

Features

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

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 wide variety of other applications.

Applications

- Electric Power Steering (EPS)
- Battery Switch
- Start/Stop Micro Hybrid
- Heavy Loads
- DC-DC Applications

Ordering Information

Base part number	Package Type	Standard Pack		Complete Part Number
		Form	Quantity	
AUIRFB8407	TO-220	Tube	50	AUIRFB8407
AUIRFSL8407	TO-262	Tube	50	AUIRFSL8407
AUIRFS8407	D2Pak	Tube	50	AUIRFS8407
AUIRFS8407	D2Pak	Tape and Reel Left	800	AUIRFS8407TRL

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.

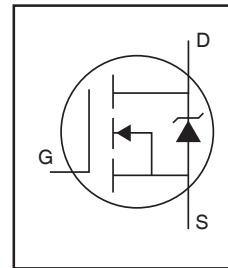
Symbol	Parameter	Max.	Units
I _D @ T _C = 25°C	Continuous Drain Current, V _{GS} @ 10V (Silicon Limited)	250①	A
I _D @ T _C = 100°C	Continuous Drain Current, V _{GS} @ 10V (Silicon Limited)	180	
I _D @ T _C = 25°C	Continuous Drain Current, V _{GS} @ 10V (Wire Bond Limited)	195	
I _{DM}	Pulsed Drain Current ②	1000③	
P _D @ T _C = 25°C	Maximum Power Dissipation	230	W
	Linear Derating Factor	1.5	W/°C
V _{GS}	Gate-to-Source Voltage	± 20	V
T _J	Operating Junction and Storage Temperature Range	-55 to + 175	°C
T _{STG}			
	Mounting torque, 6-32 or M3 screw	10lbf·in (1.1N·m)	

Avalanche Characteristics

E _{AS} (Thermally limited)	Single Pulse Avalanche Energy ③	350	mJ
E _{AS} (tested)	Single Pulse Avalanche Energy Tested Value ③	500	
I _{AR}	Avalanche Current ②	See Fig. 14, 15, 22a, 22b	A
E _{AR}	Repetitive Avalanche Energy ②		mJ

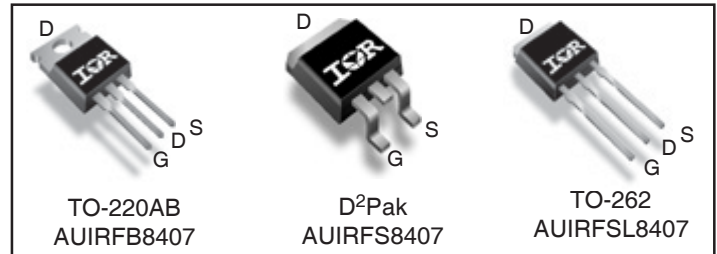
HEXFET® is a registered trademark of International Rectifier.

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



HEXFET® Power MOSFET

V _{DS}		40V
R _{DS(on)}	typ.	1.4mΩ
	(SMD version) max.	1.8mΩ
I _D (Silicon Limited)		250A①
I _D (Package Limited)		195A



G	D	S
Gate	Drain	Source

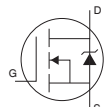
Static @ T_J = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
V _{(BR)DSS}	Drain-to-Source Breakdown Voltage	40	—	—	V	V _{GS} = 0V, I _D = 250μA
ΔV _{(BR)DSS} /ΔT _J	Breakdown Voltage Temp. Coefficient	—	0.029	—	V/°C	Reference to 25°C, I _D = 1mA ^②
R _{DS(on)} SMD	Static Drain-to-Source On-Resistance	—	1.4	1.8	mΩ	V _{GS} = 10V, I _D = 100A
R _{DS(on)} TO-220		—	1.6	2.0		V _{GS} = 10V, I _D = 100A
V _{GS(th)}	Gate Threshold Voltage	2.0	3.0	4.0	V	V _{DS} = V _{GS} , I _D = 150μA
I _{DSS}	Drain-to-Source Leakage Current	—	—	1.0	μA	V _{DS} = 40V, V _{GS} = 0V
		—	—	150		V _{DS} = 40V, V _{GS} = 0V, T _J = 125°C
I _{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	V _{GS} = 20V
	Gate-to-Source Reverse Leakage	—	—	-100		V _{GS} = -20V
R _G	Internal Gate Resistance	—	2.2	—	Ω	

Dynamic @ T_J = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
g _{fs}	Forward Transconductance	160	—	—	S	V _{DS} = 10V, I _D = 100A
Q _g	Total Gate Charge	—	150	225	nC	I _D = 100A
Q _{gs}	Gate-to-Source Charge	—	41	—		V _{DS} = 20V
Q _{gd}	Gate-to-Drain ("Miller") Charge	—	51	—		V _{GS} = 10V ^⑤
Q _{sync}	Total Gate Charge Sync. (Q _g - Q _{gd})	—	99	—		I _D = 100A, V _{DS} = 20V, V _{GS} = 10V
t _{d(on)} SMD	Turn-On Delay Time	—	19	—	ns	V _{DD} = 20V
t _r	Rise Time	—	70	—		I _D = 30A
t _{d(off)}	Turn-Off Delay Time	—	78	—		R _G = 2.7Ω
t _f	Fall Time	—	53	—		V _{GS} = 10V ^⑤
C _{iss}	Input Capacitance	—	7330	—	pF	V _{GS} = 0V
C _{oss}	Output Capacitance	—	1095	—		V _{DS} = 25V
C _{rss}	Reverse Transfer Capacitance	—	745	—		f = 1.0 MHz, See Fig. 5
C _{oss} eff. (ER)	Effective Output Capacitance (Energy Related) ^⑦	—	1310	—		V _{GS} = 0V, V _{DS} = 0V to 32V ^⑦ , See Fig. 11
C _{oss} eff. (TR)	Effective Output Capacitance (Time Related) ^⑧	—	1735	—		V _{GS} = 0V, V _{DS} = 0V to 32V ^⑧

Diode Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
I _S	Continuous Source Current (Body Diode)	—	—	250 ^①	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I _{SM}	Pulsed Source Current (Body Diode) ^②	—	—	1000 ^③	A	
V _{SD}	Diode Forward Voltage	—	1.0	1.3	V	T _J = 25°C, I _S = 100A, V _{GS} = 0V ^⑤
dv/dt	Peak Diode Recovery ^④	—	3.0	—	V/ns	T _J = 175°C, I _S = 100A, V _{DS} = 40V ^⑤
t _{rr}	Reverse Recovery Time	—	30	—	ns	T _J = 25°C V _R = 34V,
		—	30	—		T _J = 125°C I _F = 100A
Q _{rr}	Reverse Recovery Charge	—	24	—	nC	di/dt = 100A/μs ^⑤
		—	25	—		
I _{RRM}	Reverse Recovery Current	—	1.3	—	A	T _J = 25°C

Thermal Resistance

Symbol	Parameter	Typ.	Max.	Units
R _{θJC}	Junction-to-Case ^⑨	—	0.65	°C/W
R _{θCS}	Case-to-Sink, Flat Greased Surface, TO-220	0.50	—	
R _{θJA}	Junction-to-Ambient, TO-220 ^⑨	—	62	
R _{θJA}	Junction-to-Ambient (PCB Mount), D ² Pak ^⑧	—	40	

Qualification Information[†]

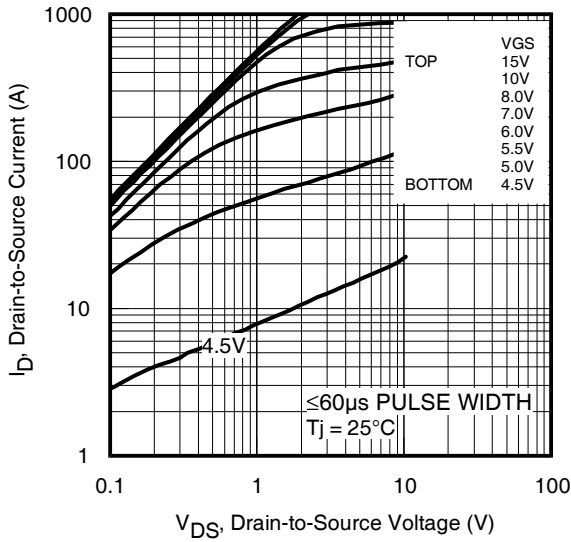
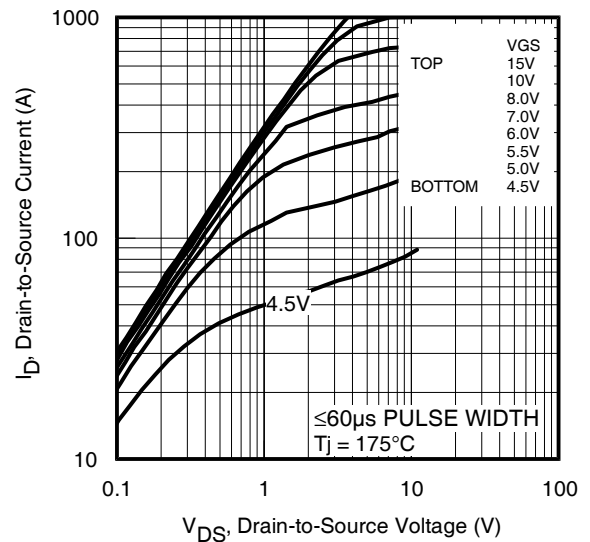
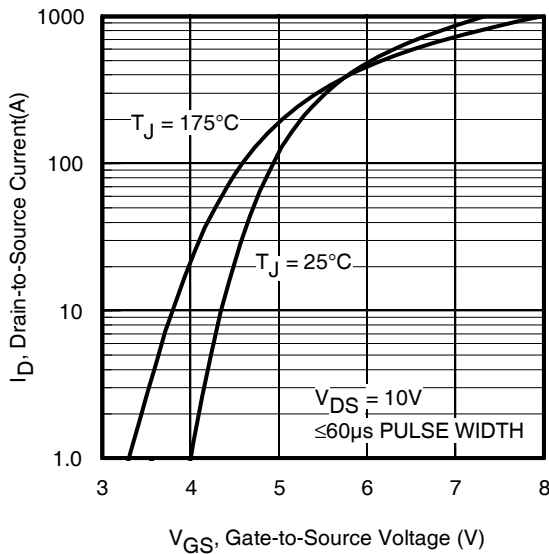
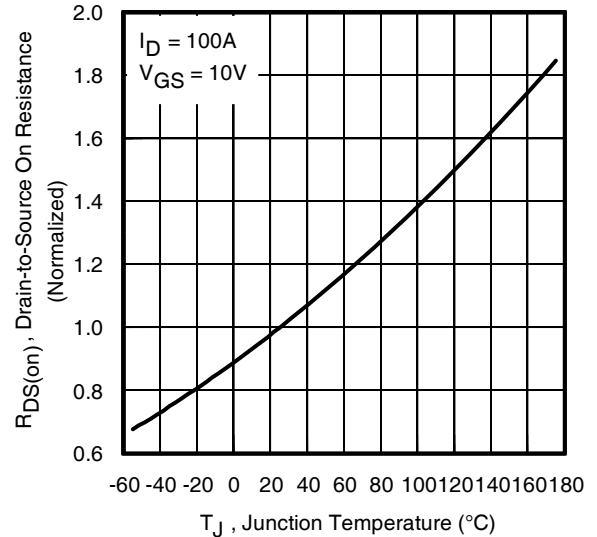
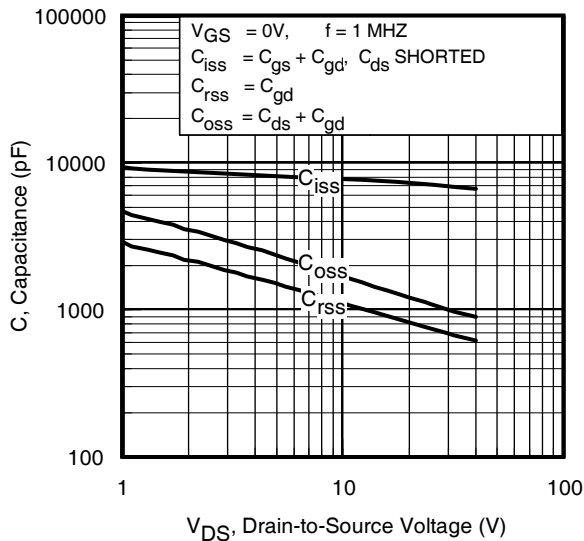
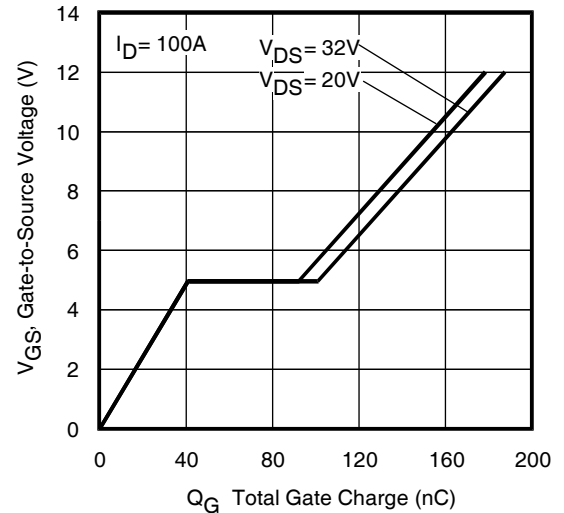
Qualification Level		Automotive (per AEC-Q101)	
		Comments: This part number(s) passed Automotive qualification. IR's Industrial and Consumer qualification level is granted by extension of the higher Automotive level.	
Moisture Sensitivity Level		D2 PAK	MSL1
		TO-262	
		TO-220	N/A
ESD	Machine Model	Class M4 (+/- 800V) ^{††} AEC-Q101-002	
	Human Body Model	Class H2 (+/- 4000V) ^{††} AEC-Q101-001	
	Charged Device Model	Class C5 (+/- 2000V) ^{††} AEC-Q101-005	
RoHS Compliant		Yes	

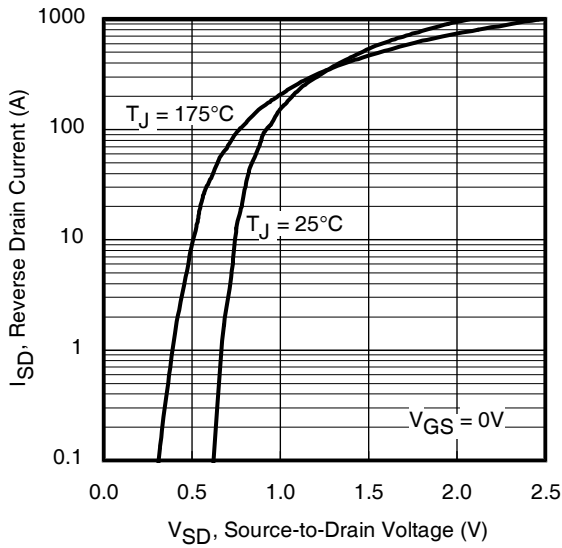
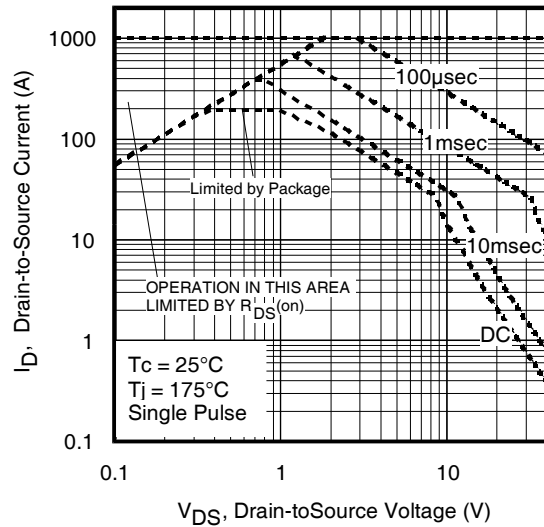
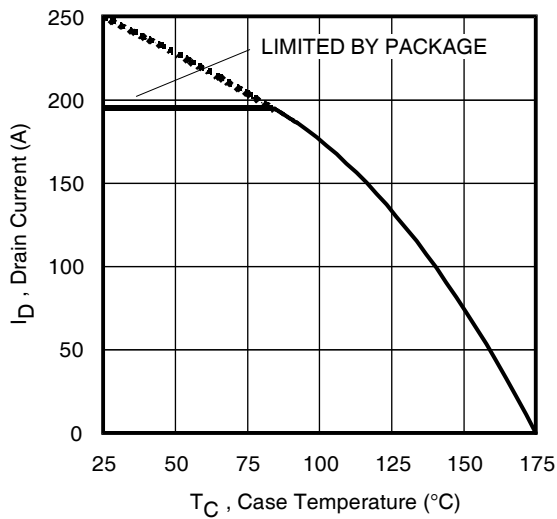
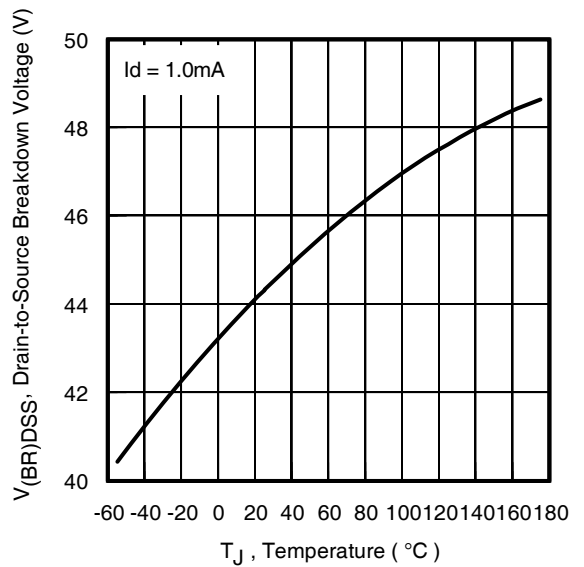
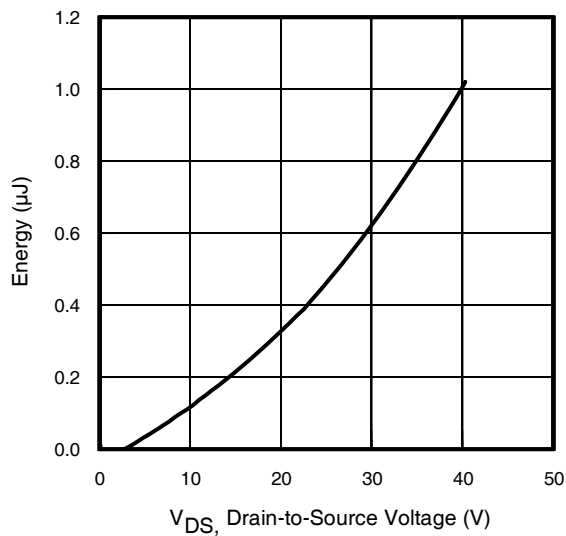
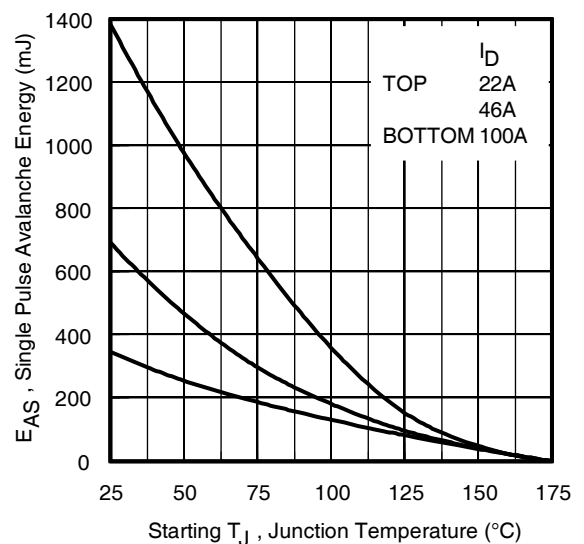
† Qualification standards can be found at International Rectifier's web site: <http://www.irf.com/>

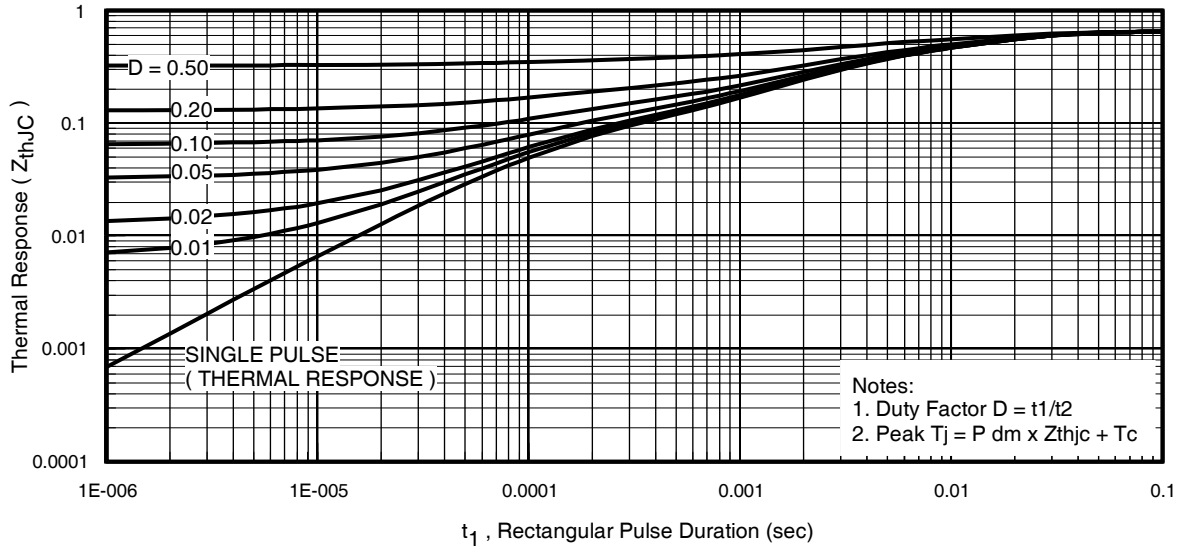
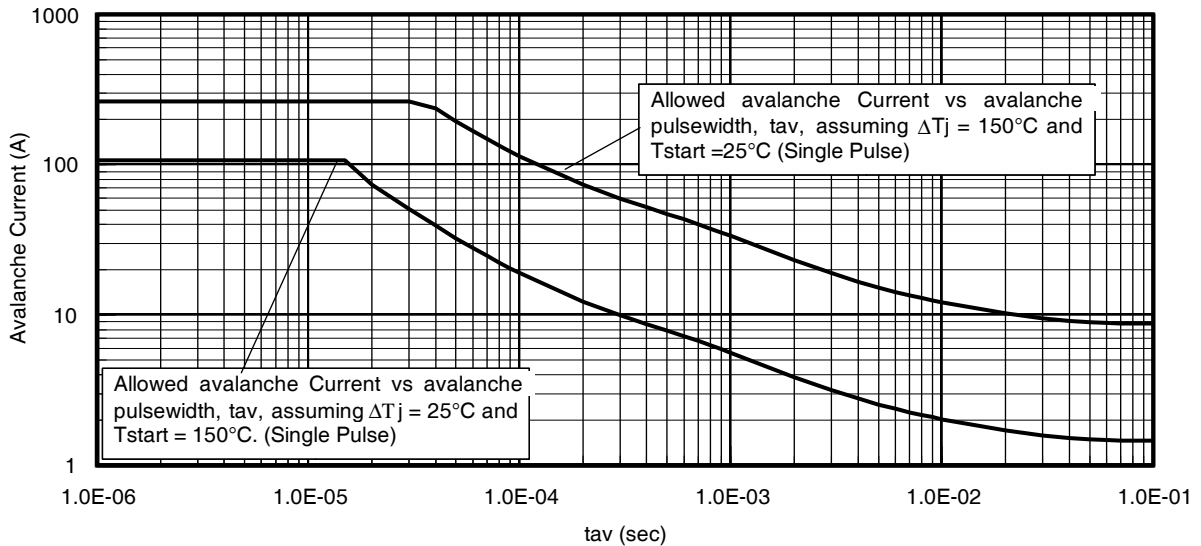
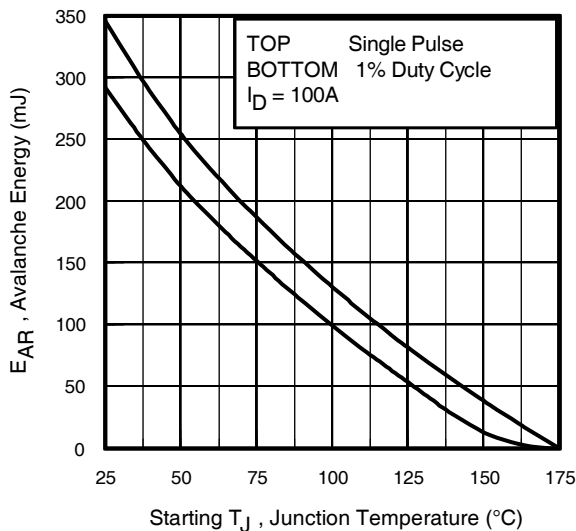
†† Highest passing voltage

Notes:

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| <ul style="list-style-type: none"> ① Calculated continuous current based on maximum allowable junction temperature. Bond wire current limit is 195A by source bonding technology. Note that current limitations arising from heating of the device leads may occur with some lead mounting arrangements. (Refer to AN-1140) ② Repetitive rating; pulse width limited by max. junction temperature. ③ Limited by T_{Jmax}, starting $T_J = 25^\circ\text{C}$, $L = 0.069\text{mH}$
$R_G = 25\Omega$, $I_{AS} = 100\text{A}$, $V_{GS} = 10\text{V}$. ④ $I_{SD} \leq 100\text{A}$, $di/dt \leq 1166\text{A}/\mu\text{s}$, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq 175^\circ\text{C}$. | <ul style="list-style-type: none"> 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 When mounted on 1" square PCB (FR-4 or G-10 Material). For recommended footprint and soldering techniques refer to application note #AN-994. ⑨ R_θ is measured at T_J approximately 90°C. ⑩ Pulse drain current is limited by source bonding technology. |
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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 10. Drain-to-Source Breakdown Voltage

Fig 11. Typical C_{OSS} Stored Energy

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

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

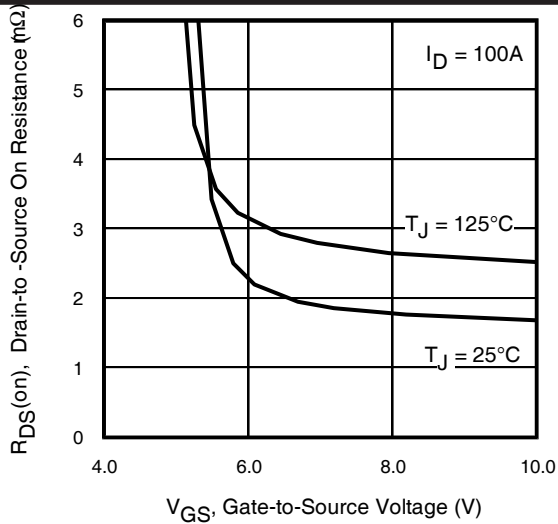
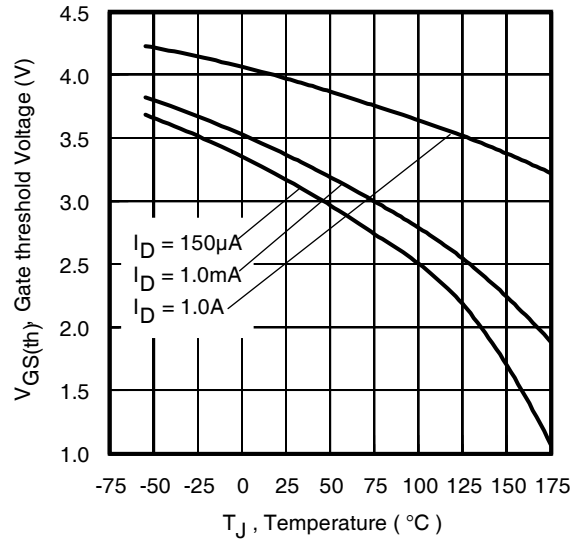
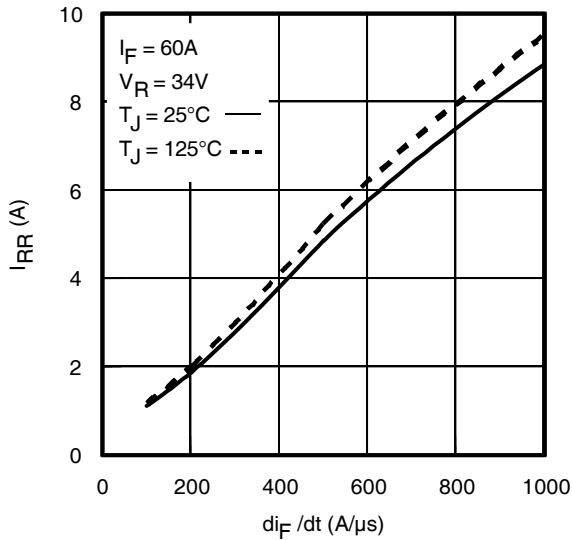
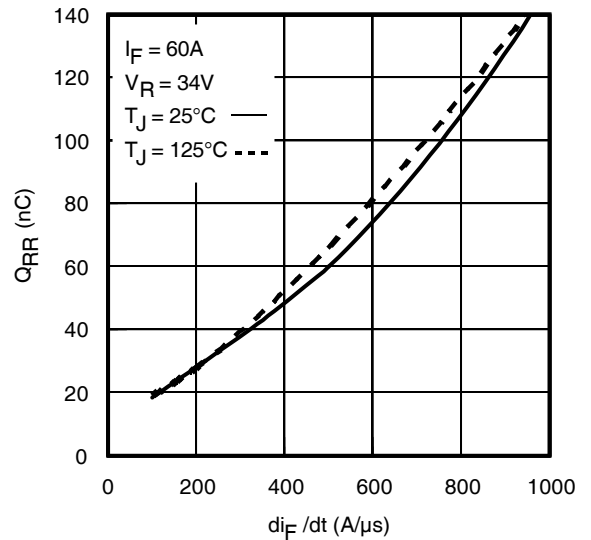
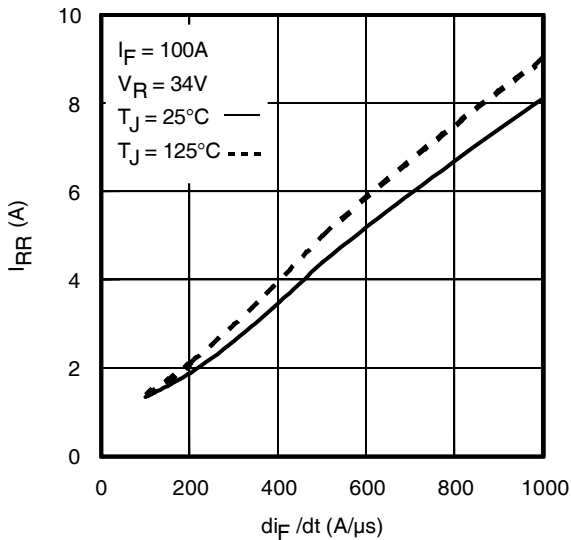
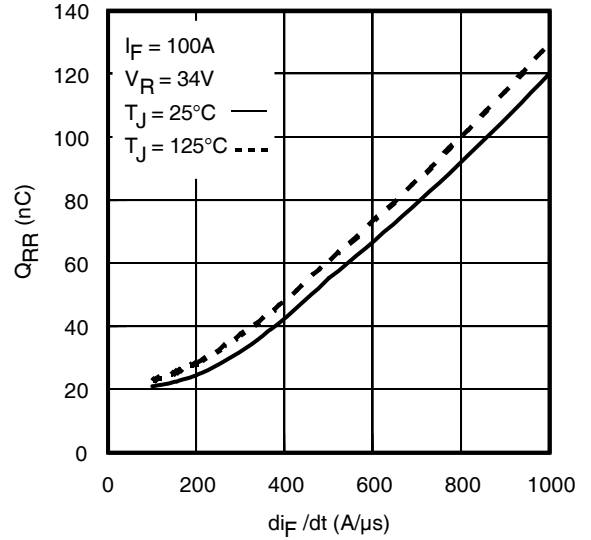
1. Avalanche failures assumption:
 Purely a thermal phenomenon and failure occurs at a temperature far in excess of T_{jmax} . This is validated for every part type.
2. Safe operation in Avalanche is allowed as long as T_{jmax} is not exceeded.
3. Equation below based on circuit and waveforms shown in Figures 24a, 24b.
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 15. Maximum Avalanche Energy vs. Temperature


Fig 16. Typical On-Resistance vs. Gate Voltage

Fig 17. Threshold Voltage vs. Temperature

Fig. 18 - Typical Recovery Current vs. di_f/dt

Fig. 19 - Typical Stored Charge vs. di_f/dt

Fig. 20 - Typical Recovery Current vs. di_f/dt

Fig. 21 - Typical Stored Charge vs. di_f/dt

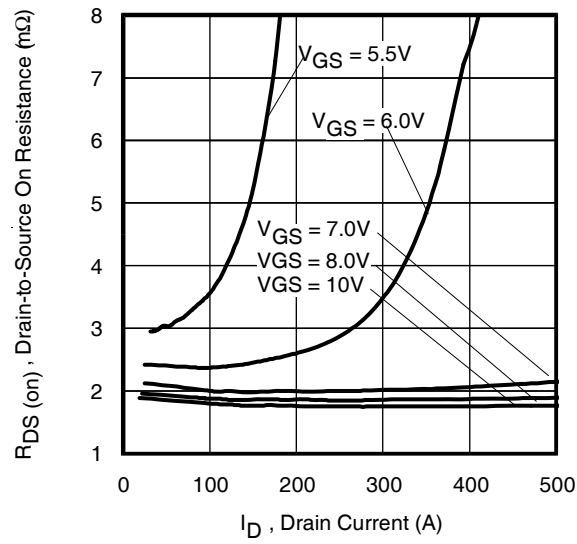


Fig 22. Typical On-Resistance vs. Drain Current

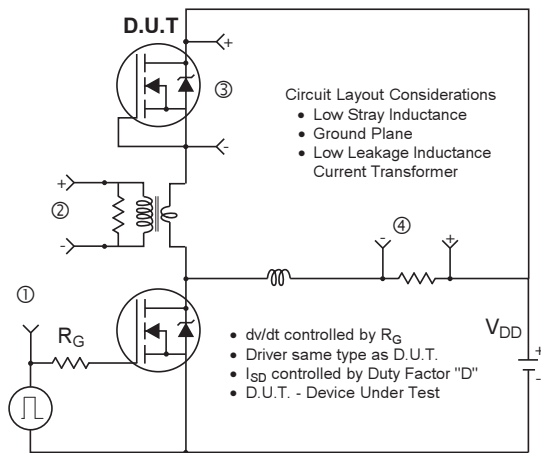
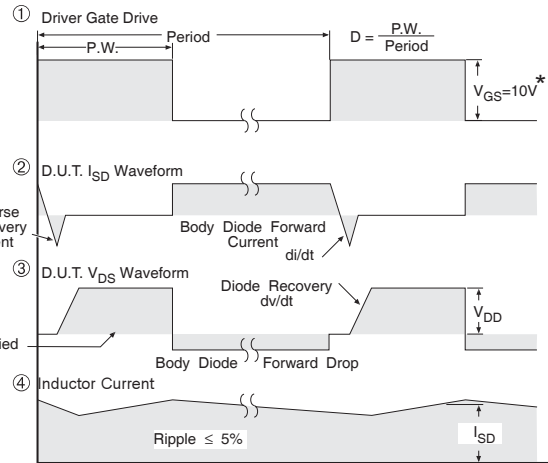


Fig 23. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET[®] Power MOSFETs



* $V_{GS} = 5V$ for Logic Level Devices

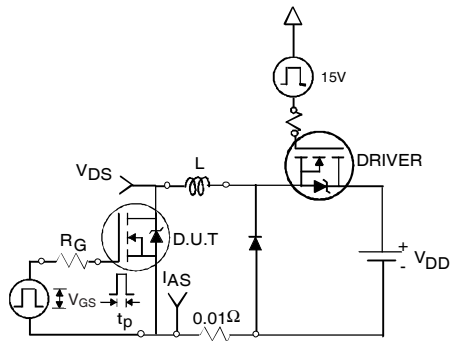


Fig 24a. Unclamped Inductive Test Circuit

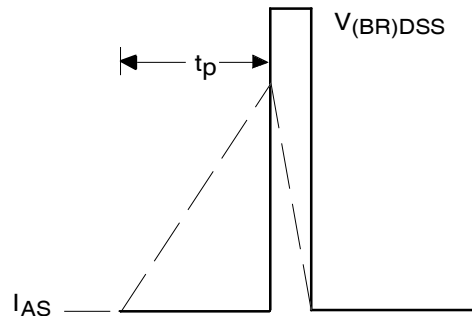


Fig 24b. Unclamped Inductive Waveforms

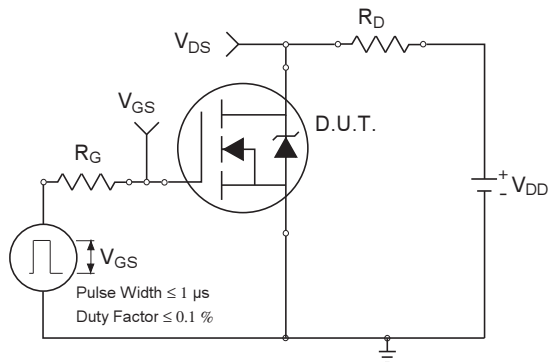


Fig 25a. Switching Time Test Circuit

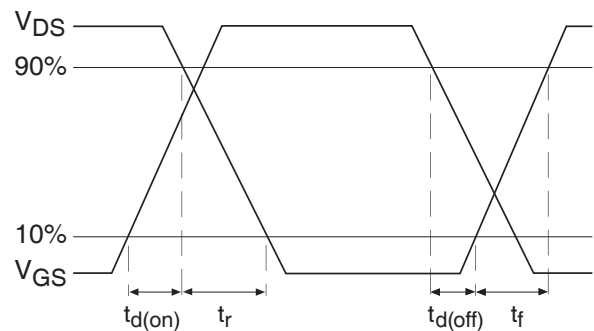


Fig 25b. Switching Time Waveforms

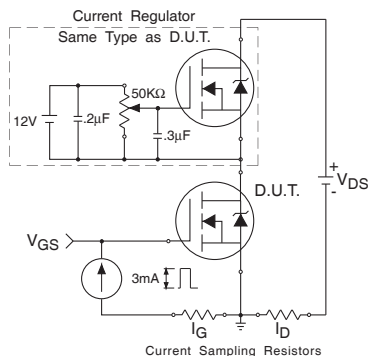


Fig 26a. Gate Charge Test Circuit

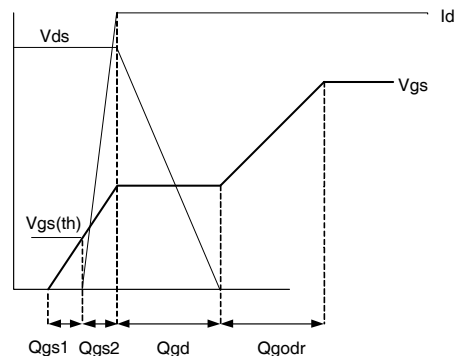
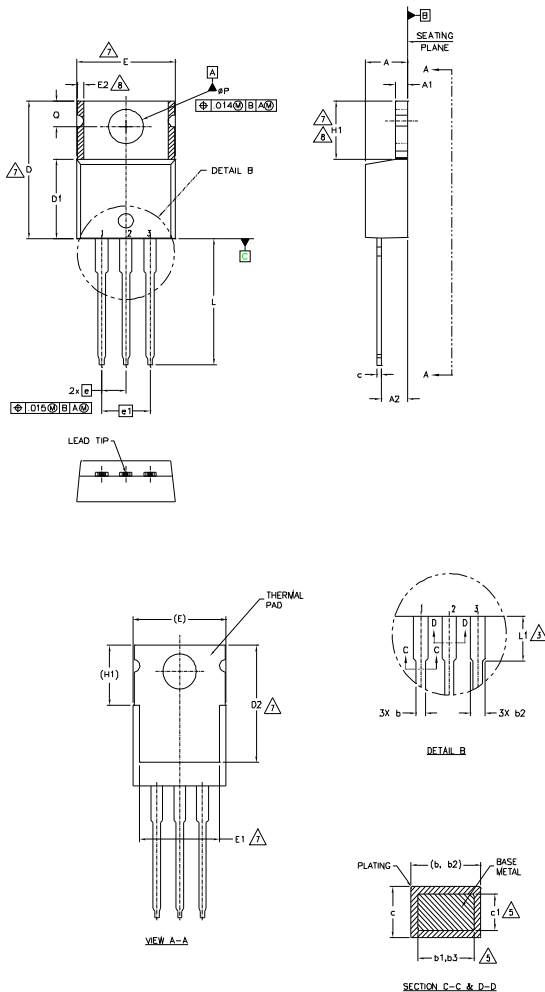


Fig 26b. Gate Charge Waveform

TO-220AB Package Outline

Dimensions are shown in millimeters (inches)



NOTES:

- 1.- DIMENSIONING AND TOLERANCING AS PER ASME Y14.5 M- 1994.
- 2.- DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS]
- 3.- LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
- 4.- DIMENSION D, D1 & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
- 5.- DIMENSION b1, b3 & 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.
- 9.- OUTLINE CONFORMS TO JEDEC TO-220, EXCEPT A2 (max.) AND D2 (min.) WHERE DIMENSIONS ARE DERIVED FROM THE ACTUAL PACKAGE OUTLINE.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	3.56	4.83	.140	.190	
A1	1.14	1.40	.045	.055	
A2	2.03	2.92	.080	.115	
b	0.38	1.01	.015	.040	
b1	0.38	0.97	.015	.038	5
b2	1.14	1.78	.045	.070	
b3	1.14	1.73	.045	.068	5
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	11.68	12.88	.460	.507	7
E	9.65	10.67	.380	.420	4,7
E1	6.86	8.89	.270	.350	7
E2	-	0.76	-	.030	8
e	2.54 BSC		.100 BSC		
e1	5.08 BSC		.200 BSC		
H1	5.84	6.86	.230	.270	7,8
L	12.70	14.73	.500	.580	
L1	3.56	4.06	.140	.160	3
ØP	3.54	4.08	.139	.161	
Q	2.54	3.42	.100	.135	

LEAD ASSIGNMENTS

HEXFET

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

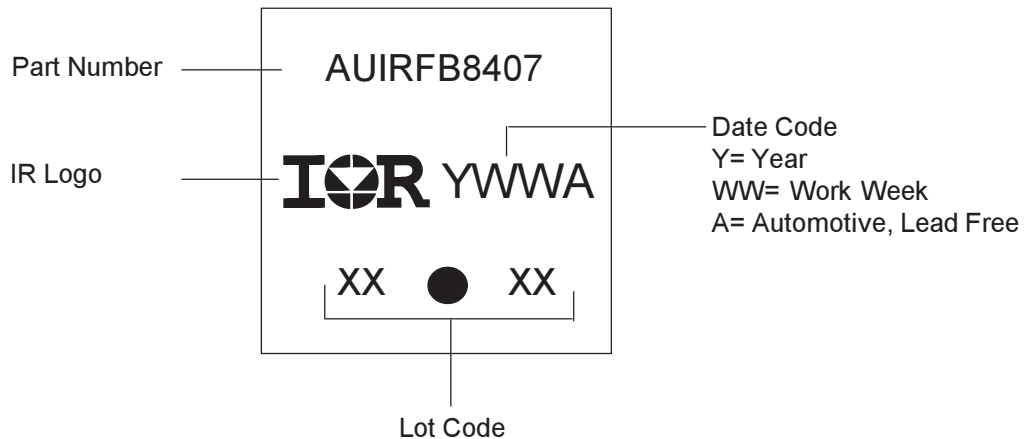
IGBTs, CoPACK

- 1.- GATE
- 2.- COLLECTOR
- 3.- EMITTER

DIODES

- 1.- ANODE
- 2.- CATHODE
- 3.- ANODE

TO-220AB Part Marking Information

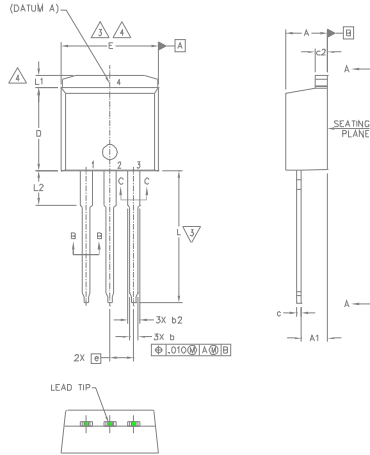


TO-220AB packages are not recommended for Surface Mount Application.

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

TO-262 Package Outline

Dimensions are shown in millimeters (inches)



- 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 b1 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

IGBTs, CoPACK

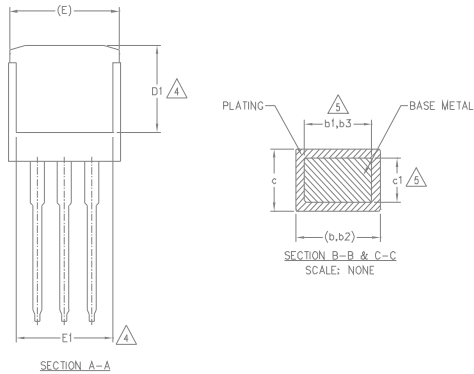
- 1.- GATE
- 2.- COLLECTOR
- 3.- EMITTER
- 4.- COLLECTOR

HEXFET

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

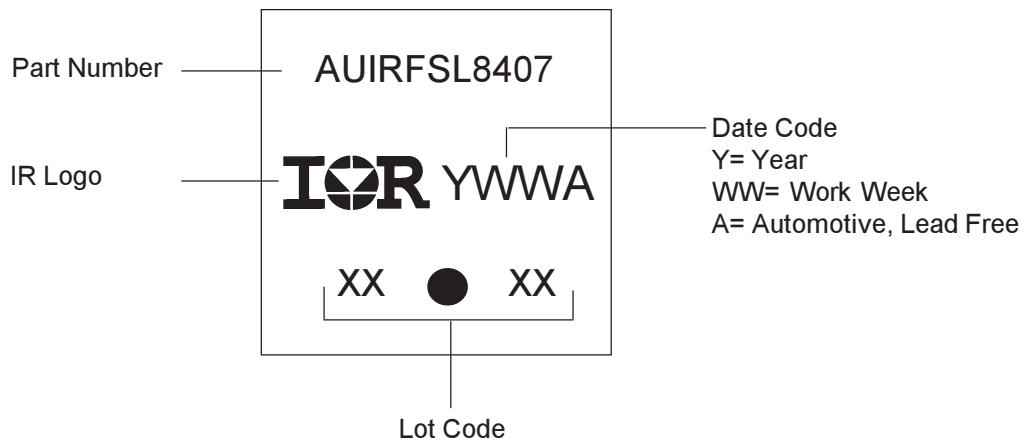
DIODES

- 1.- ANODE (TWO DIE) / OPEN (ONE DIE)
- 2.- CATHODE
- 3.- ANODE



SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	
A1	2.03	3.02	.080	.119	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	5
b2	1.14	1.78	.045	.070	
b3	1.14	1.73	.045	.068	5
c	0.38	0.74	.015	.029	
c1	0.38	0.58	.015	.023	5
c2	1.14	1.65	.045	.065	
D	8.38	9.65	.330	.380	3
D1	6.86	-	.270	-	4
E	9.65	10.67	.380	.420	3,4
E1	6.22	-	.245	-	4
e	2.54 BSC		.100 BSC		
L	13.46	14.10	.530	.555	
L1	-	1.65	-	.065	4
L2	3.56	3.71	.140	.146	

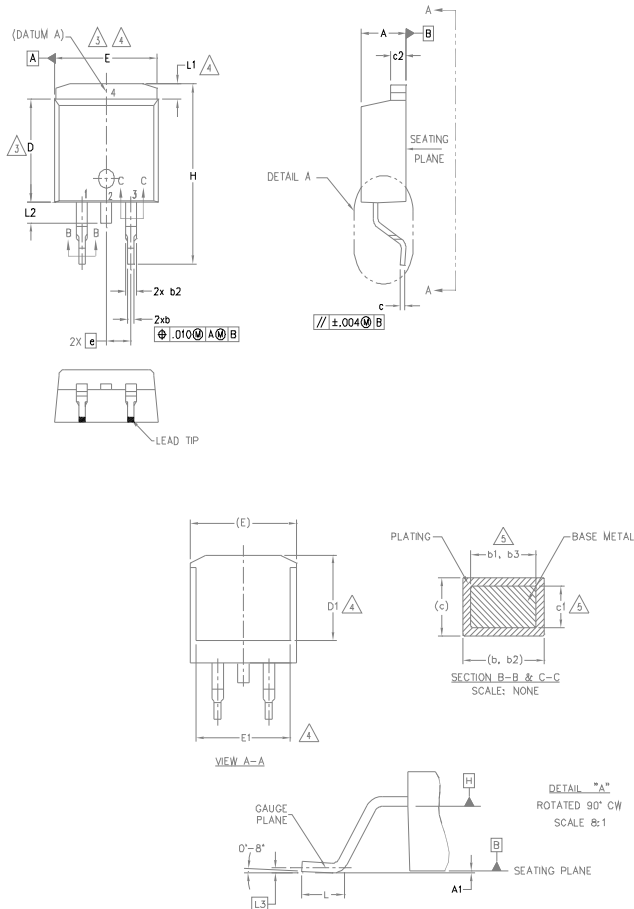
TO-262 Part Marking Information



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

D²Pak (TO-263AB) Package Outline

Dimensions are shown in millimeters (inches)



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 AT DATUM H.
4. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E, L1, D1 & E1.
5. DIMENSION b1, b3 AND c1 APPLY TO BASE METAL ONLY.
6. DATUM A & B TO BE DETERMINED AT DATUM PLANE H.
7. CONTROLLING DIMENSION: INCH.
8. OUTLINE CONFORMS TO JEDEC OUTLINE TO-263AB.

LEAD ASSIGNMENTS

DIODES

- 1.- ANODE (TWO DIE) / OPEN (ONE DIE)
- 2.- CATHODE
- 3.- ANODE

HEXFET

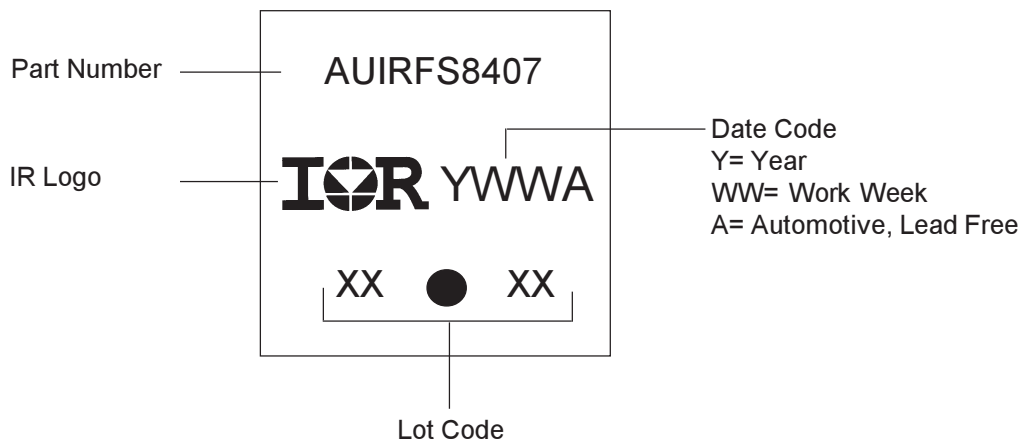
- 1.- GATE
- 2.- DRAIN
- 3.- SOURCE

IGBTs, CoPACK

- 1.- GATE
- 2.- COLLECTOR
- 3.- EMITTER

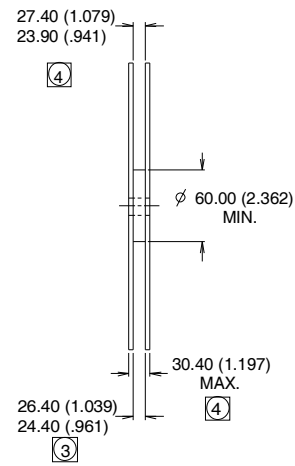
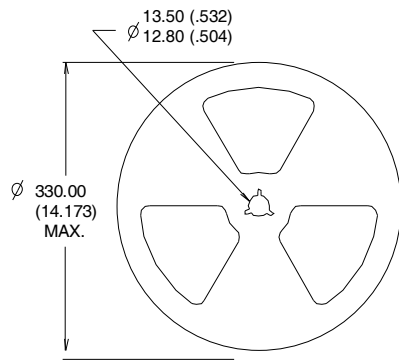
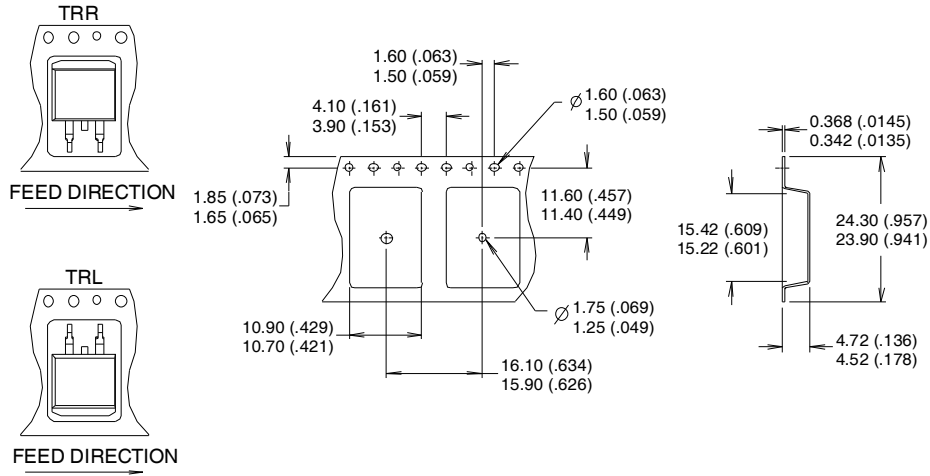
SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	
A1	0.00	0.254	.000	.010	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	5
b2	1.14	1.78	.045	.070	
b3	1.14	1.73	.045	.068	5
c	0.38	0.74	.015	.029	
c1	0.38	0.58	.015	.023	5
c2	1.14	1.65	.045	.065	
D	8.38	9.65	.330	.380	3
D1	6.86	-	.270	-	4
E	9.65	10.67	.380	.420	3,4
E1	6.22	-	.245	-	4
e	2.54 BSC		.100 BSC		
H	14.61	15.88	.575	.625	
L	1.78	2.79	.070	.110	
L1	-	1.68	-	.066	4
L2	-	1.78	-	.070	
L3	0.25 BSC		.010 BSC		

D²Pak (TO-263AB) Part Marking Information



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

D²Pak (TO-263AB) Tape & Reel Information Dimensions are shown in millimeters (inches)



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

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

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Revision History

Date	Comment
4/1/2014	<ul style="list-style-type: none"> • Updated package outline on page 10,11 & 12. • Updated typo on the fig.19 and fig.21, unit of y-axis from "A" to "nC" on page7.

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