AUTOMOTIVE GRADE

AUIRFP4310Z

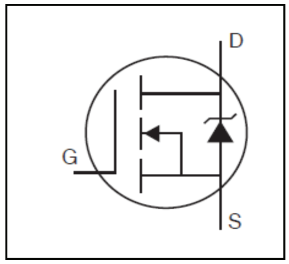
Features

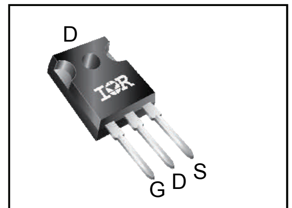
- Advanced Process Technology
- Ultra Low On-Resistance
- Dynamic dv/dt Rating
- 175°C Operating Temperature
- Fast Switching
- Repetitive Avalanche Allowed up to Tjmax
- Lead-Free, RoHS Compliant
- Automotive Qualified *

Description

Specifically designed for Automotive applications, this HEXFET® Power 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.

V_{DSS}	**100V**
$R_{DS(on)}$ typ.	**4.8mΩ**
max.	**6.0mΩ**
$I_{D\ (Silicon\ Limited)}$	**128A①**
$I_{D\ (Package\ Limited)}$	**120A**





TO-247AC

G	D	S
Gate	Drain	Source

Base Part Number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
AUIRFP4310Z	TO-247AC	Tube	25	AUIRFP4310Z

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°C	Continuous Drain Current, V_{GS} @ 10V (Silicon Limited)	128①	A
I_D @ T_C = 100°C	Continuous Drain Current, V_{GS} @ 10V (Silicon Limited)	90	
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V (Package Limited)	120	
I_{DM}	Pulsed Drain Current ②	480	
P_D @T_C = 25°C	Maximum Power Dissipation	278	W
	Linear Derating Factor	1.9	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS}	Single Pulse Avalanche Energy (Thermally Limited) ③	355	mJ
I_{AR}	Avalanche Current ②	See Fig.14,15, 22a, 22b	A
E_{AR}	Repetitive Avalanche Energy		mJ
dv/dt	Peak Diode Recovery ④	17	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 (1.1N•m)	

Thermal Resistance

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ⑧	——	0.54	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.24	——	
$R_{\theta JA}$	Junction-to-Ambient	——	40	

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

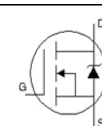
Static @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	100	——	——	V	V_{GS} = 0V, I_D = 250μA
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	——	0.11	——	V/°C	Reference to 25°C, I_D = 5mA
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	——	4.8	6.0	mΩ	V_{GS} = 10V, I_D = 77A ⑤
$V_{GS(th)}$	Gate Threshold Voltage	2.0	——	4.0	V	V_{DS} = V_{GS}, I_D = 150μA
gfs	Forward Trans conductance	169	——	——	S	V_{DS} = 50V, I_D = 77A
I_{DSS}	Drain-to-Source Leakage Current	——	——	20	μA	V_{DS} =100 V, 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	——	0.7	——	Ω	

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

Q_g	Total Gate Charge	——	125	188	nC	I_D = 77A
Q_{gs}	Gate-to-Source Charge	——	32	——		V_{DS} = 50V
Q_{gd}	Gate-to-Drain Charge	——	37	——		V_{GS} = 10V⑤
Q_{sync}	Total Gate Charge Sync. (Q_g - Q_{gd})	——	88	——		
$t_{d(on)}$	Turn-On Delay Time	——	22	——	ns	V_{DD} = 65V
t_r	Rise Time	——	81	——		I_D = 77A
$t_{d(off)}$	Turn-Off Delay Time	——	58	——		R_G= 2.7Ω
t_f	Fall Time	——	83	——		V_{GS} = 10V⑤
C_{iss}	Input Capacitance	——	7120	——	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	——	490	——		V_{DS} = 50V
C_{rss}	Reverse Transfer Capacitance	——	250	——		f = 1.0MHz
$C_{oss\ eff.(ER)}$	Effective Output Capacitance (Energy Related)	——	540	——		V_{GS} = 0V, V_{DS} = 0V to 80V⑦
$C_{oss\ eff.(TR)}$	Effective Output Capacitance (Time Related)	——	705	——		V_{GS} = 0V, V_{DS} = 0V to 80V⑥

Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	——	——	128①	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ②	——	——	480		
V_{SD}	Diode Forward Voltage	——	——	1.3	V	T_J = 25°C,I_S = 77A,V_{GS} = 0V ⑤
t_{rr}	Reverse Recovery Time	——	49	——	ns	T_J = 25°C V_{DD} = 85V
		——	57	——		T_J = 125°C I_F = 77A,
Q_{rr}	Reverse Recovery Charge	——	102	——	nC	T_J = 25°C di/dt = 100A/μs ⑤
		——	133	——		T_J = 125°C
I_{RRM}	Reverse Recovery Current	——	3.7	——	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 = 0.120mH, R_G = 50Ω, I_{AS} = 77A, V_{GS} =10V. Part not recommended for use above this value.

④ $I_{SD} \leq$ 77A, di/dt $\leq$ 1505A/μs, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq$ 175°C.

⑤ Pulse width $\leq$ 400μs; duty cycle $\leq$ 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.

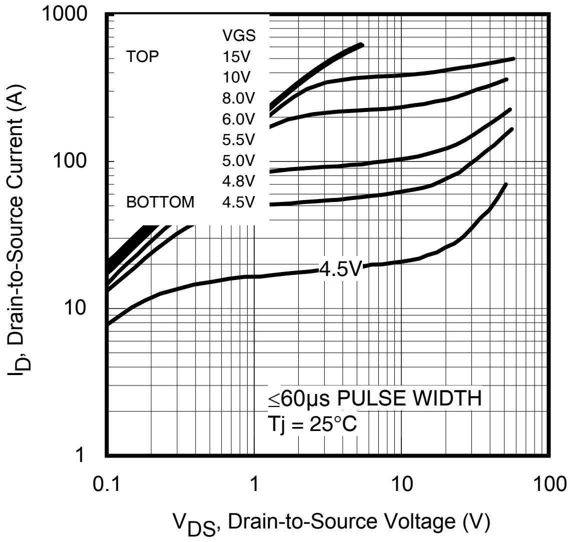


Fig. 1 Typical Output Characteristics

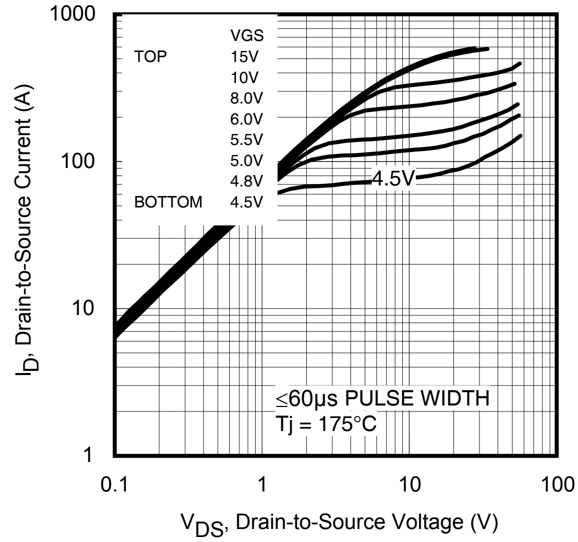


Fig. 2 Typical Output Characteristics

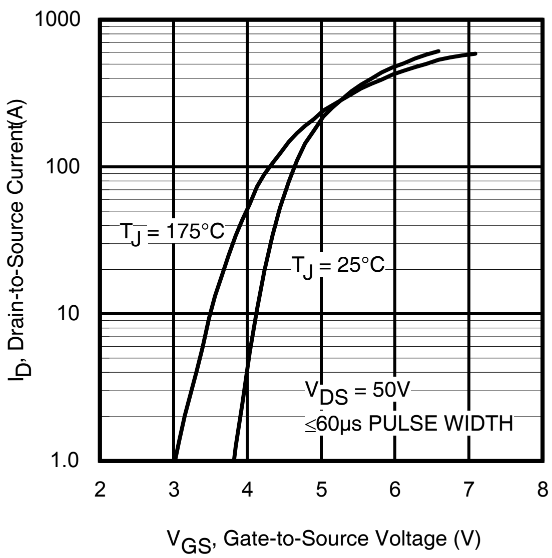


Fig. 3 Typical Transfer Characteristics

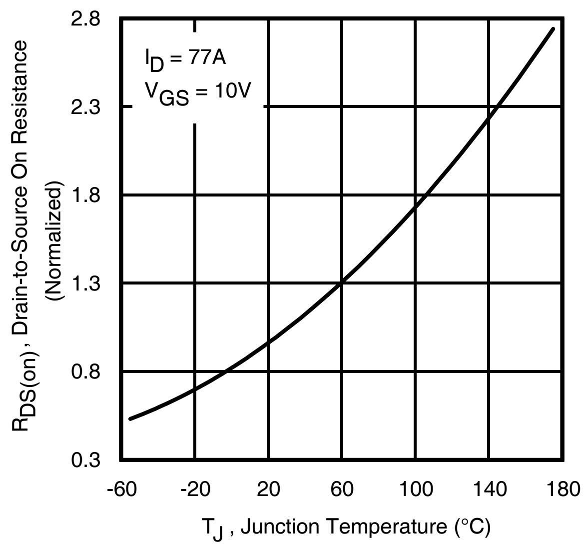


Fig. 4 Normalized On-Resistance vs. Temperature

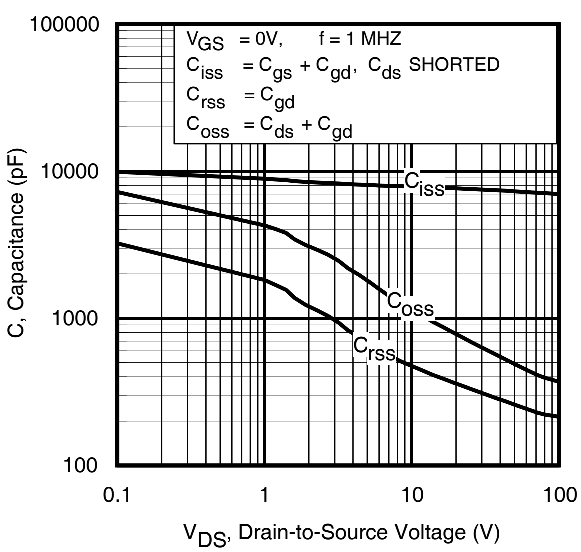


Fig 5. Typical Capacitance vs. Drain-to-Source Voltage

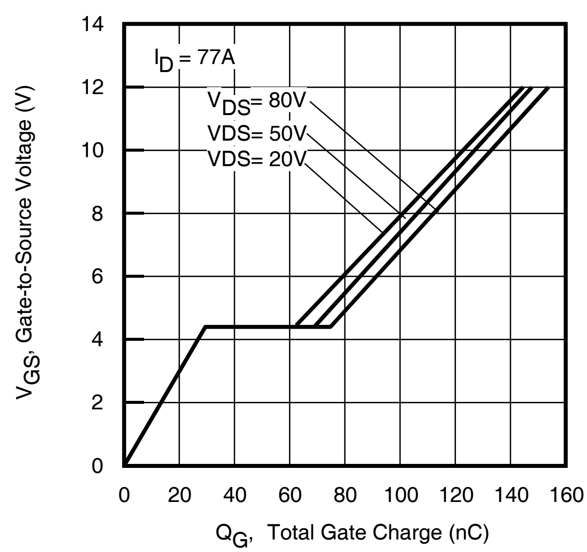


Fig 6. Typical Gate Charge vs. Gate-to-Source Voltage

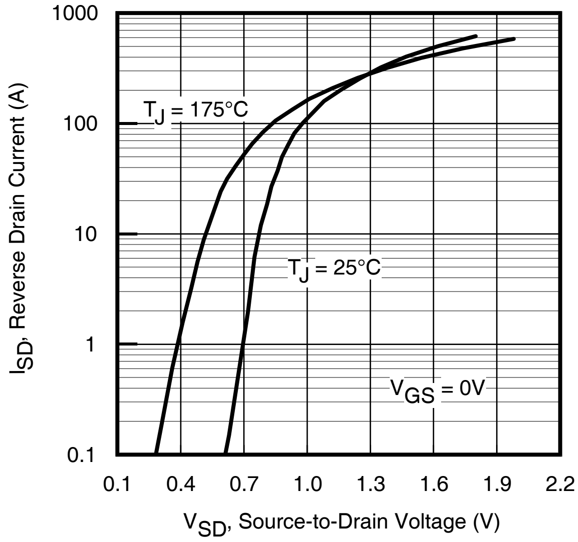


Fig. 7 Typical Source-to-Drain Diode Forward Voltage

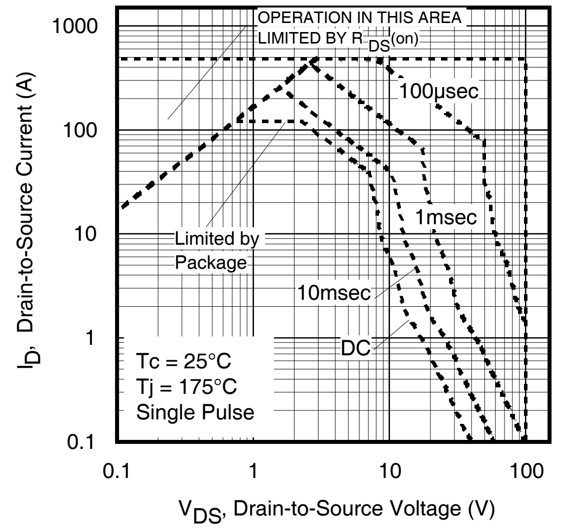


Fig 8. Maximum Safe Operating Area

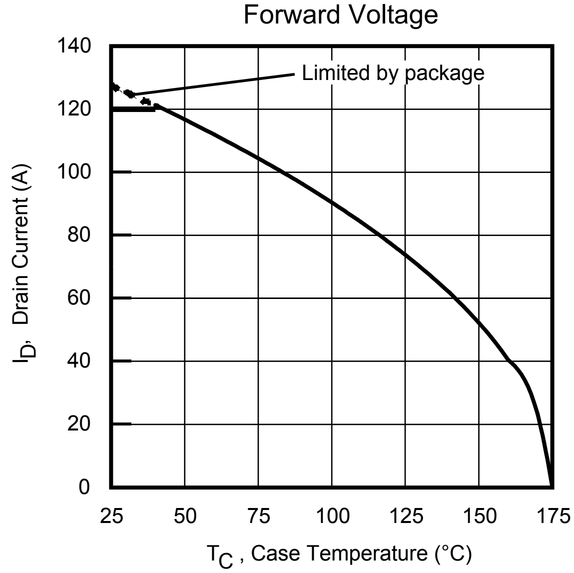


Fig 9. Maximum Drain Current vs. Case Temperature

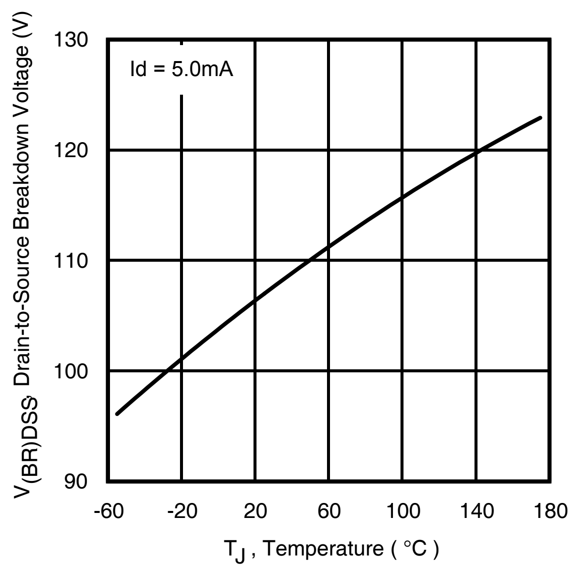


Fig 10. Drain-to-Source Breakdown Voltage

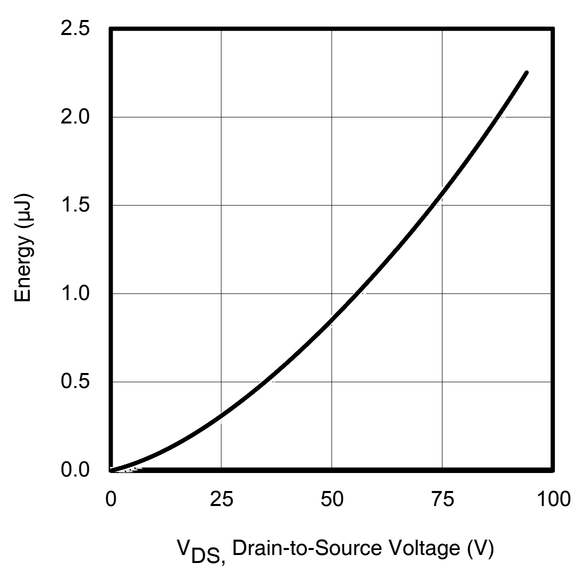


Fig 11. Typical Coss Stored Energy

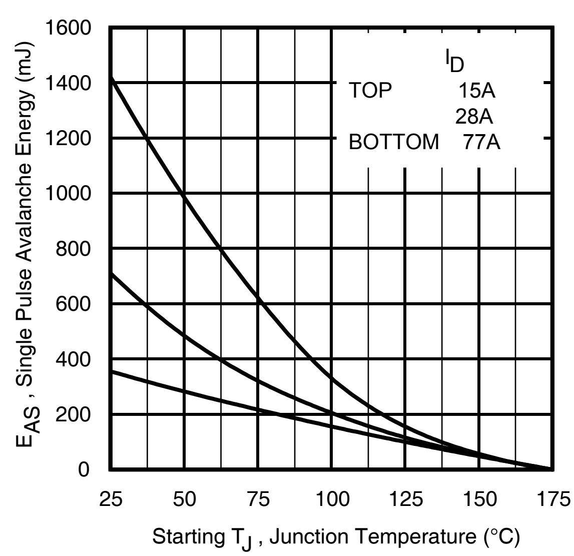


Fig 12. Maximum Avalanche Energy vs. Drain Current

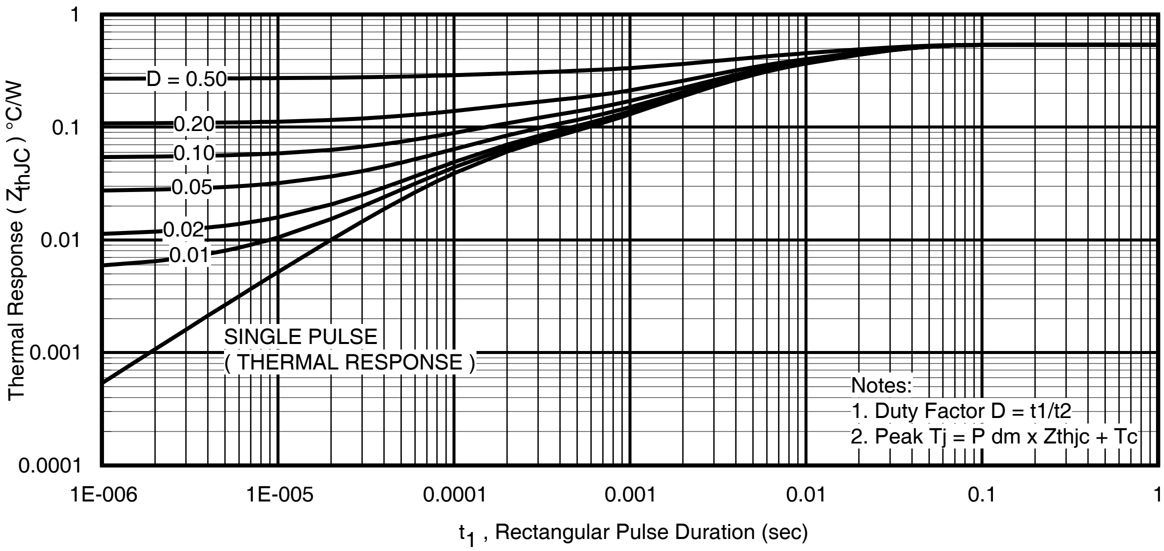


Fig 13. Maximum Effective Transient Thermal Impedance, Junction-to-Case

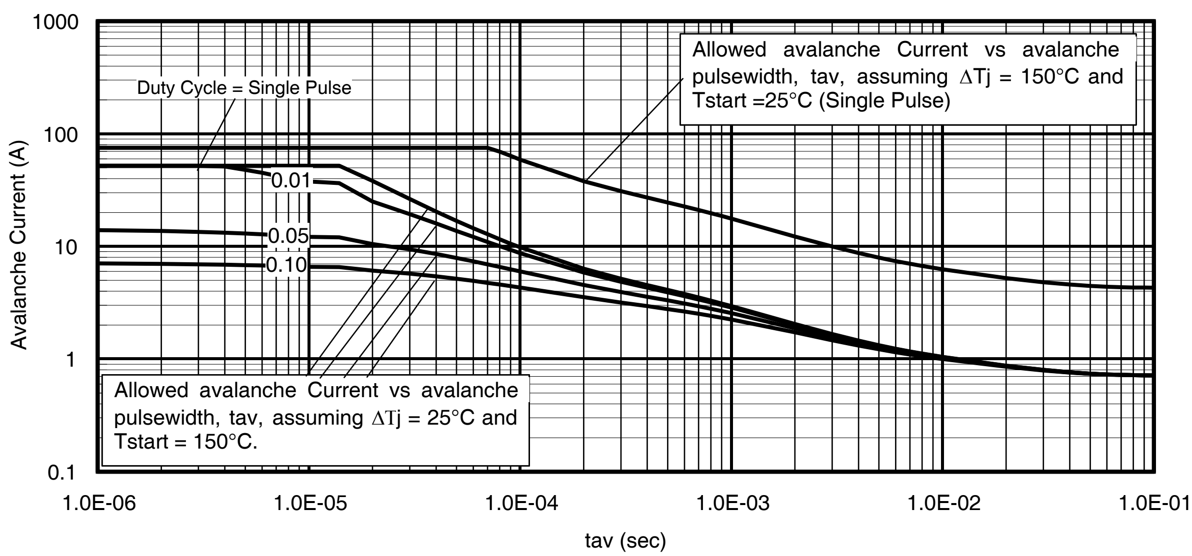


Fig 14. Avalanche Current vs. Pulse width

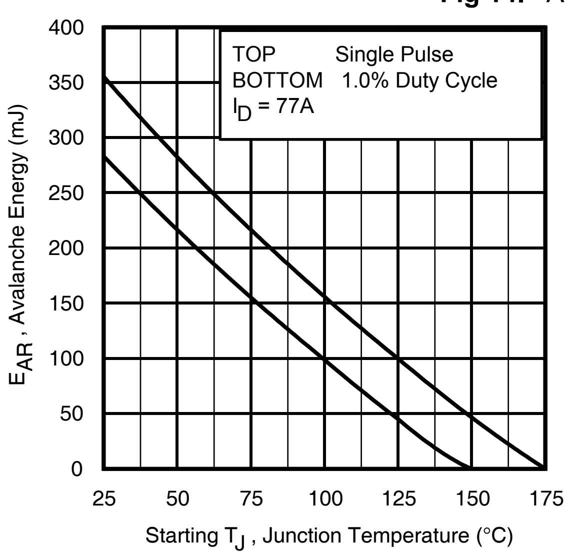


Fig 15. Maximum Avalanche Energy vs. Temperature

Notes on Repetitive Avalanche Curves , Figures 14, 15:
(For further info, see AN-1005 at www.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 23a, 23b.
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 13, 14).
   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)

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

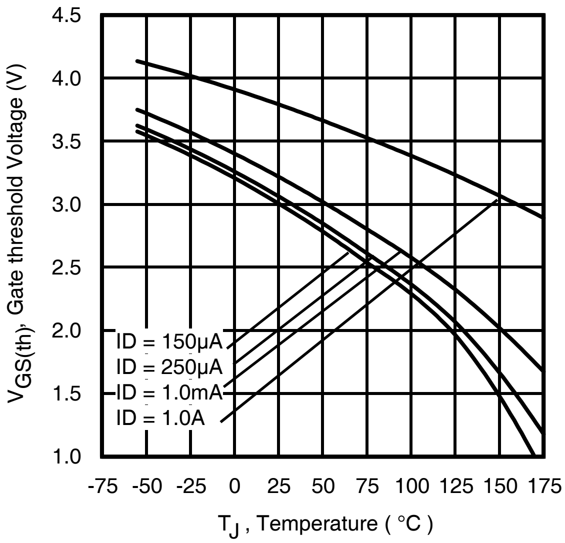


Fig 16. Threshold Voltage vs. Temperature

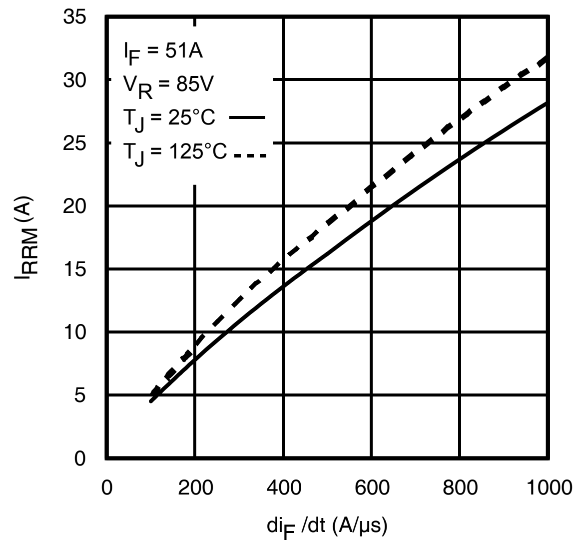


Fig. 17 - Typical Recovery Current vs. dif/dt

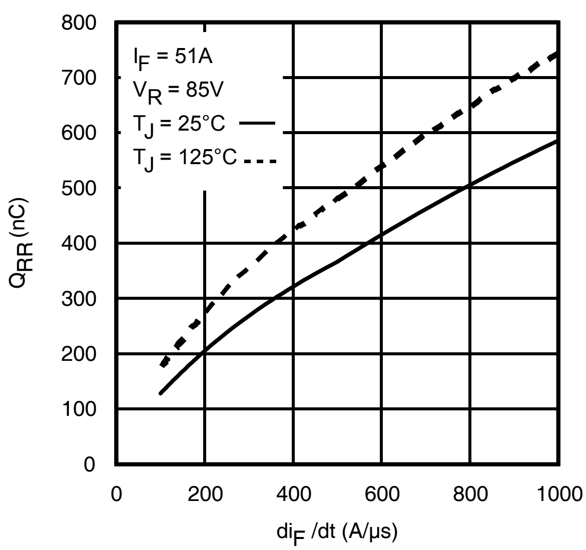


Fig. 18 - Typical Stored Charge vs. dif/dt

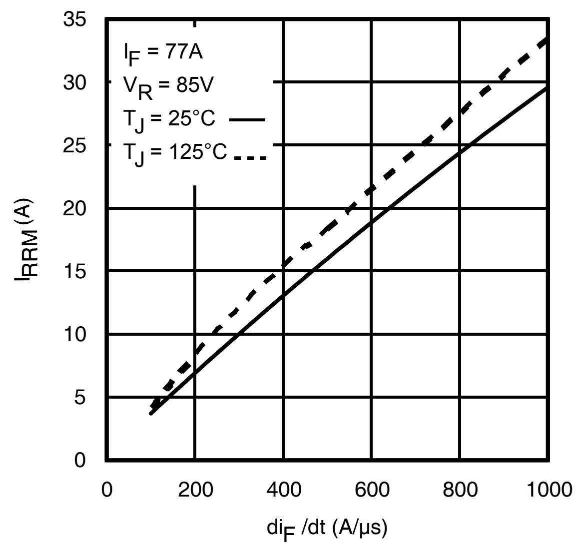


Fig. 19 - Typical Recovery Current vs. dif/dt

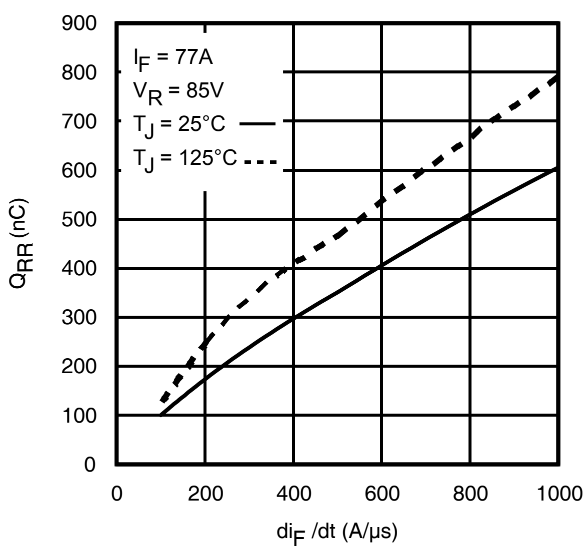


Fig. 20 - Typical Stored Charge vs. dif/dt

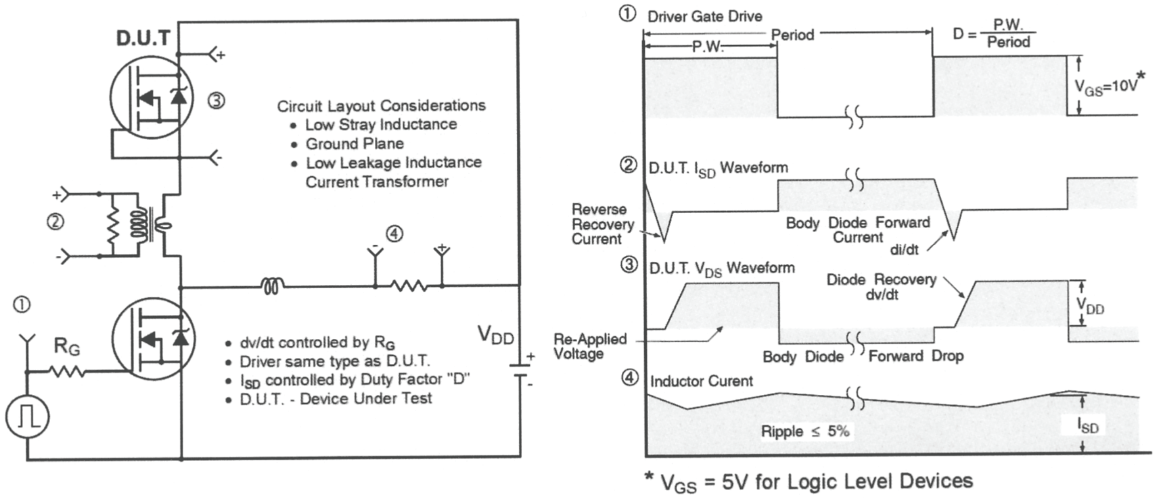


Fig 21. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

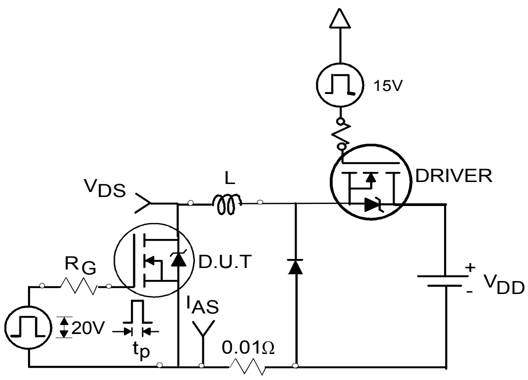


Fig 22a. Unclamped Inductive Test Circuit

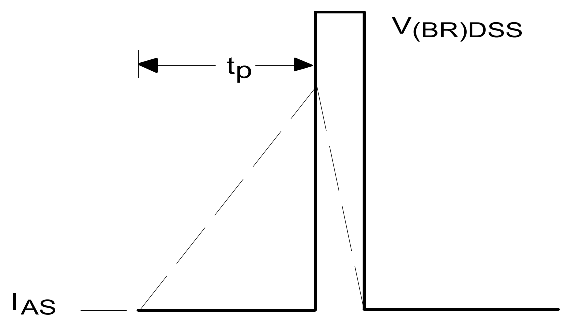


Fig 22b. Unclamped Inductive Waveforms

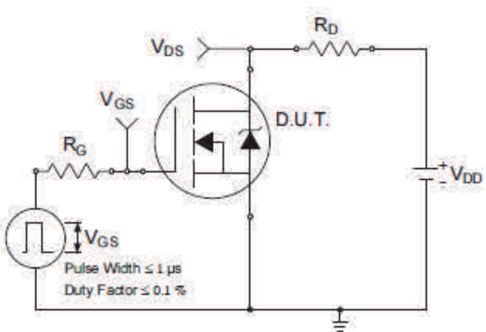


Fig 23a. Switching Time Test Circuit

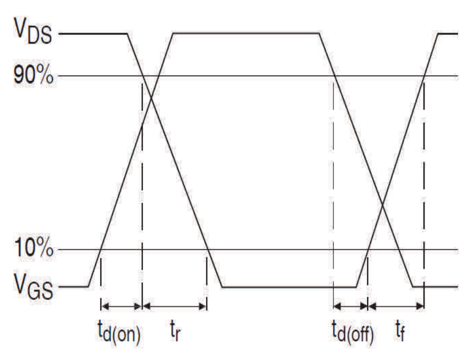


Fig 23b. Switching Time Waveforms

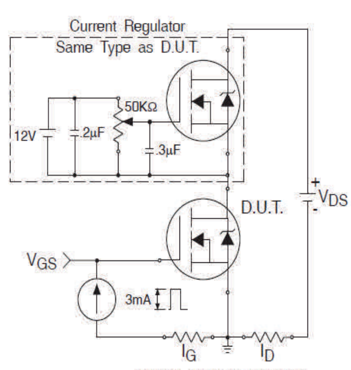


Fig 24a. Gate Charge Test Circuit

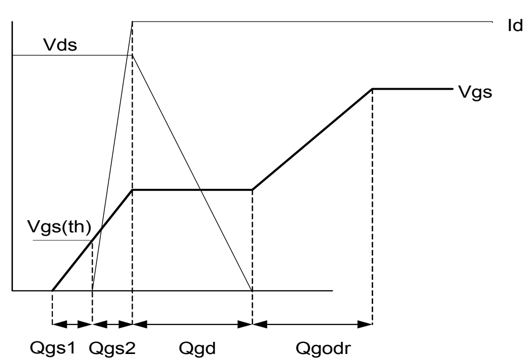
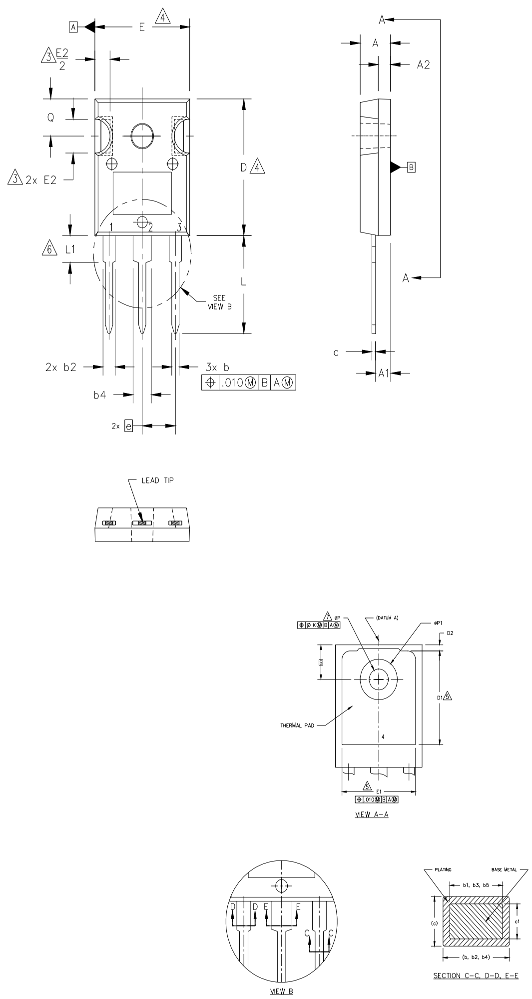


Fig 24b. Gate Charge Waveform

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	.055	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

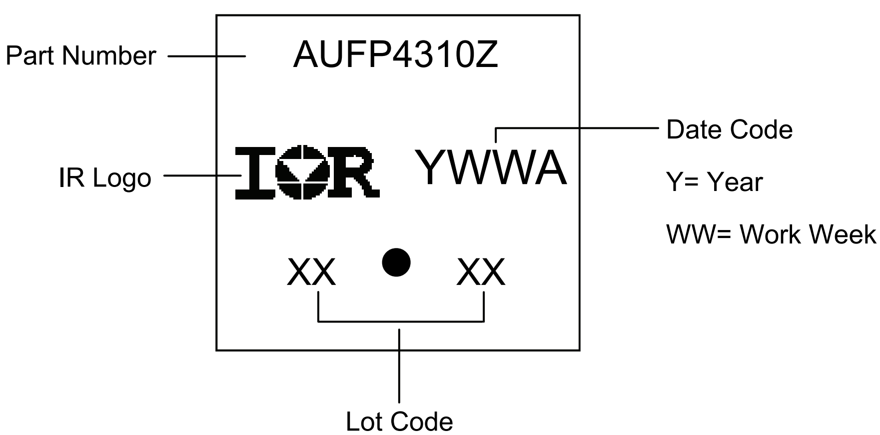
IGBTs, CoPACK

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.

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-247AC	N/A
ESD	Human Body Model	Class H2 (+/- 4000V)† AEC-Q101-001	
	Charged Device Model	Class C5 (+/- 2000V)† AEC-Q101-005	
RoHS Compliant		Yes	

† Highest passing voltage.

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