

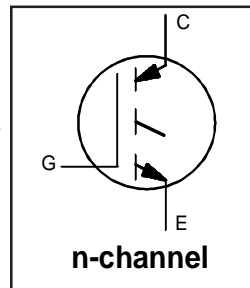
IRG4PC60U-PPbF

INSULATED GATE BIPOLAR TRANSISTOR

UltraFast Speed IGBT

Features

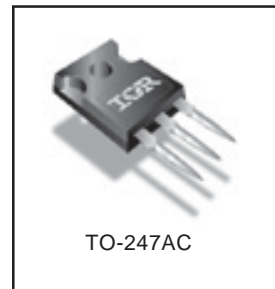
- UltraFast: Optimized for high operating frequencies up to 50 kHz in hard switching and >200 kHz in resonant mode.
- Application in UPS, Welding and High Current power supply.
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency.
- Solder plated version of industry standard TO-247AC package.
- Lead-Free



$V_{CES} = 600V$
$V_{CE(on) typ.} = 1.6V$
@ $V_{GE} = 15V, I_C = 40A$

Benefits

- Generation 4 IGBT's offer highest efficiency available.
- Solder plated version of the TO-247 allows the reflow soldering of the package heatsink to a substrate material.
- Designed for best performance when used with IR HEXFRED & IR FRED companion diodes.



Absolute Maximum Ratings

	Parameter	Max.	Units		
V_{CES}	Collector-to-Emitter Breakdown Voltage	600	V		
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	75	A		
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	40			
I_{CM}	Pulsed Collector Current ①	300			
I_{LM}	Clamped Inductive Load Current ②	300			
V_{GE}	Gate-to-Emitter Voltage	± 20	V		
E_{ARV}	Reverse Voltage Avalanche Energy ③	200	mJ		
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	520	W		
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	210			
T_J	Operating Junction and Storage Temperature Range	-55 to + 150	°C		
T_{STG}					
				Soldering Temperature, for 10 seconds	300 (0.063 in. (1.6mm from case)
				Mounting torque, 6-32 or M3 screw	10 lbf•in (1.1N•m)
	Maximum Reflow Temperature⑦	230 (Time above 183°C should not exceed 100s)	°C		

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	----	0.24	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.24	----	
$R_{\theta JA}$	Junction-to-Ambient (Typical Socket Mount)	----	40	
$R_{\theta JA}$	Junction-to-Ambient (PCB Mount, Steady State)⑥	----	20	
Wt	Weight	6 (0.21)	----	g (oz)

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	600	----	----	V	$V_{GE} = 0V, I_C = 250\mu A$
$V_{(BR)ECS}$	Emitter-to-Collector Breakdown Voltage ④	17	----	----	V	$V_{GE} = 0V, I_C = 1.0A$
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	----	0.28	----	V/ $^\circ\text{C}$	$V_{GE} = 0V, I_C = 1.0mA$
$V_{CE(ON)}$	Collector-to-Emitter Saturation Voltage	----	1.7	2.0	V	$I_C = 40A$ $V_{GE} = 15V$
		----	1.9	----		$I_C = 75A$ See Fig.2, 5
		----	1.6	----		$I_C = 40A, T_J = 150^\circ\text{C}$
$V_{GE(th)}$	Gate Threshold Voltage	3.0	----	6.0		$V_{CE} = V_{GE}, I_C = 250\mu A$
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	----	-12	----	mV/ $^\circ\text{C}$	$V_{CE} = V_{GE}, I_C = 250\mu A$
g_{fe}	Forward Transconductance ⑤	44	59	----	S	$V_{CE} \geq 100V, I_C = 40A$
I_{CES}	Zero Gate Voltage Collector Current	----	----	250	μA	$V_{GE} = 0V, V_{CE} = 600V$
		----	----	2.0		$V_{GE} = 0V, V_{CE} = 10V, T_J = 25^\circ\text{C}$
		----	----	5000		$V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$
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)	----	310	320	nC	$I_C = 40A$
Q_{ge}	Gate - Emitter Charge (turn-on)	----	41	46		$V_{CC} = 480V$ See Fig. 8
Q_{gc}	Gate - Collector Charge (turn-on)	----	110	120		$V_{GE} = 15V$
$t_{d(on)}$	Turn-On Delay Time	----	39	----	ns	$T_J = 25^\circ\text{C}$ $I_C = 40A, V_{CC} = 480V$ $V_{GE} = 15V, R_G = 5.0\Omega$
t_r	Rise Time	----	42	----		
$t_{d(off)}$	Turn-Off Delay Time	----	200	----		
t_f	Fall Time	----	100	----		
E_{on}	Turn-On Switching Loss	----	0.28	----	mJ	Energy losses include "tail" See Fig. 10, 11, 13, 14
E_{off}	Turn-Off Switching Loss	----	1.1	----		
E_{ts}	Total Switching Loss	----	1.3	1.8		
$t_{d(on)}$	Turn-On Delay Time	----	36	----	ns	$T_J = 150^\circ\text{C},$ $I_C = 40A, V_{CC} = 480V$ $V_{GE} = 15V, R_G = 5.0\Omega$ Energy losses include "tail"
t_r	Rise Time	----	42	----		
$t_{d(off)}$	Turn-Off Delay Time	----	300	----		
t_f	Fall Time	----	160	----		
E_{ts}	Total Switching Loss	----	2.6	----	mJ	See Fig. 13, 14
L_E	Internal Emitter Inductance	----	13	----	nH	Measured 5mm from package
C_{ies}	Input Capacitance	----	5860	----	pF	$V_{GE} = 0V$ $V_{CC} = 30V$ See Fig. 7 $f = 1.0MHz$
C_{oes}	Output Capacitance	----	370	----		
C_{res}	Reverse Transfer Capacitance	----	75	----		

Notes:

- ① Repetitive rating; $V_{GE} = 20V$, pulse width limited by max. junction temperature. (See fig. 13b)
- ② $V_{CC} = 80\%(V_{CES}), V_{GE} = 20V, R_G = 5.0\Omega$. (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.
- ⑥ When mounted on 1" square PCB (FR-4 or G-10 Material). For recommended footprint and soldering techniques refer to application note #AN-994.
- ⑦ Refer to application note # 1023, "Surface Mounting of Larger Devices."

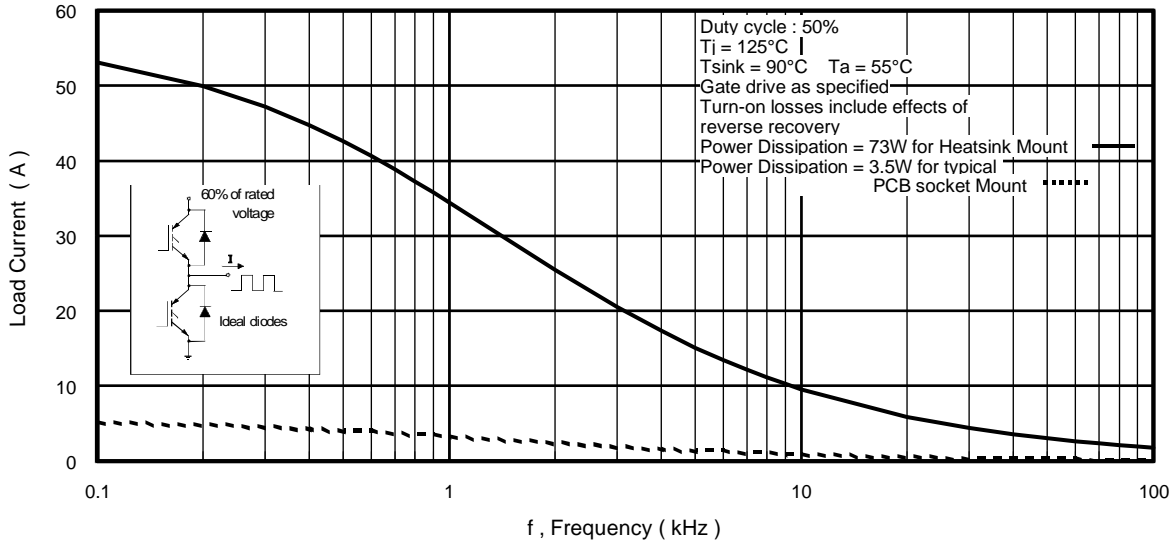


Fig. 1 - Typical Load Current vs. Frequency
(For square wave, $I = I_{RMS}$ of fundamental; for triangular wave, $I = I_{PK}$)

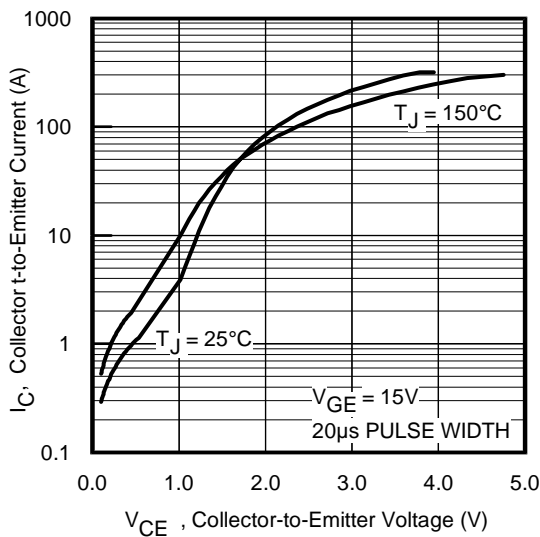


Fig. 2 - Typical Output Characteristics

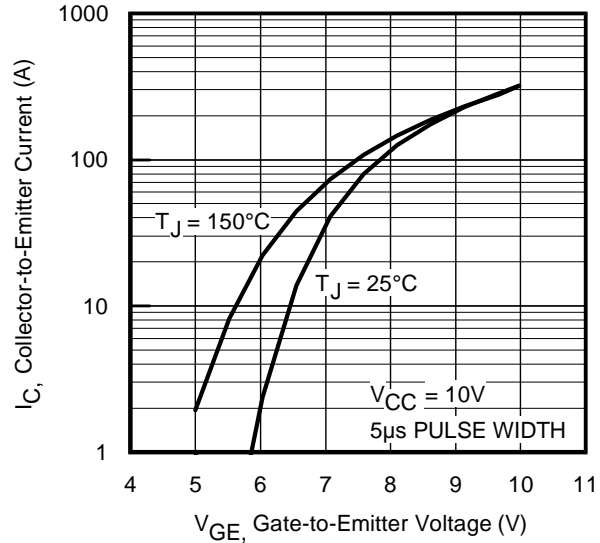


Fig. 3 - Typical Transfer Characteristics

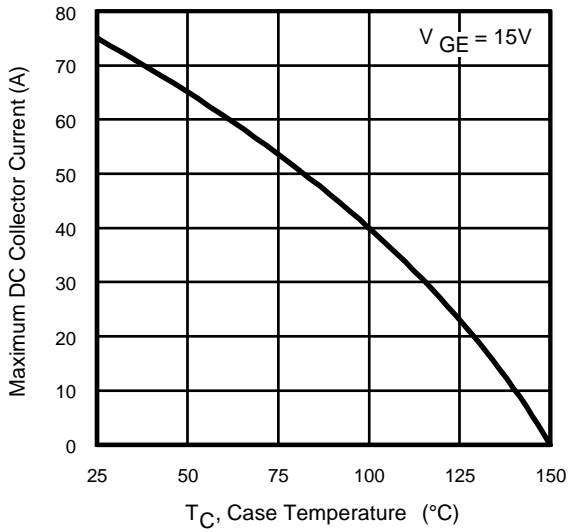


Fig. 4 - Maximum Collector Current vs. Case Temperature

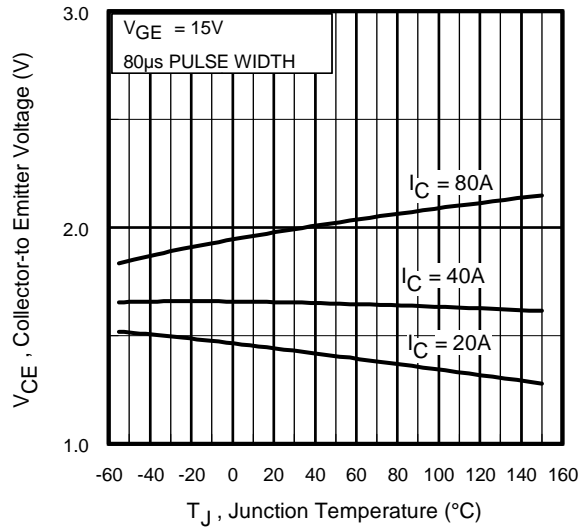


Fig. 5 - Collector-to-Emitter Voltage vs. Junction Temperature

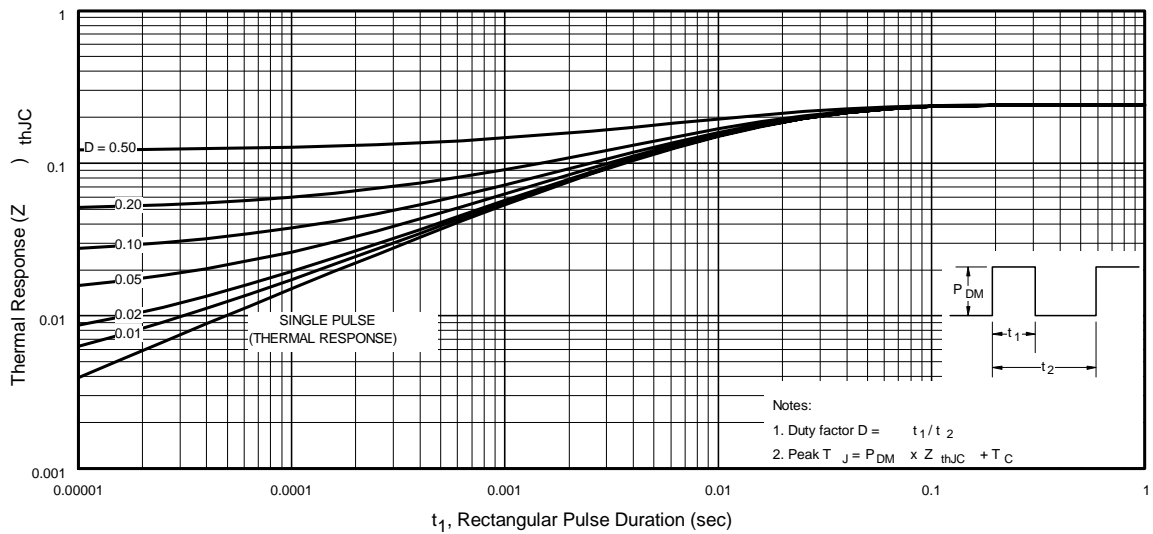


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

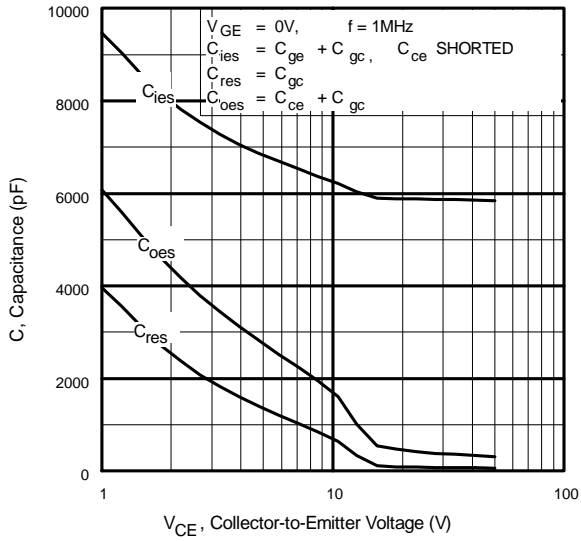


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

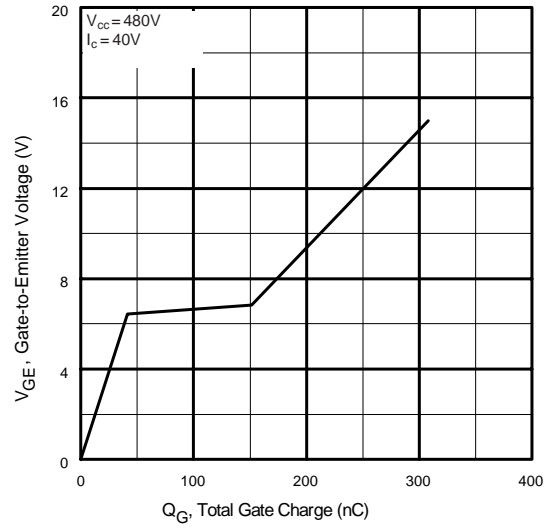


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

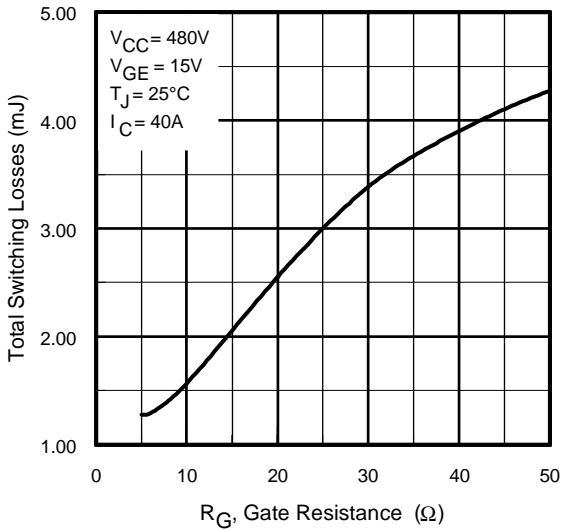


Fig. 9 - Typical Switching Losses vs. Gate Resistance

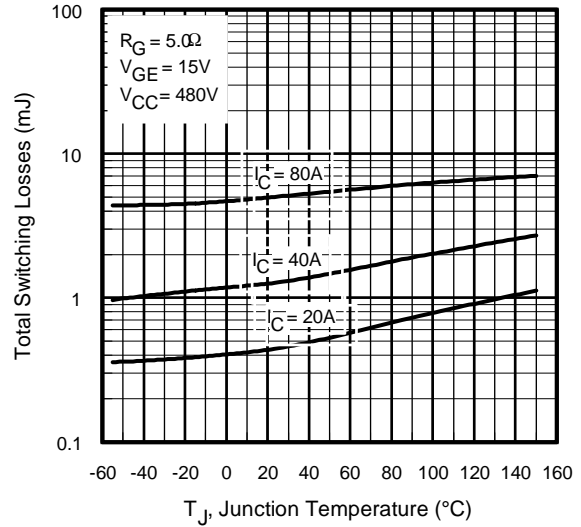


Fig. 10 - Typical Switching Losses vs. Junction Temperature

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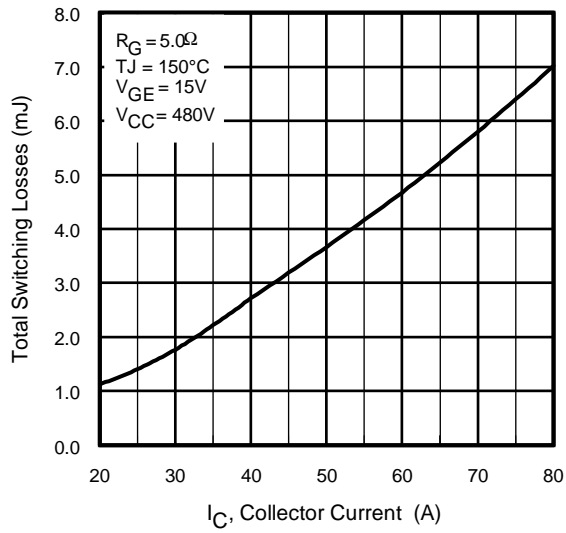


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

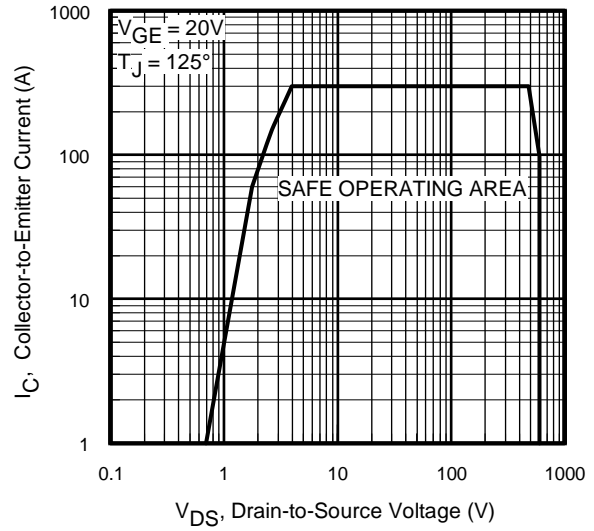


Fig. 12 - Turn-Off SOA



* 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

Note: For the most current drawings please refer to the IR website at:
<http://www.irf.com/package/>