

# SKiiP 12AC12T7V1



MiniSKiiP® 1

## Sixpack

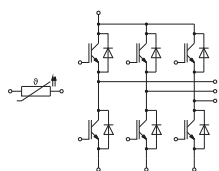
### SKiiP 12AC12T7V1

#### Features\*

- 1200V Generation 7 IGBTs (T7)
- Robust and soft switching freewheeling diodes in CAL technology
- Highly reliable spring contacts for electrical connections
- UL recognized: File no. E63532

#### Remarks

- Max. case temperature limited to  $T_C = T_S = 125^\circ\text{C}$
- Product reliability results valid for  $T_j \leq 150^\circ\text{C}$ ;  $T_{j,op} > 150^\circ\text{C}$  during overload (Details see AN19-002)
- MiniSKiiP "Technical Explanations" and "Mounting Instructions" are part of the data sheet. Please refer to both documents for further information.
- For storage and case temperature with TIM see document "Technical Explanations Thermal Interface Materials"



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> = 70 °C  | 26          | A    |
|                     | T <sub>j</sub> = 175 °C                                                        | T <sub>s</sub> = 100 °C | 22          | A    |
| I <sub>C</sub>      | λ <sub>paste</sub> =2.5 W/(mK)                                                 | T <sub>s</sub> = 70 °C  | 29          | A    |
|                     | T <sub>j</sub> = 175 °C                                                        | T <sub>s</sub> = 100 °C | 24          | A    |
| I <sub>Cnom</sub>   |                                                                                |                         | 15          | A    |
| I <sub>CRM</sub>    |                                                                                |                         | 30          | 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> = 175 °C | 7           | 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> = 70 °C  | 19          | A    |
|                     | T <sub>j</sub> = 175 °C                                                        | T <sub>s</sub> = 100 °C | 16          | A    |
| I <sub>F</sub>      | λ <sub>paste</sub> =2.5 W/(mK)                                                 | T <sub>s</sub> = 70 °C  | 21          | A    |
|                     | T <sub>j</sub> = 175 °C                                                        | T <sub>s</sub> = 100 °C | 17          | A    |
| I <sub>FRM</sub>    |                                                                                |                         | 30          | A    |
| I <sub>FSM</sub>    | t <sub>p</sub> = 10 ms, sin 180°, T <sub>j</sub> = 150 °C                      |                         | 65          | A    |
| T <sub>j</sub>      |                                                                                |                         | -40 ... 175 | °C   |
| Module              |                                                                                |                         |             |      |
| I <sub>t(RMS)</sub> | T <sub>terminal</sub> = 80 °C, 20 A per spring                                 |                         | 40          | 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> |                                                                       |                           |      |      |                  |
| $V_{CE(sat)}$          | $I_C = 15\text{ A}$                                                   | $T_j = 25^\circ\text{C}$  | 1.60 | 1.75 | V                |
|                        | $V_{GE} = 15\text{ V}$                                                | $T_j = 150^\circ\text{C}$ | 1.78 | 1.93 | V                |
|                        | chiplevel                                                             | $T_j = 175^\circ\text{C}$ | 1.82 | 1.97 | V                |
| $V_{CE0}$              |                                                                       | $T_j = 25^\circ\text{C}$  | 1.00 | 1.05 | V                |
|                        | chiplevel                                                             | $T_j = 150^\circ\text{C}$ | 0.80 | 0.85 | V                |
|                        |                                                                       | $T_j = 175^\circ\text{C}$ | 0.75 | 0.80 | V                |
| $r_{CE}$               | $V_{GE} = 15\text{ V}$                                                | $T_j = 25^\circ\text{C}$  | 40   | 47   | $\text{m}\Omega$ |
|                        | chiplevel                                                             | $T_j = 150^\circ\text{C}$ | 65   | 72   | $\text{m}\Omega$ |
|                        |                                                                       | $T_j = 175^\circ\text{C}$ | 71   | 78   | $\text{m}\Omega$ |
| $V_{GE(th)}$           | $V_{GE} = V_{CE}, I_C = 0.33\text{ mA}$                               | 5.15                      | 5.8  | 6.45 | V                |
| $I_{CES}$              | $V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_j = 25^\circ\text{C}$ |                           |      | 1    | mA               |
| $C_{ies}$              | $V_{CE} = 25\text{ V}$                                                | $f = 1\text{ MHz}$        | 2.80 |      | nF               |
| $C_{oes}$              | $V_{GE} = 0\text{ V}$                                                 | $f = 1\text{ MHz}$        | 0.04 |      | nF               |
| $C_{res}$              |                                                                       | $f = 1\text{ MHz}$        | 0.01 |      | nF               |
| $Q_G$                  | $V_{GE} = -8\text{ V} \dots +15\text{ V}$                             |                           | 210  |      | nC               |
| $R_{Gint}$             | $T_j = 25^\circ\text{C}$                                              |                           | 0    |      | $\Omega$         |

# SKiiP 12AC12T7V1



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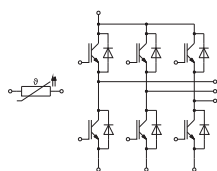
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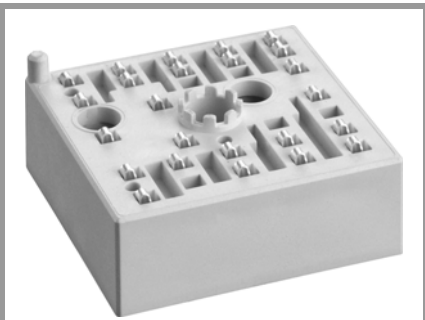


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| Characteristics        |                                                                                                                                                             |                           |      |      |      |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|------|------|------|
| Symbol                 | Conditions                                                                                                                                                  | min.                      | typ. | max. | Unit |
| <b>Inverter - IGBT</b> |                                                                                                                                                             |                           |      |      |      |
| $t_{d(on)}$            | $V_{CC} = 600\text{ V}$<br>$I_C = 15\text{ A}$<br>$R_{G\ on} = 21.3\ \Omega$<br>$R_{G\ off} = 21.3\ \Omega$<br>$V_{GE} = +15/-15\text{ V}$                  | $T_j = 25^\circ\text{C}$  | 43   |      | ns   |
|                        |                                                                                                                                                             | $T_j = 150^\circ\text{C}$ | 44   |      | ns   |
|                        |                                                                                                                                                             | $T_j = 175^\circ\text{C}$ | 46   |      | ns   |
| $t_r$                  |                                                                                                                                                             | $T_j = 25^\circ\text{C}$  | 38   |      | ns   |
|                        |                                                                                                                                                             | $T_j = 150^\circ\text{C}$ | 44   |      | ns   |
|                        |                                                                                                                                                             | $T_j = 175^\circ\text{C}$ | 47   |      | ns   |
| $E_{on}$               |                                                                                                                                                             | $T_j = 25^\circ\text{C}$  | 1.3  |      | mJ   |
|                        |                                                                                                                                                             | $T_j = 150^\circ\text{C}$ | 1.9  |      | mJ   |
|                        |                                                                                                                                                             | $T_j = 175^\circ\text{C}$ | 2    |      | mJ   |
| $t_{d(off)}$           |                                                                                                                                                             | $T_j = 25^\circ\text{C}$  | 205  |      | ns   |
|                        |                                                                                                                                                             | $T_j = 150^\circ\text{C}$ | 295  |      | ns   |
|                        |                                                                                                                                                             | $T_j = 175^\circ\text{C}$ | 320  |      | ns   |
| $t_f$                  | $@ T_j = 150^\circ\text{C}$ :<br>$di/dt_{on} = 320\text{ A}/\mu\text{s}$<br>$di/dt_{off} = 180\text{ A}/\mu\text{s}$<br>$dv/dt = 3590\text{ V}/\mu\text{s}$ | $T_j = 25^\circ\text{C}$  | 44   |      | ns   |
|                        |                                                                                                                                                             | $T_j = 150^\circ\text{C}$ | 66   |      | ns   |
|                        |                                                                                                                                                             | $T_j = 175^\circ\text{C}$ | 85   |      | ns   |
| $E_{off}$              |                                                                                                                                                             | $T_j = 25^\circ\text{C}$  | 0.98 |      | mJ   |
|                        |                                                                                                                                                             | $T_j = 150^\circ\text{C}$ | 1.7  |      | mJ   |
|                        |                                                                                                                                                             | $T_j = 175^\circ\text{C}$ | 1.8  |      | mJ   |
| $R_{th(j-s)}$          | per IGBT, $\lambda_{paste} = 0.8\text{ W}/(\text{mK})$                                                                                                      |                           | 1.4  |      | K/W  |
| $R_{th(j-s)}$          | per IGBT, $\lambda_{paste} = 2.5\text{ W}/(\text{mK})$                                                                                                      |                           | 1.2  |      | K/W  |

| Characteristics        |                                                                               |                           |      |      |               |
|------------------------|-------------------------------------------------------------------------------|---------------------------|------|------|---------------|
| Symbol                 | Conditions                                                                    | min.                      | typ. | max. | Unit          |
| <b>Inverse - Diode</b> |                                                                               |                           |      |      |               |
| $V_F = V_{EC}$         | $I_F = 15\text{ A}$<br>$V_{GE} = 0\text{ V}$<br>chiplevel                     | $T_j = 25^\circ\text{C}$  | 2.38 | 2.71 | V             |
|                        |                                                                               | $T_j = 150^\circ\text{C}$ | 2.44 | 2.77 | V             |
|                        |                                                                               | $T_j = 175^\circ\text{C}$ | 2.26 | 2.58 | V             |
| $V_{F0}$               | chiplevel                                                                     | $T_j = 25^\circ\text{C}$  | 1.30 | 1.50 | V             |
|                        |                                                                               | $T_j = 150^\circ\text{C}$ | 0.90 | 1.10 | V             |
|                        |                                                                               | $T_j = 175^\circ\text{C}$ | 0.82 | 0.98 | V             |
| $r_F$                  | chiplevel                                                                     | $T_j = 25^\circ\text{C}$  | 72   | 81   | m $\Omega$    |
|                        |                                                                               | $T_j = 150^\circ\text{C}$ | 103  | 111  | m $\Omega$    |
|                        |                                                                               | $T_j = 175^\circ\text{C}$ | 96   | 107  | m $\Omega$    |
| $I_{RRM}$              | $I_F = 15\text{ A}$<br>$V_{GE} = +15/-15\text{ V}$<br>$V_{CC} = 600\text{ V}$ | $T_j = 25^\circ\text{C}$  | 9    |      | A             |
|                        |                                                                               | $T_j = 150^\circ\text{C}$ | 11   |      | A             |
|                        |                                                                               | $T_j = 175^\circ\text{C}$ | 13   |      | A             |
| $Q_{rr}$               |                                                                               | $T_j = 25^\circ\text{C}$  | 0.9  |      | $\mu\text{C}$ |
|                        |                                                                               | $T_j = 150^\circ\text{C}$ | 2.1  |      | $\mu\text{C}$ |
|                        |                                                                               | $T_j = 175^\circ\text{C}$ | 2.4  |      | $\mu\text{C}$ |
| $E_{rr}$               | $@ T_j = 150^\circ\text{C}$ :<br>$di/dt_{off} = 350\text{ A}/\mu\text{s}$     | $T_j = 25^\circ\text{C}$  | 0.27 |      | mJ            |
|                        |                                                                               | $T_j = 150^\circ\text{C}$ | 0.81 |      | mJ            |
|                        |                                                                               | $T_j = 175^\circ\text{C}$ | 1.1  |      | mJ            |
| $R_{th(j-s)}$          | per Diode, $\lambda_{paste} = 0.8\text{ W}/(\text{mK})$                       |                           | 1.78 |      | K/W           |
| $R_{th(j-s)}$          | per Diode, $\lambda_{paste} = 2.5\text{ W}/(\text{mK})$                       |                           | 1.53 |      | K/W           |
| <b>Module</b>          |                                                                               |                           |      |      |               |
| $L_{CE}$               |                                                                               |                           | -    |      | nH            |
| $M_s$                  | to heat sink                                                                  | 2                         |      | 2.5  | Nm            |
| w                      |                                                                               |                           | 30   |      | g             |

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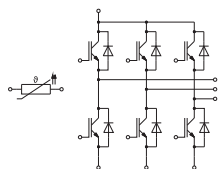
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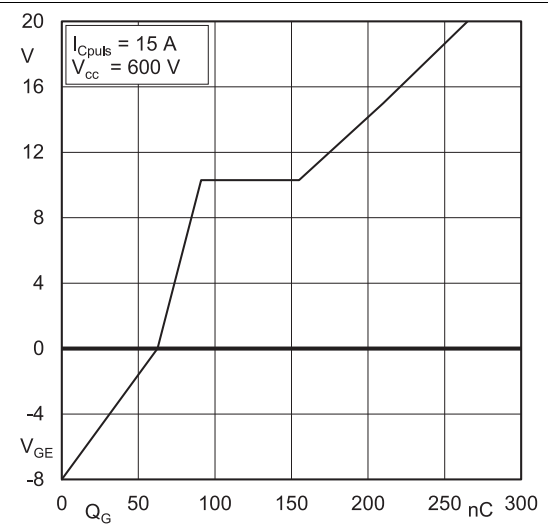
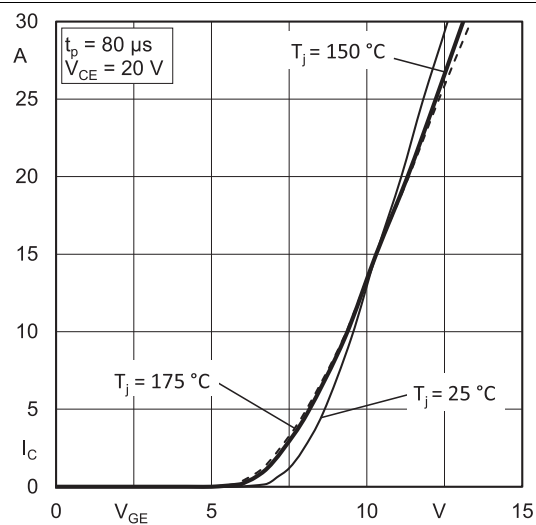
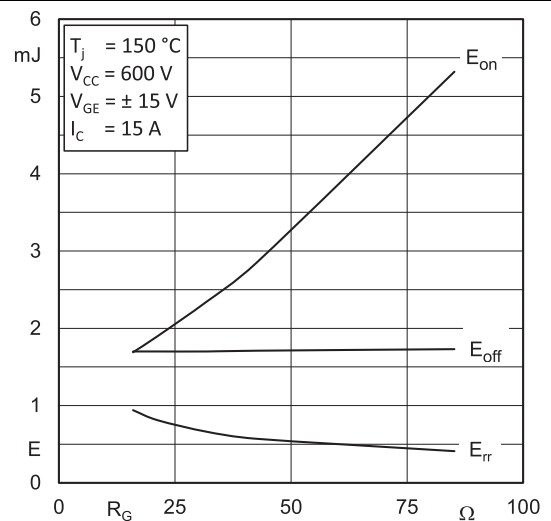
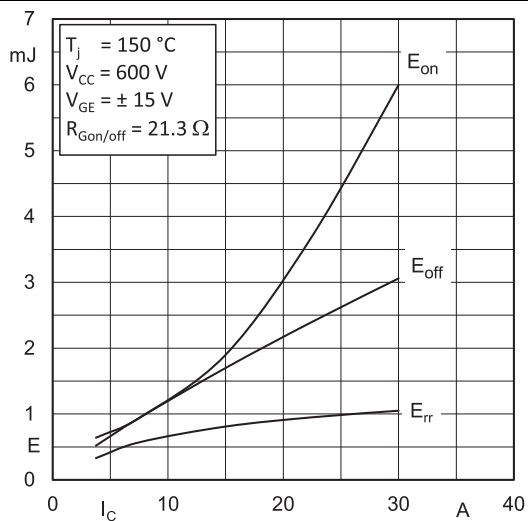
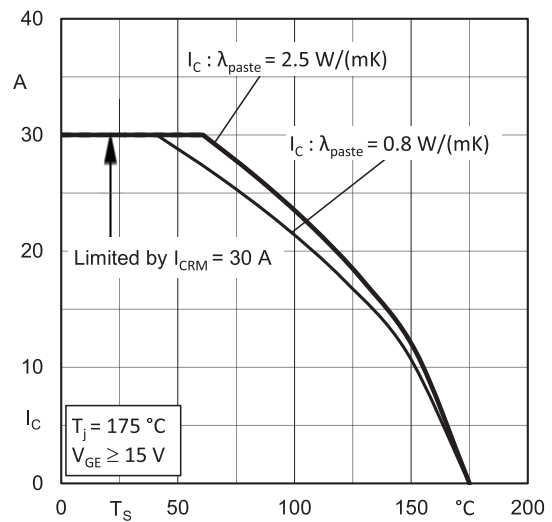
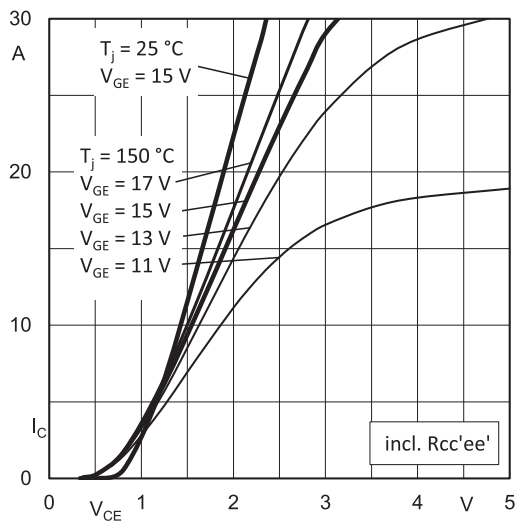
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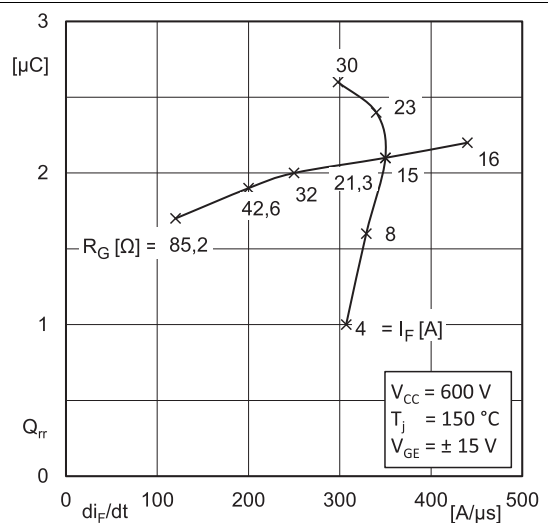
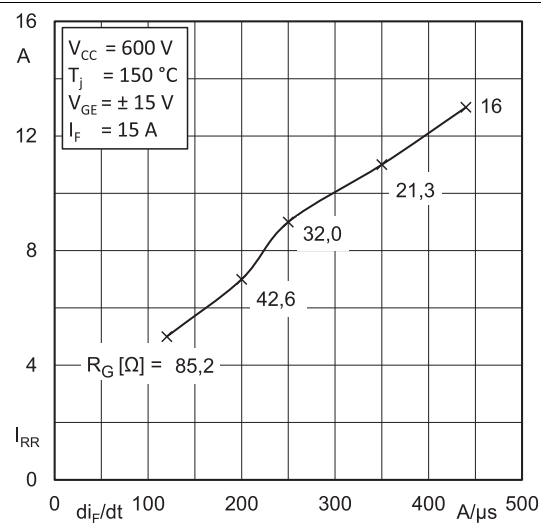
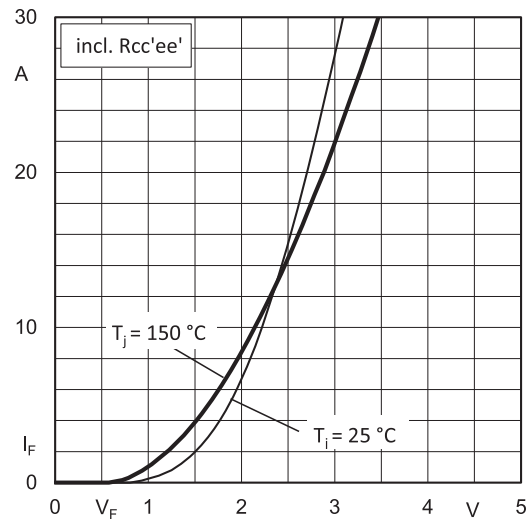
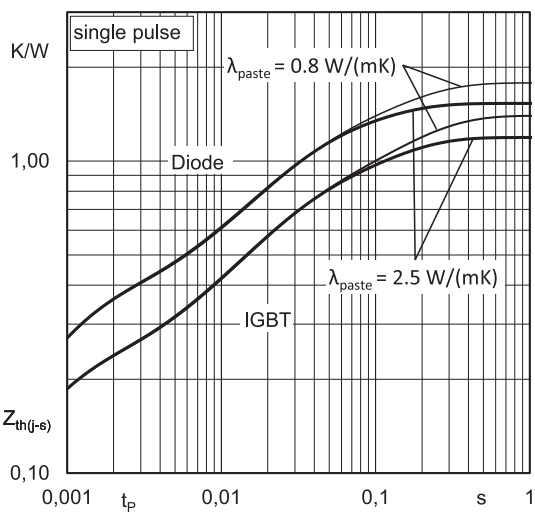
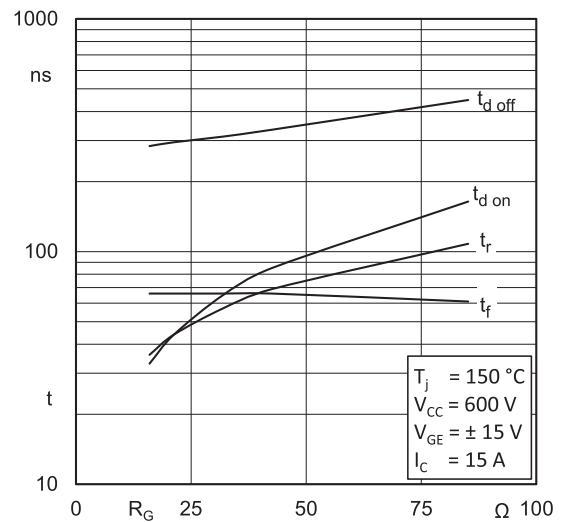
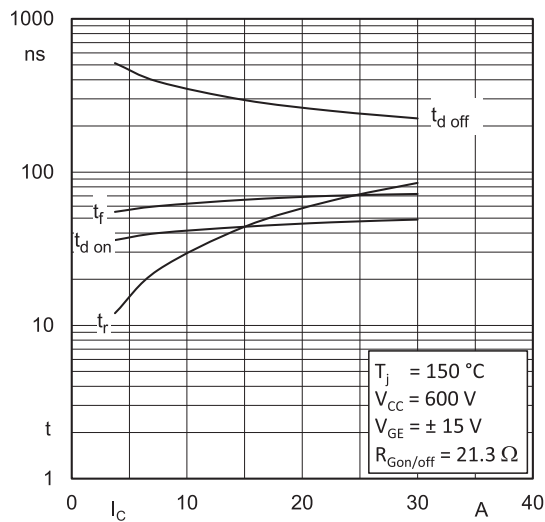
| Characteristics    |                                                                                                                                                                                   |      |                |      |          |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------|------|----------|
| Symbol             | Conditions                                                                                                                                                                        | min. | typ.           | max. | Unit     |
| Temperature Sensor |                                                                                                                                                                                   |      |                |      |          |
| $R_{100}$          | $T_r=100^{\circ}\text{C}$ ( $R_{25}=1000\Omega$ )                                                                                                                                 |      | $1670 \pm 3\%$ |      | $\Omega$ |
| $R_{(T)}$          | $R_{(T)}=1000\Omega[1+A(T-25^{\circ}\text{C})+B(T-25^{\circ}\text{C})^2]$<br>, $A = 7.635 \cdot 10^{-3}^{\circ}\text{C}^{-1}$ ,<br>$B = 1.731 \cdot 10^{-5}^{\circ}\text{C}^{-2}$ |      |                |      |          |

Creepage distance (spring to spring) between temperature sensor and phase W = 2.9mm (CTI 600)



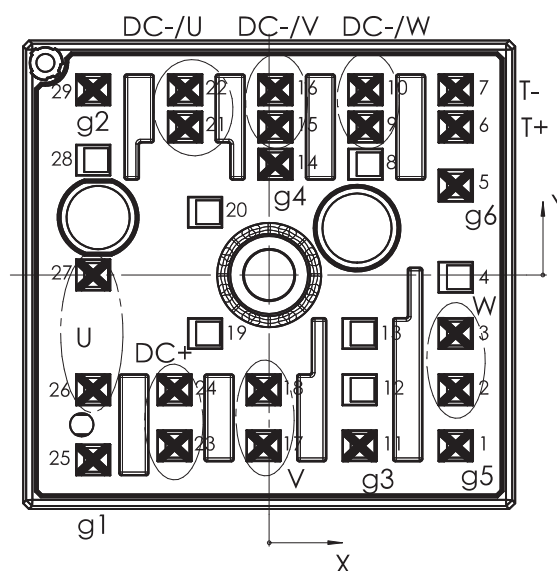
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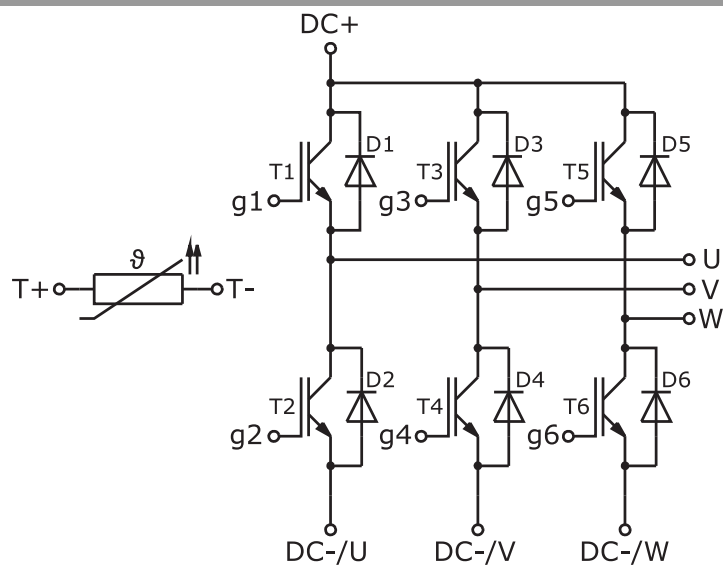


| Pin out |       |       |          |     |        |       |          |
|---------|-------|-------|----------|-----|--------|-------|----------|
| Pin     | X     | Y     | Function | Pin | X      | Y     | Function |
| 1       | 15,93 | -14,6 | g5       | 16  | 0,53   | 15,8  | DC-/V    |
| 2       | 15,93 | -9,8  | W        | 17  | -0,48  | -14,6 | V        |
| 3       | 15,93 | -5    | W        | 18  | -0,48  | -9,8  | V        |
| 4       |       |       |          | 19  |        |       |          |
| 5       | 15,93 | 7,63  | g6       | 20  |        |       |          |
| 6       | 15,93 | 12,63 | T+       | 21  | -7,18  | 12,63 | DC-/U    |
| 7       | 15,93 | 15,8  | T-       | 22  | -7,18  | 15,8  | DC-/U    |
| 8       |       |       |          | 23  | -8,08  | -14,6 | DC+      |
| 9       | 8,23  | 12,63 | DC-/W    | 24  | -8,08  | -9,8  | DC+      |
| 10      | 8,23  | 15,8  | DC-/W    | 25  | -15,03 | -15,8 | g1       |
| 11      | 7,73  | -14,6 | g3       | 26  | -15,03 | -9,8  | U        |
| 12      | 7,73  | -9,8  |          | 27  | -15,03 | 0     | U        |
| 13      |       |       |          | 28  |        |       |          |
| 14      | 0,53  | 9,45  | g4       | 29  | -15,03 | 15,8  | g2       |
| 15      | 0,53  | 12,63 | DC-/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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