

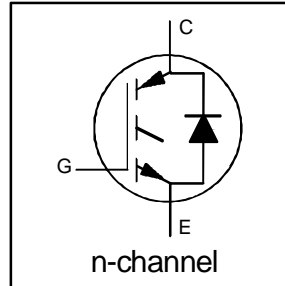
# IRGPC40MD2

INSULATED GATE BIPOLAR TRANSISTOR  
WITH ULTRAFAST SOFT RECOVERY

Short Circuit Rated  
Fast CoPack IGBT

**DIODE**  
**Features**

- Short circuit rated -10 $\mu$ s @125°C,  $V_{GE} = 15V$
- Switching-loss rating includes all "tail" losses
- HEXFRED™ soft ultrafast diodes
- Optimized for medium operating frequency ( 1 to 10kHz)

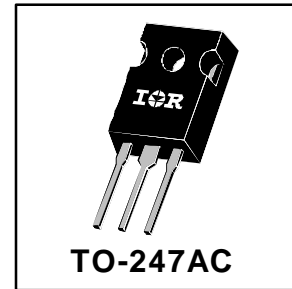


$V_{CES} = 600V$   
 $V_{CE(sat)} \leq 3.0V$   
@  $V_{GE} = 15V, I_C = 24A$

**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	40	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	24	
$I_{CM}$	Pulsed Collector Current ①	80	
$I_{LM}$	Clamped Inductive Load Current ②	80	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	15	
$I_{FM}$	Diode Maximum Forward Current	80	
$t_{sc}$	Short Circuit Withstand Time	10	$\mu$ s
$V_{GE}$	Gate-to-Emitter Voltage	$\pm 20$	V
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	160	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	65	
$T_J$	Operating Junction and	-55 to +150	°C
$T_{STG}$	Storage Temperature Range		
	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
$R_{\theta JC}$	Junction-to-Case - IGBT	—	—	0.77	°C/W
$R_{\theta JC}$	Junction-to-Case - Diode	—	—	1.7	
$R_{\theta CS}$	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)

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## Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
V <sub>(BR)CES</sub>	Collector-to-Emitter Breakdown Voltage ③	600	—	—	V	V <sub>GE</sub> = 0V, I <sub>C</sub> = 250μA
ΔV <sub>(BR)CES/ΔT<sub>J</sub></sub>	Temperature Coeff. of Breakdown Voltage	—	0.70	—	V/°C	V <sub>GE</sub> = 0V, I <sub>C</sub> = 1.0mA
V <sub>CE(on)</sub>	Collector-to-Emitter Saturation Voltage	—	2.0	3.0	V	I <sub>C</sub> = 24A, V <sub>GE</sub> = 15V
		—	2.6	—		I <sub>C</sub> = 40A
		—	2.4	—		I <sub>C</sub> = 24A, T <sub>J</sub> = 150°C
V <sub>GE(th)</sub>	Gate Threshold Voltage	3.0	—	5.5		V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250μA
ΔV <sub>GE(th)/ΔT<sub>J</sub></sub>	Temperature Coeff. of Threshold Voltage	—	-12	—	mV/°C	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250μA
g <sub>fe</sub>	Forward Transconductance ④	9.2	12	—	S	V <sub>CE</sub> = 100V, I <sub>C</sub> = 24A
I <sub>CES</sub>	Zero Gate Voltage Collector Current	—	—	250	μA	V <sub>GE</sub> = 0V, V <sub>CE</sub> = 600V
		—	—	3500		V <sub>GE</sub> = 0V, V <sub>CE</sub> = 600V, T <sub>J</sub> = 150°C
V <sub>FM</sub>	Diode Forward Voltage Drop	—	1.3	1.7	V	I <sub>C</sub> = 15A
		—	1.2	1.6		I <sub>C</sub> = 15A, T <sub>J</sub> = 150°C
I <sub>GES</sub>	Gate-to-Emitter Leakage Current	—	—	±100	nA	V <sub>GE</sub> = ±20V

## Switching Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions	
Q <sub>g</sub>	Total Gate Charge (turn-on)	—	59	80	nC	I <sub>C</sub> = 24A V <sub>CC</sub> = 400V	
Q <sub>ge</sub>	Gate - Emitter Charge (turn-on)	—	8.6	10			
Q <sub>gc</sub>	Gate - Collector Charge (turn-on)	—	25	42			
t <sub>d(on)</sub>	Turn-On Delay Time	—	26	—	ns	T <sub>J</sub> = 25°C I <sub>C</sub> = 24A, V <sub>CC</sub> = 480V V <sub>GE</sub> = 15V, R <sub>G</sub> = 10Ω Energy losses include "tail" and diode reverse recovery.	
t <sub>r</sub>	Rise Time	—	37	—			
t <sub>d(off)</sub>	Turn-Off Delay Time	—	240	410			
t <sub>f</sub>	Fall Time	—	230	420			
E <sub>on</sub>	Turn-On Switching Loss	—	0.75	—	mJ		
E <sub>off</sub>	Turn-Off Switching Loss	—	1.65	—			
E <sub>ts</sub>	Total Switching Loss	—	2.4	3.6			
t <sub>sc</sub>	Short Circuit Withstand Time	10	—	—	μs	V <sub>CC</sub> = 360V, T <sub>J</sub> = 125°C V <sub>GE</sub> = 15V, R <sub>G</sub> = 10Ω, V <sub>C<sub>PK</sub></sub> < 500V	
t <sub>d(on)</sub>	Turn-On Delay Time	—	28	—	ns	T <sub>J</sub> = 150°C, I <sub>C</sub> = 24A, V <sub>CC</sub> = 480V V <sub>GE</sub> = 15V, R <sub>G</sub> = 10Ω Energy losses include "tail" and diode reverse recovery.	
t <sub>r</sub>	Rise Time	—	37	—			
t <sub>d(off)</sub>	Turn-Off Delay Time	—	380	—			
t <sub>f</sub>	Fall Time	—	460	—			
E <sub>ts</sub>	Total Switching Loss	—	4.5	—	mJ		
L <sub>E</sub>	Internal Emitter Inductance	—	13	—	nH	Measured 5mm from package	
C <sub>ies</sub>	Input Capacitance	—	1500	—	pF	V <sub>GE</sub> = 0V V <sub>CC</sub> = 30V f = 1.0MHz	
C <sub>oes</sub>	Output Capacitance	—	190	—			
C <sub>res</sub>	Reverse Transfer Capacitance	—	20	—			
t <sub>rr</sub>	Diode Reverse Recovery Time	—	42	60	ns	T <sub>J</sub> = 25°C	I <sub>F</sub> = 15A  V <sub>R</sub> = 200V  di/dt = 200A/μs
		—	74	120		T <sub>J</sub> = 125°C	
I <sub>rr</sub>	Diode Peak Reverse Recovery Current	—	4.0	6.0	A	T <sub>J</sub> = 25°C	
		—	6.5	10		T <sub>J</sub> = 125°C	
Q <sub>rr</sub>	Diode Reverse Recovery Charge	—	80	180	nC	T <sub>J</sub> = 25°C	
		—	220	600		T <sub>J</sub> = 125°C	
di <sub>(rec)</sub> /dt	Diode Peak Rate of Fall of Recovery During t <sub>b</sub>	—	188	—	A/μs	T <sub>J</sub> = 25°C	
		—	160	—		T <sub>J</sub> = 125°C	

Notes: ① Repetitive rating; V<sub>GE</sub>=20V, pulse width limited by max. junction temperature. ② V<sub>CC</sub>=80%(V<sub>CES</sub>), V<sub>GE</sub>=20V, L=10μH, R<sub>G</sub>= 10Ω. ④ Pulse width 5.0μs, single shot.

Refer to Section D for the following: ③ Pulse width ≤ 80μs; duty factor ≤ 0.1%.

Package Outline 3 - JEDEC Outline TO-247AC

Section D - page D-13



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