

$V_{\text{DRM}} = 5200 \text{ V}$   
 $I_{\text{T(AV)M}} = 3450 \text{ A}$   
 $I_{\text{T(RMS)}} = 5420 \text{ A}$   
 $I_{\text{TSM}} = 63.0 \cdot 10^3 \text{ A}$   
 $V_{\text{T0}} = 0.96 \text{ V}$   
 $r_{\text{T}} = 0.194 \text{ m}\Omega$

# Phase Control Thyristor

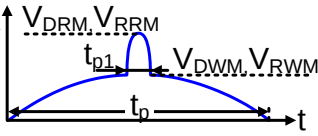
## 5STP 34N5200

Doc. No. 5SYA1002-08 Mar. 20

- Patented free-floating silicon technology
- Low on-state and switching losses
- Designed for traction, energy and industrial applications
- Optimum power handling capability
- Interdigitated amplifying gate

### Blocking

Maximum rated values <sup>1)</sup>

| Parameter                                                | Symbol                           | Conditions                                                                                                                                     | 5STP 34N5200 | Unit             |
|----------------------------------------------------------|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|--------------|------------------|
| Max. surge peak forward and reverse blocking voltage     | $V_{\text{DSM}}, V_{\text{RSM}}$ | $t_p = 10 \text{ ms}, f = 5 \text{ Hz}$<br>$T_{vj} = 5 \dots 125 \text{ }^\circ\text{C}$ , Note 1                                              | 5200         | V                |
| Max repetitive peak forward and reverse blocking voltage | $V_{\text{DRM}}, V_{\text{RRM}}$ | $f = 50 \text{ Hz}, t_p = 10 \text{ ms}, t_{p1} = 250 \text{ }\mu\text{s}$ ,<br>$T_{vj} = 5 \dots 125 \text{ }^\circ\text{C}$ , Note 1, Note 2 | 5200         | V                |
| Max crest working forward and reverse voltages           | $V_{\text{DWM}}, V_{\text{RWM}}$ |                                                            | 3470         | V                |
| Critical rate of rise of commutating voltage             | $dv/dt_{\text{crit}}$            | Exp. to $0.67 \cdot V_{\text{DRM}}, T_{vj} = 125 \text{ }^\circ\text{C}$                                                                       | 2000         | V/ $\mu\text{s}$ |

Characteristic values

| Parameter               | Symbol           | Conditions                                            | min | typ | max | Unit |
|-------------------------|------------------|-------------------------------------------------------|-----|-----|-----|------|
| Forward leakage current | $I_{\text{DRM}}$ | $V_{\text{DRM}}, T_{vj} = 125 \text{ }^\circ\text{C}$ |     |     | 500 | mA   |
| Reverse leakage current | $I_{\text{RRM}}$ | $V_{\text{RRM}}, T_{vj} = 125 \text{ }^\circ\text{C}$ |     |     | 500 | mA   |

Note 1: Voltage de-rating factor of 0.11% per  $^\circ\text{C}$  is applicable for  $T_{vj}$  below  $+5 \text{ }^\circ\text{C}$ .

Note 2: Recommended minimum ratio of  $V_{\text{DRM}} / V_{\text{DWM}}$  or  $V_{\text{RRM}} / V_{\text{RWM}} = 2$ . See App. Note 5SYA 2051.

### Mechanical data

Maximum rated values <sup>1)</sup>

| Parameter      | Symbol         | Conditions       | min | typ | max | Unit           |
|----------------|----------------|------------------|-----|-----|-----|----------------|
| Mounting force | $F_{\text{M}}$ |                  | 81  | 90  | 108 | kN             |
| Acceleration   | $a$            | Device unclamped |     |     | 50  | $\text{m/s}^2$ |
| Acceleration   | $a$            | Device clamped   |     |     | 100 | $\text{m/s}^2$ |

Characteristic values

| Parameter                 | Symbol | Conditions                                                      | min   | typ | max   | Unit |
|---------------------------|--------|-----------------------------------------------------------------|-------|-----|-------|------|
| Weight                    | $m$    |                                                                 |       |     | 2.9   | kg   |
| Housing thickness         | $H$    | $F_{\text{M}} = 90 \text{ kN}, T_a = 25 \text{ }^\circ\text{C}$ | 34.75 |     | 35.40 | mm   |
| Surface creepage distance | $D_s$  |                                                                 | 56    |     |       | mm   |
| Air strike distance       | $D_a$  |                                                                 | 22    |     |       | mm   |

1) Maximum rated values indicate limits beyond which damage to the device may occur

ABB Power Grids Switzerland Ltd, Semiconductors reserves the right to change specifications without notice.



## On-state

### Maximum rated values <sup>1)</sup>

| Parameter                         | Symbol       | Conditions                                                                                                      | min | typ | max               | Unit             |
|-----------------------------------|--------------|-----------------------------------------------------------------------------------------------------------------|-----|-----|-------------------|------------------|
| Average on-state current          | $I_{T(AV)M}$ | Half sine wave, $T_c = 70\text{ °C}$                                                                            |     |     | 3450              | A                |
| RMS on-state current              | $I_{T(RMS)}$ |                                                                                                                 |     |     | 5420              | A                |
| Peak non-repetitive surge current | $I_{TSM}$    | $t_p = 10\text{ ms}$ , $T_{vj} = 125\text{ °C}$ ,<br>sine half wave,<br>$V_D = V_R = 0\text{ V}$ , after surge  |     |     | $63.0 \cdot 10^3$ | A                |
| Limiting load integral            | $I^2t$       |                                                                                                                 |     |     | $19.8 \cdot 10^6$ | A <sup>2</sup> s |
| Peak non-repetitive surge current | $I_{TSM}$    | $t_p = 10\text{ ms}$ , $T_{vj} = 125\text{ °C}$ ,<br>sine half wave,<br>$V_R = 0.6 \cdot V_{RRM}$ , after surge |     |     | $45.5 \cdot 10^3$ | A                |
| Limiting load integral            | $I^2t$       |                                                                                                                 |     |     | $10.3 \cdot 10^6$ | A <sup>2</sup> s |

### Characteristic values

| Parameter         | Symbol     | Conditions                                                       | min | typ  | max   | Unit |
|-------------------|------------|------------------------------------------------------------------|-----|------|-------|------|
| On-state voltage  | $V_T$      | $I_T = 3000\text{ A}$ , $T_{vj} = 125\text{ °C}$                 |     | 1.47 | 1.54  | V    |
| Threshold voltage | $V_{(TO)}$ | $I_T = 2300\text{ A} - 7000\text{ A}$ , $T_{vj} = 125\text{ °C}$ |     |      | 0.96  | V    |
| Slope resistance  | $r_T$      |                                                                  |     |      | 0.194 | mΩ   |
| Holding current   | $I_H$      | $T_{vj} = 25\text{ °C}$                                          |     |      | 125   | mA   |
|                   |            | $T_{vj} = 125\text{ °C}$                                         |     |      | 75    | mA   |
| Latching current  | $I_L$      | $T_{vj} = 25\text{ °C}$                                          |     |      | 500   | mA   |
|                   |            | $T_{vj} = 125\text{ °C}$                                         |     |      | 250   | mA   |

## Switching

### Maximum rated values <sup>1)</sup>

| Parameter                                 | Symbol         | Conditions                                                                                                                                                                | min                         | typ | max  | Unit |
|-------------------------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|-----|------|------|
| Critical rate of rise of on-state current | $di/dt_{crit}$ | $T_{vj} = 125\text{ °C}$ ,<br>$I_T = 3000\text{ A}$ ,<br>$V_D \leq 0.67 \cdot V_{DRM}$ ,<br>$I_{GM} = 2\text{ A}$ , $t_r = 0.5\text{ μs}$                                 | Cont.<br>$f = 50\text{ Hz}$ |     | 250  | A/μs |
|                                           |                |                                                                                                                                                                           | Cont.<br>$f = 1\text{ Hz}$  |     | 1000 | A/μs |
| Circuit-commutated turn-off time          | $t_q$          | $T_{vj} = 125\text{ °C}$ , $I_T = 2000\text{ A}$ ,<br>$V_R = 200\text{ V}$ , $di_T/dt = -1.5\text{ A/μs}$ ,<br>$V_D \leq 0.67 \cdot V_{DRM}$ , $dv_D/dt = 20\text{ V/μs}$ |                             |     | 700  | μs   |

### Characteristic values

| Parameter                | Symbol   | Conditions                                                                                                | min  | typ  | max  | Unit |
|--------------------------|----------|-----------------------------------------------------------------------------------------------------------|------|------|------|------|
| Reverse recovery charge  | $Q_{rr}$ | $T_{vj} = 125\text{ °C}$ , $I_T = 2000\text{ A}$ ,<br>$V_R = 200\text{ V}$ , $di_T/dt = -1.5\text{ A/μs}$ | 3400 | 4770 | 5200 | μAs  |
| Reverse recovery current | $I_{RM}$ |                                                                                                           | 60   | 77   | 95   | A    |
| Gate turn-on delay time  | $t_{gd}$ | $T_{vj} = 25\text{ °C}$ , $V_D = 0.4 \cdot V_{RM}$ ,<br>$I_{GM} = 2\text{ A}$ , $t_r = 0.5\text{ μs}$     |      |      | 3    | μs   |

## Triggering

Maximum rated values <sup>1)</sup>

| Parameter                 | Symbol      | Conditions | min        | typ | max | Unit |
|---------------------------|-------------|------------|------------|-----|-----|------|
| Peak forward gate voltage | $V_{FGM}$   |            |            |     | 12  | V    |
| Peak forward gate current | $I_{FGM}$   |            |            |     | 10  | A    |
| Peak reverse gate voltage | $V_{RGM}$   |            |            |     | 10  | V    |
| Average gate power loss   | $P_{G(AV)}$ |            | see Fig. 7 |     |     | W    |

Characteristic values

| Parameter                | Symbol   | Conditions                                              | min | typ | max | Unit |
|--------------------------|----------|---------------------------------------------------------|-----|-----|-----|------|
| Gate-trigger voltage     | $V_{GT}$ | $T_{vj} = 25\text{ °C}$                                 |     |     | 2.6 | V    |
| Gate-trigger current     | $I_{GT}$ | $T_{vj} = 25\text{ °C}$                                 |     |     | 400 | mA   |
| Gate non-trigger voltage | $V_{GD}$ | $V_D = 0.4 \cdot V_{DRM}$ , $T_{vjmax} = 125\text{ °C}$ |     |     | 0.3 | V    |
| Gate non-trigger current | $I_{GD}$ | $V_D = 0.4 \cdot V_{DRM}$ , $T_{vjmax} = 125\text{ °C}$ |     |     | 10  | mA   |

## Thermal

Maximum rated values <sup>1)</sup>

| Parameter                            | Symbol    | Conditions | min | typ | max | Unit |
|--------------------------------------|-----------|------------|-----|-----|-----|------|
| Operating junction temperature range | $T_{vj}$  |            |     |     | 125 | °C   |
| Storage temperature range            | $T_{stg}$ |            | -40 |     | 140 | °C   |

Characteristic values

| Parameter                           | Symbol         | Conditions                                         | min | typ | max  | Unit |
|-------------------------------------|----------------|----------------------------------------------------|-----|-----|------|------|
| Thermal resistance junction to case | $R_{th(j-c)}$  | Double-side cooled<br>$F_m = 81... 108\text{ kN}$  |     |     | 5.7  | K/kW |
|                                     | $R_{th(j-c)A}$ | Anode-side cooled<br>$F_m = 81... 108\text{ kN}$   |     |     | 11.4 | K/kW |
|                                     | $R_{th(j-c)C}$ | Cathode-side cooled<br>$F_m = 81... 108\text{ kN}$ |     |     | 11.4 | K/kW |
| Thermal resistance case to heatsink | $R_{th(c-h)}$  | Double-side cooled<br>$F_m = 81... 108\text{ kN}$  |     |     | 1    | K/kW |
|                                     | $R_{th(c-h)}$  | Single-side cooled<br>$F_m = 81... 108\text{ kN}$  |     |     | 2    | K/kW |

Analytical function for transient thermal impedance:

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

|              |        |        |        |        |
|--------------|--------|--------|--------|--------|
| i            | 1      | 2      | 3      | 4      |
| $R_i$ (K/kW) | 3.837  | 1.254  | 0.561  | 0.048  |
| $\tau_i$ (s) | 0.7934 | 0.0893 | 0.0072 | 0.0012 |

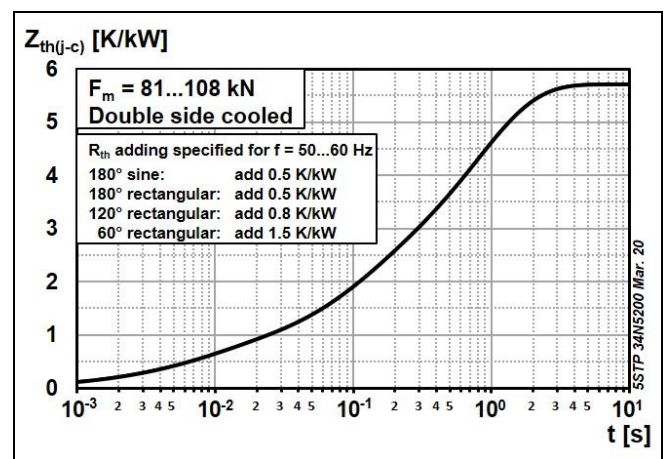


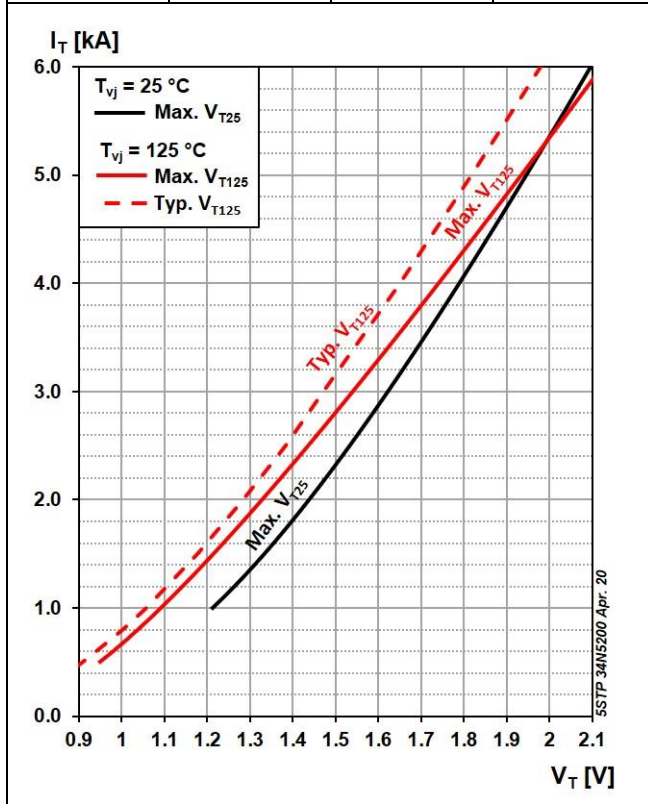
Fig. 1 Transient thermal impedance (junction-to-case) vs. time

**Max. on-state characteristic model:**

$$V_{T25} = A_{TVj} + B_{TVj} \cdot I_T + C_{TVj} \cdot \ln(I_T + 1) + D_{TVj} \cdot \sqrt{I_T}$$

Valid for  $I_T = 1000 - 70000$  A

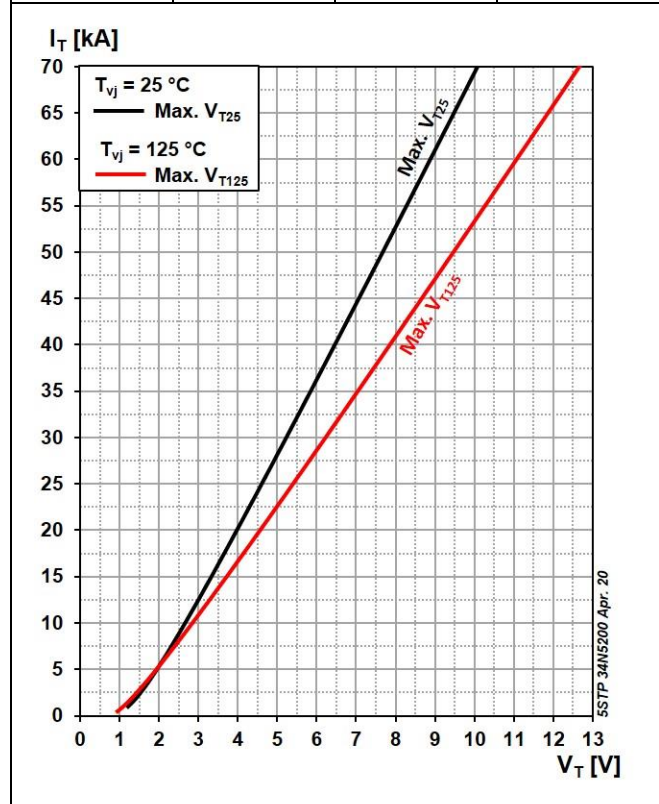
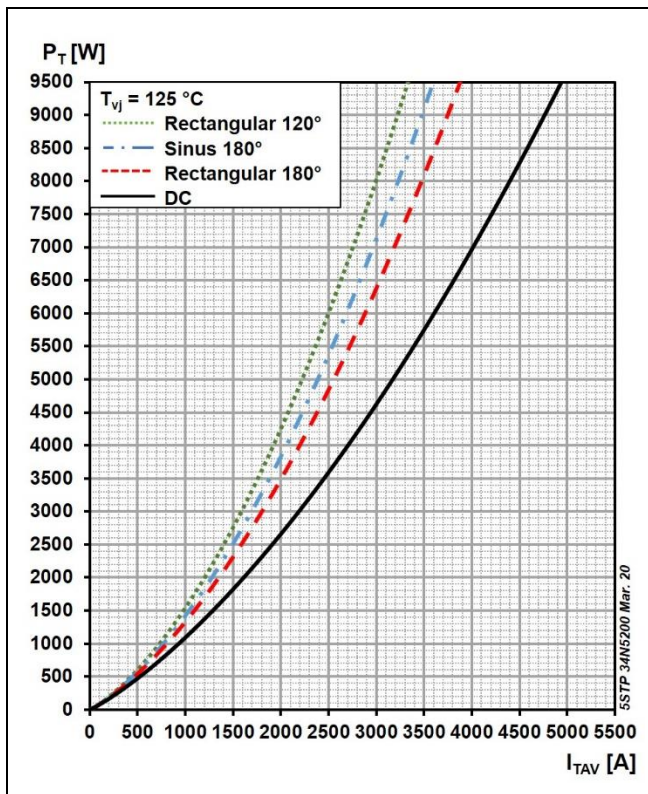
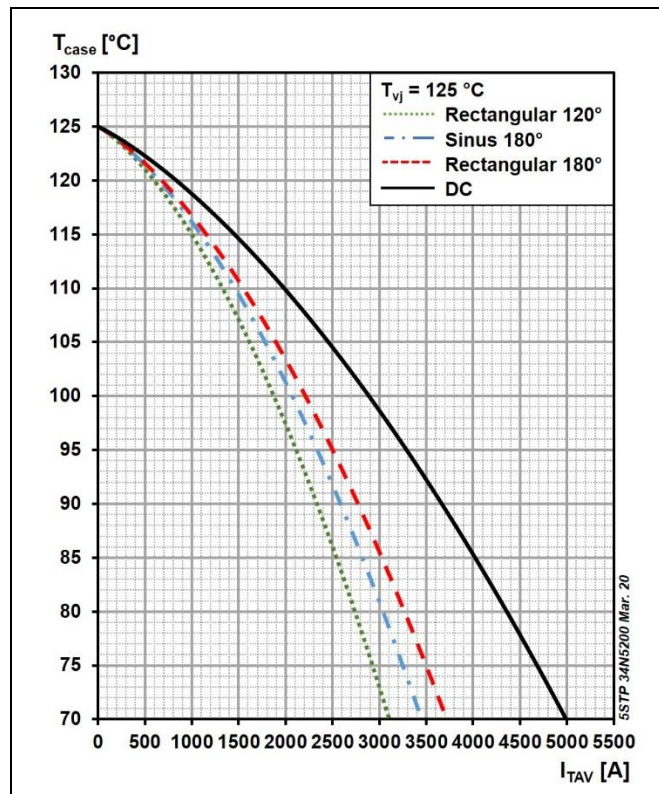
| A <sub>25</sub>      | B <sub>25</sub>      | C <sub>25</sub>      | D <sub>25</sub>      |
|----------------------|----------------------|----------------------|----------------------|
| $2.02 \cdot 10^{-1}$ | $1.14 \cdot 10^{-4}$ | $1.20 \cdot 10^{-1}$ | $2.16 \cdot 10^{-3}$ |

**Fig. 2** On-state voltage characteristics**Max. on-state characteristic model:**

$$V_{T125} = A_{TVj} + B_{TVj} \cdot I_T + C_{TVj} \cdot \ln(I_T + 1) + D_{TVj} \cdot \sqrt{I_T}$$

Valid for  $I_T = 500 - 70000$  A

| A <sub>125</sub>     | B <sub>125</sub>     | C <sub>125</sub>     | D <sub>125</sub>     |
|----------------------|----------------------|----------------------|----------------------|
| $5.69 \cdot 10^{-1}$ | $1.49 \cdot 10^{-4}$ | $3.14 \cdot 10^{-2}$ | $5.00 \cdot 10^{-3}$ |

**Fig. 3** On-state voltage characteristics**Fig. 4** On-state power dissipation vs. mean on-state current, turn-on losses excluded**Fig. 5** Max. permissible case temperature vs. mean on-state current, switching losses ignored

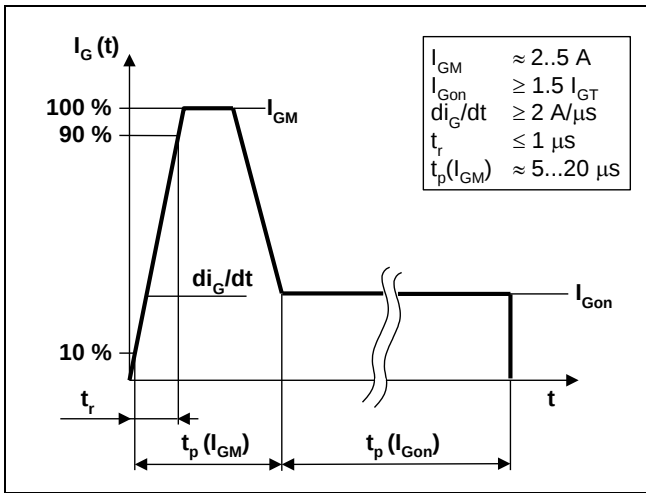


Fig. 6 Recommended gate current waveform

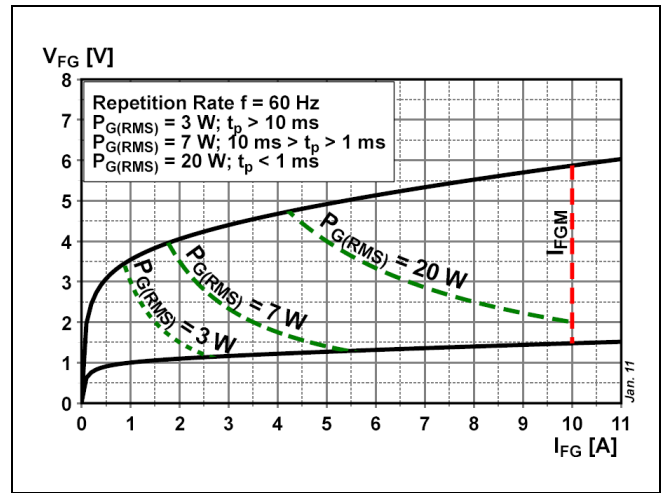


Fig. 7 Max. peak gate power loss

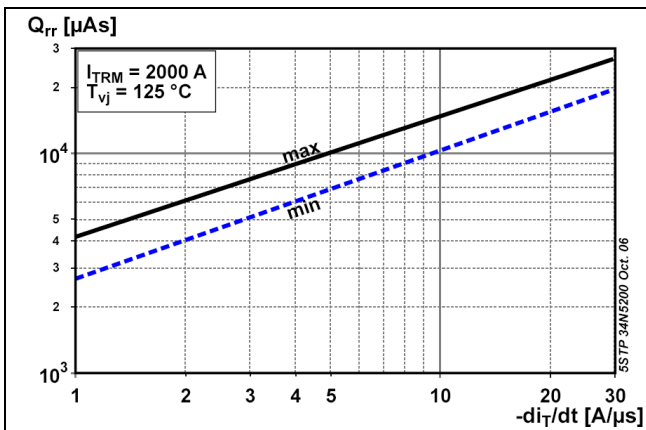


Fig. 8 Reverse recovery charge vs. decay rate of on-state current

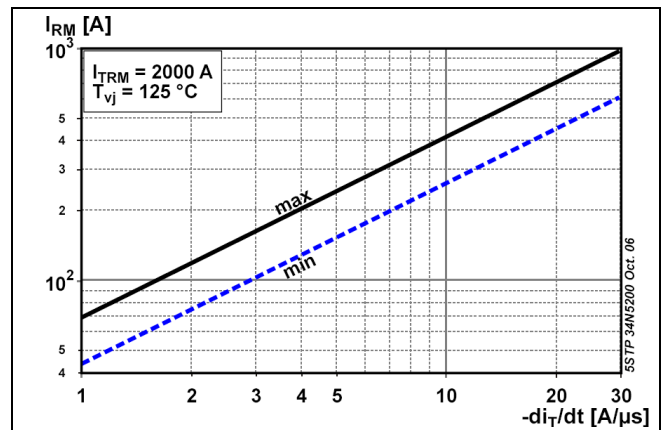


Fig. 9 Peak reverse recovery current vs. decay rate of on-state current

## Turn-on and Turn-off losses

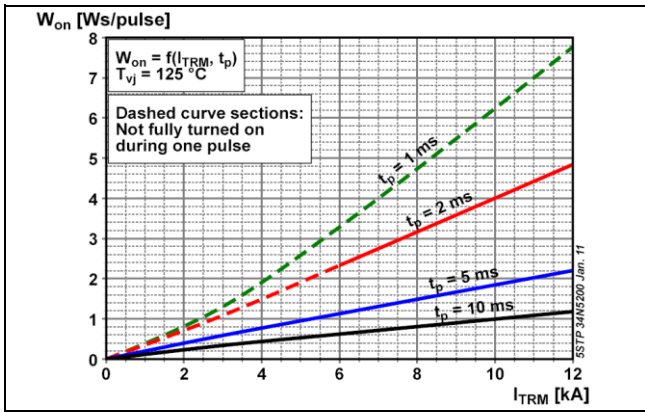


Fig. 10 Turn-on energy, half sinusoidal waves

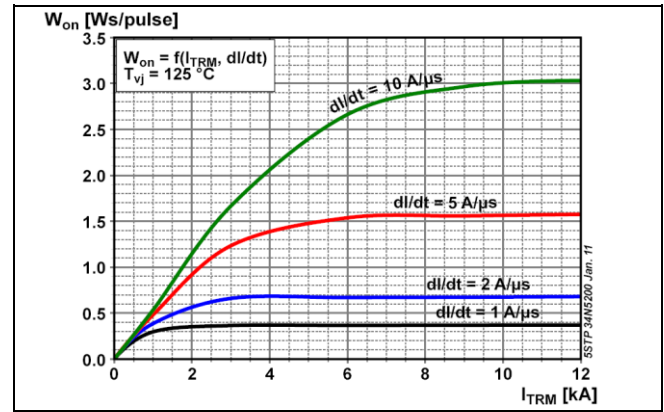


Fig. 11 Turn-on energy, rectangular waves

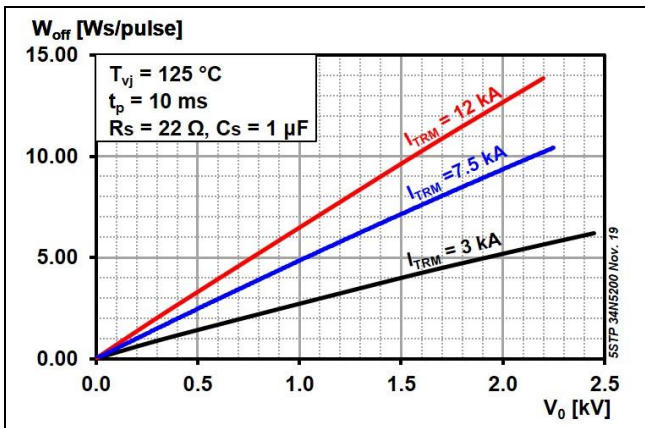


Fig. 12 Typical turn-off energy, half sinusoidal waves

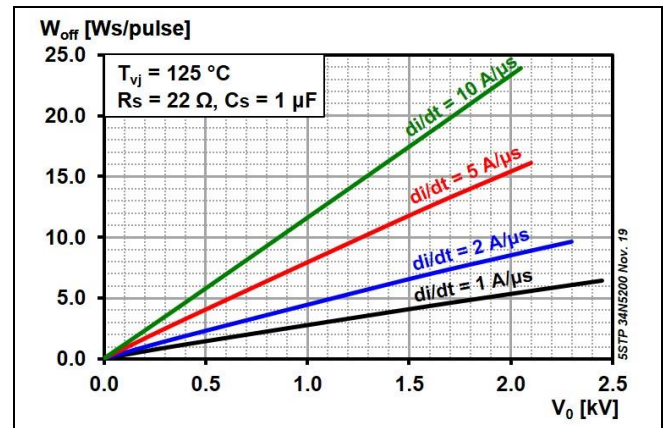


Fig. 13 Typical turn-off energy, rectangular waves

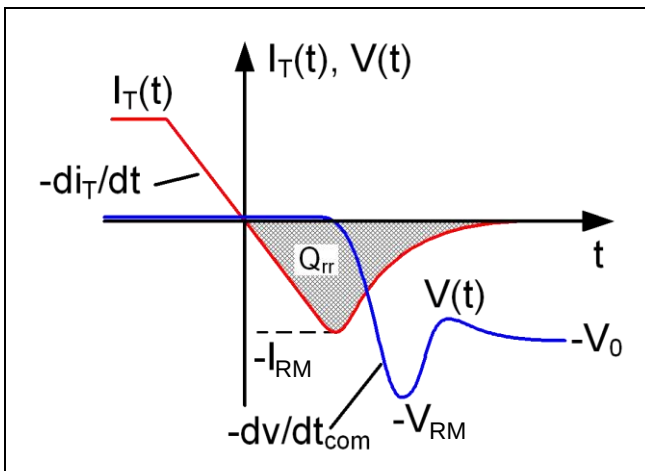


Fig. 14 Current and voltage waveforms at turn-off

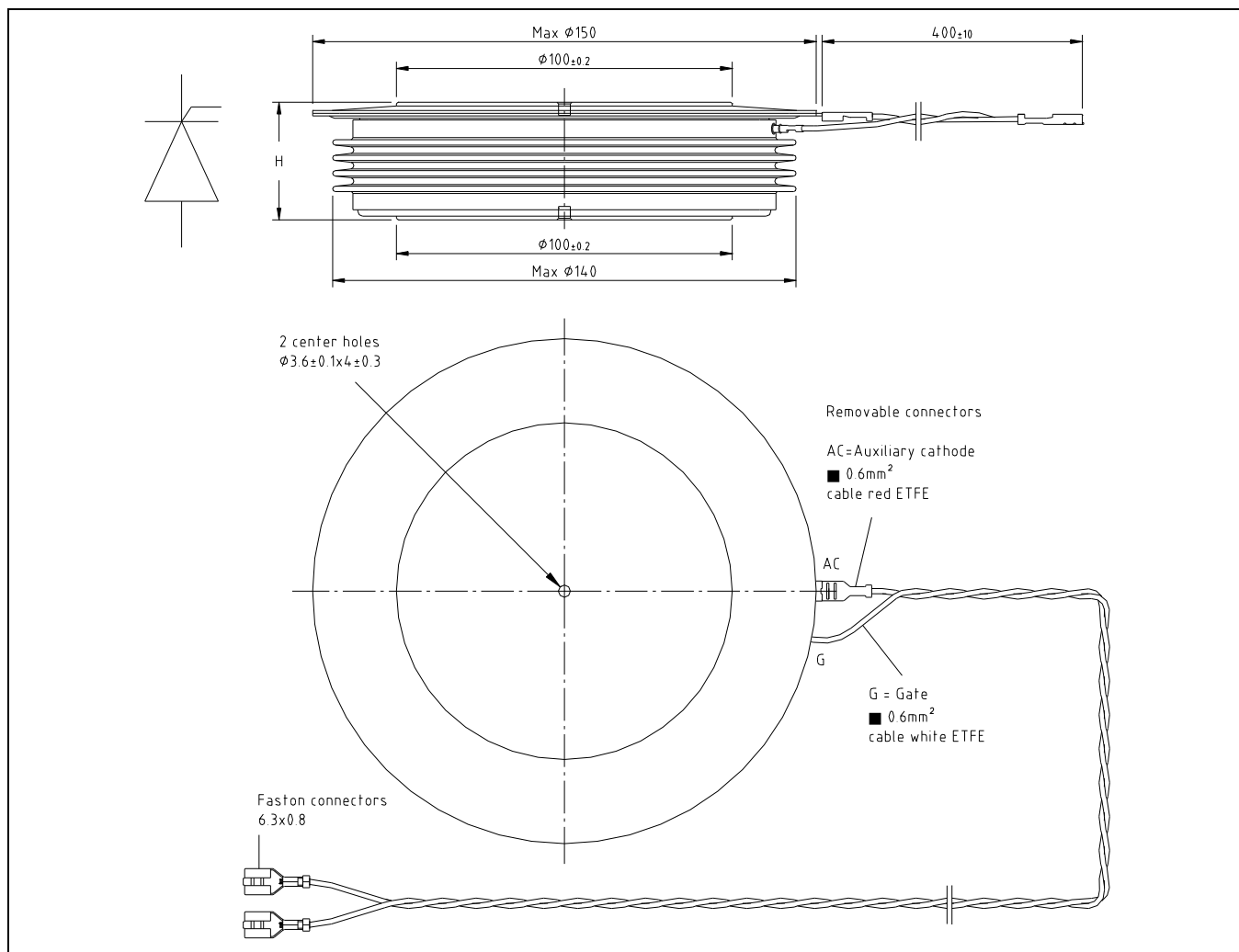
Total power loss for repetitive waveforms:

$$P_{TOT} = P_T + W_{on} \cdot f + W_{off} \cdot f$$

where

$$P_T = \frac{1}{T} \int_0^T I_T \cdot V_T(I_T) dt$$

Fig. 15 Relationships for power loss



**Fig. 16** Device Outline Drawing

### Related documents:

|           |                                                                                         |
|-----------|-----------------------------------------------------------------------------------------|
| 5SYA 2020 | Design of RC-Snubbers for Phase Control Applications                                    |
| 5SYA 2049 | Voltage definitions for phase control and bi-directionally controlled thyristors        |
| 5SYA 2051 | Voltage ratings of high power semiconductors                                            |
| 5SYA 2034 | Gate-drive recommendations for phase control and bi-directionally controlled thyristors |
| 5SYA 2036 | Recommendations regarding mechanical clamping of Press-Pack High Power Semiconductors   |
| 5SYA 2102 | Surge currents for Phase Control Thyristors                                             |
| 5SZK 9118 | General Environmental Conditions for High Power Semiconductors                          |

Please refer to <http://www.abb.com/semiconductors> for current version of documents.

ABB Power Grids Switzerland Ltd, Semiconductors reserves the right to change specifications without notice.



**ABB Power Grids Switzerland Ltd**  
**Semiconductors**  
 Fabrikstrasse 3  
 CH-5600 Lenzburg, Switzerland

Doc. No. 5SYA1002-08 Mar. 20

Telephone +41 (0)58 586 1419  
 Fax +41 (0)58 586 1306  
 Email [abbsem@ch.abb.com](mailto:abbsem@ch.abb.com)  
 Internet [www.abb.com/semiconductors](http://www.abb.com/semiconductors)