



SEMITRANS® 2

## SKM150GAR12V

## Features

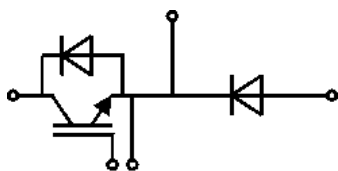
- V-IGBT = 6. Generation Trench V-IGBT (Fuji)
- CAL4 = Soft switching 4. Generation CAL-diode
- Insulated copper baseplate using DBC technology (Direct Copper Bonding)
- Increased power cycling capability
- With integrated gate resistor
- UL recognized, file no. E63532
- Lowest switching losses at High di/dt

## Typical Applications\*

- Electronic welders
- DC/DC – converter
- Brake chopper
- Switched reluctance motor

## Remarks

- Case temperature limited to  $T_c = 125^\circ\text{C}$  max.
- Recommended  $T_{op} = -40 \dots +150^\circ\text{C}$
- Product reliability results valid for  $T_j = 150^\circ\text{C}$



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## Absolute Maximum Ratings

| Symbol                    | Conditions                                                                           | Values                    | Unit             |
|---------------------------|--------------------------------------------------------------------------------------|---------------------------|------------------|
| <b>IGBT</b>               |                                                                                      |                           |                  |
| $V_{CES}$                 | $T_j = 25^\circ\text{C}$                                                             | 1200                      | V                |
| $I_C$                     | $T_j = 175^\circ\text{C}$                                                            | $T_c = 25^\circ\text{C}$  | 231              |
|                           |                                                                                      | $T_c = 80^\circ\text{C}$  | 176              |
| $I_{Cnom}$                |                                                                                      | 150                       | A                |
| $I_{CRM}$                 | $I_{CRM} = 3 \times I_{Cnom}$                                                        | 450                       | A                |
| $V_{GES}$                 |                                                                                      | -20 ... 20                | V                |
| $t_{psc}$                 | $V_{CC} = 720\text{ V}$<br>$V_{GE} \leq 15\text{ V}$<br>$V_{CES} \leq 1200\text{ V}$ | $T_j = 125^\circ\text{C}$ | 10               |
| $T_j$                     |                                                                                      | -40 ... 175               | $^\circ\text{C}$ |
| <b>Inverse diode</b>      |                                                                                      |                           |                  |
| $I_F$                     | $T_j = 175^\circ\text{C}$                                                            | $T_c = 25^\circ\text{C}$  | 189              |
|                           |                                                                                      | $T_c = 80^\circ\text{C}$  | 141              |
| $I_{Fnom}$                |                                                                                      | 150                       | A                |
| $I_{FRM}$                 | $I_{FRM} = 3 \times I_{Fnom}$                                                        | 450                       | A                |
| $I_{FSM}$                 | $t_p = 10\text{ ms, sin } 180^\circ, T_j = 25^\circ\text{C}$                         | 900                       | A                |
| $T_j$                     |                                                                                      | -40 ... 175               | $^\circ\text{C}$ |
| <b>Freewheeling diode</b> |                                                                                      |                           |                  |
| $I_F$                     | $T_j = 175^\circ\text{C}$                                                            | $T_c = 25^\circ\text{C}$  | 189              |
|                           |                                                                                      | $T_c = 80^\circ\text{C}$  | 141              |
| $I_{Fnom}$                |                                                                                      | 150                       | A                |
| $I_{FRM}$                 | $I_{FRM} = 3 \times I_{Fnom}$                                                        | 450                       | A                |
| $I_{FSM}$                 | $t_p = 10\text{ ms, sin } 180^\circ, T_j = 25^\circ\text{C}$                         | 900                       | A                |
| $T_j$                     |                                                                                      | -40 ... 175               | $^\circ\text{C}$ |
| <b>Module</b>             |                                                                                      |                           |                  |
| $I_{t(RMS)}$              |                                                                                      | 200                       | A                |
| $T_{stg}$                 |                                                                                      | -40 ... 125               | $^\circ\text{C}$ |
| $V_{isol}$                | AC sinus 50 Hz, $t = 1\text{ min}$                                                   | 4000                      | V                |

## Characteristics

| Symbol        | Conditions                                                   | min.                      | typ. | max. | Unit       |
|---------------|--------------------------------------------------------------|---------------------------|------|------|------------|
| <b>IGBT</b>   |                                                              |                           |      |      |            |
| $V_{CE(sat)}$ | $I_C = 150\text{ A}$<br>$V_{GE} = 15\text{ V}$<br>chipelevel | $T_j = 25^\circ\text{C}$  | 1.75 | 2.20 | V          |
|               |                                                              | $T_j = 150^\circ\text{C}$ | 2.20 | 2.48 | V          |
| $V_{CE0}$     | chipelevel                                                   | $T_j = 25^\circ\text{C}$  | 0.94 | 1.04 | V          |
|               |                                                              | $T_j = 150^\circ\text{C}$ | 0.88 | 0.98 | V          |
| $r_{CE}$      | $V_{GE} = 15\text{ V}$<br>chipelevel                         | $T_j = 25^\circ\text{C}$  | 5.4  | 7.7  | m $\Omega$ |
|               |                                                              | $T_j = 150^\circ\text{C}$ | 8.8  | 10   | m $\Omega$ |
| $V_{GE(th)}$  | $V_{GE} = V_{CE}, I_C = 6\text{ mA}$                         | 5.5                       | 6    | 6.5  | V          |
| $I_{CES}$     | $V_{GE} = 0\text{ V}$<br>$V_{CE} = 1200\text{ V}$            | $T_j = 25^\circ\text{C}$  |      | 0.3  | mA         |
|               |                                                              | $T_j = 150^\circ\text{C}$ | -    |      | mA         |
| $C_{ies}$     | $V_{CE} = 25\text{ V}$<br>$V_{GE} = 0\text{ V}$              | $f = 1\text{ MHz}$        | 9.0  |      | nF         |
| $C_{oes}$     | $V_{CE} = 25\text{ V}$<br>$V_{GE} = 0\text{ V}$              | $f = 1\text{ MHz}$        | 0.89 |      | nF         |
| $C_{res}$     | $V_{CE} = 25\text{ V}$<br>$V_{GE} = 0\text{ V}$              | $f = 1\text{ MHz}$        | 0.88 |      | nF         |
| $Q_G$         | $V_{GE} = -8\text{ V} \dots +15\text{ V}$                    |                           | 1650 |      | nC         |
| $R_{Gint}$    | $T_j = 25^\circ\text{C}$                                     |                           | 5.0  |      | $\Omega$   |



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- Increased power cycling capability
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### Typical Applications\*

- Electronic welders
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- Brake chopper
- Switched reluctance motor

### Remarks

- Case temperature limited to  $T_c = 125^\circ\text{C}$  max.
- Recommended  $T_{op} = -40 \dots +150^\circ\text{C}$
- Product reliability results valid for  $T_j = 150^\circ\text{C}$

### Characteristics

| Symbol        | Conditions                                                                           | min. | typ. | max. | Unit |
|---------------|--------------------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$   | $V_{CC} = 600\text{ V}$<br>$I_C = 150\text{ A}$<br>$T_j = 150^\circ\text{C}$         |      | 258  |      | ns   |
| $t_r$         | $V_{GE} = +15/-15\text{ V}$<br>$R_{G on} = 1.5\ \Omega$<br>$T_j = 150^\circ\text{C}$ |      | 32   |      | ns   |
| $E_{on}$      | $R_{G off} = 1.5\ \Omega$<br>$T_j = 150^\circ\text{C}$                               |      | 13.5 |      | mJ   |
| $t_{d(off)}$  | $di/dt_{on} = 5400\text{ A}/\mu\text{s}$<br>$T_j = 150^\circ\text{C}$                |      | 388  |      | ns   |
| $t_f$         | $di/dt_{off} = 1800\text{ A}/\mu\text{s}$<br>$T_j = 150^\circ\text{C}$               |      | 62   |      | ns   |
| $E_{off}$     | $du/dt = 8100\text{ V}/\mu\text{s}$<br>$T_j = 150^\circ\text{C}$                     |      | 14.2 |      | mJ   |
| $R_{th(j-c)}$ | per IGBT                                                                             |      |      | 0.19 | K/W  |

### Inverse diode

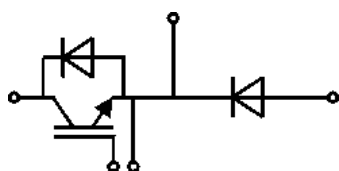
|                |                                                                                                      |                                                       |              |              |               |
|----------------|------------------------------------------------------------------------------------------------------|-------------------------------------------------------|--------------|--------------|---------------|
| $V_F = V_{EC}$ | $I_F = 150\text{ A}$<br>$V_{GE} = 0\text{ V}$<br>chiplevel                                           | $T_j = 25^\circ\text{C}$<br>$T_j = 150^\circ\text{C}$ | 2.14<br>2.07 | 2.46<br>2.38 | V             |
| $V_{F0}$       | chiplevel                                                                                            | $T_j = 25^\circ\text{C}$<br>$T_j = 150^\circ\text{C}$ | 1.30<br>0.90 | 1.50<br>1.10 | V             |
| $r_F$          | chiplevel                                                                                            | $T_j = 25^\circ\text{C}$<br>$T_j = 150^\circ\text{C}$ | 5.6<br>7.8   | 6.4<br>8.5   | m $\Omega$    |
| $I_{RRM}$      | $I_F = 150\text{ A}$<br>$T_j = 150^\circ\text{C}$                                                    |                                                       | 165          |              | A             |
| $Q_{rr}$       | $di/dt_{off} = 5800\text{ A}/\mu\text{s}$<br>$V_{GE} = \pm 15\text{ V}$<br>$T_j = 150^\circ\text{C}$ |                                                       | 22           |              | $\mu\text{C}$ |
| $E_{rr}$       | $V_{CC} = 600\text{ V}$<br>$T_j = 150^\circ\text{C}$                                                 |                                                       | 8.5          |              | mJ            |
| $R_{th(j-c)}$  | per diode                                                                                            |                                                       |              | 0.31         | K/W           |

### Freewheeling diode

|                |                                                                                                      |                                                       |              |              |               |
|----------------|------------------------------------------------------------------------------------------------------|-------------------------------------------------------|--------------|--------------|---------------|
| $V_F = V_{EC}$ | $I_F = 150\text{ A}$<br>$V_{GE} = 0\text{ V}$<br>chiplevel                                           | $T_j = 25^\circ\text{C}$<br>$T_j = 150^\circ\text{C}$ | 2.14<br>2.07 | 2.46<br>2.38 | V             |
| $V_{F0}$       | chiplevel                                                                                            | $T_j = 25^\circ\text{C}$<br>$T_j = 150^\circ\text{C}$ | 1.30<br>0.90 | 1.50<br>1.10 | V             |
| $r_F$          | chiplevel                                                                                            | $T_j = 25^\circ\text{C}$<br>$T_j = 150^\circ\text{C}$ | 5.6<br>7.8   | 6.4<br>8.5   | m $\Omega$    |
| $I_{RRM}$      | $I_F = 150\text{ A}$<br>$T_j = 150^\circ\text{C}$                                                    |                                                       | 165          |              | A             |
| $Q_{rr}$       | $di/dt_{off} = 5800\text{ A}/\mu\text{s}$<br>$V_{GE} = \pm 15\text{ V}$<br>$T_j = 150^\circ\text{C}$ |                                                       | 22           |              | $\mu\text{C}$ |
| $E_{rr}$       | $V_{CC} = 600\text{ V}$<br>$T_j = 150^\circ\text{C}$                                                 |                                                       | 8.5          |              | mJ            |
| $R_{th(j-c)}$  | per diode                                                                                            |                                                       |              | 0.31         | K/W           |

### Module

|               |                                                                                                    |                                                       |              |      |            |
|---------------|----------------------------------------------------------------------------------------------------|-------------------------------------------------------|--------------|------|------------|
| $L_{CE}$      |                                                                                                    |                                                       | 30           |      | nH         |
| $R_{CC+EE'}$  | measured per switch                                                                                | $T_c = 25^\circ\text{C}$<br>$T_c = 125^\circ\text{C}$ | 0.65<br>1.09 |      | m $\Omega$ |
| $R_{th(c-s)}$ | calculated without thermal coupling<br>( $\lambda_{grease} = 0.81\text{ W}/(\text{m}^2\text{K})$ ) |                                                       | 0.04         | 0.05 | K/W        |
| $M_s$         | to heat sink M6                                                                                    |                                                       | 3            | 5    | Nm         |
| $M_t$         |                                                                                                    | to terminals M5                                       | 2.5          | 5    | Nm         |
|               |                                                                                                    |                                                       |              |      | Nm         |
| w             |                                                                                                    |                                                       |              | 160  | g          |



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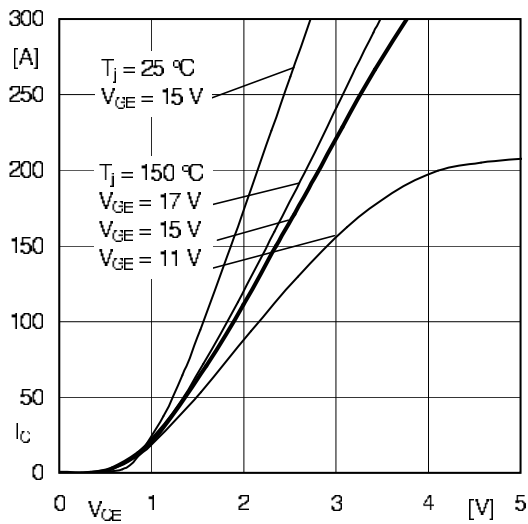


Fig. 1: Typ. output characteristic, inclusive  $R_{CC'} + E_{E'}$

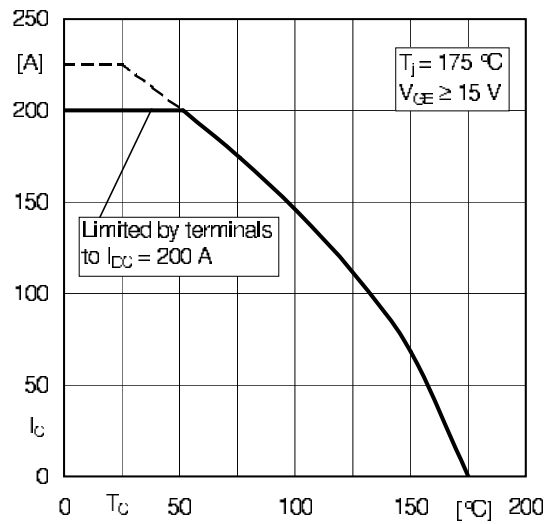


Fig. 2: Rated current vs. temperature  $I_C = f(T_C)$

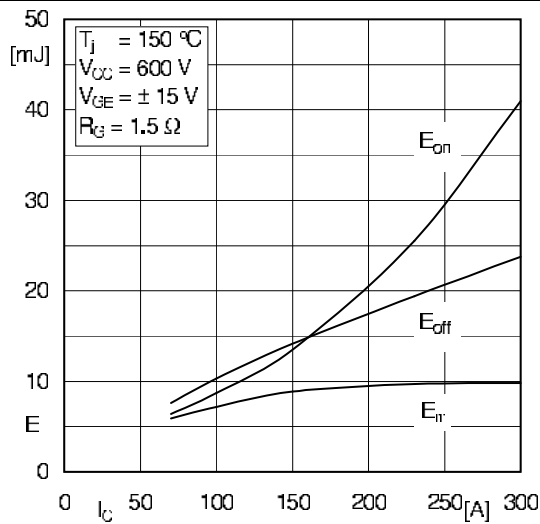


Fig. 3: Typ. turn-on /-off energy =  $f(I_C)$

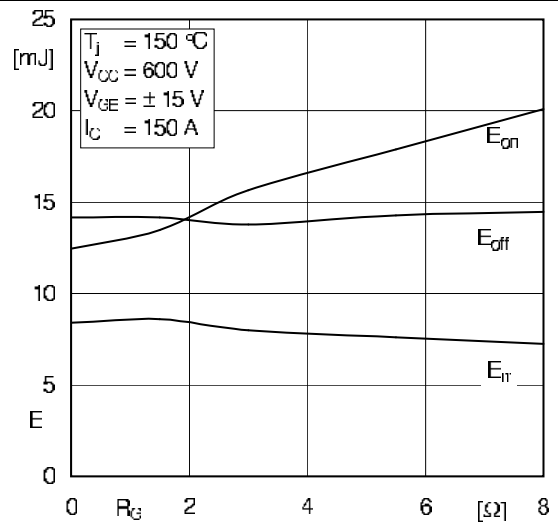


Fig. 4: Typ. turn-on /-off energy =  $f(R_G)$

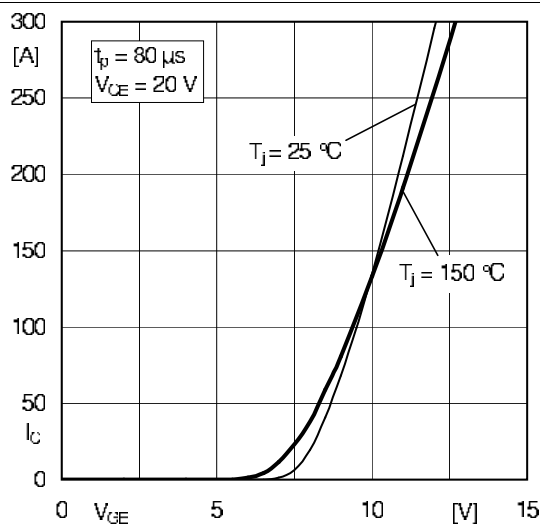


Fig. 5: Typ. transfer characteristic

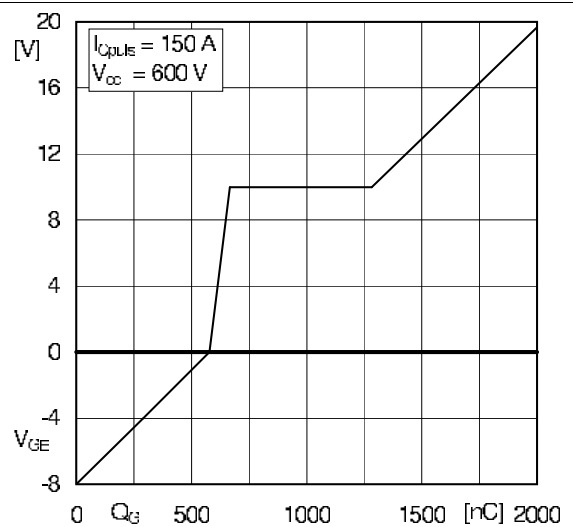


Fig. 6: Typ. gate charge characteristic

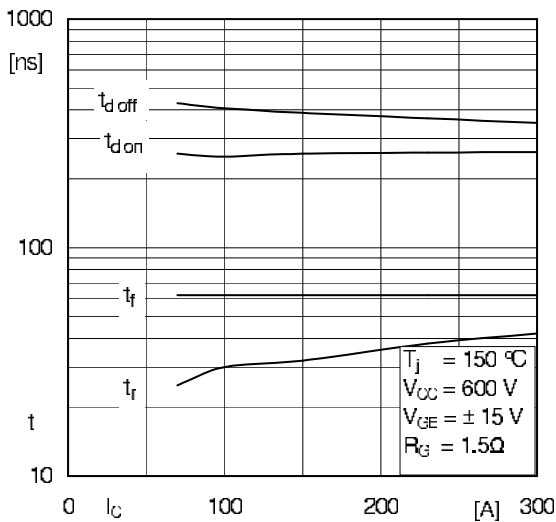


Fig. 7: Typ. switching times vs.  $I_C$

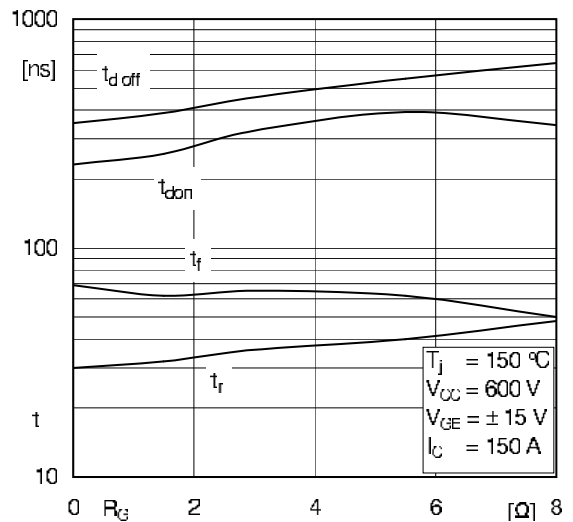


Fig. 8: Typ. switching times vs. gate resistor  $R_G$

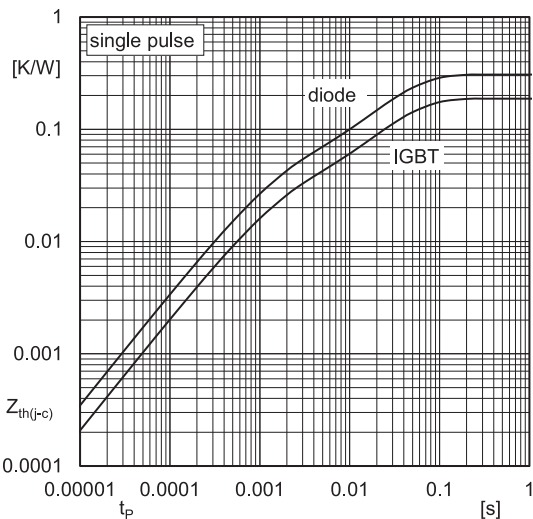


Fig. 9: Transient thermal impedance

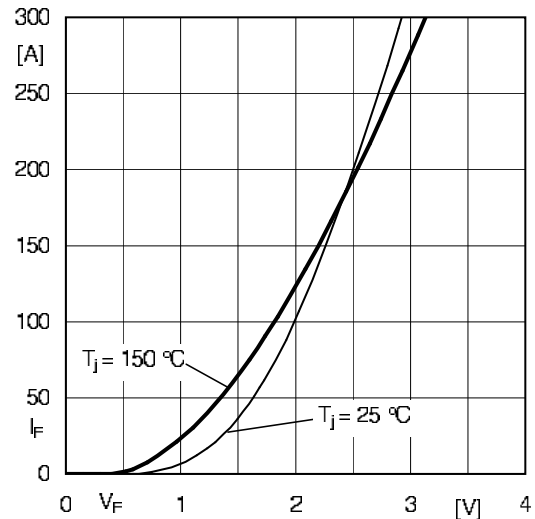


Fig. 10: Typ. CAL diode forward charact., incl.  $R_{CC'+EE'}$

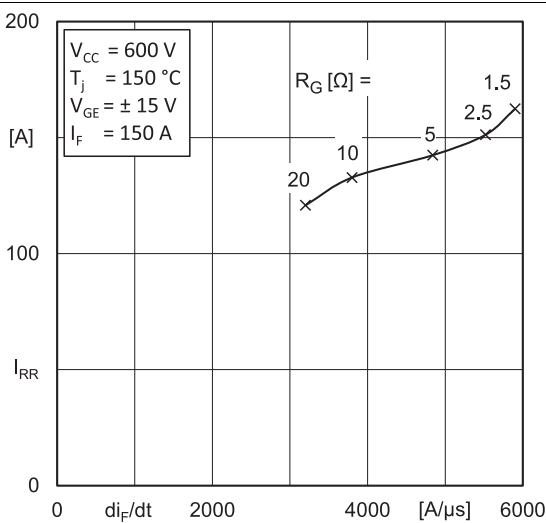


Fig. 11: CAL diode peak reverse recovery current

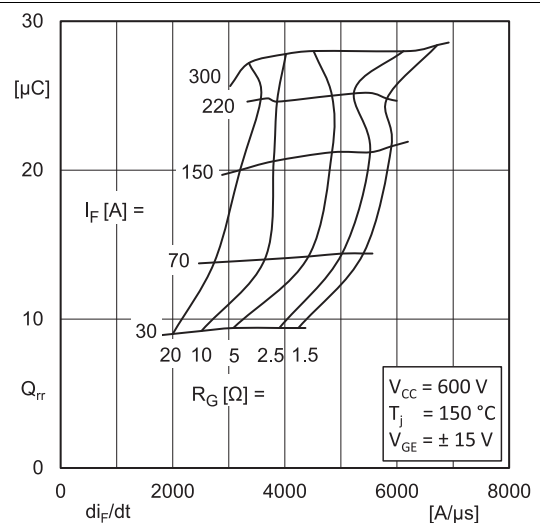
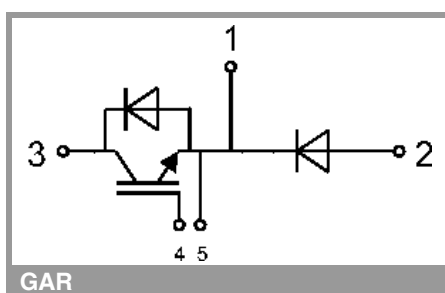


Fig. 12: Typ. CAL diode peak reverse recovery charge

Technical drawing of a 5-pin DIN connector. The drawing shows the front and side views with the following dimensions and labels:

- Overall Dimensions:**
  - Overall width: 94
  - Overall height: 34
  - Distance between mounting holes: 80 ± 0,4
- Pin Dimensions and Spacing:**
  - Pin 1 diameter:  $\phi 6,4$
  - Pin 1 to Pin 2 distance: 16,6 ± 0,4
  - Pin 2 to Pin 3 distance: 26 ± 0,4
  - Pin 3 to Pin 4 distance: 17
  - Pin 4 to Pin 5 distance: 6
  - Pin 5 to Pin 6 distance: 6
  - Pin 6 to Pin 7 distance: 17
  - Pin 7 to Pin 8 distance: 6
  - Pin 8 to Pin 9 distance: 17
  - Pin 9 to Pin 10 distance: 6
  - Pin 10 to Pin 11 distance: 17
  - Pin 11 to Pin 12 distance: 6
  - Pin 12 to Pin 13 distance: 17
  - Pin 13 to Pin 14 distance: 6
  - Pin 14 to Pin 15 distance: 17
  - Pin 15 to Pin 16 distance: 6
  - Pin 16 to Pin 17 distance: 17
  - Pin 17 to Pin 18 distance: 6
  - Pin 18 to Pin 19 distance: 17
  - Pin 19 to Pin 20 distance: 6
  - Pin 20 to Pin 21 distance: 17
  - Pin 21 to Pin 22 distance: 6
  - Pin 22 to Pin 23 distance: 17
  - Pin 23 to Pin 24 distance: 6
  - Pin 24 to Pin 25 distance: 17
  - Pin 25 to Pin 26 distance: 6
  - Pin 26 to Pin 27 distance: 17
  - Pin 27 to Pin 28 distance: 6
  - Pin 28 to Pin 29 distance: 17
  - Pin 29 to Pin 30 distance: 6
  - Pin 30 to Pin 31 distance: 17
  - Pin 31 to Pin 32 distance: 6
  - Pin 32 to Pin 33 distance: 17
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  - Pin 38 to Pin 39 distance: 17
  - Pin 39 to Pin 40 distance: 6
  - Pin 40 to Pin 41 distance: 17
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  - Pin 46 to Pin 47 distance: 17
  - Pin 47 to Pin 48 distance: 6
  - Pin 48 to Pin 49 distance: 17
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  - Pin 186 to Pin 187 distance: 17
  - Pin 187 to Pin 188 distance: 6
  - Pin 188 to Pin 189 distance: 17
  - Pin 189 to Pin 190 distance: 6
  - Pin 190 to Pin 191 distance: 17
  - Pin 191 to Pin 192 distance: 6
  - Pin 192 to Pin 193 distance: 17
  - Pin 193 to Pin 194 distance:

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This is an electrostatic discharge sensitive device (ESDS), international standard IEC 60747-1, chapter IX.

## **\*IMPORTANT INFORMATION AND WARNINGS**

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