

# SEMiX703GAR126HDs



SEMiX® 3s

## Trench IGBT Modules

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#### Features

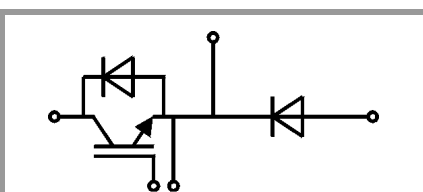
- Homogeneous Si
- Trench = Trenchgate technology
- $V_{CE(sat)}$  with positive temperature coefficient
- High short circuit capability
- UL recognised file no. E63532

#### Typical Applications\*

- AC inverter drives
- UPS
- Electronic Welding

#### Remarks

- Case temperatur limited to  $T_C=125^\circ\text{C}$  max.
- Not for new design



GAR

| Absolute Maximum Ratings |                                                                                |                         |             |      |
|--------------------------|--------------------------------------------------------------------------------|-------------------------|-------------|------|
| Symbol                   | Conditions                                                                     |                         | Values      | Unit |
| IGBT                     |                                                                                |                         |             |      |
| V <sub>CES</sub>         | T <sub>j</sub> = 25 °C                                                         |                         | 1200        | V    |
| I <sub>C</sub>           | T <sub>j</sub> = 150 °C                                                        | T <sub>c</sub> = 25 °C  | 642         | A    |
|                          |                                                                                | T <sub>c</sub> = 80 °C  | 449         | A    |
| I <sub>Cnom</sub>        |                                                                                |                         | 450         | A    |
| I <sub>CRM</sub>         | I <sub>CRM</sub> = 2xI <sub>Cnom</sub>                                         |                         | 900         | A    |
| V <sub>GES</sub>         |                                                                                |                         | -20 ... 20  | V    |
| t <sub>psc</sub>         | V <sub>CC</sub> = 600 V<br>V <sub>GE</sub> ≤ 20 V<br>V <sub>CES</sub> ≤ 1200 V | T <sub>j</sub> = 125 °C | 10          | μs   |
| T <sub>j</sub>           |                                                                                |                         | -40 ... 150 | °C   |
| Inverse diode            |                                                                                |                         |             |      |
| I <sub>F</sub>           | T <sub>j</sub> = 150 °C                                                        | T <sub>c</sub> = 25 °C  | 561         | A    |
|                          |                                                                                | T <sub>c</sub> = 80 °C  | 384         | A    |
| I <sub>Fnom</sub>        |                                                                                |                         | 450         | A    |
| I <sub>FRM</sub>         | I <sub>FRM</sub> = 2xI <sub>Fnom</sub>                                         |                         | 900         | A    |
| I <sub>FSM</sub>         | t <sub>p</sub> = 10 ms, sin 180°, T <sub>j</sub> = 25 °C                       |                         | 2900        | A    |
| T <sub>j</sub>           |                                                                                |                         | -40 ... 150 | °C   |
| Freewheeling diode       |                                                                                |                         |             |      |
| I <sub>F</sub>           | T <sub>j</sub> = 150 °C                                                        | T <sub>c</sub> = 25 °C  | 533         | A    |
|                          |                                                                                | T <sub>c</sub> = 80 °C  | 367         | A    |
| I <sub>Fnom</sub>        |                                                                                |                         | 450         | A    |
| I <sub>FRM</sub>         | I <sub>FRM</sub> = 2xI <sub>Fnom</sub>                                         |                         | 900         | A    |
| I <sub>FSM</sub>         | t <sub>p</sub> = 10 ms, sin 180°, T <sub>j</sub> = 25 °C                       |                         | 2900        | A    |
| T <sub>j</sub>           |                                                                                |                         | -40 ... 150 | °C   |
| Module                   |                                                                                |                         |             |      |
| I <sub>t(RMS)</sub>      | T <sub>terminal</sub> = 80 °C                                                  |                         | 600         | A    |
| T <sub>stg</sub>         |                                                                                |                         | -40 ... 125 | °C   |
| V <sub>isol</sub>        | AC sinus 50Hz, t = 1 min                                                       |                         | 4000        | V    |

| Characteristics      |                                                           |                         |      |      |      |      |
|----------------------|-----------------------------------------------------------|-------------------------|------|------|------|------|
| Symbol               | Conditions                                                |                         | min. | typ. | max. | Unit |
| IGBT                 |                                                           |                         |      |      |      |      |
| V <sub>CE(sat)</sub> | I <sub>C</sub> = 450 A                                    | T <sub>j</sub> = 25 °C  |      | 1.7  | 2.1  | V    |
|                      | V <sub>GE</sub> = 15 V<br>chipelevel                      | T <sub>j</sub> = 125 °C |      | 2.0  | 2.45 | V    |
| V <sub>CE0</sub>     |                                                           | T <sub>j</sub> = 25 °C  |      | 1    | 1.2  | V    |
|                      |                                                           | T <sub>j</sub> = 125 °C |      | 0.9  | 1.1  | V    |
| r <sub>CE</sub>      | V <sub>GE</sub> = 15 V                                    | T <sub>j</sub> = 25 °C  |      | 1.6  | 2.0  | mΩ   |
|                      |                                                           | T <sub>j</sub> = 125 °C |      | 2.4  | 3.0  | mΩ   |
| V <sub>GE(th)</sub>  | V <sub>GE</sub> =V <sub>CE</sub> , I <sub>C</sub> = 18 mA |                         | 5    | 5.8  | 6.5  | V    |
| I <sub>CES</sub>     | V <sub>GE</sub> = 0 V                                     | T <sub>j</sub> = 25 °C  |      | 0.1  | 0.3  | mA   |
|                      | V <sub>CE</sub> = 1200 V                                  | T <sub>j</sub> = 125 °C |      |      |      | mA   |
| C <sub>ies</sub>     | V <sub>CE</sub> = 25 V<br>V <sub>GE</sub> = 0 V           | f = 1 MHz               |      | 32.3 |      | nF   |
| C <sub>oes</sub>     |                                                           | f = 1 MHz               |      | 1.69 |      | nF   |
| C <sub>res</sub>     |                                                           | f = 1 MHz               |      | 1.46 |      | nF   |
| Q <sub>G</sub>       | V <sub>GE</sub> = - 8 V...+ 15 V                          |                         |      | 3600 |      | nC   |
| R <sub>Gint</sub>    | T <sub>j</sub> = 25 °C                                    |                         |      | 1.67 |      | Ω    |

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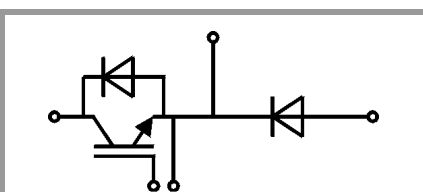
#### Typical Applications\*

- AC inverter drives
- UPS
- Electronic Welding

#### Remarks

- Case temperatur limited to  $T_C=125^\circ\text{C}$  max.
- Not for new design

| Characteristics                  |                                                                                               |                         |      |             |       |      |
|----------------------------------|-----------------------------------------------------------------------------------------------|-------------------------|------|-------------|-------|------|
| Symbol                           | Conditions                                                                                    |                         | min. | typ.        | max.  | Unit |
| t <sub>d(on)</sub>               | V <sub>CC</sub> = 600 V                                                                       | T <sub>j</sub> = 125 °C |      | 310         |       | ns   |
| t <sub>r</sub>                   | I <sub>C</sub> = 450 A                                                                        | T <sub>j</sub> = 125 °C |      | 60          |       | ns   |
| E <sub>on</sub>                  | V <sub>GE</sub> = ±15 V                                                                       | T <sub>j</sub> = 125 °C |      | 32          |       | mJ   |
| t <sub>d(off)</sub>              | R <sub>G on</sub> = 1.6 Ω                                                                     | T <sub>j</sub> = 125 °C |      | 680         |       | ns   |
| t <sub>f</sub>                   | R <sub>G off</sub> = 1.6 Ω                                                                    | T <sub>j</sub> = 125 °C |      | 135         |       | ns   |
| E <sub>off</sub>                 |                                                                                               | T <sub>j</sub> = 125 °C |      | 68          |       | mJ   |
| R <sub>th(j-c)</sub>             | per IGBT                                                                                      |                         |      |             | 0.061 | K/W  |
| Inverse diode                    |                                                                                               |                         |      |             |       |      |
| V <sub>F</sub> = V <sub>EC</sub> | I <sub>F</sub> = 450 A                                                                        | T <sub>j</sub> = 25 °C  |      | 1.6         | 1.80  | V    |
|                                  | V <sub>GE</sub> = 0 V<br>chip                                                                 | T <sub>j</sub> = 125 °C |      | 1.6         | 1.8   | V    |
| V <sub>F0</sub>                  |                                                                                               | T <sub>j</sub> = 25 °C  | 0.9  | 1           | 1.1   | V    |
|                                  |                                                                                               | T <sub>j</sub> = 125 °C | 0.7  | 0.8         | 0.9   | V    |
| r <sub>F</sub>                   |                                                                                               | T <sub>j</sub> = 25 °C  | 1.1  | 1.3         | 1.6   | mΩ   |
|                                  |                                                                                               | T <sub>j</sub> = 125 °C | 1.6  | 1.8         | 2.0   | mΩ   |
| I <sub>RRM</sub>                 | I <sub>F</sub> = 450 A                                                                        | T <sub>j</sub> = 125 °C |      | 580         |       | A    |
| Q <sub>rr</sub>                  | di/dt <sub>off</sub> = 8500 A/μs                                                              | T <sub>j</sub> = 125 °C |      | 130         |       | μC   |
| E <sub>rr</sub>                  | V <sub>GE</sub> = -15 V                                                                       | T <sub>j</sub> = 125 °C |      | 60          |       | mJ   |
|                                  | V <sub>CC</sub> = 600 V                                                                       | T <sub>j</sub> = 125 °C |      |             |       |      |
| R <sub>th(j-c)</sub>             | per diode                                                                                     |                         |      |             | 0.11  | K/W  |
| Freewheeling diode               |                                                                                               |                         |      |             |       |      |
| V <sub>F</sub> = V <sub>EC</sub> | I <sub>F</sub> = 450 A                                                                        | T <sub>j</sub> = 25 °C  |      | 1.7         | 1.91  | V    |
|                                  | V <sub>GE</sub> = 0 V<br>chip                                                                 | T <sub>j</sub> = 125 °C |      | 1.7         | 1.9   | V    |
| V <sub>F0</sub>                  |                                                                                               | T <sub>j</sub> = 25 °C  | 0.9  | 1           | 1.1   | V    |
|                                  |                                                                                               | T <sub>j</sub> = 125 °C | 0.7  | 0.8         | 0.9   | V    |
| r <sub>F</sub>                   |                                                                                               | T <sub>j</sub> = 25 °C  | 1.3  | 1.5         | 1.8   | mΩ   |
|                                  |                                                                                               | T <sub>j</sub> = 125 °C | 1.8  | 2.1         | 2.3   | mΩ   |
| I <sub>RRM</sub>                 | I <sub>F</sub> = 450 A                                                                        | T <sub>j</sub> = 125 °C |      | 580         |       | A    |
| Q <sub>rr</sub>                  | di/dt <sub>off</sub> = 8500 A/μs                                                              | T <sub>j</sub> = 125 °C |      | 130         |       | μC   |
| E <sub>rr</sub>                  | V <sub>GE</sub> = -15 V                                                                       | T <sub>j</sub> = 125 °C |      | 60          |       | mJ   |
|                                  | V <sub>CC</sub> = 600 V                                                                       | T <sub>j</sub> = 125 °C |      |             |       |      |
| R <sub>th(j-c)</sub>             | per diode                                                                                     |                         |      |             | 0.11  | K/W  |
| Module                           |                                                                                               |                         |      |             |       |      |
| L <sub>CE</sub>                  |                                                                                               |                         |      | 20          |       | nH   |
| R <sub>CC'+EE'</sub>             | res., terminal-chip                                                                           | T <sub>C</sub> = 25 °C  |      | 0.7         |       | mΩ   |
|                                  |                                                                                               | T <sub>C</sub> = 125 °C |      | 1           |       | mΩ   |
| R <sub>th(c-s)</sub>             | per module                                                                                    |                         |      | 0.04        |       | K/W  |
| M <sub>s</sub>                   | to heat sink (M5)                                                                             |                         | 3    |             | 5     | Nm   |
| M <sub>t</sub>                   |                                                                                               | to terminals (M6)       | 2.5  |             | 5     | Nm   |
|                                  |                                                                                               |                         |      |             |       | Nm   |
| w                                |                                                                                               |                         |      |             | 300   | g    |
| Temperatur Sensor                |                                                                                               |                         |      |             |       |      |
| R <sub>100</sub>                 | T <sub>C</sub> =100°C (R <sub>25</sub> =5 kΩ)                                                 |                         |      | 493 ± 5%    |       | Ω    |
| B <sub>100/125</sub>             | R <sub>(T)</sub> =R <sub>100</sub> exp[B <sub>100/125</sub> (1/T-1/T <sub>100</sub> )]; T[K]; |                         |      | 3550<br>±2% |       | K    |



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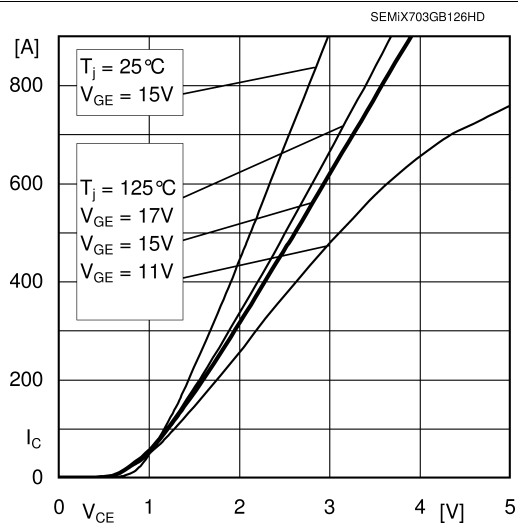


Fig. 1: Typ. output characteristic, inclusive  $R_{CC} + EE'$

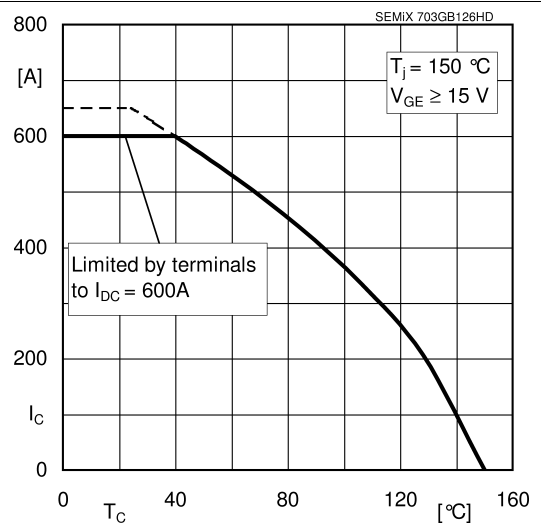


Fig. 2: Rated current vs. temperature  $I_C = f(T_C)$

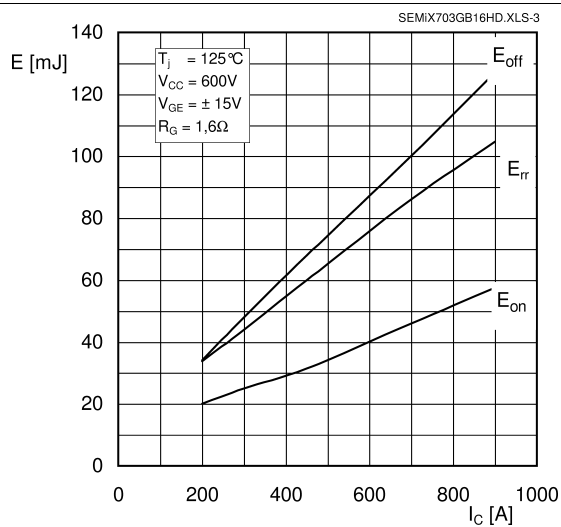


Fig. 3: Typ. turn-on /-off energy =  $f(I_C)$

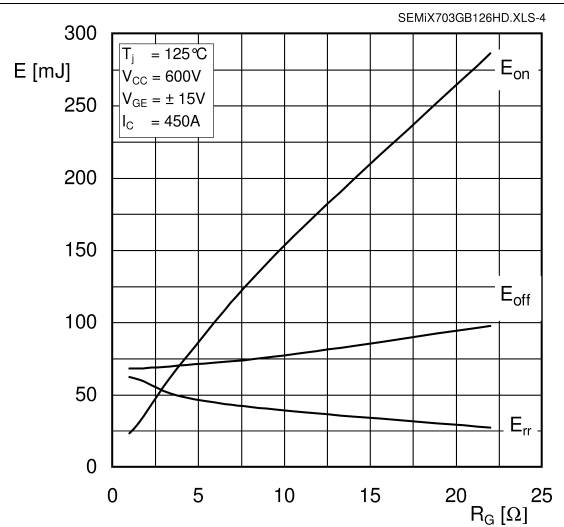


Fig. 4: Typ. turn-on /-off energy =  $f(R_G)$

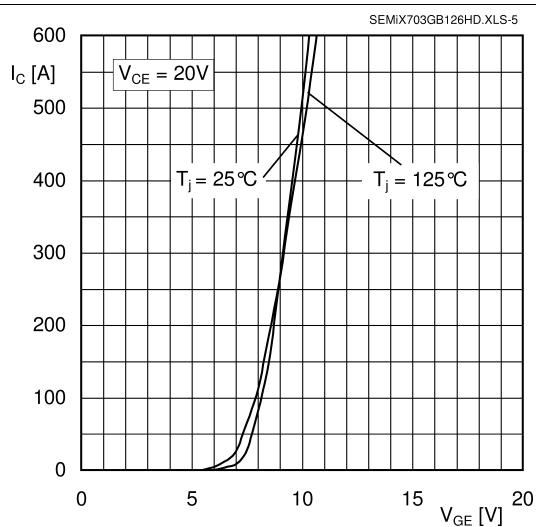


Fig. 5: Typ. transfer characteristic

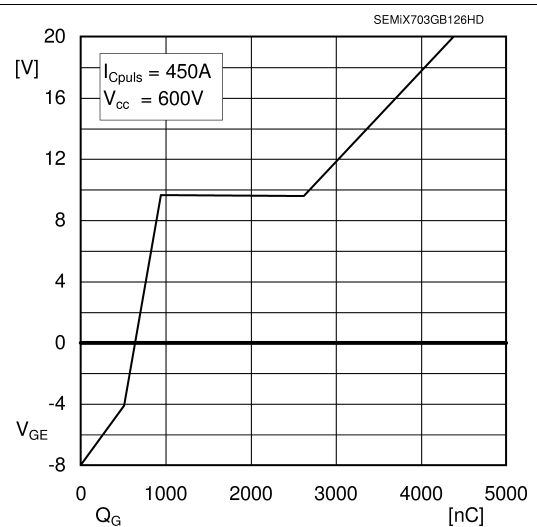


Fig. 6: Typ. gate charge characteristic

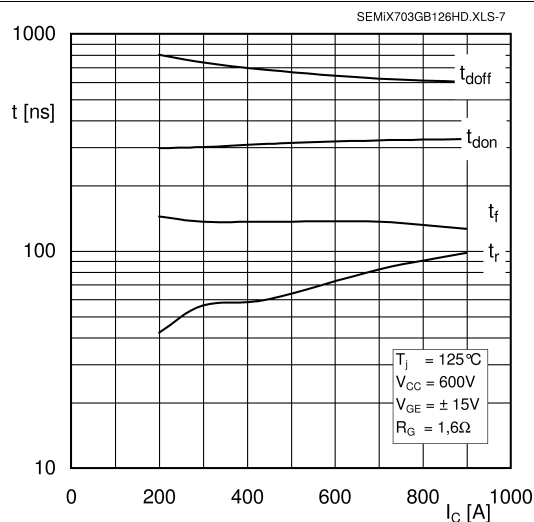


Fig. 7: Typ. switching times vs.  $I_C$

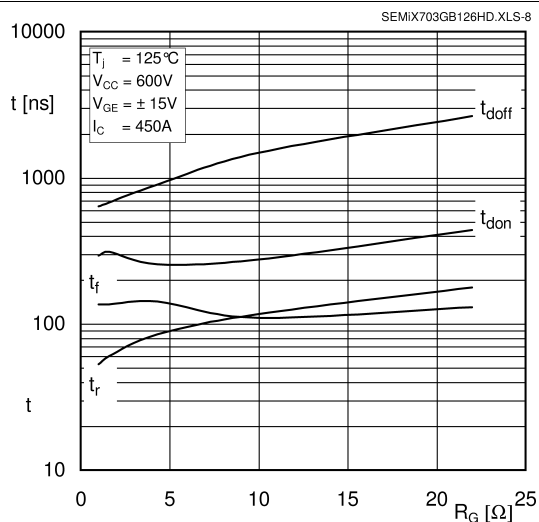


Fig. 8: Typ. switching times vs. gate resistor  $R_G$

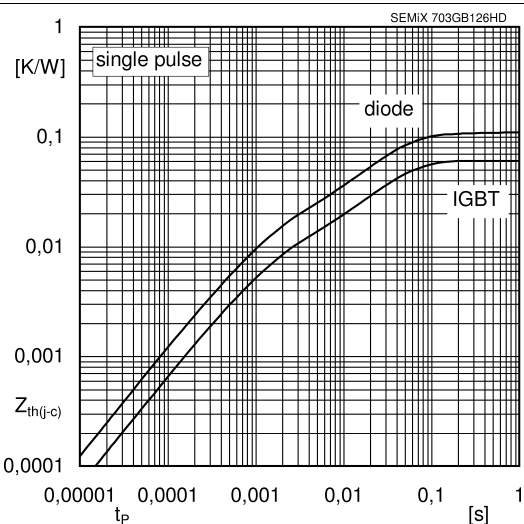


Fig. 9: Typ. transient thermal impedance

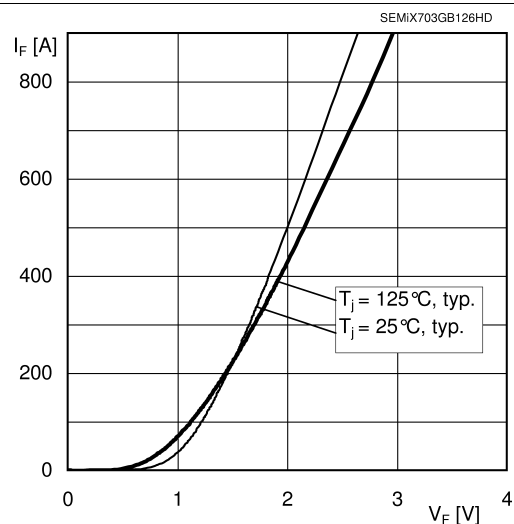


Fig. 10: Typ. CAL diode forward charact., incl.  $R_{CC'+EE'}$

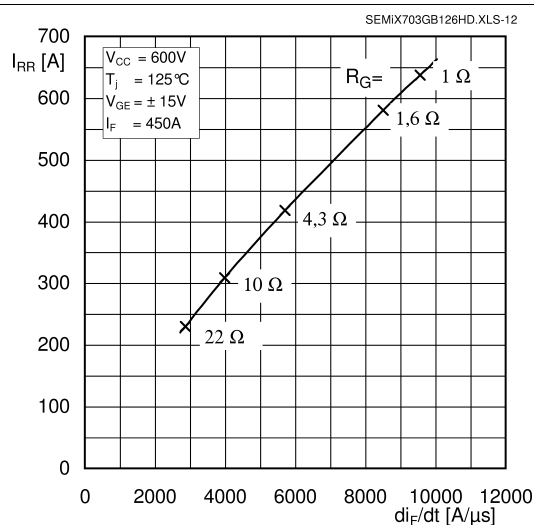


Fig. 11: Typ. CAL diode peak reverse recovery current

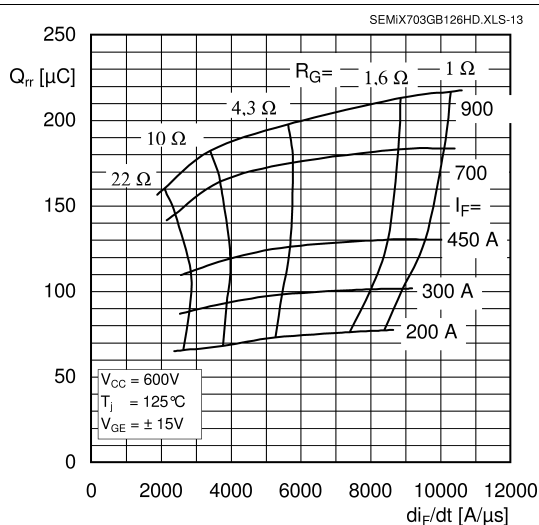
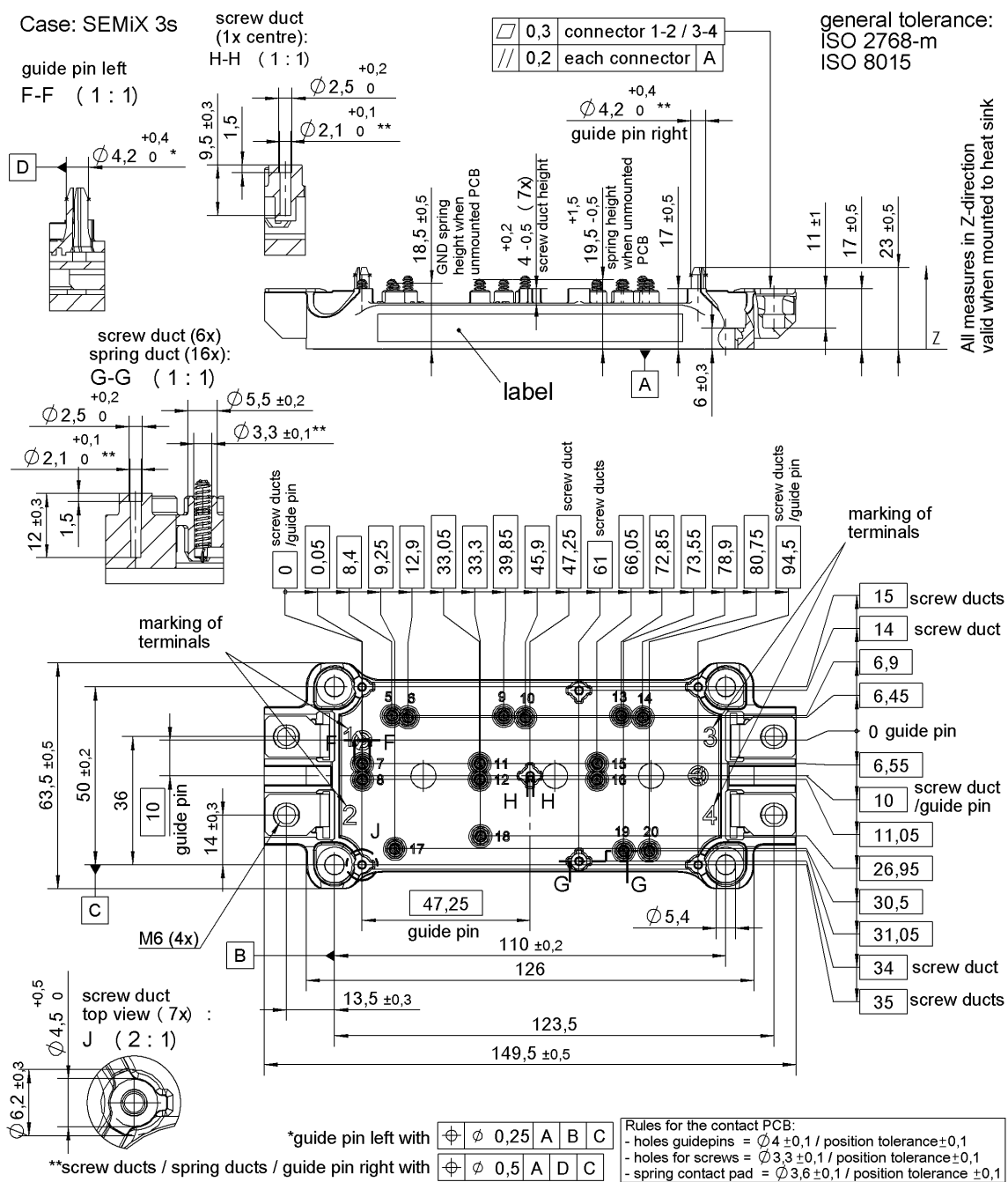
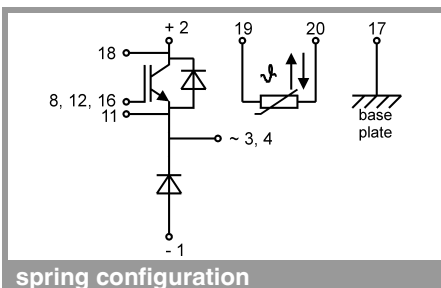


Fig. 12: Typ. CAL diode recovery charge

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## SEMiX 3s



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.