

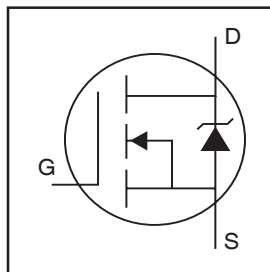
Features

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

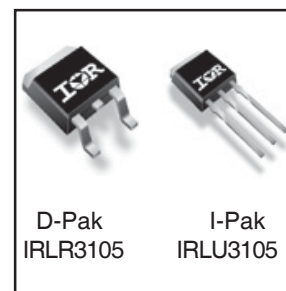
Description

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.

The D-Pak is designed for surface mounting using vapor phase, infrared, or wave soldering techniques. The straight lead version (IRLU series) is for through-hole mounting applications. Power dissipation levels up to 1.5 watts are possible in typical surface mount applications.



$V_{DSS} = 55V$
$R_{DS(on)} = 0.037\Omega$
$I_D = 25A$



Absolute Maximum Ratings

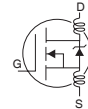
	Parameter	Max.	Units
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$	25	A
$I_D @ T_C = 100^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$	18	
I_{DM}	Pulsed Drain Current ①	100	
$P_D @ T_C = 25^\circ C$	Power Dissipation	57	W
	Linear Derating Factor	0.38	W/°C
V_{GS}	Gate-to-Source Voltage	± 16	V
E_{AS}	Single Pulse Avalanche Energy②	61	mJ
$E_{AS} (tested)$	Single Pulse Avalanche Energy Tested Value②	94	
I_{AR}	Avalanche Current①	See Fig.12a, 12b, 15, 16	A
E_{AR}	Repetitive Avalanche Energy⑥		mJ
dv/dt	Peak Diode Recovery dv/dt ③	3.4	V/ns
T_J	Operating Junction and	-55 to + 175	°C
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	2.65	°C/W
$R_{\theta JA}$	Junction-to-Ambient (PCB mount)*	—	50	
$R_{\theta JA}$	Junction-to-Ambient	—	110	

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	55	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.056	—	V/ $^\circ\text{C}$	Reference to 25°C , $I_D = 1\text{mA}$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	30	37	$\text{m}\Omega$	$V_{GS} = 10V, I_D = 15A$ ④
		—	35	43		$V_{GS} = 5.0V, I_D = 13A$ ④
$V_{GS(th)}$	Gate Threshold Voltage	1.0	—	3.0	V	$V_{DS} = V_{GS}, I_D = 250\mu A$
g_{fs}	Forward Transconductance	15	—	—	S	$V_{DS} = 25V, I_D = 15A$ ④
I_{DSS}	Drain-to-Source Leakage Current	—	—	20	μA	$V_{DS} = 55V, V_{GS} = 0V$
		—	—	250		$V_{DS} = 44V, V_{GS} = 0V, T_J = 150^\circ\text{C}$
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	—	—	20	nC	$I_D = 15A$
Q_{gs}	Gate-to-Source Charge	—	—	5.6		$V_{DS} = 44V$
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	—	9.0		$V_{GS} = 5.0V$, See Fig. 6 and 13
$t_{d(on)}$	Turn-On Delay Time	—	8.0	—		$V_{DD} = 28V$
t_r	Rise Time	—	57	—	nH	$I_D = 15A$
$t_{d(off)}$	Turn-Off Delay Time	—	25	—		$R_G = 24\Omega$
t_f	Fall Time	—	37	—		$V_{GS} = 5.0V$, See Fig. 10 ④
L_D	Internal Drain Inductance	—	4.5	—		Between lead, 6mm (0.25in.) from package and center of die contact
L_S	Internal Source Inductance ②	—	7.5	—		
C_{iss}	Input Capacitance	—	710	—	pF	$V_{GS} = 0V$
C_{oss}	Output Capacitance	—	150	—		$V_{DS} = 25V$
C_{rss}	Reverse Transfer Capacitance	—	28	—		$f = 1.0\text{MHz}$, See Fig. 5
C_{oss}	Output Capacitance	—	890	—		$V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0\text{MHz}$
C_{oss}	Output Capacitance	—	110	—		$V_{GS} = 0V, V_{DS} = 44V, f = 1.0\text{MHz}$
$C_{oss \text{ eff.}}$	Effective Output Capacitance ③	—	210	—		$V_{GS} = 0V, V_{DS} = 0V \text{ to } 44V$

**Source-Drain Ratings and Characteristics**

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	25	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	100		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}, I_S = 15A, V_{GS} = 0V$ ④
t_{rr}	Reverse Recovery Time	—	52	78	ns	$T_J = 25^\circ\text{C}, I_F = 15A, V_{DD} = 28V$
Q_{rr}	Reverse Recovery Charge	—	82	120	nC	$di/dt = 100A/\mu s$ ④
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S + L_D$)				

* When mounted on 1" square PCB (FR-4 or G-10 Material) .
For recommended footprint and soldering techniques refer to application note #AN-994
Notes ① through ③ are on page 11

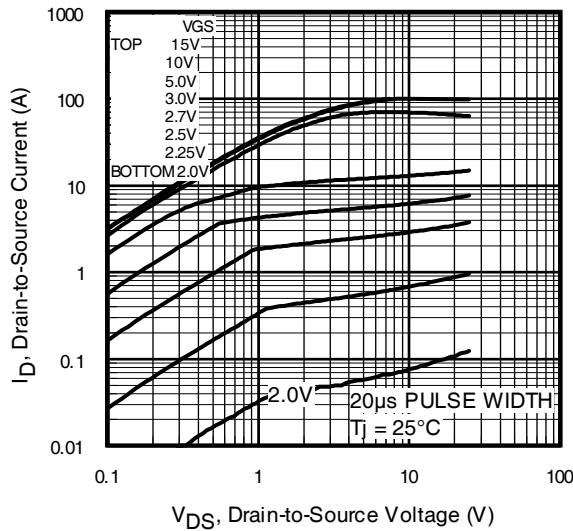


Fig 1. Typical Output Characteristics

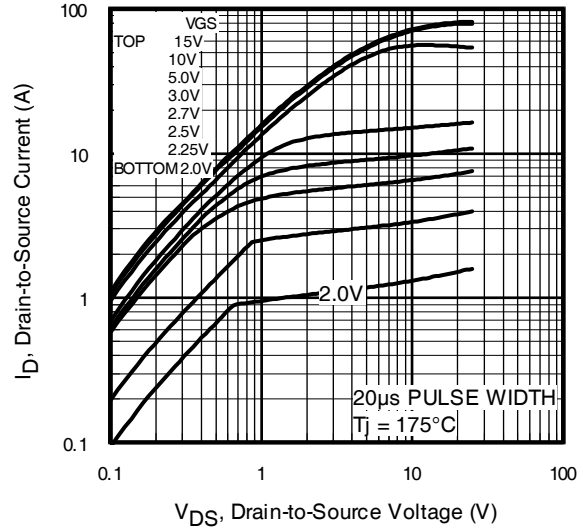


Fig 2. Typical Output Characteristics

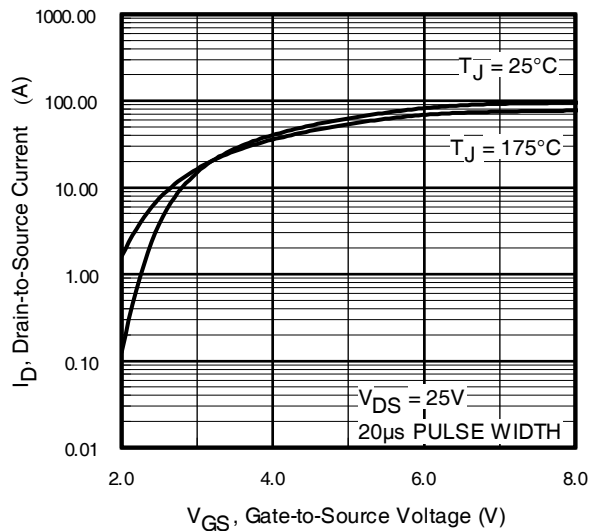


Fig 3. Typical Transfer Characteristics

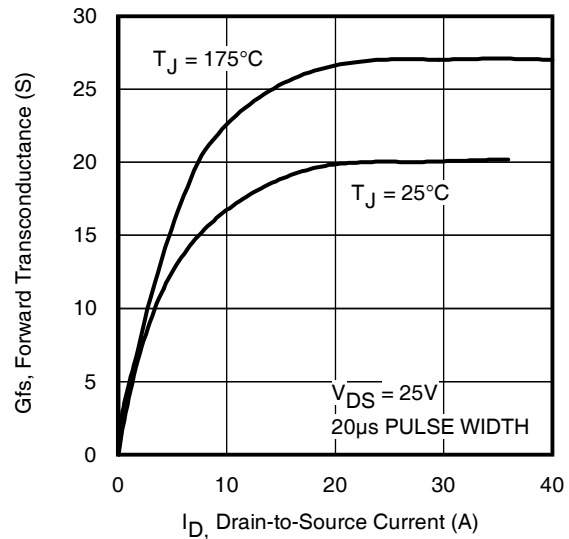
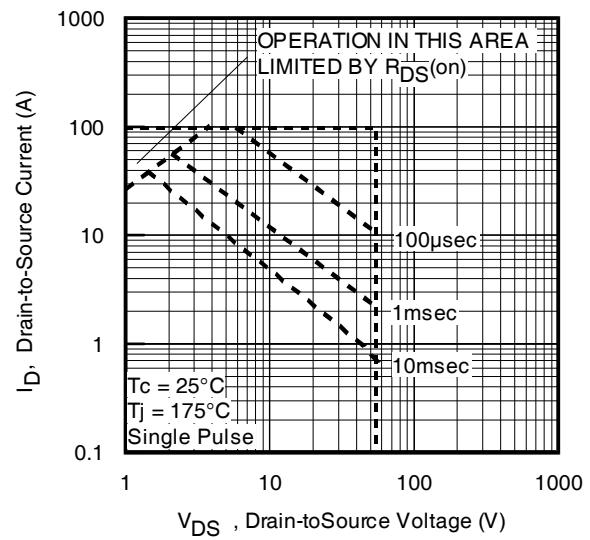
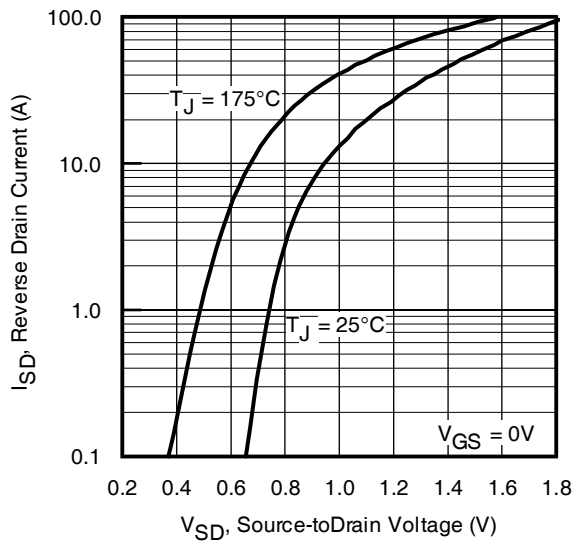
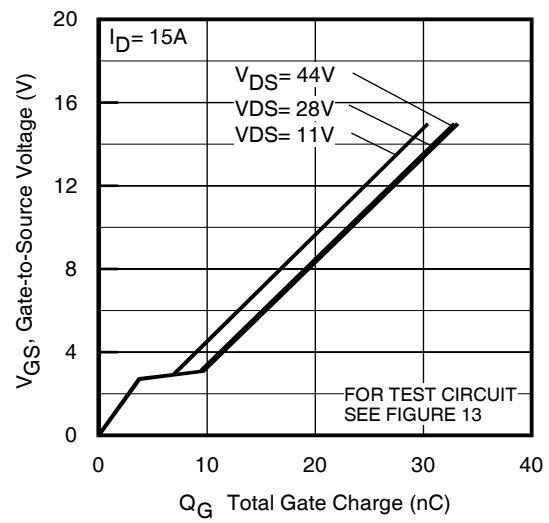
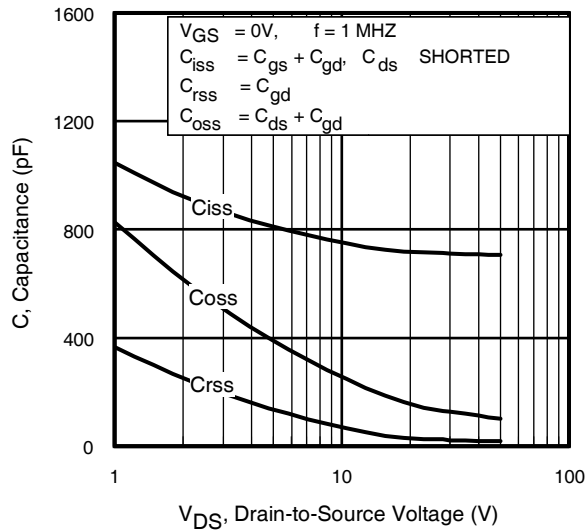


Fig 4. Typical Forward Transconductance Vs. Drain Current



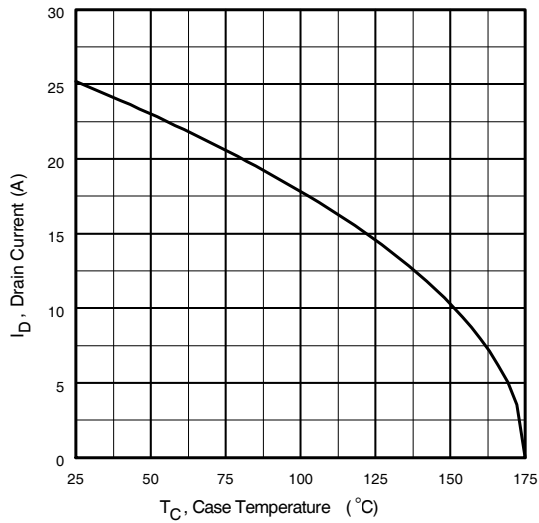


Fig 9. Maximum Drain Current Vs. Case Temperature

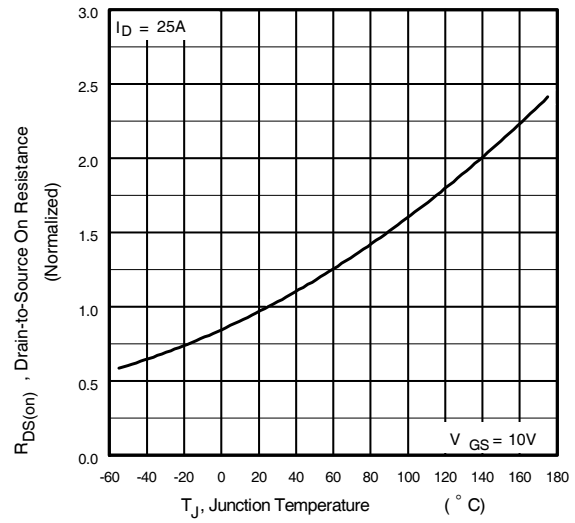


Fig 10. Normalized On-Resistance Vs. Temperature

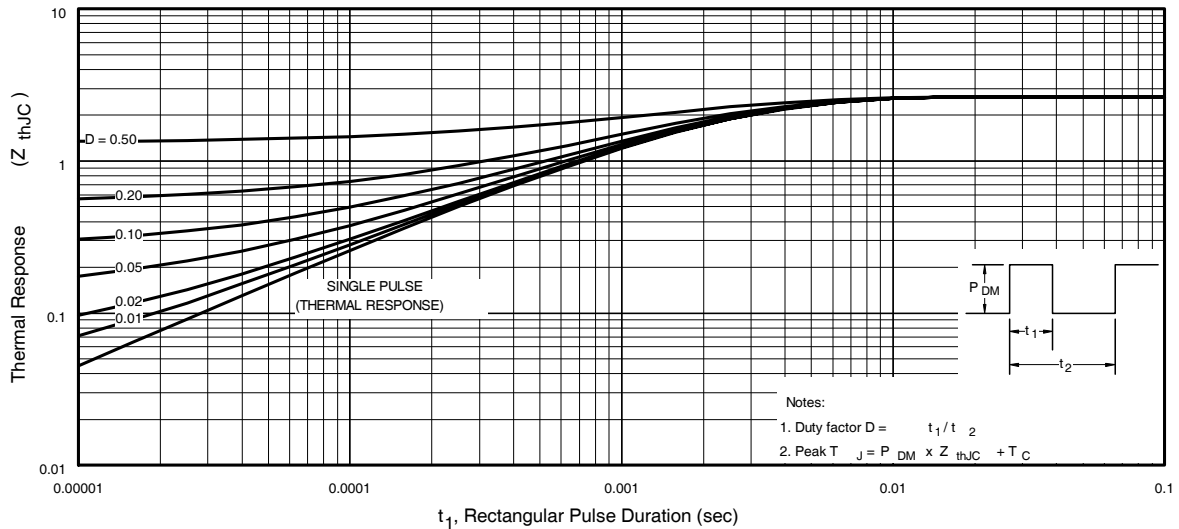


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

IRLR/U3105PbF

International
IR Rectifier

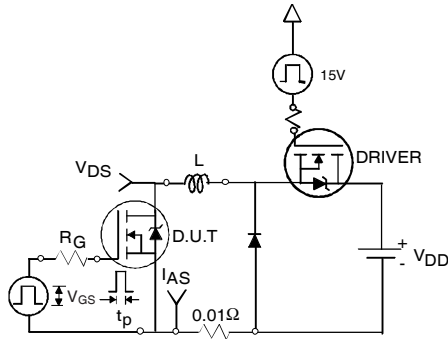


Fig 12a. Unclamped Inductive Test Circuit

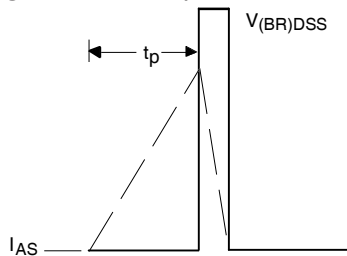


Fig 12b. Unclamped Inductive Waveforms

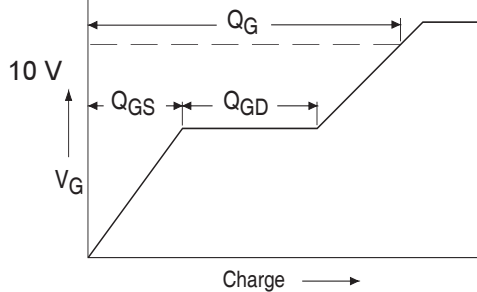


Fig 13a. Basic Gate Charge Waveform

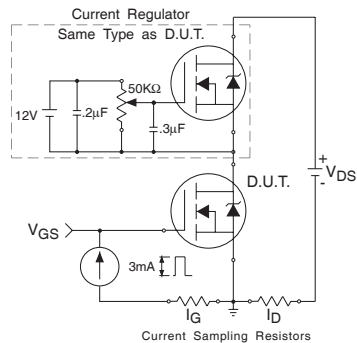


Fig 13b. Gate Charge Test Circuit

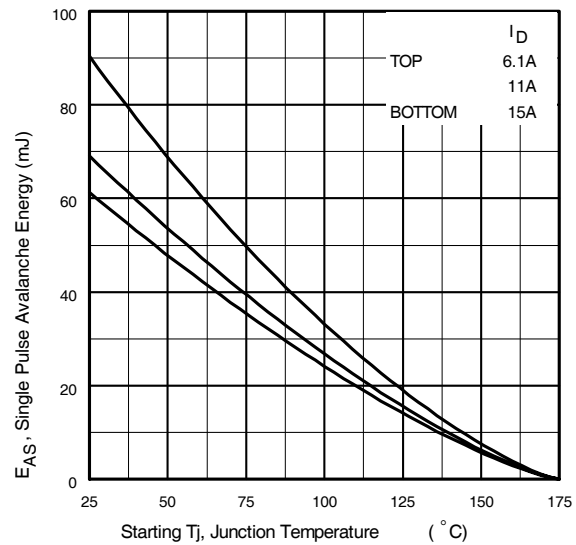


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

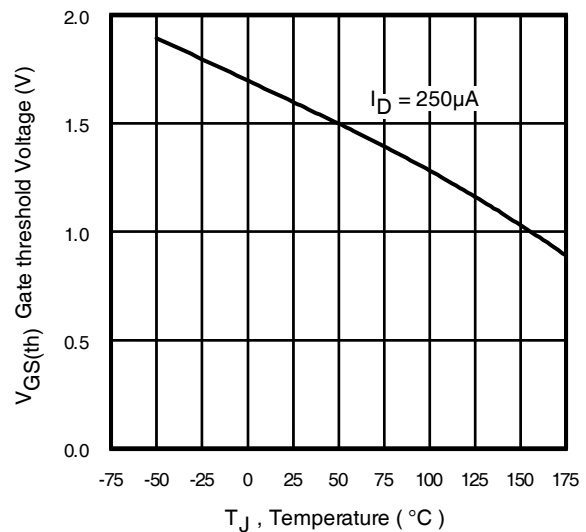


Fig 14. Threshold Voltage Vs. Temperature

www.irf.com

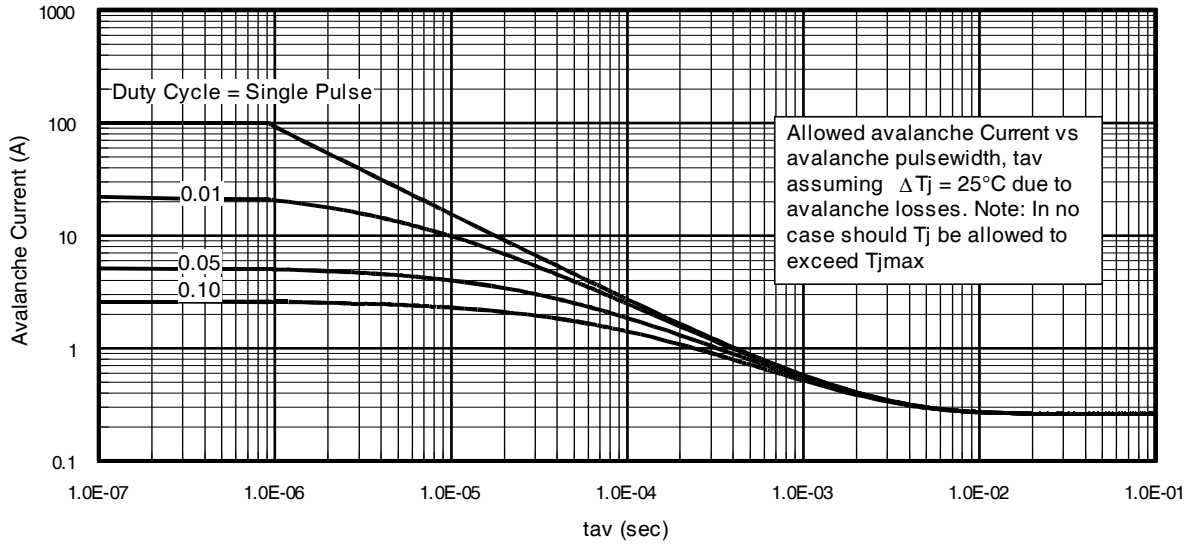


Fig 15. Typical Avalanche Current Vs. Pulsewidth

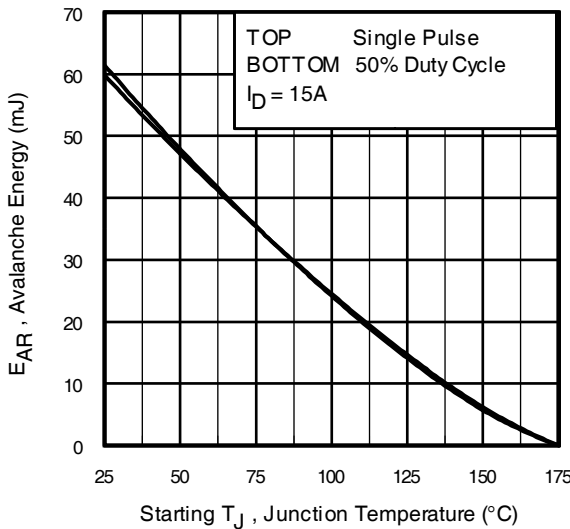


Fig 16. Maximum Avalanche Energy Vs. Temperature

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 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)

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

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

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

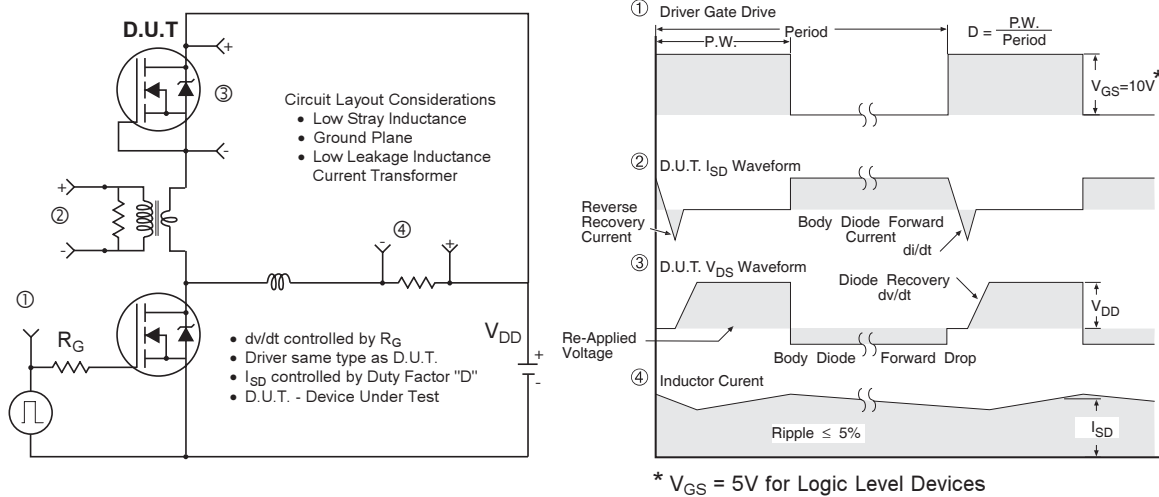


Fig 17. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

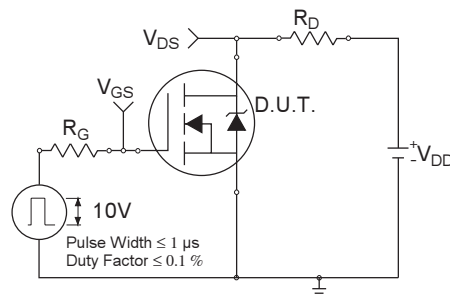


Fig 18a. Switching Time Test Circuit

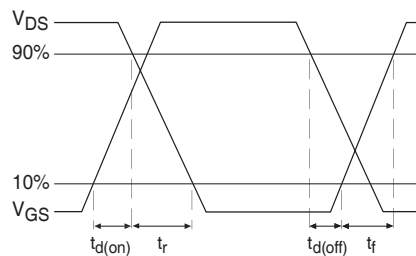
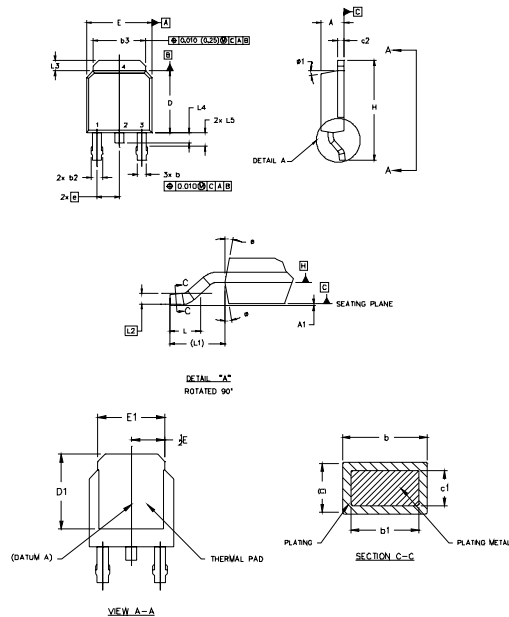


Fig 18b. Switching Time Waveforms

D-Pak (TO-252AA) Package Outline

Dimensions are shown in millimeters (inches)



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 L1 ESTABLISH A MINIMUM MOUNTING SURFACE FOR THERMAL PAD.
- 5.0 SECTION C-C DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN .005 (0.127) AND .010 (0.254) FROM THE LEAD TIP.
- 6.0 DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) 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	2.78	2.29	.098	.094	
A1		0.13		.005	
b	0.64	0.89	.025	.035	5
b1	0.64	0.79	.025	.030	5
b2	0.76	1.14	.030	.045	
b3	4.95	5.46	.195	.215	
c	0.48	0.61	.018	.024	5
c1	0.41	0.56	.016	.022	5
c2	.048	0.89	.018	.035	5
D	6.87	8.22	.270	.325	6
D1	3.21	-	.125	-	4
E	6.35	6.73	.250	.265	6
E1	4.32	-	.170	-	4
F	3.29	-	.090 BSC	-	
H	6.40	10.41	.250	.410	
L	1.40	1.76	.055	.070	
L1	2.74	8.87	.108 MIN	-	
L2	0.05	BSC	.020 BSC	-	
L3	0.88	1.27	.035	.050	
L4	1.14	1.52	.045	.060	
L5	1.14	1.52	.045	.060	
M	0"	10"	0"	10"	
M1	0"	10"	0"	10"	

LEAD ASSIGNMENTS

HEX-FET

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

IGBTs, CoPACK

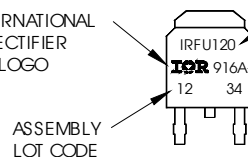
- 1- GATE
- 2- COLLECTOR
- 3- EMITTER
- 4- COLLECTOR

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

EXAMPLE: THIS IS AN IRFR120
WITH ASSEMBLY
LOT CODE 1234
ASSEMBLED ON WW 16, 1999
IN THE ASSEMBLY LINE "A"

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

INTERNATIONAL
RECTIFIER
LOGO



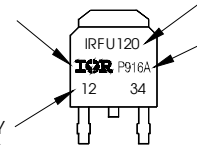
PART NUMBER

DATE CODE
YEAR 9 = 1999
WEEK 16
LINE A

ASSEMBLY
LOT CODE

OR

INTERNATIONAL
RECTIFIER
LOGO



PART NUMBER

DATE CODE
P = DESIGNATES LEAD-FREE
PRODUCT (OPTIONAL)

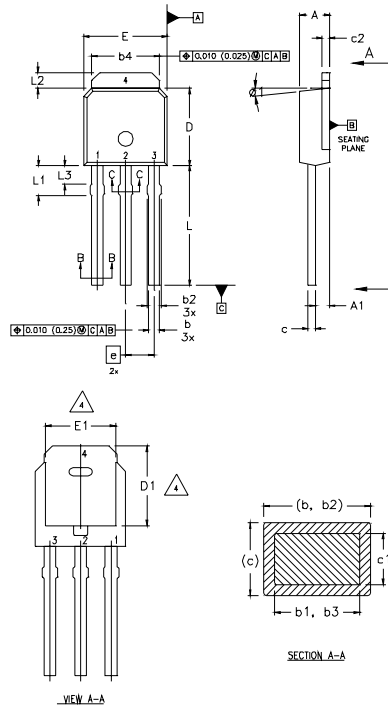
YEAR 9 = 1999
WEEK 16
A = ASSEMBLY SITE CODE

IRLR/U3105PbF

International
IR Rectifier

I-Pak (TO-251AA) Package Outline

Dimensions are shown in millimeters (inches)



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

HEXFET

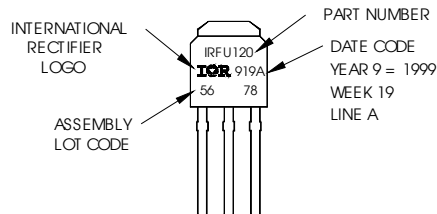
- 1.- GATE
- 2.- DRAIN
- 3.- SOURCE
- 4.- DRAIN

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	2.18	2.39	0.086	0.094	
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	0.46	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'	

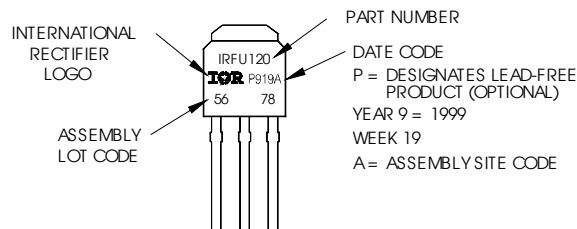
I-Pak (TO-251AA) Part Marking Information

EXAMPLE: THIS IS AN IRFU120
WITH ASSEMBLY
LOT CODE 5678
ASSEMBLED ON WW 19, 1999
IN THE ASSEMBLY LINE "A"

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

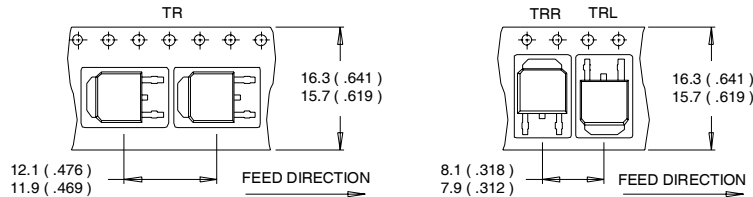


OR

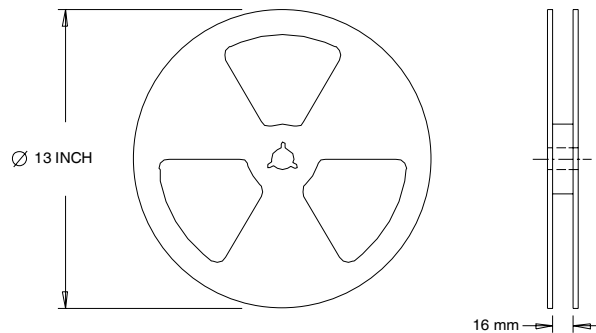


D-Pak (TO-252AA) Tape & Reel Information

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.
- ② Limited by T_{Jmax} , starting $T_J = 25^\circ\text{C}$, $L = 0.55\text{mH}$, $R_G = 25\Omega$, $I_{AS} = 15\text{A}$, $V_{GS} = 10\text{V}$
- ③ $I_{SD} \leq 25\text{A}$, $di/dt \leq 290\text{A}/\mu\text{s}$, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq 175^\circ\text{C}$
- ④ Pulse width $\leq 300\mu\text{s}$; duty cycle $\leq 2\%$.
- ⑤ 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} .
- ⑥ Limited by T_{Jmax} ; 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.

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.