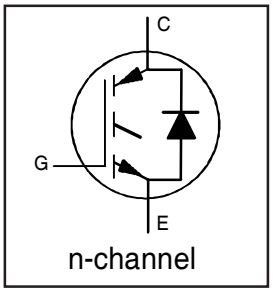
PD - 95614A

International
IOR Rectifier

# IRG4BC30FD1PbF

Fast CoPack IGBT

INSULATED GATE BIPOLAR TRANSISTOR WITH HYPERFAST DIODE




n-channel

$V_{CES}$ = 600V

$V_{CE(on)\ typ.}$ = 1.59V

@$V_{GE}$ = 15V, $I_C$ = 17A

## Features

- Fast: optimized for medium operating frequencies (1-5 kHz in hard switching, >20kHz in resonant mode).
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency than Generation 3.
- IGBT co-packaged with Hyperfast FRED diodes for ultra low recovery characteristics.
- Industry standard TO-220AB package.
- Lead-Free

## Benefits

- Generation 4 IGBT's offer highest efficiency available.
- IGBT's optimized for specific application conditions.
- FRED diodes optimized for performance with IGBT's. Minimized recovery characteristics require less / no snubbing.



TO-220AB

## Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---|---|---|---|
| $V_{CES}$ | Collector-to-Emitter Voltage | 600 | V |
| $I_C$ @ $T_C$ = 25°C | Continuous Collector Current | 31 | A |
| $I_C$ @ $T_C$ = 100°C | Continuous Collector Current | 17 | |
| $I_{CM}$ | Pulse Collector Current (Ref.Fig.C.T.5) ① | 124 | |
| $I_{LM}$ | Clamped Inductive Load current ② | 124 | |
| $I_F$ @ $T_C$ = 100°C | Diode Continuous Forward Current | 8 | |
| $I_{FM}$ | Diode Maximum Forward Current | 16 | |
| $V_{GE}$ | Gate-to-Emitter Voltage | ±20 | V |
| $P_D$ @ $T_C$ = 25°C | Maximum Power Dissipation | 100 | W |
| $P_D$ @ $T_C$ = 100°C | Maximum Power Dissipation | 42 | |
| $T_J$ | Operating Junction and | -55 to +150 | °C |
| $T_{STG}$ | Storage Temperature Range | | |
| | Storage Temperature Range, 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 / Mechanical Characteristics

| | Parameter | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| $R_{\theta JC}$ | Junction-to-Case- IGBT | — | — | 1.2 | °C/W |
| $R_{\theta JC}$ | Junction-to-Case- Diode | — | — | 2.0 | |
| $R_{\theta CS}$ | Case-to-Sink, flat, greased surface | — | 0.50 | — | |
| $R_{\theta JA}$ | Junction-to-Ambient, typical socket mount | — | — | 80 | |
| Wt | Weight | — | 2.0 (0.07) | — | g (oz.) |

# IRG4BC30FD1PbF

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

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $V_{(BR)CES}$ | Collector-to-Emitter Breakdown Voltage ③ | 600 | — | — | V | $V_{GE}$ = 0V, $I_C$ = 250µA |
| $\Delta V_{(BR)CES}/\Delta T_J$ | Temperature Coeff. of Breakdown Voltage | — | 0.69 | — | V/°C | $V_{GE}$ = 0V, $I_C$ = 1mA |
| $V_{CE(on)}$ | Collector-to-Emitter Voltage | — | 1.59 | 1.8 | V | $I_C$ = 17A, $V_{GE}$ = 15V |
| | | — | 1.99 | — | | $I_C$ = 31A, See Fig. 2, 5 |
| | | — | 1.7 | — | | $I_C$ = 17A, $T_J$ = 150°C |
| $V_{GE(th)}$ | Gate Threshold Voltage | 3.0 | — | 6.0 | V | $V_{CE}$ = $V_{GE}$, $I_C$ = 250µA |
| $\Delta V_{GE(th)}/\Delta T_J$ | Threshold Voltage temp. coefficient | — | -11 | — | mV/°C | $V_{CE}$ = $V_{GE}$, $I_C$ = 250µA |
| gfe | Forward Transconductance ④ | 6.1 | 10 | — | S | $V_{CE}$ = 100V, $I_C$ = 17A |
| $I_{CES}$ | Zero Gate Voltage Collector Current | — | — | 250 | µA | $V_{GE}$ = 0V, $V_{CE}$ = 600V |
| | | — | — | 2500 | | $V_{GE}$ = 0V, $V_{CE}$ = 600V, $T_J$ = 150°C |
| $V_{FM}$ | Diode Forward Voltage Drop | — | 2.0 | 2.4 | V | $I_F$ = 8.0A, See Fig. 13 |
| | | — | 1.3 | 1.8 | | $I_F$ = 8.0A, $T_J$ = 150°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) | — | 57 | 62 | nC | $I_C$ = 17A |
| $Q_{ge}$ | Gate-to-Emitter Charge (turn-on) | — | 10 | 12 | | $V_{CC}$ = 400V, See Fig. 8 |
| $Q_{gc}$ | Gate-to-Collector Charge (turn-on) | — | 21 | 24 | | $V_{GE}$ = 15V |
| $t_{d(on)}$ | Turn-On delay time | — | 22 | — | ns | $T_J$ = 25°C |
| $t_r$ | Rise time | — | 24 | — | | $I_C$ = 17A, $V_{CC}$ = 480V |
| $t_{d(off)}$ | Turn-Off delay time | — | 250 | 320 | | $V_{GE}$ = 15V, $R_G$ = 23Ω |
| $t_f$ | Fall time | — | 160 | 210 | | Energy losses inlcude "tail" and |
| $E_{on}$ | Turn-On Switching Loss | — | 370 | — | µJ | diode reverse recovery. |
| $E_{off}$ | Turn-Off Switching Loss | — | 1420 | — | | See Fig. 9, 10, 11, 18 |
| $E_{ts}$ | Total Switching Loss | — | 1800 | 2290 | | |
| $t_{d(on)}$ | Turn-On delay time | — | 21 | — | ns | $T_J$ = 150°C, See Fig. 9,10,11,18 |
| $t_r$ | Rise time | — | 25 | — | | $I_C$ = 17A, $V_{CC}$ = 480V |
| $t_{d(off)}$ | Turn-Off delay time | — | 400 | — | | $V_{GE}$ = 15V, $R_G$ = 23Ω |
| $t_f$ | Fall time | — | 340 | — | | Energy losses inlcude "tail" and |
| $E_{ts}$ | Total Switching Loss | — | 3280 | — | µJ | diode reverse recovery. |
| $L_E$ | Internal Emitter Inductance | — | 7.5 | — | nH | Measured 5mm from package |
| $C_{ies}$ | Input Capacitance | — | 1170 | — | pF | $V_{GE}$ = 0V |
| $C_{oes}$ | Output Capacitance | — | 100 | — | | $V_{CC}$ = 30V, See Fig. 7 |
| $C_{res}$ | Reverse Transfer Capacitance | — | 11 | — | | f = 1.0MHz |
| $t_{rr}$ | Diode Reverse Recovery Time | — | 46 | 61 | ns | $T_J$ = 25°C, See Fig. |
| | | — | 85 | 93 | | $T_J$ = 125°C, 14, $I_F$ = 12A |
| $I_{rr}$ | Diode Peak Reverse Recovery Current | — | 4.8 | 6.5 | A | $T_J$ = 25°C, See Fig. |
| | | — | 8.5 | 10 | | $T_J$ = 125°C, 15, $V_R$ = 200V |
| $Q_{rr}$ | Diode Reverse Recovery Charge | — | 110 | 190 | nC | $T_J$ = 25°C, See Fig. |
| | | | 410 | 550 | | $T_J$ = 125°C, 16, di/dt 200A/µs |
| $di_{(rec)M}/dt$ | Diode Peak Rate of Fall of Recovery | — | 260 | — | A/µs | $T_J$ = 25°C, See Fig. |
| | During $t_b$ | — | 270 | — | | $T_J$ = 125°C, 17 |

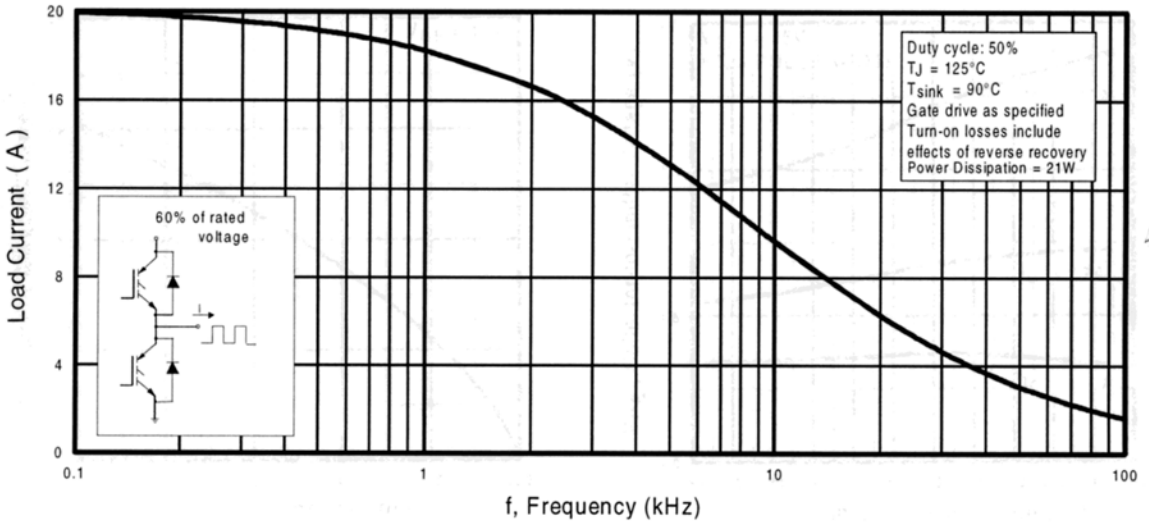



**Fig. 1** - Typical Load Current vs. Frequency
(For square wave, $I=I_{RMS}$ of fundamental; for triangular wave, $I=I_{PK}$)

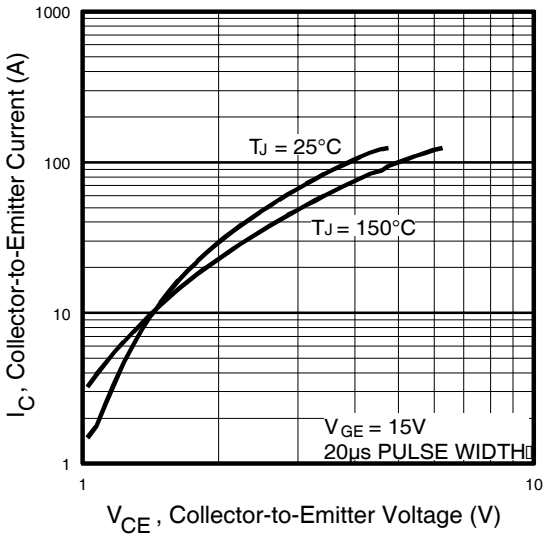



**Fig. 2** - Typical Output Characteristics

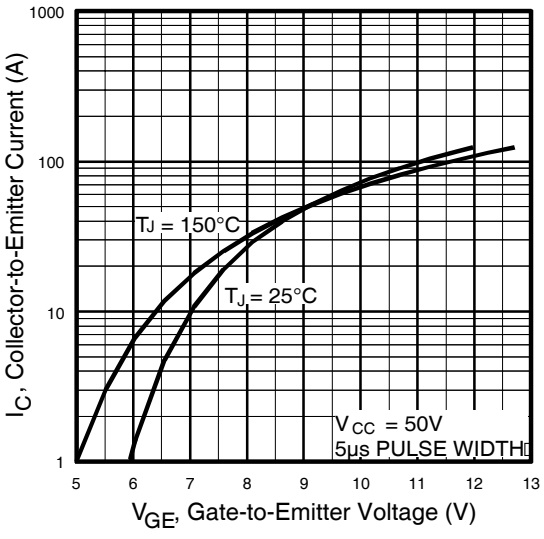



**Fig. 3** - Typical Transfer Characteristics

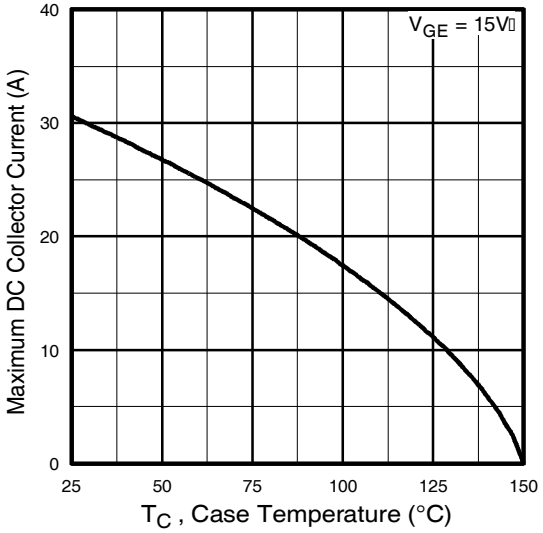



**Fig. 4** - Maximum Collector Current vs. Case Temperature

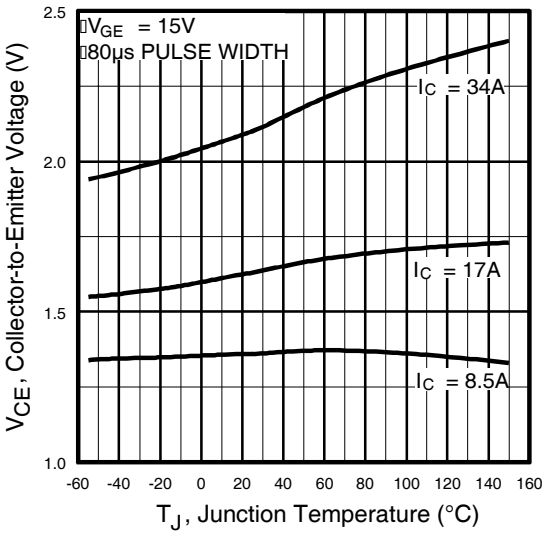



**Fig. 5** - Typical Collector-to-Emitter Voltage vs. Junction Temperature

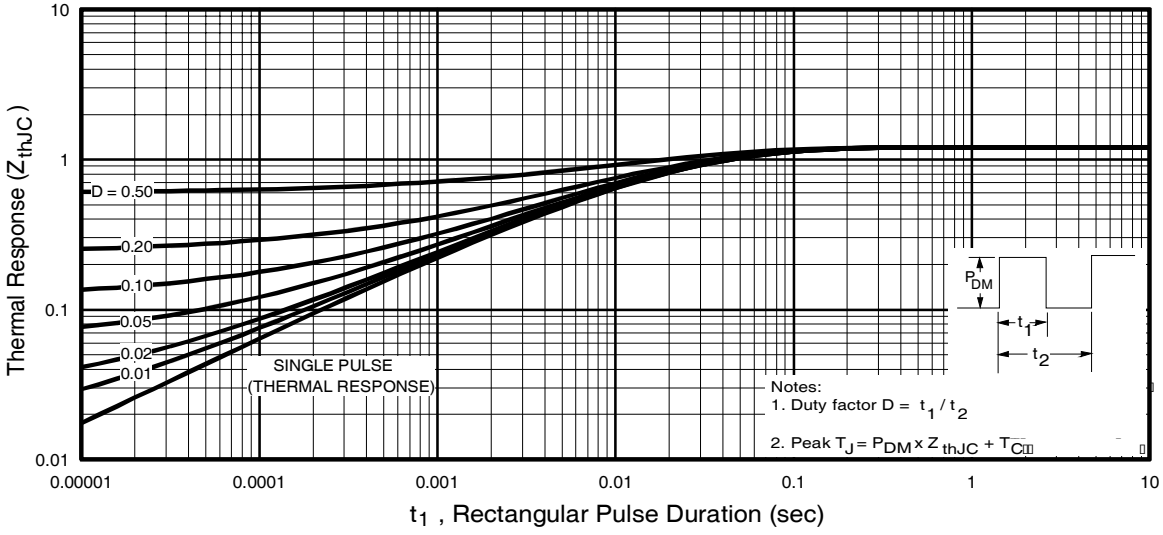



**Fig. 6** - Maximum Effective Transient Thermal Impedance, Junction-to-Case

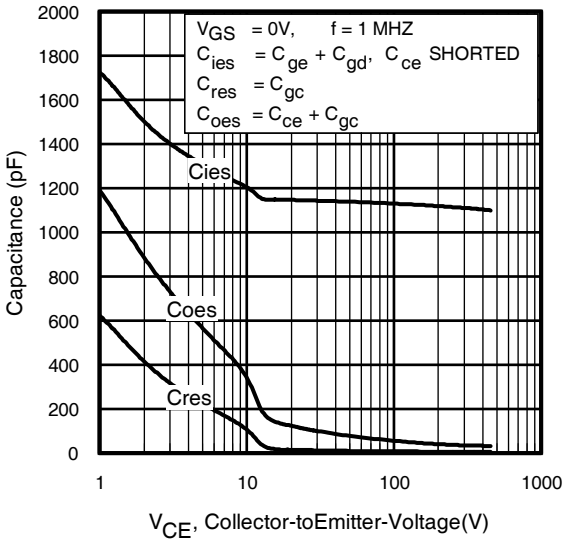



**Fig. 7 -** Typical Capacitance vs. Collector-to-Emitter Voltage

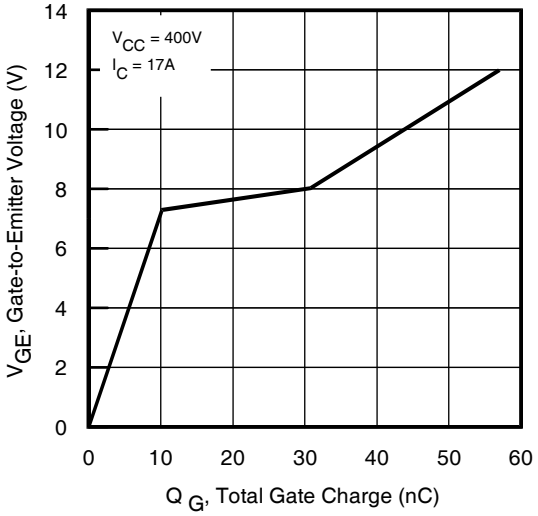



**Fig. 8** - Typical Gate Charge vs. Gate-to-Emitter Voltage

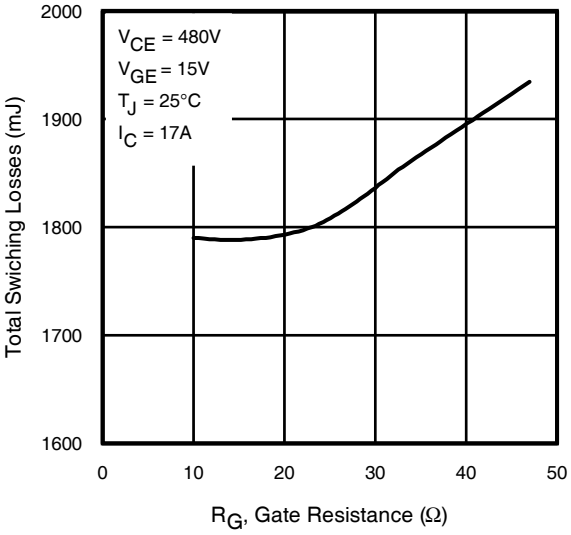



**Fig. 9** - Typical Switching Losses vs. Gate Resistance

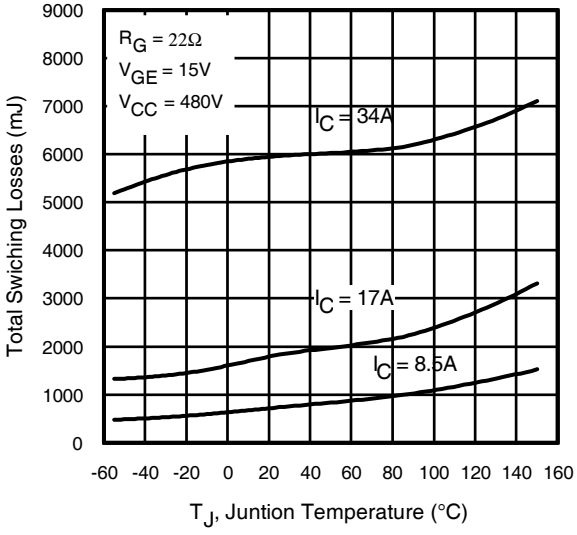



**Fig. 10** - Typical Switching Losses vs. Junction Temperature

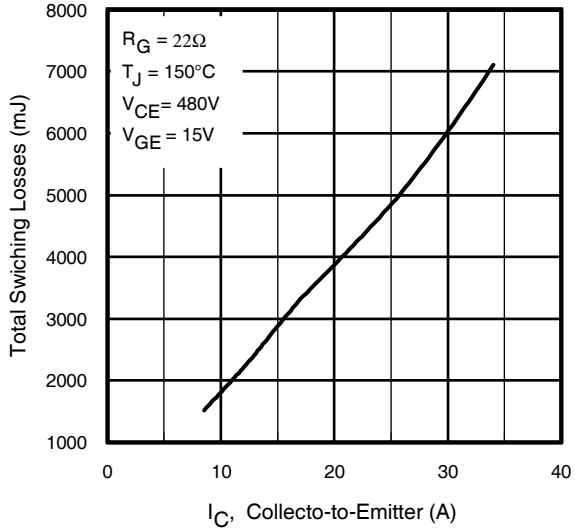



**Fig. 11 -** Typical Switching Losses vs. Collector-to-Emitter Current

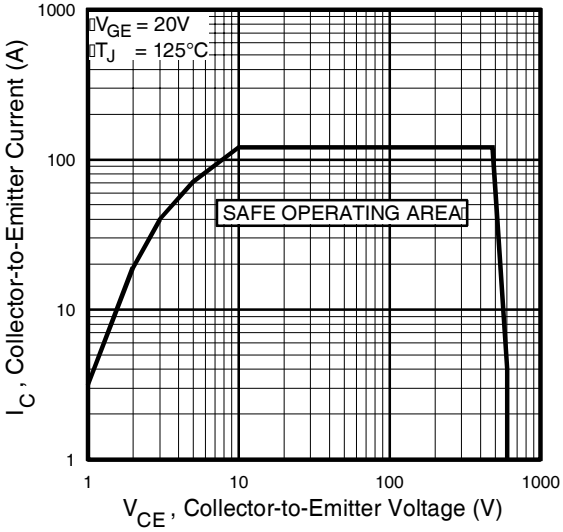



**Fig. 12** - Turn-Off SOA

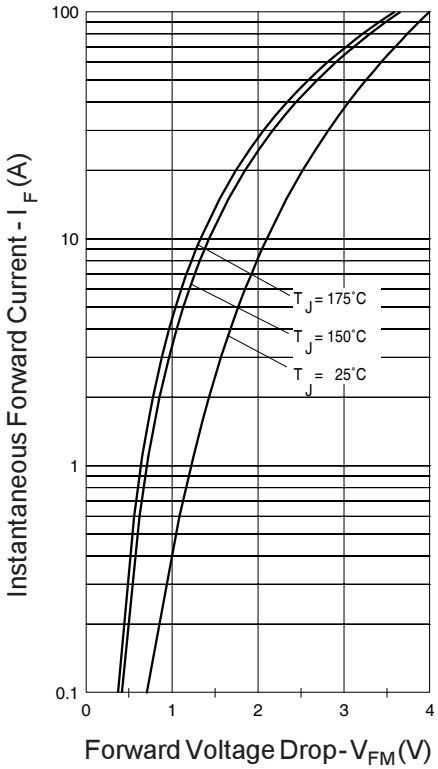



**Fig. 13** - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

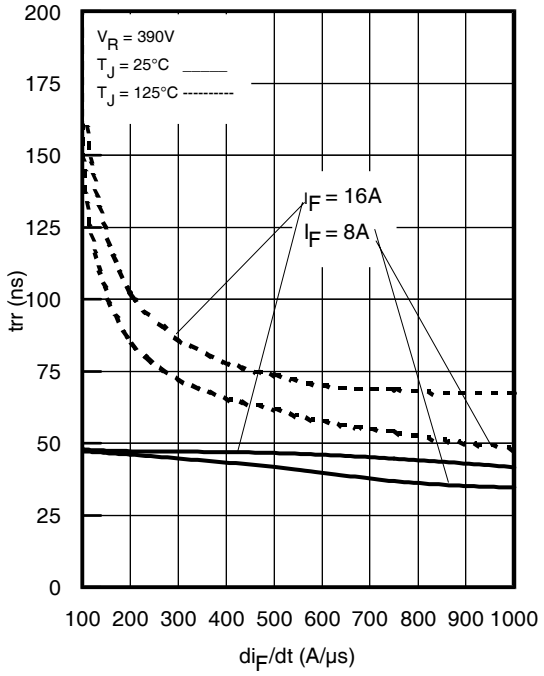



**Fig. 14** - Typical Reverse Recovery vs. $di_f/dt$

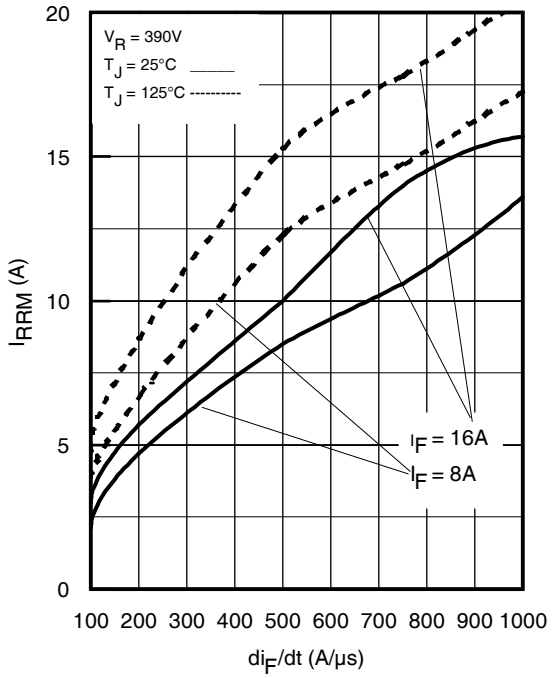



**Fig. 15** - Typical Recovery Current vs. $di_f/dt$

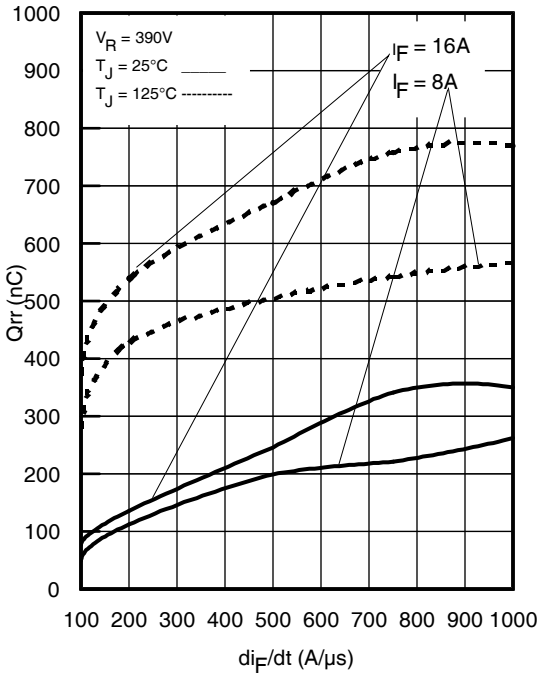



**Fig. 16** - Typical Stored Charge vs. $di_f/dt$

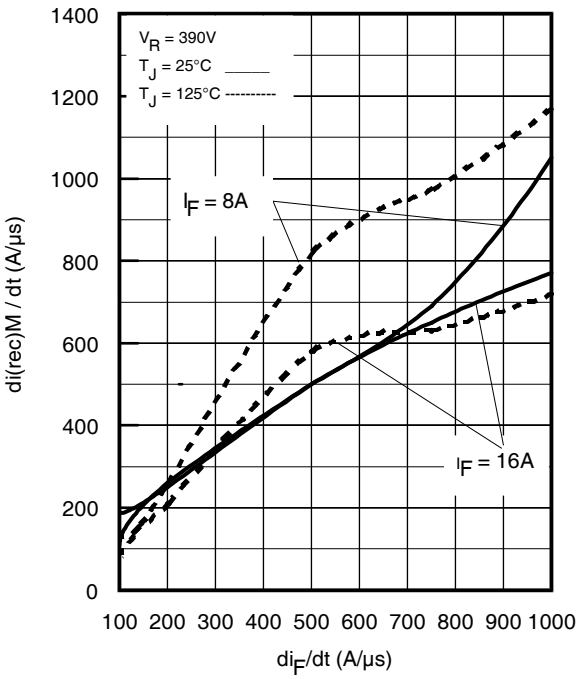



**Fig. 17** - Typical $di_{(rec)M}/dt$ vs. $di_f/dt$

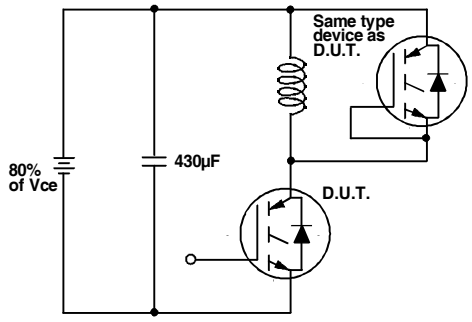



**Fig. 18a** - Test Circuit for Measurement of $I_{LM}$, $E_{on}$, $E_{off(diode)}$, $t_{rr}$, $Q_{rr}$, $I_{rr}$, $t_{d(on)}$, $t_r$, $t_{d(off)}$, $t_f$

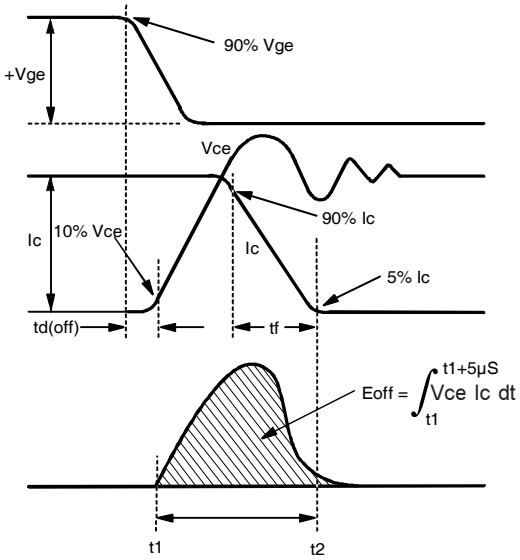



**Fig. 18b** - Test Waveforms for Circuit of Fig. 18a, Defining $E_{off}$, $t_{d(off)}$, $t_f$

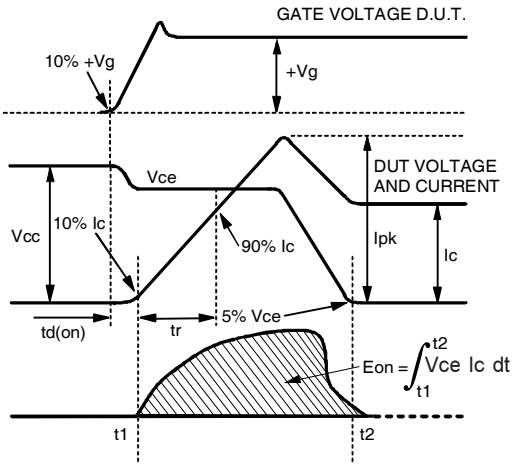



**Fig. 18c** - Test Waveforms for Circuit of Fig. 18a, Defining $E_{on}$, $t_{d(on)}$, $t_r$

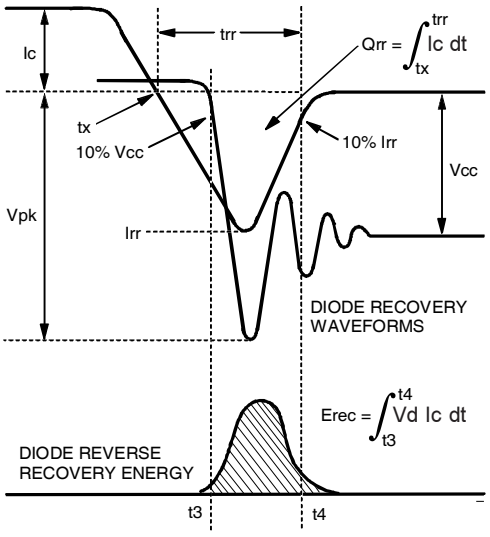



**Fig. 18d** - Test Waveforms for Circuit of Fig. 18a, Defining $E_{rec}$, $t_{rr}$, $Q_{rr}$, $I_{rr}$

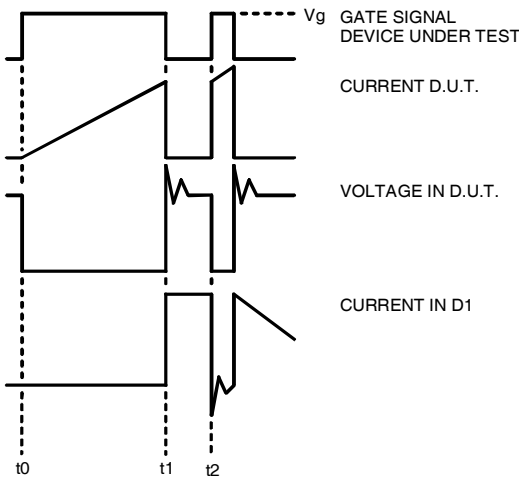



**Fig.18e** - Macro Waveforms for Figure 18a's Test Circuit

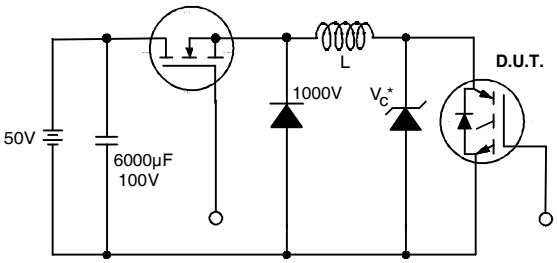
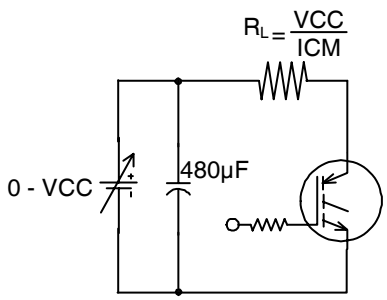


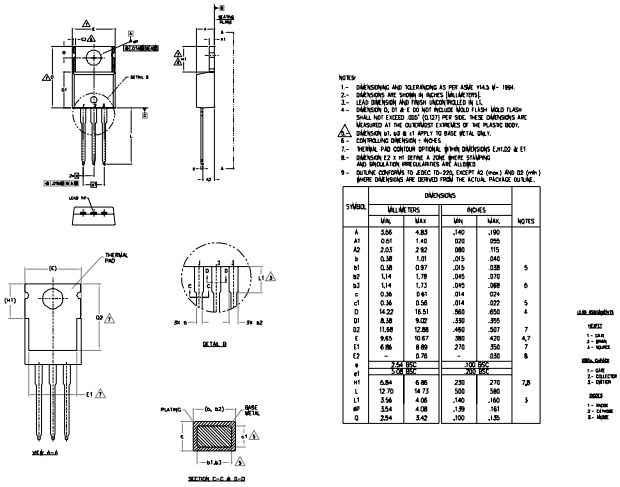

**Fig. 19** - Clamped Inductive Load Test Circuit




Pulsed Collector Current
Test Circuit

**Fig. 20** - Pulsed Collector Current
Test Circuit

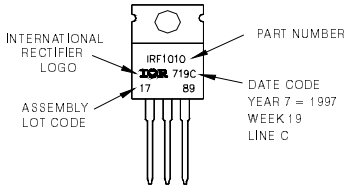
## TO-220AB Package Outline (Dimensions are shown in millimeters (inches))



## TO-220AB Part Marking Information

EXAMPLE: THIS IS AN IRF1010
LOT CODE 1789
ASSEMBLED ON WW 19, 1997
IN THE ASSEMBLY LINE "C"

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




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

## 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, $R_G$ = 23Ω (figure 19).

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

④ Pulse width 5.0µs, single shot.

⑤ Energy losses include "tail" and diode reverse recovery, using Diode FD100H06A5.

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.

International
IOR Rectifier

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