

# SEMiX202GB17E4s



SEMiX® 2s

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### Features

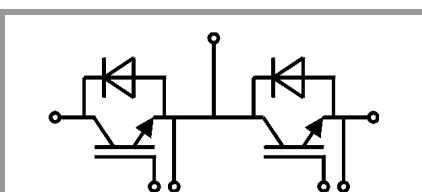
- Homogeneous Si
- Trench = Trenchgate technology
- $V_{CE(sat)}$  with positive temperature coefficient
- High short circuit capability
- UL recognized, file no. E63532

### Typical Applications\*

- AC inverter drives
- UPS
- Electronic Welding

### Remarks

- Case temperature limited to  $T_C=125^\circ\text{C}$  max.
- Product reliability results are valid for  $T_J=150^\circ\text{C}$
- Dynamic values apply to the following combination of resistors:  
 $R_{Gon,main} = 1,0/1,9 \Omega$  ( $V_{cc}=1200\text{V}/900\text{V}$ )  
 $R_{Goff,main} = 1,0/1,9 \Omega$  ( $V_{cc}=1200\text{V}/900\text{V}$ )  
 $R_{G,X} = 2,2 \Omega$   
 $R_{E,X} = 0,5 \Omega$



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### Absolute Maximum Ratings

| Symbol              | Conditions                                                                      |                         | Values      | Unit |
|---------------------|---------------------------------------------------------------------------------|-------------------------|-------------|------|
| IGBT                |                                                                                 |                         |             |      |
| V <sub>CES</sub>    | T <sub>j</sub> = 25 °C                                                          |                         | 1700        | V    |
| I <sub>C</sub>      | T <sub>j</sub> = 175 °C                                                         | T <sub>c</sub> = 25 °C  | 321         | A    |
|                     |                                                                                 | T <sub>c</sub> = 80 °C  | 248         | A    |
| I <sub>Cnom</sub>   |                                                                                 |                         | 200         | A    |
| I <sub>CRM</sub>    | I <sub>CRM</sub> = 3xI <sub>Cnom</sub>                                          |                         | 600         | A    |
| V <sub>GES</sub>    |                                                                                 |                         | -20 ... 20  | V    |
| t <sub>psc</sub>    | V <sub>CC</sub> = 1000 V<br>V <sub>GE</sub> ≤ 15 V<br>V <sub>CES</sub> ≤ 1700 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                                                          |                         | 1700        | V    |
| I <sub>F</sub>      | T <sub>j</sub> = 175 °C                                                         | T <sub>c</sub> = 25 °C  | 213         | A    |
|                     |                                                                                 | T <sub>c</sub> = 80 °C  | 157         | A    |
| I <sub>Fnom</sub>   |                                                                                 |                         | 200         | A    |
| I <sub>FRM</sub>    | I <sub>FRM</sub> = 2xI <sub>Fnom</sub>                                          |                         | 400         | A    |
| I <sub>FSM</sub>    | t <sub>p</sub> = 10 ms, sin 180°, T <sub>j</sub> = 25 °C                        |                         | 1170        | A    |
| T <sub>j</sub>      |                                                                                 |                         | -40 ... 175 | °C   |
| Module              |                                                                                 |                         |             |      |
| I <sub>t(RMS)</sub> |                                                                                 |                         | 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> = 200 A                                   | T <sub>j</sub> = 25 °C  |                         | 1.90 | 2.20 | V    |
|                      | V <sub>GE</sub> = 15 V<br>chiplevel                      | T <sub>j</sub> = 150 °C |                         | 2.30 | 2.60 | V    |
| V <sub>CE0</sub>     | chiplevel                                                | T <sub>j</sub> = 25 °C  |                         | 0.8  | 0.9  | V    |
|                      |                                                          | T <sub>j</sub> = 150 °C |                         | 0.7  | 0.8  | V    |
| r <sub>CE</sub>      | V <sub>GE</sub> = 15 V                                   | T <sub>j</sub> = 25 °C  |                         | 5.5  | 6.5  | mΩ   |
|                      | chiplevel                                                | T <sub>j</sub> = 150 °C |                         | 8    | 9    | mΩ   |
| V <sub>GE(th)</sub>  | V <sub>GE</sub> =V <sub>CE</sub> , I <sub>C</sub> = 8 mA |                         | 5.2                     | 5.8  | 6.4  | V    |
| I <sub>CES</sub>     | V <sub>GE</sub> = 0 V                                    | T <sub>j</sub> = 25 °C  |                         |      | 2.7  | mA   |
|                      | V <sub>CE</sub> = 1700 V                                 |                         |                         |      |      | mA   |
| C <sub>ies</sub>     | V <sub>CE</sub> = 25 V<br>V <sub>GE</sub> = 0 V          | f = 1 MHz               |                         | 18   |      | nF   |
| C <sub>oes</sub>     |                                                          | f = 1 MHz               |                         | 0.68 |      | nF   |
| C <sub>res</sub>     |                                                          | f = 1 MHz               |                         | 0.58 |      | nF   |
| Q <sub>G</sub>       | V <sub>GE</sub> = - 8 V...+ 15 V                         |                         |                         | 1600 |      | nC   |
| R <sub>Gint</sub>    | T <sub>j</sub> = 25 °C                                   |                         |                         | 3.75 |      | Ω    |
| t <sub>d(on)</sub>   | V <sub>CC</sub> = 1200 V                                 | T <sub>j</sub> = 150 °C |                         | 300  |      | ns   |
| t <sub>r</sub>       | I <sub>C</sub> = 200 A                                   |                         | T <sub>j</sub> = 150 °C |      | 38   |      |
| E <sub>on</sub>      | V <sub>GE</sub> = +15/-15 V                              | T <sub>j</sub> = 150 °C |                         | 75   |      | mJ   |
| t <sub>d(off)</sub>  | R <sub>G on</sub> = 2.4 Ω                                | T <sub>j</sub> = 150 °C |                         | 750  |      | ns   |
| t <sub>f</sub>       | R <sub>G off</sub> = 2.4 Ω                               | T <sub>j</sub> = 150 °C |                         | 150  |      | ns   |
| E <sub>off</sub>     | di/dt <sub>on</sub> = 6300 A/μs                          | T <sub>j</sub> = 150 °C |                         | 82   |      | mJ   |
|                      | di/dt <sub>off</sub> = 1100 A/μs                         |                         |                         |      |      |      |
|                      | du/dt = 5100 V/μs                                        |                         |                         |      |      |      |
|                      | L <sub>s</sub> = 30 nH                                   |                         |                         |      |      |      |



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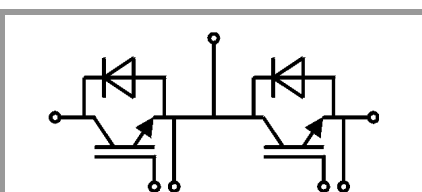
- AC inverter drives
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| Characteristics |                                                                                                                                                          |                           |      |       |           |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|------|-------|-----------|
| Symbol          | Conditions                                                                                                                                               |                           | min. | typ.  | max. Unit |
| $t_{d(on)}$     | $V_{CC} = 900 \text{ V}$                                                                                                                                 | $T_J = 150^\circ\text{C}$ |      | 360   | ns        |
| $t_r$           | $I_C = 200 \text{ A}$                                                                                                                                    | $T_J = 150^\circ\text{C}$ |      | 70    | ns        |
| $E_{on}$        | $V_{GE} = +15/-15 \text{ V}$                                                                                                                             | $T_J = 150^\circ\text{C}$ |      | 46    | mJ        |
| $t_{d(off)}$    | $R_{G on} = 3.3 \Omega$                                                                                                                                  | $T_J = 150^\circ\text{C}$ |      | 840   | ns        |
| $t_f$           | $R_{G off} = 3.3 \Omega$                                                                                                                                 | $T_J = 150^\circ\text{C}$ |      | 170   | ns        |
| $E_{off}$       | $di/dt_{on} = 3075 \text{ A}/\mu\text{s}$<br>$di/dt_{off} = 1000 \text{ A}/\mu\text{s}$<br>$du/dt = 4350 \text{ V}/\mu\text{s}$<br>$L_s = 80 \text{ nH}$ | $T_J = 150^\circ\text{C}$ |      | 68    | mJ        |
| $R_{th(j-c)}$   | per IGBT                                                                                                                                                 |                           |      | 0.122 | K/W       |

| Characteristics                  |                                                                                               |                         |      |             |       |      |
|----------------------------------|-----------------------------------------------------------------------------------------------|-------------------------|------|-------------|-------|------|
| Symbol                           | Conditions                                                                                    |                         | min. | typ.        | max.  | Unit |
| Inverse diode                    |                                                                                               |                         |      |             |       |      |
| V <sub>F</sub> = V <sub>EC</sub> | I <sub>F</sub> = 200 A                                                                        | T <sub>j</sub> = 25 °C  |      | 2.00        | 2.40  | V    |
|                                  | V <sub>GE</sub> = 0 V<br>chiplevel                                                            | T <sub>j</sub> = 150 °C |      | 2.15        | 2.57  | V    |
| V <sub>F0</sub>                  | chiplevel                                                                                     | T <sub>j</sub> = 25 °C  | 1.16 | 1.32        | 1.56  | V    |
|                                  |                                                                                               | T <sub>j</sub> = 150 °C |      | 1.08        | 1.22  | V    |
| r <sub>F</sub>                   | chiplevel                                                                                     | T <sub>j</sub> = 25 °C  | 2.7  | 3.4         | 4.2   | mΩ   |
|                                  |                                                                                               | T <sub>j</sub> = 150 °C |      | 5.4         | 6.8   | mΩ   |
| I <sub>RRM</sub>                 | I <sub>F</sub> = 200 A                                                                        | T <sub>j</sub> = 150 °C |      | 290         |       | A    |
| Q <sub>rr</sub>                  | di/dt <sub>off</sub> = 5600 A/μs                                                              | T <sub>j</sub> = 150 °C |      | 73          |       | μC   |
| E <sub>rr</sub>                  | V <sub>GE</sub> = -15 V<br>V <sub>R</sub> = 1200 V                                            | T <sub>j</sub> = 150 °C |      | 55          |       | mJ   |
| I <sub>RRM</sub>                 | I <sub>F</sub> = 200 A                                                                        | T <sub>j</sub> = 150 °C |      | 230         |       | A    |
| Q <sub>rr</sub>                  | di/dt <sub>off</sub> = 3000 A/μs                                                              | T <sub>j</sub> = 150 °C |      | 70          |       | μC   |
| E <sub>rr</sub>                  | V <sub>GE</sub> = -15 V<br>V <sub>R</sub> = 900 V                                             | T <sub>j</sub> = 150 °C |      | 45          |       | mJ   |
| R <sub>th(j-c)</sub>             | per diode                                                                                     |                         |      |             | 0.276 | K/W  |
| Module                           |                                                                                               |                         |      |             |       |      |
| L <sub>CE</sub>                  |                                                                                               |                         |      | 18          |       | 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                                                                                    |                         |      | 0.045       |       | 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                                |                                                                                               |                         |      |             | 250   | g    |
| Temperature 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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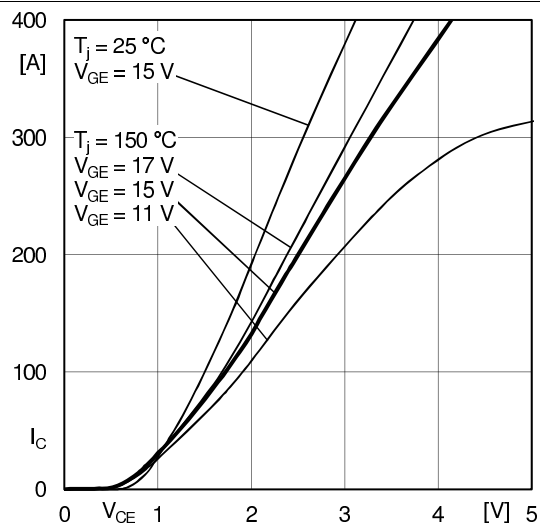


Fig. 1: Typ. output characteristic, inclusive  $R_{CC'+EE'}$

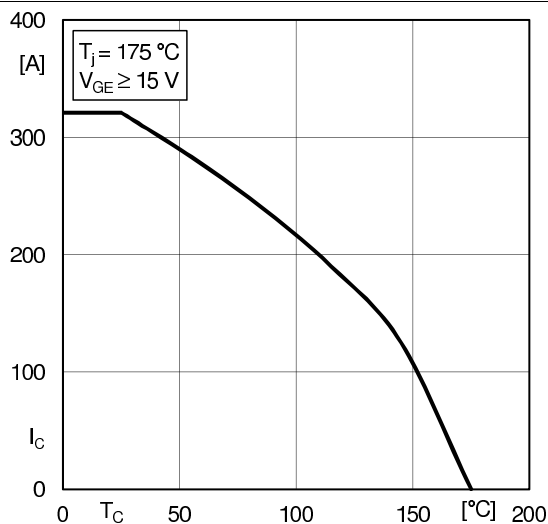


Fig. 2: Rated current vs. temperature  $I_C = f(T_C)$

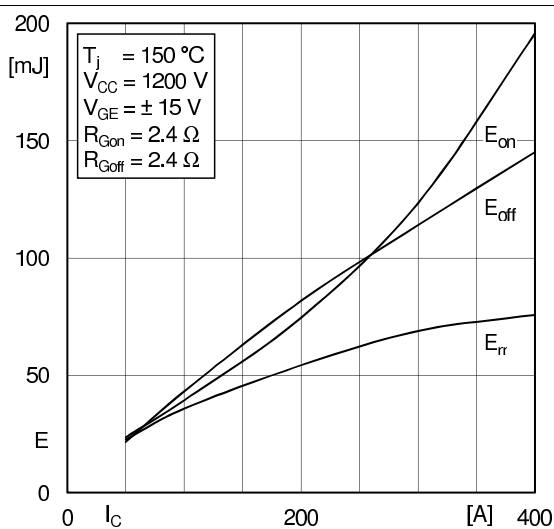


Fig. 3: Typ. turn-on /-off energy =  $f(I_C)$

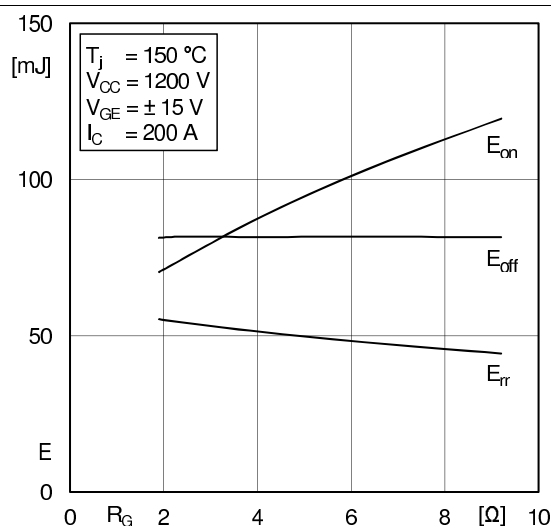


Fig. 4: Typ. turn-on /-off energy =  $f(R_G)$

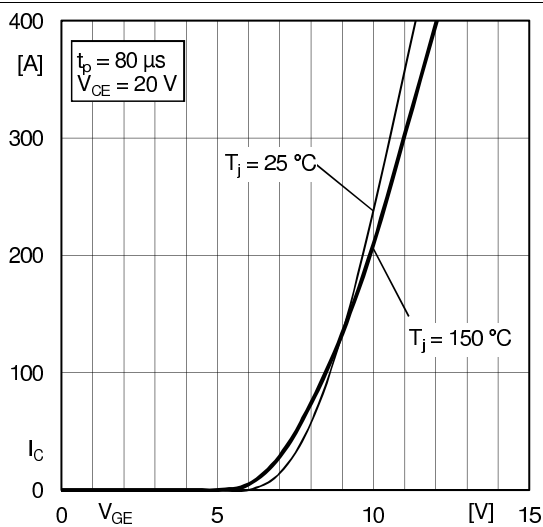


Fig. 5: Typ. transfer characteristic

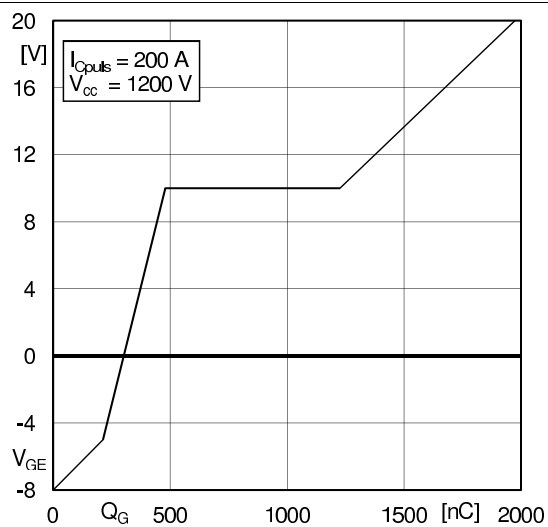


Fig. 6: Typ. gate charge characteristic

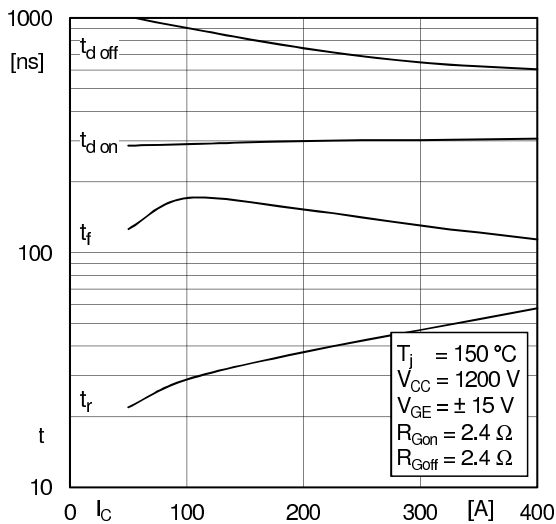


Fig. 7: Typ. switching times vs.  $I_C$

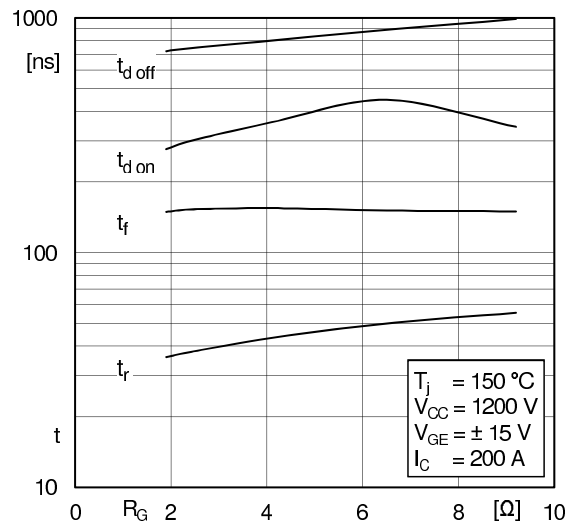


Fig. 8: Typ. switching times vs. gate resistor  $R_G$

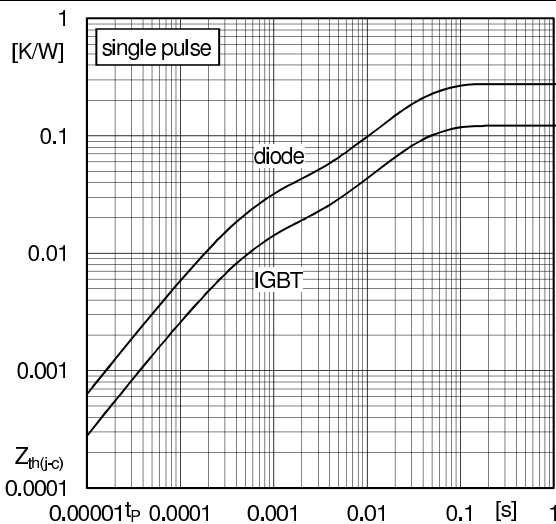


Fig. 9: Typ. transient thermal impedance

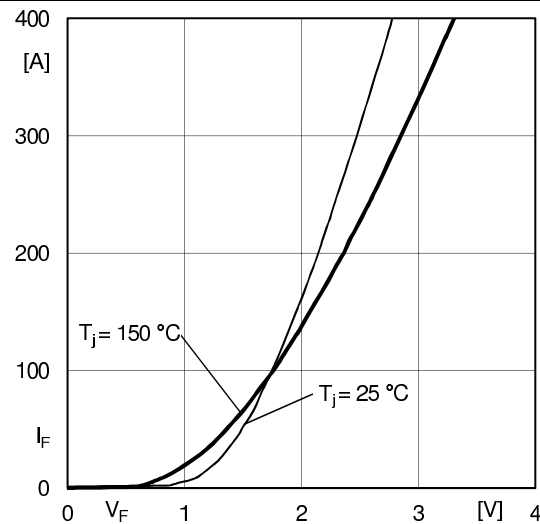


Fig. 10: Typ. CAL diode forward charact., incl.  $R_{CC'}+EE'$

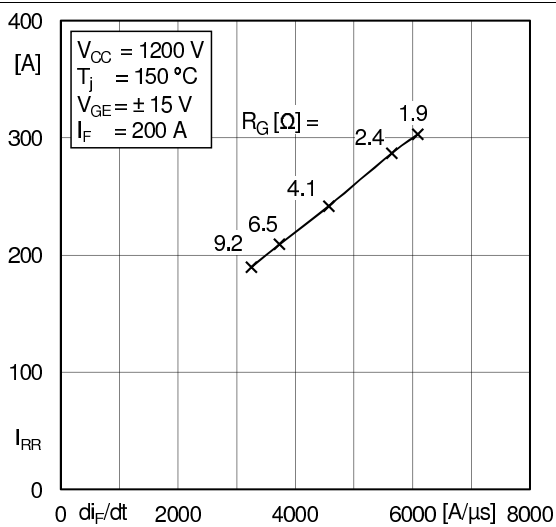


Fig. 11: Typ. CAL diode peak reverse recovery current

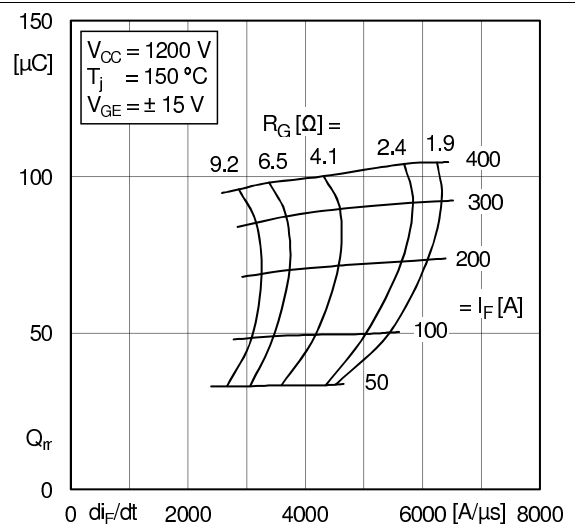


Fig. 12: Typ. CAL diode recovery charge

