

|              |   |              |
|--------------|---|--------------|
| $V_{RRM}$    | = | 4500 V       |
| $I_{FAVM}$   | = | 650 A        |
| $I_{FSM}$    | = | 16 kA        |
| $V_{F0}$     | = | 1.4 V        |
| $r_F$        | = | 1 m $\Omega$ |
| $V_{DClink}$ | = | 2800 V       |

## Fast Recovery Diode

# 5SDF 07F4501

Doc. No. 5SYA1107-03 Sep. 01

- Patented free-floating silicon technology
- Low on-state and switching losses
- Optimized for use as freewheeling diode in GTO converters with high DC link voltages
- Standard press-pack housing, hermetically cold-welded
- Cosmic radiation withstand rating

### Blocking

|              |   |              |   |  |
|--------------|---|--------------|---|--|
| $V_{RRM}$    | Repetitive peak reverse voltage               | 4500 V       | Half sine wave, $t_p = 10$ ms, $f = 50$ Hz  |  |
| $I_{RRM}$    | Repetitive peak reverse current               | $\leq 50$ mA | $V_R = V_{RRM}$ , $T_J = 125^\circ\text{C}$ |  |
| $V_{DClink}$ | Permanent DC voltage for 100 FIT failure rate | 2800 V       | 100% Duty                                   | Ambient cosmic radiation at sea level in open air. |
| $V_{DClink}$ | Permanent DC voltage for 100 FIT failure rate | V            | 5% Duty                                     |  |

### Mechanical data (see Fig. 12)

|       |   |        |                      |  |
|-------|---|--------|----------------------|--|
| $F_m$ | Mounting force                                      | min.   | 20 kN                |  |
|       |   | max.   | 24 kN                |  |
| a     | Acceleration:<br>Device unclamped<br>Device clamped |        | 50 m/s <sup>2</sup>  |  |
|       |   |        | 200 m/s <sup>2</sup> |  |
| m     | Weight  |        | 0.46 kg              |  |
| $D_s$ | Surface creepage distance                           | $\geq$ | 33 mm                |  |
| $D_a$ | Air strike distance                                 | $\geq$ | 20 mm                |  |

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**On-state** (see Fig. 2, 3)

|               |  |                                       |  |  |
|---------------|--|---------------------------------------|--|--|
| $I_{FAVM}$    | Max. average on-state current          | 650 A                                 | Half sine wave, $T_c = 85^\circ\text{C}$ |  |
| $I_{FRMS}$    | Max. RMS on-state current              | 1000 A                                |  |  |
| $I_{FSM}$     | Max. peak non-repetitive surge current | 16 kA                                 | $t_p = 10 \text{ ms}$                    | Before surge:<br>$T_c = T_j = 125^\circ\text{C}$ |
|               |  | 44 kA                                 | $t_p = 1 \text{ ms}$                     |  |
| $\int I^2 dt$ | Max. surge current integral            | $1.28 \cdot 10^6 \text{ A}^2\text{s}$ | $t_p = 10 \text{ ms}$                    | After surge:<br>$V_R \approx 0 \text{ V}$        |
|               |  | $0.8 \cdot 10^6 \text{ A}^2\text{s}$  | $t_p = 1 \text{ ms}$                     |  |
| $V_F$         | Forward voltage drop                   | $\leq 2.7 \text{ V}$                  | $I_F = 1250 \text{ A}$                   | $T_j = 125^\circ\text{C}$                        |
| $V_{F0}$      | Threshold voltage                      | 1.4 V                                 | Approximation for                        |  |
| $r_F$         | Slope resistance                       | 1 m $\Omega$                          | $I_F = 400 \dots 2000 \text{ A}$         |  |

**Turn-on** (see Fig. 4, 5)

|          |                               |                     |   |
|----------|-------------------------------|---------------------|---|
| $V_{fr}$ | Peak forward recovery voltage | $\leq 74 \text{ V}$ | $di/dt = 500 \text{ A}/\mu\text{s}$ , $T_j = 125^\circ\text{C}$ |
|----------|-------------------------------|---------------------|---|

**Turn-off** (see Fig. 6 to 11)

|          |                          |                         |   |
|----------|--------------------------|-------------------------|---|
| $I_{rr}$ | Reverse recovery current | $\leq 600 \text{ A}$    | $di/dt = 300 \text{ A}/\mu\text{s}$ , $I_F = 700 \text{ A}$ ,<br>$T_j = 125^\circ\text{C}$ , $V_{RM} = 4500 \text{ V}$ ,<br>$C_S = 3 \mu\text{F}$ (GTO snubber circuit) |
| $Q_{rr}$ | Reverse recovery charge  | $\leq 1900 \mu\text{C}$ |   |
| $E_{rr}$ | Turn-off energy          | $\leq 1 \text{ J}$      |   |

**Thermal** (see Fig. 1)

|            |                                      |                            |                     |                                |
|------------|--------------------------------------|----------------------------|---------------------|--------------------------------|
| $T_j$      | Operating junction temperature range | -40...125 $^\circ\text{C}$ |                     |                                |
| $T_{stg}$  | Storage temperature range            | -40...125 $^\circ\text{C}$ |                     |                                |
| $R_{thJC}$ | Thermal resistance junction to case  | $\leq 40 \text{ K/kW}$     | Anode side cooled   | $F_m = 20 \dots 24 \text{ kN}$ |
|            |                                      | $\leq 40 \text{ K/kW}$     | Cathode side cooled |                                |
|            |                                      | $\leq 20 \text{ K/kW}$     | Double side cooled  |                                |
| $R_{thCH}$ | Thermal resistance case to heatsink  | $\leq 10 \text{ K/kW}$     | Single side cooled  |                                |
|            |                                      | $\leq 5 \text{ K/kW}$      | Double side cooled  |                                |

Analytical function for transient thermal impedance.

$$Z_{thJC}(t) = \sum_{i=1}^n R_i (1 - e^{-t/\tau_i})$$

| i   | 1     | 2     | 3    | 4      |
|---|-------|-------|------|--------|
| $R_i(\text{K/kW})$                                | 11.83 | 4.26  | 1.63 | 2.28   |
| $\tau_i(\text{s})$                                | 0.432 | 0.071 | 0.01 | 0.0054 |
| $F_m = 20 \dots 24 \text{ kN}$ Double side cooled |       |       |      |        |

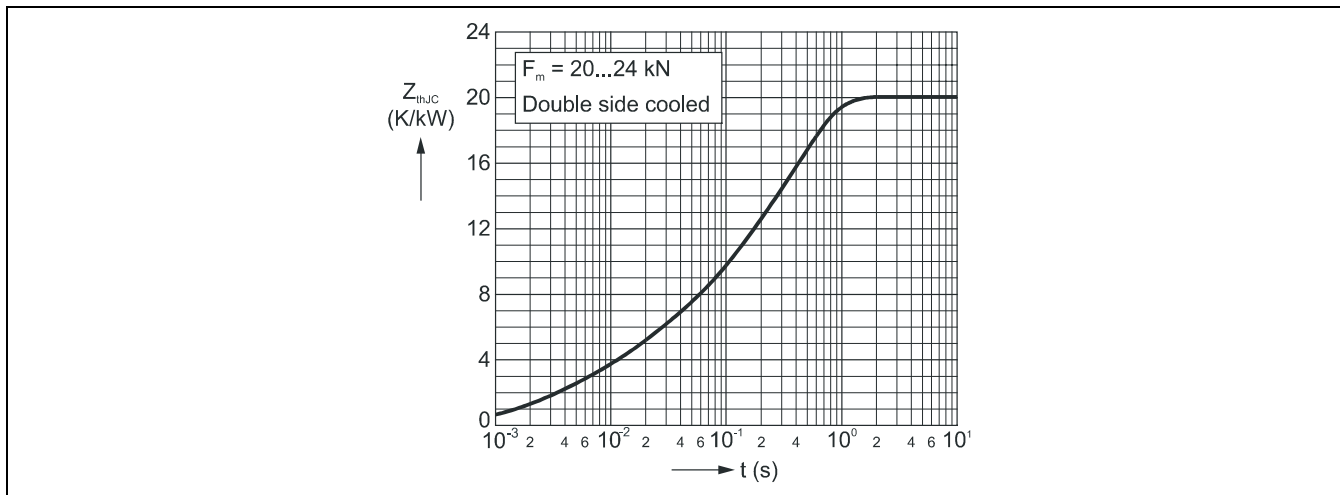


Fig. 1 Transient thermal impedance (junction-to-case) vs. time in analytical and graphical form (max. values).

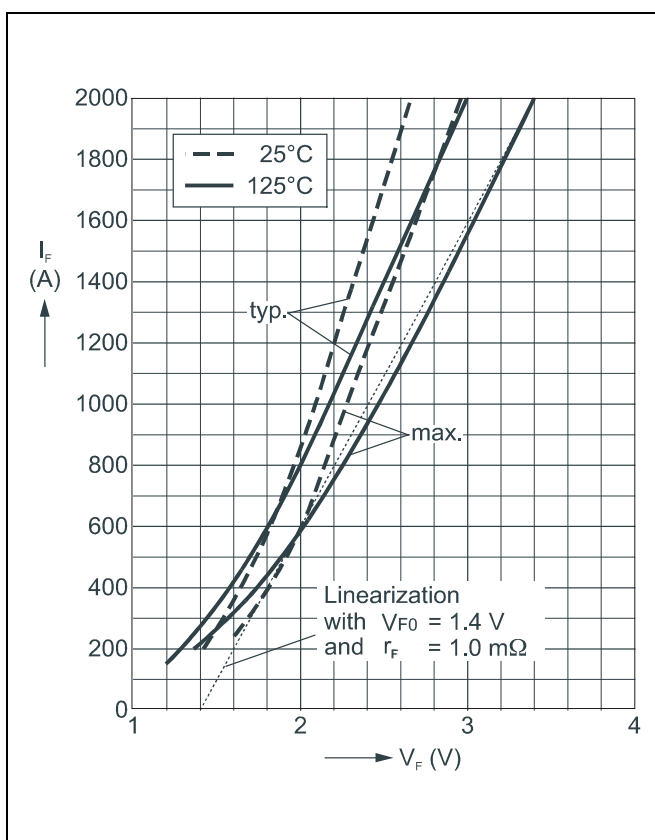


Fig. 2 Forward current vs. forward voltage (typ. and max. values) and linear approximation of max. curve at 125°C.

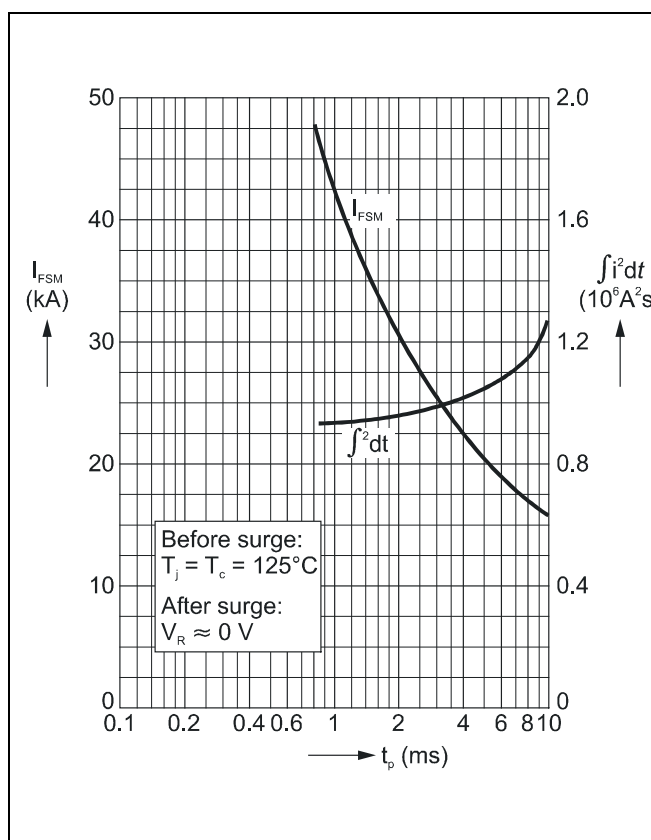


Fig. 3 Surge current and fusing integral vs. pulse width (max. values) for non-repetitive, half-sinusoidal surge current pulses.

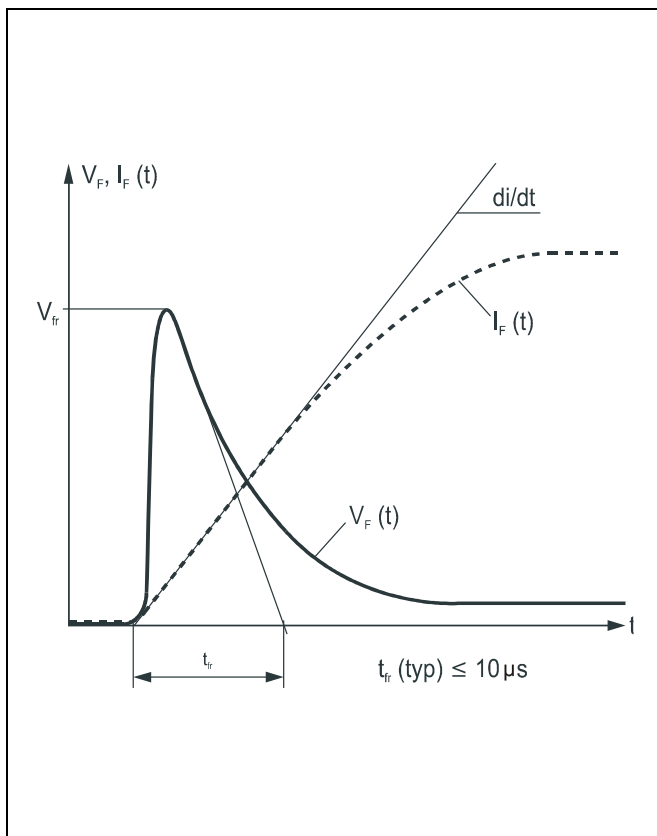


Fig. 4 Typical forward voltage waveform when the diode is turned on with a high di/dt.

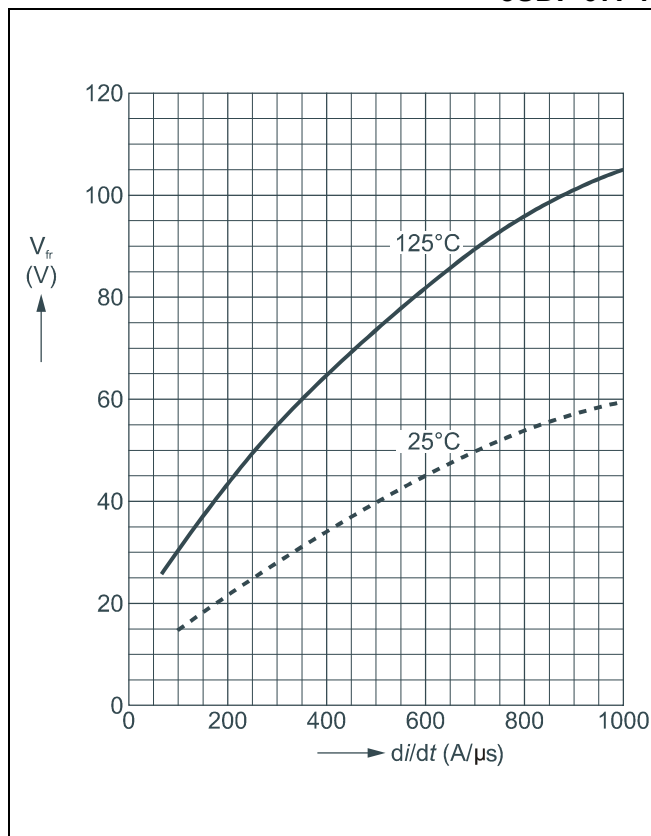


Fig. 5 Forward recovery voltage vs. turn-on di/dt (max. values).

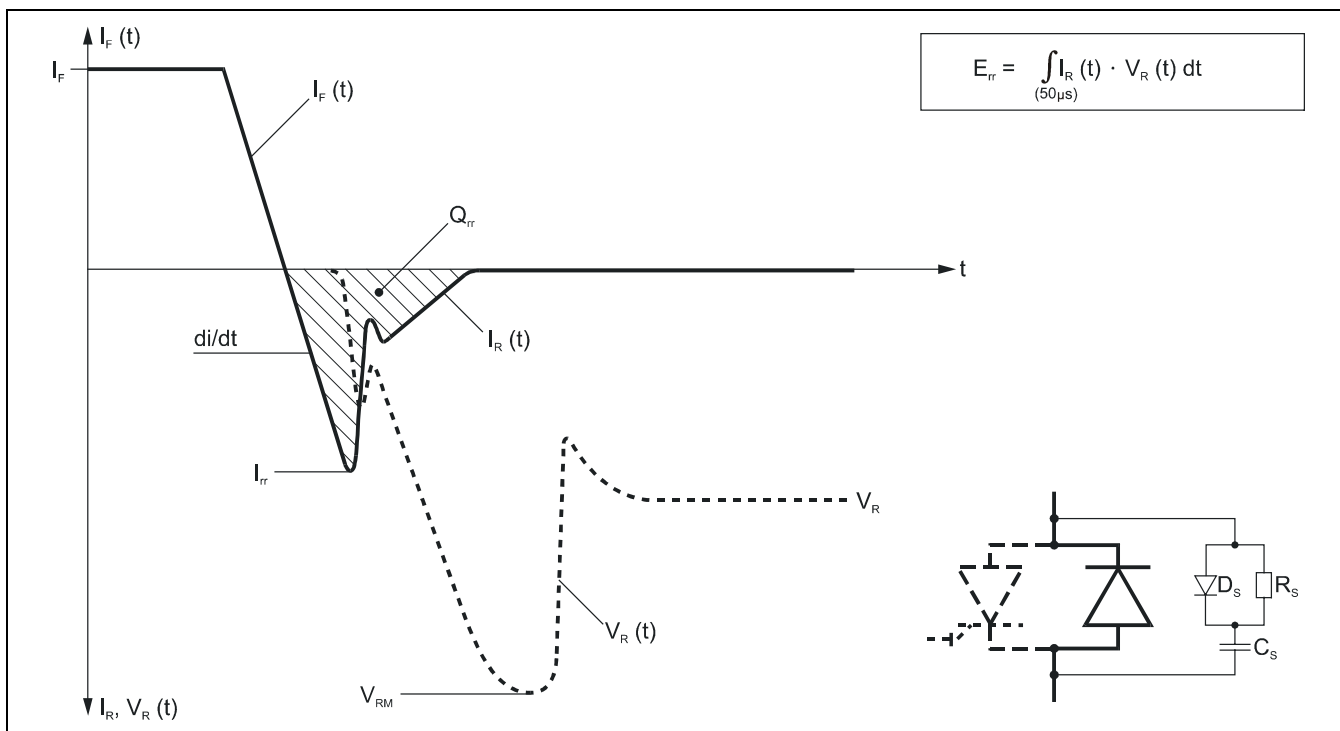


Fig. 6 Typical current and voltage waveforms at turn-off when the diode is connected to an RCD snubber, as often used in GTO circuits.

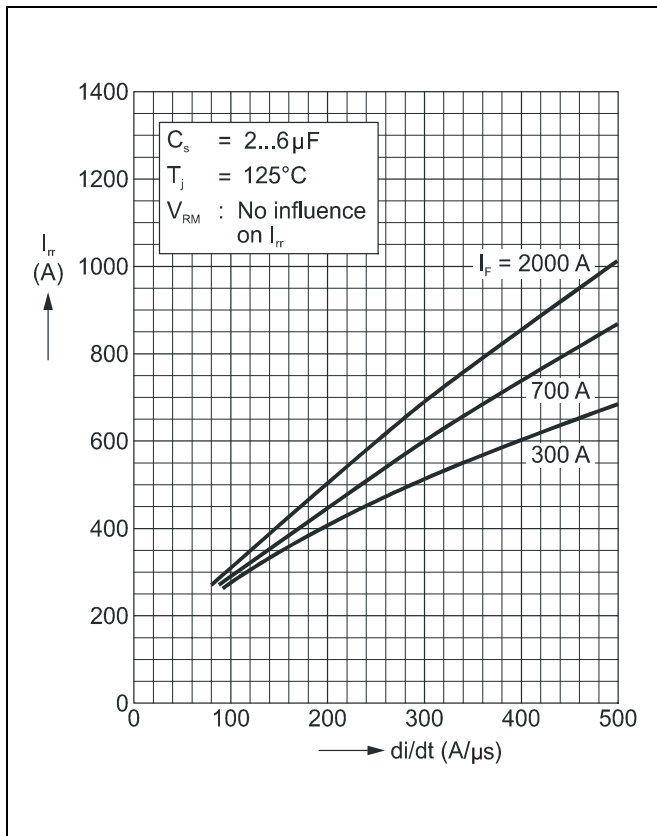


Fig. 7 Reverse recovery current vs. turn off  $di/dt$  (max. values).

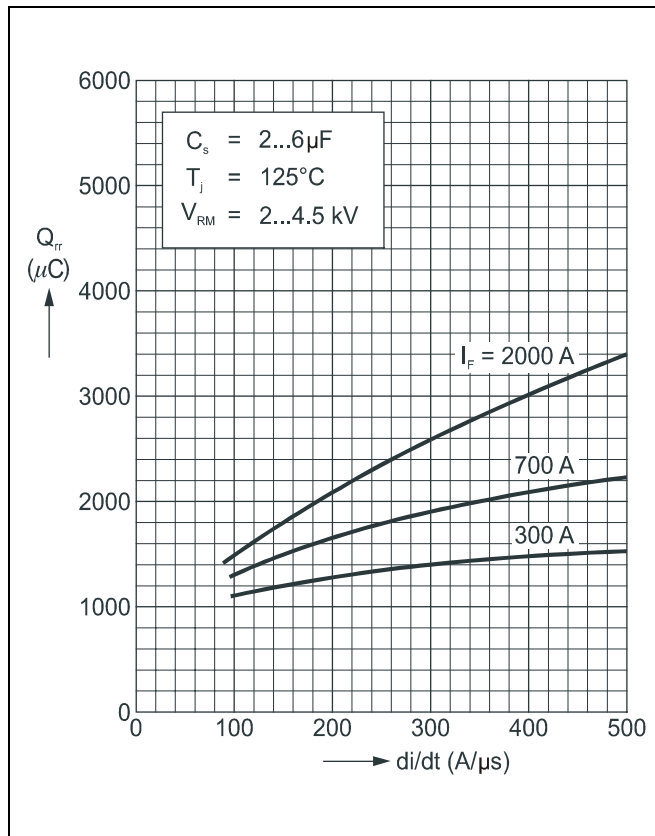


Fig. 8 Reverse recovery charge vs. turn off  $di/dt$  (max. values).

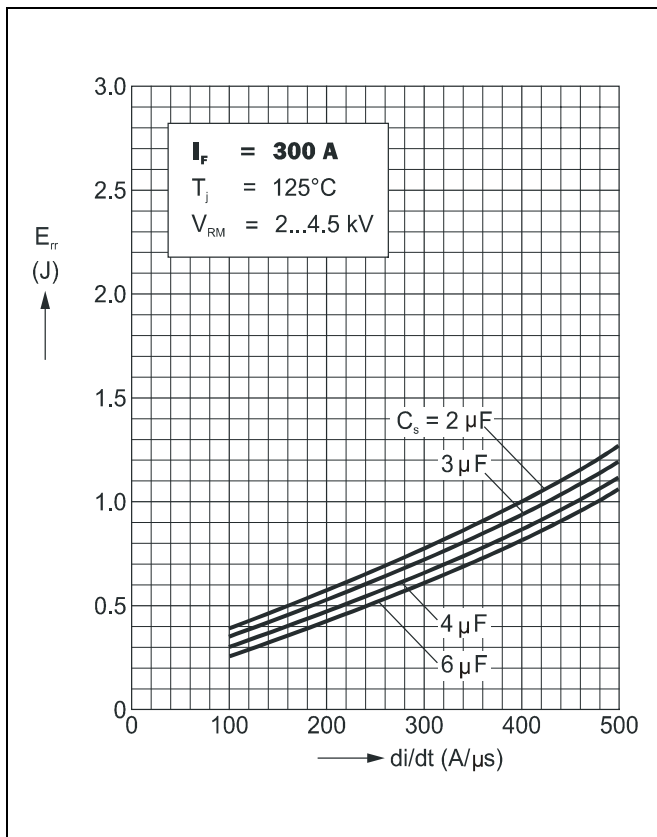


Fig. 9 Turn-off energy vs. turn-off  $di/dt$  for  $I_F = 300$  A (max. values).

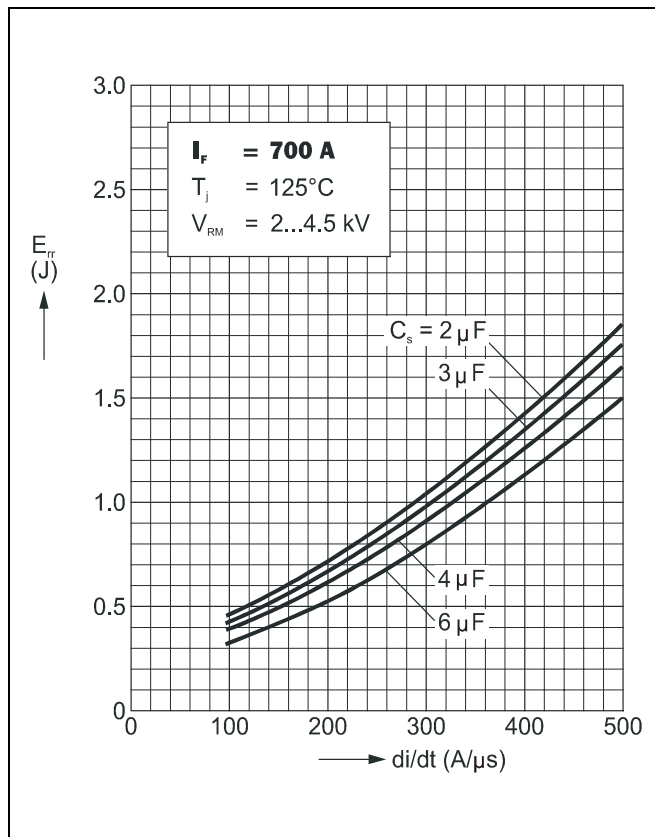


Fig. 10 Turn-off energy vs. turn-off  $di/dt$  for  $I_F = 700$  A (max. values).

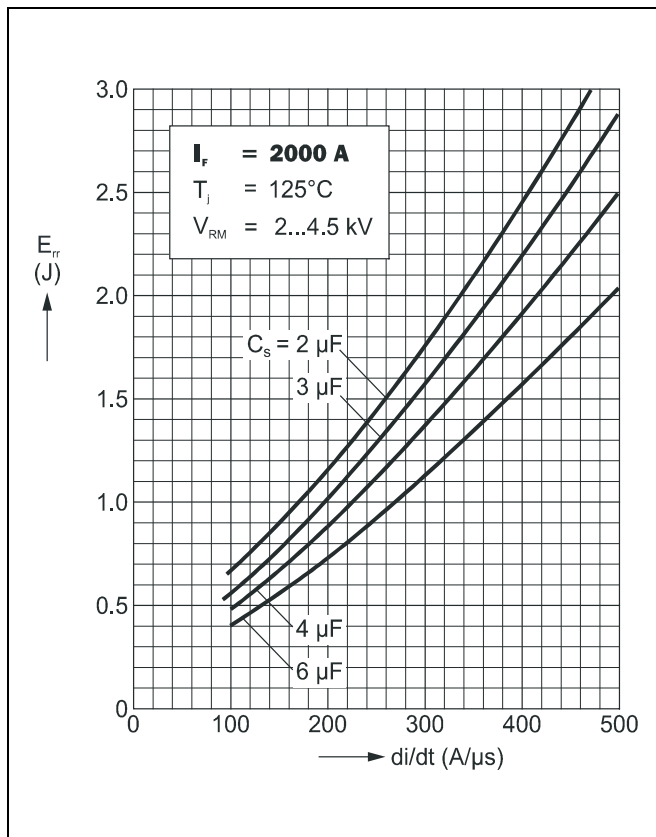


Fig. 11 Turn-off energy vs. turn-off  $di/dt$  for  $I_F = 2000 \text{ A}$  (max. values).

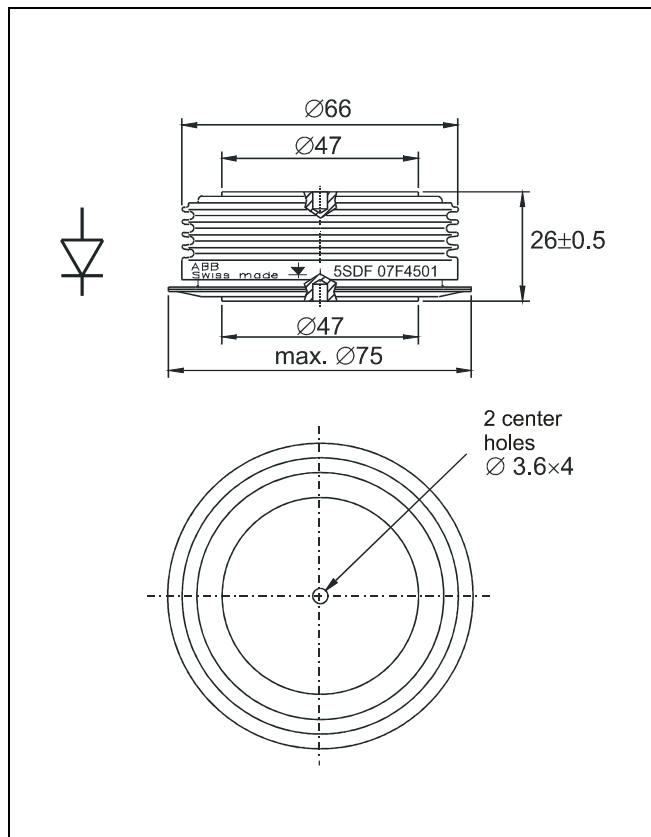


Fig. 12 Outline drawing. All dimensions are in millimeters and represent nominal values unless stated otherwise.

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