

### Features

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

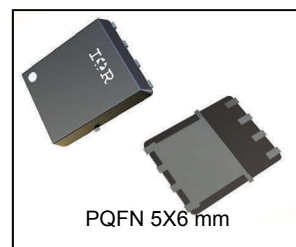
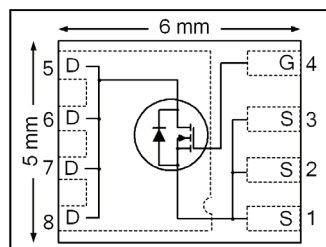
### Description

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

- Injection
- DC-DC Converter
- Automotive Lighting
- E-Horn
- 48V Automotive Systems

$V_{DSS}$	<b>100V</b>
$R_{DS(on)}$ <b>typ.</b>	<b>11.5mΩ</b>
<b>max</b>	<b>14.5mΩ</b>
$I_D$ (Silicon Limited)	<b>58A</b>



G	D	S
Gate	Drain	Source

Base Part Number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
AUIRFN7110	PQFN 5mm x 6mm	Tape and Reel	4000	AUIRFN7110TR

### 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.

	Parameter	Max.	Units
$I_D$ @ $T_{C(Bottom)} = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS}$ @ 10V (Silicon Limited)	58	A
$I_D$ @ $T_{C(Bottom)} = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS}$ @ 10V (Silicon Limited)	41	
$I_{DM}$	Pulsed Drain Current ①	232	
$P_D$ @ $T_A = 25^\circ\text{C}$	Power Dissipation ⑤	4.3	W
$P_D$ @ $T_{C(Bottom)} = 25^\circ\text{C}$	Power Dissipation	125	
	Linear Derating Factor ⑤	0.029	W/°C
$V_{GS}$	Gate-to-Source Voltage	± 20	V
$E_{AS}$	Single Pulse Avalanche Energy (Thermally Limited) ②	133	mJ
$I_{AR}$	Avalanche Current ①	See Fig. 13, 14, 17a, 17b	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
$R_{\theta JC}$ (Bottom)	Junction-to-Case ④	—	1.2	°C/W
$R_{\theta JC}$ (Top)	Junction-to-Case ④	—	32	
$R_{\theta JA}$	Junction-to-Ambient ⑤	—	35	
$R_{\theta JA}$ (<10s)	Junction-to-Ambient ⑤	—	22	

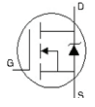
## Static Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

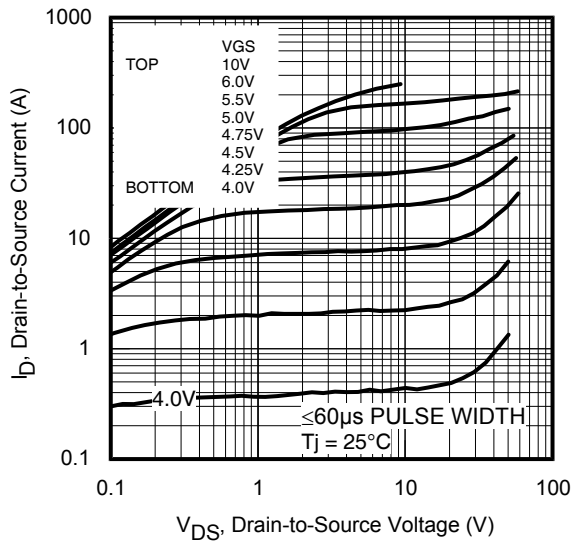
Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	100	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.09	—	V/°C	Reference to $25^\circ\text{C}$ , $I_D = 1mA$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	11.5	14.5	mΩ	$V_{GS} = 10V, I_D = 35A$ ③
$V_{GS(th)}$	Gate Threshold Voltage	2.0	3.0	4.0	V	$V_{DS} = V_{GS}, I_D = 100\mu A$
$\Delta V_{GS(th)}$	Gate Threshold Voltage Coefficient	—	-8.4	—	mV/°C	
$I_{DSS}$	Drain-to-Source Leakage Current	—	—	20	μA	$V_{DS} = 100V, V_{GS} = 0V$
		—	—	250		$V_{DS} = 100V, V_{GS} = 0V, T_J = 125^\circ\text{C}$
$I_{GSS}$	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 20V$
	Gate-to-Source Reverse Leakage	—	—	-100		$V_{GS} = -20V$
$R_G$	Gate Resistance	—	1.0	—	Ω	

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

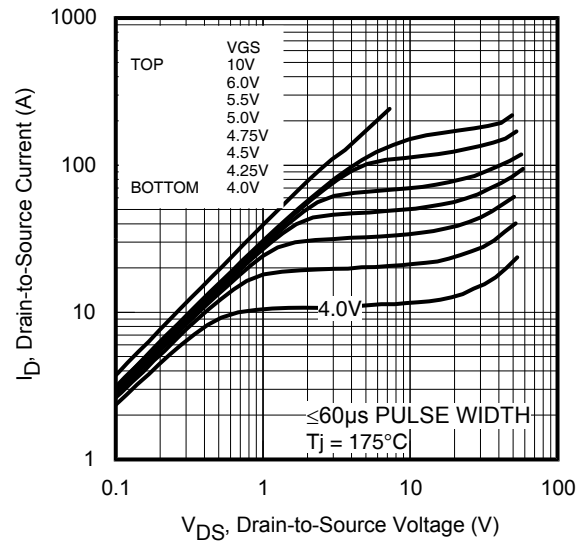
Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
gfs	Forward Trans conductance	79	—	—	S	$V_{DS} = 50V, I_D = 35A$
$Q_g$	Total Gate Charge	—	49	74	nC	$I_D = 35A$ $V_{DS} = 50V$ $V_{GS} = 10V$
$Q_{gs}$	Gate-to-Source Charge	—	14	—		
$Q_{gd}$	Gate-to-Drain Charge	—	12	—		
$Q_{sync}$	Total Gate Charge Sync. ( $Q_g - Q_{gd}$ )	—	37	—		
$t_{d(on)}$	Turn-On Delay Time	—	11	—	ns	$V_{DD} = 50V$ $I_D = 35A$ $R_G = 1.8\Omega$ $V_{GS} = 10V$
$t_r$	Rise Time	—	23	—		
$t_{d(off)}$	Turn-Off Delay Time	—	22	—		
$t_f$	Fall Time	—	18	—		
$C_{iss}$	Input Capacitance	—	3050	—	pF	$V_{GS} = 0V$
$C_{oss}$	Output Capacitance	—	290	—		$V_{DS} = 25V$
$C_{rss}$	Reverse Transfer Capacitance	—	101	—		$f = 1.0MHz$

## Diode Characteristics

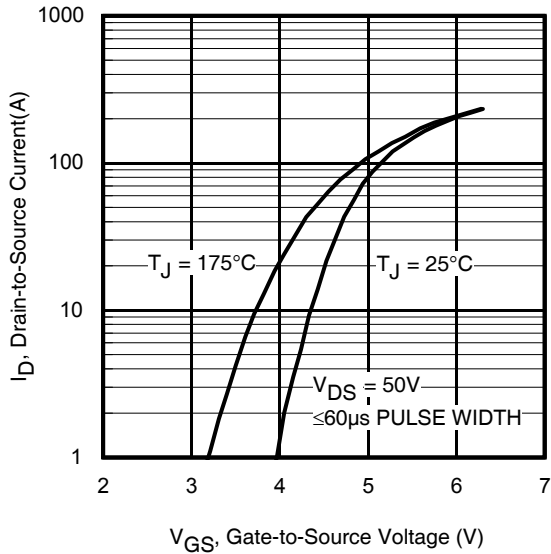
Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$I_S$	Continuous Source Current (Body Diode)	—	—	58	A	MOSFET symbol showing the integral reverse p-n junction diode. 
$I_{SM}$	Pulsed Source Current (Body Diode) ①	—	—	232		
$V_{SD}$	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}, I_S = 35A, V_{GS} = 0V$ ③
$dv/dt$	Peak Diode Recovery	—	12	—	V/ns	$T_J = 175^\circ\text{C}, I_S = 35A, V_{DS} = 100V$
$t_{rr}$	Reverse Recovery Time	—	27	—	ns	$T_J = 25^\circ\text{C}, I_F = 35A, V_{DD} = 50V$ $di/dt = 500A/\mu s$ ③
$Q_{rr}$	Reverse Recovery Charge	—	152	—	nC	
$I_{RRM}$	Reverse Recovery Current	—	9.8	—	A	



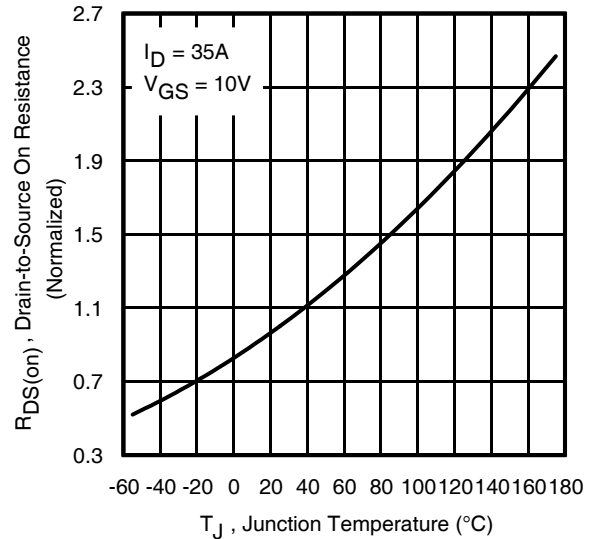
**Fig. 1** Typical Output Characteristics



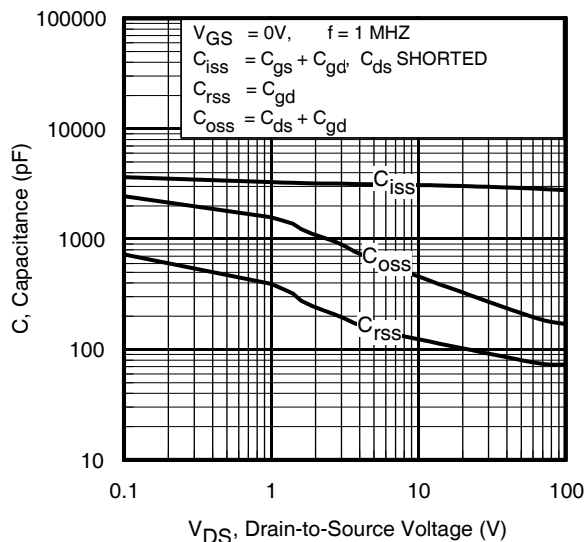
**Fig. 2** Typical Output Characteristics



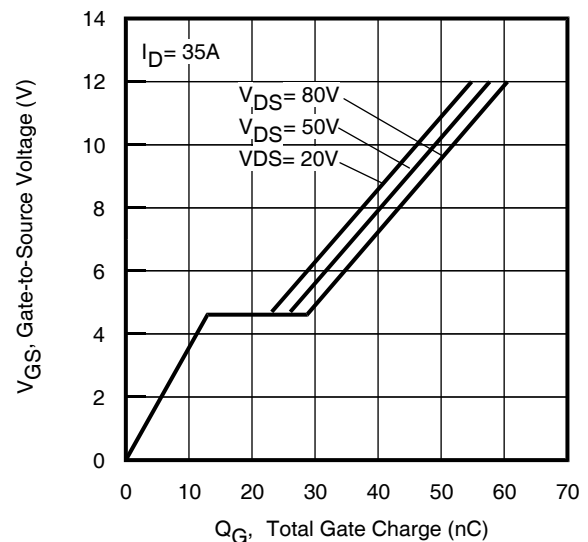
**Fig. 3** Typical Transfer Characteristics



**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

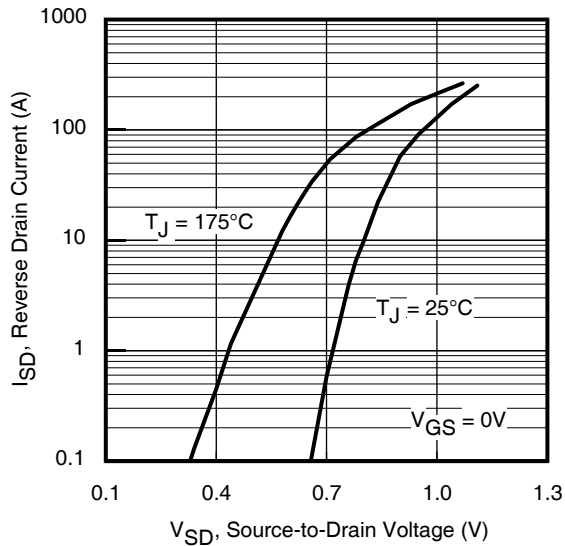


Fig. 7 Typical Source-to-Drain Diode

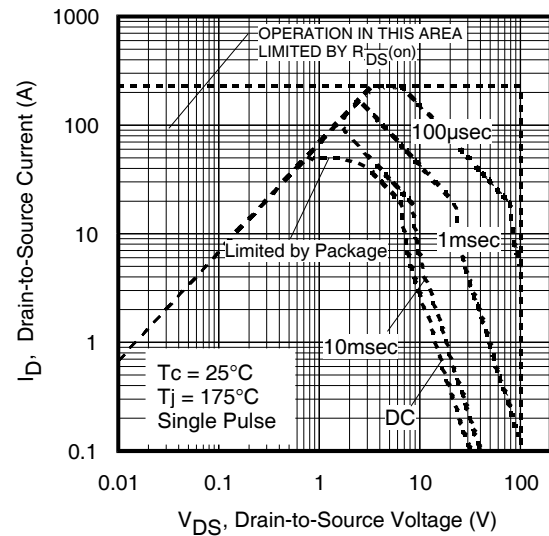


Fig 8. Maximum Safe Operating Area

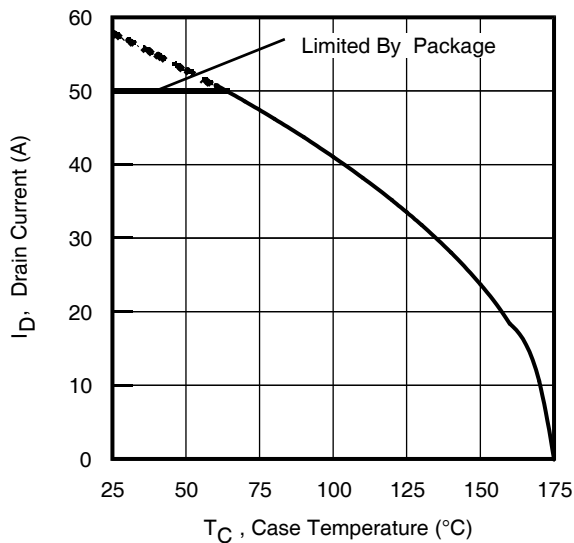


Fig 9. Maximum Drain Current vs. Case Temperature

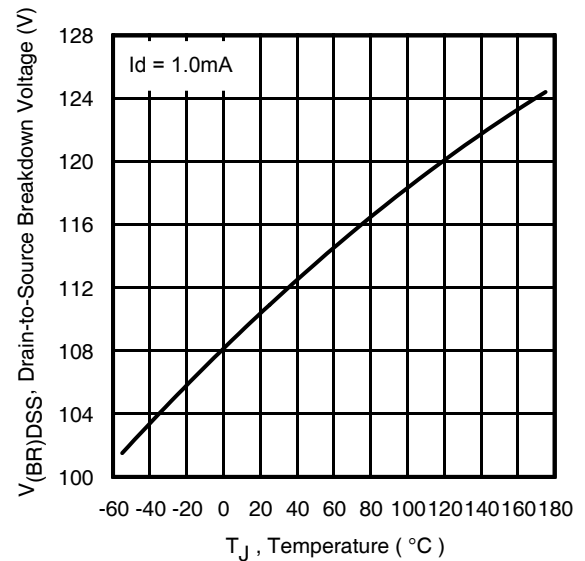


Fig 10. Drain-to-Source Breakdown Voltage

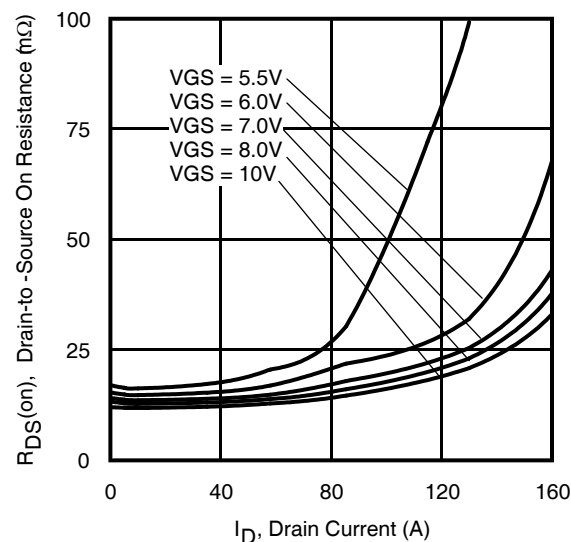
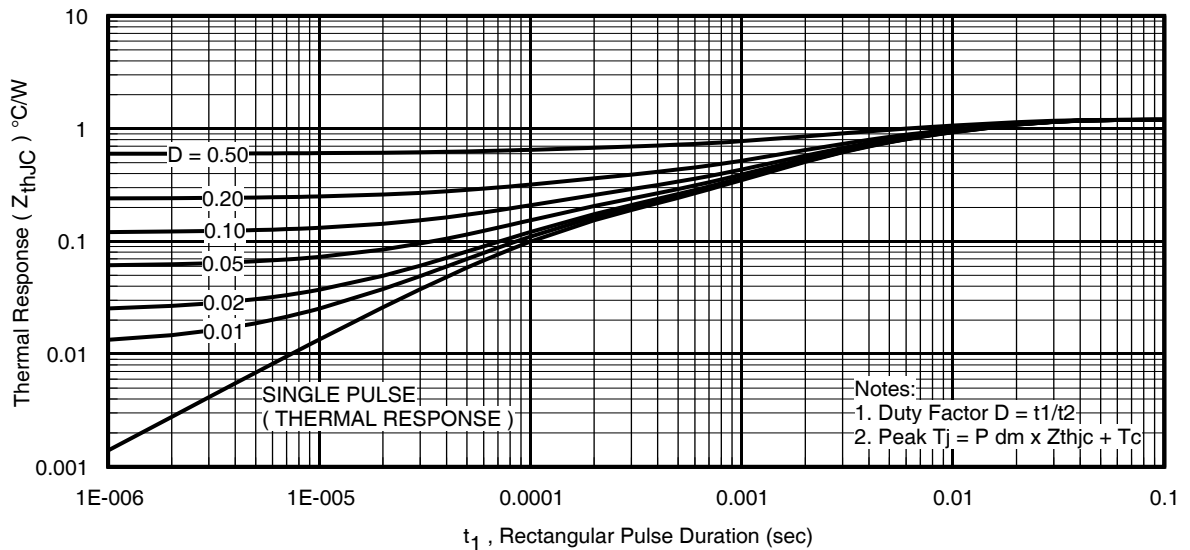
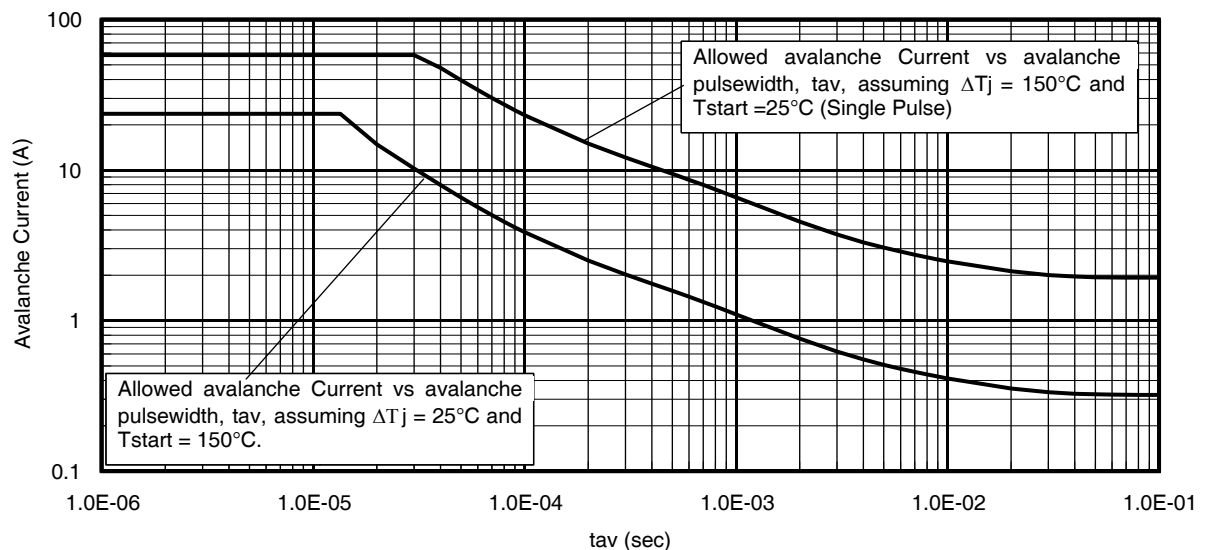


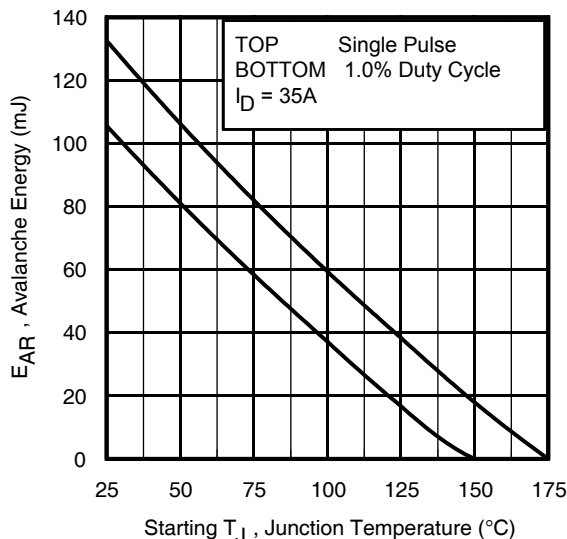
Fig 11. Typical On-Resistance vs. Drain Current



**Fig 12.** Maximum Effective Transient Thermal Impedance, Junction-to-Case



**Fig 13.** Typical Avalanche Current vs. Pulse Width



**Fig 14.** Maximum Avalanche Energy vs. Temperature

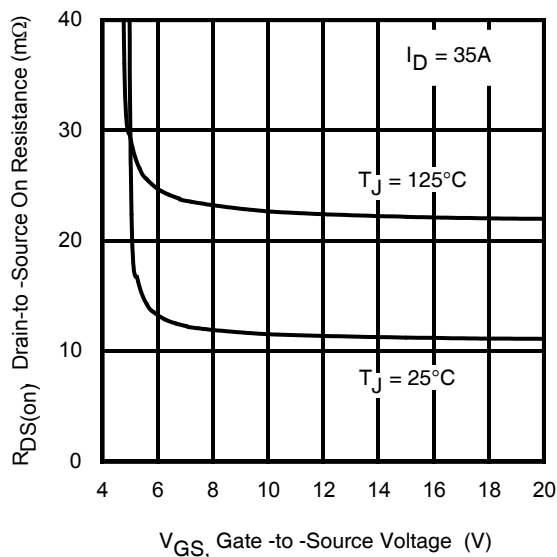
**Notes on Repetitive Avalanche Curves , Figures 13, 14:**  
(For further info, see AN-1005 at [www.irf.com](http://www.irf.com))

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 17a, 17b.
4.  $P_{D(ave)}$  = Average power dissipation per single avalanche pulse.
5. BV = Rated breakdown voltage (1.3 factor accounts for voltage in crease during avalanche).
6.  $I_{av}$  = Allowable avalanche current.
7.  $\Delta T$  = 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 12)

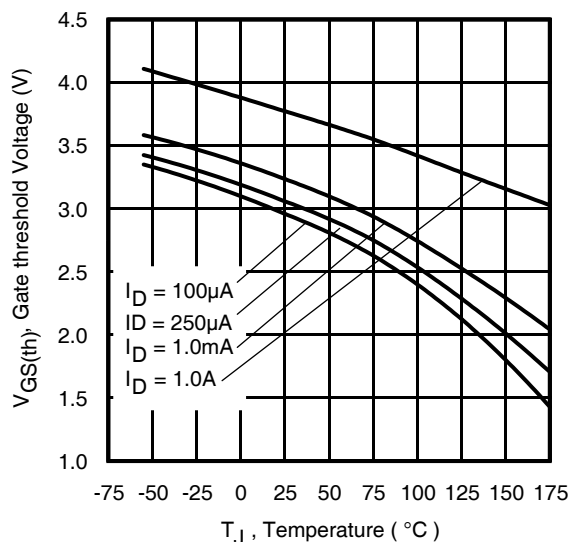
$$P_{D(ave)} = \frac{1}{2} (1.3 \cdot BV \cdot I_{av}) = \frac{\Delta T}{Z_{thJC}}$$

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

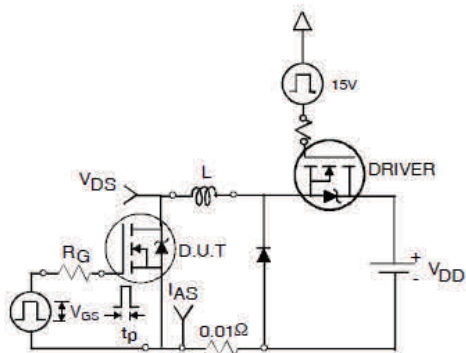
$$E_{AS(AR)} = P_{D(ave)} \cdot t_{av}$$



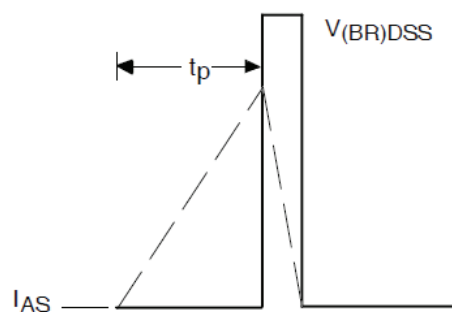
**Fig 15.** Typical On-Resistance vs. Gate Voltage



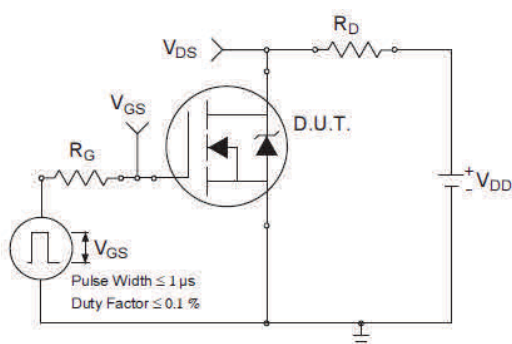
**Fig 16.** Threshold Voltage vs. Temperature



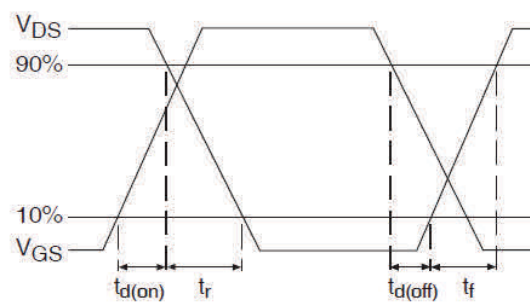
**Fig 17a.** Unclamped Inductive Test Circuit



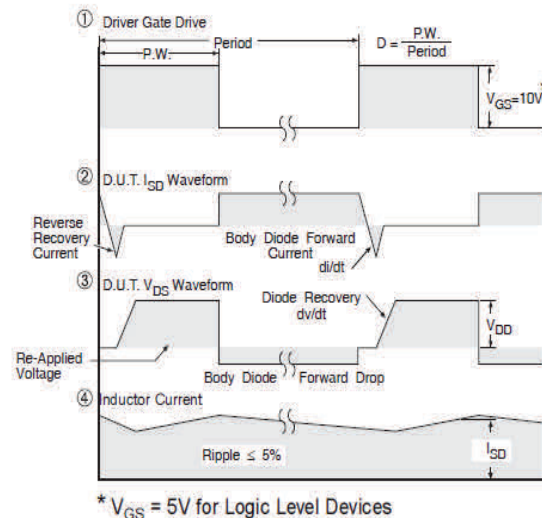
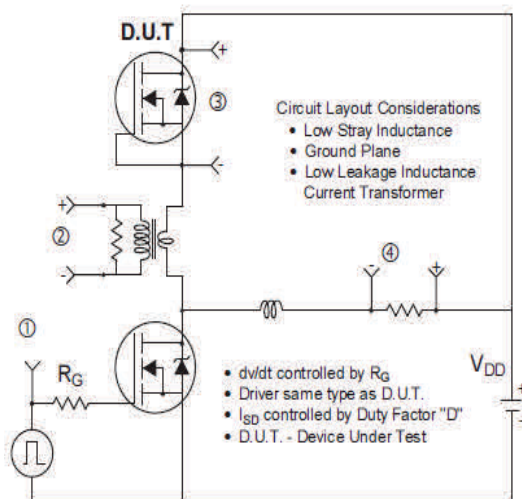
**Fig 17b.** Unclamped Inductive Waveforms



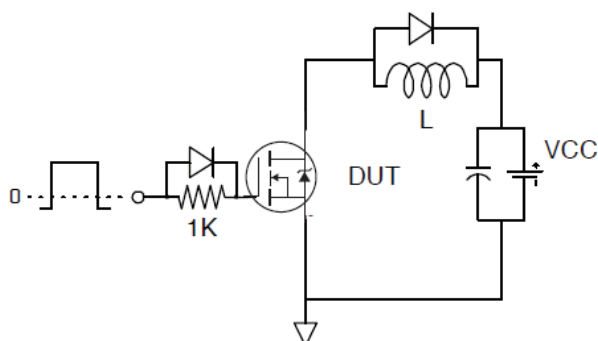
**Fig 18a.** Switching Time Test Circuit



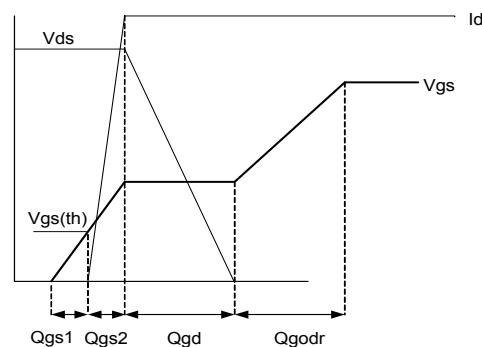
**Fig 18b.** Switching Time Waveforms



**Fig 19.** Peak Diode Recovery  $dv/dt$  Test Circuit for N-Channel HEXFET® Power MOSFETs

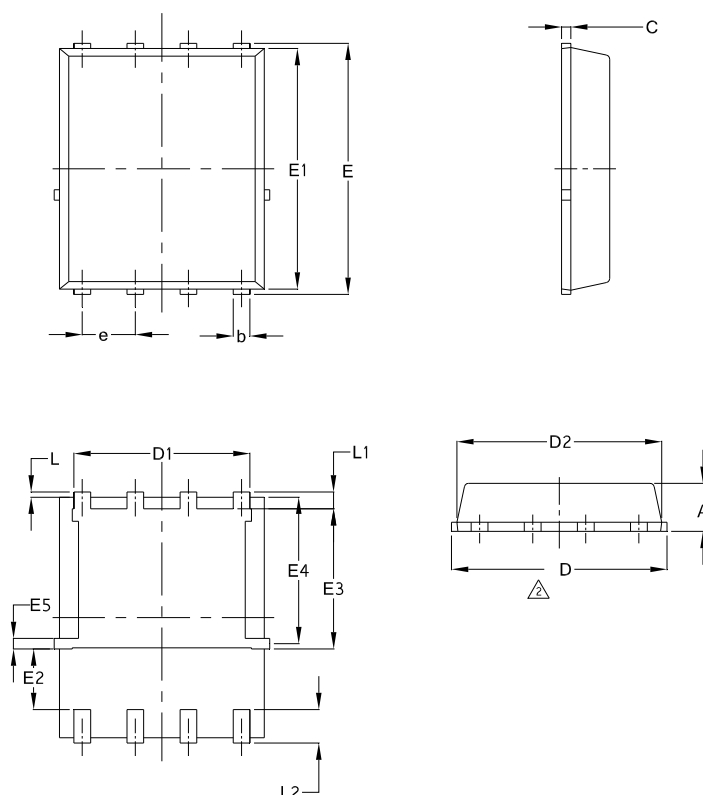


**Fig 20a.** Gate Charge Test Circuit



**Fig 20b.** Gate Charge Waveform

## PQFN 5x6 Outline "E" Package Details



SYMBOL	COMMON			
	MM		INCH	
	MIN.	MAX.	MIN.	MAX.
A	0.90	1.17	0.0354	0.0461
b	0.33	0.48	0.0130	0.0189
C	0.195	0.300	0.0077	0.0118
D	4.80	5.15	0.1890	0.2028
D1	3.91	4.31	0.1539	0.1697
D2	4.80	5.00	0.1890	0.1968
E	5.90	6.15	0.2323	0.2421
E1	5.65	6.00	0.2224	0.2362
E2	1.51	—	0.0594	—
E3	3.32	3.78	0.1307	0.1480
E4	3.42	3.58	0.1346	0.1409
E5	0.18	0.32	0.0071	0.0126
e	1.27 BSC		0.050 BSC	
L	0.05	0.25	0.0020	0.0098
L1	0.38	0.66	0.0150	0.0260
L2	0.51	0.86	0.0201	0.0339
I	0	0.18	0	0.0071

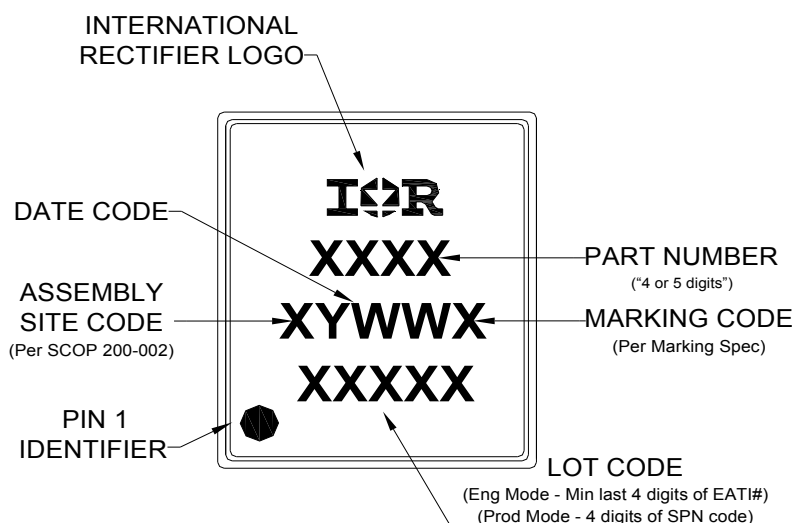
For footprint and stencil design recommendations, please refer to application note AN-1136 at

<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>

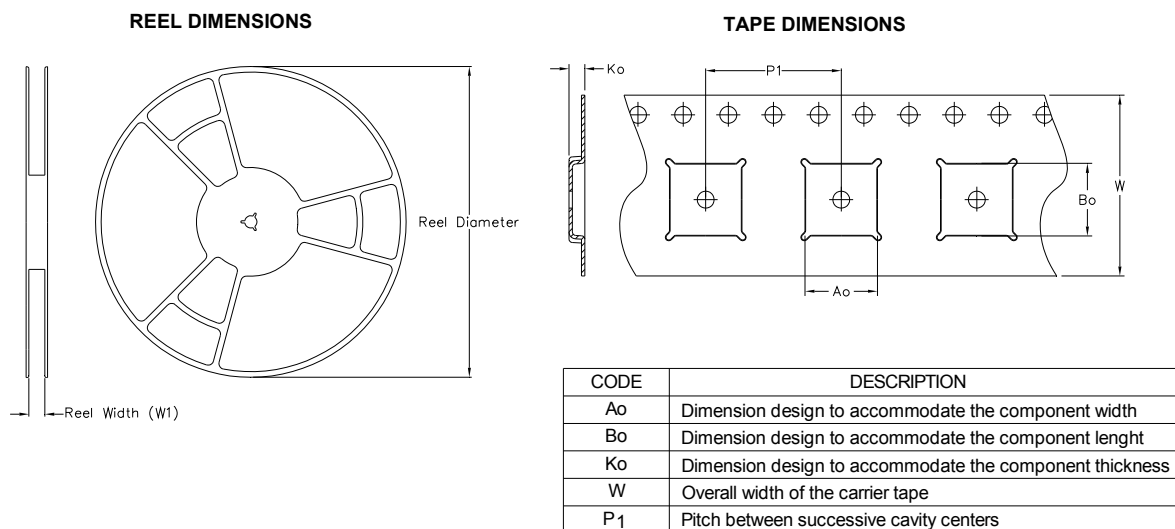
## PQFN 5x6 Outline Part Marking



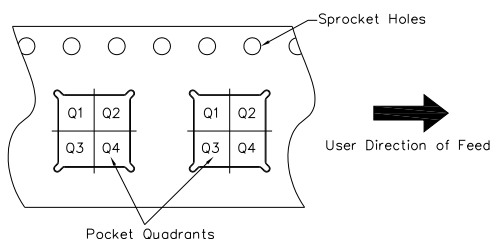
Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>



## PQFN 5x6 Outline Tape and Reel



### 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<sup>†</sup>

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) <sup>††</sup>	
		AEC-Q101-001	
	Charged Device Model	Class C5 (+/- 2000V) <sup>††</sup>	
		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 Repetitive rating; pulse width limited by max. junction temperature.
- ② Limited by  $T_{Jmax}$ , starting  $T_J = 25^{\circ}C$ ,  $L = 0.216mH$ ,  $R_G = 50\Omega$ ,  $I_{AS} = 35A$ .
- ③ Pulse width  $\leq 400\mu s$ ; duty cycle  $\leq 2\%$ .
- ④  $R_{\theta}$  is measured at  $T_J$  approximately  $90^{\circ}C$ .
- ⑤ 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>

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