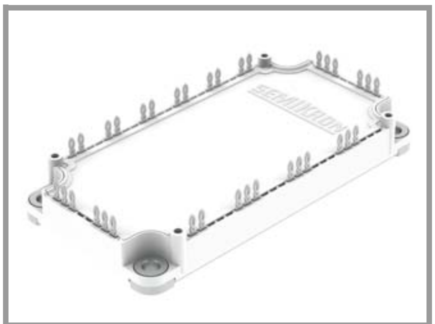
# SEMiX156GD12T4p



**SEMiX® 6p**

## Trench IGBT Modules

**SEMiX156GD12T4p**

### Features*

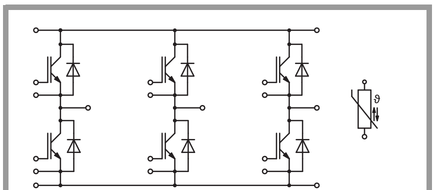
- Press Fit
- Homogeneous Si
- Trench = Trenchgate technology
- $V_{CE(sat)}$ with positive temperature coefficient
- High short circuit capability
- UL recognised file no. E63532

### Typical Applications

- AC inverter drives
- UPS
- Electronic Welding

### Remarks

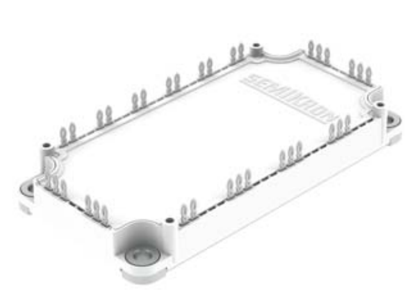
- Case temperature limited to $T_C$=125°C max.
- $V_{isol}$ between temperature sensor and power section is only 2500V
- Product reliability results valid for $T_j \leq$ 150°C (recommended $T_{jop}$= -40 ... 150°C)



**GD**

| Absolute Maximum Ratings | | | | |
|---|---|---|---|---|
| **Symbol** | **Conditions** | | **Values** | **Unit** |
| **IGBT** | | | | |
| $V_{CES}$ | $T_j$ = 25 °C | | 1200 | V |
| $I_C$ | $T_j$ = 175 °C | $T_c$ = 25 °C | 239 | A |
| | | $T_c$ = 80 °C | 184 | A |
| $I_{Cnom}$ | | | 150 | A |
| $I_{CRM}$ | $I_{CRM}$ = 3 x $I_{Cnom}$ | | 450 | A |
| $V_{GES}$ | | | -20 ... 20 | V |
| $t_{psc}$ | $V_{CC}$ = 800 V<br>$V_{GE} \leq$ 20 V<br>$V_{CES} \leq$ 1200 V | $T_j$ = 150 °C | 10 | µs |
| $T_j$ | | | -40 ... 175 | °C |
| **Inverse diode** | | | | |
| $V_{RRM}$ | $T_j$ = 25 °C | | 1200 | V |
| $I_F$ | $T_j$ = 175 °C | $T_c$ = 25 °C | 181 | A |
| | | $T_c$ = 80 °C | 136 | A |
| $I_{Fnom}$ | | | 150 | A |
| $I_{FRM}$ | $I_{FRM}$ = 2x$I_{Fnom}$ | | 300 | A |
| $I_{FSM}$ | $t_p$ = 10 ms, sin 180°, $T_j$ = 25 °C | | 900 | A |
| $T_j$ | | | -40 ... 175 | °C |
| **Module** | | | | |
| $I_{t(RMS)}$ | per connector pin | | 50 | A |
| $T_{stg}$ | | | -40 ... 125 | °C |
| $V_{isol}$ | AC sinus 50Hz, t = 1 min | | 4000 | V |

| Characteristics | | | | | | |
|---|---|---|---|---|---|---|
| **Symbol** | **Conditions** | | **min.** | **typ.** | **max.** | **Unit** |
| **IGBT** | | | | | | |
| $V_{CE(sat)}$ | $I_C$ = 150 A<br>$V_{GE}$ = 15 V<br>chiplevel | $T_j$ = 25 °C | | 1.80 | 2.05 | V |
| | | $T_j$ = 150 °C | | 2.10 | 2.40 | V |
| $V_{CE0}$ | chiplevel | $T_j$ = 25 °C | | 0.8 | 0.9 | V |
| | | $T_j$ = 150 °C | | 0.7 | 0.8 | V |
| $r_{CE}$ | $V_{GE}$ = 15 V<br>chiplevel | $T_j$ = 25 °C | | 6.7 | 7.7 | mΩ |
| | | $T_j$ = 150 °C | | 9.3 | 10.7 | mΩ |
| $V_{GE(th)}$ | $V_{GE}$=$V_{CE}$, $I_C$ = 6 mA | | 5 | 5.8 | 6.5 | V |
| $I_{CES}$ | $V_{GE}$ = 0 V, $V_{CE}$ = 1200 V, $T_j$ = 25 °C | | | | 2.0 | mA |
| $C_{ies}$ | $V_{CE}$ = 25 V<br>$V_{GE}$ = 0 V | f = 1 MHz | | 9.3 | | nF |
| $C_{oes}$ | | f = 1 MHz | | 0.58 | | nF |
| $C_{res}$ | | f = 1 MHz | | 0.51 | | nF |
| $Q_G$ | $V_{GE}$ = - 8 V...+ 15 V | | | 850 | | nC |
| $R_{Gint}$ | $T_j$ = 25 °C | | | 5.0 | | Ω |
| $t_{d(on)}$ | $V_{CC}$ = 600 V<br>$I_C$ = 150 A<br>$V_{GE}$ = +15/-15 V<br>$R_{G\,on}$ = 1.1 Ω<br>$R_{G\,off}$ = 1.1 Ω<br>di/dt$_{on}$ = 4950 A/µs<br>di/dt$_{off}$ = 1600 A/µs<br>dv/dt = 3500 V/µs<br>$L_s$ = 25 nH | $T_j$ = 150 °C | | 151 | | ns |
| $t_r$ | | $T_j$ = 150 °C | | 32 | | ns |
| $E_{on}$ | | $T_j$ = 150 °C | | 11 | | mJ |
| $t_{d(off)}$ | | $T_j$ = 150 °C | | 408 | | ns |
| $t_f$ | | $T_j$ = 150 °C | | 76 | | ns |
| $E_{off}$ | | $T_j$ = 150 °C | | 17 | | mJ |
| $R_{th(j-c)}$ | per IGBT | | | | 0.18 | K/W |
| $R_{th(c-s)}$ | per IGBT ($\lambda_{grease}$=0.81 W/(m*K)) | | | 0.04 | | K/W |



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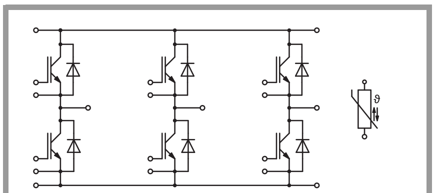
**Characteristics**

| Symbol | Conditions | | min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|
| **Inverse diode** | | | | | | |
| $V_F = V_{EC}$ | $I_F$ = 150 A<br>$V_{GE}$ = 0 V<br>chiplevel | $T_j$ = 25 °C | | 2.14 | 2.46 | V |
| | | $T_j$ = 150 °C | | 2.07 | 2.38 | V |
| $V_{F0}$ | chiplevel | $T_j$ = 25 °C | | 1.3 | 1.50 | V |
| | | $T_j$ = 150 °C | | 0.90 | 1.10 | V |
| $r_F$ | chiplevel | $T_j$ = 25 °C | | 5.6 | 6.4 | mΩ |
| | | $T_j$ = 150 °C | | 7.8 | 8.5 | mΩ |
| $I_{RRM}$ | $I_F$ = 150 A<br>$di/dt_{off}$ = 5000 A/µs<br>$V_{GE}$ = -15 V<br>$V_{CC}$ = 600 V | $T_j$ = 150 °C | | 235 | | A |
| $Q_{rr}$ | | $T_j$ = 150 °C | | 26.5 | | µC |
| $E_{rr}$ | | $T_j$ = 150 °C | | 11.5 | | mJ |
| $R_{th(j-c)}$ | per diode | | | | 0.33 | K/W |
| $R_{th(c-s)}$ | per diode ($\lambda_{grease}$=0.81 W/(m*K)) | | | 0.05 | | K/W |
| **Module** | | | | | | |
| $L_{CE}$ | | | | 18 | | nH |
| $R_{CC'+EE'}$ | measured per switch | $T_C$ = 25 °C | | 1 | | mΩ |
| | | $T_C$ = 125 °C | | 1.4 | | mΩ |
| $R_{th(c-s)1}$ | calculated without thermal coupling ($\lambda_{grease}$=0.81 W/(m*K)) | | | 0.004 | | K/W |
| $R_{th(c-s)2}$ | including thermal coupling, $T_s$ underneath module ($\lambda_{grease}$=0.81 W/(m*K)) | | | 0.006 | | K/W |
| $M_s$ | to heat sink (M5) | | 3 | | 6 | Nm |
| $M_t$ | | | | - | | Nm |
| | | | | - | | Nm |
| w | | | | 300 | | g |
| **Temperature Sensor** | | | | | | |
| $R_{100}$ | $T_c$=100°C ($R_{25}$=5 kΩ) | | | 493 ± 5% | | Ω |
| $B_{100/125}$ | $R_{(T)}=R_{100}exp[B_{100/125}(1/T-1/T_{100})]$; T[K]; | | | 3550 ±2% | | K |



GD

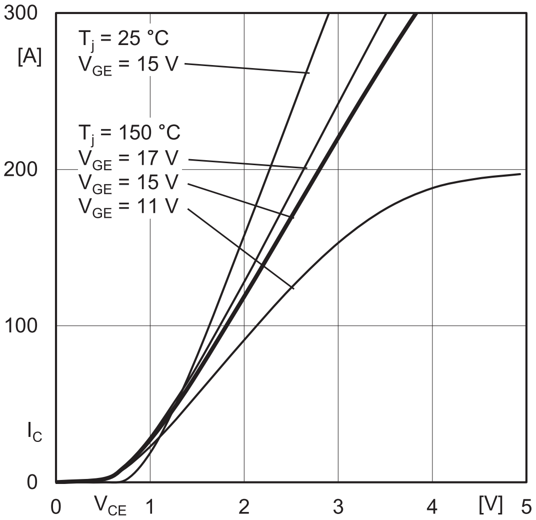



Fig. 1: Typ. output characteristic, inclusive $R_{CC'+EE'}$

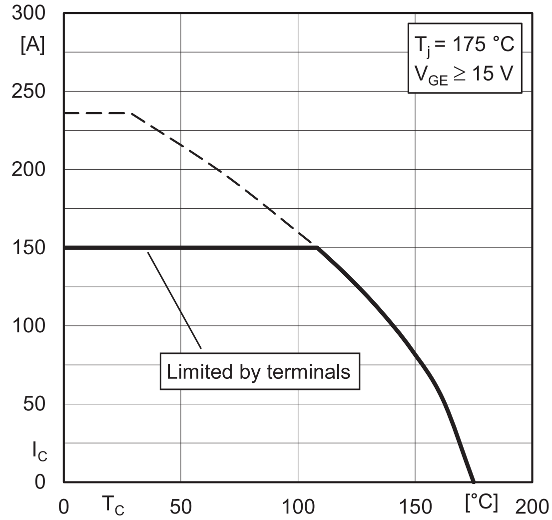



Fig. 2: Rated current vs. temperature $I_C$ = f ($T_C$)

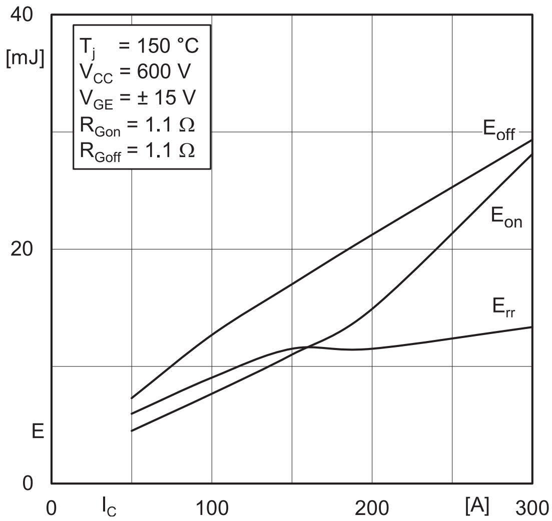



Fig. 3: Typ. turn-on /-off energy = f ($I_C$)

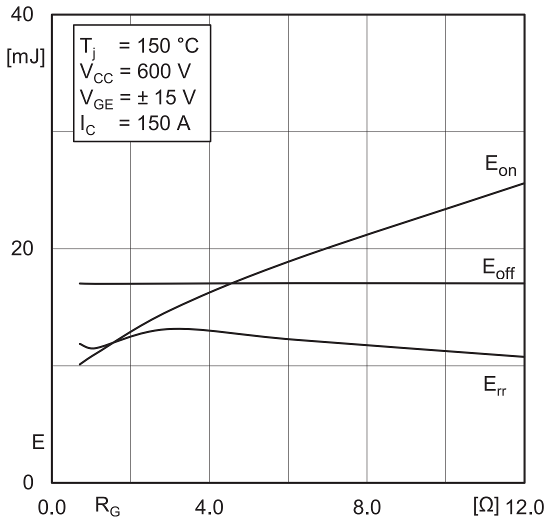



Fig. 4: Typ. turn-on /-off energy = f ($R_G$)

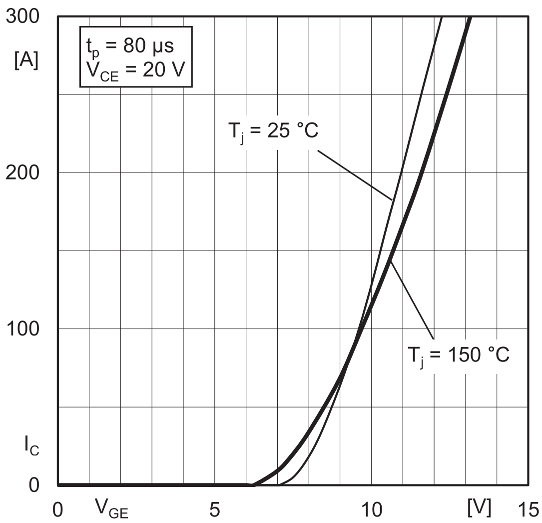



Fig. 5: Typ. transfer characteristic

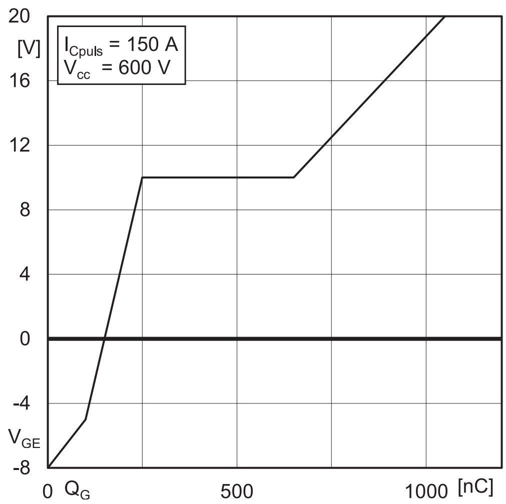



Fig. 6: Typ. gate charge characteristic

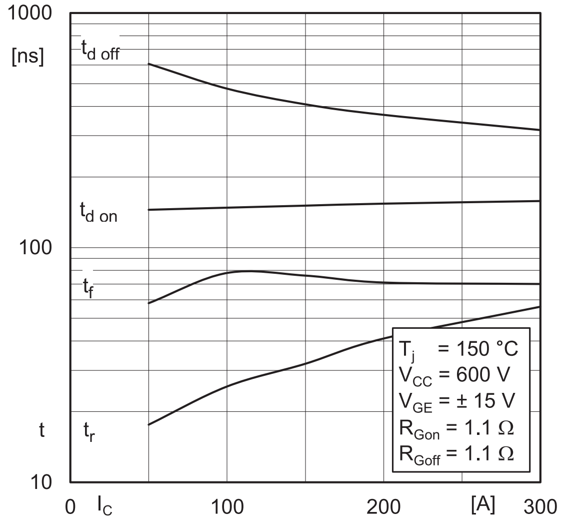



Fig. 7: Typ. switching times vs. $I_C$

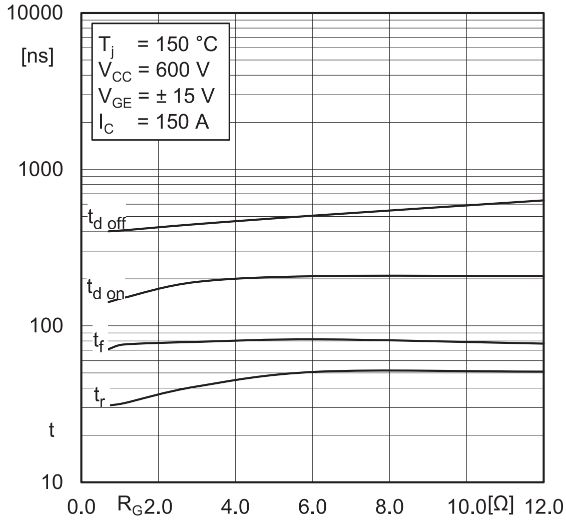



Fig. 8: Typ. switching times vs. gate resistor $R_G$

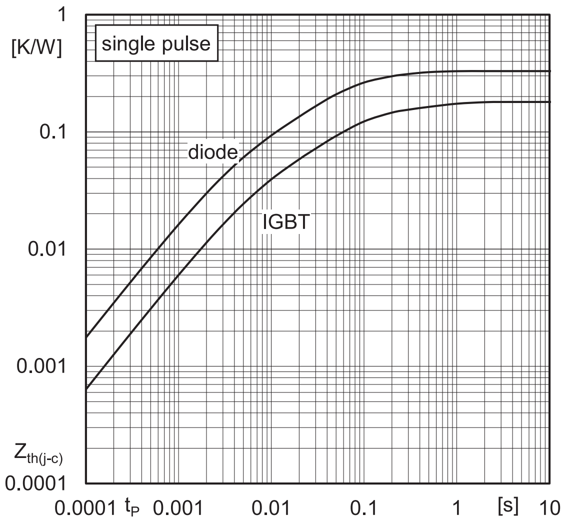



Fig. 9: Transient thermal impedance

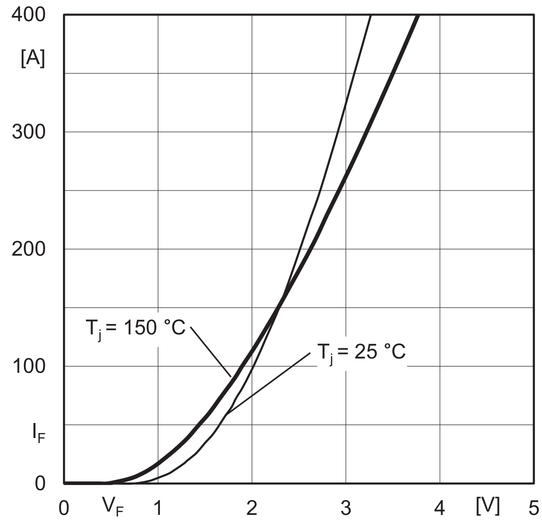



Fig. 10: Typ. CAL diode forward charact., incl. $R_{CC'+EE'}$

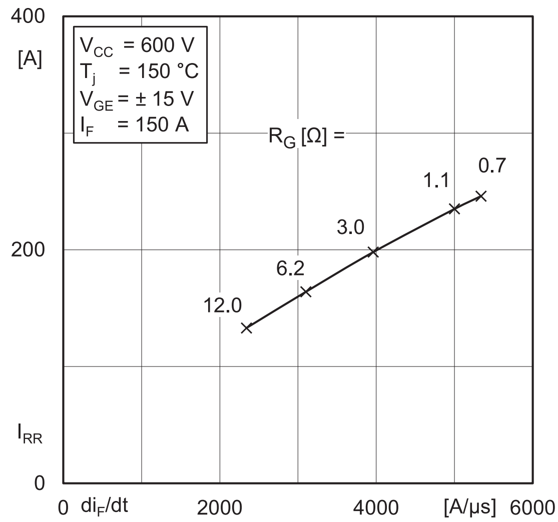



Fig. 11: Typ. CAL diode peak reverse recovery current

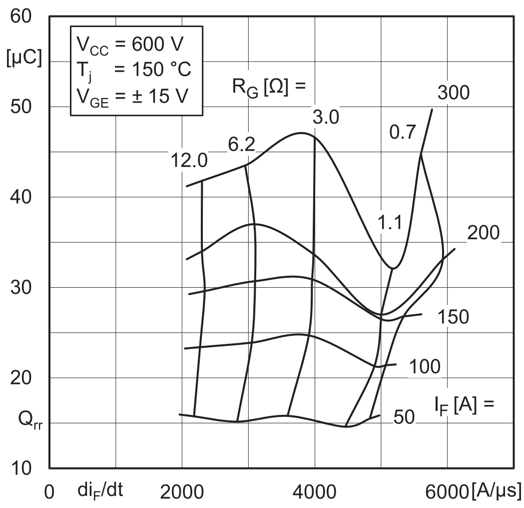
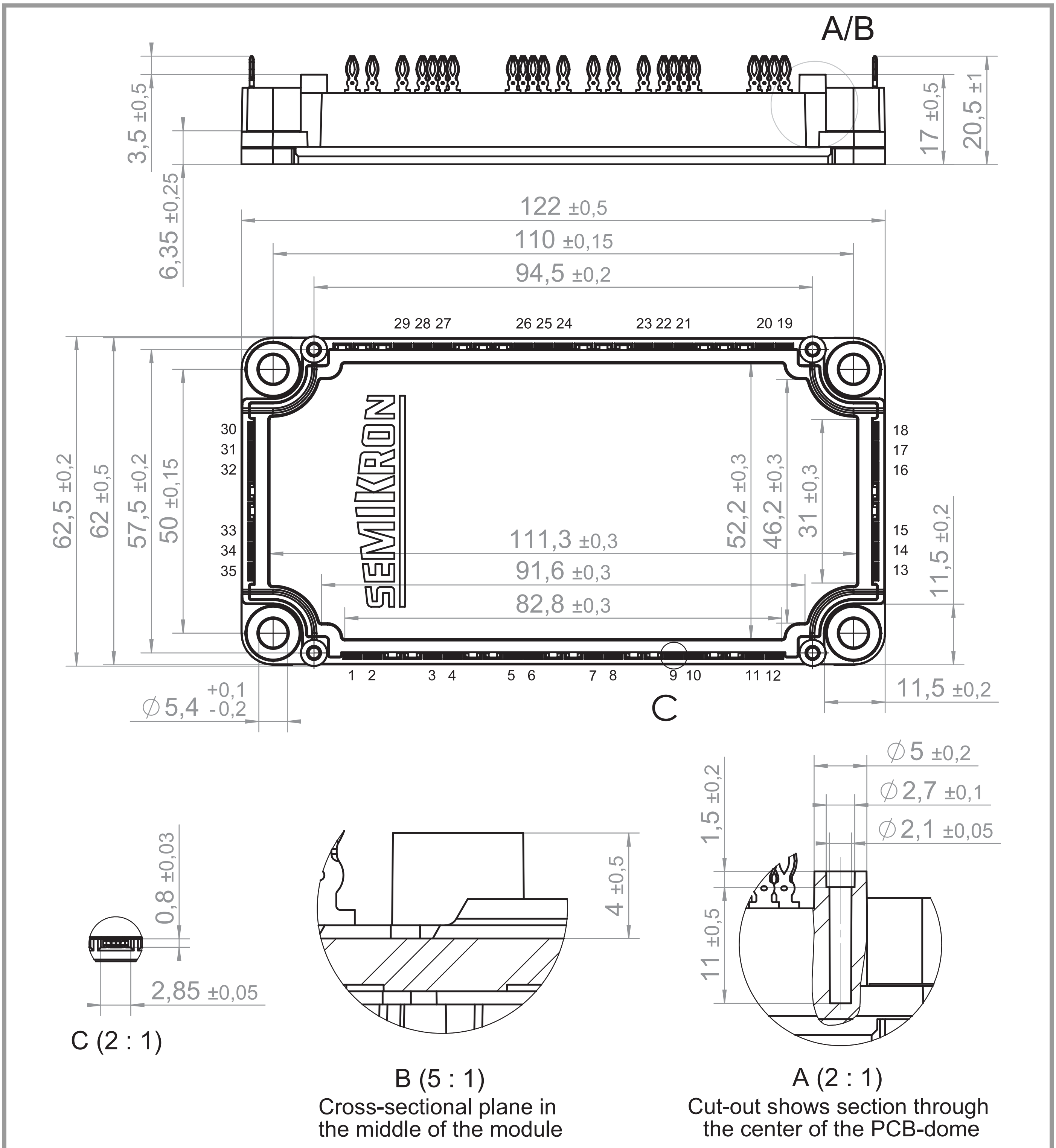
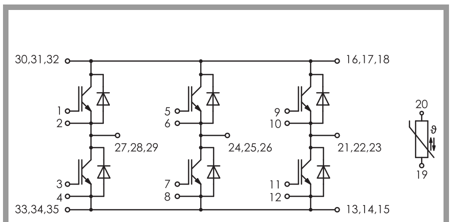


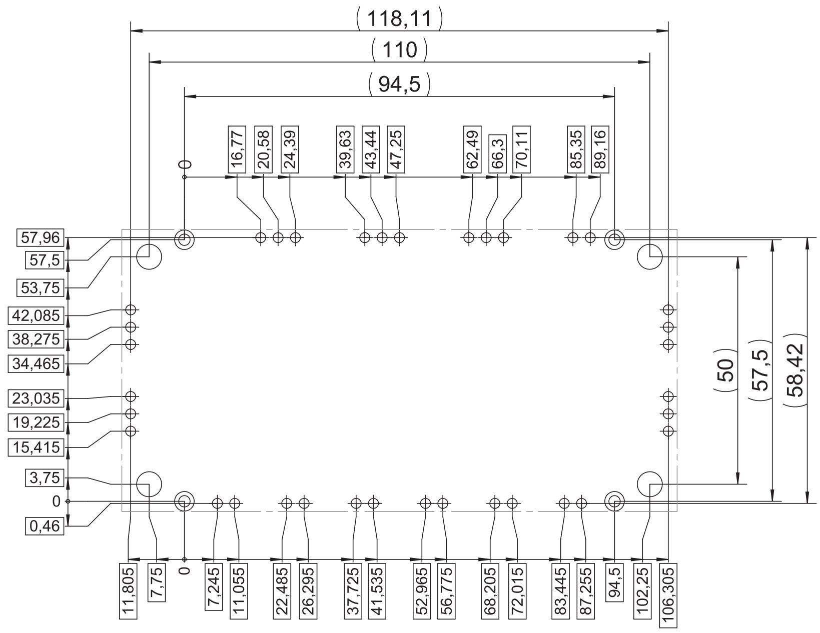

Fig. 12: Typ. CAL diode recovery charge


A/B
3,5 ±0,5
6,35 ±0,25
17 ±0,5
20,5 ±1
122 ±0,5
110 ±0,15
94,5 ±0,2
29 28 27
26 25 24
23 22 21
20 19
30
31
32
33
34
35
18
17
16
15
14
13
62,5 ±0,2
62 ±0,5
57,5 ±0,2
50 ±0,15
52,2 ±0,3
46,2 ±0,3
31 ±0,3
11,5 ±0,2
111,3 ±0,3
91,6 ±0,3
82,8 ±0,3
SEMIKRON
1 2
3 4
5 6
7 8
9 10
11 12
∅5,4 +0,1 -0,2
C
11,5 ±0,2
∅5 ±0,2
∅2,7 ±0,1
∅2,1 ±0,05
1,5 ±0,2
11 ±0,5
0,8 ±0,03
2,85 ±0,05
4 ±0,5
C (2 : 1)
B (5 : 1)
Cross-sectional plane in the middle of the module
A (2 : 1)
Cut-out shows section through the center of the PCB-dome


30,31,32
16,17,18
1
2
5
6
9
10
20
19
27,28,29
24,25,26
21,22,23
3
4
7
8
11
12
33,34,35
13,14,15

pinout




- Tolerance for PCB holes ⌖ ⌀ 0,1
- Diameter of plated holes ø 2,14 mm - 2,29 mm
- Diameter of drill ø 2,35 mm

This is an electrostatic discharge sensitive device (ESDS), international standard IEC 60747-1, chapter IX.

***IMPORTANT INFORMATION AND WARNINGS**