

# SKM 500GA123D



**SEMITRANS® 4**

## IGBT Modules

**SKM 500GA123D**

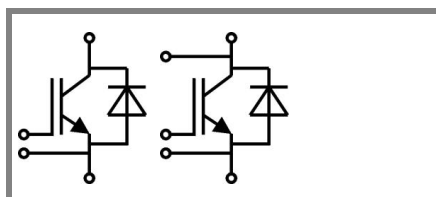
**SKM 500GA123DS**

## Features

- MOS input (voltage controlled)
- N channel, homogeneous Si
- Low inductance case
- Very low tail current with low temperature dependence
- High short circuit capability, self limiting to  $6 \times I_{Cnom}$
- Latch-up free
- Fast & soft CAL diodes
- Isolated copper baseplate using DBC Direct Copper Bonding Technology
- Large clearance (12 mm) and creepage distances (20 mm)

## Typical Applications\*

- AC inverter drives
- UPS



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| Absolute Maximum Ratings |                                                                                                                  |                                         | $T_c = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified |                    |
|--------------------------|------------------------------------------------------------------------------------------------------------------|-----------------------------------------|-----------------------------------------------------------------|--------------------|
| Symbol                   | Conditions                                                                                                       |                                         | Values                                                          | Units              |
| IGBT                     |                                                                                                                  |                                         |                                                                 |                    |
| $V_{CES}$                | $T_j = 25\text{ }^{\circ}\text{C}$                                                                               |                                         | 1200                                                            | V                  |
| $I_C$                    | $T_j = 150\text{ }^{\circ}\text{C}$                                                                              | $T_{case} = 25\text{ }^{\circ}\text{C}$ | 500                                                             | A                  |
|                          |                                                                                                                  | $T_{case} = 80\text{ }^{\circ}\text{C}$ | 420                                                             | A                  |
| $I_{CRM}$                | $I_{CRM}=2 \times I_{Cnom}$                                                                                      |                                         | 800                                                             | A                  |
| $V_{GES}$                |                                                                                                                  |                                         | $\pm 20$                                                        | V                  |
| $t_{psc}$                | $V_{CC} = 600\text{ V}; V_{GE} \leq 20\text{ V}; T_j = 125\text{ }^{\circ}\text{C}$<br>$V_{CES} < 1200\text{ V}$ |                                         | 10                                                              | $\mu\text{s}$      |
| Inverse Diode            |                                                                                                                  |                                         |                                                                 |                    |
| $I_F$                    | $T_j = 150\text{ }^{\circ}\text{C}$                                                                              | $T_{case} = 25\text{ }^{\circ}\text{C}$ | 500                                                             | A                  |
|                          |                                                                                                                  | $T_{case} = 80\text{ }^{\circ}\text{C}$ | 350                                                             | A                  |
| $I_{FRM}$                | $I_{FRM}=2 \times I_{Fnom}$                                                                                      |                                         | 800                                                             | A                  |
| $I_{FSM}$                | $t_p = 10\text{ ms}; \sin.$                                                                                      | $T_j = 150\text{ }^{\circ}\text{C}$     | 3600                                                            | A                  |
| Module                   |                                                                                                                  |                                         |                                                                 |                    |
| $I_{t(RMS)}$             |                                                                                                                  |                                         | 500                                                             | A                  |
| $T_{vj}$                 |                                                                                                                  |                                         | - 40 ...+ 150                                                   | $^{\circ}\text{C}$ |
| $T_{stg}$                |                                                                                                                  |                                         | - 40 ...+ 125                                                   | $^{\circ}\text{C}$ |
| $V_{isol}$               | AC, 1 min.                                                                                                       |                                         | 2500                                                            | V                  |

| Characteristics      |                                                                                           |                                                    | T <sub>c</sub> = 25 °C, unless otherwise specified |      |       |       |
|----------------------|-------------------------------------------------------------------------------------------|----------------------------------------------------|----------------------------------------------------|------|-------|-------|
| Symbol               | Conditions                                                                                |                                                    | min.                                               | typ. | max.  | Units |
| IGBT                 |                                                                                           |                                                    |                                                    |      |       |       |
| V <sub>GE(th)</sub>  | V <sub>GE</sub> = V <sub>CE</sub> , I <sub>C</sub> = 16 mA                                |                                                    | 4,5                                                | 5,5  | 6,5   | V     |
| I <sub>CES</sub>     | V <sub>GE</sub> = 0 V, V <sub>CE</sub> = V <sub>CES</sub>                                 | T <sub>j</sub> = 25 °C                             |                                                    | 0,1  | 0,3   | mA    |
| V <sub>CE0</sub>     |                                                                                           | T <sub>j</sub> = 25 °C                             |                                                    | 1,4  | 1,6   | V     |
|                      |                                                                                           | T <sub>j</sub> = 125 °C                            |                                                    | 1,6  | 1,8   | V     |
| r <sub>CE</sub>      | V <sub>GE</sub> = 15 V                                                                    | T <sub>j</sub> = 25°C                              |                                                    | 2,75 | 3,5   | mΩ    |
|                      |                                                                                           | T <sub>j</sub> = 125°C                             |                                                    | 3,75 | 4,75  | mΩ    |
| V <sub>CE(sat)</sub> | I <sub>Cnom</sub> = 400 A, V <sub>GE</sub> = 15 V T <sub>j</sub> = °C <sub>chiplev.</sub> |                                                    |                                                    | 2,5  | 3     | V     |
| C <sub>ies</sub>     | V <sub>CE</sub> = 25, V <sub>GE</sub> = 0 V                                               | f = 1 MHz                                          |                                                    | 26   | 40    | nF    |
| C <sub>oes</sub>     |                                                                                           |                                                    |                                                    | 4    | 5,2   | nF    |
| C <sub>res</sub>     |                                                                                           |                                                    |                                                    | 2    | 2,6   | nF    |
| R <sub>Gint</sub>    | T <sub>j</sub> = °C                                                                       |                                                    |                                                    | 1,25 |       | Ω     |
| t <sub>d(on)</sub>   | R <sub>Gon</sub> = 3,3 Ω                                                                  | V <sub>CC</sub> = 600V<br>I <sub>C</sub> = 400A    |                                                    | 250  | 600   | ns    |
| t <sub>r</sub>       |                                                                                           |                                                    |                                                    | 170  | 340   | ns    |
| E <sub>on</sub>      |                                                                                           |                                                    |                                                    | 45   |       | mJ    |
| t <sub>d(off)</sub>  | R <sub>Goff</sub> = 3,3 Ω                                                                 | T <sub>j</sub> = 125 °C<br>V <sub>GE</sub> = ± 15V |                                                    | 900  | 1100  | ns    |
| t <sub>f</sub>       |                                                                                           |                                                    |                                                    | 100  | 125   | ns    |
| E <sub>off</sub>     |                                                                                           |                                                    |                                                    |      |       | mJ    |
| R <sub>th(j-c)</sub> | per IGBT                                                                                  |                                                    |                                                    |      | 0,041 | K/W   |



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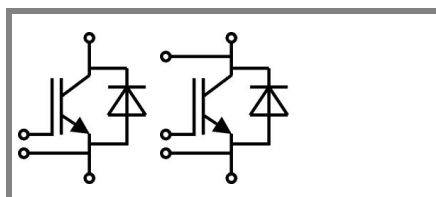
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| Characteristics           |                                                  |                                                      |           |       |       |
|---------------------------|--------------------------------------------------|------------------------------------------------------|-----------|-------|-------|
| Symbol                    | Conditions                                       | min.                                                 | typ.      | max.  | Units |
| <b>Inverse Diode</b>      |                                                  |                                                      |           |       |       |
| $V_F = V_{EC}$            | $I_{Fnom} = 400 \text{ A}; V_{GE} = 0 \text{ V}$ | $T_j = 25 \text{ }^\circ\text{C}_{\text{chiplev.}}$  | 2         | 2,5   | V     |
|                           |                                                  | $T_j = 125 \text{ }^\circ\text{C}_{\text{chiplev.}}$ | 1,8       |       | V     |
| $V_{F0}$                  |                                                  | $T_j = 25 \text{ }^\circ\text{C}$                    | 1,1       | 1,2   | V     |
|                           |                                                  | $T_j = 125 \text{ }^\circ\text{C}$                   |           |       | V     |
| $r_F$                     |                                                  | $T_j = 25 \text{ }^\circ\text{C}$                    | 2,3       | 3,3   | mΩ    |
|                           |                                                  | $T_j = 125 \text{ }^\circ\text{C}$                   |           |       | mΩ    |
| $I_{RRM}$                 | $I_F = 400 \text{ A}$                            | $T_j = 25 \text{ }^\circ\text{C}$                    | 90        |       | A     |
| $Q_{rr}$                  | $di/dt = 2000 \text{ A}/\mu\text{s}$             |                                                      | 15        |       | μC    |
| $E_{rr}$                  | $V_{GE} = 0 \text{ V}; V_{CC} = 600 \text{ V}$   |                                                      |           |       | mJ    |
| $R_{th(j-c)D}$            | per diode                                        |                                                      |           | 0,09  | K/W   |
| <b>Freewheeling Diode</b> |                                                  |                                                      |           |       |       |
| $V_F = V_{EC}$            | $I_{Fnom} = \text{A}; V_{GE} = \text{V}$         | $T_j = \text{ }^\circ\text{C}_{\text{chiplev.}}$     |           |       | V     |
| $V_{F0}$                  |                                                  | $T_j = 25 \text{ }^\circ\text{C}$                    |           |       | V     |
|                           |                                                  | $T_j = 125 \text{ }^\circ\text{C}$                   |           |       | V     |
| $r_F$                     |                                                  | $T_j = 25 \text{ }^\circ\text{C}$                    |           |       | V     |
|                           |                                                  | $T_j = 125 \text{ }^\circ\text{C}$                   |           |       | V     |
| $I_{RRM}$                 | $I_F = \text{A}$                                 | $T_j = \text{ }^\circ\text{C}$                       |           |       | A     |
| $Q_{rr}$                  |                                                  |                                                      |           |       | μC    |
| $E_{rr}$                  | $V_{GE} = 0 \text{ V}; V_{CC} = 600 \text{ V}$   |                                                      |           |       | mJ    |
|                           | per diode                                        |                                                      |           |       | K/W   |
| <b>Module</b>             |                                                  |                                                      |           |       |       |
| $L_{CE}$                  |                                                  |                                                      | 15        | 20    | nH    |
| $R_{CC'+EE'}$             | res., terminal-chip                              | $T_{\text{case}} = 25 \text{ }^\circ\text{C}$        | 0,18      |       | mΩ    |
|                           |                                                  | $T_{\text{case}} = 125 \text{ }^\circ\text{C}$       | 0,22      |       | mΩ    |
| $R_{th(c-s)}$             | per module                                       |                                                      |           | 0,038 | K/W   |
| $M_s$                     | to heat sink M6                                  |                                                      | 3         | 5     | Nm    |
| $M_t$                     | to terminals M6 (M4)                             |                                                      | 2,5 (1,1) | 5 (2) | Nm    |
| w                         |                                                  |                                                      |           | 330   | g     |

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 personal.

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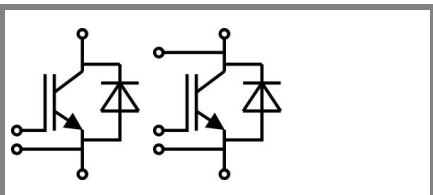
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| $Z_{th}$       |            |        |       |
|----------------|------------|--------|-------|
| Symbol         | Conditions | Values | Units |
| $Z_{th(j-c)I}$ |            |        |       |
| $R_i$          | $i = 1$    | 29     | mk/W  |
| $R_i$          | $i = 2$    | 10     | mk/W  |
| $R_i$          | $i = 3$    | 1,8    | mk/W  |
| $R_i$          | $i = 4$    | 0,2    | mk/W  |
| $\tau_{ui}$    | $i = 1$    | 0,04   | s     |
| $\tau_{ui}$    | $i = 2$    | 0,0189 | s     |
| $\tau_{ui}$    | $i = 3$    | 0,0017 | s     |
| $\tau_{ui}$    | $i = 4$    | 0,001  | s     |
| $Z_{th(j-c)D}$ |            |        |       |
| $R_i$          | $i = 1$    | 60     | mk/W  |
| $R_i$          | $i = 2$    | 23     | mk/W  |
| $R_i$          | $i = 3$    | 6,2    | mk/W  |
| $R_i$          | $i = 4$    | 0,8    | mk/W  |
| $\tau_{ui}$    | $i = 1$    | 0,0366 | s     |
| $\tau_{ui}$    | $i = 2$    | 0,042  | s     |
| $\tau_{ui}$    | $i = 3$    | 0,0009 | s     |
| $\tau_{ui}$    | $i = 4$    | 0,002  | s     |



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