

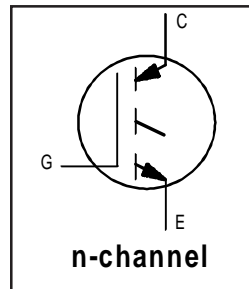
# IRG4PSC71U

INSULATED GATE BIPOLAR TRANSISTOR

UltraFast Speed IGBT

## Features

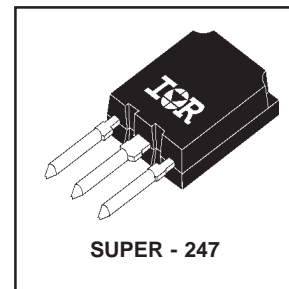
- UltraFast switching speed optimized for operating frequencies 8 to 40kHz in hard switching, 200kHz in resonant mode soft switching
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency (minimum switching and conduction losses) than prior generations
- Industry-benchmark Super-247 package with higher power handling capability compared to same footprint TO-247
- Creepage distance increased to 5.35mm



|                                   |
|-----------------------------------|
| $V_{CES} = 600V$                  |
| $V_{CE(on)} \text{ typ.} = 1.67V$ |
| @ $V_{GE} = 15V, I_C = 60A$       |

## 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



## Absolute Maximum Ratings

|                           | Parameter                                     | Max.                              | Units |
|---------------------------|---|-----------------------------------|-------|
| $V_{CES}$                 | Collector-to-Emitter Breakdown Voltage        | 600                               | V     |
| $I_C @ T_C = 25^\circ C$  | Continuous Collector Current                  | 85 <sup>⑥</sup>                   | A     |
| $I_C @ T_C = 100^\circ C$ | Continuous Collector Current                  | 60                                |       |
| $I_{CM}$                  | Pulsed Collector Current <sup>①</sup>         | 200                               |       |
| $I_{LM}$                  | Clamped Inductive Load Current <sup>②</sup>   | 200                               |       |
| $V_{GE}$                  | Gate-to-Emitter Voltage                       | $\pm 20$                          | V     |
| $E_{ARV}$                 | Reverse Voltage Avalanche Energy <sup>③</sup> | 180                               | mJ    |
| $P_D @ T_C = 25^\circ C$  | Maximum Power Dissipation                     | 350                               | W     |
| $P_D @ T_C = 100^\circ C$ | Maximum Power Dissipation                     | 140                               |       |
| $T_J$                     | Operating Junction and                        | -55 to + 150                      | °C    |
| $T_{STG}$                 | Storage Temperature Range                     |                                   |       |
|                           | Soldering Temperature, for 10 seconds         | 300 (0.063 in. (1.6mm from case ) |       |

## Thermal Resistance\ Mechanical

|                 | Parameter                                 | Min.      | Typ.     | Max. | Units   |
|-----------------|---|-----------|----------|------|---------|
| $R_{\theta JC}$ | Junction-to-Case                          | —         | —        | 0.36 | °C/W    |
| $R_{\theta CS}$ | 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)  |

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

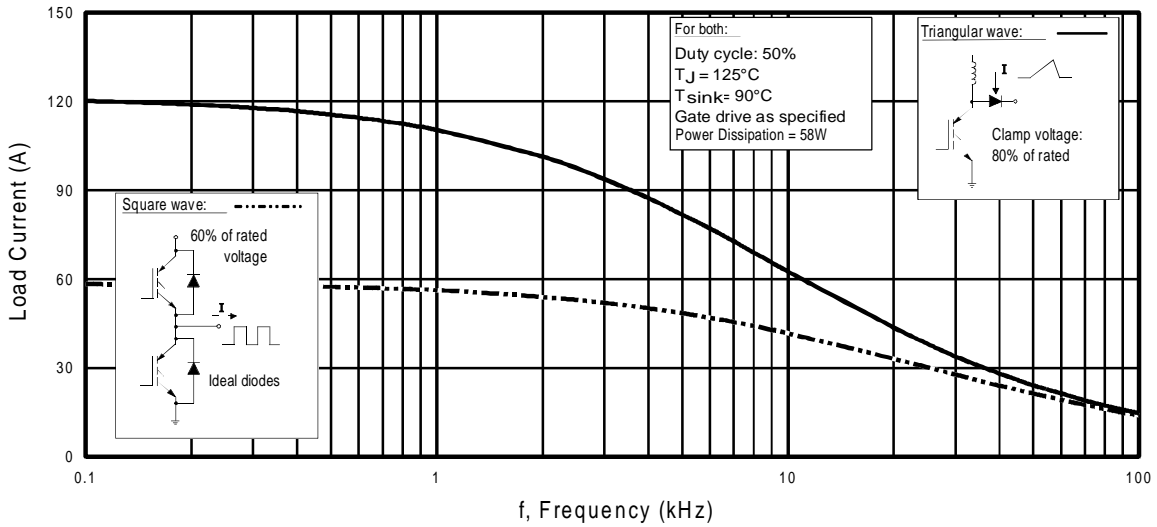
|                                 | Parameter                                | Min. | Typ. | Max.      | Units   | Conditions   |
|---------------------------------|--|------|------|-----------|---------|--|
| $V_{(BR)CES}$                   | Collector-to-Emitter Breakdown Voltage   | 600  | —    | —         | V       | $V_{GE} = 0V, I_C = 250\mu A$  |
| $V_{(BR)ECS}$                   | Emitter-to-Collector Breakdown Voltage ④ | 18   | —    | —         | V       | $V_{GE} = 0V, I_C = 1.0A$  |
| $\Delta V_{(BR)CES}/\Delta T_J$ | Temperature Coeff. of Breakdown Voltage  | —    | 0.45 | —         | V/°C    | $V_{GE} = 0V, I_C = 5.0mA$   |
| $V_{CE(ON)}$                    | Collector-to-Emitter Saturation Voltage  | —    | 1.67 | 2.0       | V       | $I_C = 60A$<br>$I_C = 100A$<br>$I_C = 60A, T_J = 150^\circ\text{C}$<br>$V_{CE} = V_{GE}, I_C = 250\mu A$<br>$V_{GE} = 15V$<br>See Fig.2, 5 |
|                                 |  | —    | 1.95 | —         |         |  |
|                                 |  | —    | 1.71 | —         |         |  |
| $V_{GE(th)}$                    | Gate Threshold Voltage                   | 3.0  | —    | 6.0       | mV/°C   | $V_{CE} = V_{GE}, I_C = 1.0mA$   |
| $\Delta V_{GE(th)}/\Delta T_J$  | Temperature Coeff. of Threshold Voltage  | —    | -10  | —         | mV/°C   | $V_{CE} = V_{GE}, I_C = 1.0mA$   |
| $g_{fe}$                        | Forward Transconductance ⑤               | 47   | 70   | —         | S       | $V_{CE} = 50V, I_C = 60A$  |
| $I_{CES}$                       | Zero Gate Voltage Collector Current      | —    | —    | 500       | $\mu A$ | $V_{GE} = 0V, V_{CE} = 600V$   |
|                                 |  | —    | —    | 2.0       |         | $V_{GE} = 0V, V_{CE} = 10V, T_J = 25^\circ\text{C}$  |
|                                 |  | —    | —    | 5.0       | mA      | $V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$  |
| $I_{GES}$                       | Gate-to-Emitter Leakage Current          | —    | —    | $\pm 100$ | nA      | $V_{GE} = \pm 20V$   |

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

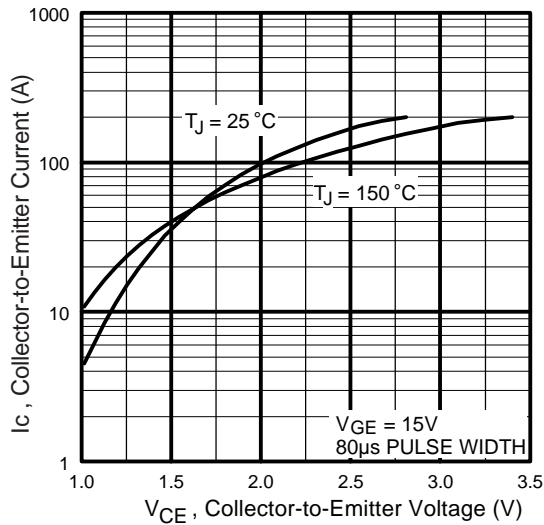
|              | Parameter                         | Min. | Typ. | Max. | Units | Conditions   |
|--------------|-----------------------------------|------|------|------|-------|--|
| $Q_g$        | Total Gate Charge (turn-on)       | —    | 340  | 520  | nC    | $I_C = 60A$<br>$V_{CC} = 400V$<br>$V_{GE} = 15V$<br>See Fig. 8   |
| $Q_{ge}$     | Gate - Emitter Charge (turn-on)   | —    | 44   | 66   |       |  |
| $Q_{gc}$     | Gate - Collector Charge (turn-on) | —    | 160  | 240  |       |  |
| $t_{d(on)}$  | Turn-On Delay Time                | —    | 34   | —    | ns    | $T_J = 25^\circ\text{C}$<br>$I_C = 60A, V_{CC} = 480V$<br>$V_{GE} = 15V, R_G = 5.0\Omega$<br>Energy losses include "tail"<br>See Fig. 10, 11, 13, 14 |
| $t_r$        | Rise Time                         | —    | 50   | —    |       |  |
| $t_{d(off)}$ | Turn-Off Delay Time               | —    | 56   | 84   |       |  |
| $t_f$        | Fall Time                         | —    | 86   | 130  |       |  |
| $E_{on}$     | Turn-On Switching Loss            | —    | 0.42 | —    | mJ    | See Fig. 10, 11, 13, 14  |
| $E_{off}$    | Turn-Off Switching Loss           | —    | 1.99 | —    |       |  |
| $E_{ts}$     | Total Switching Loss              | —    | 2.41 | 3.2  |       |  |
| $t_{d(on)}$  | Turn-On Delay Time                | —    | 30   | —    | ns    | $T_J = 150^\circ\text{C},$<br>$I_C = 60A, V_{CC} = 480V$<br>$V_{GE} = 15V, R_G = 5.0\Omega$<br>Energy losses include "tail"<br>See Fig. 13, 14       |
| $t_r$        | Rise Time                         | —    | 49   | —    |       |  |
| $t_{d(off)}$ | Turn-Off Delay Time               | —    | 129  | —    |       |  |
| $t_f$        | Fall Time                         | —    | 175  | —    |       |  |
| $E_{ts}$     | Total Switching Loss              | —    | 4.5  | —    | mJ    |  |
| $L_E$        | Internal Emitter Inductance       | —    | 13   | —    | nH    | Measured 5mm from package  |
| $C_{ies}$    | Input Capacitance                 | —    | 7500 | —    | pF    | $V_{GE} = 0V$<br>$V_{CC} = 30V$<br>$f = 1.0MHz$<br>See Fig. 7  |
| $C_{oes}$    | Output Capacitance                | —    | 720  | —    |       |  |
| $C_{res}$    | Reverse Transfer Capacitance      | —    | 93   | —    |       |  |

### Notes:

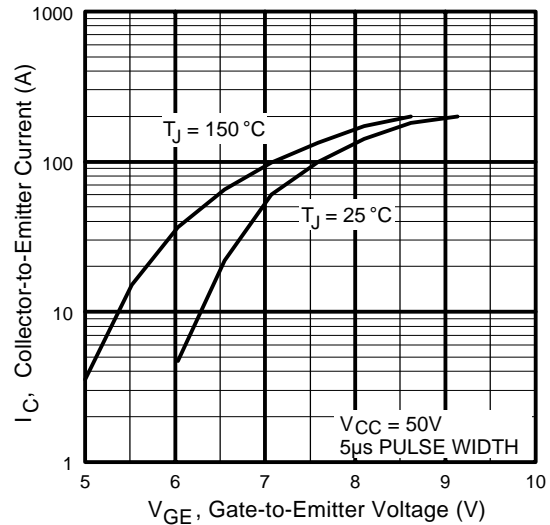
- ① Repetitive rating;  $V_{GE} = 20V$ , pulse width limited by max. junction temperature. ( See fig. 13b )
- ②  $V_{CC} = 80\%(V_{CES}), V_{GE} = 20V, L = 10\mu H, R_G = 5.0\Omega,$  (See fig. 13a)
- ③ Repetitive rating; pulse width limited by maximum junction temperature.
- ④ Pulse width  $\leq 80\mu s$ ; duty factor  $\leq 0.1\%$ .
- ⑤ Pulse width  $5.0\mu s$ , single shot.
- ⑥ Current limited by the package, (Die current = 100A)



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

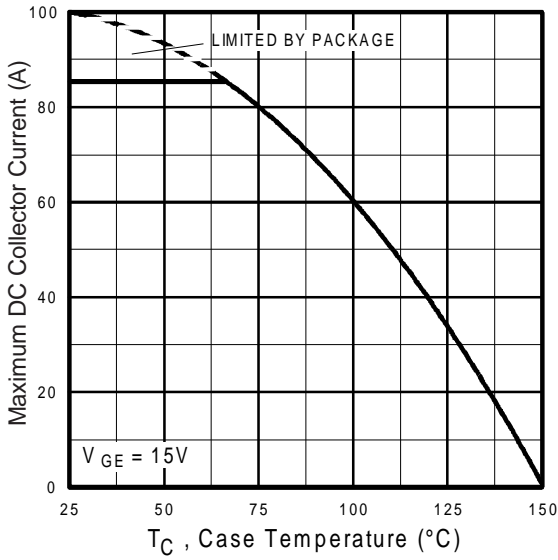


**Fig. 2 - Typical Output Characteristics**

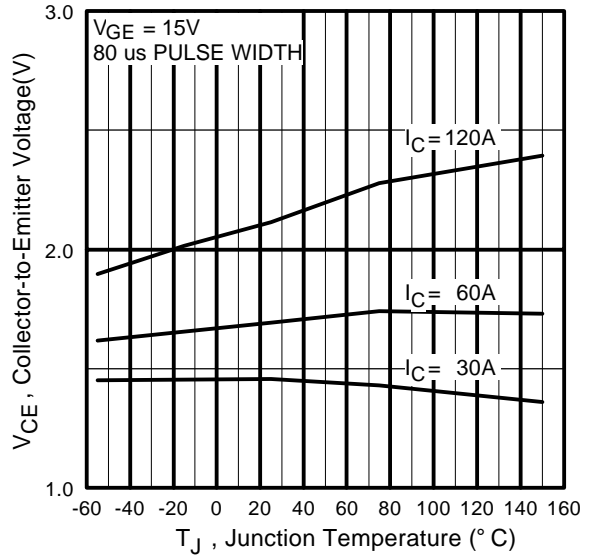


**Fig. 3 - Typical Transfer Characteristics**

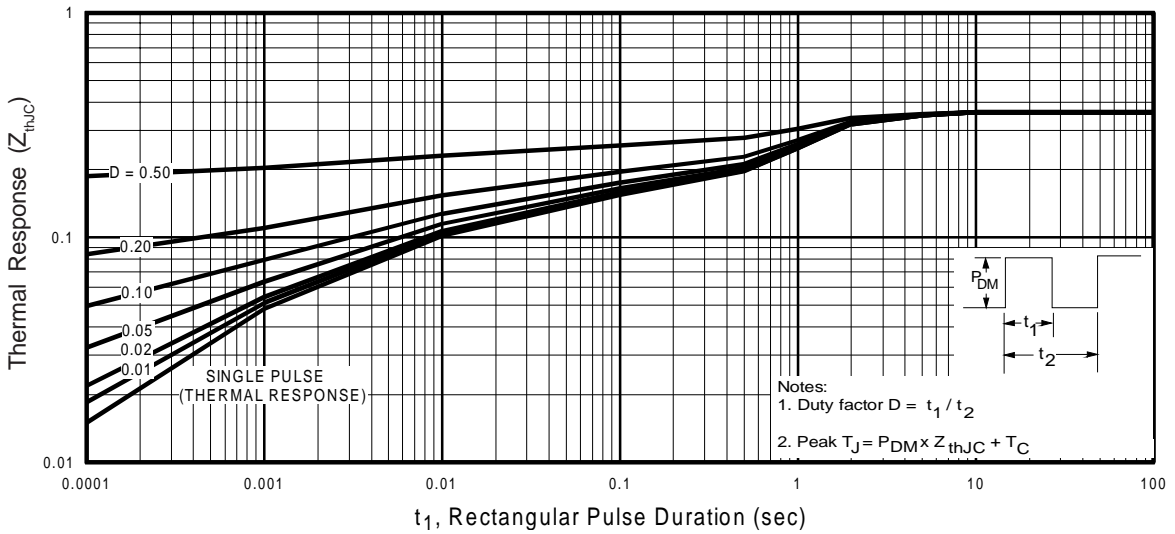
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**Fig. 4 - Maximum Collector Current vs. Case Temperature**



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



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

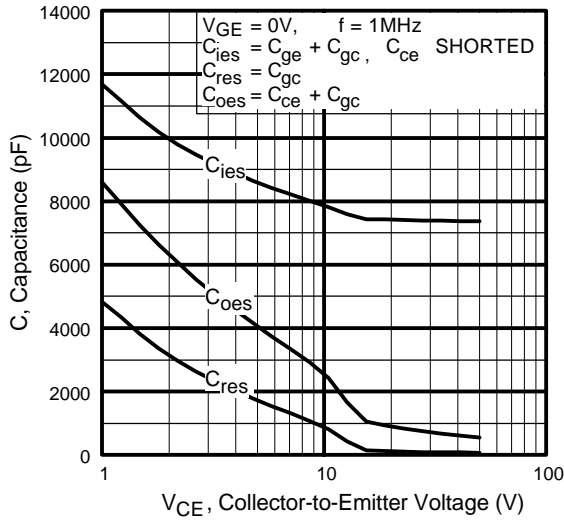


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

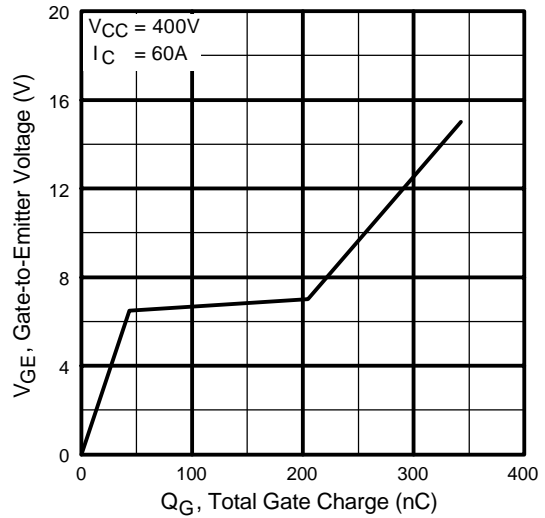


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

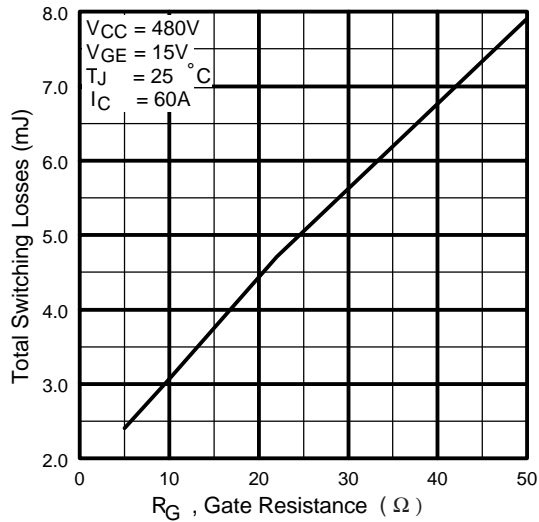


Fig. 9 - Typical Switching Losses vs. Gate Resistance

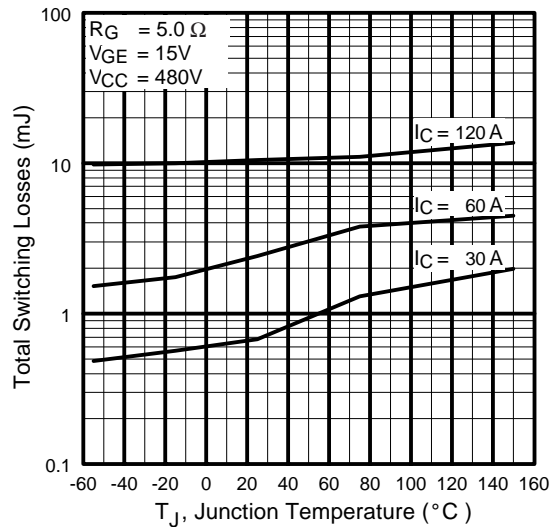
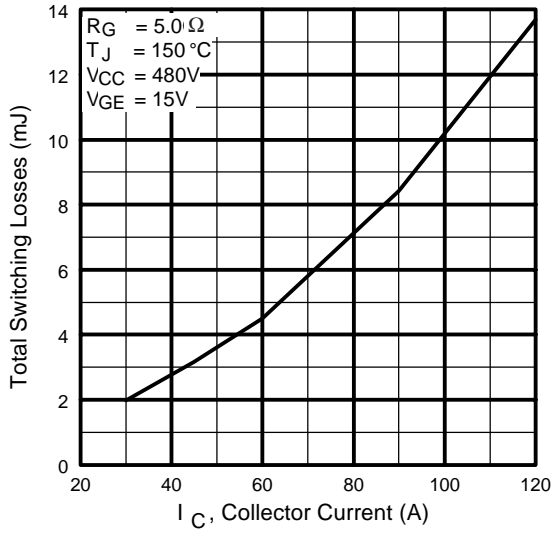
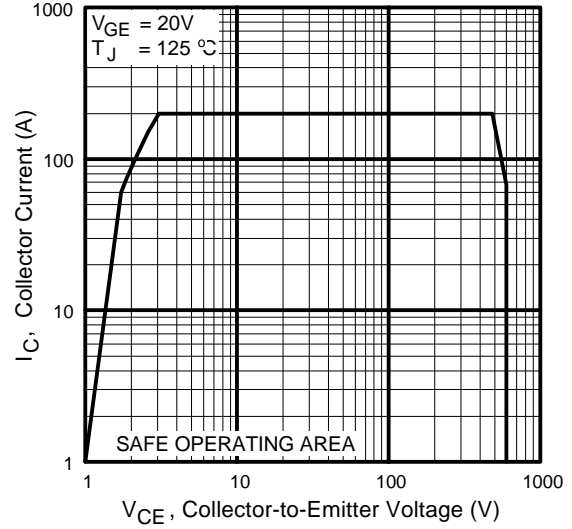


Fig. 10 - Typical Switching Losses vs. Junction Temperature

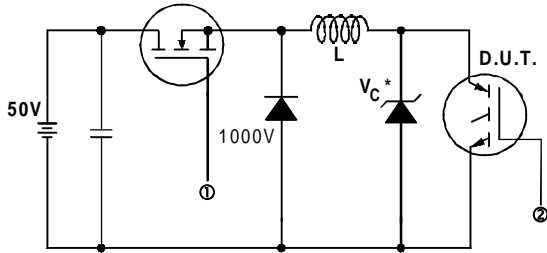
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**Fig. 11** - Typical Switching Losses vs. Collector-to-Emitter Current

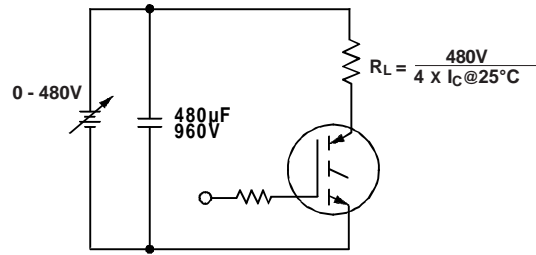


**Fig. 12** - Turn-Off SOA



\* Driver same type as D.U.T.;  $V_c = 80\%$  of  $V_{ce(max)}$   
 \* Note: Due to the 50V power supply, pulse width and inductor will increase to obtain rated  $I_d$ .

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

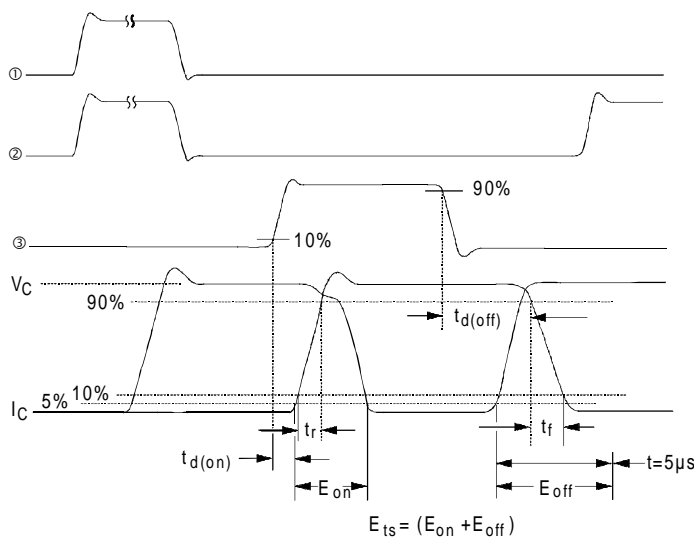


**Fig. 13b** - Pulsed Collector Current Test Circuit



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

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



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

**Case Outline and Dimensions — Super-247**

Dimensions are shown in millimeters

