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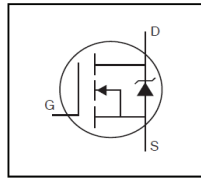
sales@integrated-circuit.com

AUTOMOTIVE GRADE

AU1RLR3636

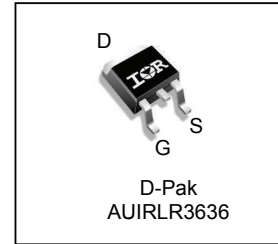
Features

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



HEXFET® Power MOSFET

V_{DS}		60V
$R_{DS(on)}$	typ.	5.4mΩ
	max.	6.8mΩ
I_D (Silicon Limited)		99A①
I_D (Package Limited)		50A



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 a wide variety of other applications.

G	D	S
Gate	Drain	Source

Base part number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
AU1RLR3636	D-Pak	Tube	75	AU1RLR3636
		Tape and Reel Left	3000	AU1RLR3636TRL

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 (T_A) 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)	99①	A
I_D @ $T_C = 100^\circ\text{C}$	Continuous Drain Current, V_{GS} @ 10V (Silicon Limited)	70①	
I_D @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, V_{GS} @ 10V (Package Limited)	50	
I_{DM}	Pulsed Drain Current ②	396	
P_D @ $T_C = 25^\circ\text{C}$	Maximum Power Dissipation	143	W
	Linear Derating Factor	0.95	W/°C
V_{GS}	Gate-to-Source Voltage	± 16	V
E_{AS}	Single Pulse Avalanche Energy (Thermally Limited) ③	170	mJ
I_{AR}	Avalanche Current ②	See Fig. 14, 15, 22a, 22b	A
E_{AR}	Repetitive Avalanche Energy ②		mJ
dv/dt	Peak Diode Recovery ④	22	V/ns
T_J	Operating Junction and	-55 to + 175	°C
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 seconds (1.6mm from case)	300	

Thermal Resistance

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ⑤	—	1.05	°C/W
$R_{\theta JA}$	Junction-to-Ambient (PCB Mount) ⑤	—	50	
$R_{\theta JA}$	Junction-to-Ambient ⑤	—	110	

HEXFET® is a registered trademark of Infineon.

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

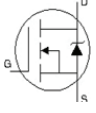
Static @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	60	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.07	—	V/ $^\circ\text{C}$	Reference to 25°C , $I_D = 5mA$ ②
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	5.4	6.8	$m\Omega$	$V_{GS} = 10V, I_D = 50A$ ⑤
		—	6.6	8.3		$V_{GS} = 4.5V, I_D = 50A$ ⑤
$V_{GS(th)}$	Gate Threshold Voltage	1.0	—	2.5	V	$V_{DS} = V_{GS}, I_D = 100\mu A$
g_{fs}	Forward Trans conductance	31	—	—	S	$V_{DS} = 25V, I_D = 50A$
$R_{G(int)}$	Internal Gate Resistance	—	0.6	—	Ω	
I_{DSS}	Drain-to-Source Leakage Current	—	—	20	μA	$V_{DS} = 60V, V_{GS} = 0V$
		—	—	250		$V_{DS} = 60V, V_{GS} = 0V, T_J = 125^\circ\text{C}$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 16V$
	Gate-to-Source Reverse Leakage	—	—	-100		$V_{GS} = -16V$

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

Q_g	Total Gate Charge	—	33	49	nC	$I_D = 50A$ $V_{DS} = 30V$ $V_{GS} = 4.5V$ ⑤
Q_{gs}	Gate-to-Source Charge	—	11	—		
Q_{gd}	Gate-to-Drain Charge	—	15	—		
Q_{sync}	Total Gate Charge Sync. ($Q_g - Q_{gd}$)	—	18	—		
$t_{d(on)}$	Turn-On Delay Time	—	45	—	ns	$V_{DD} = 39V$ $I_D = 50A$ $R_G = 7.5\Omega$ $V_{GS} = 4.5V$ ⑤
t_r	Rise Time	—	216	—		
$t_{d(off)}$	Turn-Off Delay Time	—	43	—		
t_f	Fall Time	—	69	—		
C_{iss}	Input Capacitance	—	3779	—	pF	$V_{GS} = 0V$ $V_{DS} = 50V$ $f = 1.0MHz$ $V_{GS} = 0V, V_{DS} = 0V$ to $48V$ ⑦ $V_{GS} = 0V, V_{DS} = 0V$ to $48V$ ⑥
C_{oss}	Output Capacitance	—	332	—		
C_{rss}	Reverse Transfer Capacitance	—	163	—		
$C_{oss\ eff. (ER)}$	Effective Output Capacitance (Energy Related)	—	437	—		
$C_{oss\ eff. (TR)}$	Effective Output Capacitance (Time Related)	—	636	—		

Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I _S	Continuous Source Current (Body Diode)	—	—	99①	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I _{SM}	Pulsed Source Current (Body Diode) ①	—	—	396		
V _{SD}	Diode Forward Voltage	—	—	1.3	V	T _J = 25°C, I _S = 50A, V _{GS} = 0V ⑤
t _{rr}	Reverse Recovery Time	—	27	—	ns	T _J = 25°C
		—	32	—		T _J = 125°C
Q _{rr}	Reverse Recovery Charge	—	31	—	nC	T _J = 25°C
		—	43	—		T _J = 125°C
		—	2.1	—	A	T _J = 25°C
t _{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by L _S +L _D)				

Notes:

- ① Calculated continuous current based on maximum allowable junction temperature. Bond wire current limit is 50A. 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. (See fig. 11)
- ③ Limited by T_{Jmax} , starting $T_J = 25^\circ\text{C}$, $L = 0.136mH$, $R_G = 25\Omega$, $I_{AS} = 50A$, $V_{GS} = 10V$. Part not recommended for use above this value.
- ④ $I_{SD} \leq 50A$, $di/dt \leq 1109A/\mu s$, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq 175^\circ\text{C}$.
- ⑤ Pulse width $\leq 400\mu s$; 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 When mounted on 1" square PCB (FR-4 or G-10 Material). For recommended footprint and soldering techniques refer to application note #AN-994
- ⑨ R_{θ} is measured at T_J approximately 90°C .

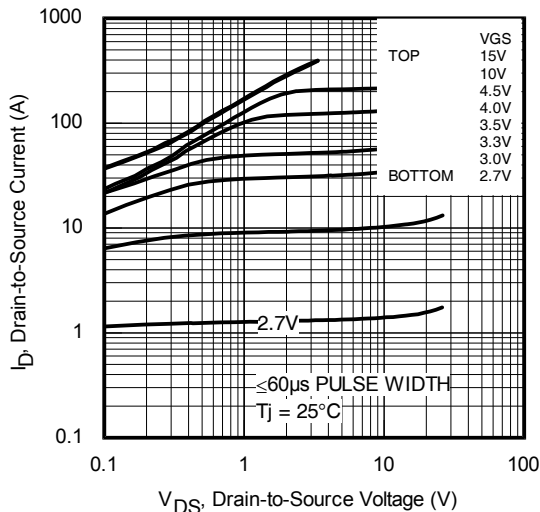


Fig. 1 Typical Output Characteristics

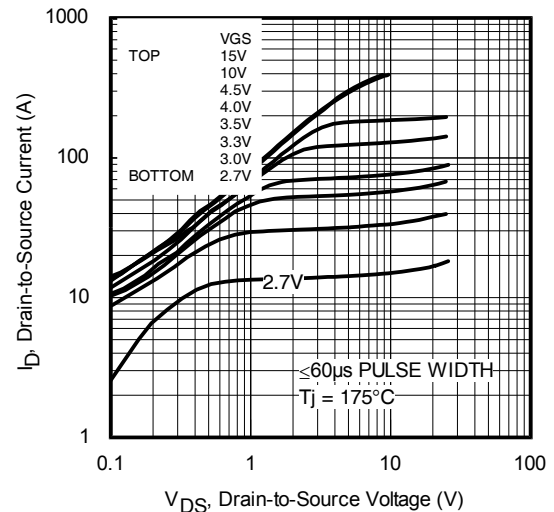


Fig. 2 Typical Output Characteristics

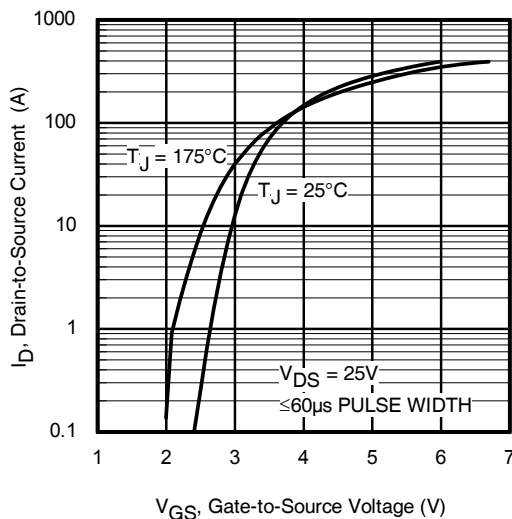


Fig. 3 Typical Transfer Characteristics

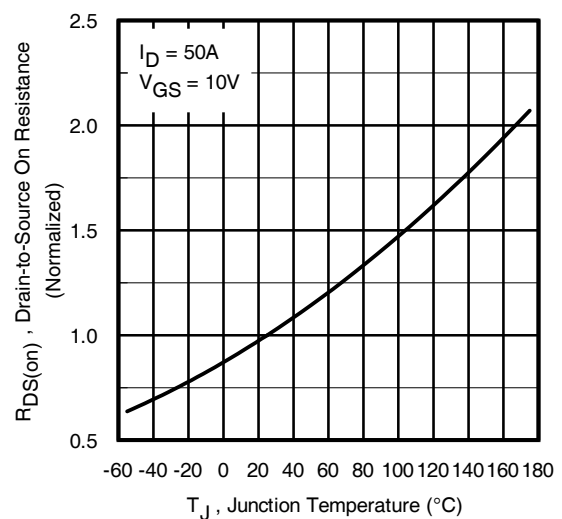


Fig. 4 Normalized On-Resistance vs. Temperature

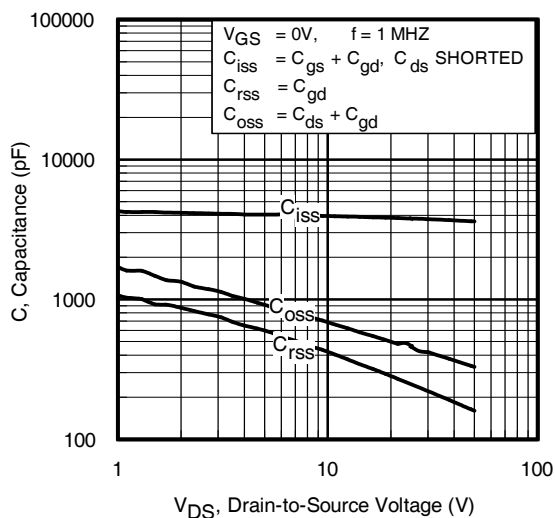


Fig. 5. Typical Capacitance vs. Drain-to-Source Voltage

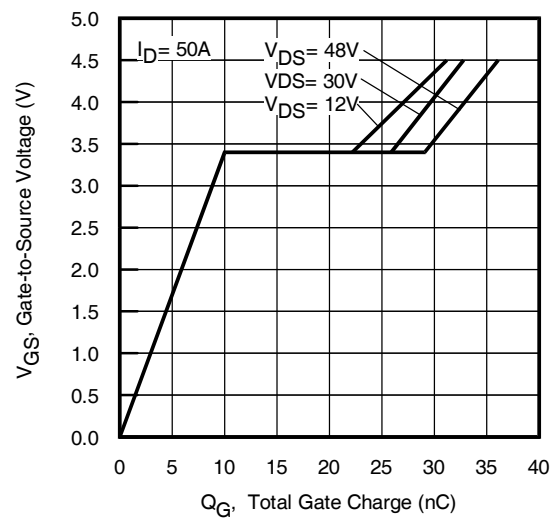


Fig. 6. Typical Gate Charge vs. Gate-to-Source Voltage

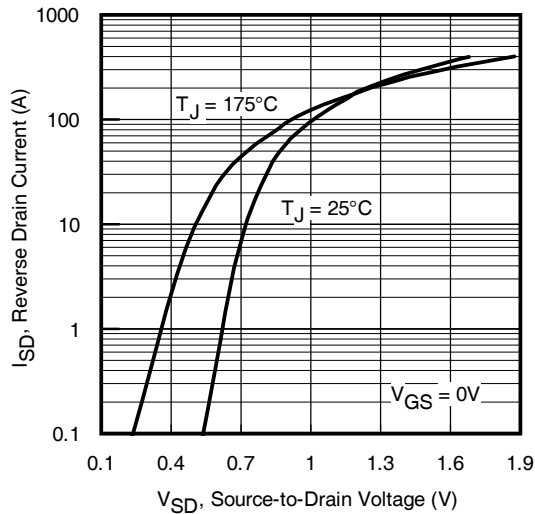


Fig. 7 Typical Source-to-Drain Diode Forward Voltage

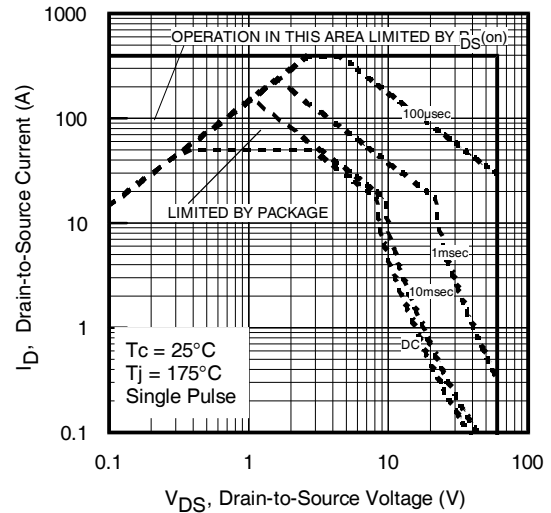


Fig. 8. Maximum Safe Operating Area

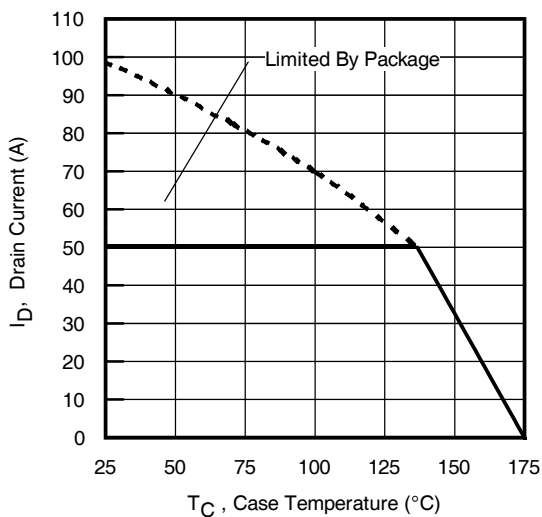


Fig. 9 Maximum Drain Current vs. Case Temperature

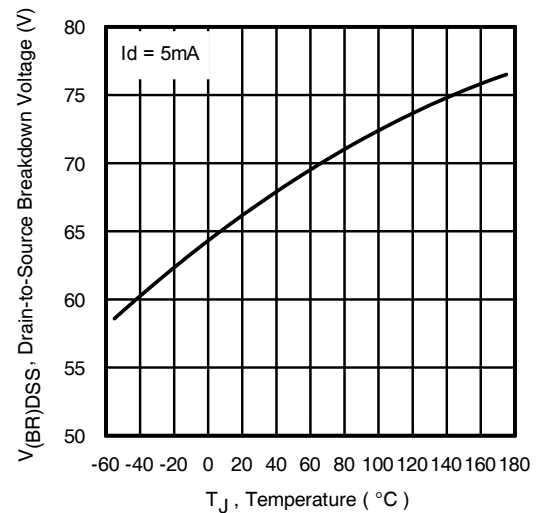


Fig. 10. Drain-to-Source Breakdown Voltage

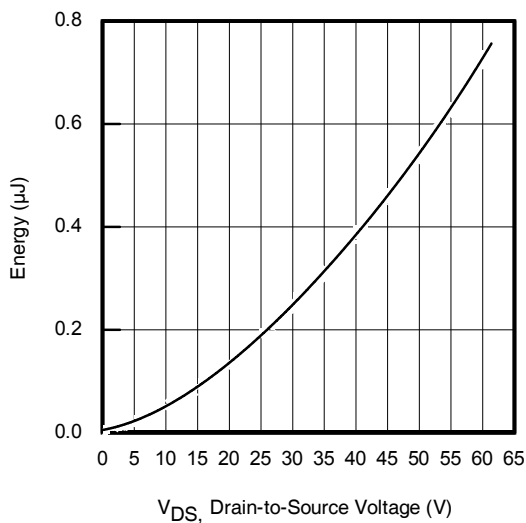


Fig. 11 Typical C_{oss} Stored Energy

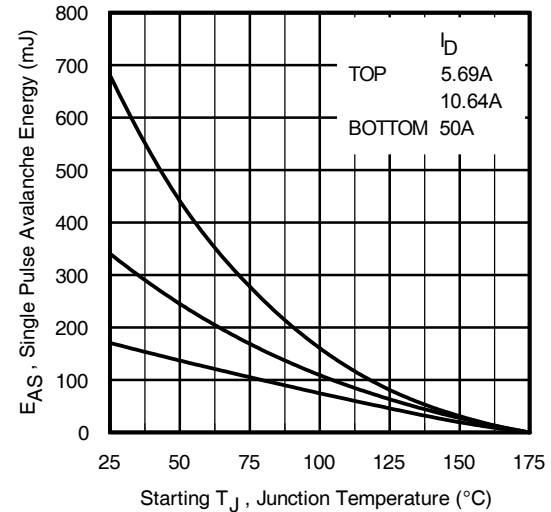


Fig. 12. Maximum Avalanche Energy vs. Drain Current

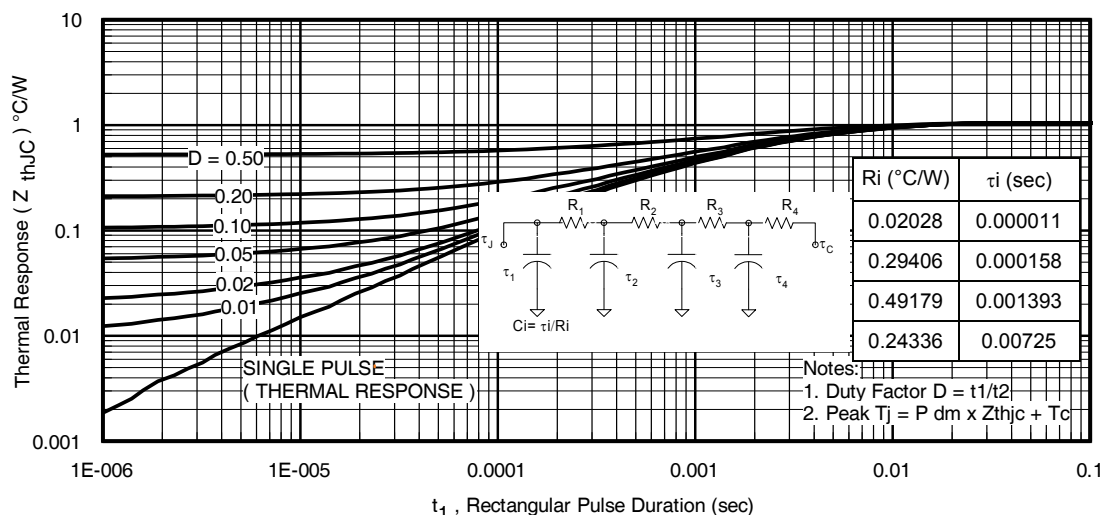


Fig 13. Maximum Effective Transient Thermal Impedance, Junction-to-Case

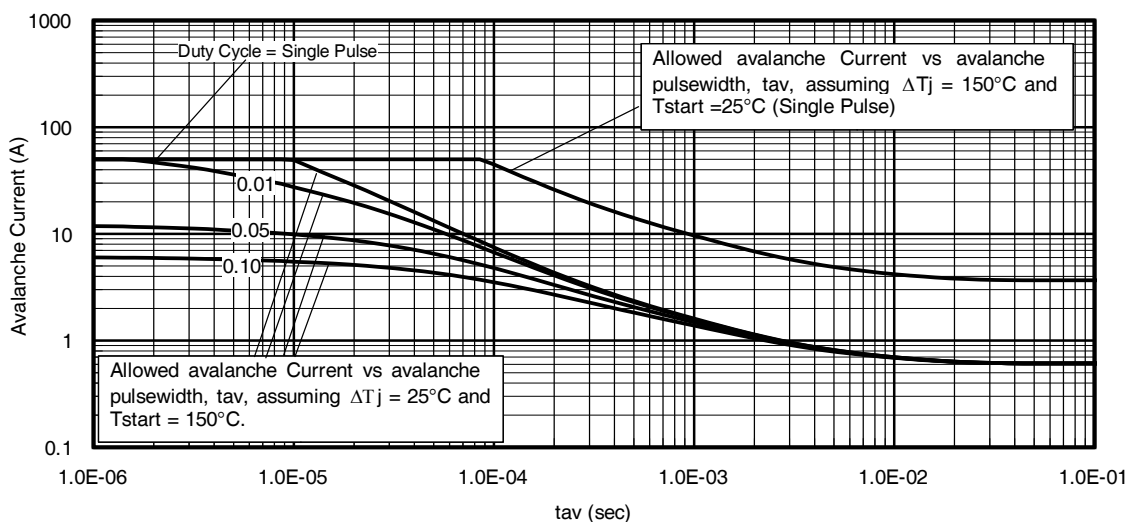


Fig 14. Typical Avalanche Current Vs. Pulse width

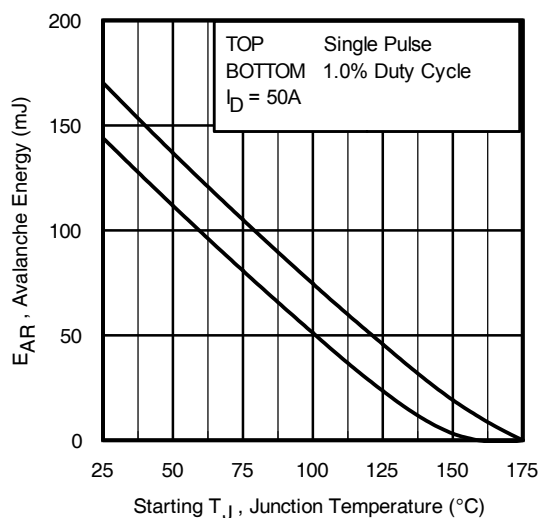


Fig 15. Maximum Avalanche Energy Vs. Temperature

Notes on Repetitive Avalanche Curves , Figures 14, 15:
 (For further info, see AN-1005 at www.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 22a, 22b.
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)

$$P_D(ave) = 1/2 (1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$$

$$I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{th}]$$

$$E_{AS(AR)} = P_D(ave) \cdot t_{av}$$

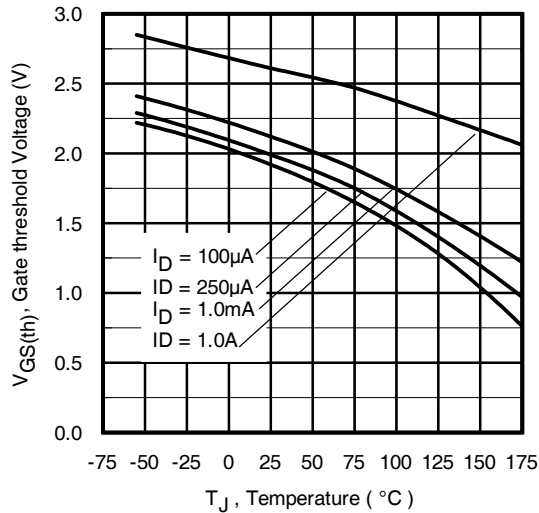


Fig 16. Threshold Voltage vs. Temperature

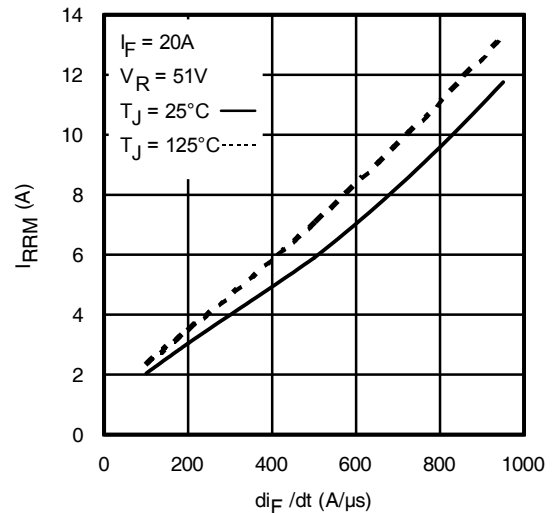


Fig. 17 - Typical Recovery Current vs. di/dt

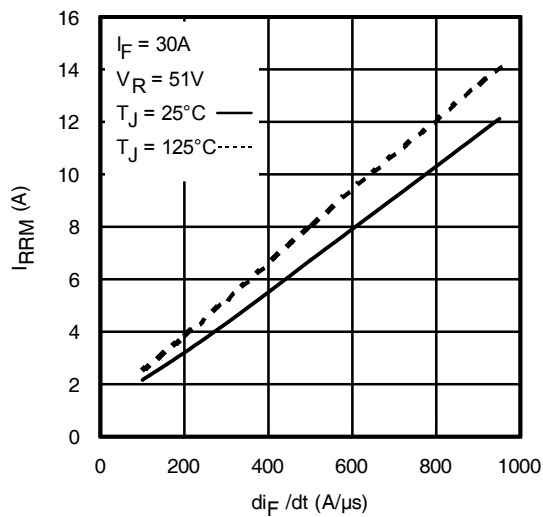


Fig. 18 - Typical Recovery Current vs. di/dt

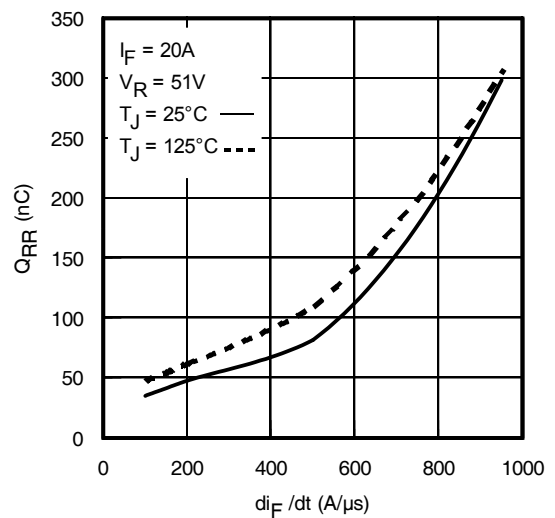


Fig. 19 - Typical Stored Charge vs. di/dt

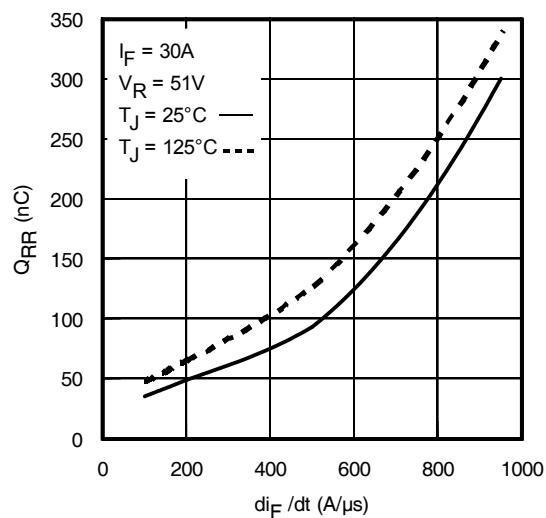


Fig. 20 - Typical Stored Charge vs. di/dt

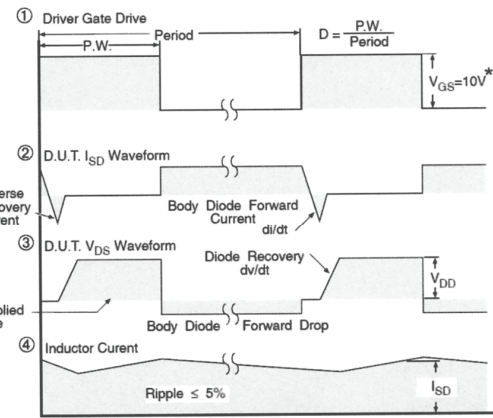
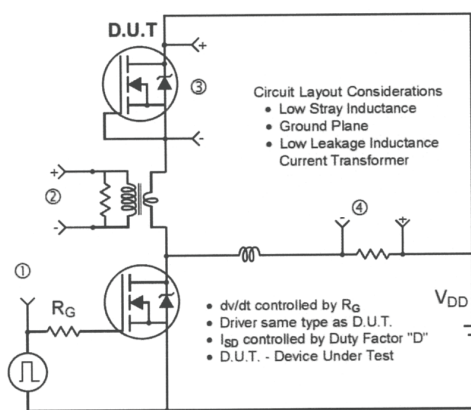


Fig 21. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

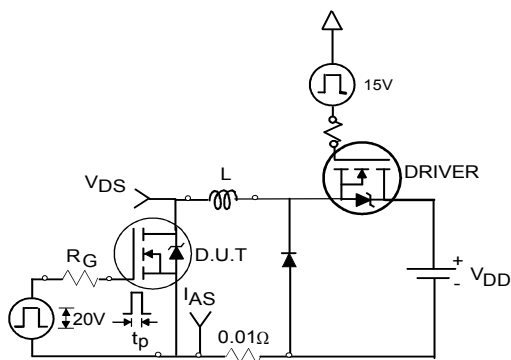


Fig 22a. Unclamped Inductive Test Circuit

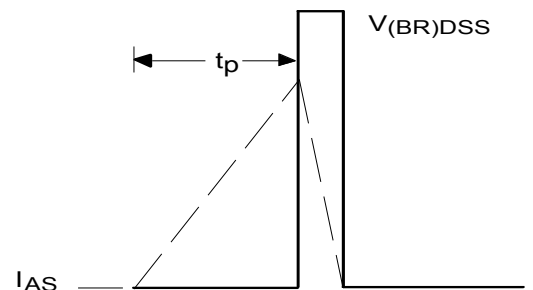


Fig 22b. Unclamped Inductive Waveforms

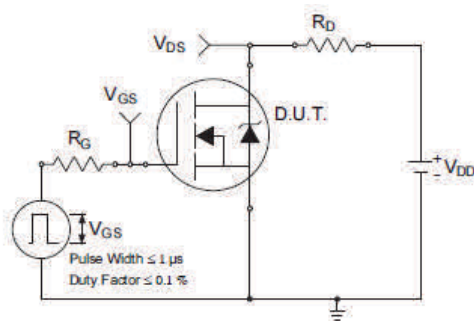


Fig 23a. Switching Time Test Circuit

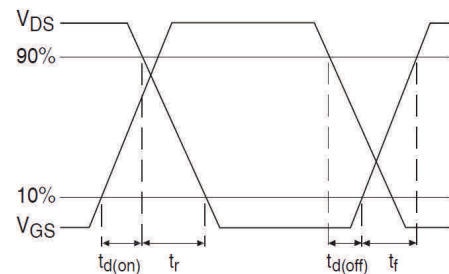


Fig 23b. Switching Time Waveforms

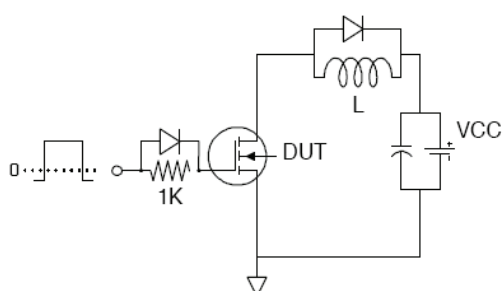


Fig 24a. Gate Charge Test Circuit

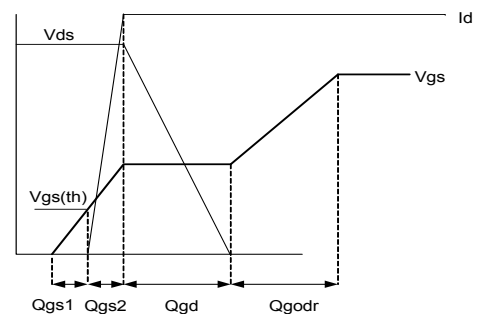
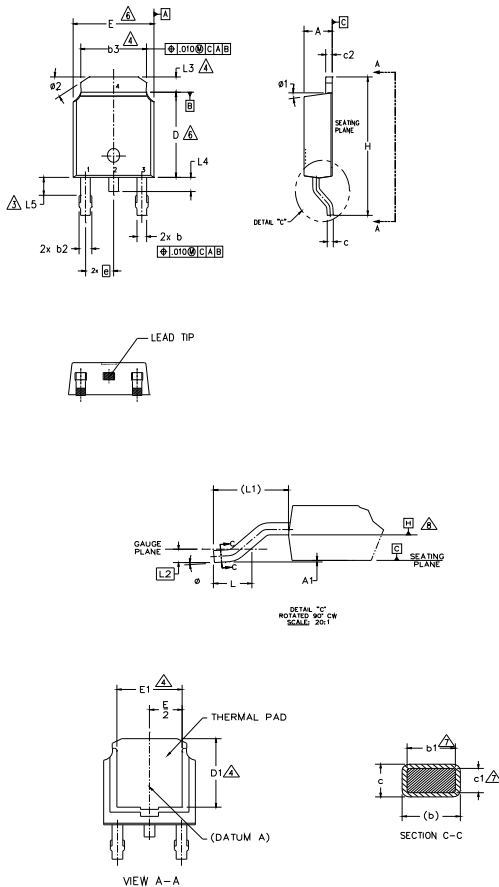


Fig 24b. Gate Charge Waveform

D-Pak (TO-252AA) Package Outline (Dimensions are shown in millimeters (inches))



NOTES:

- 1.- DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
- 2.- DIMENSION ARE SHOWN IN INCHES [MILLIMETERS].
- 3.- LEAD DIMENSION UNCONTROLLED IN L5.
- 4.- DIMENSION D1, E1, L3 & b3 ESTABLISH A MINIMUM MOUNTING SURFACE FOR THERMAL PAD.
- 5.- SECTION C-C DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN .005 AND 0.10 [0.13 AND 0.25] FROM THE LEAD TIP.
- 6.- DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005 [0.13] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
- 7.- DIMENSION b1 & c1 APPLIED TO BASE METAL ONLY.
- 8.- DATUM A & B TO BE DETERMINED AT DATUM PLANE H.
- 9.- OUTLINE CONFORMS TO JEDEC OUTLINE TO-252AA.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	2.18	2.39	.086	.094	
A1	—	0.13	—	.005	
b	0.64	0.89	.025	.035	
b1	0.65	0.79	.025	.031	7
b2	0.76	1.14	.030	.045	
b3	4.95	5.46	.195	.215	4
c	0.46	0.61	.018	.024	
c1	0.41	0.56	.016	.022	7
c2	0.46	0.89	.018	.035	
D	5.97	6.22	.235	.245	6
D1	5.21	—	.205	—	4
E	6.35	6.73	.250	.265	6
E1	4.32	—	.170	—	4
e	2.29 BSC		.090 BSC		
H	9.40	10.41	.370	.410	
L	1.40	1.78	.055	.070	
L1	2.74 BSC		.108 REF.		
L2	0.51 BSC		.020 BSC		
L3	0.89	1.27	.035	.050	4
L4	—	1.02	—	.040	
L5	1.14	1.52	.045	.060	3
ø	0"	10"	0"	10"	
ø1	0"	15"	0"	15"	
ø2	25"	35"	25"	35"	

LEAD ASSIGNMENTS

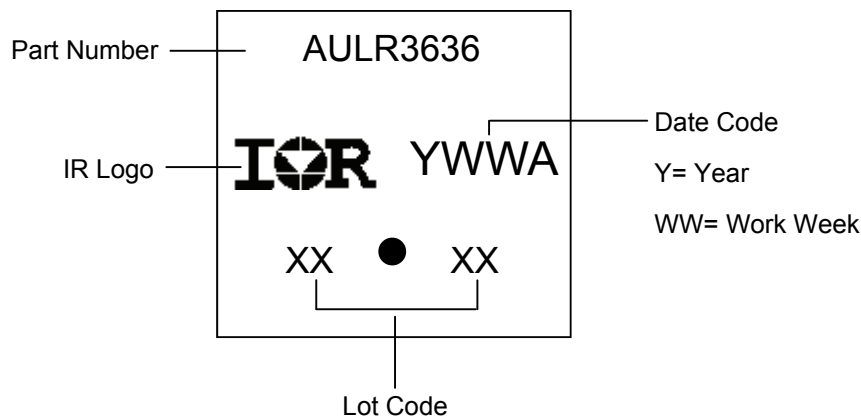
HEXFET

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

IGBT & CoPAK

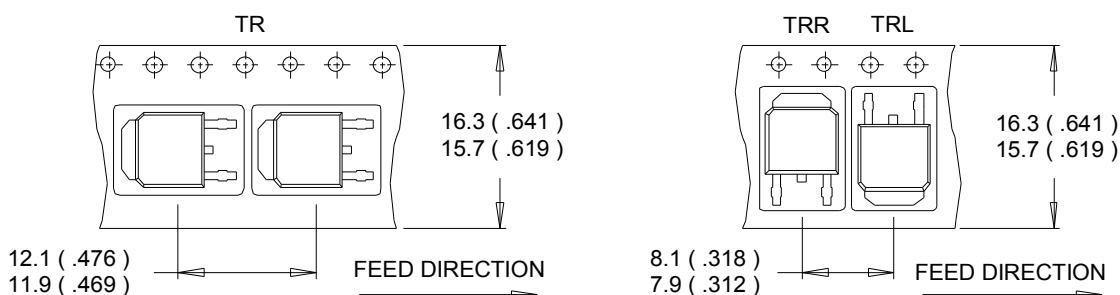
- 1.- GATE
- 2.- COLLECTOR
- 3.- EMITTER
- 4.- COLLECTOR

D-Pak (TO-252AA) Part Marking Information



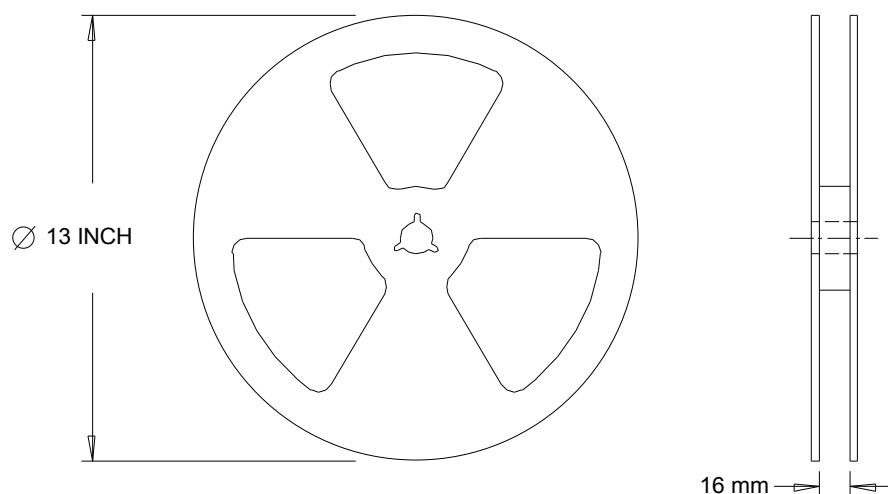
Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>

D-Pak (TO-252AA) Tape & Reel Information (Dimensions are shown in millimeters (inches))



NOTES :

1. CONTROLLING DIMENSION : MILLIMETER.
2. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).
3. OUTLINE CONFORMS TO EIA-481 & EIA-541.



NOTES :

1. OUTLINE CONFORMS TO EIA-481.

Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>

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		D-Pak	MSL1
ESD	Machine Model	Class M4 (+/- 600V) [†] AEC-Q101-002	
	Human Body Model	Class H1C (+/- 2000V) [†] AEC-Q101-001	
	Charged Device Model	Class C5 (+/- 2000V) [†] AEC-Q101-005	
RoHS Compliant		Yes	

† Highest passing voltage.

Revision History

Date	Comments
3/18/2014	- Added "Logic Level Gate Drive" bullet in the features section on page 1 - Updated data sheet with new IR corporate template
4/9/2014	- Updated package outline on page 8. - Updated typo on the fig.19 and fig.20, unit of y-axis from "A" to "nC" on page 6.
11/4/2015	- Updated datasheet with corporate template - Corrected ordering table on page 1.

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