

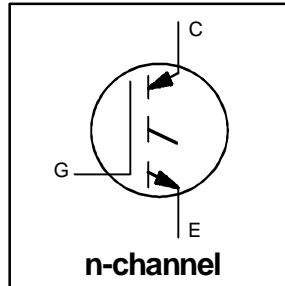
## IRGBC20M-S

INSULATED GATE BIPOLAR TRANSISTOR

Short Circuit Rated  
Fast IGBT

### Features

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

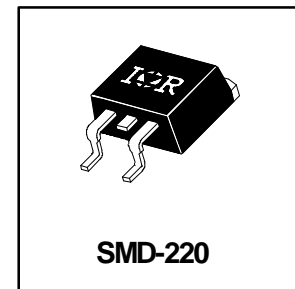


$V_{CES} = 600V$
$V_{CE(sat)} \leq 2.3V$
@ $V_{GE} = 15V, I_C = 8.0A$

### 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
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	13	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	8.0	
$I_{CM}$	Pulsed Collector Current ①	26	
$I_{LM}$	Clamped Inductive Load Current ②	26	
$t_{sc}$	Short Circuit Withstand Time	10	$\mu$ s
$V_{GE}$	Gate-to-Emitter Voltage	$\pm 20$	V
$E_{ARV}$	Reverse Voltage Avalanche Energy ③	5.0	mJ
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	60	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	24	
$T_J$	Operating Junction and	-55 to +150	°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	—	—	2.1	°C/W
$R_{\theta JA}$	Junction-to-Ambient, (PCB mount)**	—	—	40	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	—	—	80	
$Wt$	Weight	—	2 (0.07)	—	g (oz)

\*\* When mounted on 1" square PCB (FR-4 or G-10 Material)

For recommended footprint and soldering techniques refer to application note #AN-994.

**Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)**

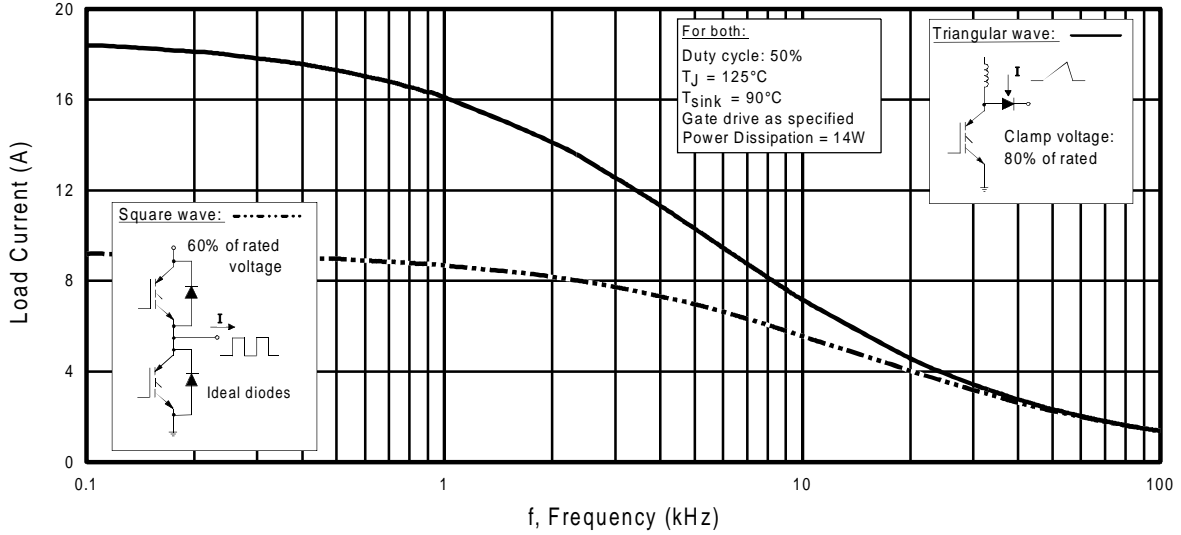
	Parameter	Min.	Typ.	Max.	Units	Conditions
V <sub>(BR)CES</sub>	Collector-to-Emitter Breakdown Voltage	600	—	—	V	V <sub>GE</sub> = 0V, I <sub>C</sub> = 250μA
V <sub>(BR)ECS</sub>	Emitter-to-Collector Breakdown Voltage ④	20	—	—	V	V <sub>GE</sub> = 0V, I <sub>C</sub> = 1.0A
ΔV <sub>(BR)CES/ΔT<sub>J</sub></sub>	Temperature Coeff. of Breakdown Voltage	—	0.42	—	V/°C	V <sub>GE</sub> = 0V, I <sub>C</sub> = 1.0mA
V <sub>CE(on)</sub>	Collector-to-Emitter Saturation Voltage	—	2.0	2.3	V	I <sub>C</sub> = 8.0A V <sub>GE</sub> = 15V
		—	2.7	—		I <sub>C</sub> = 13A See Fig. 2, 5
		—	2.5	—		I <sub>C</sub> = 8.0A, T <sub>J</sub> = 150°C
V <sub>GE(th)</sub>	Gate Threshold Voltage	3.0	—	5.5		V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250μA
ΔV <sub>GE(th)/ΔT<sub>J</sub></sub>	Temperature Coeff. of Threshold Voltage	—	-11	—	mV/°C	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250μA
g <sub>fe</sub>	Forward Transconductance ⑤	2.7	3.8	—	S	V <sub>CE</sub> = 100V, I <sub>C</sub> = 8.0A
I <sub>CES</sub>	Zero Gate Voltage Collector Current	—	—	250	μA	V <sub>GE</sub> = 0V, V <sub>CE</sub> = 600V
		—	—	1000		V <sub>GE</sub> = 0V, V <sub>CE</sub> = 600V, T <sub>J</sub> = 150°C
I <sub>GES</sub>	Gate-to-Emitter Leakage Current	—	—	±100	nA	V <sub>GE</sub> = ±20V

**Switching Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)**

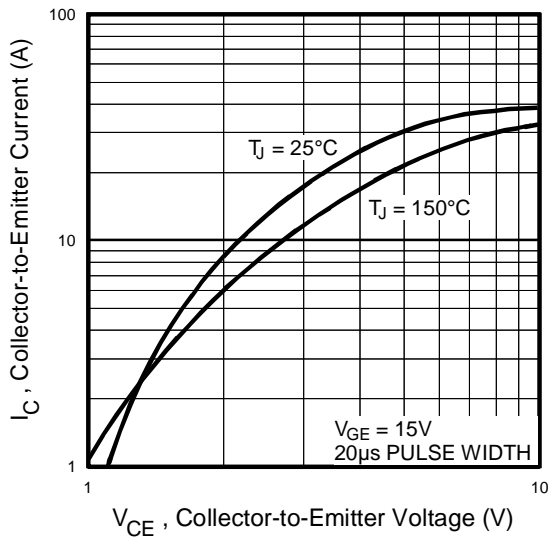
	Parameter	Min.	Typ.	Max.	Units	Conditions
Q <sub>g</sub>	Total Gate Charge (turn-on)	—	7.9	16	nC	I <sub>C</sub> = 8.0A V <sub>CC</sub> = 400V See Fig. 8 V <sub>GE</sub> = 15V
Q <sub>ge</sub>	Gate - Emitter Charge (turn-on)	—	3.6	5.2		
Q <sub>gc</sub>	Gate - Collector Charge (turn-on)	—	6.0	9.0		
t <sub>d(on)</sub>	Turn-On Delay Time	—	29	—	ns	T <sub>J</sub> = 25°C I <sub>C</sub> = 8.0A, V <sub>CC</sub> = 480V V <sub>GE</sub> = 15V, R <sub>G</sub> = 50Ω Energy losses include "tail"
t <sub>r</sub>	Rise Time	—	22	—		
t <sub>d(off)</sub>	Turn-Off Delay Time	—	270	400		
t <sub>f</sub>	Fall Time	—	280	510		
E <sub>on</sub>	Turn-On Switching Loss	—	0.14	—	mJ	See Fig. 9, 10, 11, 14
E <sub>off</sub>	Turn-Off Switching Loss	—	0.86	—		
E <sub>ts</sub>	Total Switching Loss	—	1.0	2.0		
t <sub>sc</sub>	Short Circuit Withstand Time	10	—	—	μs	V <sub>CC</sub> = 360V, T <sub>J</sub> = 125°C V <sub>GE</sub> = 15V, R <sub>G</sub> = 50Ω, V <sub>C<sub>PK</sub></sub> < 500V
t <sub>d(on)</sub>	Turn-On Delay Time	—	27	—	ns	T <sub>J</sub> = 150°C, I <sub>C</sub> = 8.0A, V <sub>CC</sub> = 480V V <sub>GE</sub> = 15V, R <sub>G</sub> = 50Ω Energy losses include "tail"
t <sub>r</sub>	Rise Time	—	21	—		
t <sub>d(off)</sub>	Turn-Off Delay Time	—	370	—		
t <sub>f</sub>	Fall Time	—	420	—		
E <sub>ts</sub>	Total Switching Loss	—	1.4	—	mJ	See Fig. 10, 14
L <sub>E</sub>	Internal Emitter Inductance	—	7.5	—	nH	Measured 5mm from package
C <sub>ies</sub>	Input Capacitance	—	365	—	pF	V <sub>GE</sub> = 0V V <sub>CC</sub> = 30V See Fig. 7 f = 1.0MHz
C <sub>oes</sub>	Output Capacitance	—	47	—		
C <sub>res</sub>	Reverse Transfer Capacitance	—	4.8	—		

**Notes:**

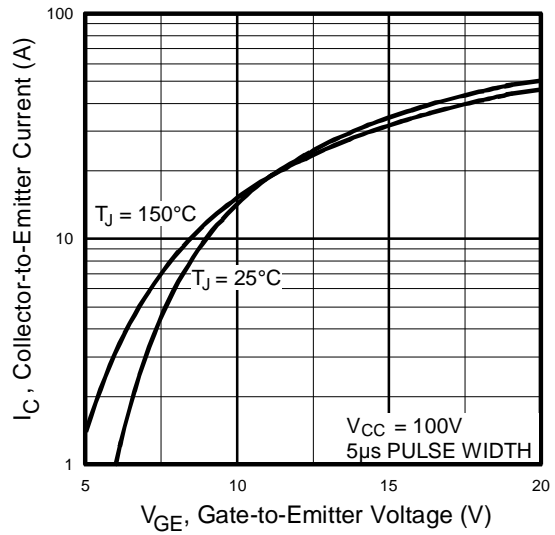
- ① Repetitive rating; V<sub>GE</sub>=20V, pulse width limited by max. junction temperature. ( See fig. 13b )
- ② V<sub>CC</sub>=80%(V<sub>CES</sub>), V<sub>GE</sub>=20V, L=10μH, R<sub>G</sub>= 50Ω, ( See fig. 13a )
- ③ Repetitive rating; pulse width limited by maximum junction temperature.
- ④ Pulse 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**

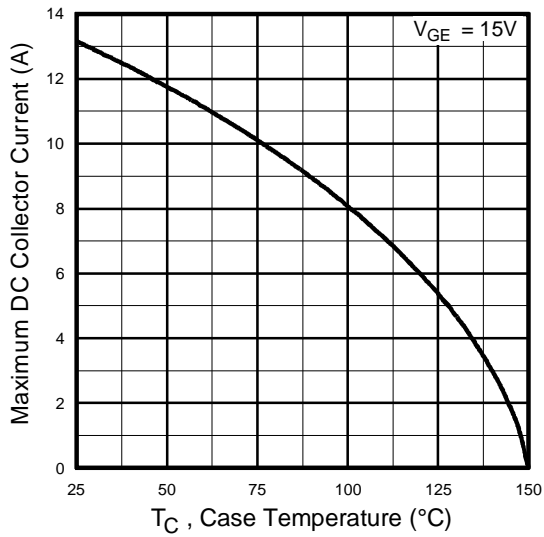


Fig. 4 - Maximum Collector Current vs. Case Temperature

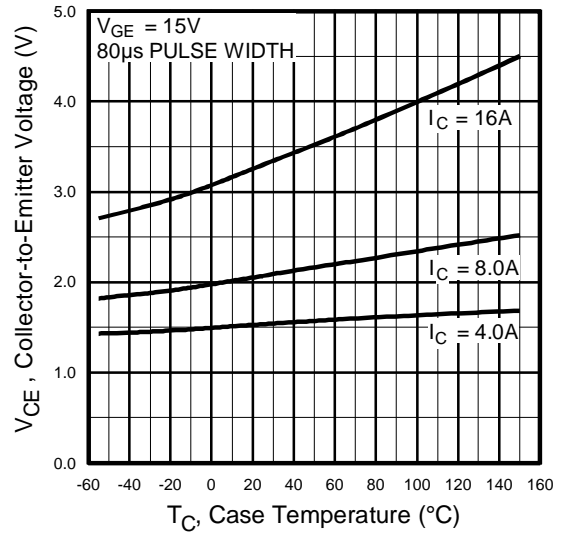


Fig. 5 - Collector-to-Emitter Voltage vs. Case Temperature

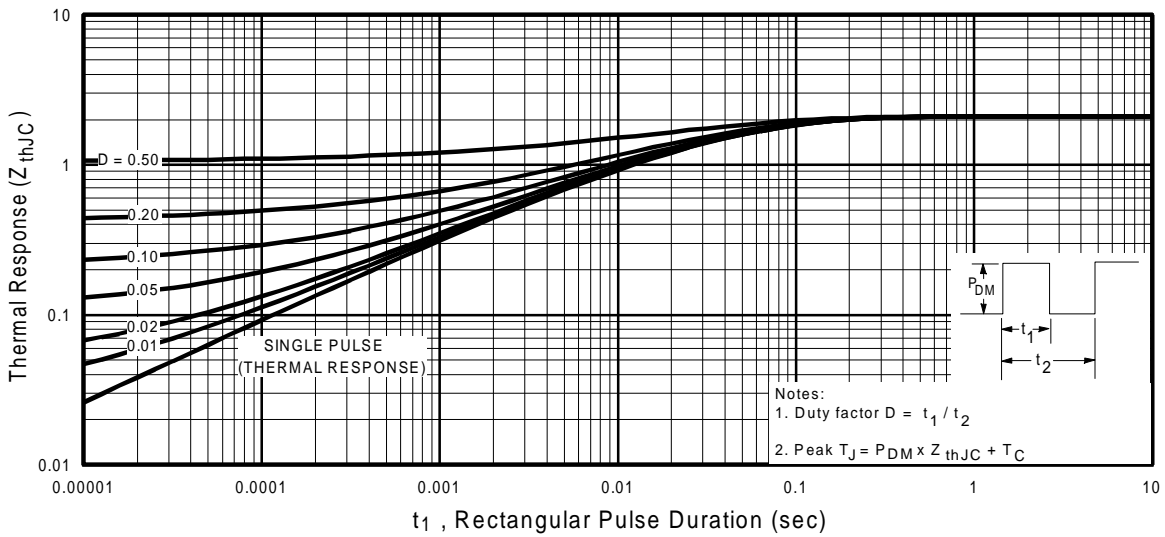
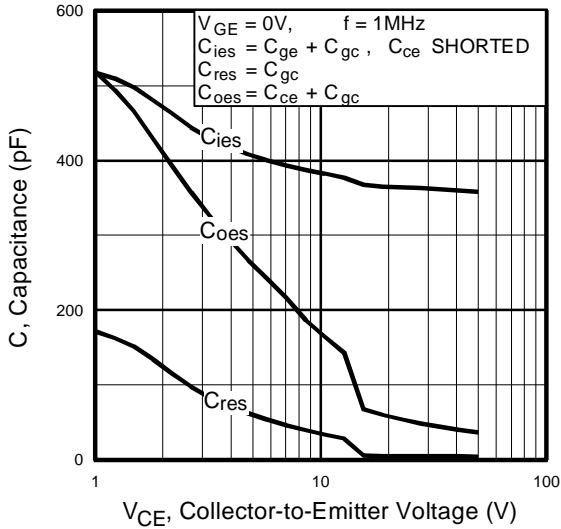
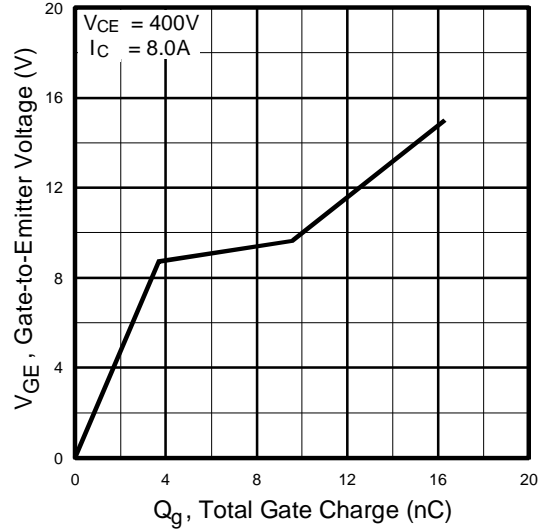


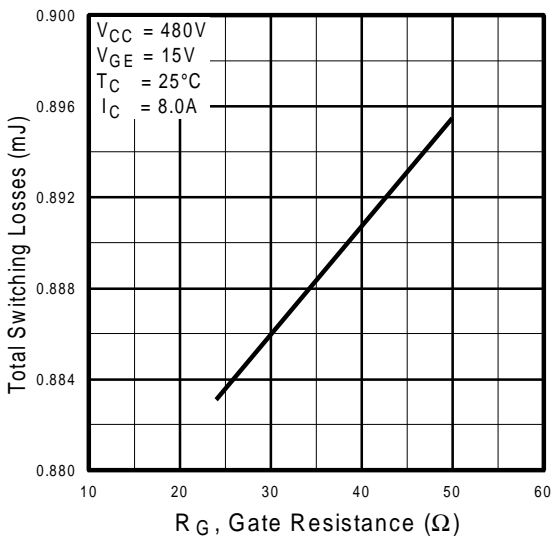
Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case



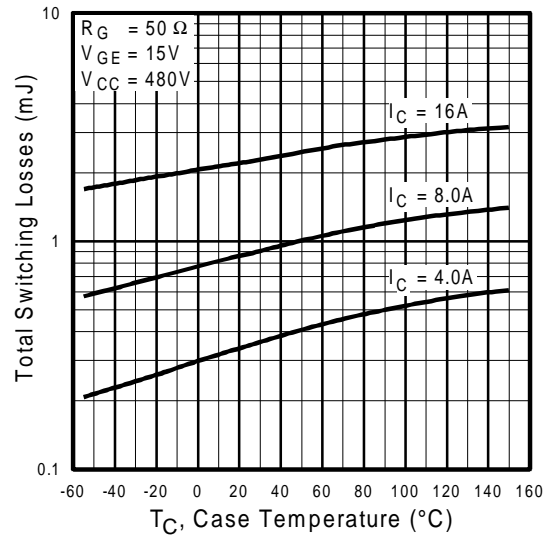
**Fig. 7** - Typical Capacitance vs. Collector-to-Emitter Voltage



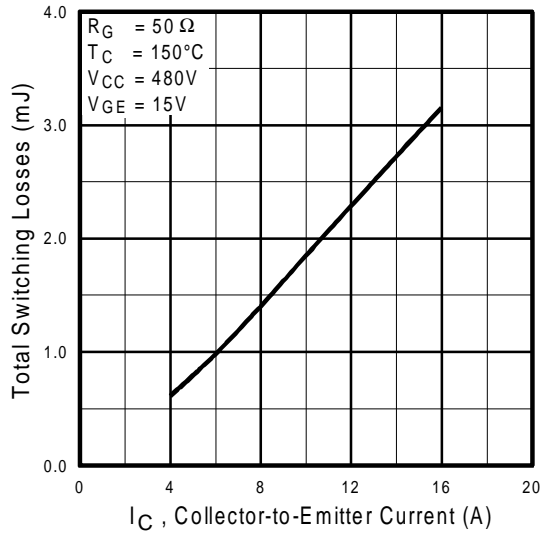
**Fig. 8** - Typical Gate Charge vs. Gate-to-Emitter Voltage



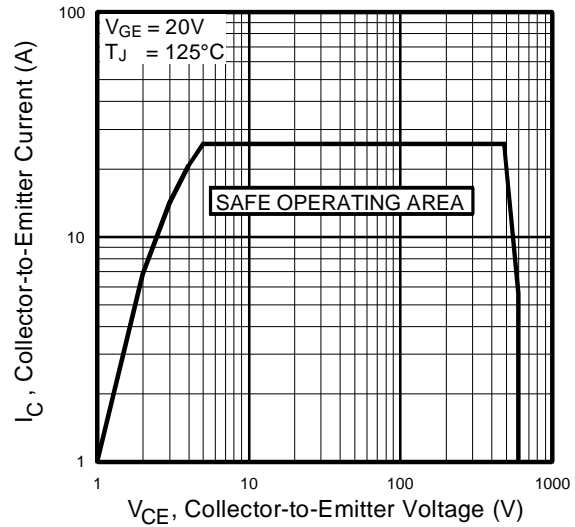
**Fig. 9** - Typical Switching Losses vs. Gate Resistance



**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

**Package Outline 2 - SMD-220 Section D - page D-12**