



International
IR Rectifier

PD - 9.764

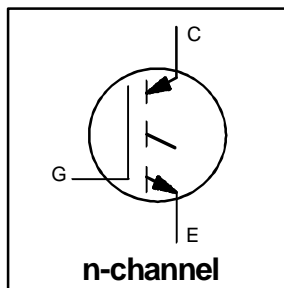
IRGPH40F

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



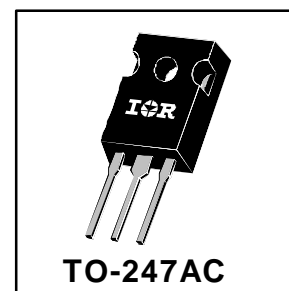
$V_{CES} = 1200V$

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

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

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
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	29	A
$I_C @ T_C = 100^\circ C$	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
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	160	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	65	
T_J	Operating Junction and	-55 to +150	°C
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 sec.		
	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)



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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	1200	—	—	V	$V_{GE} = 0V, I_C = 250\mu A$
$V_{(BR)ECS}$	Emitter-to-Collector Breakdown Voltage ④	20	—	—	V	$V_{GE} = 0V, I_C = 1.0A$
$\Delta V_{(BR)CES}/\Delta T_J$	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	$I_C = 17A$ $I_C = 29A$ $I_C = 17A, T_J = 150^\circ\text{C}$ $V_{GE} = 15V$ See Fig. 2, 5
		—	3.2	—		
		—	3.0	—		
$V_{GE(th)}$	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	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		$V_{GE} = 0V, V_{CE} = 1200V, T_J = 150^\circ\text{C}$
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)	—	45	67	nC	$I_C = 17A$ $V_{CC} = 400V$ $V_{GE} = 15V$ See Fig. 8
Q_{ge}	Gate - Emitter Charge (turn-on)	—	11	16		
Q_{gc}	Gate - Collector Charge (turn-on)	—	17	26		
$t_{d(on)}$	Turn-On Delay Time	—	33	—	ns	$T_J = 25^\circ\text{C}$ $I_C = 17A, V_{CC} = 960V$ $V_{GE} = 15V, R_G = 10\Omega$ Energy losses include "tail"
t_r	Rise Time	—	17	—		
$t_{d(off)}$	Turn-Off Delay Time	—	250	490		
t_f	Fall Time	—	210	390		
E_{on}	Turn-On Switching Loss	—	1.0	—	mJ	See Fig. 9, 10, 11, 14
E_{off}	Turn-Off Switching Loss	—	3.0	—		
E_{ts}	Total Switching Loss	—	4.0	7.5		
$t_{d(on)}$	Turn-On Delay Time	—	32	—	ns	$T_J = 150^\circ\text{C}$, $I_C = 17A, V_{CC} = 960V$ $V_{GE} = 15V, R_G = 10\Omega$ Energy losses include "tail"
t_r	Rise Time	—	20	—		
$t_{d(off)}$	Turn-Off Delay Time	—	480	—		
t_f	Fall Time	—	450	—		
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	$V_{GE} = 0V$ $V_{CC} = 30V$ $f = 1.0MHz$ See Fig. 7
C_{oes}	Output Capacitance	—	75	—		
C_{res}	Reverse Transfer Capacitance	—	15	—		

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.



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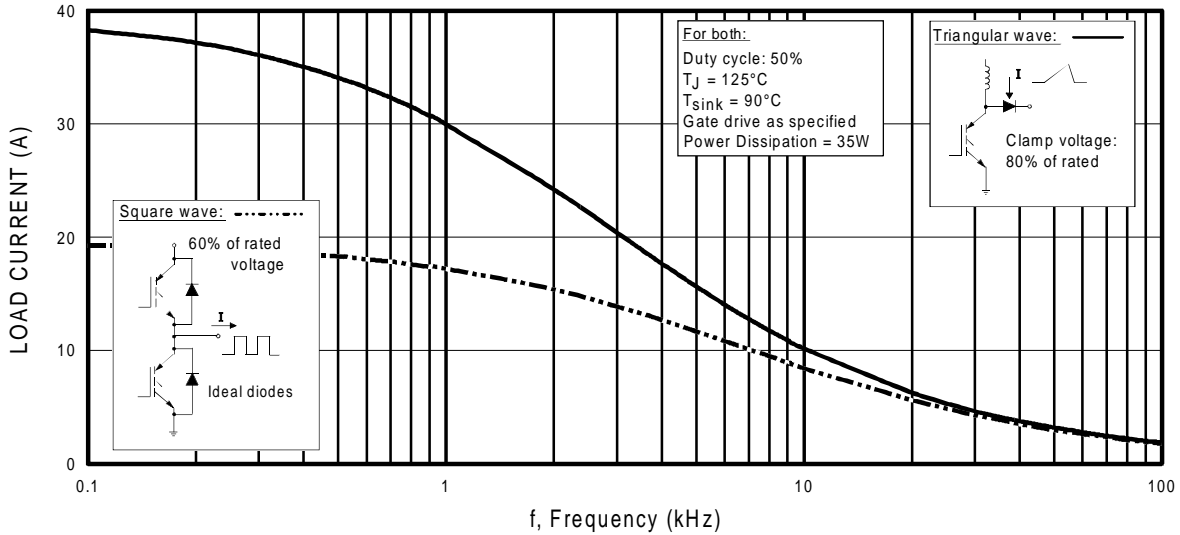


Fig. 1 - Typical Load Current vs. Frequency
(For square wave, $I = I_{RMS}$ of fundamental; for triangular wave, $I = I_{PK}$)

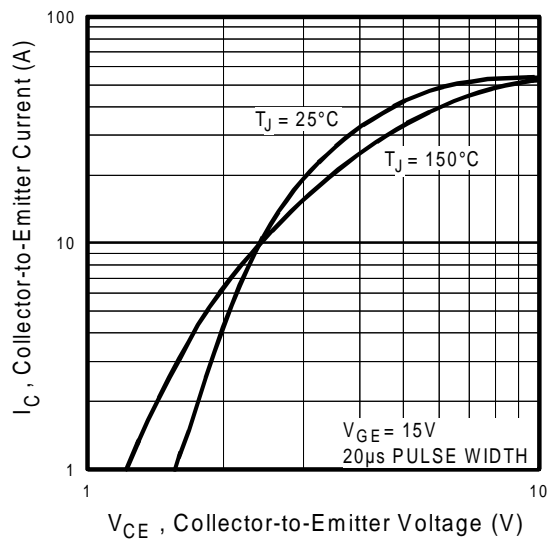


Fig. 2 - Typical Output Characteristics

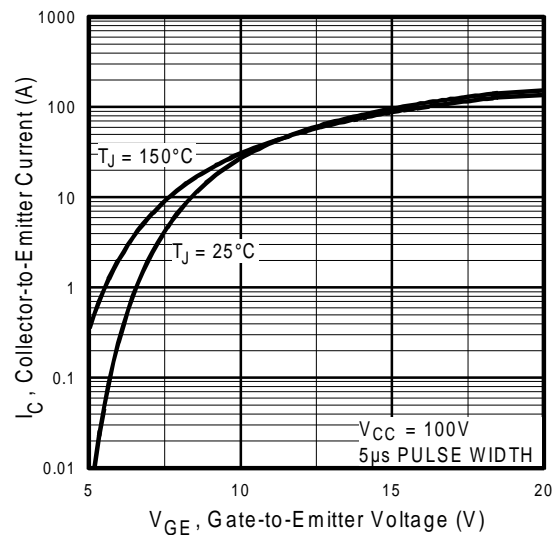


Fig. 3 - Typical Transfer Characteristics



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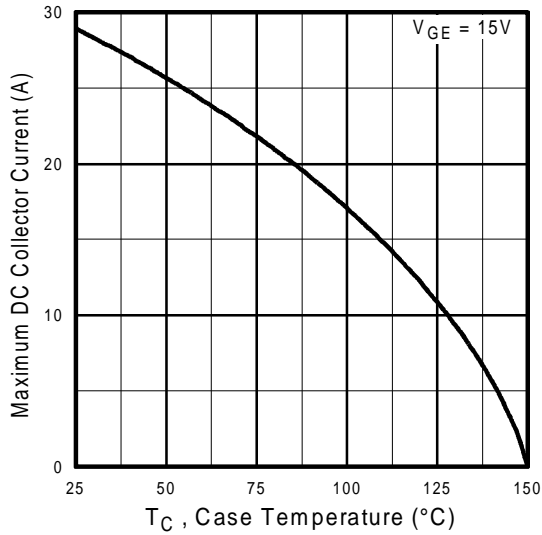


Fig. 4 - Maximum Collector Current vs. Case Temperature

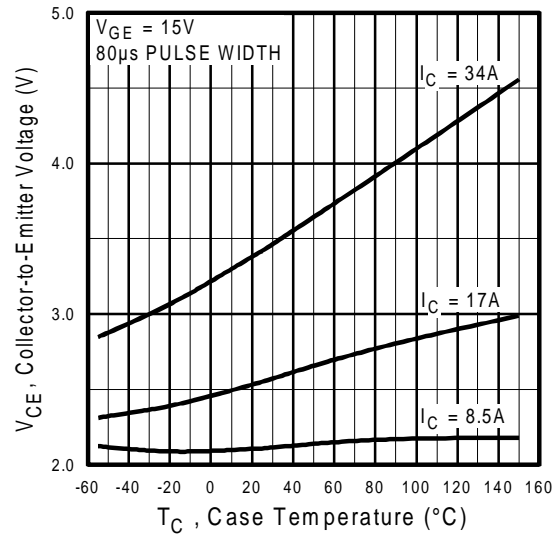


Fig. 5 - Collector-to-Emitter Voltage vs. Case Temperature

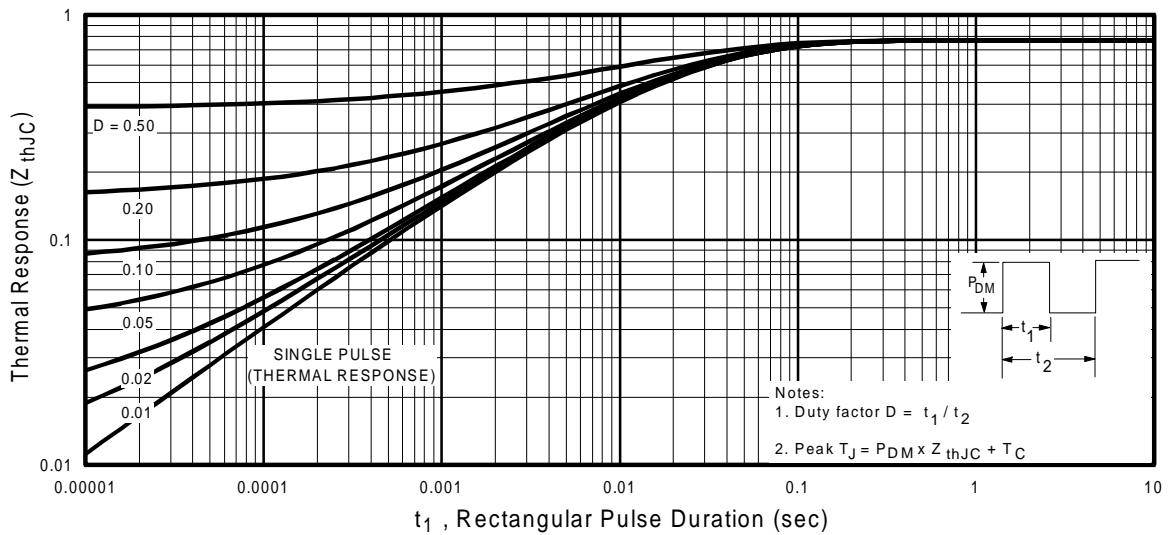


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case



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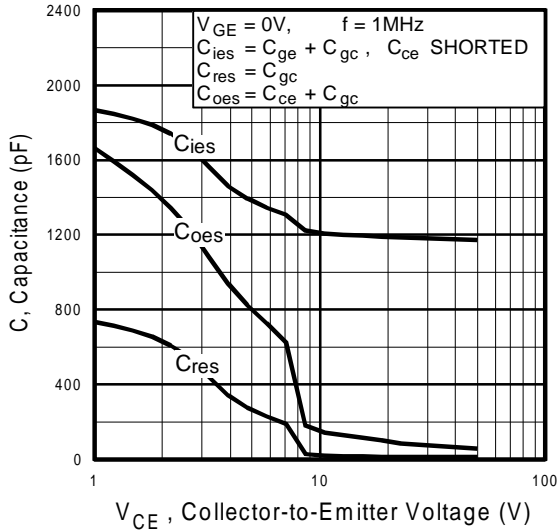


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

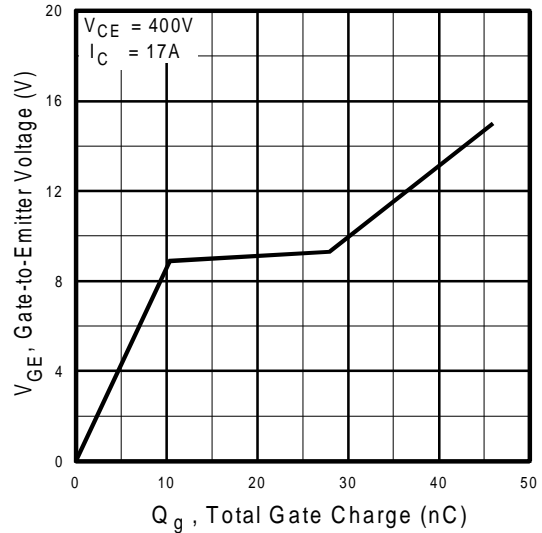


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

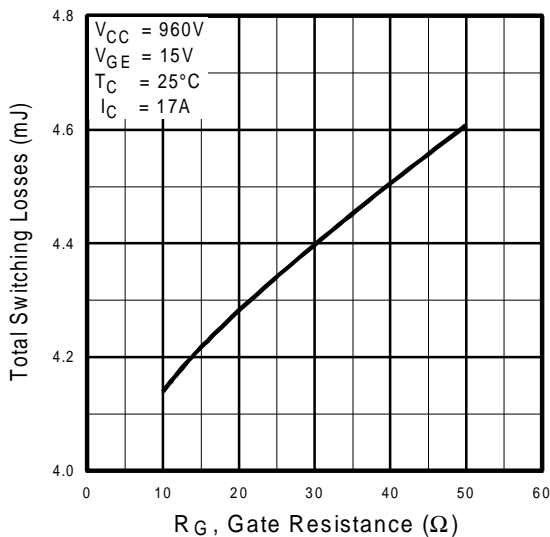


Fig. 9 - Typical Switching Losses vs. Gate Resistance

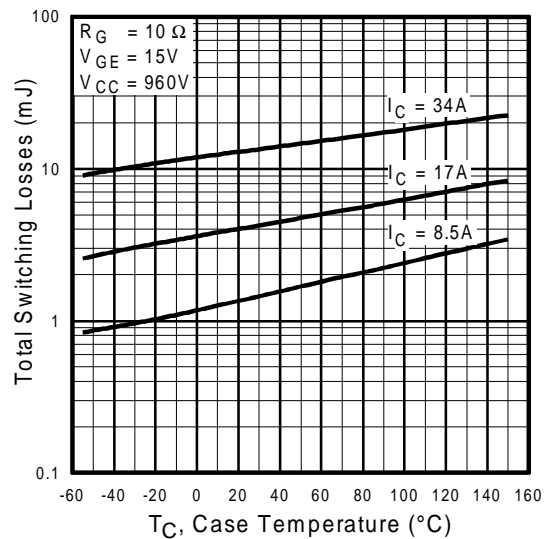


Fig. 10 - Typical Switching Losses vs. Case Temperature



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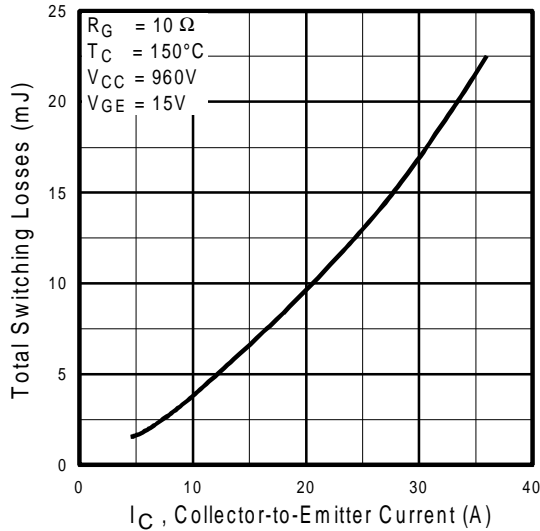


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

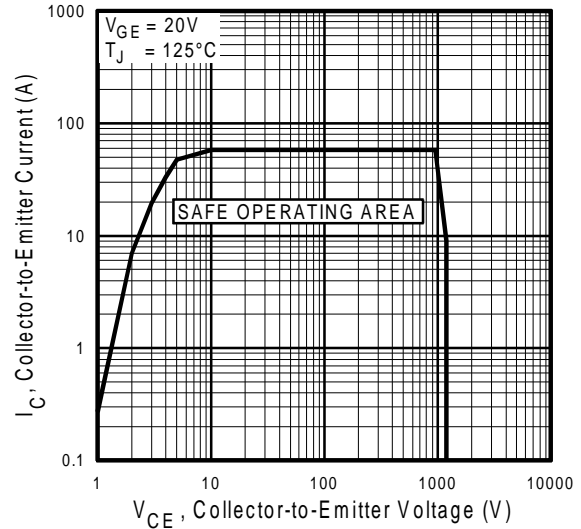


Fig. 12 - Turn-Off SOA

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