

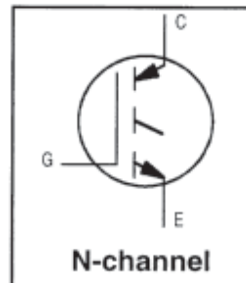
# IRG4RC20FPbF

INSULATED GATE BIPOLAR TRANSISTOR

Fast Speed IGBT

### Features

- Fast: Optimized for medium operating frequencies (1-5 kHz in hard switching, >20 kHz in resonant mode).
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency than previous generation IGBTs.
- Industry standard TO-252AA package
- Combines very low  $V_{CE(on)}$  with low switching losses
- Lead-Free



$V_{CES} = 600V$
$V_{CE(on)} \text{ typ.} = 1.82V$
@ $V_{GE} = 15V, I_C = 12A$

### Benefits

- Generation 4 IGBTs offer highest efficiency
- Optimized for specific application conditions
- High power density and current rating



### Absolute Maximum Ratings

	Parameter	Max.	Units
$V_{CES}$	Collector-to-Emitter Breakdown Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	22	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	12	
$I_{CM}$	Pulsed Collector Current ①	44	
$I_{LM}$	Clamped Inductive Load Current ②	44	
$V_{GE}$	Gate-to-Emitter Voltage	$\pm 20$	V
$E_{ARV}$	Reverse Voltage Avalanche Energy ③	5.0	mJ
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	66	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	26	
$T_J$ $T_{STG}$	Operating Junction and Storage Temperature Range	-55 to + 150	°C
	Soldering Temperature, for 10 seconds	300 (0.063 in. (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	—	1.9	°C/W
$R_{\theta JA}$	Junction-to-Ambient (PCB mount)*	—	50	
Wt	Weight	0.3 (0.01)	—	g (oz)

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

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

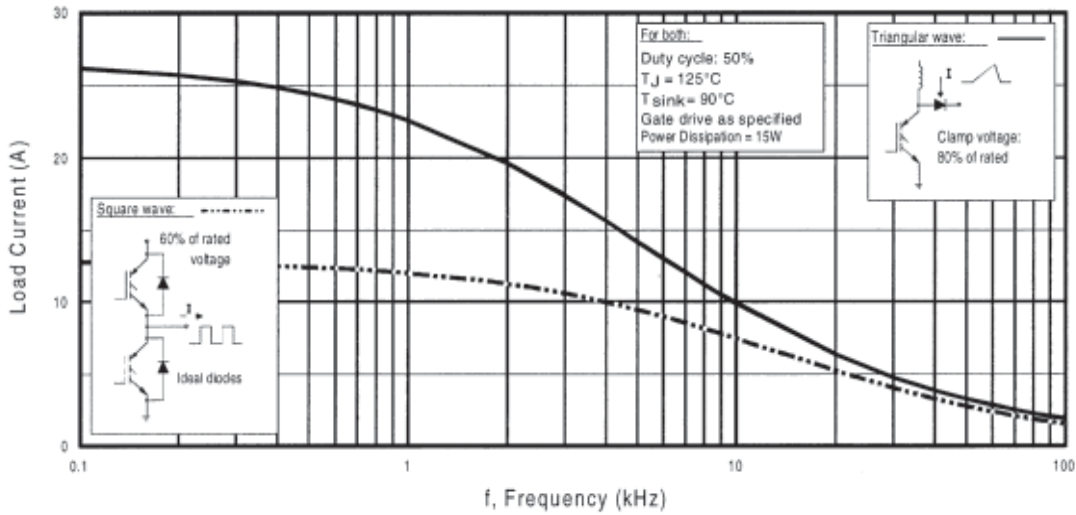
	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	600	—	—	V	$V_{GE} = 0V, I_C = 250\mu A$
$V_{(BR)ECS}$	Emitter-to-Collector Breakdown Voltage ④	18	—	—	V	$V_{GE} = 0V, I_C = 1.0A$
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.72	—	V/°C	$V_{GE} = 0V, I_C = 1.0mA$
$V_{CE(ON)}$	Collector-to-Emitter Saturation Voltage	—	1.82	2.1	V	$I_C = 12A, V_{GE} = 15V$ See Fig.2, 5
		—	2.42	—		
		—	2.04	—		
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	6.0		$V_{CE} = V_{GE}, I_C = 250\mu A$
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	—	-11	—	mV/°C	$V_{CE} = V_{GE}, I_C = 250\mu A$
$g_{fe}$	Forward Transconductance ⑤	5.2	7.75	—	S	$V_{CE} = 100V, I_C = 12A$
$I_{CES}$	Zero Gate Voltage Collector Current	—	—	250	$\mu A$	$V_{GE} = 0V, V_{CE} = 600V$
		—	—	2.0		$V_{GE} = 0V, V_{CE} = 10V, T_J = 25^\circ C$
		—	—	1000		$V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ C$
$I_{CES}$	Gate-to-Emitter Leakage Current	—	—	$\pm 100$	nA	$V_{GE} = \pm 20V$

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

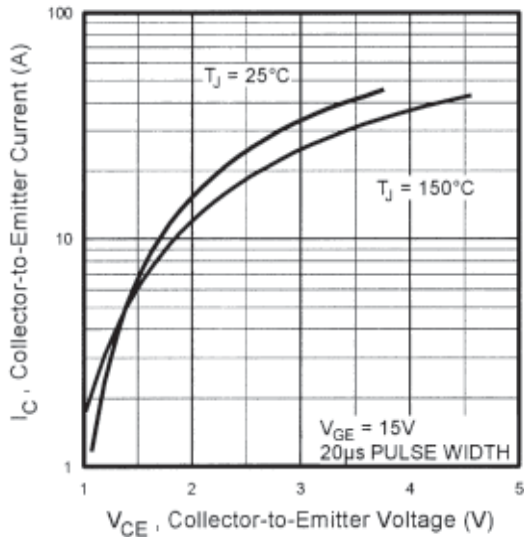
	Parameter	Min.	Typ.	Max.	Units	Conditions
$Q_g$	Total Gate Charge (turn-on)	—	27	40	nC	$I_C = 12A, V_{CC} = 400V, V_{GE} = 15V$ See Fig. 8
$Q_{ge}$	Gate - Emitter Charge (turn-on)	—	4.8	6.8		
$Q_{gc}$	Gate - Collector Charge (turn-on)	—	11.4	17		
$t_{d(on)}$	Turn-On Delay Time	—	26	—	ns	$T_J = 25^\circ C, I_C = 12A, V_{CC} = 480V, V_{GE} = 15V, R_G = 50\Omega$ Energy losses include "tail" See Fig. 9, 10, 14
$t_r$	Rise Time	—	24	—		
$t_{d(off)}$	Turn-Off Delay Time	—	194	290		
$t_f$	Fall Time	—	226	340		
$E_{on}$	Turn-On Switching Loss	—	0.19	—	mJ	See Fig. 9, 10, 14
$E_{off}$	Turn-Off Switching Loss	—	0.92	—		
$E_{ts}$	Total Switching Loss	—	1.11	1.4	ns	$T_J = 150^\circ C, I_C = 12A, V_{CC} = 480V, V_{GE} = 15V, R_G = 50\Omega$ Energy losses include "tail" See Fig. 11, 14
$t_{d(on)}$	Turn-On Delay Time	—	25	—		
$t_r$	Rise Time	—	26	—		
$t_{d(off)}$	Turn-Off Delay Time	—	263	—		
$t_f$	Fall Time	—	443	—		
$E_{ts}$	Total Switching Loss	—	1.89	—	mJ	See Fig. 11, 14
$L_E$	Internal Emitter Inductance	—	7.5	—	nH	Measured 5mm from package
$C_{ies}$	Input Capacitance	—	540	—	pF	$V_{GE} = 0V, V_{CC} = 30V, f = 1.0MHz$ See Fig. 7
$C_{oes}$	Output Capacitance	—	37	—		
$C_{res}$	Reverse Transfer Capacitance	—	7.0	—		

### Notes:

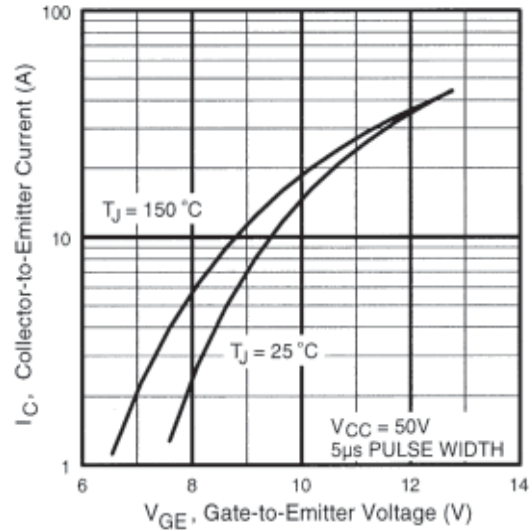
- ① Repetitive rating;  $V_{GE} = 20V$ , pulse width limited by max. junction temperature. ( See fig. 13b )
- ②  $V_{CC} = 80\%(V_{CES}), V_{GE} = 20V, L = 10\mu H, R_G = 50\Omega$ , (See fig. 13a)
- ③ Repetitive rating; pulse width limited by maximum junction temperature.
- ④ Pulse width  $\leq 80\mu s$ ; duty factor  $\leq 0.1\%$ .
- ⑤ Pulse width  $5.0\mu s$ , single shot.



**Fig. 1 - Typical Load Current vs. Frequency**  
 (Load Current =  $I_{\text{RMS}}$  of fundamental)



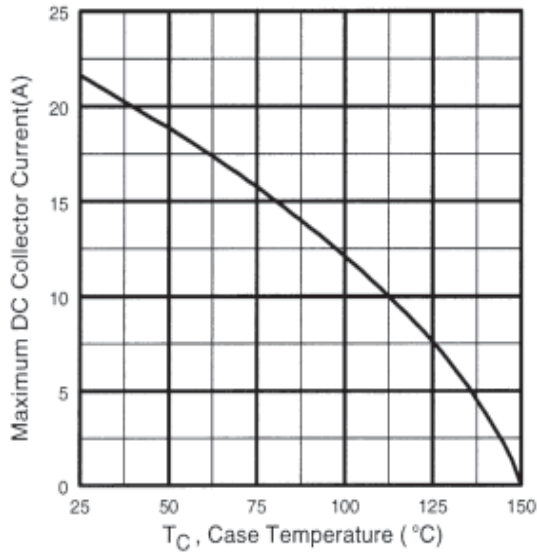
**Fig. 2 - Typical Output Characteristics**



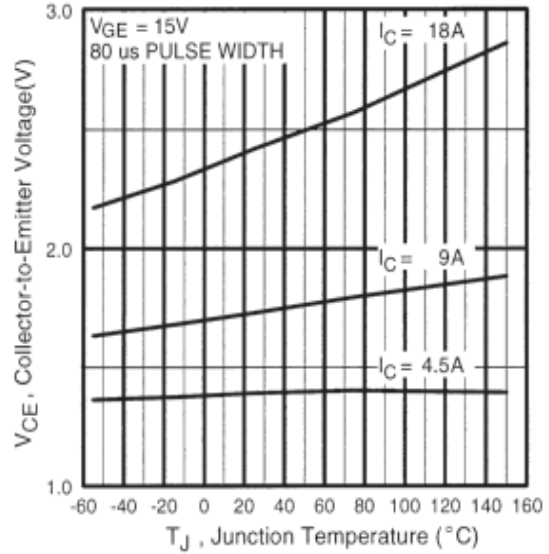
**Fig. 3 - Typical Transfer Characteristics**

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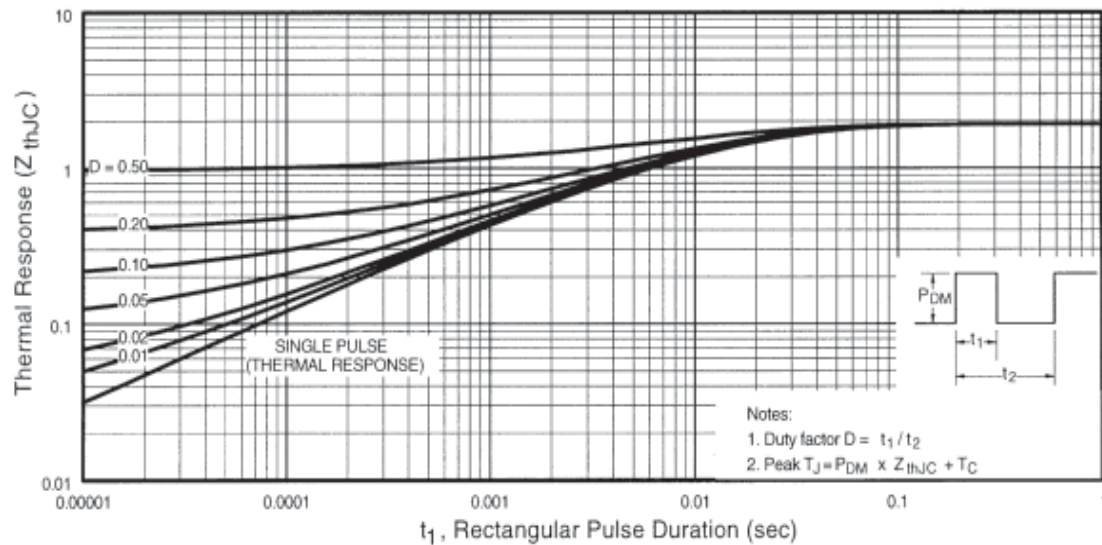
International  
**IR** Rectifier



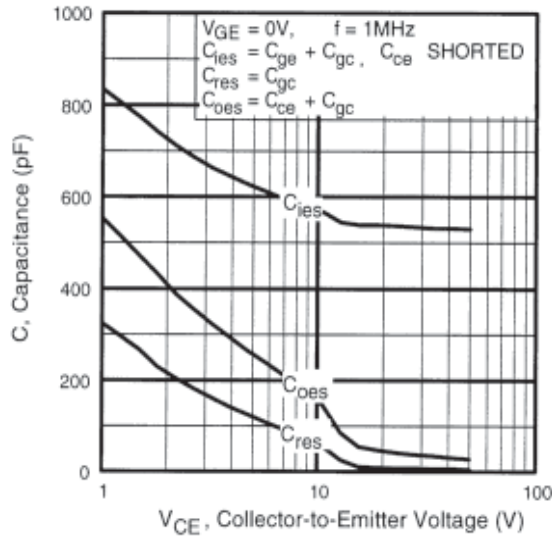
**Fig. 4** - Maximum Collector Current vs. Case Temperature



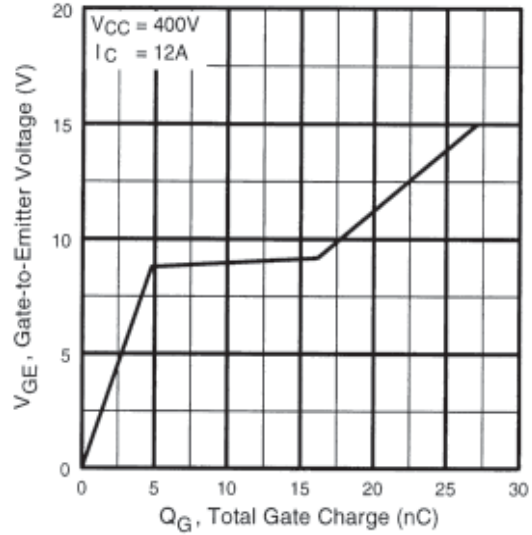
**Fig. 5** - Typical Collector-to-Emitter Voltage vs. Junction Temperature



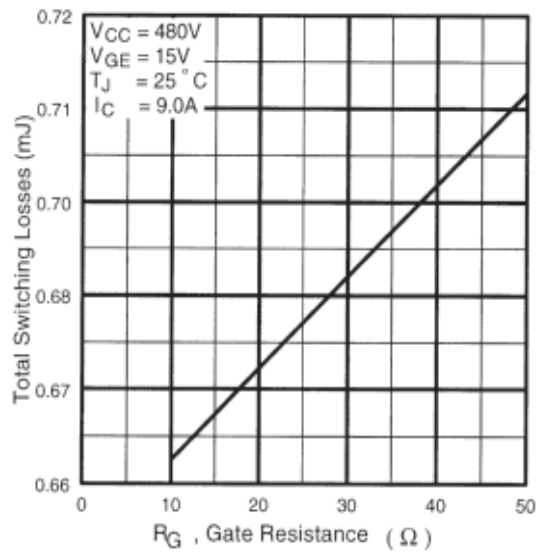
**Fig. 6** - Maximum Effective Transient Thermal Impedance, Junction-to-Case



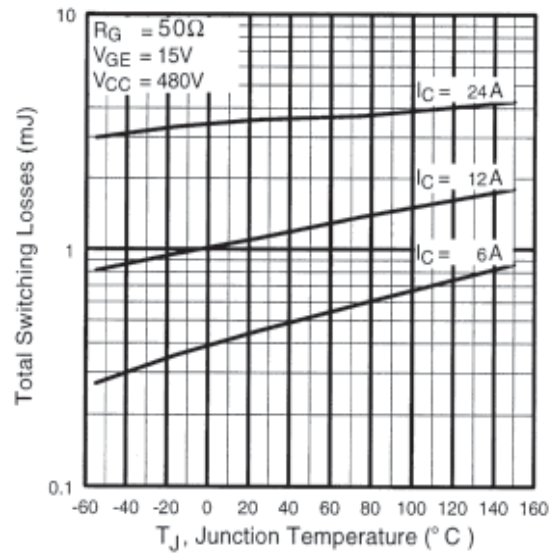
**Fig. 7** - Typical Capacitance vs. Collector-to-Emitter Voltage



**Fig. 8** - Typical Gate Charge vs. Gate-to-Emitter Voltage



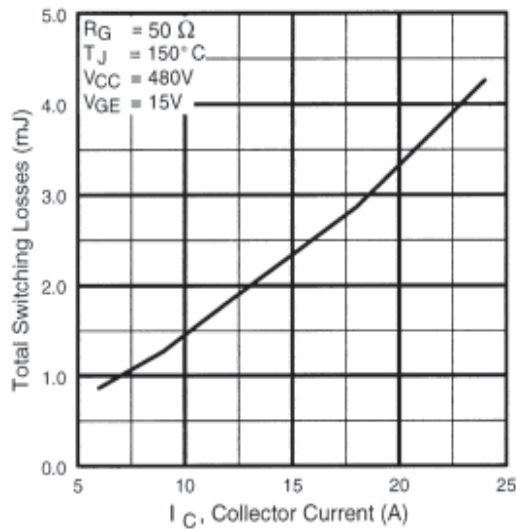
**Fig. 9** - Typical Switching Losses vs. Gate Resistance



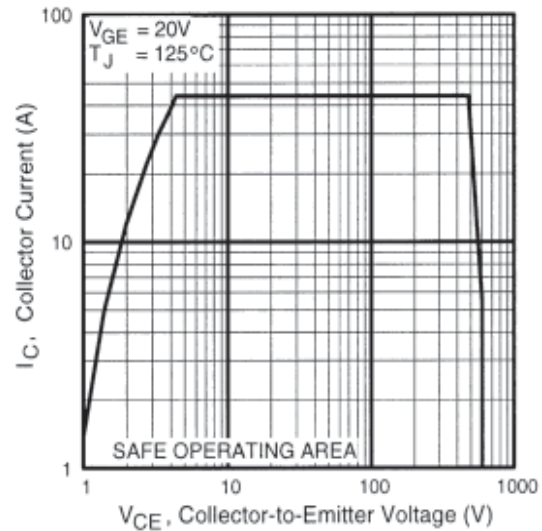
**Fig. 10** - Typical Switching Losses vs. Junction Temperature

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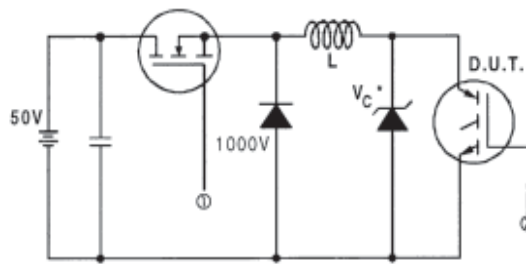
International  
**IRF** Rectifier



**Fig. 11** - Typical Switching Losses vs. Collector-to-Emitter Current

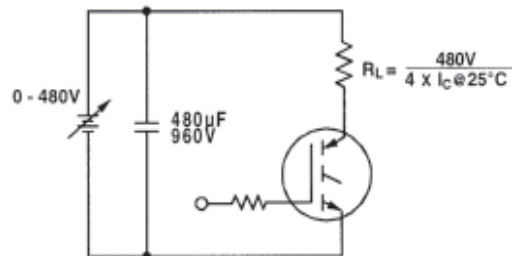


**Fig. 12** - Turn-Off SOA

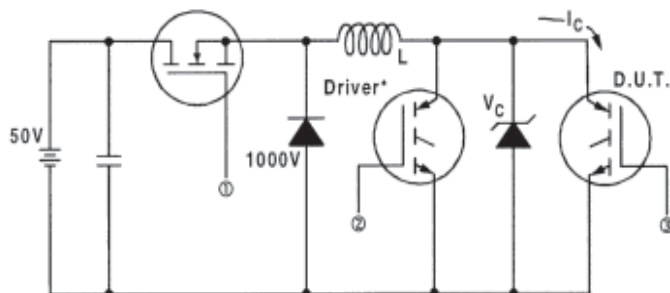


\* Driver same type as D.U.T.;  $V_C = 80\%$  of  $V_{CE}(\text{max})$   
\* Note: Due to the 50V power supply, pulse width and inductor will increase to obtain rated  $I_C$ .

**Fig. 13a** - Clamped Inductive Load Test Circuit

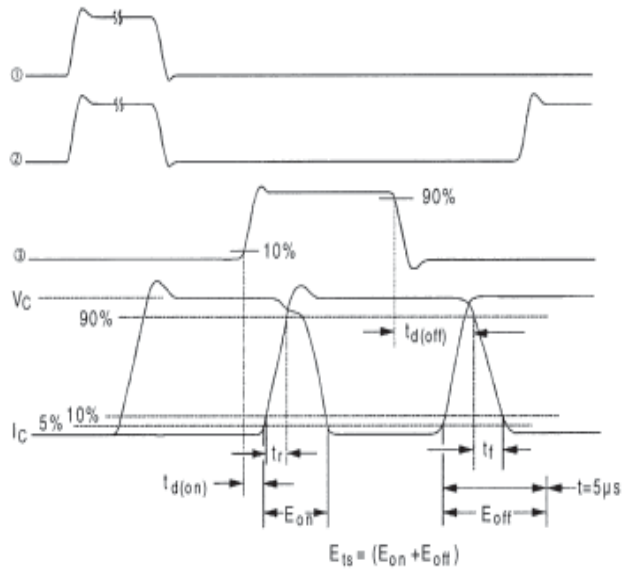


**Fig. 13b** - Pulsed Collector Current Test Circuit



**Fig. 14a** - Switching Loss Test Circuit

\* Driver same type as D.U.T.,  $V_C = 480\text{V}$



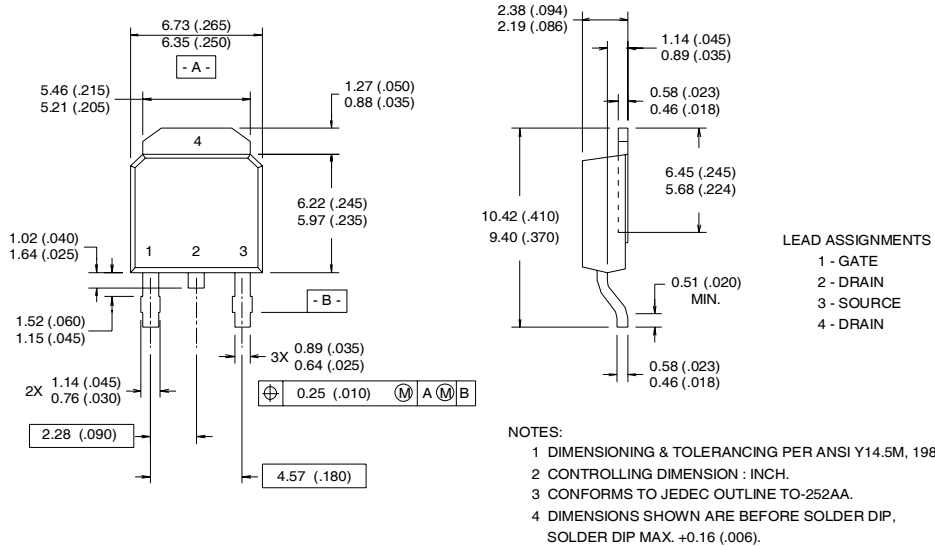
**Fig. 14b** - Switching Loss Waveforms

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**IR** Rectifier

## D-Pak (TO-252AA) Package Outline

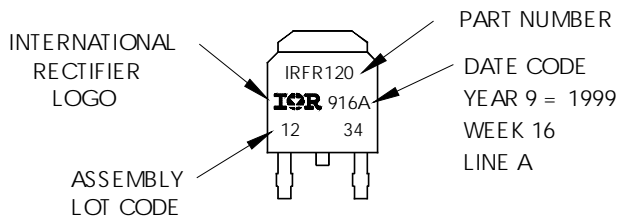
Dimensions are shown in millimeters (inches)



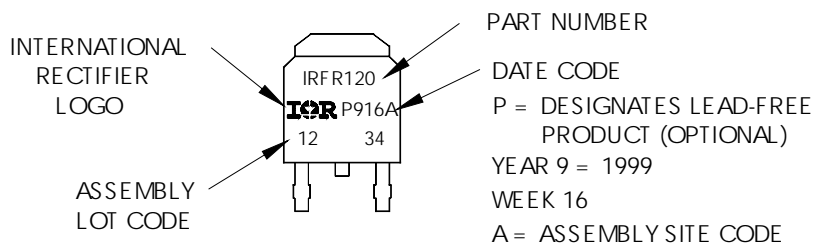
## D-Pak (TO-252AA) Part Marking Information

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

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



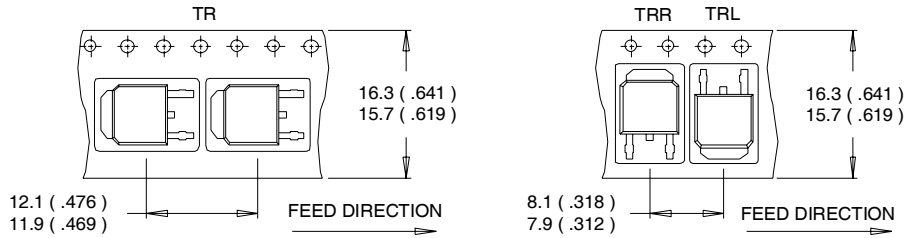
**OR**





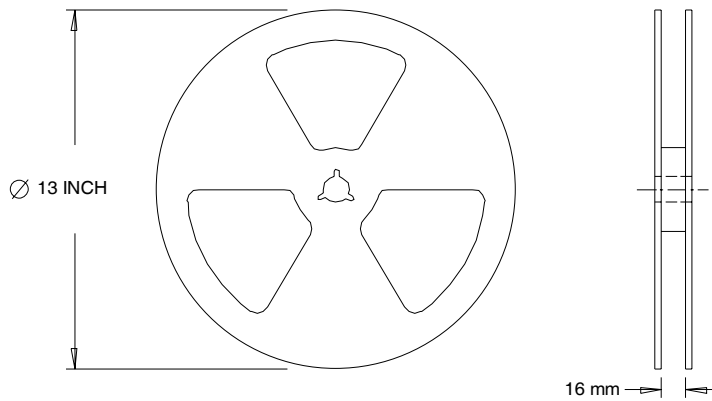
## D-Pak (TO-252AA) Tape & Reel Information

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.

Data and specifications subject to change without notice.  
 This product has been designed and qualified for the industrial 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/>

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