

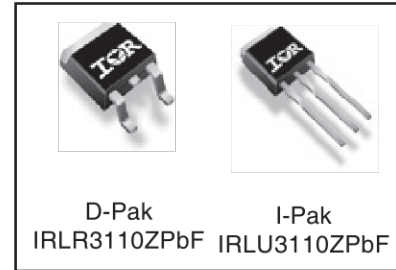
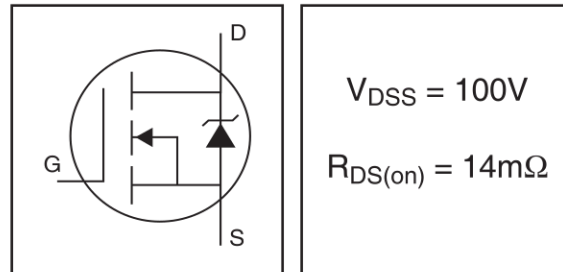
Features

- Advanced Process Technology
- Ultra Low On-Resistance
- 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.

HEXFET® Power MOSFET



Absolute Maximum Ratings

	Parameter	Max.	Units
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$ (Silicon Limited)	63	A
$I_D @ T_C = 100^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$ (Silicon Limited)	45	
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$ (Package Limited)	42	
I_{DM}	Pulsed Drain Current ①	250	
$P_D @ T_C = 25^\circ C$	Power Dissipation	140	W
	Linear Derating Factor	0.95	W/°C
V_{GS}	Gate-to-Source Voltage	±16	V
E_{AS} (Thermally limited)	Single Pulse Avalanche Energy ②	110	mJ
E_{AS} (Tested)	Single Pulse Avalanche Energy Tested Value ③	140	
I_{AR}	Avalanche Current ①	See Fig.12a, 12b, 15, 16	A
E_{AR}	Repetitive Avalanche Energy ⑤		mJ
T_J	Operating Junction and	-55 to + 175	°C
T_{STG}	Storage Temperature Range		
	Reflow Soldering Temperature, for 10 seconds	300	
	Mounting Torque, 6-32 or M3 screw	10 lbf•in (1.1N•m)	

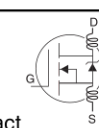
Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ③	—	1.05	°C/W
$R_{\theta JA}$	Junction-to-Ambient (PCB mount) ⑦⑧	—	40	
$R_{\theta JA}$	Junction-to-Ambient ⑧	—	110	

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Electrical Characteristics @ 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
ΔV _{(BR)DSS} /ΔT _J	Breakdown Voltage Temp. Coefficient	—	0.077	—	V/°C	Reference to 25°C, I _D = 1mA
R _{DS(on)}	Static Drain-to-Source On-Resistance	—	11	14	mΩ	V _{GS} = 10V, I _D = 38A ③
		—	12	16		V _{GS} = 4.5V, I _D = 32A ③
V _{GS(th)}	Gate Threshold Voltage	1.0	—	2.5	V	V _{DS} = V _{GS} , I _D = 100μA
g _{fs}	Forward Transconductance	52	—	—	S	V _{DS} = 25V, I _D = 38A
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°C
I _{GSS}	Gate-to-Source Forward Leakage	—	—	200	nA	V _{GS} = 16V
	Gate-to-Source Reverse Leakage	—	—	-200		V _{GS} = -16V
Q _g	Total Gate Charge	—	34	48	nC	I _D = 38A
Q _{gs}	Gate-to-Source Charge	—	10	—		V _{DS} = 50V
Q _{gd}	Gate-to-Drain ("Miller") Charge	—	15	—		V _{GS} = 4.5V ③
t _{d(on)}	Turn-On Delay Time	—	24	—	ns	V _{DD} = 50V
t _r	Rise Time	—	110	—		I _D = 38A
t _{d(off)}	Turn-Off Delay Time	—	33	—		R _G = 3.7Ω
t _f	Fall Time	—	48	—		V _{GS} = 4.5V ③
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	—	3980	—	pF	V _{GS} = 0V
C _{oss}	Output Capacitance	—	310	—		V _{DS} = 25V
C _{rss}	Reverse Transfer Capacitance	—	130	—		f = 1.0MHz
C _{oss}	Output Capacitance	—	1820	—		V _{GS} = 0V, V _{DS} = 1.0V, f = 1.0MHz
C _{oss}	Output Capacitance	—	170	—		V _{GS} = 0V, V _{DS} = 80V, f = 1.0MHz
C _{oss eff.}	Effective Output Capacitance	—	320	—		V _{GS} = 0V, V _{DS} = 0V to 80V ④

Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I _S	Continuous Source Current (Body Diode)	—	—	63	A	MOSFET symbol showing the integral reverse p-n junction diode.
I _{SM}	Pulsed Source Current (Body Diode) ①	—	—	250		
V _{SD}	Diode Forward Voltage	—	—	1.3	V	T _J = 25°C, I _S = 38A, V _{GS} = 0V ③
t _{rr}	Reverse Recovery Time	—	34	51	ns	T _J = 25°C, I _F = 38A, V _{DD} = 50V
Q _{rr}	Reverse Recovery Charge	—	42	63	nC	di/dt = 100A/μs ③
t _{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)				

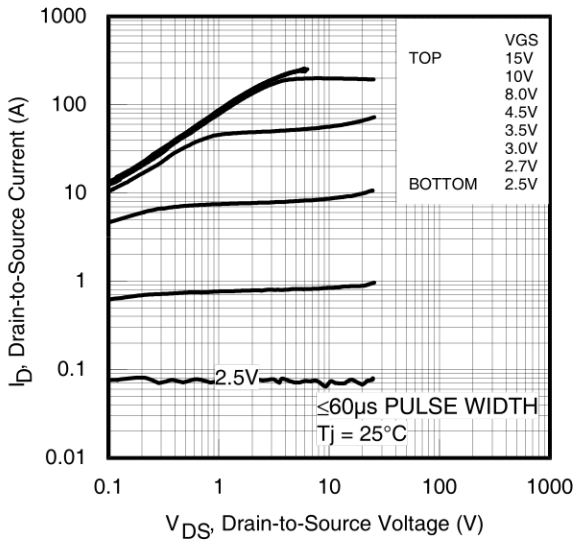


Fig 1. Typical Output Characteristics

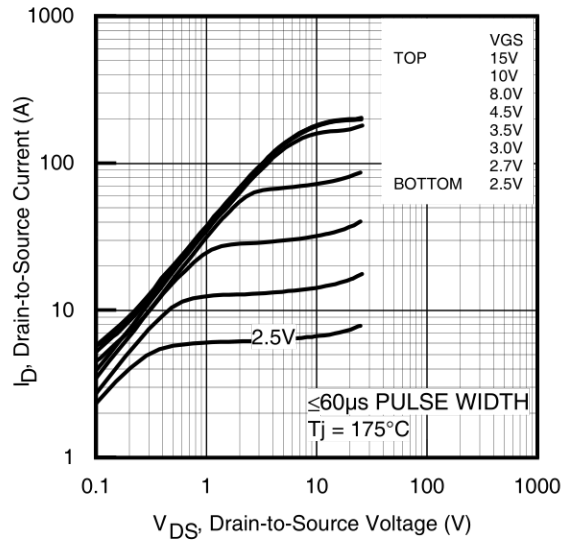


Fig 2. Typical Output Characteristics

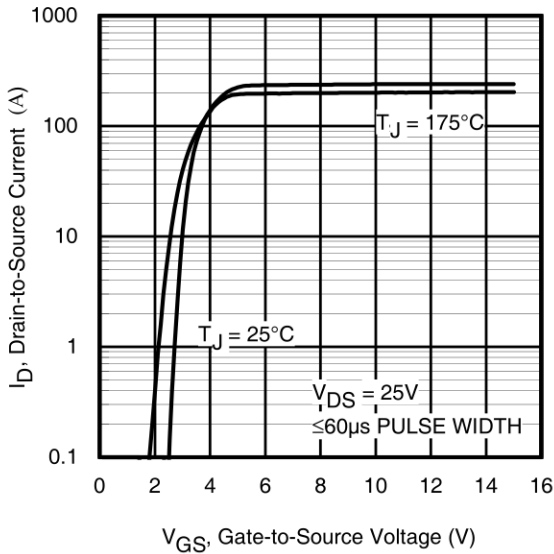


Fig 3. Typical Transfer Characteristics

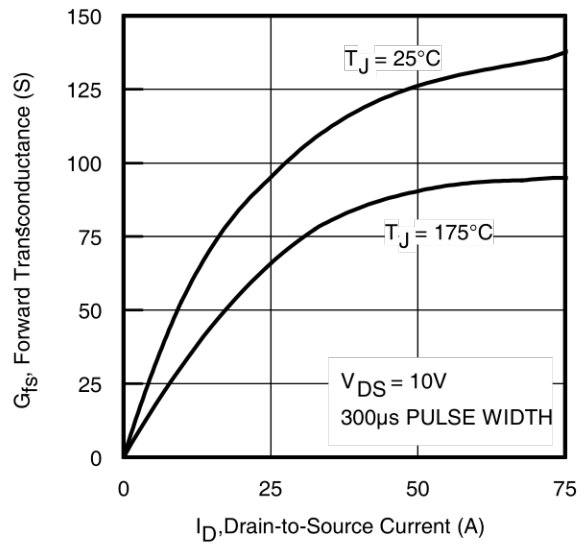


Fig 4. Typical Forward Transconductance vs. Drain Current

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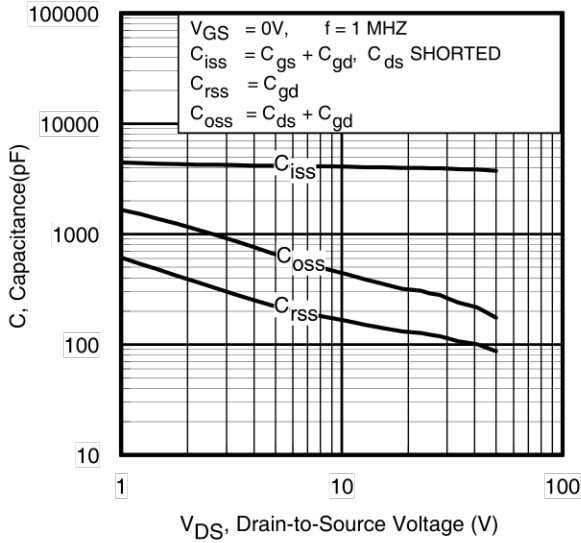


Fig 5. Typical Capacitance vs. Drain-to-Source Voltage

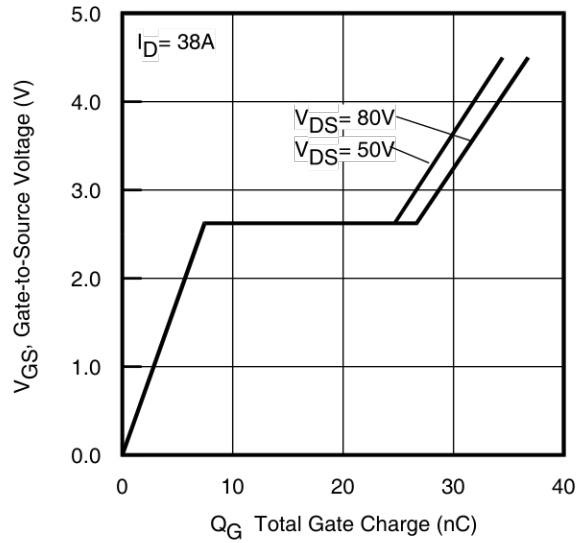


Fig 6. Typical Gate Charge vs. Gate-to-Source Voltage

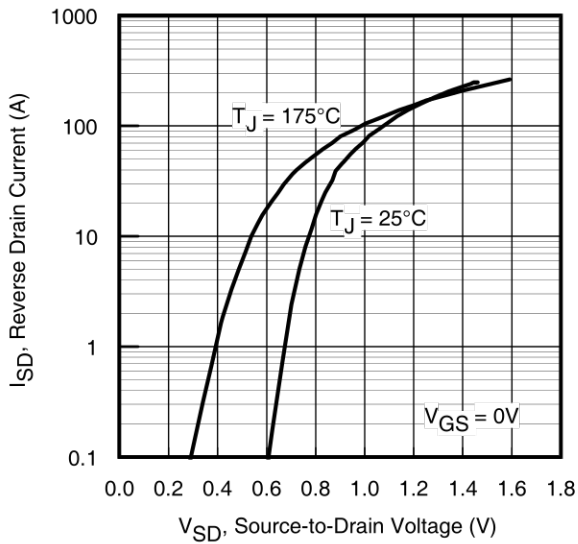


Fig 7. Typical Source-Drain Diode Forward Voltage

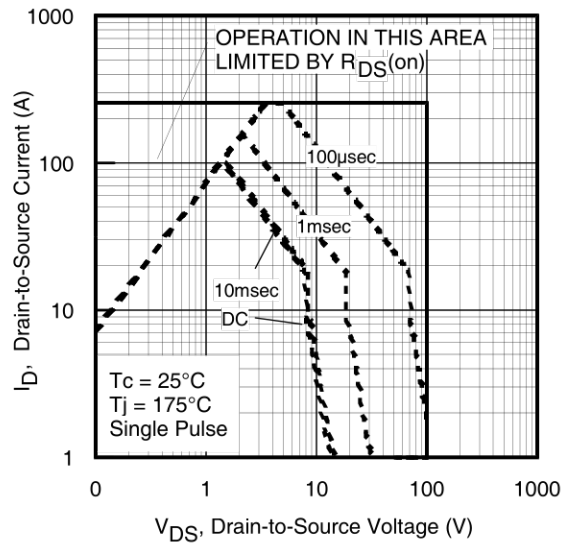


Fig 8. Maximum Safe Operating Area

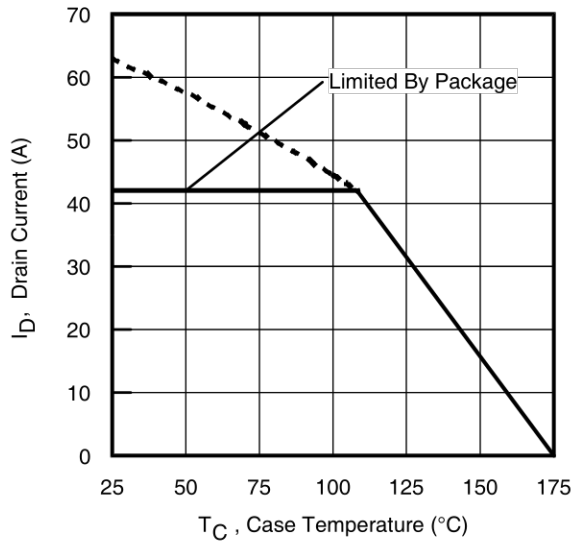


Fig 9. Maximum Drain Current vs. Case Temperature

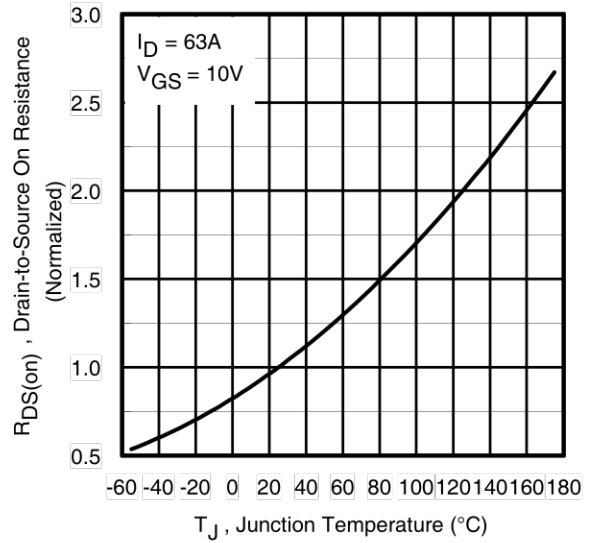


Fig 10. Normalized On-Resistance vs. Temperature

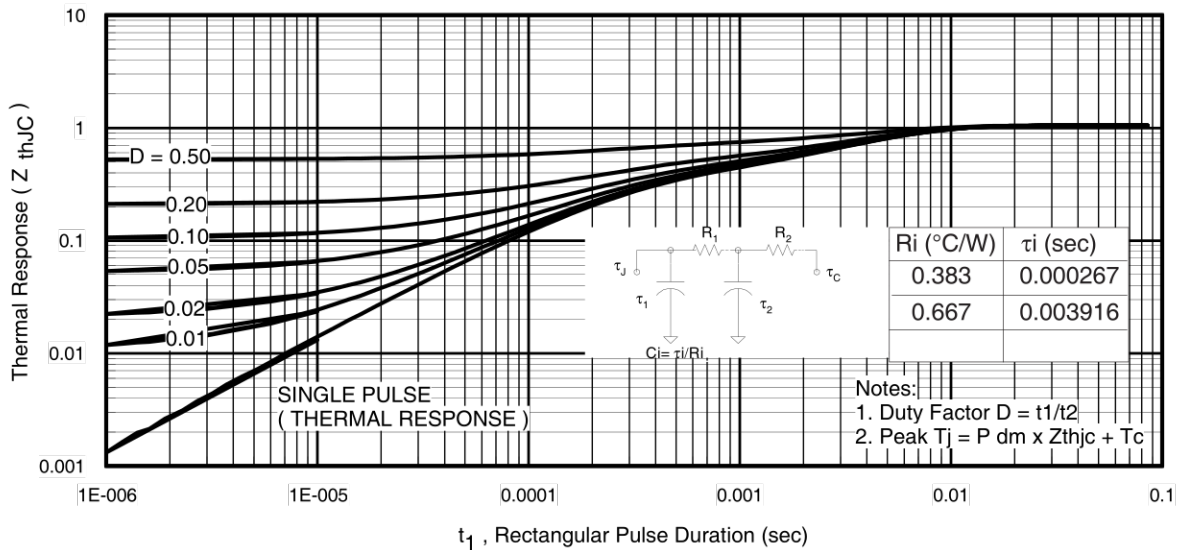


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

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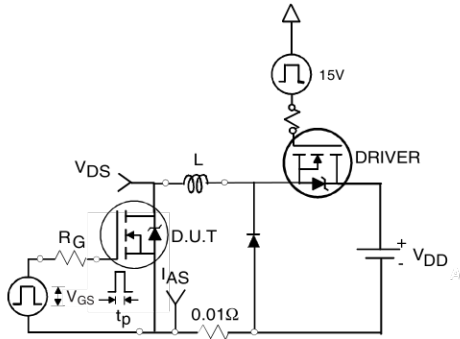


Fig 12a. Unclamped Inductive Test Circuit

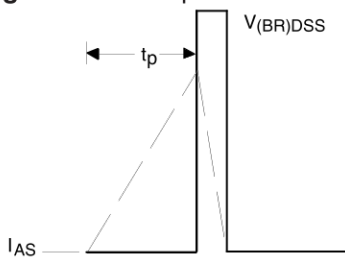


Fig 12b. Unclamped Inductive Waveforms

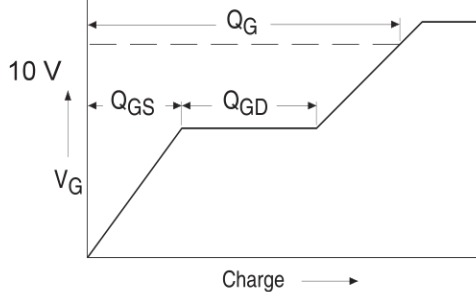


Fig 13a. Basic Gate Charge Waveform

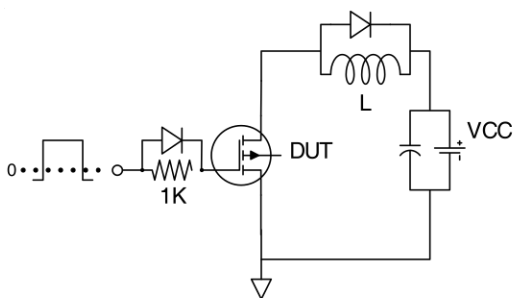


Fig 13b. Gate Charge Test Circuit

6

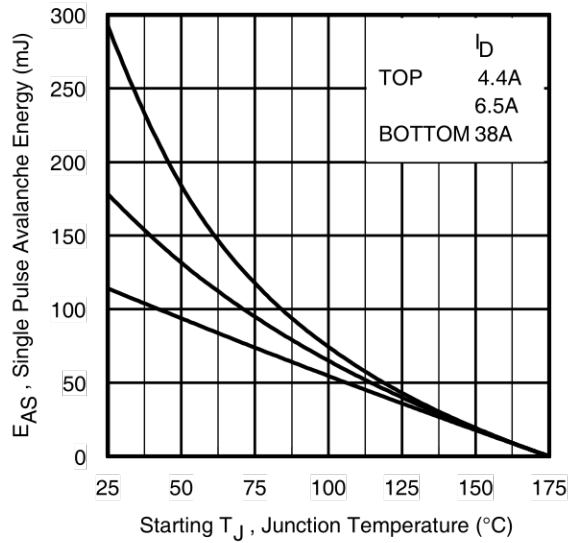


Fig 12c. Maximum Avalanche Energy vs. Drain Current

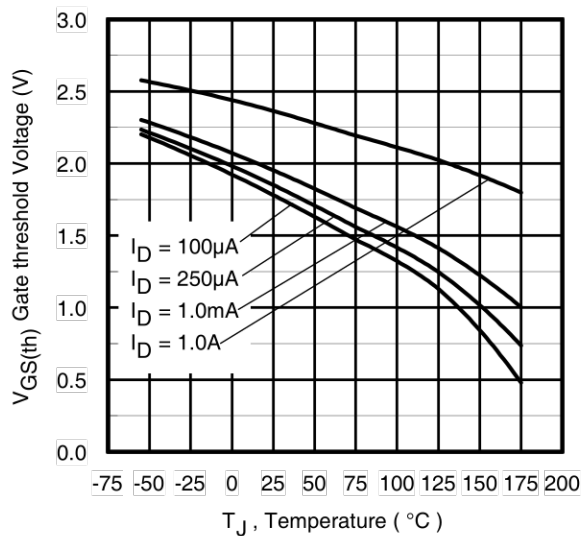


Fig 14. Threshold Voltage vs. Temperature

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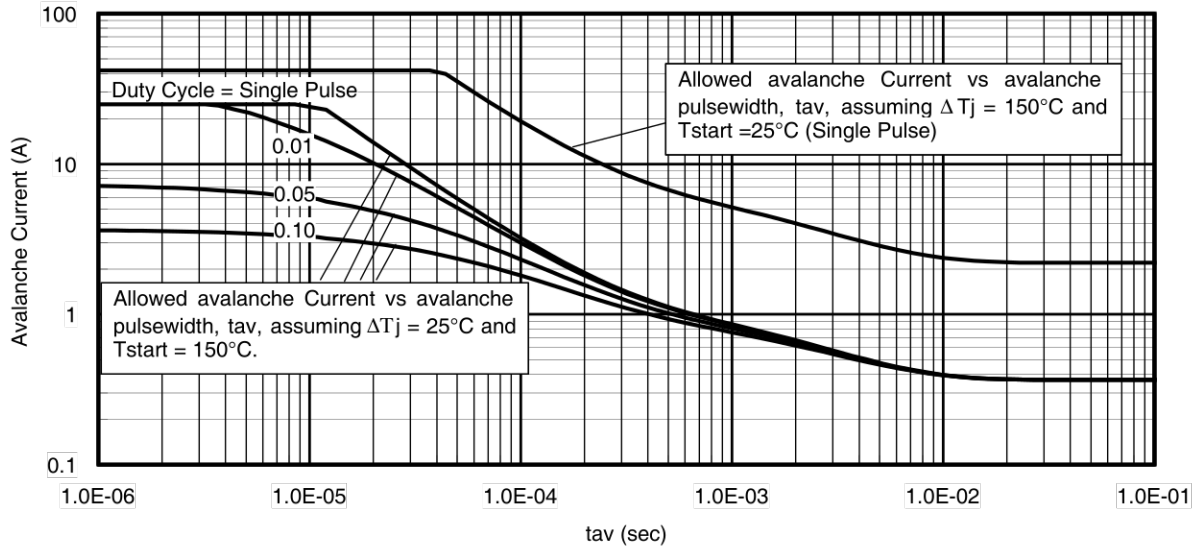


Fig 15. Typical Avalanche Current vs.Pulsewidth

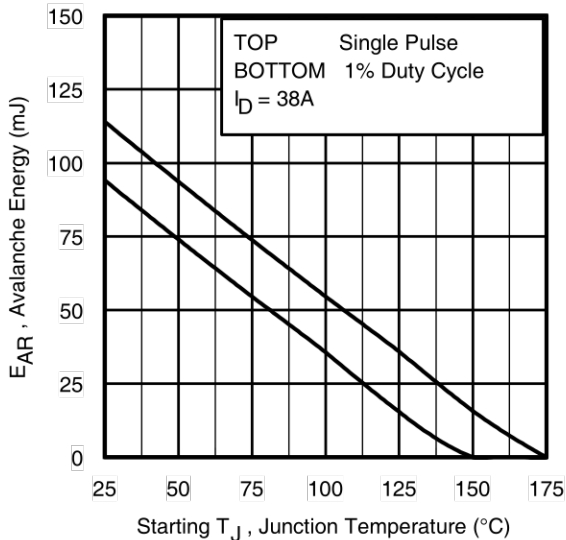


Fig 16. Maximum Avalanche Energy vs. Temperature

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 neither T_{jmax} nor I_{av} (max) is 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)

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

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

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

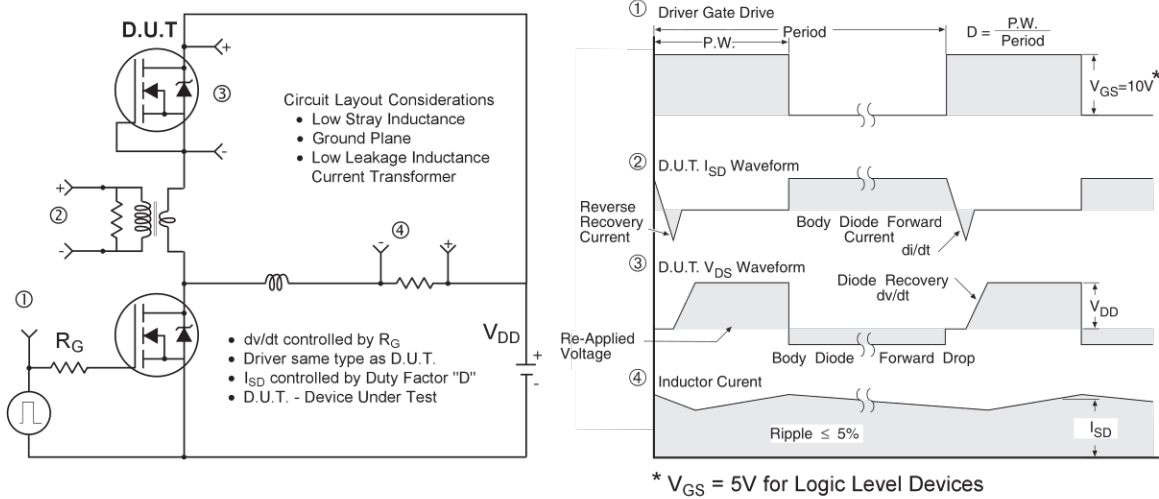


Fig 17. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

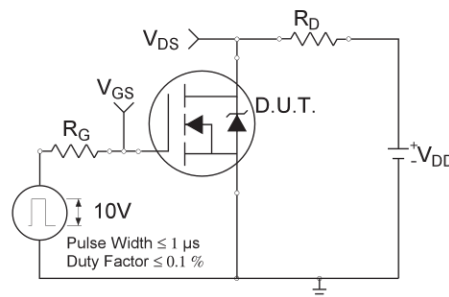


Fig 18a. Switching Time Test Circuit

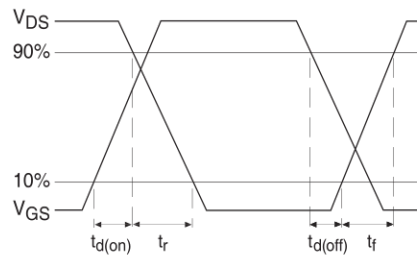
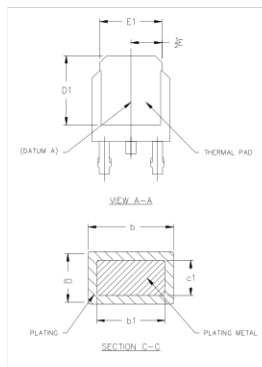
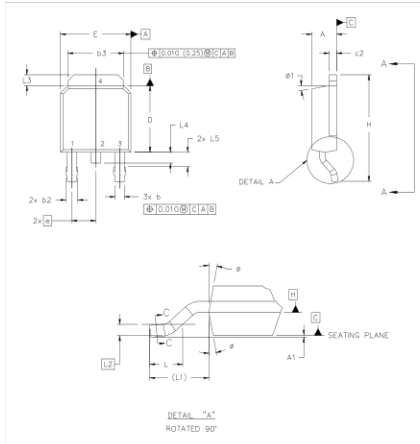


Fig 18b. Switching Time Waveforms

D-Pak (TO-252AA) Package Outline



- NOTES:
- 1.0 DIMENSIONING AND TOLERANCING PER ASME Y14.5 M- 1994.
 - 2.0 DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS].
 - 3.0 LEAD DIMENSION UNCONTROLLED IN L5
 - 4.0 DIMENSION D1 AND E1 ESTABLISH A MINIMUM MOUNTING SURFACE FOR THERMAL PAD.
 - 5.0 SECTION C-C DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN .005 [.0127] AND .010 [.0254] FROM THE LEAD TIP.
 - 6.0 DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (.0127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
 - 7.0 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	0.84	0.89	.025	.035	5 LEAD ASSIGNMENTS
b1	0.84	0.79	.025	.031	5
b2	0.76	1.14	.030	.045	
b3	4.95	5.46	.195	.215	
c	0.46	0.61	.018	.024	5
c1	0.41	0.56	.016	.022	5
c2	.046	0.89	.018	.035	5
D	5.97	6.22	.235	.245	6
D1	5.21	-	.206	-	4
E	6.35	6.73	.250	.265	6
E1	4.32	-	.170	-	4
e	2.29		.090 BSC		
H	9.40	10.41	.370	.410	
L	1.40	1.78	.055	.070	
L1	2.74 REF.		.108 REF.		
L2	0.051 BSC		.020 BSC		
L3	0.89	1.27	.035	.050	
L4		1.02		.040	
L5	1.14	1.52	.045	.060	3
ø	0"	10"	0"	10"	
ø1	0"	15"	0"	15"	

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

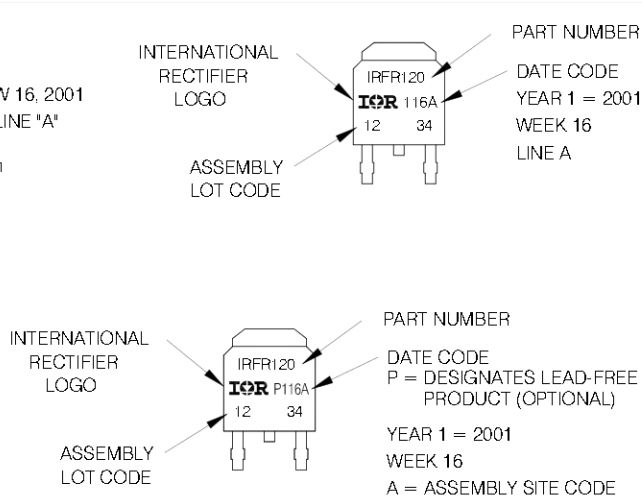
IGBTs, CoPACK
1.- GATE
2.- COLLECTOR
3.- EMITTER
4.- COLLECTOR

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

EXAMPLE: THIS IS AN IRFR120
WITH ASSEMBLY
LOT CODE 1234
ASSEMBLED ON WW 16, 2001
IN THE ASSEMBLY LINE "A"

Note: "P" in assembly line position
indicates "Lead-Free"

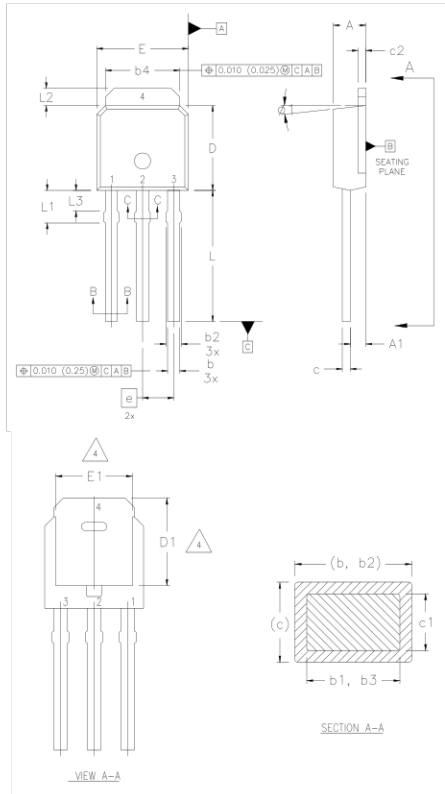
OR



IRLR/U3110ZPbF

International
IR Rectifier

I-Pak (TO-251AA) Package Outline



NOTES:

- 1 DIMENSIONING AND TOLERANCING PER ASME Y14.5 M- 1994.
- 2 DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
- 3 DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
- 4 THERMAL PAD CONTOUR OPTION WITHIN DIMENSION b4, L2, E1 & D1.
- 5 LEAD DIMENSION UNCONTROLLED IN L3.
- 6 DIMENSION b1, b3 APPLY TO BASE METAL ONLY.
- 7 OUTLINE CONFORMS TO JEDEC OUTLINE TO-251AA.
- 8 CONTROLLING DIMENSION : INCHES.

LEAD ASSIGNMENTS

HEXFEET

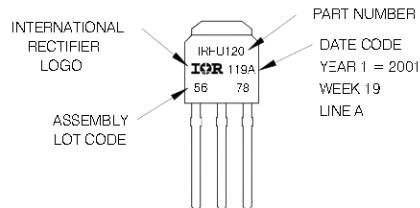
- 1.- GATE
- 2.- DRAIN
- 3.- SOURCE
- 4.- DRAIN

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	2.18	2.39	0.086	.094	
A1	0.89	1.14	0.035	0.045	
b	0.64	0.89	0.025	0.035	
b1	0.64	0.79	0.025	0.031	4
b2	0.76	1.14	0.030	0.045	
b3	0.76	1.04	0.030	0.041	
b4	5.00	5.46	0.195	0.215	4
c	0.46	0.61	0.018	0.024	
c1	0.41	0.56	0.016	0.022	
c2	.046	0.86	0.018	0.035	
D	5.97	6.22	0.235	0.245	3, 4
D1	5.21	-	0.205	-	4
E	6.35	6.73	0.250	0.265	3, 4
E1	4.32	-	0.170	-	4
e	2.29		0.090 BSC		
L	8.89	9.60	0.350	0.380	
L1	1.91	2.29	0.075	0.090	
L2	0.89	1.27	0.035	0.050	4
L3	1.14	1.52	0.045	0.060	5
ø1	Ø	15'	Ø	15'	

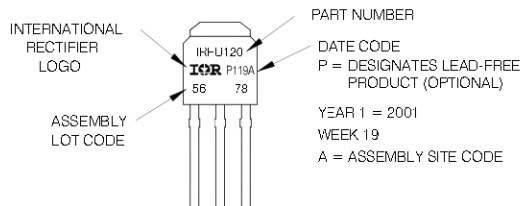
I-Pak (TO-251AA) Part Marking Information

EXAMPLE: THIS IS AN IRFU120
WITH ASSEMBLY
LOT CODE 5678
ASSEMBLED ON WW 19, 2001
IN THE ASSEMBLY LINE A

Note: P in assembly line position
indicates Lead-Free

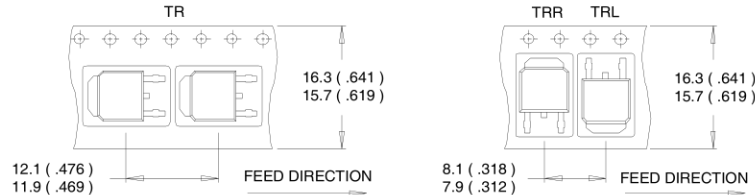


OR



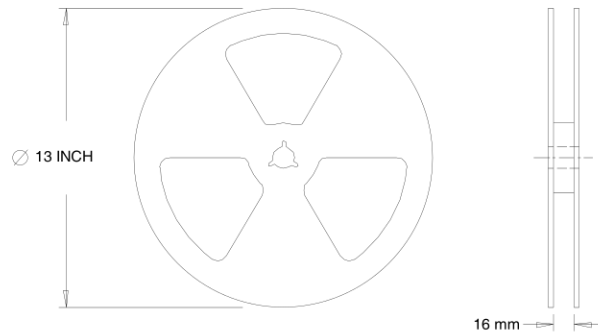
D-Pak (TO-252AA) Tape & Reel Information

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.

Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11).
- ② Limited by T_{Jmax} , starting $T_J = 25^\circ\text{C}$, $L = 0.16\text{mH}$, $R_G = 25\Omega$, $I_{AS} = 38\text{A}$, $V_{GS} = 10\text{V}$. Part not recommended for use above this value.
- ③ Pulse width $\leq 1.0\text{ms}$; duty cycle $\leq 2\%$.
- ④ C_{oss} 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} .
- ⑤ Limited by T_{Jmax} , see Fig.12a, 12b, 15, 16 for typical repetitive avalanche performance.
- ⑥ This value determined from sample failure population. 100% tested to this value in production.
- ⑦ When mounted on 1" square PCB (FR-4 or G-10 Material).
- ⑧ R_θ is measured at T_J approximately 90°C .

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

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