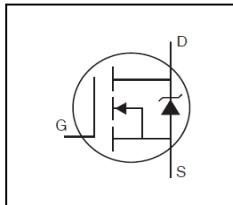


Features

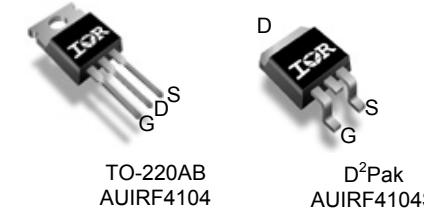
- Advanced Process Technology
- Ultra Low On-Resistance
- 175°C Operating Temperature
- Fast Switching
- Fully Avalanche Rated
- Repetitive Avalanche Allowed up to T_{jmax}
- Lead-Free, RoHS Compliant
- Automotive Qualified *



V_{DSS}	40V
$R_{DS(on)}$ typ. max.	4.3mΩ
	5.5mΩ
I_D (Silicon Limited)	120A⑨
I_D (Package Limited)	75A

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 wide variety of other applications.



G	D	S
Gate	Drain	Source

Base part number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
AUIRF4104	TO-220	Tube	50	AUIRF4104
AUIRF4104S	D²-Pak	Tube	50	AUIRF4104S
		Tape and Reel Left	800	AUIRF4104STRL

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.

Symbol	Parameter	Max.	Units
I_D @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, V_{GS} @ 10V (Silicon Limited)	120⑨	A
I_D @ $T_C = 100^\circ\text{C}$	Continuous Drain Current, V_{GS} @ 10V (Silicon Limited)	84⑨	
I_D @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, V_{GS} @ 10V (Wire Bond Limited)	75	
I_{DM}	Pulsed Drain Current ①	470	
P_D @ $T_C = 25^\circ\text{C}$	Maximum Power Dissipation	140	W
	Linear Derating Factor	0.95	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS}	Single Pulse Avalanche Energy (Thermally Limited) ②	120	mJ
E_{AS} (tested)	Single Pulse Avalanche Energy Tested Value ⑤	220	
I_{AR}	Avalanche Current ①	See Fig.15,16, 12a, 12b	A
E_{AR}	Repetitive Avalanche Energy ⑤		mJ
T_J	Operating Junction and	-55 to + 175	°C
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 seconds (1.6mm from case)	300	
	Mounting torque, 6-32 or M3 screw⑧	10 lbf·in (1.1N·m)	

Thermal Resistance

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ⑦	—	1.05	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient	—	62	
$R_{\theta JA}$	Junction-to-Ambient (PCB Mount, steady state)	—	40	

HEXFET® is a registered trademark of Infineon.

*Qualification standards can be found at www.infineon.com

Static @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(\text{BR})\text{DSS}}$	Drain-to-Source Breakdown Voltage	40	—	—	V	$V_{\text{GS}} = 0\text{V}$, $I_D = 250\mu\text{A}$
$\Delta V_{(\text{BR})\text{DSS}}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.032	—	V/ $^\circ\text{C}$	Reference to 25°C , $I_D = 1\text{mA}$
$R_{\text{DS}(\text{on})}$	Static Drain-to-Source On-Resistance	—	4.3	5.5	$\text{m}\Omega$	$V_{\text{GS}} = 10\text{V}$, $I_D = 75\text{A}$ ③
$V_{\text{GS}(\text{th})}$	Gate Threshold Voltage	2.0	—	4.0	V	$V_{\text{DS}} = V_{\text{GS}}$, $I_D = 250\mu\text{A}$
g_{fs}	Forward Trans conductance	63	—	—	S	$V_{\text{DS}} = 10\text{V}$, $I_D = 75\text{A}$
I_{DSS}	Drain-to-Source Leakage Current	—	—	20	μA	$V_{\text{DS}} = 40\text{V}$, $V_{\text{GS}} = 0\text{V}$
		—	—	250		$V_{\text{DS}} = 40\text{V}$, $V_{\text{GS}} = 0\text{V}$, $T_J = 125^\circ\text{C}$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	200	nA	$V_{\text{GS}} = 20\text{V}$
	Gate-to-Source Reverse Leakage	—	—	-200		$V_{\text{GS}} = -20\text{V}$

Dynamic Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

Q_g	Total Gate Charge	—	68	100	nC	$I_D = 75\text{A}$ $V_{\text{DS}} = 32\text{V}$ $V_{\text{GS}} = 10\text{V}$ ③
Q_{gs}	Gate-to-Source Charge	—	21	—		
Q_{gd}	Gate-to-Drain Charge	—	27	—		
$t_{\text{d}(\text{on})}$	Turn-On Delay Time	—	16	—		$V_{\text{DD}} = 20\text{V}$ $I_D = 75\text{A}$
t_r	Rise Time	—	130	—	ns	$R_G = 6.8\Omega$ $V_{\text{GS}} = 10\text{V}$ ③
$t_{\text{d}(\text{off})}$	Turn-Off Delay Time	—	38	—		
t_f	Fall Time	—	77	—		
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	—	3000	—	pF	$V_{\text{GS}} = 0\text{V}$
C_{oss}	Output Capacitance	—	660	—		$V_{\text{DS}} = 25\text{V}$
C_{rss}	Reverse Transfer Capacitance	—	380	—		$f = 1.0\text{MHz}$, See Fig. 5
C_{oss}	Output Capacitance	—	2160	—		$V_{\text{GS}} = 0\text{V}$, $V_{\text{DS}} = 1.0\text{V}$ $f = 1.0\text{MHz}$
C_{oss}	Output Capacitance	—	560	—		$V_{\text{GS}} = 0\text{V}$, $V_{\text{DS}} = 32\text{V}$ $f = 1.0\text{MHz}$
$C_{\text{oss eff.}}$	Effective Output Capacitance	—	850	—		$V_{\text{GS}} = 0\text{V}$, $V_{\text{DS}} = 0\text{V}$ to 32V ④

Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_s	Continuous Source Current (Body Diode)	—	—	75	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	470		
V_{SD}	Diode Forward Voltage	—	—	1.3		$T_J = 25^\circ\text{C}$, $I_s = 75\text{A}$, $V_{\text{GS}} = 0\text{V}$ ③
t_{rr}	Reverse Recovery Time	—	23	35		$T_J = 25^\circ\text{C}$, $I_F = 75\text{A}$, $V_{\text{DD}} = 20\text{V}$ $di/dt = 100\text{A}/\mu\text{s}$ ③
Q_{rr}	Reverse Recovery Charge	—	6.8	10	nC	
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by $L_s + L_D$)				

Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11)
- ② Limited by T_{Jmax} , starting $T_J = 25^\circ\text{C}$, $L = 0.04\text{mH}$, $R_G = 25\Omega$, $I_{\text{AS}} = 75\text{A}$, $V_{\text{GS}} = 10\text{V}$. Part not recommended for use above this value.
- ③ Pulse width $\leq 1.0\text{ms}$; duty cycle $\leq 2\%$.
- ④ Coss eff. is a fixed capacitance that gives the same charging time as Coss while VDS is rising from 0 to 80% VDSS.
- ⑤ This value determined from sample failure population, $T_J = 25^\circ\text{C}$, $L = 0.04\text{mH}$, $R_G = 25\Omega$, $I_{\text{AS}} = 75\text{A}$, $V_{\text{GS}} = 10\text{V}$.
- ⑥ This is applied to D²Pak When mounted on 1" square PCB (FR-4 or G-10 Material). For recommended footprint and soldering techniques refer to application note #AN-994
- ⑦ R_θ is measured at T_J of approximately 90°C
- ⑧ This is only applied to TO-220AB package.
- ⑨ Calculated continuous current based on maximum allowable junction temperature. Bond wire current limit is 75A. Note that current limitations arising from heating of the device leads may occur with some lead mounting arrangements. (Refer to AN-1140)

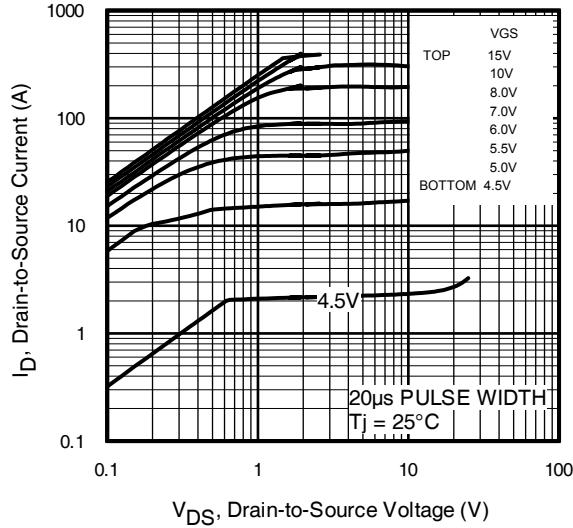


Fig. 1 Typical Output Characteristics

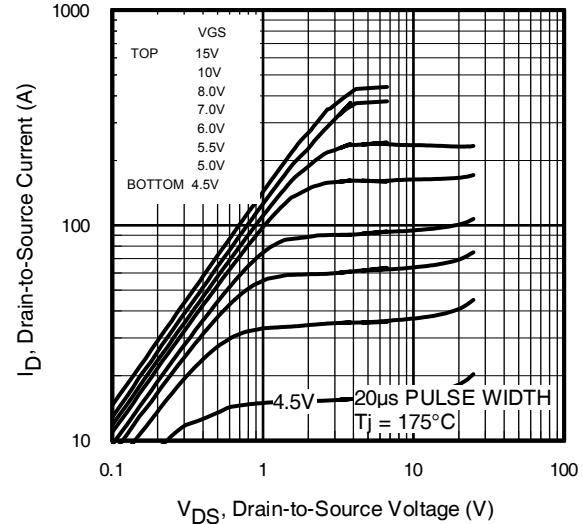


Fig. 2 Typical Output Characteristics

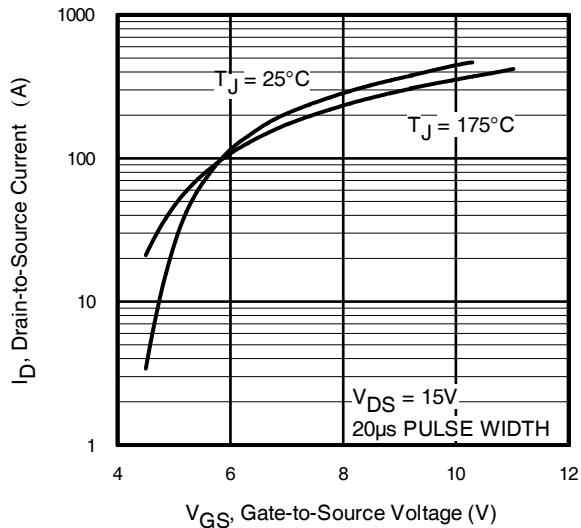


Fig. 3 Typical Transfer Characteristics

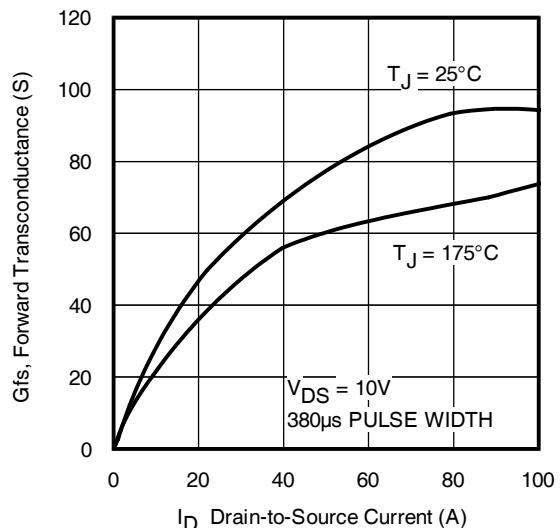


Fig. 4 Typical Forward Transconductance vs. Drain Current

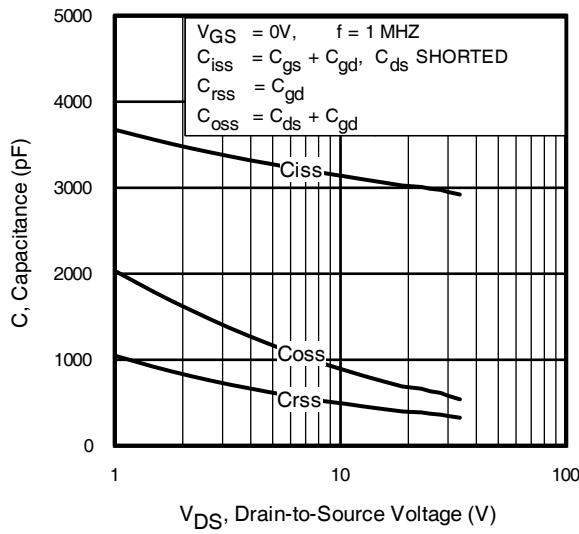


Fig 5. Typical Capacitance vs.
Drain-to-Source Voltage

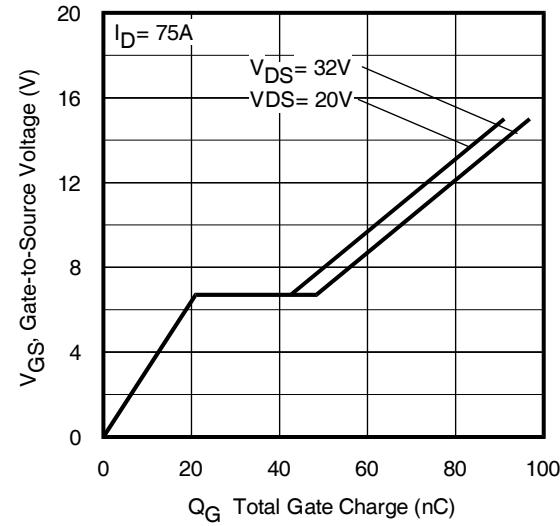


Fig 6. Typical Gate Charge vs.
Gate-to-Source Voltage

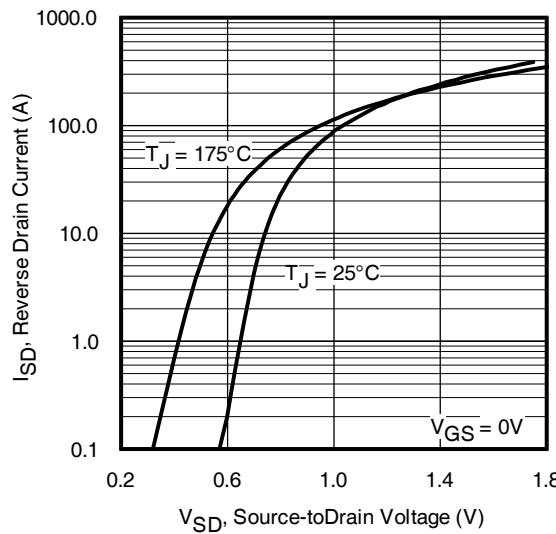


Fig. 7 Typical Source-to-Drain Diode
Forward Voltage

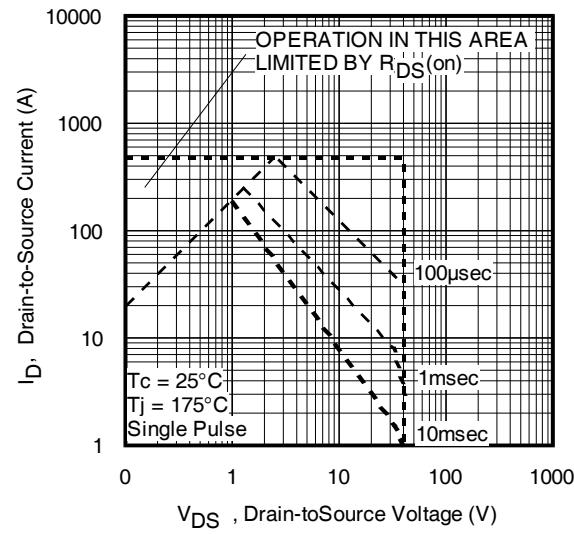


Fig 8. Maximum Safe Operating Area

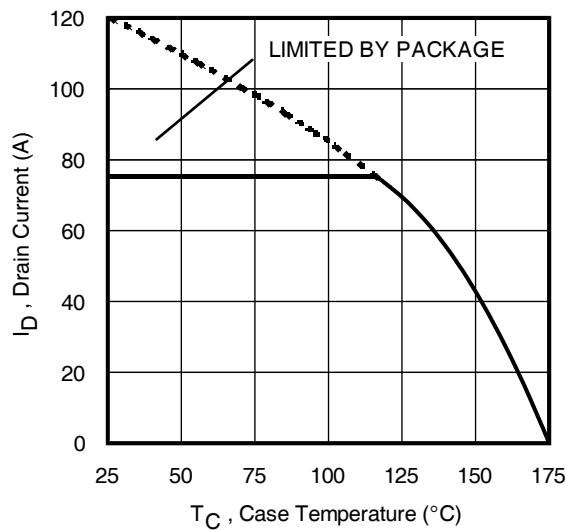


Fig 9. Maximum Drain Current vs. Case Temperature

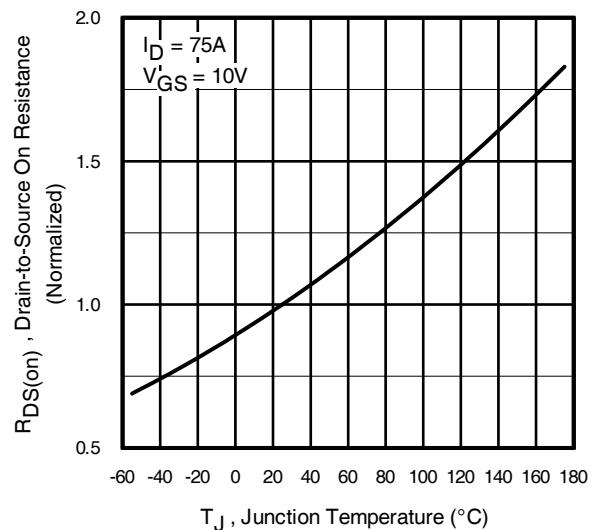


Fig 10. Normalized On-Resistance vs. Temperature

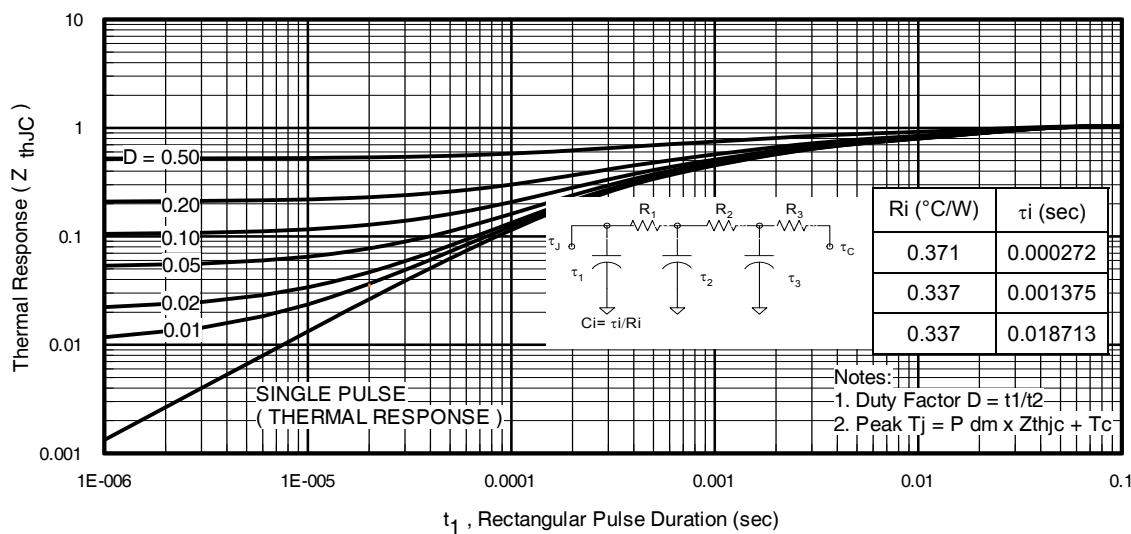


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

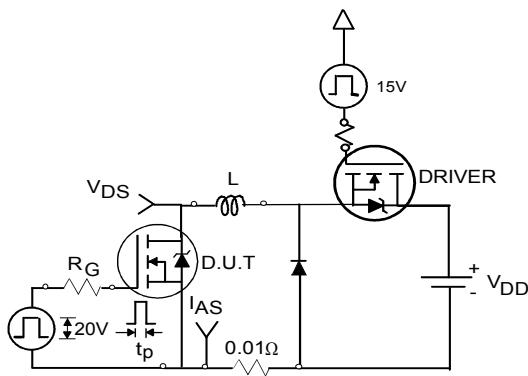


Fig 12a. Unclamped Inductive Test Circuit

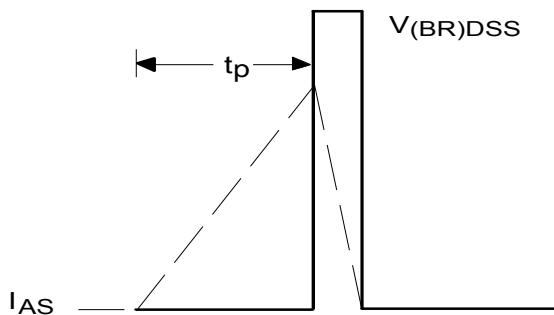


Fig 12b. Unclamped Inductive Waveforms

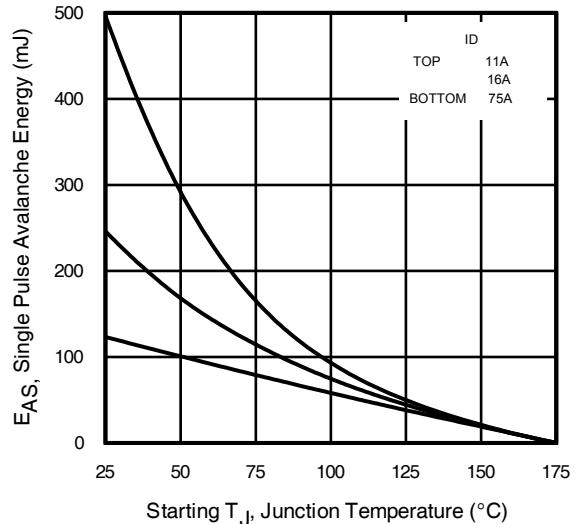


Fig 12c. Maximum Avalanche Energy vs. Drain Current

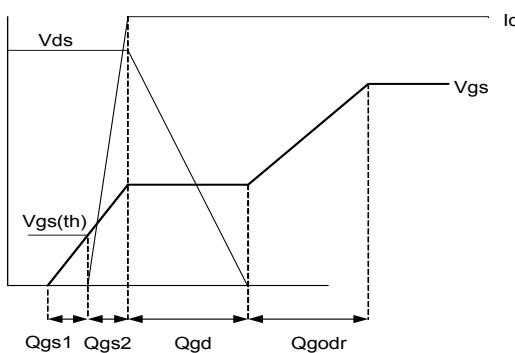


Fig 13a. Gate Charge Waveform

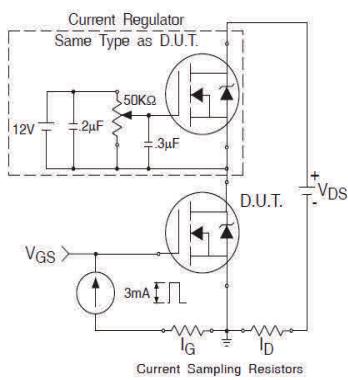


Fig 13b. Gate Charge Test Circuit

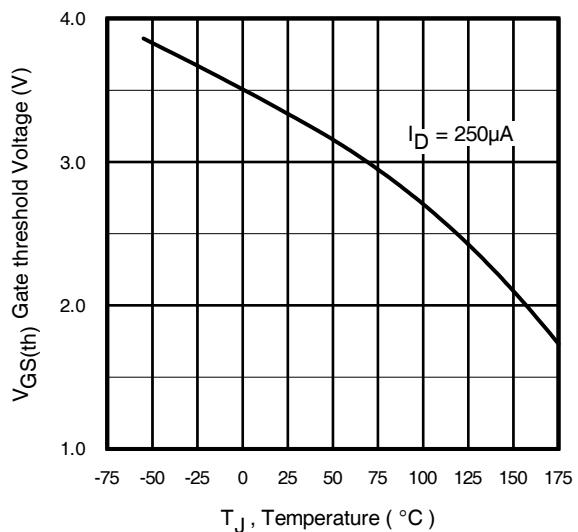


Fig 14. Threshold Voltage vs. Temperature

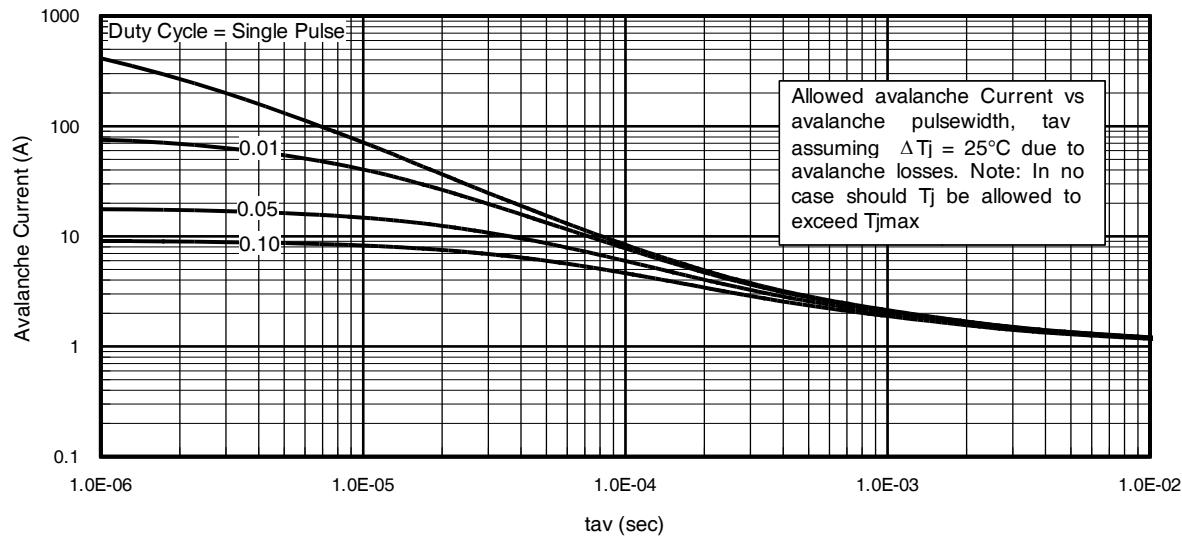
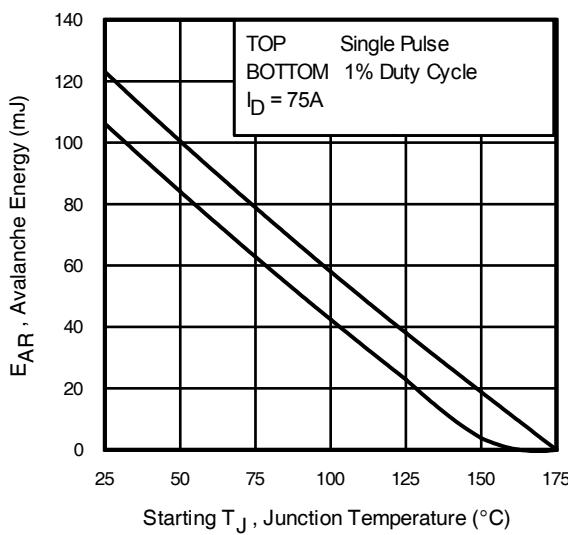


Fig 15. Typical Avalanche Current vs. Pulse width



Notes on Repetitive Avalanche Curves , Figures 15, 16:
(For further info, see AN-1005 at www.infineon.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 12a, 12b.
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 15, 16).

tav = Average time in avalanche.
 D = Duty cycle in avalanche = $t_{av} \cdot f$
 $Z_{thJC}(D, tav)$ = 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. Maximum Avalanche Energy
vs. Temperature

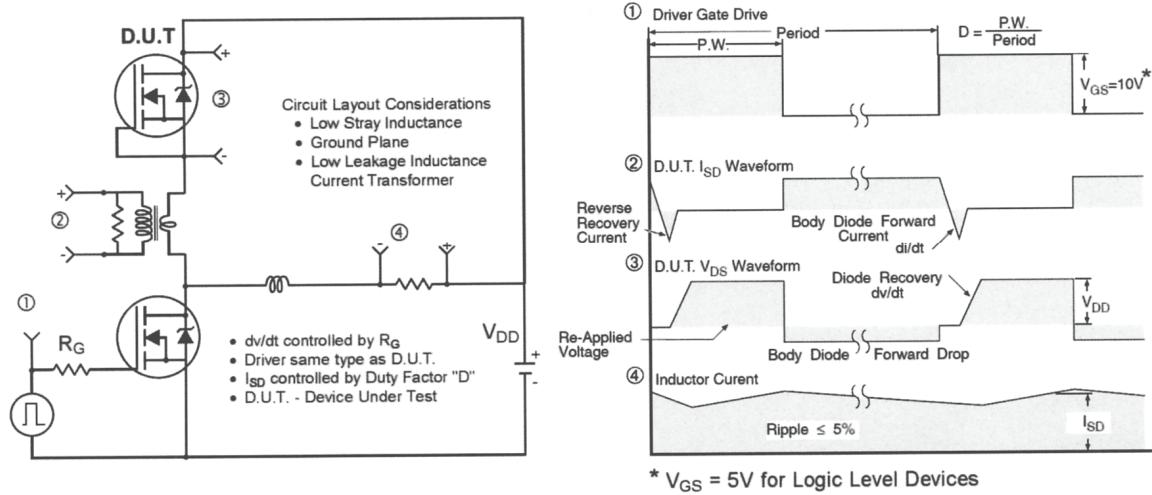


Fig 17. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

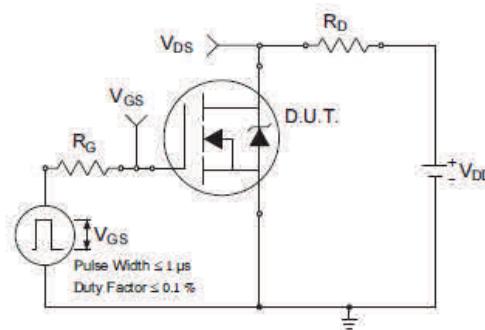


Fig 18a. Switching Time Test Circuit

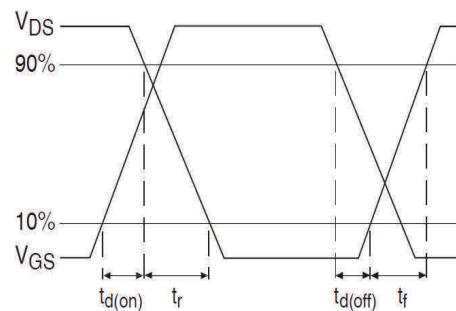
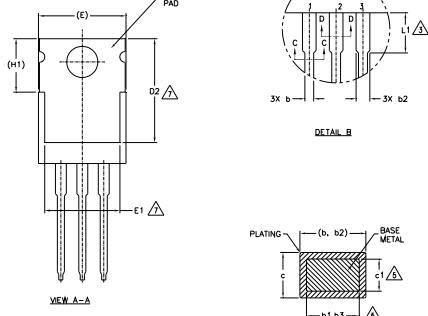
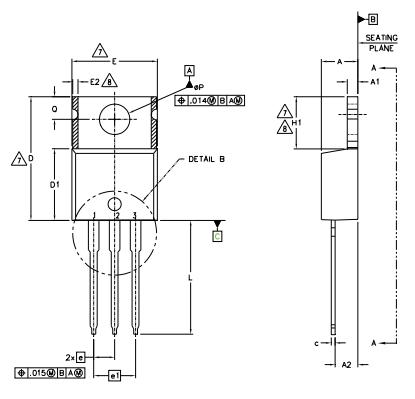


Fig 18b. Switching Time Waveforms

TO-220AB Package Outline (Dimensions are shown in millimeters (inches))


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	5	
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	
OP	3.54	4.08	.139	.161		
Q	2.54	3.42	.100	.135		

LEAD ASSIGNMENTS
HEXFET

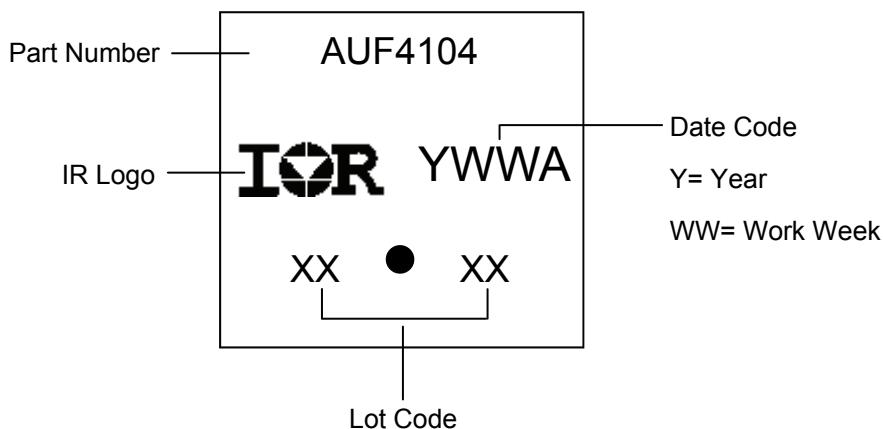
- GATE
- DRAIN
- SOURCE

IGBTs, CoPACK

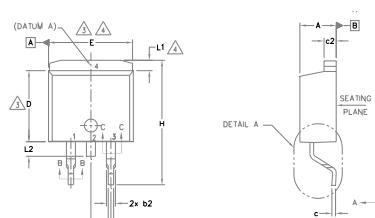
- GATE
- COLLECTOR
- Emitter

DIODES

- ANODE
- CATHODE
- ANODE

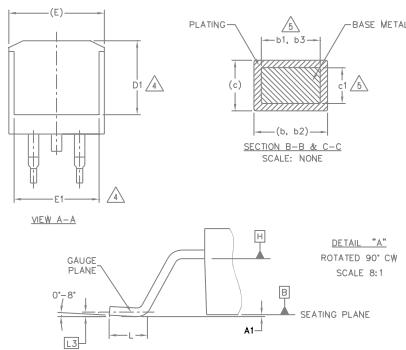
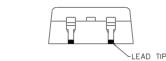
TO-220AB Part Marking Information


TO-220AB package is not recommended for Surface Mount Application.

D²Pak (TO-263AB) Package Outline (Dimensions are shown in millimeters (inches))


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY AT DATUM H.
4. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E, L1, D1 & E1.
5. DIMENSION b1, b3 AND c1 APPLY TO BASE METAL ONLY.
6. DATUM A & B TO BE DETERMINED AT DATUM PLANE H.
7. CONTROLLING DIMENSION: INCH.
8. OUTLINE CONFORMS TO JEDEC OUTLINE TO-263AB.



SYMBOL	DIMENSIONS				NOTES	
	MILLIMETERS		INCHES			
	MIN.	MAX.	MIN.	MAX.		
A	4.06	4.83	.160	.190		
A1	0.00	0.254	.000	.010		
b	0.51	0.99	.020	.039		
b1	0.51	0.89	.020	.035	5	
b2	1.14	1.78	.045	.070		
b3	1.14	1.73	.045	.068	5	
c	0.38	0.74	.015	.029		
c1	0.38	0.58	.015	.023	5	
c2	1.14	1.65	.045	.065		
D	8.38	9.65	.330	.380	3	
D1	6.86	—	.270	—	4	
E	9.65	10.67	.380	.420	3,4	
E1	6.22	—	.245	—	4	
e	2.54 BSC		.100 BSC			
H	14.61	15.88	.575	.625		
L	1.78	2.79	.070	.110		
L1	—	1.68	—	.066	4	
L2	—	1.78	—	.070		
L3	0.25 BSC		.010 BSC			

LEAD ASSIGNMENTS
DIODES

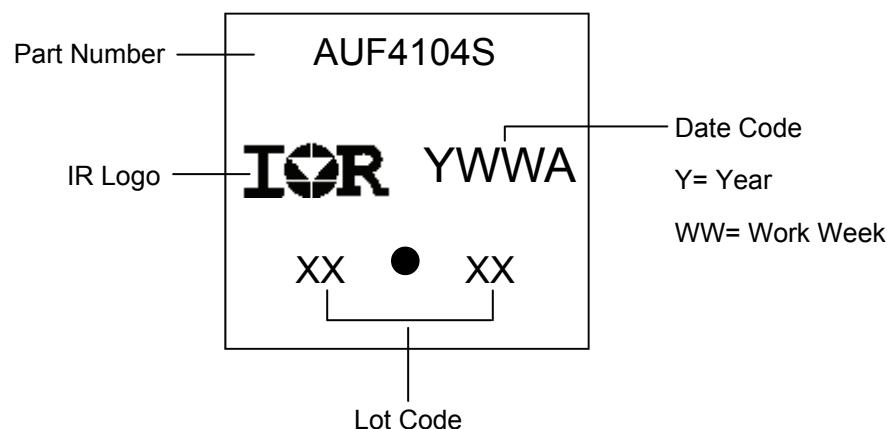
1. ANODE (TWO DIE) / OPEN (ONE DIE)
2. 4. CATHODE
3. ANODE

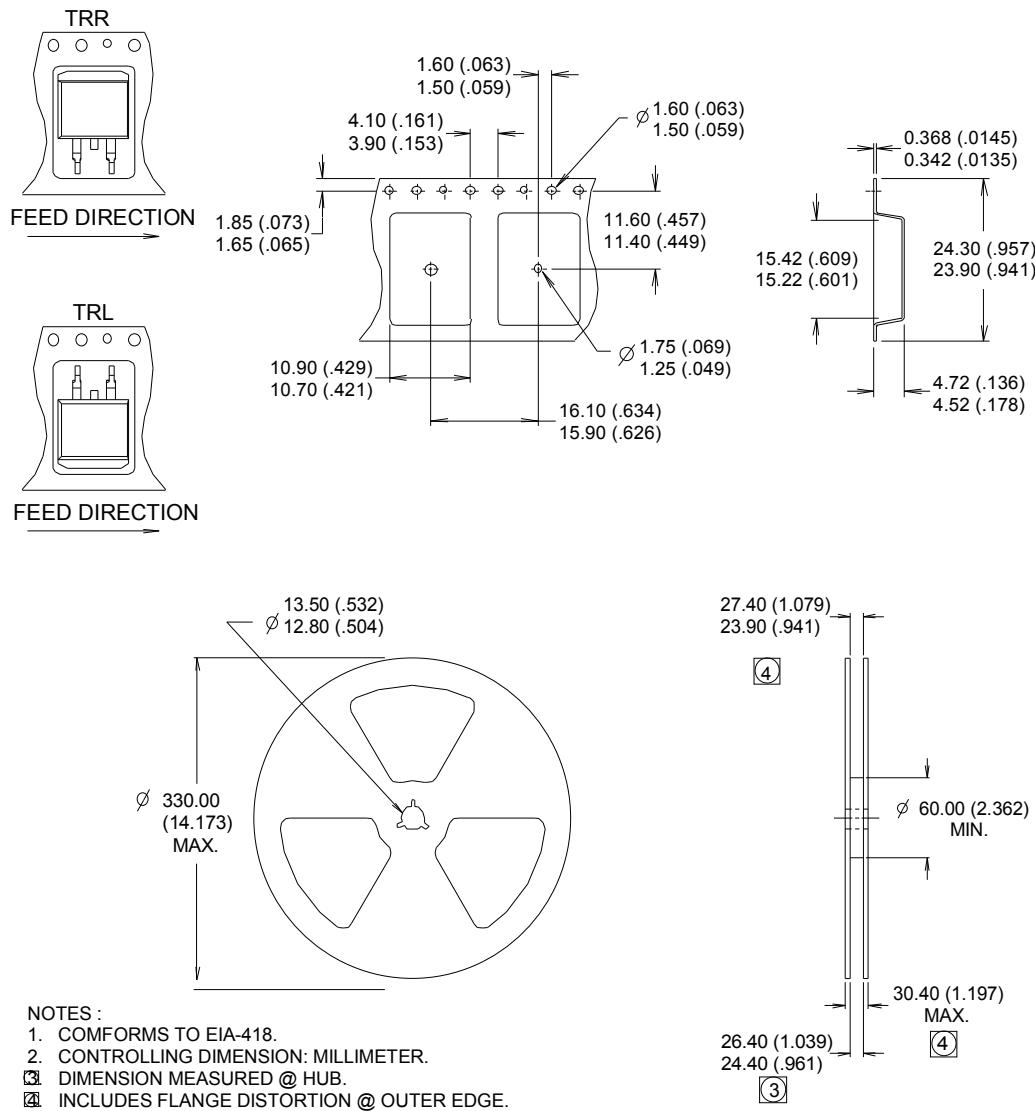
HEXFET

1. GATE
2. 4. DRAIN
3. SOURCE

IGBTs, CoPACK

1. GATE
2. 4. COLLECTOR
3. Emitter

D²Pak (TO-263AB) Part Marking Information


D²Pak (TO-263AB) Tape & Reel Information (Dimensions are shown in millimeters (inches))

Qualification Information

Qualification Level		Automotive (per AEC-Q101)	
		Comments: This part number(s) passed Automotive qualification. Infineon's Industrial and Consumer qualification level is granted by extension of the higher Automotive level.	
Moisture Sensitivity Level		TO-220AB	N/A
		D ² -Pak	MSL1
ESD	Machine Model	Class M4 [†] AEC-Q101-002	
	Human Body Model	Class H1C [†] AEC-Q101-001	
	Charged Device Model	Class C3 [†] AEC-Q101-005	
RoHS Compliant		Yes	

† Highest passing voltage.

Revision History

Date	Comments
9/30/2015	<ul style="list-style-type: none"> Updated datasheet with corporate template Corrected ordering table on page 1.

Published by
Infineon Technologies AG
81726 München, Germany

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