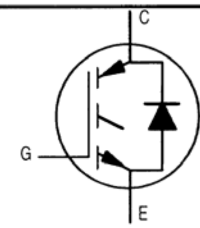
PD- 95895

International
**IOR** Rectifier

# IRG4PSC71UDPbF

UltraFast CoPack IGBT

## INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

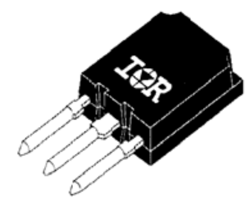



n-channel

$V_{CES}$ = 600V

$V_{CE(on)\ typ.}$ = 1.67V

@$V_{GE}$ = 15V, $I_C$ = 60A



SUPER - 247

### Features

- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency (minimum switching and conduction losses) than prior generations
- IGBT co-packaged with HEXFRED ultrafast, ultrasoft recovery anti-parallel diodes for use in bridge configurations
- Industry-benchmark Super-247 package with higher power handling capability compared to same footprint TO-247
- Creepage distance increased to 5.35mm
- Lead-Free

### Benefits

- Generation 4 IGBT's offer highest efficiencies available
- Maximum power density, twice the power handling of TO-247, less space than TO-264
- IGBTs optimized for specific application conditions
- HEXFRED diodes optimized for performance with IGBTs
- Cost and space saving in designs that require multiple, paralleled IGBTs

### Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---|---|---|---|
| $V_{CES}$ | Collector-to-Emitter Voltage | 600 | V |
| $I_C$ @ $T_C$ = 25°C | Continuous Collector Current | 85⑤ | A |
| $I_C$ @ $T_C$ = 100°C | Continuous Collector Current | 60 | |
| $I_{CM}$ | Pulsed Collector Current ① | 200 | |
| $I_{LM}$ | Clamped Inductive Load Current ② | 200 | |
| $I_F$ @ $T_C$ = 100°C | Diode Continuous Forward Current | 60 | |
| $I_{FM}$ | Diode Maximum Forward Current | 350 | |
| $V_{GE}$ | Gate-to-Emitter Voltage | ± 20 | V |
| $P_D$ @ $T_C$ = 25°C | Maximum Power Dissipation | 350 | W |
| $P_D$ @ $T_C$ = 100°C | Maximum Power Dissipation | 140 | |
| $T_J$<br>$T_{STG}$ | Operating Junction and<br>Storage Temperature Range | -55 to +150 | °C |
| | Soldering Temperature, for 10 sec. | 300 (0.063 in. (1.6mm) from case) | |

### Thermal Resistance\ Mechanical

| | Parameter | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| $R_{\theta JC}$ | Junction-to-Case - IGBT | —— | —— | 0.36 | °C/W |
| $R_{\theta JC}$ | Junction-to-Case - Diode | —— | —— | 0.69 | |
| $R_{\theta CS}$ | Case-to-Sink, flat, greased surface | —— | 0.24 | —— | |
| $R_{\theta JA}$ | Junction-to-Ambient, typical socket mount | —— | —— | 38 | |
| | Recommended Clip Force | 20.0(2.0) | —— | —— | N (kgf) |
| | Weight | —— | 6 (0.21) | —— | g (oz) |



09/13/04

## 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 | — | 0.39 | — | V/°C | $V_{GE}$ = 0V, $I_C$ = 10mA | |
| $V_{CE(on)}$ | Collector-to-Emitter Saturation Voltage | — | 1.67 | 2.0 | V | $I_C$ = 60A | $V_{GE}$ = 15V |
| | | — | 1.95 | — | | $I_C$ = 100A | See Fig. 2, 5 |
| | | — | 1.71 | — | | $I_C$ = 60A, $T_J$ = 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 | — | -13 | — | mV/°C | $V_{CE}$ = $V_{GE}$, $I_C$ = 1.5mA | |
| $g_{fe}$ | Forward Transconductance ④ | 47 | 70 | — | S | $V_{CE}$ = 50V, $I_C$ = 60A | |
| $I_{CES}$ | Zero Gate Voltage Collector Current | — | — | 500 | μA | $V_{GE}$ = 0V, $V_{CE}$ = 600V | |
| | | — | — | 13 | mA | $V_{GE}$ = 0V, $V_{CE}$ = 600V, $T_J$ = 150°C | |
| $V_{FM}$ | Diode Forward Voltage Drop | — | 1.4 | 1.7 | V | $I_C$ = 60A | See Fig. 13 |
| | | — | 1.3 | — | | $I_C$ = 60A, $T_J$ = 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) | — | 340 | 520 | nC | $I_C$ = 60A | |
| Qge | Gate - Emitter Charge (turn-on) | — | 44 | 66 | | $V_{CC}$ = 400V See Fig. 8 | |
| $Q_{gc}$ | Gate - Collector Charge (turn-on) | — | 160 | 240 | | $V_{GE}$ = 15V | |
| $t_{d(on)}$ | Turn-On Delay Time | — | 90 | — | ns | $T_J$ = 25°C | |
| $t_r$ | Rise Time | — | 94 | — | | $I_C$ = 60A, $V_{CC}$ = 480V | |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 245 | 368 | | $V_{GE}$ = 15V, $R_G$ = 5.0Ω | |
| $t_f$ | Fall Time | — | 110 | 167 | | Energy losses include "tail" and | |
| $E_{on}$ | Turn-On Switching Loss | — | 3.26 | — | mJ | diode reverse recovery. | |
| $E_{off}$ | Turn-Off Switching Loss | — | 2.27 | — | | See Fig. 9, 10, 11, 18 | |
| $E_{ts}$ | Total Switching Loss | — | 5.53 | 7.2 | | | |
| $t_{d(on)}$ | Turn-On Delay Time | — | 91 | — | ns | $T_J$ = 150°C, See Fig. 9, 10, 11, 18 | |
| $t_r$ | Rise Time | — | 88 | — | | $I_C$ = 60A, $V_{CC}$ = 480V | |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 353 | — | | $V_{GE}$ = 15V, $R_G$ = 5.0Ω | |
| $t_f$ | Fall Time | — | 150 | — | | Energy losses include "tail" and | |
| $E_{ts}$ | Total Switching Loss | — | 7.1 | — | mJ | diode reverse recovery. | |
| $L_E$ | Internal Emitter Inductance | — | 13 | — | nH | Measured 5mm from package | |
| $C_{ies}$ | Input Capacitance | — | 7500 | — | pF | $V_{GE}$ = 0V | |
| $C_{oes}$ | Output Capacitance | — | 720 | — | | $V_{CC}$ = 30V See Fig. 7 | |
| $C_{res}$ | Reverse Transfer Capacitance | — | 93 | — | | $f$ = 1.0MHz | |
| $t_{rr}$ | Diode Reverse Recovery Time | — | 82 | 120 | ns | $T_J$ = 25°C See Fig. | |
| | | — | 140 | 210 | | $T_J$ = 125°C 14 | $I_F$ = 60A |
| $I_{rr}$ | Diode Peak Reverse Recovery Current | — | 8.2 | 12 | A | $T_J$ = 25°C See Fig. | |
| | | — | 13 | 20 | | $T_J$ = 125°C 15 | $V_R$ = 200V |
| $Q_{rr}$ | Diode Reverse Recovery Charge | — | 364 | 546 | nC | $T_J$ = 25°C See Fig. | |
| | | — | 1084 | 1625 | | $T_J$ = 125°C 16 | di/dt = 200A/μs |
| $di_{(rec)M}/dt$ During $t_b$ | Diode Peak Rate of Fall of Recovery | — | 328 | — | A/μs | $T_J$ = 25°C See Fig. | |
| | | — | 266 | — | | $T_J$ = 125°C 17 | |

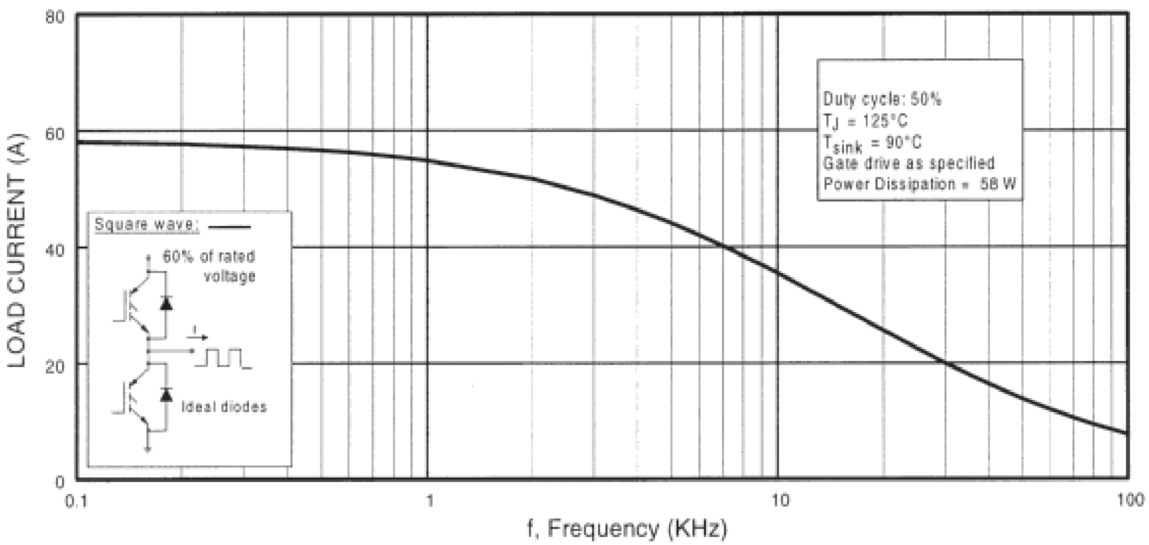



**Fig. 1** - Typical Load Current vs. Frequency
(Load Current = $I_{RMS}$ of fundamental)

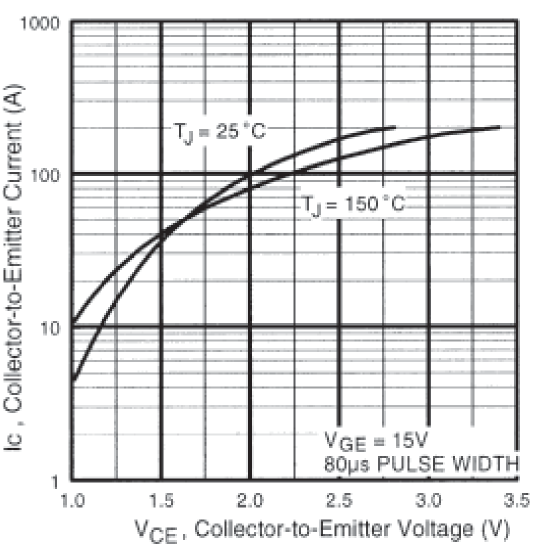



**Fig. 2** - Typical Output Characteristics

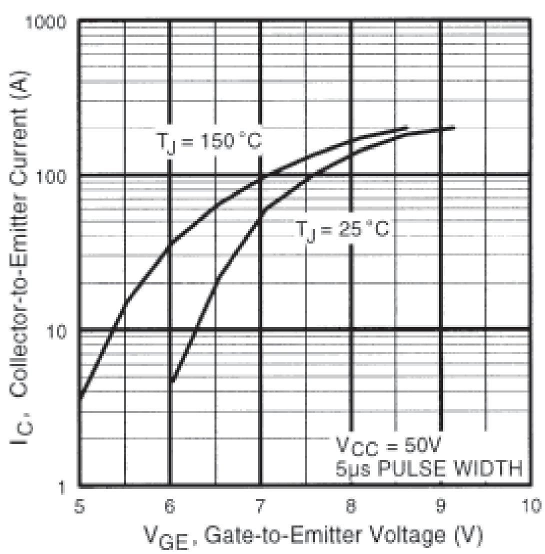



**Fig. 3** - Typical Transfer Characteristics

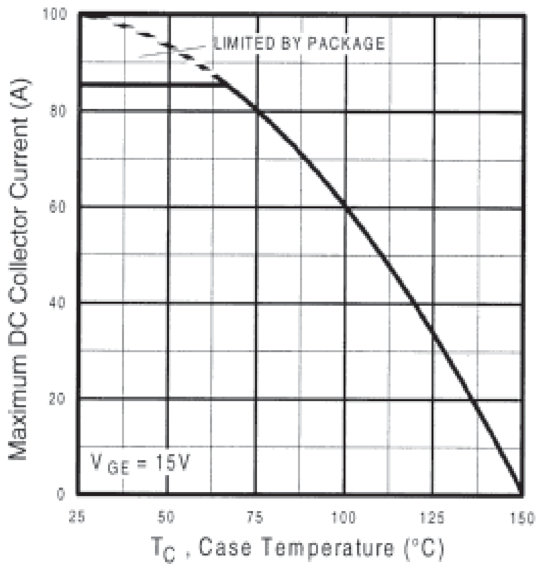



Fig. 4 - Maximum Collector Current vs. Case Temperature

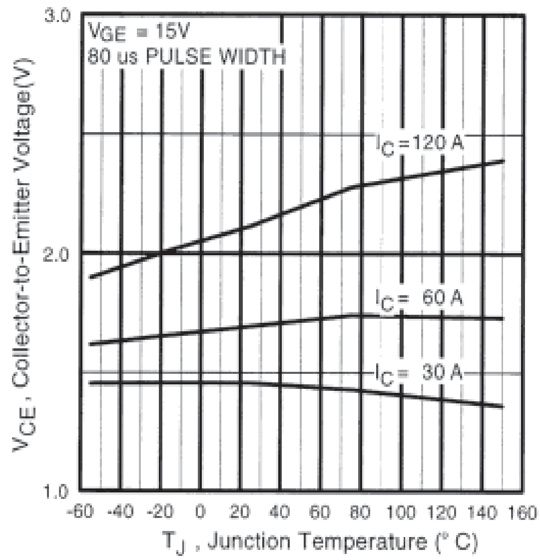



Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

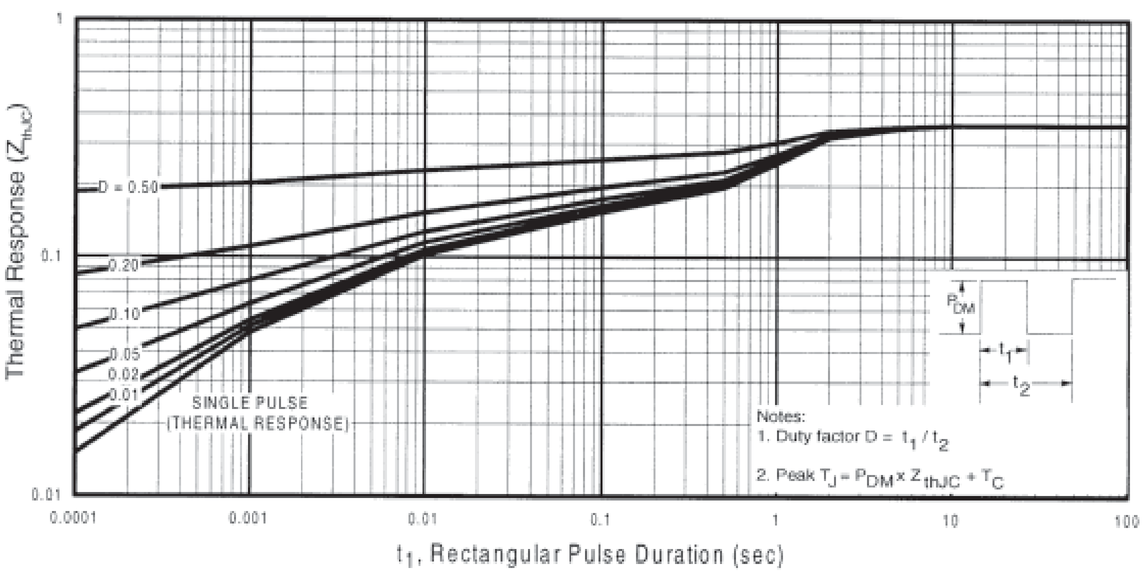



Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case

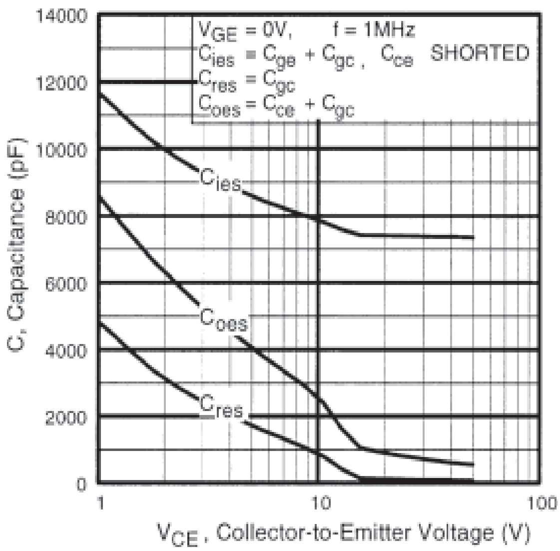



**Fig. 7 -** Typical Capacitance vs. Collector-to-Emitter Voltage

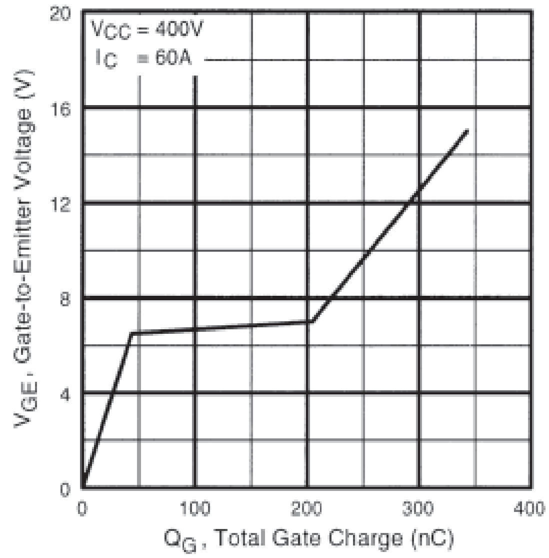



**Fig. 8** - Typical Gate Charge vs. Gate-to-Emitter Voltage

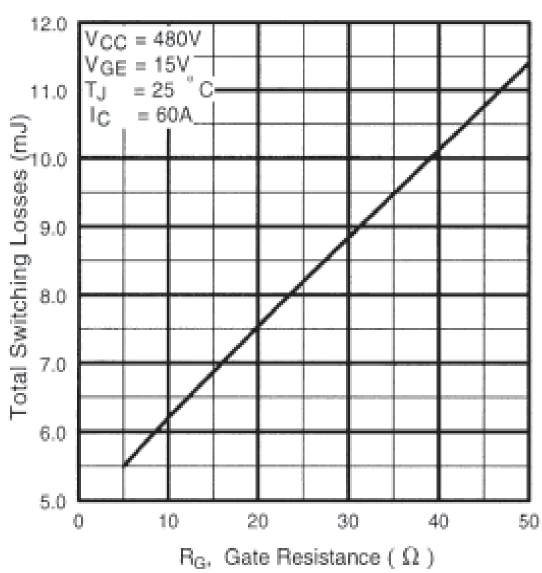



**Fig. 9** - Typical Switching Losses vs. Gate Resistance

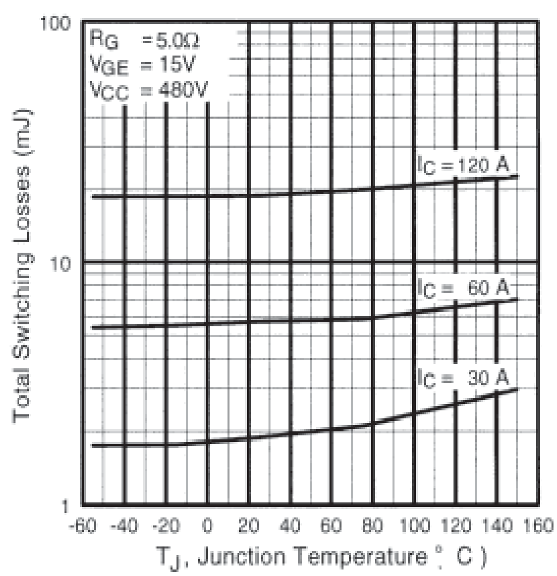



**Fig. 10** - Typical Switching Losses vs. Junction Temperature

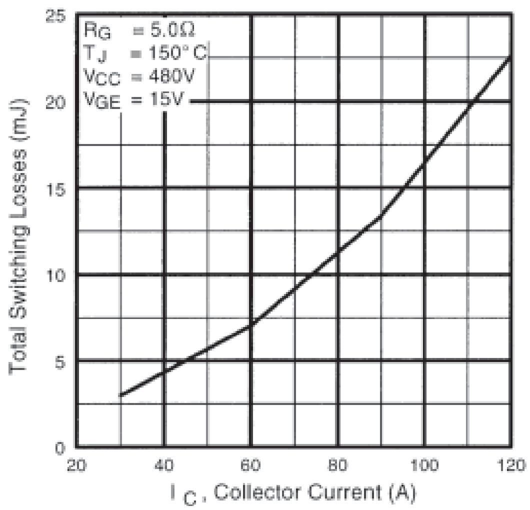



**Fig. 11 -** Typical Switching Losses vs. Collector-to-Emitter Current

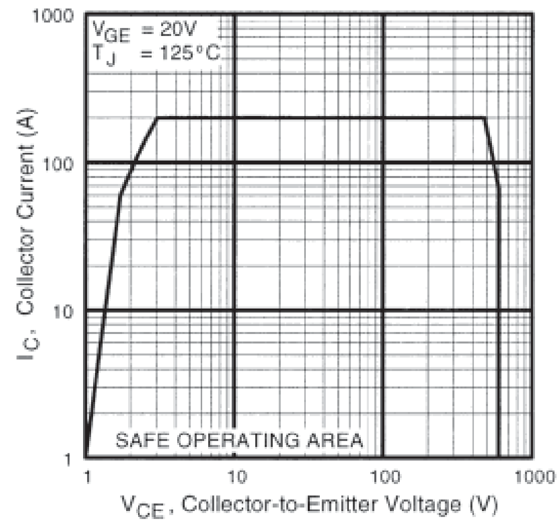



**Fig. 12** - Turn-Off SOA

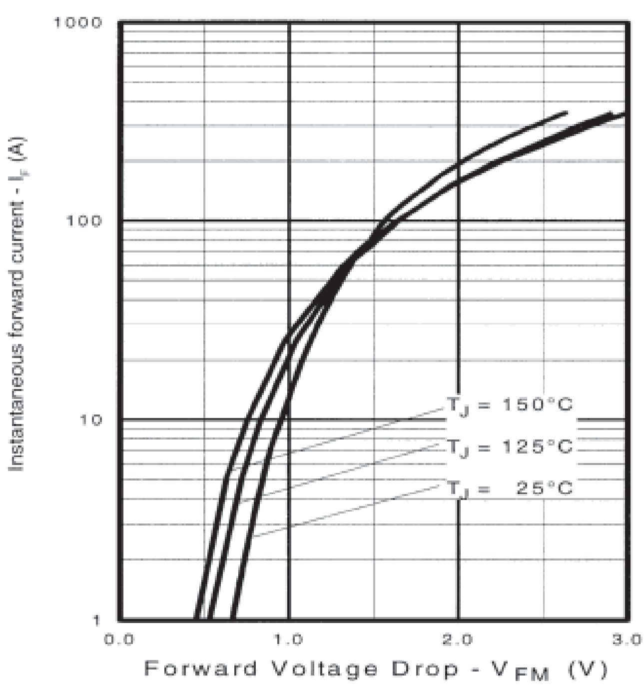



**Fig. 13** - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

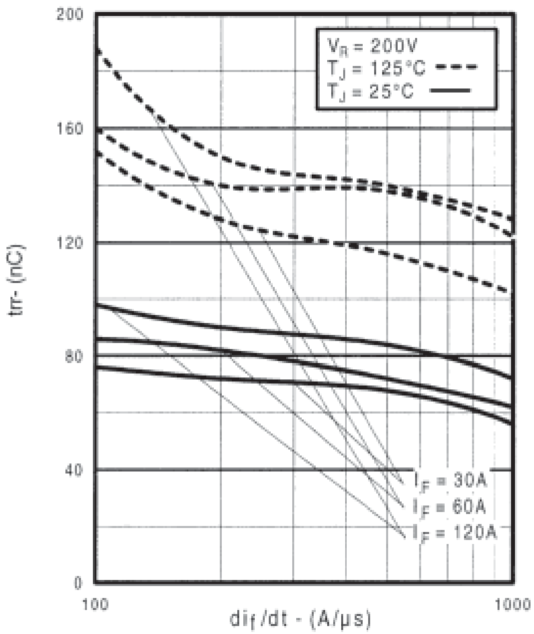



**Fig. 14** - Typical Reverse Recovery vs. $di_f/dt$

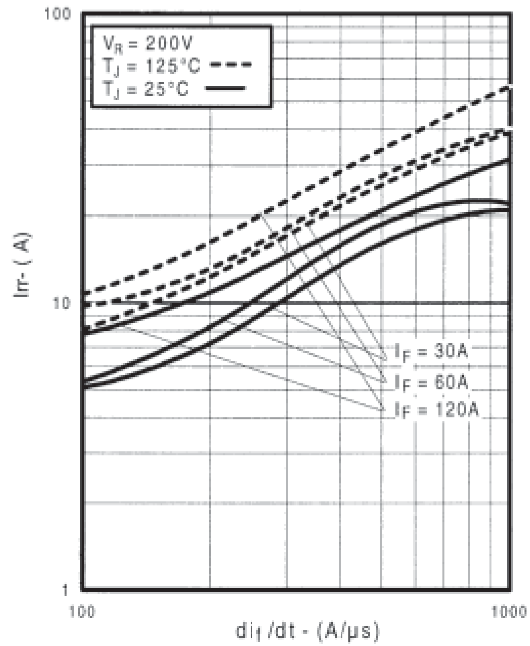



**Fig. 15** - Typical Recovery Current vs. $di_f/dt$

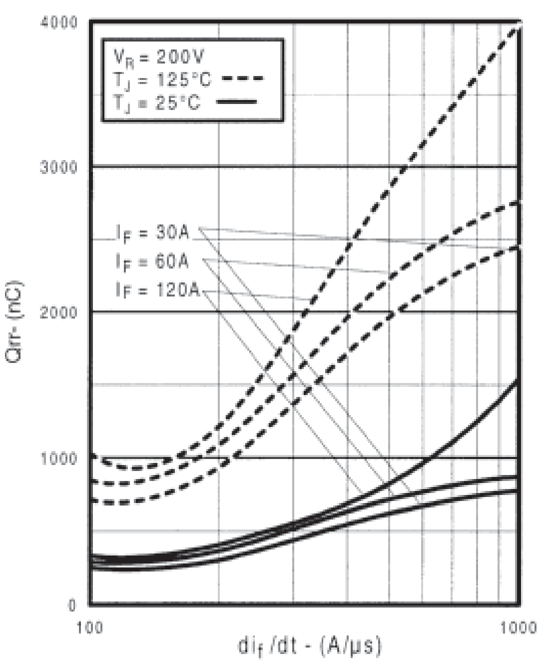



**Fig. 16** - Typical Stored Charge vs. $di_f/dt$

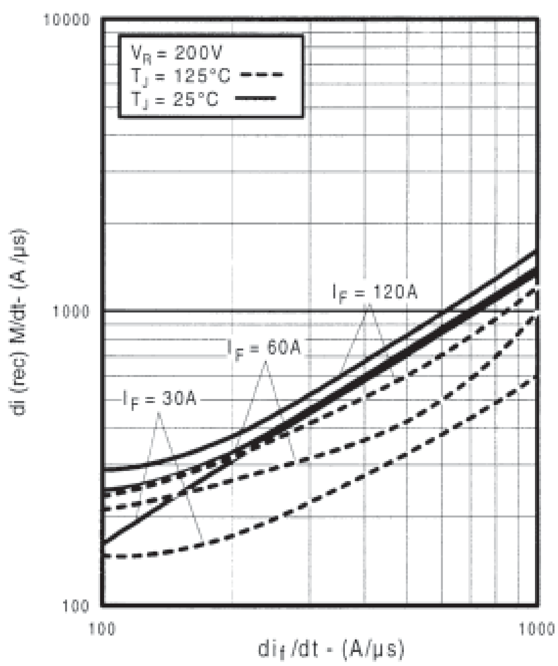



**Fig. 17** - Typical $di_{(rec)M}/dt$ vs. $di_f/dt$

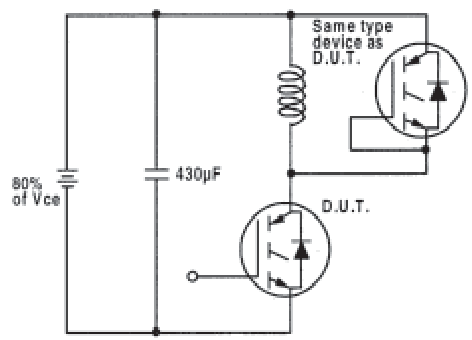



**Fig. 18a** - Test Circuit for Measurement of
$I_{LM}$, $E_{on}$, $E_{off(diode)}$, $t_{rr}$, $Q_{rr}$, $I_{rr}$, $t_{d(on)}$, $t_r$, $t_{d(off)}$, $t_f$

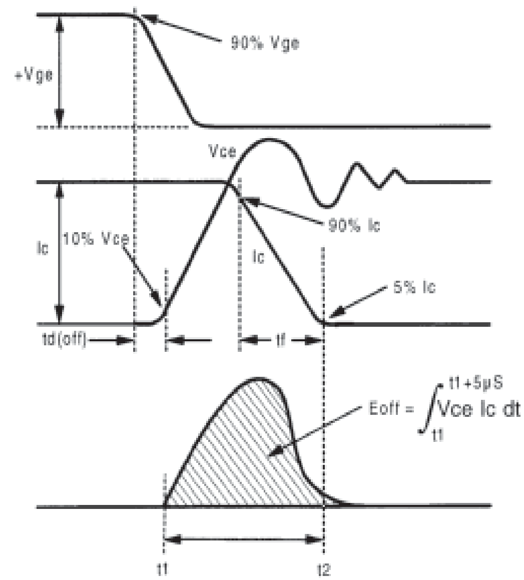



**Fig. 18b** - Test Waveforms for Circuit of Fig. 18a, Defining
$E_{off}$, $t_{d(off)}$, $t_f$

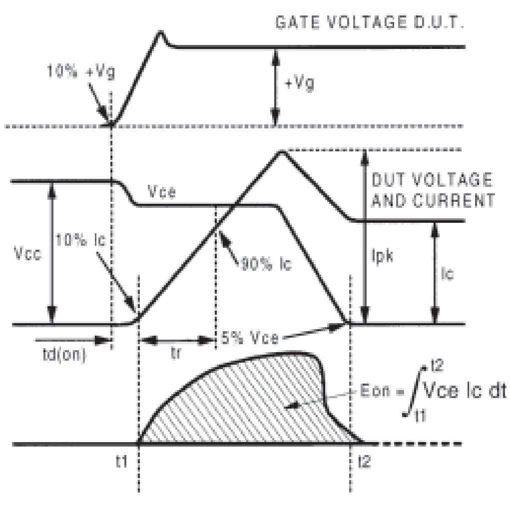



**Fig. 18c** - Test Waveforms for Circuit of Fig. 18a,
Defining $E_{on}$, $t_{d(on)}$, $t_r$

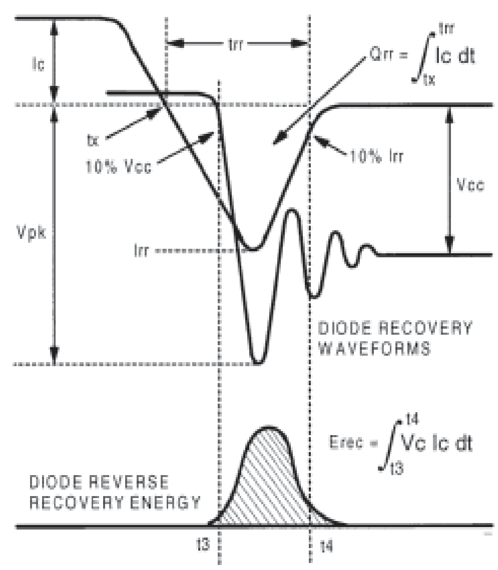



**Fig. 18d** - Test Waveforms for Circuit of Fig. 18a,
Defining $E_{rec}$, $t_{rr}$, $Q_{rr}$, $I_{rr}$

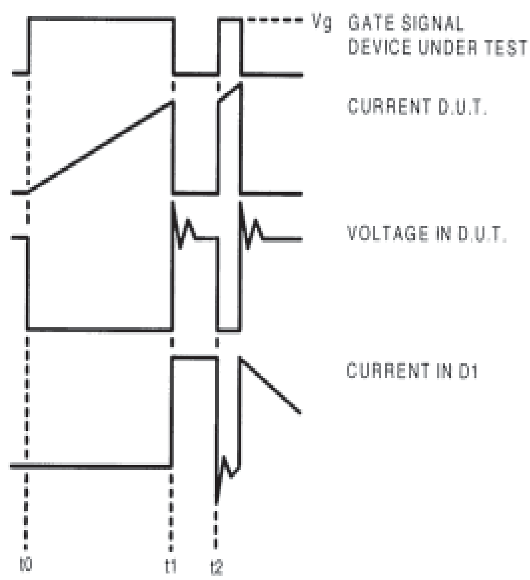



Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

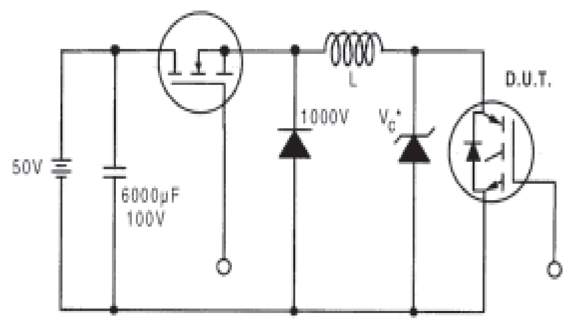



Figure 19. Clamped Inductive Load Test Circuit

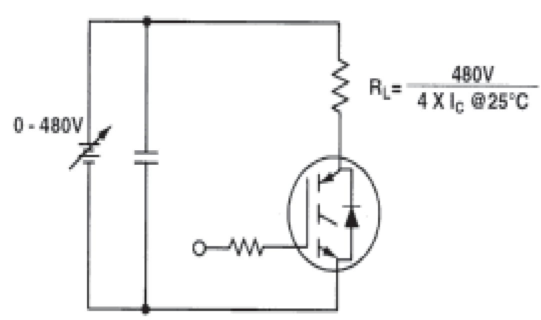



Figure 20. Pulsed Collector Current Test Circuit

Notes:

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

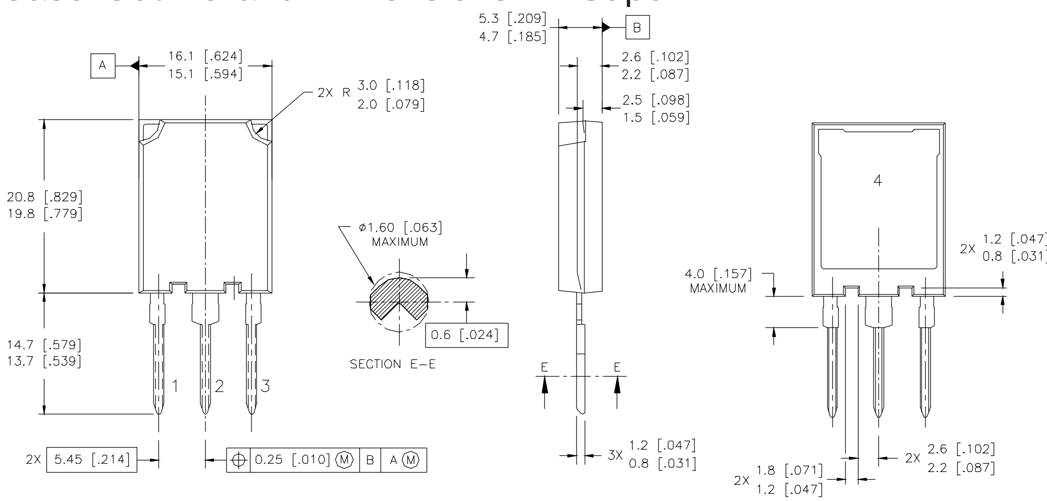
② $V_{CC}$=80%($V_{CES}$), $V_{GE}$=20V, L=10µH, $R_G$= 5.0Ω (figure 19)

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

④ Pulse width 5.0µs, single shot

⑤ Current limited by the package, (Die current = 100A)

## Case Outline and Dimensions — Super-247



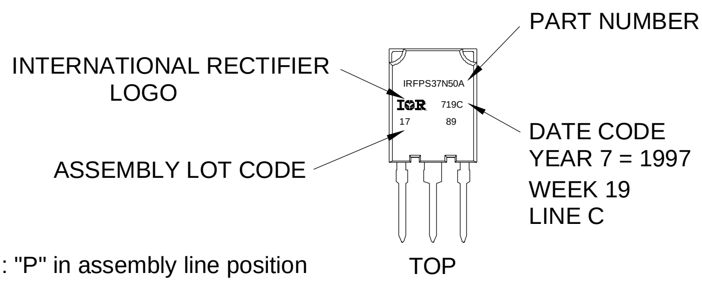

NOTES:
1. DIMENSIONS & TOLERANCING PER ASME Y14.5M-1994
2. CONTROLLING DIMENSION: MILLIMETER
3. DIMENSIONS ARE SHOWN IN MILLIMETRES [INCHES]

LEAD ASSIGNMENTS

| MOSFET | IGBT |
|---|---|
| 1 - GATE | 1 - GATE |
| 2 - DRAIN | 2 - COLLECTOR |
| 3 - SOURCE | 3 - EMITTER |
| 4 - DRAIN | 4 - COLLECTOR |

## Super-247 (TO-274AA) Part Marking Information

EXAMPLE: THIS IS AN IRFPS37N50A WITH
ASSEMBLY LOT CODE 1789
ASSEMBLED ON WW 19, 1997
IN THE ASSEMBLY LINE "C"




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

Data and specifications subject to change without notice.

International
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**IR WORLD HEADQUARTERS:** 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105
TAC Fax: (310) 252-7903
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