

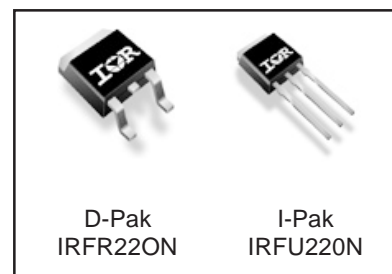
### Applications

- High frequency DC-DC converters

$V_{DSS}$	$R_{DS(on)}$ max (m $\Omega$ )	$I_D$
200V	600	5.0A

### 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	5.0	A
$I_D$ @ $T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS}$ @ 10V	3.5	
$I_{DM}$	Pulsed Drain Current ①	20	
$P_D$ @ $T_C = 25^\circ\text{C}$	Power Dissipation	43	W
	Linear Derating Factor	0.71	W/ $^\circ\text{C}$
$V_{GS}$	Gate-to-Source Voltage	$\pm 20$	V
dv/dt	Peak Diode Recovery dv/dt ③	7.5	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 Forward Converters

Notes ① through ⑤ are on page 10

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# IRFR/U220N

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	200	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.23	—	V/°C	Reference to $25^\circ\text{C}$ , $I_D = 1\text{mA}$ ④
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	—	600	mΩ	$V_{GS} = 10V, I_D = 2.9A$ ④
$V_{GS(th)}$	Gate Threshold Voltage	2.0	—	4.0	V	$V_{DS} = V_{GS}, I_D = 250\mu A$
$I_{DSS}$	Drain-to-Source Leakage Current	—	—	25	μA	$V_{DS} = 200V, V_{GS} = 0V$
		—	—	250		$V_{DS} = 160V, V_{GS} = 0V, T_J = 150^\circ\text{C}$
$I_{GSS}$	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 20V$
	Gate-to-Source Reverse Leakage	—	—	-100		$V_{GS} = -20V$

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$g_{fs}$	Forward Transconductance	2.6	—	—	S	$V_{DS} = 50V, I_D = 2.9A$
$Q_g$	Total Gate Charge	—	15	23	nC	$I_D = 2.9A$
$Q_{gs}$	Gate-to-Source Charge	—	2.4	3.6		$V_{DS} = 160V$
$Q_{gd}$	Gate-to-Drain ("Miller") Charge	—	6.1	9.2		$V_{GS} = 10V,$
$t_{d(on)}$	Turn-On Delay Time	—	6.4	—	ns	$V_{DD} = 100V$
$t_r$	Rise Time	—	11	—		$I_D = 2.9A$
$t_{d(off)}$	Turn-Off Delay Time	—	20	—		$R_G = 24\Omega$
$t_f$	Fall Time	—	12	—		$V_{GS} = 10V$ ④
$C_{iss}$	Input Capacitance	—	300	—	pF	$V_{GS} = 0V$
$C_{oss}$	Output Capacitance	—	53	—		$V_{DS} = 25V$
$C_{rss}$	Reverse Transfer Capacitance	—	15	—		$f = 1.0\text{MHz}$
$C_{oss}$	Output Capacitance	—	300	—		$V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0\text{MHz}$
$C_{oss}$	Output Capacitance	—	23	—		$V_{GS} = 0V, V_{DS} = 160V, f = 1.0\text{MHz}$
$C_{oss \text{ eff.}}$	Effective Output Capacitance	—	46	—		$V_{GS} = 0V, V_{DS} = 0V \text{ to } 160V$ ⑤

## Avalanche Characteristics

	Parameter	Typ.	Max.	Units
$E_{AS}$	Single Pulse Avalanche Energy②	—	46	mJ
$I_{AR}$	Avalanche Current①	—	2.9	A
$E_{AR}$	Repetitive Avalanche Energy①	—	4.3	mJ

## Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	3.5	°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)	—	—	5.0	A	MOSFET symbol showing the integral reverse p-n junction diode.
$I_{SM}$	Pulsed Source Current (Body Diode) ①	—	—	20		
$V_{SD}$	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}, I_S = 2.9A, V_{GS} = 0V$ ④
$t_{rr}$	Reverse Recovery Time	—	90	140	ns	$T_J = 25^\circ\text{C}, I_F = 2.9A$
$Q_{rr}$	Reverse Recovery Charge	—	320	480	nC	$di/dt = 100A/\mu s$ ④
$t_{on}$	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S + L_D$ )				

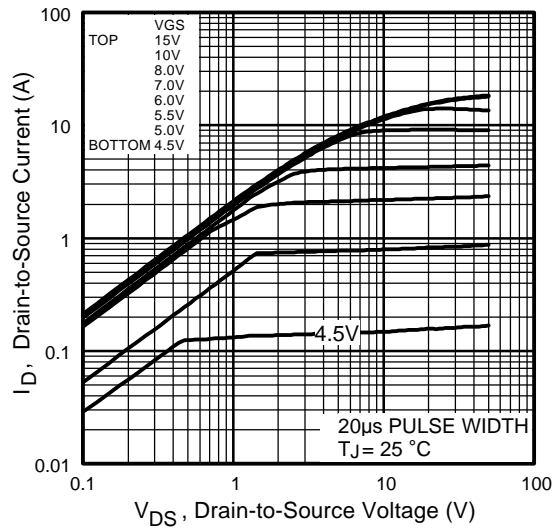


Fig 1. Typical Output Characteristics

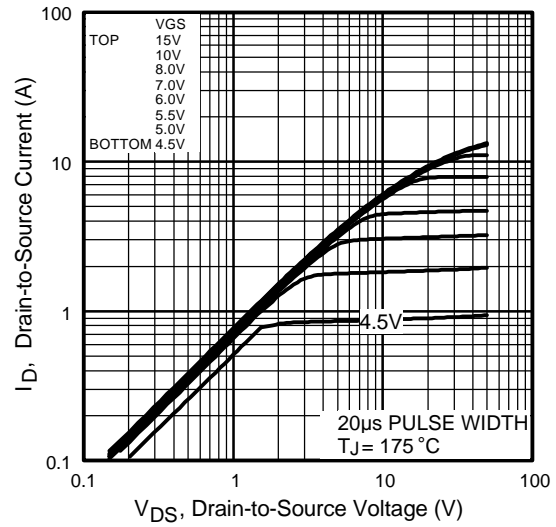


Fig 2. Typical Output Characteristics

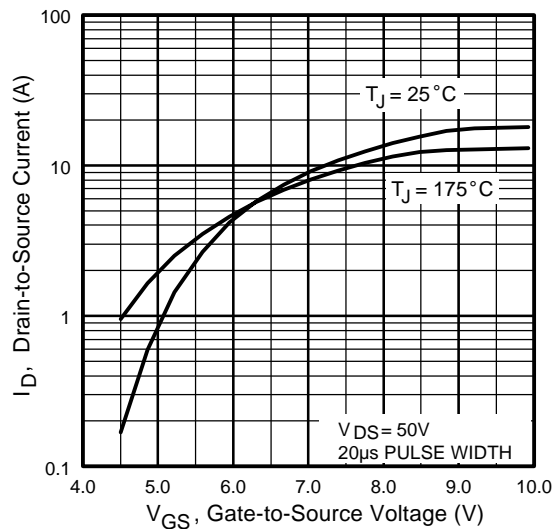


Fig 3. Typical Transfer Characteristics

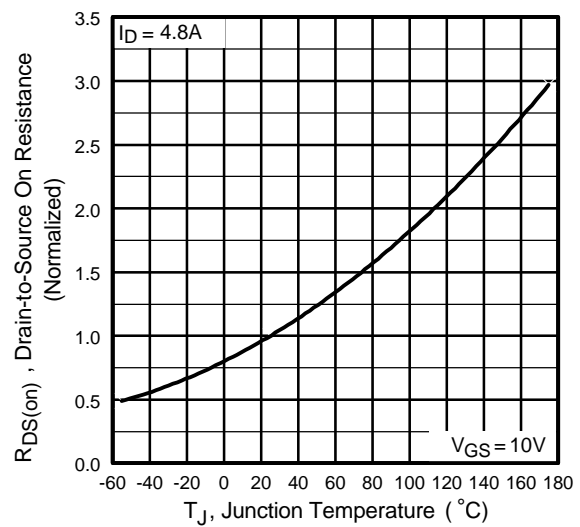
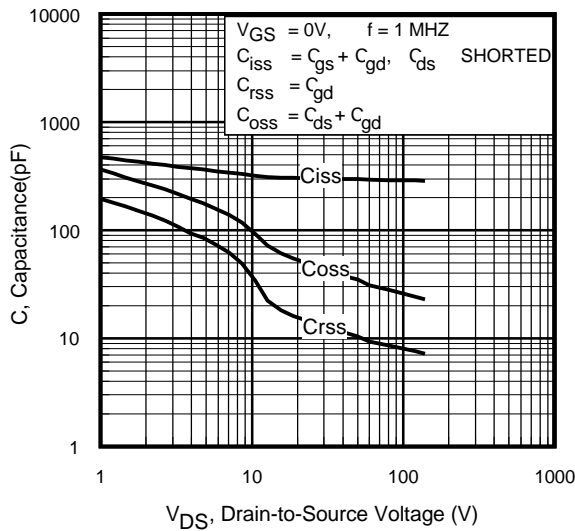
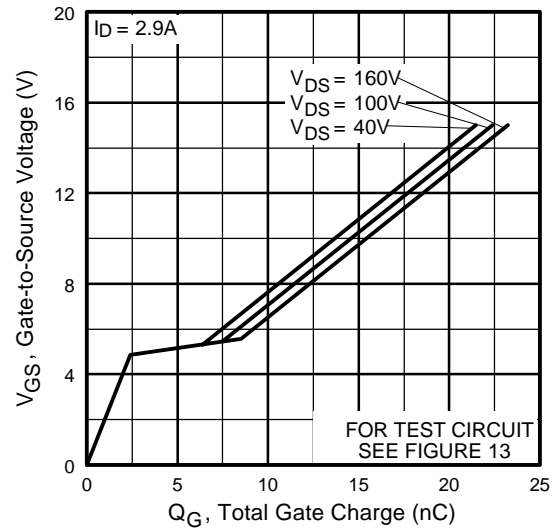


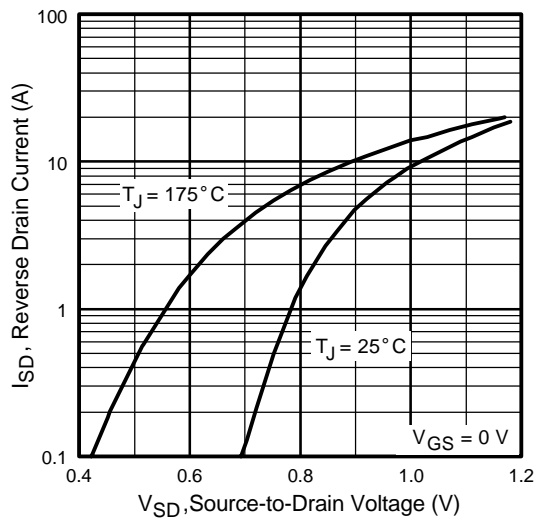
Fig 4. Normalized On-Resistance Vs. Temperature



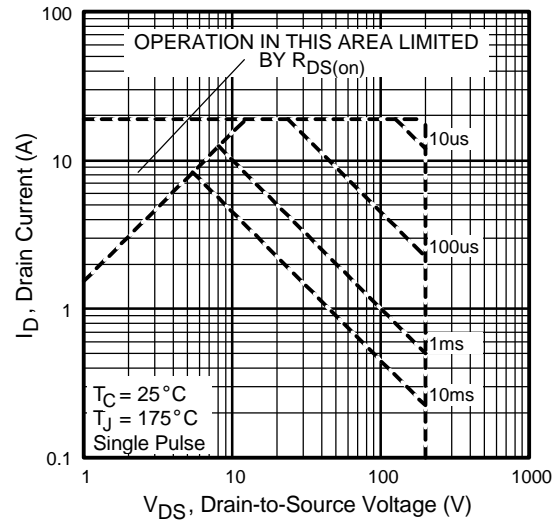
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



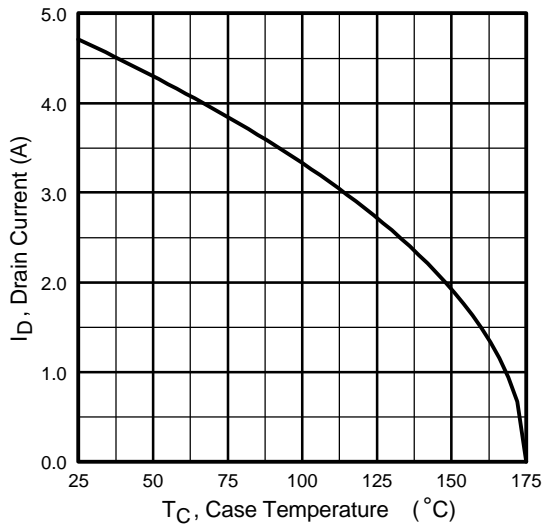
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



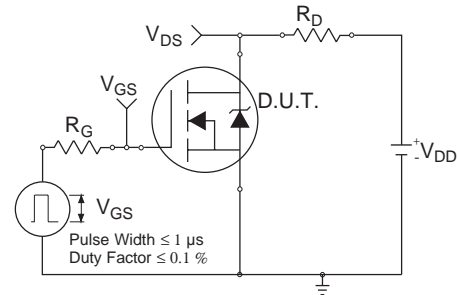
**Fig 7.** Typical Source-Drain Diode Forward Voltage



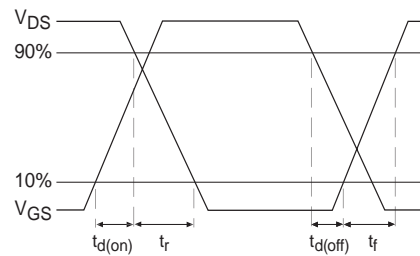
**Fig 8.** Maximum Safe Operating Area



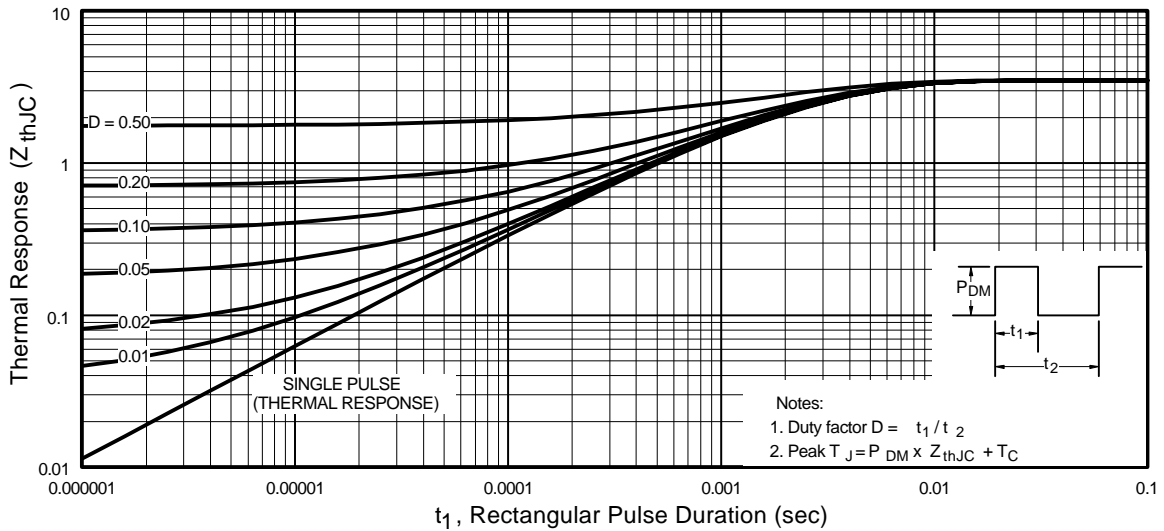
**Fig 9.** Maximum Drain Current Vs. Case Temperature



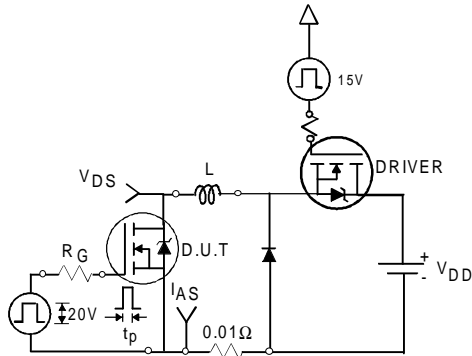
**Fig 10a.** Switching Time Test Circuit



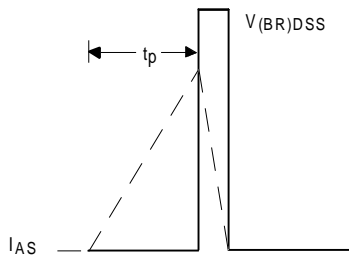
**Fig 10b.** Switching Time Waveforms



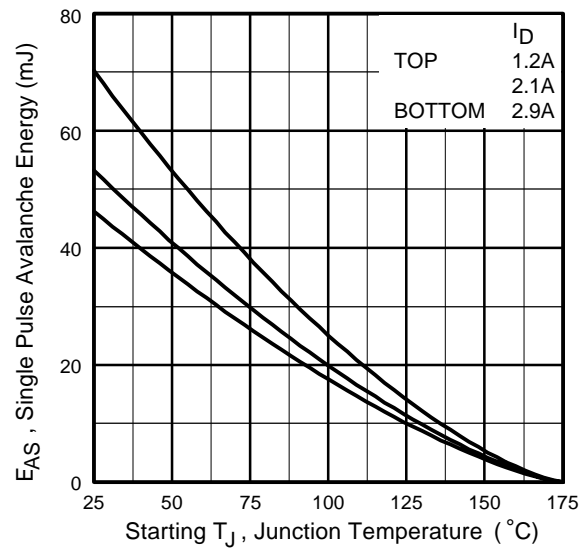
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case



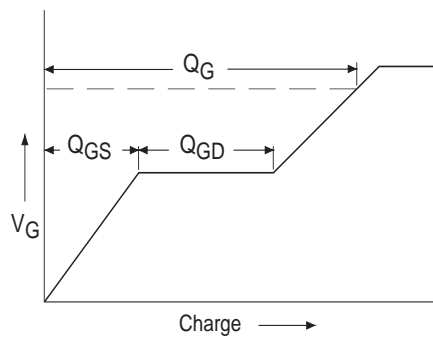
**Fig 12a.** Unclamped Inductive Test Circuit



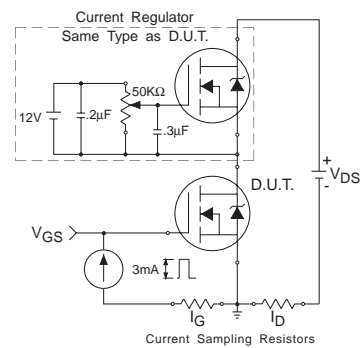
**Fig 12b.** Unclamped Inductive Waveforms



**Fig 12c.** Maximum Avalanche Energy Vs. Drain Current

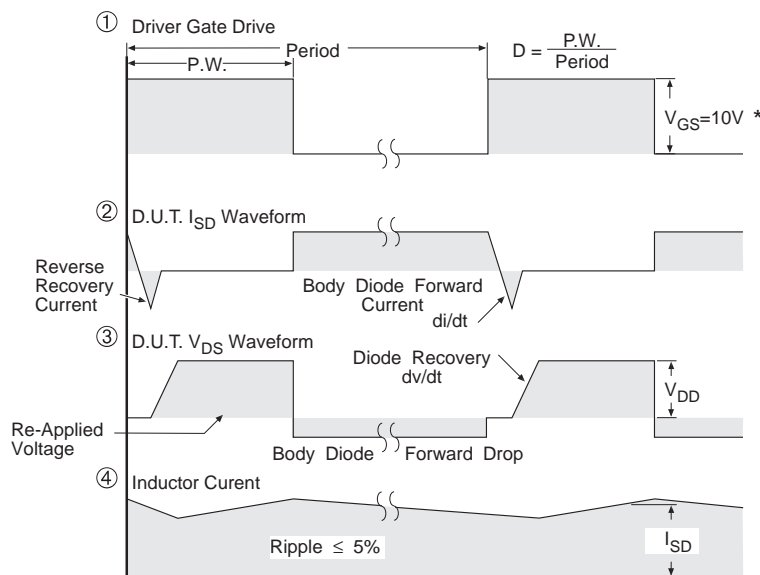
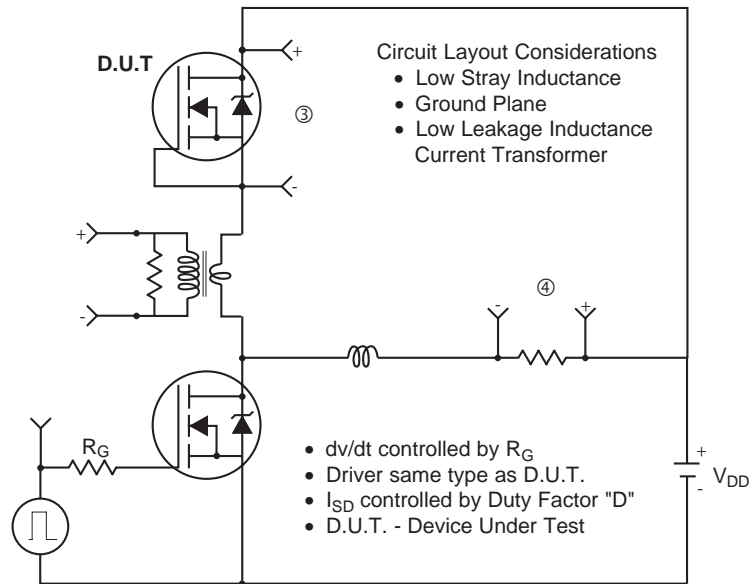


**Fig 13a.** Basic Gate Charge Waveform



**Fig 13b.** Gate Charge Test Circuit

### Peak Diode Recovery $dv/dt$ Test Circuit

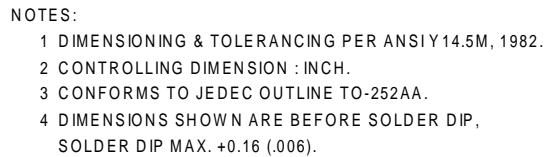


\*  $V_{GS} = 5V$  for Logic Level Devices

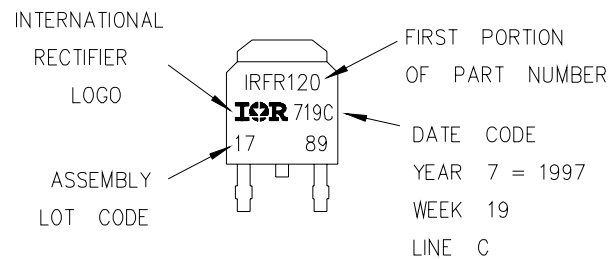
**Fig 14.** For N-Channel HEXFET® Power MOSFETs

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Dimensions are shown in millimeters (inches)



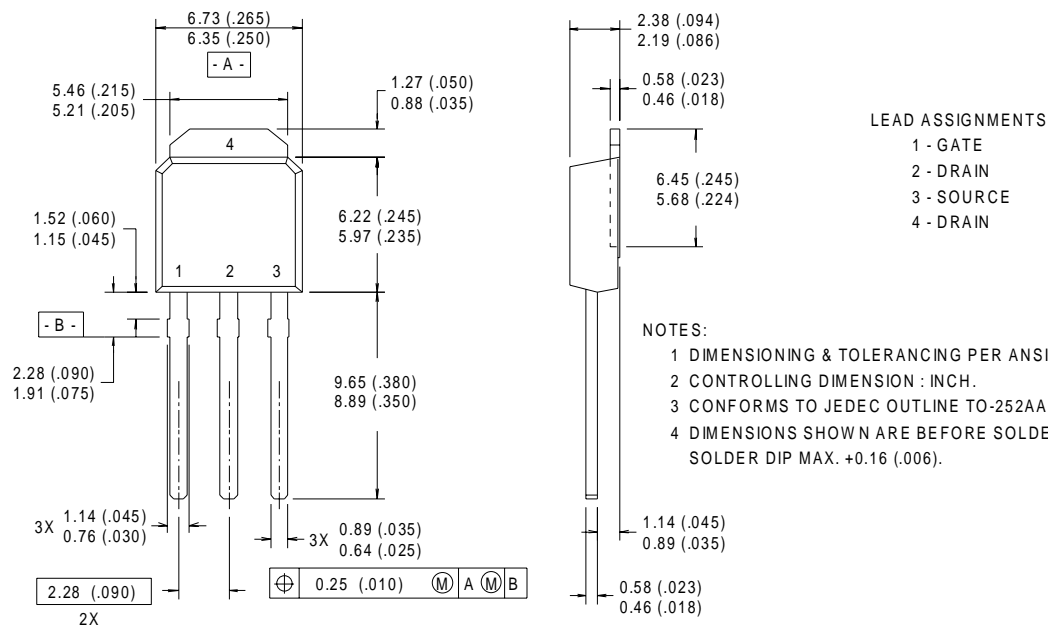
EXAMPLE: THIS IS AN IRFR120  
LOT CODE 1789  
ASSEMBLED ON WW 19, 1997  
IN THE ASSEMBLY LINE "C"





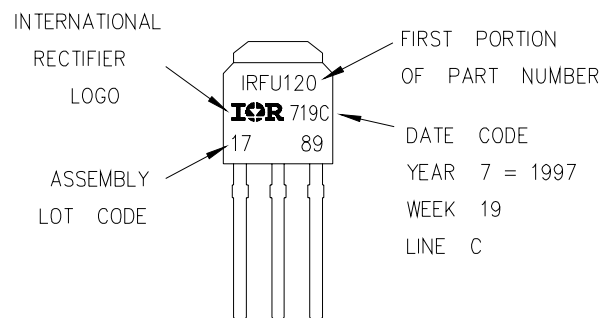
## I-Pak (TO-251AA) Package Outline

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"

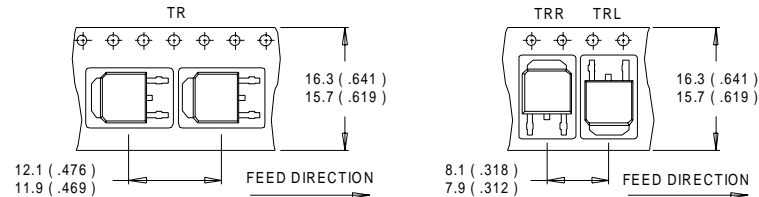


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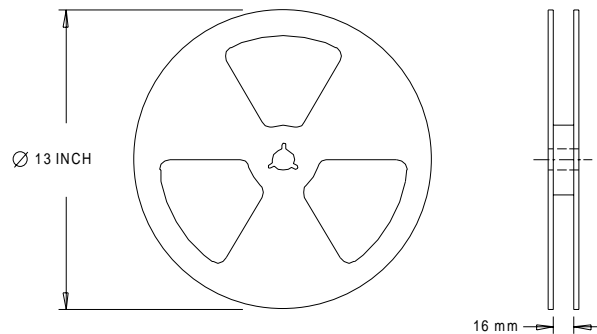
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## D-Pak (TO-252AA) Tape & Reel Information

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  $T_J = 25^\circ\text{C}$ ,  $L = 11\text{mH}$ ,  $R_G = 25\Omega$ ,  $I_{AS} = 2.9\text{A}$ .
  - ③  $I_{SD} \leq 2.9\text{A}$ ,  $di/dt \leq 320\text{A}/\mu\text{s}$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  $T_J \leq 175^\circ\text{C}$ .
  - ④ Pulse width  $\leq 400\mu\text{s}$ ; 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.

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**IR** Rectifier

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