

**5SNG 0450X330300****LinPak phase leg IGBT module**

$$V_{CE} = 3300 \text{ V}$$

$$I_C = 2 \times 450 \text{ A}$$

Ultra low inductance phase-leg module  
 Compact design with very high current density  
 Paralleling without derating  
 AISiC base-plate for high power cycling capability  
 AlN substrate for low thermal resistance  
 Low-loss, fast and rugged SPT+ chip-set

**Maximum rated values <sup>1)</sup>**

| Parameter                      | Symbol       | Conditions  | min | max  | Unit               |
|--------------------------------|--------------|---|-----|------|--------------------|
| Collector-emitter voltage      | $V_{CES}$    | $V_{GE} = 0 \text{ V}$ , $T_{vj} \geq 25 \text{ °C}$  |     | 3300 | V                  |
| DC collector current           | $I_C$        | $T_C = 105 \text{ °C}$ , $T_{vj} = 150 \text{ °C}$  |     | 450  | A                  |
| Peak collector current         | $I_{CM}$     | $t_p = 1 \text{ ms}$  |     | 900  | A                  |
| Gate-emitter voltage           | $V_{GES}$    |   | -20 | 20   | V                  |
| Total power dissipation        | $P_{tot}$    | $T_C = 25 \text{ °C}$ , $T_{vj} = 150 \text{ °C}$   |     | 4000 | W                  |
| DC forward current             | $I_F$        |   |     | 450  | A                  |
| Peak forward current           | $I_{FRM}$    | $t_p = 1 \text{ ms}$  |     | 900  | A                  |
| Surge current                  | $I_{FSM}$    | $V_R = 0 \text{ V}$ , $T_{vj} = 150 \text{ °C}$ ,<br>$t_p = 10 \text{ ms}$ , half-sinewave  |     | 4000 | A                  |
| IGBT short circuit SOA         | $t_{psc}$    | $V_{CC} = 2500 \text{ V}$ , $V_{CEM \text{ CHIP}} \leq 3300 \text{ V}$<br>$V_{GE} \leq 15 \text{ V}$ , $T_{vj \text{ start}} \leq 150 \text{ °C}$ |     | 10   | $\mu\text{s}$      |
| Isolation voltage              | $V_{ISOL}$   | 1 min, $f = 50 \text{ Hz}$  |     | 6000 | V                  |
| Junction temperature           | $T_{vj}$     |   |     | 175  | $^{\circ}\text{C}$ |
| Junction operating temperature | $T_{vj(op)}$ |   | -40 | 150  | $^{\circ}\text{C}$ |
| Case temperature               | $T_C$        |   | -40 | 150  | $^{\circ}\text{C}$ |
| Storage temperature            | $T_{stg}$    |   | -40 | 125  | $^{\circ}\text{C}$ |
| Mounting torques <sup>2)</sup> | $M_s$        | Base-heatsink, M6 screws  | 4   | 6    | Nm                 |
|                                | $M_{t1}$     | Main terminals, M8 screws   | 8   | 10   |                    |
|                                | $M_{t2}$     | Auxiliary terminals, M3 screws  | 0.9 | 1.1  |                    |

<sup>1)</sup> Maximum rated values indicate limits beyond which damage to the device may occur per IEC 60747

<sup>2)</sup> For detailed mounting instructions refer to ABB Document No. 5SYA 2039

### IGBT characteristic values <sup>3)</sup>

| Parameter  | Symbol              | Conditions  | min                                   | typ   | max | Unit          |
|--|---------------------|---|---------------------------------------|-------|-----|---------------|
| Collector (-emitter) breakdown voltage             | $V_{(BR)CES}$       | $V_{GE} = 0\text{ V}$ , $I_C = 10\text{ mA}$ , $T_{vj} = 25\text{ °C}$  | 3300                                  |       |     | V             |
| Collector-emitter <sup>4)</sup> saturation voltage | $V_{CE\text{ sat}}$ | $I_C = 450\text{ A}$ , $V_{GE} = 15\text{ V}$   | $T_{vj} = 25\text{ °C}$               | 2.5   | 2.9 | V             |
|  |                     |   | $T_{vj} = 125\text{ °C}$              | 3.1   | 3.4 | V             |
|  |                     |   | $T_{vj} = 150\text{ °C}$              | 3.25  |     | V             |
| Collector cut-off current                          | $I_{CES}$           | $V_{CE} = 3300\text{ V}$ , $V_{GE} = 0\text{ V}$  | $T_{vj} = 25\text{ °C}$               | 0.005 |     | mA            |
|  |                     |   | $T_{vj} = 125\text{ °C}$              | 4     |     | mA            |
|  |                     |   | $T_{vj} = 150\text{ °C}$              | 15    |     | mA            |
| Gate leakage current                               | $I_{GES}$           | $V_{CE} = 0\text{ V}$ , $V_{GE} = \pm 20\text{ V}$ , $T_{vj} = 125\text{ °C}$   | -500                                  |       | 500 | nA            |
| Gate-emitter threshold voltage                     | $V_{GE(TO)}$        | $I_C = 40\text{ mA}$ , $V_{CE} = V_{GE}$ , $T_{vj} = 25\text{ °C}$  | 4.7                                   |       | 6.7 | V             |
| Gate charge  | $Q_{ge}$            | $I_C = 450\text{ A}$ , $V_{CE} = 1800\text{ V}$ , $V_{GE} = -15\text{ V} \dots 15\text{ V}$   |                                       | 3.3   |     | $\mu\text{C}$ |
| Input capacitance                                  | $C_{ies}$           | $V_{CE} = 25\text{ V}$ , $V_{GE} = 0\text{ V}$ , $f = 1\text{ MHz}$ ,<br>$T_{vj} = 25\text{ °C}$  |                                       | 54    |     | nF            |
| Output capacitance                                 | $C_{oes}$           |   |                                       | 3.1   |     | nF            |
| Reverse transfer capacitance                       | $C_{res}$           |   |                                       | 2.4   |     | nF            |
| Internal gate resistance                           | $R_{Gint}$          | per switch  |                                       | 1.19  |     | $\Omega$      |
| Turn-on delay time                                 | $t_{d(on)}$         | $V_{CC} = 1800\text{ V}$ , $I_C = 450\text{ A}$ ,<br>$R_G = 1.5\text{ }\Omega$ , $C_{GE} = 0\text{ nF}$ ,<br>$V_{GE} = \pm 15\text{ V}$ ,<br>$L_\sigma = 30\text{ nH}$ , inductive load | $T_{vj} = 25\text{ °C}$               | 320   |     | ns            |
|  |                     |   | $T_{vj} = 125\text{ °C}$              | 350   |     | ns            |
|  |                     |   | $T_{vj} = 150\text{ °C}$              | 355   |     | ns            |
| Rise time  | $t_r$               | $V_{CC} = 1800\text{ V}$ , $I_C = 450\text{ A}$ ,<br>$R_G = 1.5\text{ }\Omega$ , $C_{GE} = 0\text{ nF}$ ,<br>$V_{GE} = \pm 15\text{ V}$ ,<br>$L_\sigma = 30\text{ nH}$ , inductive load | $T_{vj} = 25\text{ °C}$               | 75    |     | ns            |
|  |                     |   | $T_{vj} = 125\text{ °C}$              | 85    |     | ns            |
|  |                     |   | $T_{vj} = 150\text{ °C}$              | 90    |     | ns            |
| Turn-off delay time                                | $t_{d(off)}$        | $V_{CC} = 1800\text{ V}$ , $I_C = 450\text{ A}$ ,<br>$R_G = 1.5\text{ }\Omega$ , $C_{GE} = 0\text{ nF}$ ,<br>$V_{GE} = \pm 15\text{ V}$ ,<br>$L_\sigma = 30\text{ nH}$ , inductive load | $T_{vj} = 25\text{ °C}$               | 860   |     | ns            |
|  |                     |   | $T_{vj} = 125\text{ °C}$              | 1015  |     | ns            |
|  |                     |   | $T_{vj} = 150\text{ °C}$              | 1050  |     | ns            |
| Fall time  | $t_f$               | $V_{CC} = 1800\text{ V}$ , $I_C = 450\text{ A}$ ,<br>$R_G = 1.5\text{ }\Omega$ , $C_{GE} = 0\text{ nF}$ ,<br>$V_{GE} = \pm 15\text{ V}$ ,<br>$L_\sigma = 30\text{ nH}$ , inductive load | $T_{vj} = 25\text{ °C}$               | 250   |     | ns            |
|  |                     |   | $T_{vj} = 125\text{ °C}$              | 350   |     | ns            |
|  |                     |   | $T_{vj} = 150\text{ °C}$              | 375   |     | ns            |
| Turn-on switching energy                           | $E_{on}$            | $V_{CC} = 1800\text{ V}$ , $I_C = 450\text{ A}$ ,<br>$R_G = 1.5\text{ }\Omega$ , $C_{GE} = 0\text{ nF}$ ,<br>$V_{GE} = \pm 15\text{ V}$ ,<br>$L_\sigma = 30\text{ nH}$ , inductive load | $T_{vj} = 25\text{ °C}$               | 520   |     | mJ            |
|  |                     |   | $T_{vj} = 125\text{ °C}$              | 700   |     | mJ            |
|  |                     |   | $T_{vj} = 150\text{ °C}$              | 770   |     | mJ            |
| Turn-off switching energy                          | $E_{off}$           | $V_{CC} = 1800\text{ V}$ , $I_C = 450\text{ A}$ ,<br>$R_G = 1.5\text{ }\Omega$ , $C_{GE} = 0\text{ nF}$ ,<br>$V_{GE} = \pm 15\text{ V}$ ,<br>$L_\sigma = 30\text{ nH}$ , inductive load | $T_{vj} = 25\text{ °C}$               | 530   |     | mJ            |
|  |                     |   | $T_{vj} = 125\text{ °C}$              | 730   |     | mJ            |
|  |                     |   | $T_{vj} = 150\text{ °C}$              | 800   |     | mJ            |
| Short circuit current                              | $I_{sc}$            | $V_{CC} = 2500\text{ V}$ , $V_{GE} = 15\text{ V}$   | $T_{vj\text{ start}} = 150\text{ °C}$ | 1900  |     | A             |

<sup>3)</sup> Characteristic values according to IEC 60747 - 9

<sup>4)</sup> Collector-emitter saturation voltage is given at chip level

## Diode characteristic values <sup>5)</sup>

| Parameter                     | Symbol           | Conditions  | min                      | typ  | max  | Unit |    |
|-------------------------------|------------------|---|--------------------------|------|------|------|----|
| Forward voltage <sup>6)</sup> | V <sub>F</sub>   | I <sub>F</sub> = 450 A  | T <sub>vj</sub> = 25 °C  | 2.05 | 2.5  | V    |    |
|                               |                  |   | T <sub>vj</sub> = 125 °C |      | 2.25 | 2.6  | V  |
|                               |                  |   | T <sub>vj</sub> = 150 °C |      | 2.2  |      | V  |
| Peak reverse recovery current | I <sub>RM</sub>  |   | T <sub>vj</sub> = 25 °C  | 820  |      | A    |    |
|                               |                  |   | T <sub>vj</sub> = 125 °C |      | 920  |      | A  |
|                               |                  |   | T <sub>vj</sub> = 150 °C |      | 930  |      | A  |
| Recovered charge              | Q <sub>rr</sub>  | V <sub>CC</sub> = 1800 V,<br>I <sub>F</sub> = 450 A,<br>V <sub>GE</sub> = ±15 V,<br>R <sub>G</sub> = 1.5 Ω, C <sub>GE</sub> = 0 nF,<br>L <sub>σ</sub> = 30 nH, inductive load | T <sub>vj</sub> = 25 °C  | 320  |      | μC   |    |
|                               |                  |   | T <sub>vj</sub> = 125 °C |      | 490  |      | μC |
|                               |                  |   | T <sub>vj</sub> = 150 °C |      | 570  |      | μC |
| Reverse recovery time         | t <sub>rr</sub>  |   | T <sub>vj</sub> = 25 °C  | 790  |      | ns   |    |
|                               |                  |   | T <sub>vj</sub> = 125 °C |      | 1050 |      | ns |
|                               |                  |   | T <sub>vj</sub> = 150 °C |      | 1130 |      | ns |
| Reverse recovery energy       | E <sub>rec</sub> |   | T <sub>vj</sub> = 25 °C  | 360  |      | mJ   |    |
|                               |                  |   | T <sub>vj</sub> = 125 °C |      | 580  |      | mJ |
|                               |                  |   | T <sub>vj</sub> = 150 °C |      | 690  |      | mJ |

<sup>5)</sup> Characteristic values according to IEC 60747 - 2

<sup>6)</sup> Forward voltage is given at chip level

## NTC Thermistor

| Parameter      | Symbol              | Conditions  | min | typ  | max | Unit |
|----------------|---------------------|---|-----|------|-----|------|
| Rated resistor | R <sub>25</sub>     |   |     | 4.7  |     | kΩ   |
| B-value        | B <sub>25/85</sub>  | R <sub>2</sub> = R <sub>25</sub> exp [B <sub>25/85</sub> (1/T <sub>2</sub> - 1/(298.15K))]  |     | 3371 |     | K    |
|                | B <sub>25/100</sub> | R <sub>2</sub> = R <sub>25</sub> exp [B <sub>25/100</sub> (1/T <sub>2</sub> - 1/(298.15K))] |     | 3435 |     | K    |

## Package properties <sup>7)</sup>

| Parameter   | Symbol                         | Conditions                            | min | typ         | max | Unit |
|---|--------------------------------|---------------------------------------|-----|-------------|-----|------|
| IGBT thermal resistance junction to case                | R <sub>th(j-c)IGBT</sub>       |                                       |     |             | 31  | K/kW |
| Diode thermal resistance junction to case               | R <sub>th(j-c)DIODE</sub>      |                                       |     |             | 54  | K/kW |
| IGBT thermal resistance <sup>2)</sup> case to heatsink  | R <sub>th(c-s)IGBT</sub>       | IGBT per switch, λ grease = 1W/m x K  |     | 30          |     | K/kW |
| Diode thermal resistance <sup>2)</sup> case to heatsink | R <sub>th(c-s)DIODE</sub>      | Diode per switch, λ grease = 1W/m x K |     | 35          |     | K/kW |
| Comparative tracking index                              | CTI                            |                                       | 600 |             |     |      |
| Module stray inductance                                 | L <sub>σ CE</sub>              | total C1-E2                           |     | 10          |     | nH   |
| Resistance, terminal-chip                               | R <sub>C1E1</sub> IGBT / Diode | T <sub>C</sub> = 25 °C                |     | 0.25 / 0.34 |     | mΩ   |
|   |                                | T <sub>C</sub> = 125 °C               |     | 0.35 / 0.47 |     |      |
|   |                                | T <sub>C</sub> = 150 °C               |     | 0.37 / 0.50 |     |      |
|   | R <sub>C2E2</sub> IGBT / Diode | T <sub>C</sub> = 25 °C                |     | 0.35 / 0.44 |     |      |
|   |                                | T <sub>C</sub> = 125 °C               |     | 0.49 / 0.62 |     |      |
|   |                                | T <sub>C</sub> = 150 °C               |     | 0.53 / 0.66 |     |      |

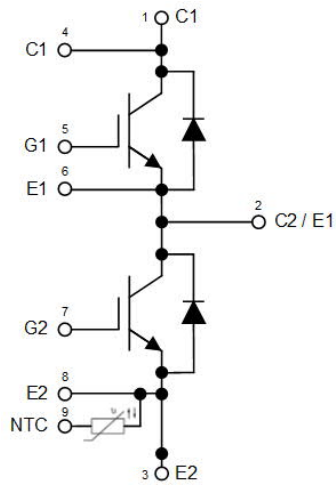
<sup>2)</sup> For detailed mounting instructions refer to ABB Document No. 5SYA 2039

## Mechanical properties <sup>7)</sup>

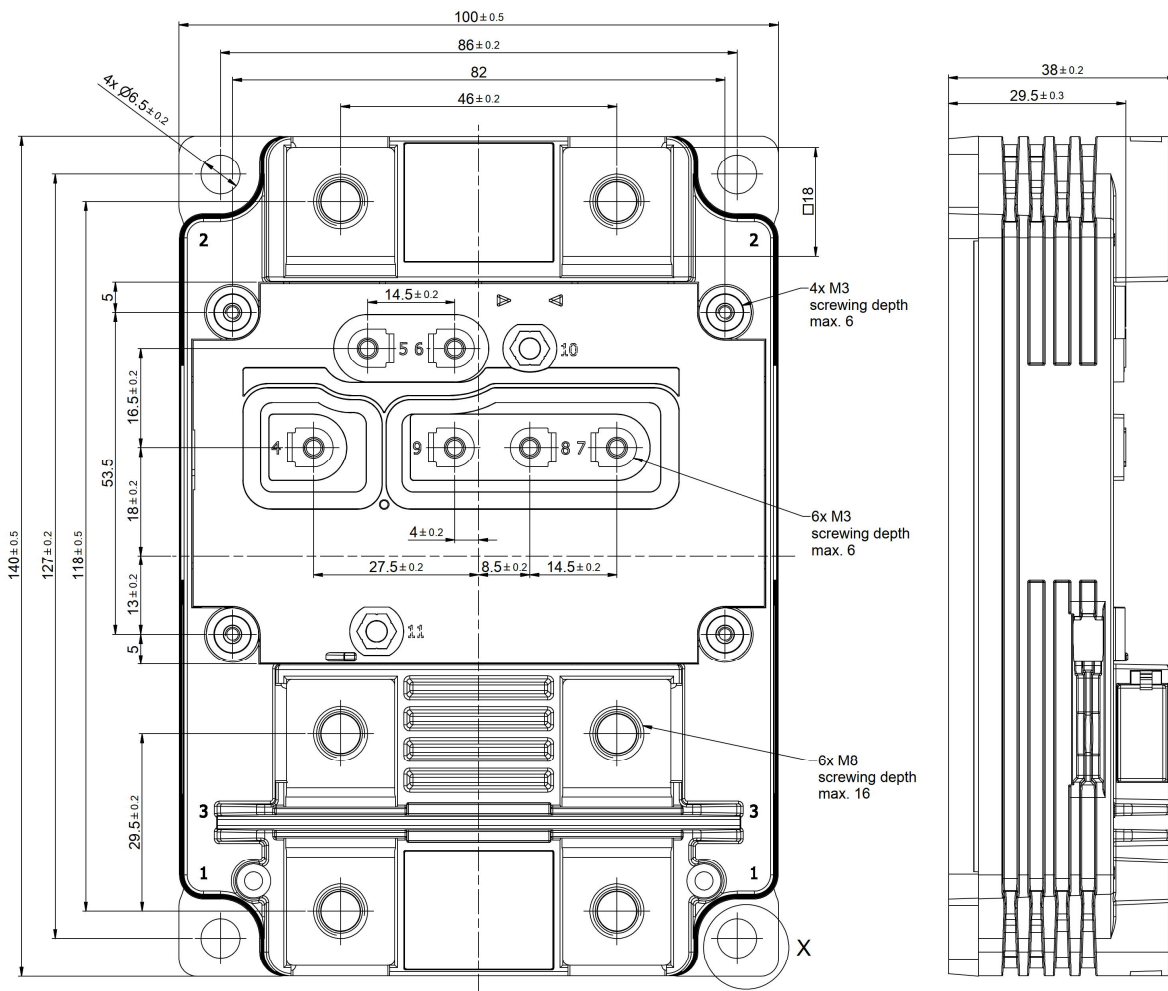
| Parameter                 | Symbol         | Conditions                              | min            | typ            | max | Unit |
|---------------------------|----------------|---|----------------|----------------|-----|------|
| Dimensions                | L x W x H      | Typical                                 |                | 140 x 100 x 38 |     | mm   |
| Clearance distance in air | d <sub>a</sub> | according to IEC 60664-1 and EN 50124-1 | Term. to base: | 20             |     | mm   |
|                           |                |   | Term. to term: | 8              |     |      |
| Surface creepage distance | d <sub>s</sub> | according to IEC 60664-1 and EN 50124-1 | Term. to base: | 30             |     | mm   |
|                           |                |   | Term. to term: | 30             |     |      |
| Mass                      | m              |   |                | 820            |     | g    |

<sup>7)</sup> Package and mechanical properties according to IEC 60747 - 15

## Electrical configuration



## Outline drawing



Note: all dimensions are shown in millimeters

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.

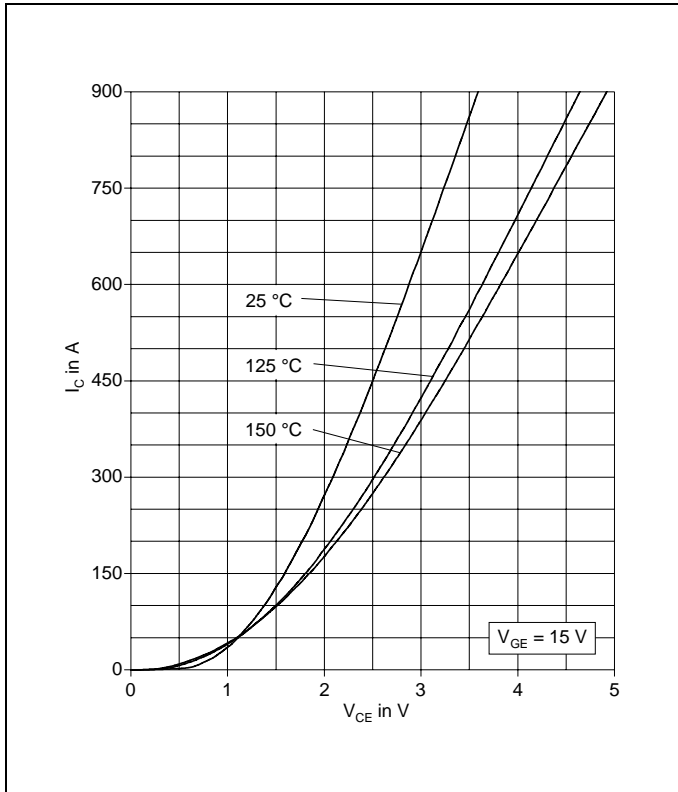


Fig. 1 Typical on-state characteristics, chip level

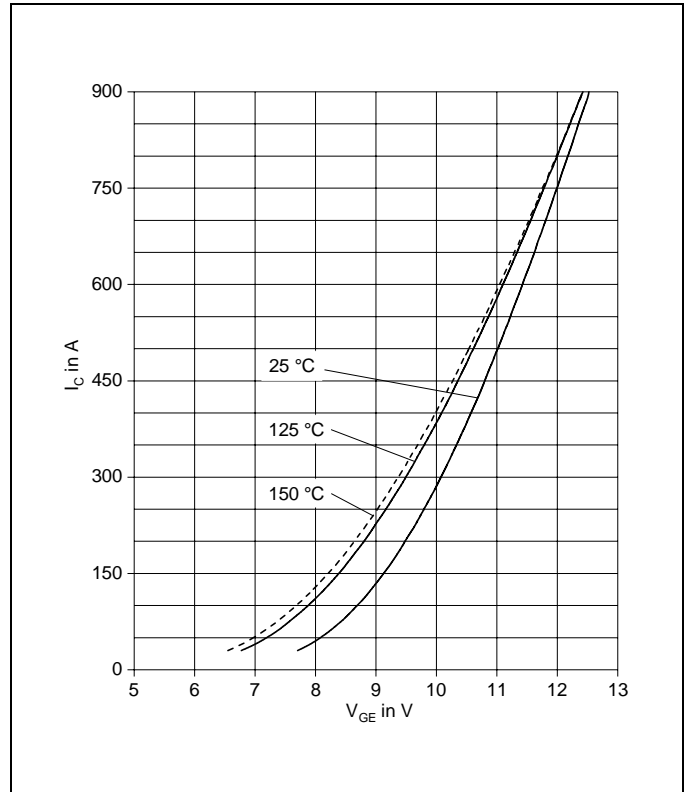


Fig. 2 Typical transfer characteristics, chip level

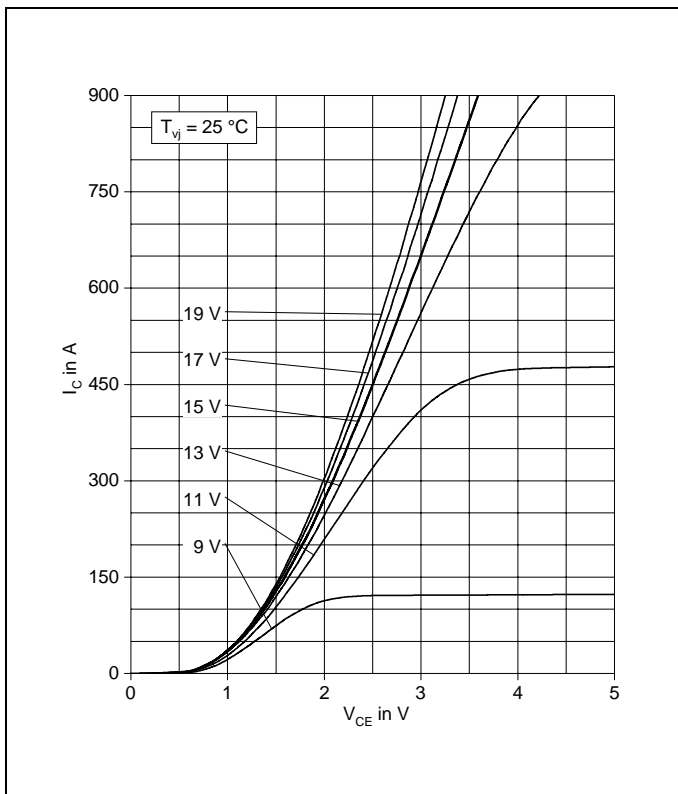


Fig. 3 Typical output characteristics, chip level

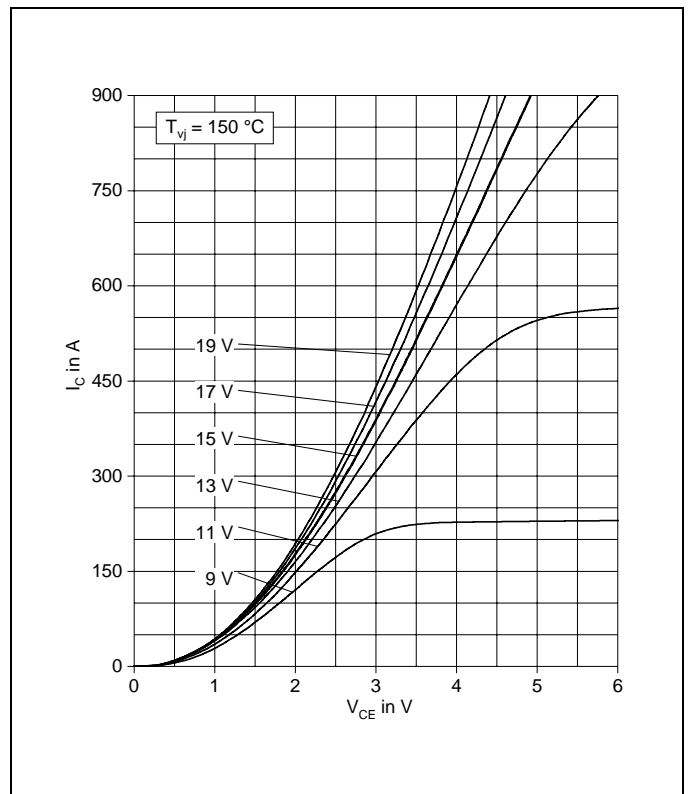


Fig. 4 Typical output characteristics, chip level

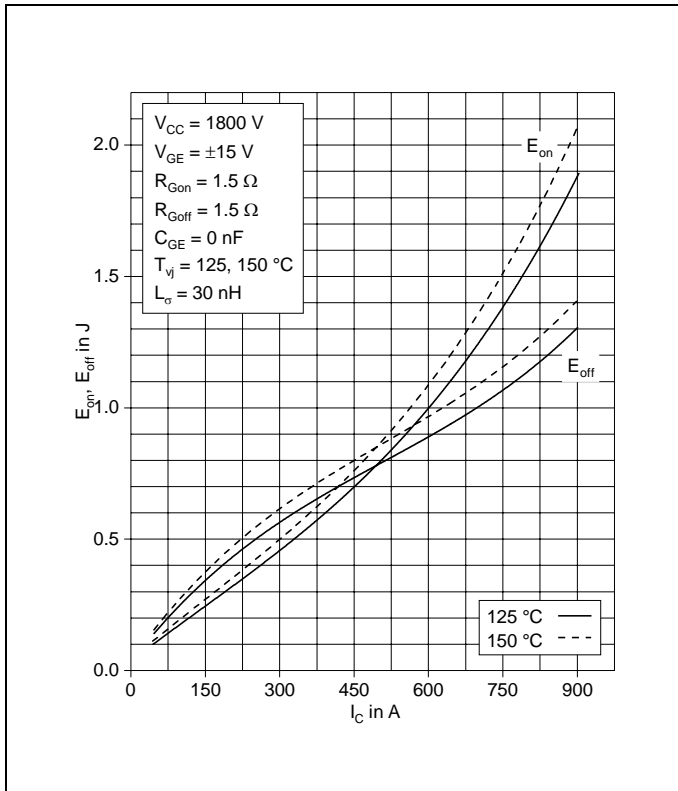


Fig. 5 Typical switching energies per pulse vs. collector current

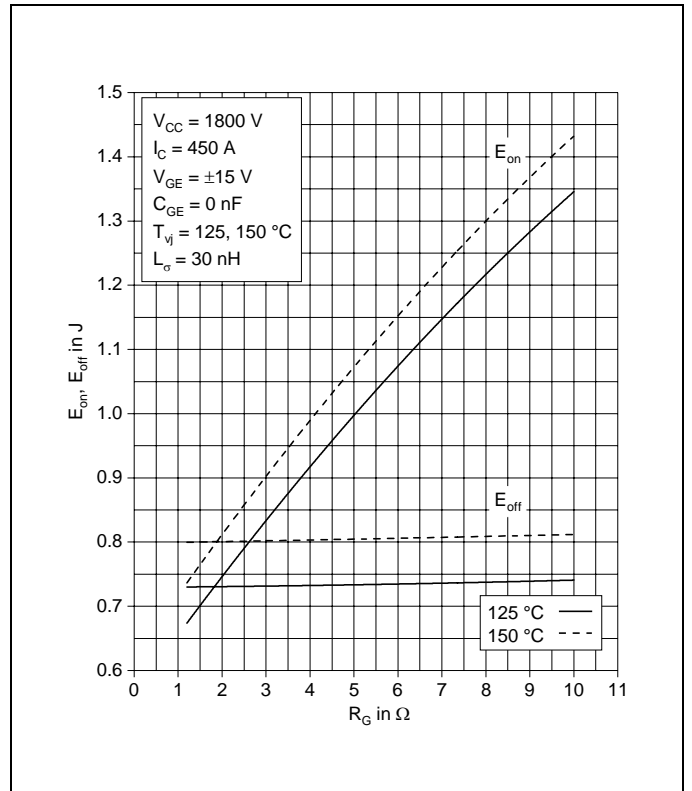


Fig. 6 Typical switching energies per pulse vs. gate resistor

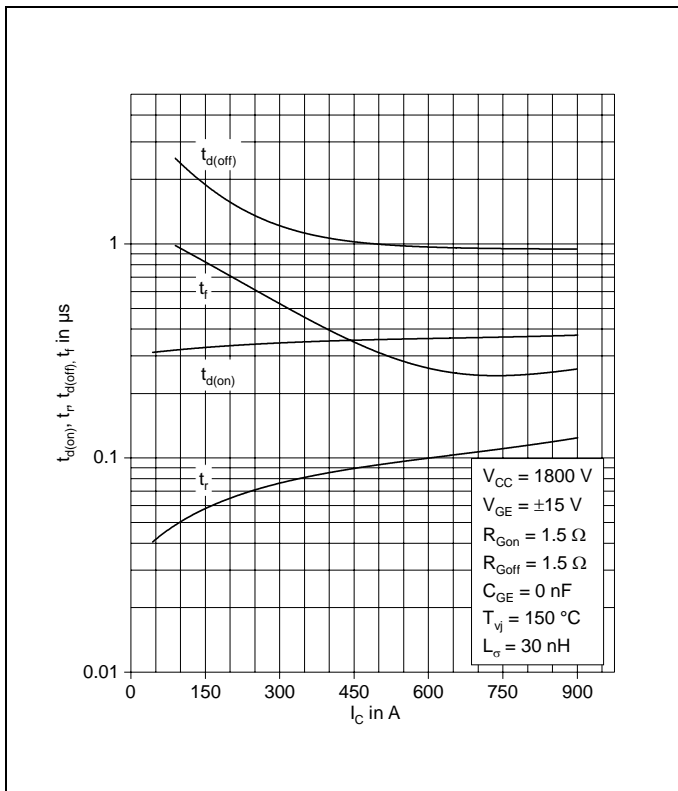


Fig. 7 Typical switching times vs. collector current

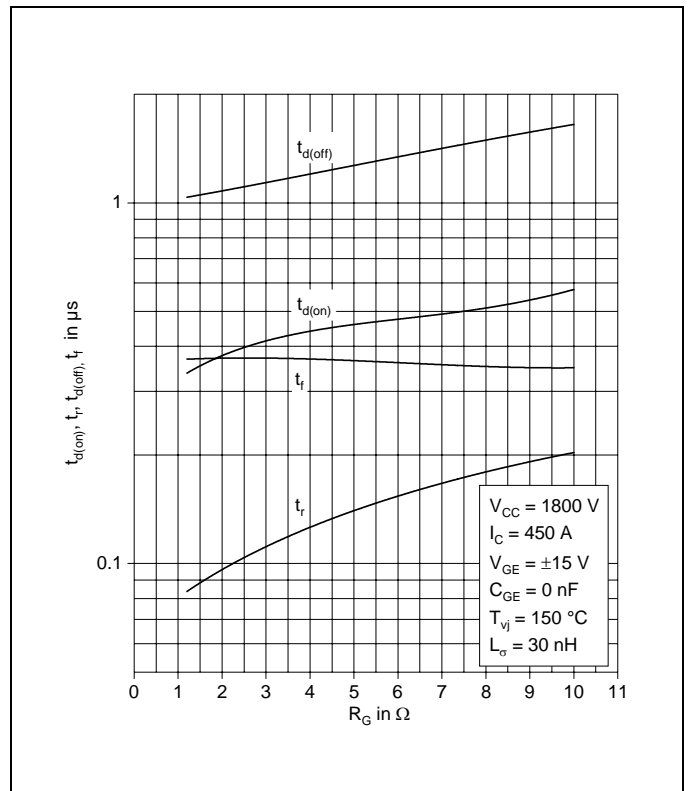


Fig. 8 Typical switching times vs. gate resistor

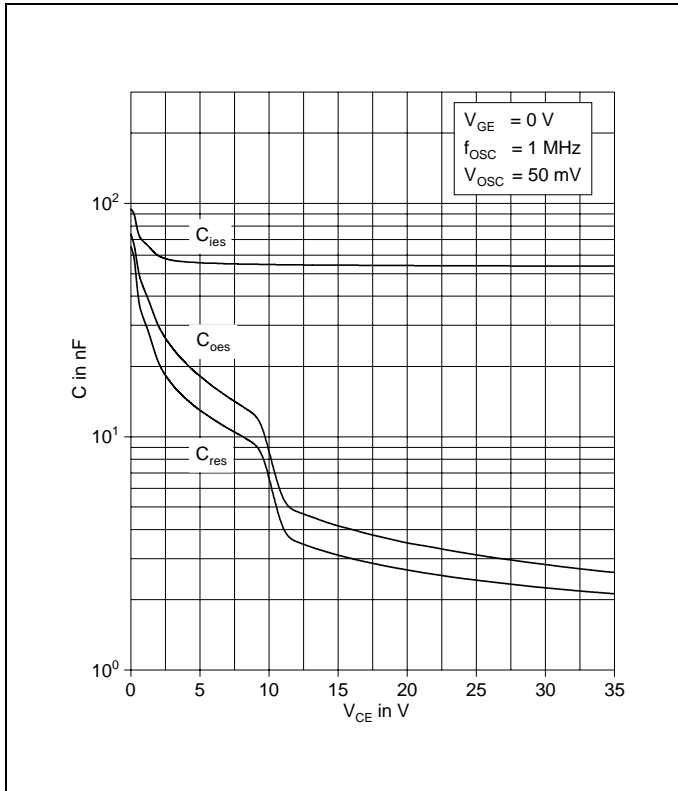


Fig. 9 Typical capacitances vs. collector-emitter voltage

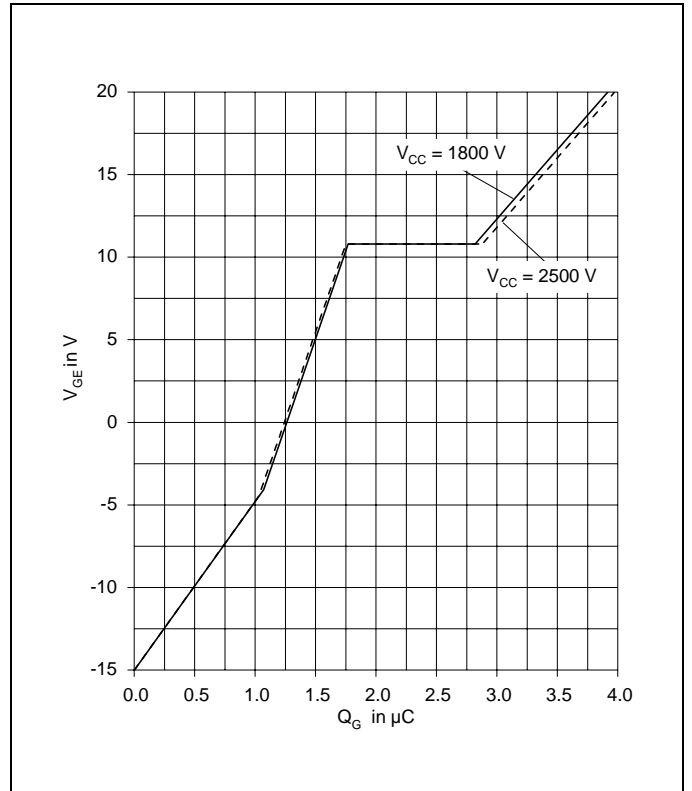


Fig. 10 Typical gate charge characteristics

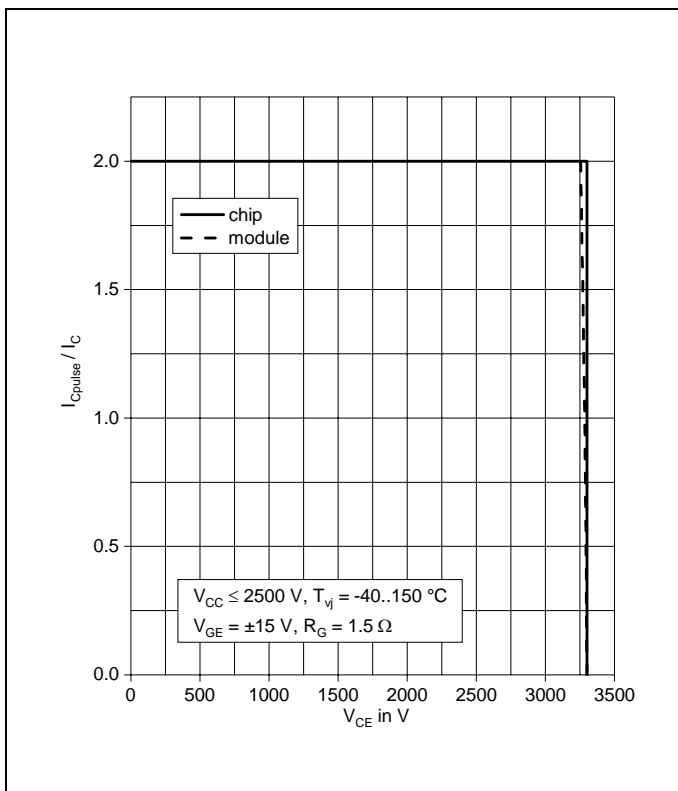


Fig. 11 Turn-off safe operating area (RBSOA)

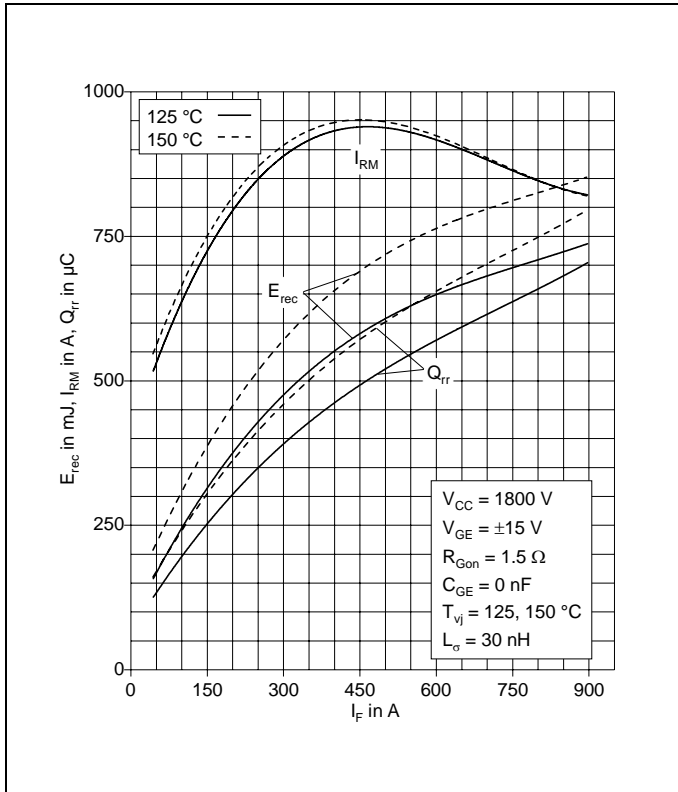


Fig. 12 Typical reverse recovery characteristics vs. forward current

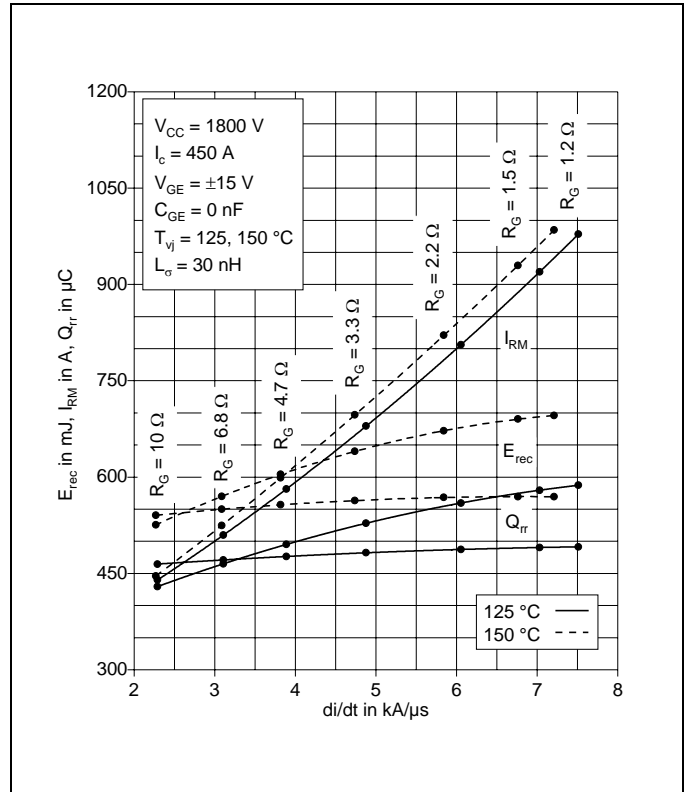


Fig. 13 Typical reverse recovery characteristics vs. di/dt

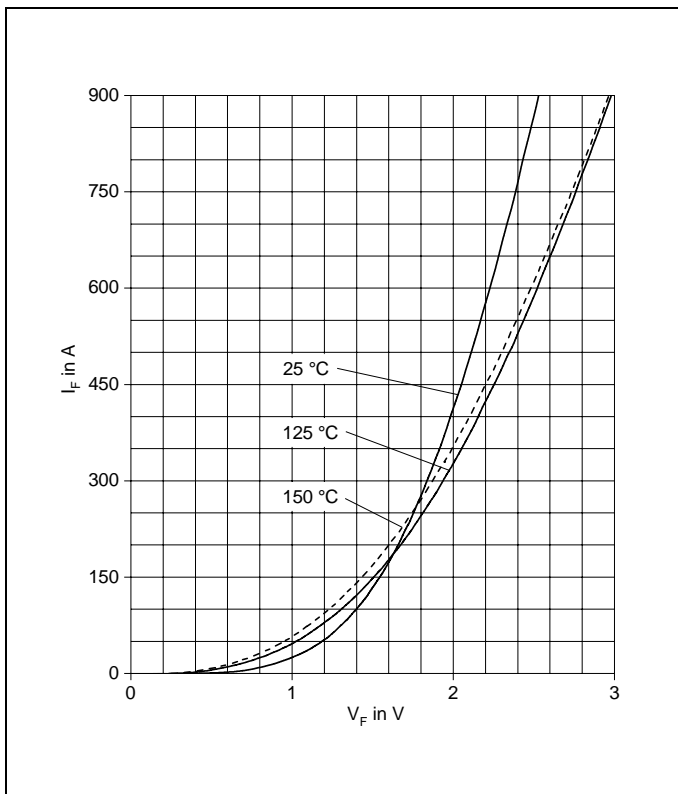


Fig. 14 Typical diode forward characteristics chip level

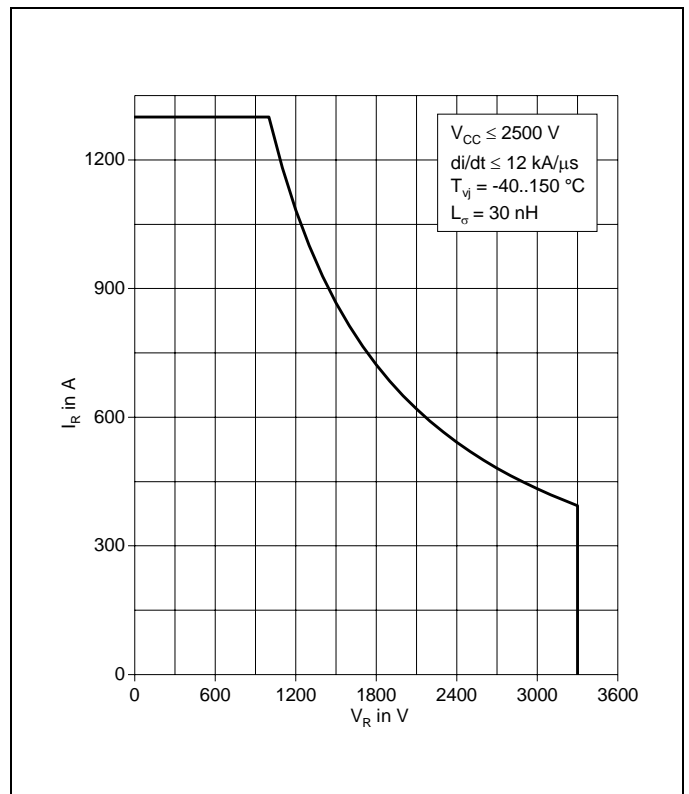


Fig. 15 Safe operating area diode (SOA)



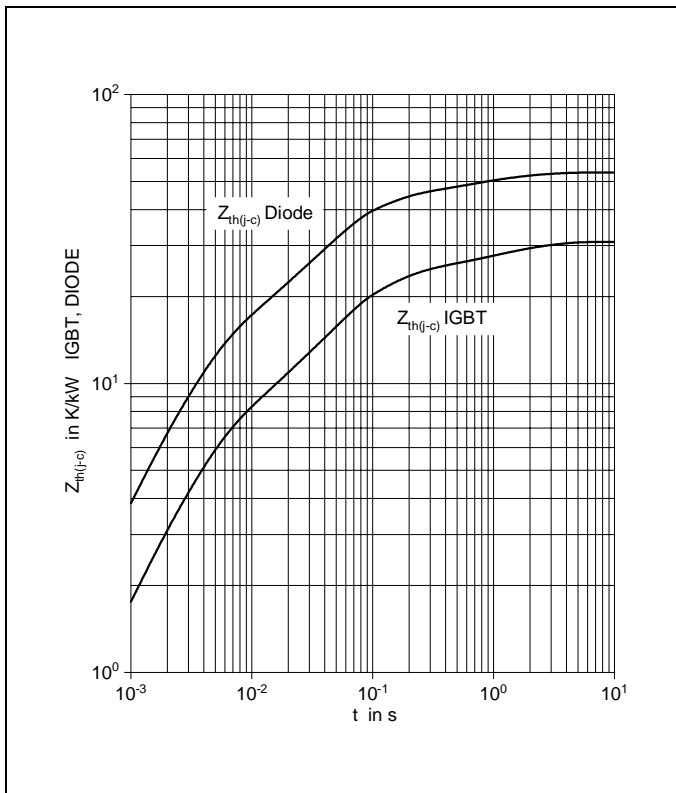


Fig. 16 Thermal impedance vs. time

Analytical function for transient thermal impedance:

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

|       |               |       |      |      |   |   |
|-------|---------------|-------|------|------|---|---|
|       | i             | 1     | 2    | 3    | 4 | 5 |
| IGBT  | Ri(K/kW)      | 17.38 | 7.31 | 6.23 |   |   |
|       | $\tau_i$ (ms) | 65.7  | 1220 | 3.67 |   |   |
| DIODE | Ri(K/kW)      | 31.1  | 12.6 | 9.95 |   |   |
|       | $\tau_i$ (ms) | 54.4  | 3.33 | 881  |   |   |

#### Related documents:

- 5SYA 2042 Failure rates of IGBT modules due to cosmic rays
- 5SYA 2043 Load - cycle capability of HiPaks
- 5SYA 2045 Thermal runaway during blocking
- 5SYA 2053 Applying IGBT
- 5SYA 2057 IGBT diode safe operating area (SOA)
- 5SYA 2058 Surge currents for IGBT diodes
- 5SYA 2093 Thermal design of IGBT modules
- 5SYA 2098 Paralleling of IGBT modules
- 5SYA 2107 Mounting instructions for LinPak 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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