

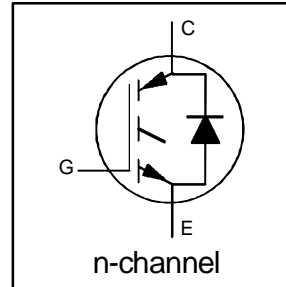
## IRGPH40MD2

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)



$$V_{CES} = 1200V$$

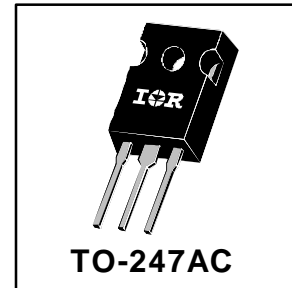
$$V_{CE(sat)} \leq 3.4V$$

@ $V_{GE} = 15V, I_C = 18A$

### 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	1200	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	31	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	18	
$I_{CM}$	Pulsed Collector Current ①	62	
$I_{LM}$	Clamped Inductive Load Current ②	62	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	8.0	
$I_{FM}$	Diode Maximum Forward Current	62	
$t_{sc}$	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	$^\circ C$
$T_{STG}$	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	$^\circ C/W$
$R_{\theta JC}$	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)

# IRGPH40MD2



## 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 ②	1200	—	—	V	V <sub>GE</sub> = 0V, I <sub>C</sub> = 250μA
ΔV <sub>(BR)CES</sub> /ΔT <sub>J</sub>	Temp. Coeff. of Breakdown Voltage	—	1.1	—	V/°C	V <sub>GE</sub> = 0V, I <sub>C</sub> = 1.0mA
V <sub>CE(on)</sub>	Collector-to-Emitter Saturation Voltage	—	2.3	3.4	V	I <sub>C</sub> = 18A V <sub>GE</sub> = 15V
		—	3.0	—		I <sub>C</sub> = 31A
		—	2.8	—		I <sub>C</sub> = 18A, 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)</sub> /ΔT <sub>J</sub>	Temp. Coeff. of Threshold Voltage	—	-14	—	mV/°C	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250μA
g <sub>fe</sub>	Forward Transconductance ④	4.0	10	—	S	V <sub>CE</sub> = 100V, I <sub>C</sub> = 18A
I <sub>CES</sub>	Zero Gate Voltage Collector Current	—	—	250	μA	V <sub>GE</sub> = 0V, V <sub>CE</sub> = 1200V
		—	—	3500		V <sub>GE</sub> = 0V, V <sub>CE</sub> = 1200V, T <sub>J</sub> = 150°C
V <sub>FM</sub>	Diode Forward Voltage Drop	—	2.6	3.3	V	I <sub>C</sub> = 8A
		—	2.3	3.0		I <sub>C</sub> = 8A, 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)	—	50	75	nC	I <sub>C</sub> = 18A V <sub>CC</sub> = 400V	
Q <sub>ge</sub>	Gate - Emitter Charge (turn-on)	—	11	21			
Q <sub>gc</sub>	Gate - Collector Charge (turn-on)	—	15	30			
t <sub>d(on)</sub>	Turn-On Delay Time	—	67	—	ns	T <sub>J</sub> = 25°C I <sub>C</sub> = 18A, V <sub>CC</sub> = 800V V <sub>GE</sub> = 15V, R <sub>G</sub> = 10Ω Energy losses include "tail" and diode reverse recovery.	
t <sub>r</sub>	Rise Time	—	89	—			
t <sub>d(off)</sub>	Turn-Off Delay Time	—	340	930			
t <sub>f</sub>	Fall Time	—	510	930			
E <sub>on</sub>	Turn-On Switching Loss	—	2.1	—			
E <sub>off</sub>	Turn-Off Switching Loss	—	5.9	—	mJ		
E <sub>ts</sub>	Total Switching Loss	—	8.0	13			
t <sub>sc</sub>	Short Circuit Withstand Time	10	—	—	μs	V <sub>CC</sub> = 720V, T <sub>J</sub> = 125°C V <sub>GE</sub> = 15V, R <sub>G</sub> = 10Ω, V <sub>CPK</sub> < 1000V	
t <sub>d(on)</sub>	Turn-On Delay Time	—	64	—	ns	T <sub>J</sub> = 150°C, I <sub>C</sub> = 18A, V <sub>CC</sub> = 800V V <sub>GE</sub> = 15V, R <sub>G</sub> = 10Ω Energy losses include "tail" and diode reverse recovery.	
t <sub>r</sub>	Rise Time	—	74	—			
t <sub>d(off)</sub>	Turn-Off Delay Time	—	550	—			
t <sub>f</sub>	Fall Time	—	1200	—			
E <sub>ts</sub>	Total Switching Loss	—	16	—			
L <sub>E</sub>	Internal Emitter Inductance	—	13	—	nH	Measured 5mm from package	
C <sub>ies</sub>	Input Capacitance	—	1400	—	pF	V <sub>GE</sub> = 0V V <sub>CC</sub> = 30V f = 1.0MHz	
C <sub>oes</sub>	Output Capacitance	—	100	—			
C <sub>res</sub>	Reverse Transfer Capacitance	—	15	—			
t <sub>rr</sub>	Diode Reverse Recovery Time	—	63	95	ns	T <sub>J</sub> = 25°C	I <sub>F</sub> = 8A
		—	106	160		T <sub>J</sub> = 125°C	
I <sub>rr</sub>	Diode Peak Reverse Recovery Current	—	4.5	8.0	A	T <sub>J</sub> = 25°C	V <sub>R</sub> = 200V
		—	6.2	11		T <sub>J</sub> = 125°C	
Q <sub>rr</sub>	Diode Reverse Recovery Charge	—	140	380	nC	T <sub>J</sub> = 25°C	di/dt = 200A/μs
		—	335	880		T <sub>J</sub> = 125°C	
di <sub>(rec)</sub> M/dt	Diode Peak Rate of Fall of Recovery During t <sub>b</sub>	—	133	—	A/μs	T <sub>J</sub> = 25°C	
		—	85	—		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.

③ Pulse width ≤ 80μs; duty factor ≤ 0.1%.

Refer to Section D - page D-13 for Package Outline 3 - JEDEC Outline TO-247AC



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