

SKiM® 4

## IGBT Modules

### SKiM301MLI07E4

#### Features

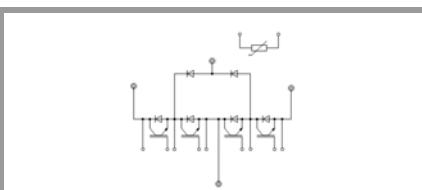
- IGBT 4 Trench Gate Technology
- Solder technology
- $V_{CE(sat)}$  with positive temperature coefficient
- Low inductance case
- Isolated by  $Al_2O_3$  DCB (Direct Copper Bonded) ceramic substrate
- Pressure contact technology for thermal contacts
- Spring contact system to attach driver PCB to the control terminals
- High short circuit capability, self limiting to  $6 \times I_C$
- Integrated temperature sensor

#### Typical Applications\*

- UPS
- 3 Level Inverter

#### Remarks

- Case temperature limited to  $T_c = 125^\circ C$  max, recommended  $T_{op} = -40 \dots +150^\circ C$



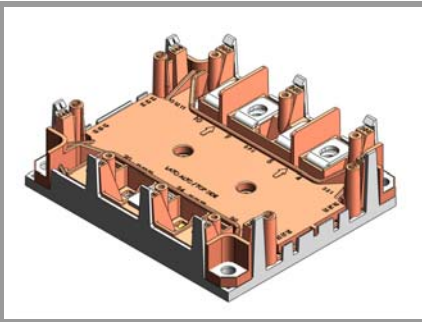
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#### Absolute Maximum Ratings

| Symbol                | Conditions   | Values              | Unit       |         |
|-----------------------|--|---------------------|------------|---------|
| <b>IGBT</b>           |  |                     |            |         |
| $V_{CES}$             |  | 650                 | V          |         |
| $I_C$                 | $T_j = 175^\circ C$  | $T_s = 25^\circ C$  | 256        | A       |
|                       |  | $T_s = 70^\circ C$  | 202        | A       |
| $I_{Cnom}$            |  | 300                 | A          |         |
| $I_{CRM}$             | $I_{CRM} = 2 \times I_{Cnom}$                                  | 600                 | A          |         |
| $V_{GES}$             |  | -20 ... 20          | V          |         |
| $t_{psc}$             | $V_{CC} = 360 V$<br>$V_{GE} \leq 15 V$<br>$V_{CES} \leq 650 V$ | $T_j = 150^\circ C$ | 6          | $\mu s$ |
|                       |  |                     |            |         |
| $T_j$                 |  | -40 ... 175         | $^\circ C$ |         |
| <b>Inverse diode</b>  |  |                     |            |         |
| $I_F$                 | $T_j = 175^\circ C$  | $T_s = 25^\circ C$  | 198        | A       |
|                       |  | $T_s = 70^\circ C$  | 154        | A       |
| $I_{Fnom}$            |  | 300                 | A          |         |
| $I_{FRM}$             | $I_{FRM} = 2 \times I_{Fnom}$                                  | 600                 | A          |         |
| $I_{FSM}$             | $t_p = 10 ms, \sin 180^\circ, T_j = 25^\circ C$                | 1476                | A          |         |
| $T_j$                 |  | -40 ... 175         | $^\circ C$ |         |
| <b>Clamping diode</b> |  |                     |            |         |
| $I_F$                 | $T_j = 175^\circ C$  | $T_s = 25^\circ C$  | 198        | A       |
|                       |  | $T_s = 70^\circ C$  | 154        | A       |
| $I_{Fnom}$            |  | 200                 | A          |         |
| $I_{FRM}$             | $I_{FRM} = 2 \times I_{Fnom}$                                  | 400                 | A          |         |
| $I_{FSM}$             | $t_p = 10 ms, \sin 180^\circ, T_j = 25^\circ C$                | 1476                | A          |         |
| $T_j$                 |  | -40 ... 175         | $^\circ C$ |         |
| <b>Module</b>         |  |                     |            |         |
| $I_{t(RMS)}$          | $T_{terminal} = 80^\circ C$                                    | 400                 | A          |         |
| $T_{stg}$             |  | -40 ... 125         | $^\circ C$ |         |
| $V_{isol}$            | AC sinus 50 Hz, $t = 1 min$                                    | 2500                | V          |         |

#### Characteristics

| Symbol        | Conditions                                     | min.                | typ.  | max. | Unit      |
|---------------|--|---------------------|-------|------|-----------|
| <b>IGBT</b>   |  |                     |       |      |           |
| $V_{CE(sat)}$ | $I_C = 300 A$<br>$V_{GE} = 15 V$<br>chipelevel | $T_j = 25^\circ C$  | 1.45  | 1.90 | V         |
|               |  | $T_j = 150^\circ C$ | 1.70  | 2.10 | V         |
| $V_{CE0}$     |  | $T_j = 25^\circ C$  | 0.9   | 1    | V         |
|               |  | $T_j = 150^\circ C$ | 0.82  | 0.9  | V         |
| $r_{CE}$      | $V_{GE} = 15 V$                                | $T_j = 25^\circ C$  | 1.8   | 3.0  | $m\Omega$ |
|               |  | $T_j = 150^\circ C$ | 2.9   | 4.0  | $m\Omega$ |
| $V_{GE(th)}$  | $V_{GE} = V_{CE}, I_C = 4.8 mA$                | 5.1                 | 5.8   | 6.4  | V         |
| $I_{CES}$     | $V_{GE} = 0 V$<br>$V_{CE} = 650 V$             | $T_j = 25^\circ C$  |       |      | mA        |
|               |  | $T_j = 150^\circ C$ |       |      | mA        |
| $C_{ies}$     | $V_{CE} = 25 V$                                |                     | 18.48 |      | nF        |
| $C_{oes}$     | $V_{GE} = 0 V$                                 |                     | 1.16  |      | nF        |
| $C_{res}$     |  |                     | 0.55  |      | nF        |
| $Q_G$         | $V_{GE} = -8 V \dots +15 V$                    |                     |       |      | nC        |
| $R_{Gint}$    | $T_j = 25^\circ C$                             |                     | 1.0   |      | $\Omega$  |



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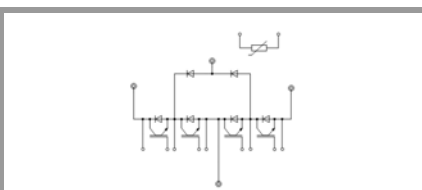
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| Characteristics |                              |                     |      |        |      |      |
|-----------------|------------------------------|---------------------|------|--------|------|------|
| Symbol          | Conditions                   |                     | min. | typ.   | max. | Unit |
| $t_{d(on)}$     | $V_{CE} = 300 V$             | $T_j = 150^\circ C$ |      | 149.14 |      | ns   |
| $t_r$           | $I_C = 300 A$                | $T_j = 150^\circ C$ |      | 79.71  |      | ns   |
| $E_{on}$        | $R_{G on} = 2.7 \Omega$      | $T_j = 150^\circ C$ |      | 2.78   |      | mJ   |
| $t_{d(off)}$    | $R_{G off} = 2.7 \Omega$     | $T_j = 150^\circ C$ |      | 420    |      | ns   |
| $t_f$           | $di/dt_{on} = 5566 A/\mu s$  | $T_j = 150^\circ C$ |      | 180    |      | ns   |
| $E_{off}$       | $di/dt_{off} = 1353 A/\mu s$ | $T_j = 150^\circ C$ |      | 17.48  |      | mJ   |
| $R_{th(j-s)}$   | per IGBT                     |                     |      | 0.3    |      | K/W  |

| Characteristics           |  |                     |      |                |       |            |
|---------------------------|--|---------------------|------|----------------|-------|------------|
| Symbol                    | Conditions   |                     | min. | typ.           | max.  | Unit       |
| <b>Inverse diode</b>      |  |                     |      |                |       |            |
| $V_F = V_{EC}$            | $I_F = 300 A$  | $T_j = 25^\circ C$  |      | 1.6            | 2.0   | V          |
|                           | $V_{GE} = 0 V$<br>chipelevel                                   | $T_j = 150^\circ C$ |      | 1.7            | 2.2   | V          |
| $V_{F0}$                  |  | $T_j = 25^\circ C$  | 0.95 | 1.04           | 1.236 | V          |
|                           |  | $T_j = 150^\circ C$ |      | 0.85           | 0.99  | V          |
| $r_F$                     |  | $T_j = 25^\circ C$  | 1.2  | 1.8            | 2.6   | m $\Omega$ |
|                           |  | $T_j = 150^\circ C$ |      | 2.7            | 3.9   | m $\Omega$ |
| $I_{RRM}$                 |  |                     |      |                |       | A          |
| $Q_{rr}$                  |  |                     |      |                |       | $\mu C$    |
| $E_{rr}$                  | $V_{GE} = -15 V$<br>$V_R = 300 V$                              |                     |      |                |       | mJ         |
| $R_{th(j-s)}$             | per diode  |                     |      | 0.45           |       | K/W        |
| <b>Clamping diode</b>     |  |                     |      |                |       |            |
| $V_F = V_{EC}$            | $I_F = 200 A$  | $T_j = 25^\circ C$  |      | 1.4            | 1.8   | V          |
|                           | $V_{GE} = 0 V$<br>chipelevel                                   | $T_j = 150^\circ C$ |      | 1.4            | 1.8   | V          |
| $V_{F0}$                  |  | $T_j = 25^\circ C$  | 0.95 | 1.04           | 1.236 | V          |
|                           |  | $T_j = 150^\circ C$ |      | 0.85           | 0.99  | V          |
| $r_F$                     |  | $T_j = 25^\circ C$  | 1.2  | 1.8            | 2.6   | m $\Omega$ |
|                           |  | $T_j = 150^\circ C$ |      | 2.7            | 3.9   | m $\Omega$ |
| $I_{RRM}$                 |  |                     |      |                |       | A          |
| $Q_{rr}$                  |  |                     |      |                |       | $\mu C$    |
| $E_{rr}$                  | $V_{GE} = -15 V$<br>$V_R = 300 V$                              |                     |      |                |       | mJ         |
| $R_{th(j-s)}$             | per diode  |                     |      | 0.45           |       | K/W        |
| <b>Module</b>             |  |                     |      |                |       |            |
| $L_{CE}$                  |  |                     |      | 22             |       | nH         |
| $R_{CC+EE}$               | terminal-chip  | $T_s = 25^\circ C$  |      | 1.35           |       | m $\Omega$ |
|                           |  | $T_s = 125^\circ C$ |      | 1.75           |       | m $\Omega$ |
| $M_s$                     | to heat sink (M5)  |                     | 2    |                | 3     | Nm         |
| $M_t$                     | to terminals M6  |                     | 4    |                | 5     | Nm         |
| w                         |  |                     |      | 317            |       | g          |
| <b>Temperature Sensor</b> |  |                     |      |                |       |            |
| $R_{100}$                 | $T_c = 100^\circ C$ ( $R_{25} = 5 k\Omega$ )                   |                     |      | $493 \pm 5\%$  |       | $\Omega$   |
| $B_{100/125}$             | $R(T) = R_{100} \exp[B_{100/125}(1/T - 1/T_{100})]$ ; $T[K]$ ; |                     |      | $3550 \pm 2\%$ |       | K          |

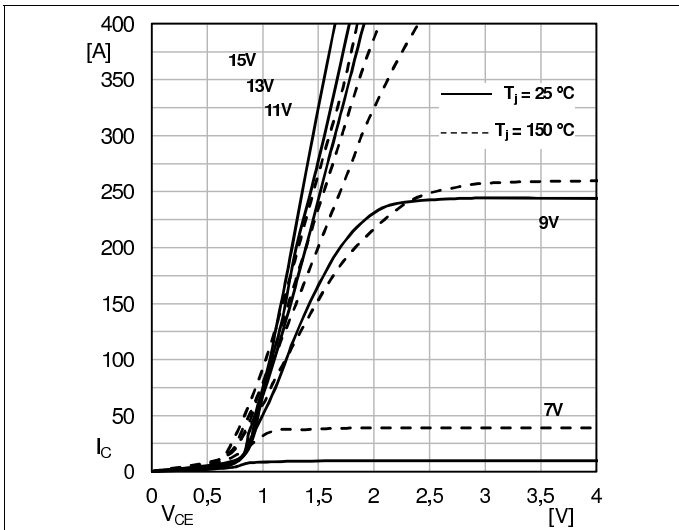


Fig. 3: Typ. IGBT output characteristic, inclusive  $R_{CC+EE}$

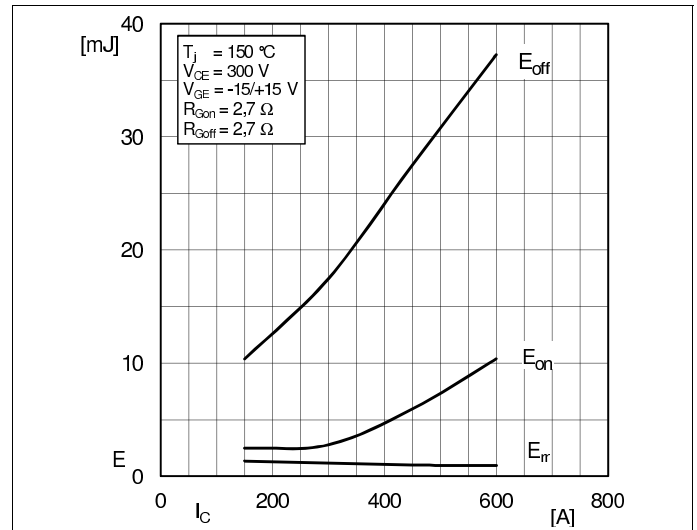


Fig. 6: Typ. turn-on /-off energy =  $f(I_C)$

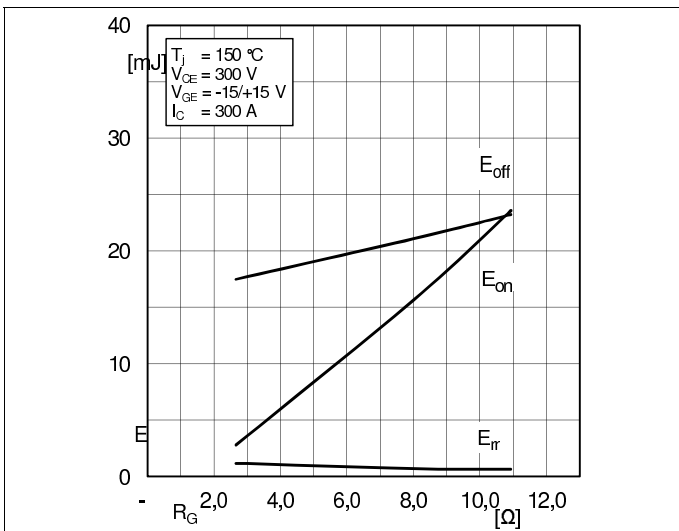


Fig. 8: Typ. turn-on /-off energy =  $f(R_G)$

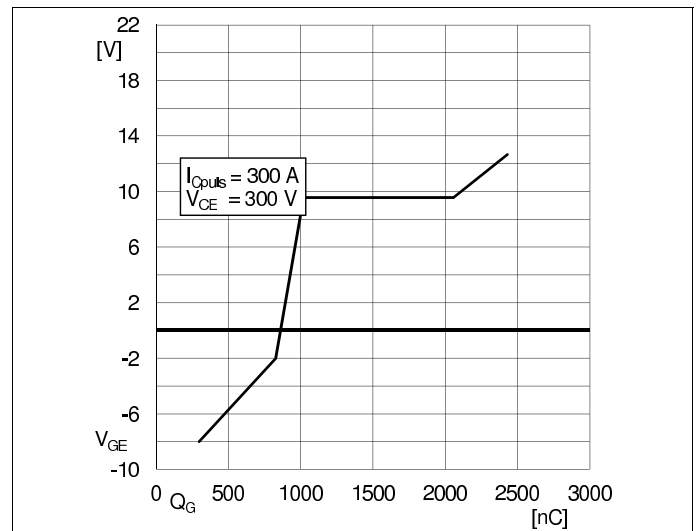


Fig. 10: Gate charge characteristic

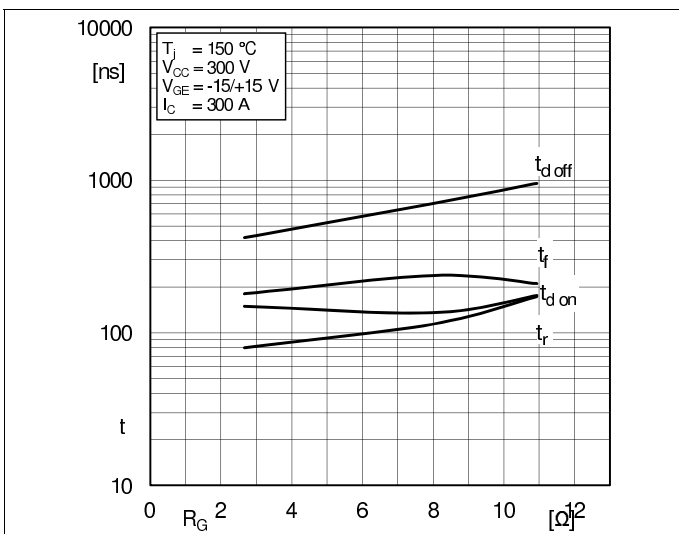


Fig. 12: Typ. switching times vs. gate resistor  $R_G$

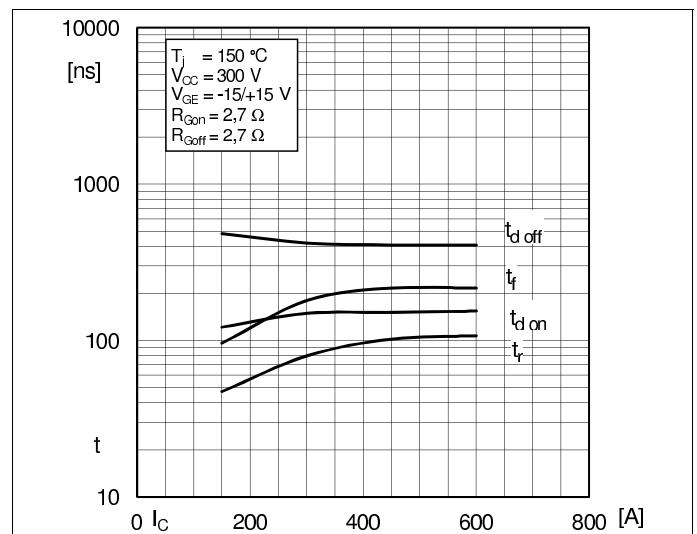
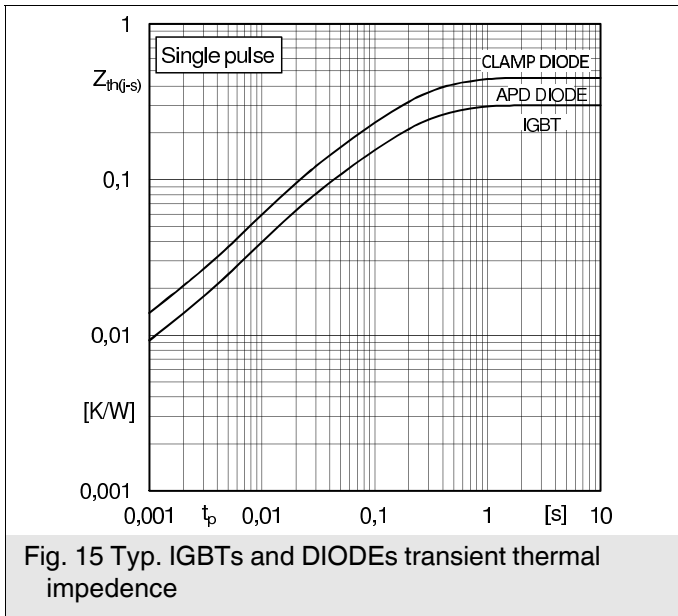
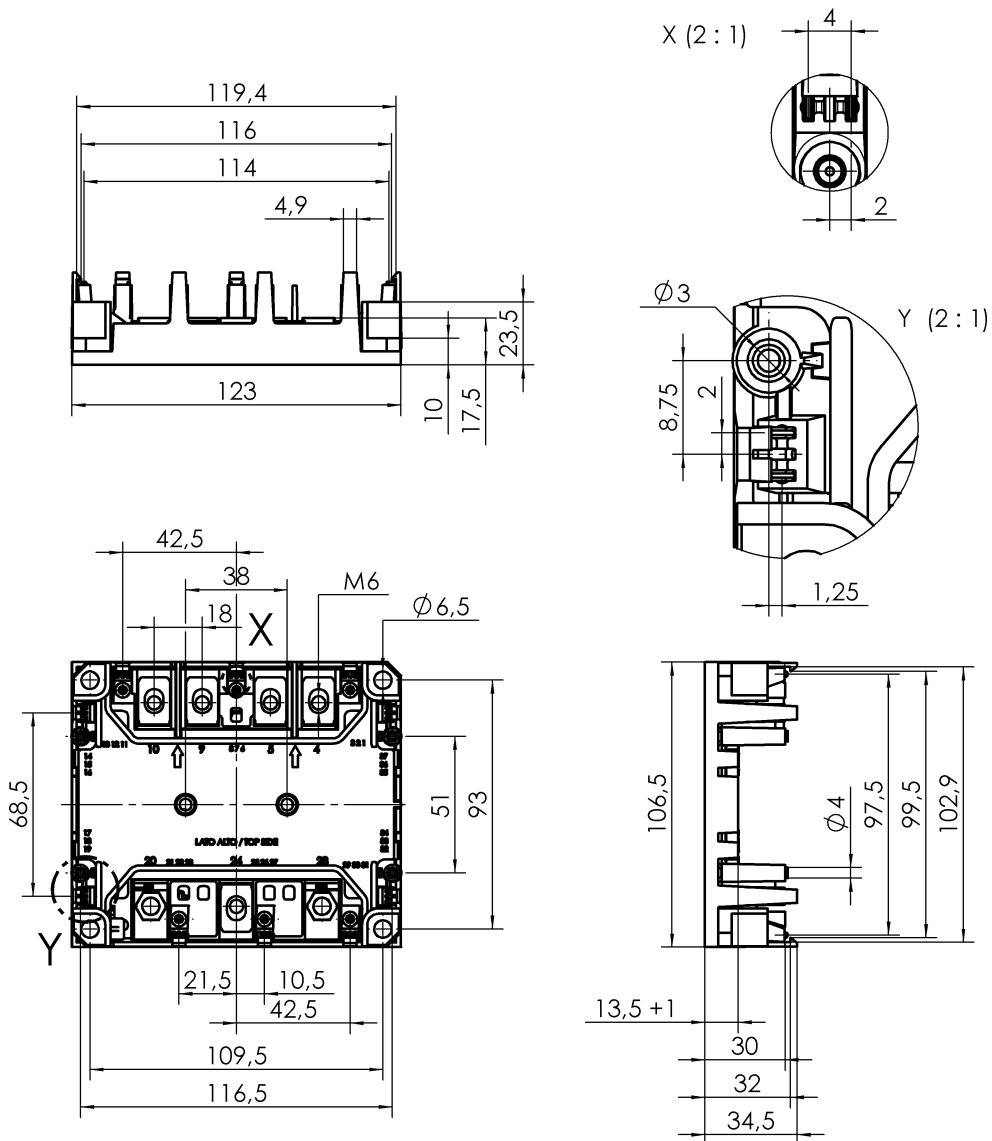


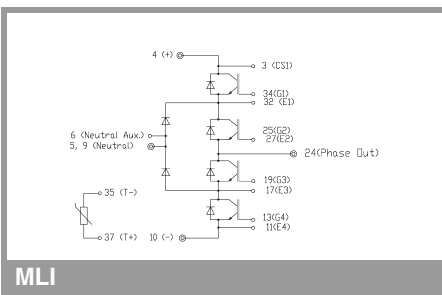
Fig. 14: Typ. switching times vs.  $I_C$



# SKiM301MLI07E4



## SKiM 4



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

\* The specifications of our components may not be considered as an assurance of component characteristics. Components have to be tested for the respective application. Adjustments may be necessary. The use of SEMIKRON products in life support appliances and systems is subject to prior specification and written approval by SEMIKRON. We therefore strongly recommend prior consultation of our staff.