

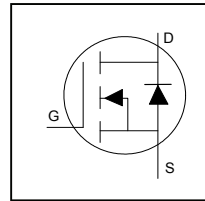
Features

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

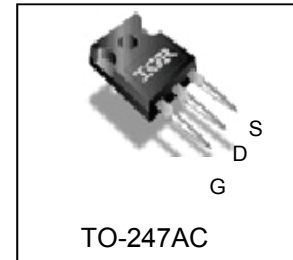
Description

Specifically designed for Automotive applications, this HEXFET® Power MOSFETs utilizes the latest processing techniques to achieve 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}	100V
R_{DS(on)} typ.	3.7mΩ
	max
I_D (Silicon Limited)	180A①
I_D (Package Limited)	120A



G	D	S
Gate	Drain	Source

Ordering Information

Base part number	Package Type	Standard Pack		Complete Part Number
		Form	Quantity	
AUIRFP4110	TO-247AC	Tube	25	AUIRFP4110

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°C	Continuous Drain Current, V _{GS} @ 10V (Silicon Limited)	180①	A
I _D @ T _C = 100°C	Continuous Drain Current, V _{GS} @ 10V (Silicon Limited)	130①	
I _D @ T _C = 25°C	Continuous Drain Current, V _{GS} @ 10V (Package Limited)	120	
I _{DM}	Pulsed Drain Current ②	670	
P _D @ T _C = 25°C	Maximum Power Dissipation	370	W
	Linear Derating Factor	2.5	W/°C
V _{GS}	Gate-to-Source Voltage	± 20	V
E _{AS} (Thermally limited)	Single Pulse Avalanche Energy ③	190	mJ
I _{AR}	Avalanche Current ②	108	A
E _{AR}	Repetitive Avalanche Energy ⑤	37	mJ
dv/dt	Peak Diode Recovery ④	5.3	V/ns
T _J T _{STG}	Operating Junction and Storage Temperature Range	-55 to + 175	°C
	Soldering Temperature, for 10 seconds (1.6mm from case)	300	
	Mounting Torque, 6-32 or M3 Screw	10 lbf·in (1.1 N·m)	

Thermal Resistance

	Parameter	Typ.	Max.	Units
R _{θJC}	Junction-to-Case ⑧	—	0.402	°C/W
R _{θCS}	Case-to-Sink, Flat Greased Surface	0.24	—	
R _{θJA}	Junction-to-Ambient	—	40	

HEXFET® is a registered trademark of International Rectifier.
 *Qualification standards can be found at <http://www.irf.com/>


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

	Parameter	Min.	Typ.	Max.	Units	Conditions
V _{(BR)DSS}	Drain-to-Source Breakdown Voltage	100	—	—	V	V _{GS} = 0V, I _D = 250μA
ΔV _{(BR)DSS} /ΔT _J	Breakdown Voltage Temp. Coefficient	—	0.108	—	V/°C	Reference to 25°C, I _D = 5mA
R _{DS(on)}	Static Drain-to-Source On-Resistance	—	3.7	4.5	mΩ	V _{GS} = 10V, I _D = 75A ⑤
V _{GS(th)}	Gate Threshold Voltage	2.0	—	4.0	V	V _{DS} = V _{GS} , I _D = 250μA
g _{fs}	Forward Trans conductance	160	—	—	S	V _{DS} = 50V, I _D = 75A
I _{DSS}	Drain-to-Source Leakage Current	—	—	20	μA	V _{DS} = 100V, V _{GS} = 0V
		—	—	250		V _{DS} = 100V, 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	Gate Resistance	—	1.3	—	Ω	

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

Q _g	Total Gate Charge	—	150	210	nC	I _D = 75A
Q _{gs}	Gate-to-Source Charge	—	35	—		V _{DS} = 50V
Q _{gd}	Gate-to-Drain Charge	—	43	—		V _{GS} = 10V ⑤
t _{d(on)}	Turn-On Delay Time	—	25	—	ns	V _{DD} = 65V
t _r	Rise Time	—	67	—		I _D = 75A
t _{d(off)}	Turn-Off Delay Time	—	78	—		R _G = 2.6Ω
t _f	Fall Time	—	88	—		V _{GS} = 10V ⑤
C _{iss}	Input Capacitance	—	9620	—	pF	V _{GS} = 0V
C _{oss}	Output Capacitance	—	670	—		V _{DS} = 50V
C _{rss}	Reverse Transfer Capacitance	—	250	—		f = 1.0MHz
C _{oss eff.(ER)}	Effective Output Capacitance (Energy Related)	—	820	—		V _{GS} = 0V, V _{DS} = 0V to 80V ⑦
C _{oss eff.(TR)}	Output Capacitance (Time Related)	—	950	—		V _{GS} = 0V, V _{DS} = 0V to 80V ⑧

Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I _S	Continuous Source Current (Body Diode)	—	—	180 ①	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I _{SM}	Pulsed Source Current (Body Diode) ②	—	—	670		
V _{SD}	Diode Forward Voltage	—	—	1.3	V	T _J = 25°C, I _S = 75A, V _{GS} = 0V ⑤
t _{rr}	Reverse Recovery Time	—	50	75	ns	T _J = 25°C V _{DD} = 85V
		—	60	90		T _J = 125°C I _F = 75A,
Q _{rr}	Reverse Recovery Charge	—	94	140	nC	T _J = 25°C di/dt = 100A/μs ⑤
		—	140	210		T _J = 125°C
I _{RRM}	Reverse Recovery Current	—	3.5	—	A	T _J = 25°C

Notes:

- ① Calculated continuous current based on maximum allowable junction temperature. Bond wire current limit is 120A. Note that current limitations 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 = 0.033mH, R_G = 25Ω, I_{AS} = 108A, V_{GS} = 10V. Part not recommended for use above this value.
- ④ I_{SD} ≤ 75A, di/dt ≤ 630A/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 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		TO-247AC	N/A
ESD	Machine Model	Class M4 (+/- 800) ^{††} AEC-Q101-002	
	Human Body Model	Class H3A (+/- 6000V) ^{††} AEC-Q101-001	
	Charged Device Model	Class C5 (+/- 2000) ^{††} AEC-Q101-005	
RoHS Compliant		Yes	

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

†† Highest passing voltage.

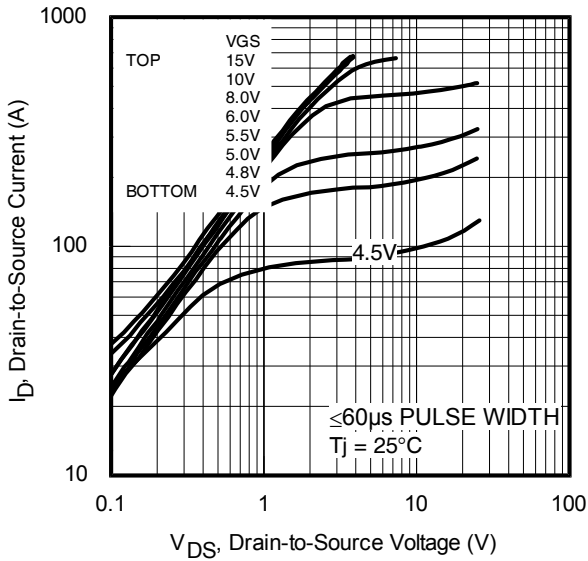


Fig 1. Typical Output Characteristics

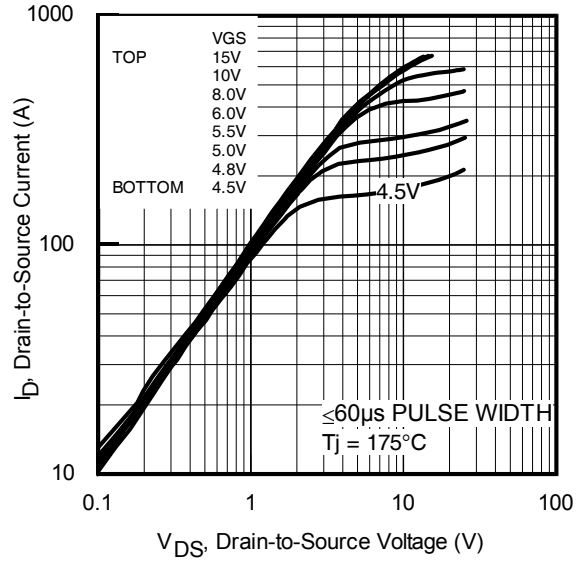


Fig 2. Typical Output Characteristics

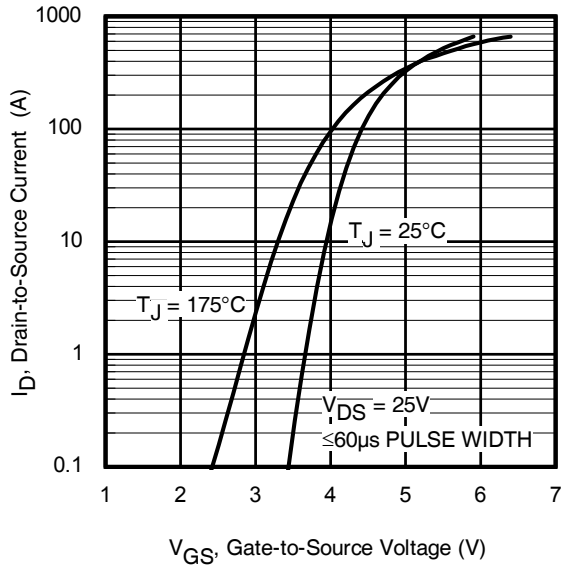


Fig 3. Typical Transfer Characteristics

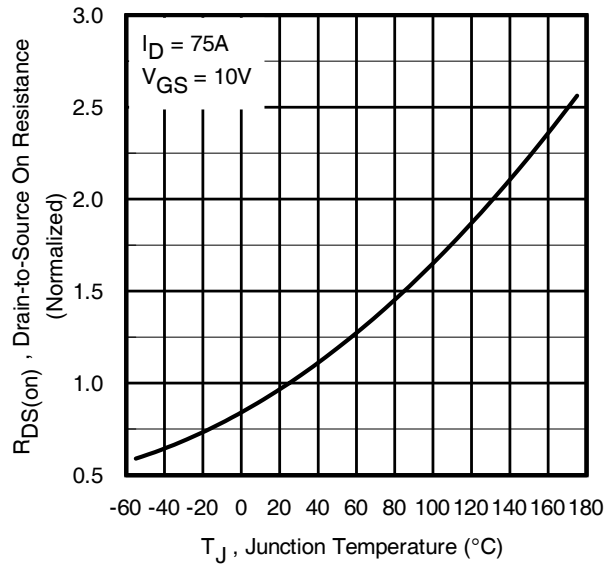


Fig 4. Normalized On-Resistance vs. Temperature

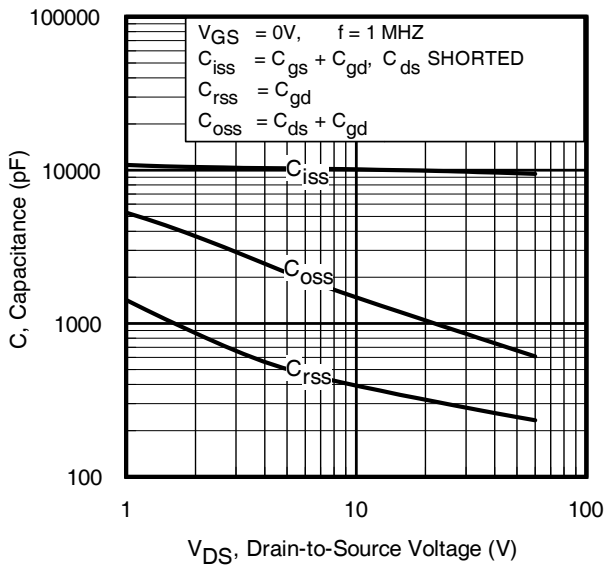


Fig 5. Typical Capacitance vs. Drain-to-Source Voltage

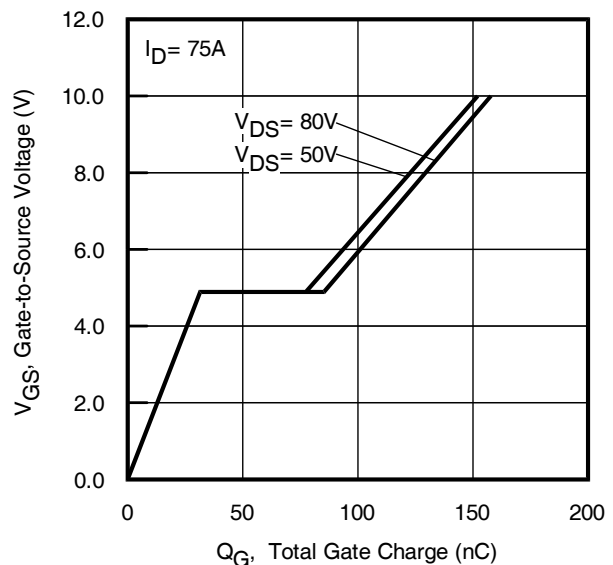
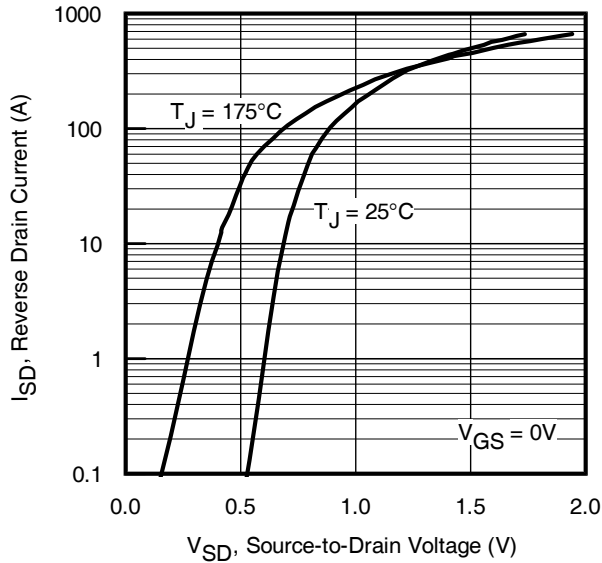
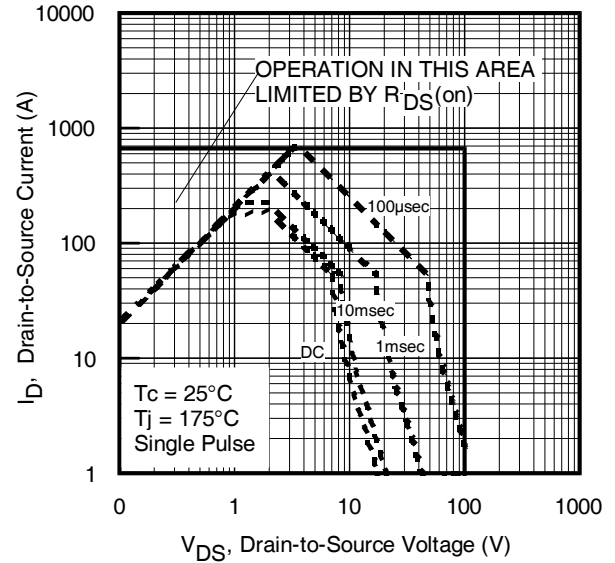
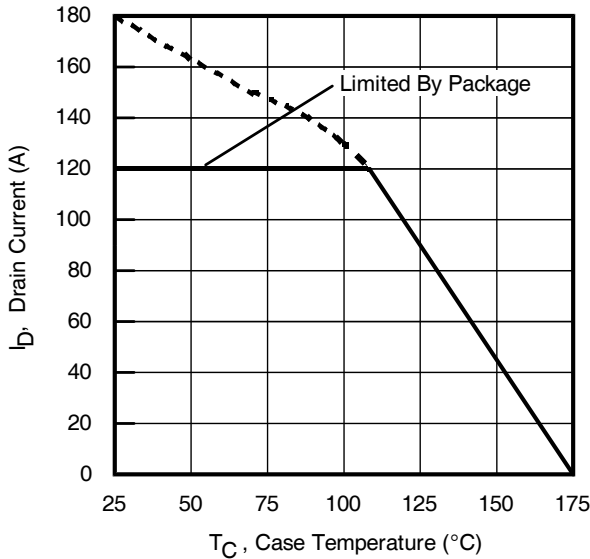
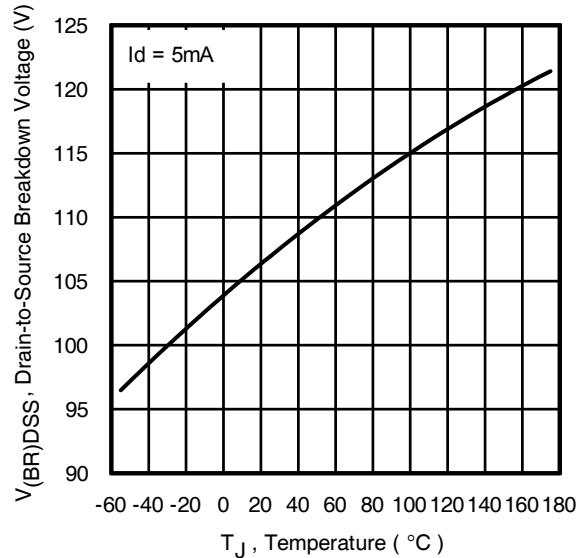
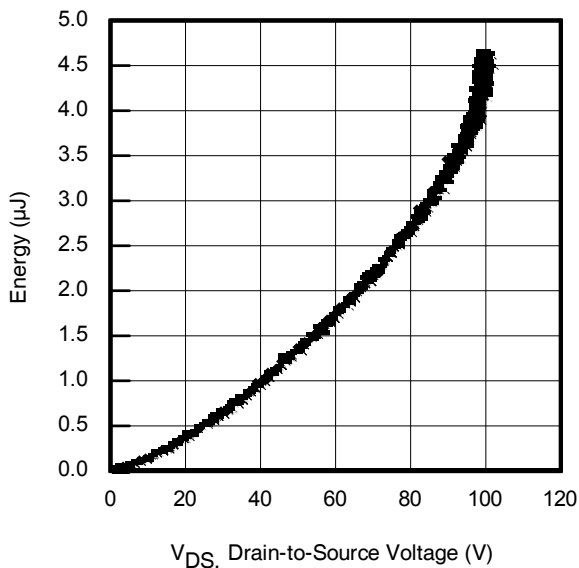
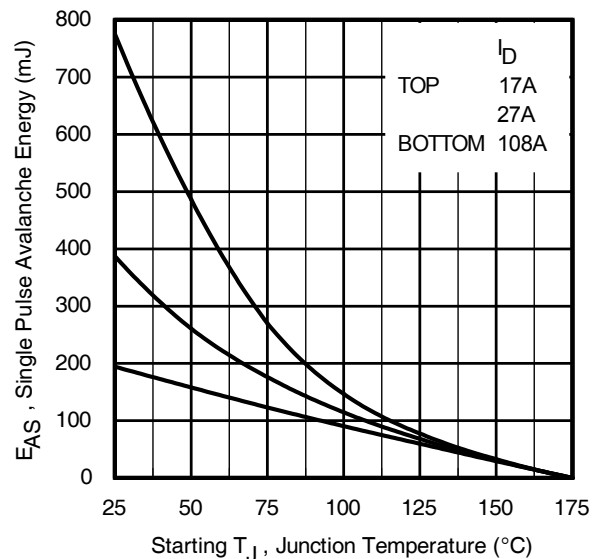


Fig 6. Typical Gate Charge vs. Gate-to-Source Voltage


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. Threshold Voltage vs. Temperature

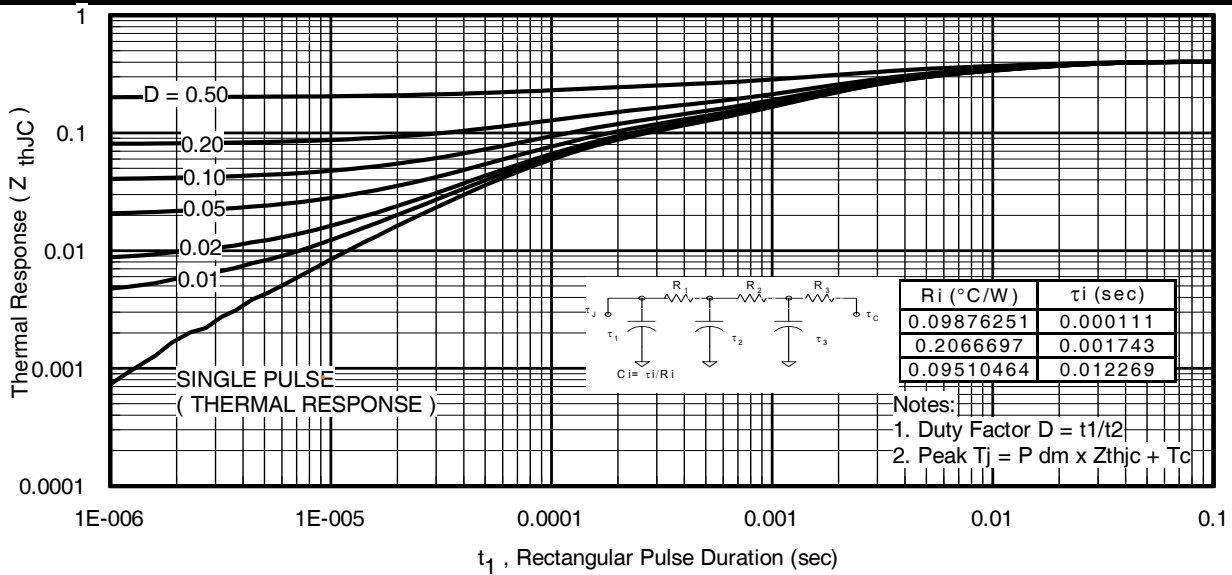


Fig 13. Maximum Effective Transient Thermal Impedance, Junction-to-Case

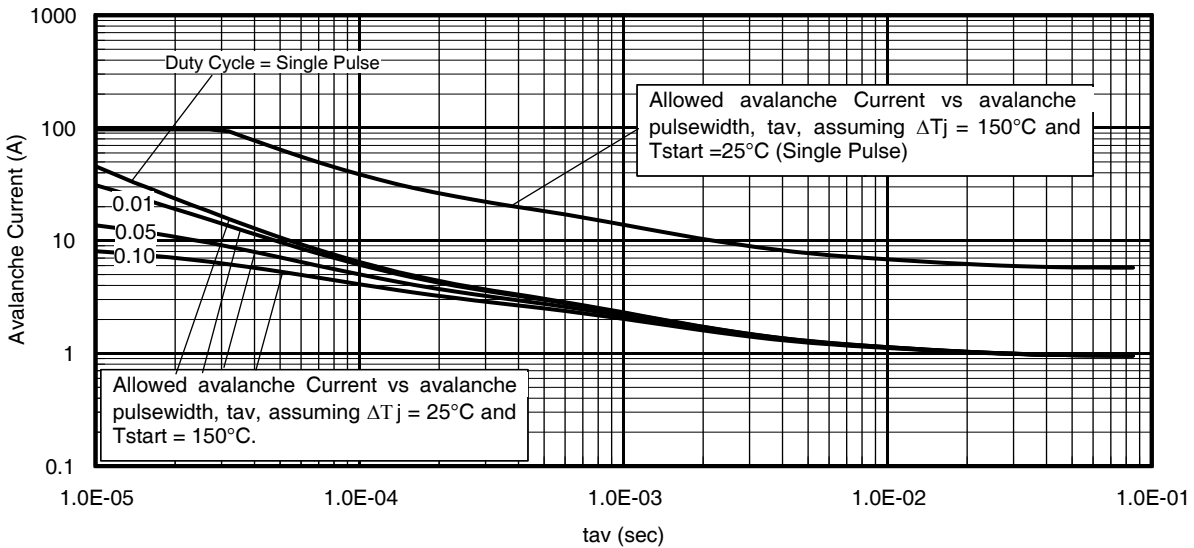
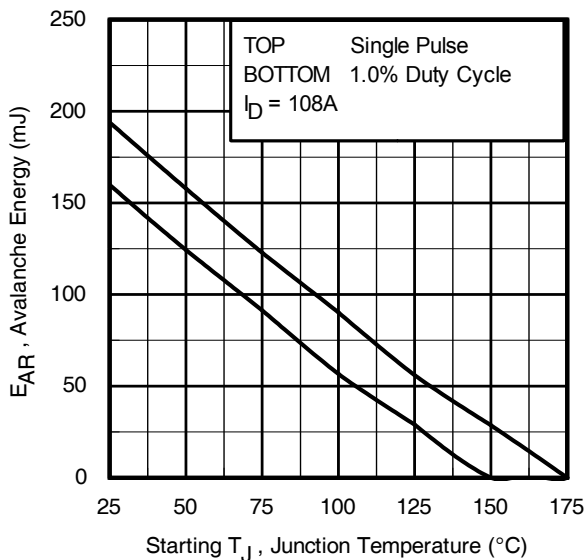


Fig 14. Avalanche Current vs. Pulse width



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

- 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.
- Safe operation in Avalanche is allowed as long as T_{jmax} is not exceeded.
- Equation below based on circuit and waveforms shown in Figures 22a,22b.
- P_D (ave) = Average power dissipation per single avalanche pulse.
- BV = Rated breakdown voltage (1.3 factor accounts for voltage increase during avalanche).
- I_{av} = Allowable avalanche current.
- ΔT = Allowable rise in junction temperature, not exceed T_{jmax} (assumed as $25^{\circ}C$ 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

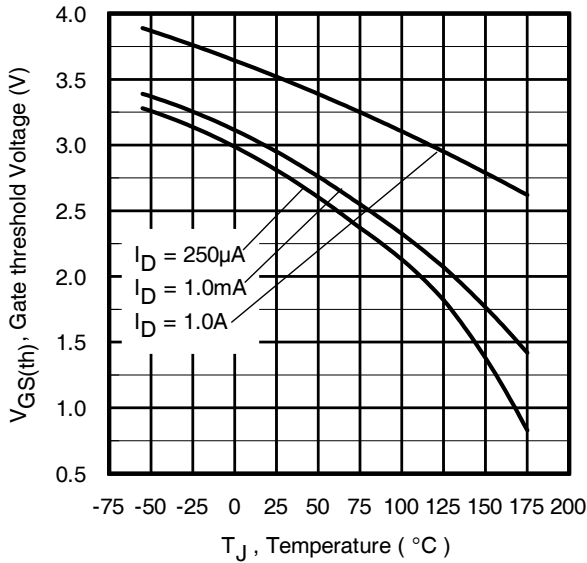


Fig 16. Threshold Voltage vs. Temperature

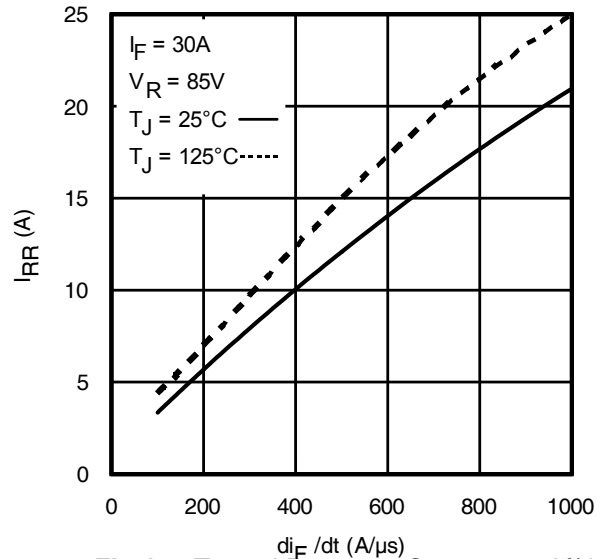


Fig 17. Typical Recovery Current vs. di/dt

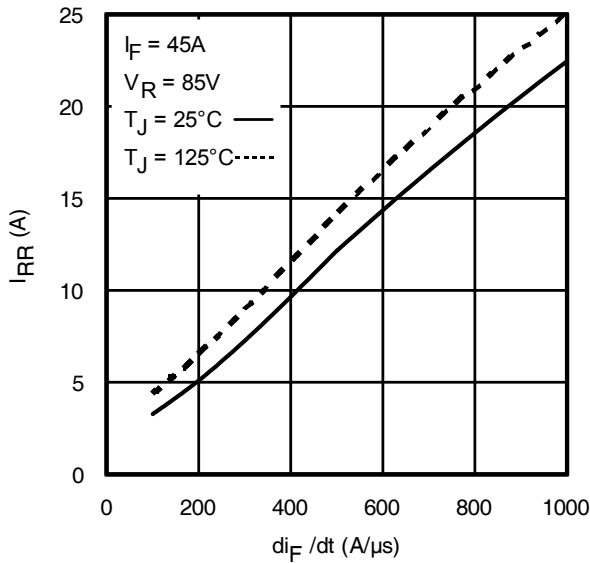


Fig 18. Typical Recovery Current vs. di/dt

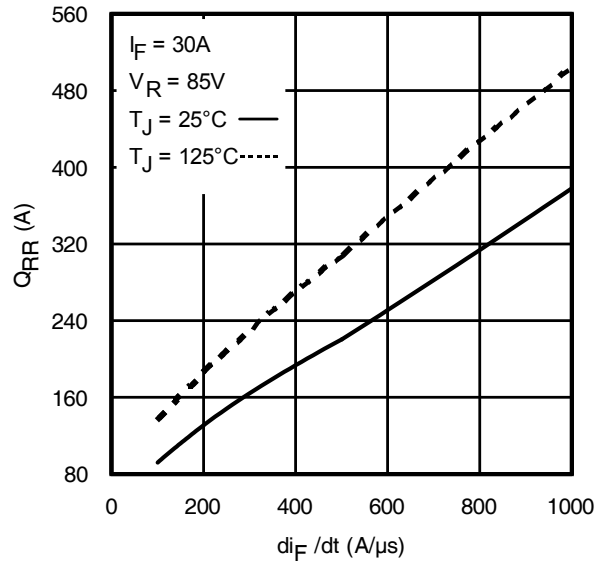


Fig 19. Typical Stored Charge vs. di/dt

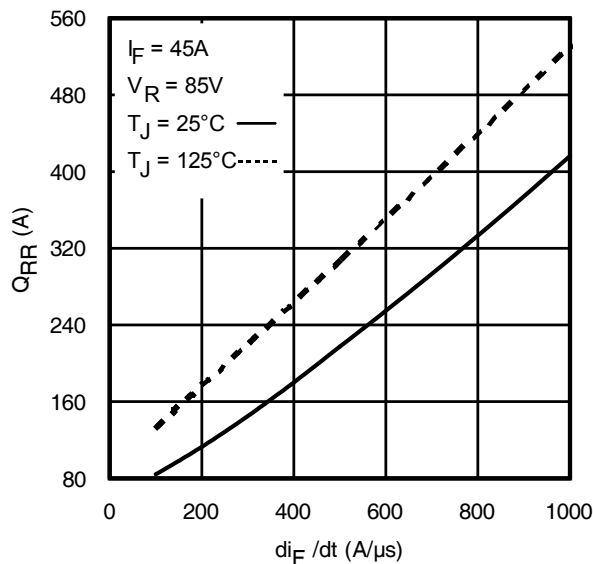


Fig 20. Typical Stored Charge vs. di/dt

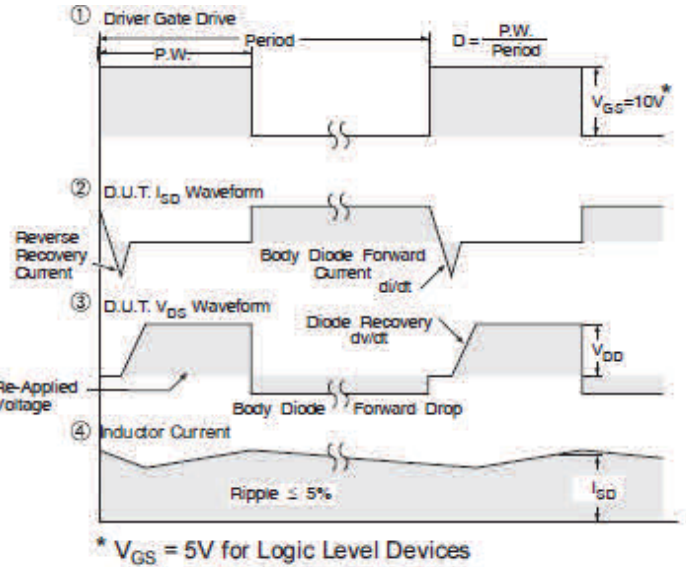
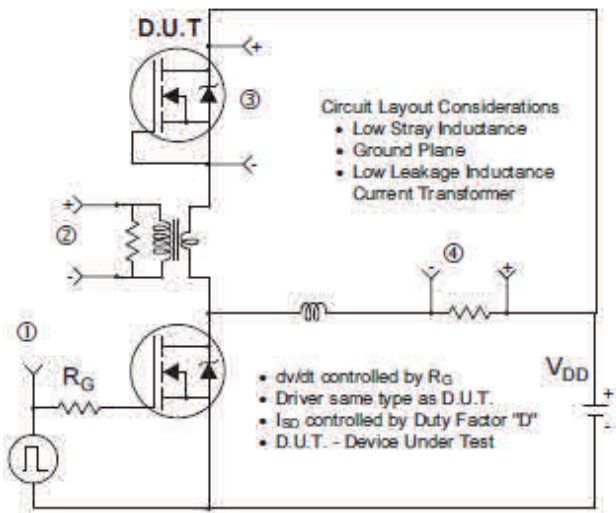


Fig 21. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

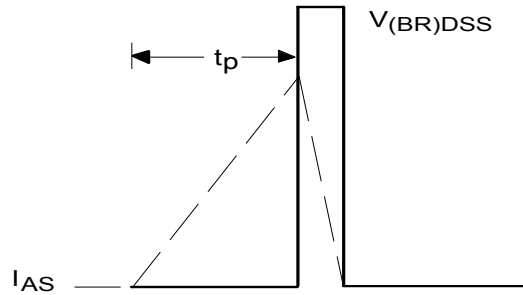
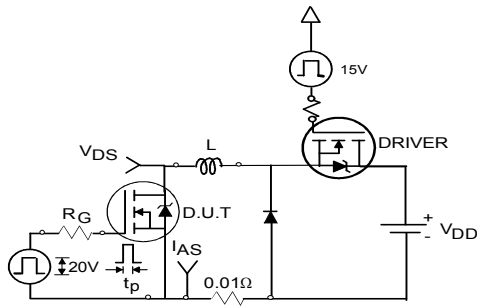


Fig 22a. Unclamped Inductive Test Circuit

Fig 22b. Unclamped Inductive Waveforms

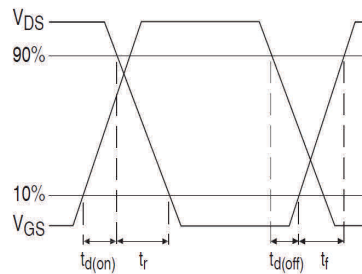
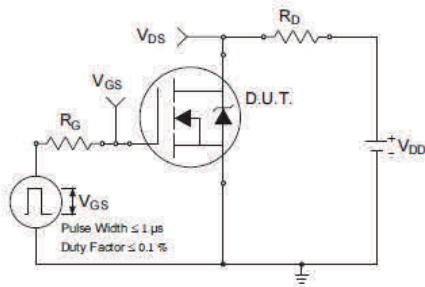


Fig 23a. Switching Time Test Circuit

Fig 23b. Switching Time Waveforms

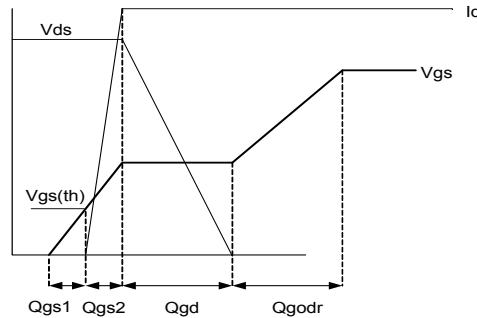
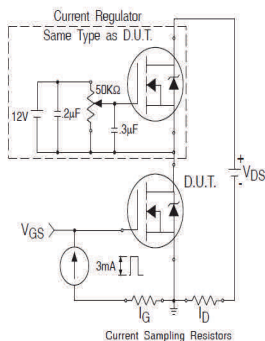
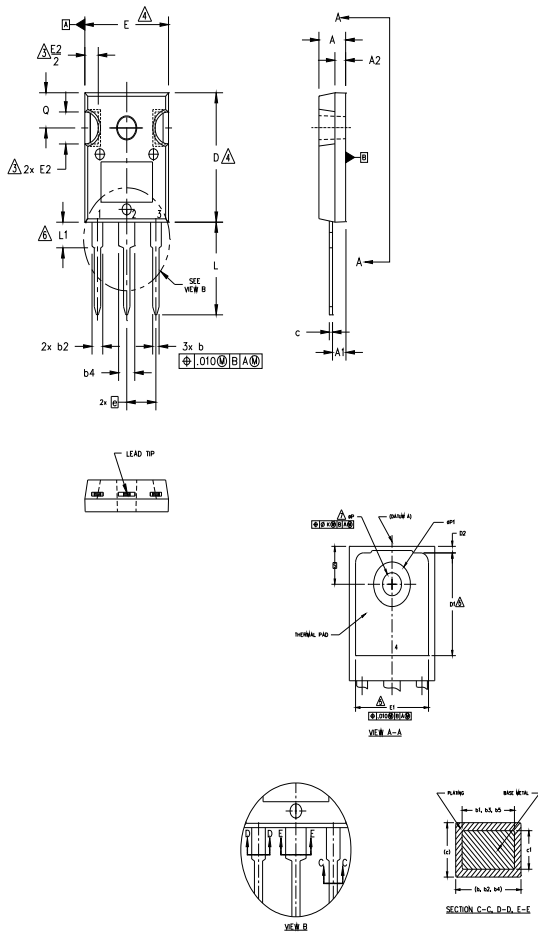


Fig 24a. Gate Charge Test Circuit

Fig 24b. Gate Charge Waveform

TO-247AC Package Outline

Dimensions are shown in millimeters (inches)



- NOTES:
1. DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M 1994.
 2. DIMENSIONS ARE SHOWN IN INCHES.
 3. CONTOUR OF SLOT OPTIONAL.
 4. DIMENSION D & 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. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS D1 & E1.
 6. LEAD FINISH UNCONTROLLED IN L1.
 7. ØP TO HAVE A MAXIMUM DRAFT ANGLE OF 1.5 ° TO THE TOP OF THE PART WITH A MAXIMUM HOLE DIAMETER OF .154 INCH.
 8. OUTLINE CONFORMS TO JEDEC OUTLINE TO-247AC .

SYMBOL	DIMENSIONS				NOTES
	INCHES		MILLIMETERS		
	MIN.	MAX.	MIN.	MAX.	
A	.183	.209	4.65	5.31	
A1	.087	.102	2.21	2.59	
A2	.059	.098	1.50	2.49	
b	.039	.065	0.99	1.40	
b1	.039	.053	0.99	1.35	
b2	.065	.094	1.65	2.39	
b3	.065	.092	1.65	2.34	
b4	.102	.135	2.59	3.43	
b5	.102	.133	2.59	3.38	
c	.015	.035	0.38	0.89	
c1	.015	.033	0.38	0.84	
D	.776	.815	19.71	20.70	4
D1	.515	-	13.08	-	5
D2	.020	.053	0.51	1.35	
E	.602	.625	15.29	15.87	4
E1	.530	-	13.46	-	
E2	.178	.216	4.52	5.49	
e	.215 BSC		5.46 BSC		
Øk	.010		0.25		
L	.559	.634	14.20	16.10	
L1	.146	.169	3.71	4.29	
ØP	.140	.144	3.56	3.66	
ØP1	-	.291	-	7.39	
Q	.209	.224	5.31	5.69	
S	.217 BSC		5.51 BSC		

LEAD ASSIGNMENTS

HEXFET

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

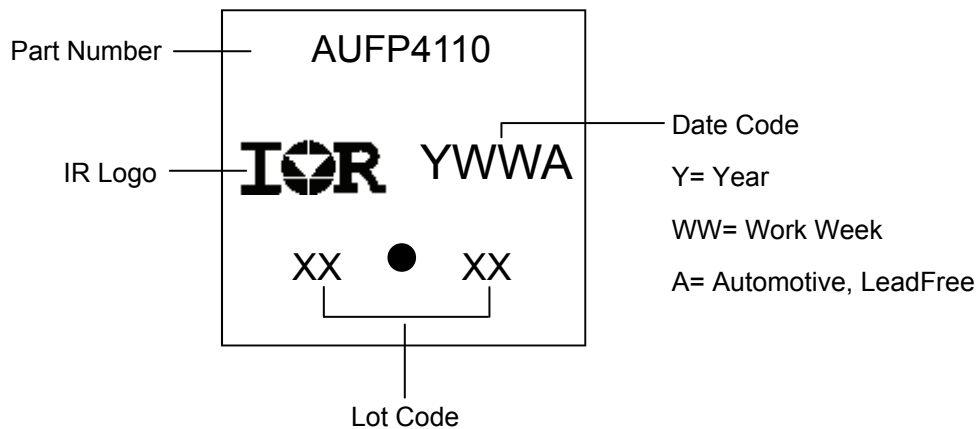
IGBTs, CoPACK

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

DIODES

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

TO-247AC Part Marking Information



TO-247AC package is not recommended for Surface Mount Application.

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

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IR warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with IR's standard warranty. Testing and other quality control techniques are used to the extent IR deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

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

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

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