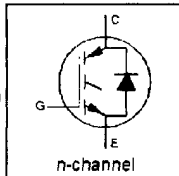


**International
Rectifier**

PD - 9.1123

IRGPC50KD2
**INSULATED GATE BIPOLAR TRANSISTOR
WITH ULTRAFAST SOFT RECOVERY DIODE**
**Short Circuit Rated
UltraFast CoPack IGBT**
Features

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



$$V_{CES} = 600V$$

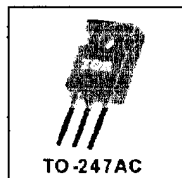
$$V_{CE(sat)} \leq 2.7V$$

$$@V_{GE} = 15V, I_C = 30A$$

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
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	52	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	30	A
I_{CV}	Pulsed Collector Current	100	A
I_{LW}	Clamped Inductive Load Current	100	A
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	25	A
I_{FW}	Diode Maximum Forward Current	100	A
t_{SC}	Short Circuit Withstand Time	10	µs
V_{GE}	Gate-to-Emitter Voltage	±20	V
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	200	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	52	W
T_J	Operating Junction and Storage Temperature Range	-55 to +150	°C
T_{SOL}	Soldering Temperature, for 10 sec.	300 (0.063 in. (1.6mm) from case)	°C
	Mounting Torque, 6-32 or M3 Screw	10 lbf-in (1.1 N-m)	

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
R_{JC}	Junction-to-Case - IGBT		0.64		°C/W
R_{JD}	Junction-to-Case - Diode		0.63		°C/W
R_{JA}	Case to Sink, flat, greased surface		0.24		°C/W
R_{JA}	Junction-to-Ambient, typical socket mount		40		°C/W
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	$V_{GE} = 0\text{V}$, $I_C = 1\text{mA}$
$V_{CE(sat)}$ Collector-to-Emitter Saturation Voltage	---	2.0	2.7	V	$I_C = 30\text{A}$
	---	2.6	---	---	$I_C = 52\text{A}$
	---	2.3	---	---	$I_C = 30\text{A}$, $T_J = 150^\circ\text{C}$
$V_{GE(th)}$ 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	9.8	17	---	S	$V_{CE} = 100\text{V}$, $I_C = 30\text{A}$
I_{CES} Zero Gate Voltage Collector Current	---	---	250	μA	$V_{GE} = 0\text{V}$, $V_{CE} = 600\text{V}$
	---	---	6500	---	$V_{GE} = 0\text{V}$, $V_{CE} = 600\text{V}$, $T_J = 150^\circ\text{C}$
V_{FM} Diode Forward Voltage Drop	---	1.3	1.7	V	$I_C = 25\text{A}$
	---	1.2	1.5	---	$I_C = 25\text{A}$, $T_J = 150^\circ\text{C}$
I_{GSS} 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)	---	120	200	---	$I_C = 30\text{A}$
Q_{ge} Gate - Emitter Charge (turn-on)	---	21	42	nC	$V_{CC} = 400\text{V}$
Q_{gc} Gate - Collector Charge (turn-on)	---	44	73	---	---
$t_{d(on)}$ Turn-On Delay Time	---	74	---	---	$T_J = 25^\circ\text{C}$
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	---	$V_{CC} = 15\text{V}$, $R_G = 5\Omega$
t_f Fall Time	---	190	290	---	Energy losses include "tail" and diode reverse recovery
E_{on} Turn-On Switching Loss	---	2.1	---	---	---
E_{off} Turn-Off Switching Loss	---	0.9	---	mJ	---
E_{sw} Total Switching Loss	---	3.0	4.5	---	---
t_{sc} Short Circuit Withstand Time	10	---	---	μs	$V_{CC} = 360\text{V}$, $T_J = 125^\circ\text{C}$
	---	---	---	---	$V_{GE} = 15\text{V}$, $R_G = 5.0\Omega$, $V_{CE(pk)} < 500\text{V}$
$t_{d(on)}$ Turn-On Delay Time	---	77	---	---	$T_J = 150^\circ\text{C}$
t_r Rise Time	---	100	---	ns	$I_C = 30\text{A}$, $V_{CC} = 480\text{V}$
$t_{d(off)}$ Turn-Off Delay Time	---	530	---	---	$V_{CC} = 15\text{V}$, $R_G = 5\Omega$
t_f Fall Time	---	360	---	---	Energy losses include "tail" and diode reverse recovery
E_{on} Total Switching Loss	---	4.5	---	mJ	Measured 5mm from package
L_L Internal Emitter Inductance	---	13	---	nH	---
C_{iss} Input Capacitance	---	2900	---	---	$V_{GE} = 0\text{V}$
C_{oss} Output Capacitance	---	220	---	pF	$V_{CC} = 30\text{V}$
C_{res} Reverse Transfer Capacitance	---	30	---	---	$f = 1\text{MHz}$
t_{rr} Diode Reverse Recovery Time	---	50	75	ns	$T_J = 25^\circ\text{C}$
	---	105	160	---	$T_J = 125^\circ\text{C}$
I_{rr} Diode Peak Reverse Recovery Current	---	4.5	10	A	$T_J = 25^\circ\text{C}$
	---	8.0	15	---	$T_J = 125^\circ\text{C}$
Q_{rr} Diode Reverse Recovery Charge	---	112	375	nC	$T_J = 25^\circ\text{C}$
	---	420	1200	---	$T_J = 125^\circ\text{C}$
$di/dt_{pk,swdt}$ Diode Peak Rate of Fall of Recovery During t_r	---	250	---	A/ μs	$T_J = 25^\circ\text{C}$
	---	160	---	---	$T_J = 125^\circ\text{C}$

Notes:

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

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

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

④ Pulse width 5.0 μs , single shot

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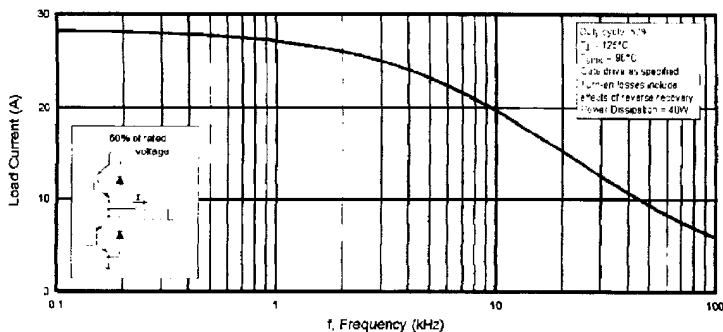


Fig. 1 - Typical Load Current vs Frequency
(Load Current = I_{RMS} of fundamental)

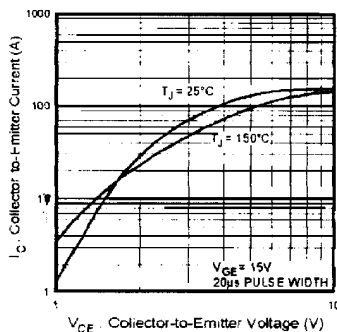


Fig. 2 - Typical Output Characteristics

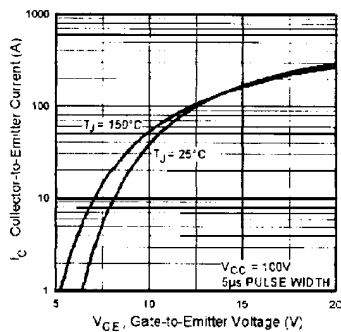


Fig. 3 - Typical Transfer Characteristics

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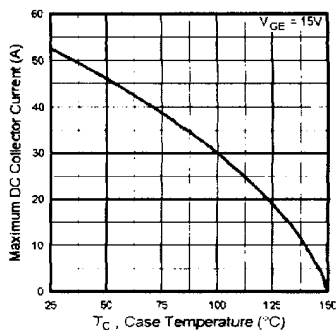


Fig. 4 - Maximum Collector Current vs. Case Temperature

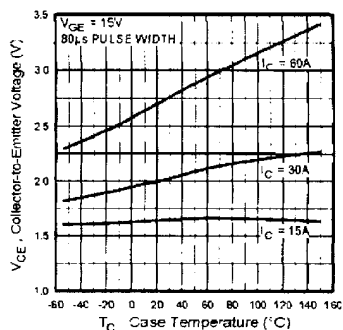


Fig. 5 - Collector-to-Emitter Voltage vs. Case Temperature

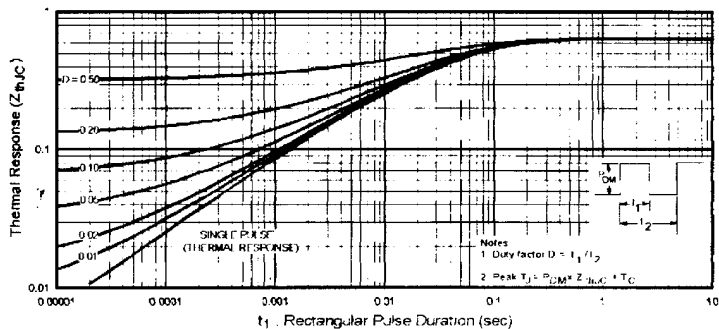


Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case



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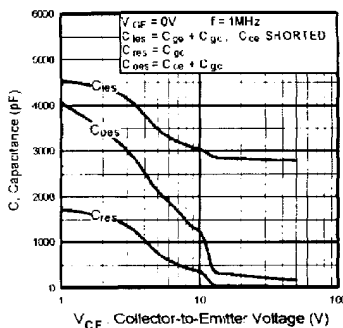


Fig. 7 - Typical Capacitance vs.
Collector-to-Emitter Voltage

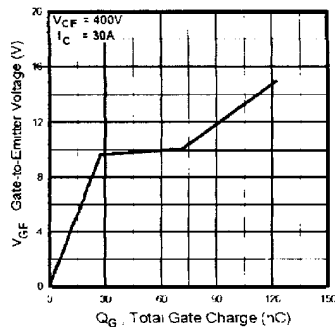


Fig. 8 - Typical Gate Charge vs.
Gate-to-Emitter Voltage

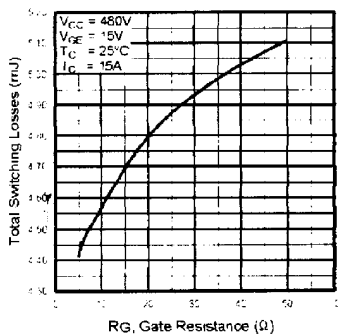


Fig. 9 - Typical Switching Losses vs. Gate
Resistance

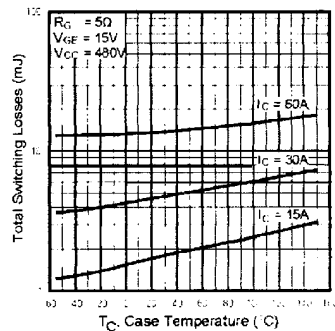
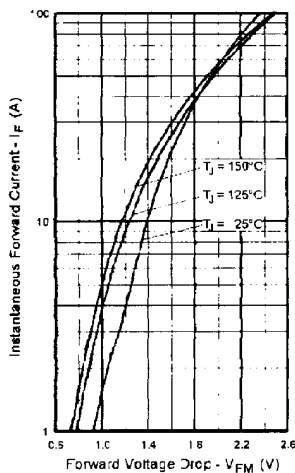
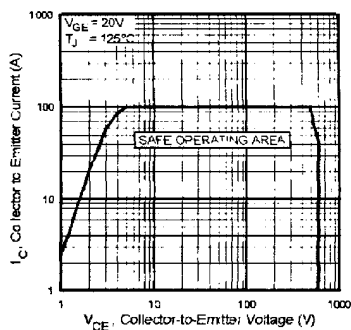
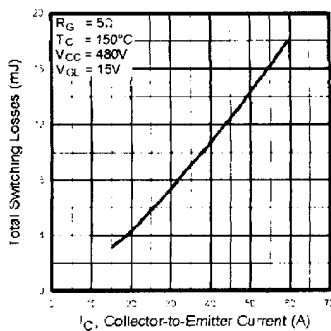
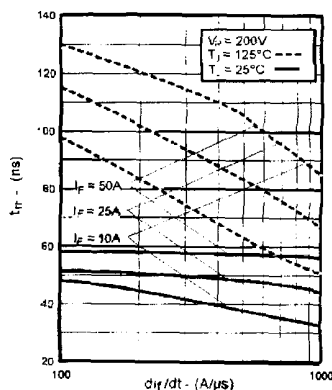
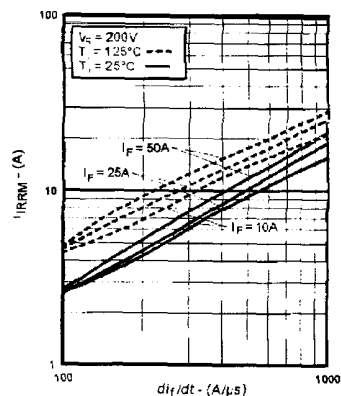
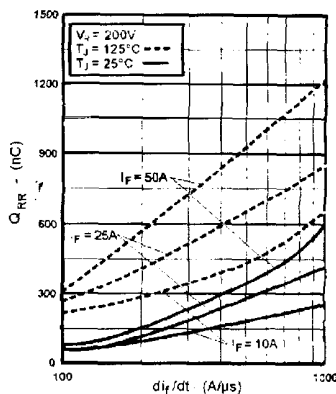
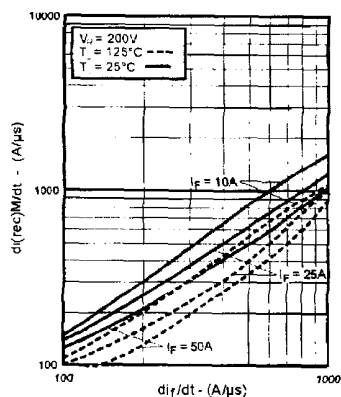


Fig. 10 - Typical Switching Losses vs.
Case Temperature

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Fig. 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 $dI_{rec})/dt$ vs. di/dt

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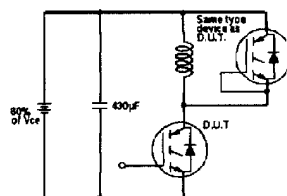


Fig. 18a - Test Circuit for Measurement of t_M , E_{on} , $E_{off}(\text{diode})$, t_M , Q_M , t_M , $t_d(\text{on})$, t_M , $t_d(\text{off})$, t_r

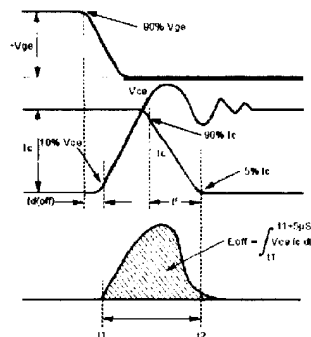


Fig. 18b - Test Waveforms for Circuit of Fig. 18a Defining E_{on} , $t_d(\text{off})$, t_r

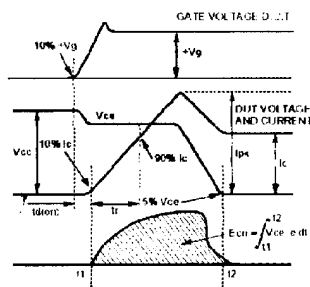


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_d(\text{on})$, t_r

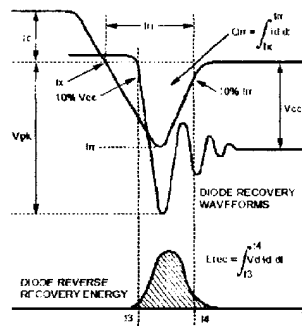


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_M , Q_M , t_M



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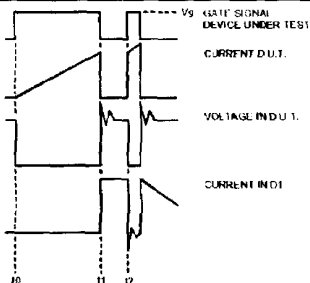


Fig. 18a - Macro Waveforms for Test Circuit of Fig. 18a

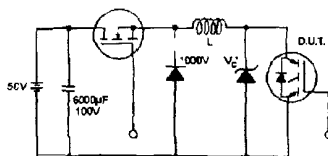


Fig. 19 - Clamped inductive Load Test Circuit

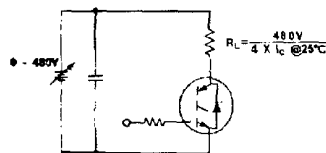
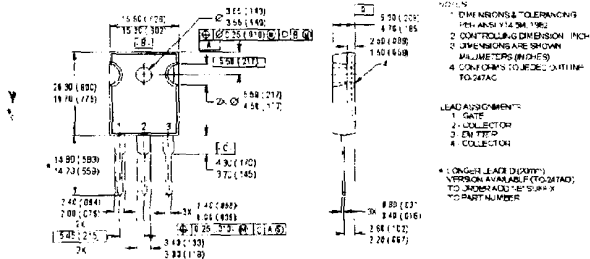


Fig. 20 - Pulsed Collector Current Test Circuit



CONFORMS TO JEDEC OUTLINE TO-247AC (TO-3PA)

Derivations in $\mathcal{M}(\mathcal{A})$ -trees and $\mathcal{M}(\mathcal{B})$ -trees