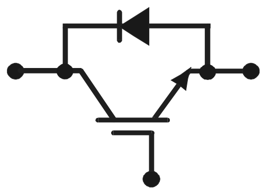
$V_{CE}$ = 2500 V
$I_C$ = 1200 A



# ABB HiPak™

# IGBT Module

# 5SNA 1200E250100

## PRELIMINARY

Doc. No. 5SYA 1557-01 Oct 03

- **Low-loss, rugged SPT chip-set**
- **Smooth switching SPT chip-set for good EMC**
- **Industry standard package**
- **High power density**
- **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 | | 2500 | V |
| DC collector current | $I_C$ | $T_c$ = 80 °C | | 1200 | A |
| Peak collector current | $I_{CM}$ | $t_p$ = 1 ms, $T_c$ = 80 °C | | 2400 | A |
| Gate-emitter voltage | $V_{GES}$ | | -20 | 20 | V |
| Total power dissipation | $P_{tot}$ | $T_c$ = 25 °C, per switch (IGBT) | | 13900 | W |
| DC forward current | $I_F$ | | | 1200 | A |
| Peak forward current | $I_{FM}$ | | | 2400 | A |
| Surge current | $I_{FSM}$ | $V_R$ = 0 V, $T_{vj}$ = 125 °C,<br>$t_p$ = 10 ms, half-sinewave | | 11000 | A |
| IGBT short circuit SOA | $t_{psc}$ | $V_{CC}$ = 1800 V, $V_{CEM\,CHIP} \leq$ 2500 V<br>$V_{GE} \leq$ 15 V, $T_{vj} \leq$ 125 °C | | 10 | µs |
| Isolation voltage | $V_{isol}$ | 1 min, f = 50 Hz | | 5000 | V |
| Junction temperature | $T_{vj}$ | | | 150 | °C |
| Junction operating temperature | $T_{vj(op)}$ | | -40 | 125 | °C |
| Storage temperature | $T_{stg}$ | | -40 | 125 | °C |
| Mounting torques | $M_1$ | Base-heatsink, M6 screws | 4 | 6 | Nm |
| | $M_2$ | Main terminals, M8 screws | 8 | 10 | |

1) Maximum rated values indicate limits beyond which damage to the device may occur

**ABB Switzerland Ltd, Semiconductors reserves the right to change specifications without notice.**

## IGBT characteristic values

| 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 | | 2500 | | | V |
| Collector-emitter [2] saturation voltage | $V_{CE\ sat}$ | $I_C$ = 1200 A, $V_{GE}$ = 15 V | $T_{vj}$ = 25 °C | | 2.5 | | V |
| | | | $T_{vj}$ = 125 °C | | 3.1 | 3.4 | V |
| Collector cut-off current | $I_{CES}$ | $V_{CE}$ = 2500 V, $V_{GE}$ = 0 V | $T_{vj}$ = 25 °C | | | 12 | mA |
| | | | $T_{vj}$ = 125 °C | | | 120 | 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 | $V_{GE(TO)}$ | $I_C$ = 240 mA, $V_{CE}$ = $V_{GE}$, $T_{vj}$ = 25 °C | | 6 | | 7.5 | V |
| Gate charge | $Q_{ge}$ | $I_C$ = 1200 A, $V_{CE}$ = 1250 V, $V_{GE}$ = -15 V .. 15 V | | | 12.2 | | µC |
| Input capacitance | $C_{ies}$ | $V_{CE}$ = 25 V, $V_{GE}$ = 0 V, f = 1 MHz, $T_{vj}$ = 25 °C | | | 186 | | nF |
| Output capacitance | $C_{oes}$ | | | | 13.7 | | |
| Reverse transfer capacitance | $C_{res}$ | | | | 2.98 | | |
| Turn-on delay time | $t_{d(on)}$ | $V_{CC}$ = 1250 V, $I_C$ = 1200 A, $R_G$ = 1.5 Ω, $V_{GE}$ = ±15 V, $L_\sigma$ = 100 nH, inductive load | $T_{vj}$ = 25 °C | | 375 | | ns |
| | | | $T_{vj}$ = 125 °C | | 365 | | |
| Rise time | $t_r$ | | $T_{vj}$ = 25 °C | | 240 | | ns |
| | | | $T_{vj}$ = 125 °C | | 250 | | |
| Turn-off delay time | $t_{d(off)}$ | $V_{CC}$ = 1250 V, $I_C$ = 1200 A, $R_G$ = 1.5 Ω, $V_{GE}$ = ±15 V, $L_\sigma$ = 100 nH, inductive load | $T_{vj}$ = 25 °C | | 875 | | ns |
| | | | $T_{vj}$ = 125 °C | | 980 | | |
| Fall time | $t_f$ | | $T_{vj}$ = 25 °C | | 300 | | ns |
| | | | $T_{vj}$ = 125 °C | | 345 | | |
| Turn-on switching energy | $E_{on}$ | $V_{CC}$ = 1250 V, $I_C$ = 1200 A, $V_{GE}$ = ±15, $R_G$ = 1.5 Ω, $L_\sigma$ = 100 nH, inductive load | $T_{vj}$ = 25 °C | | 820 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 1150 | | |
| Turn-off switching energy | $E_{off}$ | $V_{CC}$ = 1250 V, $I_C$ = 1200 A, $V_{GE}$ = ±15, $R_G$ = 1.5 Ω, $L_\sigma$ = 100 nH, inductive load | $T_{vj}$ = 25 °C | | 980 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 1250 | | |
| Short circuit current | $I_{SC}$ | $t_{psc}$ ≤ 10 µs, $V_{GE}$ = 15 V, $T_{vj}$ = 125 °C, $V_{CC}$ = 1800 V, $V_{CEM\ CHIP}$ ≤ 2500 V | | | 5800 | | A |
| Module stray inductance | $L_{\sigma\ CE}$ | | | | 10 | | nH |
| Resistance, terminal-chip | $R_{CC'+EE'}$ | | $T_C$ = 25 °C | | 0.06 | | mΩ |
| | | | $T_C$ = 125 °C | | 0.085 | | |

2) Collector emitter saturation voltage is given at chip level

## Diode characteristic values

| Parameter | Symbol | Conditions | | min | typ | max | Unit |
|---|---|---|---|---|---|---|---|
| Continous forward voltage [3] | $V_F$ | $I_F$ = 1200 A | $T_{vj}$ = 25 °C | | 1.75 | | V |
| | | | $T_{vj}$ = 125 °C | | 1.8 | | |
| Peak reverse recovery current | $I_{RM}$ | $V_{CC}$ = 1250 V, $I_F$ = 1200 A, $V_{GE}$ = ±15 V, $R_G$ = 1.5 Ω, $L_\sigma$ = 100 nH, inductive load | $T_{vj}$ = 25 °C | | 965 | | A |
| | | | $T_{vj}$ = 125 °C | | 1180 | | |
| Recovered charge | $Q_{RR}$ | | $T_{vj}$ = 25 °C | | 680 | | µC |
| | | | $T_{vj}$ = 125 °C | | 1150 | | |
| Reverse recovery time | $t_{rr}$ | | $T_{vj}$ = 25 °C | | 1250 | | ns |
| | | | $T_{vj}$ = 125 °C | | 970 | | |
| Reverse recovery energy | $E_{rec}$ | | $T_{vj}$ = 25 °C | | 580 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 990 | | |

3) Forward voltage is given at chip level

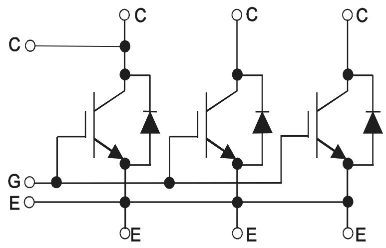
## Thermal properties

| 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 | $R_{th(j-c)DIODE}$ | | | | 0.017 | K/W |
| Thermal resistance case to heatsink | $R_{th(c-h)}$ | per module, λ grease = 1W/m x K | | 0.006 | | K/W |

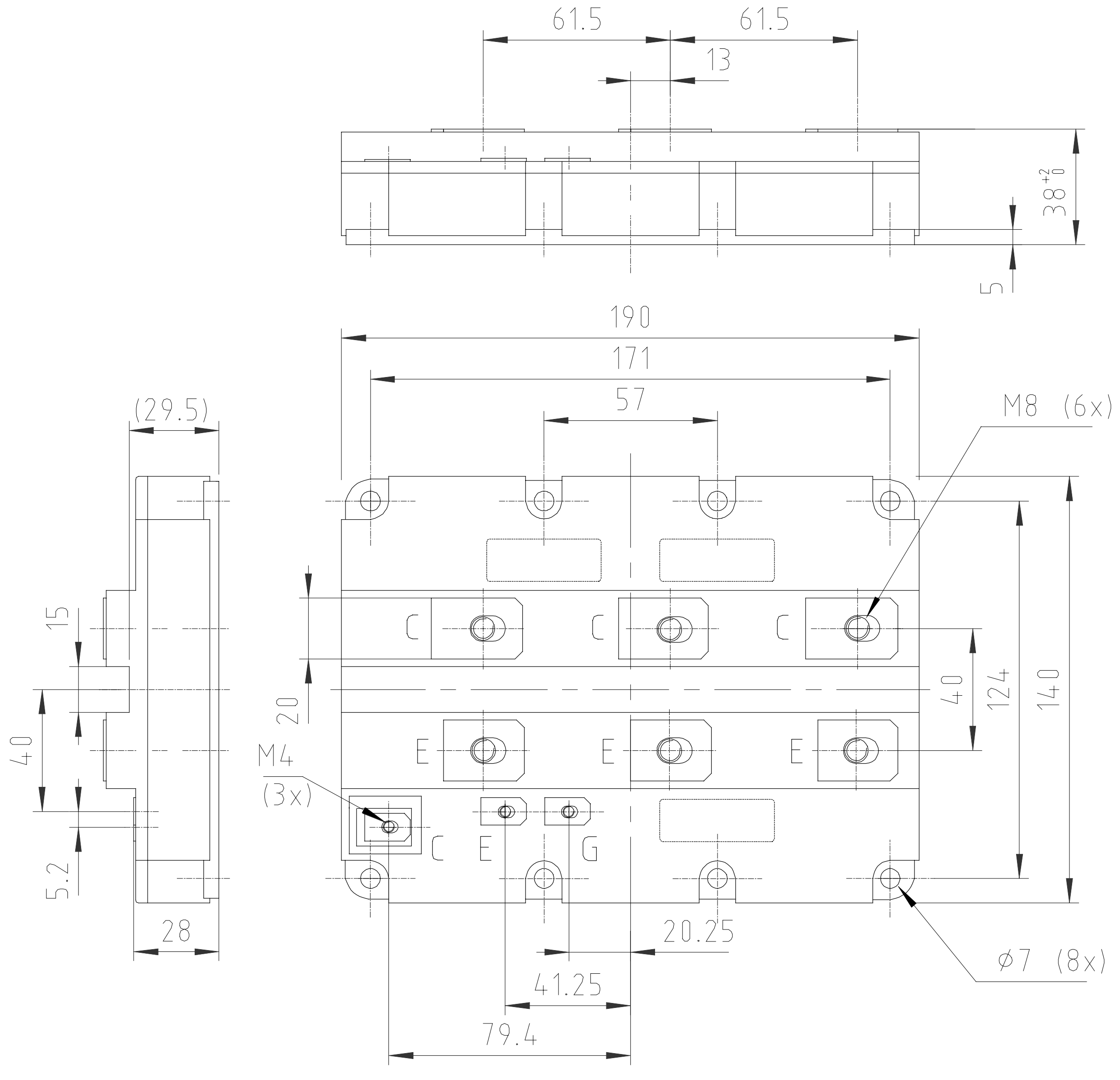
## Mechanical properties

| Parameter | Symbol | Conditions | | min | typ | max | Unit |
|---|---|---|---|---|---|---|---|
| Dimensions | L x W x H | Typical , see outline drawing | | 190 x 140 x 38 | | | mm |
| Clearance distance | $D_C$ | according to IEC 60664-1 and EN 50124-1 | Term. to base: | 23 | | | mm |
| | | | Term. to term: | 19 | | | |
| Surface creepage distance | $D_{SC}$ | according to IEC 60664-1 and EN 50124-1 | Term. to base: | 33 | | | mm |
| | | | Term. to term: | 32 | | | |
| Weight | | | | | 1500 | | gr |

## Electrical configuration




## Outline drawing




**Note: all dimensions are shown in mm**

**This is an electrostatic sensitive device, please observe the international standard IEC 60747-1, chap. IX.**

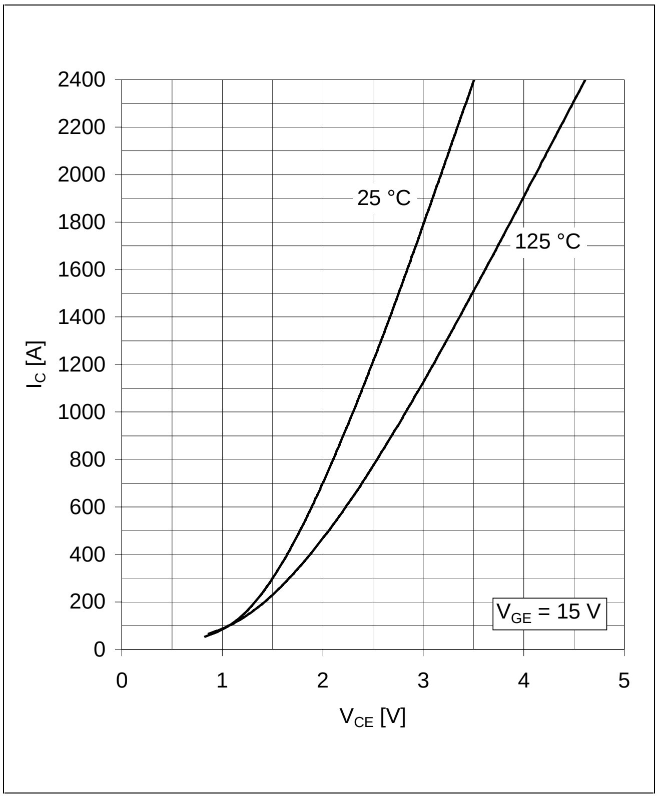



**Fig. 1** Typical onstate characteristics, chip level

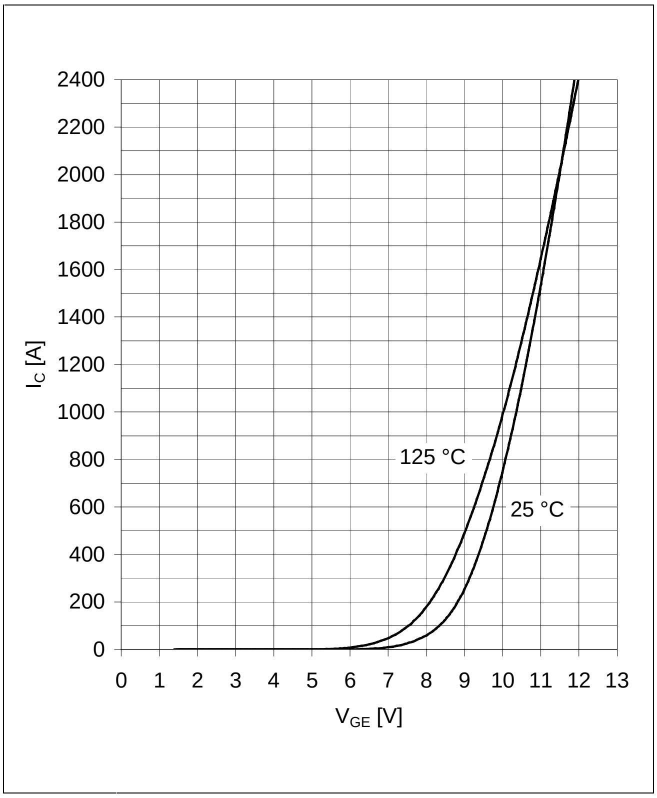



**Fig. 2** Typical transfer characteristics, chip level

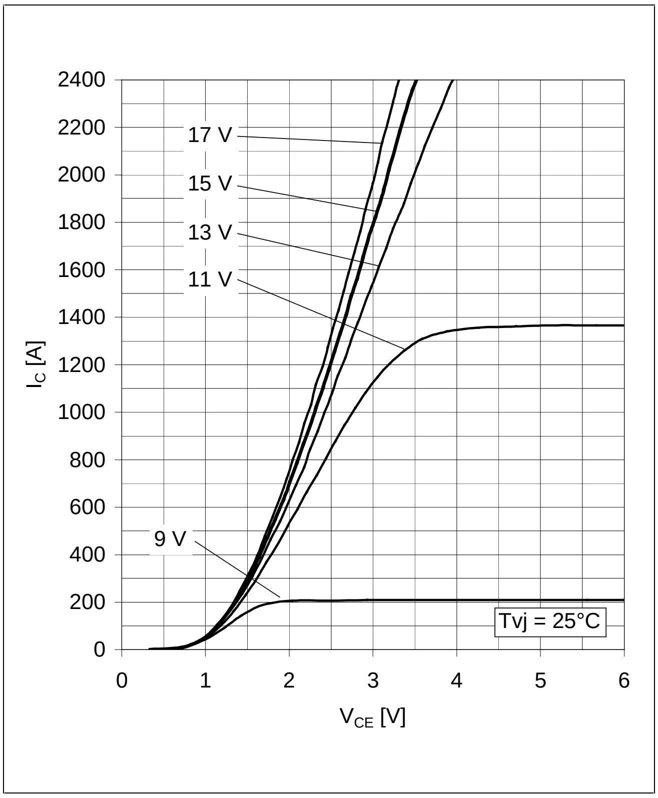



**Fig. 3** Typical output characteristics, chip level

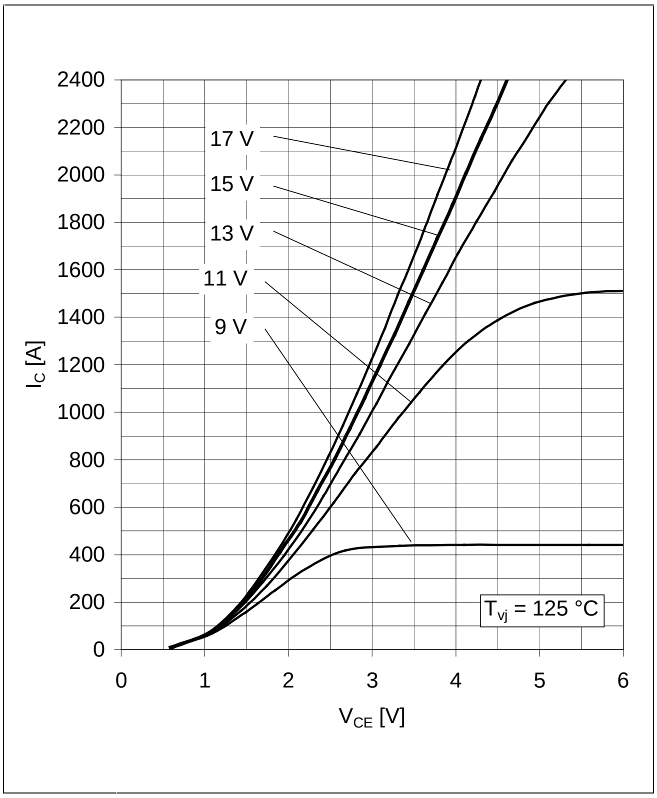



**Fig. 4** Typical output characteristics, chip level

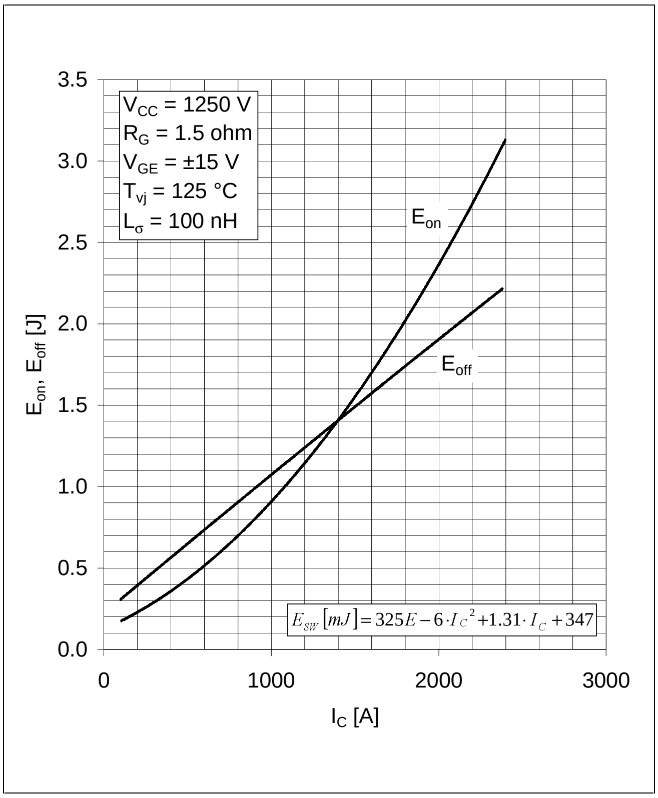



**Fig. 5** Typical switching energies per pulse vs collector current

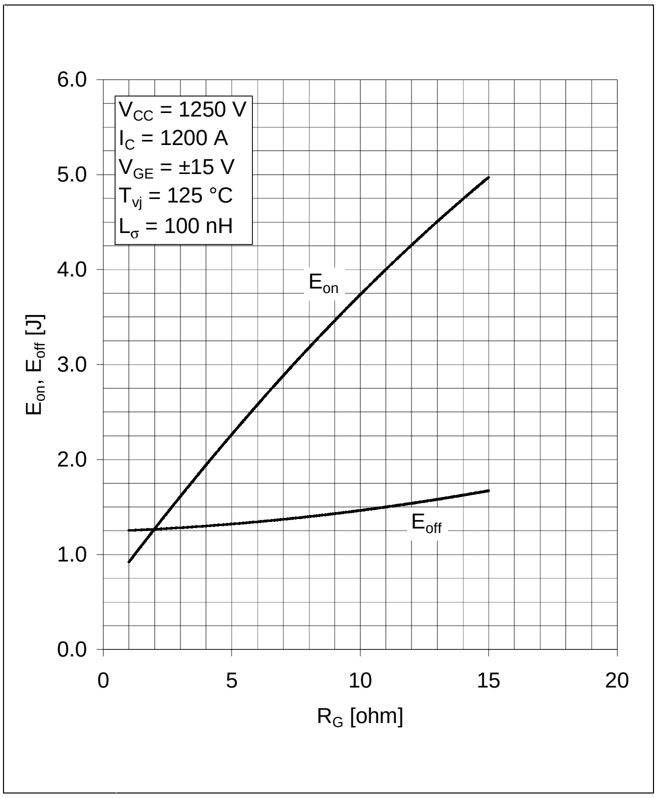



**Fig. 6** Typical switching energies per pulse vs gate resistor

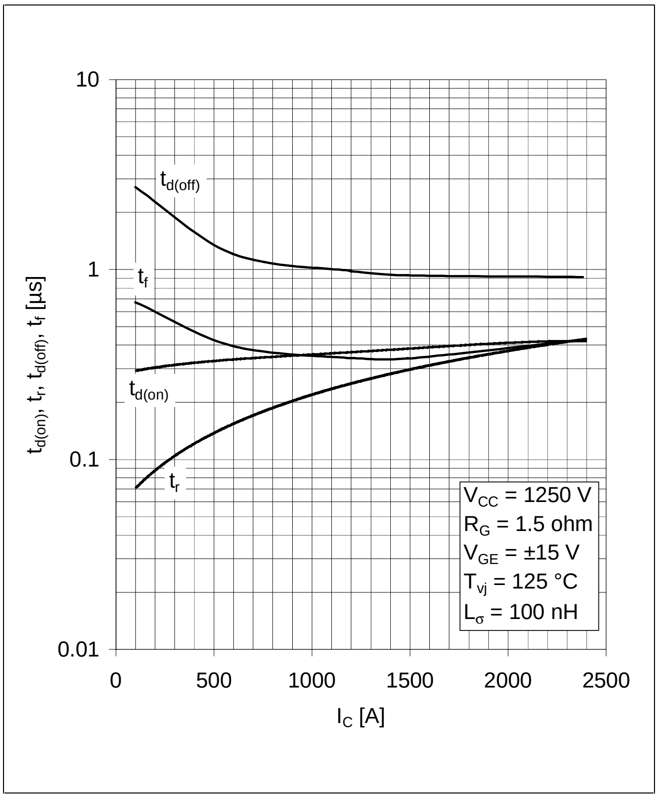



**Fig. 7** Typical switching times vs collector current

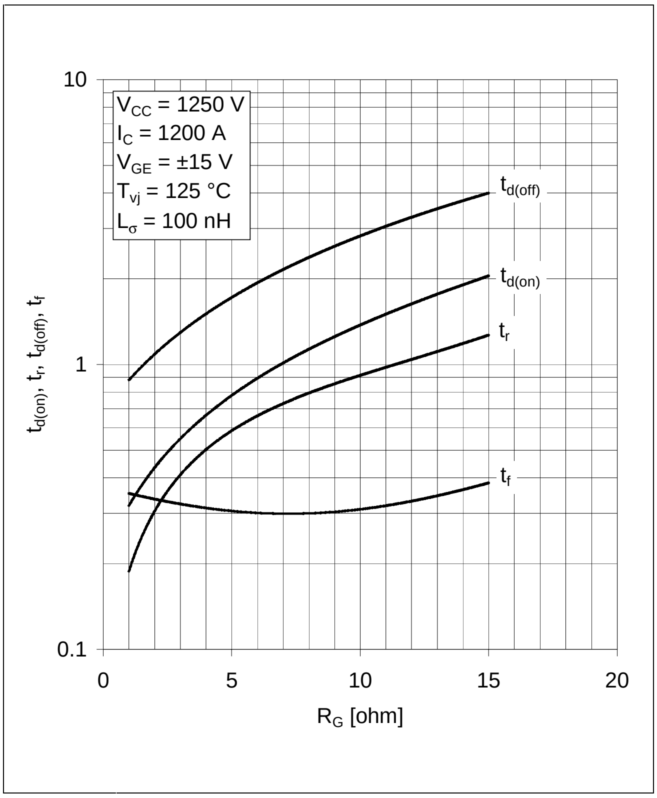



**Fig. 8** Typical switching times vs gate resistor

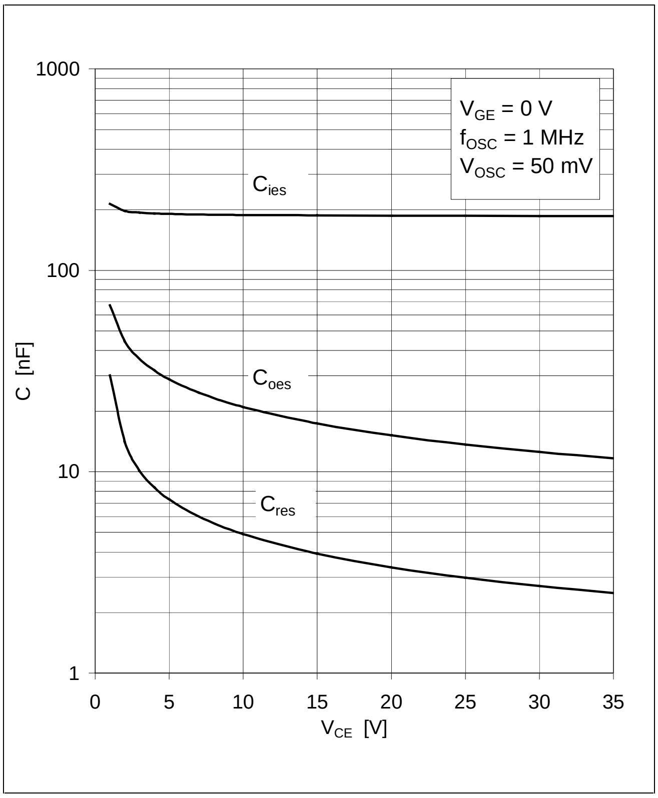



**Fig. 9** Typical capacitances vs collector-emitter voltage

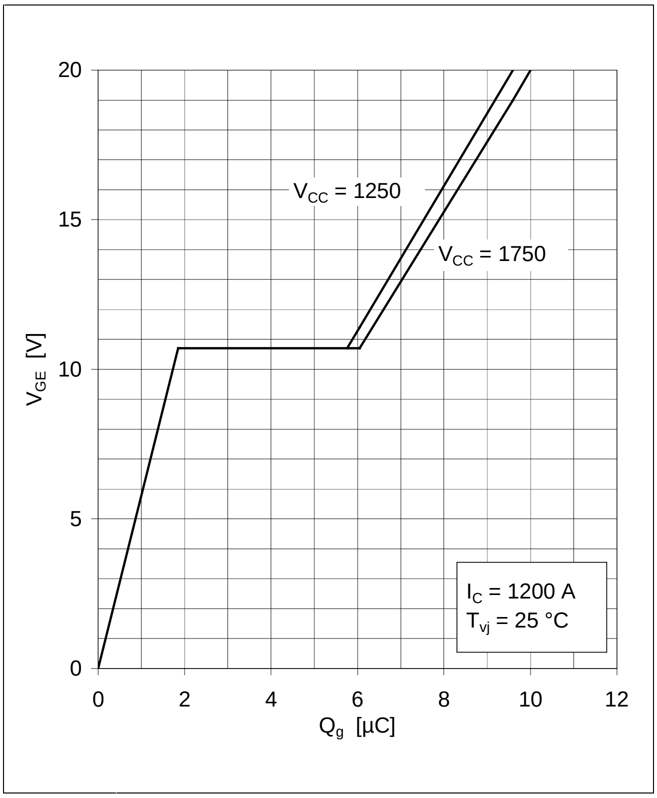



**Fig. 10** Typical gate charge characteristics

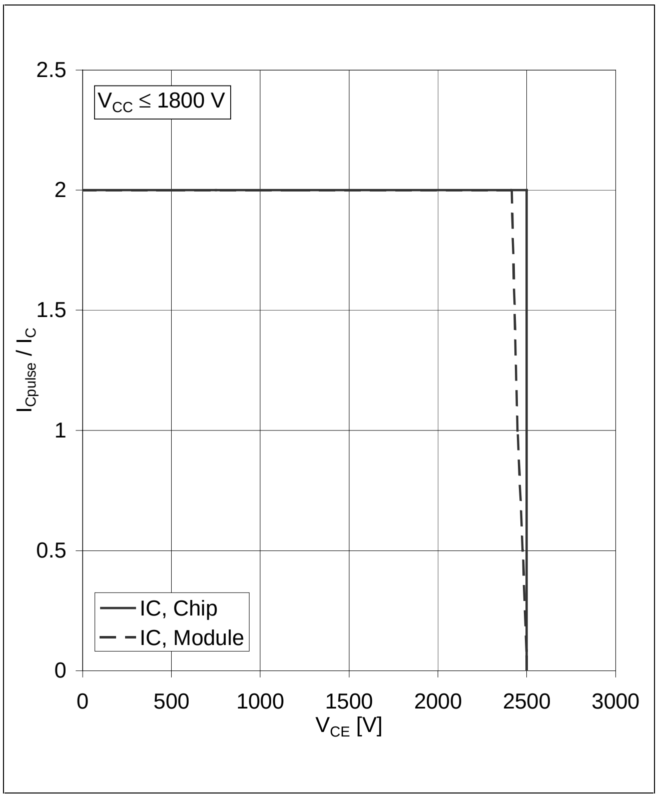



**Fig. 11** Turn-off safe operating area (RBSOA)

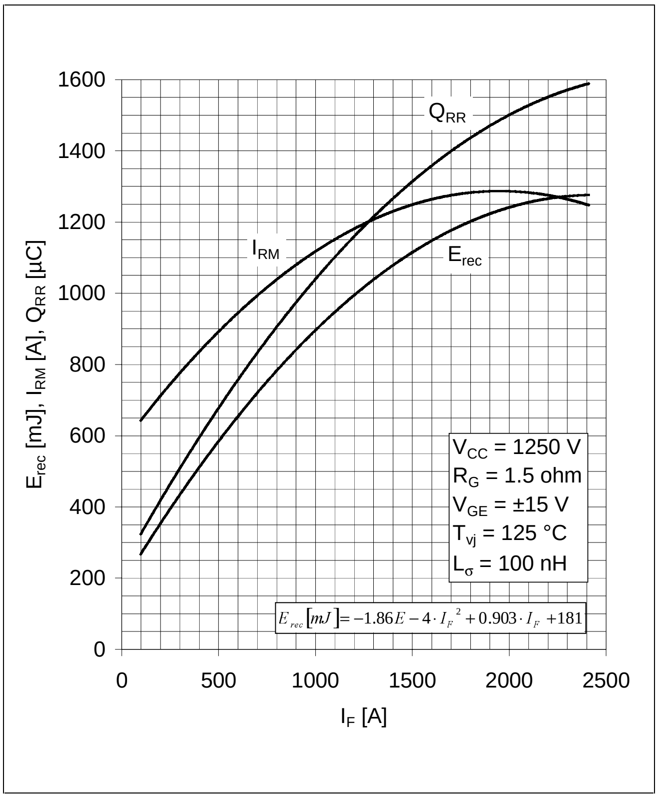



**Fig. 12** Typical reverse recovery characteristics vs forward current

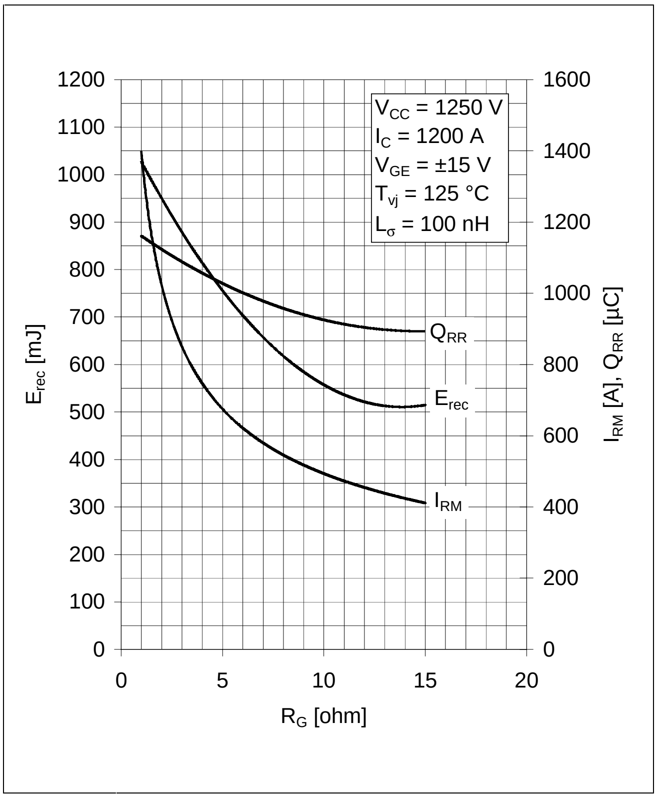



**Fig. 13** Typical reverse recovery characteristics vs gate resistor

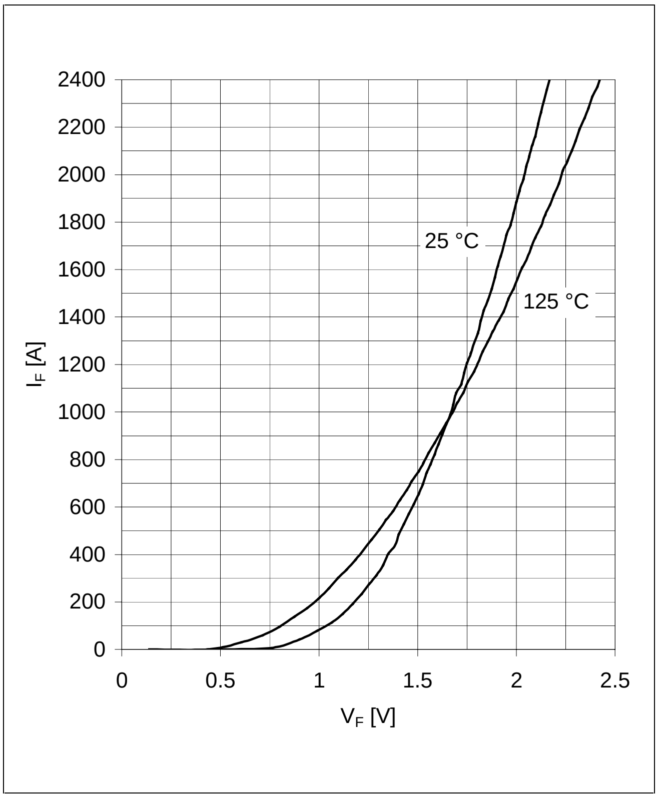



**Fig. 14** Typical diode forward characteristics, chip level

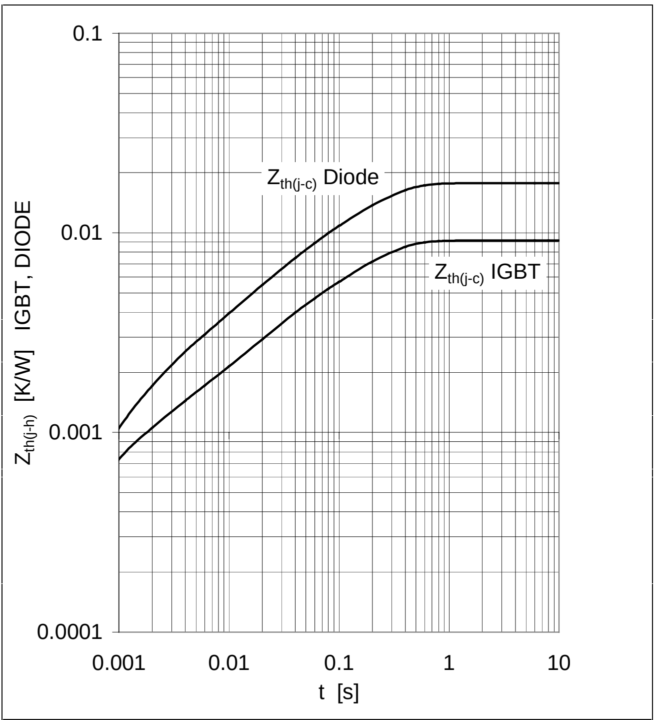



**Fig. 15** Thermal impedance vs time

## Analytical function for transient thermal impedance:

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

| | i | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| IGBT | Ri(K/kW) | 5.97 | 1.99 | 0.619 | 0.465 | |
| | $\tau_i$(ms) | 179 | 22 | 2.4 | 0.54 | |
| DIODE | Ri(K/kW) | 11.1 | 3.36 | 1.27 | 1.34 | |
| | $\tau_i$(ms) | 189 | 30 | 7.4 | 1.4 | |



**ABB Switzerland Ltd**
**Semiconductors**
Fabrikstrasse 3
CH-5600 Lenzburg, Switzerland

Telephone +41 (0)58 586 1419
Fax +41 (0)58 586 1306
Email abbsem@ch.abb.com
Internet www.abb.com/semiconductors

Doc. No. 5SYA 1557-01 Oct 03