

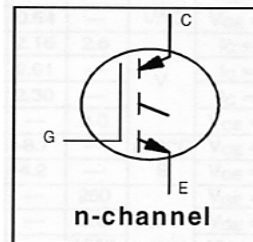
# IRG4RC10UPbF

## INSULATED GATE BIPOLAR TRANSISTOR

## UltraFast Speed IGBT

### Features

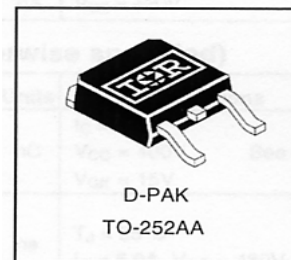
- UltraFast: Optimized for high operating frequencies ( 8-40 kHz in hard switching, >200 kHz in resonant mode)
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency than previous generation
- Industry standard TO-252AA package
- Lead-Free



|                                   |
|-----------------------------------|
| $V_{CES} = 600V$                  |
| $V_{CE(on)} \text{ typ.} = 2.15V$ |
| @ $V_{GE} = 15V, I_C = 5.0A$      |

### Benefits

- Generation 4 IGBT's offer highest efficiency available
- IGBT's optimized for specified application conditions



### Absolute Maximum Ratings

|                           | Parameter                          | Max.                               | Units      |
|---------------------------|------------------------------------|------------------------------------|------------|
| $V_{CES}$                 | Collector-to-Emitter Voltage       | 600                                | V          |
| $I_C @ T_C = 25^\circ C$  | Continuous Collector Current       | 8.5                                | A          |
| $I_C @ T_C = 100^\circ C$ | Continuous Collector Current       | 5.0                                |            |
| $I_{CM}$                  | Pulsed Collector Current ①         | 34                                 |            |
| $I_{LM}$                  | Clamped Inductive Load Current ②   | 34                                 |            |
| $V_{GE}$                  | Gate-to-Emitter Voltage            | $\pm 20$                           | V          |
| $E_{ARV}$                 | Reverse Voltage Avalanche Energy ③ | 110                                | mJ         |
| $P_D @ T_C = 25^\circ C$  | Maximum Power Dissipation          | 38                                 | W          |
| $P_D @ T_C = 100^\circ C$ | Maximum Power Dissipation          | 15                                 |            |
| $T_J$                     | Operating Junction and             | -55 to +150                        | $^\circ C$ |
| $T_{STG}$                 | Storage Temperature Range          |                                    |            |
|                           | Soldering Temperature, for 10 sec. | 300 (0.063 in. (1.6mm) from case ) |            |

### Thermal Resistance

|                 | Parameter                        | Typ.       | Max. | Units        |
|-----------------|----------------------------------|------------|------|--------------|
| $R_{\theta JC}$ | Junction-to-Case                 | —          | 3.3  | $^\circ C/W$ |
| $R_{\theta JA}$ | 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)

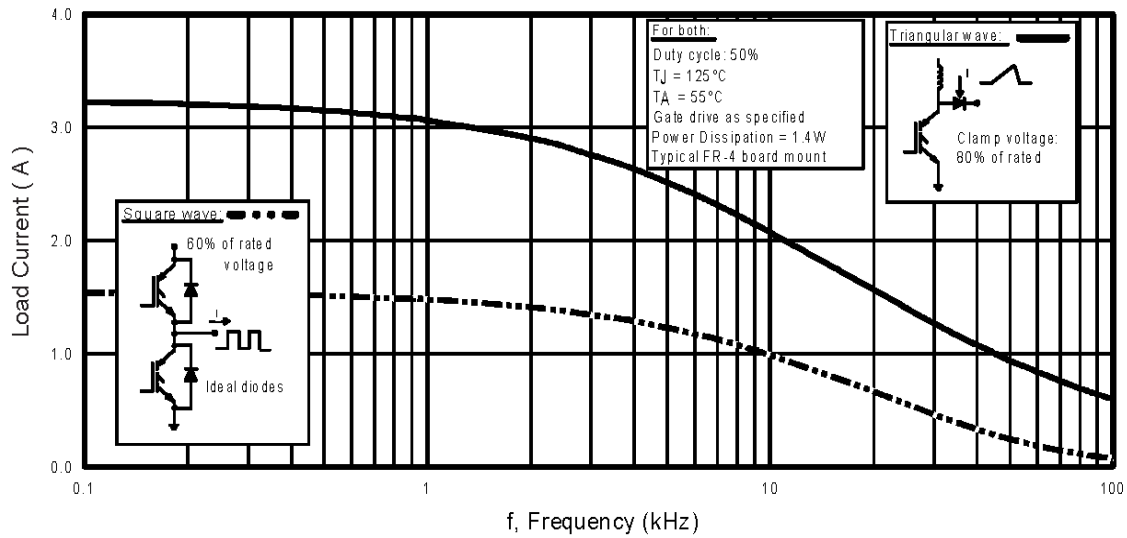
|                                 | Parameter                                | Min. | Typ. | Max.      | Units   | Conditions                                            |
|---------------------------------|------------------------------------------|------|------|-----------|---------|-------------------------------------------------------|
| $V_{(BR)CES}$                   | Collector-to-Emitter Breakdown Voltage   | 600  | —    | —         | V       | $V_{GE} = 0V, I_C = 250\mu A$                         |
| $V_{(BR)ECS}$                   | Emitter-to-Collector Breakdown Voltage ④ | 14   | —    | —         | V       | $V_{GE} = 0V, I_C = 1.0A$                             |
| $\Delta V_{(BR)CES}/\Delta T_J$ | Temperature Coeff. of Breakdown Voltage  | —    | 0.54 | —         | V/°C    | $V_{GE} = 0V, I_C = 1.0mA$                            |
| $V_{CE(ON)}$                    | Collector-to-Emitter Saturation Voltage  | —    | 2.15 | 2.6       | V       | $I_C = 5.0A, V_{GE} = 15V$                            |
|                                 |                                          | —    | 2.61 | —         |         | $I_C = 8.5A$ See Fig. 2, 5                            |
|                                 |                                          | —    | 2.30 | —         |         | $I_C = 5.0A, T_J = 150^\circ\text{C}$                 |
| $V_{GE(th)}$                    | 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  | —    | -8.7 | —         | mV/°C   | $V_{CE} = V_{GE}, I_C = 250\mu A$                     |
| $g_{fe}$                        | Forward Transconductance ⑤               | 2.8  | 4.2  | —         | S       | $V_{CE} = 100V, I_C = 5.0A$                           |
| $I_{CES}$                       | Zero Gate Voltage Collector Current      | —    | —    | 250       | $\mu A$ | $V_{GE} = 0V, V_{CE} = 600V$                          |
|                                 |                                          | —    | —    | 2.0       |         | $V_{GE} = 0V, V_{CE} = 10V, T_J = 25^\circ\text{C}$   |
|                                 |                                          | —    | —    | 1000      |         | $V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$ |
| $I_{GES}$                       | Gate-to-Emitter Leakage Current          | —    | —    | $\pm 100$ | nA      | $V_{GE} = \pm 20V$                                    |

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

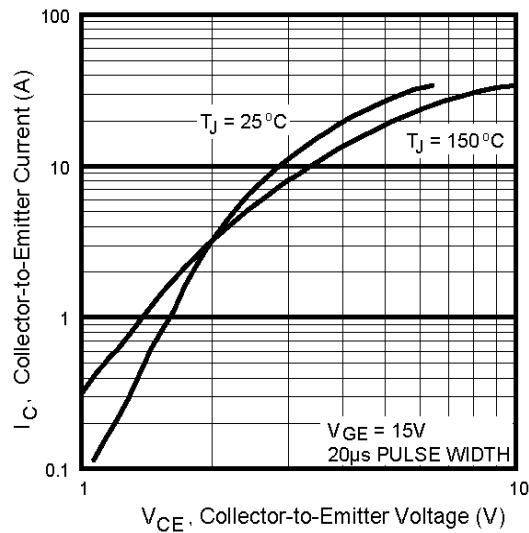
|              | Parameter                         | Min. | Typ. | Max. | Units | Conditions                                                                                                                   |
|--------------|-----------------------------------|------|------|------|-------|------------------------------------------------------------------------------------------------------------------------------|
| $Q_g$        | Total Gate Charge (turn-on)       | —    | 15   | 22   | nC    | $I_C = 5.0A$                                                                                                                 |
| $Q_{ge}$     | Gate - Emitter Charge (turn-on)   | —    | 2.6  | 4.0  |       | $V_{CC} = 400V$ See Fig. 8                                                                                                   |
| $Q_{gc}$     | Gate - Collector Charge (turn-on) | —    | 5.8  | 8.7  |       | $V_{GE} = 15V$                                                                                                               |
| $t_{d(on)}$  | Turn-On Delay Time                | —    | 19   | —    | ns    | $T_J = 25^\circ\text{C}$<br>$I_C = 5.0A, V_{CC} = 480V$<br>$V_{GE} = 15V, R_G = 100\Omega$<br>Energy losses include "tail"   |
| $t_r$        | Rise Time                         | —    | 11   | —    |       |                                                                                                                              |
| $t_{d(off)}$ | Turn-Off Delay Time               | —    | 116  | 240  |       |                                                                                                                              |
| $t_f$        | Fall Time                         | —    | 81   | 180  | mJ    | See Fig. 9, 10, 14                                                                                                           |
| $E_{on}$     | Turn-On Switching Loss            | —    | 0.08 | —    |       |                                                                                                                              |
| $E_{off}$    | Turn-Off Switching Loss           | —    | 0.16 | —    |       |                                                                                                                              |
| $E_{ts}$     | Total Switching Loss              | —    | 0.24 | 0.36 | ns    | $T_J = 150^\circ\text{C},$<br>$I_C = 5.0A, V_{CC} = 480V$<br>$V_{GE} = 15V, R_G = 100\Omega$<br>Energy losses include "tail" |
| $t_{d(on)}$  | Turn-On Delay Time                | —    | 18   | —    |       |                                                                                                                              |
| $t_r$        | Rise Time                         | —    | 14   | —    |       |                                                                                                                              |
| $t_{d(off)}$ | Turn-Off Delay Time               | —    | 180  | —    | mJ    | See Fig. 11, 14                                                                                                              |
| $t_f$        | Fall Time                         | —    | 150  | —    |       |                                                                                                                              |
| $E_{ts}$     | Total Switching Loss              | —    | 0.36 | —    |       |                                                                                                                              |
| $L_E$        | Internal Emitter Inductance       | —    | 7.5  | —    | nH    | Measured 5mm from package                                                                                                    |
| $C_{ies}$    | Input Capacitance                 | —    | 270  | —    | pF    | $V_{GE} = 0V$<br>$V_{CC} = 30V$ See Fig. 7<br>$f = 1.0MHz$                                                                   |
| $C_{oes}$    | Output Capacitance                | —    | 21   | —    |       |                                                                                                                              |
| $C_{res}$    | Reverse Transfer Capacitance      | —    | 3.5  | —    |       |                                                                                                                              |

### Notes:

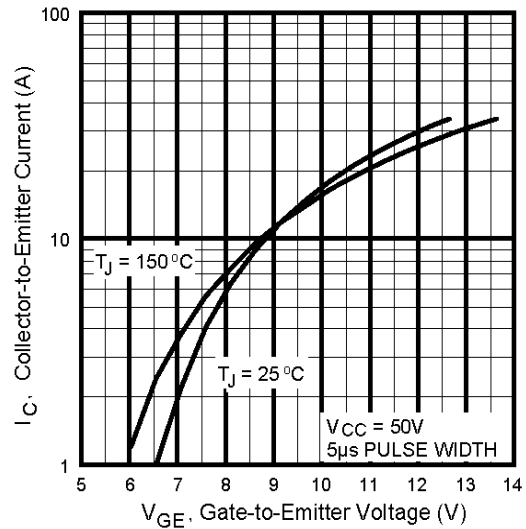
- ① Repetitive rating;  $V_{GE} = 20V$ , pulse width limited by max. junction temperature. ( See fig. 13b )
- ②  $V_{CC} = 80\%(V_{CES})$ ,  $V_{GE} = 20V$ ,  $L = 10\mu H$ ,  $R_G = 100\Omega$ , (See fig. 13a)
- ③ Repetitive rating; pulse width limited by maximum junction temperature.
- ④ Pulse width  $\leq 80\mu s$ ; duty factor  $\leq 0.1\%$ .
- ⑤ Pulse width  $5.0\mu s$ , single shot.



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



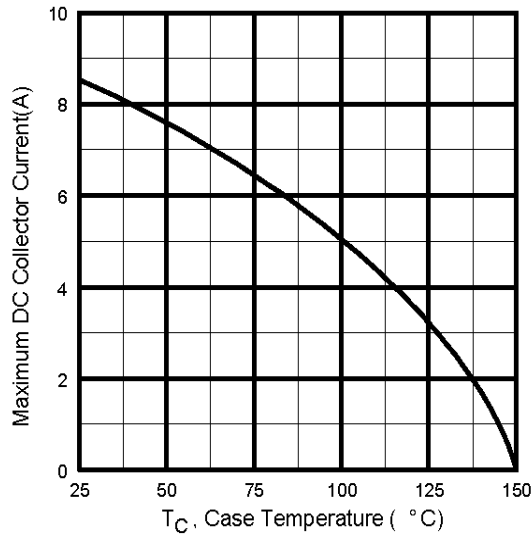
**Fig. 2** - Typical Output Characteristics



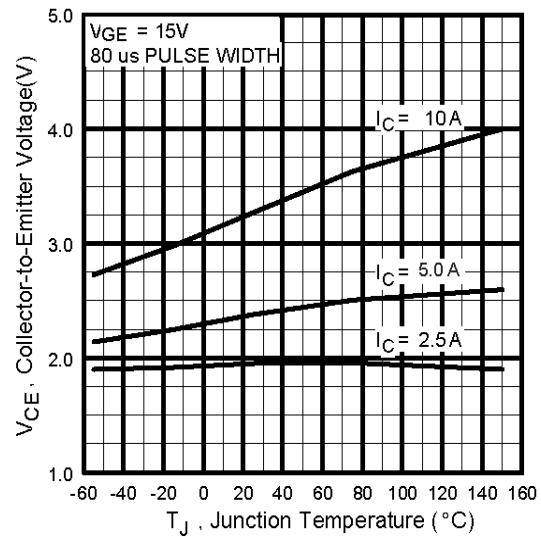
**Fig. 3** - Typical Transfer Characteristics

# IRG4RC10UPbF

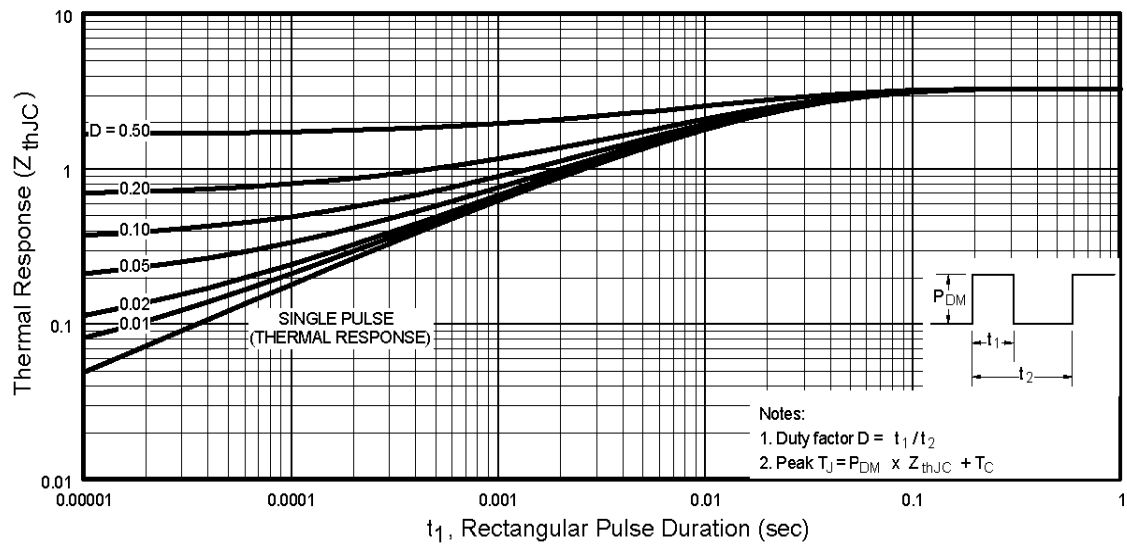
International  
**IR** Rectifier



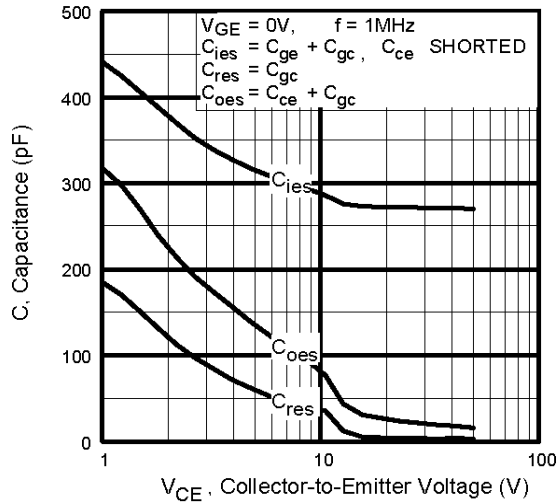
**Fig. 4** - Maximum Collector Current vs. Case Temperature



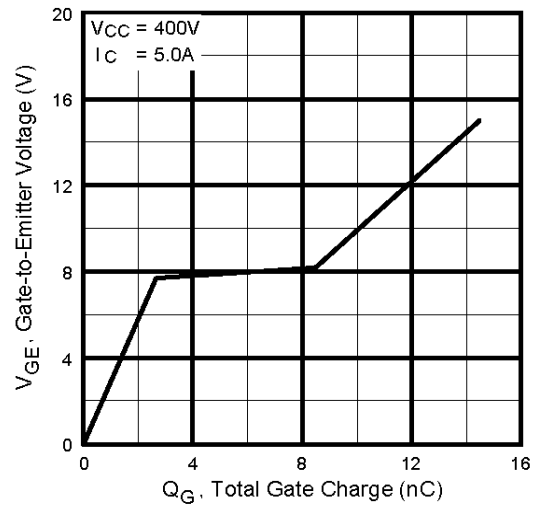
**Fig. 5** - Typical Collector-to-Emitter Voltage vs. Junction Temperature



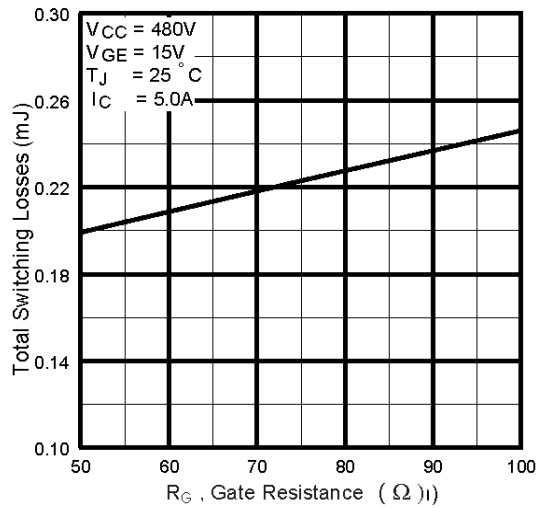
**Fig. 6** - Maximum Effective Transient Thermal Impedance, Junction-to-Case



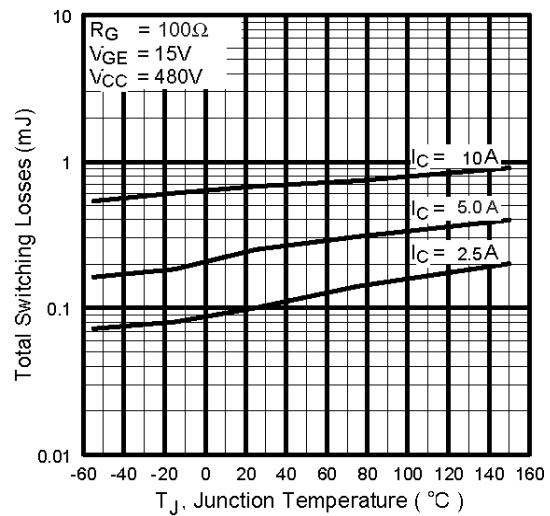
**Fig. 7** - Typical Capacitance vs. Collector-to-Emitter Voltage



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



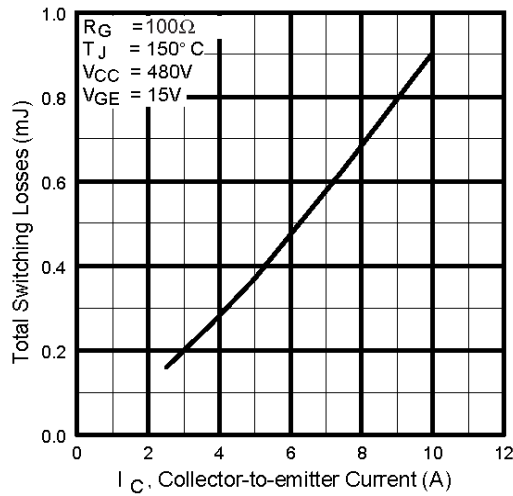
**Fig. 9** - Typical Switching Losses vs. Gate Resistance



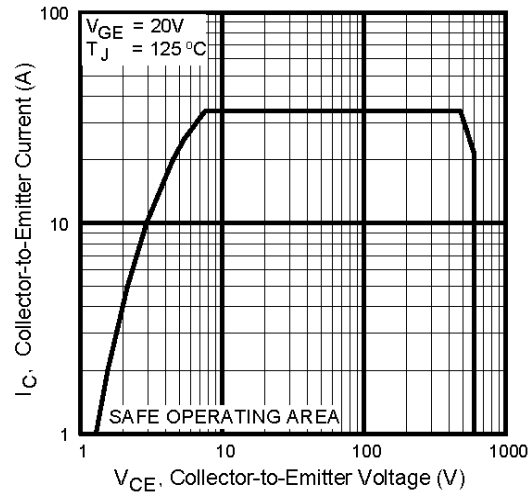
**Fig. 10** - Typical Switching Losses vs. Junction Temperature

# IRG4RC10UPbF

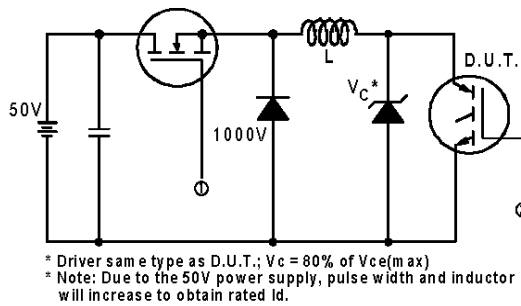
International  
**IR** Rectifier



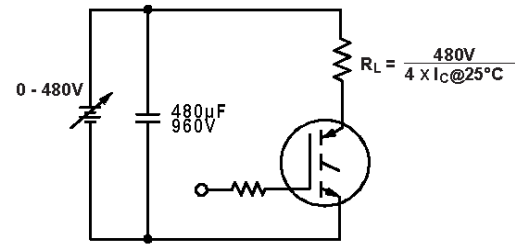
**Fig. 11** - Typical Switching Losses vs. Collector-to-Emitter Current



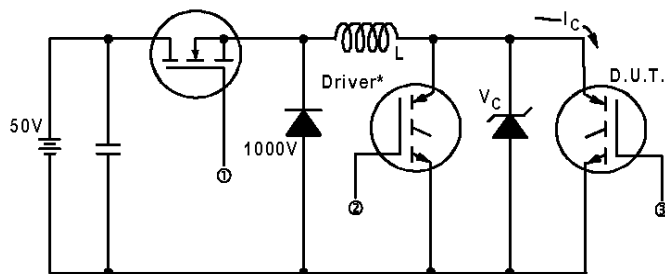
**Fig. 12** - Turn-Off SOA



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

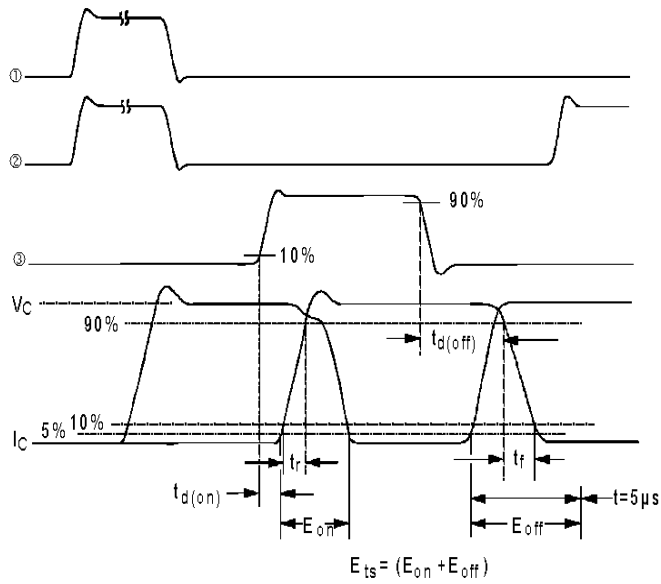


**Fig. 13b** - Pulsed Collector Current Test Circuit



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

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



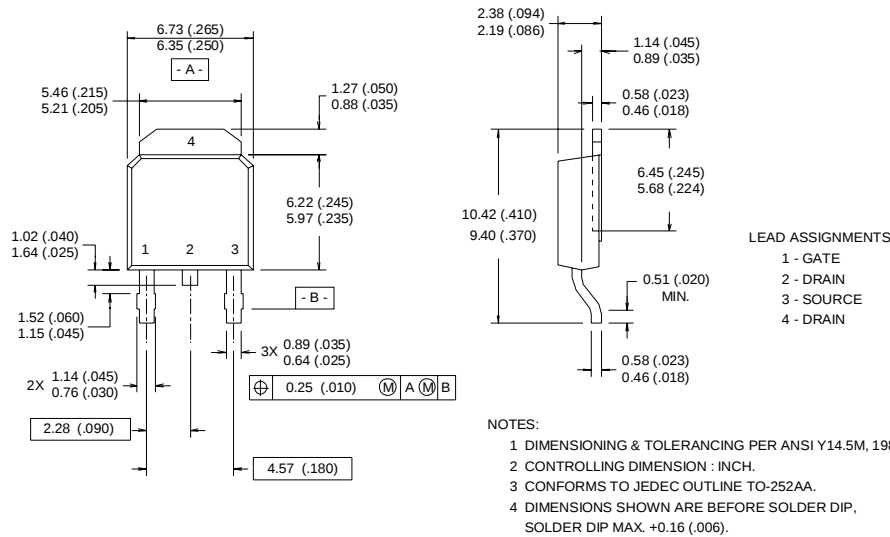
**Fig. 14b** - Switching Loss  
Waveforms

# IRG4RC10UPbF

International  
**IR** Rectifier

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

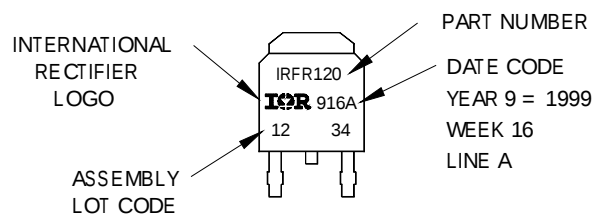
Dimensions are shown in millimeters (inches)



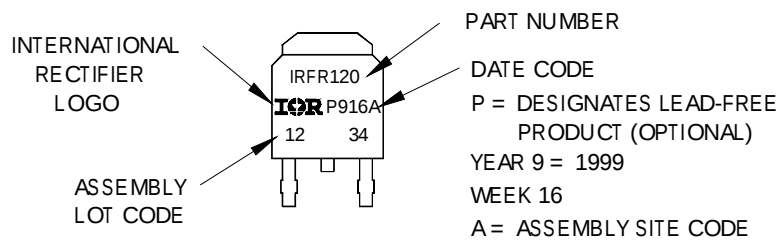
## D-Pak (TO-252AA) Part Marking Information

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

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

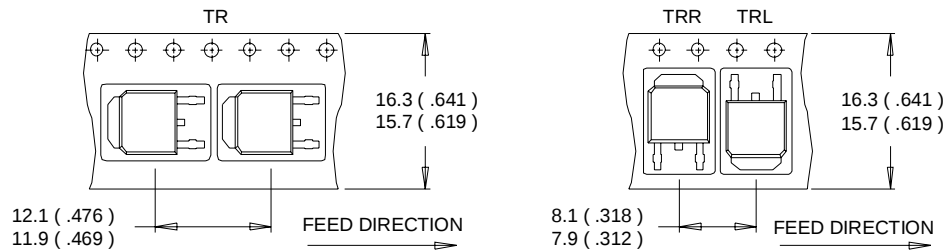


OR



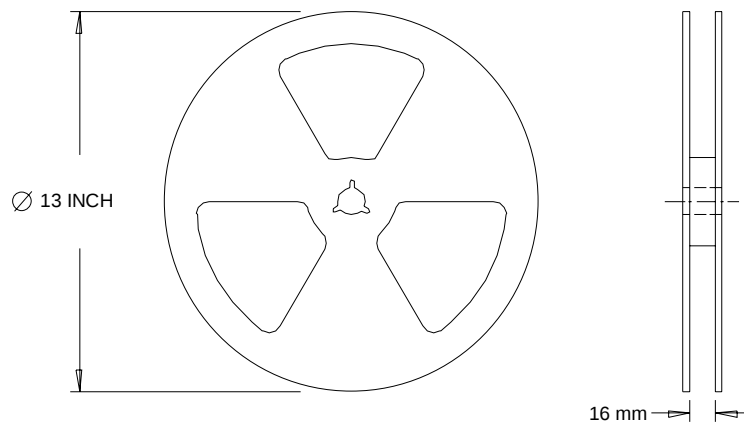
## D-Pak (TO-252AA) Tape & Reel Information

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.

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