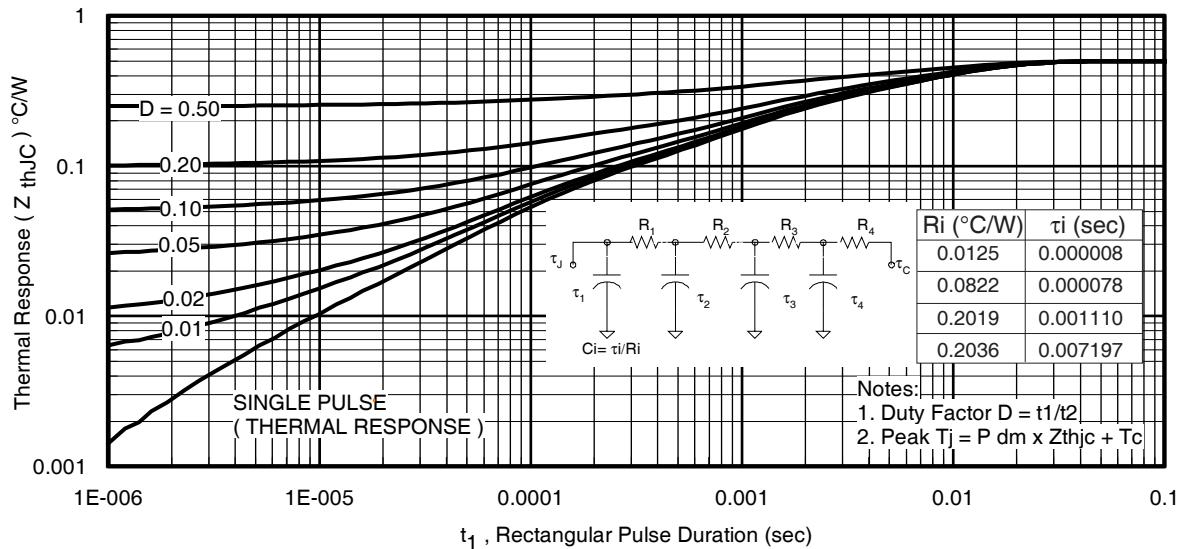


Fig 13. Maximum Effective Transient Thermal Impedance, Junction-to-Case

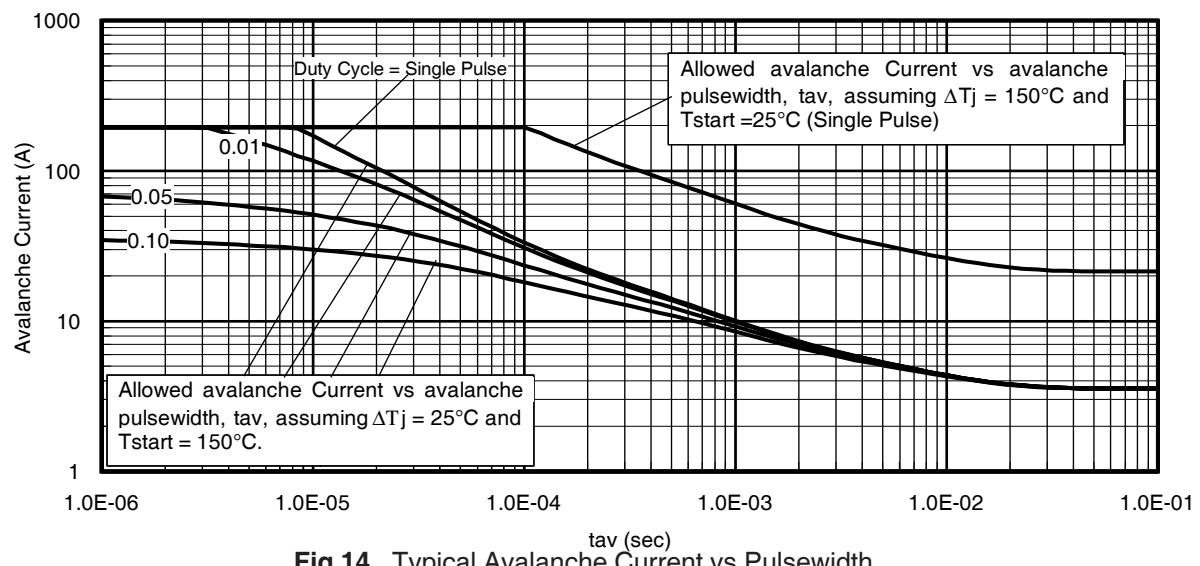
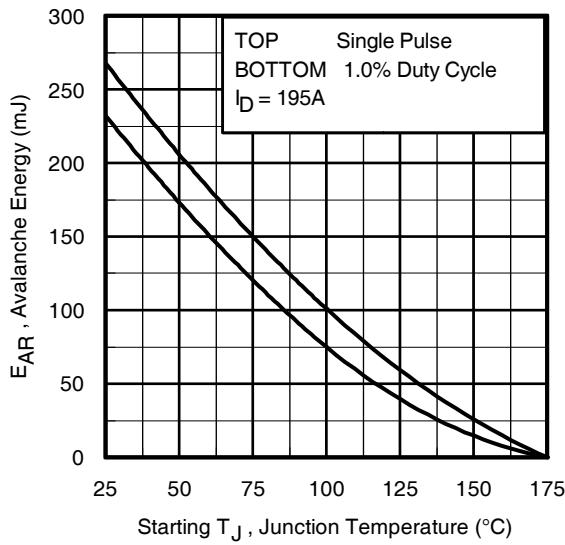


Fig 14. Typical Avalanche Current vs. Pulsewidth



**Fig 15.** Maximum Avalanche Energy vs. Temperature

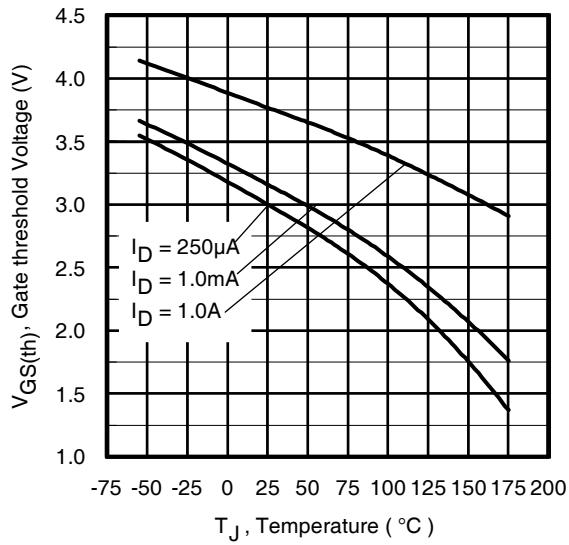
**Notes on Repetitive Avalanche Curves , Figures 14, 15:**  
(For further info, see AN-1005 at [www.irf.com](http://www.irf.com))

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.  $\Delta T$  = 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)

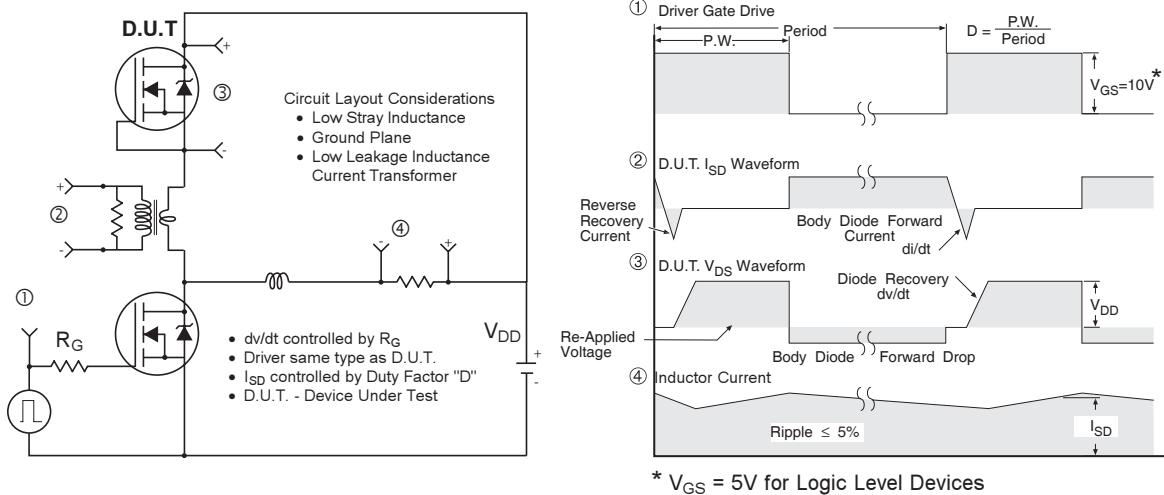
$$P_{D(ave)} = 1/2 (1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$$

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

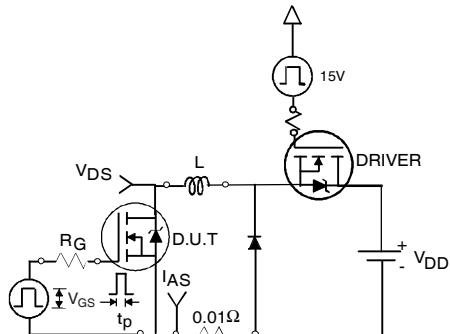
$$E_{AS(AR)} = P_{D(ave)} \cdot t_{av}$$



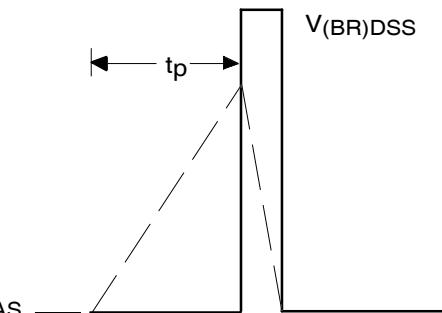
**Fig 16.** Threshold Voltage vs. Temperature



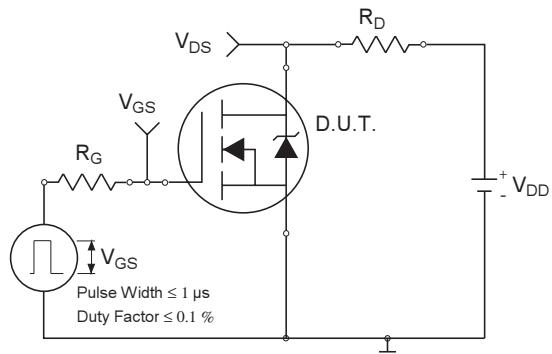
**Fig 21.** Peak Diode Recovery  $dv/dt$  Test Circuit for N-Channel HEXFET® Power MOSFETs



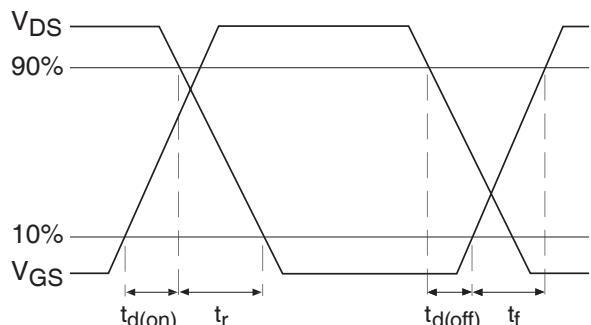
**Fig 22a.** Unclamped Inductive Test Circuit



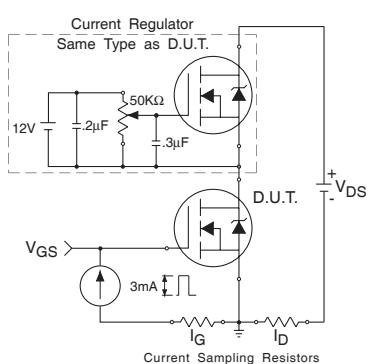
**Fig 22b.** Unclamped Inductive Waveforms



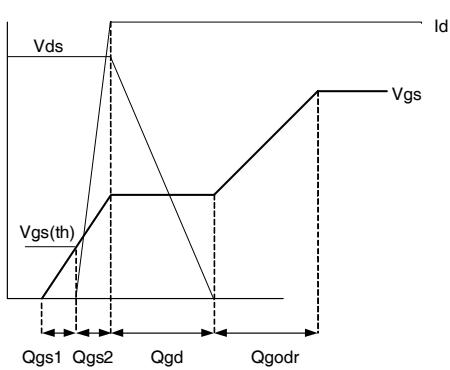
**Fig 23a.** Switching Time Test Circuit



**Fig 23b.** Switching Time Waveforms



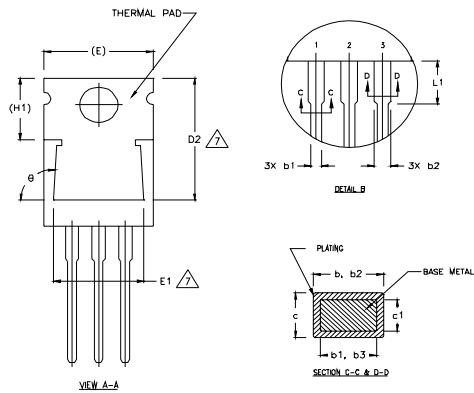
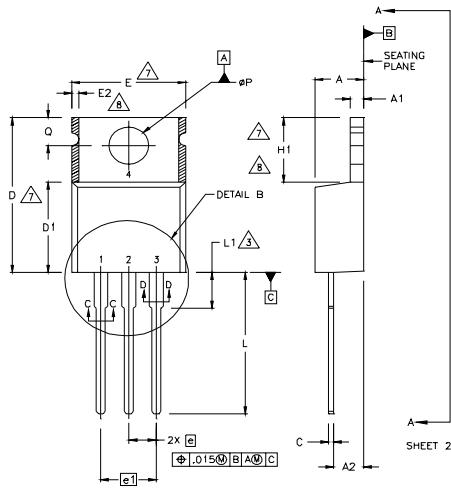
**Fig 24a.** Gate Charge Test Circuit



**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.
- 5 DIMENSION b1 & c1 APPLY TO BASE METAL ONLY.
- 6 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

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

#### IGBTs...CoPACK

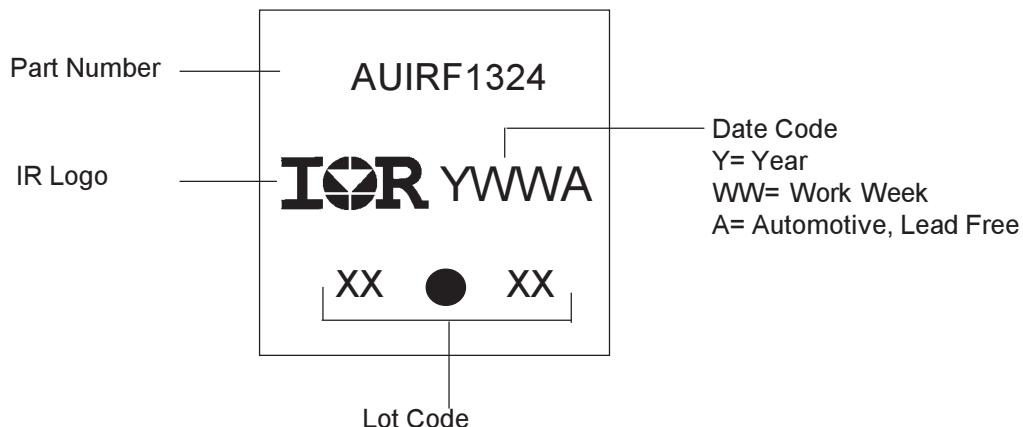
- 1.- GATE
- 2.- COLLECTOR
- 3.- Emitter

#### 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		
L	12.70	14.73	.500	.580		
L1	-	6.35	-	.250		
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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<http://www.irf.com/technical-info/>

### WORLD HEADQUARTERS:

233 Kansas St., El Segundo, California 90245

Tel: (310) 252-7105

ООО "ЛайфЭлектроникс"

"LifeElectronics" LLC

ИНН 7805602321 КПП 780501001 Р/С 40702810122510004610 ФАКБ "АБСОЛЮТ БАНК" (ЗАО) в г.Санкт-Петербурге К/С 30101810900000000703 БИК 044030703

Компания «Life Electronics» занимается поставками электронных компонентов импортного и отечественного производства от производителей и со складов крупных дистрибуторов Европы, Америки и Азии.

С конца 2013 года компания активно расширяет линейку поставок компонентов по направлению коаксиальный кабель, кварцевые генераторы и конденсаторы (керамические, пленочные, электролитические), за счёт заключения дистрибуторских договоров

Мы предлагаем:

- Конкурентоспособные цены и скидки постоянным клиентам.
- Специальные условия для постоянных клиентов.
- Подбор аналогов.
- Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.
- Приемлемые сроки поставки, возможна ускоренная поставка.
- Доставку товара в любую точку России и стран СНГ.
- Комплексную поставку.
- Работу по проектам и поставку образцов.
- Формирование склада под заказчика.
- Сертификаты соответствия на поставляемую продукцию (по желанию клиента).
- Тестирование поставляемой продукции.
- Поставку компонентов, требующих военную и космическую приемку.
- Входной контроль качества.
- Наличие сертификата ISO.

В составе нашей компании организован Конструкторский отдел, призванный помочь разработчикам, и инженерам.

Конструкторский отдел помогает осуществить:

- Регистрацию проекта у производителя компонентов.
- Техническую поддержку проекта.
- Защиту от снятия компонента с производства.
- Оценку стоимости проекта по компонентам.
- Изготовление тестовой платы монтаж и пусконаладочные работы.



Тел: +7 (812) 336 43 04 (многоканальный)  
Email: org@lifeelectronics.ru