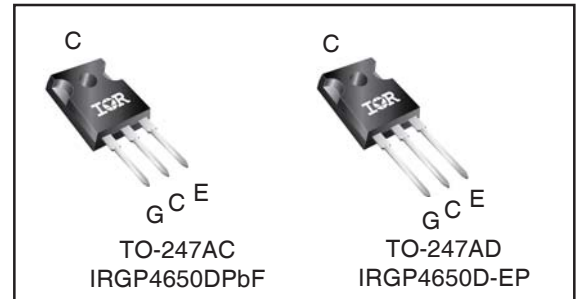
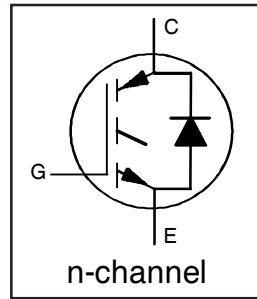


INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

$V_{CES} = 600V$
$I_C = 50A, T_C = 100^\circ C$
$t_{SC} \geq 5\mu s, T_{J(max)} = 175^\circ C$
$V_{CE(on)} \text{ typ.} = 1.60V @ I_C = 35A$



G	C	E
Gate	Collector	Emitter

Applications

- Industrial Motor Drive
- Inverters
- UPS
- Welding

Features	Benefits
Low $V_{CE(ON)}$ and Switching Losses	High efficiency in a wide range of applications and switching frequencies
Square RBSOA and Maximum Junction Temperature 175°C	Improved reliability due to rugged hard switching performance and higher power capability
Positive $V_{CE(ON)}$ Temperature Coefficient	Excellent current sharing in parallel operation
5 μs short circuit SOA	Enables short circuit protection scheme
Lead-Free, RoHS compliant	Environmentally friendly

Base part number	Package Type	Standard Pack		Orderable part number
		Form	Quantity	
IRGP4650DPbF	TO-247AC	Tube	25	IRGP4650DPbF
IRGP4650D-EPbF	TO-247AD	Tube	25	IRGP4650D-EPbF

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	76	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	50	
I_{CM}	Pulse Collector Current, $V_{GE} = 15V$	105	
I_{LM}	Clamped Inductive Load Current, $V_{GE} = 20V$ ①	140	
$I_F @ T_C = 25^\circ C$	Diode Continuous Forward Current	76	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	50	V
I_{FM}	Diode Maximum Forward Current ④	140	
V_{GE}	Continuous Gate-to-Emitter Voltage	± 20	
	Transient Gate-to-Emitter Voltage	± 30	W
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	268	
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	134	
T_J	Operating Junction and	-55 to +175	°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
$R_{\theta JC}$ (IGBT)	Junction-to-Case (IGBT) ②	—	—	0.56	°C/W
$R_{\theta JC}$ (Diode)	Junction-to-Case (Diode) ②	—	—	1.0	
$R_{\theta CS}$	Case-to-Sink (flat, greased surface)	—	0.24	—	
$R_{\theta JA}$	Junction-to-Ambient (typical socket mount)	—	—	40	

Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
V _{(BR)CES}	Collector-to-Emitter Breakdown Voltage	600	—	—	V	V _{GE} = 0V, I _C = 100μA ③
ΔV _{(BR)CES} /ΔT _J	Temperature Coeff. of Breakdown Voltage	—	1.3	—	mV/°C	V _{GE} = 0V, I _C = 1mA (25°C-175°C)
V _{CE(on)}	Collector-to-Emitter Saturation Voltage	—	1.60	1.90	V	I _C = 35A, V _{GE} = 15V, T _J = 25°C
		—	1.90	—		I _C = 35A, V _{GE} = 15V, T _J = 150°C
		—	2.00	—		I _C = 35A, V _{GE} = 15V, T _J = 175°C
V _{GE(th)}	Gate Threshold Voltage	4.0	—	6.5	V	V _{CE} = V _{GE} , I _C = 1.0mA
ΔV _{GE(th)} /ΔT _J	Threshold Voltage temp. coefficient	—	-18	—	mV/°C	V _{CE} = V _{GE} , I _C = 1.0mA (25°C - 175°C)
g _f e	Forward Transconductance	—	25	—	S	V _{CE} = 50V, I _C = 35A, PW = 60μs
I _{CES}	Collector-to-Emitter Leakage Current	—	1.0	70	μA	V _{GE} = 0V, V _{CE} = 600V
		—	770	—		V _{GE} = 0V, V _{CE} = 600V, T _J = 175°C
V _{FM}	Diode Forward Voltage Drop	—	2.0	3.0	V	I _F = 35A
		—	1.4	—		I _F = 35A, T _J = 175°C
I _{GES}	Gate-to-Emitter Leakage Current	—	—	±100	nA	V _{GE} = ±20V

Switching Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions		
Q _g	Total Gate Charge (turn-on)	—	69	104	nC	I _C = 35A V _{GE} = 15V V _{CC} = 400V		
Q _{ge}	Gate-to-Emitter Charge (turn-on)	—	18	27				
Q _{gc}	Gate-to-Collector Charge (turn-on)	—	29	44				
E _{on}	Turn-On Switching Loss	—	390	508	μJ	I _C = 35A, V _{CC} = 400V, V _{GE} = 15V R _G = 10Ω, L = 200μH, L _S = 150nH, T _J = 25°C Energy losses include tail & diode reverse recovery ⑤		
E _{off}	Turn-Off Switching Loss	—	632	753				
E _{total}	Total Switching Loss	—	1022	1261				
t _{d(on)}	Turn-On delay time	—	46	56	ns	I _C = 35A, V _{CC} = 400V, V _{GE} = 15V R _G = 10Ω, L = 200μH, L _S = 150nH, T _J = 25°C		
t _r	Rise time	—	33	42				
t _{d(off)}	Turn-Off delay time	—	105	117				
t _f	Fall time	—	44	54				
E _{on}	Turn-On Switching Loss	—	1013	—			μJ	I _C = 35A, V _{CC} = 400V, V _{GE} = 15V R _G = 10Ω, L = 200μH, L _S = 150nH, T _J = 175°C Energy losses include tail & diode reverse recovery ⑤
E _{off}	Turn-Off Switching Loss	—	929	—				
E _{total}	Total Switching Loss	—	1942	—				
t _{d(on)}	Turn-On delay time	—	43	—	ns	I _C = 35A, V _{CC} = 400V, V _{GE} = 15V R _G = 10Ω, L = 200μH, L _S = 150nH T _J = 175°C		
t _r	Rise time	—	35	—				
t _{d(off)}	Turn-Off delay time	—	127	—				
t _f	Fall time	—	61	—				
C _{ies}	Input Capacitance	—	2113	—	pF	V _{GE} = 0V V _{CC} = 30V f = 1.0Mhz		
C _{oes}	Output Capacitance	—	197	—				
C _{res}	Reverse Transfer Capacitance	—	65	—				
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T _J = 175°C, I _C = 140A V _{CC} = 480V, V _p ≤ 600V R _G = 10Ω, V _{GE} = +20V to 0V		
SCSOA	Short Circuit Safe Operating Area	5	—	—	μs	V _{CC} = 400V, V _p ≤ 600V R _G = 10Ω, V _{GE} = +15V to 0V		
E _{rec}	Reverse Recovery Energy of the Diode	—	304	—	μJ	T _J = 175°C		
t _{rr}	Diode Reverse Recovery Time	—	120	—	ns	V _{CC} = 400V, I _F = 35A		
I _{rr}	Peak Reverse Recovery Current	—	25	—	A	V _{GE} = 15V, R _G = 10Ω, L = 210μH, L _S = 150nH		

Notes:

- ① V_{CC} = 80% (V_{CES}), V_{GE} = 20V, L = 19μH, R_G = 10Ω.
- ② R_θ is measured at T_J of approximately 90°C.
- ③ Refer to AN-1086 for guidelines for measuring V_{(BR)CES} safely.
- ④ Pulse width limited by max. junction temperature.
- ⑤ Values influenced by parasitic L and C in measurement.