# International IOR Rectifier

## IRGBC30F

INSULATED GATE BIPOLAR TRANSISTOR
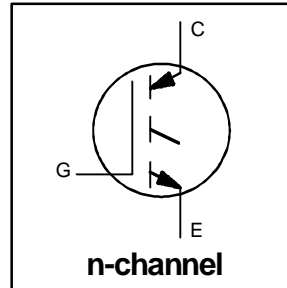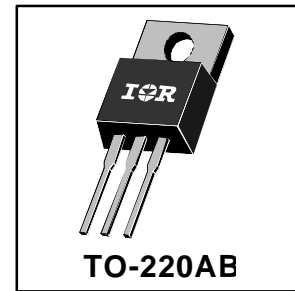
Fast Speed IGBT

### Features

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



**n-channel**

$V_{CES} = 600V$

$V_{CE(sat)} \leq 2.1V$

$@V_{GE} = 15V, I_C = 17A$

### 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.

**TO-220AB**

### Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---|---|---|---|
| $V_{CES}$ | Collector-to-Emitter Voltage | 600 | V |
| $I_C$ @ $T_C$ = 25°C | Continuous Collector Current | 31 | |
| $I_C$ @ $T_C$ = 100°C | Continuous Collector Current | 17 | A |
| $I_{CM}$ | Pulsed Collector Current ① | 120 | |
| $I_{LM}$ | Clamped Inductive Load Current ② | 120 | |
| $V_{GE}$ | Gate-to-Emitter Voltage | ±20 | V |
| $E_{ARV}$ | Reverse Voltage Avalanche Energy ③ | 10 | mJ |
| $P_D$ @ $T_C$ = 25°C | Maximum Power Dissipation | 100 | W |
| $P_D$ @ $T_C$ = 100°C | Maximum Power Dissipation | 42 | |
| $T_J$ | Operating Junction and | -55 to +150 | |
| $T_{STG}$ | Storage Temperature Range | | °C |
| | 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 | — | — | 1.2 | |
| $R_{\theta CS}$ | Case-to-Sink, flat, greased surface | — | 0.50 | — | °C/W |
| $R_{\theta JA}$ | Junction-to-Ambient, typical socket mount | — | — | 80 | |
| Wt | Weight | — | 2.0 (0.07) | — | g (oz) |

## Electrical Characteristics @ $T_J$ = 25°C (unless otherwise specified)

| | Parameter | Min. | Typ. | Max. | Units | Conditions | |
|---|---|---|---|---|---|---|---|
| $V_{(BR)CES}$ | Collector-to-Emitter Breakdown Voltage | 600 | — | — | V | $V_{GE}$ = 0V, $I_C$ = 250µA | |
| $V_{(BR)ECS}$ | 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 | — | 0.69 | — | V/°C | $V_{GE}$ = 0V, $I_C$ = 1.0mA | |
| $V_{CE(on)}$ | Collector-to-Emitter Saturation Voltage | — | 1.8 | 2.1 | | $I_C$ = 17A | $V_{GE}$ = 15V |
| | | — | 2.4 | — | V | $I_C$ = 31A | See Fig. 2, 5 |
| | | — | 2.2 | — | | $I_C$ = 17A, $T_J$ = 150°C | |
| $V_{GE(th)}$ | Gate Threshold Voltage | 3.0 | — | 5.5 | | $V_{CE}$ = $V_{GE}$, $I_C$ = 250µA | |
| $\Delta V_{GE(th)}/\Delta T_J$ | Temperature Coeff. of Threshold Voltage | — | -11 | — | mV/°C | $V_{CE}$ = $V_{GE}$, $I_C$ = 250µA | |
| $g_{fe}$ | Forward Transconductance ⑤ | 6.1 | 10 | — | S | $V_{CE}$ = 100V, $I_C$ = 17A | |
| $I_{CES}$ | Zero Gate Voltage Collector Current | — | — | 250 | µA | $V_{GE}$ = 0V, $V_{CE}$ = 600V | |
| | | — | — | 1000 | | $V_{GE}$ = 0V, $V_{CE}$ = 600V, $T_J$ = 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) | — | 27 | 30 | | $I_C$ = 17A |
| $Q_{ge}$ | Gate - Emitter Charge (turn-on) | — | 4.1 | 5.9 | nC | $V_{CC}$ = 400V        See Fig. 8 |
| $Q_{gc}$ | Gate - Collector Charge (turn-on) | — | 12 | 15 | | $V_{GE}$ = 15V |
| $t_{d(on)}$ | Turn-On Delay Time | — | 25 | — | | $T_J$ = 25°C |
| $t_r$ | Rise Time | — | 21 | — | ns | $I_C$ = 17A, $V_{CC}$ = 480V |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 210 | 320 | | $V_{GE}$ = 15V, $R_G$ = 23Ω |
| $t_f$ | Fall Time | — | 300 | 500 | | Energy losses include "tail" |
| $E_{on}$ | Turn-On Switching Loss | — | 0.30 | — | | |
| $E_{off}$ | Turn-Off Switching Loss | — | 2.1 | — | mJ | See Fig. 9, 10, 11, 14 |
| $E_{ts}$ | Total Switching Loss | — | 2.4 | 3.5 | | |
| $t_{d(on)}$ | Turn-On Delay Time | — | 25 | — | | $T_J$ = 150°C, |
| $t_r$ | Rise Time | — | 21 | — | ns | $I_C$ = 17A, $V_{CC}$ = 480V |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 290 | — | | $V_{GE}$ = 15V, $R_G$ = 23Ω |
| $t_f$ | Fall Time | — | 590 | — | | Energy losses include "tail" |
| $E_{ts}$ | Total Switching Loss | — | 3.6 | — | mJ | See Fig. 10, 14 |
| $L_E$ | Internal Emitter Inductance | — | 7.5 | — | nH | Measured 5mm from package |
| $C_{ies}$ | Input Capacitance | — | 670 | — | | $V_{GE}$ = 0V |
| $C_{oes}$ | Output Capacitance | — | 100 | — | pF | $V_{CC}$ = 30V          See Fig. 7 |
| $C_{res}$ | Reverse Transfer Capacitance | — | 10 | — | | $f$ = 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=10µH, $R_G$= 23Ω, ( See fig. 13a )

③ Repetitive rating; pulse width limited by maximum junction temperature.

④ Pulse width ≤ 80µs; duty factor ≤ 0.1%.
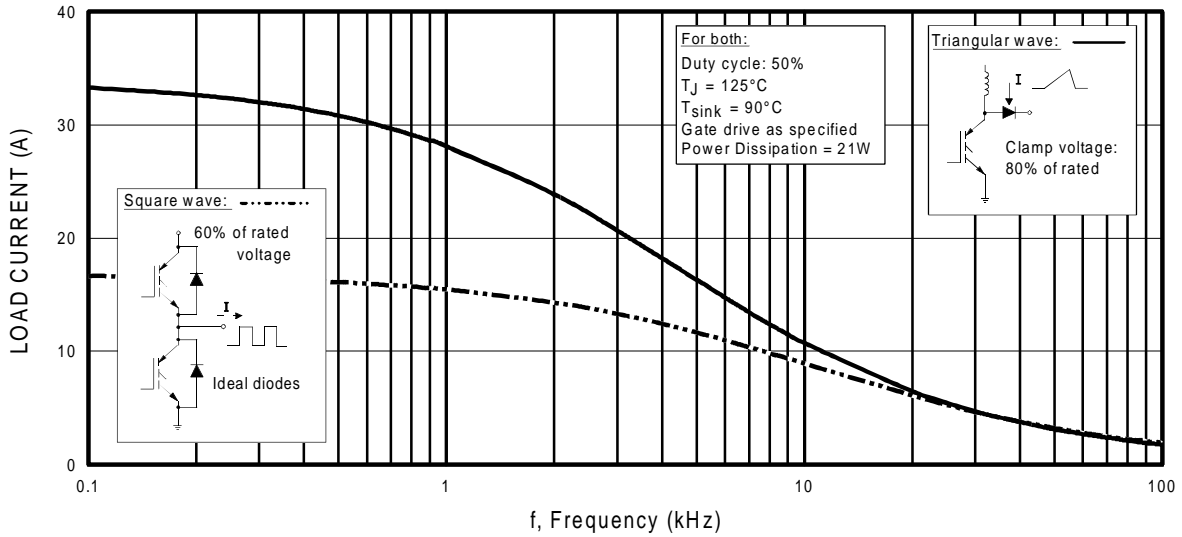
⑤ Pulse width 5.0µs, single shot.

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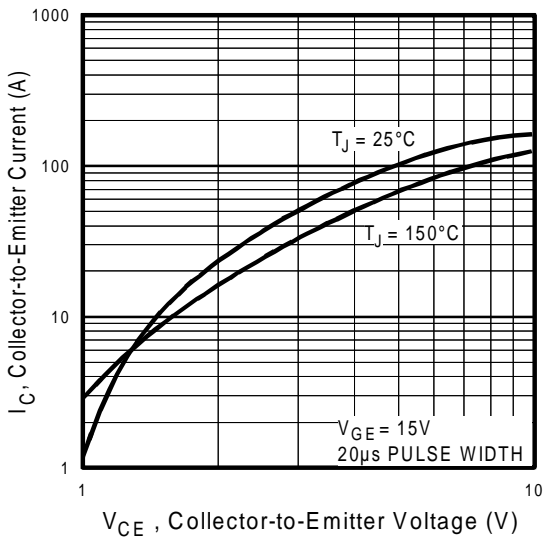(For square wave, I=I$_{RMS}$ of fundamental; for triangular wave, I=I$_{PK}$)



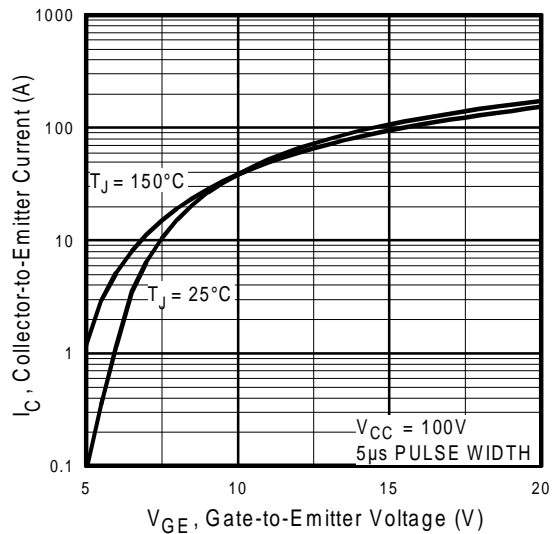**Fig. 2** - Typical Output Characteristics



**Fig. 3** - Typical Transfer Characteristics
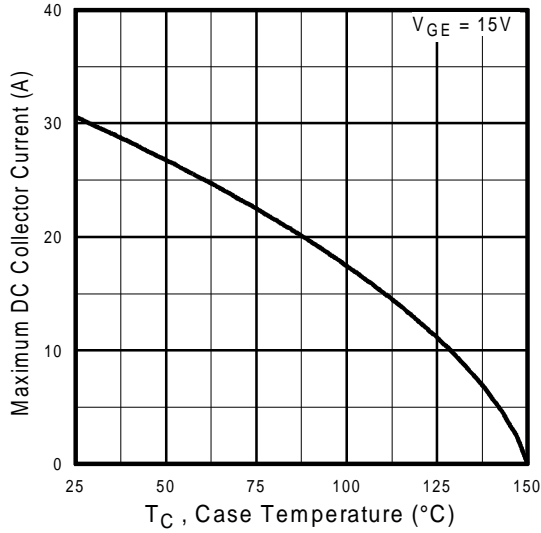
Revision 0

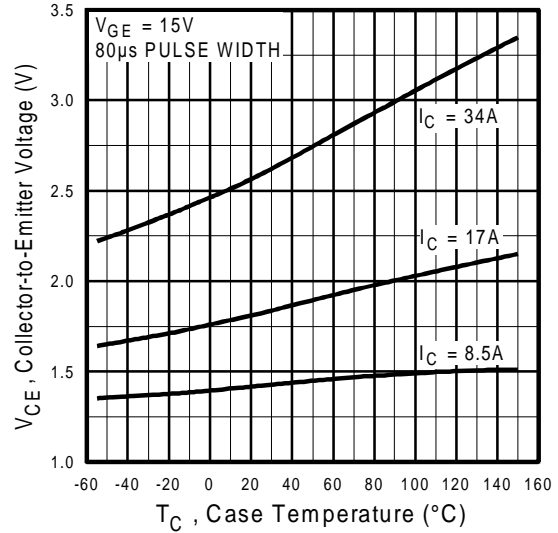**Fig. 4** - Maximum Collector Current vs.
Case Temperature



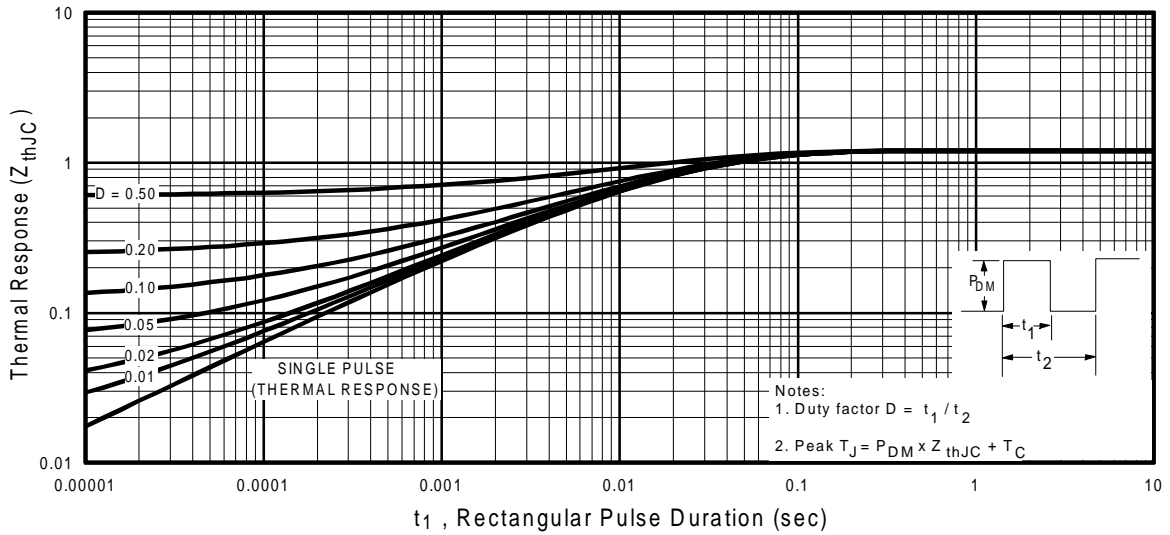**Fig. 5** - Collector-to-Emitter Voltage vs.
Case Temperature



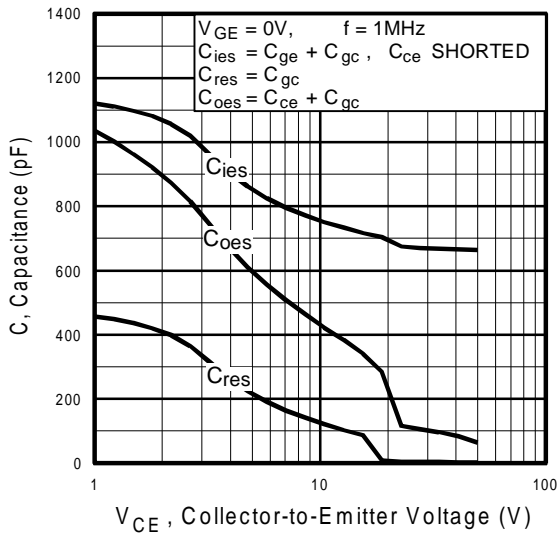**Fig. 6** - Maximum Effective Transient Thermal Impedance, Junction-to-Case
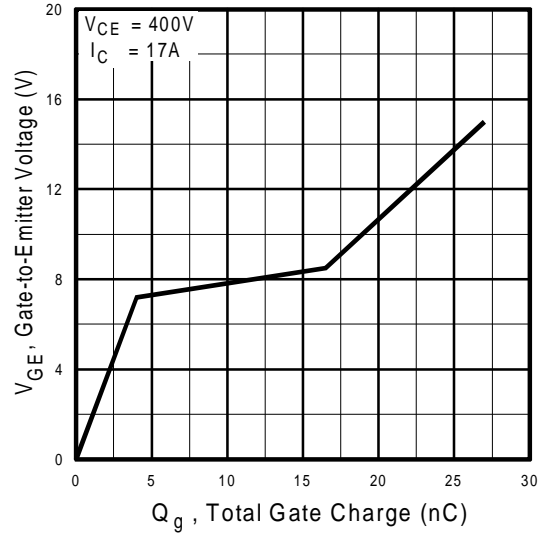
**Fig. 7 -** Typical Capacitance vs.
Collector-to-Emitter Voltage



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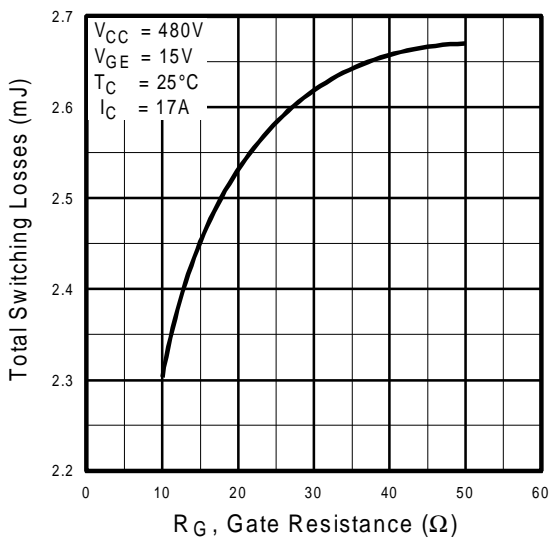Gate-to-Emitter Voltage



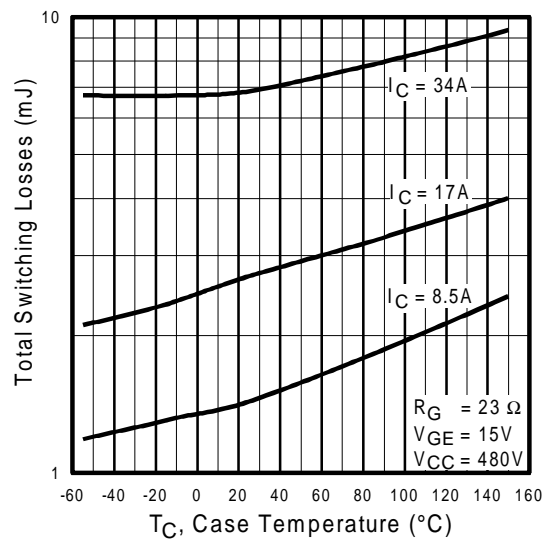**Fig. 9** - Typical Switching Losses vs. Gate
Resistance



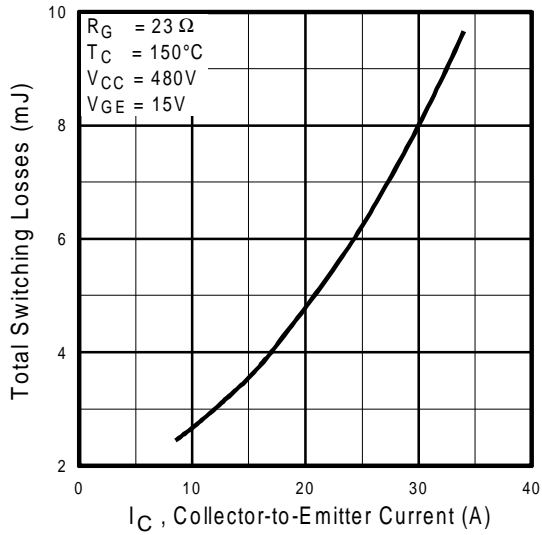**Fig. 10** - Typical Switching Losses vs.
Case Temperature

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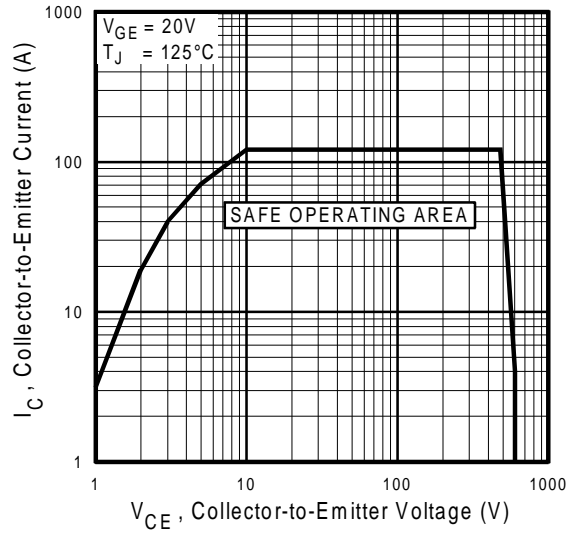Collector-to-Emitter Current

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

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

**Appendix C: Section D - page D-5**

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 1** - JEDEC Outline TO-220AB          **Section D - page D-12**