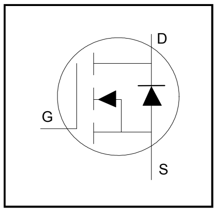
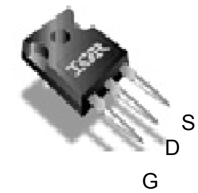
HEXFET® Power MOSFET

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 *



V_{DSS}		300V
$R_{DS(on)}$	typ.	56mΩ
	max	69mΩ
I_D		38A

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.



TO-247AC

G	D	S
Gate	Drain	Source

Ordering Information

Base part number	Package Type	Standard Pack Form	Standard Pack Quantity	Complete Part Number
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_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V	38	A
I_D @ T_C = 100°C	Continuous Drain Current, V_{GS} @ 10V	27	
I_{DM}	Pulsed Drain Current ①	152	
P_D @T_C = 25°C	Maximum Power Dissipation	341	W
	Linear Derating Factor	2.3	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
$E_{AS\ (Thermally\ limited)}$	Single Pulse Avalanche Energy ②	541	mJ
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
$R_{\theta JC}$	Junction-to-Case ⑧	——	0.44	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat Greased Surface	0.24	——	
$R_{\theta JA}$	Junction-to-Ambient ⑦	——	40	

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

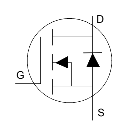
Static @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	300	—	—	V	V_{GS} = 0V, I_D = 250μA
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.24	—	V/°C	Reference to 25°C, I_D = 3.5mA
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	56	69	mΩ	V_{GS} = 10V, I_D = 24A ④
$V_{GS(th)}$	Gate Threshold Voltage	3.0	—	5.0	V	V_{DS} = V_{GS}, I_D = 250μA
I_{DSS}	Drain-to-Source Leakage Current	—	—	20	μA	V_{DS} =300 V, V_{GS} = 0V
		—	—	250		V_{DS} =300V,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)

	Parameter	Min.	Typ.	Max.	Units	Conditions
gfs	Forward Transconductance	45	—	—	S	V_{DS} = 50V, I_D =24A
Q_g	Total Gate Charge	—	83	125	nC	I_D = 24A
Q_{gs}	Gate-to-Source Charge	—	28	42		V_{DS} = 150V
Q_{gd}	Gate-to-Drain Charge	—	26	39		V_{GS} = 10V
$t_{d(on)}$	Turn-On Delay Time	—	18	—	ns	V_{DD} = 195V
t_r	Rise Time	—	23	—		I_D = 24A
$t_{d(off)}$	Turn-Off Delay Time	—	34	—		R_G= 2.2Ω
t_f	Fall Time	—	20	—		V_{GS} = 10V
C_{iss}	Input Capacitance	—	5168	—	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	—	300	—		V_{DS} = 50V
C_{rss}	Reverse Transfer Capacitance	—	77	—		f = 1.0MHz
$C_{oss\ eff.(ER)}$	Effective Output Capacitance (Energy Related)	—	196	—		V_{GS} = 0V, VDS = 0V to 240V⑥ See Fig.11
$C_{oss\ eff.(TR)}$	Output Capacitance (Time Related)	—	265	—		V_{GS} = 0V, VDS = 0V to 240V⑤

Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)①	—	—	40	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	160		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	T_J = 25°C,I_S = 24A,V_{GS} = 0V ④
t_{rr}	Reverse Recovery Time	—	302	—	ns	T_J = 25°C V_{DD} = 255V
		—	379	—		T_J = 125°C I_F = 24A,
Q_{rr}	Reverse Recovery Charge	—	1739	—	nC	T_J = 25°C di/dt = 100A/μs ④
		—	2497	—		T_J = 125°C
I_{RRM}	Reverse Recovery Current	—	13	—	A	T_J = 25°C

Notes:

① Repetitive rating; pulse width limited by max. junction temperature.
② Recommended max EAS limit, starting T_J = 25°C, L = 2.05mH, R_G = 50Ω, I_{AS} = 24A, V_{GS} =10V.
③ $I_{SD} \leq$ 24A, di/dt $\leq$ 1771A/μs, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq$ 175°C.
④ Pulse width $\leq$ 400μs; duty cycle $\leq$ 2%.
⑤ 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}.
⑥ 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}.
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
⑧ Rθ 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 (+/- 500V)[††] AEC-Q101-002	
	Human Body Model	Class H2 (+/- 4000V)[††] 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.

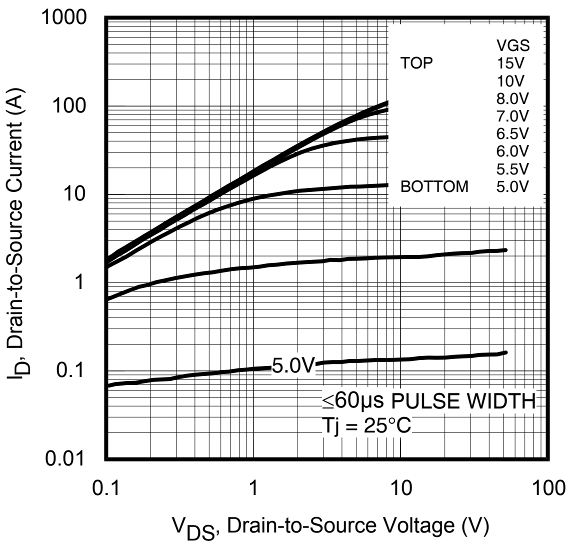


Fig 1. Typical Output Characteristics

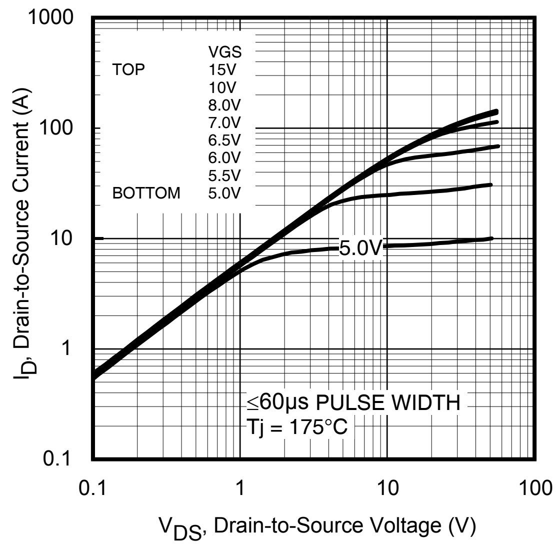


Fig 2. Typical Output Characteristics

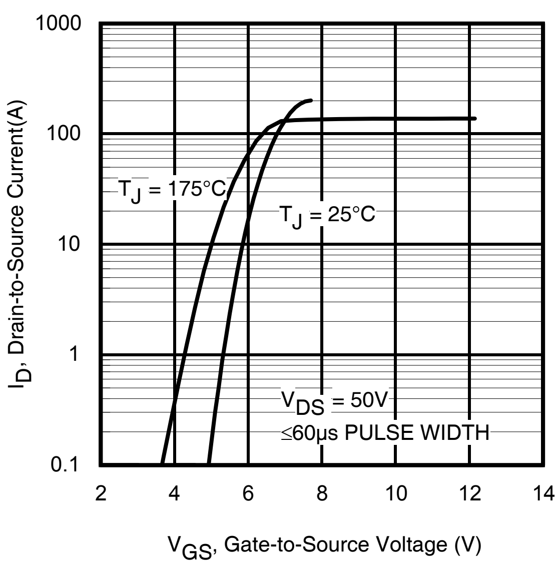


Fig 3. Typical Transfer Characteristics

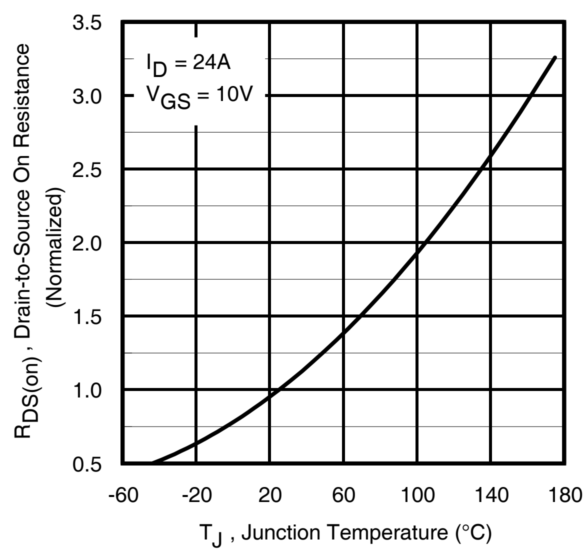


Fig 4. Normalized On-Resistance vs. Temperature

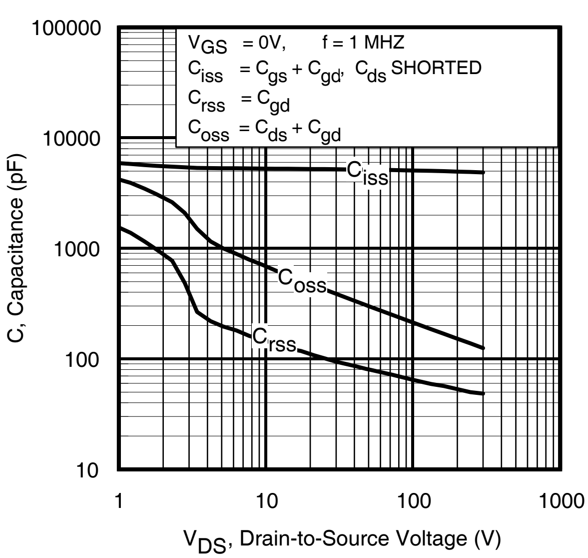


Fig 5. Typical Capacitance vs. Drain-to-Source Voltage

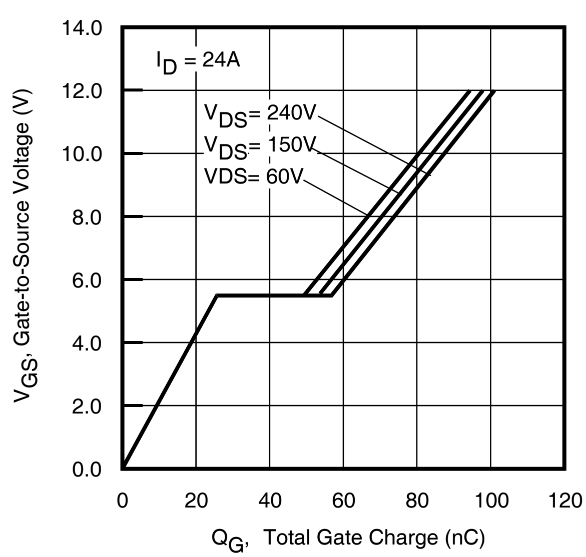


Fig 6. Typical Gate Charge vs. Gate-to-Source Voltage

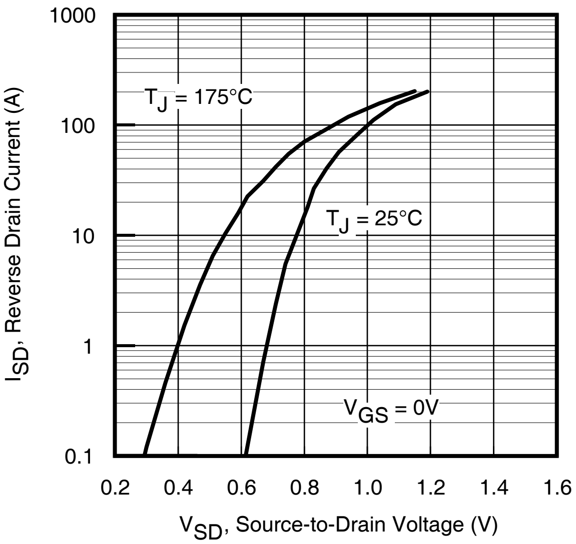


Fig 7. Typical Source-Drain Diode Forward Voltage

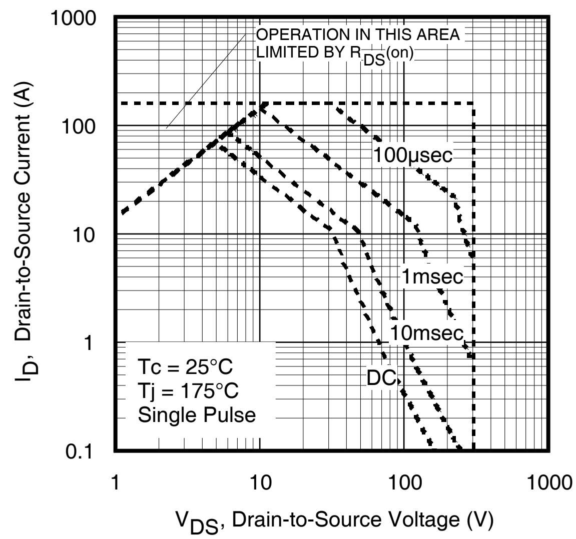


Fig 8. Maximum Safe Operating Area

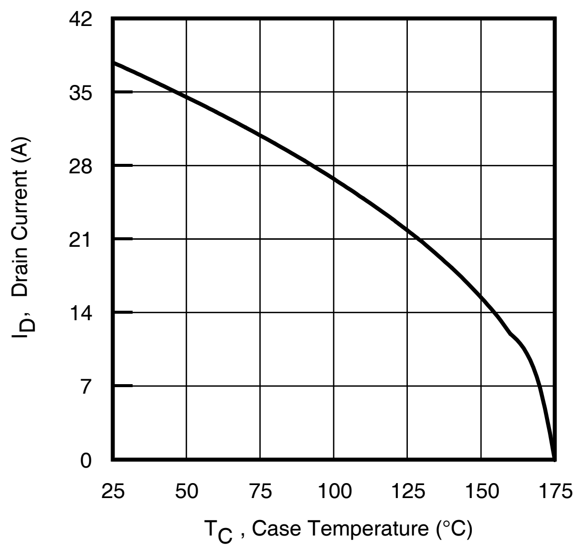


Fig 9. Maximum Drain Current vs. Case Temperature

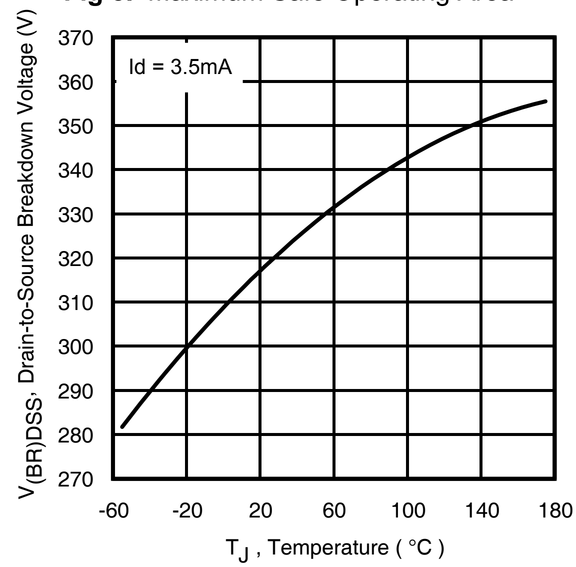


Fig 10. Drain-to–Source Breakdown Voltage

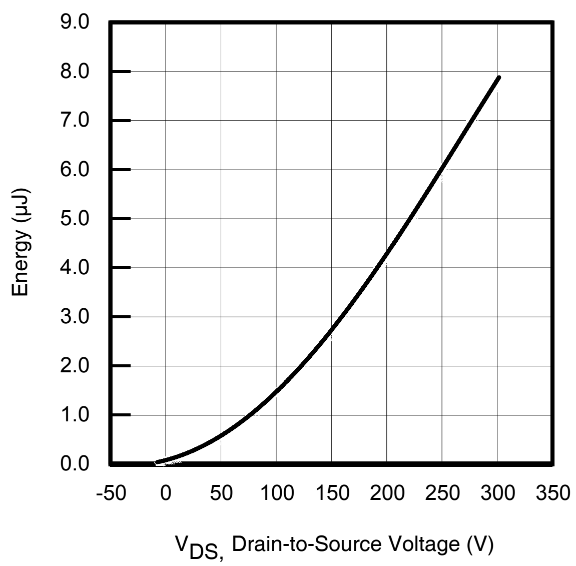


Fig 11. Typical C_{oss} Stored Energy

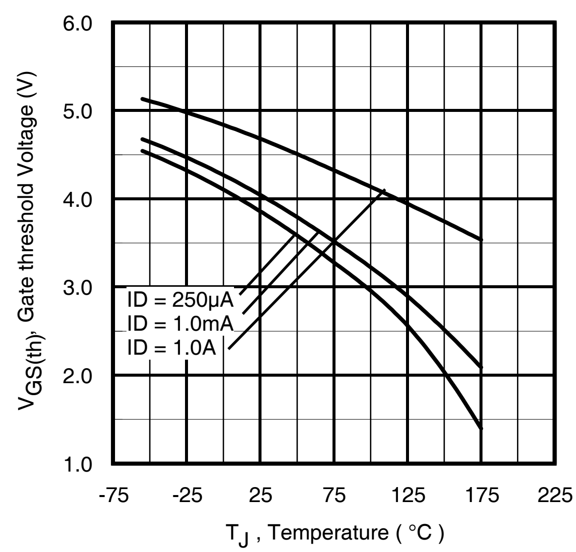


Fig 12. Threshold Voltage vs. Temperature

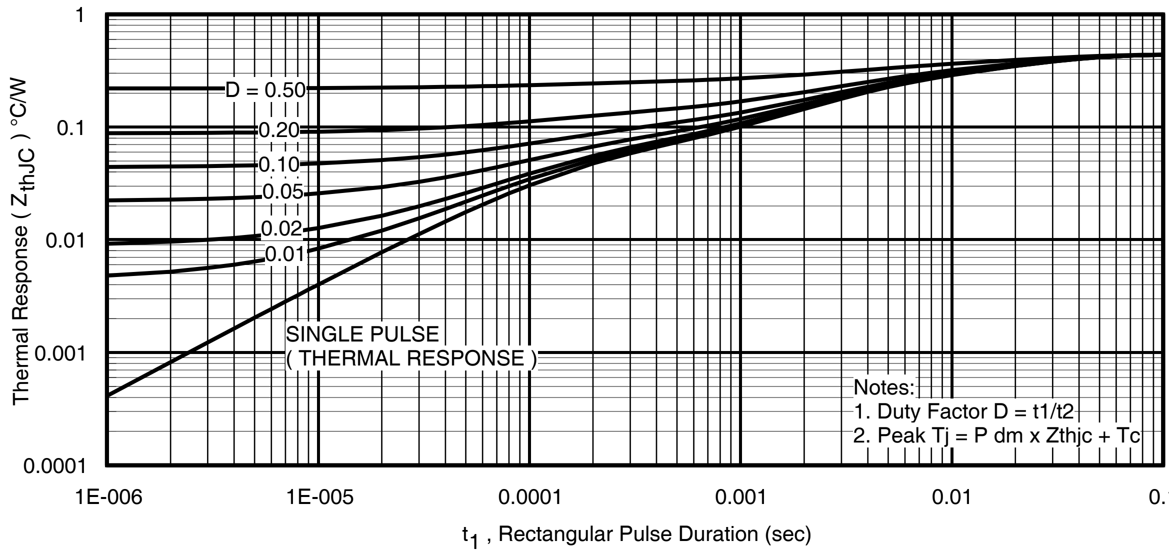


Fig 13. Maximum Effective Transient Thermal Impedance, Junction-to-Case

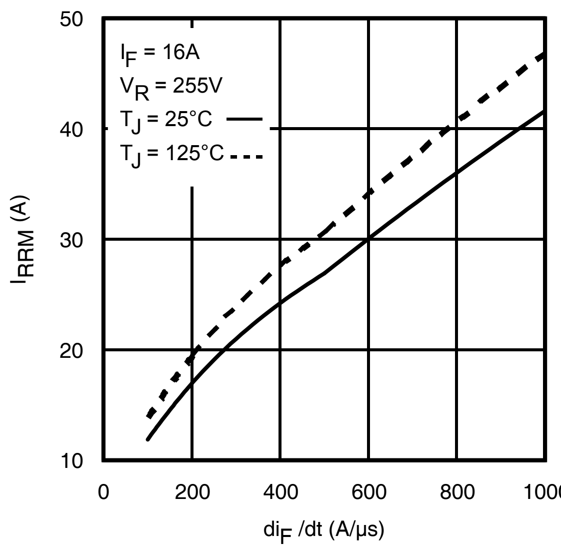


Fig 14. Typical Recovery Current vs. dif/dt

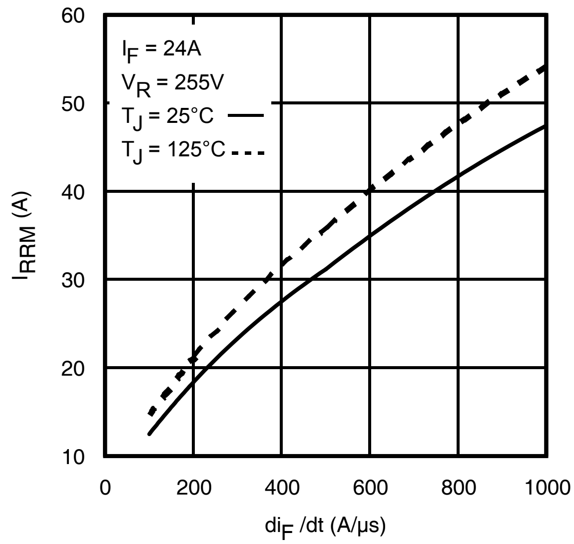


Fig 15. Typical Recovery Current vs. dif/dt

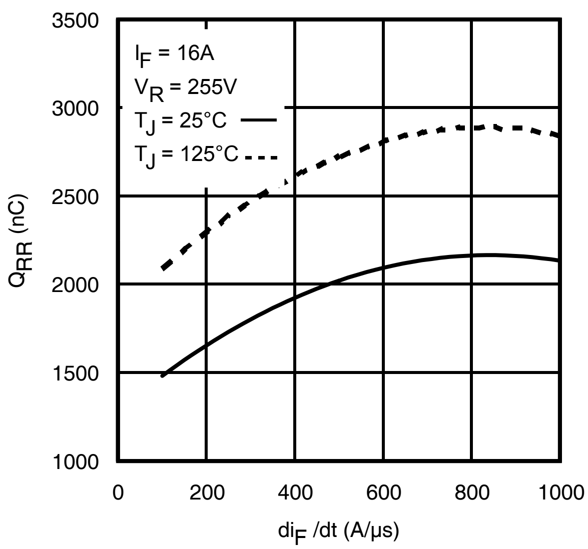


Fig 16. Typical Stored Charge vs. dif/dt

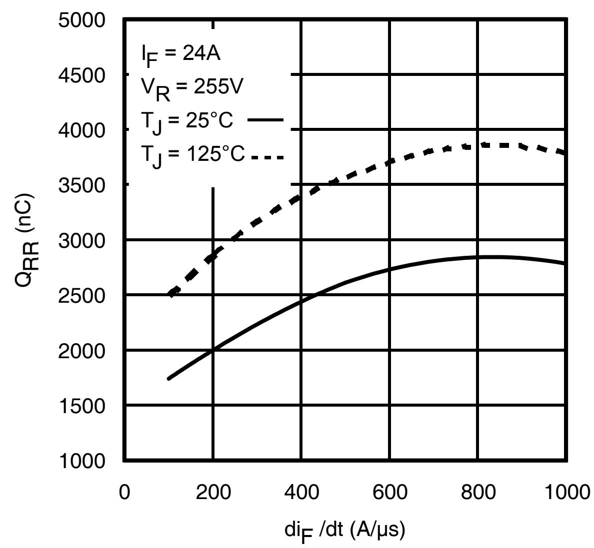


Fig 17. Typical Stored Charge vs. dif/dt

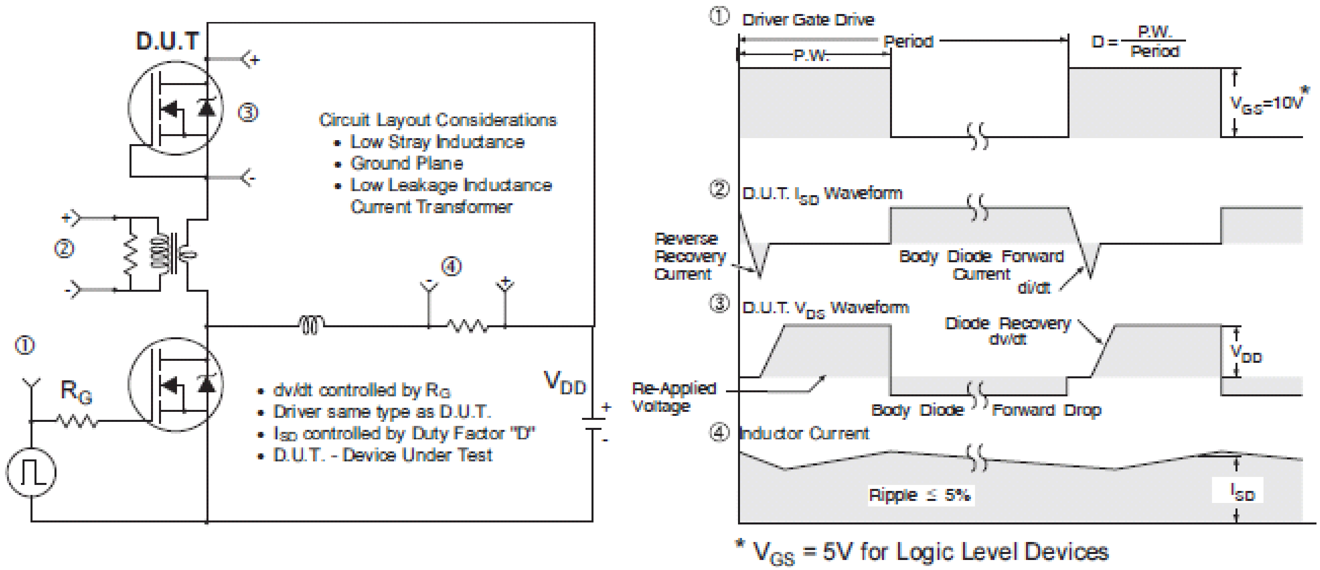


Fig 18. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

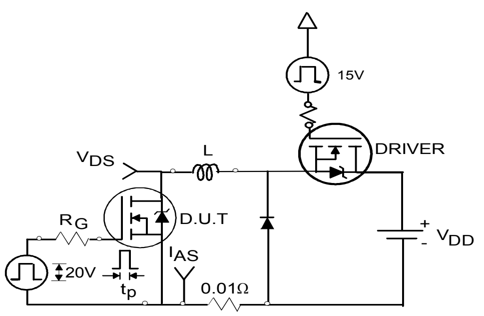


Fig 19a. Unclamped Inductive Test Circuit

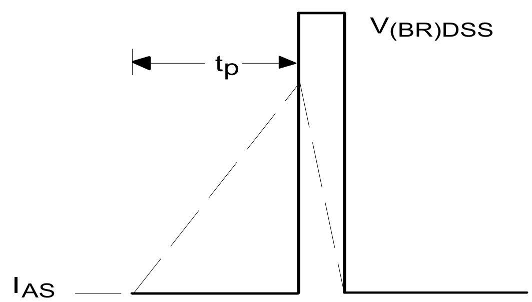


Fig 19b. Unclamped Inductive Waveforms

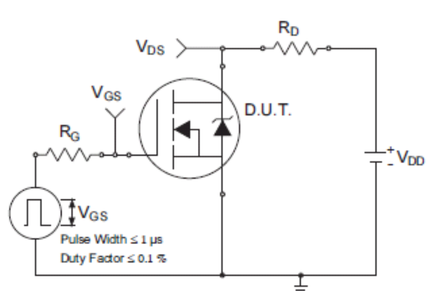


Fig 20a. Switching Time Test Circuit

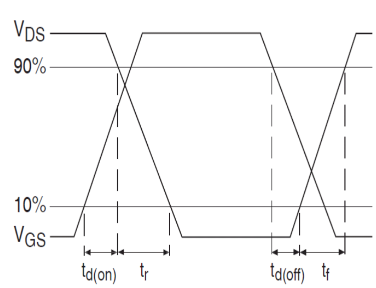


Fig 20b. Switching Time Waveforms

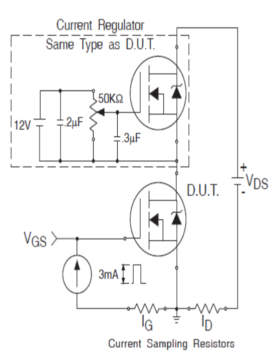


Fig 21a. Gate Charge Test Circuit

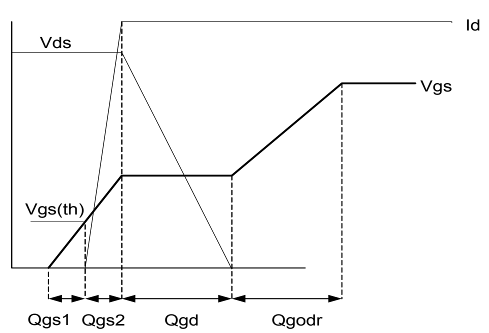
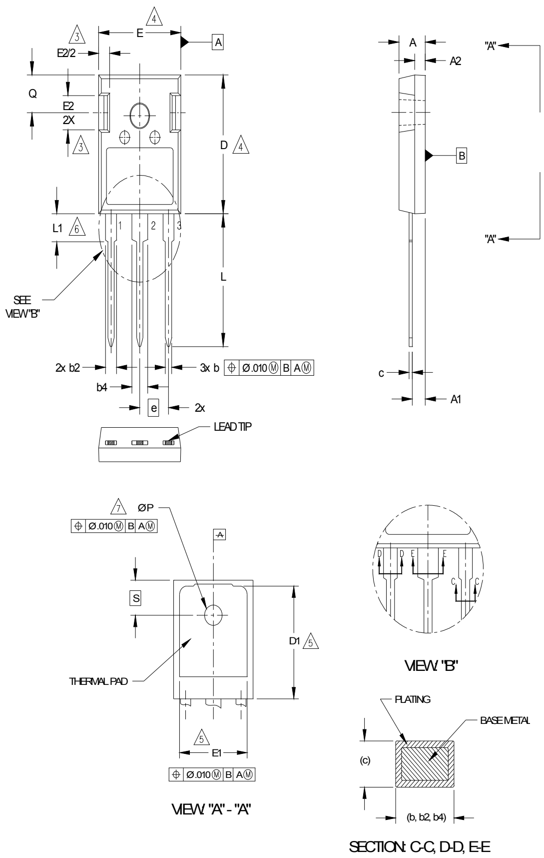


Fig 21b. Gate Charge Waveform

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	
ø P	.138	.143	3.51	3.65	
Q	.216	.236	5.49	6.00	
S	.238	.248	6.04	6.30	

LEAD ASSIGNMENTS

HEXFET

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

IGBTs, CoPACK

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

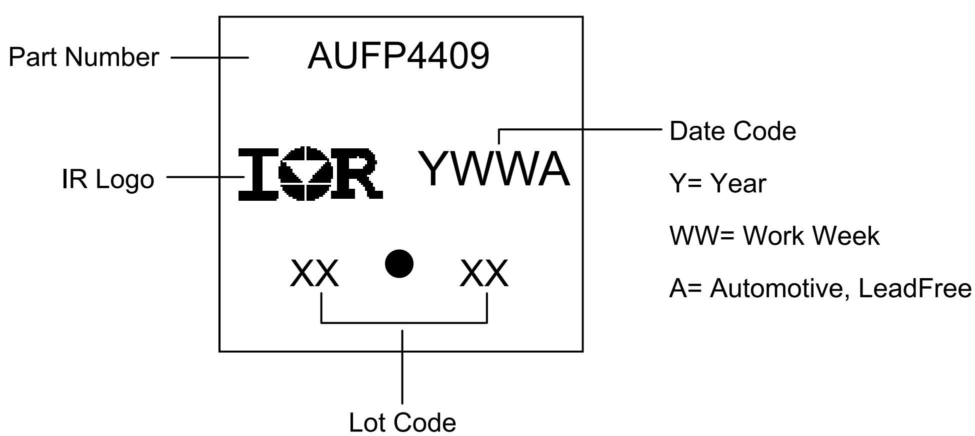
DIODES

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

NOTES:

1 DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M 1994.
2 DIMENSIONS ARE SHOWN IN INCHES AND MILLIMETERS.
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 ø 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/

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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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Tel: (310) 252-7105

