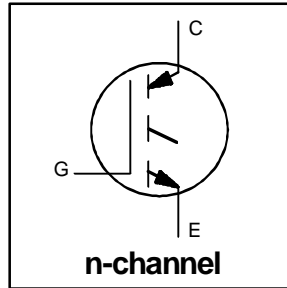


**Features**

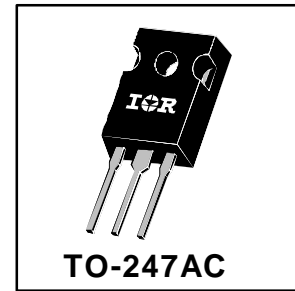
- Switching-loss rating includes all "tail" losses
- Optimized for medium operating frequency (1 to 10kHz) See Fig. 1 for Current vs. Frequency curve



|                             |
|-----------------------------|
| $V_{CES} = 1200V$           |
| $V_{CE(sat)} \leq 2.9V$     |
| @ $V_{GE} = 15V, I_C = 25A$ |

**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.



**Absolute Maximum Ratings**

|                           | Parameter  | Max.                              | Units      |
|---------------------------|--|-----------------------------------|------------|
| $V_{CES}$                 | Collector-to-Emitter Voltage                     | 1200                              | V          |
| $I_C @ T_C = 25^\circ C$  | Continuous Collector Current                     | 45                                | A          |
| $I_C @ T_C = 100^\circ C$ | Continuous Collector Current                     | 25                                |            |
| $I_{CM}$                  | Pulsed Collector Current ①                       | 90                                |            |
| $I_{LM}$                  | Clamped Inductive Load Current ②                 | 90                                |            |
| $V_{GE}$                  | Gate-to-Emitter Voltage                          | $\pm 20$                          |            |
| $E_{ARV}$                 | Reverse Voltage Avalanche Energy ③               | 20                                | mJ         |
| $P_D @ T_C = 25^\circ C$  | Maximum Power Dissipation                        | 200                               | W          |
| $P_D @ T_C = 100^\circ C$ | Maximum Power Dissipation                        | 78                                |            |
| $T_J$                     | Operating Junction and Storage Temperature Range | -55 to +150                       | $^\circ C$ |
| $T_{STG}$                 | 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        |
|-----------------|---|------|----------|------|--------------|
| $R_{\theta JC}$ | Junction-to-Case                          | —    | —        | 0.64 | $^\circ C/W$ |
| $R_{\theta CS}$ | Case-to-Sink, flat, greased surface       | —    | 0.24     | —    |              |
| $R_{\theta JA}$ | 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)

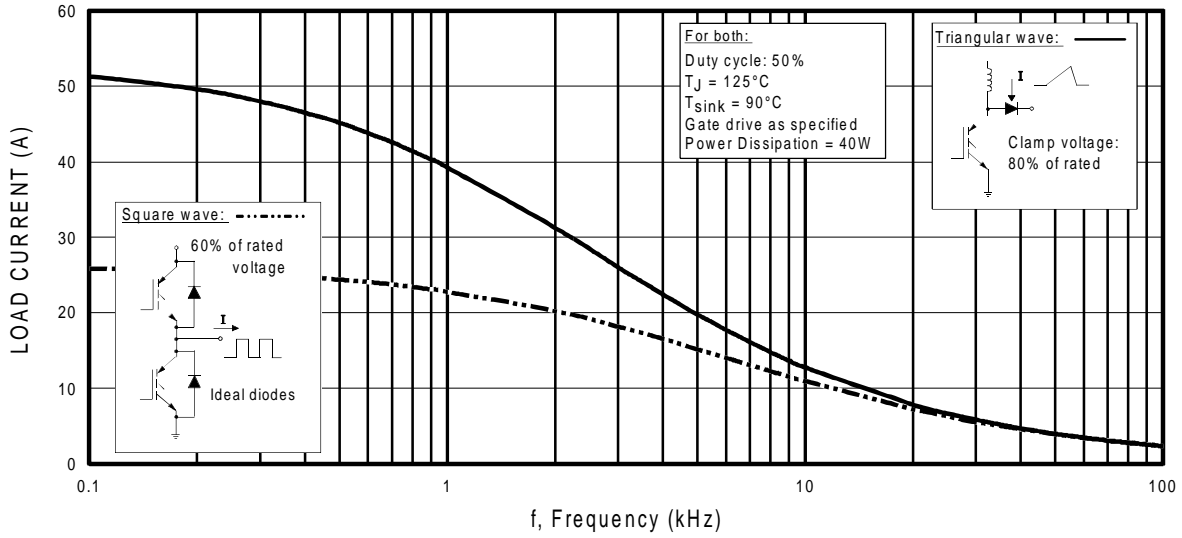
|                                 | Parameter                                | Min. | Typ. | Max.      | Units               | Conditions  |
|---------------------------------|--|------|------|-----------|---------------------|---|
| $V_{(BR)CES}$                   | Collector-to-Emitter Breakdown Voltage   | 1200 | —    | —         | V                   | $V_{GE} = 0V, I_C = 250\mu A$   |
| $V_{(BR)ECS}$                   | Emitter-to-Collector Breakdown Voltage ① | 20   | —    | —         | V                   | $V_{GE} = 0V, I_C = 1.0A$   |
| $\Delta V_{(BR)CES}/\Delta T_J$ | Temperature Coeff. of Breakdown Voltage  | —    | 1.3  | —         | $V/^\circ\text{C}$  | $V_{GE} = 0V, I_C = 1.0mA$  |
| $V_{CE(on)}$                    | Collector-to-Emitter Saturation Voltage  | —    | 2.1  | 2.9       | V                   | $I_C = 25A$<br>$I_C = 45A$<br>$I_C = 25A, T_J = 150^\circ\text{C}$<br>$V_{GE} = 15V$<br>See Fig. 2, 5 |
|                                 |  | —    | 2.5  | —         |                     |   |
|                                 |  | —    | 2.4  | —         |                     |   |
| $V_{GE(th)}$                    | 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  | —    | -14  | —         | $mV/^\circ\text{C}$ | $V_{CE} = V_{GE}, I_C = 250\mu A$   |
| $g_{fe}$                        | Forward Transconductance ②               | 7.5  | 17   | —         | S                   | $V_{CE} = 100V, I_C = 25A$  |
| $I_{CES}$                       | Zero Gate Voltage Collector Current      | —    | —    | 250       | $\mu A$             | $V_{GE} = 0V, V_{CE} = 1200V$   |
|                                 |  | —    | —    | 1200      |                     | $V_{GE} = 0V, V_{CE} = 1200V, T_J = 150^\circ\text{C}$  |
| $I_{GES}$                       | Gate-to-Emitter Leakage Current          | —    | —    | $\pm 100$ | nA                  | $V_{GE} = \pm 20V$  |

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

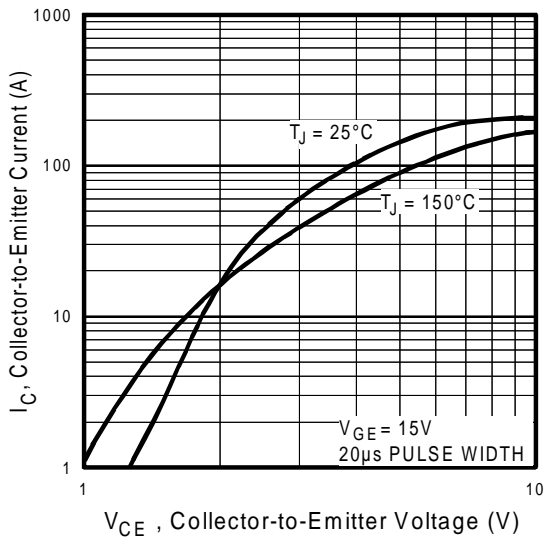
|              | Parameter                         | Min. | Typ. | Max. | Units | Conditions   |
|--------------|-----------------------------------|------|------|------|-------|--|
| $Q_g$        | Total Gate Charge (turn-on)       | —    | 82   | 100  | nC    | $I_C = 25A$<br>$V_{CC} = 400V$<br>$V_{GE} = 15V$<br>See Fig. 8   |
| $Q_{ge}$     | Gate - Emitter Charge (turn-on)   | —    | 16   | 21   |       |  |
| $Q_{gc}$     | Gate - Collector Charge (turn-on) | —    | 30   | 43   |       |  |
| $t_{d(on)}$  | Turn-On Delay Time                | —    | 34   | —    | ns    | $T_J = 25^\circ\text{C}$<br>$I_C = 25A, V_{CC} = 960V$<br>$V_{GE} = 15V, R_G = 5.0\Omega$<br>Energy losses include "tail"    |
| $t_r$        | Rise Time                         | —    | 13   | —    |       |  |
| $t_{d(off)}$ | Turn-Off Delay Time               | —    | 320  | 480  |       |  |
| $t_f$        | Fall Time                         | —    | 240  | 330  |       |  |
| $E_{on}$     | Turn-On Switching Loss            | —    | 1.4  | —    | mJ    | See Fig. 9, 10, 11, 14   |
| $E_{off}$    | Turn-Off Switching Loss           | —    | 4.5  | —    |       |  |
| $E_{ts}$     | Total Switching Loss              | —    | 5.9  | 8.2  |       |  |
| $t_{d(on)}$  | Turn-On Delay Time                | —    | 33   | —    | ns    | $T_J = 150^\circ\text{C}$ ,<br>$I_C = 25A, V_{CC} = 960V$<br>$V_{GE} = 15V, R_G = 5.0\Omega$<br>Energy losses include "tail" |
| $t_r$        | Rise Time                         | —    | 15   | —    |       |  |
| $t_{d(off)}$ | Turn-Off Delay Time               | —    | 590  | —    |       |  |
| $t_f$        | Fall Time                         | —    | 500  | —    |       |  |
| $E_{ts}$     | Total Switching Loss              | —    | 13   | —    | mJ    | See Fig. 10, 14  |
| $L_E$        | Internal Emitter Inductance       | —    | 13   | —    | nH    | Measured 5mm from package  |
| $C_{ies}$    | Input Capacitance                 | —    | 2400 | —    | pF    | $V_{GE} = 0V$<br>$V_{CC} = 30V$<br>$f = 1.0MHz$<br>See Fig. 7  |
| $C_{oes}$    | Output Capacitance                | —    | 140  | —    |       |  |
| $C_{res}$    | Reverse Transfer Capacitance      | —    | 28   | —    |       |  |

### Notes:

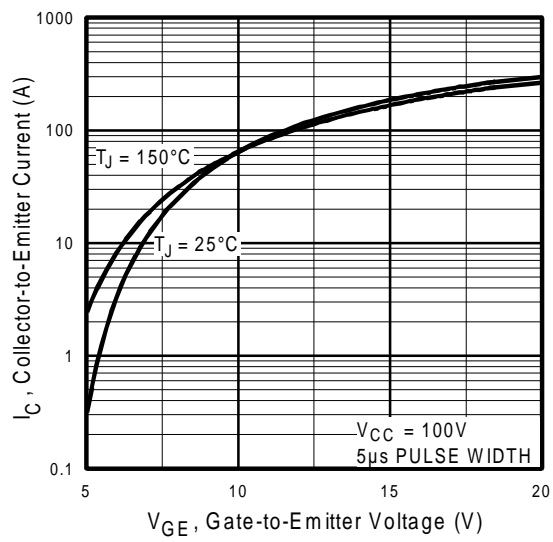
- ① Repetitive rating;  $V_{GE}=20V$ , pulse width limited by max. junction temperature. ( See fig. 13b )
- ②  $V_{CC}=80\%(V_{CES}), V_{GE}=20V, L=10\mu H, R_G=5.0\Omega$ , ( See fig. 13a )
- ③ Repetitive rating; pulse width limited by maximum junction temperature.
- ④ Pulse width  $\leq 80\mu s$ ;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



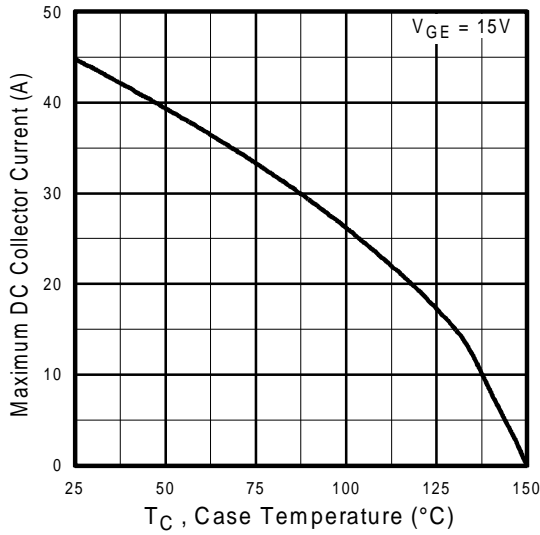
**Fig. 1 - Typical Load Current vs. Frequency**  
 (For square wave,  $I = I_{RMS}$  of fundamental; for triangular wave,  $I = I_{PK}$ )



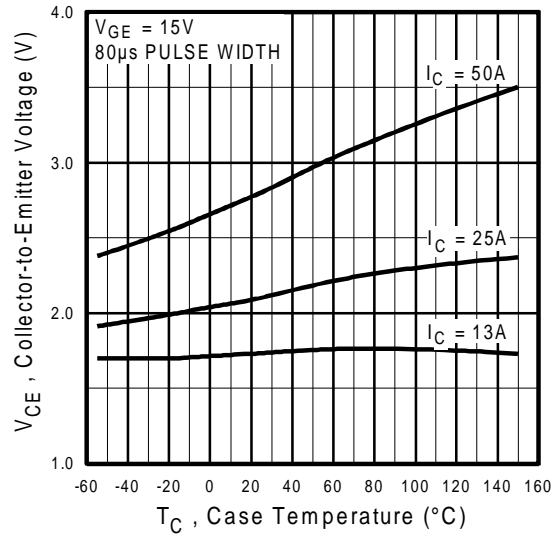
**Fig. 2 - Typical Output Characteristics**



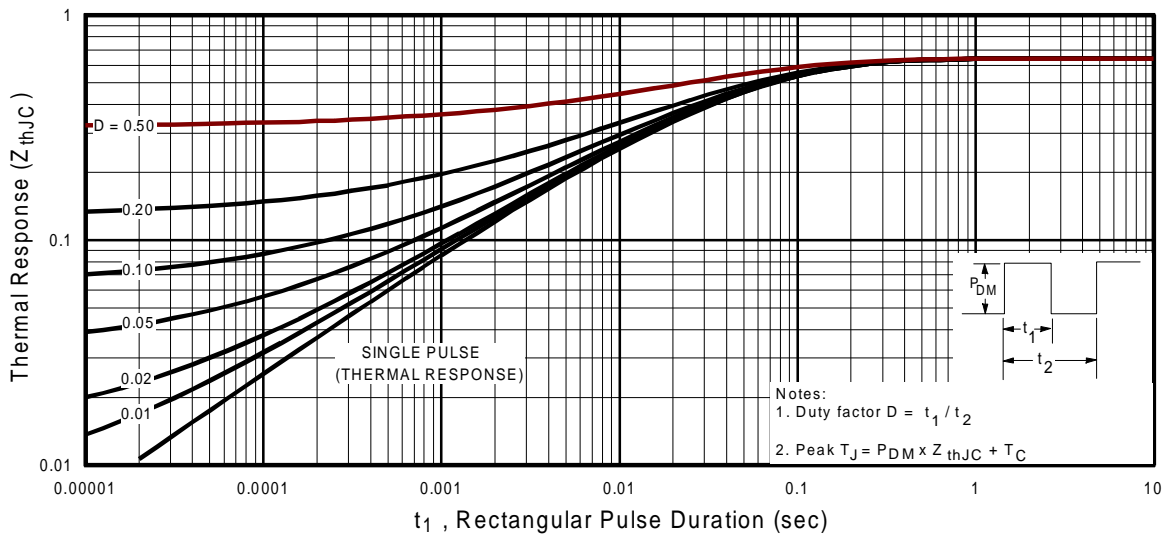
**Fig. 3 - Typical Transfer Characteristics**



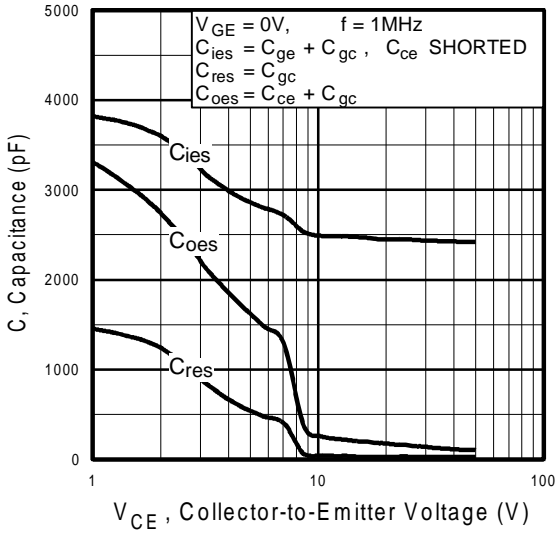
**Fig. 4 - Maximum Collector Current vs. Case Temperature**



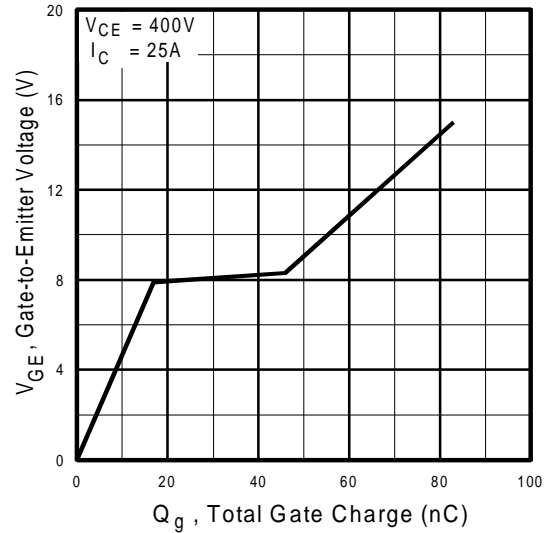
**Fig. 5 - Collector-to-Emitter Voltage vs. Case Temperature**



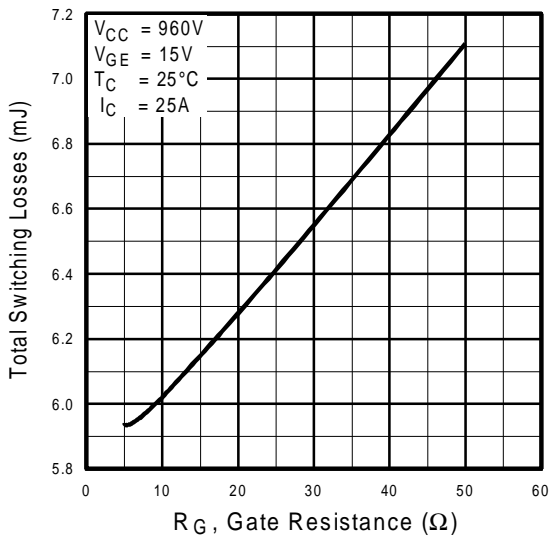
**Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case**



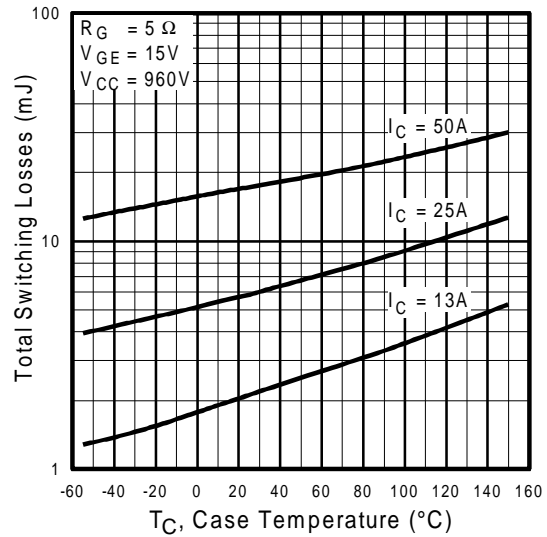
**Fig. 7** - Typical Capacitance vs. Collector-to-Emitter Voltage



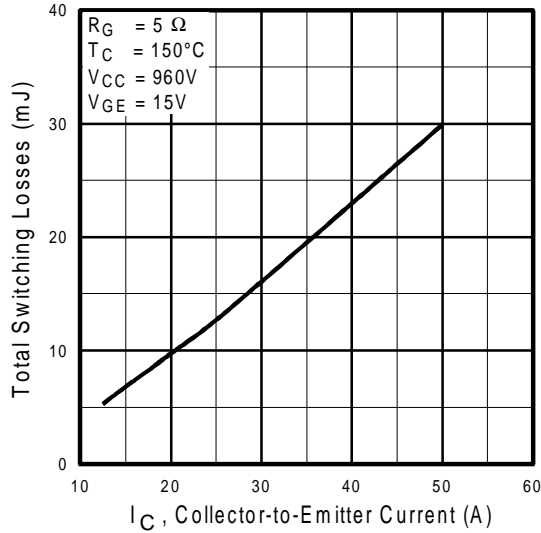
**Fig. 8** - Typical Gate Charge vs. Gate-to-Emitter Voltage



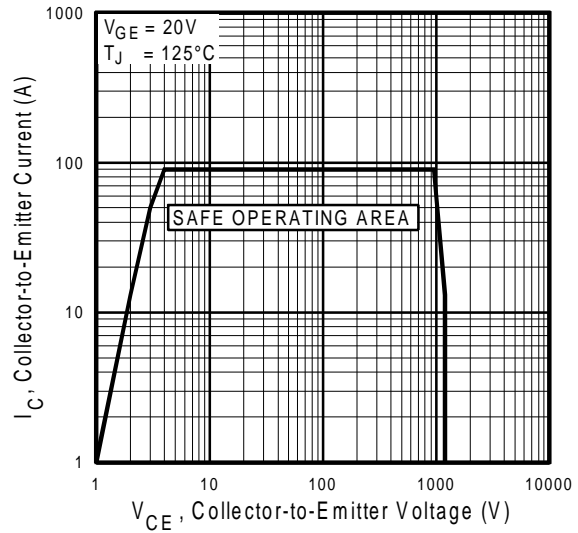
**Fig. 9** - Typical Switching Losses vs. Gate Resistance



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



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



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

Refer to **Section D** for the following:

**Appendix G: Section D - page D-9**

Fig. 13a - Clamped Inductive Load Test Circuit

Fig. 13b - Pulsed Collector Current Test Circuit

Fig. 14a - Switching Loss Test Circuit

Fig. 14b - Switching Loss Waveform

**Package Outline 3 - JEDEC Outline TO-247AC (TO-3P) Section D - page D-13**