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International
IR Rectifier

PD - 9.1248

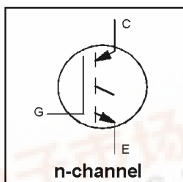
IRGPH40K

INSULATED GATE BIPOLAR TRANSISTOR

Short Circuit Rated
UltraFast IGBT

Features

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

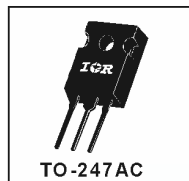


V_{CES} = 1200V
V_{CE(sat)} ≤ 3.5V
@ V_{GE} = 15V, I_C = 10A

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	1200	V
I _C @ T _C = 25°C	Continuous Collector Current	18	
I _C @ T _C = 100°C	Continuous Collector Current	10	A
I _{CM}	Pulsed Collector Current ①	36	
I _{LM}	Clamped Inductive Load Current ②	36	
t _{sc}	Short Circuit Withstand Time	10	μ s
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	Operating Junction and Storage Temperature Range	-55 to +150	
T _{STG}	Soldering Temperature, for 10 sec.	300 (0.063 in. (1.6mm) from case)	°C
	Mounting torque, 6-32 or M3 screw.	10 lbf-in (1.1N-m)	

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
R _{θJC}	Junction-to-Case	—	—	0.77	
R _{θCS}	Case-to-Sink, flat, greased surface	—	0.24	—	°C/W
R _{θJA}	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	
$V_{BRV_{CES}}$	Collector-to-Emitter Breakdown Voltage	1200	—	—	V	$V_{GE} = 0V, I_C = 250\mu\text{A}$	
$V_{BRV_{ECS}}$	Emitter-to-Collector Breakdown Voltage ④	20	—	—	V	$V_{GE} = 0V, I_C = 1.0A$	
$\Delta V_{BRV_{CES}}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.97	—	V/°C	$V_{GE} = 0V, I_C = 1.0mA$	
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage	—	2.8	3.5	V	$V_{GE} = 15V$ See Fig. 2, 5	
		—	3.6	—			$I_C = 10A$
		—	2.9	—			$I_C = 10A, T_J = 150^\circ\text{C}$
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	6.0		$V_{CE} = V_{GE}, I_C = 250\mu\text{A}$	
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	—	-11	—	mV/°C	$V_{CE} = V_{GE}, I_C = 250\mu\text{A}$	
g_{fs}	Forward Transconductance ⑤	2.2	6.5	—	S	$V_{CE} = 100V, I_C = 10A$	
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_{β}	Total Gate Charge (turn-on)	—	50	75	nC	$I_C = 10A$ $V_{CC} = 400V$ See Fig. 8 $V_{GE} = 15V$
$Q_{\beta e}$	Gate - Emitter Charge (turn-on)	—	13	20		
$Q_{\beta c}$	Gate - Collector Charge (turn-on)	—	14	21		
$t_{\beta(on)}$	Turn-On Delay Time	—	27	—	ns	$T_J = 25^\circ\text{C}$ $I_C = 10A, V_{CC} = 960V$ $V_{GE} = 15V, R_G = 10\Omega$ Energy losses include "tail"
t_r	Rise Time	—	9.1	—		
$t_{\beta(off)}$	Turn-Off Delay Time	—	140	390	mJ	See Fig. 9, 10, 11, 14
t_f	Fall Time	—	210	490		
E_{on}	Turn-On Switching Loss	—	0.45	—	mJ	See Fig. 9, 10, 11, 14
E_{off}	Turn-Off Switching Loss	—	0.95	—		
E_{TS}	Total Switching Loss	—	1.40	2.7		
t_{sc}	Short Circuit Withstand Time	10	—	—	μs	$V_{GE} = 10V, V_{CC} = 720V, T_J = 125^\circ\text{C}$ $V_{GE} = 15V, R_G = 10\Omega, V_{CPK} < 1000V$
$t_{\beta(on)}$	Turn-On Delay Time	—	25	—		
t_r	Rise Time	—	8.0	—	ns	$T_J = 150^\circ\text{C}$ $I_C = 10A, V_{CC} = 960V$ $V_{GE} = 15V, R_G = 10\Omega$ Energy losses include "tail"
$t_{\beta(off)}$	Turn-Off Delay Time	—	310	—		
t_f	Fall Time	—	390	—	mJ	See Fig. 10, 14
E_{TS}	Total Switching Loss	—	2.8	—		
L_E	Internal Emitter Inductance	—	13	—	nH	Measured 5mm from package
C_{ies}	Input Capacitance	—	1400	—	pF	$V_{GE} = 0V$ $V_{CC} = 30V$ See Fig. 7 $f = 1.0\text{MHz}$
C_{oes}	Output Capacitance	—	100	—		
C_{res}	Reverse Transfer Capacitance	—	15	—		

Notes:

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

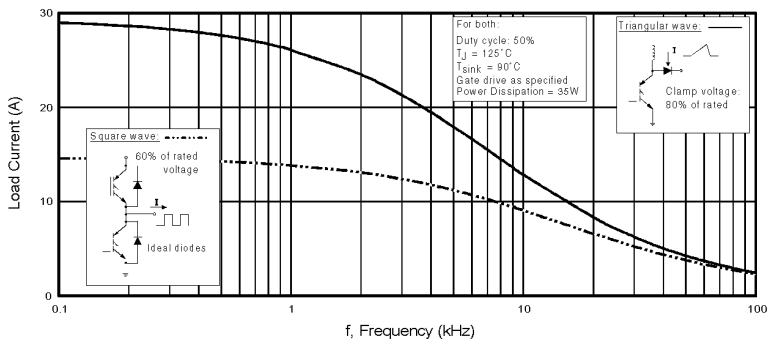


Fig. 1 - Typical Load Current vs. Frequency
 (For square wave, $I = I_{RMS}$ of fundamental; for triangular wave, $I = I_{PK}$)

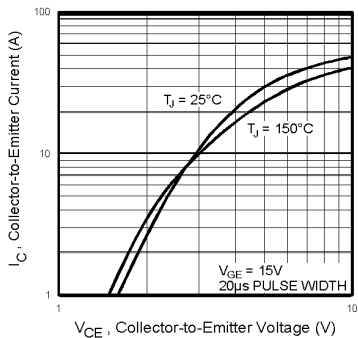


Fig. 2 - Typical Output Characteristics

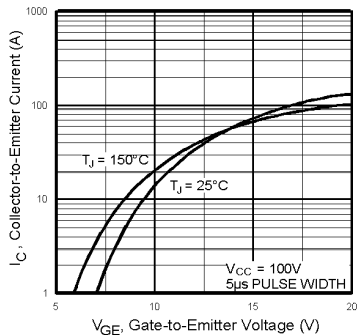


Fig. 3 - Typical Transfer Characteristics

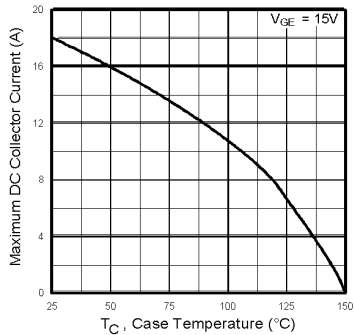


Fig. 4 - Maximum Collector Current vs. Case Temperature

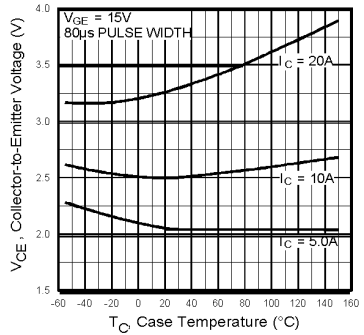


Fig. 5 - Collector-to-Emitter Voltage vs. Case Temperature

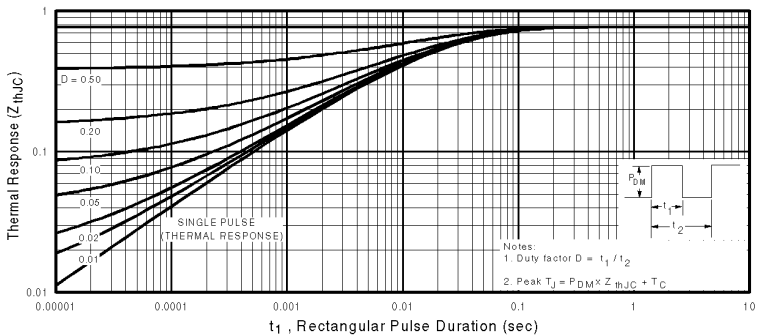


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

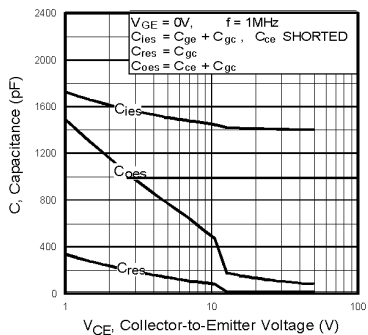


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

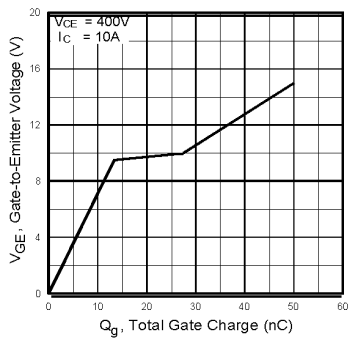


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

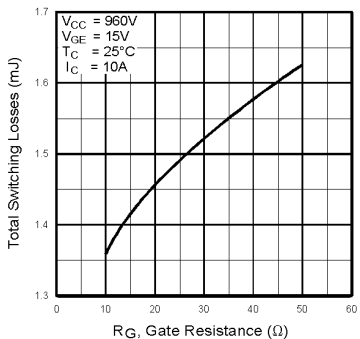


Fig. 9 - Typical Switching Losses vs. Gate Resistance

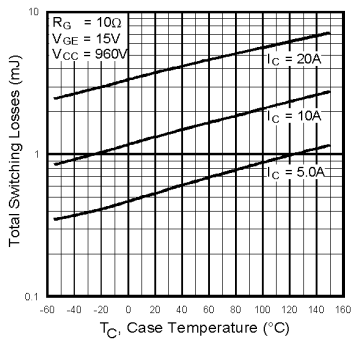


Fig. 10 - Typical Switching Losses vs. Case Temperature

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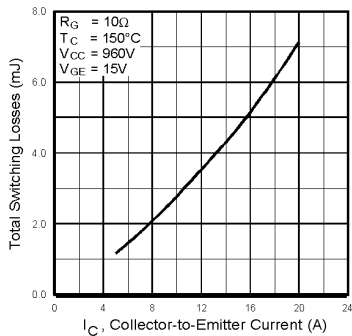


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

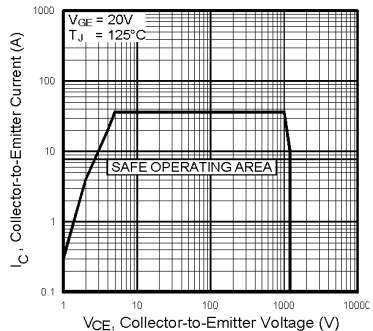
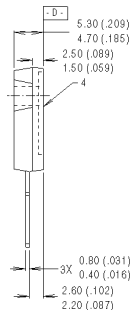
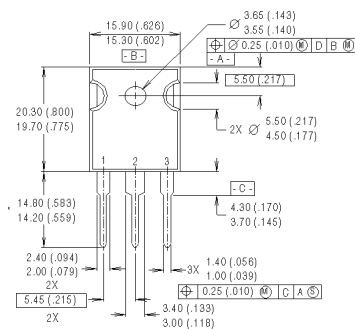


Fig. 12 - Turn-Off SOA



NOTES:

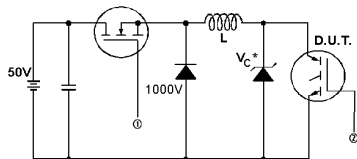
- 1 DIMENSIONS & TOLERANCING PER ANSI Y14.5M, 1982.
- 2 CONTROLLING DIMENSION : INCH.
- 3 DIMENSIONS ARE SHOWN MILLIMETERS (INCHES).
- 4 CONFORMS TO JEDEC OUTLINE TO-247AC.

LEAD ASSIGNMENTS

- 1 - GATE
- 2 - COLLECTOR
- 3 - EMITTER
- 4 - COLLECTOR

* LONGER LEADED (20mm) VERSION AVAILABLE (TO-247AD) TO ORDER ADD *-E* SUFFIX TO PART NUMBER

CONFORMS TO JEDEC OUTLINE TO-247AC (TO-3P)
 Dimensions in Millimeters and (Inches)



* Driver same type as D.U.T.; $V_c = 80\%$ of $V_{ce(max)}$
 * Note: Due to the 50V power supply, pulse width and inductor will increase to obtain rated Id.

Fig. 13a - Clamped Inductive Load Test Circuit

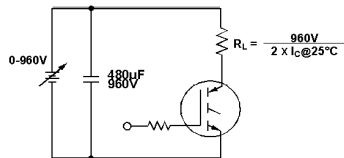


Fig. 13b - Pulsed Collector Current Test Circuit

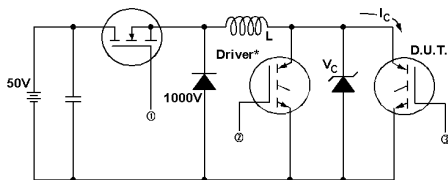


Fig. 14a - Switching Loss Test Circuit

* Driver same type as D.U.T., $V_c = 960V$

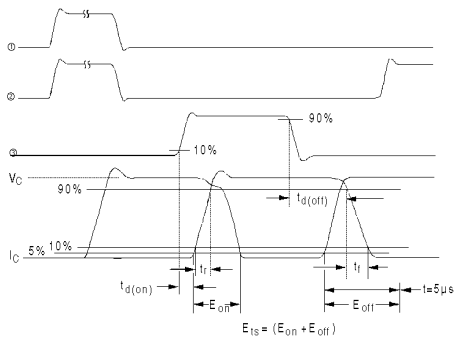


Fig. 14b - Switching Loss Waveforms