

AUTOMOTIVE MOSFET

IRF3710Z
IRF3710ZS
IRF3710ZL

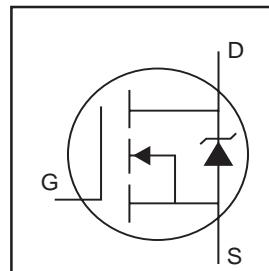
HEXFET® Power MOSFET

Features

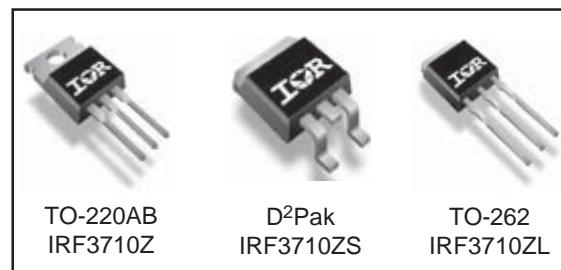
- Advanced Process Technology
- Ultra Low On-Resistance
- Dynamic dv/dt Rating
- 175°C Operating Temperature
- Fast Switching
- Repetitive Avalanche Allowed up to Tjmax

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.



$V_{DSS} = 100V$
 $R_{DS(on)} = 18m\Omega$
 $I_D = 59A$



Absolute Maximum Ratings

	Parameter	Max.	Units
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$ (Silicon Limited)	59	A
$I_D @ T_C = 100^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$ (See Fig. 9)	42	
I_{DM}	Pulsed Drain Current ①	240	
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	160	W
	Linear Derating Factor	1.1	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS}	Single Pulse Avalanche Energy (Thermally Limited) ②	170	mJ
E_{AS} (tested)	Single Pulse Avalanche Energy Tested Value ⑦	200	
I_{AR}	Avalanche Current ①	See Fig.12a,12b,15,16	A
E_{AR}	Repetitive Avalanche Energy ⑥		mJ
T_J	Operating Junction and	-55 to + 175	°C
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	
	Mounting torque, 6-32 or M3 screw	10 lbf·in (1.1N·m)	

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	0.92	°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) ⑧	—	40	

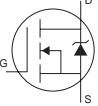
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Static @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(\text{BR})\text{DSS}}$	Drain-to-Source Breakdown Voltage	100	—	—	V	$V_{GS} = 0V, I_D = 250\mu\text{A}$
$\Delta V_{DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.10	—	V/ $^\circ\text{C}$	Reference to $25^\circ\text{C}, I_D = 1\text{mA}$
$R_{DS(\text{on})}$	Static Drain-to-Source On-Resistance	—	14	18	$\text{m}\Omega$	$V_{GS} = 10V, I_D = 35\text{A}$ ④
$V_{GS(\text{th})}$	Gate Threshold Voltage	2.0	—	4.0	V	$V_{DS} = V_{GS}, I_D = 250\mu\text{A}$
g_{fs}	Forward Transconductance	35	—	—	S	$V_{DS} = 50V, I_D = 35\text{A}$
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	—	—	200	nA	$V_{GS} = 20V$
	Gate-to-Source Reverse Leakage	—	—	-200		$V_{GS} = -20V$
Q_g	Total Gate Charge	—	82	120	nC	$I_D = 35\text{A}$
Q_{gs}	Gate-to-Source Charge	—	19	28		$V_{DS} = 80V$
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	27	40		$V_{GS} = 10V$ ④
$t_{d(on)}$	Turn-On Delay Time	—	17	—	ns	$V_{DD} = 50V$
t_r	Rise Time	—	77	—		$I_D = 35\text{A}$
$t_{d(off)}$	Turn-Off Delay Time	—	41	—		$R_G = 6.8\Omega$
t_f	Fall Time	—	56	—		$V_{GS} = 10V$ ④
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	—	2900	—		$V_{GS} = 0V$
C_{oss}	Output Capacitance	—	290	—		$V_{DS} = 25V$
C_{rss}	Reverse Transfer Capacitance	—	150	—		$f = 1.0\text{MHz}$, See Fig. 5
C_{oss}	Output Capacitance	—	1130	—		$V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0\text{MHz}$
C_{oss}	Output Capacitance	—	170	—		$V_{GS} = 0V, V_{DS} = 80V, f = 1.0\text{MHz}$
$C_{oss \text{ eff.}}$	Effective Output Capacitance	—	280	—		$V_{GS} = 0V, V_{DS} = 0V \text{ to } 80V$

Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	59	A	MOSFET symbol showing the integral reverse p-n junction diode.
	Pulsed Source Current (Body Diode) ①	—	—	240		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}, I_S = 35\text{A}, V_{GS} = 0V$ ④
t_{rr}	Reverse Recovery Time	—	50	75	ns	$T_J = 25^\circ\text{C}, I_F = 35\text{A}, V_{DD} = 25V$
Q_{rr}	Reverse Recovery Charge	—	100	160	nC	$dI/dt = 100\text{A}/\mu\text{s}$ ④
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)				

Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11).
- ② Limited by $T_{J\max}$, starting $T_J = 25^\circ\text{C}$, $L = 0.27\text{mH}$, $R_G = 25\Omega$, $I_{AS} = 35\text{A}$, $V_{GS} = 10V$. Part not recommended for use above this value.
- ③ $I_{SD} \leq 35\text{A}$, $di/dt \leq 380\text{A}/\mu\text{s}$, $V_{DD} \leq V_{(\text{BR})\text{DSS}}$, $T_J \leq 175^\circ\text{C}$.
- ④ Pulse width $\leq 1.0\text{ms}$; duty cycle $\leq 2\%$.
- ⑤ $C_{oss \text{ eff.}}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .
- ⑥ Limited by $T_{J\max}$, see Fig.12a, 12b, 15, 16 for typical repetitive avalanche performance.
- ⑦ This value determined from sample failure population. 100% tested to this value in production.
- ⑧ 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.

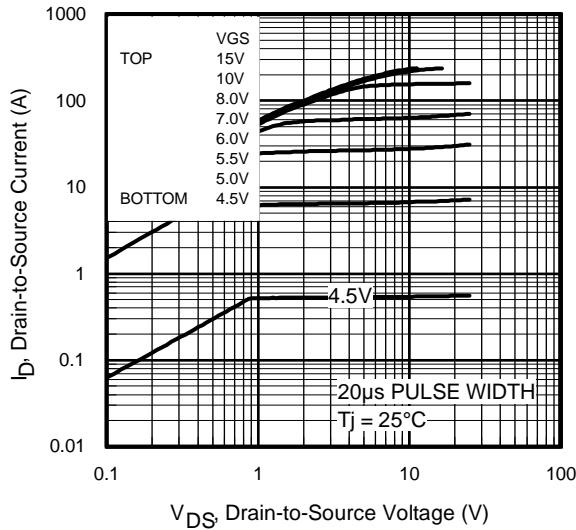


Fig 1. Typical Output Characteristics

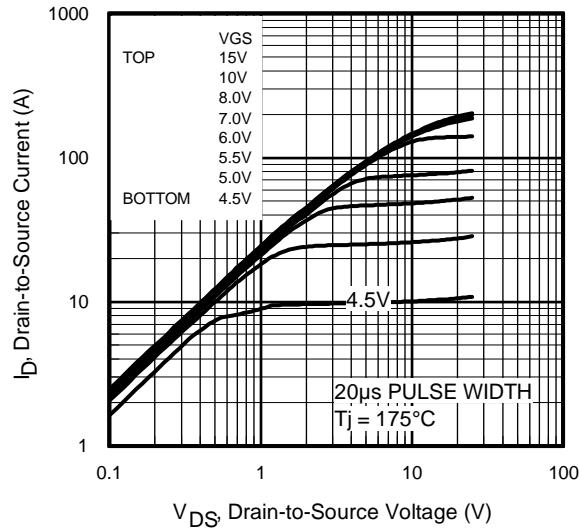


Fig 2. Typical Output Characteristics

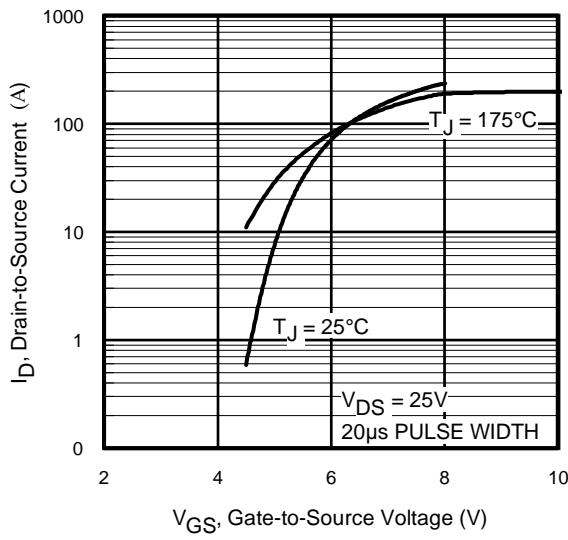


Fig 3. Typical Transfer Characteristics

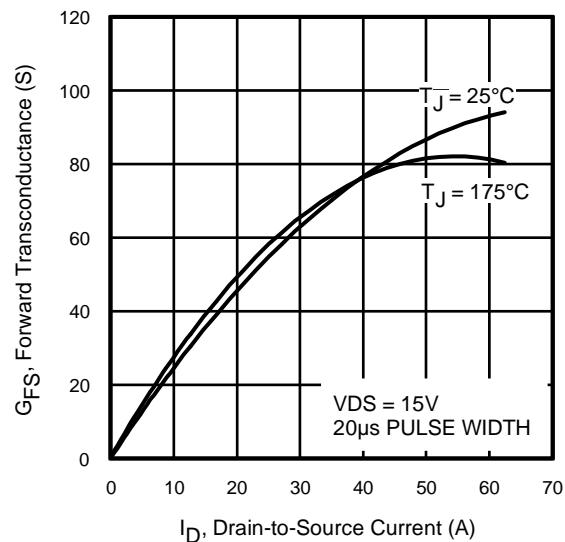


Fig 4. Typical Forward Transconductance vs. Drain Current

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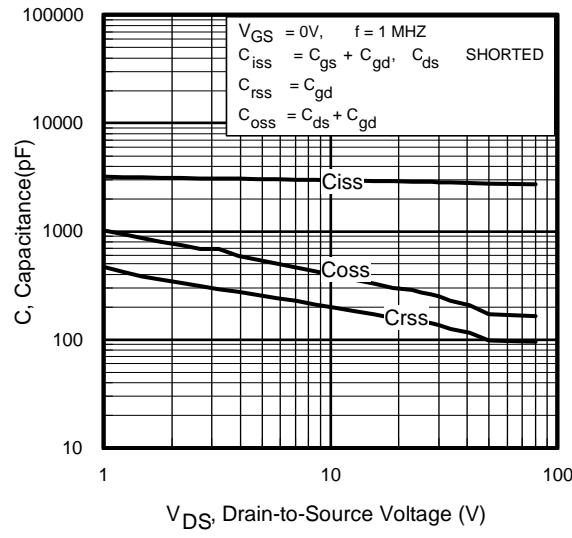


Fig 5. Typical Capacitance vs.
Drain-to-Source Voltage

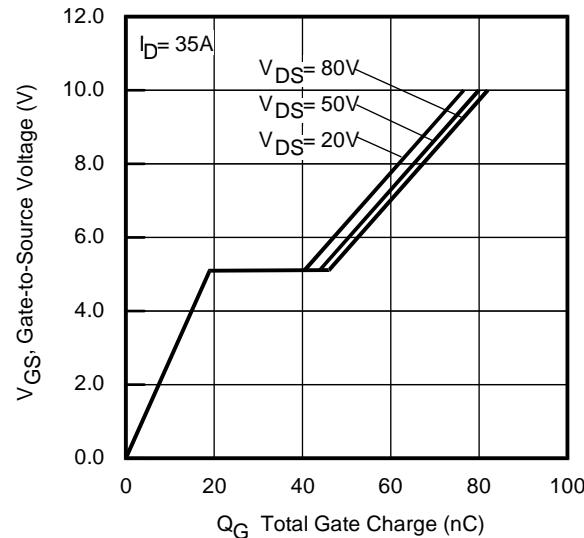


Fig 6. Typical Gate Charge vs.
Gate-to-Source Voltage

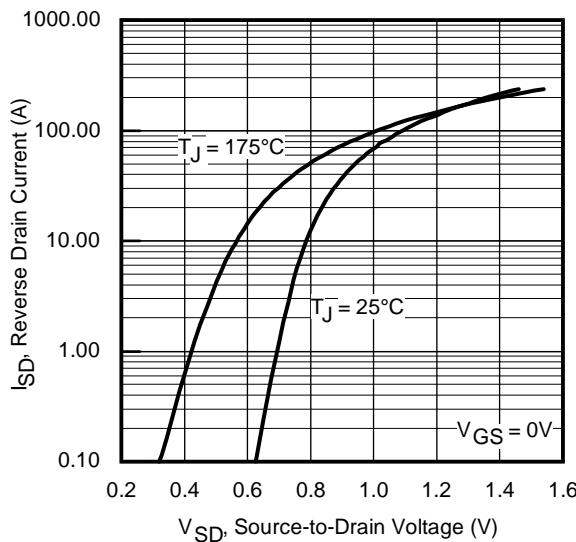


Fig 7. Typical Source-Drain Diode
Forward Voltage

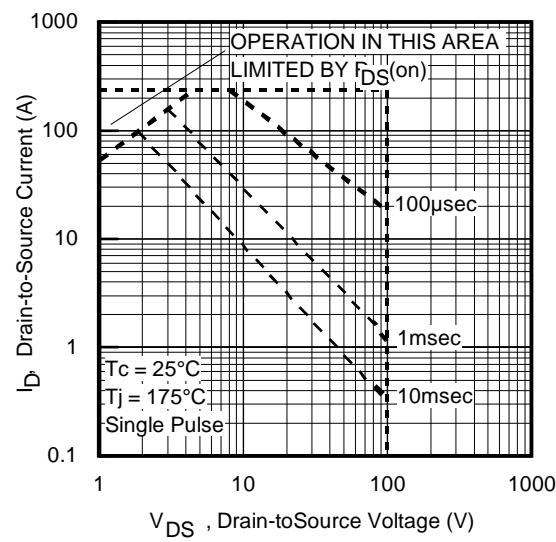


Fig 8. Maximum Safe Operating Area

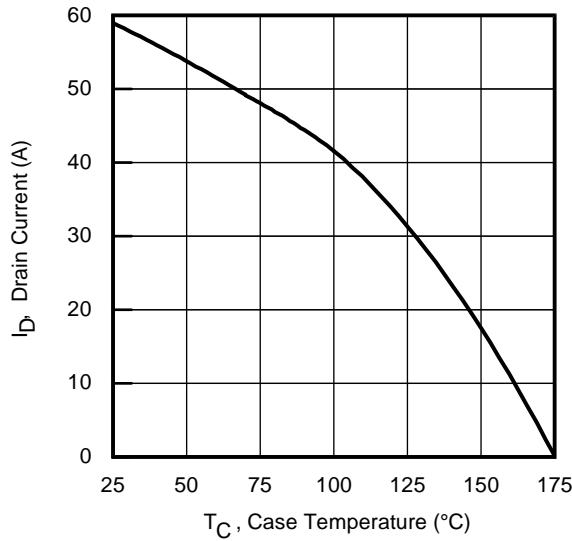


Fig 9. Maximum Drain Current vs.
Case Temperature

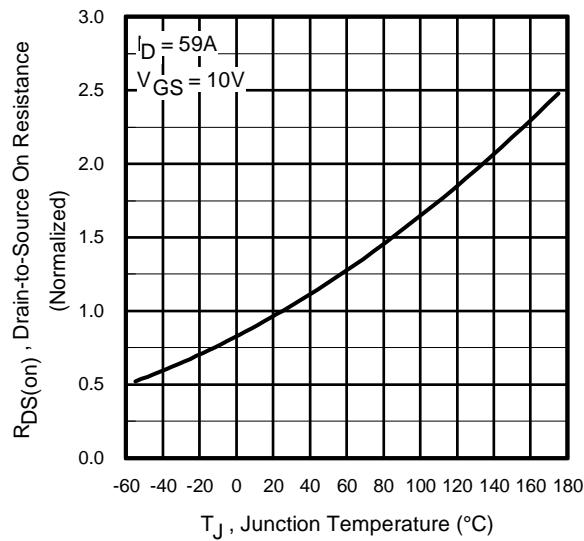


Fig 10. Normalized On-Resistance
vs. Temperature

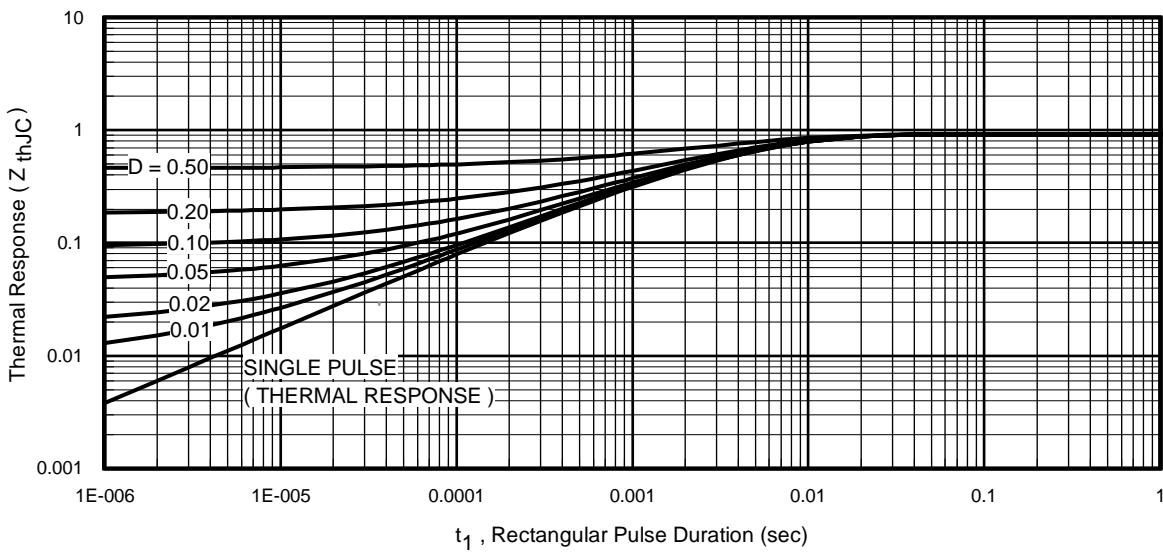


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

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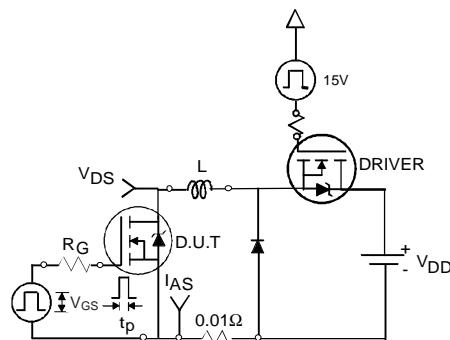


Fig 12a. Unclamped Inductive Test Circuit

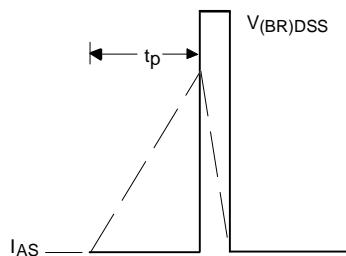


Fig 12b. Unclamped Inductive Waveforms

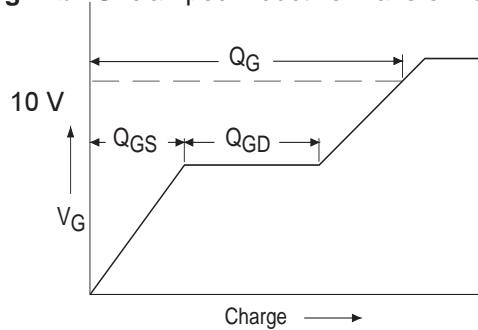


Fig 13a. Basic Gate Charge Waveform

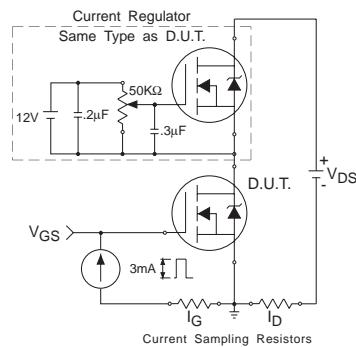


Fig 13b. Gate Charge Test Circuit
6

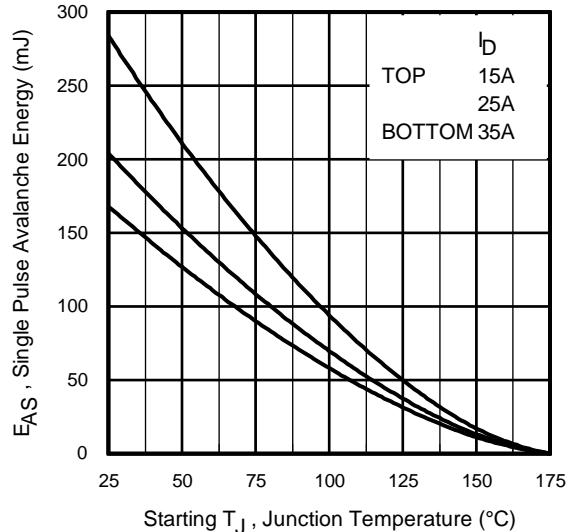


Fig 12c. Maximum Avalanche Energy vs. Drain Current

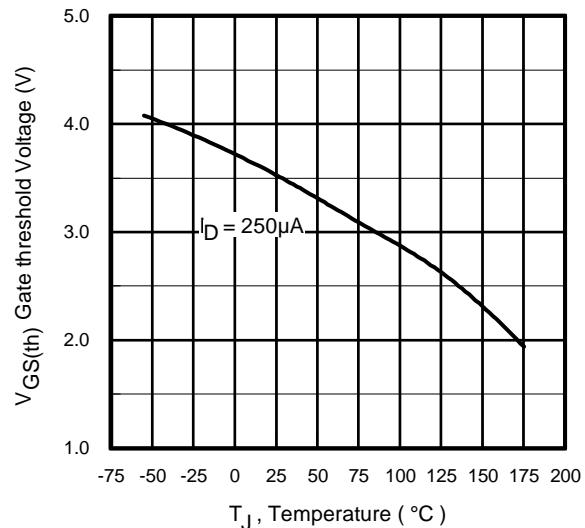


Fig 14. Threshold Voltage vs. Temperature
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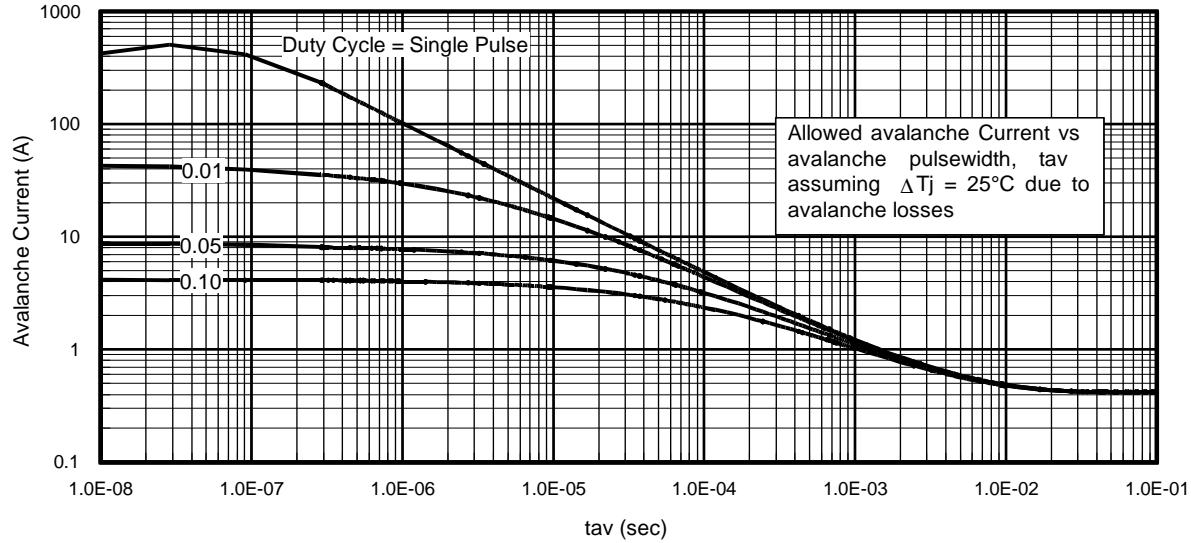


Fig 15. Typical Avalanche Current vs.Pulsewidth

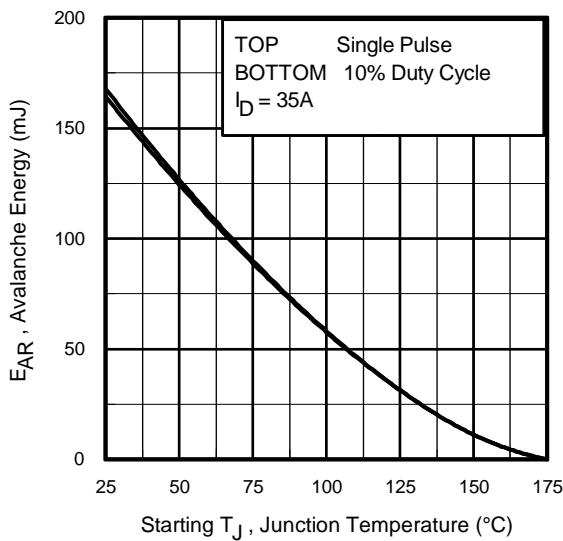


Fig 16. Maximum Avalanche Energy vs. Temperature

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**Notes on Repetitive Avalanche Curves , Figures 15, 16:
 (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 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).
- t_{av} = Average time in avalanche.
- D = Duty cycle in avalanche = $t_{av} \cdot f$
- $Z_{thJC}(D, t_{av})$ = Transient thermal resistance, see figure 11)

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

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

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

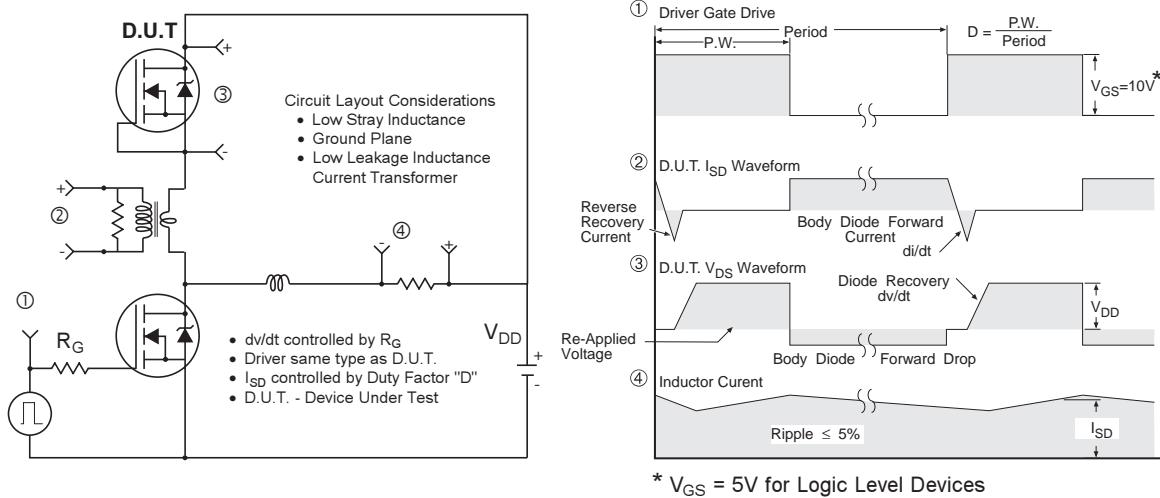


Fig 17. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

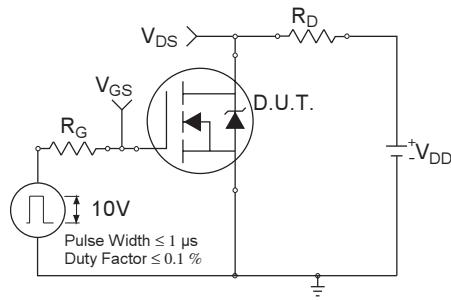


Fig 18a. Switching Time Test Circuit

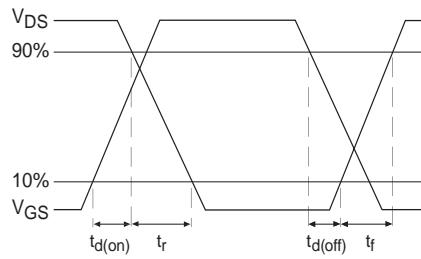
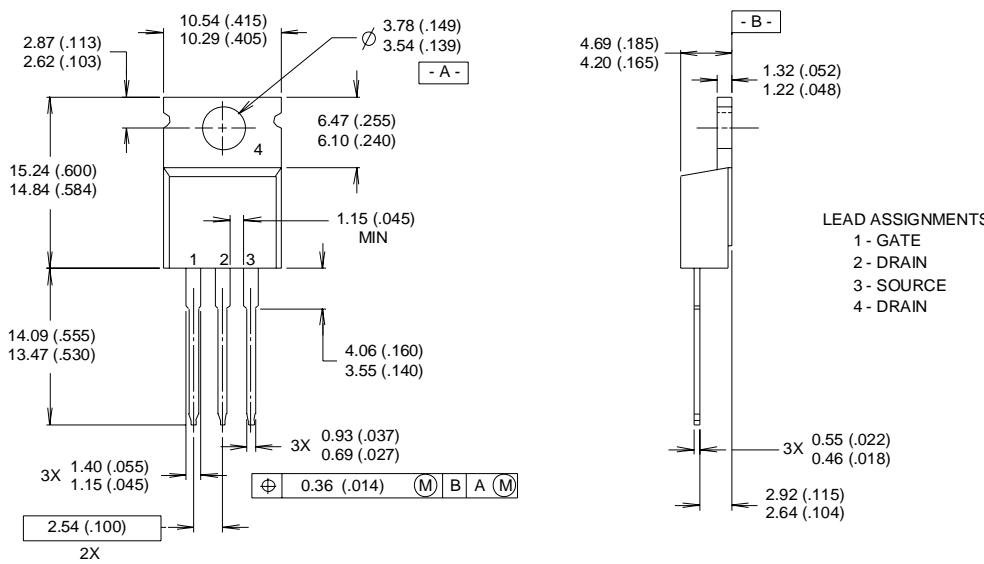


Fig 18b. Switching Time Waveforms

TO-220AB Package Outline

Dimensions are shown in millimeters (inches)



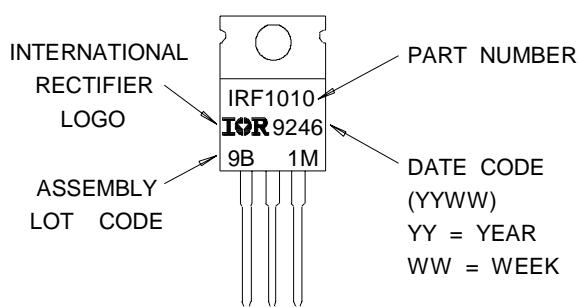
NOTES:

- 1 DIMENSIONING & TOLERANCING PER ANSI Y14.5M, 1982.
- 2 CONTROLLING DIMENSION : INCH

- 3 OUTLINE CONFORMS TO JEDEC OUTLINE TO-220AB.
- 4 HEATSINK & LEAD MEASUREMENTS DO NOT INCLUDE BURRS.

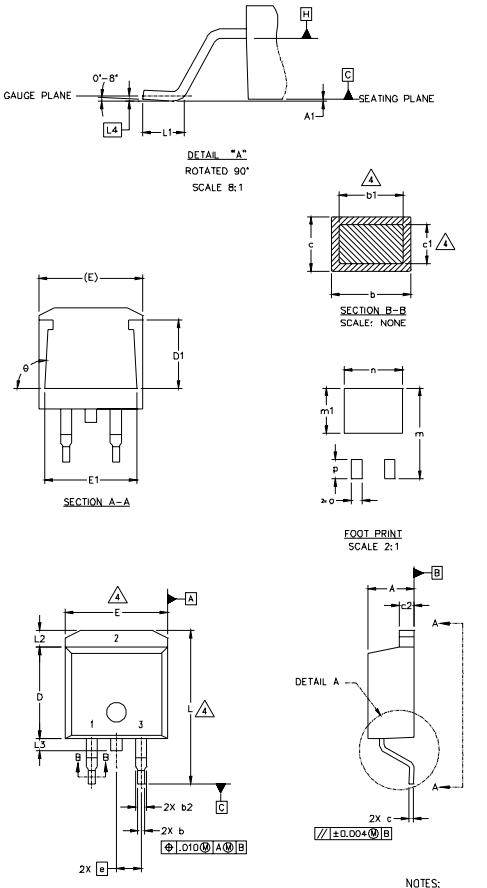
TO-220AB Part Marking Information

EXAMPLE : THIS IS AN IRF1010
 WITH ASSEMBLY
 LOT CODE 9B1M



D²Pak Package Outline

Dimensions are shown in millimeters (inches)



SYMBOL	DIMENSIONS				NOTES	
	MILLIMETERS		INCHES			
	MIN.	MAX.	MIN.	MAX.		
A	4.06	4.83	.160	.190		
A1		0.127		.005		
b	0.51	0.99	.020	.039		
b1	0.51	0.89	.020	.035	4	
b2	1.14	1.40	.045	.055		
c	0.43	0.63	.017	.025		
c1	0.38	0.74	.015	.029	4	
c2	1.14	1.40	.045	.055		
D	8.51	9.65	.335	.380	3	
D1	5.33		.210			
E	9.65	10.67	.380	.420	3	
E1	6.22		.245			
e	2.54	BSC	.100	BSC		
L	14.61	15.88	.575	.625		
L1	1.78	2.79	.070	.110		
L2		1.65		.065		
L3	1.27	1.78	.050	.070		
L4	0.25	BSC	.010	BSC		
m	17.78		.700			
m1	8.89		.350			
n	11.43		.450			
o	2.08		.082			
p	3.81		.150			
theta	90°	93°	90°	93°		

LEAD ASSIGNMENTS

HEXFET	IGBTs, CoPACK	DIODES
1.- GATE 2.- DRAIN 3.- SOURCE	1.- GATE 2.- COLLECTOR 3.- Emitter	1.- ANODE * 2.- CATHODE 3.- ANODE

* PART DEPENDENT.

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994

2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].

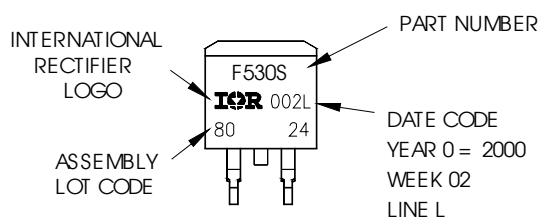
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.

4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.

5. CONTROLLING DIMENSION: INCH.

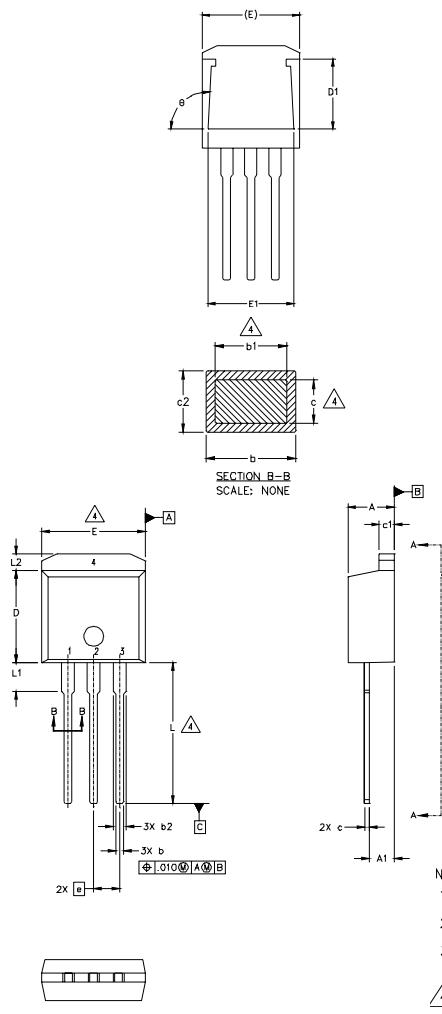
D²Pak Part Marking Information

EXAMPLE: THIS IS AN IRF530S WITH
LOT CODE 8024
ASSEMBLED ON WW 02, 2000
IN THE ASSEMBLY LINE "L"



TO-262 Package Outline

Dimensions are shown in millimeters (inches)



S Y M B O L	DIMENSIONS				N O T E S	
	MILLIMETERS		INCHES			
	MIN.	MAX.	MIN.	MAX.		
A	4.06	4.83	.160	.190		
A1	2.03	2.92	.080	.115		
b	0.51	0.99	.020	.039		
b1	0.51	0.89	.020	.035	4	
b2	1.14	1.40	.045	.055		
c	0.38	0.63	.015	.025	4	
c1	1.14	1.40	.045	.055		
c2	0.43	0.63	.017	.029		
D	8.51	9.65	.335	.380	3	
D1	5.33		.210			
E	9.65	10.67	.380	.420	3	
E1	6.22		.245			
e	2.54	BSC	.100	BSC		
L	13.46	14.09	.530	.555		
L1	3.56	3.71	.140	.146		
L2		1.65		.065		

LEAD ASSIGNMENTS

HEXFET

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

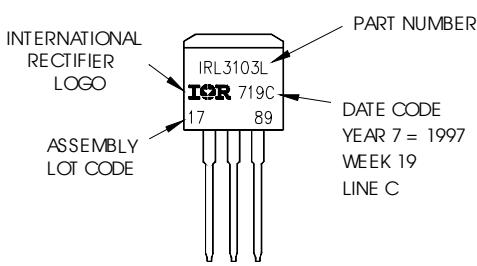
IGBT

- 1- GATE
- 2- COLLECTOR
- 3- Emitter
- 4- DRAIN

- 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.
 4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
 5. CONTROLLING DIMENSION: INCH.

TO-262 Part Marking Information

EXAMPLE: THIS IS AN IRL3103L
 LOT CODE 1789
 ASSEMBLED ON WW 19, 1997
 IN THE ASSEMBLY LINE "C"

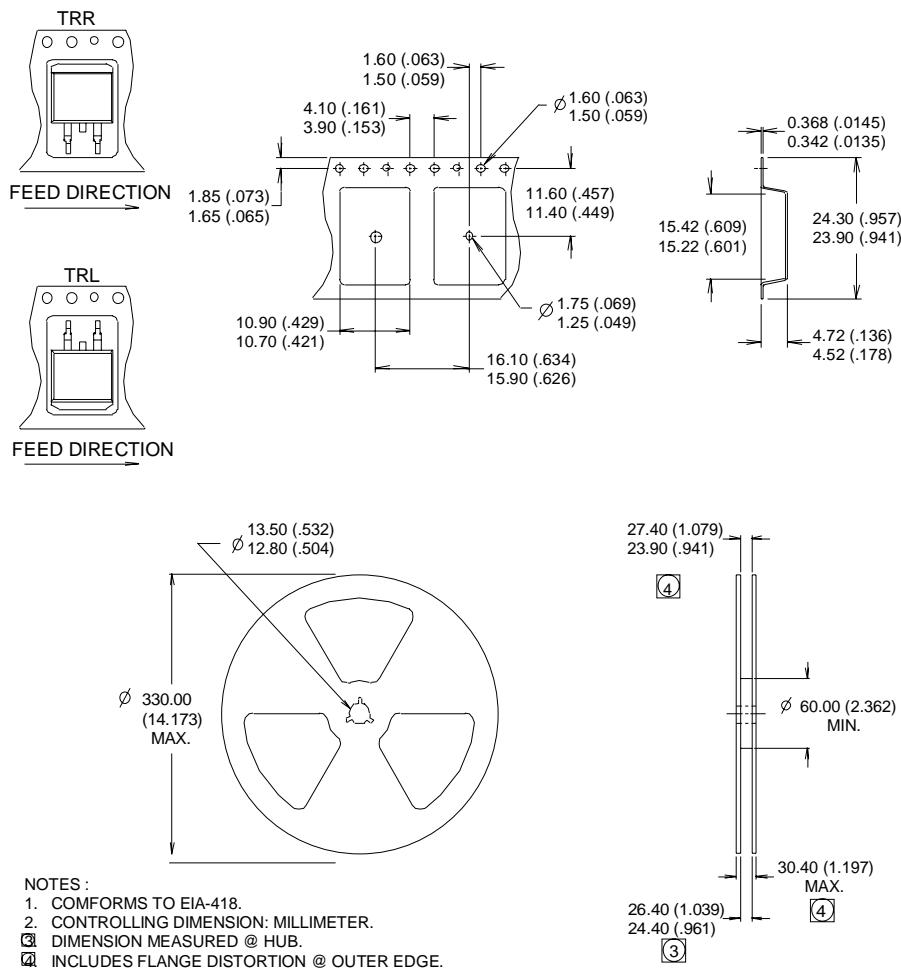


IRF3710Z/S/L

International
IR Rectifier

D²Pak Tape & Reel Information

Dimensions are shown in millimeters (inches)



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

Data and specifications subject to change without notice.
This product has been designed and qualified for the Automotive [Q101] market.
Qualification Standards can be found on IR's Web site.

International
IR Rectifier

IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105
TAC Fax: (310) 252-7903

Visit us at www.irf.com for sales contact information. 08/03
www.irf.com

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