

International IR Rectifier

PD - 9.683A

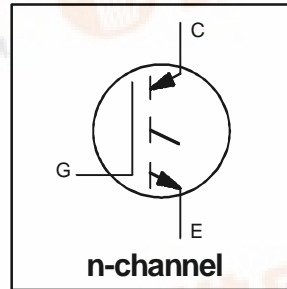
IRGBC40U

INSULATED GATE BIPOLAR TRANSISTOR

UltraFast IGBT

Features

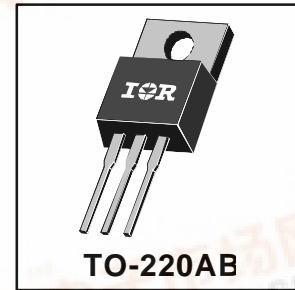
- Switching-loss rating includes all "tail" losses
- Optimized for high operating frequency (over 5kHz)
See Fig. 1 for Current vs. Frequency curve



| |
|-----------------------------|
| $V_{CES} = 600V$ |
| $V_{CE(sat)} \leq 3.0V$ |
| @ $V_{GE} = 15V, I_C = 20A$ |

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 | 600 | V |
| $I_C @ T_C = 25^\circ C$ | Continuous Collector Current | 40 | A |
| $I_C @ T_C = 100^\circ C$ | Continuous Collector Current | 20 | |
| I_{CM} | Pulsed Collector Current ^① | 160 | |
| I_{LM} | Clamped Inductive Load Current ^② | 160 | |
| V_{GE} | Gate-to-Emitter Voltage | ± 20 | V |
| E_{ARV} | Reverse Voltage Avalanche Energy ^③ | 15 | mJ |
| $P_D @ T_C = 25^\circ C$ | Maximum Power Dissipation | 160 | W |
| $P_D @ T_C = 100^\circ C$ | Maximum Power Dissipation | 65 | |
| T_J | Operating Junction and Storage Temperature Range | -55 to +150 | °C |
| T_{STG} | | | |
| | | | |
| | 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 | — | — | 0.77 | °C/W |
| $R_{\theta CS}$ | Case-to-Sink, flat, greased surface | — | 0.50 | — | |
| $R_{\theta JA}$ | Junction-to-Ambient, typical socket mount | — | — | 80 | |
| Wt | Weight | — | 2.0 (0.07) | — | 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 | $V_{GE} = 0V, I_C = 1.0A$ |
| $\Delta V_{(BR)CES}/\Delta T_J$ | Temp. Coeff. of Breakdown Voltage | — | 0.63 | — | V/°C | $V_{GE} = 0V, I_C = 1.0mA$ |
| $V_{CE(on)}$ | Collector-to-Emitter Saturation Voltage | — | 2.2 | 3.0 | V | $I_C = 20A$ $I_C = 40A$ $I_C = 20A, T_J = 150^\circ\text{C}$ $V_{GE} = 15V$ See Fig. 2, 5 |
| | | — | 2.7 | — | | |
| | | — | 2.3 | — | | |
| $V_{GE(th)}$ | 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/°C | $V_{CE} = V_{GE}, I_C = 250\mu A$ |
| g_{fe} | Forward Transconductance ⑤ | 11 | 18 | — | S | $V_{CE} = 100V, I_C = 20A$ |
| I_{CES} | Zero Gate Voltage Collector Current | — | — | 250 | μA | $V_{GE} = 0V, V_{CE} = 600V$ |
| | | — | — | 1000 | | $V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$ |
| I_{GES} | Gate-to-Emitter Leakage Current | — | — | ± 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) | — | 51 | 67 | nC | $I_C = 20A$ $V_{CC} = 400V$ $V_{GE} = 15V$ See Fig. 8 |
| Q_{ge} | Gate - Emitter Charge (turn-on) | — | 8.9 | 11 | | |
| Q_{gc} | Gate - Collector Charge (turn-on) | — | 20 | 33 | | |
| $t_{d(on)}$ | Turn-On Delay Time | — | 25 | — | ns | $T_J = 25^\circ\text{C}$ $I_C = 20A, V_{CC} = 480V$ $V_{GE} = 15V, R_G = 10\Omega$ Energy losses include "tail" |
| t_r | Rise Time | — | 21 | — | | |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 96 | 190 | | |
| t_f | Fall Time | — | 43 | 120 | | |
| E_{on} | Turn-On Switching Loss | — | 0.34 | — | mJ | See Fig. 9, 10, 11, 14 |
| E_{off} | Turn-Off Switching Loss | — | 0.41 | — | | |
| E_{ts} | Total Switching Loss | — | 0.75 | 1.6 | | |
| $t_{d(on)}$ | Turn-On Delay Time | — | 25 | — | ns | $T_J = 150^\circ\text{C}$, $I_C = 20A, V_{CC} = 480V$ $V_{GE} = 15V, R_G = 10\Omega$ Energy losses include "tail" |
| t_r | Rise Time | — | 23 | — | | |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 174 | — | | |
| t_f | Fall Time | — | 140 | — | | |
| E_{ts} | Total Switching Loss | — | 1.4 | — | mJ | See Fig. 10, 14 |
| L_E | Internal Emitter Inductance | — | 7.5 | — | nH | Measured 5mm from package |
| C_{ies} | Input Capacitance | — | 1500 | — | pF | $V_{GE} = 0V$ $V_{CC} = 30V$ $f = 1.0MHz$ See Fig. 7 |
| C_{oes} | Output Capacitance | — | 190 | — | | |
| C_{res} | Reverse Transfer Capacitance | — | 17 | — | | |

Notes:

- ① Repetitive rating; $V_{GE}=20V$, pulse width limited by max. junction temperature. (See fig. 13b)
- ② $V_{CC}=80\%(V_{CES}), V_{GE}=20V, L=10\mu H, R_G=10\Omega$, (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.

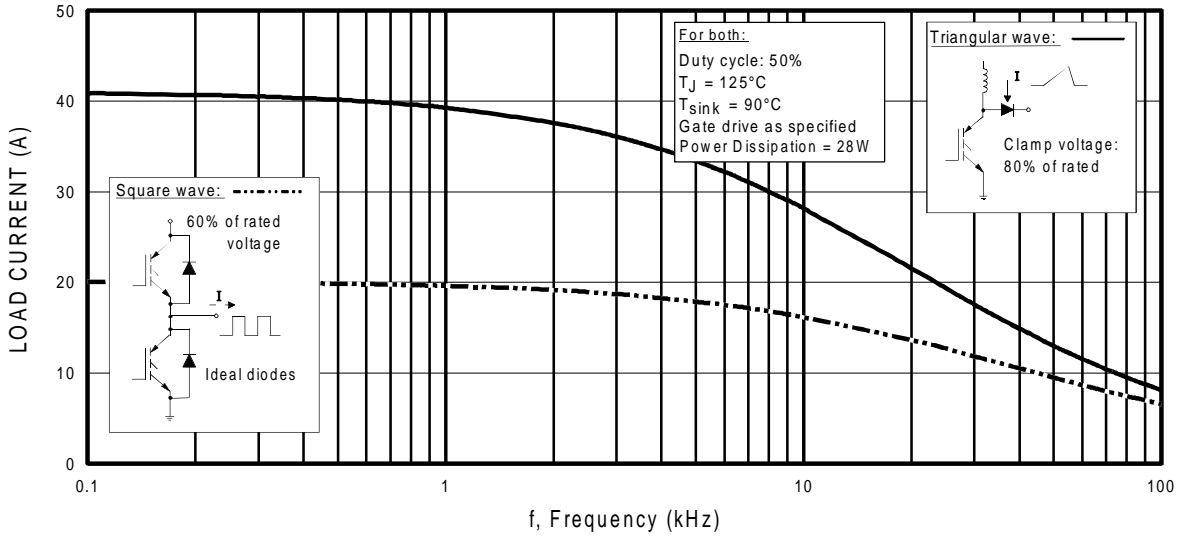


Fig. 1 - Typical Load Current vs. Frequency
 (For square wave, $I = I_{RMS}$ of fundamental; for triangular wave, $I = I_{PK}$)

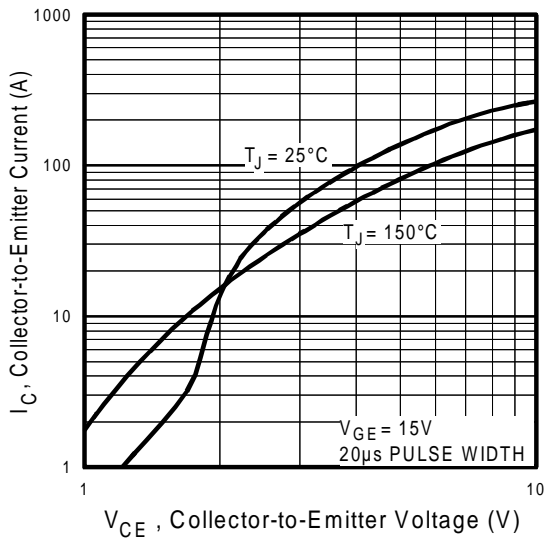


Fig. 2 - Typical Output Characteristics

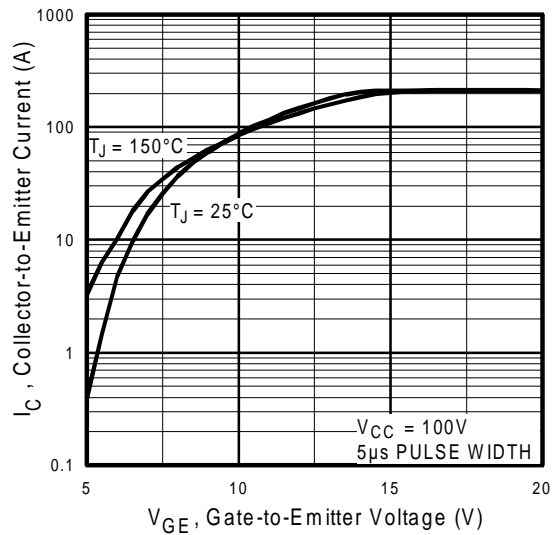


Fig. 3 - Typical Transfer Characteristics

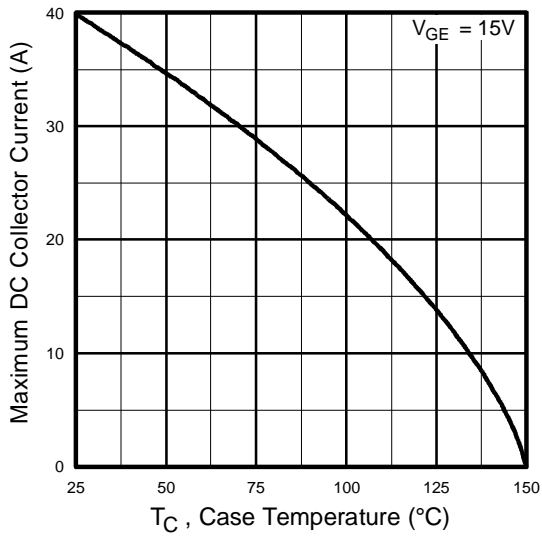


Fig. 4 - Maximum Collector Current vs. Case Temperature

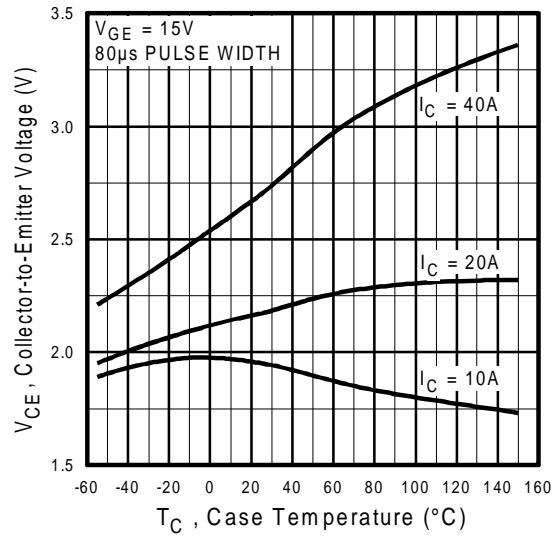


Fig. 5 - Collector-to-Emitter Voltage vs. Case Temperature

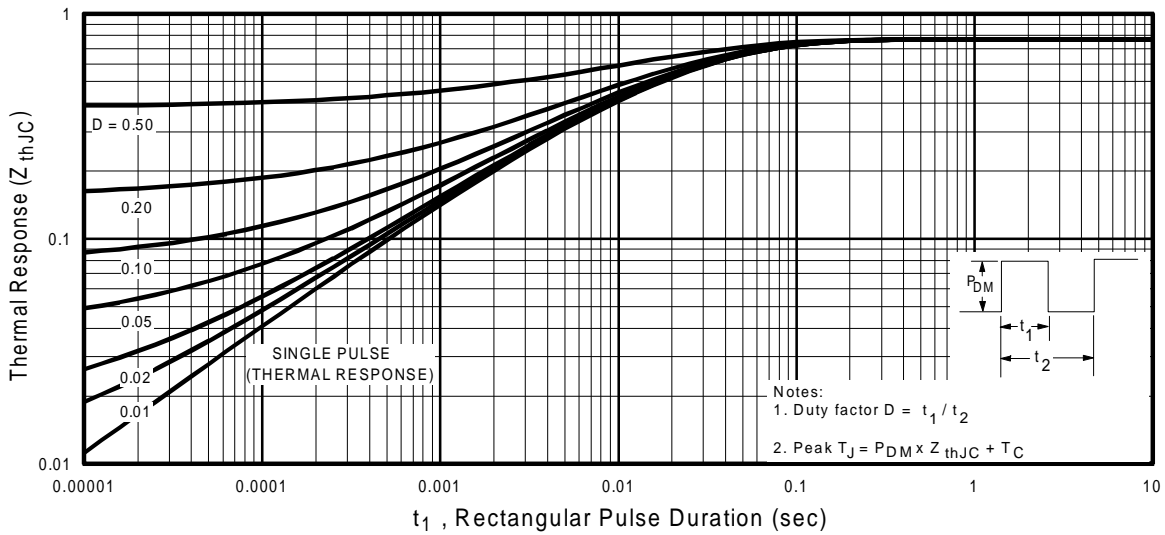


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

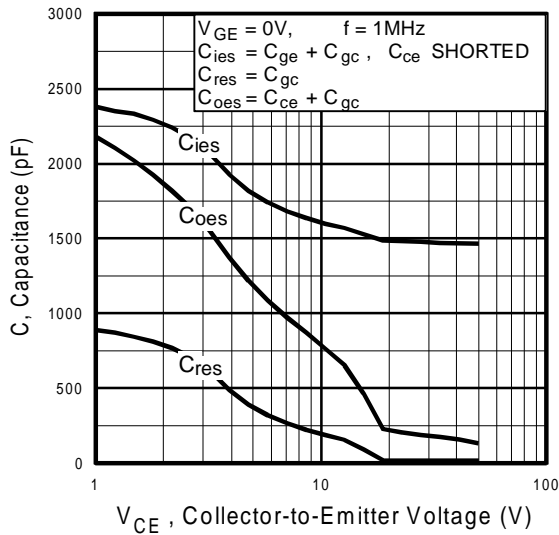


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

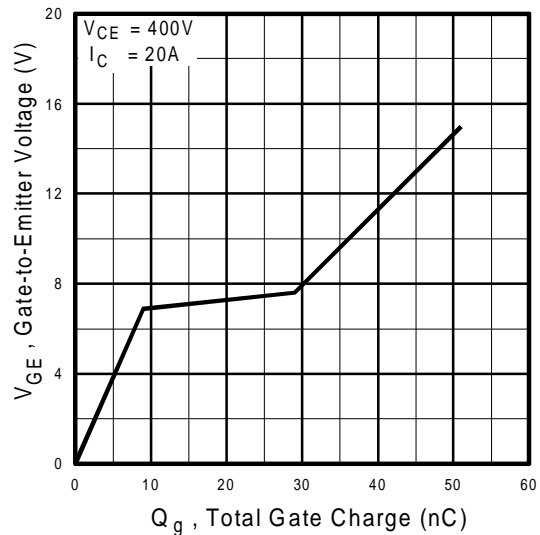


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

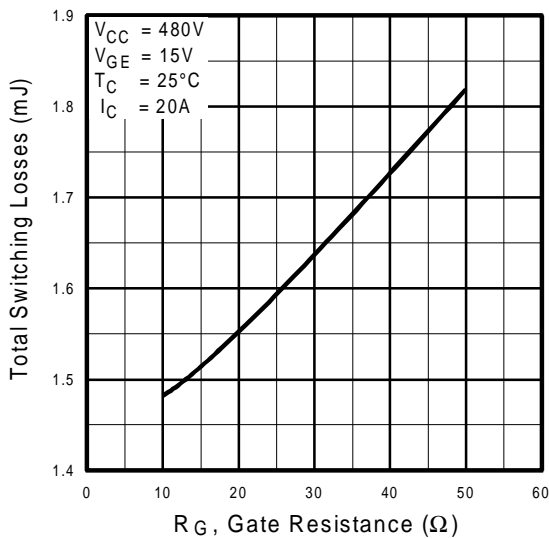


Fig. 9 - Typical Switching Losses vs. Gate Resistance

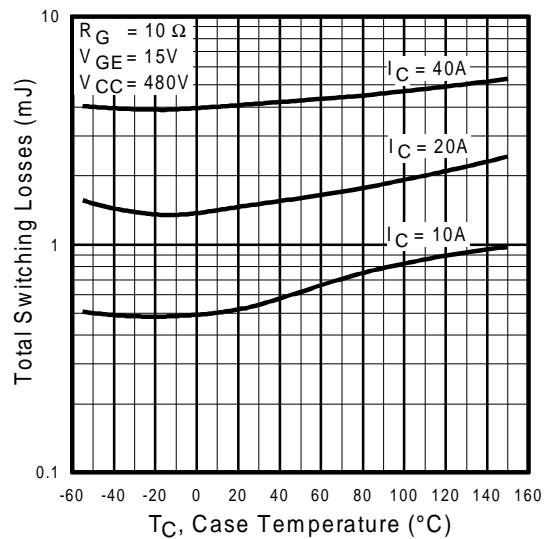


Fig. 10 - Typical Switching Losses vs. Case Temperature

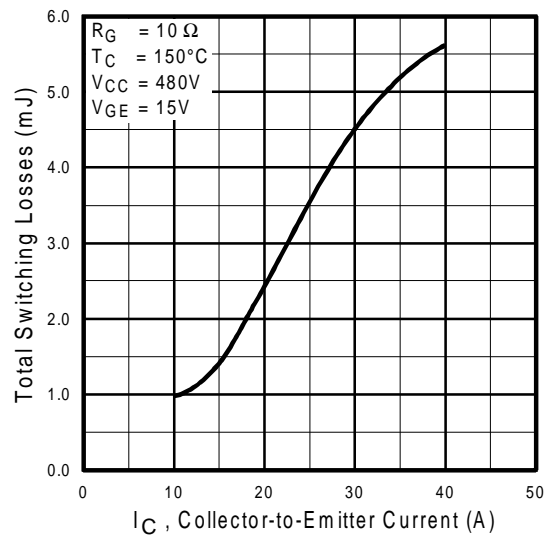


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

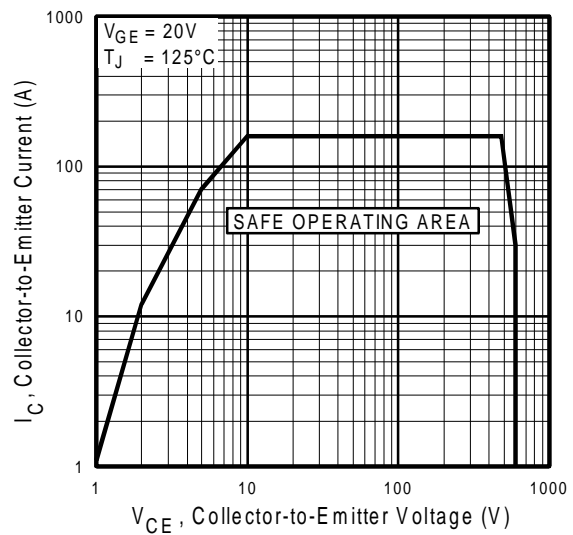


Fig. 12 - Turn-Off SOA

Refer to Section D for the following:

Appendix 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