

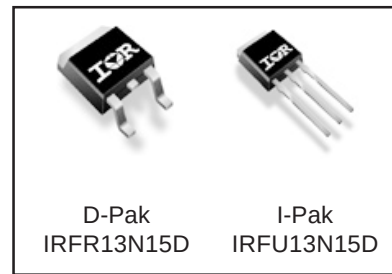
Applications

- High frequency DC-DC converters

V_{DSS}	$R_{DS(on)}$ max	I_D
150V	0.18 Ω	14A

Benefits

- Low Gate-to-Drain Charge to Reduce Switching Losses
- Fully Characterized Capacitance Including Effective C_{OSS} to Simplify Design, (See App. Note AN1001)
- Fully Characterized Avalanche Voltage and Current



Absolute Maximum Ratings

	Parameter	Max.	Units
I_D @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, V_{GS} @ 10V	14	A
I_D @ $T_C = 100^\circ\text{C}$	Continuous Drain Current, V_{GS} @ 10V	9.8	
I_{DM}	Pulsed Drain Current ①	56	
P_D @ $T_C = 25^\circ\text{C}$	Power Dissipation	86	W
	Linear Derating Factor	0.57	W/ $^\circ\text{C}$
V_{GS}	Gate-to-Source Voltage	± 30	V
dv/dt	Peak Diode Recovery dv/dt ③	3.8	V/ns
T_J	Operating Junction and	-55 to + 175	$^\circ\text{C}$
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	

Typical SMPS Topologies

- Telecom 48V input Active Clamp Forward Converter

Notes ① through ⑤ are on page 10

www.irf.com

IRFR13N15D/IRFU13N15D

International
IR Rectifier

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	150	—	—	V	$V_{GS} = 0V$, $I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.17	—	V/°C	Reference to 25°C , $I_D = 1mA$ ⑥
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	—	0.18	Ω	$V_{GS} = 10V$, $I_D = 8.3A$ ④
$V_{GS(th)}$	Gate Threshold Voltage	3.0	—	5.5	V	$V_{DS} = V_{GS}$, $I_D = 250\mu A$
I_{DSS}	Drain-to-Source Leakage Current	—	—	25	μA	$V_{DS} = 150V$, $V_{GS} = 0V$
		—	—	250		$V_{DS} = 120V$, $V_{GS} = 0V$, $T_J = 150^\circ\text{C}$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 30V$
	Gate-to-Source Reverse Leakage	—	—	-100		$V_{GS} = -30V$

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
g_{fs}	Forward Transconductance	5.0	—	—	S	$V_{DS} = 50V$, $I_D = 8.3A$
Q_g	Total Gate Charge	—	19	29	nC	$I_D = 8.3A$
Q_{gs}	Gate-to-Source Charge	—	5.5	8.2		$V_{DS} = 120V$
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	9.4	14		$V_{GS} = 10V$, ④
$t_{d(on)}$	Turn-On Delay Time	—	8.0	—	ns	$V_{DD} = 75V$
t_r	Rise Time	—	26	—		$I_D = 8.3A$
$t_{d(off)}$	Turn-Off Delay Time	—	12	—		$R_G = 11\Omega$
t_f	Fall Time	—	11	—		$V_{GS} = 10V$ ④
C_{iss}	Input Capacitance	—	620	—	pF	$V_{GS} = 0V$
C_{oss}	Output Capacitance	—	130	—		$V_{DS} = 25V$
C_{rss}	Reverse Transfer Capacitance	—	38	—		$f = 1.0MHz$
C_{oss}	Output Capacitance	—	780	—		$V_{GS} = 0V$, $V_{DS} = 1.0V$, $f = 1.0MHz$
C_{oss}	Output Capacitance	—	62	—		$V_{GS} = 0V$, $V_{DS} = 120V$, $f = 1.0MHz$
$C_{oss \text{ eff.}}$	Effective Output Capacitance	—	110	—		$V_{GS} = 0V$, $V_{DS} = 0V$ to $120V$ ⑤

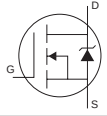
Avalanche Characteristics

	Parameter	Typ.	Max.	Units
E_{AS}	Single Pulse Avalanche Energy②	—	130	mJ
I_{AR}	Avalanche Current①	—	8.3	A
E_{AR}	Repetitive Avalanche Energy①	—	8.6	mJ

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	1.75	°C/W
$R_{\theta JA}$	Junction-to-Ambient (PCB mount)*	—	50	
$R_{\theta JA}$	Junction-to-Ambient	—	110	

Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	14	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	56		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}$, $I_S = 8.3A$, $V_{GS} = 0V$ ④
t_{rr}	Reverse Recovery Time	—	110	—	ns	$T_J = 25^\circ\text{C}$, $I_F = 8.3A$
Q_{rr}	Reverse Recovery Charge	—	520	—	nC	$di/dt = 100A/\mu s$ ④
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S + L_D$)				

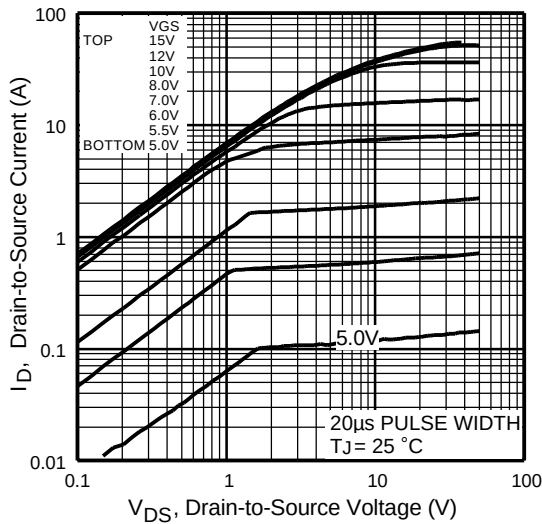


Fig 1. Typical Output Characteristics

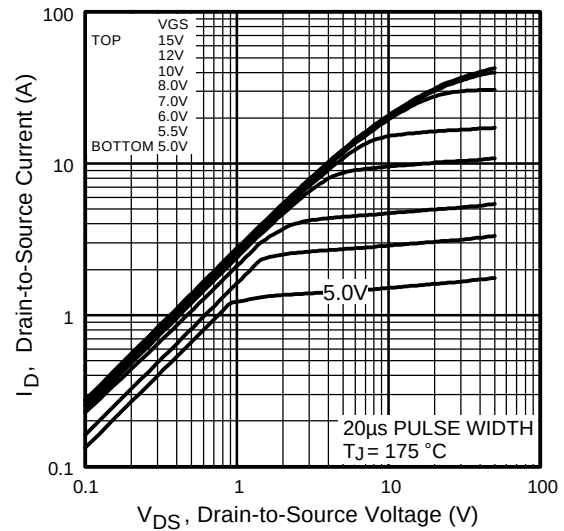


Fig 2. Typical Output Characteristics

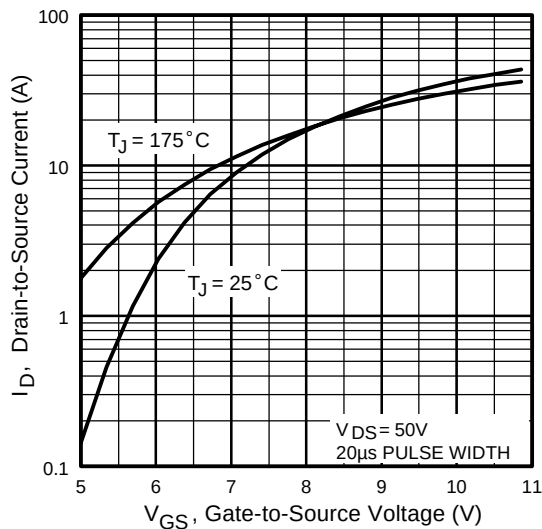


Fig 3. Typical Transfer Characteristics

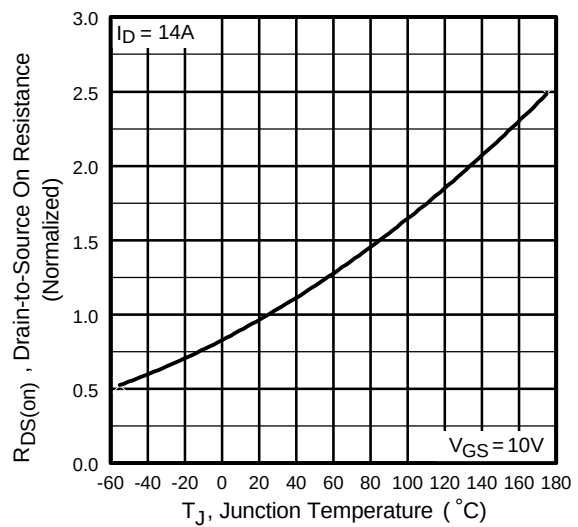


Fig 4. Normalized On-Resistance Vs. Temperature

IRFR13N15D/IRFU13N15D

International
IR Rectifier

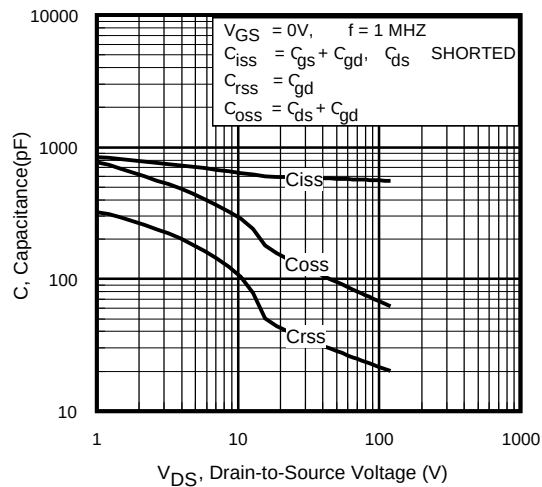


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

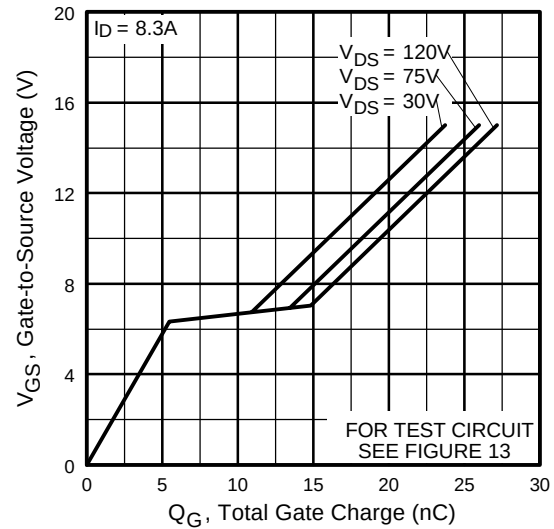


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

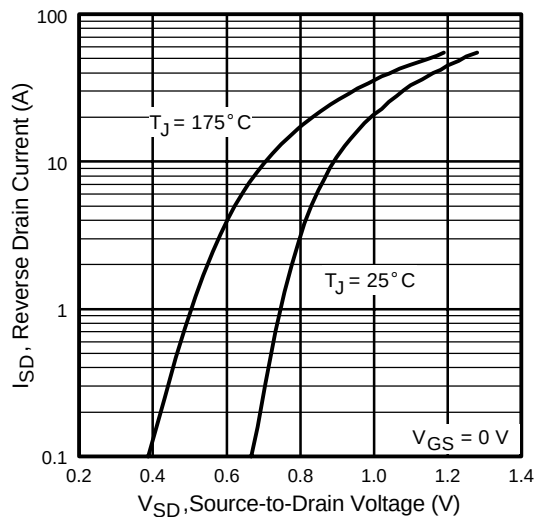


Fig 7. Typical Source-Drain Diode Forward Voltage

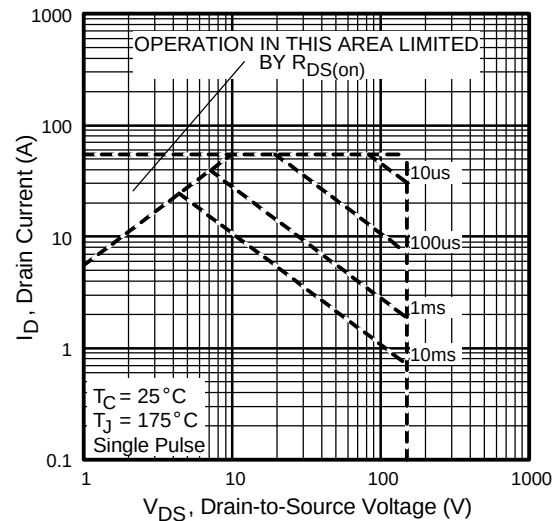


Fig 8. Maximum Safe Operating Area

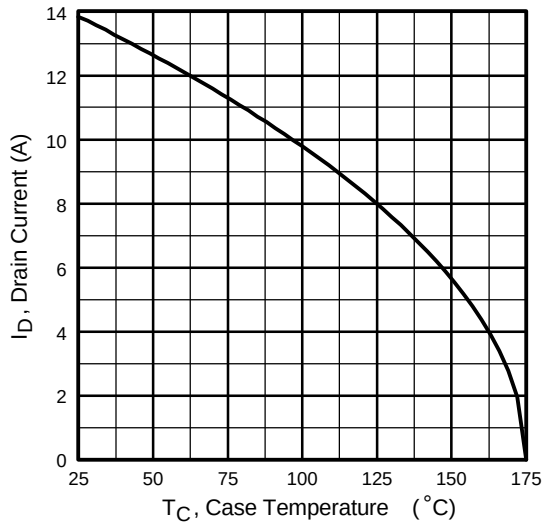


Fig 9. Maximum Drain Current Vs. Case Temperature

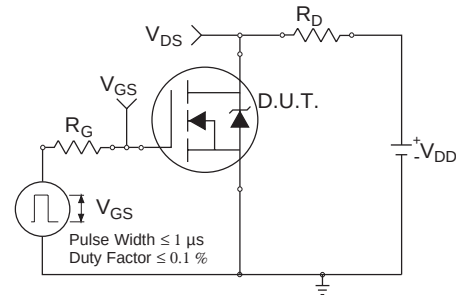


Fig 10a. Switching Time Test Circuit

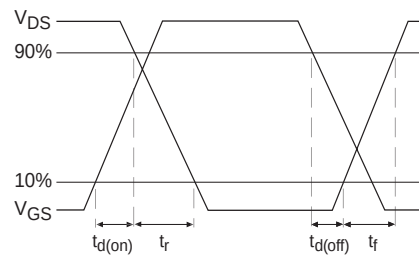


Fig 10b. Switching Time Waveforms

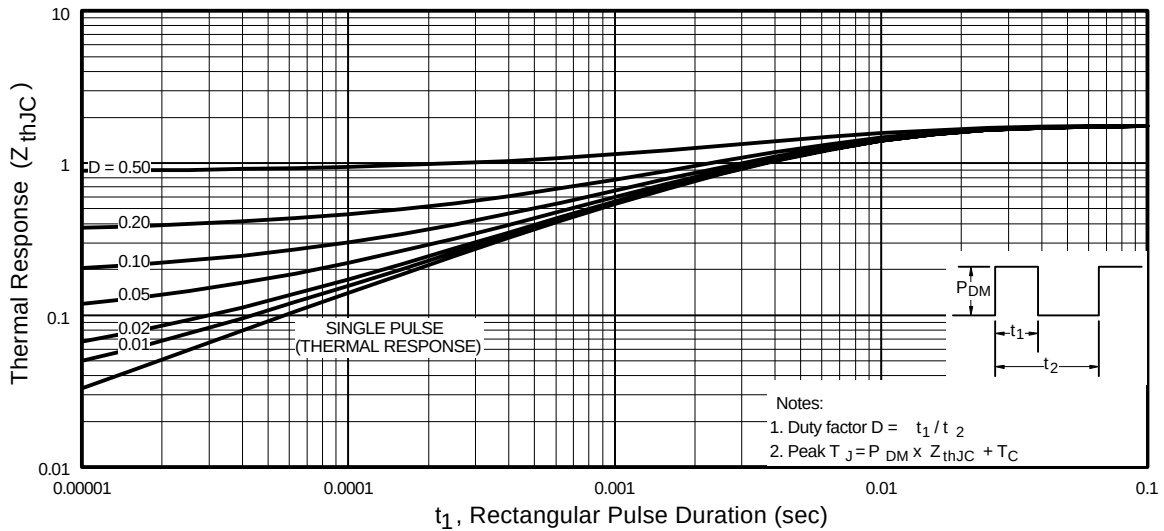


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

IRFR13N15D/IRFU13N15D

International
IR Rectifier

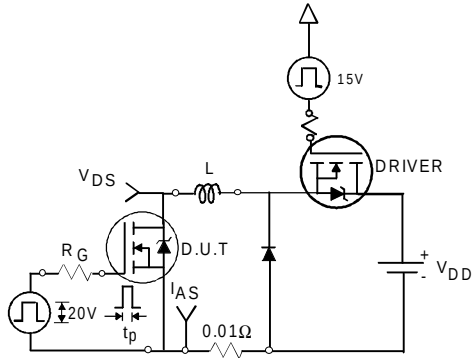


Fig 12a. Unclamped Inductive Test Circuit

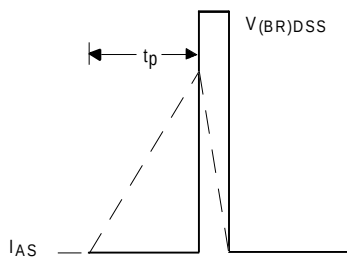


Fig 12b. Unclamped Inductive Waveforms

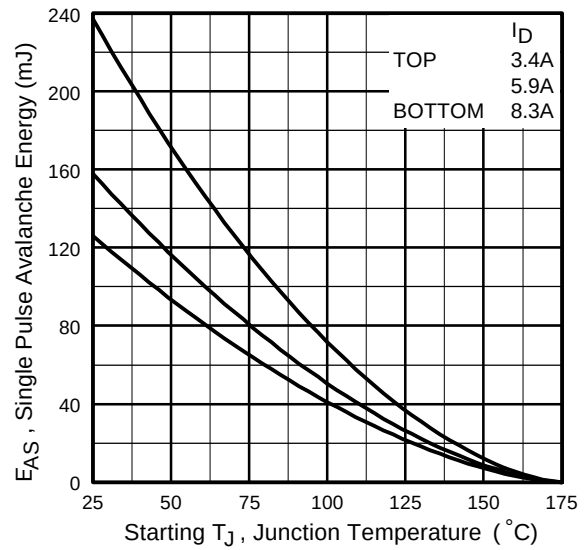


Fig 12c. Maximum Avalanche Energy
Vs. Drain Current

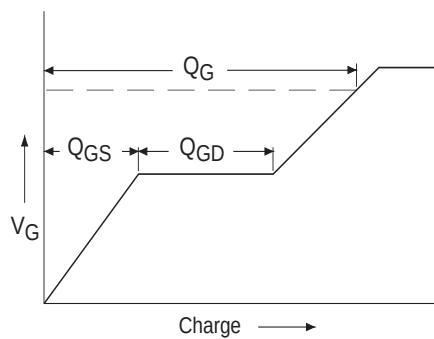


Fig 13a. Basic Gate Charge Waveform

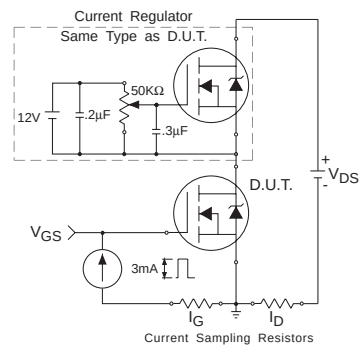
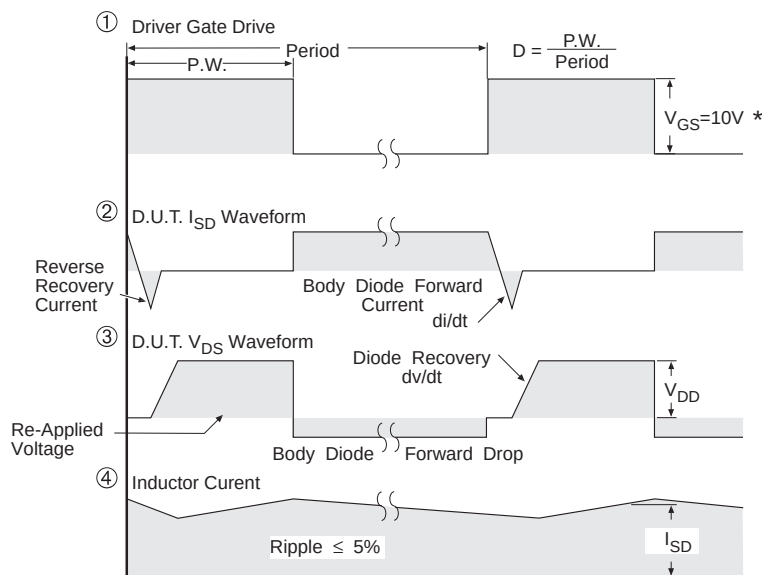
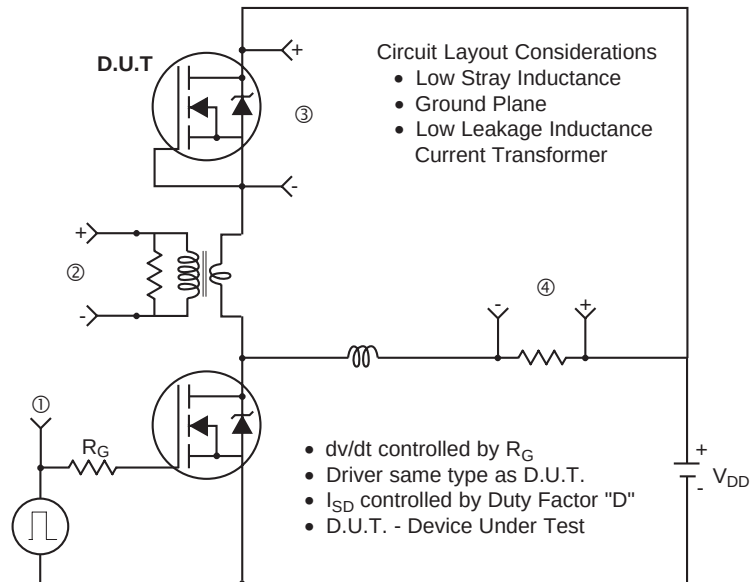


Fig 13b. Gate Charge Test Circuit

Peak Diode Recovery dv/dt Test Circuit



* $V_{GS} = 5V$ for Logic Level Devices

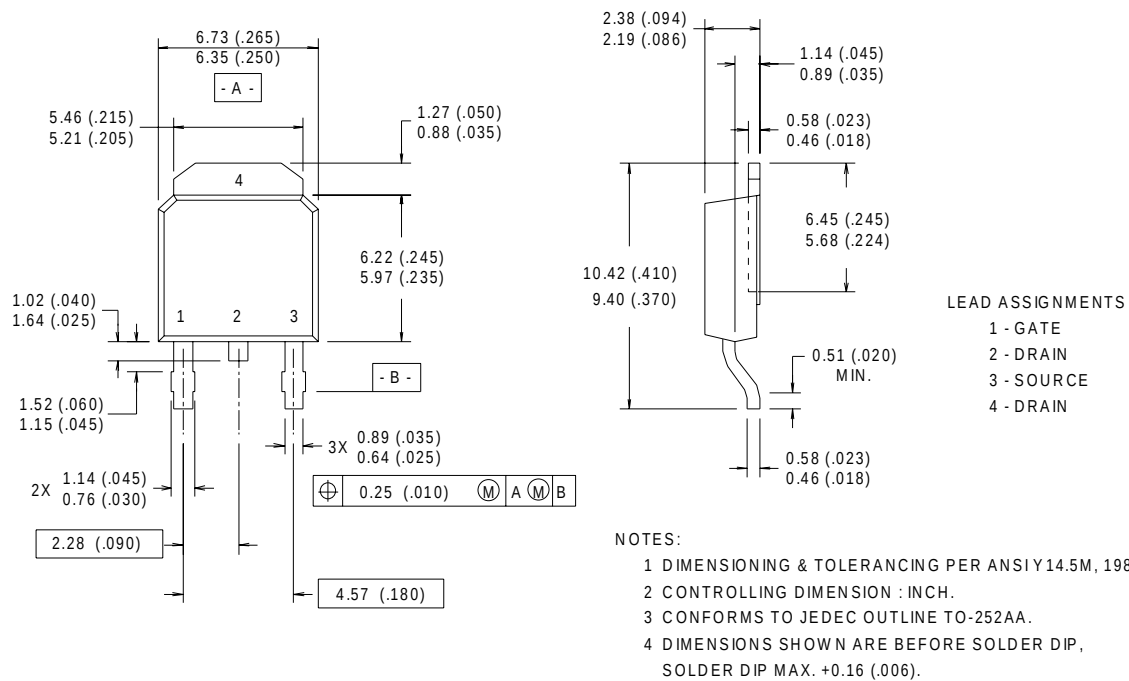
Fig 14. For N-Channel HEXFET® Power MOSFETs

IRFR13N15D/IRFU13N15D

International
IR Rectifier

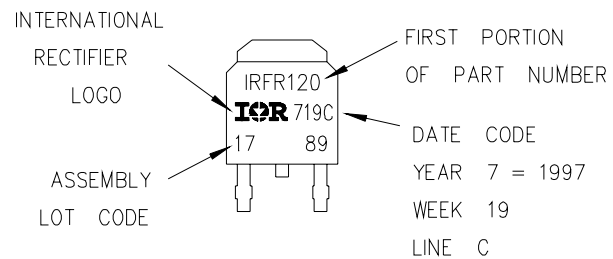
D-Pak (TO-252AA) Package Outline

Dimensions are shown in millimeters (inches)



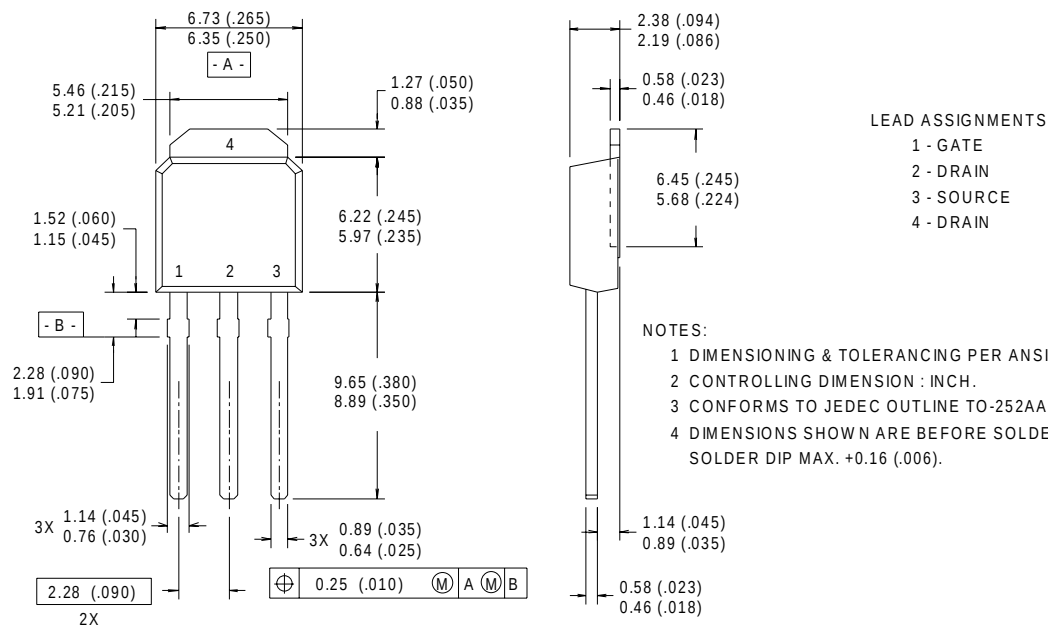
D-Pak (TO-252AA) Part Marking Information

EXAMPLE: THIS IS AN IRFR120
LOT CODE 1789
ASSEMBLED ON WW 19, 1997
IN THE ASSEMBLY LINE "C"



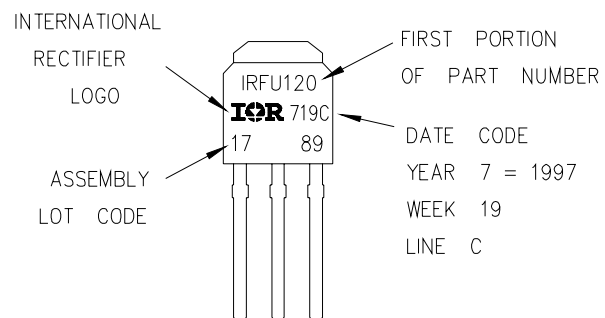
I-Pak (TO-251AA) Package Outline

Dimensions are shown in millimeters (inches)



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

EXAMPLE: THIS IS AN IRFU120
LOT CODE 1789
ASSEMBLED ON WW 19, 1997
IN THE ASSEMBLY LINE "C"

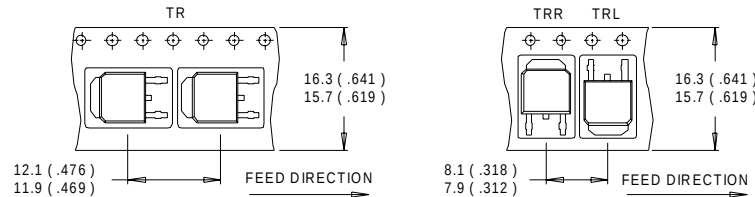


IRFR13N15D/IRFU13N15D

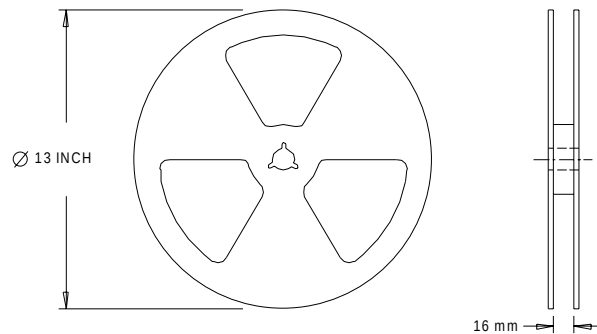
International
IR Rectifier

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 Starting $T_J = 25^\circ\text{C}$, $L = 3.8\text{mH}$
 $R_G = 25\Omega$, $I_{AS} = 8.3\text{A}$.
 - ③ $I_{SD} \leq 8.3\text{A}$, $di/dt \leq 280\text{A}/\mu\text{s}$, $V_{DD} \leq V_{(BR)DSS}$,
 $T_J \leq 175^\circ\text{C}$
 - 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}
- * When mounted on 1" square PCB (FR-4 or G-10 Material).
For recommended footprint and soldering techniques refer to application note #AN-994.

International
IR Rectifier

IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105
IR EUROPEAN REGIONAL CENTRE: 439/445 Godstone Rd, Whyteleafe, Surrey CR3 0BL, UK Tel: ++ 44 (0)20 8645 8000
IR CANADA: 15 Lincoln Court, Brampton, Ontario L6T3Z2, Tel: (905) 453 2200
IR GERMANY: Saalburgstrasse 157, 61350 Bad Homburg Tel: ++ 49 (0) 6172 96590
IR ITALY: Via Liguria 49, 10071 Borgaro, Torino Tel: ++ 39 011 451 0111
IR JAPAN: K&H Bldg., 2F, 30-4 Nishi-Ikebukuro 3-Chome, Toshima-Ku, Tokyo 171 Tel: 81 (0)3 3983 0086
IR SOUTHEAST ASIA: 1 Kim Seng Promenade, Great World City West Tower, 13-11, Singapore 237994 Tel: ++ 65 (0)838 4630
IR TAIWAN: 16 Fl. Suite D. 207, Sec. 2, Tun Haw South Road, Taipei, 10673 Tel: 886-(0)2 2377 9936

Data and specifications subject to change without notice. 6/00