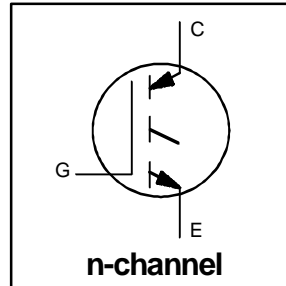


### INSULATED GATE BIPOLAR TRANSISTOR

Short Circuit Rated  
UltraFast IGBT

#### Features

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



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

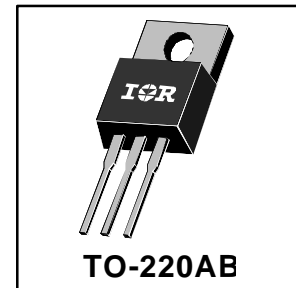
$$V_{CE(\text{sat})} \leq 3.8\text{V}$$

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

#### 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
$V_{CES}$	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ\text{C}$	Continuous Collector Current	23	A
$I_C @ T_C = 100^\circ\text{C}$	Continuous Collector Current	14	
$I_{CM}$	Pulsed Collector Current ①	46	
$I_{LM}$	Clamped Inductive Load Current ②	46	
$t_{sc}$	Short Circuit Withstand Time	10	$\mu\text{s}$
$V_{GE}$	Gate-to-Emitter Voltage	$\pm 20$	V
$E_{ARV}$	Reverse Voltage Avalanche Energy ③	10	mJ
$P_D @ T_C = 25^\circ\text{C}$	Maximum Power Dissipation	100	W
$P_D @ T_C = 100^\circ\text{C}$	Maximum Power Dissipation	42	
$T_J$	Operating Junction and	-55 to +150	$^\circ\text{C}$
$T_{STG}$	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
$R_{\theta JC}$	Junction-to-Case	—	—	1.2	$^\circ\text{C/W}$
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	—	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	—	—	80	
$Wt$	Weight	—	2 (0.07)	—	g (oz)

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

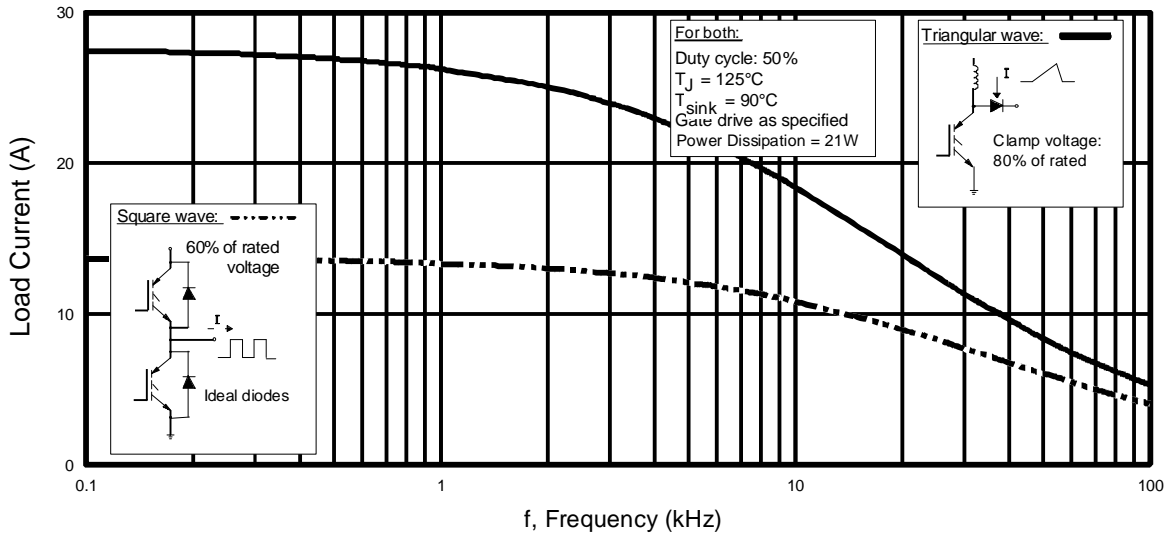
	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	600	—	—	V	$V_{GE} = 0V, I_C = 250\mu A$
$V_{(BR)ECS}$	Emitter-to-Collector Breakdown Voltage <sup>④</sup>	20	—	—	V	$V_{GE} = 0V, I_C = 1.0A$
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	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 <sup>⑤</sup>	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)**

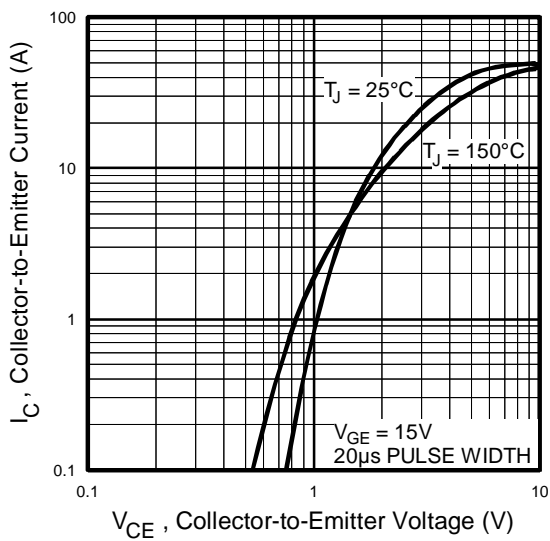
	Parameter	Min.	Typ.	Max.	Units	Conditions
$Q_g$	Total Gate Charge (turn-on)	—	39	58	nC	$I_C = 14A$
$Q_{ge}$	Gate - Emitter Charge (turn-on)	—	8.7	13		$V_{CC} = 400V$ See Fig. 8
$Q_{gc}$	Gate - Collector Charge (turn-on)	—	15	23		$V_{GE} = 15V$
$t_{d(on)}$	Turn-On Delay Time	—	31	—	ns	$T_J = 25^\circ\text{C}$
$t_r$	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
$E_{off}$	Turn-Off Switching Loss	—	0.3	—		
$E_{ts}$	Total Switching Loss	—	0.6	0.9		
$t_{sc}$	Short Circuit Withstand Time	10	—	—	$\mu s$	$V_{CC} = 360V, T_J = 125^\circ\text{C}$ $V_{GE} = 15V, R_G = 23\Omega, V_{CPK} < 500V$
$t_{d(on)}$	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	—	1.2	—	mJ	See Fig. 10, 14
$L_E$	Internal Emitter Inductance	—	7.5	—	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:**

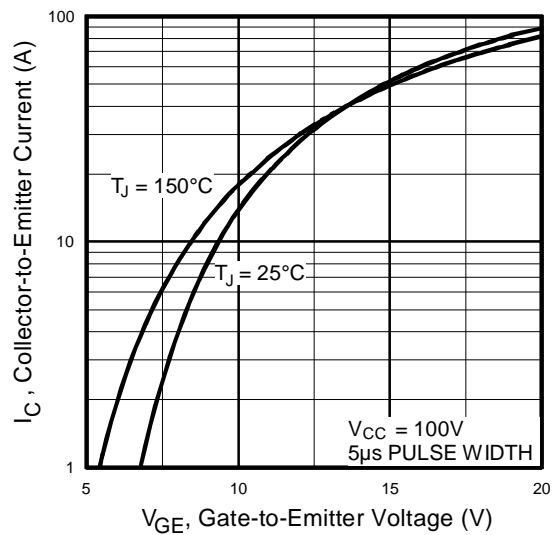
- ① Repetitive rating;  $V_{GE}=20V$ , pulse width limited by max. junction temperature. ( See fig. 13b )
- ②  $V_{CC}=80\%(V_{CES}), V_{GE}=20V, L=10\mu H, R_G=23\Omega,$  ( See fig. 13a )
- ③ Repetitive rating; pulse width limited by maximum junction temperature.
- ④ Pulse width  $\leq 80\mu s$ ; duty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



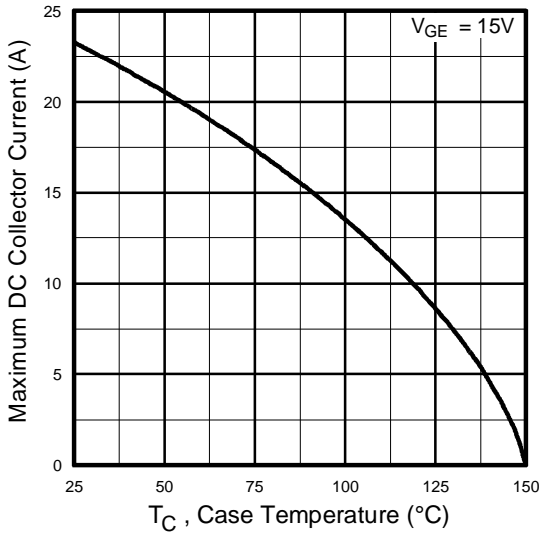
**Fig. 1 - Typical Load Current vs. Frequency**  
 (For square wave,  $I = I_{RMS}$  of fundamental; for triangular wave,  $I = I_{PK}$ )



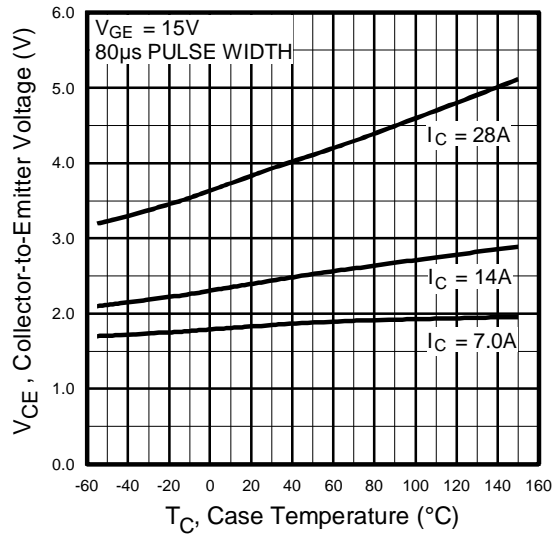
**Fig. 2 - Typical Output Characteristics**



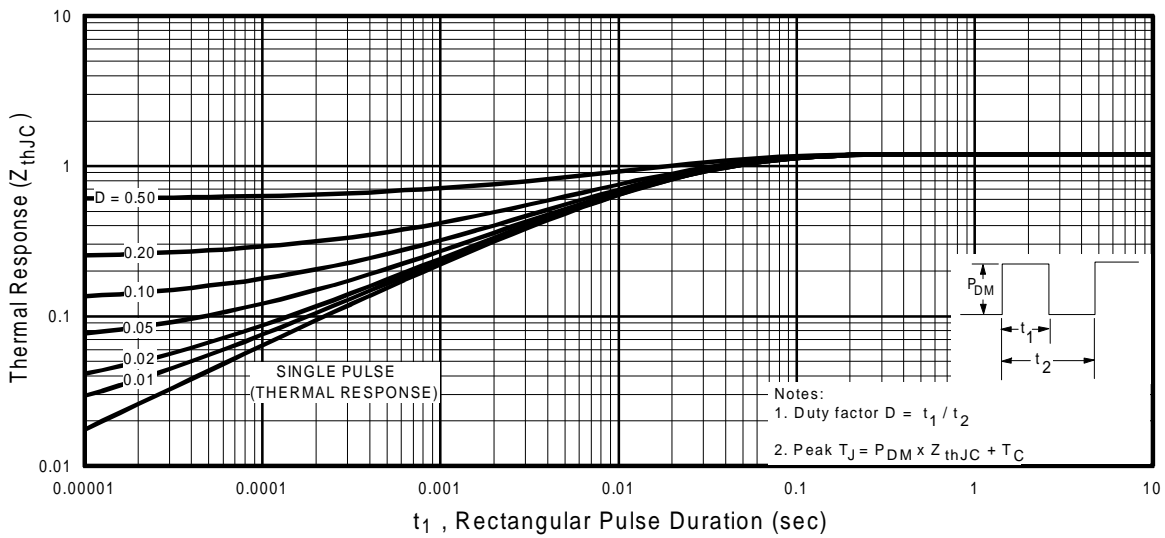
**Fig. 3 - Typical Transfer Characteristics**



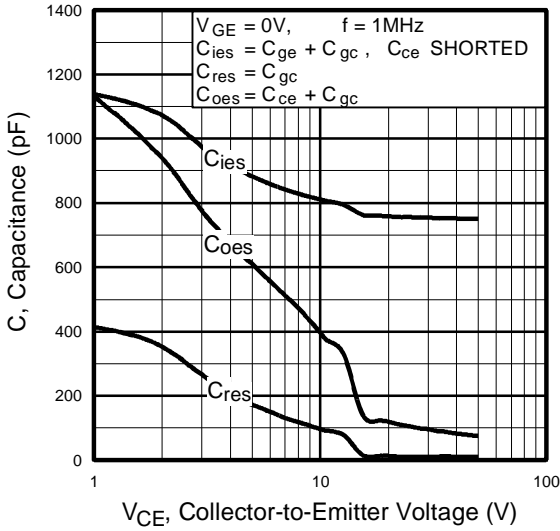
**Fig. 4 - Maximum Collector Current vs. Case Temperature**



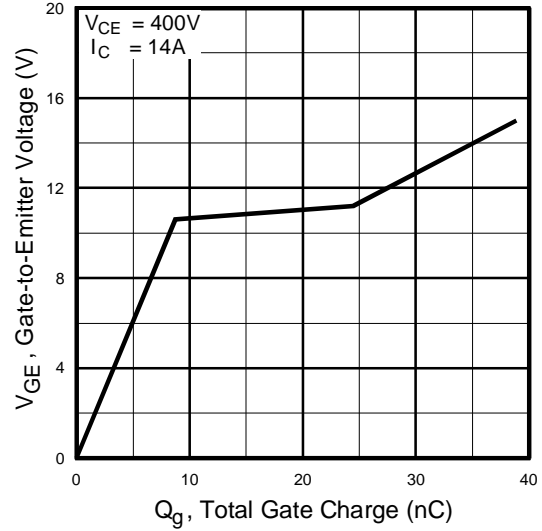
**Fig. 5 - Collector-to-Emitter Voltage vs. Case Temperature**



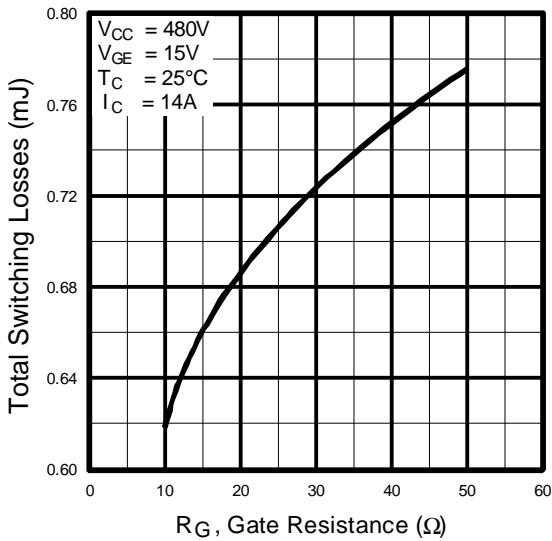
**Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case**



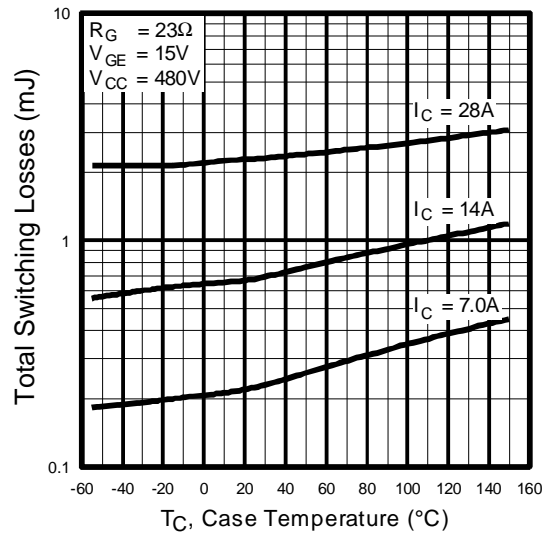
**Fig. 7** - Typical Capacitance vs. Collector-to-Emitter Voltage



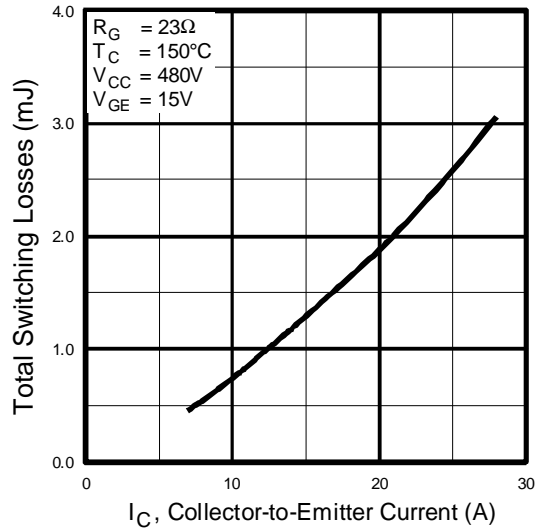
**Fig. 8** - Typical Gate Charge vs. Gate-to-Emitter Voltage



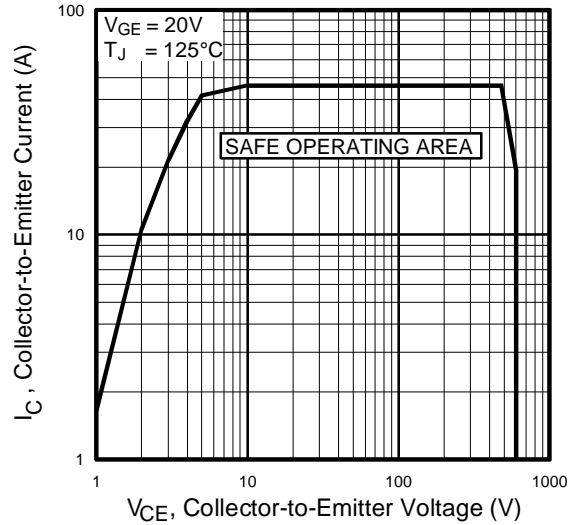
**Fig. 9** - Typical Switching Losses vs. Gate Resistance



**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