2 IGBT,Inverter

2.1 Maximum Rated Values

Parameter	Conditions	Symbol	Value	Unit
Collector-emitter voltage	T_{vj} = 25°C	V_{CES}	750	V
Implemented collector current		I_{CN}	450	A
Continuous DC collector current	T_C = 120°C, $T_{vj\,max}$ = 175°C	$I_{C\,nom}$	300	A
Repetitive peak collector current	t_P = 1 ms	I_{CRM}	900	A
Total power dissipation	T_C = 25°C, $T_{vj\,max}$ = 175°C	P_{tot}	1667	W
Gate-emitter peak voltage		V_{GES}	+/-20	V

2.2 Characteristic Values

Parameter	Conditions		Symbol	min.	typ.	max.	Unit
Collector-emitter saturation voltage	I_C = 300 A, V_{GE} = 15 V I_C = 300 A, V_{GE} = 15 V I_C = 300 A, V_{GE} = 15 V	T_{vj} = 25°C T_{vj} = 150°C T_{vj} = 175°C	$V_{CE\,sat}$		1.20 1.27 1.29	1.44	V
Gate threshold voltage	I_C = 4.85 mA, V_{CE} = V_{GE}	T_{vj} = 25°C	V_{GEth}	4.90	5.80	6.50	V
Gate charge	V_{GE} = -8 V ... 15 V, V_{CE} = 400V		Q_G		2.15		µC
Internal gate resistor		T_{vj} = 25°C	R_{Gint}		2.0		Ω
Input capacitance	f = 1 MHz, V_{CE} = 25 V, V_{GE} = 0 V	T_{vj} = 25°C	C_{ies}		38.5		nF
Reverse transfer capacitance	f = 1 MHz, V_{CE} = 25 V, V_{GE} = 0 V	T_{vj} = 25°C	C_{res}		0.18		nF
Collector-emitter cut-off current	V_{CE} = 450 V, V_{GE} = 0 V	T_{vj} = 25°C	I_{CES}			0.1	mA
Gate-emitter leakage current	V_{CE} = 0 V, V_{GE} = 20 V	T_{vj} = 25°C	I_{GES}			400	nA
Turn-on delay time, inductive load	I_C = 300 A, V_{CE} = 400 V V_{GE} = -8/+15 V R_{Gon} = 3.6 Ω	T_{vj} = 25°C T_{vj} = 150°C T_{vj} = 175°C	$t_{d\,on}$		0.34 0.36 0.36		µs
Rise time, inductive load	I_C = 300 A, V_{CE} = 400 V V_{GE} = -8/+15 V R_{Gon} = 3.6 Ω	T_{vj} = 25°C T_{vj} = 150°C T_{vj} = 175°C	t_r		0.06 0.07 0.07		µs
Turn-off delay time, inductive load	I_C = 300 A, V_{CE} = 400 V V_{GE} = -8/+15 V R_{Goff} = 2.4 Ω	T_{vj} = 25°C T_{vj} = 150°C T_{vj} = 175°C	$t_{d\,off}$		0.48 0.54 0.56		µs
Fall time, inductive load	I_C = 300 A, V_{CE} = 400 V V_{GE} = -8/+15 V R_{Goff} = 2.4 Ω	T_{vj} = 25°C T_{vj} = 150°C T_{vj} = 175°C	t_f		0.07 0.12 0.13		µs
Turn-on energy loss per pulse	I_C = 300 A, V_{CE} = 400 V, L_S = 25 nH V_{GE} = -8/+15 V, di/dt = 3400 A/µs (T_{vj} = 175°C) R_{Gon} = 3.6 Ω	T_{vj} = 25°C T_{vj} = 150°C T_{vj} = 175°C	E_{on}		11.5 13.5 14.5		mJ
Turn-off energy loss per pulse	I_C = 300 A, V_{CE} = 400 V, L_S = 25 nH V_{GE} = -8/+15 V, du/dt = 3200 V/µs (T_{vj} = 175°C) R_{Goff} = 2.4 Ω	T_{vj} = 25°C T_{vj} = 150°C T_{vj} = 175°C	E_{off}		12.0 15.5 17.0		mJ
SC data	V_{GE} ≤ 15 V, V_{CC} = 400 V V_{CEmax} = V_{CES} -L_{sCE} ·di/dt	t_P ≤ 3 µs, T_{vj} = 175°C	I_{SC}		2000		A
Thermal resistance, junction to case	per IGBT		R_{thJC}			0.090[1)]	K/W
Thermal resistance, case to heatsink	per IGBT λ_{Paste} = 1 W/(m·K) / λ_{grease} = 1 W/(m·K) Clamping Force F = 700N		R_{thCH}		0.100[1)]		K/W
Temperature under switching conditions	t_{op} continuous for 10s within a period of 30s, occurrence maximum 3000 times over lifetime		$T_{vj\,op}$	-40 150		150 175	°C

[1)] with double sided cooling, evaluation according to HybridPACK cool application note

3 Diode, Inverter

3.1 Maximum Rated Values

Parameter	Conditions	Symbol	Value	Unit
Repetitive peak reverse voltage	T_{vj} = 25°C	V_{RRM}	750	V
Implemented forward current		I_{FN}	450	A
Continuous DC forward current		I_F	300	A
Repetitive peak forward current	t_P = 1 ms	I_{FRM}	900	A
I²t - value	V_R = 0 V, t_P = 10 ms, T_{vj} = 150°C	I²t	8500	A²s

3.2 Characteristic Values

Parameter	Conditions		Symbol	min.	typ.	max.	Unit
Forward voltage	I_F = 300 A, V_{GE} = 0 V I_F = 300 A, V_{GE} = 0 V I_F = 300 A, V_{GE} = 0 V	T_{vj} = 25°C T_{vj} = 150°C T_{vj} = 175°C	V_F		1.55 1.45 1.40	1.83	V
Peak reverse recovery current	I_F = 300 A, - di_F/dt = 3400 A/µs (T_{vj} = 175°C) V_R = 400 V V_{GE} = -8 V	T_{vj} = 25°C T_{vj} = 150°C T_{vj} = 175°C	I_{RM}		170 235 250		A
Recovered charge	I_F = 300 A, - di_F/dt = 3400 A/µs (T_{vj} = 175°C) V_R = 400 V V_{GE} = -8 V	T_{vj} = 25°C T_{vj} = 150°C T_{vj} = 175°C	Q_r		12.0 26.0 31.0		µC
Reverse recovery energy	I_F = 300 A, - di_F/dt = 3400 A/µs (T_{vj} = 175°C) V_R = 400 V V_{GE} = -8 V	T_{vj} = 25°C T_{vj} = 150°C T_{vj} = 175°C	E_{rec}		2.90 6.60 8.00		mJ
Thermal resistance, junction to case	per diode		R_{thJC}			0.145[1]	K/W
Thermal resistance, case to heatsink	per diode λ_{Paste} = 1 W/(m·K) / λ_{grease} = 1 W/(m·K) Clamping Force F = 700N		R_{thCH}		0.140[1]		K/W
Temperature under switching conditions	t_{op} continuous for 10s within a period of 30s, occurrence maximum 3000 times over lifetime		$T_{vj\ op}$	-40 150		150 175	°C

4 Module

Parameter	Conditions	Symbol	Value	Unit
Isolation test voltage	RMS, f = 50 Hz, t = 1 min.	V_{ISOL}	2.5	kV
Material of module baseplate			Cu	
Internal isolation	basic insulation (class 1, IEC 61140)		Al_2O_3	
Creepage distance	terminal to heatsink terminal to terminal	d_{Creep}	3.5	mm
Clearance	terminal to heatsink terminal to terminal	d_{Clear}	3.5	mm
Comperative tracking index		CTI	> 600	

Parameter	Conditions	Symbol	min.	typ.	max.	Unit
Stray inductance module		L_{sCE}		15		nH
Storage temperature		T_{stg}	-40		125	°C
Terminal connection torque	Screw M5	M		-		Nm
Mounting force per clamp		F		-	750	N
Weight		G		31		g

5 Temperature Sensor

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Forward voltage	I_{TS} = 0.22 mA, T_{vj} = 25°C	V_{TS}	2.220[2]	2.280	2.340[2]	V
temperature coefficient (tcr)	I_{TS} = 0.22 mA	TC_{TS}		-5.50		mV/K

[1] with double sided cooling, evaluation according to HybridPACK cool application note
[2] Verified by design, not by test