

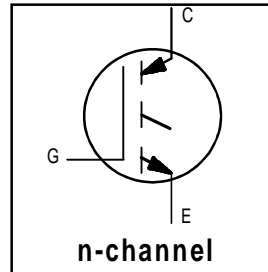
IRG4PH50K

INSULATED GATE BIPOLAR TRANSISTOR

Short Circuit Rated
UltraFast IGBT

Features

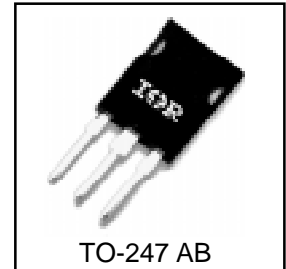
- High short circuit rating optimized for motor control, $t_{sc} = 10\mu s$, $V_{CC} = 720V$, $T_J = 125^\circ C$, $V_{GE} = 15V$
- Combines low conduction losses with high switching speed
- Latest generation design provides tighter parameter distribution and higher efficiency than previous generations



$V_{CES} = 1200V$
$V_{CE(on) typ.} = 2.77V$
@ $V_{GE} = 15V$, $I_C = 24A$

Benefits

- As a Freewheeling Diode we recommend our HEXFRED™ ultrafast, ultrasoft recovery diodes for minimum EMI/Noise and switching losses in the Diode and IGBT
- Latest generation 4 IGBTs offer highest power density motor controls possible
- This part replaces the IRGPH50K and IRGPH50M devices



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	1200	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	45	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	24	
I_{CM}	Pulsed Collector Current ①	90	
I_{LM}	Clamped Inductive Load Current ②	90	
t_{sc}	Short Circuit Withstand Time	10	μs
V_{GE}	Gate-to-Emitter Voltage	± 20	V
E_{ARV}	Reverse Voltage Avalanche Energy ③	190	mJ
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	200	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	78	
T_J	Operating Junction and Storage Temperature Range	-55 to +150	$^\circ C$
T_{STG}			
	Mounting torque, 6-32 or M3 screw.	10 lbf•in (1.1N•m)	

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	0.64	$^\circ C/W$
$R_{\theta CS}$	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)

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	$V_{GE} = 0\text{V}$, $I_C = 250\mu\text{A}$
$V_{(BR)ECS}$	Emitter-to-Collector Breakdown Voltage	18	—	—	V	$V_{GE} = 0\text{V}$, $I_C = 1.0\text{A}$
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.91	—	$\text{V}/^\circ\text{C}$	$V_{GE} = 0\text{V}$, $I_C = 2.0\text{mA}$
$V_{CE(ON)}$	Collector-to-Emitter Saturation Voltage	—	2.77	3.5	V	$I_C = 24\text{A}$ $V_{GE} = 15\text{V}$ $I_C = 45\text{A}$ see figures 2, 5 $I_C = 24\text{A}$, $T_J = 150^\circ\text{C}$
		—	3.28	—		
		—	2.54	—		
$V_{GE(th)}$	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	—	-10	—	$\text{mV}/^\circ\text{C}$	$V_{CE} = V_{GE}$, $I_C = 2.0\text{mA}$
g_{fe}	Forward Transconductance	13	19	—	S	$V_{CE} = 100\text{V}$, $I_C = 24\text{A}$
I_{CES}	Zero Gate Voltage Collector Current	—	—	250	μA	$V_{GE} = 0\text{V}$, $V_{CE} = 1200\text{V}$
		—	—	2.0		$V_{GE} = 0\text{V}$, $V_{CE} = 10\text{V}$, $T_J = 25^\circ\text{C}$
		—	—	5000		$V_{GE} = 0\text{V}$, $V_{CE} = 1200\text{V}$, $T_J = 150^\circ\text{C}$
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)	—	180	270	nC	$I_C = 24\text{A}$ $V_{CC} = 400\text{V}$ see figure 8 $V_{GE} = 15\text{V}$
Q_{ge}	Gate - Emitter Charge (turn-on)	—	25	38		
Q_{gc}	Gate - Collector Charge (turn-on)	—	70	110		
$t_{d(on)}$	Turn-On Delay Time	—	36	—	ns	$T_J = 25^\circ\text{C}$ $I_C = 24\text{A}$, $V_{CC} = 960\text{V}$ $V_{GE} = 15\text{V}$, $R_G = 5.0\Omega$
t_r	Rise Time	—	27	—		
$t_{d(off)}$	Turn-Off Delay Time	—	200	300		
t_f	Fall Time	—	130	190	mJ	Energy losses include "tail" see figures 9,10,14
E_{on}	Turn-On Switching Loss	—	1.21	—		
E_{off}	Turn-Off Switching Loss	—	2.25	—		
E_{ts}	Total Switching Loss	—	3.46	4.1		
t_{sc}	Short Circuit Withstand Time	10	—	—	μs	$V_{CC} = 720\text{V}$, $T_J = 125^\circ\text{C}$ $V_{GE} = 15\text{V}$, $R_G = 5.0\Omega$
$t_{d(on)}$	Turn-On Delay Time	—	35	—	ns	$T_J = 150^\circ\text{C}$, $I_C = 24\text{A}$, $V_{CC} = 960\text{V}$ $V_{GE} = 15\text{V}$, $R_G = 5.0\Omega$ Energy losses include "tail" see figures 10,11,14
t_r	Rise Time	—	29	—		
$t_{d(off)}$	Turn-Off Delay Time	—	380	—		
t_f	Fall Time	—	280	—	mJ	
E_{ts}	Total Switching Loss	—	7.80	—		
L_E	Internal Emitter Inductance	—	13	—		
C_{ies}	Input Capacitance	—	2800	—	pF	$V_{GE} = 0\text{V}$ $V_{CC} = 30\text{V}$ see figure 7 $f = 1.0\text{MHz}$
C_{oes}	Output Capacitance	—	140	—		
C_{res}	Reverse Transfer Capacitance	—	53	—		

Notes:

- ① Repetitive rating; $V_{GE} = 20\text{V}$, pulse width limited by max. junction temperature. (see figure 13b)
- ② $V_{CC} = 80\%$ (V_{CES}), $V_{GE} = 20\text{V}$, $L = 10\mu\text{H}$, $R_G = 5.0\Omega$, (see figure 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.

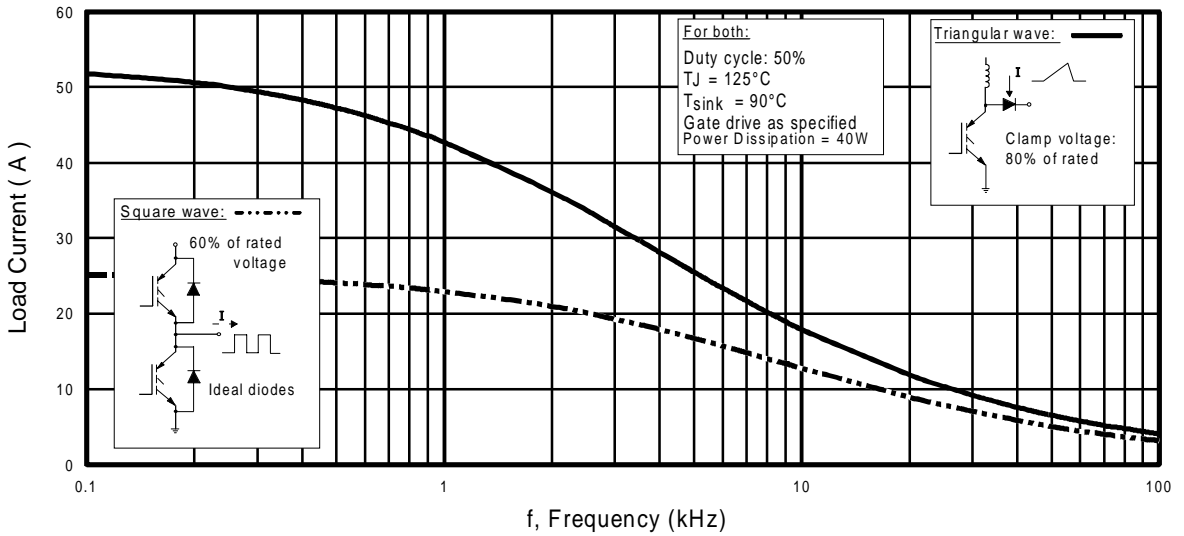


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

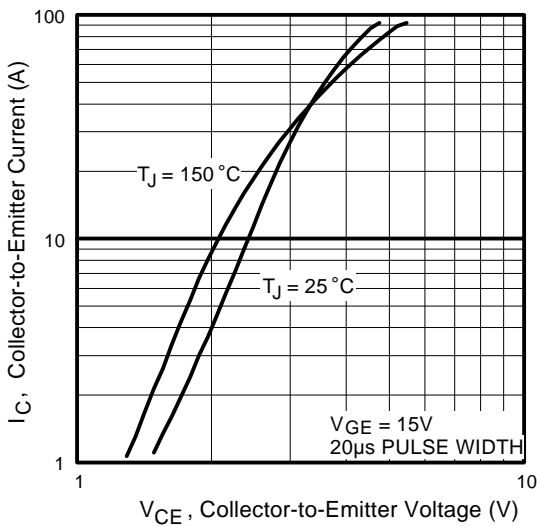


Fig. 2 - Typical Output Characteristics

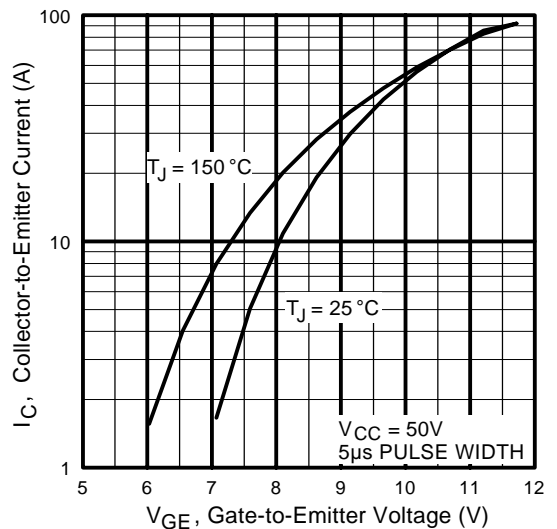


Fig. 3 - Typical Transfer Characteristics

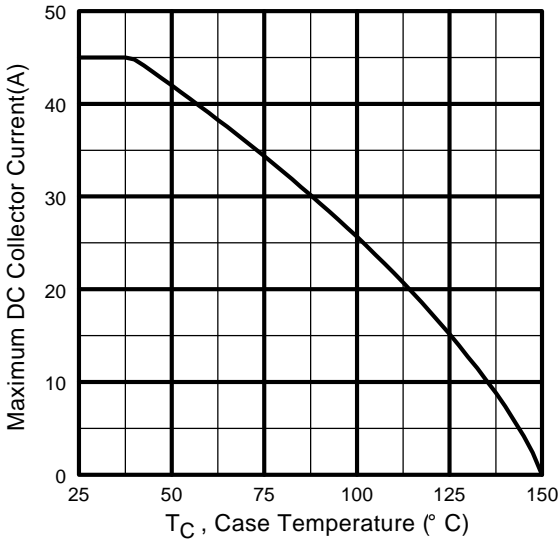


Fig. 4 - Maximum Collector Current vs. Case Temperature

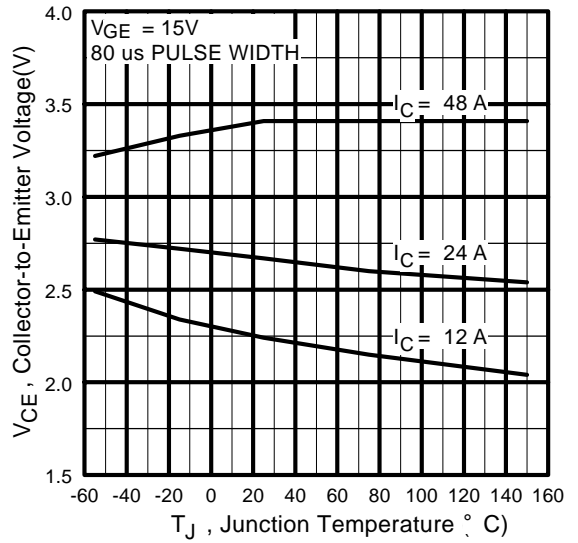


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

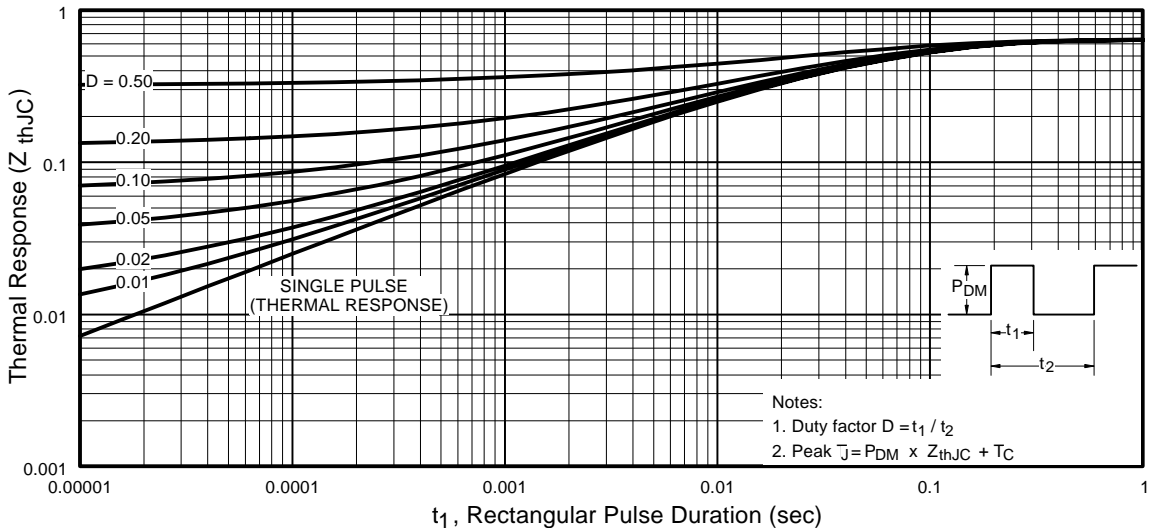


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

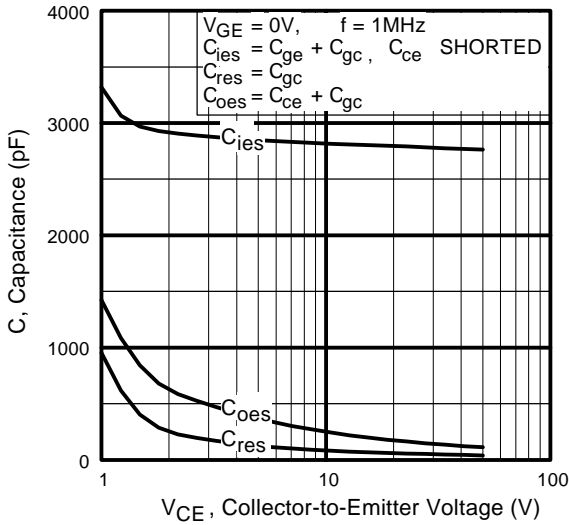


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

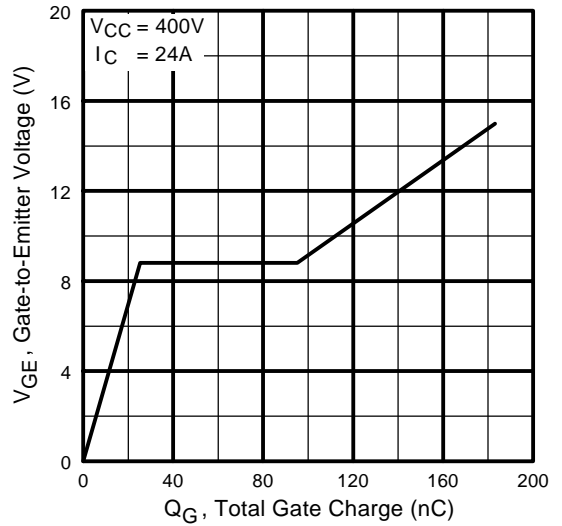


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

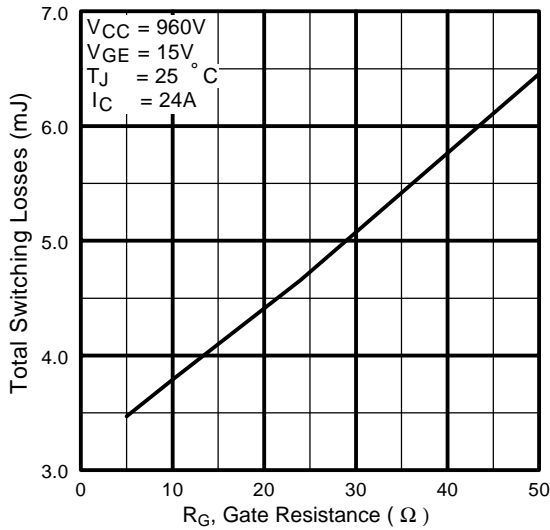


Fig. 9 - Typical Switching Losses vs. Gate Resistance

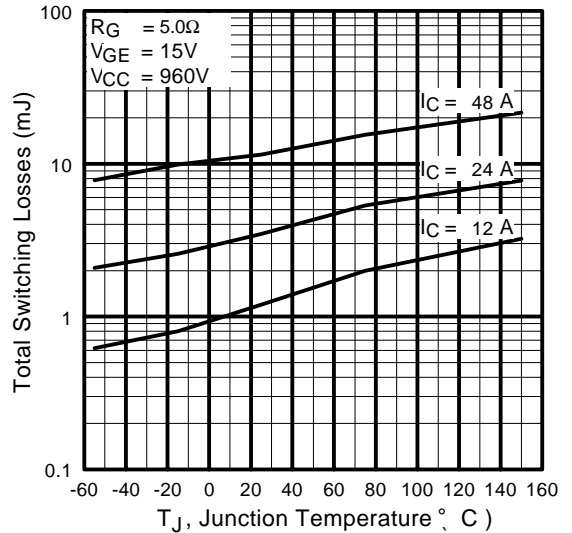


Fig. 10 - Typical Switching Losses vs. Junction Temperature

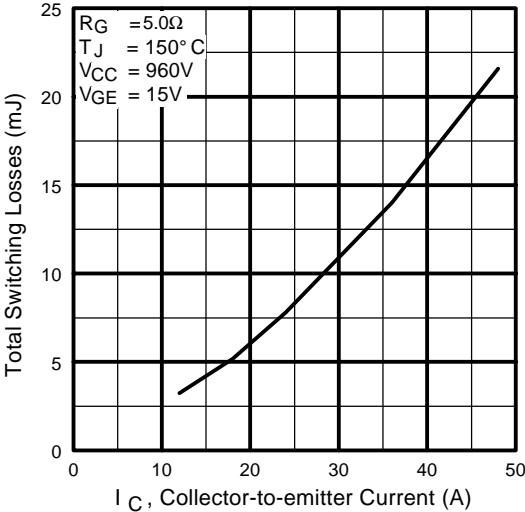


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

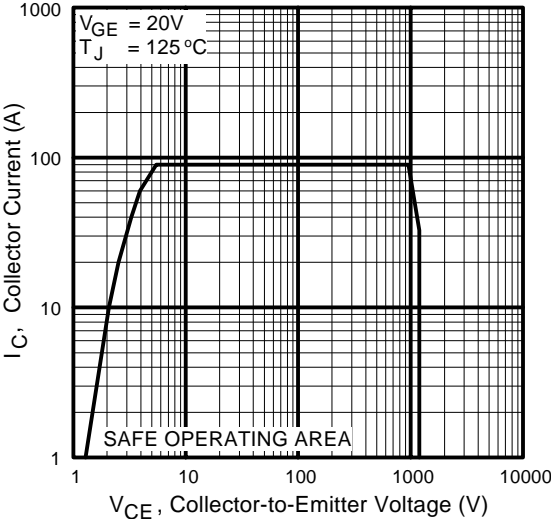


Fig. 12 - Turn-Off SOA