Data Sheet, Doc. No. 5SYA 1468-02 06-2019

# 5SJA 2000L520300
# StakPak BIGT Module

- Low-loss, rugged BIGT chip
- Optimized for low switching frequency
- Smooth switching for good EMC
- High tolerance to uneven mounting pressure
- Explosion resistant package
- Remains in low impedance state for up to 1 minute after failure*

Maximum rated values [1]

| Parameter | Symbol | Conditions | min | max | Unit |
|---|---|---|---|---|---|
| Collector-emitter voltage | $V_{CES}$ | $V_{GE}$ = 0 V, $T_{vj} \geq$ 25 °C | | 5200 | V |
| DC collector current | $I_C$ | $T_C$ = 108 °C, $T_{vj}$ = 125 °C | | 2000 | A |
| Peak collector current | $I_{CM}$ | $t_p$ = 1 ms | | 4000 | A |
| Gate-emitter voltage | $V_{GES}$ | | -20 | 20 | V |
| DC forward current | $I_F$ | | | 2000 | A |
| Peak forward current | $I_{FRM}$ | $t_p$ = 1 ms | | 4000 | A |
| Surge current | $I_{FSM}$ | $V_R$ = 0 V, $T_{vj}$ = 125 °C,<br>$t_p$ = 10 ms, half-sinewave | | 28000 | A |
| IGBT short circuit SOA | $t_{psc}$ | $V_{CC}$ = 3400 V, $V_{CEM\ CHIP} \leq$ 5200 V<br>$V_{GE} \leq$ 15 V, $T_{vj\ start} \leq$ 125 °C | | 10 | µs |
| Junction temperature | $T_{vj}$ | | 5 | 150 | °C |
| Junction operating temperature | $T_{vj(op)}$ | | 5 | 125 | °C |
| Case temperature | $T_C$ | | 5 | 70 | °C |
| Storage temperature | $T_{stg}$ | | -40 | 70 | °C |
| Mounting force [2) 3)] | $F_M$ | | 40 | 60 | kN |

[1)] Maximum rated values indicate limits beyond which damage to the device may occur per IEC 60747
[2)] For detailed mounting instructions refer to ABB Document No. 5SYA 2039
[3)] All electric characteristics are valid only when the module is clamped
* Functionality is load profile dependent and needs to be agreed upon

## IGBT characteristic values [3]

| Parameter | Symbol | Conditions | | min | typ | max | Unit |
|---|---|---|---|---|---|---|---|
| Collector (-emitter) breakdown voltage | $V_{(BR)CES}$ | $V_{GE}$ = 0 V, $I_C$ = 10 mA | $T_{vj}$ = 25 °C | 5200 | | | V |
| Collector-emitter [4] saturation voltage | $V_{CE\,sat}$ | $I_C$ = 2000 A, $V_{GE}$ = 15 V | $T_{vj}$ = 25 °C | | 2.73 | | V |
| | | | $T_{vj}$ = 125 °C | | 3.14 | 3.44 | V |
| Collector cut-off current | $I_{CES}$ | $V_{CE}$ = 5200 V, $V_{GE}$ = 0 V | $T_{vj}$ = 25 °C | | | 0.2 | mA |
| | | | $T_{vj}$ = 125 °C | | 50 | 100 | mA |
| Gate leakage current | $I_{GES}$ | $V_{CE}$ = 0 V, $V_{GE}$ = ± 20 V, $T_{vj}$ = 125 °C | | -500 | | 500 | nA |
| Gate-emitter threshold voltage | $V_{GE(TO)}$ | $I_C$ = 320 mA, $V_{CE}$ = $V_{GE}$, $T_{vj}$ = 25 °C | | 5.2 | | 7.2 | V |
| Gate charge | $Q_{ge}$ | $I_C$ = 2000 A, $V_{CE}$ = 2800 V, $V_{GE}$ = -15 V ..15 V | | | 17.0 | | µC |
| Input capacitance | $C_{ies}$ | $V_{CE}$ = 25 V, $V_{GE}$ = 0 V, f = 1 MHz, $T_{vj}$ = 25 °C | | | 292 | | nF |
| Internal gate resistance | $R_{Gint}$ | | | | 0.156 | | Ω |
| Turn-on delay time | $t_{d(on)}$ | $V_{CC}$ = 2800 V, $I_C$ = 2000 A, $R_G$ = 1.8 Ω, $C_{GE}$ = 330 nF, $V_{GE}$ = ±15 V, $L_\sigma$ = 150 nH, inductive load | $T_{vj}$ = 25 °C | | 1050 | | ns |
| | | | $T_{vj}$ = 125 °C | | 880 | | ns |
| Rise time | $t_r$ | | $T_{vj}$ = 25 °C | | 440 | | ns |
| | | | $T_{vj}$ = 125 °C | | 430 | | ns |
| Turn-off delay time | $t_{d(off)}$ | $V_{CC}$ = 2800 V, $I_C$ = 2000 A, $R_G$ = 1.8 Ω, $C_{GE}$ = 330 nF, $V_{GE}$ = ±15 V, $L_\sigma$ = 150 nH, inductive load | $T_{vj}$ = 25 °C | | 2750 | | ns |
| | | | $T_{vj}$ = 125 °C | | 3040 | | ns |
| Fall time | $t_f$ | | $T_{vj}$ = 25 °C | | 800 | | ns |
| | | | $T_{vj}$ = 125 °C | | 920 | | ns |
| Turn-on switching energy | $E_{on}$ | $V_{CC}$ = 2800 V, $I_C$ = 2000 A, $R_G$ = 1.8 Ω, $C_{GE}$ = 330 nF, $V_{GE}$ = ±15 V, $L_\sigma$ = 150 nH, inductive load | $T_{vj}$ = 25 °C | | 8800 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 11100 | | mJ |
| Turn-off switching energy | $E_{off}$ | $V_{CC}$ = 2800 V, $I_C$ = 2000 A, $R_G$ = 1.8 Ω, $C_{GE}$ = 330 nF, $V_{GE}$ = ±15 V, $L_\sigma$ = 150 nH, inductive load | $T_{vj}$ = 25 °C | | 9200 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 12300 | | mJ |
| Short circuit current | $I_{SC}$ | $V_{CC}$ = 3400 V, $V_{GE}$ = 15 V | $T_{vj\,start}$ = 125 °C | | 12000 | | A |

[3] Characteristic values according to IEC 60747 – 9
[4] Collector-emitter saturation voltage is given at chip level

## Diode characteristic values [5)]

| Parameter | Symbol | Conditions | | min | typ | max | Unit |
|---|---|---|---|---|---|---|---|
| Forward voltage [6)] | $V_F$ | $I_F$ = 2000 A | $T_{vj}$ = 25 °C | | 2.29 | | V |
| | | | $T_{vj}$ = 125 °C | | 2.51 | 2.81 | V |
| Peak reverse recovery current | $I_{RM}$ | $V_{CC}$ = 2800 V, $I_F$ = 2000 A, $V_{GE}$ = ±15 V, $R_G$ = 1.8 Ω, $C_{GE}$ = 330 nF, di/dt = 4.7 kA/µs, $L_\sigma$ = 150 nH, inductive load | $T_{vj}$ = 25 °C | | 2400 | | A |
| | | | $T_{vj}$ = 125 °C | | 2800 | | A |
| Recovered charge | $Q_{rr}$ | | $T_{vj}$ = 25 °C | | 3300 | | µC |
| | | | $T_{vj}$ = 125 °C | | 5000 | | µC |
| Reverse recovery time | $t_{rr}$ | | $T_{vj}$ = 25 °C | | 2900 | | ns |
| | | | $T_{vj}$ = 125 °C | | 3300 | | ns |
| Reverse recovery energy | $E_{rec}$ | | $T_{vj}$ = 25 °C | | 5800 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 9100 | | mJ |

[5)] Characteristic values according to IEC 60747 – 2
[6)] Forward voltage is given at chip level

## Package properties [7)]

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|---|---|---|---|---|---|---|
| BIGT thermal resistance junction to case | $R_{th(j-c)BIGT}$ | | | | 3.75 | K/kW |
| BIGT thermal resistance [2)] case to heatsink | $R_{th(c-h)BIGT}$ | Heatsink flatness:<br>Complete module area: < 100µm<br>Each submodule area: < 20µm<br>Roughness: < 1.6µm | | 0.83 | | K/kW |
| Comparative tracking index | CTI | | 600 | | | |

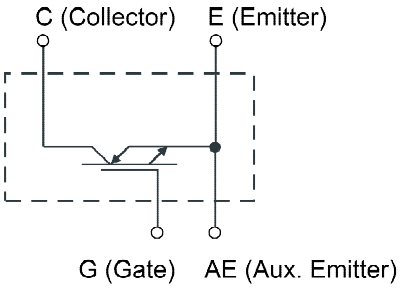
[2)] For detailed mounting instructions refer to ABB Document No. 5SYA 2037-02

## Mechanical properties [7)]

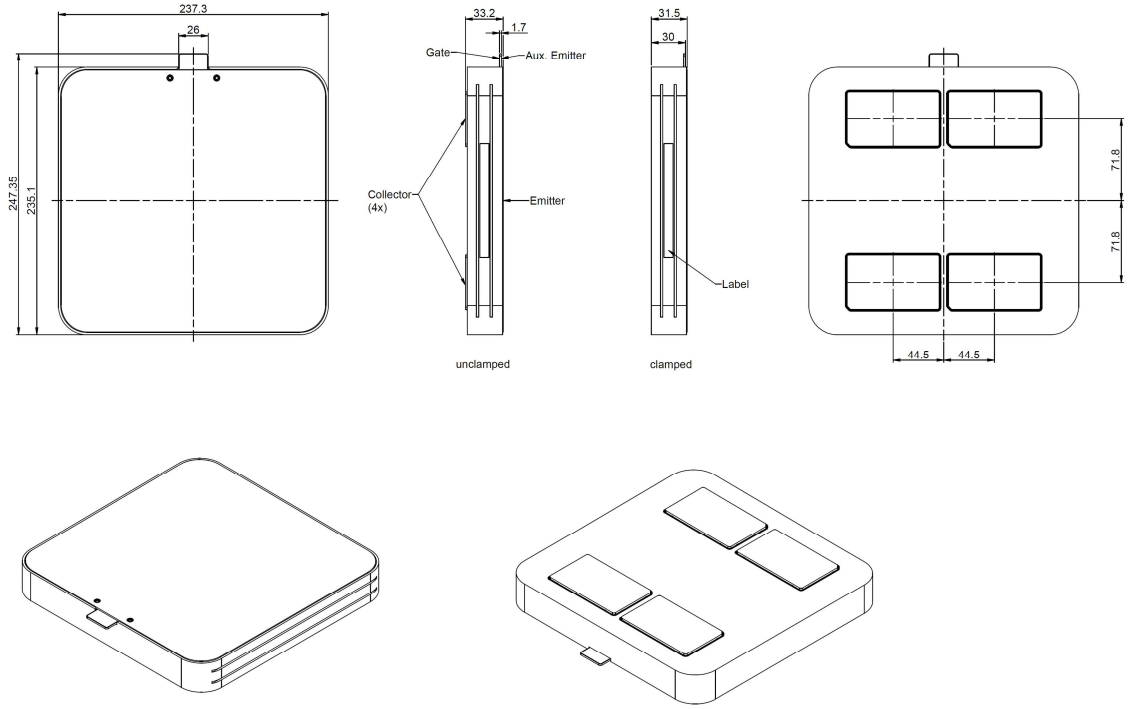
| Parameter | Symbol | Conditions | min | typ | max | Unit |
|---|---|---|---|---|---|---|
| Dimensions | L x W x H | Typical | | 247.4 x 237.3 x 31.5 | | mm |
| | | | | 247.4 x 237.3 x 33.2 | | mm |
| Clearance distance in air | $d_a$ | according to IEC 60664-1 and EN 50124-1 | 23 | | | mm |
| Surface creepage distance | $d_s$ | | 30 | | | mm |
| Mass | m | | | 3350 | | g |

[7)] Package and mechanical properties according to IEC 60747 – 15

Electrical configuration




Outline drawing (mm)






Note: This is an electrostatic sensitive device, please observe the international standard IEC 60747-1, chap. VIII. This product has been designed and qualified for Industrial Level.

Fig. 1 Typical on-state characteristics, chip level

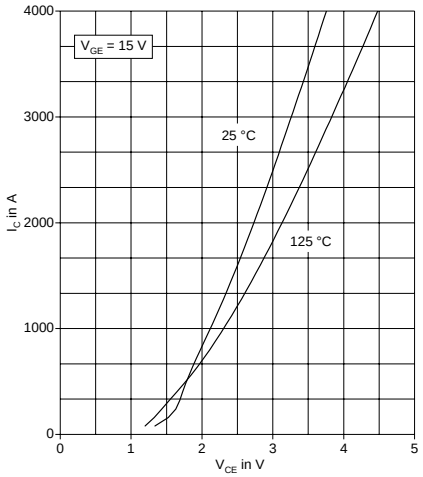



Fig. 2 Typical transfer characteristics, chip level

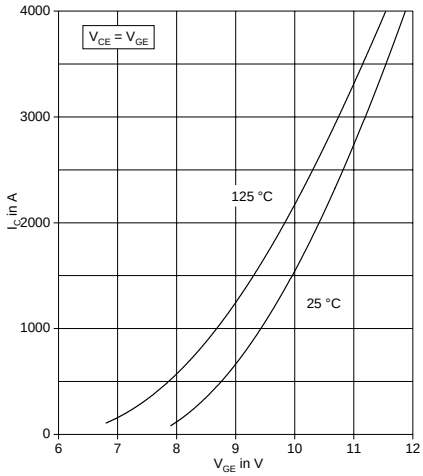



Fig. 3 Typical output characteristics, chip level

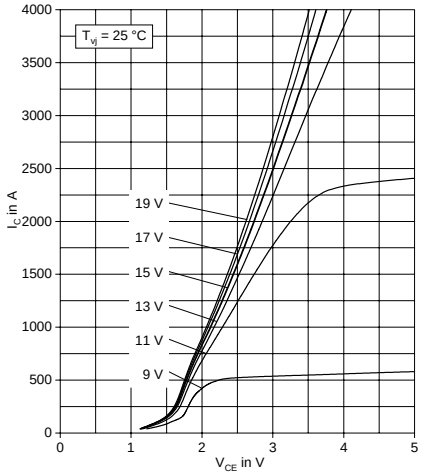



Fig. 4 Typical output characteristics, chip level

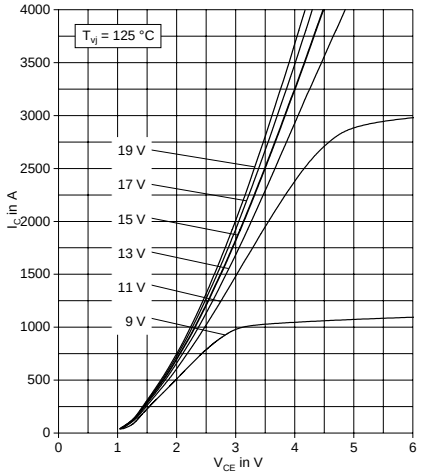



Fig. 5 Typical switching energies per pulse vs. collector current

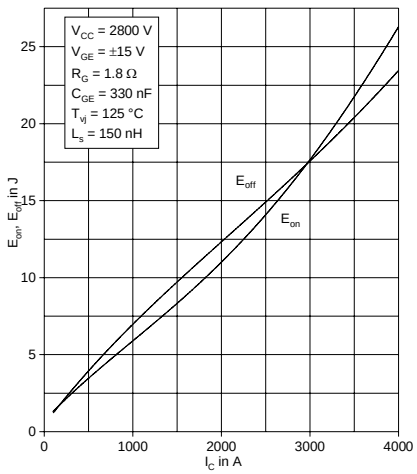



Fig. 6 Typical switching energies per pulse vs. gate resistor

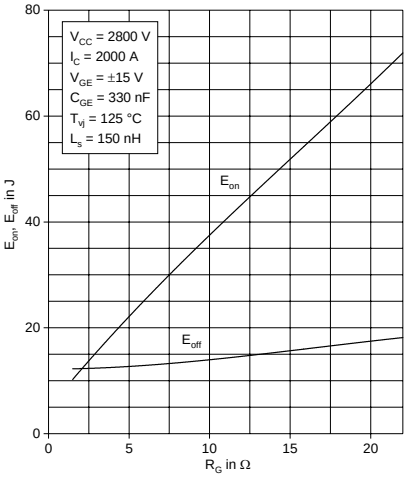


Fig. 7 Typical switching times vs. collector current

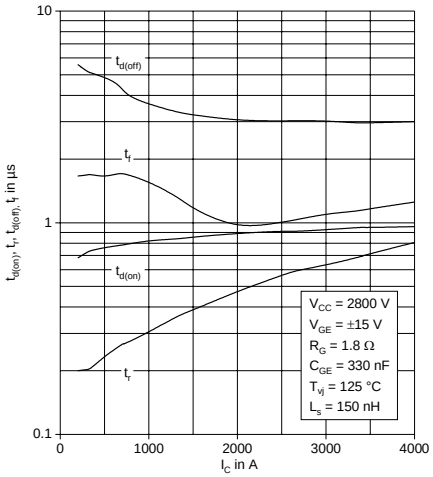



Fig. 8 Typical switching times vs. gate resistor

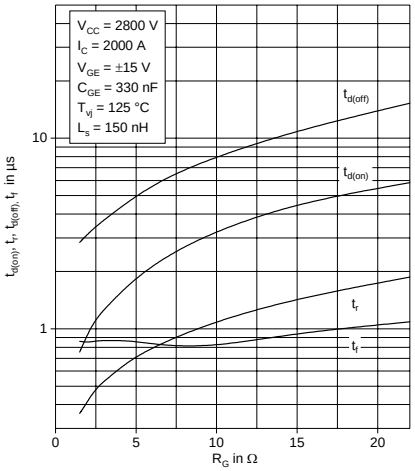



Fig. 9 Typical gate charge characteristics

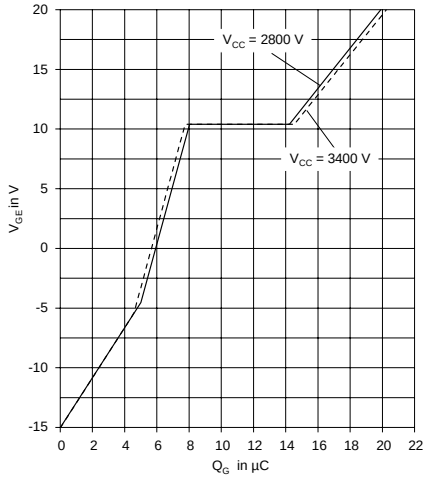



Fig. 10 Turn-off safe operating area (RBSOA)

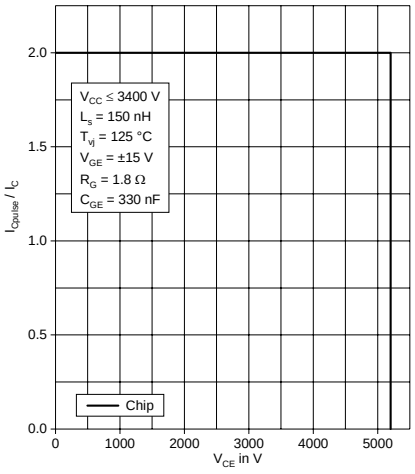



Fig. 11 Typicial diode forward characteristics chip level

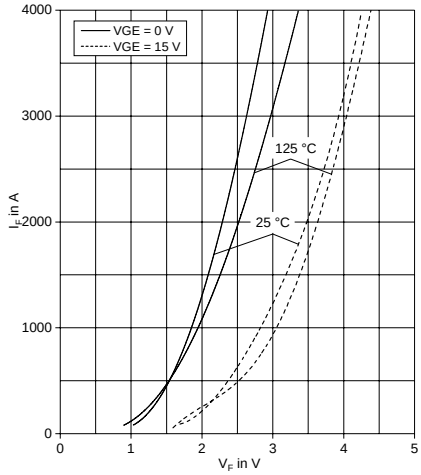



Fig. 12 Typical reverse recovery characteristics vs. forward current

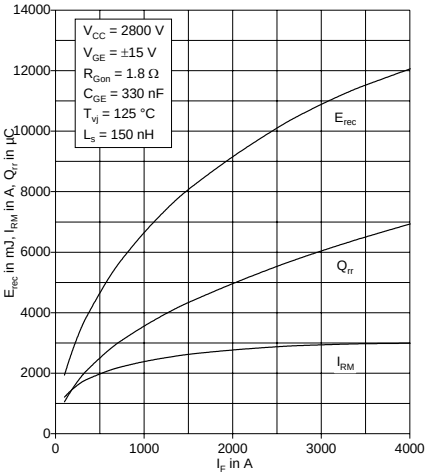


Fig. 13 Typical reverse recovery characteristics vs. di/dt

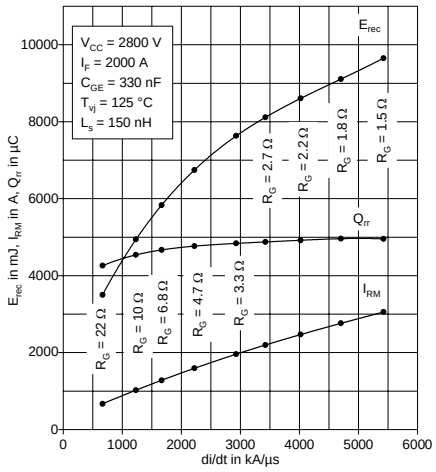



Fig. 14 Safe operating area diode (SOA)

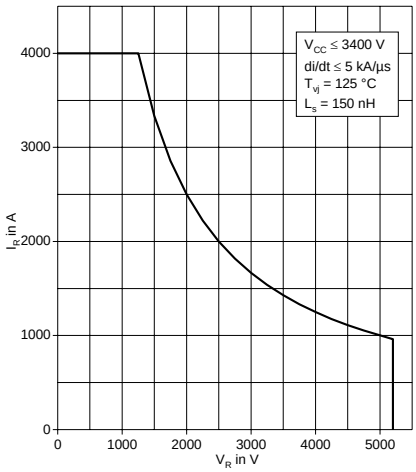
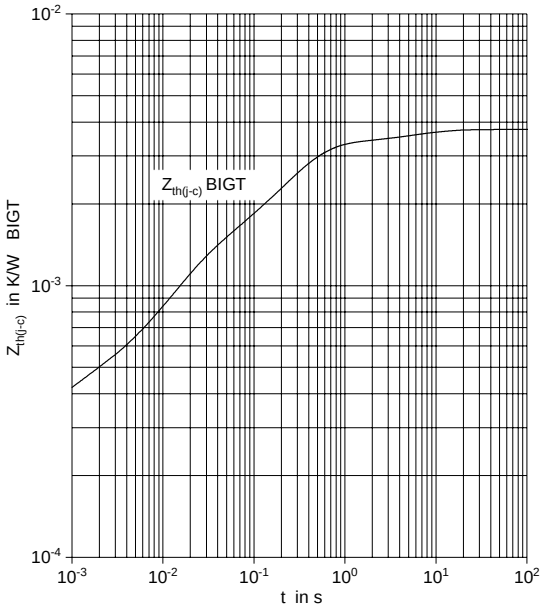



Fig. 15 Thermal impedance vs. time




Analytical function of the transient thermal resistance

$$Z_{th(j-c)}(t) = \sum_{i=1}^{n} R_i(1 - e^{-t/\tau_i})$$

| | i | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| IGBT | Ri(K/kW) | 0.397 | 0.819 | 2.089 | 0.449 | |
| | $\tau_i$(s) | 0.0004 | 0.0168 | 0.2862 | 6.0189 | |

Related documents:

- 5SYA 2045 Thermal runaway during blocking
- 5SYA 2053 Applying IGBT
- 5SYA 2093 Thermal design of IGBT modules

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