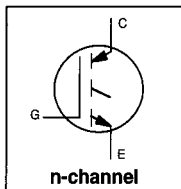


INSULATED GATE BIPOLAR TRANSISTOR
Short Circuit Rated
UltraFast IGBT
Features

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

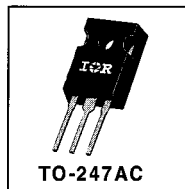
See Figure 1 for Current vs. Frequency curve


V_{CE} = 600V
V_{CE(sat)} ≤ 3.1V
@ V_{GE} = 15V, I_C = 41A

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 _{CE}	Collector-to-Emitter Voltage	600	V
I _C @ T _C = 25°C	Continuous Collector Current	70 *	A
I _C @ T _C = 100°C	Continuous Collector Current	41	
I _{CM}	Pulsed Collector Current ①	140	
I _{LM}	Clamped Inductive Load Current ②	140	
t _{sc}	Short Circuit Withstand Time	10	μs
V _{GE}	Gate-to-Emitter Voltage	±20	V
E _{ARV}	Reverse Voltage Avalanche Energy ③	25	mJ
P _D @ T _C = 25°C	Maximum Power Dissipation	280	W
P _D @ T _C = 100°C	Maximum Power Dissipation	110	
T _J	Operating Junction and Storage Temperature Range	-55 to +150	°C
T _{STG}	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 _{θJC}	Junction-to-Case	-----	-----	0.45	°C/W
R _{θCS}	Case-to-Sink, flat, greased surface	-----	0.24	-----	
R _{θJA}	Junction-to-Ambient, typical socket mount	-----	-----	40	
Wt	Weight	-----	6 (0.21)	-----	g (oz)

Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{BR(ES)}$	Collector-to-Emitter Breakdown Voltage	600	—	—	V	$V_{GE} = 0\text{V}$, $I_C = 250\mu\text{A}$
$V_{BR(ECS)}$	Emitter-to-Collector Breakdown Voltage ①	20	—	—	V	$V_{GE} = 0\text{V}$, $I_C = 1.0\text{A}$
$\Delta V_{BR(ECS)}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.36	—	$^\circ\text{V}/^\circ\text{C}$	$V_{GE} = 0\text{V}$, $I_C = 2.0\text{mA}$
$V_{CE(ON)}$	Collector-to-Emitter Saturation Voltage	—	2.1	3.1	V	$I_C = 41\text{A}$
		—	2.6	—		$I_C = 72\text{A}$
		—	2.3	—		$I_C = 41\text{A}$, $T_J = 150^\circ\text{C}$
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	5.5	$^\circ\text{mV}/^\circ\text{C}$	$V_{CE} = V_{GE}$, $I_C = 250\mu\text{A}$
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	—	-18	—		$V_{CE} = V_{GE}$, $I_C = 250\mu\text{A}$
g_{fs}	Forward Transconductance ②	20	30	—	S	$V_{CE} = 100\text{V}$, $I_C = 41\text{A}$
I_{CES}	Zero Gate Voltage Collector Current	—	—	250	μA	$V_{GE} = 0\text{V}$, $V_{CE} = 600\text{V}$
		—	—	5000		$V_{GE} = 0\text{V}$, $V_{CE} = 600\text{V}$, $T_J = 150^\circ\text{C}$
I_{GES}	Gate-to-Emitter Leakage Current	—	—	± 100	nA	$V_{GE} = \pm 20\text{V}$

Switching Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
Q_g	Total Gate Charge (turn-on)	—	140	220	nC	$I_C = 41\text{A}$
Q_{ge}	Gate - Emitter Charge (turn-on)	—	29	44		$V_{CC} = 400\text{V}$ See Fig. 8
Q_{gc}	Gate - Collector Charge (turn-on)	—	43	65		$V_{GE} = 15\text{V}$
$t_{d(on)}$	Turn-On Delay Time	—	38	—	ns	$I_C = 41\text{A}$, $V_{CC} = 480\text{V}$ $V_{GE} = 15\text{V}$, $R_G = 3.3\Omega$
t_r	Rise Time	—	28	—		
$t_{d(off)}$	Turn-Off Delay Time	—	130	290		
t_f	Fall Time	—	110	220		
E_{on}	Turn-On Switching Loss	—	1.0	—	mJ	Energy losses include "tail" See Fig. 9, 10, 11, 14
E_{off}	Turn-Off Switching Loss	—	0.9	—		
E_{ts}	Total Switching Loss	—	1.9	2.9		
t_{sc}	Short Circuit Withstand Time	10	—	—	μs	$V_{CC} = 360\text{V}$, $T_J = 125^\circ\text{C}$ $V_{GE} = 15\text{V}$, $R_G = 3.3\Omega$, $V_{CPK} < 500\text{V}$
$t_{d(on)}$	Turn-On Delay Time	—	38	—	ns	$T_J = 150^\circ\text{C}$, $I_C = 41\text{A}$, $V_{CC} = 480\text{V}$ $V_{GE} = 15\text{V}$, $R_G = 3.3\Omega$
t_r	Rise Time	—	31	—		
$t_{d(off)}$	Turn-Off Delay Time	—	290	—		
t_f	Fall Time	—	150	—		
E_{ts}	Total Switching Loss	—	3.6	—	mJ	See Fig. 10, 14
L_E	Internal Emitter Inductance	—	13	—	nH	Measured 5mm from package
C_{ies}	Input Capacitance	—	4200	—	pF	$V_{GE} = 0\text{V}$
C_{oss}	Output Capacitance	—	340	—		$V_{CC} = 30\text{V}$ See Fig. 7
C_{res}	Reverse Transfer Capacitance	—	32	—		$f = 1.0\text{MHz}$

Notes:

① Repetitive rating; $V_{GE} = 20\text{V}$, pulse width limited by max. junction temperature.
(See fig. 13b)

② $V_{CC} = 80\%(V_{CES})$, $V_{GE} = 20\text{V}$, $L = 10\mu\text{H}$,
 $R_G = 3.3\Omega$, (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 $5.0\mu\text{s}$, single shot.

* Current limited by package, (Die Current = 72A)

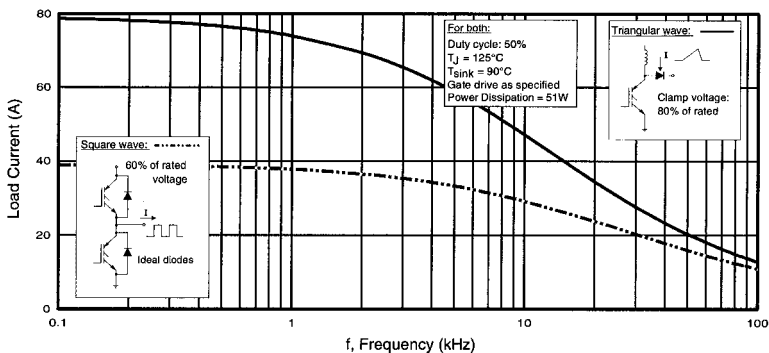


Fig. 1 - Typical Load Current vs. Frequency
(For square wave, $I = I_{\text{RMS}}$ of fundamental; for triangular wave, $I = I_{\text{PK}}$)

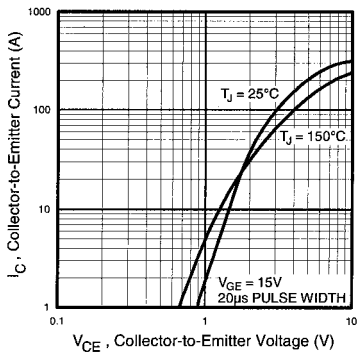


Fig. 2 - Typical Output Characteristics

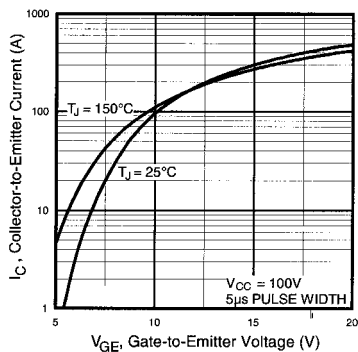


Fig. 3 - Typical Transfer Characteristics

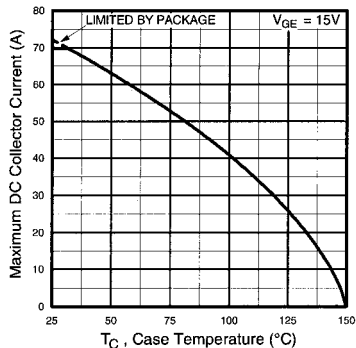


Fig. 4 - Maximum Collector Current vs. Case Temperature

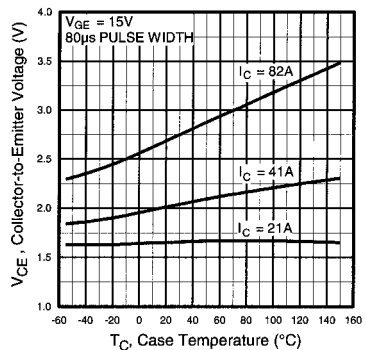


Fig. 5 - Collector-to-Emitter Voltage vs. Case Temperature

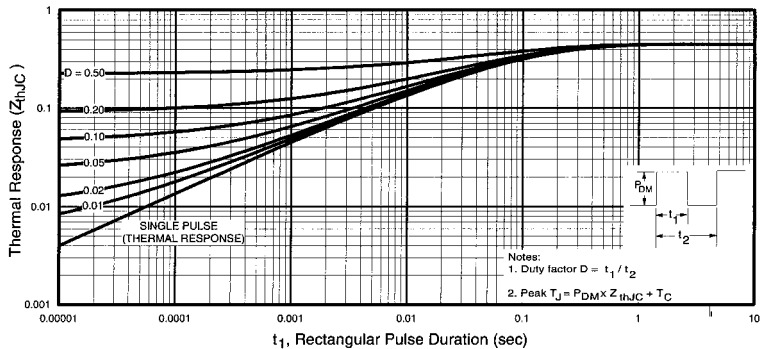


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

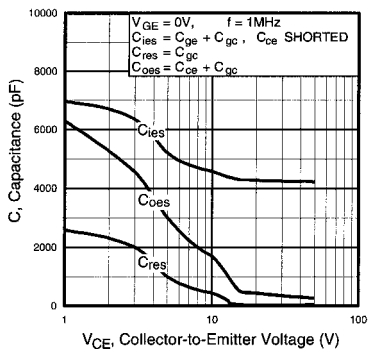


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

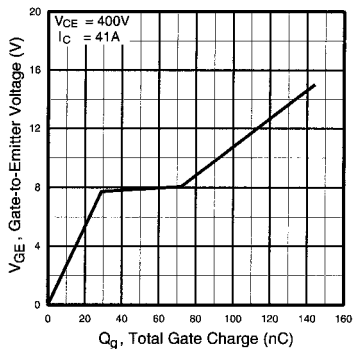


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

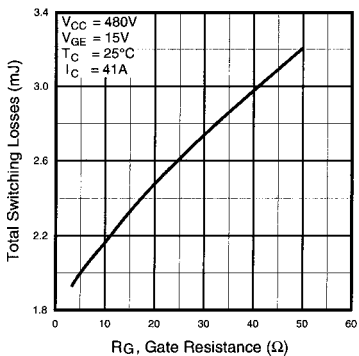


Fig. 9 - Typical Switching Losses vs. Gate Resistance

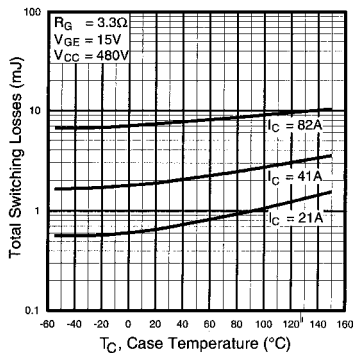


Fig. 10 - Typical Switching Losses vs. Case Temperature

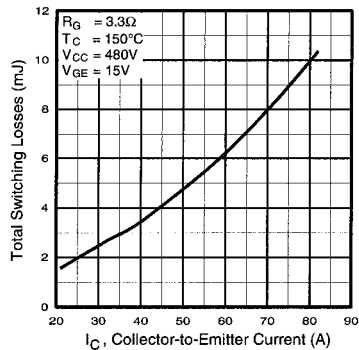


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

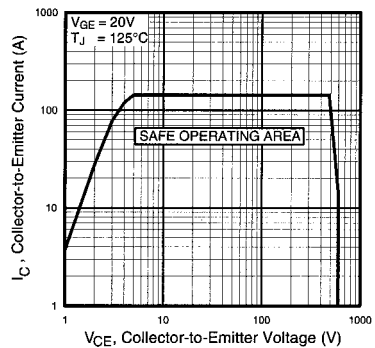
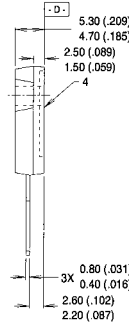
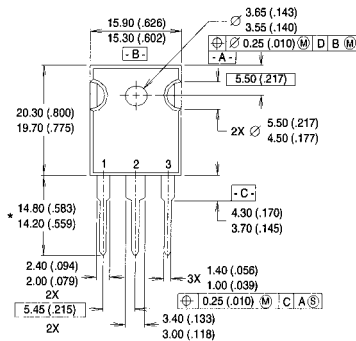


Fig. 12 - Turn-Off SOA



NOTES:

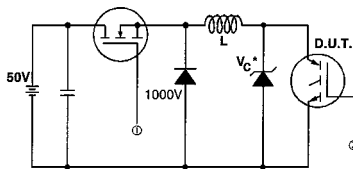
- 1 DIMENSIONS & TOLERANCING PER ANSI Y14.5M, 1982.
- 2 CONTROLLING DIMENSION : INCH.
- 3 DIMENSIONS ARE SHOWN MILLIMETERS (INCHES).
- 4 CONFORMS TO JEDEC OUTLINE TO-247AC.

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 I_d .

Fig. 13a - Clamped Inductive Load Test Circuit

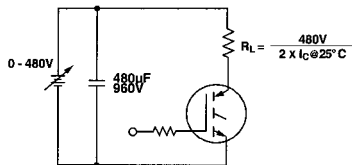


Fig. 13b - Pulsed Collector Current Test Circuit

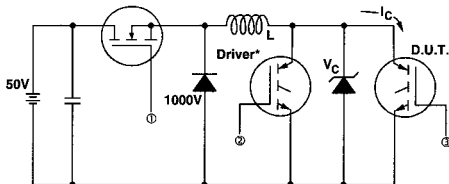


Fig. 14a - Switching Loss Test Circuit

* Driver same type as D.U.T., $V_c = 480V$

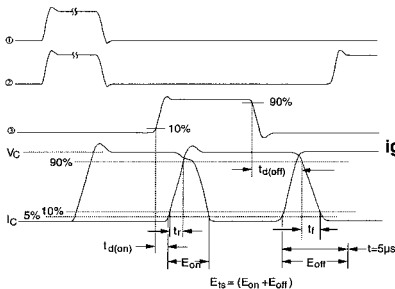


Fig. 14b - Switching Loss Waveforms

International Rectifier

WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, Tel: (310) 322 3331

EUROPEAN HEADQUARTERS: Hurst Green, Oxsted, Surrey RH8 9BB, UK Tel: (44) 0883 713215

IR CANADA: 7321 Victoria Park Ave., Suite 201, Markham, Ontario L3R 3L1, Tel: (905) 475 1897 **IR GERMANY:**

Saalburgstrasse 157, 61350 Bad Homburg Tel: 6172 37066 **IR ITALY:** Via Liguria 49, 10071 Borgaro, Torino Tel: (39) 1145

10111 **IR FAR EAST:** K&H Bldg., 2F, 3-30-4 Nishi-Ikeburo 3-Chome, Toshima-Ki, Tokyo 171 Tel: (03)3983 0641 **IR**

SOUTHEAST ASIA: 315 Outram Road, #10-02 Tan Boon Liat Building, Singapore 0316 Tel: 65 221 8371

Data and specifications subject to change without notice. 4/95