

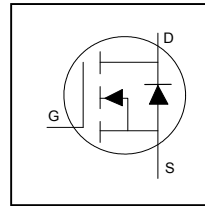
**Features**

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

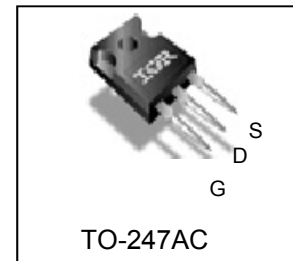
**Description**

Specifically designed for Automotive applications, this HEXFET® Power MOSFETs utilizes the latest processing techniques to achieve low on-resistance per silicon area. This benefit combined with the fast switching speed and ruggedized device design that HEXFET power MOSFETs are well known for, provides the designer with an extremely efficient and reliable device for use in Automotive and a wide variety of other applications.

HEXFET® Power MOSFET



<b>V<sub>DSS</sub></b>	<b>300V</b>
<b>R<sub>DS(on)</sub> typ.</b>	<b>56mΩ</b>
	<b>69mΩ</b>
<b>I<sub>D</sub></b>	<b>38A</b>



<b>G</b>	<b>D</b>	<b>S</b>
Gate	Drain	Source

**Ordering Information**

Base part number	Package Type	Standard Pack		Complete Part Number
		Form	Quantity	
AUIRFP4409	TO-247AC	Tube	25	AUIRFP4409

**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 (TA) is 25°C, unless otherwise specified.

	Parameter	Max.	Units
I <sub>D</sub> @ T <sub>C</sub> = 25°C	Continuous Drain Current, V <sub>GS</sub> @ 10V	38	A
I <sub>D</sub> @ T <sub>C</sub> = 100°C	Continuous Drain Current, V <sub>GS</sub> @ 10V	27	
I <sub>DM</sub>	Pulsed Drain Current ①	152	
P <sub>D</sub> @ T <sub>C</sub> = 25°C	Maximum Power Dissipation	341	W
	Linear Derating Factor	2.3	W/°C
V <sub>GS</sub>	Gate-to-Source Voltage	± 20	V
E <sub>AS</sub> (Thermally limited)	Single Pulse Avalanche Energy ②	541	mJ
T <sub>J</sub> T <sub>STG</sub>	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 <sub>θJC</sub>	Junction-to-Case ③	—	0.44	°C/W
R <sub>θCS</sub>	Case-to-Sink, Flat Greased Surface	0.24	—	
R <sub>θJA</sub>	Junction-to-Ambient ④	—	40	

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

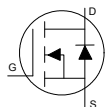
**Static @ T<sub>J</sub> = 25°C (unless otherwise specified)**

	Parameter	Min.	Typ.	Max.	Units	Conditions
V <sub>(BR)DSS</sub>	Drain-to-Source Breakdown Voltage	300	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA
ΔV <sub>(BR)DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temp. Coefficient	—	0.24	—	V/°C	Reference to 25°C, I <sub>D</sub> = 3.5mA
R <sub>DS(on)</sub>	Static Drain-to-Source On-Resistance	—	56	69	mΩ	V <sub>GS</sub> = 10V, I <sub>D</sub> = 24A ④
V <sub>GS(th)</sub>	Gate Threshold Voltage	3.0	—	5.0	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA
I <sub>DSS</sub>	Drain-to-Source Leakage Current	—	—	20	μA	V <sub>DS</sub> = 300V, V <sub>GS</sub> = 0V
		—	—	250		V <sub>DS</sub> = 300V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 125°C
I <sub>GSS</sub>	Gate-to-Source Forward Leakage	—	—	100	nA	V <sub>GS</sub> = 20V
	Gate-to-Source Reverse Leakage	—	—	-100		V <sub>GS</sub> = -20V
R <sub>G</sub>	Gate Resistance	—	1.3	—	Ω	

**Dynamic Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)**

g <sub>fs</sub>	Forward Transconductance	45	—	—	S	V <sub>DS</sub> = 50V, I <sub>D</sub> = 24A
Q <sub>g</sub>	Total Gate Charge	—	83	125	nC	I <sub>D</sub> = 24A
Q <sub>gs</sub>	Gate-to-Source Charge	—	28	42		V <sub>DS</sub> = 150V
Q <sub>gd</sub>	Gate-to-Drain Charge	—	26	39		V <sub>GS</sub> = 10V
t <sub>d(on)</sub>	Turn-On Delay Time	—	18	—	ns	V <sub>DD</sub> = 195V
t <sub>r</sub>	Rise Time	—	23	—		I <sub>D</sub> = 24A
t <sub>d(off)</sub>	Turn-Off Delay Time	—	34	—		R <sub>G</sub> = 2.2Ω
t <sub>f</sub>	Fall Time	—	20	—		V <sub>GS</sub> = 10V
C <sub>iss</sub>	Input Capacitance	—	5168	—	pF	V <sub>GS</sub> = 0V
C <sub>oss</sub>	Output Capacitance	—	300	—		V <sub>DS</sub> = 50V
C <sub>rss</sub>	Reverse Transfer Capacitance	—	77	—		f = 1.0MHz
C <sub>oss eff.(ER)</sub>	Effective Output Capacitance (Energy Related)	—	196	—		V <sub>GS</sub> = 0V, V <sub>DS</sub> = 0V to 240V <sup>⑥</sup>
C <sub>oss eff.(TR)</sub>	Output Capacitance (Time Related)	—	265	—		See Fig.11
						V <sub>GS</sub> = 0V, V <sub>DS</sub> = 0V to 240V <sup>⑤</sup>

**Diode Characteristics**

	Parameter	Min.	Typ.	Max.	Units	Conditions
I <sub>S</sub>	Continuous Source Current (Body Diode) ①	—	—	40	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I <sub>SM</sub>	Pulsed Source Current (Body Diode) ①	—	—	160		
V <sub>SD</sub>	Diode Forward Voltage	—	—	1.3	V	T <sub>J</sub> = 25°C, I <sub>S</sub> = 24A, V <sub>GS</sub> = 0V ④
t <sub>rr</sub>	Reverse Recovery Time	—	302	—	ns	T <sub>J</sub> = 25°C V <sub>DD</sub> = 255V
		—	379	—		T <sub>J</sub> = 125°C I <sub>F</sub> = 24A,
Q <sub>rr</sub>	Reverse Recovery Charge	—	1739	—	nC	T <sub>J</sub> = 25°C di/dt = 100A/μs ④
		—	2497	—		T <sub>J</sub> = 125°C
I <sub>RSM</sub>	Reverse Recovery Current	—	13	—	A	T <sub>J</sub> = 25°C

**Notes:**

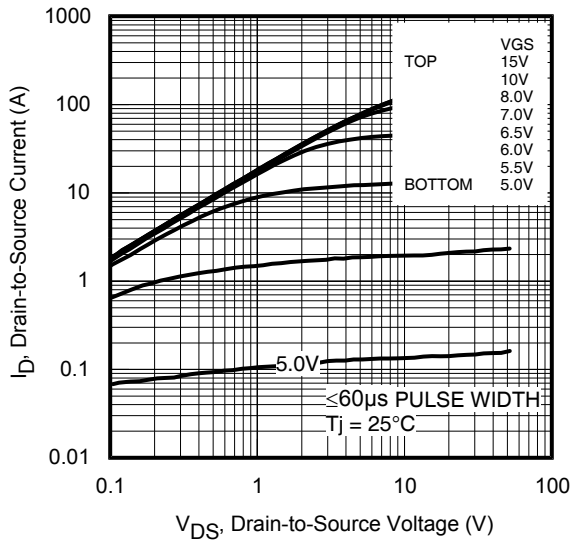
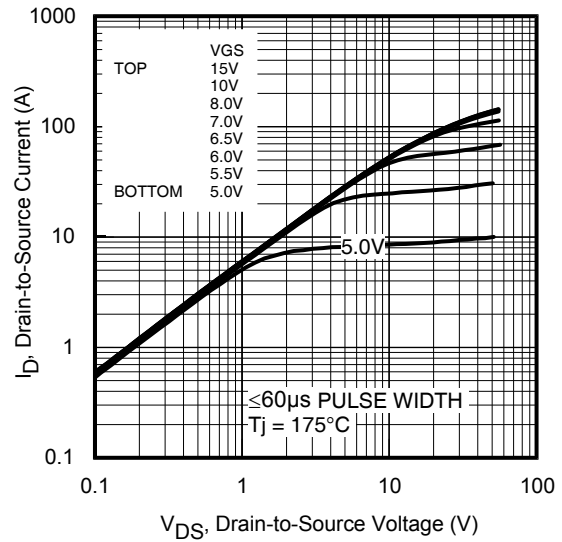
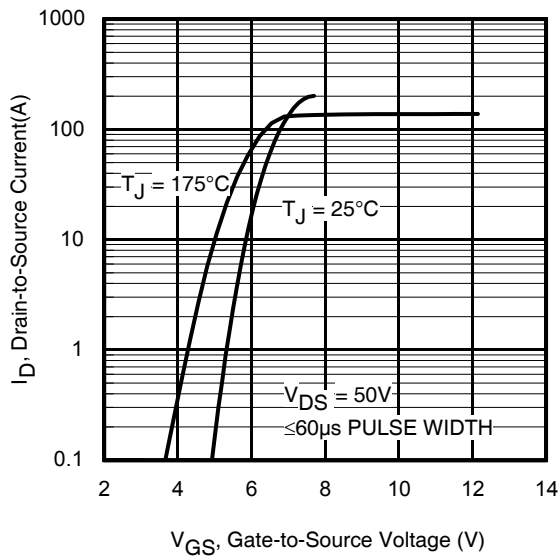
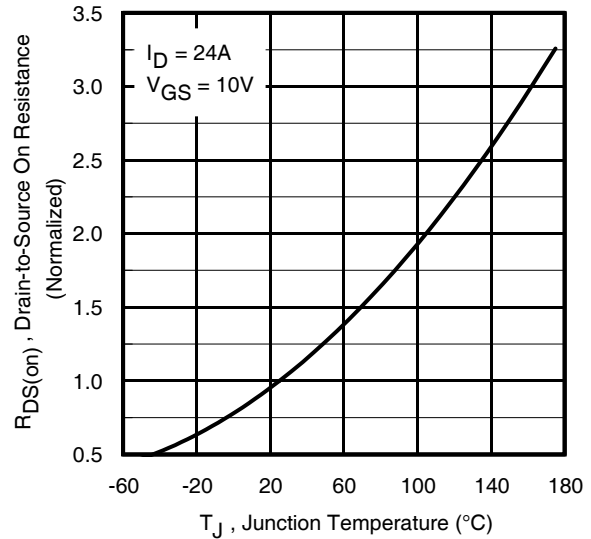
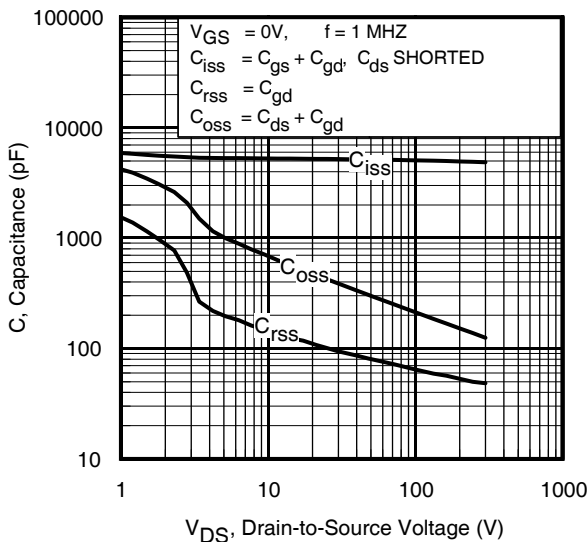
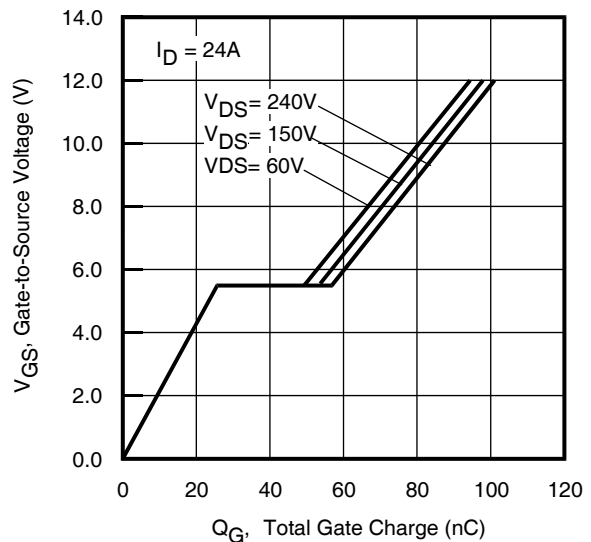
- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Recommended max EAS limit, starting T<sub>J</sub> = 25°C, L = 2.05mH, R<sub>G</sub> = 50Ω, I<sub>AS</sub> = 24A, V<sub>GS</sub> = 10V.
- ③ I<sub>SD</sub> ≤ 24A, di/dt ≤ 1771A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>J</sub> ≤ 175°C.
- ④ Pulse width ≤ 400μs; duty cycle ≤ 2%.
- ⑤ C<sub>oss eff. (TR)</sub> is a fixed capacitance that gives the same charging time as C<sub>oss</sub> while V<sub>DS</sub> is rising from 0 to 80% V<sub>DSS</sub>.
- ⑥ C<sub>oss eff. (ER)</sub> is a fixed capacitance that gives the same energy as C<sub>oss</sub> while V<sub>DS</sub> is rising from 0 to 80% V<sub>DSS</sub>.
- ⑦ When mounted on 1" square PCB (FR-4 or G-10 Material). For recommended footprint and soldering techniques refer to application note #AN-994 [http://www.irf.com/technical-info/app\\_notes/an-994.pdf](http://www.irf.com/technical-info/app_notes/an-994.pdf)
- ⑧ R<sub>θ</sub> is measured at T<sub>J</sub> approximately 90°C

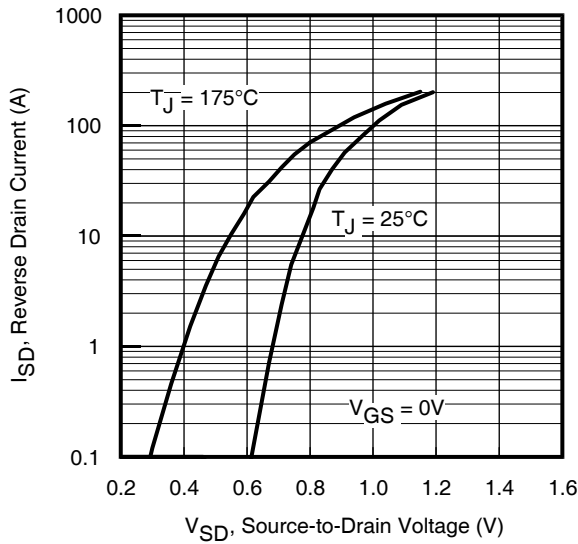
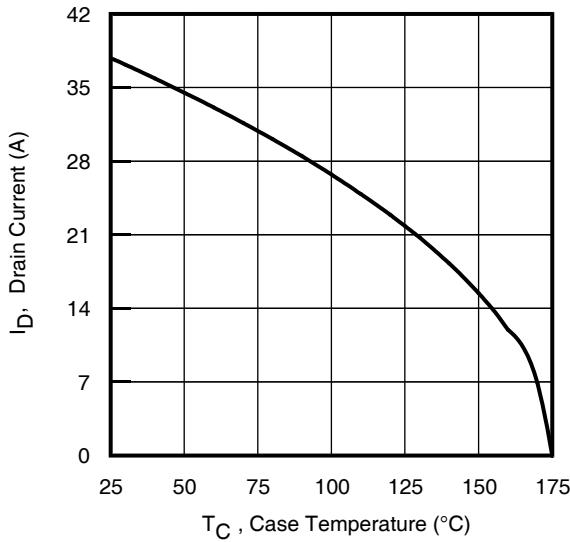
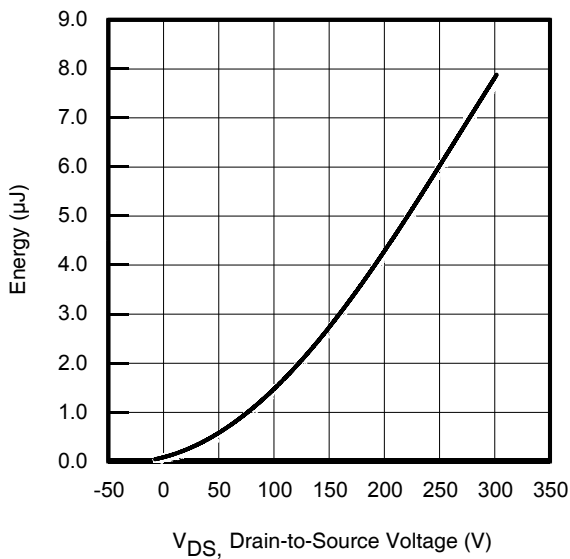
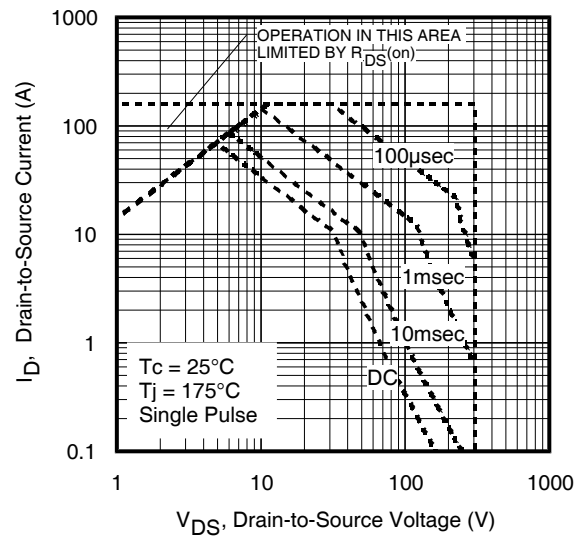
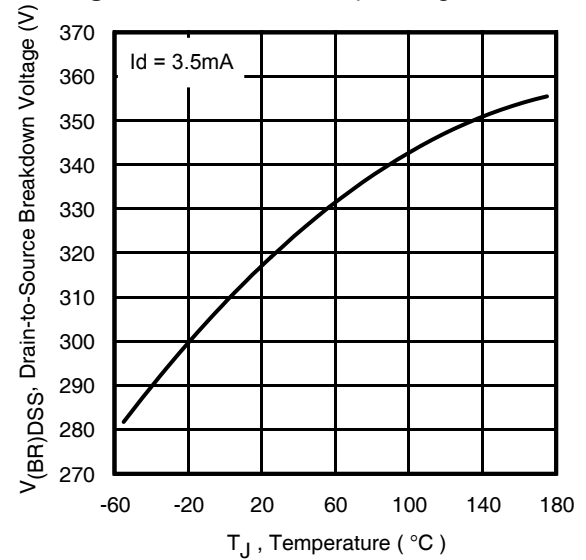
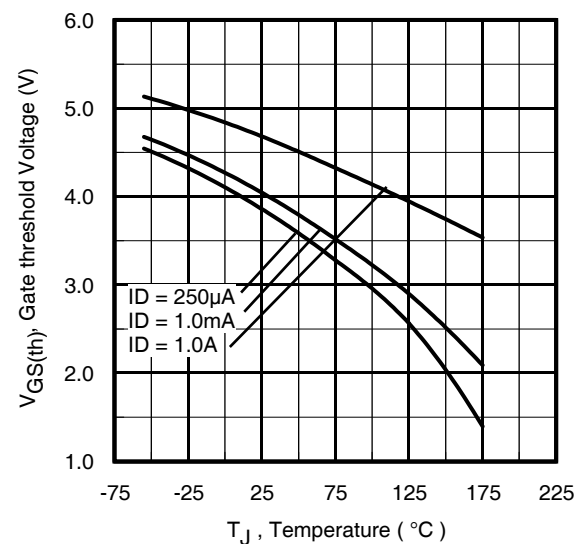
**Qualification Information<sup>†</sup>**

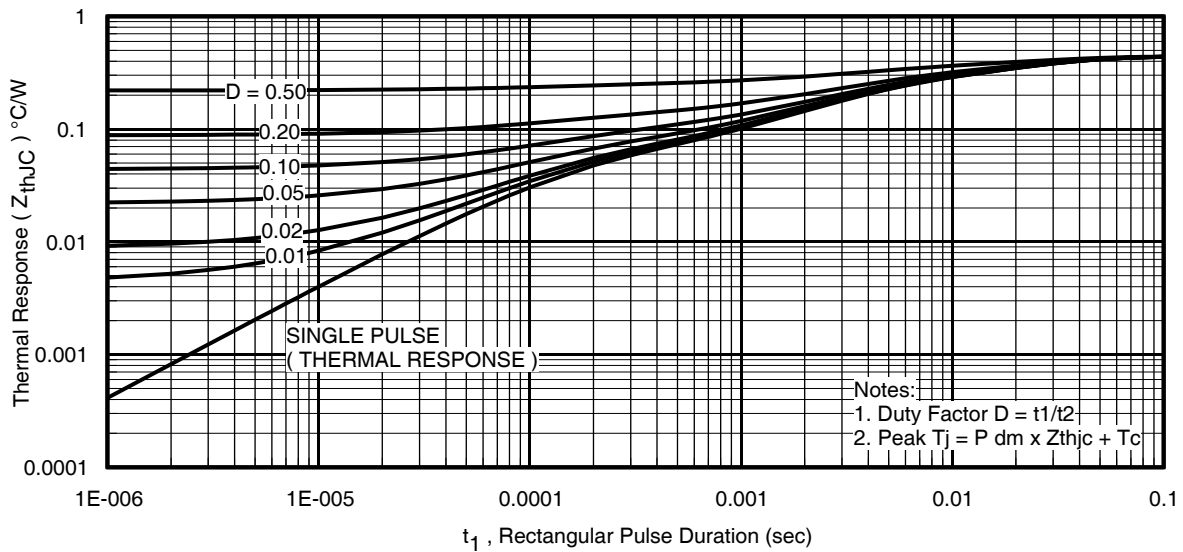
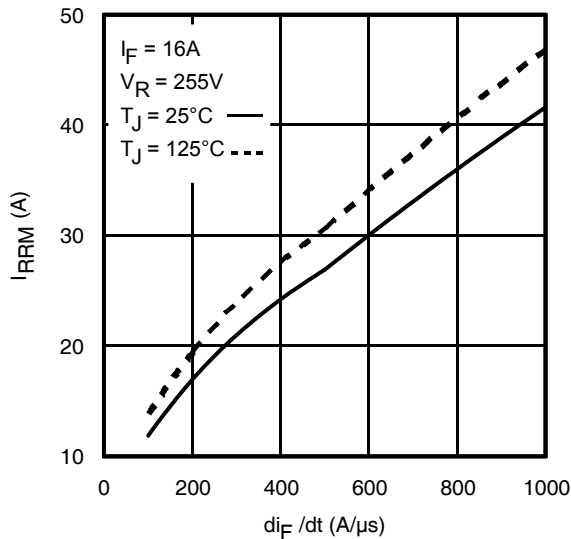
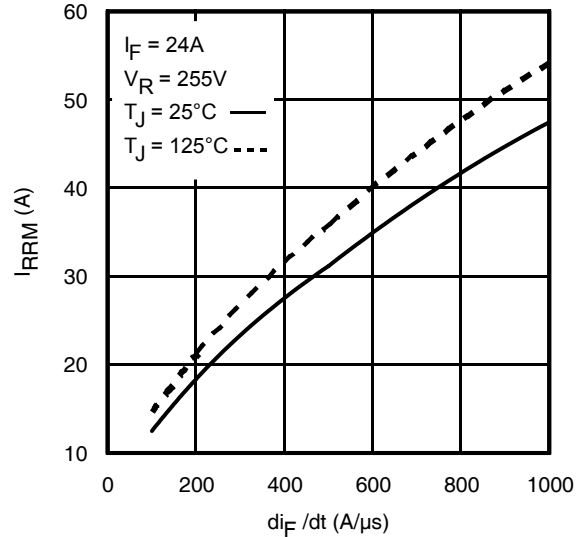
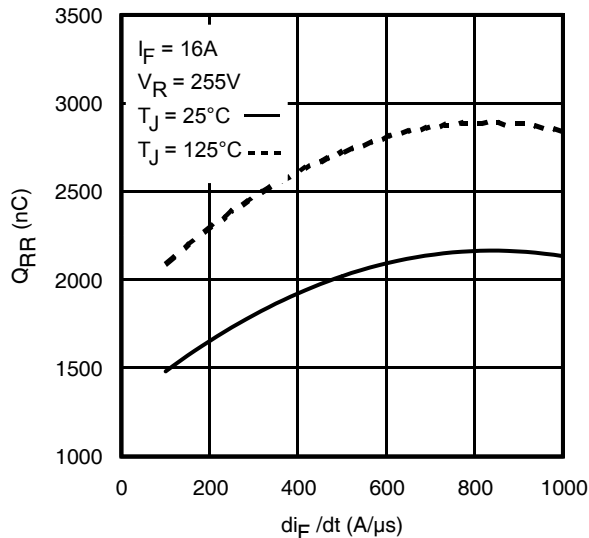
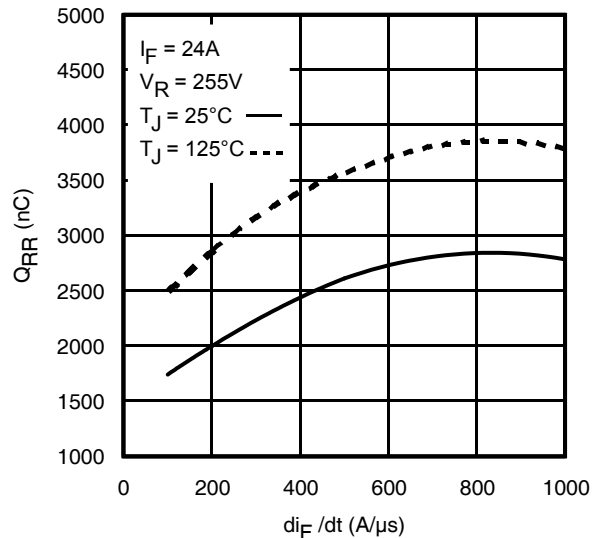
<b>Qualification Level</b>		Automotive (per AEC-Q101)	
		Comments: This part number(s) passed Automotive qualification. IR's Industrial and Consumer qualification level is granted by extension of the higher Automotive level.	
<b>Moisture Sensitivity Level</b>		TO-247AC	N/A
<b>ESD</b>	Machine Model	Class M4 (+/- 500V) <sup>††</sup> AEC-Q101-002	
	Human Body Model	Class H2 (+/- 4000V) <sup>††</sup> AEC-Q101-001	
	Charged Device Model	Class C5 (+/- 2000) <sup>††</sup> AEC-Q101-005	
<b>RoHS Compliant</b>		Yes	

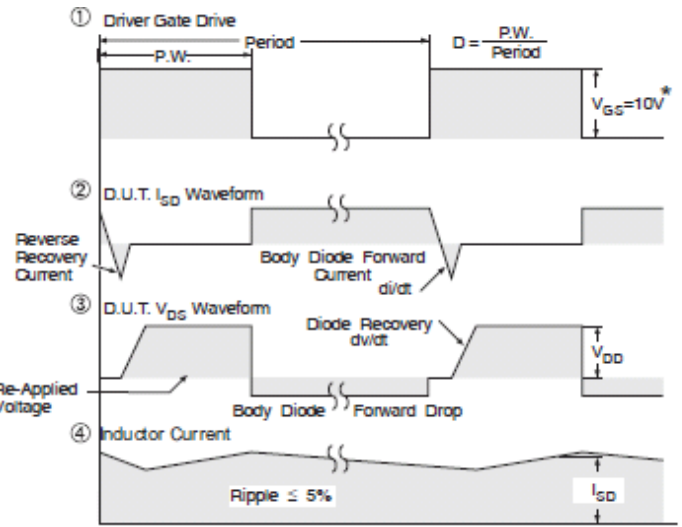
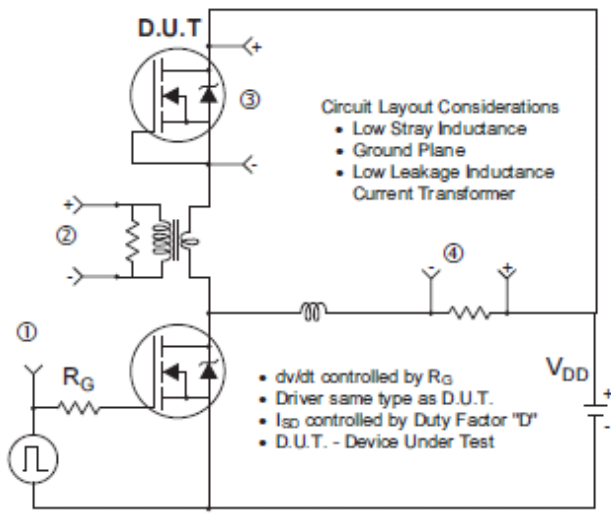
† Qualification standards can be found at International Rectifier's web site: <http://www.irf.com/>

†† 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**

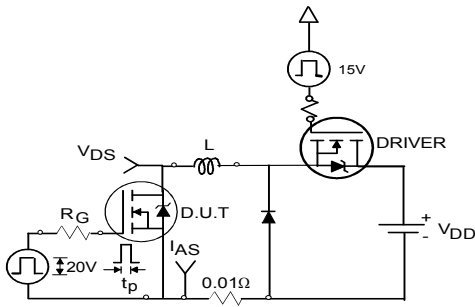

**Fig 7.** Typical Source-Drain Diode Forward Voltage

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

**Fig 11.** Typical  $C_{oss}$  Stored Energy

**Fig 8.** Maximum Safe Operating Area

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

**Fig 12.** Threshold Voltage vs. Temperature


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

**Fig 14.** Typical Recovery Current vs.  $di_F/dt$ 

**Fig 15.** Typical Recovery Current vs.  $di_F/dt$ 

**Fig 16.** Typical Stored Charge vs.  $di_F/dt$ 

**Fig 17.** Typical Stored Charge vs.  $di_F/dt$

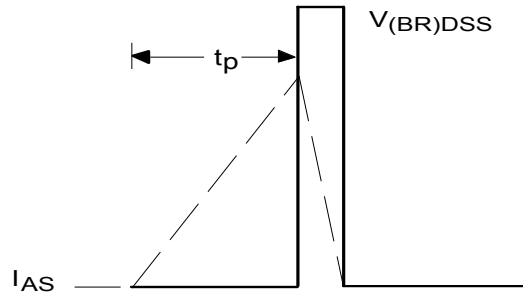


\*  $V_{GS} = 5V$  for Logic Level Devices

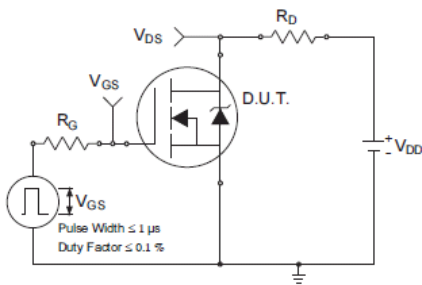
**Fig 18.** Peak Diode Recovery  $dv/dt$  Test Circuit for N-Channel HEXFET® Power MOSFETs



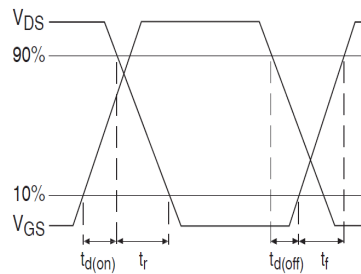
**Fig 19a.** Unclamped Inductive Test Circuit



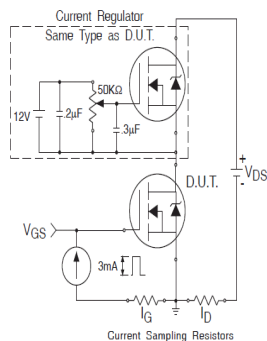
**Fig 19b.** Unclamped Inductive Waveforms



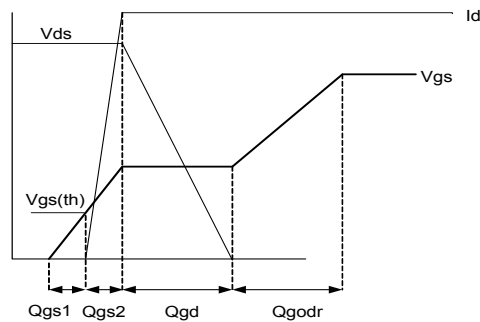
**Fig 20a.** Switching Time Test Circuit



**Fig 20b.** Switching Time Waveforms



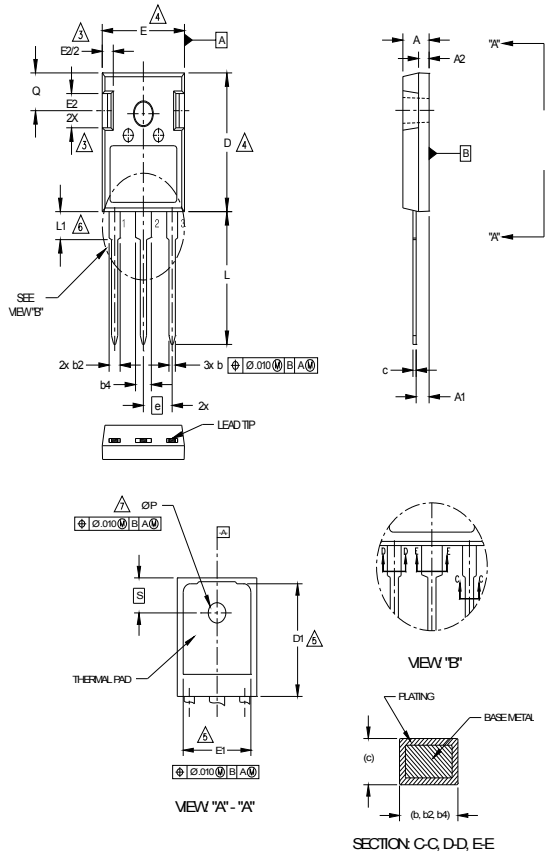
**Fig 21a.** Gate Charge Test Circuit



**Fig 21b.** Gate Charge Waveform

## TO-247AC Package Outline

Dimensions are shown in millimeters (inches)

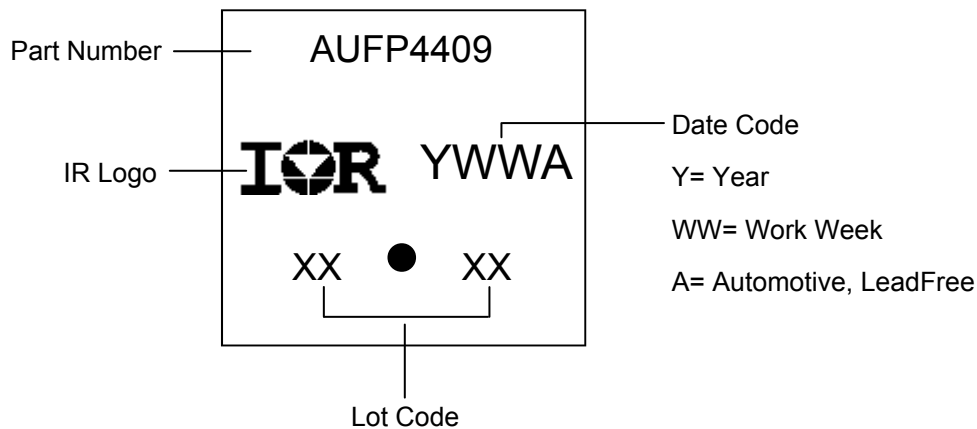


SYMBOL	DIMENSIONS				NOTES
	INCHES		MILLIMETERS		
	MIN.	MAX.	MIN.	MAX.	
A	.190	.204	4.83	5.20	
A1	.090	.100	2.29	2.54	
A2	.075	.085	1.91	2.16	
b	.042	.052	1.07	1.33	
b2	.075	.094	1.91	2.41	
b4	.113	.133	2.87	3.38	
c	.022	.026	0.55	0.68	
D	.819	.830	20.80	21.10	4
D1	.640	.694	16.25	17.65	5
E	.620	.635	15.75	16.13	4
E1	.512	.570	13.00	14.50	
E2	.145	.196	3.68	5.00	
e	.215 Typical		5.45 Typical		
L	.780	.800	19.80	20.32	
L1	.161	.173	4.10	4.40	
∅ P	.138	.143	3.51	3.65	
Q	.216	.236	5.49	6.00	
S	.238	.248	6.04	6.30	

- LEAD ASSIGNMENTS**
- HEXFET**
- GATE
  - DRAIN
  - SOURCE
  - DRAIN
- IGBTs, CoPACK**
- GATE
  - COLLECTOR
  - EMITTER
  - COLLECTOR
- DIODES**
- ANODE/OPEN
  - CATHODE
  - ANODE

- NOTES:**
- DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M 1994.
  - DIMENSIONS ARE SHOWN IN INCHES AND MILLIMETERS.
  - CONTOUR OF SLOT OPTIONAL.
  - 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.
  - THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS D1 & E1.
  - LEAD FINISH UNCONTROLLED IN L1.
  - ∅ P TO HAVE A MAXIMUM DRAFT ANGLE OF 1.5° TO THE TOP OF THE PART WITH A MAXIMUM HOLE DIAMETER OF .154 INCH.

## 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/>



**IMPORTANT NOTICE**

Unless specifically designated for the automotive market, International Rectifier Corporation and its subsidiaries (IR) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or services without notice. Part numbers designated with the "AU" prefix follow automotive industry and / or customer specific requirements with regards to product discontinuance and process change notification. All products are sold subject to IR's terms and conditions of sale supplied at the time of order acknowledgment.

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.

IR assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using IR components. To minimize the risks with customer products and applications, customers should provide adequate design and operating safeguards.

Reproduction of IR information in IR data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alterations is an unfair and deceptive business practice. IR is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of IR products or serviced with statements different from or beyond the parameters stated by IR for that product or service voids all express and any implied warranties for the associated IR product or service and is an unfair and deceptive business practice. IR is not responsible or liable for any such statements.

IR products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or in other applications intended to support or sustain life, or in any other application in which the failure of the IR product could create a situation where personal injury or death may occur. Should Buyer purchase or use IR products for any such unintended or unauthorized application, Buyer shall indemnify and hold International Rectifier and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that IR was negligent regarding the design or manufacture of the product.

Only products certified as military grade by the Defense Logistics Agency (DLA) of the US Department of Defense, are designed and manufactured to meet DLA military specifications required by certain military, aerospace or other applications. Buyers acknowledge and agree that any use of IR products not certified by DLA as military-grade, in applications requiring military grade products, is solely at the Buyer's own risk and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

IR products are neither designed nor intended for use in automotive applications or environments unless the specific IR products are designated by IR as compliant with ISO/TS 16949 requirements and bear a part number including the designation "AU". Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, IR will not be responsible for any failure to meet such requirements.

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

# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[International Rectifier:](#)

[AUIRFP4409](#)