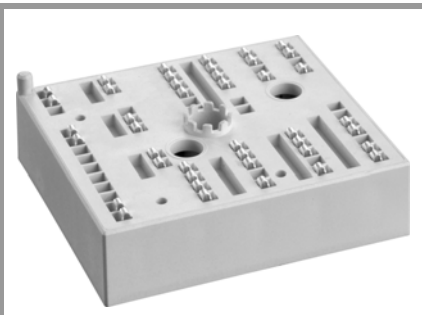




MiniSKiiP® 2

## Sixpack

## SKiiP 24AC12T4V1

### Features\*

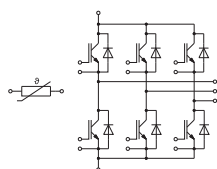
- Trench 4 IGBTs
- Robust and soft switching freewheeling diodes in CAL technology
- Highly reliable spring contacts for electrical connections
- UL recognized: File no. E63532

### Typical Applications

- Inverter up to 22 kVA
- Typical motor power 11 kW

### Remarks

- $V_{CEsat}$ ,  $V_F$  = chip level value
- Case temp. limited to  $T_C = 125^\circ\text{C}$  max. (for baseplateless modules  $T_C = T_S$ )
- product rel. results valid for  $T_j \leq 150$  (recomm.  $T_{op} = -40 \dots +150^\circ\text{C}$ )



AC

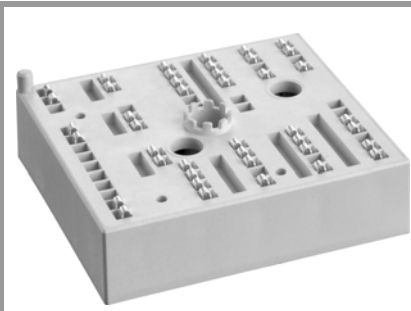
### Absolute Maximum Ratings

| Symbol              | Conditions                                                                     |                         | Values      | Unit |
|---------------------|--------------------------------------------------------------------------------|-------------------------|-------------|------|
| Inverter - IGBT     |                                                                                |                         |             |      |
| V <sub>CES</sub>    | T <sub>j</sub> = 25 °C                                                         |                         | 1200        | V    |
| I <sub>C</sub>      | λ <sub>paste</sub> =0.8 W/(mK)                                                 | T <sub>s</sub> = 25 °C  | 52          | A    |
|                     | T <sub>j</sub> = 175 °C                                                        | T <sub>s</sub> = 70 °C  | 43          | A    |
| I <sub>C</sub>      | λ <sub>paste</sub> =2.5 W/(mK)                                                 | T <sub>s</sub> = 25 °C  | 59          | A    |
|                     | T <sub>j</sub> = 175 °C                                                        | T <sub>s</sub> = 70 °C  | 48          | A    |
| I <sub>Cnom</sub>   |                                                                                |                         | 35          | A    |
| I <sub>CRM</sub>    |                                                                                |                         | 105         | A    |
| V <sub>GES</sub>    |                                                                                |                         | -20 ... 20  | V    |
| t <sub>psc</sub>    | V <sub>CC</sub> = 800 V<br>V <sub>GE</sub> ≤ 15 V<br>V <sub>CES</sub> ≤ 1200 V | T <sub>j</sub> = 150 °C | 10          | μs   |
| T <sub>j</sub>      |                                                                                |                         | -40 ... 175 | °C   |
| Inverse - Diode     |                                                                                |                         |             |      |
| V <sub>RRM</sub>    | T <sub>j</sub> = 25 °C                                                         |                         | 1200        | V    |
| I <sub>F</sub>      | λ <sub>paste</sub> =0.8 W/(mK)                                                 | T <sub>s</sub> = 25 °C  | 44          | A    |
|                     | T <sub>j</sub> = 175 °C                                                        | T <sub>s</sub> = 70 °C  | 35          | A    |
| I <sub>F</sub>      | λ <sub>paste</sub> =2.5 W/(mK)                                                 | T <sub>s</sub> = 25 °C  | 49          | A    |
|                     | T <sub>j</sub> = 175 °C                                                        | T <sub>s</sub> = 70 °C  | 40          | A    |
| I <sub>FRM</sub>    |                                                                                |                         | 105         | A    |
| I <sub>FSM</sub>    | t <sub>p</sub> = 10 ms, sin 180°, T <sub>j</sub> = 150 °C                      |                         | 170         | A    |
| T <sub>j</sub>      |                                                                                |                         | -40 ... 175 | °C   |
| Module              |                                                                                |                         |             |      |
| I <sub>t(RMS)</sub> | T <sub>terminal</sub> = 80 °C, 20 A per spring                                 |                         | 100         | A    |
| T <sub>stg</sub>    | module without TIM                                                             |                         | -40 ... 125 | °C   |
| V <sub>isol</sub>   | AC sinus 50 Hz, t = 1 min                                                      |                         | 2500        | V    |

### Characteristics

| Symbol                 | Conditions                                                                             | min.                      | typ. | max. | Unit       |
|------------------------|----------------------------------------------------------------------------------------|---------------------------|------|------|------------|
| <b>Inverter - IGBT</b> |                                                                                        |                           |      |      |            |
| $V_{CE(sat)}$          | $I_C = 35 \text{ A}$<br>$V_{GE} = 15 \text{ V}$<br>chipelevel                          | $T_j = 25^\circ\text{C}$  | 1.85 | 2.10 | V          |
|                        |                                                                                        | $T_j = 150^\circ\text{C}$ | 2.25 | 2.45 | V          |
| $V_{CE0}$              | chipelevel                                                                             | $T_j = 25^\circ\text{C}$  | 0.80 | 0.90 | V          |
|                        |                                                                                        | $T_j = 150^\circ\text{C}$ | 0.70 | 0.80 | V          |
| $r_{CE}$               | $V_{GE} = 15 \text{ V}$<br>chipelevel                                                  | $T_j = 25^\circ\text{C}$  | 30   | 34   | m $\Omega$ |
|                        |                                                                                        | $T_j = 150^\circ\text{C}$ | 44   | 47   | m $\Omega$ |
| $V_{GE(th)}$           | $V_{GE} = V_{CE}, I_C = 1 \text{ mA}$                                                  | 5                         | 5.8  | 6.5  | V          |
| $I_{CES}$              | $V_{GE} = 0 \text{ V}, V_{CE} = 1200 \text{ V}, T_j = 25^\circ\text{C}$                |                           |      | 1    | mA         |
| $C_{ies}$              | $V_{CE} = 25 \text{ V}$                                                                | $f = 1 \text{ MHz}$       | 1.95 |      | nF         |
| $C_{oes}$              | $V_{GE} = 0 \text{ V}$                                                                 | $f = 1 \text{ MHz}$       | 0.16 |      | nF         |
| $C_{res}$              |                                                                                        | $f = 1 \text{ MHz}$       | 0.12 |      | nF         |
| $Q_G$                  | $V_{GE} = -8 \text{ V} \dots +15 \text{ V}$                                            |                           | 200  |      | nC         |
| $R_{Gint}$             | $T_j = 25^\circ\text{C}$                                                               |                           | 0    |      | $\Omega$   |
| $t_{d(on)}$            | $V_{CC} = 600 \text{ V}$                                                               | $T_j = 150^\circ\text{C}$ | 21   |      | ns         |
| $t_r$                  | $I_C = 35 \text{ A}$                                                                   | $T_j = 150^\circ\text{C}$ | 31   |      | ns         |
| $E_{on}$               | $R_{G on} = 15 \Omega$                                                                 | $T_j = 150^\circ\text{C}$ | 3.7  |      | mJ         |
| $t_{d(off)}$           | $R_{G off} = 15 \Omega$                                                                | $T_j = 150^\circ\text{C}$ | 310  |      | ns         |
| $t_f$                  | $di/dt_{on} = 1300 \text{ A}/\mu\text{s}$<br>$di/dt_{off} = 460 \text{ A}/\mu\text{s}$ | $T_j = 150^\circ\text{C}$ | 63   |      | ns         |
| $E_{off}$              | $V_{GE} = +15/-15 \text{ V}$                                                           | $T_j = 150^\circ\text{C}$ | 3    |      | mJ         |
| $R_{th(j-s)}$          | per IGBT, $\lambda_{paste}=0.8 \text{ W/(mK)}$                                         |                           | 0.85 |      | K/W        |
| $R_{th(j-s)}$          | per IGBT, $\lambda_{paste}=2.5 \text{ W/(mK)}$                                         |                           | 0.69 |      | K/W        |

# SKiiP 24AC12T4V1



MiniSKiiP® 2

## Sixpack

### SKiiP 24AC12T4V1

#### Features\*

- Trench 4 IGBTs
- Robust and soft switching freewheeling diodes in CAL technology
- Highly reliable spring contacts for electrical connections
- UL recognized: File no. E63532

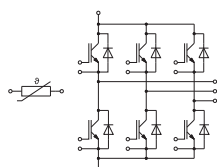
#### Typical Applications

- Inverter up to 22 kVA
- Typical motor power 11 kW

#### Remarks

- $V_{CEsat}$ ,  $V_F$  = chip level value
- Case temp. limited to  $T_C = 125^\circ\text{C}$  max. (for baseplateless modules  $T_C = T_S$ )
- product rel. results valid for  $T_j \leq 150$  (recomm.  $T_{op} = -40 \dots +150^\circ\text{C}$ )

| Characteristics                  |                                                                                                                                                                |                         |      |           |      |      |
|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|------|-----------|------|------|
| Symbol                           | Conditions                                                                                                                                                     |                         | min. | typ.      | max. | Unit |
| Inverse - Diode                  |                                                                                                                                                                |                         |      |           |      |      |
| V <sub>F</sub> = V <sub>EC</sub> | I <sub>F</sub> = 35 A                                                                                                                                          | T <sub>j</sub> = 25 °C  |      | 2.30      | 2.62 | V    |
|                                  | V <sub>GE</sub> = 0 V                                                                                                                                          | T <sub>j</sub> = 150 °C |      | 2.29      | 2.62 | V    |
|                                  | chipllevel                                                                                                                                                     |                         |      |           |      |      |
| V <sub>F0</sub>                  | chipllevel                                                                                                                                                     | T <sub>j</sub> = 25 °C  |      | 1.30      | 1.50 | V    |
|                                  |                                                                                                                                                                | T <sub>j</sub> = 150 °C |      | 0.90      | 1.10 | V    |
| r <sub>F</sub>                   | chipllevel                                                                                                                                                     | T <sub>j</sub> = 25 °C  |      | 29        | 32   | mΩ   |
|                                  |                                                                                                                                                                | T <sub>j</sub> = 150 °C |      | 40        | 43   | mΩ   |
| I <sub>RRM</sub>                 | I <sub>F</sub> = 35 A                                                                                                                                          | T <sub>j</sub> = 150 °C |      | 38        |      | A    |
| Q <sub>rr</sub>                  | di/dt <sub>off</sub> = 1400 A/μs                                                                                                                               | T <sub>j</sub> = 150 °C |      | 6.2       |      | μC   |
| E <sub>rr</sub>                  | V <sub>GE</sub> = +15/-15 V                                                                                                                                    | T <sub>j</sub> = 150 °C |      | 2.3       |      | mJ   |
|                                  | V <sub>CC</sub> = 600 V                                                                                                                                        |                         |      |           |      |      |
| R <sub>th(j-s)</sub>             | per Diode, λ <sub>paste</sub> =0.8 W/(mK)                                                                                                                      |                         |      | 1.2       |      | K/W  |
| R <sub>th(j-s)</sub>             | per Diode, λ <sub>paste</sub> =2.5 W/(mK)                                                                                                                      |                         |      | 1         |      | K/W  |
| Module                           |                                                                                                                                                                |                         |      |           |      |      |
| L <sub>CE</sub>                  |                                                                                                                                                                |                         |      | -         |      | nH   |
| M <sub>s</sub>                   | to heat sink                                                                                                                                                   |                         | 2    |           | 2.5  | Nm   |
| w                                |                                                                                                                                                                |                         |      | 55        |      | g    |
| Temperature Sensor               |                                                                                                                                                                |                         |      |           |      |      |
| R <sub>100</sub>                 | T <sub>r</sub> =100°C (R <sub>25</sub> =1000Ω)                                                                                                                 |                         |      | 1670 ± 3% |      | Ω    |
| R <sub>(T)</sub>                 | R <sub>(T)</sub> =1000Ω[1+A(T-25°C)+B(T-25°C) <sup>2</sup> ]<br>, A = 7.635*10 <sup>-3</sup> °C <sup>-1</sup> ,<br>B = 1.731*10 <sup>-5</sup> °C <sup>-2</sup> |                         |      |           |      |      |



AC

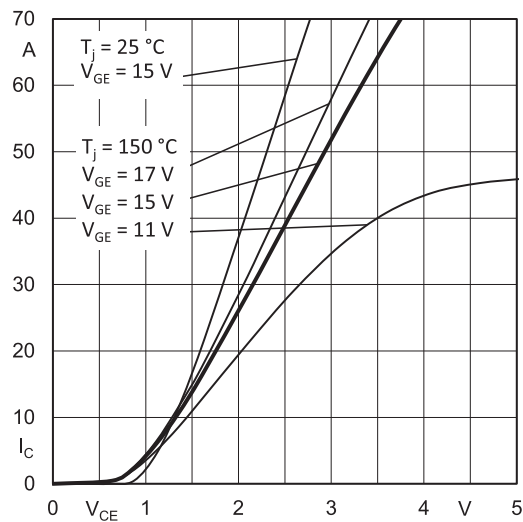


Fig. 1: Typ. output characteristic

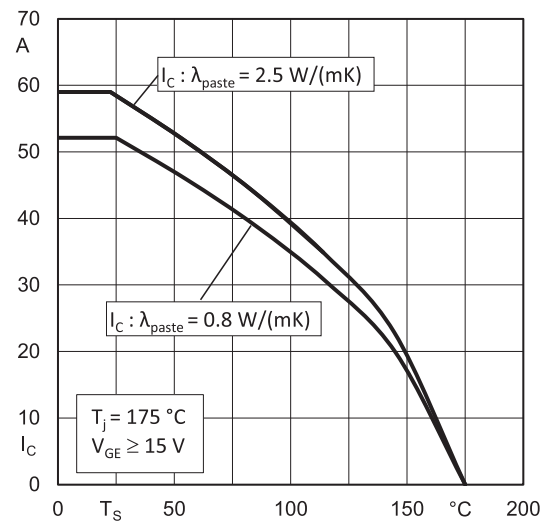


Fig. 2: Rated current vs. temperature  $I_C = f(T_S)$

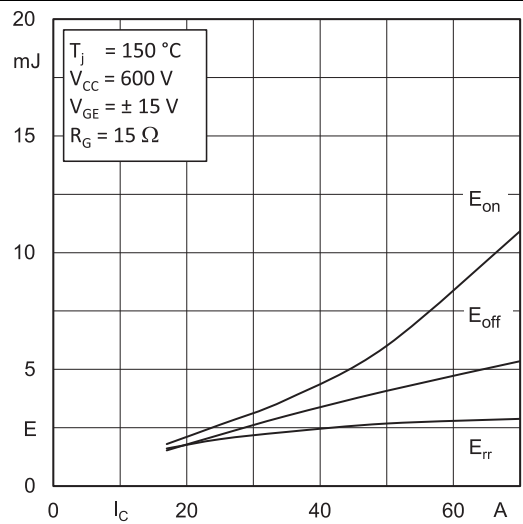


Fig. 3: Typ. turn-on /-off energy =  $f(I_C)$

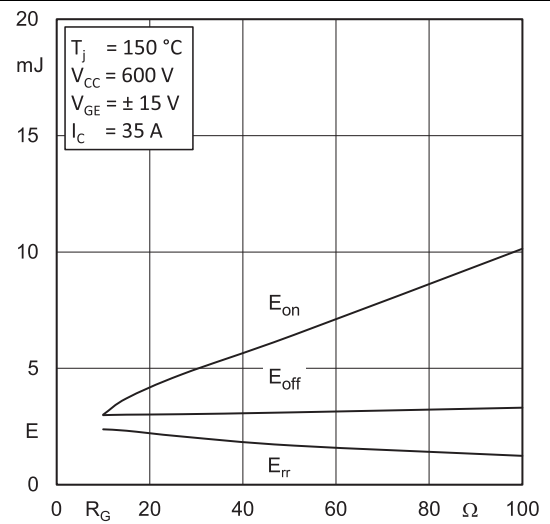


Fig. 4: Typ. turn-on /-off energy =  $f(R_G)$

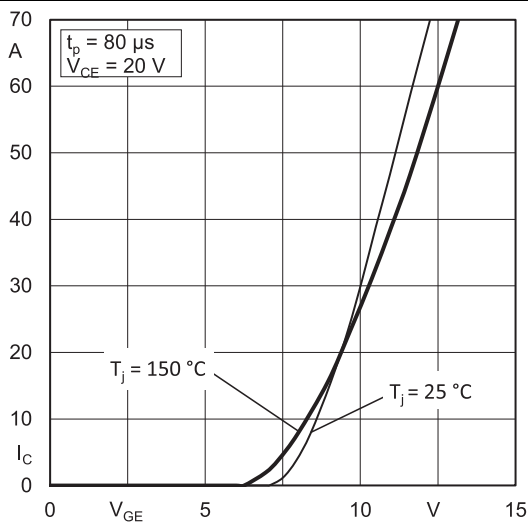


Fig. 5: Typ. transfer characteristic

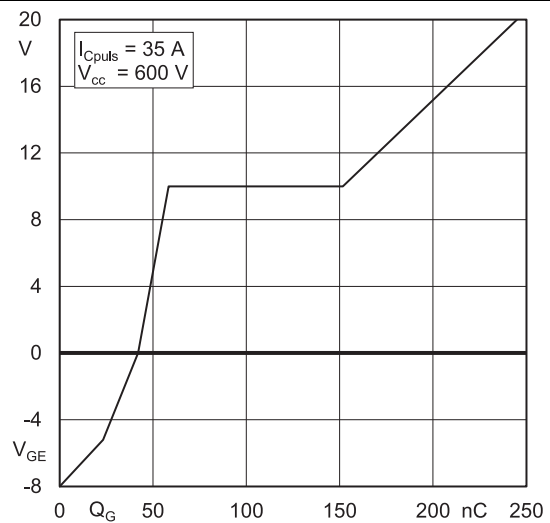


Fig. 6: Typ. gate charge characteristic

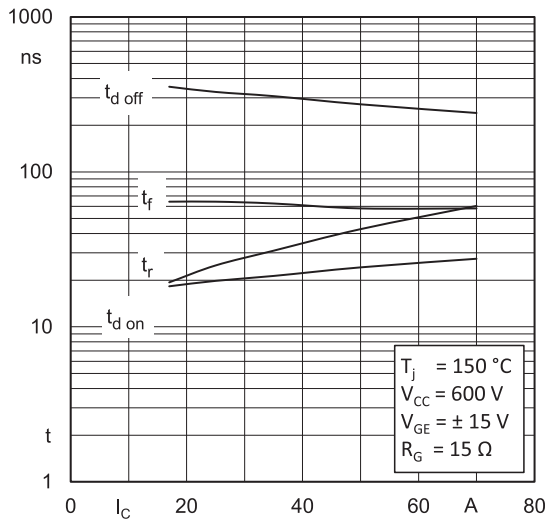


Fig. 7: Typ. switching times vs.  $I_C$

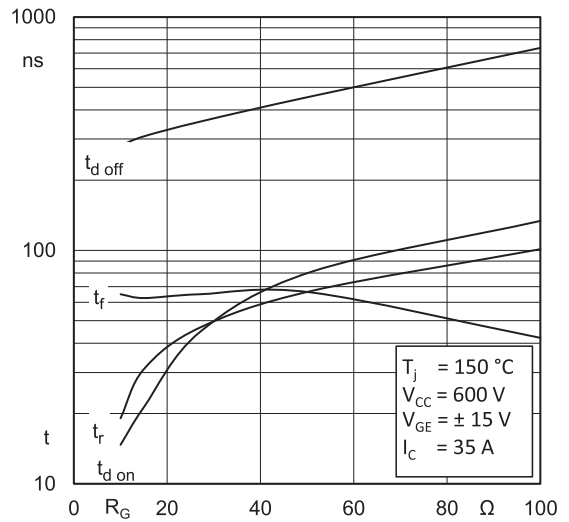


Fig. 8: Typ. switching times vs. gate resistor  $R_G$

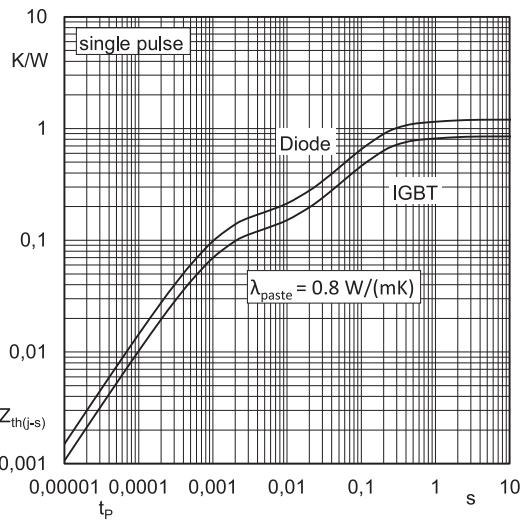


Fig. 9: Typ. transient thermal impedance

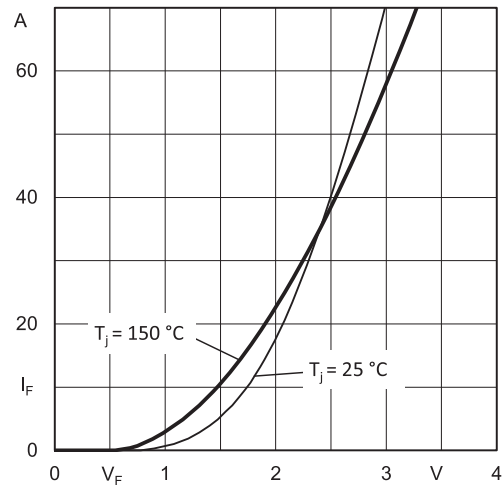


Fig. 10: Typ. CAL diode forward characteristic

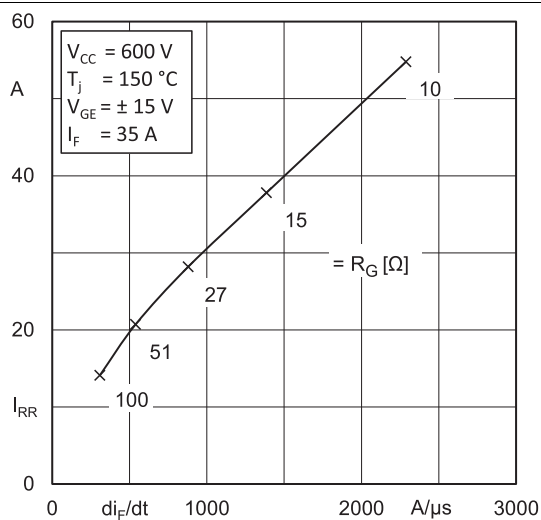


Fig. 11: Typ. CAL diode peak reverse recovery current

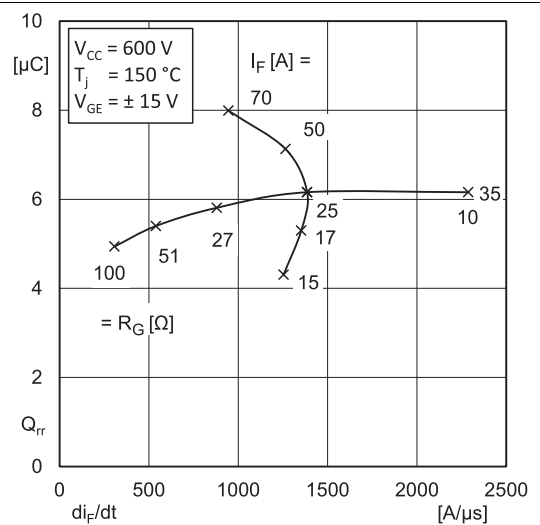
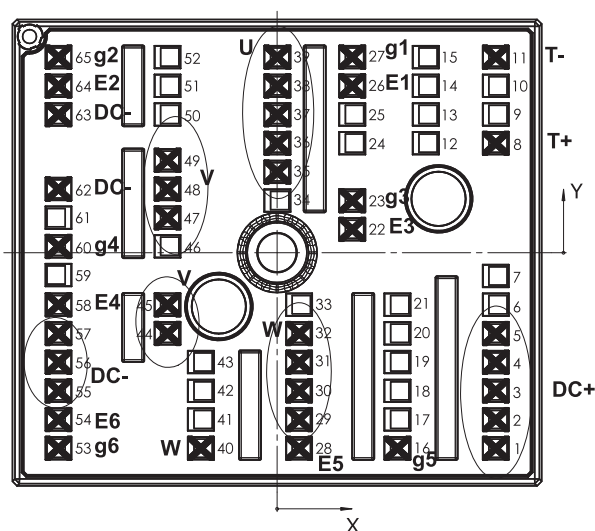


Fig. 12: Typ. CAL diode recovery charge

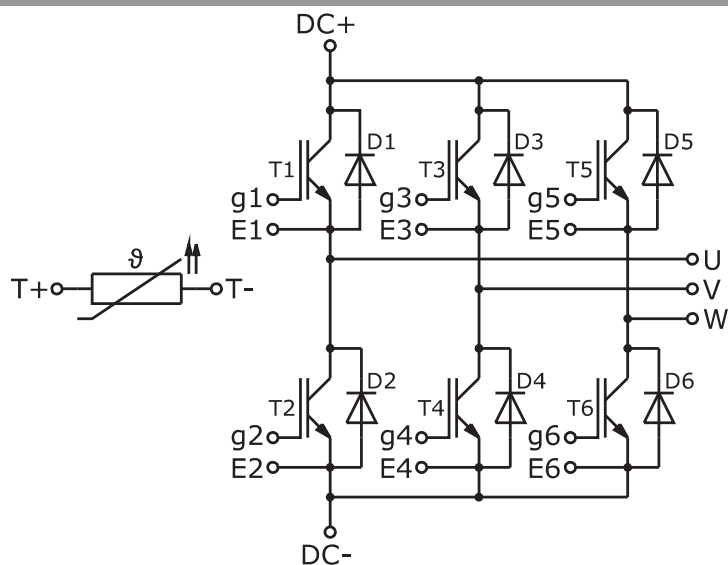
## SKiiP 24AC12T4V1

| Pin out |       |        |          |     |        |        |          |     |        |        |          |
|---------|-------|--------|----------|-----|--------|--------|----------|-----|--------|--------|----------|
| Pin     | X     | Y      | Function | Pin | X      | Y      | Function | Pin | X      | Y      | Function |
| 1       | 24,38 | -21,80 | DC+      | 23  | 8,38   | 5,80   | g3       | 45  | -12,23 | -5,80  | V        |
| 2       | 24,38 | -18,60 | DC+      | 24  | 8,38   | 12,20  |          | 46  | -12,23 | 0,70   |          |
| 3       | 24,38 | -15,40 | DC+      | 25  | 8,38   | 15,40  |          | 47  | -12,23 | 3,90   | V        |
| 4       | 24,38 | -12,20 | DC+      | 26  | 8,38   | 18,60  | E1       | 48  | -12,23 | 7,10   | V        |
| 5       | 24,38 | -9,00  | DC+      | 27  | 8,38   | 21,80  | g1       | 49  | -12,23 | 10,30  | V        |
| 6       | 24,38 | -5,80  |          | 28  | 2,46   | -21,80 | E5       | 50  | -12,23 | 15,40  |          |
| 7       | 24,38 | -2,60  |          | 29  | 2,46   | -18,60 | W        | 51  | -12,23 | 18,60  |          |
| 8       | 24,38 | 12,20  | T+       | 30  | 2,46   | -15,40 | W        | 52  | -12,23 | 21,80  |          |
| 9       | 24,38 | 15,40  |          | 31  | 2,46   | -12,20 | W        | 53  | -24,38 | -21,80 | g6       |
| 10      | 24,38 | 18,60  |          | 32  | 2,46   | -9,00  | W        | 54  | -24,38 | -18,60 | E6       |
| 11      | 24,38 | 21,80  | T-       | 33  | 2,46   | -5,80  |          | 55  | -24,38 | -15,40 | DC-      |
| 12      | 16,58 | 12,20  |          | 34  | 0,03   | 5,80   |          | 56  | -24,38 | -12,20 | DC-      |
| 13      | 16,58 | 15,40  |          | 35  | 0,03   | 9,00   | U        | 57  | -24,38 | -9,00  | DC-      |
| 14      | 16,58 | 18,60  |          | 36  | 0,03   | 12,20  | U        | 58  | -24,38 | -5,80  | E4       |
| 15      | 16,58 | 21,80  |          | 37  | 0,03   | 15,40  | U        | 59  | -24,38 | -2,50  |          |
| 16      | 13,42 | -21,80 | g5       | 38  | 0,03   | 18,60  | U        | 60  | -24,38 | 0,70   | g4       |
| 17      | 13,42 | -18,60 |          | 39  | 0,03   | 21,80  | U        | 61  | -24,38 | 3,90   |          |
| 18      | 13,42 | -15,40 |          | 40  | -8,51  | -21,80 | W        | 62  | -24,38 | 7,10   | DC-      |
| 19      | 13,42 | -12,20 |          | 41  | -8,51  | -18,60 |          | 63  | -24,38 | 15,40  | DC-      |
| 20      | 13,42 | -9,00  |          | 42  | -8,51  | -15,40 |          | 64  | -24,38 | 18,60  | E2       |
| 21      | 13,42 | -5,80  |          | 43  | -8,51  | -12,20 |          | 65  | -24,38 | 21,80  | g2       |
| 22      | 8,38  | 2,60   | E3       | 44  | -12,23 | -9,00  | V        |     |        |        |          |

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**

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