

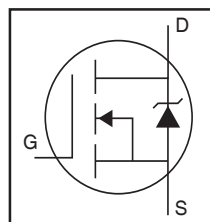
Features

- Advanced Process Technology
- Ultra Low On-Resistance
- Logic Level Gate Drive
- Dynamic dv/dt Rating
- 175°C Operating Temperature
- Fast Switching
- Repetitive Avalanche Allowed up to Tjmax
- Lead-Free, RoHS Compliant
- Automotive Qualified *

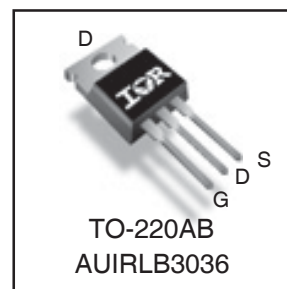
Description

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 a wide variety of other applications.

HEXFET® Power MOSFET



V_{DSS}	60V
$R_{DS(on)}$ typ. max.	1.9mΩ 2.4mΩ
I_D (Silicon Limited)	270A ①
I_D (Package Limited)	195A



G	D	S
Gate	Drain	Source

Base Part Number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
AUIRLB3036	TO-220	Tube	50	AUIRLB3036

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)	270①	A
$I_D @ T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Silicon Limited)	190	
$I_D @ T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Package Limited)	195	
I_{DM}	Pulsed Drain Current ②	1100	
$P_D @ T_C = 25^\circ\text{C}$	Maximum Power Dissipation	380	W
	Linear Derating Factor	2.5	W/°C
V_{GS}	Gate-to-Source Voltage	±16	V
E_{AS}	Single Pulse Avalanche Energy (Thermally Limited) ③	290	mJ
I_{AR}	Avalanche Current ②	See Fig. 14, 15, 22a, 22b	A
E_{AR}	Repetitive Avalanche Energy ②		mJ
dv/dt	Peak Diode Recovery ④	8.0	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	10lbf·in (1.1N·m)	

Thermal Resistance

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ⑤	—	0.40	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient (PCB Mount) ⑤	—	62	

HEXFET® is a registered trademark of International Rectifier.

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

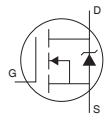
Static Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
V _{(BR)DSS}	Drain-to-Source Breakdown Voltage	60	—	—	V	V _{GS} = 0V, I _D = 250μA
ΔV _{(BR)DSS/ΔT_J}	Breakdown Voltage Temp. Coefficient	—	0.061	—	V/°C	Reference to 25°C, I _D = 5mA
R _{DS(on)}	Static Drain-to-Source On-Resistance	—	1.9	2.4	mΩ	V _{GS} = 10V, I _D = 165A ⑤
		—	2.2	2.8		V _{GS} = 4.5V, I _D = 140A ⑤
V _{GS(th)}	Gate Threshold Voltage	1.0	—	2.5	V	V _{DS} = V _{GS} , I _D = 250μA
g _{fs}	Forward Transconductance	340	—	—	S	V _{DS} = 10V, I _D = 165A
R _{G(int)}	Internal Gate Resistance	—	2.0	—	Ω	
I _{DSS}	Drain-to-Source Leakage Current	—	—	20	μA	V _{DS} = 60V, V _{GS} = 0V
		—	—	250		V _{DS} = 60V, 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

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

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
Q _g	Total Gate Charge	—	91	140	nC	I _D = 165A
Q _{gs}	Gate-to-Source Charge	—	31	—		V _{DS} = 30V
Q _{gd}	Gate-to-Drain ("Miller") Charge	—	51	—		V _{GS} = 4.5V ⑤
Q _{sync}	Total Gate Charge Sync. (Q _g - Q _{gd})	—	40	—		I _D = 165A, V _{DS} = 0V, V _{GS} = 4.5V
t _{d(on)}	Turn-On Delay Time	—	66	—	ns	V _{DD} = 39V
t _r	Rise Time	—	220	—		I _D = 165A
t _{d(off)}	Turn-Off Delay Time	—	110	—		R _G = 2.1Ω
t _f	Fall Time	—	110	—		V _{GS} = 4.5V ⑤
C _{iss}	Input Capacitance	—	11210	—	pF	V _{GS} = 0V
C _{OSS}	Output Capacitance	—	1020	—		V _{DS} = 50V
C _{rSS}	Reverse Transfer Capacitance	—	500	—		f = 1.0MHz
C _{OSS} eff. (ER)	Effective Output Capacitance (Energy Related)	—	1430	—		V _{GS} = 0V, V _{DS} = 0V to 48V ⑦
C _{OSS} eff. (TR)	Effective Output Capacitance (Time Related)	—	1880	—		V _{GS} = 0V, V _{DS} = 0V to 48V ⑥

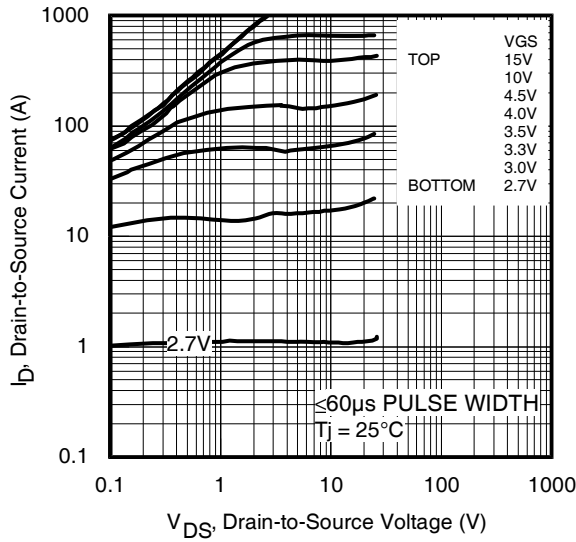
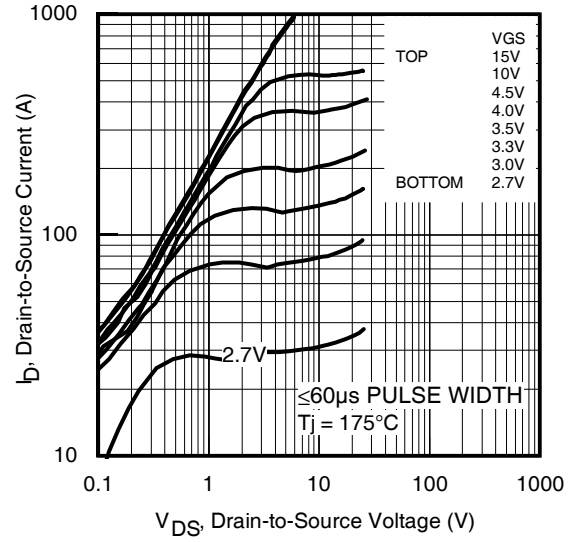
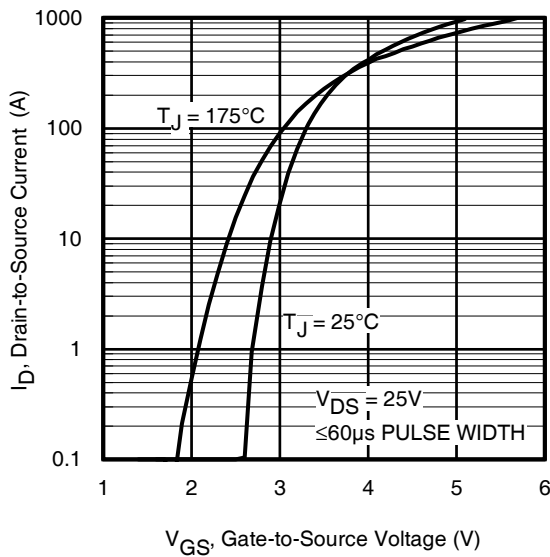
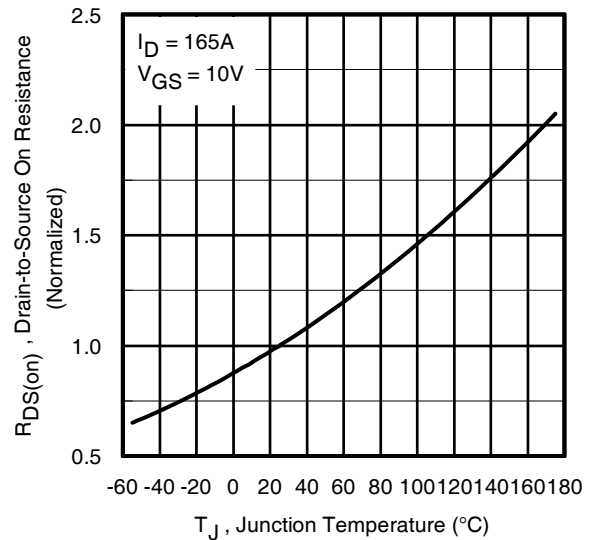
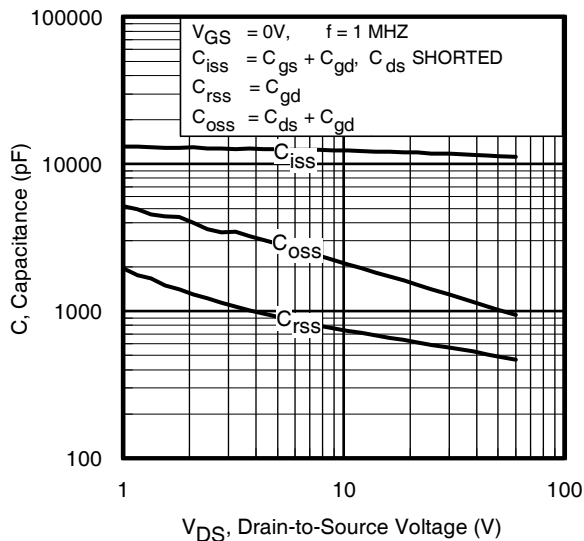
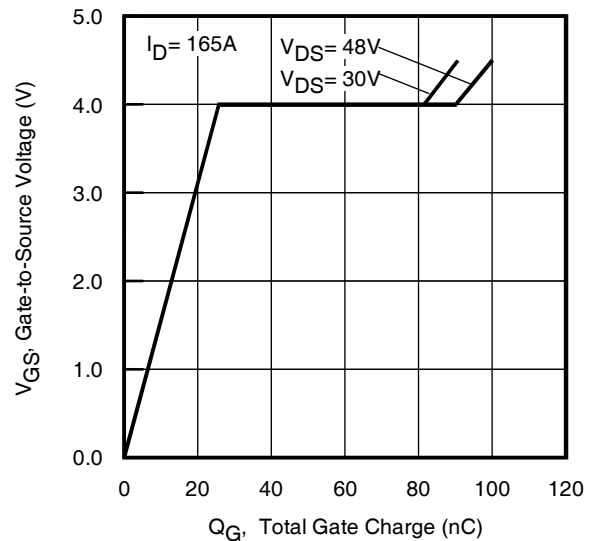
Diode Characteristics

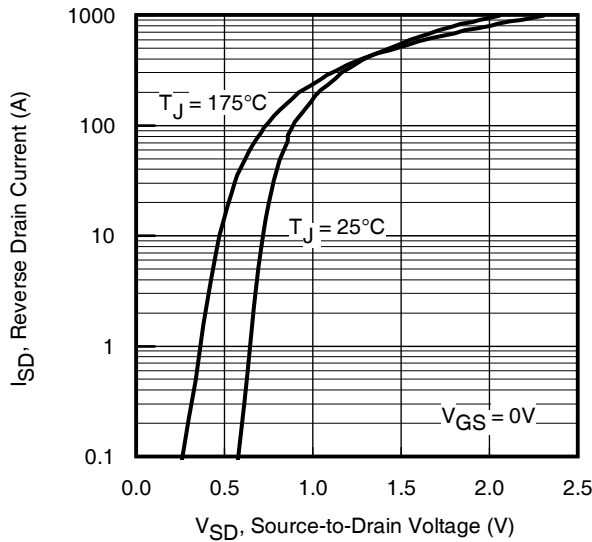
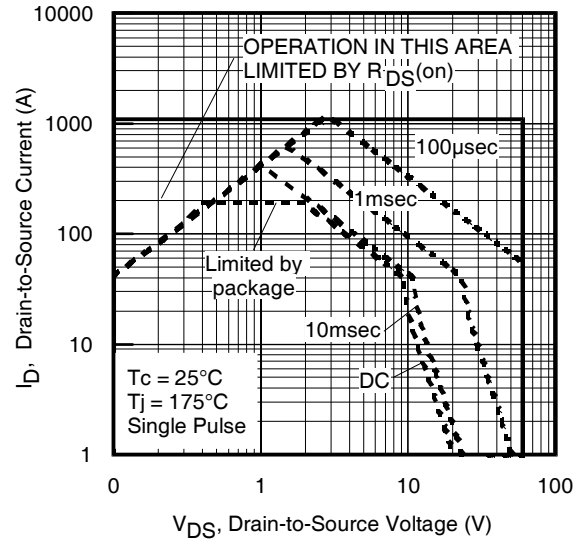
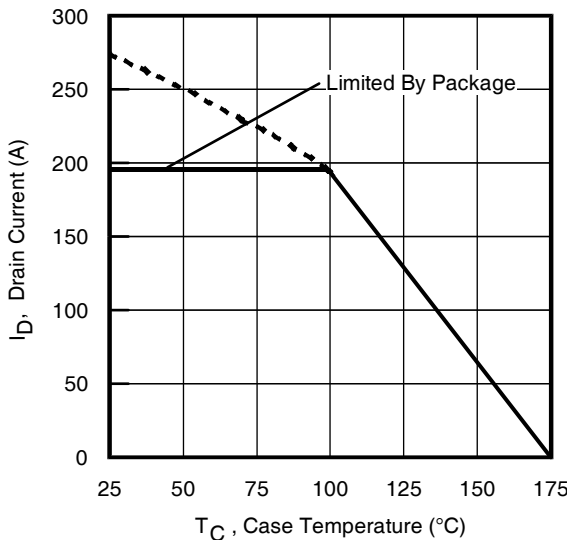
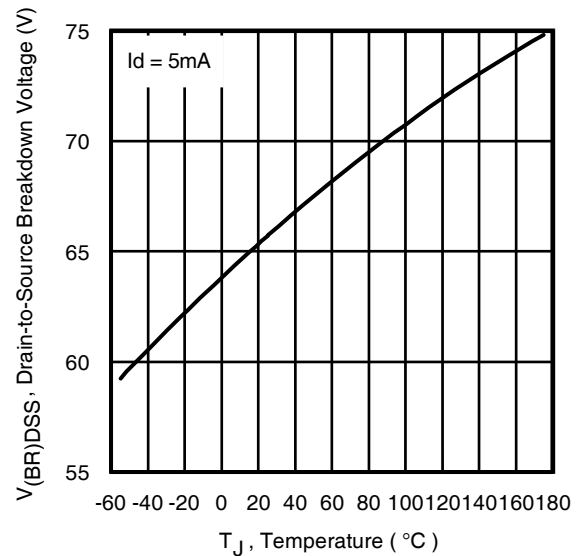
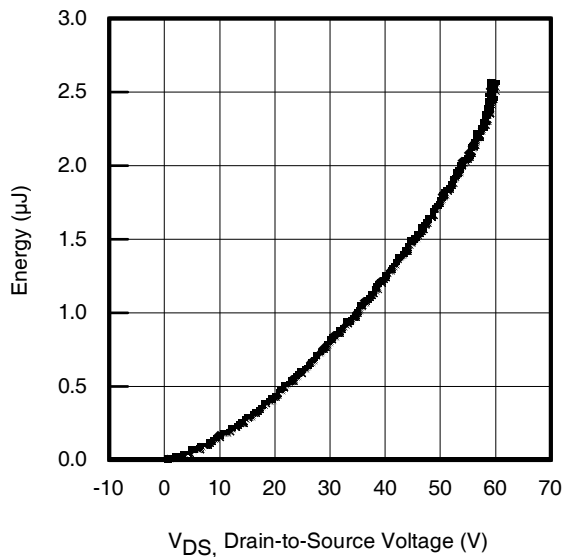
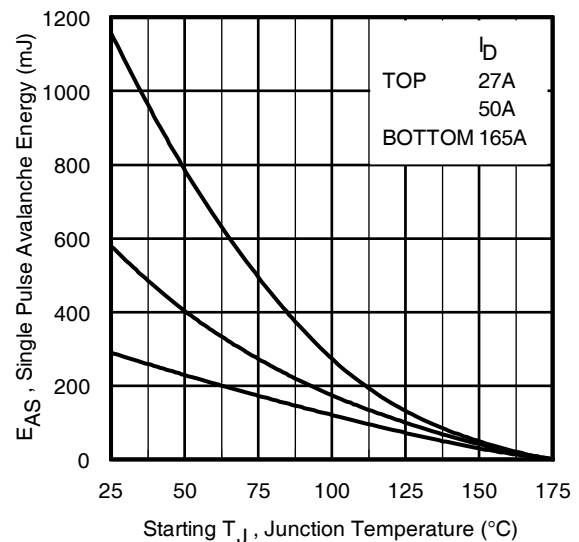
Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
I _S	Continuous Source Current (Body Diode)	—	—	270①	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I _{SM}	Pulsed Source Current (Body Diode) ③	—	—	1100		
V _{SD}	Diode Forward Voltage	—	—	1.3	V	T _J = 25°C, I _S = 165A, V _{GS} = 0V ⑤
t _{rr}	Reverse Recovery Time	—	62	—	ns	T _J = 25°C V _R = 51V,
		—	66	—		T _J = 125°C I _F = 165A
Q _{rr}	Reverse Recovery Charge	—	310	—	nC	T _J = 25°C di/dt = 100A/μs ⑤
		—	360	—		T _J = 125°C
I _{RPM}	Reverse Recovery Current	—	4.4	—	A	T _J = 25°C
t _{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)				

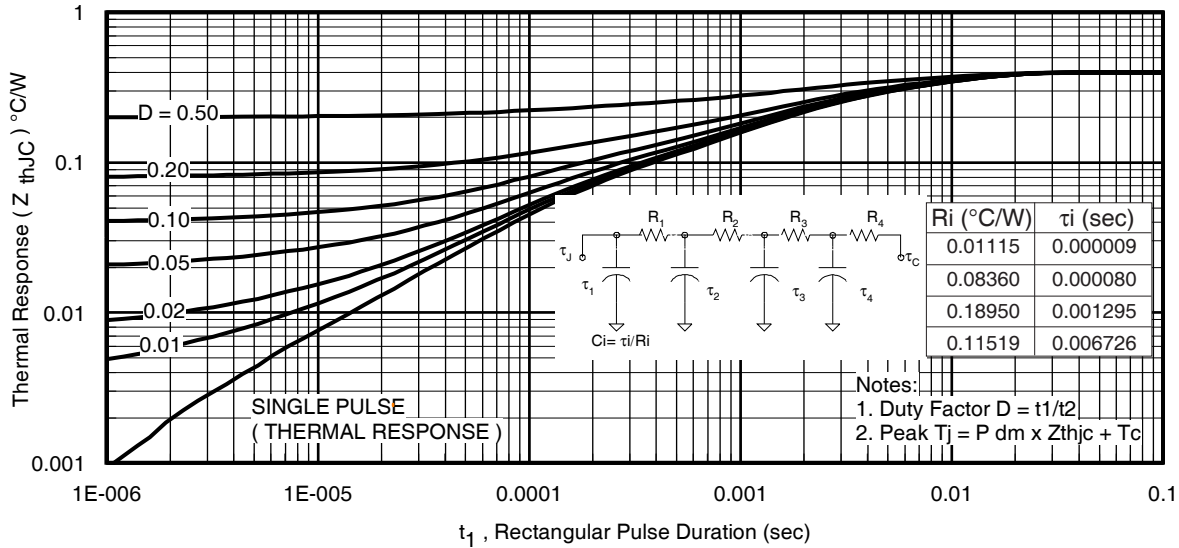
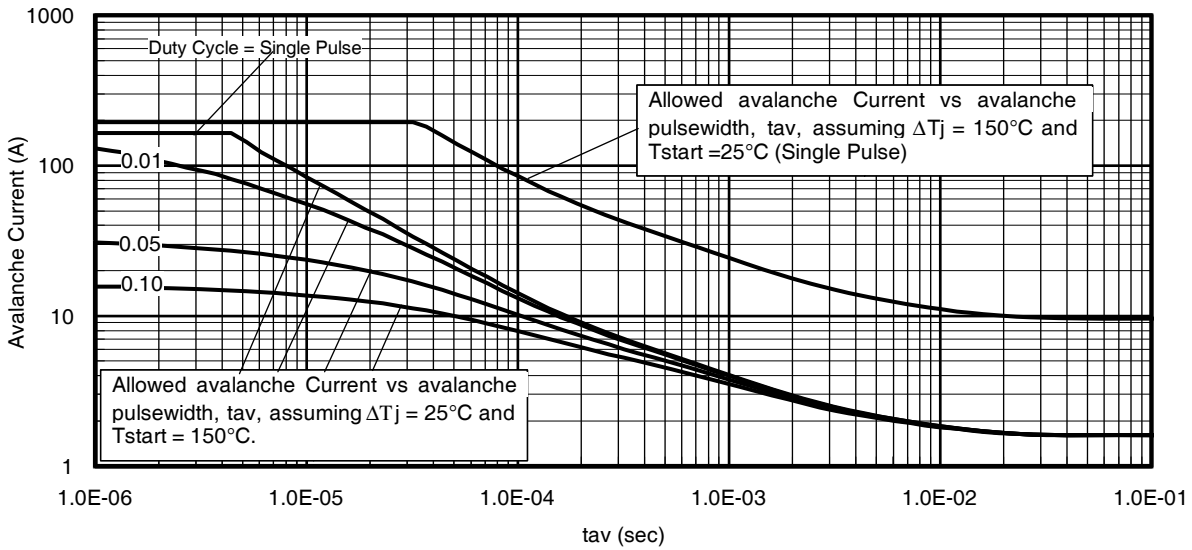
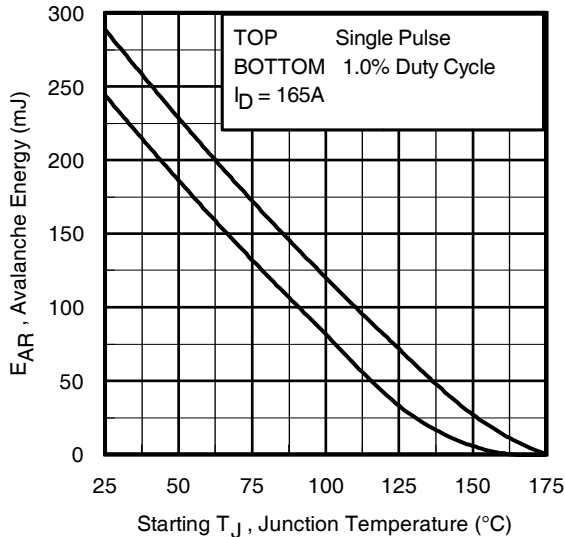
Notes:

- 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°C, L = 0.021mH
R_G = 25Ω, I_{AS} = 165A, V_{GS} = 10V. Part not recommended for use above this value.
- ④ I_{SD} ≤ 165A, di/dt ≤ 430A/μs, V_{DD} ≤ V_{(BR)DSS}, T_J ≤ 175°C.

- ⑤ Pulse width ≤ 400μs; duty cycle ≤ 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 techniques refer to application note #AN-994.
- ⑨ R_θ is measured at T_J approximately 90°C.


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

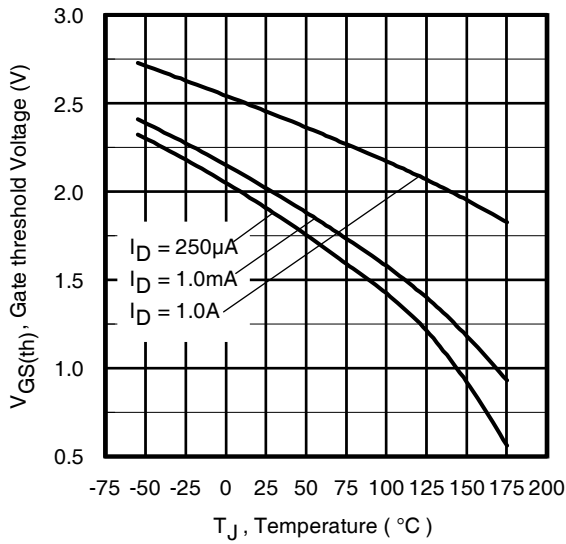
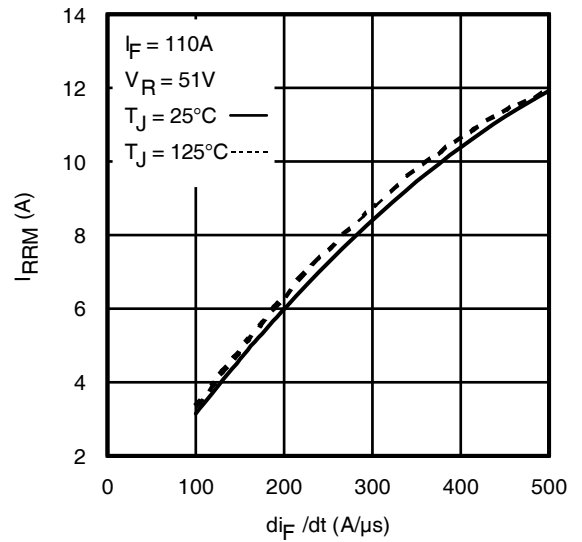
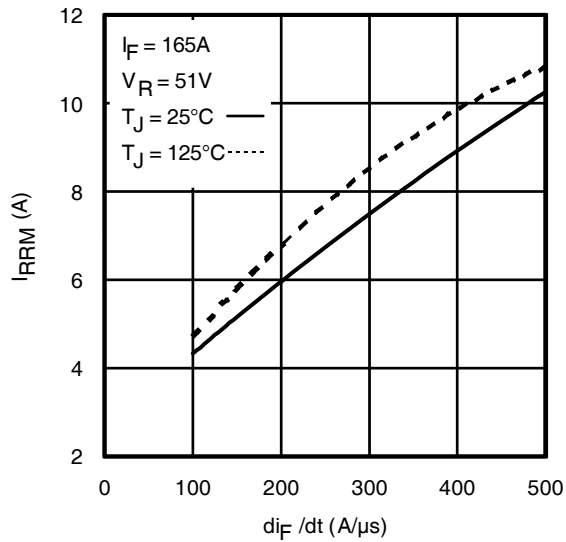
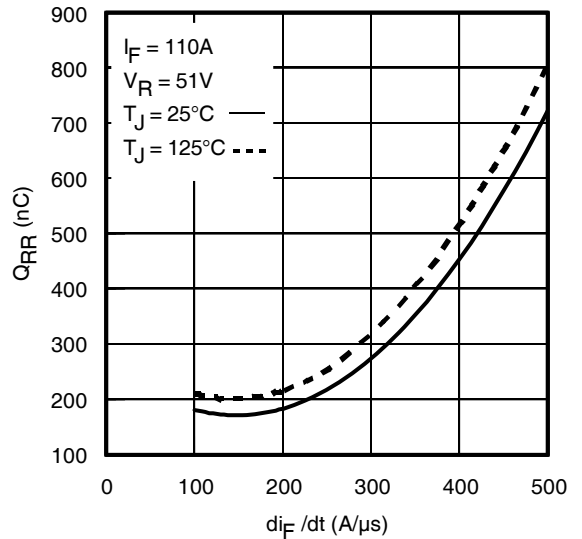
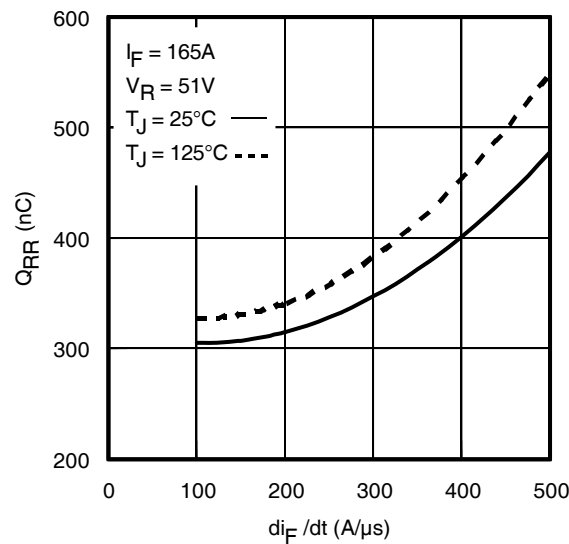

Fig 13. Maximum Effective Transient Thermal Impedance, Junction-to-Case

Fig 14. Typical Avalanche Current vs. Pulsewidth

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)**

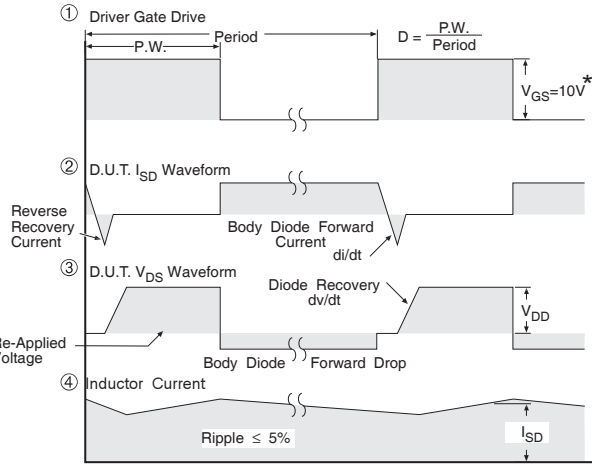
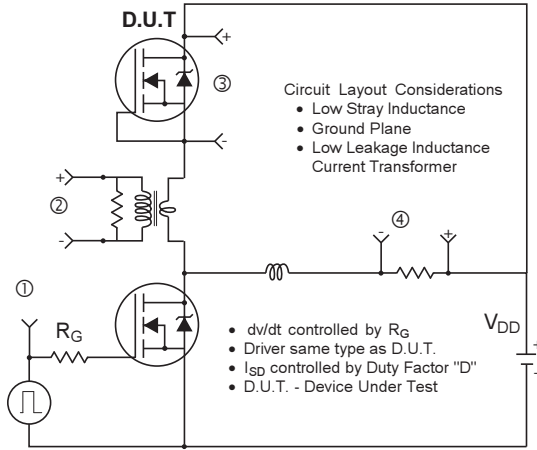
1. Avalanche failures assumption:
Purely a thermal phenomenon and failure occurs at a temperature far in excess of T_{jmax} . This is validated for every part type.
2. Safe operation in Avalanche is allowed as long as T_{jmax} is not exceeded.
3. Equation below based on circuit and waveforms shown in 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. 17 - Typical Recovery Current vs. di_F/dt

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

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

Fig. 20 - Typical Stored Charge vs. di_F/dt



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

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

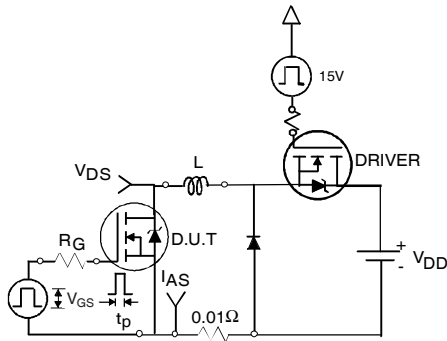


Fig 22a. Unclamped Inductive Test Circuit

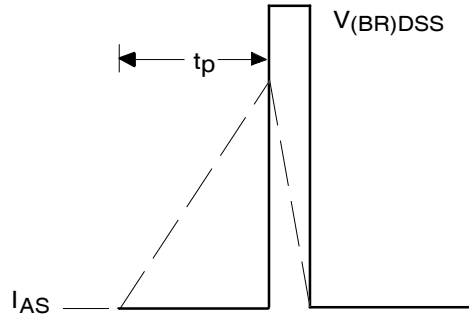


Fig 22b. Unclamped Inductive Waveforms

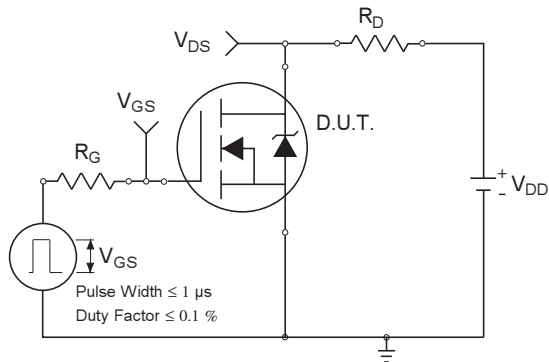


Fig 23a. Switching Time Test Circuit

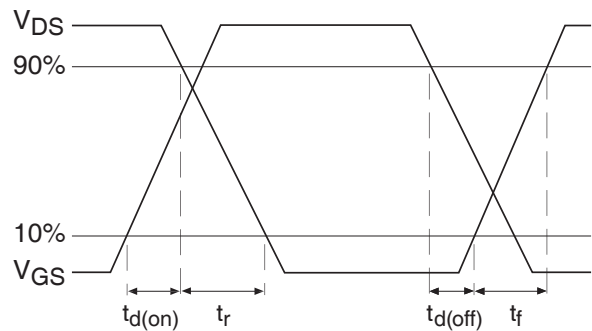


Fig 23b. Switching Time Waveforms

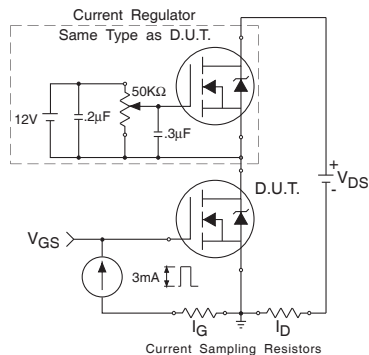


Fig 24a. Gate Charge Test Circuit

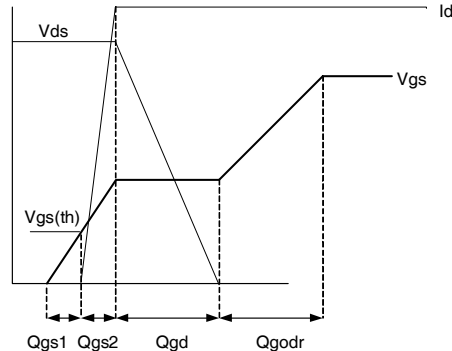
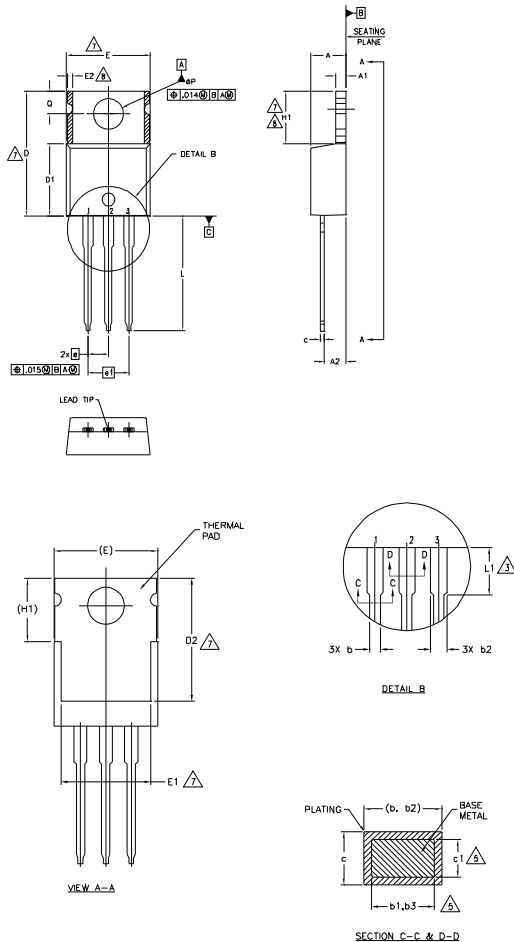


Fig 24b. Gate Charge Waveform

TO-220AB Package Outline

Dimensions are shown in millimeters (inches)



- NOTES:
- 1.- DIMENSIONING AND TOLERANCING 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

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

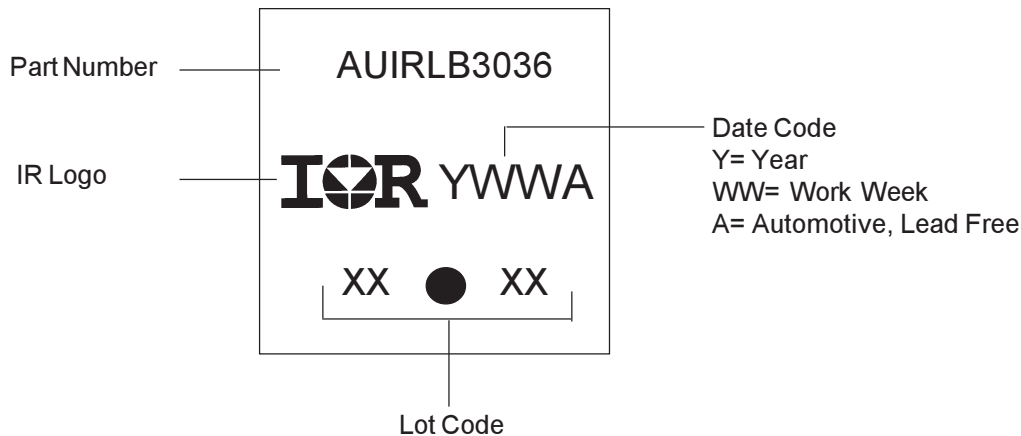
IGBTs, CoPACK

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

DIODES

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

TO-220AB Part Marking Information



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

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-220AB	N/A
ESD	Machine Model	Class M4 (+/- 800V) ^{†††} AEC-Q101-002
	Human Body Model	Class H3A (+/- 6000V) ^{†††} 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/>

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

††† Highest passing voltage.

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For technical support, please contact IR’s Technical Assistance Center

<http://www.irf.com/technical-info/>

WORLD HEADQUARTERS:

101 N. Sepulveda Blvd., El Segundo, California 90245

Tel: (310) 252-7105

Revision History

Date	Comments
4/8/2014	• Updated typo on the fig.19 and fig.20, unit of y-axis from "A" to "nC" on page 6.