

$V_{DRM} = 2800 \text{ V}$
 $I_{T(AV)M} = 1400 \text{ A}$
 $I_{T(RMS)} = 2210 \text{ A}$
 $I_{TSM} = 18 \times 10^3 \text{ A}$
 $V_{T0} = 0.82 \text{ V}$
 $r_T = 0.37 \text{ m}\Omega$

Phase Control Thyristor

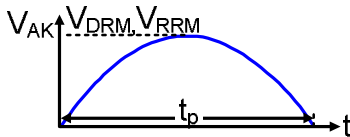
5STP 16F2800

Doc. No. 5SYA1022-04 May 12

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

Blocking

Maximum rated values ¹⁾

| Parameter | Symbol | Conditions | 5STP 16F2800 | Unit |
|--|--------------------------|--|--------------|------------------|
| Max repetitive peak forward and reverse blocking voltage | V_{DRM} , V_{RRM} | $f = 50 \text{ Hz}$, $t_p = 10 \text{ ms}$, $T_{vj} = 5 \dots 125^\circ\text{C}$, Note 1 | 2800 | V |
| | |  | | |
| Critical rate of rise of commutating voltage | dv/dt_{crit} | Exp. to 1880 V, $T_{vj} = 125^\circ\text{C}$ | 1000 | V/ μs |

Characteristic values

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|-------------------------|-----------|--|-----|-----|-----|------|
| Forward leakage current | I_{DRM} | V_{DRM} , $T_{vj} = 125^\circ\text{C}$ | | | 200 | mA |
| Reverse leakage current | I_{RRM} | V_{RRM} , $T_{vj} = 125^\circ\text{C}$ | | | 200 | mA |

Note 1: Voltage de-rating factor of 0.11% per °C is applicable for T_{vj} below +5 °C

Mechanical data

Maximum rated values ¹⁾

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|----------------|--------|------------------|-----|-----|-----|----------------|
| Mounting force | F_M | | 14 | 22 | 24 | kN |
| Acceleration | a | Device unclamped | | | 50 | m/s^2 |
| Acceleration | a | Device clamped | | | 100 | m/s^2 |

Characteristic values

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|---------------------------|--------|--|------|-----|------|------|
| Weight | m | | | | 0.6 | kg |
| Housing thickness | H | $F_M = 22 \text{ kN}$, $T_a = 25^\circ\text{C}$ | 25.9 | | 26.3 | mm |
| Surface creepage distance | D_S | | 25 | | | mm |
| Air strike distance | D_a | | 14 | | | mm |

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

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On-state

Maximum rated values ¹⁾

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|-----------------------------------|--------------|---|-----|-----|--------------------|--------|
| Average on-state current | $I_{T(AV)M}$ | Half sine wave, $T_c = 70\text{ °C}$ | | | 1400 | A |
| RMS on-state current | $I_{T(RMS)}$ | | | | 2210 | A |
| Peak non-repetitive surge current | I_{TSM} | $t_p = 10\text{ ms}$, $T_{vj} = 125\text{ °C}$, sine wave after surge: $V_D = V_R = 0\text{ V}$ | | | 18×10^3 | A |
| Limiting load integral | I^2t | | | | 1.62×10^6 | A^2s |
| Peak non-repetitive surge current | I_{TSM} | $t_p = 8.3\text{ ms}$, $T_{vj} = 125\text{ °C}$, sine wave after surge: $V_D = V_R = 0\text{ V}$ | | | 19×10^3 | A |
| Limiting load integral | I^2t | | | | 1.5×10^6 | A^2s |

Characteristic values

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|-------------------|------------|---|-----|-----|------|-----------|
| On-state voltage | V_T | $I_T = 2000\text{ A}$, $T_{vj} = 125\text{ °C}$ | | | 1.55 | V |
| Threshold voltage | $V_{(T0)}$ | $I_T = 800\text{ A} - 2400\text{ A}$, $T_{vj} = 125\text{ °C}$ | | | 0.82 | V |
| Slope resistance | r_T | | | | 0.37 | $m\Omega$ |
| Holding current | I_H | $T_{vj} = 25\text{ °C}$ | | | 75 | mA |
| | | $T_{vj} = 125\text{ °C}$ | | | 60 | mA |
| Latching current | I_L | $T_{vj} = 25\text{ °C}$ | | | 500 | mA |
| | | $T_{vj} = 125\text{ °C}$ | | | 200 | mA |

Switching

Maximum rated values ¹⁾

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|---|----------------|---|-----|-----|------|-----------|
| Critical rate of rise of on-state current | di/dt_{crit} | $T_{vj} = 125\text{ °C}$, $I_{TRM} = 2000\text{ A}$, Cont. $f = 50\text{ Hz}$ | | | 150 | $A/\mu s$ |
| Critical rate of rise of on-state current | di/dt_{crit} | $V_D \leq 1880\text{ V}$, $I_{FG} = 2\text{ A}$, $t_r = 0.5\text{ }\mu s$ Cont. $f = 1\text{ Hz}$ | | | 1000 | $A/\mu s$ |
| Circuit-commutated turn-off time | t_q | $T_{vj} = 125\text{ °C}$, $I_{TRM} = 2000\text{ A}$, $V_R = 200\text{ V}$, $di_T/dt = -1.5\text{ A}/\mu s$, $V_D \leq 0.67 \cdot V_{DRM}$, $dv_D/dt = 20\text{ V}/\mu s$ | 800 | | | μs |

Characteristic values

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|--------------------------|----------|---|-----|-----|------|----------|
| Reverse recovery charge | Q_{rr} | $T_{vj} = 125\text{ °C}$, $I_{TRM} = 2000\text{ A}$, $V_R = 200\text{ V}$, $di_T/dt = -1.5\text{ A}/\mu s$ | 780 | | 2000 | μAs |
| Reverse recovery current | I_{RM} | | 30 | | 55 | A |
| Gate turn-on delay time | t_{gd} | $T_{vj} = 25\text{ °C}$, $V_D = 0.4 \cdot V_{RM}$, $I_{FG} = 2\text{ A}$, $t_r = 0.5\text{ }\mu s$ | | | 3 | μs |

Triggering

Maximum rated values ¹⁾

| 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. 9 | | | W |

Characteristic values

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|--------------------------|-----------------|---|-----|-----|-----|------|
| Gate-trigger voltage | V _{GT} | T _{vj} = 25 °C | | | 2.6 | V |
| Gate-trigger current | I _{GT} | T _{vj} = 25 °C | | | 400 | mA |
| Gate non-trigger voltage | V _{GD} | V _D = 0.4 x V _{DRM} , T _{vjmax} = 125 °C | 0.3 | | | V |
| Gate non-trigger current | I _{GD} | V _D = 0.4 x V _{DRM} , T _{vjmax} = 125 °C | 10 | | | mA |

Thermal

Maximum rated values ¹⁾

| 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 F _m = 14...24 kN | | | 17 | K/kW |
| | R _{th(j-c)A} | Anode-side cooled F _m = 14...24 kN | | | 33 | K/kW |
| | R _{th(j-c)C} | Cathode-side cooled F _m = 14...24 kN | | | 35 | K/kW |
| Thermal resistance case to heatsink | R _{th(c-h)} | Double-side cooled F _m = 14...24 kN | | | 4 | K/kW |
| | R _{th(c-h)} | Single-side cooled F _m = 14...24 kN | | | 8 | 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) | 10.350 | 3.760 | 2.290 | 0.670 |
| τ _i (s) | 0.3723 | 0.0525 | 0.0057 | 0.0023 |

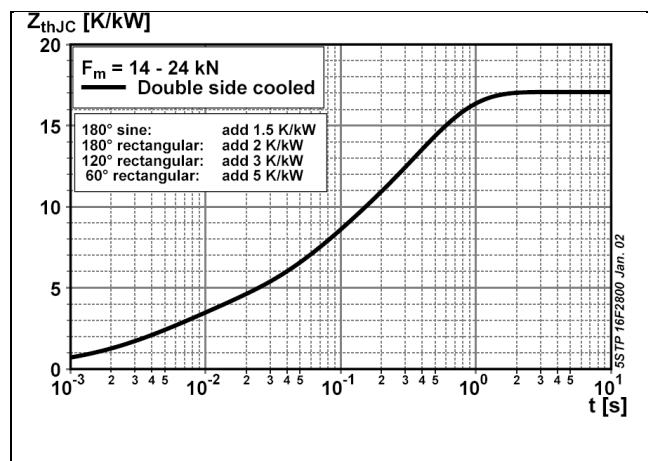


Fig. 1 Transient thermal impedance (junction-to-case) vs. time

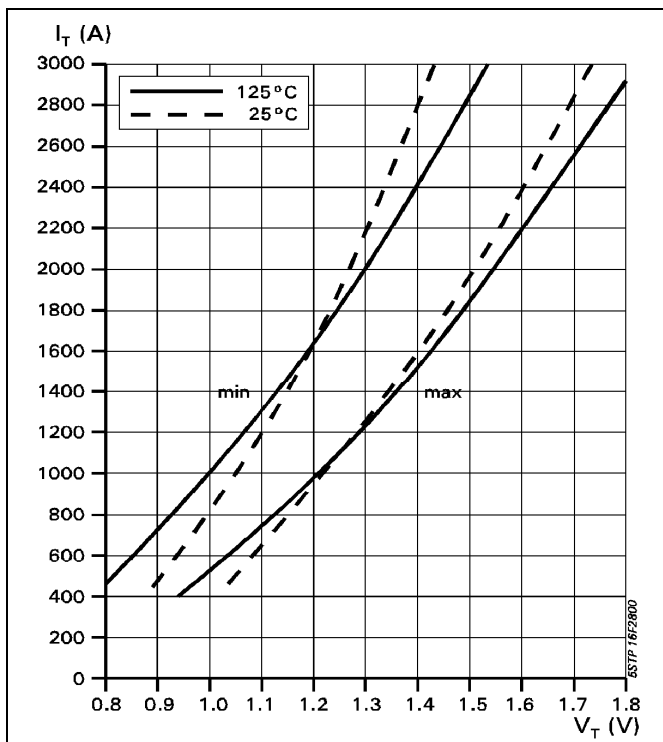


Fig. 2 On-state voltage characteristics

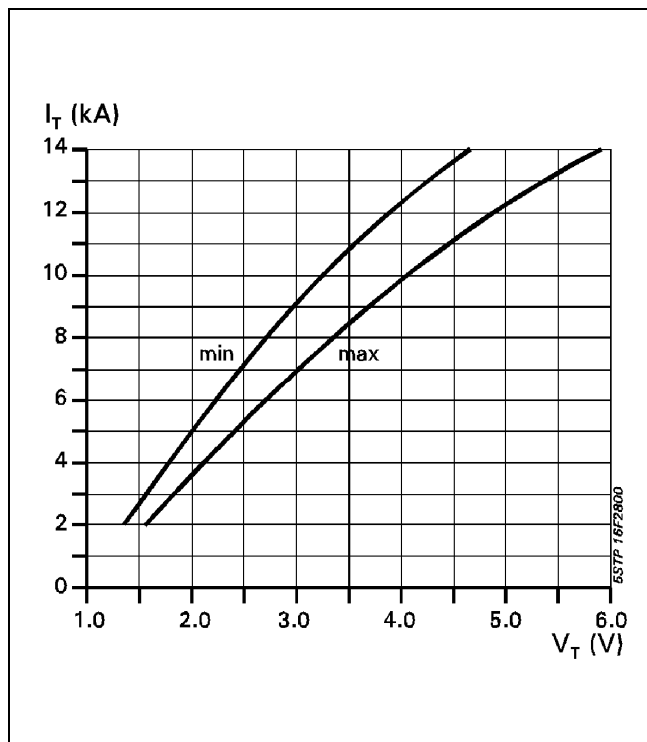


Fig. 3 On-state characteristics, $T_j = 125^\circ\text{C}$, 10ms half sine

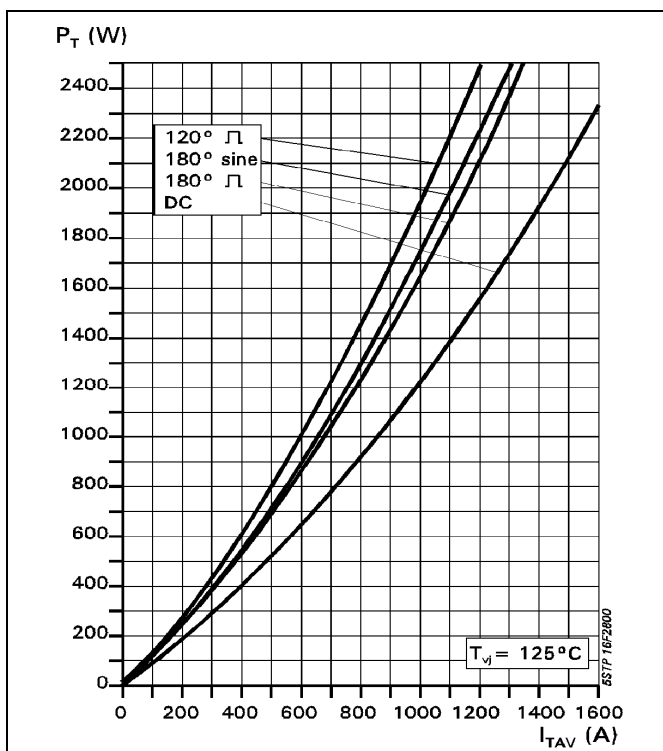


Fig. 4 On-state power dissipation vs. mean on-state current, turn-on losses excluded

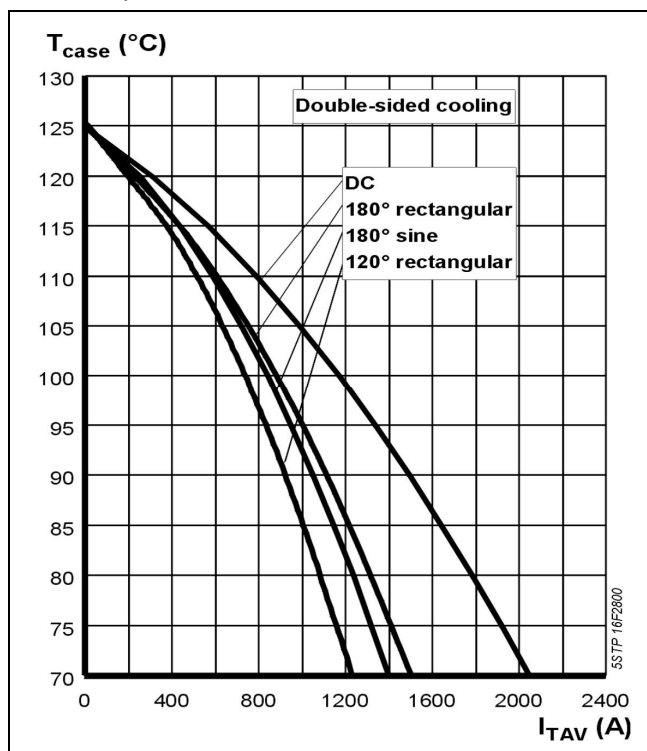


Fig. 5 Max. permissible case temperature vs. mean on-state current, switching losses ignored

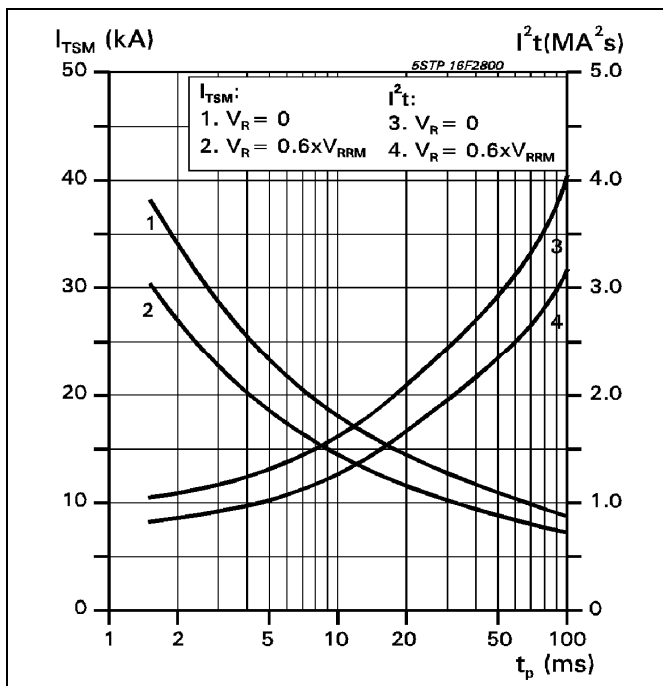


Fig. 6 Surge on-state current vs. pulse length, half-sine wave

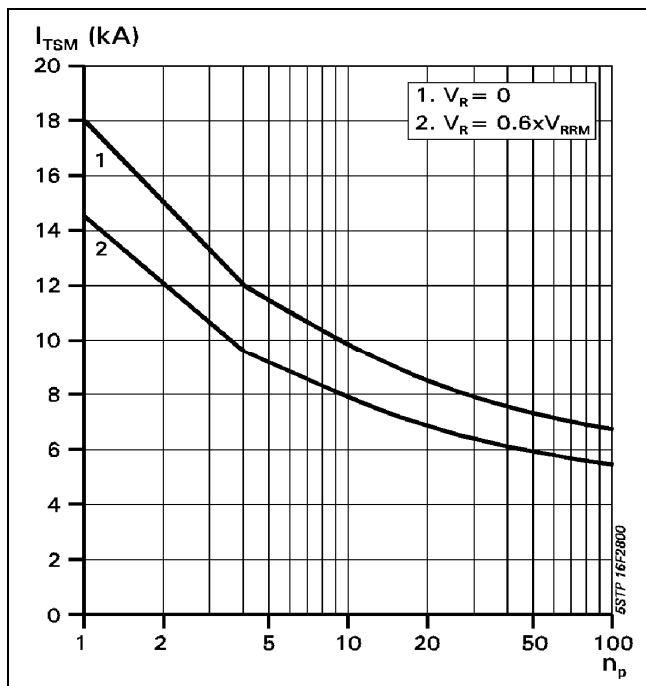


Fig. 7 Surge on-state current vs. number of pulses, half-sine wave, 10 ms, 50Hz

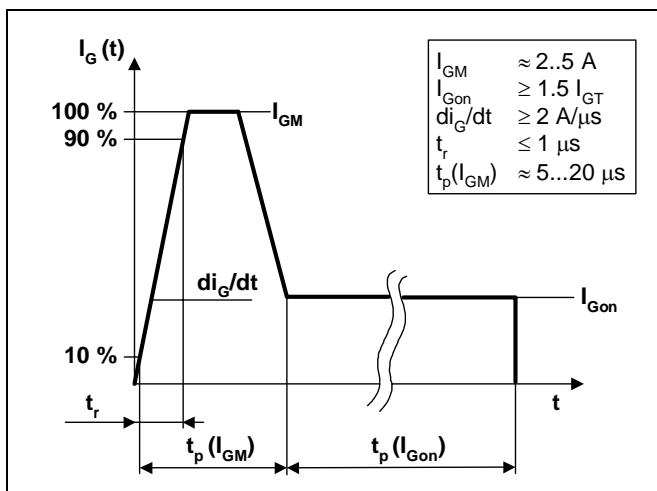


Fig. 8 Recommended gate current waveform

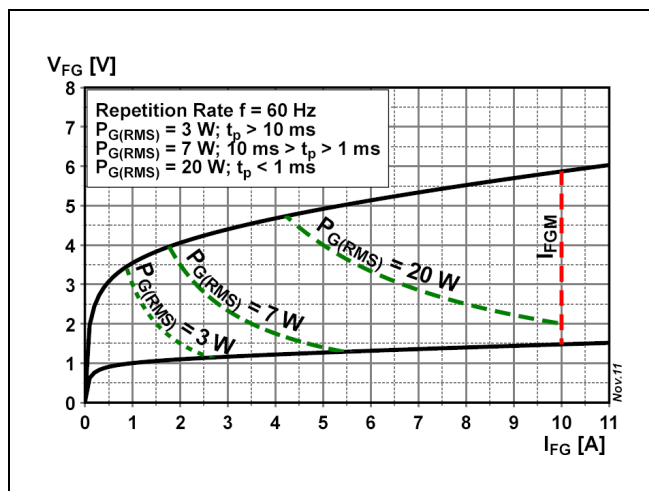


Fig. 9 Max. peak gate power loss

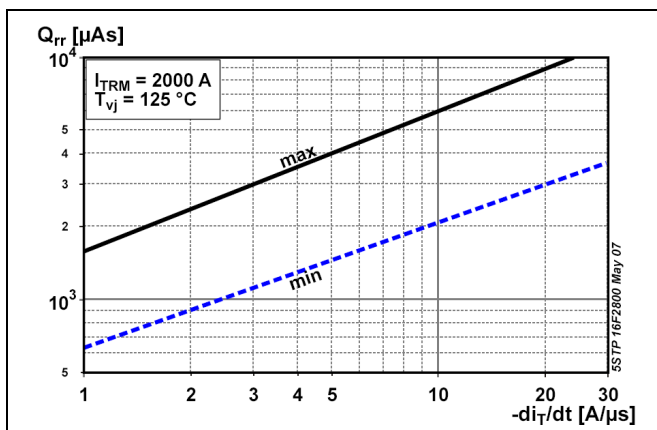


Fig. 10 Reverse recovery charge vs. decay rate of on-state current

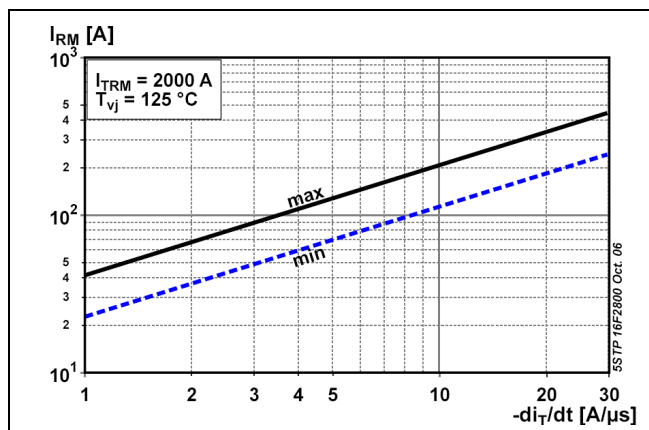


Fig. 11 Peak reverse recovery current vs. decay rate of on-state current

Turn-on and Turn-off losses

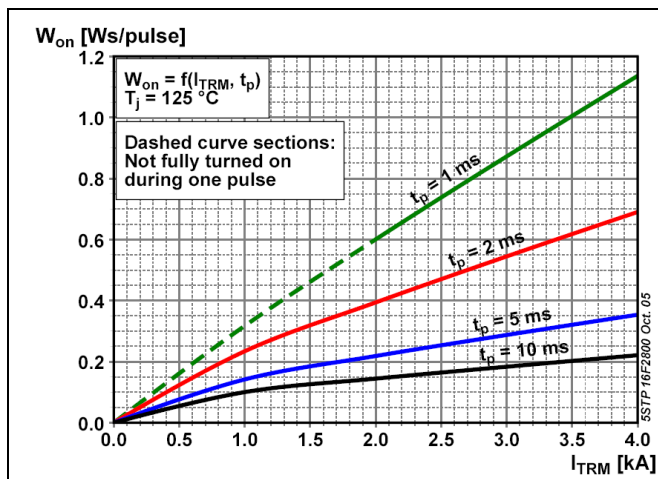


Fig. 12 Turn-on energy, half sinusoidal waves

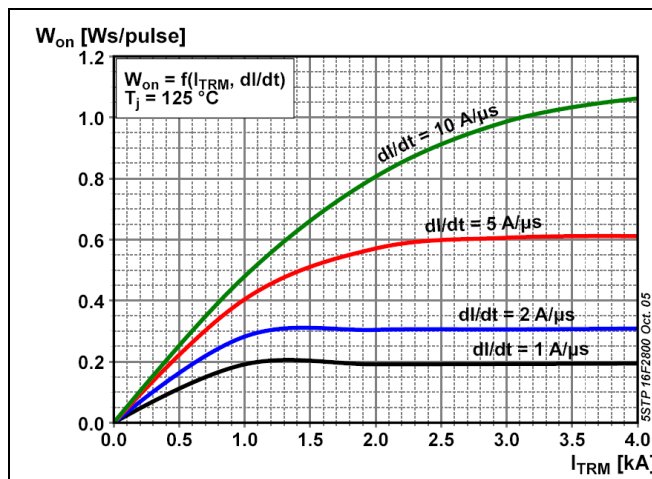


Fig. 13 Turn-on energy, rectangular waves

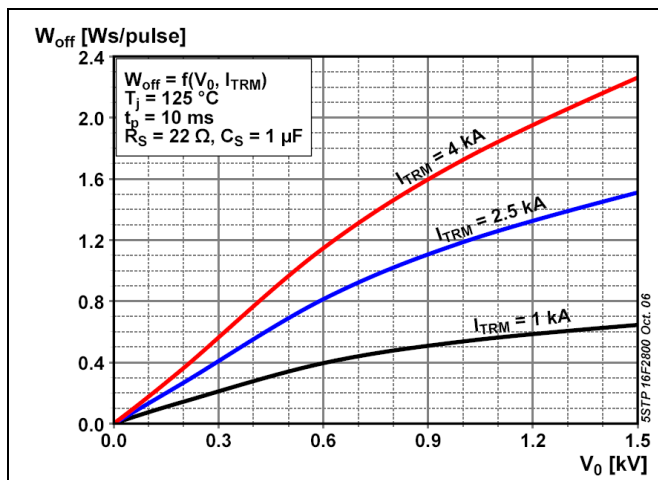


Fig. 14 Turn-off energy, half sinusoidal waves

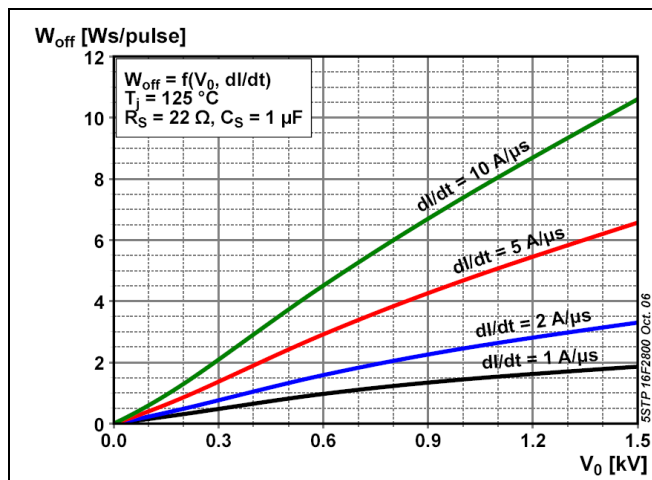


Fig. 15 Turn-off energy, rectangular waves

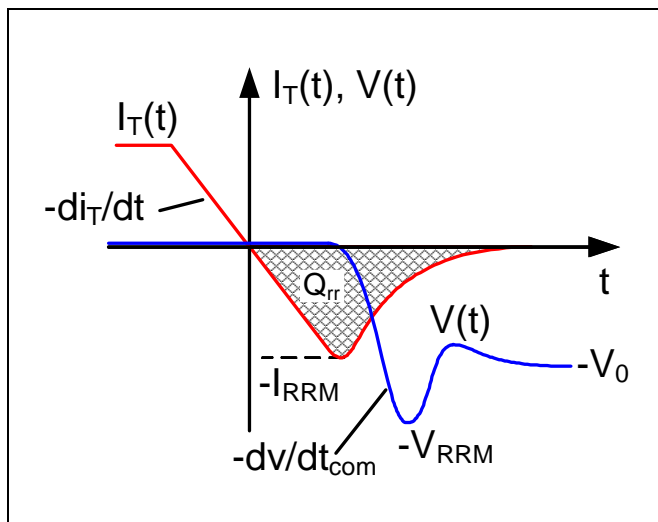


Fig. 16 Current and voltage waveforms at turn-off

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. 17 Relationships for power loss

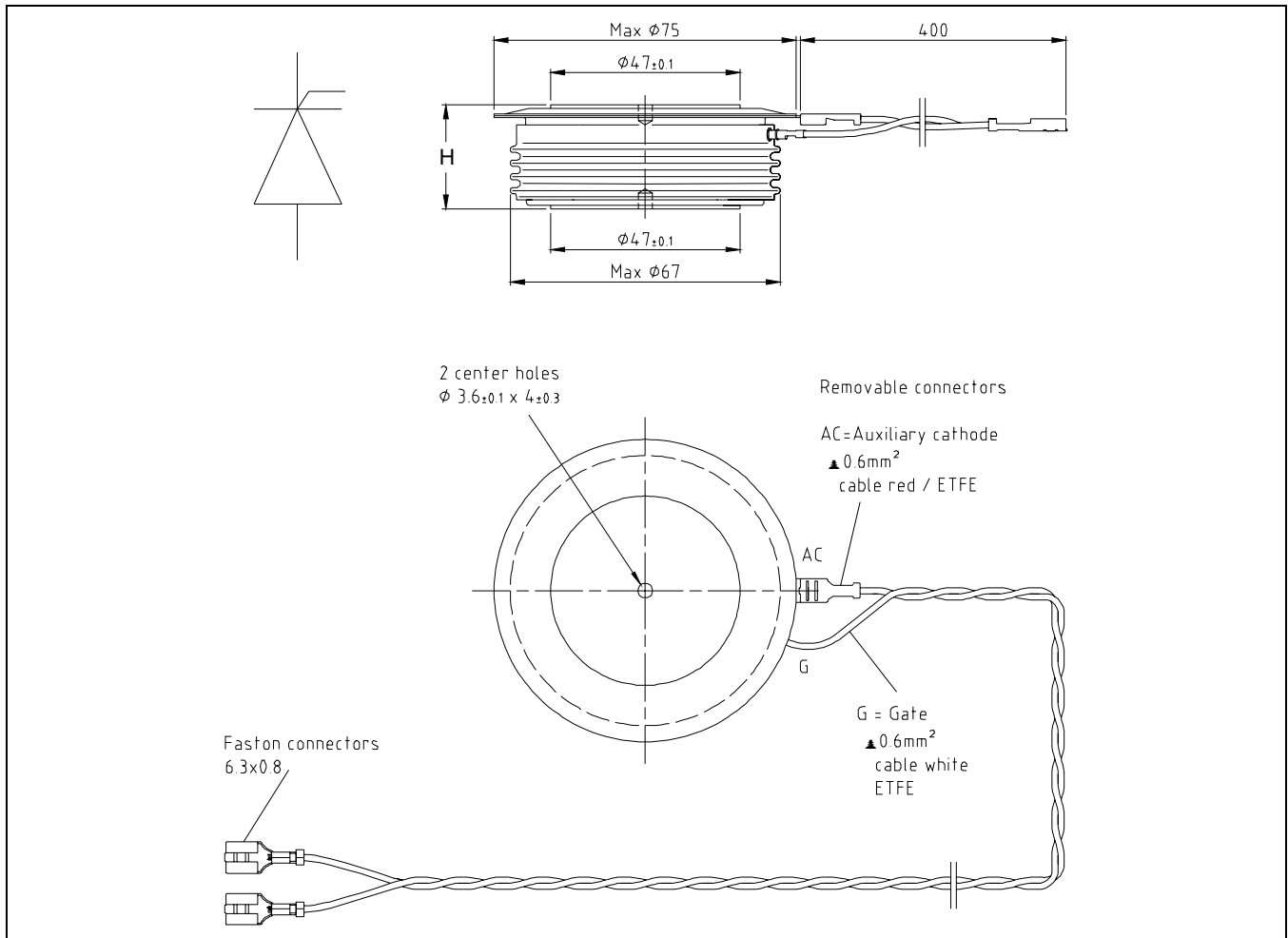


Fig. 18 Device Outline Drawing

Related documents:

| | |
|-----------|---|
| 5SYA 2020 | Design of RC-Snubber for Phase Control Applications |
| 5SYA 2049 | Voltage definitions for phase control thyristors and diodes |
| 5SYA 2051 | Voltage ratings of high power semiconductors |
| 5SYA 2034 | Gate-Drive Recommendations for PCT's |
| 5SYA 2036 | Recommendations regarding mechanical clamping of Press Pack High Power Semiconductors |
| 5SZK 9104 | Specification of environmental class for pressure contact diodes, PCTs and GTO, STORAGE available on request, please contact factory |
| 5SZK 9105 | Specification of environmental class for pressure contact diodes, PCTs and GTO, TRANSPORTATION available on request, please contact factory |

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