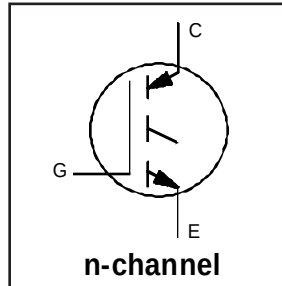


**INSULATED GATE BIPOLAR TRANSISTOR**

Short Circuit Rated  
UltraFast IGBT

**Features**

- Short circuit rated -  $10\mu\text{s}$  @  $125^\circ\text{C}$ ,  $V_{\text{GE}} = 15\text{V}$
- Switching-loss rating includes all "tail" losses
- Optimized for high operating frequency (over 5kHz) See Fig. 1 for Current vs. Frequency curve



$$V_{\text{CES}} = 600\text{V}$$

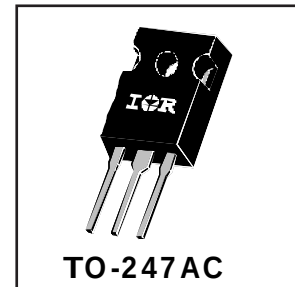
$$V_{\text{CE(sat)}} \leq 3.8\text{V}$$

$$\text{@ } V_{\text{GE}} = 15\text{V}, I_{\text{C}} = 14\text{A}$$

**Description**

Insulated Gate Bipolar Transistors (IGBTs) from International Rectifier have higher usable current densities than comparable bipolar transistors, while at the same time having simpler gate-drive requirements of the familiar power MOSFET. They provide substantial benefits to a host of high-voltage, high-current applications.

These new short circuit rated devices are especially suited for motor control and other applications requiring short circuit withstand capability.



**Absolute Maximum Ratings**

|                                                   | Parameter                          | Max.                              | Units            |
|---------------------------------------------------|------------------------------------|-----------------------------------|------------------|
| $V_{\text{CES}}$                                  | Collector-to-Emitter Voltage       | 600                               | V                |
| $I_{\text{C}} @ T_{\text{C}} = 25^\circ\text{C}$  | Continuous Collector Current       | 23                                | A                |
| $I_{\text{C}} @ T_{\text{C}} = 100^\circ\text{C}$ | Continuous Collector Current       | 14                                |                  |
| $I_{\text{CM}}$                                   | Pulsed Collector Current ①         | 46                                |                  |
| $I_{\text{LM}}$                                   | Clamped Inductive Load Current ②   | 46                                |                  |
| $t_{\text{sc}}$                                   | Short Circuit Withstand Time       | 10                                | $\mu\text{s}$    |
| $V_{\text{GE}}$                                   | Gate-to-Emitter Voltage            | $\pm 20$                          | V                |
| $E_{\text{ARV}}$                                  | Reverse Voltage Avalanche Energy ③ | 10                                | mJ               |
| $P_{\text{D}} @ T_{\text{C}} = 25^\circ\text{C}$  | Maximum Power Dissipation          | 100                               | W                |
| $P_{\text{D}} @ T_{\text{C}} = 100^\circ\text{C}$ | Maximum Power Dissipation          | 42                                |                  |
| $T_{\text{J}}$                                    | Operating Junction and             | -55 to +150                       | $^\circ\text{C}$ |
| $T_{\text{STG}}$                                  | 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 (1.1N•m)                |                  |

**Thermal Resistance**

|                       | Parameter                                 | Min. | Typ.     | Max. | Units              |
|-----------------------|-------------------------------------------|------|----------|------|--------------------|
| $R_{\theta\text{JC}}$ | Junction-to-Case                          | —    | —        | 1.2  | $^\circ\text{C/W}$ |
| $R_{\theta\text{CS}}$ | Case-to-Sink, flat, greased surface       | —    | 0.24     | —    |                    |
| $R_{\theta\text{JA}}$ | Junction-to-Ambient, typical socket mount | —    | —        | 40   |                    |
| Wt                    | Weight                                    | —    | 6 (0.21) | —    | g (oz)             |

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

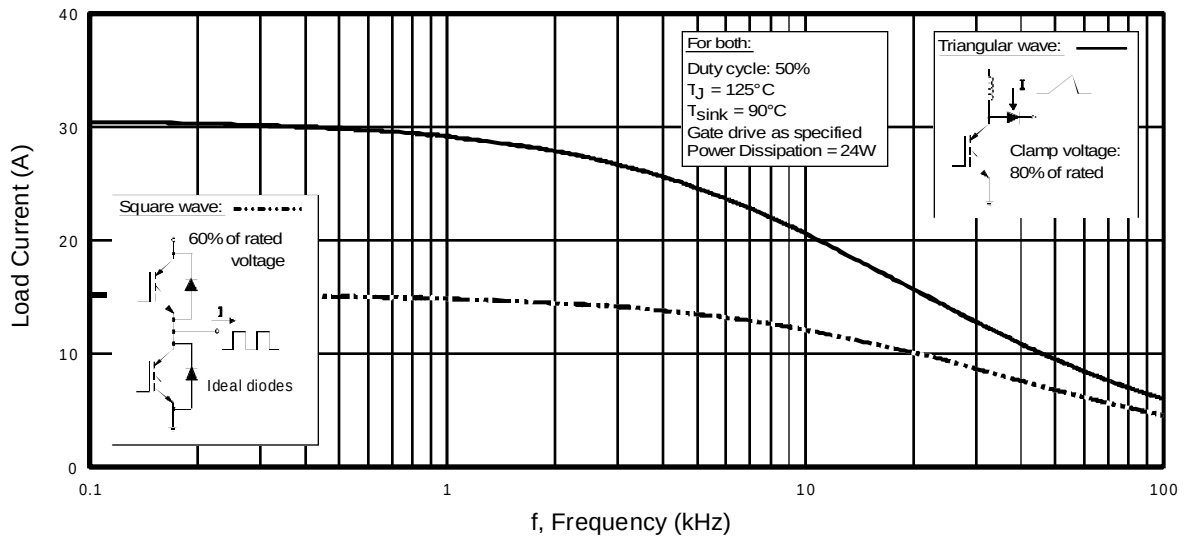
|                                 | Parameter                                | Min. | Typ. | Max.      | Units                | Conditions                                            |
|---------------------------------|------------------------------------------|------|------|-----------|----------------------|-------------------------------------------------------|
| $V_{(BR)CES}$                   | Collector-to-Emitter Breakdown Voltage   | 600  | —    | —         | V                    | $V_{GE} = 0V, I_C = 250\mu A$                         |
| $V_{(BR)ECS}$                   | Emitter-to-Collector Breakdown Voltage ④ | 20   | —    | —         | V                    | $V_{GE} = 0V, I_C = 1.0A$                             |
| $\Delta V_{(BR)CES}/\Delta T_J$ | Temperature Coeff. of Breakdown Voltage  | —    | 0.30 | —         | V/ $^\circ\text{C}$  | $V_{GE} = 0V, I_C = 1.0mA$                            |
| $V_{CE(on)}$                    | Collector-to-Emitter Saturation Voltage  | —    | 2.5  | 3.8       | V                    | $I_C = 14A, V_{GE} = 15V$                             |
|                                 |                                          | —    | 3.3  | —         |                      | $I_C = 23A$ See Fig. 2, 5                             |
|                                 |                                          | —    | 2.5  | —         |                      | $I_C = 14A, T_J = 150^\circ\text{C}$                  |
| $V_{GE(th)}$                    | Gate Threshold Voltage                   | 3.0  | —    | 5.5       |                      | $V_{CE} = V_{GE}, I_C = 250\mu A$                     |
| $\Delta V_{GE(th)}/\Delta T_J$  | Temperature Coeff. of Threshold Voltage  | —    | -13  | —         | mV/ $^\circ\text{C}$ | $V_{CE} = V_{GE}, I_C = 250\mu A$                     |
| $g_{fe}$                        | Forward Transconductance ⑤               | 3.3  | 6.5  | —         | S                    | $V_{CE} = 100V, I_C = 14A$                            |
| $I_{CES}$                       | Zero Gate Voltage Collector Current      | —    | —    | 600       | $\mu A$              | $V_{GE} = 0V, V_{CE} = 600V$                          |
|                                 |                                          | —    | —    | 1100      |                      | $V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$ |
| $I_{GES}$                       | Gate-to-Emitter Leakage Current          | —    | —    | $\pm 100$ | nA                   | $V_{GE} = \pm 20V$                                    |

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

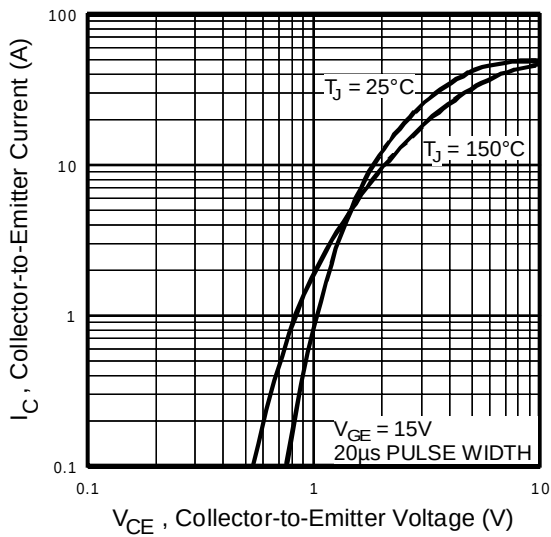
|              | Parameter                         | Min. | Typ. | Max. | Units   | Conditions                                                                                 |
|--------------|-----------------------------------|------|------|------|---------|--------------------------------------------------------------------------------------------|
| $Q_g$        | Total Gate Charge (turn-on)       | —    | 39   | 58   | nC      | $I_C = 14A$                                                                                |
| $Q_{ge}$     | Gate - Emitter Charge (turn-on)   | —    | 8.7  | 13   |         | $V_{CC} = 400V$ See Fig. 8                                                                 |
| $Q_{gc}$     | Gate - Collector Charge (turn-on) | —    | 15   | 23   |         | $V_{GE} = 15V$                                                                             |
| $t_{d(on)}$  | Turn-On Delay Time                | —    | 31   | —    | ns      | $T_J = 25^\circ\text{C}$                                                                   |
| $t_r$        | Rise Time                         | —    | 23   | —    |         | $I_C = 14A, V_{CC} = 480V$                                                                 |
| $t_{d(off)}$ | Turn-Off Delay Time               | —    | 100  | 150  |         | $V_{GE} = 15V, R_G = 23\Omega$                                                             |
| $t_f$        | Fall Time                         | —    | 84   | 130  |         | Energy losses include "tail"                                                               |
| $E_{on}$     | Turn-On Switching Loss            | —    | 0.3  | —    | mJ      | See Fig. 9, 10, 11, 14                                                                     |
| $E_{off}$    | Turn-Off Switching Loss           | —    | 0.3  | —    |         |                                                                                            |
| $E_{ts}$     | Total Switching Loss              | —    | 0.6  | 0.9  |         |                                                                                            |
| $t_{sc}$     | Short Circuit Withstand Time      | 10   | —    | —    | $\mu s$ | $V_{CC} = 360V, T_J = 125^\circ\text{C}$<br>$V_{GE} = 15V, R_G = 23\Omega, V_{CPK} < 500V$ |
| $t_{d(on)}$  | Turn-On Delay Time                | —    | 30   | —    | ns      | $T_J = 150^\circ\text{C},$                                                                 |
| $t_r$        | Rise Time                         | —    | 23   | —    |         | $I_C = 14A, V_{CC} = 480V$                                                                 |
| $t_{d(off)}$ | Turn-Off Delay Time               | —    | 170  | —    |         | $V_{GE} = 15V, R_G = 23\Omega$                                                             |
| $t_f$        | Fall Time                         | —    | 170  | —    |         | Energy losses include "tail"                                                               |
| $E_{ts}$     | Total Switching Loss              | —    | 1.4  | —    | mJ      | See Fig. 10, 14                                                                            |
| $L_E$        | Internal Emitter Inductance       | —    | 13   | —    | nH      | Measured 5mm from package                                                                  |
| $C_{ies}$    | Input Capacitance                 | —    | 740  | —    | pF      | $V_{GE} = 0V$                                                                              |
| $C_{oes}$    | Output Capacitance                | —    | 92   | —    |         | $V_{CC} = 30V$ See Fig. 7                                                                  |
| $C_{res}$    | Reverse Transfer Capacitance      | —    | 9.4  | —    |         | $f = 1.0MHz$                                                                               |

**Notes:**

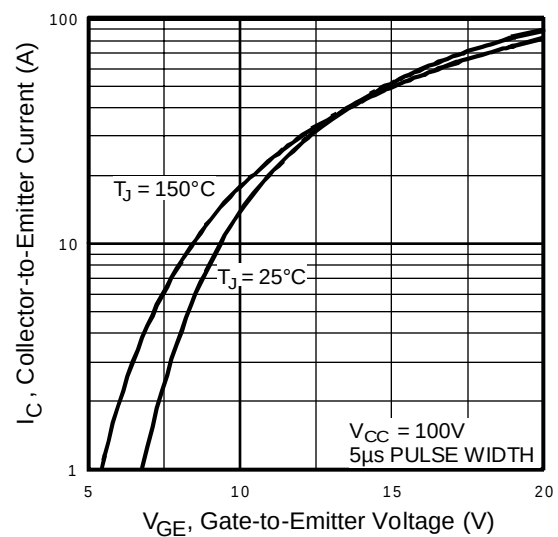
- ① Repetitive rating;  $V_{GE}=20V$ , pulse width limited by max. junction temperature. ( See fig. 13b )
- ②  $V_{CC}=80\%(V_{CES}), V_{GE}=20V, L=10\mu H, R_G=23\Omega$ , ( See fig. 13a )
- ③ Repetitive rating; pulse width limited by maximum junction temperature.
- ④ Pulse width  $\leq 80\mu s$ ; duty factor  $\leq 0.1\%$ .
- ⑤ Pulse width 5.0 $\mu s$ , single shot.



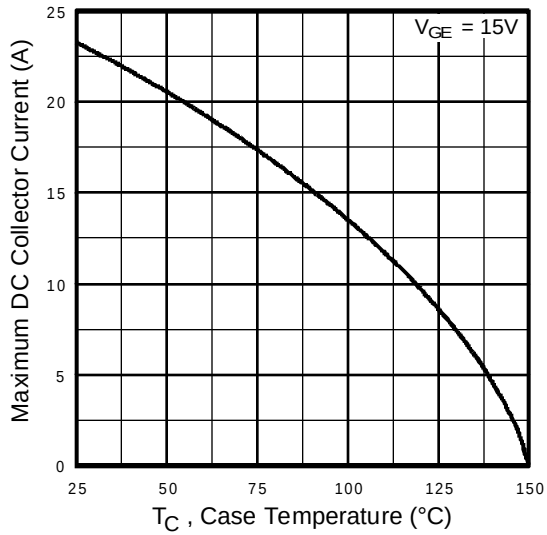
**Fig. 1 - Typical Load Current vs. Frequency**  
(For square wave,  $I = I_{\text{RMS}}$  of fundamental; for triangular wave,  $I = I_{\text{PK}}$ )



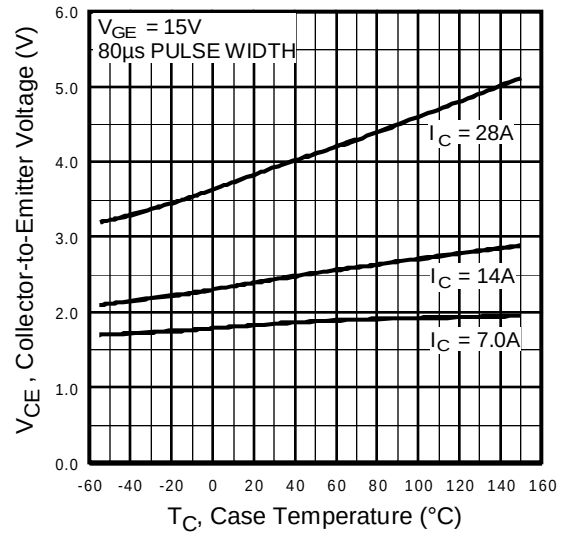
**Fig. 2 - Typical Output Characteristics**



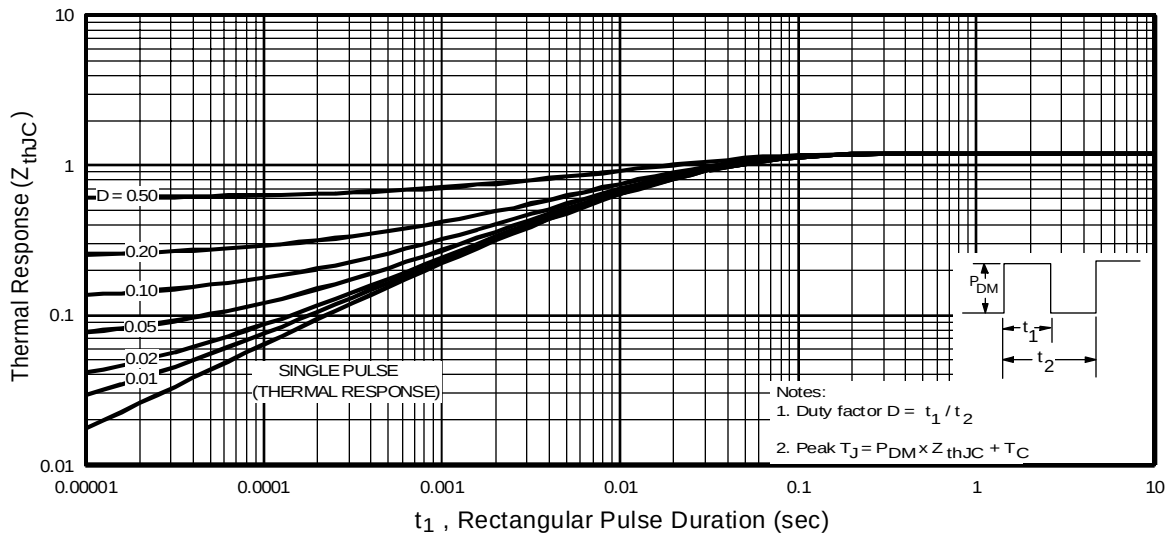
**Fig. 3 - Typical Transfer Characteristics**



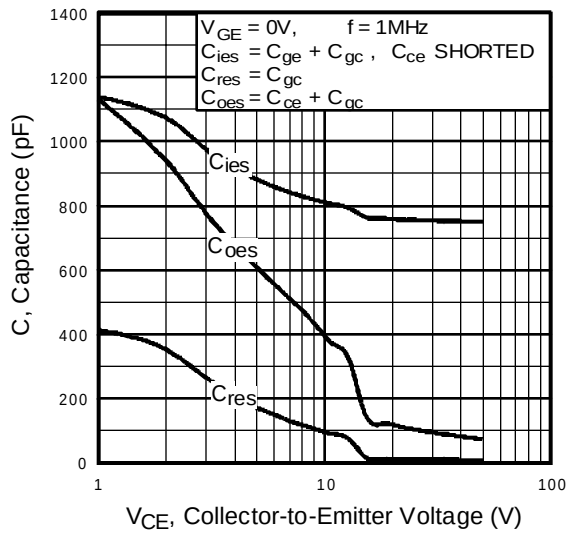
**Fig. 4** - Maximum Collector Current vs. Case Temperature



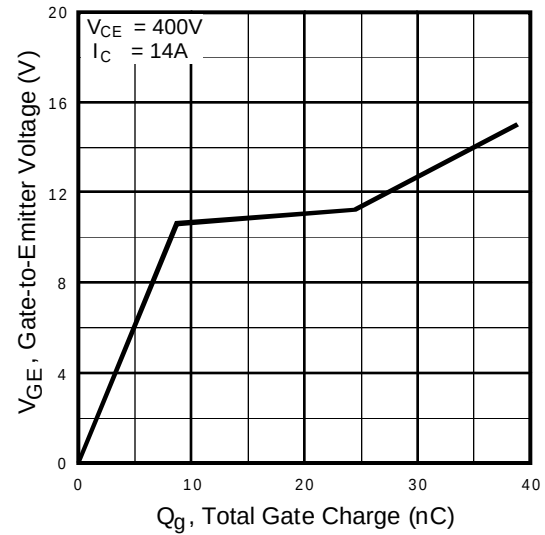
**Fig. 5** - Collector-to-Emitter Voltage vs. Case Temperature



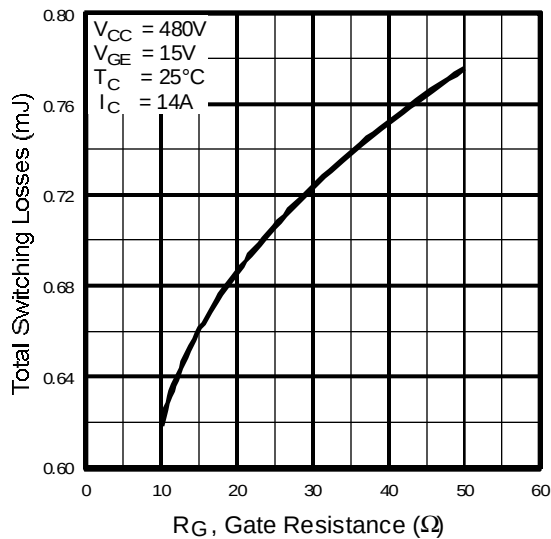
**Fig. 6** - Maximum Effective Transient Thermal Impedance, Junction-to-Case



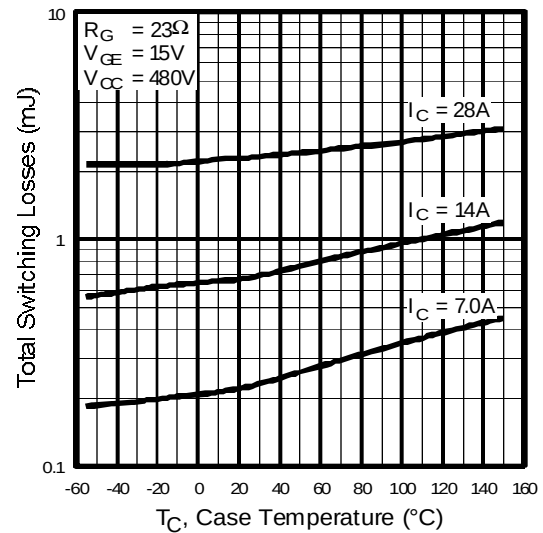
**Fig. 7** - Typical Capacitance vs. Collector-to-Emitter Voltage



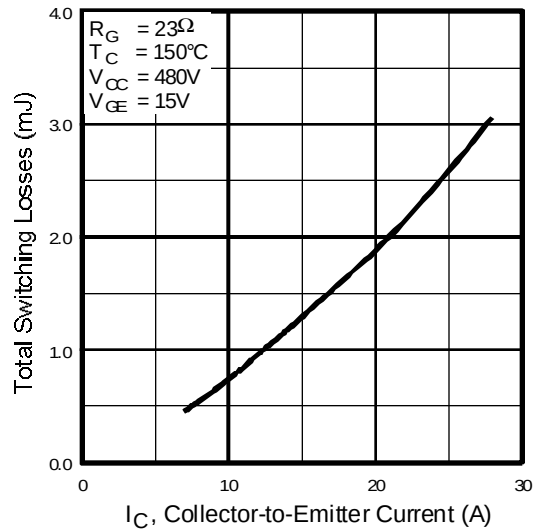
**Fig. 8** - Typical Gate Charge vs. Gate-to-Emitter Voltage



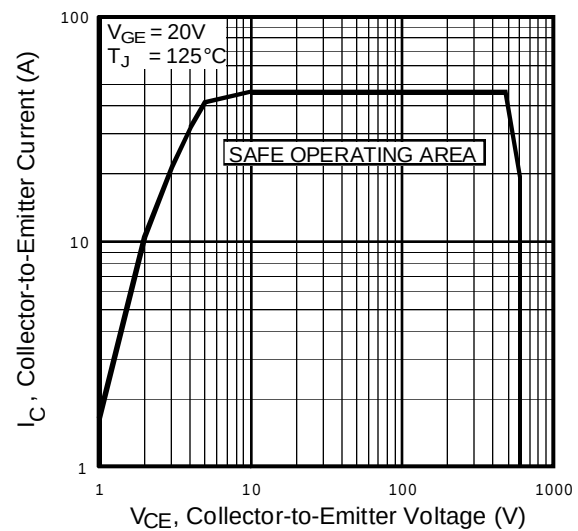
**Fig. 9** - Typical Switching Losses vs. Gate Resistance



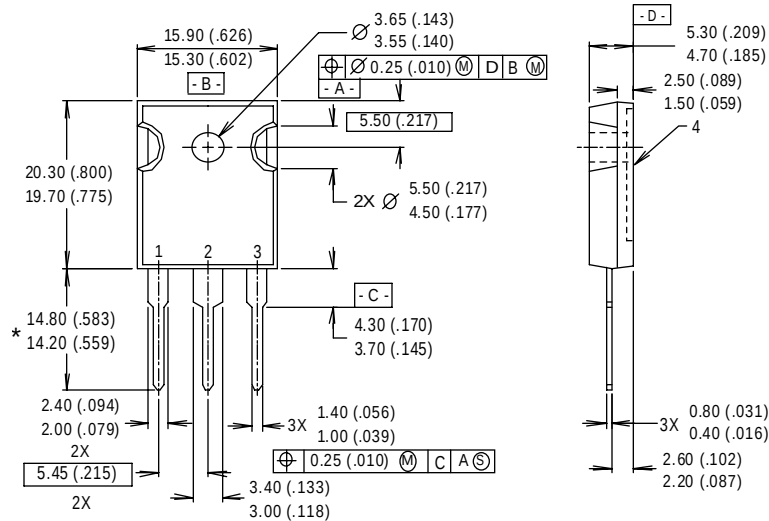
**Fig. 10** - Typical Switching Losses vs. Case Temperature



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



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



**NOTES:**

- 1 DIMENSIONS & TOLERANCING PER ANSI Y14.5M, 1982.
- 2 CONTROLLING DIMENSION : INCH.
- 3 DIMENSIONS ARE SHOWN MILLIMETERS (INCHES).
- 4 CONFORMS TO JEDEC OUTLINE TO-247AC.

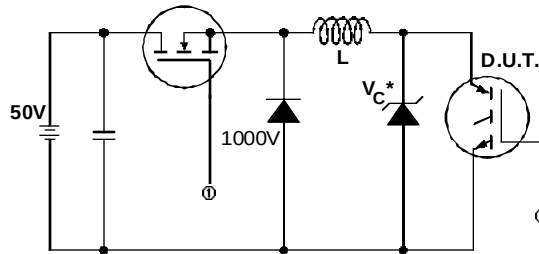
**LEAD ASSIGNMENTS**

- 1 - GATE
- 2 - COLLECTOR
- 3 - EMITTER
- 4 - COLLECTOR

\* LONGER LEADED (20mm) VERSION AVAILABLE (TO-247AD) TO ORDER ADD "-E" SUFFIX TO PART NUMBER

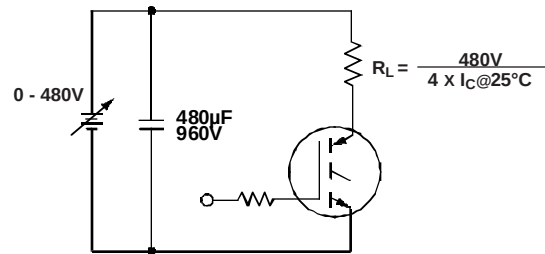
**CONFORMS TO JEDEC OUTLINE TO-247AC (TO-3P)**

Dimensions in Millimeters and (Inches)

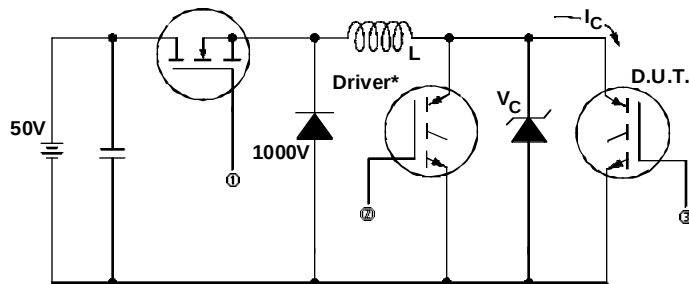


\* Driver same type as D.U.T.;  $V_c = 80\%$  of  $V_{ce(max)}$   
 \* Note: Due to the 50V power supply, pulse width and inductor will increase to obtain rated  $I_d$ .

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

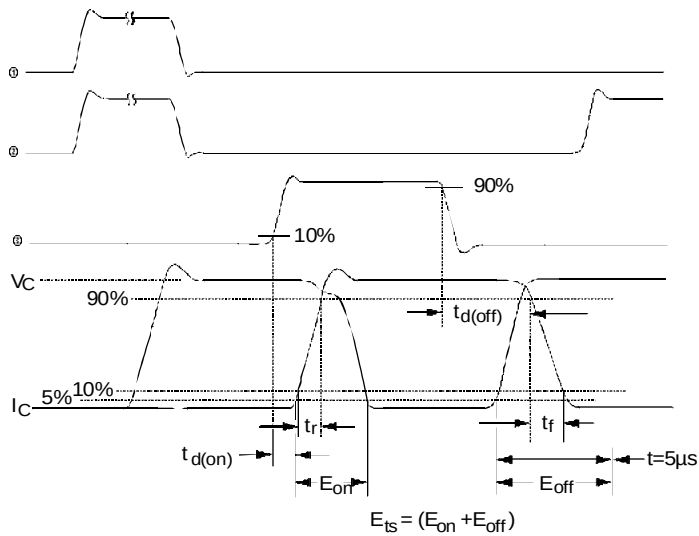


**Fig. 13b** - Pulsed Collector Current Test Circuit



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

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



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