PD - 9.782A

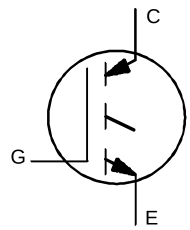
International Rectifier

IRGB440U

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



n-channel

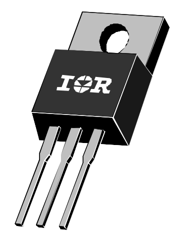
V_{CES} = 500V

$V_{CE(sat)} \leq$ 3.0V

@V_{GE} = 15V, I_C = 22A

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	500	V
I_C @ T_C = 25°C	Continuous Collector Current	40	
I_C @ T_C = 100°C	Continuous Collector Current	22	A
I_{CM}	Pulsed Collector Current ①	80	
I_{LM}	Clamped Inductive Load Current ②	80	
V_{GE}	Gate-to-Emitter Voltage	±20	V
E_{ARV}	Reverse Voltage Avalanche Energy ③	15	mJ
P_D @ T_C = 25°C	Maximum Power Dissipation	160	W
P_D @ T_C = 100°C	Maximum Power Dissipation	65	
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to +150	°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	—	—	0.77	
$R_{\theta CS}$	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)

Revision 0

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

	Parameter	Min.	Typ.	Max.	Units	Conditions	
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	500	—	—	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	—	0.35	—	V/°C	V_{GE} = 0V, I_C = 1.0mA	
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	2.4	3.0	V	I_C = 22A	V_{GE} = 15V
		—	2.8	—		I_C = 40A	See Fig. 2, 5
		—	2.4	—		I_C = 22A, 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	6.6	13	—	S	V_{CE} = 100V, I_C = 22A	
I_{CES}	Zero Gate Voltage Collector Current	—	—	250	µA	V_{GE} = 0V, V_{CE} = 500V	
		—	—	1000		V_{GE} = 0V, V_{CE} = 500V, 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)	—	55	83	nC	I_C = 22A
Q_{ge}	Gate - Emitter Charge (turn-on)	—	11	17		V_{CC} = 400V See Fig. 8
Q_{gc}	Gate - Collector Charge (turn-on)	—	19	29		V_{GE} = 15V
$t_{d(on)}$	Turn-On Delay Time	—	27	—	ns	T_J = 25°C
t_r	Rise Time	—	13	—		I_C = 22A, V_{CC} = 400V
$t_{d(off)}$	Turn-Off Delay Time	—	100	150		V_{GE} = 15V, R_G = 10Ω
t_f	Fall Time	—	56	100		Energy losses include "tail"
E_{on}	Turn-On Switching Loss	—	0.37	—	mJ	See Fig. 9, 10, 11, 14
E_{off}	Turn-Off Switching Loss	—	0.18	—		
E_{ts}	Total Switching Loss	—	0.55	0.70		
$t_{d(on)}$	Turn-On Delay Time	—	27	—	ns	T_J = 150°C,
t_r	Rise Time	—	15	—		I_C = 22A, V_{CC} = 400V
$t_{d(off)}$	Turn-Off Delay Time	—	137	—		V_{GE} = 15V, R_G = 10Ω
t_f	Fall Time	—	100	—		Energy losses include "tail"
E_{ts}	Total Switching Loss	—	0.96	—	mJ	See Fig. 10, 14
L_E	Internal Emitter Inductance	—	7.5	—	nH	Measured 5mm from package
C_{ies}	Input Capacitance	—	1400	—	pF	V_{GE} = 0V
C_{oes}	Output Capacitance	—	250	—		V_{CC} = 30V See Fig. 7
C_{res}	Reverse Transfer Capacitance	—	42	—		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= 10Ω, (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.

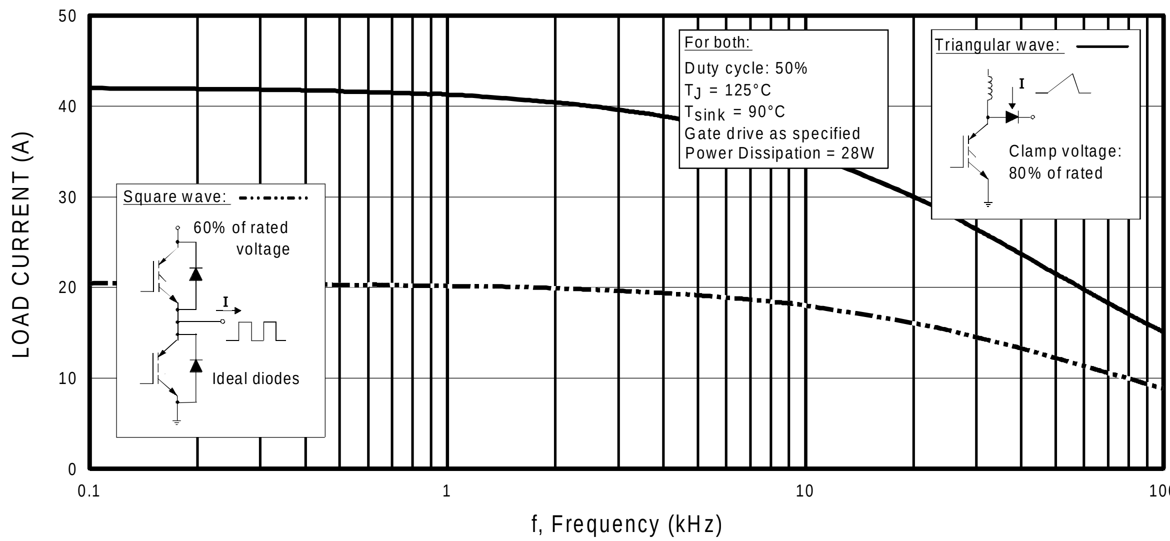


Fig. 1 - Typical Load Current vs. Frequency
(For square wave, $I=I_{RMS}$ of fundamental; for triangular wave, $I=I_{PK}$)

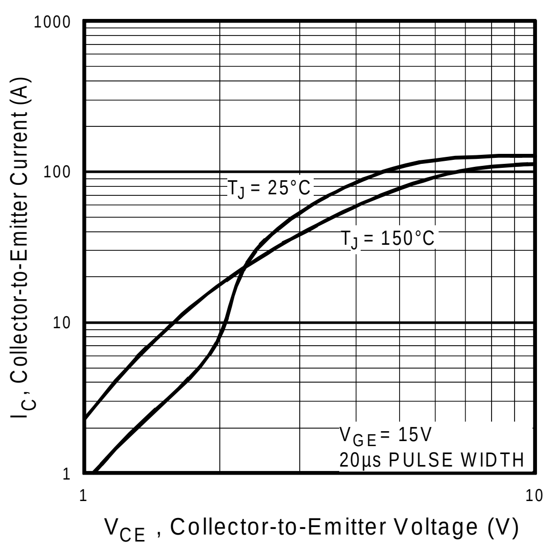


Fig. 2 - Typical Output Characteristics

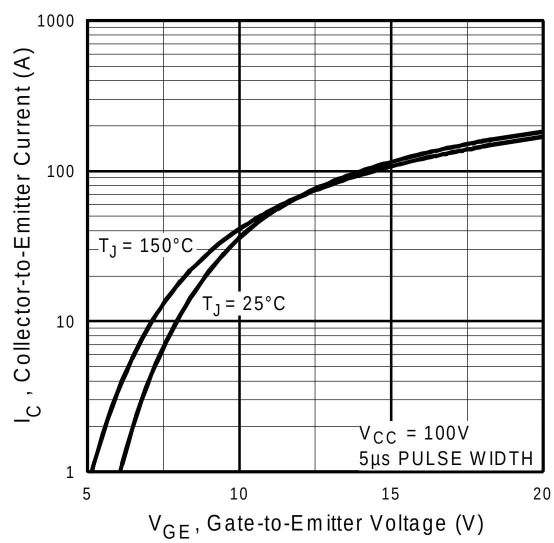


Fig. 3 - Typical Transfer Characteristics

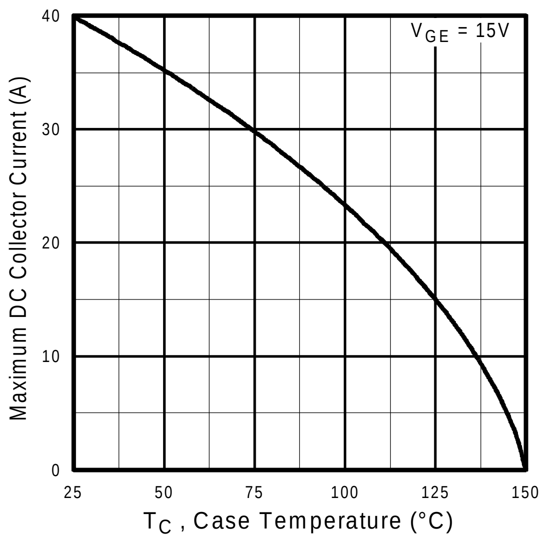


Fig. 4 - Maximum Collector Current vs. Case Temperature

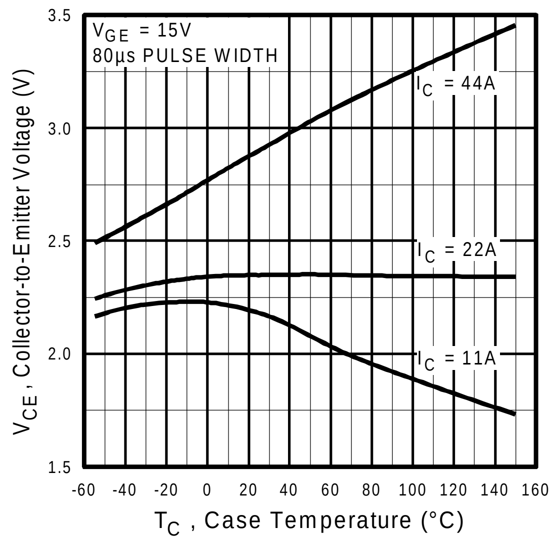


Fig. 5 - Collector-to-Emitter Voltage vs. Case Temperature

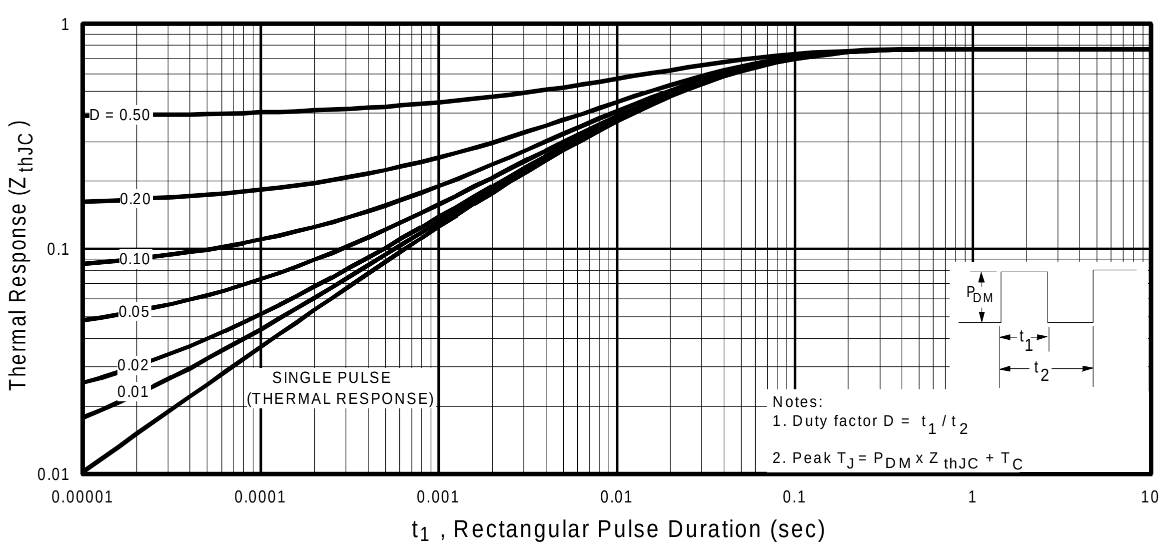


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

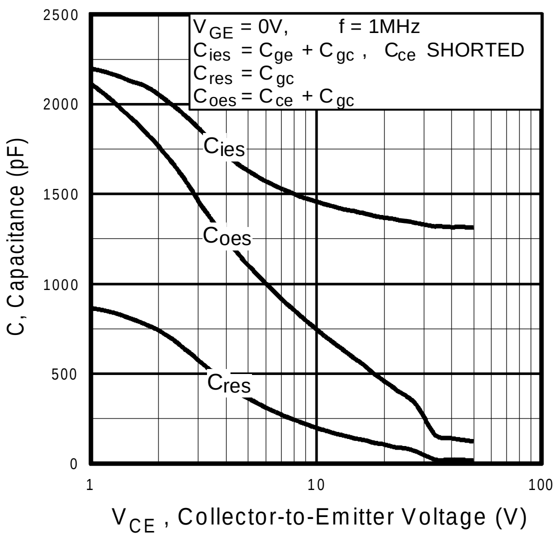


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

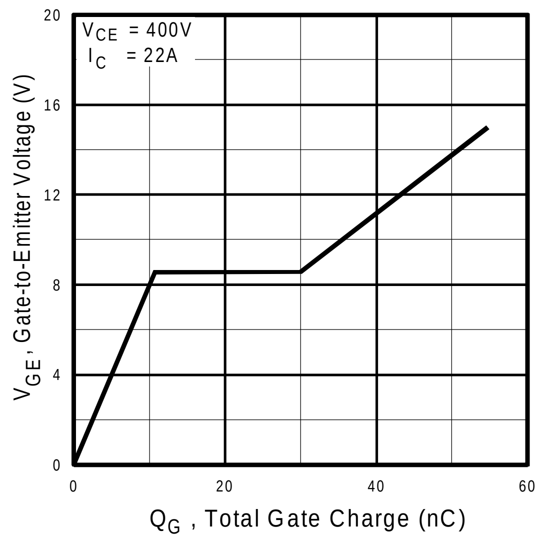


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

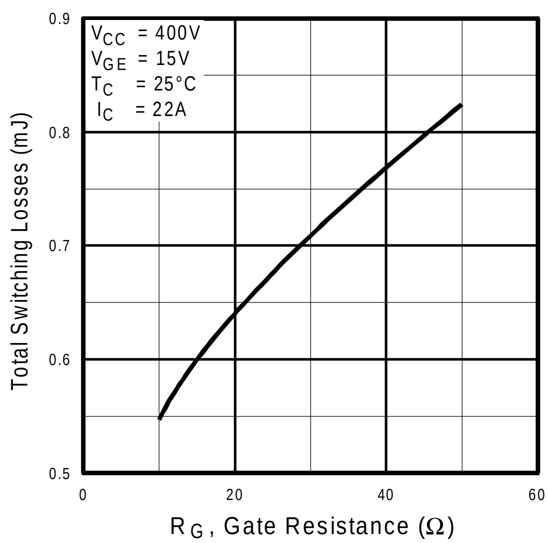


Fig. 9 - Typical Switching Losses vs. Gate Resistance

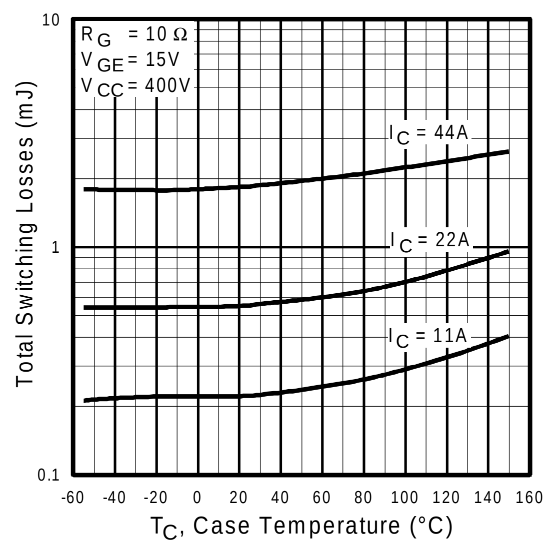


Fig. 10 - Typical Switching Losses vs. Case Temperature

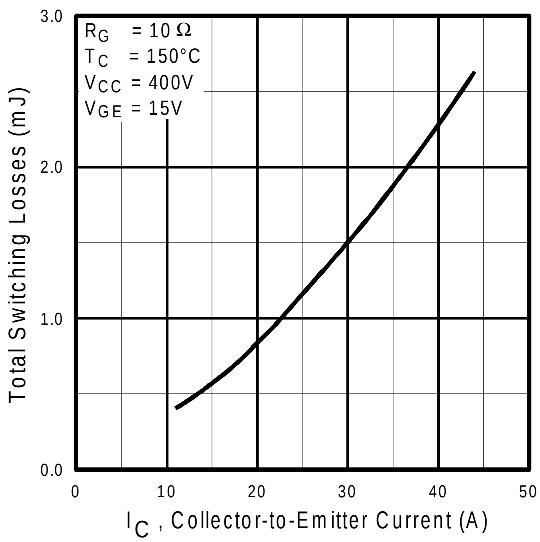


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

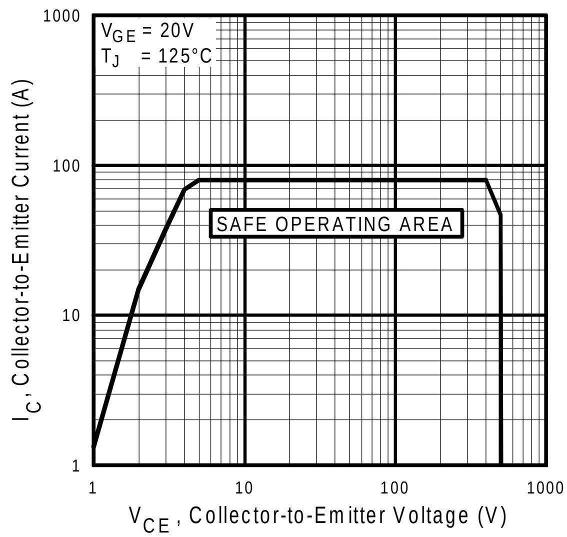


Fig. 12 - Turn-Off SOA

Refer to Section D for the following:

Appendix A: Section D - page D-3

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-220 AB **Section D - page D-12**