



**THE DATASHEET OF
AUIRFN8405TR**



Features

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

Description

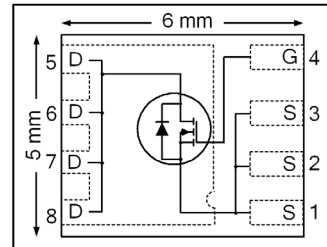
Specifically designed for Automotive applications, this HEXFET® Power MOSFET utilizes the latest processing techniques to achieve extremely low on-resistance per silicon area. Additional features of this design are a 175°C junction operating temperature, fast switching speed and improved repetitive avalanche rating. These features combine to make this product an extremely efficient and reliable device for use in Automotive and wide variety of other applications.

Applications

- Electric Power Steering (EPS)
- Battery Switch
- Start/Stop Micro Hybrid
- Heavy Loads
- DC-DC Converter

HEXFET® POWER MOSFET

V_{DSS}	40V
R_{DS(on)} typ.	1.6mΩ
max	2.0mΩ
I_D (Silicon Limited)	187A^①
I_D (Package Limited)	95A



G	D	S
Gate	Drain	Source

Base Part Number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
AUIRFN8405	PQFN 5mm x 6mm	Tape and Reel	4000	AUIRFN8405TR

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)	187 ^①	A
I _D @ T _{C(Bottom)} = 100°C	Continuous Drain Current, V _{GS} @ 10V (Silicon Limited)	132 ^①	
I _D @ T _C = 25°C	Continuous Drain Current, V _{GS} @ 10V (Package Limited)	95	
I _{DM}	Pulsed Drain Current ^②	670 ^②	
P _D @ T _A = 25°C	Power Dissipation	3.3	W
P _D @ T _{C(Bottom)} = 25°C	Power Dissipation	136	
	Linear Derating Factor	0.022	W/°C
V _{GS}	Gate-to-Source Voltage	± 20	V
T _J T _{STG}	Operating Junction and Storage Temperature Range	-55 to + 175	°C

Avalanche Characteristics

E _{AS} (Thermally Limited)	Single Pulse Avalanche Energy ^③	190	mJ
E _{AS} (Tested)	Single Pulse Avalanche Energy	365	
I _{AR}	Avalanche Current ^②	See Fig. 14, 15, 22a, 22b	A
E _{AR}	Repetitive Avalanche Energy ^②		mJ

HEXFET® is a registered trademark of International Rectifier.

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

Thermal Resistance

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$ (Bottom)	Junction-to-Case ⑨	—	1.1	°C/W
$R_{\theta JC}$ (Top)	Junction-to-Case ⑨	—	30	
$R_{\theta JA}$	Junction-to-Ambient ⑧	—	44	
$R_{\theta JA}$ (<10s)	Junction-to-Ambient ⑧	—	28	


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

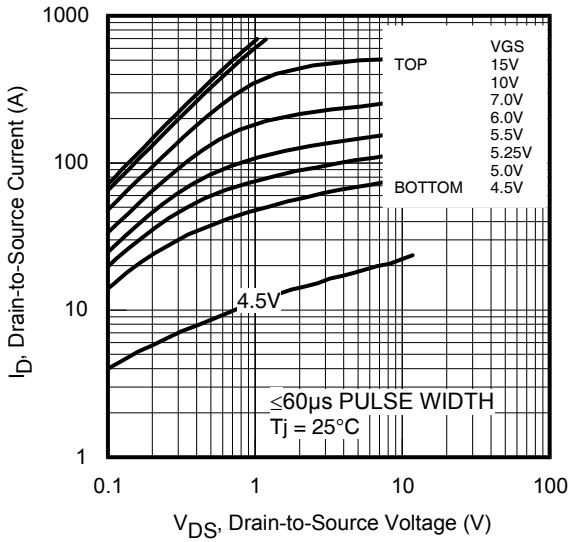
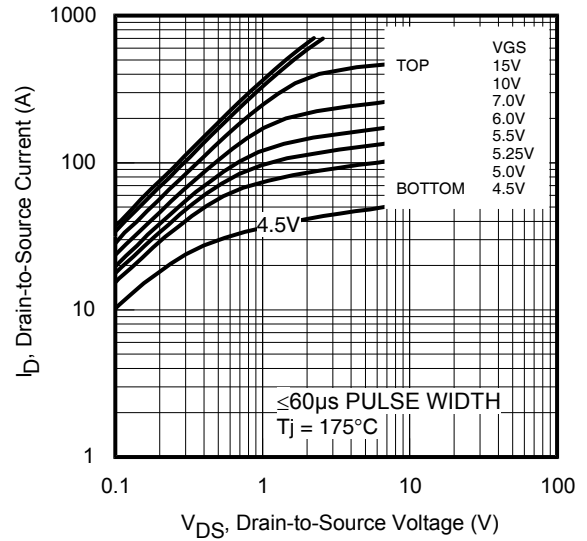
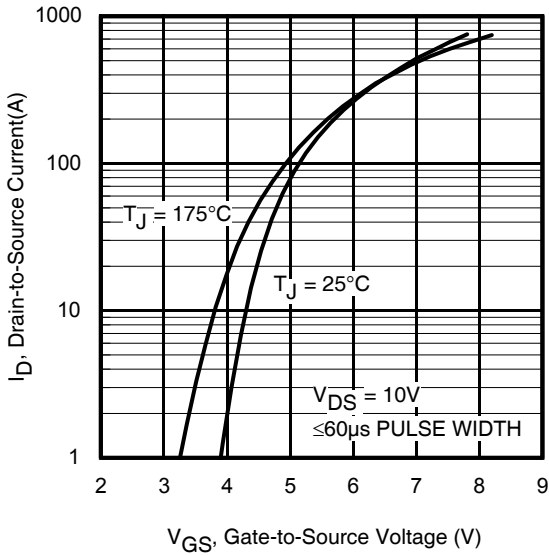
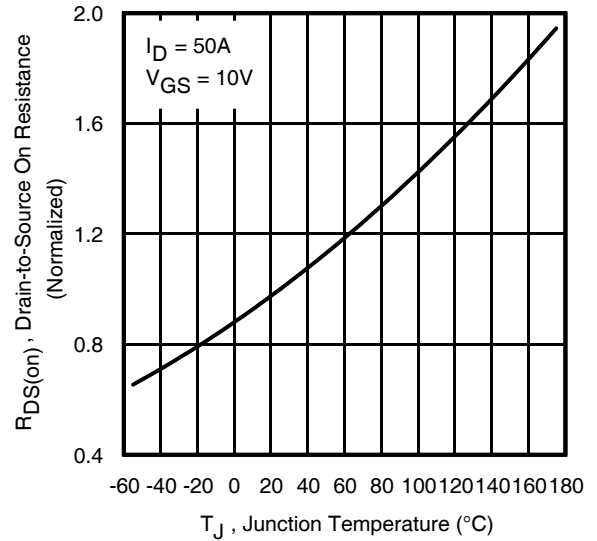
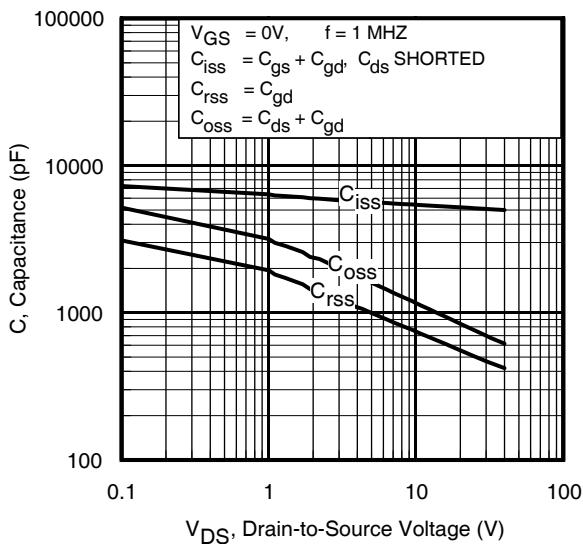
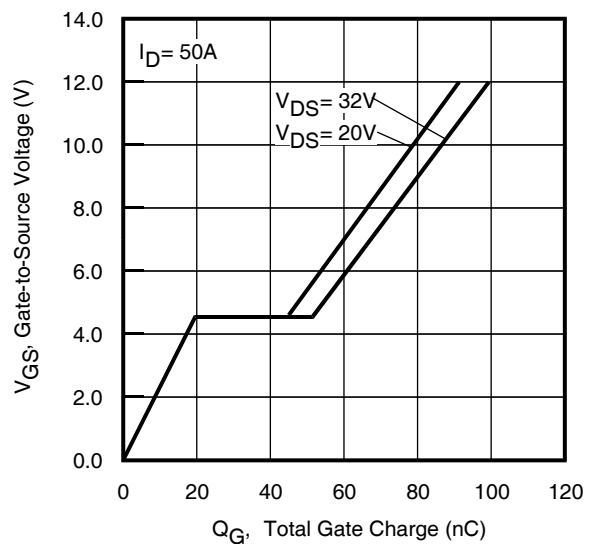
Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	40	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	37	—	mV/°C	Reference to $25^\circ\text{C}, I_D = 1.0\text{mA}$ ⑤
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	1.6	2.0	m Ω	$V_{GS} = 10V, I_D = 50A$
$V_{GS(th)}$	Gate Threshold Voltage	2.2	—	3.9	V	$V_{DS} = V_{GS}, I_D = 100\mu A$
I_{DSS}	Drain-to-Source Leakage Current	—	—	1.0	μA	$V_{DS} = 40V, V_{GS} = 0V$
		—	—	150		$V_{DS} = 40V, V_{GS} = 0V, T_J = 125^\circ\text{C}$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 20V$
	Gate-to-Source Reverse Leakage	—	—	-100		$V_{GS} = -20V$
R_G	Internal Gate Resistance	—	2.4	—	Ω	

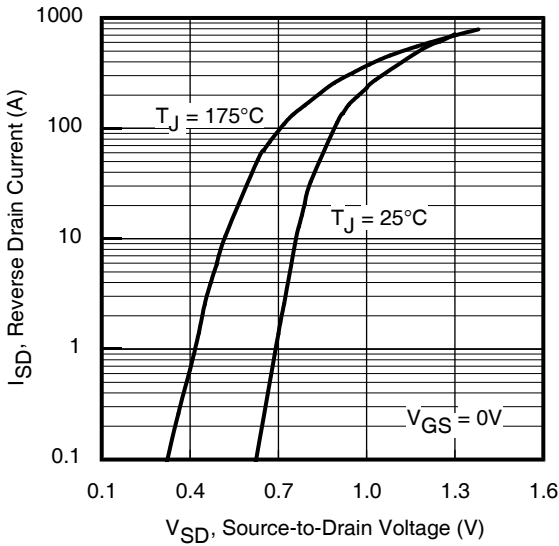
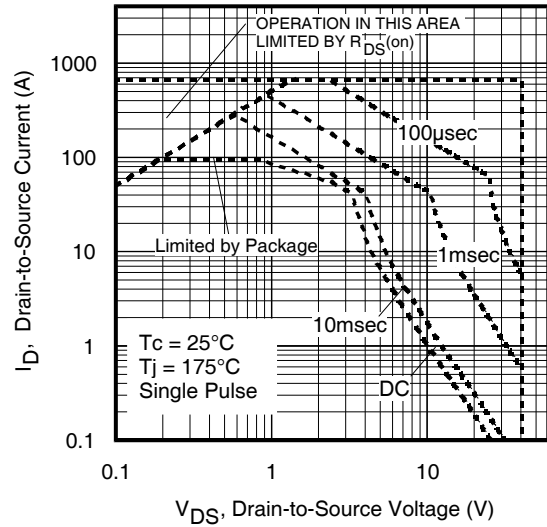
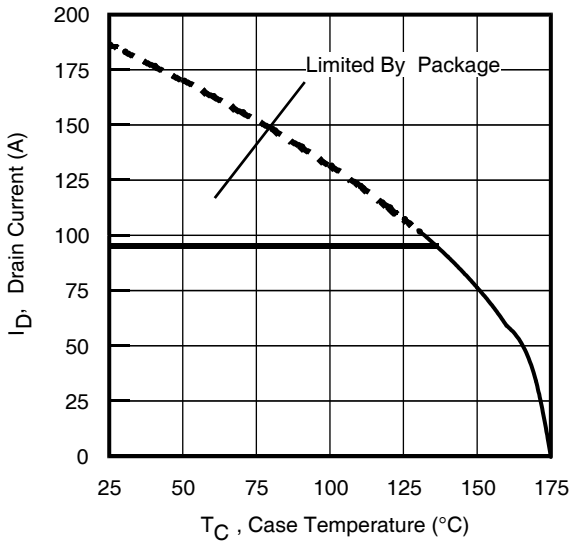
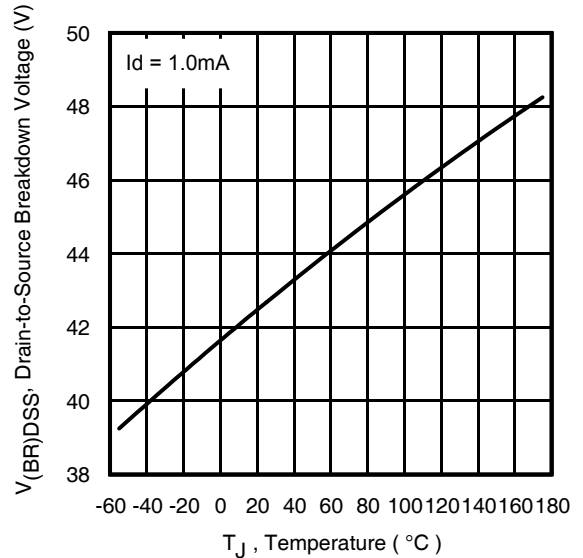
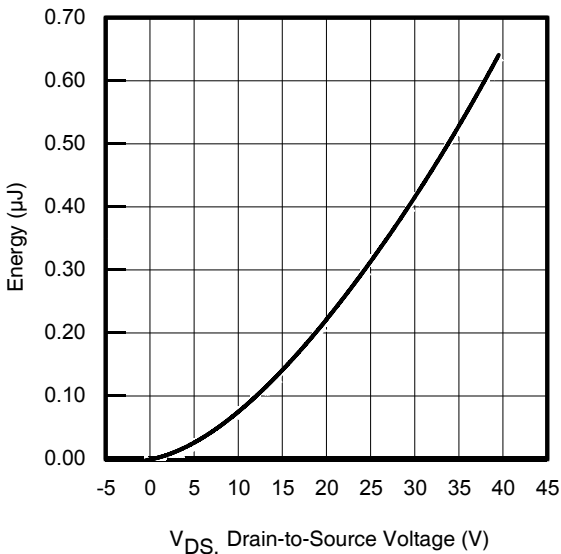
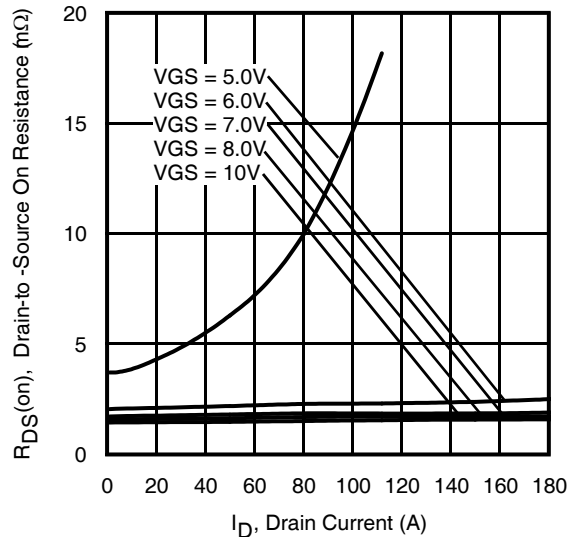
Dynamic Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

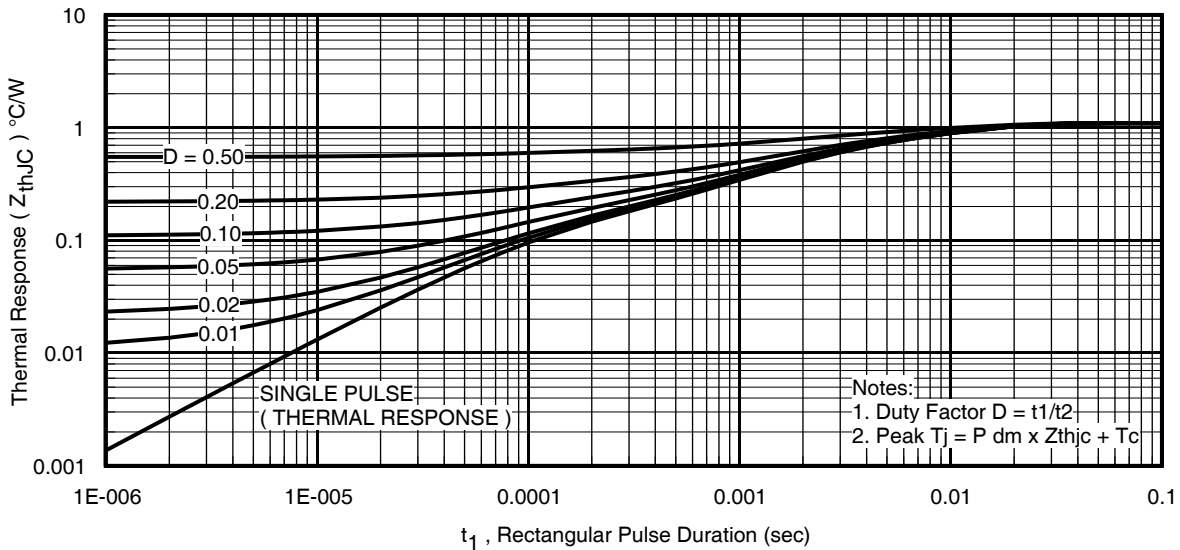
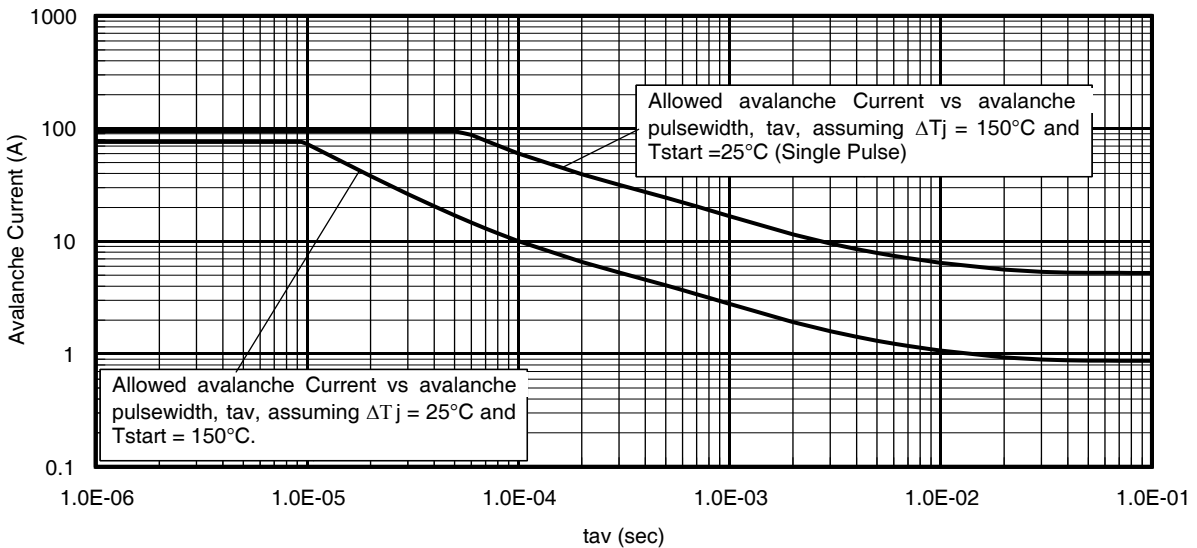
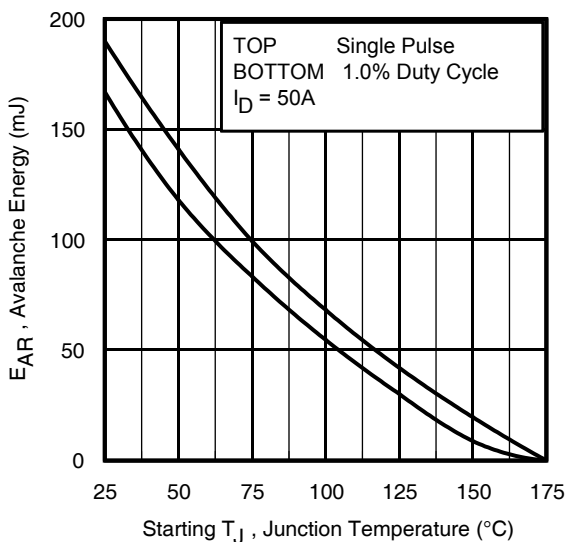
Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
gfs	Forward Transconductance	145	—	—	S	$V_{DS} = 10V, I_D = 50A$
Q_g	Total Gate Charge	—	78	117	nC	$I_D = 50A$
Q_{gs}	Gate-to-Source Charge	—	21	—		$V_{DS} = 20V$
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	25	—		$V_{GS} = 10V$ ⑤
Q_{sync}	Total Gate Charge Sync. ($Q_g - Q_{gd}$)	—	53	—		
$t_{d(on)}$	Turn-On Delay Time	—	9.5	—	ns	$V_{DD} = 20V$
t_r	Rise Time	—	30	—		$I_D = 50A$
$t_{d(off)}$	Turn-Off Delay Time	—	58	—		$R_G = 2.7\Omega$
t_f	Fall Time	—	33	—		$V_{GS} = 10V$ ⑤
C_{iss}	Input Capacitance	—	5142	—	pF	$V_{GS} = 0V$
C_{oss}	Output Capacitance	—	758	—		$V_{DS} = 25V$
C_{rss}	Reverse Transfer Capacitance	—	501	—		$f = 1.0\text{MHz}$
$C_{oss\text{ eff. (ER)}}$	Effective Output Capacitance (Energy Related)	—	900	—		$V_{GS} = 0V, V_{DS} = 0V\text{ to }32V$ ⑦
$C_{oss\text{ eff. (TR)}}$	Effective Output Capacitance (Time Related)	—	1094	—		$V_{GS} = 0V, V_{DS} = 0V\text{ to }32V$ ⑥

Diode Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	187 ①	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	670 ⑩	A	
V_{SD}	Diode Forward Voltage	—	0.9	1.3	V	$T_J = 25^\circ\text{C}, I_S = 50A, V_{GS} = 0V$ ⑤
dv/dt	Peak Diode Recovery ④	—	5.2	—	V/ns	$T_J = 175^\circ\text{C}, I_S = 50A, V_{DS} = 40V$
t_{rr}	Reverse Recovery Time	—	27	—	ns	$T_J = 25^\circ\text{C}$ $V_R = 34V,$
		—	28	—		$T_J = 125^\circ\text{C}$ $I_F = 50A$
Q_{rr}	Reverse Recovery Charge	—	16	—	nC	$T_J = 25^\circ\text{C}$ $di/dt = 100A/\mu s$ ⑤
		—	18	—		$T_J = 125^\circ\text{C}$
I_{RRM}	Reverse Recovery Current	—	0.92	—	A	$T_J = 25^\circ\text{C}$


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. Typical On-Resistance vs. Drain Current

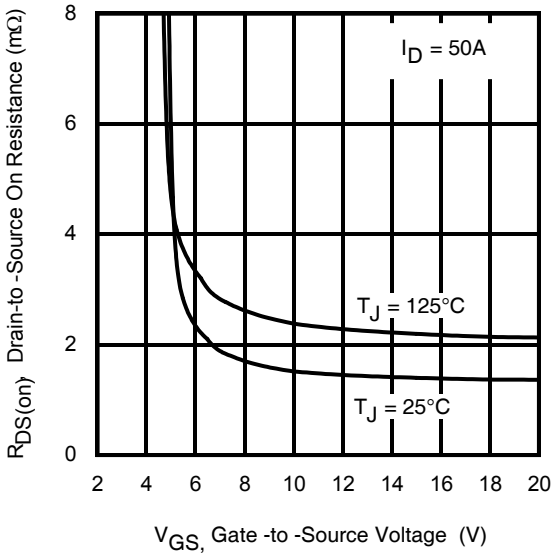
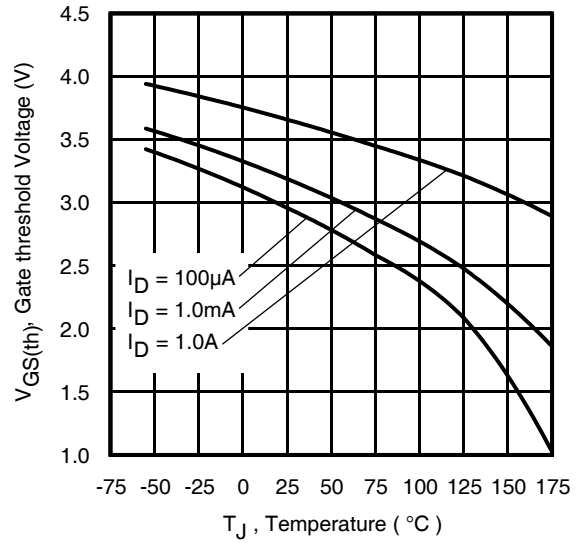
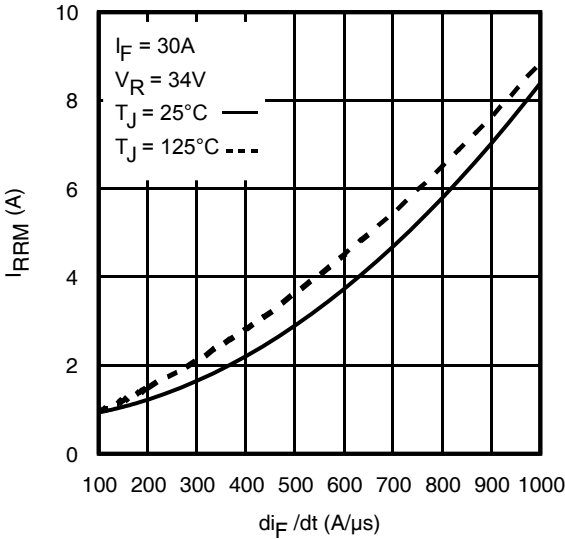
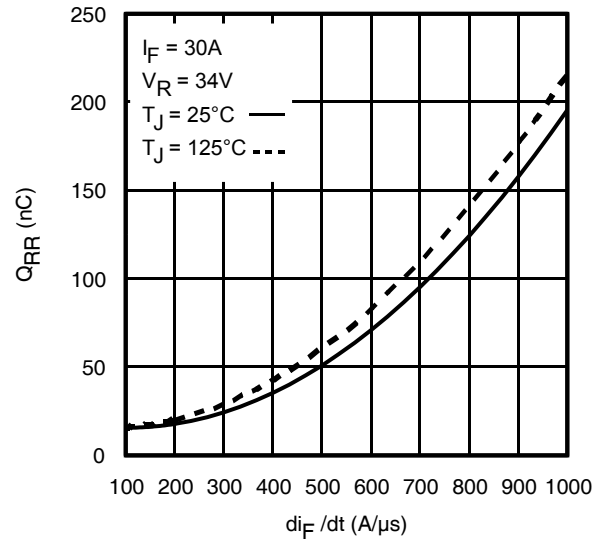
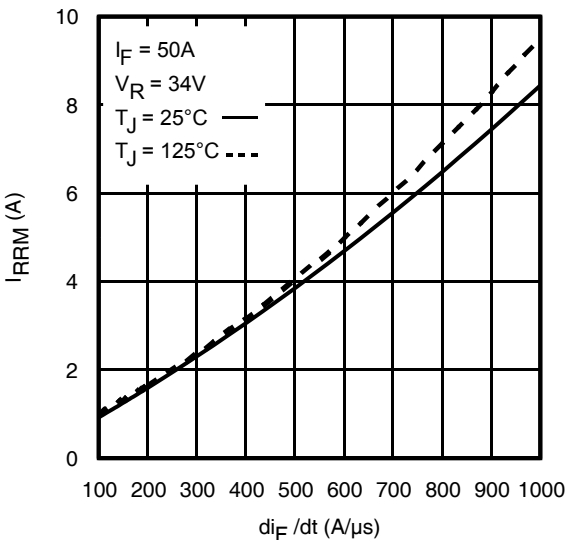
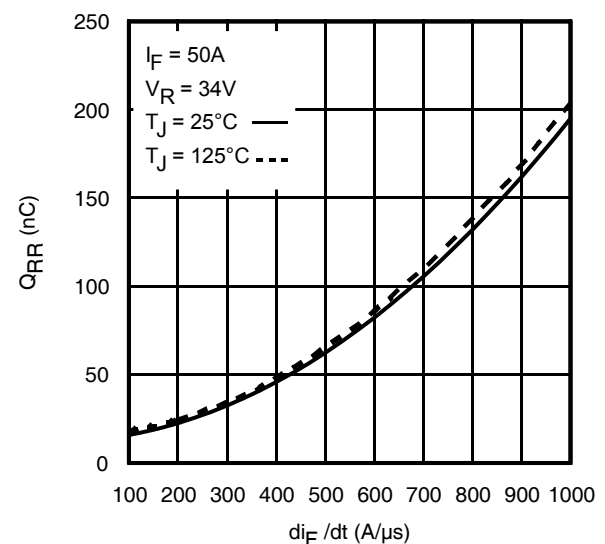

Fig 13. Maximum Effective Transient Thermal Impedance, Junction-to-Case

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.irf.com)**

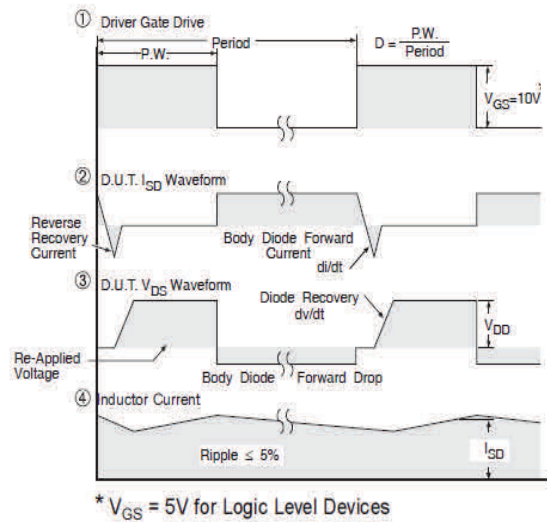
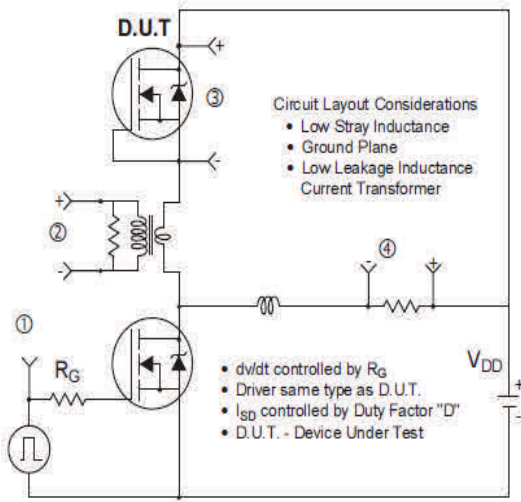
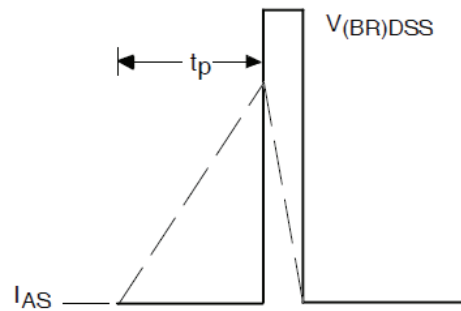
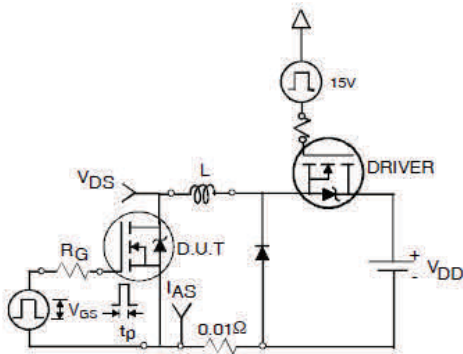
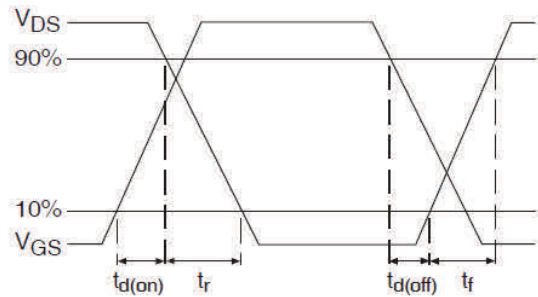
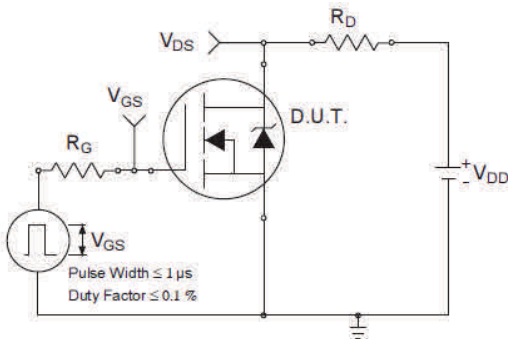
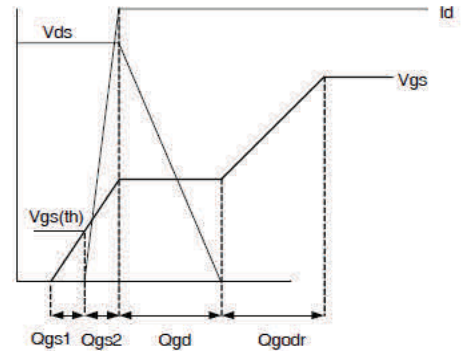
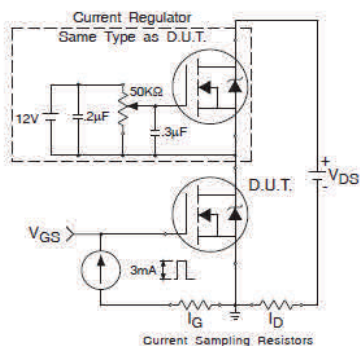
1. Avalanche failures assumption:
Purely a thermal phenomenon and failure occurs at a temperature far in excess of T_{jmax} . This is validated for every part type.
2. Safe operation in Avalanche is allowed as long as T_{jmax} is not exceeded.
3. Equation below based on circuit and waveforms shown in 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)

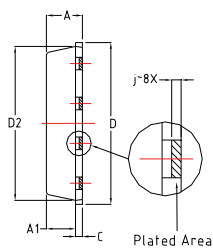
$$P_{D(ave)} = 1/2 (1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$$

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

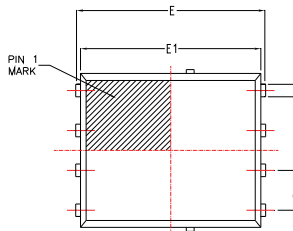
$$E_{AS(AR)} = P_{D(ave)} \cdot t_{av}$$


Fig 16. Typical On-Resistance vs. Gate Voltage

Fig 17. Threshold Voltage vs. Temperature

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

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

Fig. 20 - Typical Recovery Current vs. di_F/dt

Fig. 21 - Typical Stored Charge vs. di_F/dt


Fig 22. 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

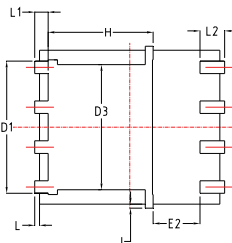
PQFN 5x6 Outline "E" Package Details


SIDE VIEW



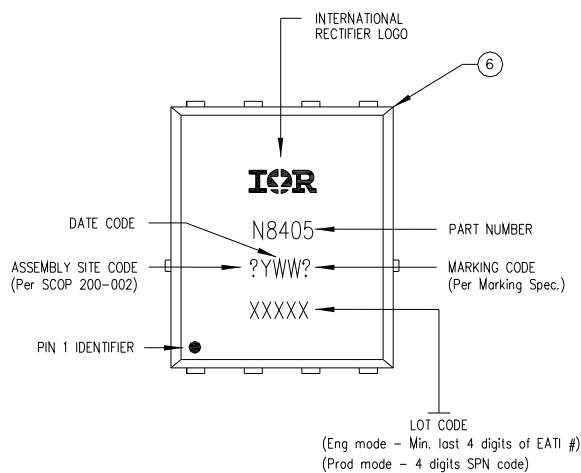
TOP VIEW

DIM	MM		
	MIN	NOM	MAX
A	0.90	1.10	1.17
A1	0.824	0.897	0.97
b	0.33	0.41	0.50
c	0.150	0.20	0.250
D	4.80	4.98	5.15
D1	3.91	4.22	4.36
D2	4.80	4.90	5.00
D3	3.85	4.00	4.15
E	5.90	6.05	6.15
E1	5.65	5.76	5.85
E2	1.10	/	/
e	1.27 BSC		
L	0.05	0.15	0.25
L1	0.38	0.425	0.50
L2	0.51	0.785	0.86
H	3.25	3.35	3.58
I	0	/	0.18
j	0.1015 BSC		



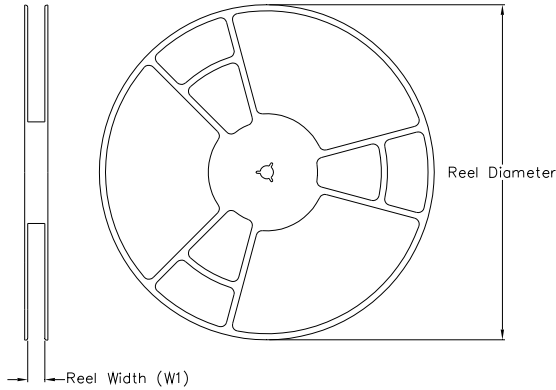
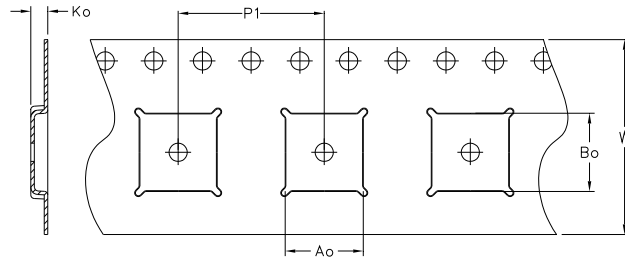
BOTTOM VIEW

For footprint and stencil design recommendations, please refer to application note AN-1136 at <http://www.irf.com/technical-info/appnotes/an-1136.pdf>
 For visual inspection recommendations, please refer to application note AN-1154 at <http://www.irf.com/technical-info/appnotes/an-1154.pdf>

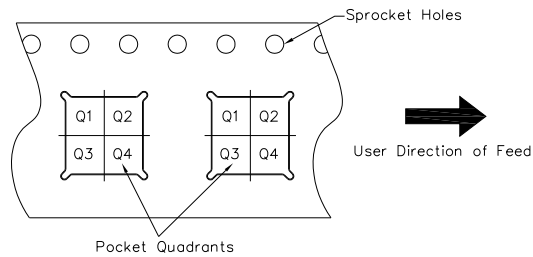
PQFN 5x6 Outline "E" Part Marking


TOP MARKING (LASER)

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

PQFN 5x6 Outline "E" Tape and Reel
REEL DIMENSIONS

TAPE DIMENSIONS


CODE	DESCRIPTION
Ao	Dimension design to accommodate the component width
Bo	Dimension design to accommodate the component length
Ko	Dimension design to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


Note: All dimension are nominal

Package Type	Reel Diameter (Inch)	QTY	Reel Width W1 (mm)	Ao (mm)	Bo (mm)	Ko (mm)	P1 (mm)	W (mm)	Pin 1 Quadrant
5 X 6 PQFN	13	4000	12.4	6.300	5.300	1.20	8.00	12	Q1

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. IR's Industrial and Consumer qualification level is granted by extension of the higher Automotive level.	
Moisture Sensitivity Level		PQFN 5mm x 6mm	MSL1
ESD	Human Body Model	Class H1C (+/- 2000V) ^{††}	
		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.

Notes:

- ① Calculated continuous current based on maximum allowable junction temperature. Bond wire current limit is 95A. Note that current limitations arising from heating of the device leads may occur with some lead mounting arrangements. (Refer to AN-1140)
- ② Repetitive rating; pulse width limited by max. junction temperature.
- ③ Limited by T_{Jmax} , starting $T_J = 25^\circ\text{C}$, $L = 0.152\text{mH}$, $R_G = 50\Omega$, $I_{AS} = 50\text{A}$, $V_{GS} = 10\text{V}$.
- ④ $I_{SD} \leq 50\text{A}$, $di/dt \leq 961\text{A}/\mu\text{s}$, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq 175^\circ\text{C}$.
- ⑤ Pulse width $\leq 400\mu\text{s}$; duty cycle $\leq 2\%$.
- ⑥ Coss eff. (TR) is a fixed capacitance that gives the same charging time as Coss while VDS is rising from 0 to 80%VDSS.
- ⑦ Coss eff. (ER) is a fixed capacitance that gives the same energy as Coss while VDS is rising from 0 to 80% VDSS.
- 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: <http://www.irf.com/technical-info/appnotes/an-994.pdf>
- ⑨ R_θ is measured at T_J approximately 90°C .
- ⑩ Pulse drain current is limited at 380A by source bonding technology.

Revision History

Date	Comments
9/24/2018	<ul style="list-style-type: none"> • Updated datasheet with corporate template • Corrected typo on Gate-to-Source Leakage from “Ω” to “nA” on page 2

Published by
Infineon Technologies AG
81726 München, Germany
© Infineon Technologies AG 2015
All Rights Reserved.

IMPORTANT NOTICE

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics (“Beschaffenheitsgarantie”). With respect to any examples, hints or any typical values stated herein and/or any information regarding the application of the product, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

In addition, any information given in this document is subject to customer’s compliance with its obligations stated in this document and any applicable legal requirements, norms and standards concerning customer’s products and any use of the product of Infineon Technologies in customer’s applications.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer’s technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

For further information on the product, technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies office (www.infineon.com).

WARNINGS

Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies’ products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.

Looking for pricing, stock, or lifecycle information?

Click below to explore more details on WIN SOURCE:

 [View AUIRFN8405TR on WIN SOURCE](#)

 [Infineon Technologies](#) Information

Optimize Your Supply Chain with WIN SOURCE Solutions

-  Global Sourcing Solution
-  Obsolete Management
-  Cost Control Management
-  Shortage Management
-  Alternative Solution
-  Excess Inventory Management