PD - 9.764

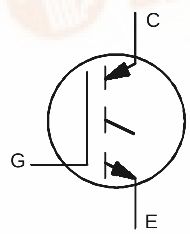
International IOR Rectifier

IRGPH40F

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

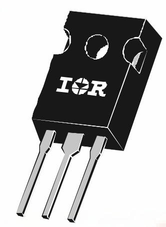
$V_{CES} = 1200V$

$V_{CE(sat)} \leq 3.3V$

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

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-247AC

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	1200	V
I_C @ $T_C = 25°C$	Continuous Collector Current	29	A
I_C @ $T_C = 100°C$	Continuous Collector Current	17	
I_{CM}	Pulsed Collector Current ①	58	
I_{LM}	Clamped Inductive Load Current ②	58	
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	°C/W
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	—	0.24	—	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	—	—	40	
Wt	Weight	—	6 (0.21)	—	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	1200	—	—	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	—	1.3	—	V/°C	V_{GE} = 0V, I_C = 1.0mA	
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	2.5	3.3	V	I_C = 17A	V_{GE} = 15V
		—	3.2	—		I_C = 29A	See Fig. 2, 5
		—	3.0	—		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	—	-13	—	mV/°C	$V_{CE} = V_{GE}$, I_C = 250µA	
g_{fe}	Forward Transconductance ⑤	5.0	11	—	S	V_{CE} = 100V, I_C = 17A	
I_{CES}	Zero Gate Voltage Collector Current	—	—	250	µA	V_{GE} = 0V, V_{CE} = 1200V	
		—	—	1000		V_{GE} = 0V, V_{CE} = 1200V, 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)	—	45	67	nC	I_C = 17A	
Q_{ge}	Gate - Emitter Charge (turn-on)	—	11	16		V_{CC} = 400V	See Fig. 8
Q_{gc}	Gate - Collector Charge (turn-on)	—	17	26		V_{GE} = 15V	
$t_{d(on)}$	Turn-On Delay Time	—	33	—	ns	T_J = 25°C	
t_r	Rise Time	—	17	—		I_C = 17A, V_{CC} = 960V	
$t_{d(off)}$	Turn-Off Delay Time	—	250	490		V_{GE} = 15V, R_G = 10Ω	
t_f	Fall Time	—	210	390		Energy losses include "tail"	
E_{on}	Turn-On Switching Loss	—	1.0	—	mJ		
E_{off}	Turn-Off Switching Loss	—	3.0	—		See Fig. 9, 10, 11, 14	
E_{ts}	Total Switching Loss	—	4.0	7.5			
$t_{d(on)}$	Turn-On Delay Time	—	32	—	ns	T_J = 150°C,	
t_r	Rise Time	—	20	—		I_C = 17A, V_{CC} = 960V	
$t_{d(off)}$	Turn-Off Delay Time	—	480	—		V_{GE} = 15V, R_G = 10Ω	
t_f	Fall Time	—	450	—		Energy losses include "tail"	
E_{ts}	Total Switching Loss	—	8.3	—	mJ	See Fig. 10, 14	
L_E	Internal Emitter Inductance	—	13	—	nH	Measured 5mm from package	
C_{ies}	Input Capacitance	—	1200	—	pF	V_{GE} = 0V	
C_{oes}	Output Capacitance	—	75	—		V_{CC} = 30V	See Fig. 7
C_{res}	Reverse Transfer Capacitance	—	15	—		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.

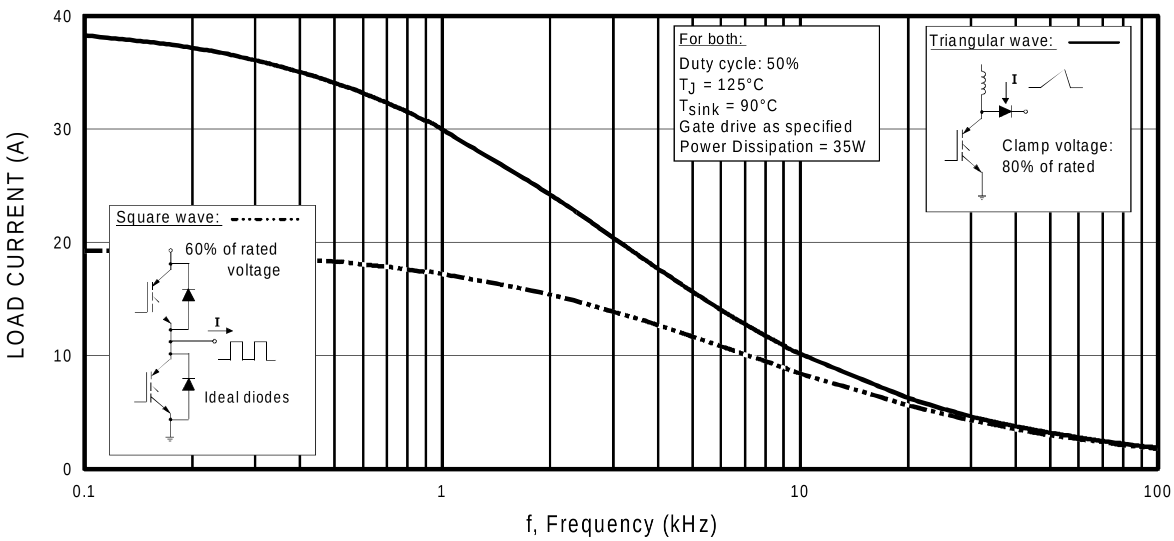


Fig. 1 - Typical Load Current vs. Frequency
(For square wave, $I=I_{RMS}$ of fundamental; for triangular wave, $I=I_{PK}$)

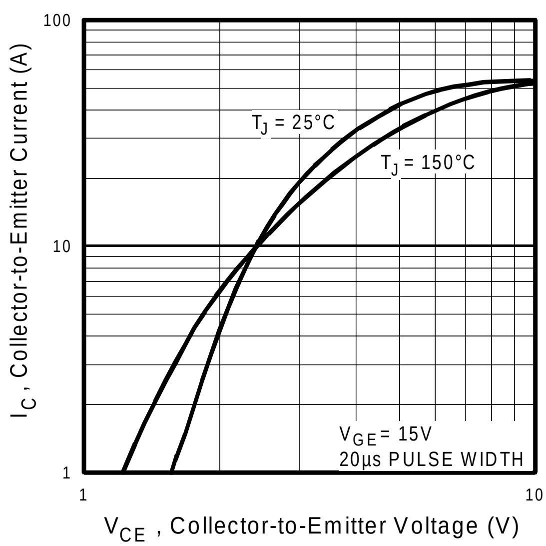


Fig. 2 - Typical Output Characteristics

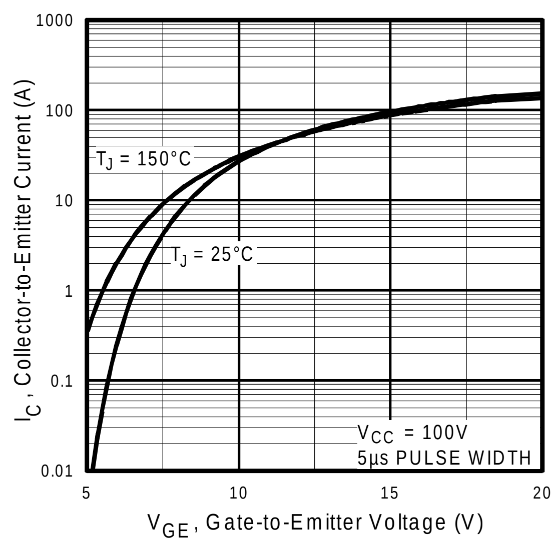


Fig. 3 - Typical Transfer Characteristics

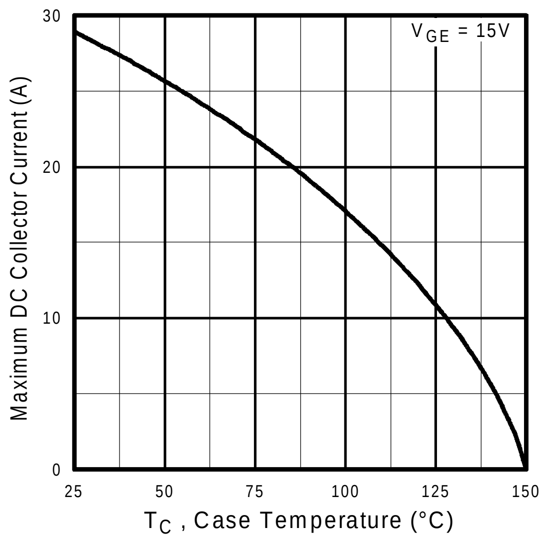


Fig. 4 - Maximum Collector Current vs. Case Temperature

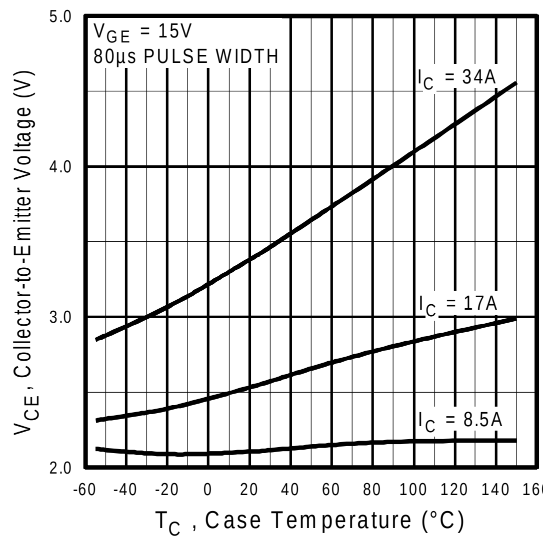


Fig. 5 - Collector-to-Emitter Voltage vs. Case Temperature

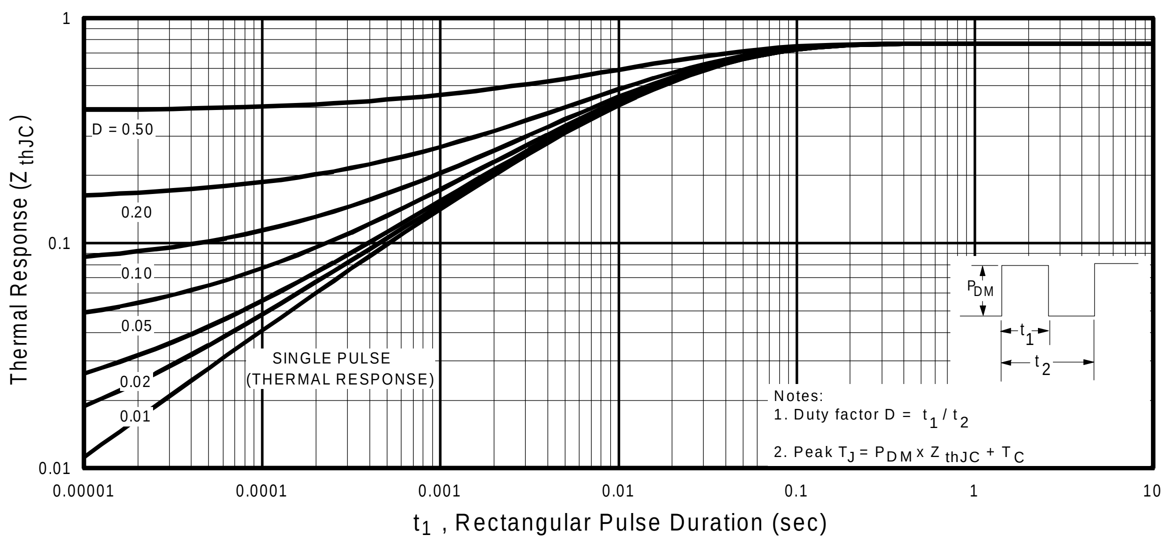


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

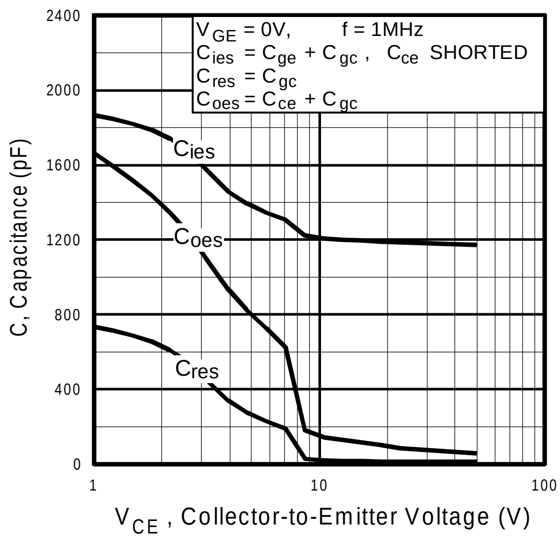


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

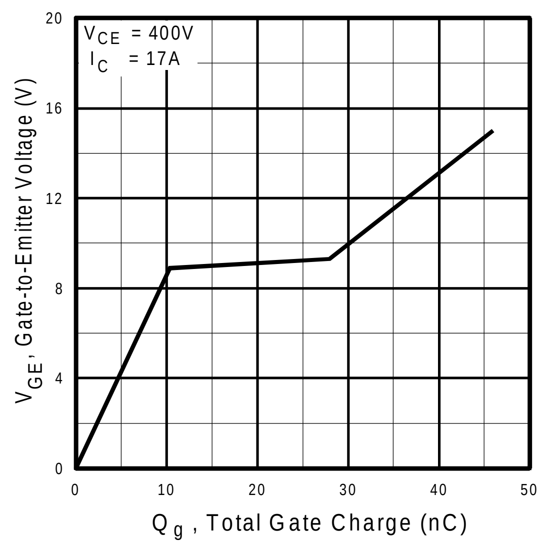


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

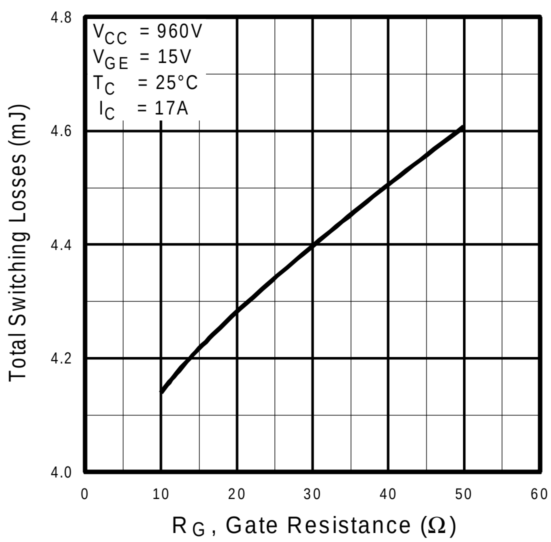


Fig. 9 - Typical Switching Losses vs. Gate Resistance

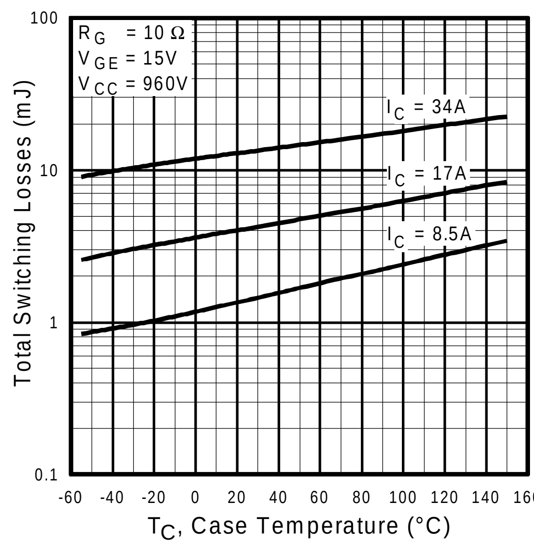


Fig. 10 - Typical Switching Losses vs. Case Temperature

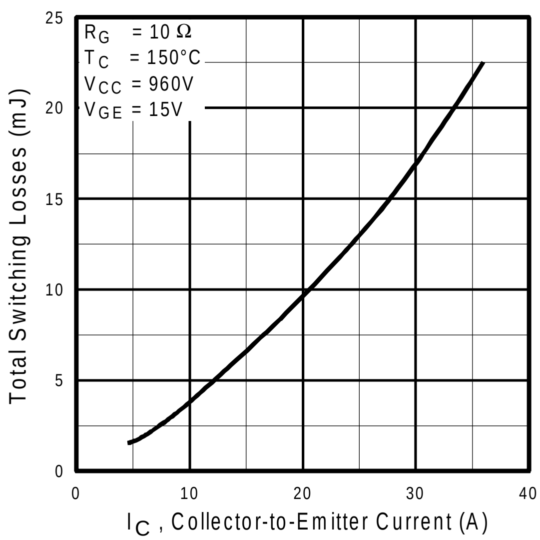


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

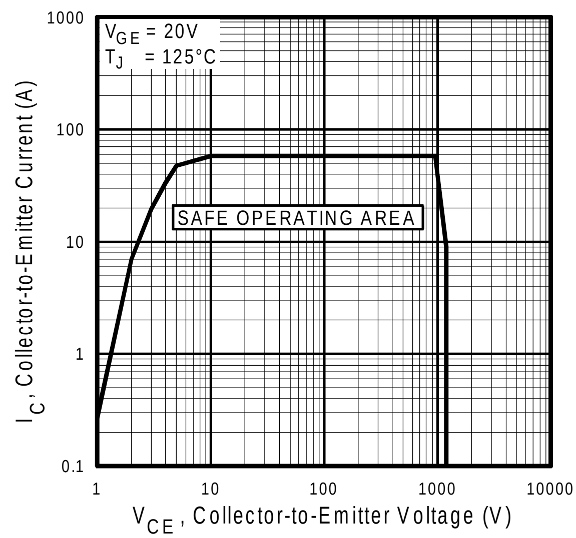


Fig. 12 - Turn-Off SOA

Refer to Section D for the following:

Appendix G: Section D - page D-9

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 3 - JEDEC Outline TO-247AC (TO-3P) **Section D - page D-13**