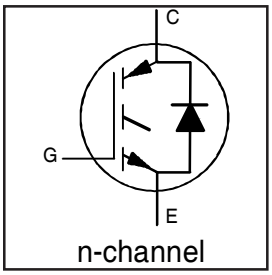
PD - 95328

International
IOR Rectifier

# IRG4RC10UDPbF

## INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

UltraFast CoPack IGBT



n-channel

$V_{CES}$ = 600V

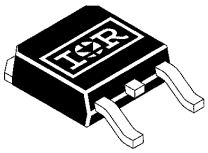
$V_{CE(on)\ typ.}$ = 2.15V

@$V_{GE}$ = 15V, $I_C$ = 5.0A

$t_f$ (typ.) = 140ns

### Features

- UltraFast: Optimized for medium 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
- IGBT co-packaged with HEXFRED™ ultrafast, ultra-soft-recovery anti-parallel diodes for use in bridge configurations
- Industry standard TO-252AA package
- Lead-Free



D-PAK
TO-252AA

### Benefits

- Generation 4 IGBT's offer highest efficiencies available
- IGBT's optimized for specific application conditions
- HEXFRED diodes optimized for performance with IGBT's . Minimized recovery characteristics require less/no snubbing
- Lower losses than MOSFET's conduction and Diode losses

### Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---|---|---|---|
| $V_{CES}$ | Collector-to-Emitter Voltage | 600 | V |
| $I_C$ @ $T_C$ = 25°C | Continuous Collector Current | 8.5 | A |
| $I_C$ @ $T_C$ = 100°C | Continuous Collector Current | 5.0 | |
| $I_{CM}$ | Pulsed Collector Current ① | 34 | |
| $I_{LM}$ | Clamped Inductive Load Current ② | 34 | |
| $I_F$ @ $T_C$ = 100°C | Diode Continuous Forward Current | 4.0 | |
| $I_{FM}$ | Diode Maximum Forward Current | 16 | |
| $V_{GE}$ | Gate-to-Emitter Voltage | ± 20 | V |
| $P_D$ @ $T_C$ = 25°C | Maximum Power Dissipation | 38 | W |
| $P_D$ @ $T_C$ = 100°C | Maximum Power Dissipation | 15 | |
| $T_J$ | Operating Junction and | -55 to +150 | °C |
| $T_{STG}$ | Storage Temperature Range | | |
| | Soldering Temperature, for 10 sec. | 300 (0.063 in. (1.6mm) from case) | |
| | Mounting Torque, 6-32 or M3 Screw. | 10 lbf•in (1.1 N•m) | |

### Thermal Resistance

| | Parameter | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| $R_{\theta JC}$ | Junction-to-Case - IGBT | ––– | ––– | 3.3 | °C/W |
| $R_{\theta JC}$ | Junction-to-Case - Diode | ––– | ––– | 7.0 | |
| $R_{\theta JA}$ | Junction-to-Ambient (PCB mount)* | ––– | ––– | 50 | |
| Wt | Weight | ––– | 0.3 (0.01) | ––– | g (oz) |

Details of note ① through ④ are on the last page

## Electrical Characteristics @ $T_J$ = 25°C (unless otherwise specified)

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $V_{(BR)CES}$ | Collector-to-Emitter Breakdown Voltage③ | 600 | — | — | V | $V_{GE}$ = 0V, $I_C$ = 250µA |
| $\Delta V_{(BR)CES}/\Delta T_J$ | 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°C |
| $V_{GE(th)}$ | Gate Threshold Voltage | 3.0 | — | 6.0 | | $V_{CE}$ = $V_{GE}$, $I_C$ = 250µA |
| $\Delta V_{GE(th)}/\Delta T_J$ | Temperature Coeff. of Threshold Voltage | — | -8.7 | — | mV/°C | $V_{CE}$ = $V_{GE}$, $I_C$ = 250µA |
| $g_{fe}$ | Forward Transconductance ④ | 2.8 | 4.2 | — | S | $V_{CE}$ = 100V, $I_C$ = 5.0A |
| $I_{CES}$ | Zero Gate Voltage Collector Current | — | — | 250 | µA | $V_{GE}$ = 0V, $V_{CE}$ = 600V |
| | | — | — | 1000 | | $V_{GE}$ = 0V, $V_{CE}$ = 600V, $T_J$ = 150°C |
| $V_{FM}$ | Diode Forward Voltage Drop | — | 1.5 | 1.8 | V | $I_C$ = 4.0A See Fig. 13 |
| | | — | 1.4 | 1.7 | | $I_C$ = 4.0A, $T_J$ = 125°C |
| $I_{GES}$ | Gate-to-Emitter Leakage Current | — | — | ±100 | nA | $V_{GE}$ = ±20V |

## Switching Characteristics @ $T_J$ = 25°C (unless otherwise specified)

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $Q_g$ | Total Gate Charge (turn-on) | — | 15 | 22 | nC | $I_C$ = 5.0A |
| Qge | 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 | — | 40 | — | ns | $T_J$ = 25°C |
| $t_r$ | Rise Time | — | 16 | — | | $I_C$ = 5.0A, $V_{CC}$ = 480V |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 87 | 130 | | $V_{GE}$ = 15V, $R_G$ = 100Ω |
| $t_f$ | Fall Time | — | 140 | 210 | | Energy losses include "tail" and |
| $E_{on}$ | Turn-On Switching Loss | — | 0.14 | — | mJ | diode reverse recovery. |
| $E_{off}$ | Turn-Off Switching Loss | — | 0.12 | — | | See Fig. 9, 10, 18 |
| $E_{ts}$ | Total Switching Loss | — | 0.26 | 0.33 | | |
| $t_{d(on)}$ | Turn-On Delay Time | — | 38 | — | ns | $T_J$ = 150°C, See Fig. 11, 18 |
| $t_r$ | Rise Time | — | 18 | — | | $I_C$ = 5.0A, $V_{CC}$ = 480V |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 95 | — | | $V_{GE}$ = 15V, $R_G$ = 100Ω |
| $t_f$ | Fall Time | — | 250 | — | | Energy losses include "tail" and |
| $E_{ts}$ | Total Switching Loss | — | 0.45 | — | mJ | diode reverse recovery. |
| $L_E$ | Internal Emitter Inductance | — | 7.5 | — | nH | Measured 5mm from package |
| $C_{ies}$ | Input Capacitance | — | 270 | — | pF | $V_{GE}$ = 0V |
| $C_{oes}$ | Output Capacitance | — | 21 | — | | $V_{CC}$ = 30V See Fig. 7 |
| $C_{res}$ | Reverse Transfer Capacitance | — | 3.5 | — | | $f$ = 1.0MHz |
| $t_{rr}$ | Diode Reverse Recovery Time | — | 28 | 42 | ns | $T_J$ = 25°C See Fig. |
| | | — | 38 | 57 | | $T_J$ = 125°C 14 $I_F$ = 4.0A |
| $I_{rr}$ | Diode Peak Reverse Recovery Current | — | 2.9 | 5.2 | A | $T_J$ = 25°C See Fig. |
| | | — | 3.7 | 6.7 | | $T_J$ = 125°C 15 $V_R$ = 200V |
| $Q_{rr}$ | Diode Reverse Recovery Charge | — | 40 | 60 | nC | $T_J$ = 25°C See Fig. |
| | | — | 70 | 105 | | $T_J$ = 125°C 16 di/dt = 200A/µs |
| $di_{(rec)M}/dt$ | Diode Peak Rate of Fall of Recovery | — | 280 | — | A/µs | $T_J$ = 25°C See Fig. |
| | During $t_b$ | — | 235 | — | | $T_J$ = 125°C 17 |

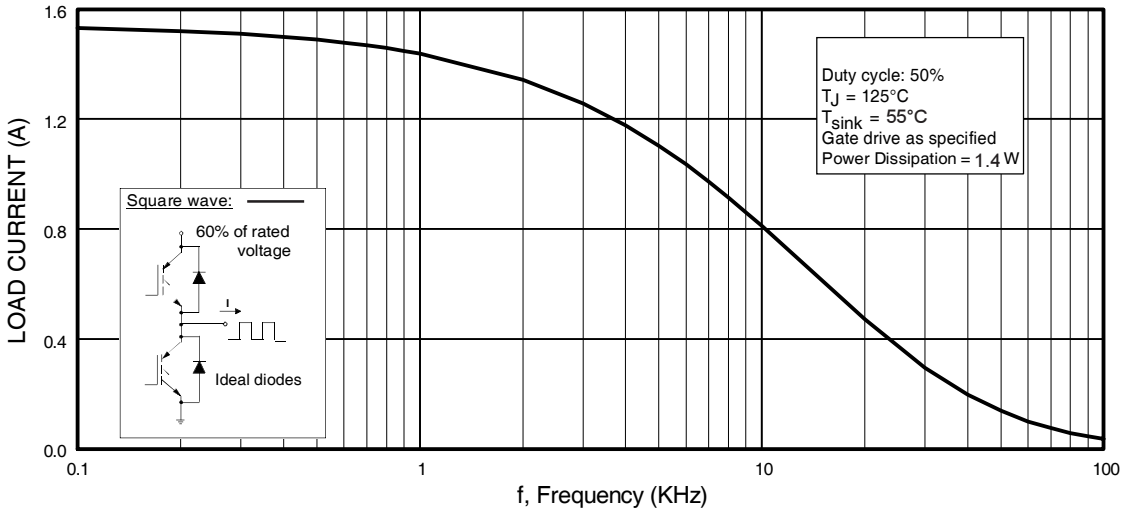



**Fig. 1** - Typical Load Current vs. Frequency
(Load Current = $I_{RMS}$ of fundamental)

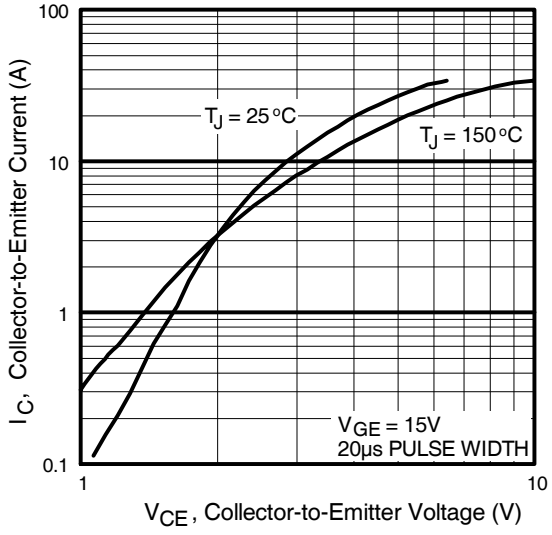



**Fig. 2** - Typical Output Characteristics

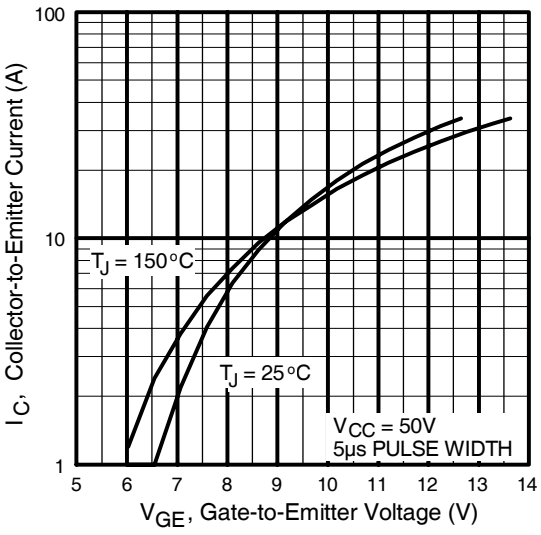



**Fig. 3** - Typical Transfer Characteristics

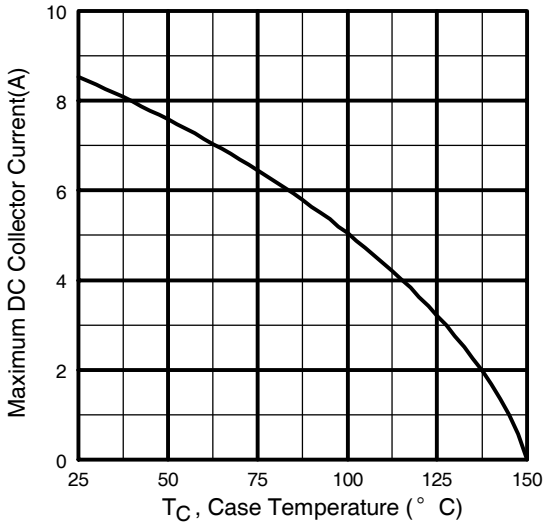



**Fig. 4** - Maximum Collector Current vs. Case Temperature

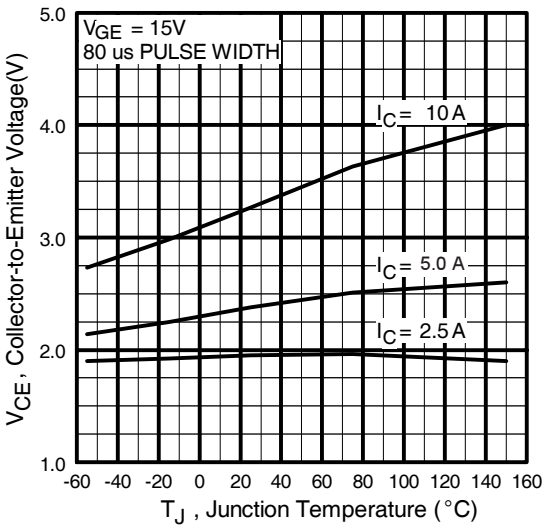



**Fig. 5** - Typical Collector-to-Emitter Voltage vs. Junction Temperature

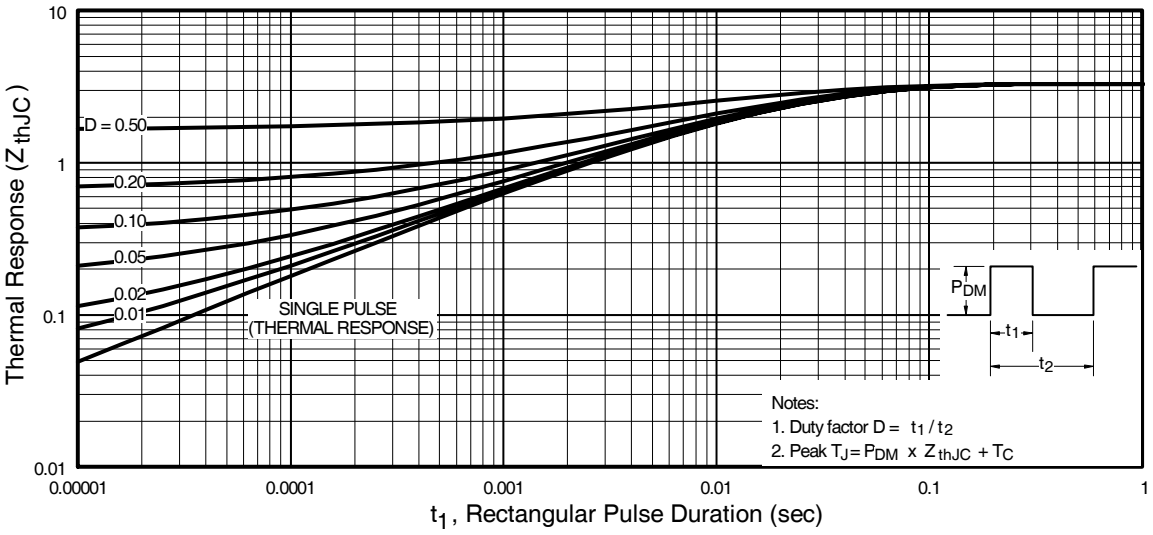



**Fig. 6** - Maximum Effective Transient Thermal Impedance, Junction-to-Case

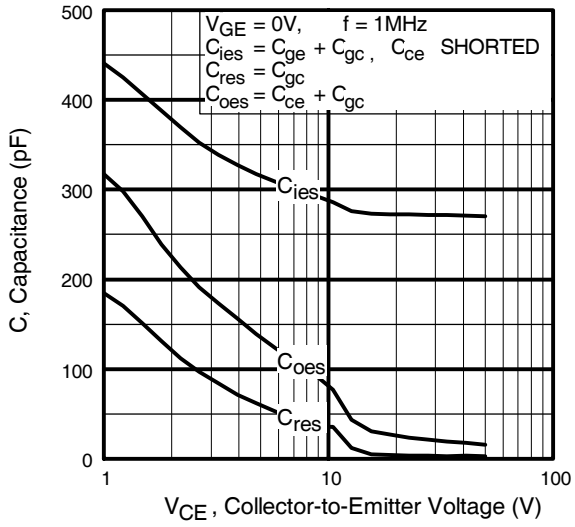



**Fig. 7 -** Typical Capacitance vs. Collector-to-Emitter Voltage

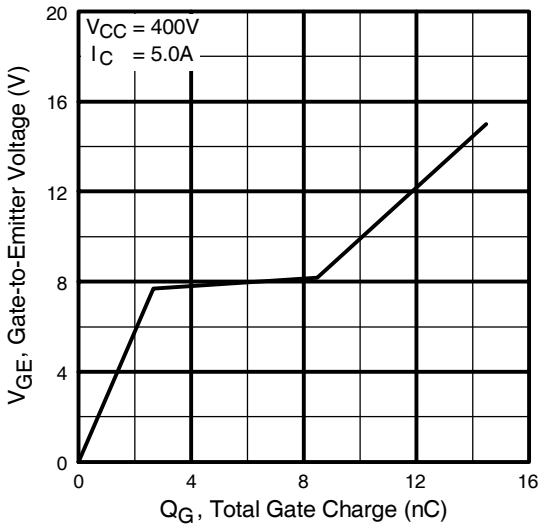



**Fig. 8** - Typical Gate Charge vs. Gate-to-Emitter Voltage

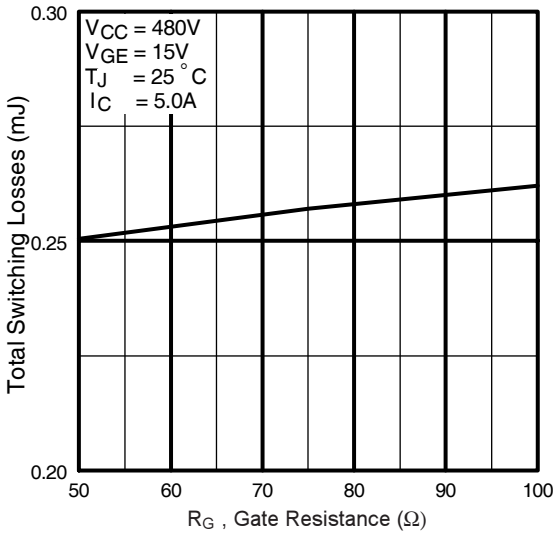



**Fig. 9** - Typical Switching Losses vs. Gate Resistance

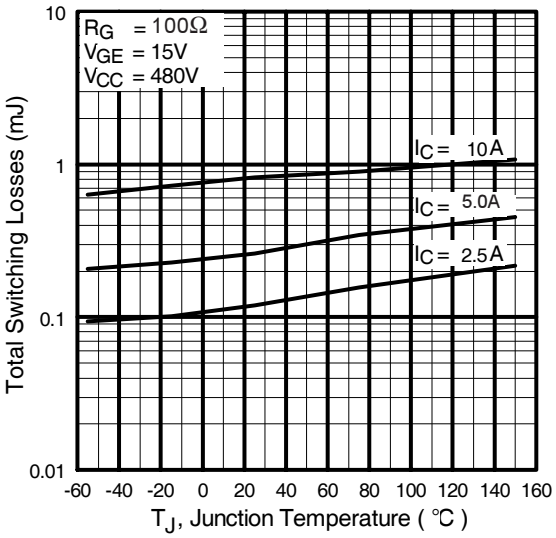



**Fig. 10** - Typical Switching Losses vs. Junction Temperature

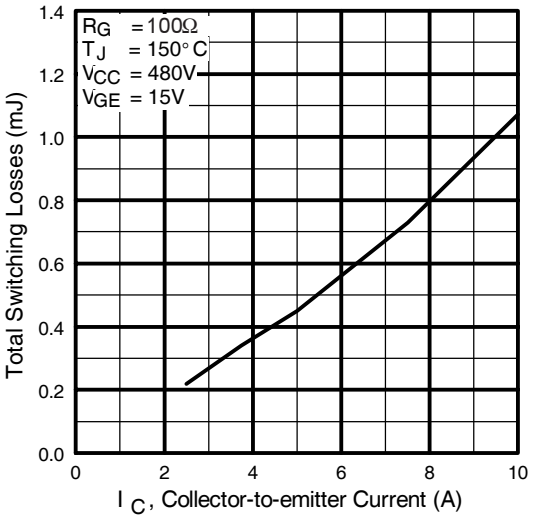



**Fig. 11 -** Typical Switching Losses vs. Collector-to-Emitter Current

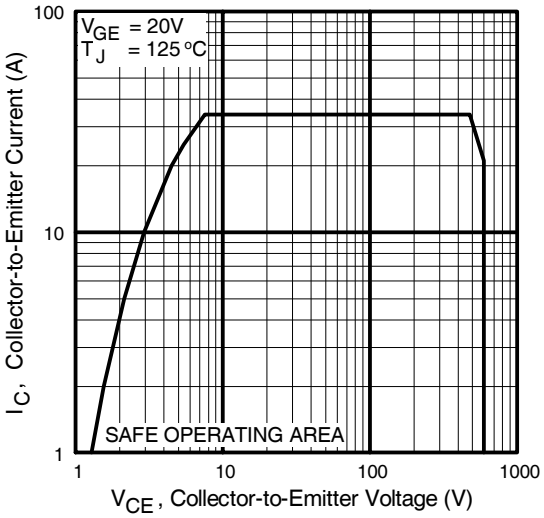



**Fig. 12** - Turn-Off SOA

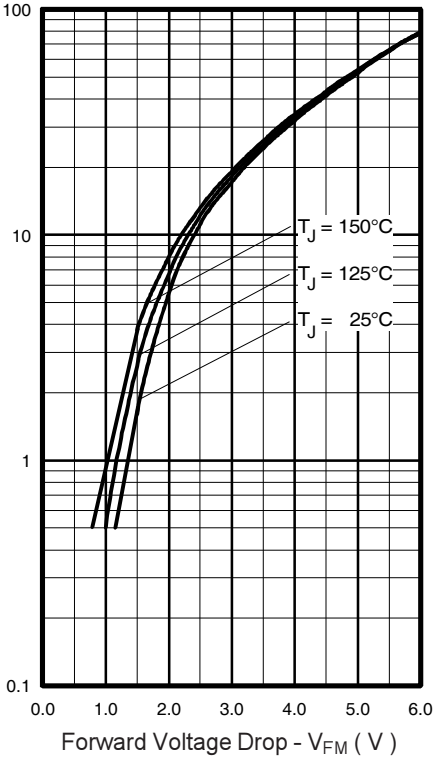



**Fig. 13** - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

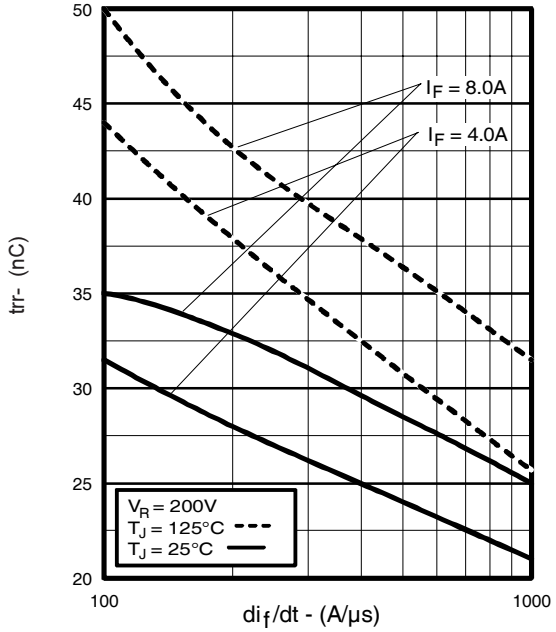



**Fig. 14** - Typical Reverse Recovery vs. $di_f/dt$

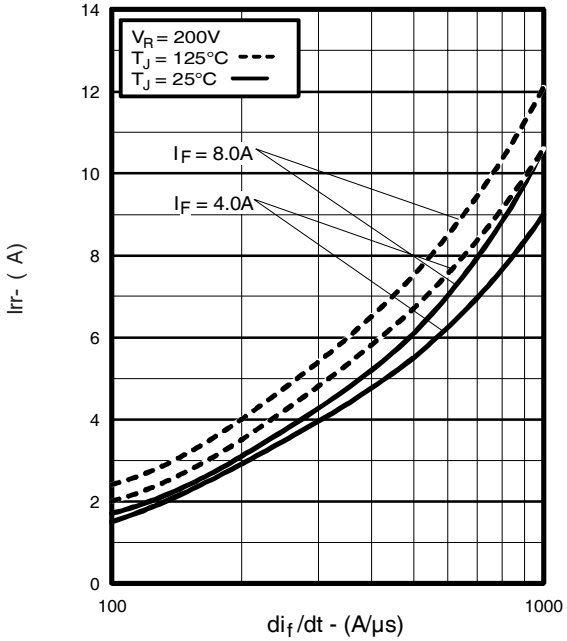



**Fig. 15** - Typical Recovery Current vs. $di_f/dt$

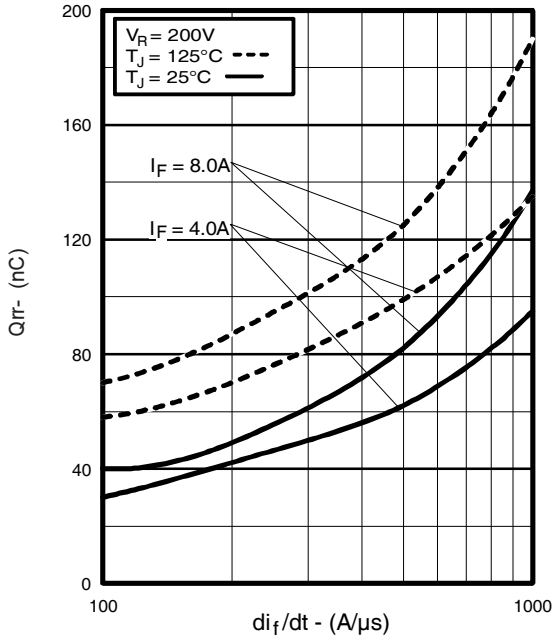



**Fig. 16** - Typical Stored Charge vs. $di_f/dt$

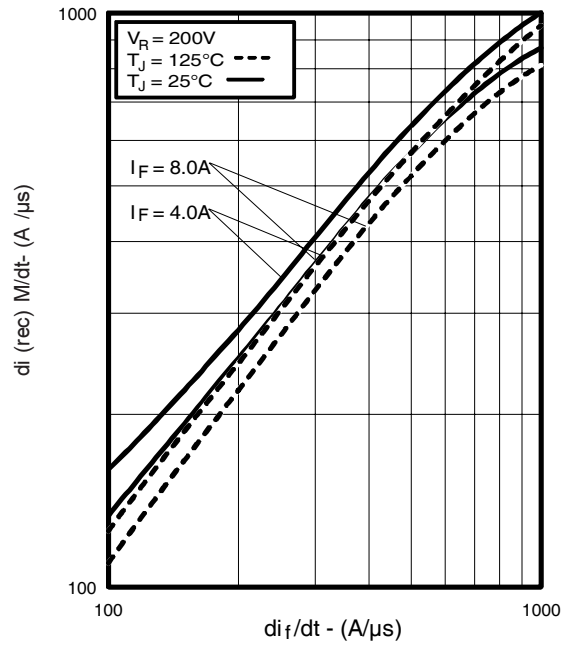



**Fig. 17** - Typical $di_{(rec)M}/dt$ vs. $di_f/dt$,

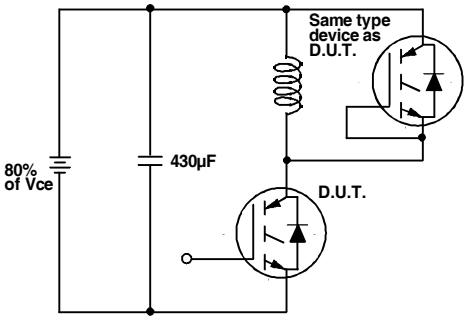



**Fig. 18a** - Test Circuit for Measurement of $I_{LM}$, $E_{on}$, $E_{off(diode)}$, $t_{rr}$, $Q_{rr}$, $I_{rr}$, $t_{d(on)}$, $t_r$, $t_{d(off)}$, $t_f$

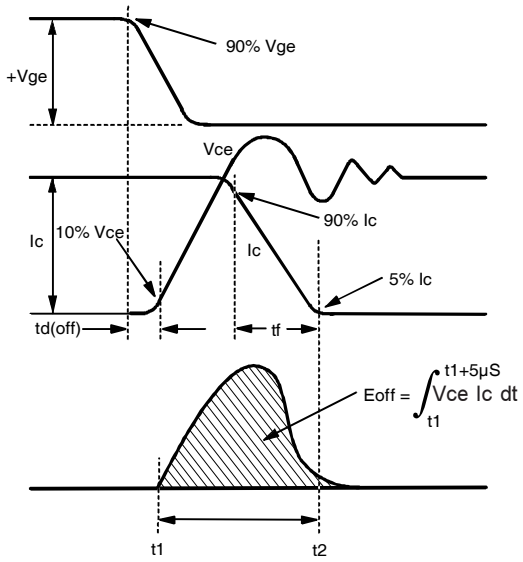



**Fig. 18b** - Test Waveforms for Circuit of Fig. 18a, Defining $E_{off}$, $t_{d(off)}$, $t_f$

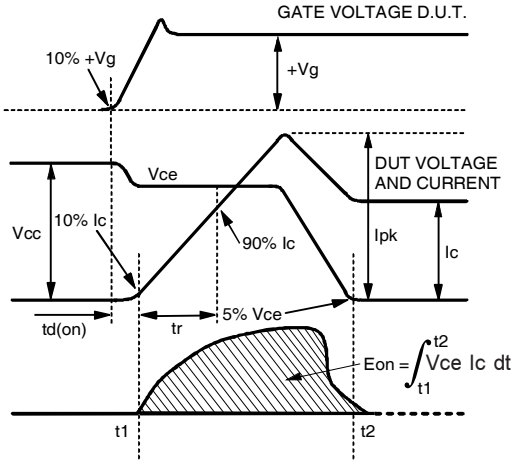



**Fig. 18c** - Test Waveforms for Circuit of Fig. 18a, Defining $E_{on}$, $t_{d(on)}$, $t_r$

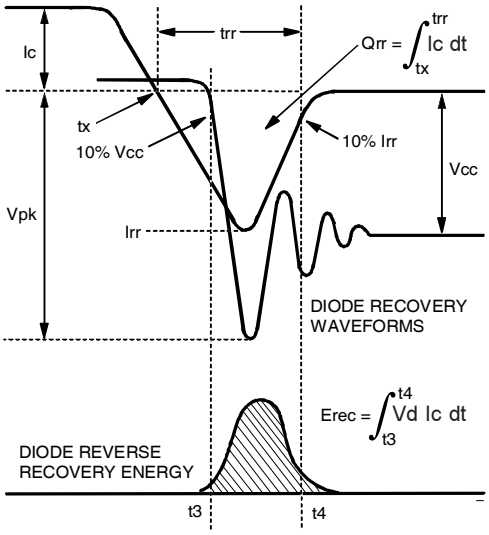
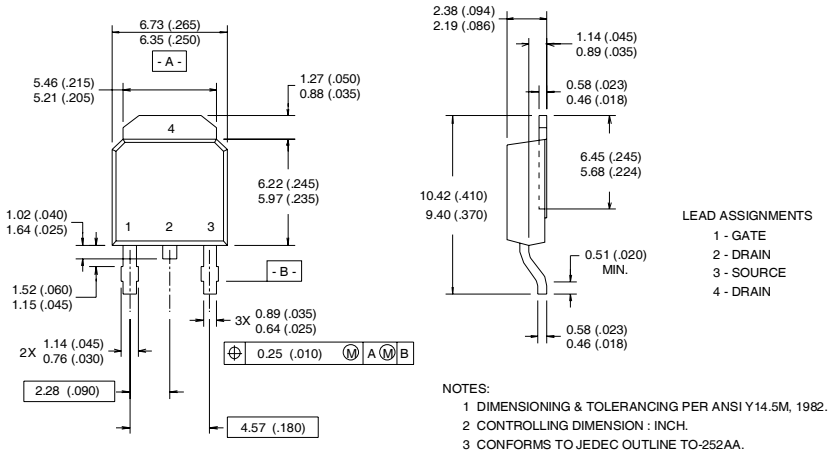



**Fig. 18d** - Test Waveforms for Circuit of Fig. 18a, Defining $E_{rec}$, $t_{rr}$, $Q_{rr}$, $I_{rr}$

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

Dimensions are shown in millimeters (inches)

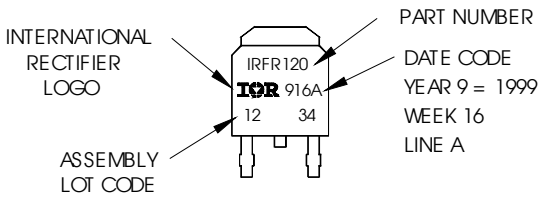



NOTES:
1 DIMENSIONING & TOLERANCING PER ANSI Y14.5M, 1982.
2 CONTROLLING DIMENSION : INCH.
3 CONFORMS TO JEDEC OUTLINE TO-252AA.
4 DIMENSIONS SHOWN ARE BEFORE SOLDER DIP, SOLDER DIP MAX. +0.16 (.006).

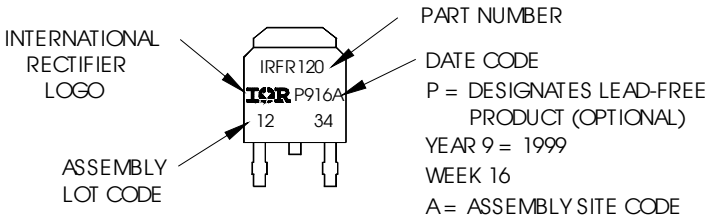
## D-Pak (TO-252AA) Part Marking Information (Lead-Free)

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



Notes:

① Repetitive rating: $V_{GE}$=20V; pulse width limited by maximum junction temperature (figure 20)

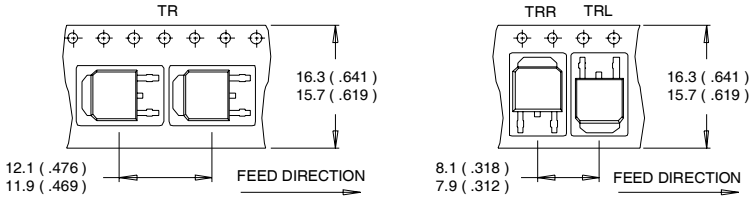
② $V_{CC}$=80%($V_{CES}$), $V_{GE}$=20V, L=10μH, $R_G$ = 100Ω (figure 19)

③ Pulse width ≤ 80μs; duty factor ≤ 0.1%.

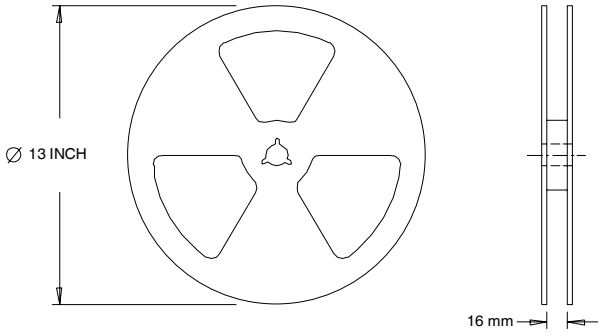
④ Pulse width 5.0μs, single shot.

## 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.



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TAC Fax: (310) 252-7903
Visit us at www.irf.com for sales contact information.

*Data and specifications subject to change without notice.* 6/04

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

ENTEGRECİ

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### Parça koduyla arama

Üretici parça numarasını yazın; stok ve fiyatı hemen görün.

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Entegreden kapasitöre tüm elektronik komponent kategorileri.

**Kategorilere göz atın**

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Aradığınız üreticinin ürünlerini tek sayfada inceleyin.

**Üreticileri görün**

### Toplu alım ve teklif

Listede olmayan ya da yüksek adetli parçalar için teklif isteyin.

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