

International Rectifier

PD - 9.1123

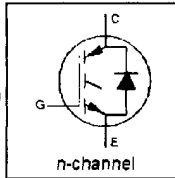
IRGPC50KD2

INSULATED GATE BIPOLAR TRANSISTOR
WITH ULTRAFAST SOFT RECOVERY DIODE

Short Circuit Rated
UltraFast CoPack IGBT

Features

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

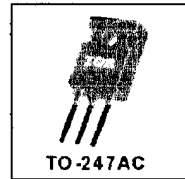


V_{CES} = 600V
V_{CE(sat)} < 2.7V
@V_{GE} = 15V, I_C = 30A

Description

Co-packaged IGBTs are a natural extension of International Rectifier's well known IGBT line. They provide the convenience of an IGBT and an ultrafast recovery diode in one package, resulting in 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	600	V
I _C @ T _C = 25°C	Continuous Collector Current	32	
I _C @ T _C = 100°C	Continuous Collector Current	30	
I _{CM}	Pulsed Collector Current	100	A
I _{CLM}	Clamped Inductive Load Current	100	
I _{FM} @ T _C = 100°C	Diode Continuous Forward Current	25	
I _{FM}	Diode Maximum Forward Current	100	
t _{SC}	Short Circuit Withstand Time	10	μ s
V _{GE}	Gate-to-Emitter Voltage	\pm 20	V
P _C @ T _C = 25°C	Maximum Power Dissipation	200	W
P _C @ T _C = 100°C	Maximum Power Dissipation	52	
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 (1.1 N-m)	

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
R _{JC}	Junction-to-Case - IGBT	-----	-----	0.64	°C/W
R _{JC}	Junction-to-Case - Diode	-----	-----	0.83	
R _{CS}	Case to Sink, flat, greased surface	-----	0.24	-----	
R _{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
$V_{BR(ES)}$	Collector-to-Emitter Breakdown Voltage	600	---	V	$V_{GE} = 0\text{V}$, $I_C = 250\mu\text{A}$
$\Delta V_{BR(ES)}/\Delta T$	Temperature Coeff. of Breakdown Voltage	0.60	---	V/°C	$V_{GE} = 0\text{V}$, $I_C = 1.0\text{mA}$
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage	2.0	2.7	V	$I_C = 30\text{A}$ $I_E = 52\text{A}$ $I_C = 30\text{A}$, $T_J = 150^\circ\text{C}$
$V_{GE(th)}$	Gate Threshold Voltage	3.0	5.5	V	$V_{CE} = V_{GE}$, $I_C = 250\mu\text{A}$
$\Delta V_{GE(th)}/\Delta T$	Temperature Coeff. of Threshold Voltage	-14	---	mV/°C	$V_{CE} = V_{GE}$, $I_C = 250\mu\text{A}$
g_{fs}	Forward Transconductance \oplus	9.8	17	S	$V_{CE} = 100\text{V}$, $I_C = 30\text{A}$
I_{CES}	Zero Gate Voltage Collector Current	---	250	μA	$V_{CE} = 0\text{V}$, $V_{GE} = 600\text{V}$
V_{FEM}	Diode Forward Voltage Drop	1.3	1.7	V	$V_{CE} = 0\text{V}$, $V_{GE} = 600\text{V}$, $T_J = 150^\circ\text{C}$ $I_C = 25\text{A}$
I_{GSE}	Gate-to-Emitter Leakage Current	---	± 100	nA	$I_C = 25\text{A}$, $T_J = 150^\circ\text{C}$ $V_{GE} = \pm 20\text{V}$

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

Parameter	Min.	Typ.	Max.	Units	Conditions
t_{ON}	Total Gate Charge (turn-on)	120	200	ns	$I_C = 30\text{A}$
Q_{GE}	Gate - Emitter Charge (turn-on)	27	42	nC	$V_{CC} = 400\text{V}$
Q_{G}	Gate - Collector Charge (turn-on)	44	73	nC	
$t_{d(on)}$	Turn-On Delay Time	74	---	ns	$T_J = 25^\circ\text{C}$
t_r	Rise Time	100	---	ns	$I_C = 30\text{A}$, $V_{CC} = 480\text{V}$
$t_{d(off)}$	Turn-Off Delay Time	260	460	ns	$V_{CC} = 15\text{V}$, $R_G = 5.0\Omega$
t_f	Fall Time	190	290	ns	Energy losses include "tail" and diode reverse recovery
E_{sw}	Turn-On Switching Loss	2.1	---	mJ	
E_{off}	Turn-Off Switching Loss	0.9	---	mJ	
E_{sw}	Total Switching Loss	3.0	4.5	mJ	
I_{sc}	Short Circuit Withstand Time	10	---	μs	$V_{CC} = 360\text{V}$, $T_J = 125^\circ\text{C}$ $V_{GE} = 15\text{V}$, $R_G = 5.0\Omega$, $V_{CE(pk)} < 500\text{V}$
$t_{d(on)}$	Turn-On Delay Time	77	---	ns	$T_J = 150^\circ\text{C}$
t_r	Rise Time	100	---	ns	$I_C = 30\text{A}$, $V_{CC} = 480\text{V}$
$t_{d(off)}$	Turn-Off Delay Time	530	---	ns	$V_{CC} = 15\text{V}$, $R_G = 5.0\Omega$
t_f	Fall Time	360	---	ns	Energy losses include "tail" and diode reverse recovery
E_{sw}	Total Switching Loss	4.5	---	mJ	diode reverse recovery
L_E	Internal Emitter Inductance	13	---	nH	Measured 5mm from package
C_{iss}	Input Capacitance	2900	---	pF	$V_{GE} = 0\text{V}$
C_{oss}	Output Capacitance	220	---	pF	$V_{CC} = 30\text{V}$
C_{res}	Reverse Transfer Capacitance	30	---	pF	$f = 1.0\text{MHz}$
t_{rr}	Diode Reverse Recovery Time	50	75	ns	$T_J = 25^\circ\text{C}$
I_{rr}	Diode Peak Reverse Recovery Current	105	160	A	$T_J = 125^\circ\text{C}$
		4.5	10	A	$T_J = 25^\circ\text{C}$
		8.0	15	A	$T_J = 125^\circ\text{C}$
Q_{rr}	Diode Reverse Recovery Charge	112	375	nC	$T_J = 25^\circ\text{C}$
		420	1200	nC	$T_J = 125^\circ\text{C}$
di_{pk}/dt	Diode Peak Rate of Fall of Recovery During t_{rr}	250	---	A/ μs	$T_J = 25^\circ\text{C}$
		160	---	A/ μs	$T_J = 125^\circ\text{C}$

Notes:

① Repetitive rating; $V_{GE} = 20\text{V}$, pulse width limited by max junction temperature

② $V_{CC} = 80\%(V_{CES})$, $V_{GE} = 20\text{V}$, $L = 10\mu\text{H}$, \oplus Pulse width 5.0 μs , $R_G = 5.0\Omega$ single shot

③ Pulse width $\leq 80\mu\text{s}$, duty factor $\leq 0.1\%$



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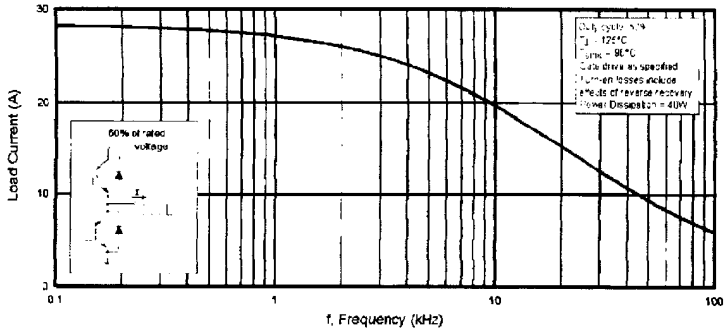


Fig. 1 - Typical Load Current vs Frequency
(Load Current = I_{RMS} of fundamental)

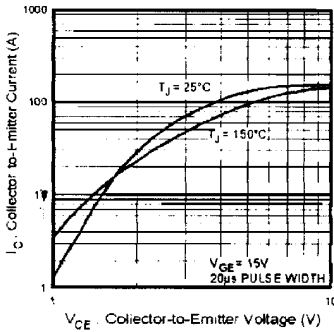


Fig. 2 - Typical Output Characteristics

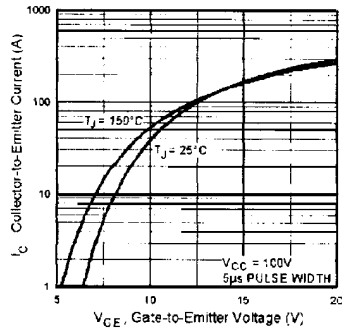


Fig. 3 - Typical Transfer Characteristics

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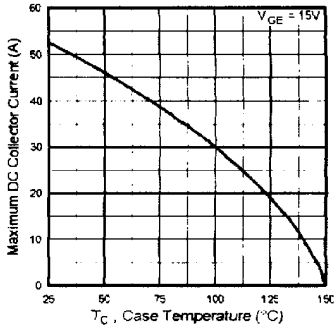


Fig. 4 - Maximum Collector Current vs. Case Temperature

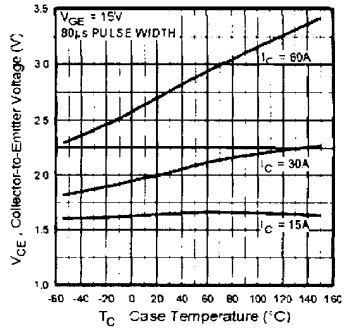


Fig. 5 - Collector-to-Emitter Voltage vs. Case Temperature

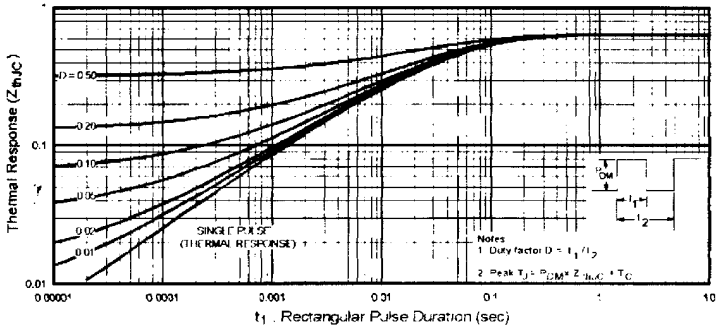


Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case



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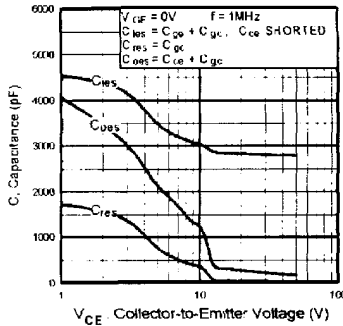


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

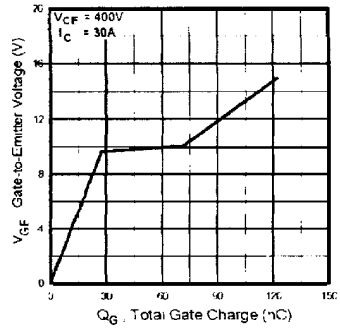


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

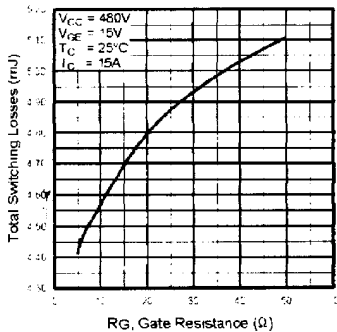


Fig. 9 - Typical Switching Losses vs. Gate Resistance

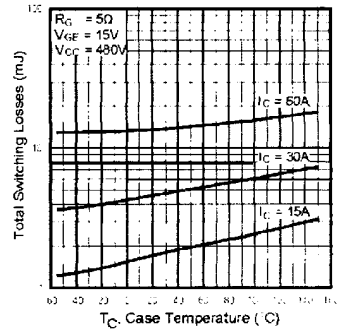


Fig. 10 - Typical Switching Losses vs. Case Temperature

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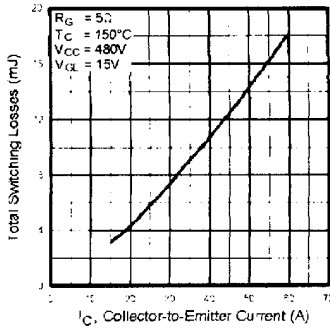


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

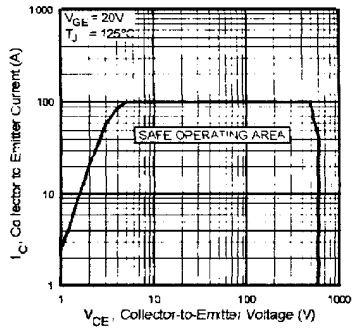


Fig. 12 - Turn-Off SOA

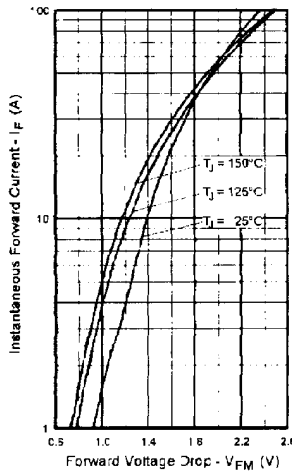


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current



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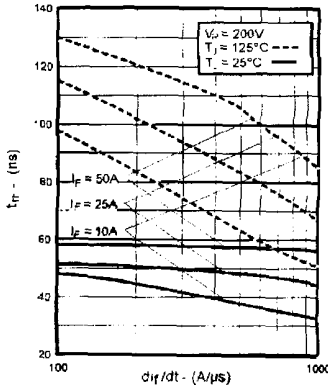


Fig. 14 - Typical Reverse Recovery vs di/dt

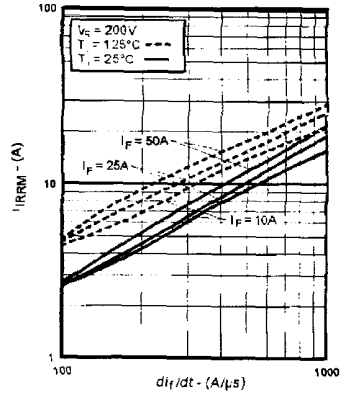


Fig. 15 - Typical Recovery Current vs di/dt

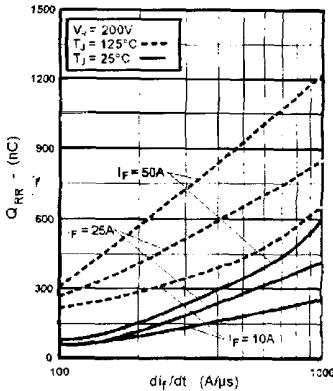


Fig. 16 - Typical Stored Charge vs di/dt

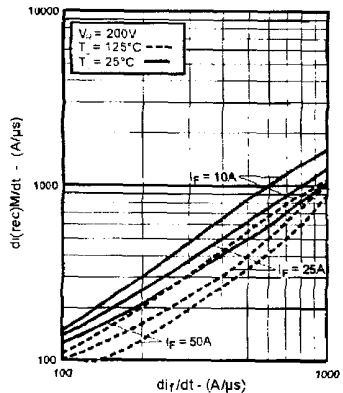


Fig. 17 - Typical $di_{(rec)M}/dt$ vs di/dt

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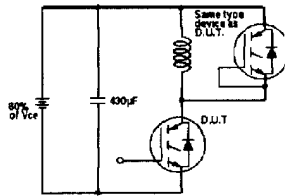


Fig. 18a - Test Circuit for Measurement of t_r , E_{on} , $E_{off}(\text{diode})$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_r

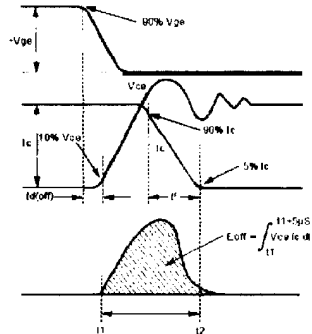


Fig. 18b - Test Waveforms for Circuit of Fig. 18a Defining E_{off} , $t_{d(on)}$, t_r

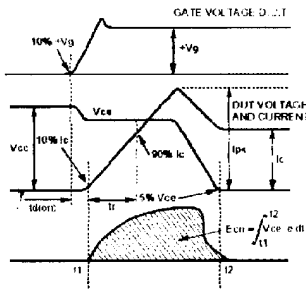


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

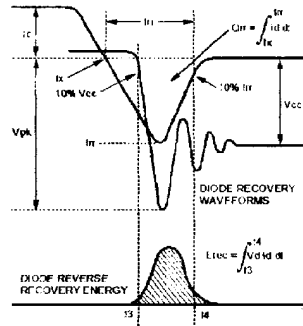


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

