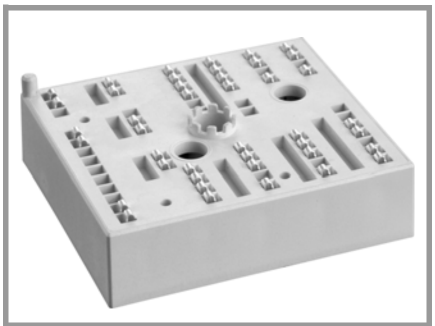


MiniSKiiP® 2

3-Level NPC IGBT-Module

**SKiiP 28MLI07E3V1**

### Features*

- 650V Trench IGBTs
- Robust and soft diodes in CAL technology
- Highly reliable spring contacts for electrical connections
- UL recognised: File no. E63532
- NTC T-Sensor

### Typical Applications

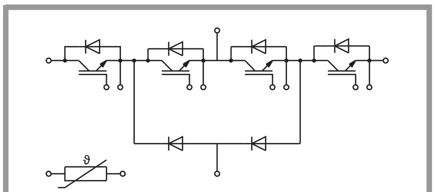
- Uninterruptible power supplies (UPS)
- Solar inverters

### Remarks

- Case temperature limited to $T_C$=125°C max.; $T_C$=$T_S$ (valid for baseplate-less modules)
- Product reliability results are valid for $T_{jop}$=150°C

### Footnotes

1) Please find further technical information on the SEMIKRON website.



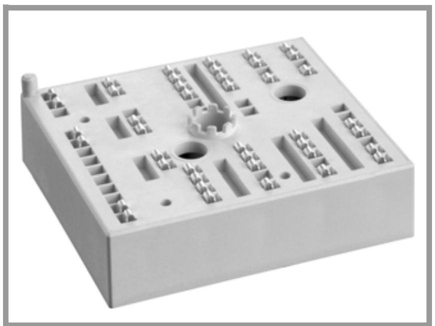
MLI

**Absolute Maximum Ratings**

| Symbol | Conditions | | Values | Unit |
|---|---|---|---|---|
| **IGBT** | | | | |
| $V_{CES}$ | | | 650 | V |
| $I_C$ | $\lambda_{paste}$=0.8 W/(mK) $T_j$ = 175 °C | $T_s$ = 25 °C | 135 | A |
| | | $T_s$ = 70 °C | 107 | A |
| $I_C$ | $\lambda_{paste}$=2.5 W/(mK) $T_j$ = 175 °C | $T_s$ = 25 °C | 163 | A |
| | | $T_s$ = 70 °C | 130 | A |
| $I_{Cnom}$ | | | 150 | A |
| $I_{CRM}$ | | | 450 | A |
| $V_{GES}$ | | | -20 ... 20 | V |
| $t_{psc}$ | $V_{CC}$ = 360 V $V_{GE}$ ≤ 15 V $V_{CES}$ ≤ 650 V | $T_j$ = 150 °C | 6 | µs |
| $T_j$ | | | -40 ... 175 | °C |
| **Inverse diode** | | | | |
| $I_F$ | $\lambda_{paste}$=0.8 W/(mK) $T_j$ = 175 °C | $T_s$ = 25 °C | 126 | A |
| | | $T_s$ = 70 °C | 97 | A |
| $I_F$ | $\lambda_{paste}$=2.5 W/(mK) $T_j$ = 175 °C | $T_s$ = 25 °C | 151 | A |
| | | $T_s$ = 70 °C | 118 | A |
| $I_{FRM}$ | | | 300 | A |
| $I_{FSM}$ | $t_p$ = 10 ms, sin 180°, $T_j$ = 25 °C | | 1200 | A |
| $T_j$ | | | -40 ... 175 | °C |
| **Clamping diode** | | | | |
| $I_F$ | $\lambda_{paste}$=0.8 W/(mK) $T_j$ = 175 °C | $T_s$ = 25 °C | 126 | A |
| | | $T_s$ = 70 °C | 97 | A |
| $I_F$ | $\lambda_{paste}$=2.5 W/(mK) $T_j$ = 175 °C | $T_s$ = 25 °C | 151 | A |
| | | $T_s$ = 70 °C | 118 | A |
| $I_{FRM}$ | | | 300 | A |
| $I_{FSM}$ | 10 ms, sin 180°, $T_j$ = 25 °C | | 1200 | A |
| $T_j$ | | | -40 ... 175 | °C |
| **Module** | | | | |
| $I_{t(RMS)}$ | $T_{terminal}$ = 80°C, 20A per spring | | 120 | A |
| $T_{stg}$ | | | -40 ... 125 | °C |
| $V_{isol}$ | AC sinus 50 Hz, t = 1 min | | 2500 | V |

**Characteristics**

| Symbol | Conditions | | min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|
| **IGBT** | | | | | | |
| $V_{CE(sat)}$ | $I_C$ = 150 A $V_{GE}$ = 15 V chiplevel | $T_j$ = 25 °C | | 1.45 | 1.90 | V |
| | | $T_j$ = 150 °C | | 1.70 | 2.10 | V |
| $V_{CE0}$ | chiplevel | $T_j$ = 25 °C | | 0.90 | 1.00 | V |
| | | $T_j$ = 150 °C | | 0.82 | 0.90 | V |
| $r_{CE}$ | $V_{GE}$ = 15 V chiplevel | $T_j$ = 25 °C | | 3.7 | 6.0 | mΩ |
| | | $T_j$ = 150 °C | | 5.9 | 8.0 | mΩ |
| $V_{GE(th)}$ | $V_{GE}$ = $V_{CE}$, $I_C$ = 2.4 mA | | 5.1 | 5.8 | 6.4 | V |
| $I_{CES}$ | $V_{GE}$ = 0 V $V_{CE}$ = 650 V | $T_j$ = 25 °C | | | 1.5 | mA |
| | | | | - | | mA |
| $C_{ies}$ | $V_{CE}$ = 25 V $V_{GE}$ = 0 V | f = 1 MHz | | 9.24 | | nF |
| $C_{oes}$ | | f = 1 MHz | | 0.58 | | nF |
| $C_{res}$ | | f = 1 MHz | | 0.27 | | nF |



## MiniSKiiP® 2

3-Level NPC IGBT-Module

**SKiiP 28MLI07E3V1**

### Features*

- 650V Trench IGBTs
- Robust and soft diodes in CAL technology
- Highly reliable spring contacts for electrical connections
- UL recognised: File no. E63532
- NTC T-Sensor

### Typical Applications

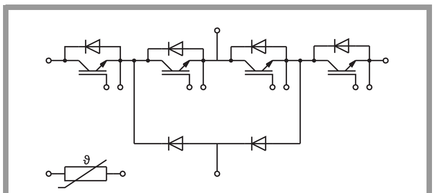
- Uninterruptible power supplies (UPS)
- Solar inverters

### Remarks

- Case temperature limited to $T_C$=125°C max.; $T_C$=$T_S$ (valid for baseplate-less modules)
- Product reliability results are valid for $T_{jop}$=150°C

### Footnotes

[1] Please find further technical information on the SEMIKRON website.



MLI

| Characteristics | | | | | | |
|---|---|---|---|---|---|---|
| **Symbol** | **Conditions** | | **min.** | **typ.** | **max.** | **Unit** |
| **IGBT** | | | | | | |
| $Q_G$ | $V_{GE}$ = - 8 V...+ 15 V | | | 1200 | | nC |
| $R_{Gint}$ | $T_j$ = 25 °C | | | 2.0 | | Ω |
| **T1 / T4** | | | | | | |
| $t_{d(on)}$ | $V_{CE}$ = 300 V | $T_j$ = 150 °C | | 108 | | ns |
| $t_r$ | $I_C$ = 150 A | $T_j$ = 150 °C | | 73 | | ns |
| $E_{on}$ | $V_{GE}$ = +15/-15 V | $T_j$ = 150 °C | | 5.5 | | mJ |
| $t_{d(off)}$ | $R_{G\ on}$ = 3 Ω | $T_j$ = 150 °C | | 268 | | ns |
| $t_f$ | $R_{G\ off}$ = 1.6 Ω<br>$di/dt_{on}$ = 2100 A/µs | $T_j$ = 150 °C | | 76 | | ns |
| $E_{off}$ | $di/dt_{off}$ = 1700 A/µs | $T_j$ = 150 °C | | 5.6 | | mJ |
| $R_{th(j-s)}$ | per IGBT, $\lambda_{paste}$=0.8 W/(mK) | | | 0.55 | | K/W |
| $R_{th(j-s)}$ | per IGBT, $\lambda_{paste}$=2.5 W/(mK) | | | 0.41 | | K/W |
| **T2 / T3** | | | | | | |
| $t_{d(on)}$ | $V_{CE}$ = 300 V | $T_j$ = 150 °C | | 106 | | ns |
| $t_r$ | $I_C$ = 150 A | $T_j$ = 150 °C | | 64 | | ns |
| $E_{on}$ | $V_{GE}$ = +15/-15 V | $T_j$ = 150 °C | | 2 | | mJ |
| $t_{d(off)}$ | $R_{G\ on}$ = 3 Ω | $T_j$ = 150 °C | | 268 | | ns |
| $t_f$ | $R_{G\ off}$ = 1.6 Ω<br>$di/dt_{on}$ = 2520 A/µs | $T_j$ = 150 °C | | 77 | | ns |
| $E_{off}$ | $di/dt_{off}$ = 1750 A/µs | $T_j$ = 150 °C | | 5.2 | | mJ |
| $R_{th(j-s)}$ | per IGBT, $\lambda_{paste}$=0.8 W/(mK) | | | 0.55 | | K/W |
| $R_{th(j-s)}$ | per IGBT, $\lambda_{paste}$=2.5 W/(mK) | | | 0.41 | | K/W |
| **Inverse diode** | | | | | | |
| $V_F = V_{EC}$ | $I_F$ = 150 A | $T_j$ = 25 °C | | 1.40 | 1.76 | V |
| | $V_{GE}$ = 0 V<br>chiplevel | $T_j$ = 150 °C | | 1.39 | 1.77 | V |
| $V_{F0}$ | chiplevel | $T_j$ = 25 °C | | 1.04 | 1.24 | V |
| | | $T_j$ = 150 °C | | 0.85 | 0.99 | V |
| $r_F$ | chiplevel | $T_j$ = 25 °C | | 2.4 | 3.5 | mΩ |
| | | $T_j$ = 150 °C | | 3.6 | 5.2 | mΩ |
| $I_{RRM}$ | $I_F$ = 150 A | $T_j$ = 150 °C | | 121 | | A |
| $Q_{rr}$ | $di/dt_{off}$ = 2450 A/µs | $T_j$ = 150 °C | | 20 | | µC |
| $E_{rr}$ | $V_{GE}$ = -15 V<br>$V_R$ = 300 V | $T_j$ = 150 °C | | 5.5 | | mJ |
| $R_{th(j-s)}$ | per Diode, $\lambda_{paste}$=0.8 W/(mK) | | | 0.75 | | K/W |
| $R_{th(j-s)}$ | per Diode, $\lambda_{paste}$=2.5 W/(mK) | | | 0.58 | | K/W |
| **Clamping diode** | | | | | | |
| $V_F = V_{EC}$ | $I_F$ = 150 A | $T_j$ = 25 °C | | 1.40 | 1.76 | V |
| | $V_{GE}$ = 0 V<br>chiplevel | $T_j$ = 150 °C | | 1.39 | 1.77 | V |
| $V_{F0}$ | chiplevel | $T_j$ = 25 °C | | 1.04 | 1.24 | V |
| | | $T_j$ = 150 °C | | 0.85 | 0.99 | V |
| $r_F$ | chiplevel | $T_j$ = 25 °C | | 2.4 | 3.5 | mΩ |
| | | $T_j$ = 150 °C | | 3.6 | 5.2 | mΩ |
| $I_{RRM}$ | $I_F$ = 150 A | $T_j$ = 150 °C | | 116 | | A |
| $Q_{rr}$ | $di/dt_{off}$ = 2210 A/µs | $T_j$ = 150 °C | | 13.2 | | µC |
| $E_{rr}$ [1] | $V_{GE}$ = -15 V<br>$V_R$ = 300 V | $T_j$ = 150 °C | | 2.6 | | mJ |
| $R_{th(j-s)}$ | per Diode, $\lambda_{paste}$=0.8 W/(mK) | | | 0.75 | | K/W |
| $R_{th(j-s)}$ | per Diode, $\lambda_{paste}$=2.5 W/(mK) | | | 0.58 | | K/W |
| **Module** | | | | | | |
| $M_s$ | to heat sink | | 2 | | 2.5 | Nm |
| w | weight | | | 55 | | g |
| **Temperature Sensor** | | | | | | |
| $R_{25}$ | NTC, $T_r$ = 25 °C [1] | | | 5.0 ± 5% | | kΩ |

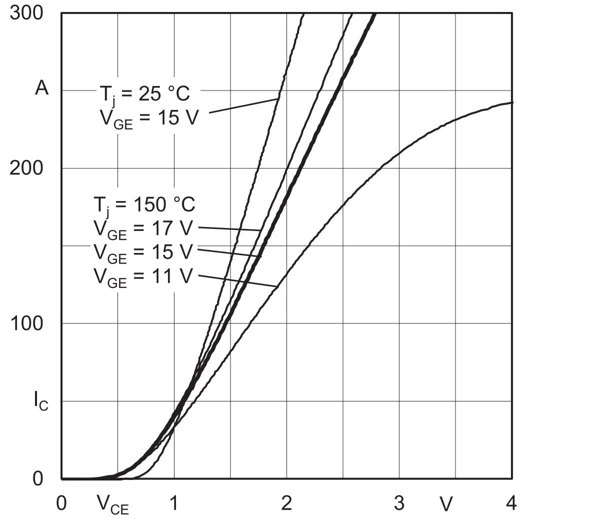



Fig. 1: Typ. IGBT1 output characteristic, incl. $R_{CC'+EE'}$

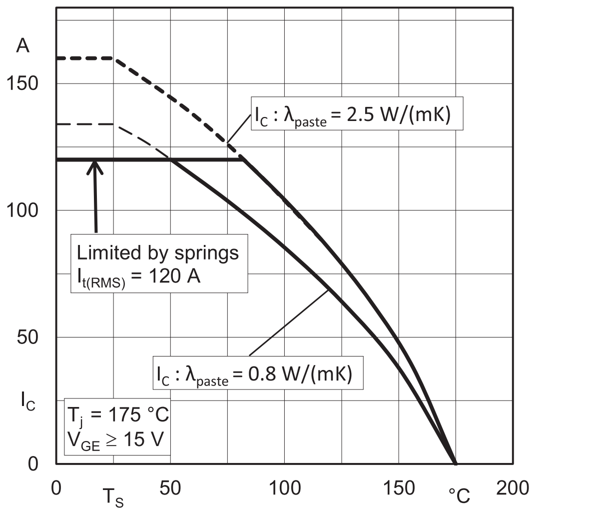



Fig. 2: Rated current vs. temperature $I_C = f(T_S)$

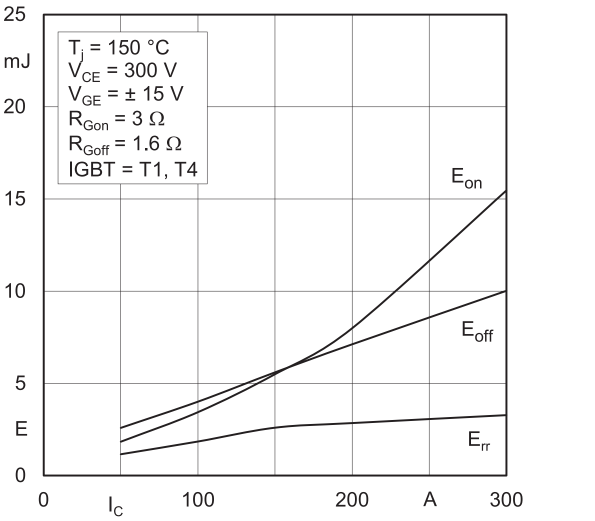



Fig. 3: Typ. IGBT1 & Diode5 turn-on /-off energy = f ($I_C$)

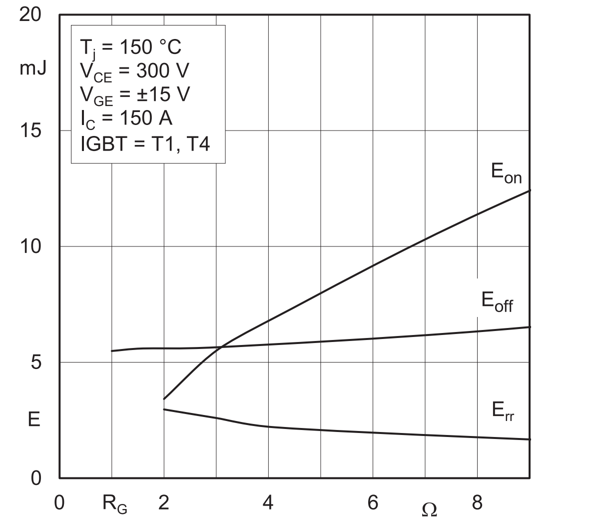



Fig. 4: Typ. IGBT1 & Diode5 turn-on /-off energy = f($R_G$)

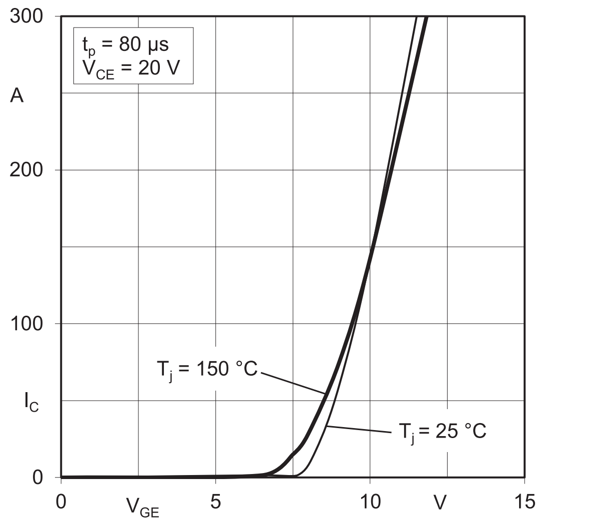



Fig. 5: Typ. IGBT1 transfer characteristic

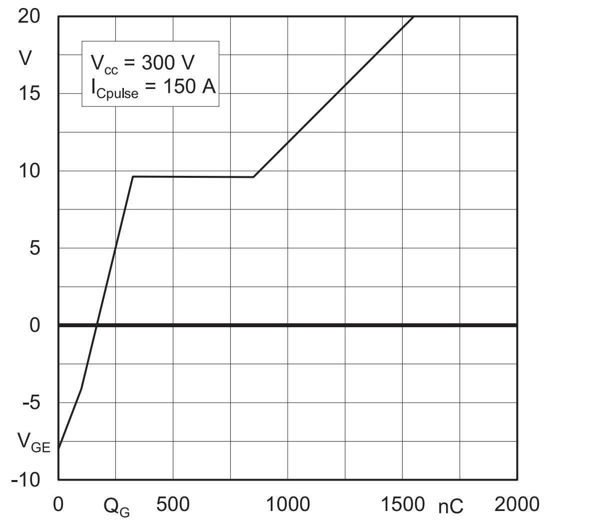



Fig. 6: Typ. IGBT1 gate charge characteristic

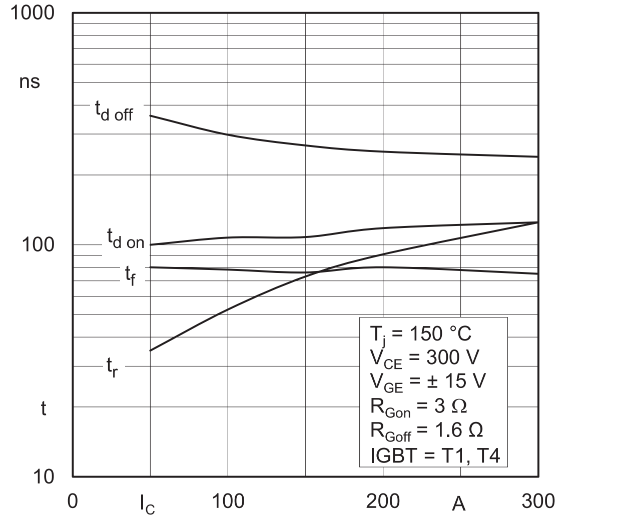



Fig. 7: Typ. IGBT1 switching times vs. $I_C$

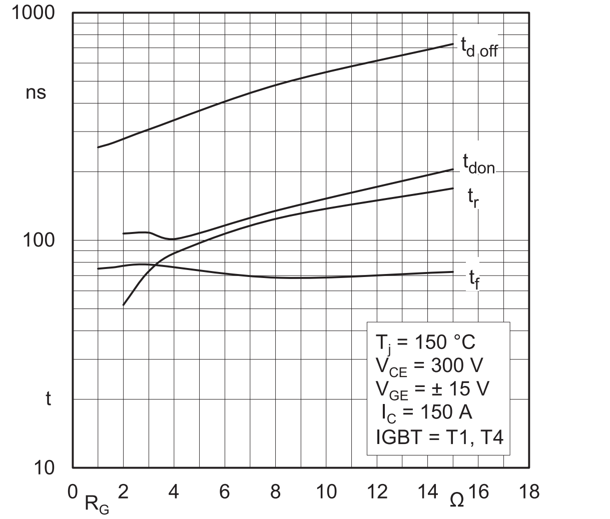



Fig. 8: Typ. IGBT1 switching times vs. gate resistor $R_G$

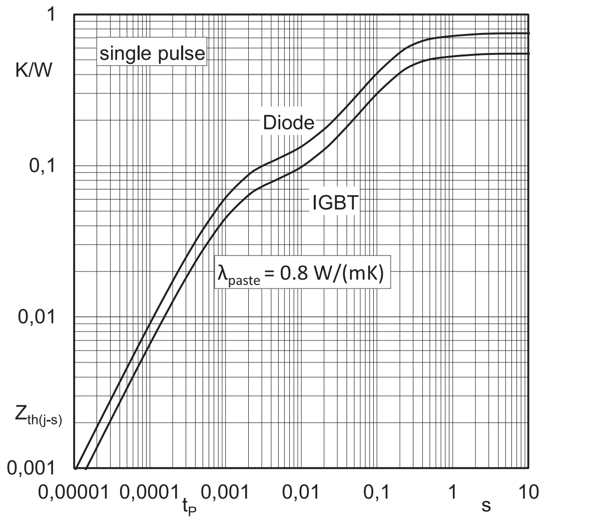



Fig. 9: Typ. transient thermal impedance of IGBT1 & Diode5

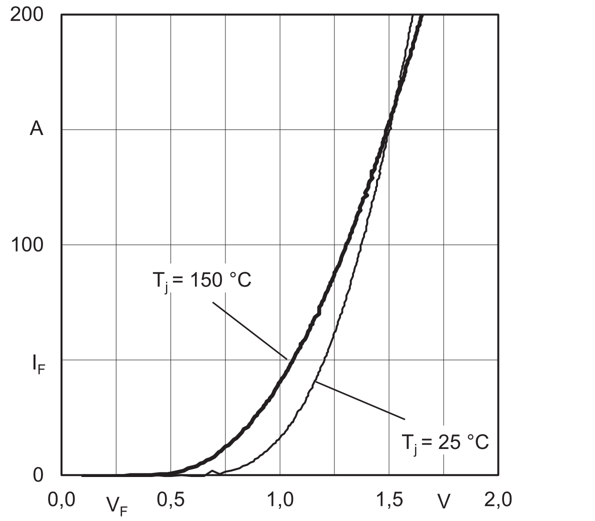



Fig. 10: Typ. Diode5 forward characteristic, incl. $R_{CC'+EE'}$

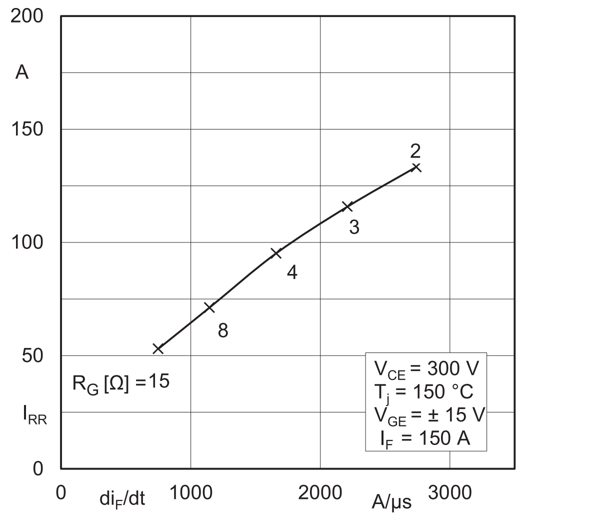



Fig. 11: Typ. Diode5 peak reverse recovery current

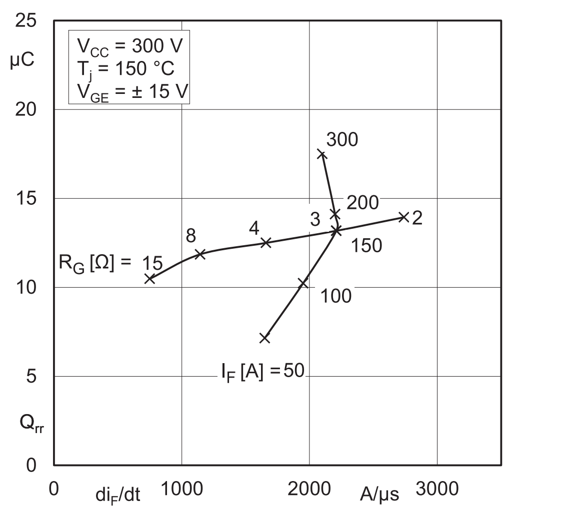
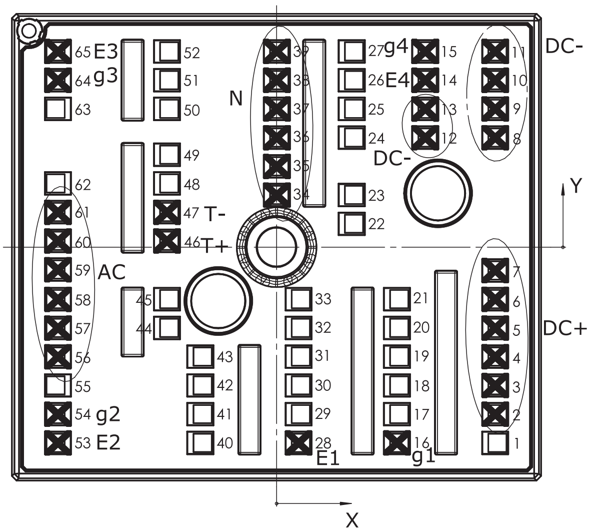



Fig. 12: Typ. Diode5 recovery charge

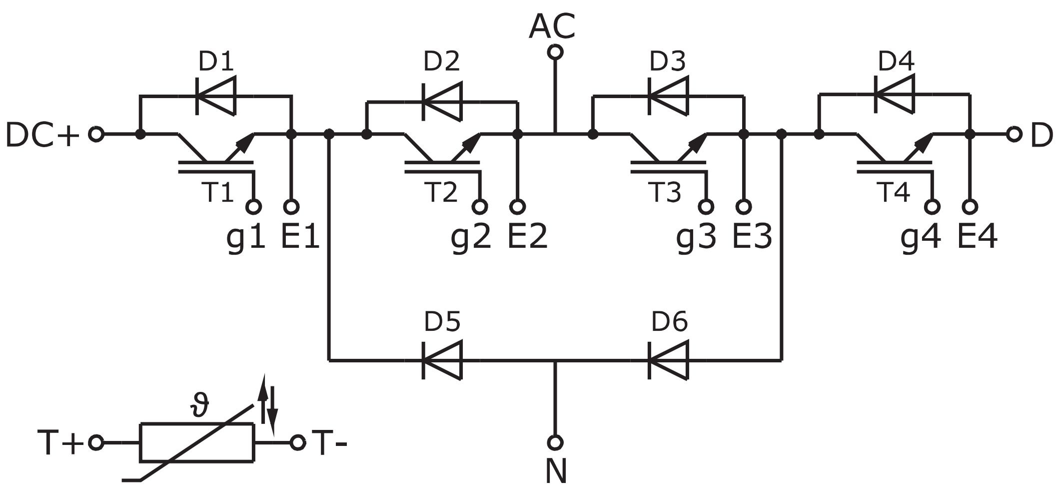
 

| Pin out | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pin* | *X* | *Y* | *Function* | *Pin* | *X* | *Y* | *Function* | *Pin* | *X* | *Y* | *Function* |
| 1 | 24,38 | -21,80 | | 23 | 8,38 | 5,80 | | 45 | -12,23 | -5,80 | |
| 2 | 24,38 | -18,60 | DC+ | 24 | 8,38 | 12,20 | | 46 | -12,23 | 0,70 | T+ |
| 3 | 24,38 | -15,40 | DC+ | 25 | 8,38 | 15,40 | | 47 | -12,23 | 3,90 | T- |
| 4 | 24,38 | -12,20 | DC+ | 26 | 8,38 | 18,60 | | 48 | -12,23 | 7,10 | |
| 5 | 24,38 | -9,00 | DC+ | 27 | 8,38 | 21,80 | | 49 | -12,23 | 10,30 | |
| 6 | 24,38 | -5,80 | DC+ | 28 | 2,46 | -21,80 | E1 | 50 | -12,23 | 15,40 | |
| 7 | 24,38 | -2,60 | DC+ | 29 | 2,46 | -18,60 | | 51 | -12,23 | 18,60 | |
| 8 | 24,38 | 12,20 | DC- | 30 | 2,46 | -15,40 | | 52 | -12,23 | 21,80 | |
| 9 | 24,38 | 15,40 | DC- | 31 | 2,46 | -12,20 | | 53 | -24,38 | -21,80 | E2 |
| 10 | 24,38 | 18,60 | DC- | 32 | 2,46 | -9,00 | | 54 | -24,38 | -18,60 | g2 |
| 11 | 24,38 | 21,80 | DC- | 33 | 2,46 | -5,80 | | 55 | -24,38 | -15,40 | |
| 12 | 16,58 | 12,20 | DC- | 34 | 0,03 | 5,80 | N | 56 | -24,38 | -12,20 | AC |
| 13 | 16,58 | 15,40 | DC- | 35 | 0,03 | 9,00 | N | 57 | -24,38 | -9,00 | AC |
| 14 | 16,58 | 18,60 | E4 | 36 | 0,03 | 12,20 | N | 58 | -24,38 | -5,80 | AC |
| 15 | 16,58 | 21,80 | g4 | 37 | 0,03 | 15,40 | N | 59 | -24,38 | -2,50 | AC |
| 16 | 13,42 | -21,80 | G1 | 38 | 0,03 | 18,60 | N | 60 | -24,38 | 0,70 | AC |
| 17 | 13,42 | -18,60 | | 39 | 0,03 | 21,80 | N | 61 | -24,38 | 3,90 | AC |
| 18 | 13,42 | -15,40 | | 40 | -8,51 | -21,80 | | 62 | -24,38 | 7,10 | |
| 19 | 13,42 | -12,20 | | 41 | -8,51 | -18,60 | | 63 | -24,38 | 15,40 | |
| 20 | 13,42 | -9,00 | | 42 | -8,51 | -15,40 | | 64 | -24,38 | 18,60 | g3 |
| 21 | 13,42 | -5,80 | | 43 | -8,51 | -12,20 | | 65 | -24,38 | 21,80 | E3 |
| 22 | 8,38 | 2,60 | | 44 | -12,23 | -9,00 | | | | | |

all values in mm




Pinout and Dimensions




Pinout

This is an electrostatic discharge sensitive device (ESDS) due to international standard IEC 61340.

***IMPORTANT INFORMATION AND WARNINGS**