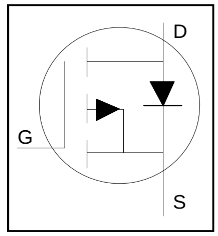
International
IOR Rectifier

AUTOMOTIVE GRADE

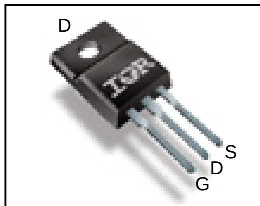
AUIRFI4905

HEXFET® Power MOSFET

Features
- Advanced Planar Technology
- P-Channel MOSFET
- Low On-Resistance
- Dynamic dV/dT Rating
- 175°C Operating Temperature
- Fast Switching
- Fully Avalanche Rated
- Repetitive Avalanche Allowed up to Tjmax
- Lead-Free, RoHS Compliant
- Automotive Qualified *



V_{DSS}	-55V
$R_{DS(on)}$ max.	20mΩ
$I_{D\ (Silicon\ Limited)}$	-39A



TO-220 Full-Pak

G	D	S
Gate	Drain	Source

Description
Specifically designed for Automotive applications, this cellular design of HEXFET® Power MOSFETs utilizes the latest processing techniques to achieve low on-resistance per silicon area. This benefit combined with the fast switching speed an 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.

Base Part Number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
AUIRFI4905	TO-220 Full-Pak	Tube	50	AUIRFI4905

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 @ $T_{C\ (Bottom)}$ = 25°C	Continuous Drain Current, V_{GS} @ -10V (Silicon Limited)	-39	A
I_D @ $T_{C\ (Bottom)}$ = 100°C	Continuous Drain Current, V_{GS} @ -10V (Silicon Limited)	-27	
I_{DM}	Pulsed Drain Current ①	-155	
P_D @$T_{C\ (Bottom)}$ = 25°C	Power Dissipation	55	W
	Linear Derating Factor	0.37	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS}	Single Pulse Avalanche Energy (Thermally Limited) ②	1247	mJ
I_{AR}	Avalanche Current ①	See Fig. 14, 15, 22a, 22b	A
E_{AR}	Repetitive Avalanche Energy ①		
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 175	°C

Thermal Resistance

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ⑤	——	2.73	°C/W
$R_{\theta JA}$	Junction-to-Ambient	——	65	

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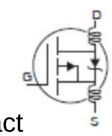
*Qualification standards can be found at http://www.irf.com/

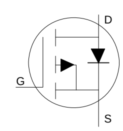
Static Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	-55	——	——	V	V_{GS} = 0V, I_D = -250μA
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	——	-0.049	——	V/°C	Reference to 25°C, I_D = -1.0mA
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	——	——	20	mΩ	V_{GS} = -10V, I_D = -23A ④
$V_{GS(th)}$	Gate Threshold Voltage	-2.0	——	-4.0	V	V_{DS} = V_{GS}, I_D = -250μA
gfs	Forward Transconductance	17	——	——	S	V_{DS} = -10V, I_D = -23A
I_{DSS}	Drain-to-Source Leakage Current	——	——	-25	μA	V_{DS} = -55V, V_{GS} = 0V
		——	——	-250		V_{DS} = -44V, 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

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

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
Q_g	Total Gate Charge	——	110	165	nC	I_D = -23A
Q_{gs}	Gate-to-Source Charge	——	18	——		V_{DS} = -44V
Q_{gd}	Gate-to-Drain ("Miller") Charge	——	51	——		V_{GS} = -10V ④
$t_{d(on)}$	Turn-On Delay Time	——	14	——	ns	V_{DD} = -55V
t_r	Rise Time	——	45	——		I_D = -23A
$t_{d(off)}$	Turn-Off Delay Time	——	71	——		R_G = 2.7Ω
t_f	Fall Time	——	61	——		V_{GS} = -10V ④
L_D	Internal Drain Inductance	——	4.5	——	nH	Between lead, 6mm (0.25in.) from package and center of die contact 
L_S	Internal Source Inductance	——	7.5	——		
C_{iss}	Input Capacitance	——	3560	——	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	——	1290	——		V_{DS} = -25V
C_{rss}	Reverse Transfer Capacitance	——	480	——		f = 1.0 MHz

Diode Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	——	——	-39	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ①	——	——	-155	A	
V_{SD}	Diode Forward Voltage	——	——	-1.6	V	T_J = 25°C, I_S = -23A, V_{GS} = 0V ④
dv/dt	Peak Diode Recovery ③	——	2.8	——	V/ns	T_J = 175°C, I_S= -23A, V_{DS} = -55V
t_{rr}	Reverse Recovery Time	——	64	——	ns	T_J = 25°C, I_F = -23A, V_R = -28V
Q_{rr}	Reverse Recovery Charge	——	164	——	nC	di/dt = 100A/μs④

Notes:

① Repetitive rating; pulse width limited by max. junction temperature.

② Limited by T_{Jmax}, starting T_J = 25°C, L = 4.7mH, R_G = 50Ω, I_{AS} = -23A, V_{GS} =-10V.

③ $I_{SD} \leq$ -23A, di/dt $\leq$ 1026A/μs, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq$ 150°C.

④ Pulse width $\leq$ 400μs; duty cycle $\leq$ 2%.

⑤ R_θ is measured at T_J approximately 90°C.

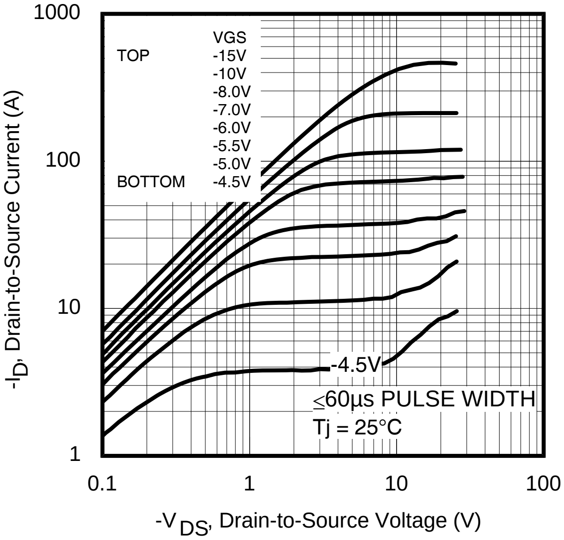


Fig. 1 Typical Output Characteristics

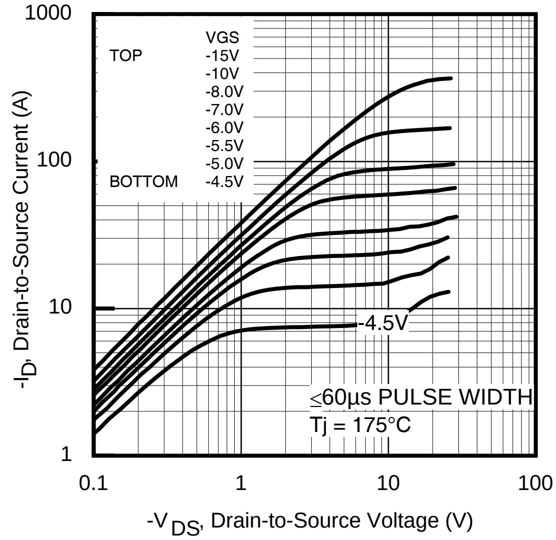


Fig. 2 Typical Output Characteristics

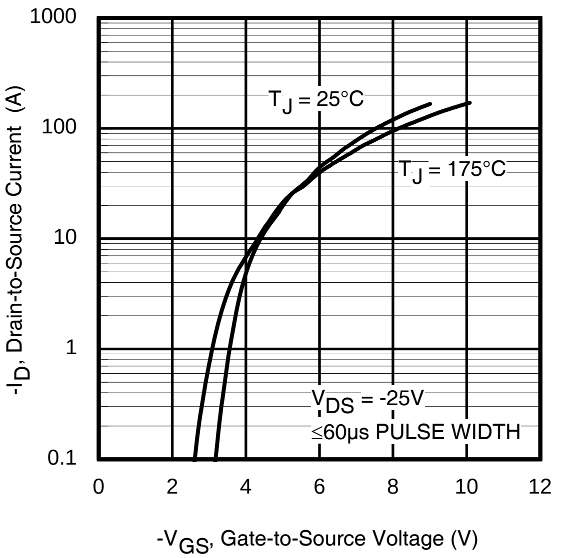


Fig. 3 Typical Transfer Characteristics

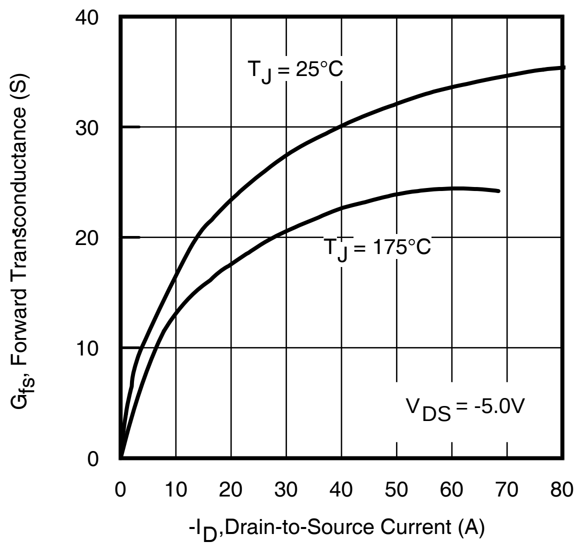


Fig. 4 Typical Forward Transconductance vs Drain Current

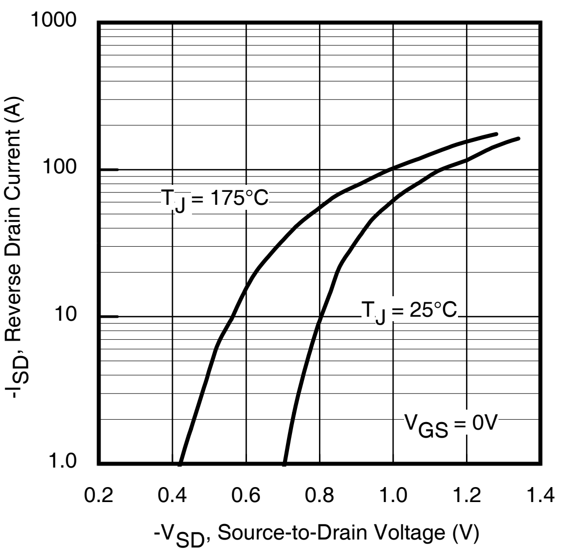


Fig. 5 Typical Source-to-Drain Diode Forward Voltage

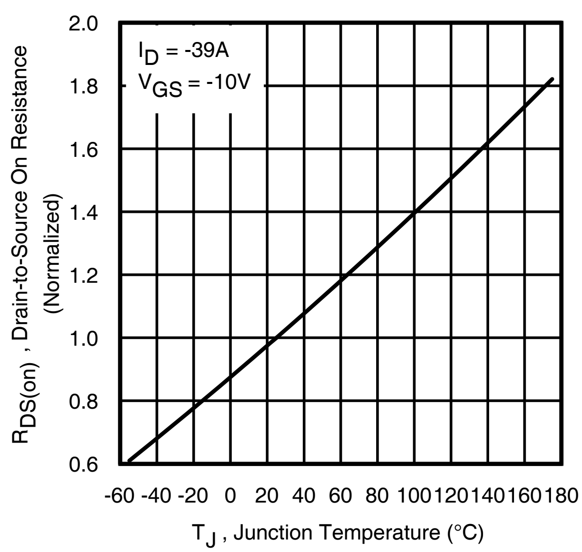


Fig. 6 Normalized On-Resistance vs. Temperature

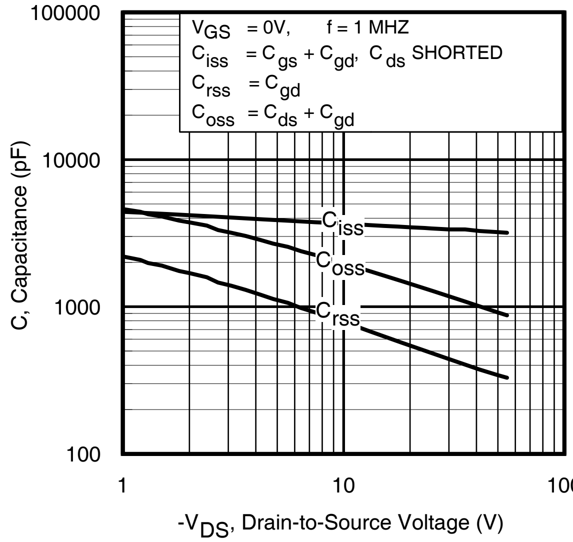


Fig 7. Typical Capacitance vs. Drain-to-Source Voltage

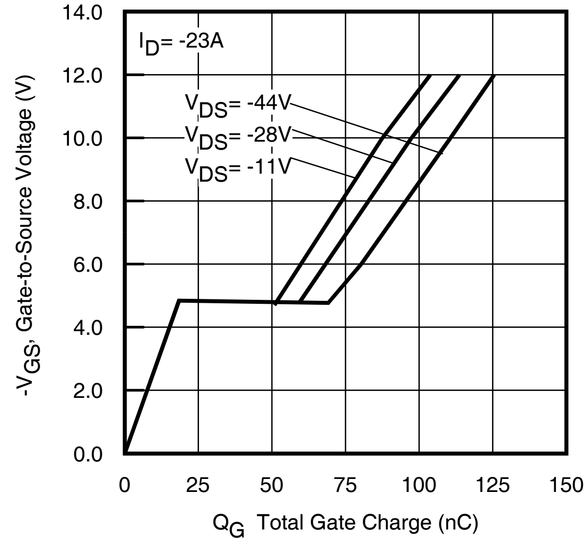


Fig 8. Typical Gate Charge vs. Gate-to-Source Voltage

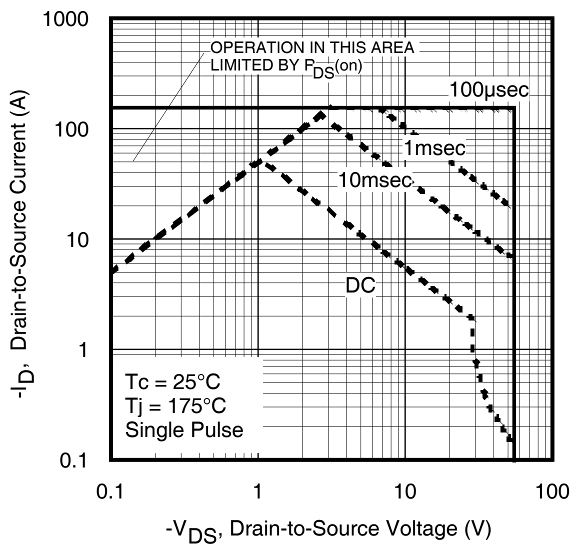


Fig 9. Maximum Safe Operating Area

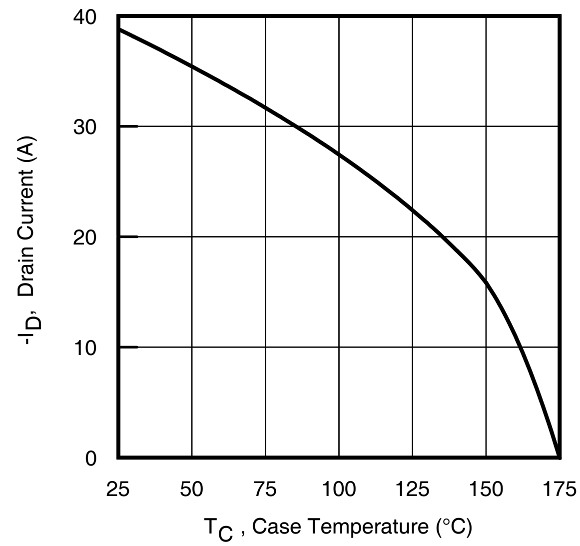


Fig 10. Maximum Drain Current vs. Case Temperature

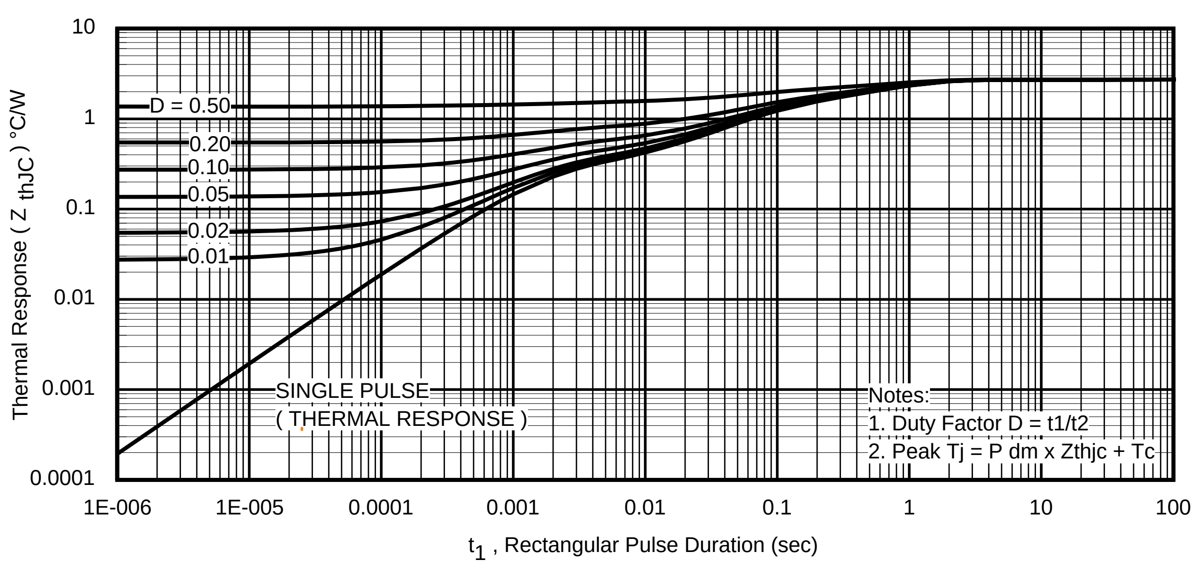


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

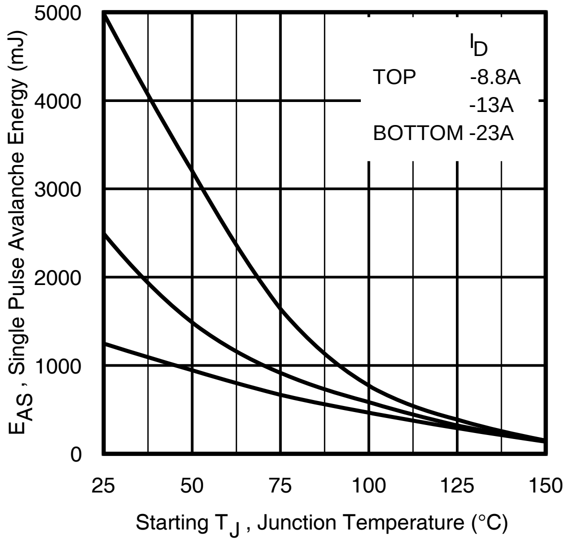


Fig 12. Maximum Avalanche Energy vs. Drain Current

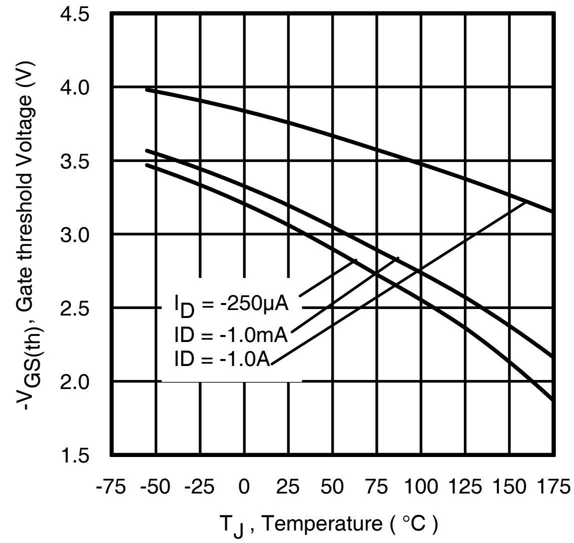


Fig 13. Threshold Voltage vs. Temperature

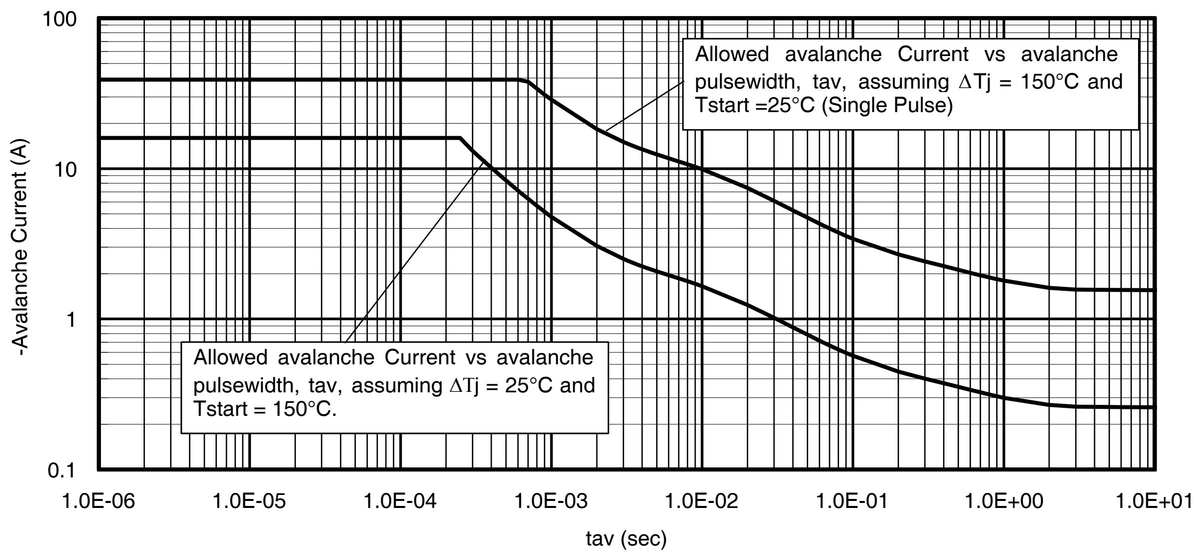


Fig 14. Typical Avalanche Current vs. Pulse Width

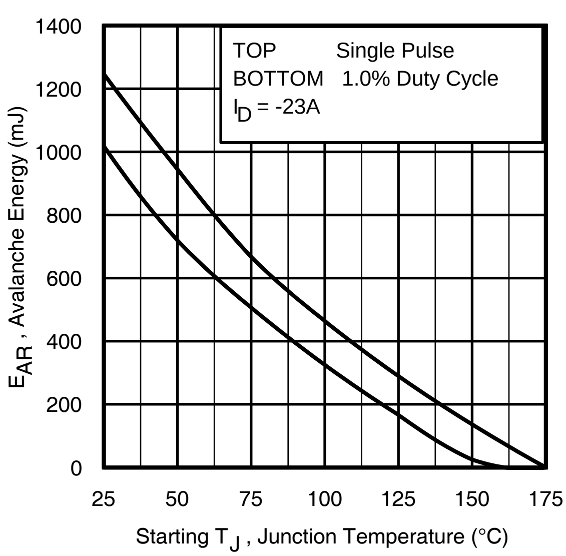


Fig 15. Maximum Avalanche Energy vs. Temperature

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)

$$\mathbf{P_{D\ (ave)} = 1/2\ (\ 1.3 \cdot BV \cdot I_{av}) = \Delta T /\ Z_{thJC}}$$
$$\mathbf{I_{av} = 2\Delta T /\ [1.3 \cdot BV \cdot Z_{th}]}$$
$$\mathbf{E_{AS\ (AR)} = P_{D\ (ave)} \cdot t_{av}}$$

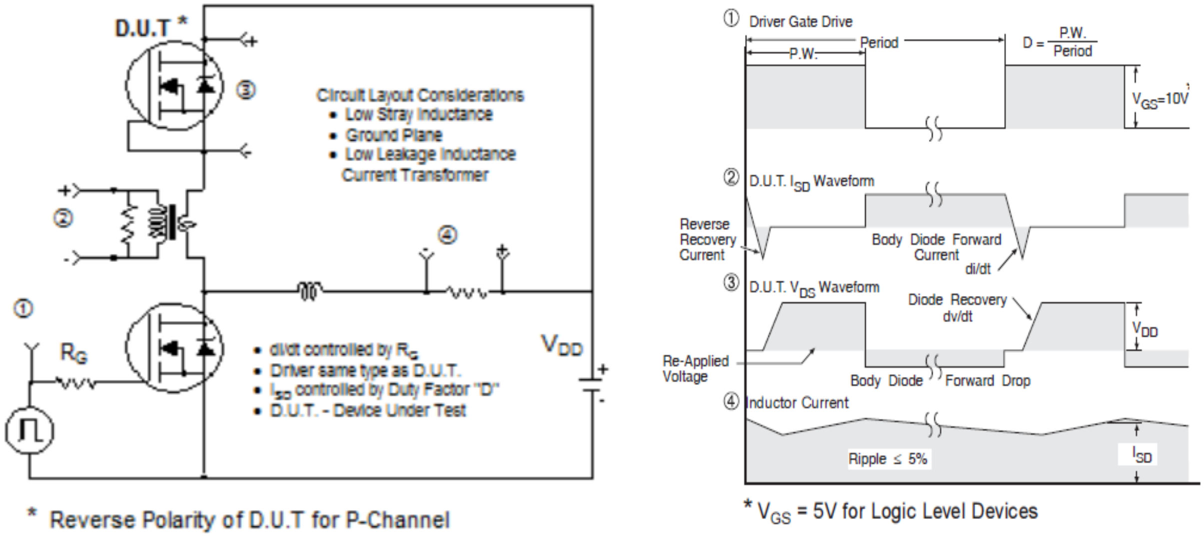


Fig 16. Peak Diode Recovery dv/dt Test Circuit for P-Channel HEXFET® Power MOSFETs

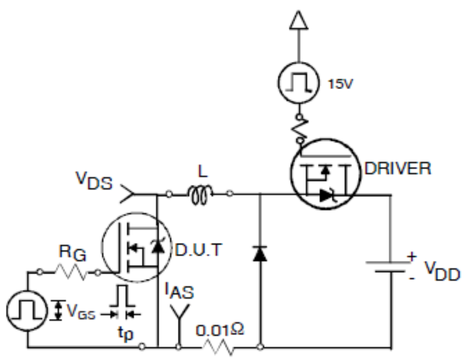


Fig 17a. Unclamped Inductive Test Circuit

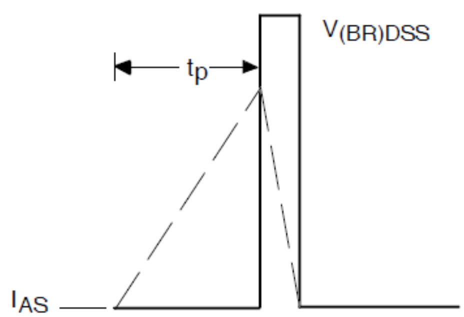


Fig 17b. Unclamped Inductive Waveforms

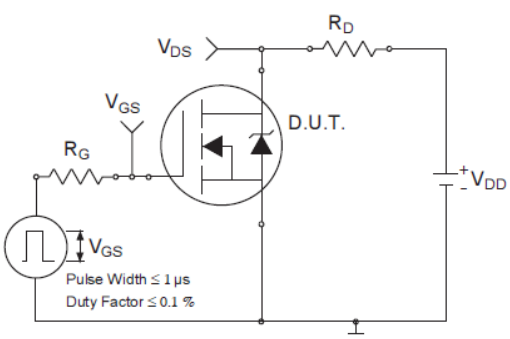


Fig 18a. Switching Time Test Circuit

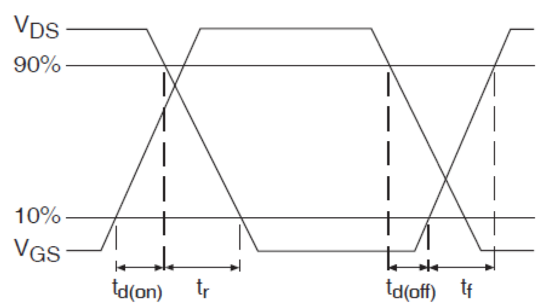


Fig 18b. Switching Time Waveforms

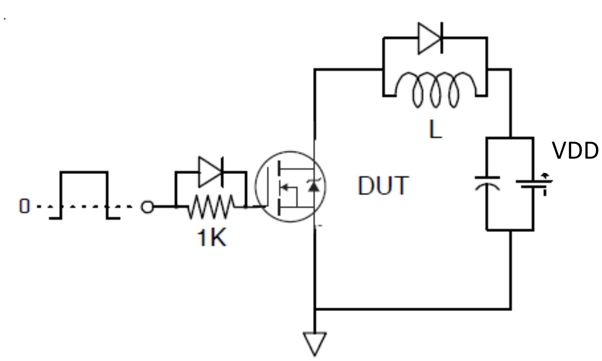


Fig 19a. Gate Charge Test Circuit

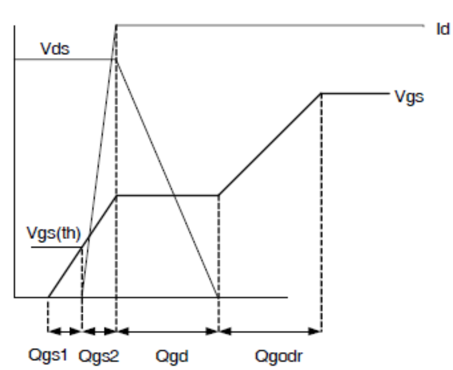
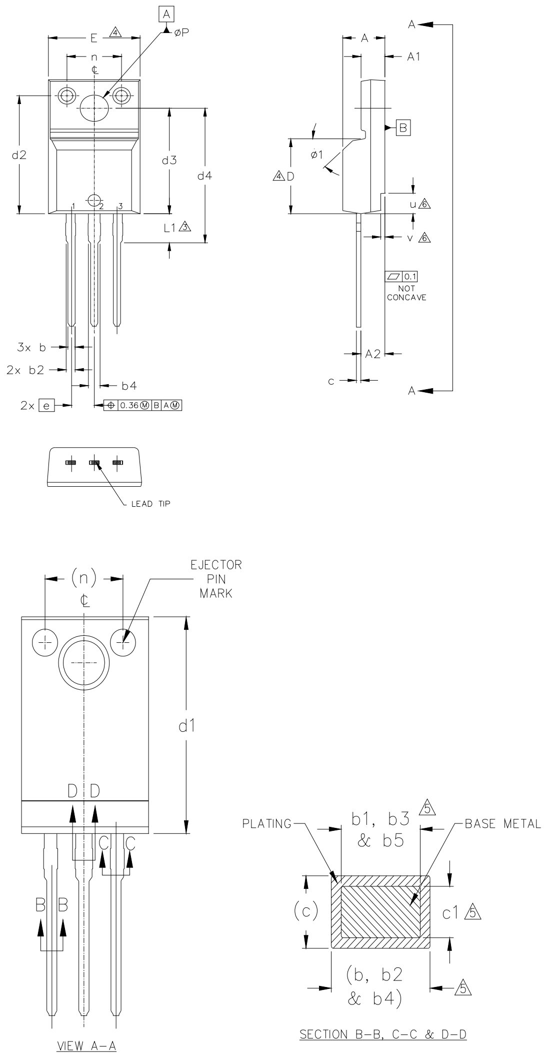


Fig 19b. Gate Charge Waveform

TO-220 Full-Pak Package Outline

Dimensions are shown in millimeters (inches)



NOTES:

1.0 DIMENSIONING AND TOLERANCING AS PER ASME Y14.5 M– 1994.

2.0 DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].

3.0 LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.

4.0 DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTER MOST EXTREMES OF THE PLASTIC BODY.

5.0 DIMENSION b1, b3, b5 & c1 APPLY TO BASE METAL ONLY.

6.0 STEP OPTIONAL ON PLASTIC BODY DEFINED BY DIMENSIONS u & v.

7.0 CONTROLLING DIMENSION : INCHES.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.57	4.83	.180	.190	
A1	2.57	2.83	.101	.111	
A2	2.41	2.92	.095	.115	
b	0.62	.094	0.24	.037	
b1	0.62	0.89	.024	0.35	5
b2	0.76	1.27	.030	.050	
b3	0.76	1.22	.030	.048	5
b4	1.02	1.52	.040	.060	
b5	1.02	1.47	.040	.058	5
c	0.33	0.63	.013	.025	
c1	0.33	0.58	.013	.023	5
D	8.65	9.80	.341	.386	4
d1	15.80	16.12	.622	.635	
d2	13.97	14.22	.550	.560	
d3	12.30	12.92	.484	.509	
d4	8.64	9.91	.340	.390	
E	9.63	10.63	.379	.419	4
e	2.54 BSC		.100 BSC		
L	13.20	13.72	.520	.540	
L1	3.10	2.31	.122	.138	3
n	6.05	6.15	.238	.242	
øP	3.05	3.45	.120	.136	
u	2.40	2.50	.094	.098	6
v	0.40	0.50	.016	.020	6
ø1	–	45°	–	45°	

LEAD ASSIGNMENTS

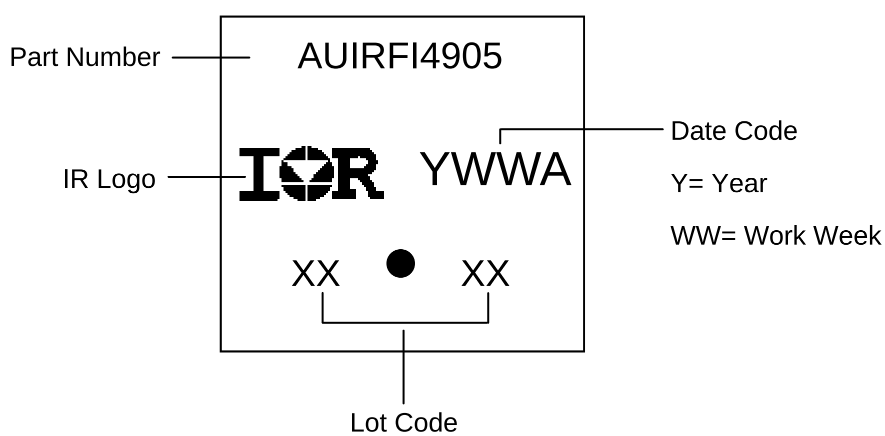
HEXFET

1.– GATE
2.– DRAIN
3.– SOURCE

IGBTs, CoPACK

1.– GATE
2.– COLLECTOR
3.– EMITTER

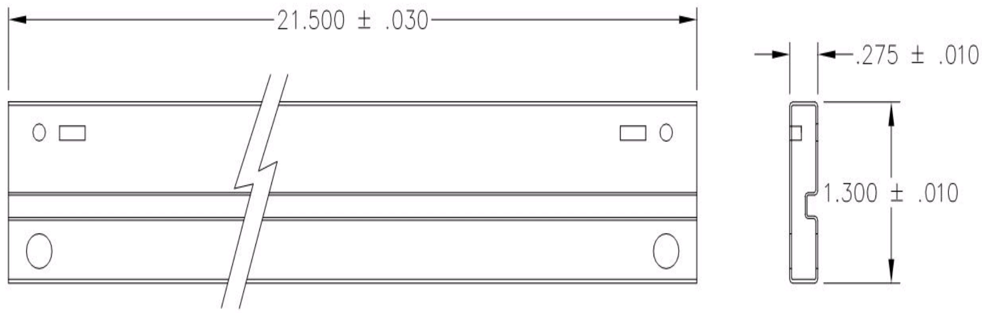
TO-220 Full-Pak Part Marking Information



TO-220AB Full-Pak 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-220AB Full-Pak Tube Sketch



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-220 Full-Pak	N/A
ESD	Machine Model	Class M4 (+/- 700V)†† 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.

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

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

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