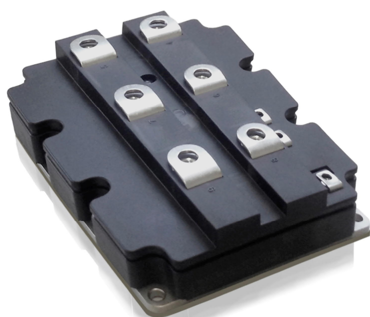
Data Sheet, Doc. No. 5SYA 1470-00 05-2019

# 5SNA 1800E330400
# HiPak IGBT module



- Ultra low loss TSPT+ technology
- Very soft switching FCE diode with increased diode area
- Exceptional ruggedness and highest current rating
- AlSiC base-plate for high power cycling capability
- AlN substrate for low thermal resistance

Maximum rated values [1)]

| Parameter | Symbol | Conditions | min | max | Unit |
|---|---|---|---|---|---|
| Collector-emitter voltage | $V_{CES}$ | $V_{GE}$ = 0 V, $T_{vj}$ ≥ 25 °C | | 3300 | V |
| | | $V_{GE}$ = 0 V, $T_{vj}$ = -40 °C | | 3000 | |
| DC collector current | $I_C$ | $T_C$ = 98 °C, $T_{vj}$ = 150 °C | | 1800 | A |
| Peak collector current | $I_{CM}$ | $t_p$ = 1 ms | | 3600 | A |
| Gate-emitter voltage | $V_{GES}$ | | -20 | 20 | V |
| DC forward current | $I_F$ | | | 1800 | A |
| Peak forward current | $I_{FRM}$ | $t_p$ = 1 ms | | 3600 | A |
| Surge current | $I_{FSM}$ | $V_R$ = 0 V, $T_{vj\ start}$ = 150 °C, $t_p$ = 10 ms, half-sinewave | | 14300 | A |
| IGBT short circuit SOA | $t_{psc}$ | $V_{CC}$ = 2500 V, $V_{CEM\ CHIP}$ ≤ <:VBRCES_25_min:> V $V_{GE}$ ≤ 15 V, $T_{vj\ start}$ ≤ 150 °C | | 10 | µs |
| Isolation voltage | $V_{isol}$ | 1 min, f = 50 Hz | | 6000 | V |
| Junction temperature | $T_{vj}$ | | | 175 | °C |
| Junction operating temperature | $T_{vj(op)}$ | | -40 | 150 | °C |
| Case temperature | $T_C$ | | -40 | 125 | °C |
| Storage temperature | $T_{stg}$ | | -50 | 125 | °C |
| Mounting torques [2)] | $M_s$ | Base-heatsink, M6 screws | 4 | 6 | Nm |
| | $M_{t1}$ | Main terminals, M8 screws | 8 | 10 | |
| | $M_{t2}$ | Auxiliary terminals, M3 screws | 2 | 3 | |

[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 [3)]

| Parameter | Symbol | Conditions | | min | typ | max | Unit |
|---|---|---|---|---|---|---|---|
| Collector (-emitter) breakdown voltage | $V_{(BR)CES}$ | $V_{GE}$ = 0 V, $I_C$ = 10 mA | $T_{vj}$ = 150 °C | 3300 | | | V |
| | | | $T_{vj}$ = 25 °C | 3300 | | | |
| | | | $T_{vj}$ = -40 °C | 3000 | | | |
| Collector-emitter [4)] saturation voltage | $V_{CE\,sat}$ | $I_C$ = 1800 A, $V_{GE}$ = 15 V | $T_{vj}$ = 25 °C | | 2.3 | 2.7 | V |
| | | | $T_{vj}$ = 125 °C | | 2.75 | 3.2 | |
| | | | $T_{vj}$ = 150 °C | | 2.9 | | |
| Collector cut-off current | $I_{CES}$ | $V_{CE}$ = 3300 V, $V_{GE}$ = 0 V | $T_{vj}$ = 25 °C | | | 1 | mA |
| | | | $T_{vj}$ = 125 °C | | 22 | | |
| | | | $T_{vj}$ = 150 °C | | 120 | | |
| Gate leakage current | $I_{GES}$ | $V_{CE}$ = 0 V, $V_{GE}$ = ± 20 V, $T_{vj}$ = 125 °C | | -500 | | 500 | nA |
| Gate-emitter threshold voltage | $V_{GE(TO)}$ | $I_C$ = 240 mA, $V_{CE}$ = $V_{GE}$, $T_{vj}$ = 25 °C | | 6.7 | | 8.7 | V |
| Gate charge | $Q_{ge}$ | $I_C$ = 1800 A, $V_{CE}$ = 1800 V, $V_{GE}$ = -15 V ..15 V | | | 18 | | µC |
| Input capacitance | $C_{ies}$ | $V_{CE}$ = 25 V, $V_{GE}$ = 0 V, f = 1 MHz, $T_{vj}$ = 25 °C | | | 239 | | nF |
| Internal gate resistance | $R_{Gint}$ | | | | 0.83 | | Ω |
| Turn-on delay time | $t_{d(on)}$ | $V_{CC}$ = 1800 V, $I_C$ = 1800 A, $R_G$ = 1.2 Ω, $C_{GE}$ = 330 nF, $V_{GE}$ = ±15 V, $L_\sigma$ = 100 nH, inductive load | $T_{vj}$ = 25 °C | | 1120 | | ns |
| | | | $T_{vj}$ = 150 °C | | 1120 | | |
| Rise time | $t_r$ | | $T_{vj}$ = 25 °C | | 310 | | ns |
| | | | $T_{vj}$ = 150 °C | | 320 | | |
| Turn-off delay time | $t_{d(off)}$ | $V_{CC}$ = 1800 V, $I_C$ = 1800 A, $R_G$ = 4.7 Ω, $C_{GE}$ = 330 nF, $V_{GE}$ = ±15 V, $L_\sigma$ = 100 nH, inductive load | $T_{vj}$ = 25 °C | | 2890 | | ns |
| | | | $T_{vj}$ = 150 °C | | 3470 | | |
| Fall time | $t_f$ | | $T_{vj}$ = 25 °C | | 350 | | ns |
| | | | $T_{vj}$ = 150 °C | | 420 | | |
| Turn-on switching energy | $E_{on}$ | $V_{CC}$ = 1800 V, $I_C$ = 1800 A, $R_G$ = 1.2 Ω, $C_{GE}$ = 330 nF, $V_{GE}$ = ±15 V, $L_\sigma$ = 100 nH, inductive load | $T_{vj}$ = 25 °C | | 3.50 | | J |
| | | | $T_{vj}$ = 125 °C | | 4.30 | | |
| | | | $T_{vj}$ = 150 °C | | 4.55 | | |
| Turn-off switching energy | $E_{off}$ | $V_{CC}$ = 1800 V, $I_C$ = 1800 A, $R_G$ = 4.7 Ω, $C_{GE}$ = 330 nF, $V_{GE}$ = ±15 V, $L_\sigma$ = 100 nH, inductive load | $T_{vj}$ = 25 °C | | 3.00 | | J |
| | | | $T_{vj}$ = 125 °C | | 4.00 | | |
| | | | $T_{vj}$ = 150 °C | | 4.25 | | |
| Short circuit current | $I_{SC}$ | $V_{CC}$ = 2500 V, $V_{GE}$ = 15 V | $T_{vj\,start}$ = 150 °C | | 6600 | | 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)] | $V_F$ | $I_F$ = 1800 A | $T_{vj}$ = 25 °C | | 2.0 | 2.45 | V |
| | | | $T_{vj}$ = 125 °C | | 2.2 | 2.65 | |
| | | | $T_{vj}$ = 150 °C | | 2.15 | | |
| Peak reverse recovery current | $I_{RM}$ | $V_{CC}$ = 1800 V, $I_F$ = 1800 A, $V_{GE}$ = ±15 V, $R_G$ = 1.2 Ω, $C_{GE}$ = 330 nF, di/dt = 6.7 kA/µs, $L_\sigma$ = 100 nH, inductive load | $T_{vj}$ = 25 °C | | 2340 | | A |
| | | | $T_{vj}$ = 125 °C | | 2750 | | |
| | | | $T_{vj}$ = 150 °C | | 3010 | | |
| Recovered charge | $Q_{rr}$ | | $T_{vj}$ = 25 °C | | 1260 | | µC |
| | | | $T_{vj}$ = 125 °C | | 2060 | | |
| | | | $T_{vj}$ = 150 °C | | 2400 | | |
| Reverse recovery time | $t_{rr}$ | | $T_{vj}$ = 25 °C | | 850 | | ns |
| | | | $T_{vj}$ = 125 °C | | 1080 | | |
| | | | $T_{vj}$ = 150 °C | | 1220 | | |
| Reverse recovery energy | $E_{rec}$ | | $T_{vj}$ = 25 °C | | 1.40 | | J |
| | | | $T_{vj}$ = 125 °C | | 2.30 | | |
| | | | $T_{vj}$ = 150 °C | | 2.60 | | |

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 |
|---|---|---|---|---|---|---|---|
| IGBT thermal resistance junction to case | $R_{th(j-c)IGBT}$ | | | | | 0.009 | K/W |
| Diode thermal resistance junction to case | $R_{th(j-c)DIODE}$ | | | | | 0.014 | K/W |
| IGBT thermal resistance [2)] case to heatsink | $R_{th(c-s)IGBT}$ | IGBT per switch, λ grease = 1W/m x K | | | 0.007 | | K/W |
| Diode thermal resistance [2)] case to heatsink | $R_{th(c-s)DIODE}$ | Diode per switch, λ grease = 1W/m x K | | | 0.010 | | K/W |
| Partial discharge extinction voltage | $V_e$ | f = 50 Hz, $Q_{PD}$ ≤ 10 pC (acc. To IEC 61287) | | 2600 | | | V |
| Comparative tracking index | CTI | | | 600 | | | |
| Module stray inductance | $L_{\sigma CE}$ | | | | 8 | | nH |
| Resistance, terminal-chip | $R_{CC'+EE'}$ | | $T_C$ = 25 °C | | 0.055 | | mΩ |
| | | | $T_C$ = 125 °C | | 0.075 | | |
| | | | $T_C$ = 150 °C | | 0.080 | | |

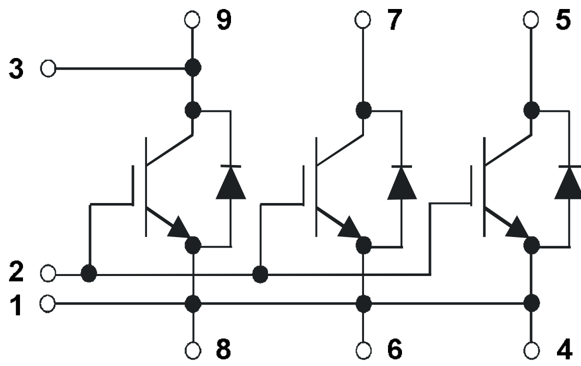
2) For detailed mounting instructions refer to ABB Document No. 5SYA 2039

## Mechanical properties [7)]

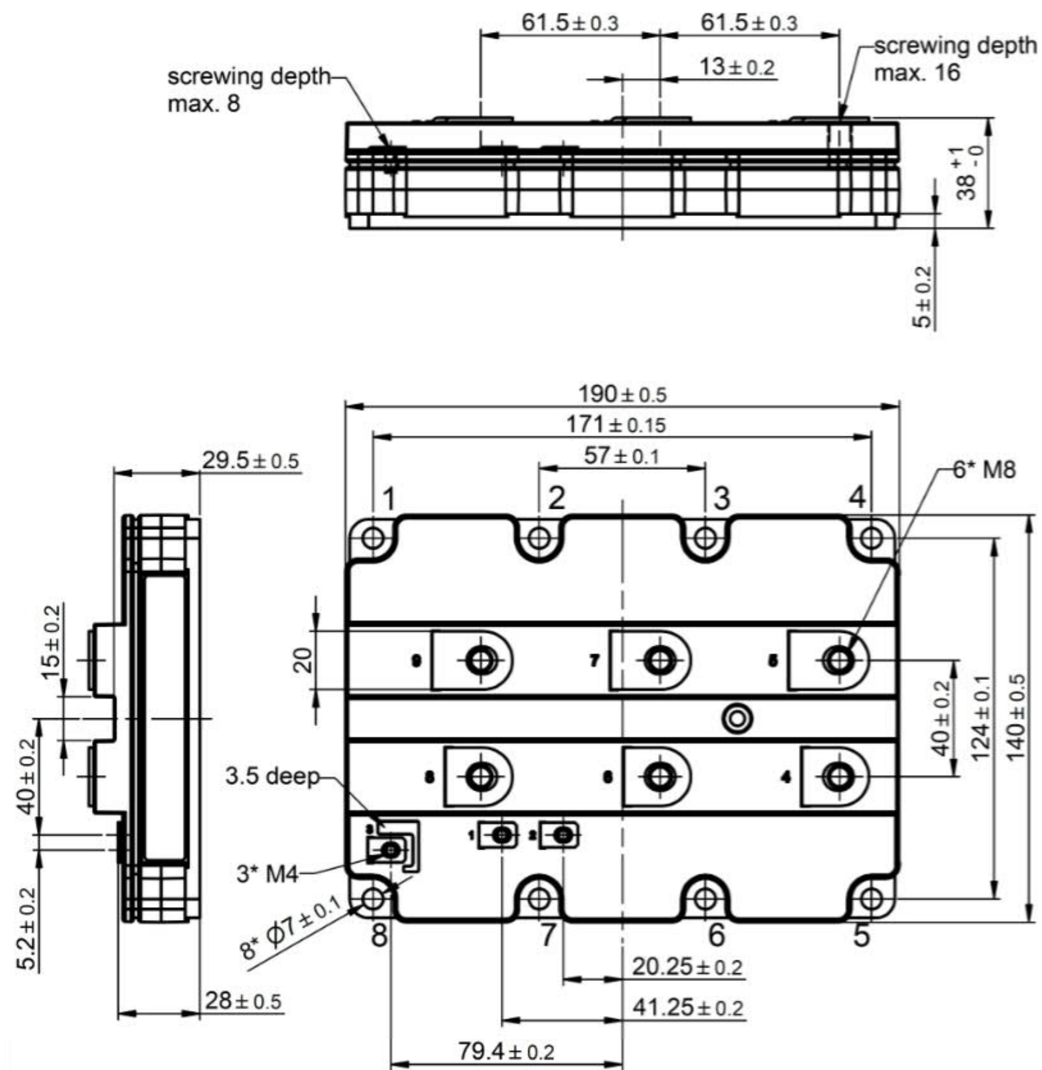
| Parameter | Symbol | Conditions | | min | typ | max | Unit |
|---|---|---|---|---|---|---|---|
| Dimensions | L x W x H | Typical | | | 190 x 140 x 38 | | mm |
| Clearance distance in air | $d_a$ | according to IEC 60664-1 and EN 50124-1 | Term. to base: | 23 | | | mm |
| | | | Term. to term: | 19 | | | |
| Surface creepage distance | $d_s$ | according to IEC 60664-1 and EN 50124-1 | Term. to base: | 28.2 | | | mm |
| | | | Term. to term: | 28.2 | | | |
| Mass | m | | | | 1190 | | 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

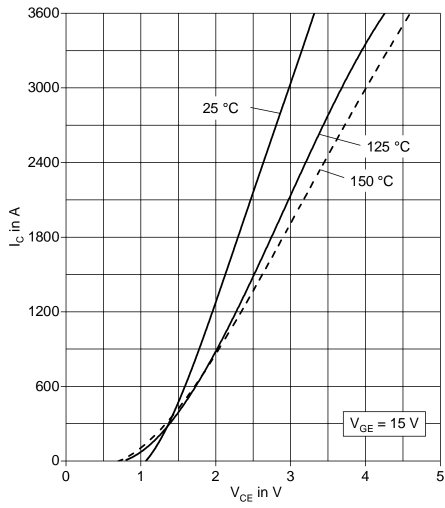



Fig. 2 Typical transfer characteristics, chip level

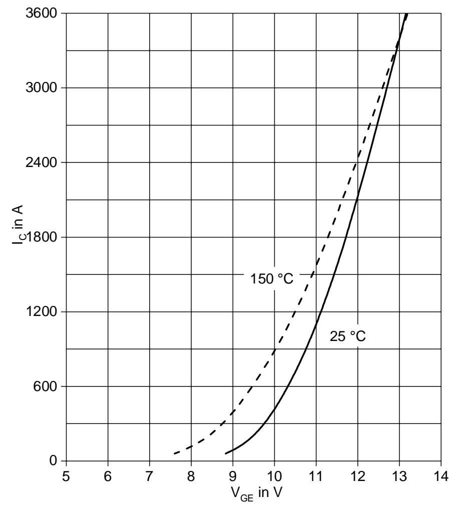



Fig. 3 Typical output characteristics, chip level

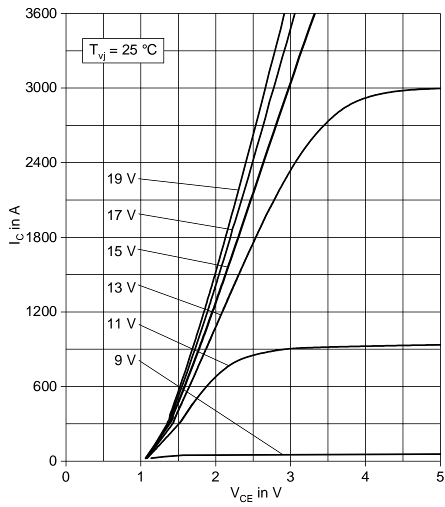



Fig. 4 Typical output characteristics, chip level

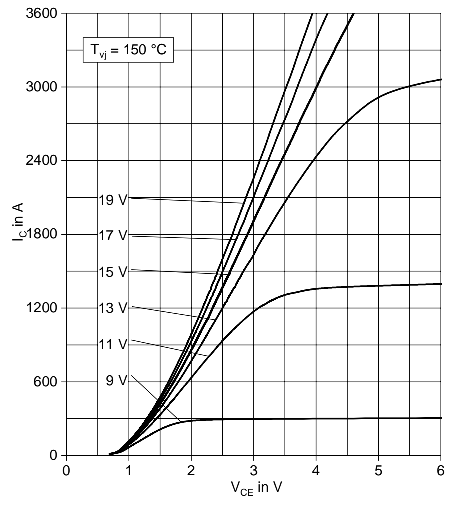



Fig. 5 Typical switching energies per pulse vs. collector current

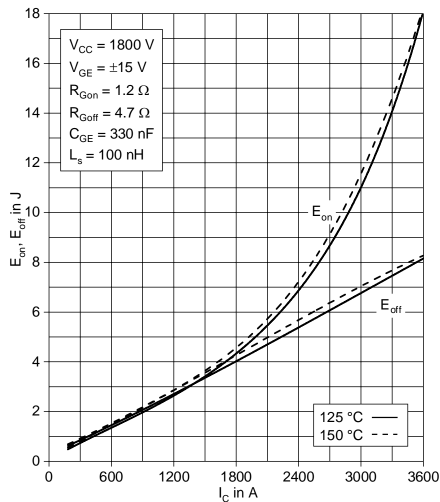



Fig. 6 Typical switching energies per pulse vs. gate resistor

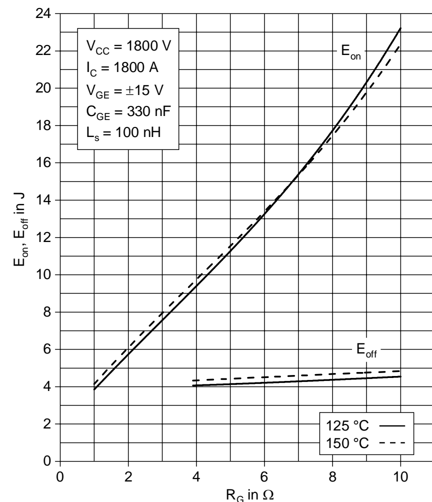


Fig. 7 Typical switching times vs. collector current

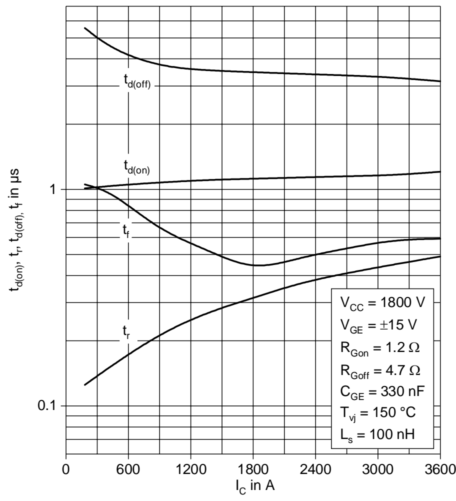



Fig. 8 Typical switching times vs. gate resistor

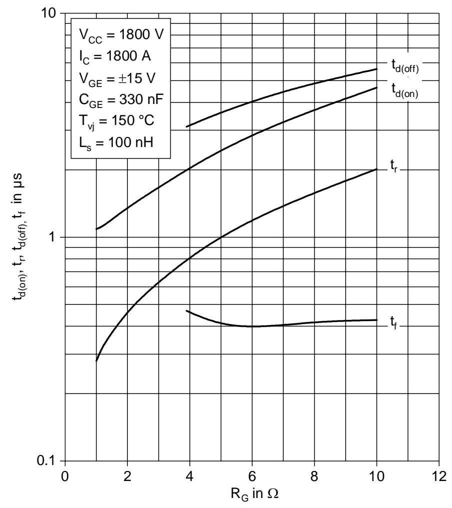



Fig. 9 Typical gate charge characteristics

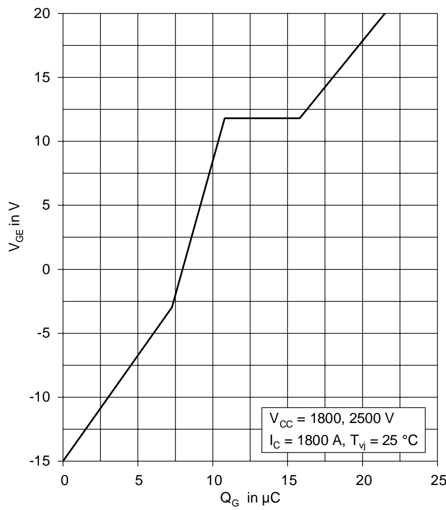



Fig. 10 Turn-off safe operating area (RBSOA)

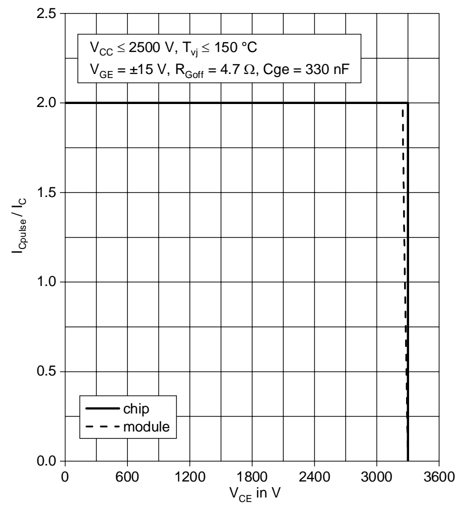



Fig. 11 Typicial diode forward characteristics chip level

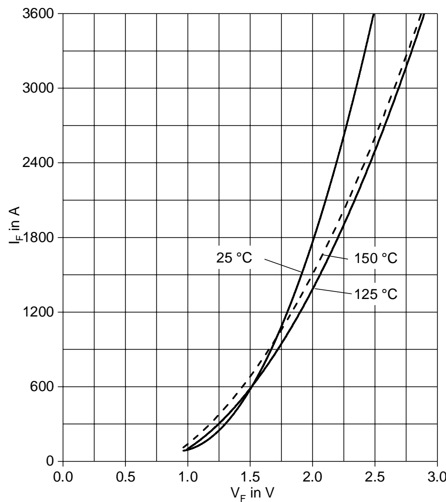



Fig. 12 Typical reverse recovery characteristics vs. forward current

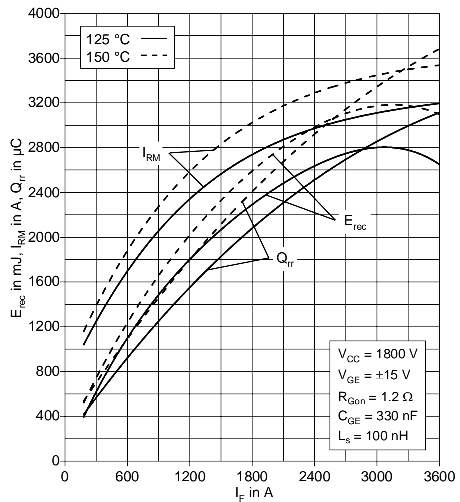


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Fig. 13 Typical reverse recovery characteristics vs. di/dt

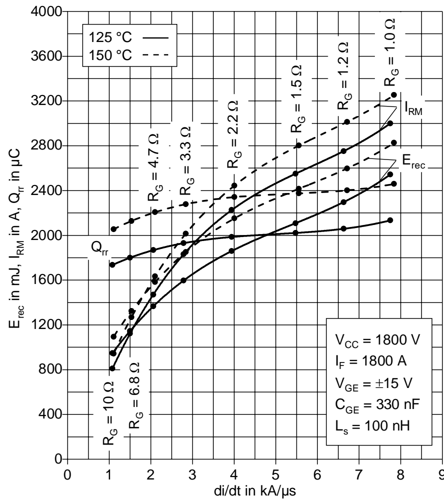


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Fig. 14 Safe operating area diode (SOA)

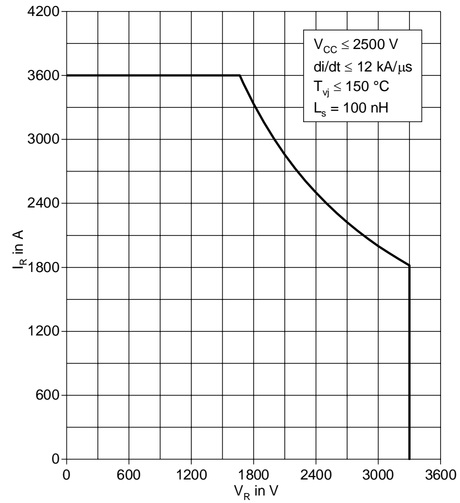


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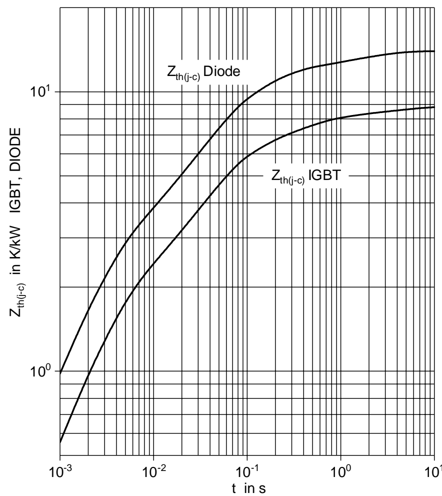
Fig. 15 Thermal impedance vs. time

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Analytical function of the transient thermal resistance

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

| | i | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| IGBT | Ri(K/kW) | 1.631 | 4.286 | 2.089 | 0.855 | |
| | τi(ms) | 2.986 | 48.79 | 364.8 | 3593 | |
| DIODE | Ri(K/kW) | 2.441 | 4.23 | 5.055 | 2.253 | |
| | τi(ms) | 2.434 | 36.51 | 116.2 | 1641 | |

Related documents:

- 5SYA 2039 Mounting Instructions for HiPak modules
- 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
- 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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