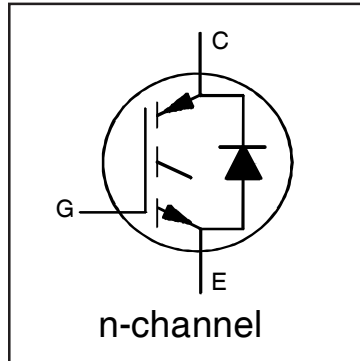


IRGP4069DPbF IRGP4069D-EPbF

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

Features

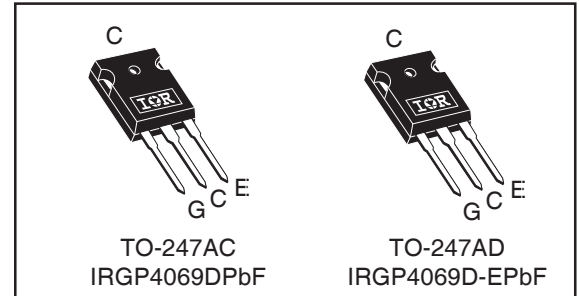
- Low $V_{CE(ON)}$ Trench IGBT Technology
- Low Switching Losses
- Maximum Junction Temperature 175 °C
- 5 μ S short circuit SOA
- Square RBSOA
- 100% of The Parts Tested for I_{LM}
- Positive $V_{CE(ON)}$ Temperature Coefficient
- Tight Parameter Distribution
- Lead Free Package



$V_{CES} = 600V$
$I_{C(Nominal)} = 35A$
$t_{SC} \geq 5\mu s, T_{J(max)} = 175^{\circ}C$
$V_{CE(on)} \text{ typ.} = 1.6V$

Benefits

- High Efficiency in a Wide Range of Applications
- Suitable for a Wide Range of Switching Frequencies due to Low $V_{CE(ON)}$ and Low Switching Losses
- Rugged Transient Performance for Increased Reliability
- Excellent Current Sharing in Parallel Operation



G	C	E
Gate	Collector	Emitter

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	
$I_{NOMINAL}$	Nominal Current	35	
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 ②	140	
V_{GE}	Continuous Gate-to-Emitter Voltage	± 20	
	Transient Gate-to-Emitter Voltage	± 30	
$P_D @ T_C = 25^{\circ}C$	Maximum Power Dissipation	268	W
$P_D @ T_C = 100^{\circ}C$	Maximum Power Dissipation	134	
T_J	Operating Junction and	-55 to +175	$^{\circ}C$
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 sec.		
	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)	Thermal Resistance Junction-to-Case-(each IGBT) ④	—	—	0.56	$^{\circ}C/W$
$R_{\theta JC}$ (Diode)	Thermal Resistance Junction-to-Case-(each Diode) ④	—	—	1.0	
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink (flat, greased surface)	—	0.24	—	
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (typical socket mount)	—	—	40	

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	600	—	—	V	$V_{GE} = 0V, I_C = 100\mu\text{A}$ ③
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	1.3	—	mV/°C	$V_{GE} = 0V, I_C = 1\text{mA}$ (25°C-175°C)
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.6	1.85	V	$I_C = 35A, V_{GE} = 15V, T_J = 25^\circ\text{C}$ ②
		—	1.9	—		$I_C = 35A, V_{GE} = 15V, T_J = 150^\circ\text{C}$ ②
		—	2.0	—		$I_C = 35A, V_{GE} = 15V, T_J = 175^\circ\text{C}$ ②
$V_{GE(th)}$	Gate Threshold Voltage	4.0	—	6.5	V	$V_{CE} = V_{GE}, I_C = 1.0\text{mA}$
$\Delta V_{GE(th)}/\Delta T_J$	Threshold Voltage temp. coefficient	—	-18	—	mV/°C	$V_{CE} = V_{GE}, I_C = 1.0\text{mA}$ (25°C - 175°C)
g_{fe}	Forward Transconductance	—	25	—	S	$V_{CE} = 50V, I_C = 35A, PW = 60\mu\text{s}$
I_{CES}	Collector-to-Emitter Leakage Current	—	1.0	70	μA	$V_{GE} = 0V, V_{CE} = 600V$
		—	770	—		$V_{GE} = 0V, V_{CE} = 600V, T_J = 175^\circ\text{C}$
V_{FM}	Diode Forward Voltage Drop	—	2.2	3.8	V	$I_F = 35A$
		—	1.4	—		$I_F = 35A, T_J = 175^\circ\text{C}$
I_{GES}	Gate-to-Emitter Leakage Current	—	—	± 100	nA	$V_{GE} = \pm 20V$

Switching Characteristics @ $T_J = 25^\circ\text{C}$ (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	$I_C = 35A, V_{CC} = 400V, V_{GE} = 15V$ $R_G = 10\Omega, L = 200\mu\text{H}, L_S = 150\text{nH}, T_J = 25^\circ\text{C}$ Energy losses include tail & diode reverse recovery
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	$I_C = 35A, V_{CC} = 400V, V_{GE} = 15V$ $R_G = 10\Omega, L = 200\mu\text{H}, L_S = 150\text{nH}, T_J = 25^\circ\text{C}$
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	—		
E_{off}	Turn-Off Switching Loss	—	929	—		
E_{total}	Total Switching Loss	—	1942	—		
$t_{d(on)}$	Turn-On delay time	—	43	—	ns	$I_C = 35A, V_{CC} = 400V, V_{GE} = 15V$ $R_G = 10\Omega, L = 200\mu\text{H}, L_S = 150\text{nH}$ $T_J = 175^\circ\text{C}$
t_r	Rise time	—	35	—		
$t_{d(off)}$	Turn-Off delay time	—	127	—		
t_f	Fall time	—	61	—		
C_{ies}	Input Capacitance	—	2113	—	pF	$V_{GE} = 0V$ $V_{CC} = 30V$ $f = 1.0\text{MHz}$
C_{oes}	Output Capacitance	—	197	—		
C_{res}	Reverse Transfer Capacitance	—	65	—		
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				$T_J = 175^\circ\text{C}, I_C = 140A$ $V_{CC} = 480V, V_p = 600V$ $R_g = 10\Omega, V_{GE} = +20V \text{ to } 0V$
SCSOA	Short Circuit Safe Operating Area	5	—	—	μs	$V_{CC} = 400V, V_p = 600V$ $R_g = 10\Omega, V_{GE} = +15V \text{ to } 0V$
E_{rec}	Reverse Recovery Energy of the Diode	—	304	—	μJ	$T_J = 175^\circ\text{C}$
t_{rr}	Diode Reverse Recovery Time	—	120	—	ns	$V_{CC} = 400V, I_F = 35A$
I_{rr}	Peak Reverse Recovery Current	—	25	—	A	$V_{GE} = 15V, R_g = 10\Omega, L = 210\mu\text{H}, L_s = 150\text{nH}$

Notes:

- $V_{CC} = 80\% (V_{CES}), V_{GE} = 20V, L = 19\mu\text{H}, R_G = 10\Omega.$
- Pulse width limited by max. junction temperature.
- Refer to AN-1086 for guidelines for measuring $V_{(BR)CES}$ safely.
- R_θ is measured at T_J of approximately $90^\circ\text{C}.$