# 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 | | $I_{CN}$ | 660 | A |
| Continuous DC collector current | $T_C$ = 80°C, $T_{vj\,max}$ = 175°C | $I_{C\,nom}$ | 450[1] | A |
| Repetitive peak collector current | $t_P$ = 1 ms | $I_{CRM}$ | 1320 | A |
| Total power dissipation | $T_C$ = 75°C, $T_{vj\,max}$ = 175°C | $P_{tot}$ | 1053[1] | W |
| Gate-emitter peak voltage | | $V_{GES}$ | +/-20 | V |

## 2.2 Characteristic Values

| | | | | min. | typ. | max. | |
|---|---|---|---|---|---|---|---|
| Collector-emitter saturation voltage | $I_C$ = 450 A, $V_{GE}$ = 15 V<br>$I_C$ = 450 A, $V_{GE}$ = 15 V<br>$I_C$ = 450 A, $V_{GE}$ = 15 V<br><br>$I_C$ = 660 A, $V_{GE}$ = 15 V<br>$I_C$ = 660 A, $V_{GE}$ = 15 V | $T_{vj}$ = 25°C<br>$T_{vj}$ = 150°C<br>$T_{vj}$ = 175°C<br><br>$T_{vj}$ = 25°C<br>$T_{vj}$ = 175°C | $V_{CE\,sat}$ | | 1.10<br>1.15<br>1.15<br><br>1.25<br>1.35 | 1.35 | V |
| Gate threshold voltage | $I_C$ = 9.60 mA, $V_{CE}$ = $V_{GE}$ | $T_{vj}$ = 25°C<br>$T_{vj}$ = 175°C | $V_{GEth}$ | 4.90 | 5.80<br>4,10 | 6.50 | V |
| Gate charge | $V_{GE}$ = -8 V ... 15 V, $V_{CE}$ = 400V | | $Q_G$ | | 4.40 | | µC |
| Internal gate resistor | | $T_{vj}$ = 25°C | $R_{Gint}$ | | 0.7 | | Ω |
| Input capacitance | f = 1 MHz, $V_{CE}$ = 50 V, $V_{GE}$ = 0 V | $T_{vj}$ = 25°C | $C_{ies}$ | | 80.0 | | nF |
| Output capacitance | f = 1 MHz, $V_{CE}$ = 50 V, $V_{GE}$ = 0 V | $T_{vj}$ = 25°C | $C_{oes}$ | | 1.00 | | nF |
| Reverse transfer capacitance | f = 1 MHz, $V_{CE}$ = 50 V, $V_{GE}$ = 0 V | $T_{vj}$ = 25°C | $C_{res}$ | | 0.30 | | nF |
| Collector-emitter cut-off current | $V_{CE}$ = 750 V, $V_{GE}$ = 0 V<br>$V_{CE}$ = 750 V, $V_{GE}$ = 0 V | $T_{vj}$ = 25°C<br>$T_{vj}$ = 175°C | $I_{CES}$ | | 5 | 1.0 | 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 | $I_C$ = 450 A, $V_{CE}$ = 400 V<br>$V_{GE}$ = -8 V / +15 V<br>$R_{Gon}$ = 2.4 Ω | $T_{vj}$ = 25°C<br>$T_{vj}$ = 150°C<br>$T_{vj}$ = 175°C | $t_{d\,on}$ | | 0.28<br>0.29<br>0.30 | | µs |
| Rise time, inductive load | $I_C$ = 450 A, $V_{CE}$ = 400 V<br>$V_{GE}$ = -8 V / +15 V<br>$R_{Gon}$ = 2.4 Ω | $T_{vj}$ = 25°C<br>$T_{vj}$ = 150°C<br>$T_{vj}$ = 175°C | $t_r$ | | 0.07<br>0.08<br>0.08 | | µs |
| Turn-off delay time, inductive load | $I_C$ = 450 A, $V_{CE}$ = 400 V<br>$V_{GE}$ = -8 V / +15 V<br>$R_{Goff}$ = 5.1 Ω | $T_{vj}$ = 25°C<br>$T_{vj}$ = 150°C<br>$T_{vj}$ = 175°C | $t_{d\,off}$ | | 0.94<br>1.05<br>1.05 | | µs |
| Fall time, inductive load | $I_C$ = 450 A, $V_{CE}$ = 400 V<br>$V_{GE}$ = -8 V / +15 V<br>$R_{Goff}$ = 5.1 Ω | $T_{vj}$ = 25°C<br>$T_{vj}$ = 150°C<br>$T_{vj}$ = 175°C | $t_f$ | | 0.04<br>0.05<br>0.06 | | µs |
| Turn-on energy loss per pulse | $I_C$ = 450 A, $V_{CE}$ = 400 V, $L_S$ = 20 nH<br>$V_{GE}$ = -8 V / +15 V<br>$R_{Gon}$ = 2.4 Ω<br>di/dt ($T_{vj}$ 25°C) = 5500 A/µs<br>di/dt ($T_{vj}$ 150°C) = 5000 A/µs | $T_{vj}$ = 25°C<br>$T_{vj}$ = 150°C<br>$T_{vj}$ = 175°C | $E_{on}$ | | 13.5<br>17.5<br>18.0 | | mJ |
| Turn-off energy loss per pulse | $I_C$ = 450 A, $V_{CE}$ = 400 V, $L_S$ = 20 nH<br>$V_{GE}$ = -8 V / +15 V<br>$R_{Goff}$ = 5.1 Ω<br>dv/dt ($T_{vj}$ 25°C) = 3100 V/µs<br>dv/dt ($T_{vj}$ 150°C) = 2500 V/µs | $T_{vj}$ = 25°C<br>$T_{vj}$ = 150°C<br>$T_{vj}$ = 175°C | $E_{off}$ | | 23.5<br>29.0<br>30.0 | | mJ |
| SC data | $V_{GE}$ ≤ 15 V, $V_{CC}$ = 400 V<br>$V_{CEmax}$ = $V_{CES}$ -$L_{sCE}$ ·di/dt | $t_P$ ≤ 6 µs, $T_{vj}$ = 25°C<br>$t_P$ ≤ 3 µs, $T_{vj}$ = 175°C | $I_{SC}$ | | 4800<br>3900 | | A |
| Thermal resistance, junction to case | per IGBT | | $R_{thJC}$ | | 0.080 | 0.095 | K/W |
| Thermal resistance, case to heatsink | per IGBT<br>$\lambda_{Paste}$ = 1 W/(m·K) / $\lambda_{grease}$ = 1 W/(m·K) | | $R_{thCH}$ | | 0.050[2] | | K/W |
| Temperature under switching conditions | $t_{op}$ continuous<br>for 10s within a period of 30s, occurence maximum 3000 times over lifetime | | $T_{vj\,op}$ | -40<br>150 | | 150[3]<br>175 | °C |

[1] Verified by characterization / design not by test.
[2] cooler alpha = 1500 W/(m²K); RthHF_typ = 0,06 K/W
[3] For Tvjop > 150°C: Baseplate temperature has to be limited to 125°C.

# 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 | | $I_{FN}$ | 660 | A |
| Continuous DC forward current | | $I_F$ | 450[1)] | A |
| Repetitive peak forward current | $t_P$ = 1 ms | $I_{FRM}$ | 1320 | A |
| $I^2t$ - value | $V_R$ = 0 V, $t_P$ = 10 ms, $T_{vj}$ = 150°C<br>$V_R$ = 0 V, $t_P$ = 10 ms, $T_{vj}$ = 175°C | $I^2t$ | 19000<br>16000 | A²s<br>A²s |

## 3.2 Characteristic Values

| | | | min. | typ. | max. | |
|---|---|---|---|---|---|---|
| Forward voltage | $I_F$ = 450 A, $V_{GE}$ = 0 V<br>$I_F$ = 450 A, $V_{GE}$ = 0 V<br>$I_F$ = 450 A, $V_{GE}$ = 0 V<br><br>$I_F$ = 660 A, $V_{GE}$ = 0 V<br>$I_F$ = 660 A, $V_{GE}$ = 0 V | $T_{vj}$ = 25°C<br>$T_{vj}$ = 150°C<br>$T_{vj}$ = 175°C<br><br>$T_{vj}$ = 25°C<br>$T_{vj}$ = 175°C | $V_F$ | | 1.45<br>1.30<br>1.25<br><br>1.60<br>1.45 | 1.65 | V |
| Peak reverse recovery current | $I_F$ = 450 A, - $di_F/dt$ = 5000 A/µs ($T_{vj}$ = 150°C)<br>$V_R$ = 400 V<br>$V_{GE}$ = -8 V | $T_{vj}$ = 25°C<br>$T_{vj}$ = 150°C<br>$T_{vj}$ = 175°C | $I_{RM}$ | | 250<br>350<br>370 | | A |
| Recovered charge | $I_F$ = 450 A, - $di_F/dt$ = 5000 A/µs ($T_{vj}$ = 150°C)<br>$V_R$ = 400 V<br>$V_{GE}$ = -8 V | $T_{vj}$ = 25°C<br>$T_{vj}$ = 150°C<br>$T_{vj}$ = 175°C | $Q_r$ | | 20.0<br>40.0<br>45.0 | | µC |
| Reverse recovery energy | $I_F$ = 450 A, - $di_F/dt$ = 5000 A/µs ($T_{vj}$ = 150°C)<br>$V_R$ = 400 V<br>$V_{GE}$ = -8 V | $T_{vj}$ = 25°C<br>$T_{vj}$ = 150°C<br>$T_{vj}$ = 175°C | $E_{rec}$ | | 7.00<br>13.0<br>15.0 | | mJ |
| Thermal resistance, junction to case | per diode | | $R_{thJC}$ | | 0.125 | 0.150 | K/W |
| Thermal resistance, case to heatsink | per diode<br>$\lambda_{Paste}$ = 1 W/(m·K) / $\lambda_{grease}$ = 1 W/(m·K) | | $R_{thCH}$ | | 0.050[2)] | | K/W |
| Temperature under switching conditions | $t_{op}$ continuous<br>for 10s within a period of 30s, occurence maximum 3000 times over lifetime | | $T_{vj\,op}$ | -40<br>150 | | 150[3)]<br>175 | °C |

# 4 NTC-Thermistor

| Parameter | Conditions | Symbol | min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|
| Rated resistance | $T_C$ = 25°C | $R_{25}$ | | 5.00 | | kΩ |
| Deviation of R100 | $T_C$ = 100°C, $R_{100}$ = 493 Ω | ΔR/R | 5 | | 5 | % |
| Power dissipation | $T_C$ = 25°C | $P_{25}$ | | | 20.0 | mW |
| B-value | $R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298{,}15\ K))]$ | $B_{25/50}$ | | 3375 | | K |
| B-value | $R_2 = R_{25} \exp [B_{25/80}(1/T_2 - 1/(298{,}15\ K))]$ | $B_{25/80}$ | | 3411 | | K |
| B-value | $R_2 = R_{25} \exp [B_{25/100}(1/T_2 - 1/(298{,}15\ K))]$ | $B_{25/100}$ | | 3433 | | K |

Specification according to the valid application note.

[1)] Verified by characterization / design not by test.
[2)] cooler alpha = 1500 W/(m²K); RthHF_typ = 0,06 K/W
[3)] For Tvjop > 150°C: Baseplate temperature has to be limited to 125°C.