Ultra low-loss, rugged SPT+ chip-set
Smooth switching SPT+ chip-set for good EMC
AlSiC base-plate for high power cycling capability
AlN substrate for low thermal resistance
Recognized under UL1557, File E196689

Maximum rated values

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>min</th>
<th>max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-emitter voltage</td>
<td>$V_{CES}$</td>
<td>$V_{GE} = 0 \text{ V}, T_{vj} \geq 25 \text{ °C}$</td>
<td>3300</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>DC collector current</td>
<td>$I_C$</td>
<td>$T_J = 100 \text{ °C}, T_{case} = 150 \text{ °C}$</td>
<td>250</td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Peak collector current</td>
<td>$I_{CM}$</td>
<td>$t_p = 1 \text{ ms}$</td>
<td>500</td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Gate-emitter voltage</td>
<td>$V_{GES}$</td>
<td></td>
<td>-20</td>
<td>20</td>
<td>V</td>
</tr>
<tr>
<td>Total power dissipation</td>
<td>$P_{tot}$</td>
<td>$T_c = 25 \text{ °C}, T_{vj} = 150 \text{ °C}$</td>
<td>2450</td>
<td></td>
<td>W</td>
</tr>
<tr>
<td>DC forward current</td>
<td>$I_F$</td>
<td></td>
<td>250</td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Peak forward current</td>
<td>$I_{RMS}$</td>
<td>$t_p = 1 \text{ ms}$</td>
<td>500</td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Surge current</td>
<td>$I_{FMAX}$</td>
<td>$V_n = 0 \text{ V}, T_{vj} = 150 \text{ °C}$, $t_p = 10 \text{ ms, half-sinewave}$</td>
<td>2250</td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>IGBT short circuit SOA</td>
<td>$t_{psc}$</td>
<td>$V_{CC} = 2500 \text{ V}, V_{CEM \ chip} \leq 3300 \text{ V}$</td>
<td>10</td>
<td></td>
<td>µs</td>
</tr>
<tr>
<td>Junction temperature</td>
<td>$T_{ij}$</td>
<td></td>
<td>175</td>
<td></td>
<td>°C</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>$T_{VJ(0)}$</td>
<td></td>
<td>-50</td>
<td>150</td>
<td>°C</td>
</tr>
<tr>
<td>Case temperature</td>
<td>$T_C$</td>
<td></td>
<td>-50</td>
<td>125</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>$T_A$</td>
<td></td>
<td>-50</td>
<td>125</td>
<td>°C</td>
</tr>
<tr>
<td>Mounting torques $^2$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$^1$ 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
### IGBT Characteristic Values

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>min</th>
<th>typ</th>
<th>max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector (-emitter) breakdown voltage</td>
<td>( V_{BR(FES)} )</td>
<td>( V_{GE} = 0 \text{ V}, I_c = 10 \text{ mA}, T_{Vj} = 25 \text{ °C} )</td>
<td>3300</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Collector-emitter saturation voltage</td>
<td>( V_{CE} )</td>
<td>( I_c = 250 \text{ A}, V_{GE} = 15 \text{ V} )</td>
<td>2.5</td>
<td>2.9</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Collector cut-off current</td>
<td>( I_{CES} )</td>
<td>( V_{CE} = 3300 \text{ V}, V_{CE} = 0 \text{ V} )</td>
<td>3.5</td>
<td>7</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Gate leakage current</td>
<td>( I_{GS} )</td>
<td>( V_{CE} = 0 \text{ V}, V_{GE} = 20 \text{ V}, T_{Vj} = 125 \text{ °C} )</td>
<td>-500</td>
<td>500</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Gate-emitter threshold voltage</td>
<td>( V_{GE(TOD)} )</td>
<td>( I_c = 40 \text{ mA}, V_{CE} = V_{GE}, T_{Vj} = 25 \text{ °C} )</td>
<td>5</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Gate charge</td>
<td>( Q_{ge} )</td>
<td>( I_c = 250 \text{ A}, V_{CE} = 1800 \text{ V}, V_{GE} = -15 \text{ V} \ldots 15 \text{ V} )</td>
<td>1.8</td>
<td></td>
<td></td>
<td>μC</td>
</tr>
<tr>
<td>Input capacitance</td>
<td>( C_{in} )</td>
<td>( V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 1 \text{ MHz}, T_{Vj} = 25 \text{ °C} )</td>
<td>25.2</td>
<td></td>
<td></td>
<td>nF</td>
</tr>
<tr>
<td>Output capacitance</td>
<td>( C_{out} )</td>
<td>( V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 1 \text{ MHz}, T_{Vj} = 25 \text{ °C} )</td>
<td>2.1</td>
<td></td>
<td></td>
<td>nF</td>
</tr>
<tr>
<td>Reverse transfer capacitance</td>
<td>( C_{res} )</td>
<td>( V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 1 \text{ MHz}, T_{Vj} = 25 \text{ °C} )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn-on delay time</td>
<td>( t_{d(on)} )</td>
<td>( V_{CC} = 1800 \text{ V}, I_c = 250 \text{ A}, R_o = 10 \text{ Ω}, C_{GE} = 0 \text{ nF}, V_{GE} = \pm 15 \text{ V} )</td>
<td>445</td>
<td>450</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Rise time</td>
<td>( t_r )</td>
<td>( V_{CC} = 1800 \text{ V}, I_c = 250 \text{ A}, R_o = 10 \text{ Ω}, C_{GE} = 0 \text{ nF}, V_{GE} = \pm 15 \text{ V} )</td>
<td>195</td>
<td>200</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Turn-off delay time</td>
<td>( t_{d(off)} )</td>
<td>( V_{CC} = 1800 \text{ V}, I_c = 250 \text{ A}, R_o = 10 \text{ Ω}, C_{GE} = 0 \text{ nF}, V_{GE} = \pm 15 \text{ V} )</td>
<td>1160</td>
<td>1330</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Fall time</td>
<td>( t_f )</td>
<td>( V_{CC} = 1800 \text{ V}, I_c = 250 \text{ A}, R_o = 10 \text{ Ω}, C_{GE} = 0 \text{ nF}, V_{GE} = \pm 15 \text{ V} )</td>
<td>260</td>
<td>330</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Turn-on switching energy</td>
<td>( E_{on} )</td>
<td>( V_{CC} = 1800 \text{ V}, I_c = 250 \text{ A}, R_o = 10 \text{ Ω}, C_{GE} = 0 \text{ nF}, V_{GE} = \pm 15 \text{ V} )</td>
<td>360</td>
<td></td>
<td></td>
<td>mJ</td>
</tr>
<tr>
<td>Turn-off switching energy</td>
<td>( E_{off} )</td>
<td>( V_{CC} = 1800 \text{ V}, I_c = 250 \text{ A}, R_o = 10 \text{ Ω}, C_{GE} = 0 \text{ nF}, V_{GE} = \pm 15 \text{ V} )</td>
<td>460</td>
<td></td>
<td></td>
<td>mJ</td>
</tr>
<tr>
<td>Short circuit current</td>
<td>( I_{SC} )</td>
<td>( I_{sc} \leq 10 \mu\text{A}, V_{GE} = 15 \text{ V}, V_{CE} = 2500 \text{ V}, V_{CL(CHIP)} \leq 3300 \text{ V} )</td>
<td>1090</td>
<td></td>
<td></td>
<td>A</td>
</tr>
</tbody>
</table>

---

3) Characteristic values according to IEC 60747 - 9
4) Collector-emitter saturation voltage is given at chip level
### Diode characteristic values \(^6\)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>min</th>
<th>typ</th>
<th>max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward voltage (^6)</td>
<td>(V_F)</td>
<td>(I_F = 250\ A) (T_J = 25\ \degree C) (T_J = 125\ \degree C) (T_J = 150\ \degree C)</td>
<td>2.05</td>
<td>2.5</td>
<td>2.25</td>
<td>2.6</td>
</tr>
<tr>
<td>Reverse recovery current</td>
<td>(I_{rr})</td>
<td>(T_J = 125\ \degree C) (T_J = 150\ \degree C) (T_J = 175\ \degree C)</td>
<td>320</td>
<td>A</td>
<td>330</td>
<td>A</td>
</tr>
<tr>
<td>Recovered charge</td>
<td>(Q_{rr})</td>
<td>(V_{CC} = 1800\ V), (I_{F} = 250\ A), (V_{GE} = \pm 15\ V), (R_{G} = 10\ \Omega), (C_{GE} = 0\ nF), (di/dt = 1\ kA/\mu s), (L = 400\ nH), (inductive\ load) (T_J = 25\ \degree C) (T_J = 125\ \degree C) (T_J = 150\ \degree C)</td>
<td>280</td>
<td>(\mu) C</td>
<td>270</td>
<td>(\mu) C</td>
</tr>
<tr>
<td>Reverse recovery time</td>
<td>(t_{rr})</td>
<td>(T_J = 25\ \degree C) (T_J = 125\ \degree C) (T_J = 175\ \degree C)</td>
<td>1160</td>
<td>ns</td>
<td>1580</td>
<td>ns</td>
</tr>
<tr>
<td>Reverse recovery energy</td>
<td>(E_{rec})</td>
<td>(T_J = 25\ \degree C) (T_J = 125\ \degree C) (T_J = 175\ \degree C)</td>
<td>180</td>
<td>mJ</td>
<td>310</td>
<td>mJ</td>
</tr>
</tbody>
</table>

\(^6\) Characteristic values according to IEC 60747 – 2

\(^6\) Forward voltage is given at chip level

### Package properties \(^7\)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>min</th>
<th>typ</th>
<th>max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>IGBT thermal resistance</td>
<td>(R_{th(j-c)})</td>
<td>junction to case (T_J = 25\ \degree C) (T_J = 125\ \degree C) (T_J = 175\ \degree C)</td>
<td>0.051</td>
<td>K/W</td>
<td>0.102</td>
<td>K/W</td>
</tr>
<tr>
<td>Diode thermal resistance</td>
<td>(R_{th(j-c)})</td>
<td>junction to case (T_J = 25\ \degree C) (T_J = 125\ \degree C) (T_J = 175\ \degree C)</td>
<td>0.027</td>
<td>K/W</td>
<td>0.102</td>
<td>K/W</td>
</tr>
<tr>
<td>IGBT thermal resistance (^2)</td>
<td>(R_{th(j-c)})</td>
<td>case to heatsink (T_J = 25\ \degree C) (T_J = 125\ \degree C) (T_J = 175\ \degree C)</td>
<td>0.048</td>
<td>K/W</td>
<td>0.096</td>
<td>K/W</td>
</tr>
<tr>
<td>Diode thermal resistance (^2)</td>
<td>(R_{th(j-c)})</td>
<td>case to heatsink (T_J = 25\ \degree C) (T_J = 125\ \degree C) (T_J = 175\ \degree C)</td>
<td>0.027</td>
<td>K/W</td>
<td>0.096</td>
<td>K/W</td>
</tr>
<tr>
<td>Comparative tracking index</td>
<td>CTI</td>
<td>(T_J = 25\ \degree C) (T_J = 125\ \degree C) (T_J = 175\ \degree C)</td>
<td>125</td>
<td>nH</td>
<td>180</td>
<td>nH</td>
</tr>
<tr>
<td>Module stray inductance</td>
<td>(L_{CE})</td>
<td>(T_J = 25\ \degree C) (T_J = 125\ \degree C) (T_J = 175\ \degree C)</td>
<td>0.25</td>
<td>mH</td>
<td>0.33</td>
<td>mH</td>
</tr>
<tr>
<td>Resistance, terminal-chip</td>
<td>(R_{CC+EE})</td>
<td>per switch (T_J = 25\ \degree C) (T_J = 125\ \degree C) (T_J = 175\ \degree C)</td>
<td>0.35</td>
<td>mΩ</td>
<td>0.33</td>
<td>mΩ</td>
</tr>
</tbody>
</table>

\(^2\) For detailed mounting instructions refer to ABB Document No. 5SYA 2039

### Mechanical properties \(^7\)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>min</th>
<th>typ</th>
<th>max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td>L x W x H</td>
<td>Typical</td>
<td>73 x 140 x 48</td>
<td>mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clearance distance in air</td>
<td>(d_a)</td>
<td>according to IEC 60664-1 and EN 50124-1 (T_J = 25\ \degree C) (T_J = 125\ \degree C) (T_J = 175\ \degree C) (Term. to base:)</td>
<td>35</td>
<td>mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface creepage distance</td>
<td>(d_s)</td>
<td>according to IEC 60664-1 and EN 50124-1 (T_J = 25\ \degree C) (T_J = 125\ \degree C) (T_J = 175\ \degree C) (C1 to E1:)</td>
<td>54</td>
<td>mm</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>(m)</td>
<td></td>
<td>620</td>
<td>g</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^7\) Package and mechanical properties according to IEC 60747 – 15
Electrical configuration

Outline drawing 2)

Note: all dimensions are shown in millimeters
2) For detailed mounting instructions refer to ABB Document No. 5SYA 2039

This is an electrostatic sensitive device, please observe the international standard IEC 60747-1, chap. IX.
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 capacitances vs. collector-emitter voltage

Fig. 10  Typical gate charge characteristics

Fig. 11  Turn-off safe operating area (RBSOA)
Fig. 12  Typical reverse recovery characteristics vs. forward current

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

Fig. 14  Typical diode forward characteristics chip level

Fig. 15  Safe operating area diode (SOA)
Analytical function for transient thermal impedance:

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

**Fig. 16** Thermal impedance vs. time

### Related documents:
- 5SYA 2042 Failure rates of HiPak modules due to cosmic rays
- 5SYA 2043 Load - cycle capability of HiPaks
- 5SYA 2045 Thermal runaway during blocking
- 5SYA 2053 Applying IGBT
- 5SYA 2058 Surge currents for IGBT diodes
- 5SYA 2093 Thermal design of IGBT modules
- 5SYA 2098 Paralleliong of IGBT modules
- 5SZK 9111 Specification of environmental class for HiPak Storage
- 5SZK 9112 Specification of environmental class for HiPak Transportation
- 5SZK 9113 Specification of environmental class for HiPak Operation (Industry)
- 5SZK 9120 Specification of environmental class for HiPak

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