

International

**IR** Rectifier

INSULATED GATE BIPOLAR TRANSISTOR WITH  
ULTRAFAST SOFT RECOVERY DIODE

PD - 95908

**IRG4PSH71UDPbF**

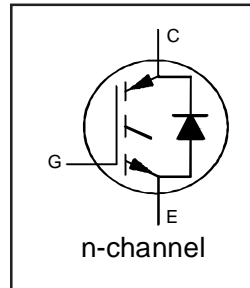
UltraFast Copack IGBT

**Features**

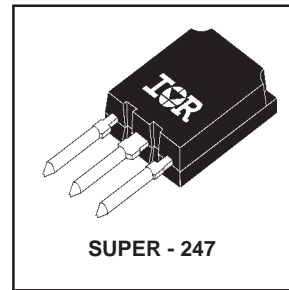
- UltraFast switching speed optimized for operating frequencies 8 to 40kHz in hard switching, 200kHz in resonant mode soft switching
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency (minimum switching and conduction losses) than prior generations
- Industry-benchmark 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 the TO-247, less space than TO-264
- IGBTs optimized for specific application conditions
- Cost and space saving in designs that require multiple, paralleled IGBTs
- HEXFRED™ antiparallel Diode minimizes switching losses and EMI



$V_{CES} = 1200V$   
 $V_{CE(on) typ.} = 2.52V$   
@  $V_{GE} = 15V, I_C = 50A$



**Absolute Maximum Ratings**

|                           | Parameter                                   | Max.                              | Units |
|---------------------------|---|-----------------------------------|-------|
| $V_{CES}$                 | Collector-to-Emitter Voltage                | 1200                              | V     |
| $I_C @ T_C = 25^\circ C$  | Continuous Collector Current                | 99                                | A     |
| $I_C @ T_C = 100^\circ C$ | Continuous Collector Current                | 50                                |       |
| $I_{CM}$                  | Pulse Collector Current <sup>Ⓢ</sup>        | 200                               |       |
| $I_{LM}$                  | Clamped Inductive Load current <sup>Ⓢ</sup> | 200                               |       |
| $V_{GE}$                  | Gate-to-Emitter Voltage                     | ±20                               | V     |
| $I_F @ T_C = 100^\circ C$ | Diode Continuous Forward Current            | 70                                | W     |
| $I_{FM}$                  | Diode Maximum Forward Current               | 200                               |       |
| $P_D @ T_C = 25^\circ C$  | Maximum Power Dissipation                   | 350                               |       |
| $P_D @ T_C = 100^\circ C$ | Maximum Power Dissipation                   | 140                               |       |
| $T_J$                     | 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) |       |

**Thermal / Mechanical Characteristics**

|                 | Parameter                                 | Min.     | Typ.     | Max. | Units   |
|-----------------|---|----------|----------|------|---------|
| $R_{\theta JC}$ | Junction-to-Case- IGBT                    | ---      | ---      | 0.36 | °C/W    |
| $R_{\theta JC}$ | Junction-to-Case- Diode                   | ---      | ---      | 0.36 |         |
| $R_{\theta CS}$ | Case-to-Sink, flat, greased surface       | ---      | 0.24     | ---  |         |
| $R_{\theta JA}$ | Junction-to-Ambient, typical socket mount | ---      | ---      | 38   |         |
|                 | Recommended Clip Force                    | 20 (2.0) |          |      | N (kgf) |
| Wt              | Weight                                    | ---      | 6 (0.21) | ---  | g (oz.) |

# IRG4PSH71UDPbF

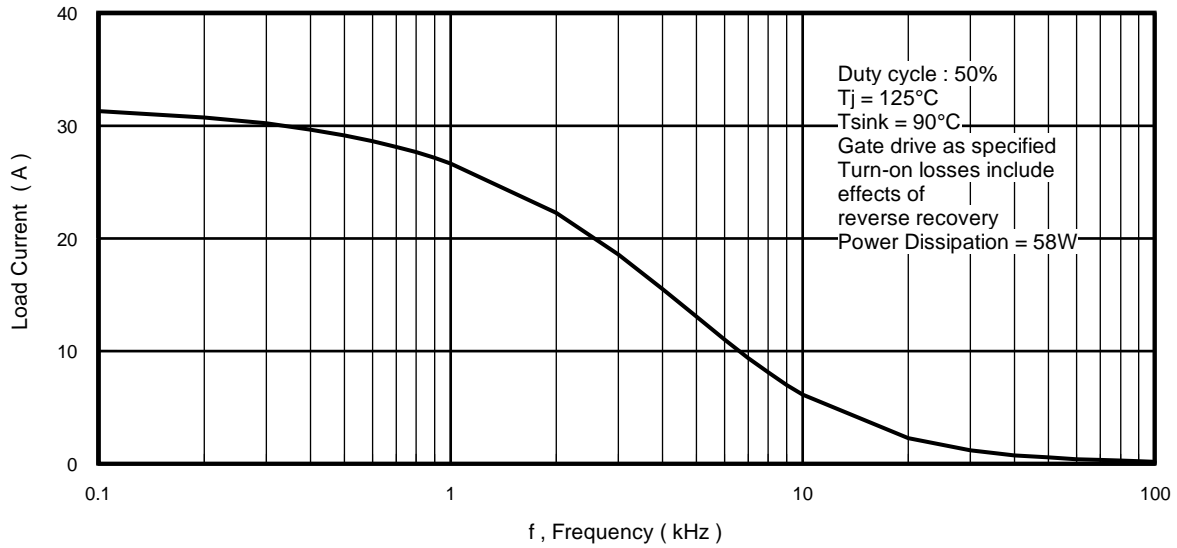
International  
IR Rectifier

## Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)

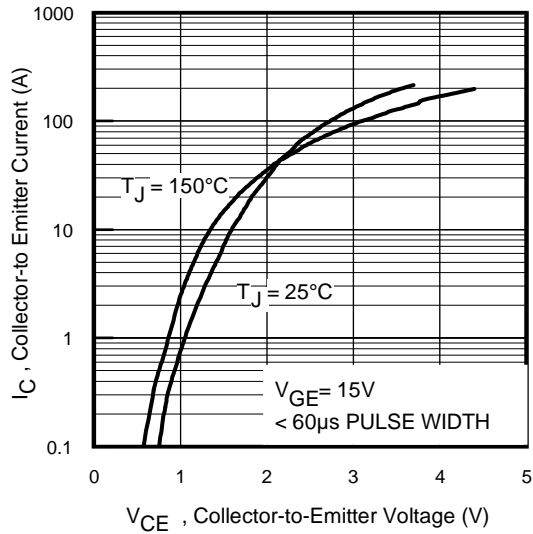
| Parameter                              | Min.                                    | Typ. | Max. | Units | Conditions   |   |
|--|---|------|------|-------|--|---|
| V <sub>(BR)CES</sub>                   | 1200                                    | —    | —    | V     | V <sub>GE</sub> = 0V, I <sub>C</sub> = 250μA               |   |
| V <sub>(BR)ECS</sub>                   | 19                                      | —    | —    | V     | V <sub>GE</sub> = 0V, I <sub>C</sub> = 1.0A                |   |
| ΔV <sub>(BR)CES</sub> /ΔT <sub>J</sub> | —                                       | 0.78 | —    | V/°C  | V <sub>GE</sub> = 0V, I <sub>C</sub> = 1mA                 |   |
| V <sub>CE(on)</sub>                    | Collector-to-Emitter Saturation Voltage | —    | 2.52 | 2.70  | V  | I <sub>C</sub> = 70A<br>I <sub>C</sub> = 140A<br>I <sub>C</sub> = 70A, T <sub>J</sub> = 150°C<br>V <sub>GE</sub> = 15V<br>See Fig.2, 5                                |
|  |   | —    | 3.17 | —     |  |   |
|  |   | —    | 2.68 | —     |  |   |
| V <sub>GE(th)</sub>                    | 3.0                                     | —    | 6.0  |       | V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250μA |   |
| ΔV <sub>GE(th)</sub> /ΔT <sub>J</sub>  | —                                       | -9.2 | —    | mV/°C | V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 1.0mA |   |
| g <sub>fE</sub>                        | 48                                      | 72   | —    | S     | V <sub>CE</sub> = 100V, I <sub>C</sub> = 70A               |   |
| I <sub>CES</sub>                       | Zero Gate Voltage Collector Current     | —    | —    | 500   | μA   | V <sub>GE</sub> = 0V, V <sub>CE</sub> = 1200V<br>V <sub>GE</sub> = 0V, V <sub>CE</sub> = 10V<br>V <sub>GE</sub> = 0V, V <sub>CE</sub> = 1200V, T <sub>J</sub> = 150°C |
|  |   | —    | —    | 2.0   |  |   |
|  |   | —    | —    | 5000  |  |   |
| V <sub>FM</sub>                        | Diode Forward Voltage Drop              | —    | 2.92 | 3.9   | V  | I <sub>F</sub> = 70A See Fig.13<br>I <sub>F</sub> = 70A, T <sub>J</sub> = 150°C   |
|  |   | —    | 2.88 | 3.7   |  |   |
| I <sub>GES</sub>                       | Gate-to-Emitter Leakage Current         | —    | —    | ±100  | nA   | V <sub>GE</sub> = ±20V  |

## Switching Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)

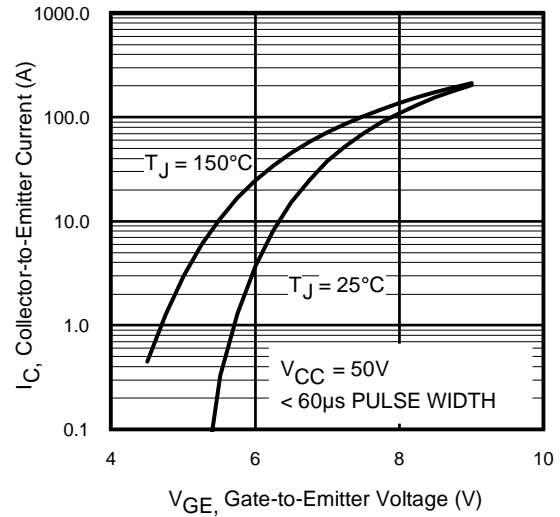
| Parameter                | Min.  | Typ. | Max. | Units | Conditions   |  |
|--------------------------|---|------|------|-------|--|--|
| Q <sub>g</sub>           | —   | 380  | 570  | nC    | I <sub>C</sub> = 70A<br>V <sub>CC</sub> = 400V See Fig.8<br>V <sub>GE</sub> = 15V  |  |
| Q <sub>ge</sub>          | —   | 61   | 24   |       |  |  |
| Q <sub>gc</sub>          | —   | 130  | 200  |       |  |  |
| t <sub>d(on)</sub>       | —   | 46   | —    | ns    | I <sub>C</sub> = 70A, V <sub>CC</sub> = 960V<br>V <sub>GE</sub> = 15V, R <sub>G</sub> = 5.0Ω<br>Energy losses include "tail"<br>See Fig. 9, 10, 11, 14                         |  |
| t <sub>r</sub>           | —   | 77   | —    |       |  |  |
| t <sub>d(off)</sub>      | —   | 250  | 350  |       |  |  |
| t <sub>f</sub>           | —   | 220  | 330  |       |  |  |
| E <sub>on</sub>          | —   | 8.8  | —    |       |  | mJ   |
| E <sub>off</sub>         | —   | 9.4  | —    |       |  |  |
| E <sub>tot</sub>         | —   | 18.2 | 19.7 |       |  |  |
| t <sub>d(on)</sub>       | —   | 43   | —    | ns    | T <sub>J</sub> = 150°C, See Fig. 9, 10, 11, 14<br>I <sub>C</sub> = 70A, V <sub>CC</sub> = 960V<br>V <sub>GE</sub> = 15V, R <sub>G</sub> = 5.0Ω<br>Energy losses include "tail" |  |
| t <sub>r</sub>           | —   | 78   | —    |       |  |  |
| t <sub>d(off)</sub>      | —   | 330  | —    |       |  |  |
| t <sub>f</sub>           | —   | 480  | —    |       |  |  |
| E <sub>TS</sub>          | —   | 26   | —    | mJ    |  |  |
| L <sub>E</sub>           | Internal Emitter Inductance                               | —    | 13   | nH    | Measured 5mm from package  |  |
| C <sub>ies</sub>         | Input Capacitance   | —    | 6640 | pF    | V <sub>GE</sub> = 0V<br>V <sub>CC</sub> = 30V, See Fig.7<br>f = 1.0MHz   |  |
| C <sub>oes</sub>         | Output Capacitance  | —    | 420  |       |  |  |
| C <sub>res</sub>         | Reverse Transfer Capacitance                              | —    | 60   |       |  |  |
| t <sub>rr</sub>          | Diode Reverse Recovery Time                               | —    | 110  | 170   | ns   | T <sub>J</sub> =25°C See Fig 14<br>T <sub>J</sub> =125°C |
|                          |   | —    | 180  | 270   |  |  |
| I <sub>rr</sub>          | Diode Peak Reverse Recovery Current                       | —    | 6.0  | 9.0   | A  | T <sub>J</sub> =25°C See Fig 15<br>T <sub>J</sub> =125°C |
|                          |   | —    | 8.9  | 13    |  |  |
| Q <sub>rr</sub>          | Diode Reverse Recovery Charge                             | —    | 350  | 530   | nC   | T <sub>J</sub> =25°C See Fig 16<br>T <sub>J</sub> =125°C |
|                          |   | —    | 870  | 1300  |  |  |
| di <sub>(rec)M</sub> /dt | Diode Peak Rate of Fall of Recovery During t <sub>b</sub> | —    | 150  | 230   | A/μs   | T <sub>J</sub> =25°C See Fig 17<br>T <sub>J</sub> =125°C |
|                          |   | —    | 130  | 200   |  |  |



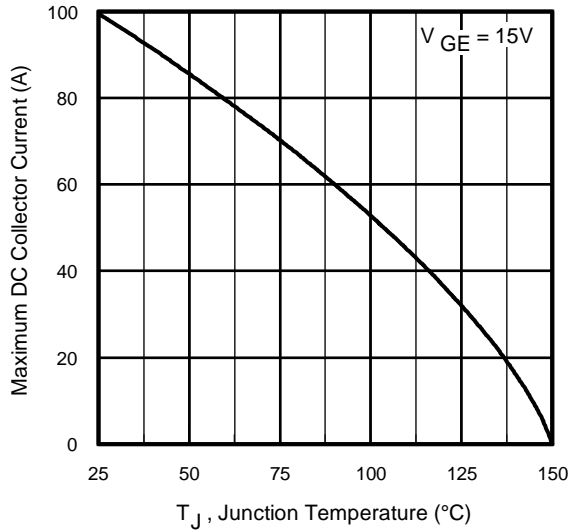
**Fig. 1 - Typical Load Current vs. Frequency**  
 (For square wave,  $I = I_{\text{RMS}}$  of fundamental; for triangular wave,  $I = I_{\text{PK}}$ )



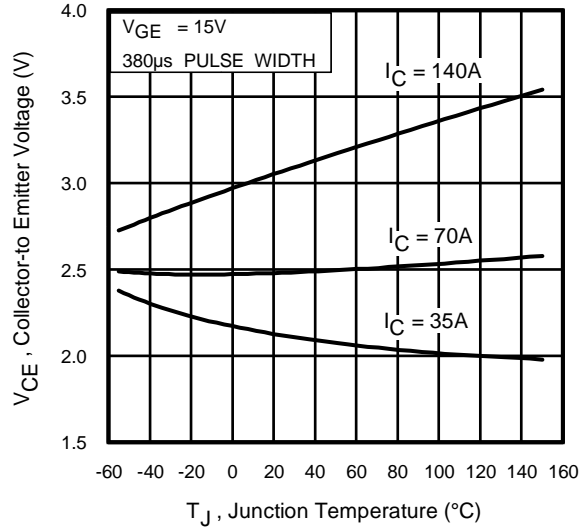
**Fig. 2 - Typical Output Characteristics**



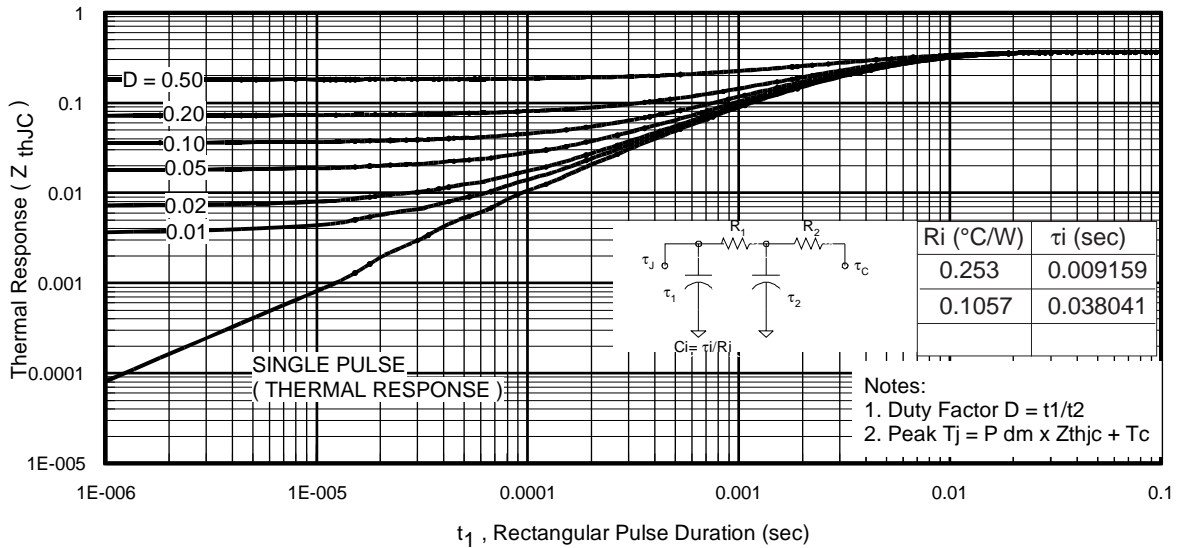
**Fig. 3 - Typical Transfer Characteristics**



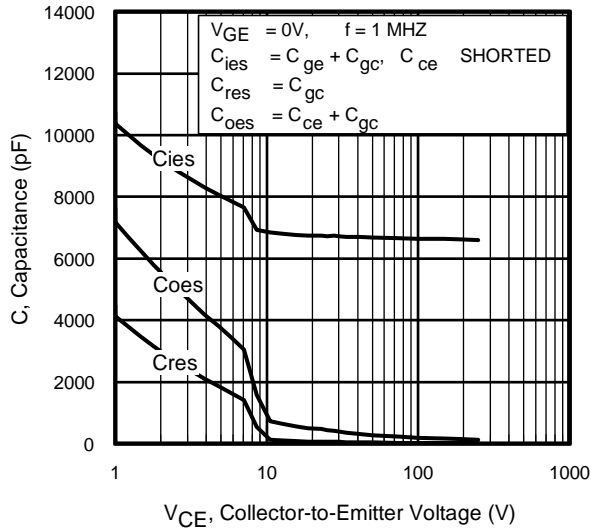
**Fig. 4** - Maximum Collector Current vs. Case Temperature



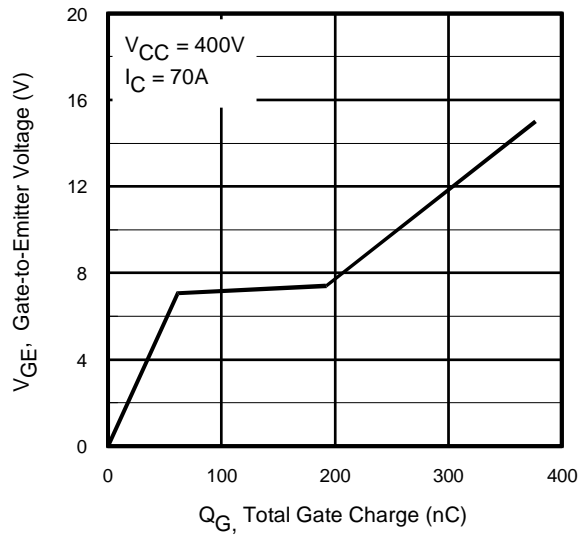
**Fig. 5** - Collector-to-Emitter Voltage vs. Junction Temperature



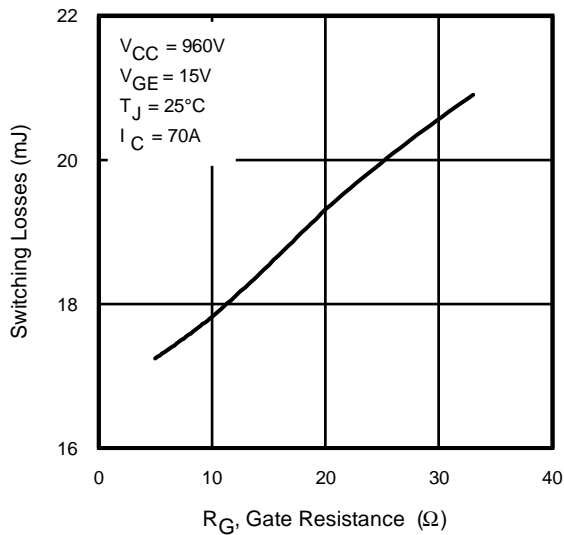
**Fig. 6** - Maximum Effective Transient Thermal Impedance, Junction-to-Case



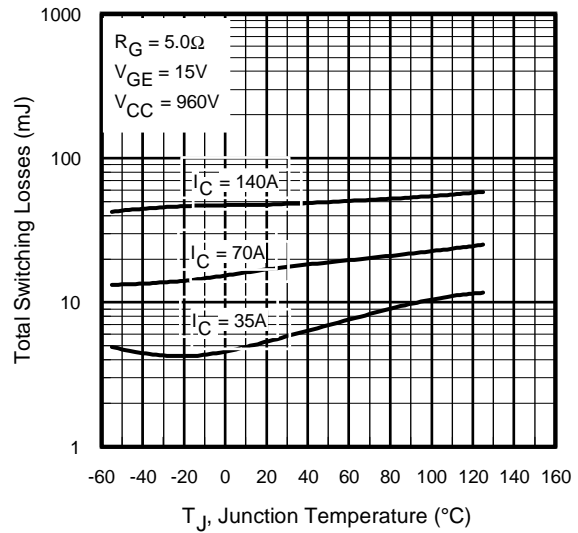
**Fig. 7** - Typical Capacitance vs. Collector-to-Emitter Voltage



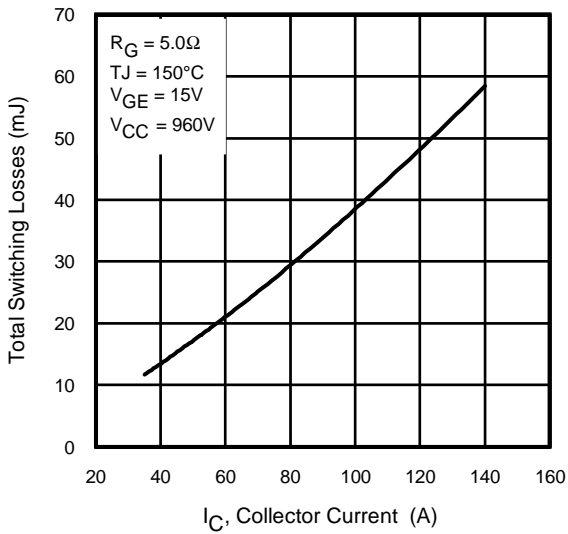
**Fig. 8** - Typical Gate Charge vs. Gate-to-Emitter Voltage



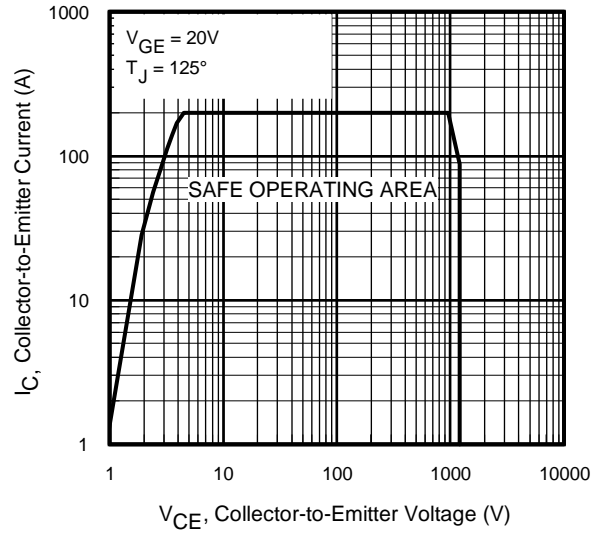
**Fig. 9** - Typical Switching Losses vs. Gate Resistance



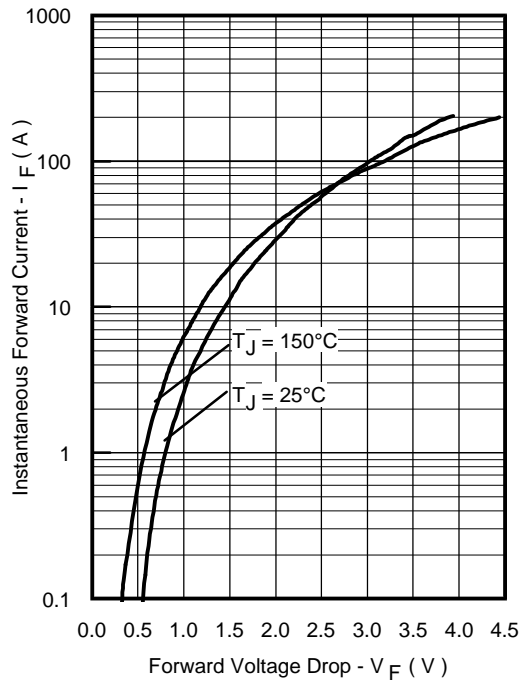
**Fig. 10** - Typical Switching Losses vs. Junction Temperature



**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

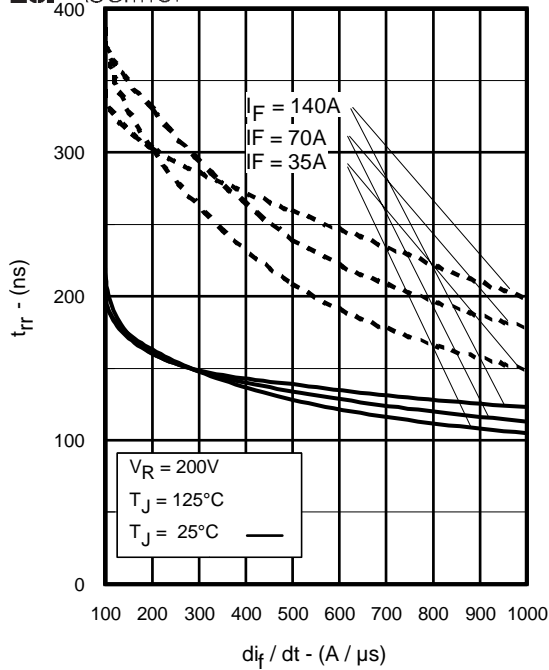


Fig. 14 - Typical Reverse Recovery vs.  $di_f/dt$

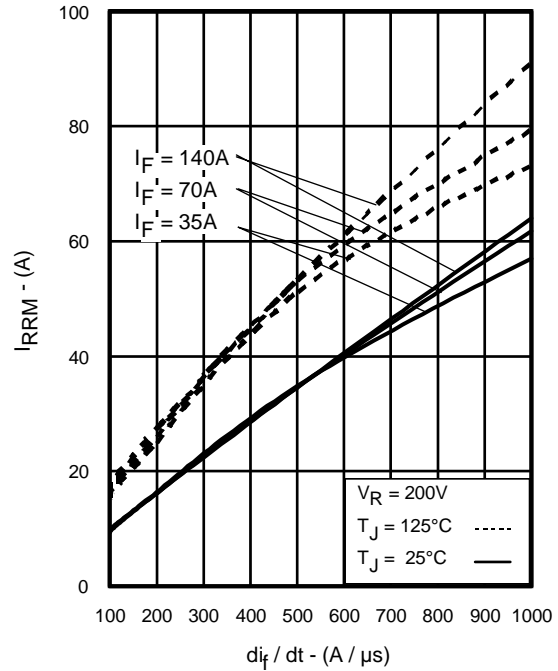


Fig. 15 - Typical Recovery Current vs.  $di_f/dt$

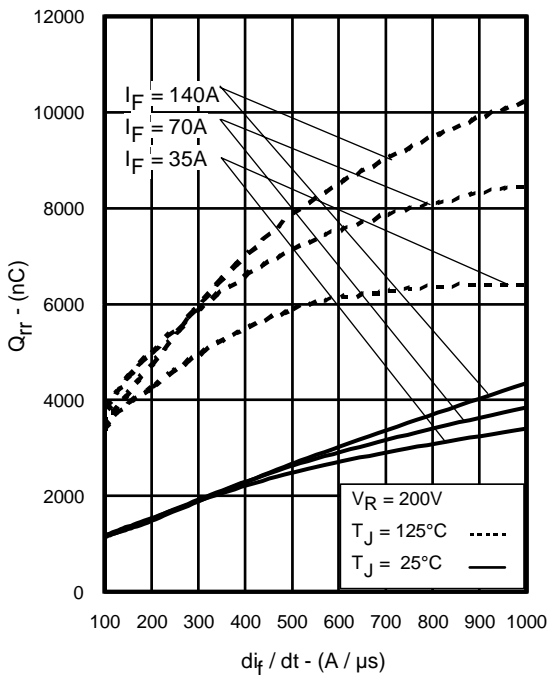


Fig. 16 - Typical Stored Charge vs.  $di_f/dt$   
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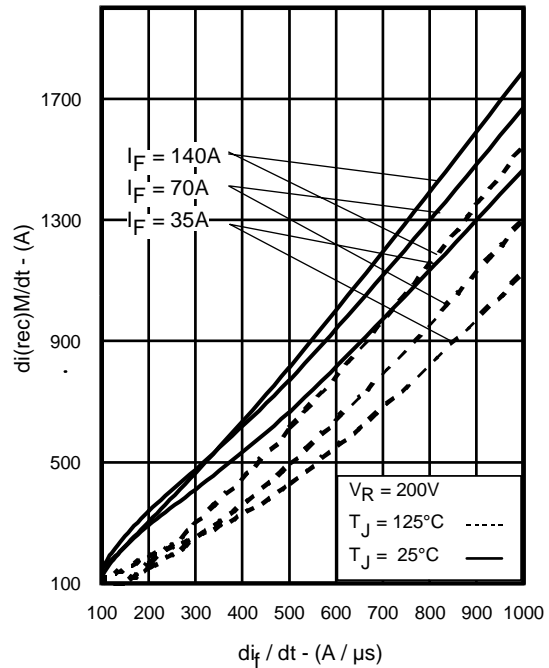
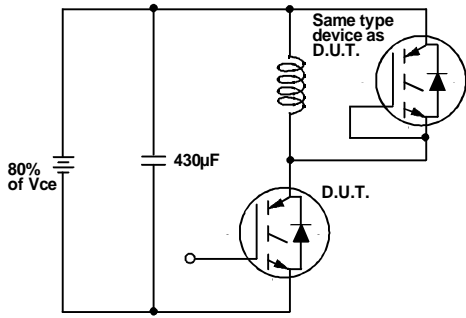
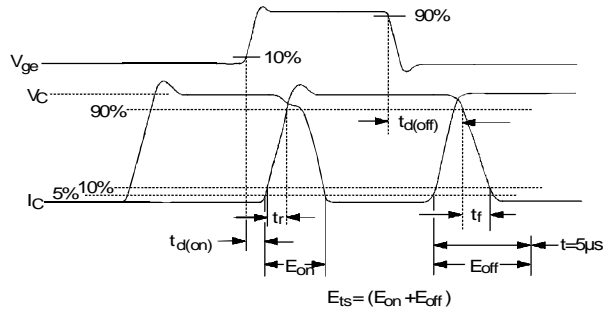


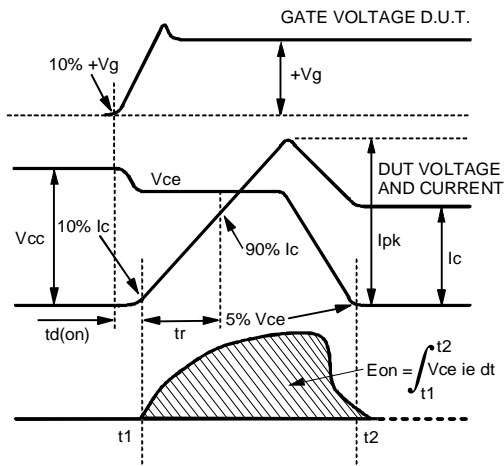
Fig. 17 - Typical  $di_{(rec)}M/dt$  vs.  $di_f/dt$



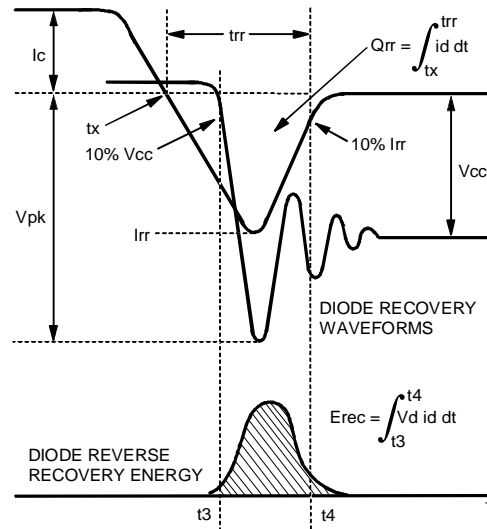
**Fig. 18a** - Test Circuit for Measurement of  $I_{LM}$ ,  $E_{on}$ ,  $E_{off}$ (diode),  $t_{rr}$ ,  $Q_{rr}$ ,  $I_{rr}$ ,  $t_{d(on)}$ ,  $t_r$ ,  $t_{d(off)}$ ,  $t_f$



**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  $E_{rec}$ ,  $t_{rr}$ ,  $Q_{rr}$ ,  $I_{rr}$



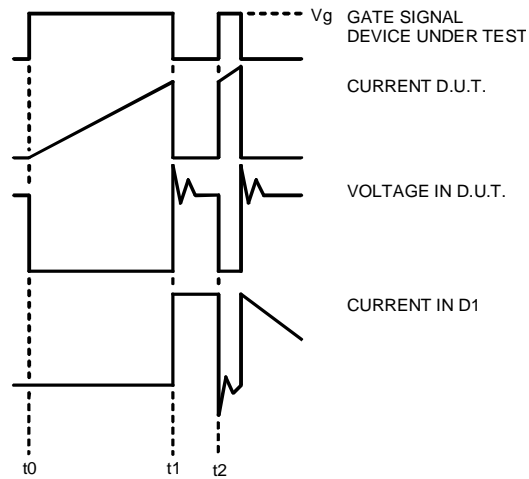


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

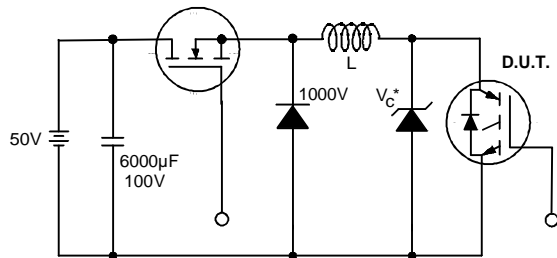


Figure 19. Clamped Inductive Load Test Circuit

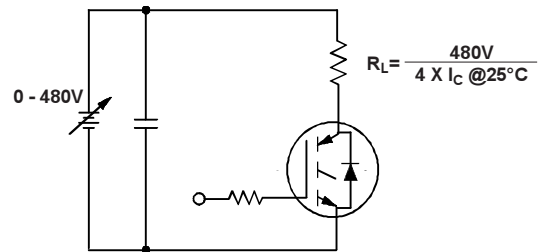
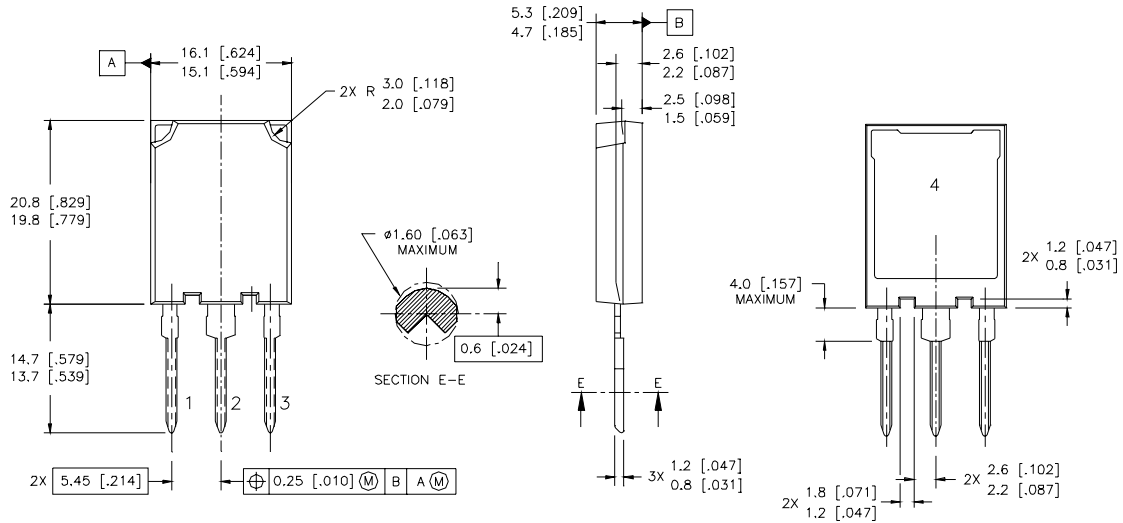


Figure 20. Pulsed Collector Current Test Circuit

# IRG4PSH71UDPbF

## 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 |

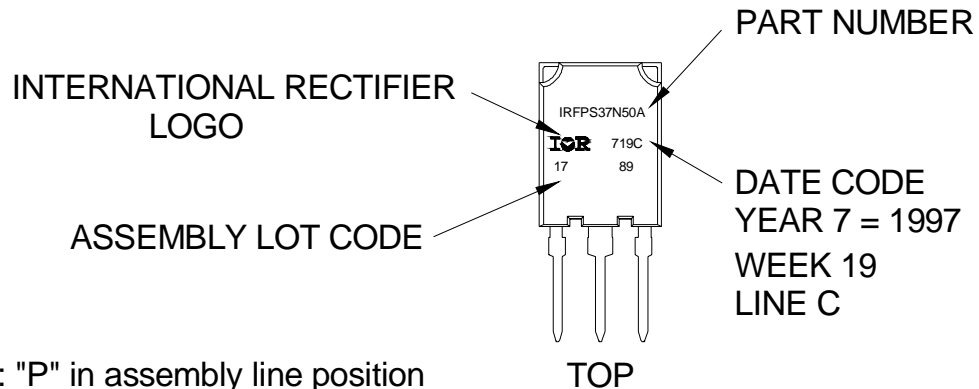
**Super TO-247™ package is not recommended for Surface Mount Application.**

**Notes:**

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

## 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.  
This product has been designed and qualified for the Consumer market.  
Qualification Standards can be found on IR's Web site.

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**IR** Rectifier

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TAC Fax: (310) 252-7903

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