# Thyristor
# AGA 2000-25-H-01

## Key Parameters

| | | | |
|---|---|---|---|
| $V_{DRM}$ | = | 2500 | V |
| $I_{TGQM}$ | = | 2000 | A |
| $I_{TSM}$ | = | 16 | kA |
| $V_{T0}$ | = | 1.66 | V |
| $r_T$ | = | 0.57 | mΩ |
| $V_{Dclink}$ | = | 1400 | V |

## Features

- Patented free-floating silicon technology
- Low on-state and switching losses
- Annular gate electrode
- Industry standard housing
- Cosmic radiation withstand rating

### Blocking

| Symbols and parameters | | | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | min | typ | max | |
| $V_{DRM}$ | Repetitive peak off-state voltage | $V_{GR} \geq 2$ V | | | 2500 | V |
| $V_{RRM}$ | Repetitive peak reverse voltage | | | | 17 | V |
| $V_{DC\text{-}link}$ | Permanent DC voltage for 100 FIT failure rate | -40 ≤ $T_j$ ≤ 125 °C. Ambient cosmic radiation at sea level in open air. | | | 1400 | V |
| $I_{DRM}$ | Repetitive peak off-state current | $V_D = V_{DRM}$, $V_{GR} \geq 2$ V | | | 30 | mA |
| $I_{RRM}$ | Repetitive peak reverse current | $V_R = V_{RRM}$, $R_{GK} = \infty$ | | | 50 | mA |

### Mechanical data

| Symbols and parameters | | | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | min | typ | max | |
| $F_m$ | Mounting force | | 17 | | 24 | kN |
| A | Acceleration:<br>Device unclamped<br>Device clamped | | | | <br>50<br>200 | $m/s^2$ |
| m | Weight | | | | 0.8 | kg |
| $D_s$ | Surface creepage distance | | 22 | | | mm |
| $D_a$ | Air strike distance | | 13 | | | mm |

## GTO Data

| Symbols and parameters | | | | Value | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | min | typ | max | |
| $I_{T(AV)M}$ | Max. average on-state current | Half sine wave, $T_C$ = 85 °C | | | | 830 | A |
| $I_{T(RMS)}$ | Max. RMS on-state current | | | | | 1300 | kA |
| $I_{TSM}$ | Max. peak non-repetitive surge current | $t_P$ = 10 ms<br>$t_P$ = 1 ms | $T_j$ = 125 °C<br>After surge:<br>$V_D = V_R$ = 0V | | | 16<br>32 | kA |
| $I^2t$ | Limiting load integral | $t_P$ = 10 ms<br>$t_P$ = 1 ms | | | | $1.28\times10^6$<br>$0.51\times10^6$ | $A^2s$ |
| $V_T$ | On-state voltage | $I_T$ = 2000 A | | | | 2.8 | V |
| $V_{(T0)}$ | Threshold voltage | $I_T$= 200-2500 A | $T_j$ = 125 °C | | | 1.66 | V |
| $r_T$ | Slope resistance | | | | | 0.57 | mΩ |
| $I_H$ | Holding current | $T_j$ = 25°C | | | | 50 | A |

## Turn-on switching

| Symbols and parameters | | | | Value | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | min | typ | max | |
| $di_T/dt_{cr}$ | Critical rate of rise of on state current | $I_T$ = 2000 A,<br>$T_j$ = 125 °C<br>$I_{GM}$ = 30 A,<br>$di_G/dt$ = 20 A/µs | f = 200 Hz | | | 400 | A/µs |
| | | | f = 1 Hz | | | 700 | A/µs |
| $t_{on(min)}$ | Min. on-time | $V_D$ = 0.5 $V_{DRM}$, $T_{vj}$=125 °C<br>$I_T$ = 2000 A,<br>di/dt = 200 A/µs,<br>$I_{GM}$ = 30 A,<br>$di_G/dt$ = 20 A/µs,<br>$C_S$ = 4 µF, $R_S$ = 5 Ω | | 80 | | | µs |
| $t_d$ | Delay time | | | | | 1.5 | µs |
| $t_r$ | Rise time | | | | | 3.5 | µs |
| $E_{on}$ | Turn-on energy per pulse | | | | | 0.75 | J |

**Turn-off switching**

| Symbols and parameters | | | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | min | typ | max | |
| $I_{TGQM}$ | Max. controllable turn-off current | $V_{DM} = V_{DRM}$, $di_{GQ}/dt = 30$ A/µs $C_S = 4$ µF, $L_S \leq 0.3$ µH | | | 2000 | A |
| $t_{off}$ | Min. off-time | $V_D = 0.5\ V_{DRM}$, $T_{vj} = 125$ °C $V_{DM} = V_{DRM}$, $di_{GQ}/dt = 30$ A/µs, $I_{TGQ} = I_{TGQM}$, $R_S = 5\ \Omega$, CS = 4 µF, $L_S \leq 0.3$ µH | 80 | | | µs |
| $t_S$ | Storage time | $V_D = 0.5\ V_{DRM}$, $T_{vj} = 125$ °C $V_{DM} \leq V_{DRM}$, $di_{GQ}/dt = 30$ A/µs, $I_{TGQ} = I_{TGQM}$, $R_S = 5\ \Omega$, CS = 4 µF, $L_S \leq 0.3$ µH | | | 22 | µs |
| $t_f$ | Fall time | | | | 2 | µs |
| $E_{off}$ | Turn-on energy per pulse | | | | 3.5 | J |
| $I_{GQM}$ | Peak turn-off gate current | | | | 700 | A |

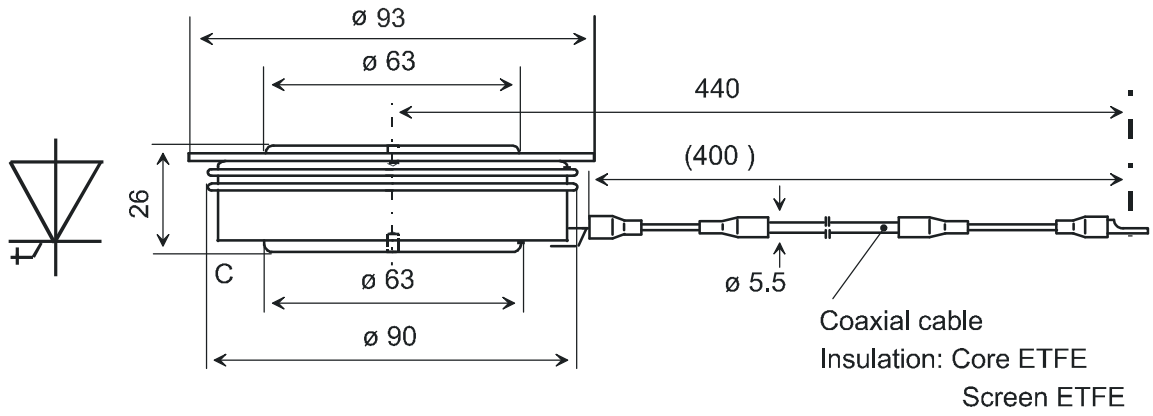
**Gate**

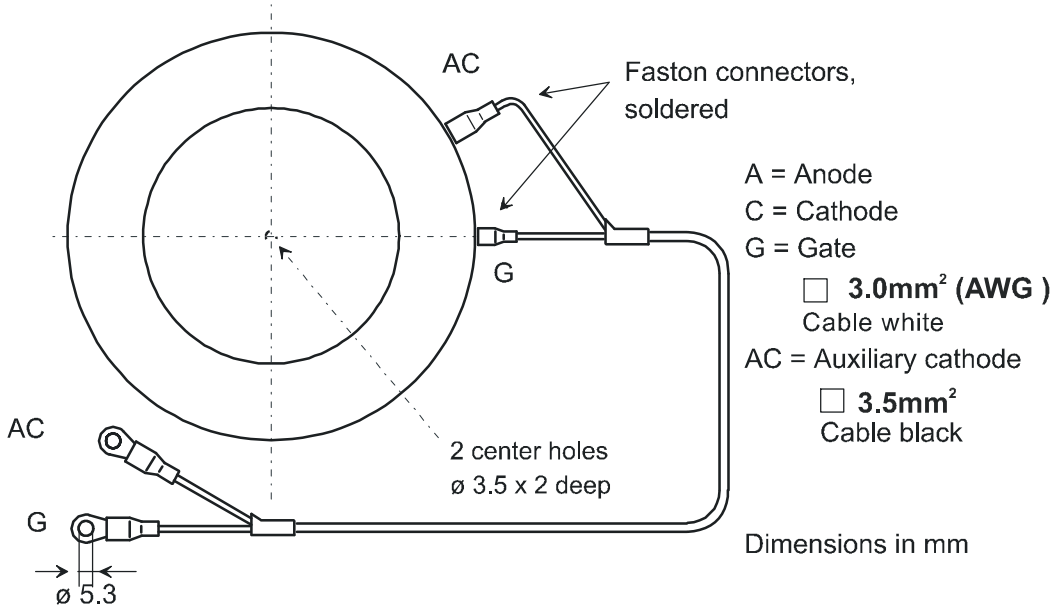
| Symbols and parameters | | | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | min | typ | max | |
| $V_{GRM}$ | Repetitive peak reverse voltage | | | | 17 | V |
| $I_{GRM}$ | Repetitive peak reverse current | $V_{GR} = V_{GRM}$ | | | 50 | mA |
| $V_{GT}$ | Gate trigger voltage | $T_{vj} = 25$°C, $V_D = 24$ V, $R_A = 0.1\ \Omega$ | | 1.0 | | V |
| $I_{GT}$ | Gate trigger current | | | 2.5 | | A |

**Thermal**

| Symbols and parameters | | | Value | Unit |
|---|---|---|---|---|
| $T_j$ | Junction operating temperature | | -40 ... 125 | °C |
| $R_{thJC}$ | Thermal resistance junction to case | Anode side cooled | 30 | K/kW |
| | | Cathode side cooled | 39 | K/kW |
| | | Double side cooled | 17 | K/kW |
| $R_{thCH}$ | Thermal resistance case to heatsink (Double side cooled) | Single side cooled | 10 | K/kW |
| | | Double side cooled | 5 | K/kW |

## DIMENSIONS


ø 93
ø 63
440
(400 )
26
C
ø 63
ø 90
ø 5.5
Coaxial cable
Insulation: Core ETFE
Screen ETFE


AC
Faston connectors,
soldered
A = Anode
C = Cathode
G = Gate
3.0mm² (AWG )
Cable white
AC = Auxiliary cathode
3.5mm²
Cable black
G
2 center holes
ø 3.5 x 2 deep
AC
G
ø 5.3
Dimensions in mm

**Analytical function for transient thermal impedance:**

$$Z_{thJC}(t) = \sum_{i=1}^{4} R_i(1 - e^{-t/\tau_i})$$

| i | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| $R_i$ (K/kW) | 11.7 | 4.7 | 0.64 | 0.0001 |
| $\tau_i$ (s) | 0.9 | 0.26 | 0.002 | 0.001 |

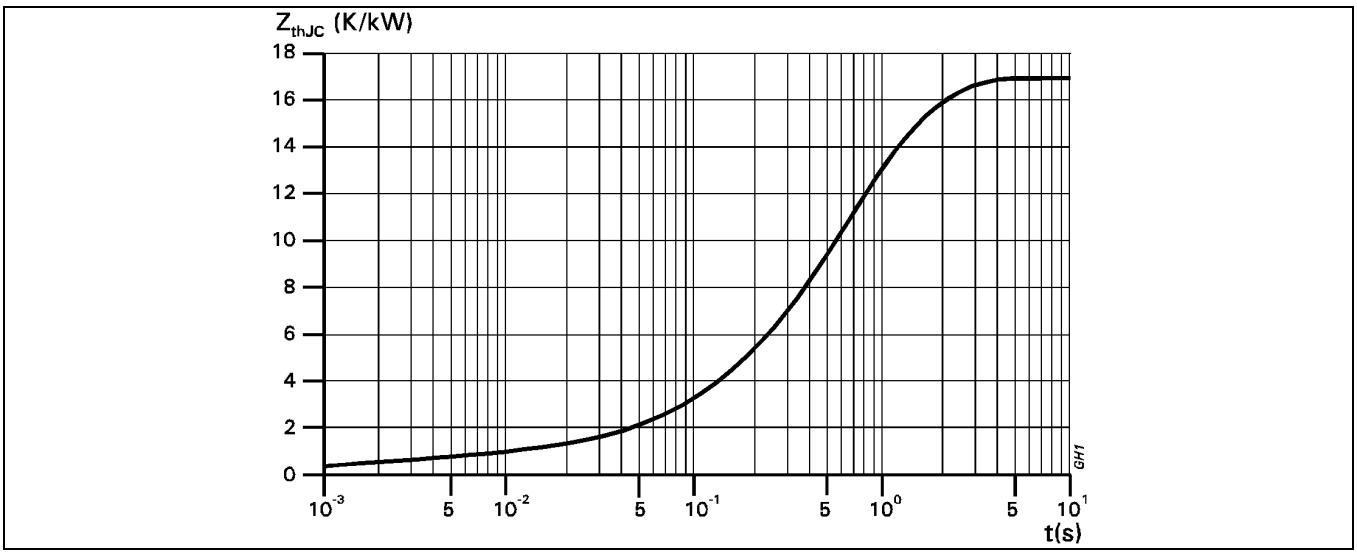



**Fig. 1** Transient thermal impedance, junction to case.

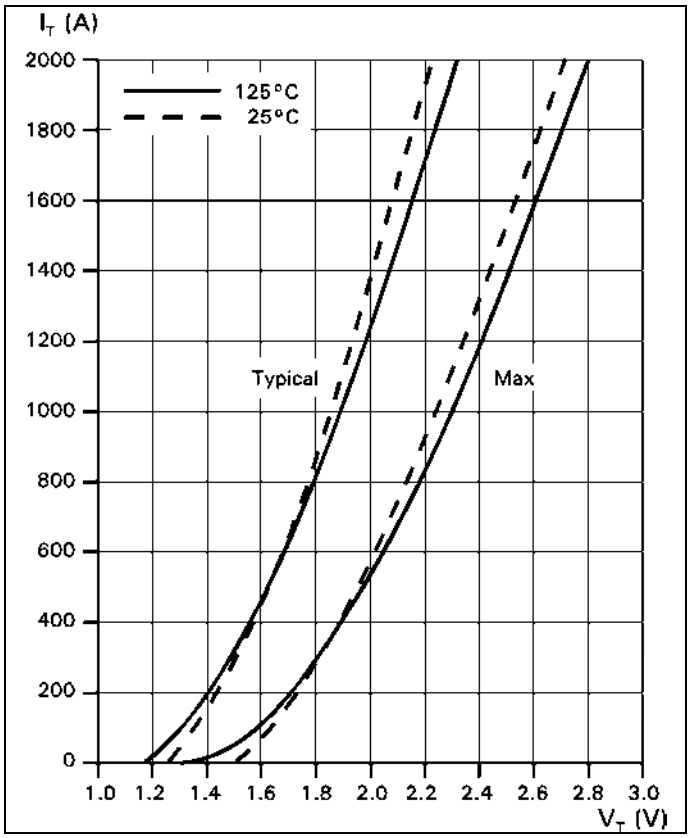



**Fig. 2** On-state characteristics

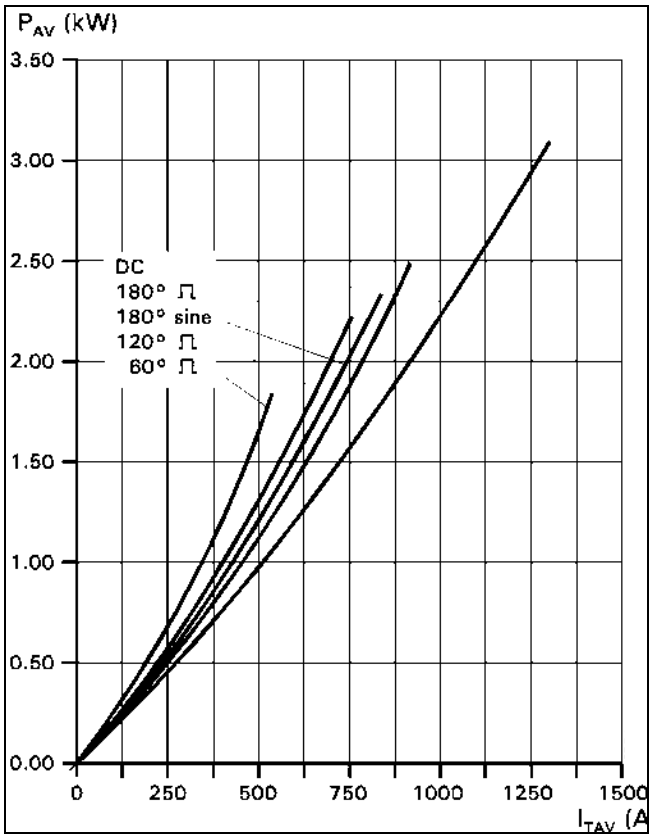



**Fig. 3** Average on-state power dissipation vs. average on-state current.

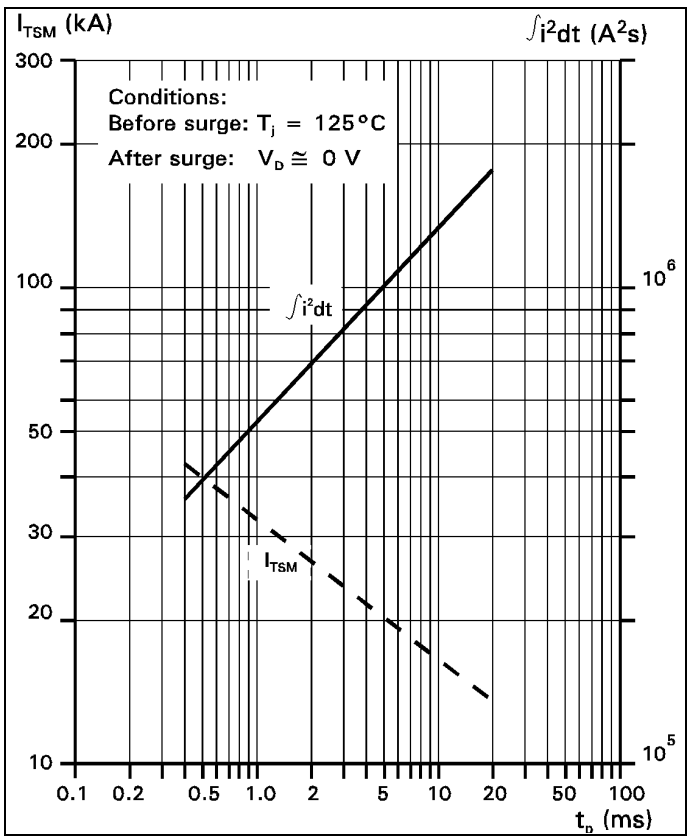



**Fig. 4** Surge current and fusing integral vs. pulse width

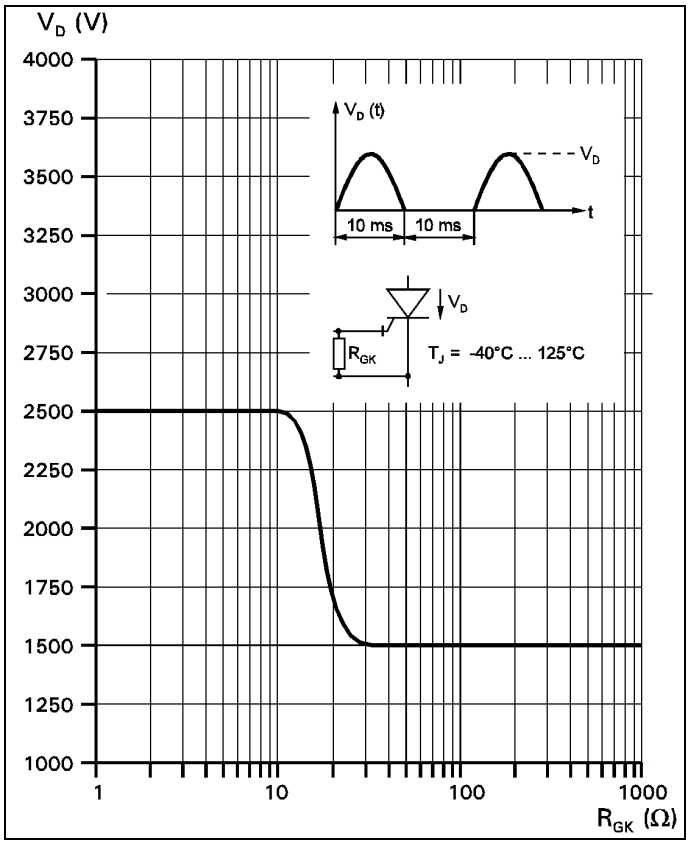



**Fig. 5** Forward blocking voltage vs. gate-cathode resistance.

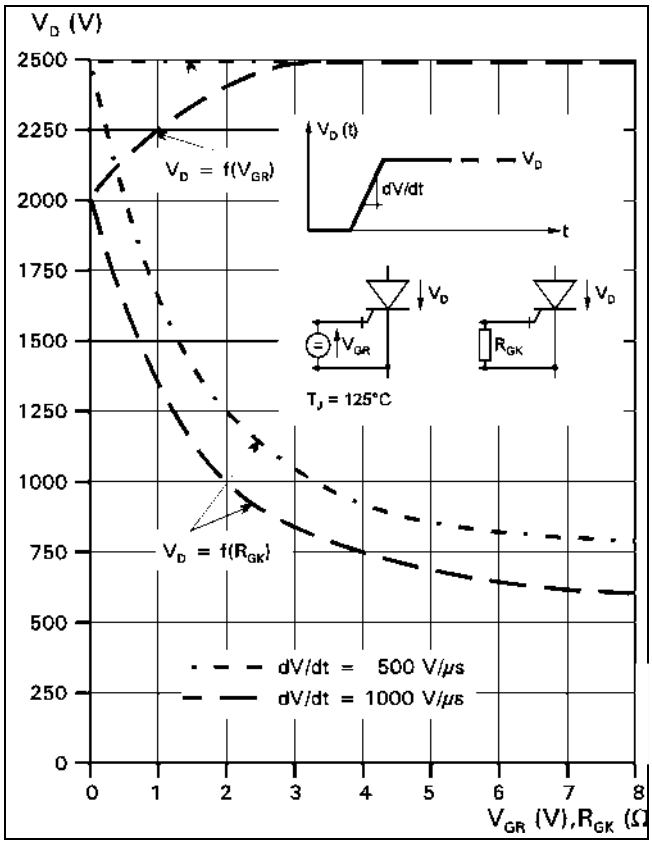



**Fig. 6** Static dv/dt capability: Forward blocking voltage vs. neg. gate voltage or gate cathode resistance.

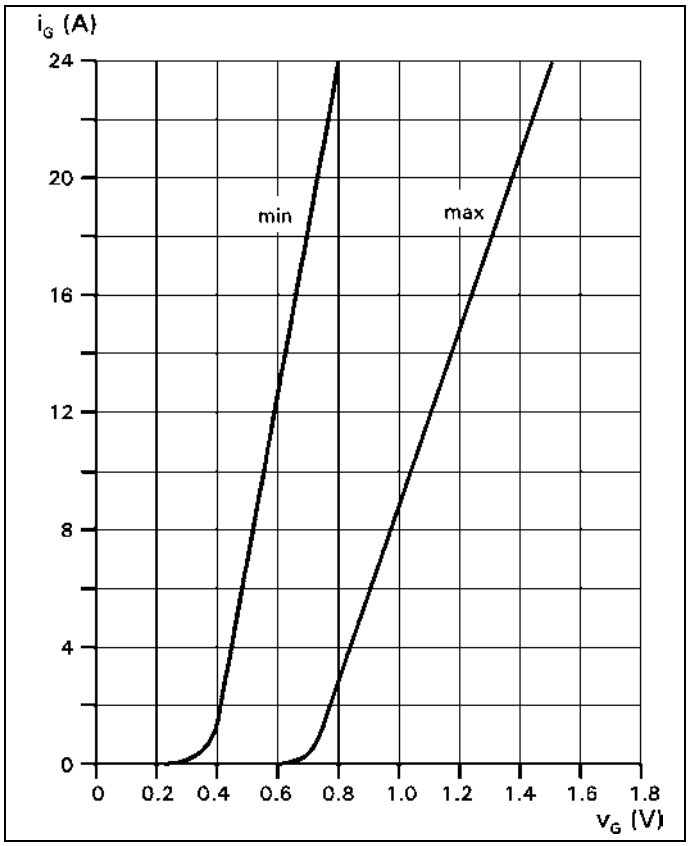



**Fig. 7** Forwarde gate current vs. forard gate voltage.

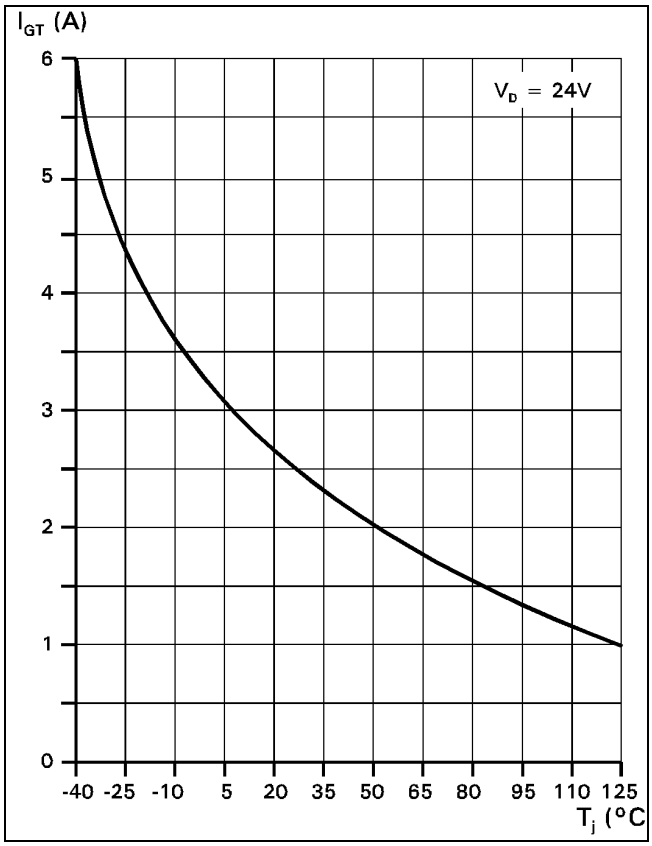



**Fig. 8** Gate trigger current vs. junction temperature

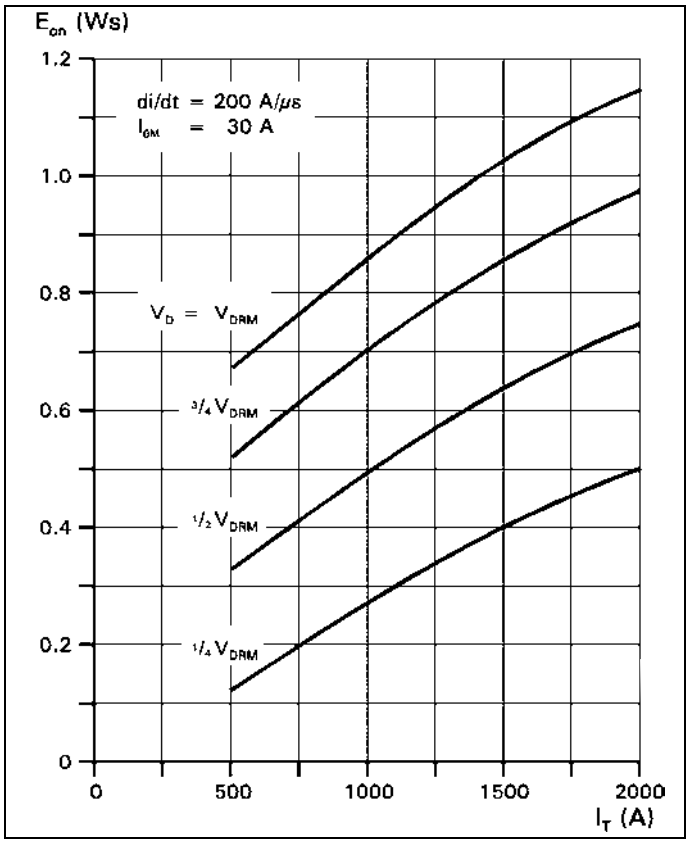



**Fig. 9** Turn-on energy per pulse vs. on-state current and turn-on voltage.

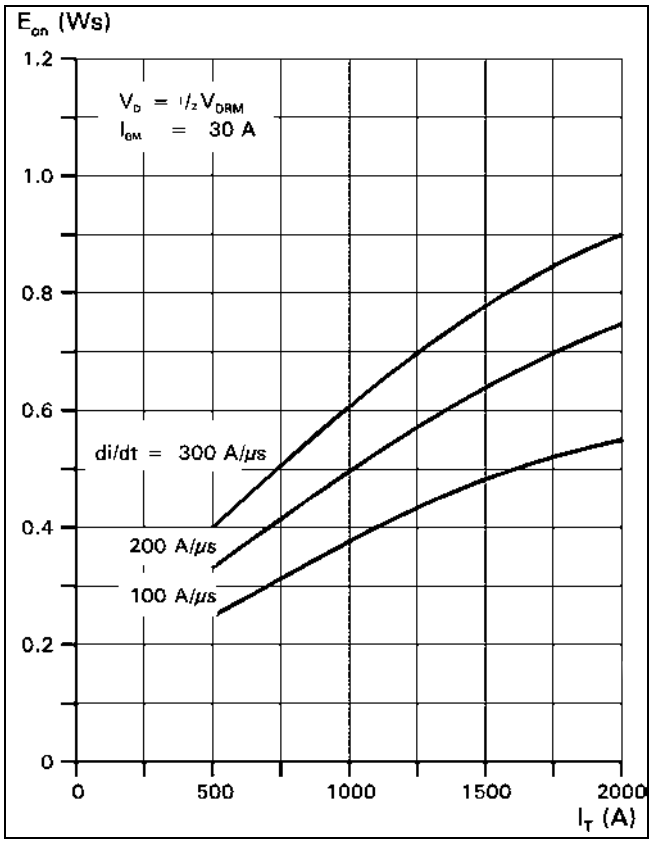



**Fig. 10** Turn-on energy per pulse vs. on.-state current and current rise rate

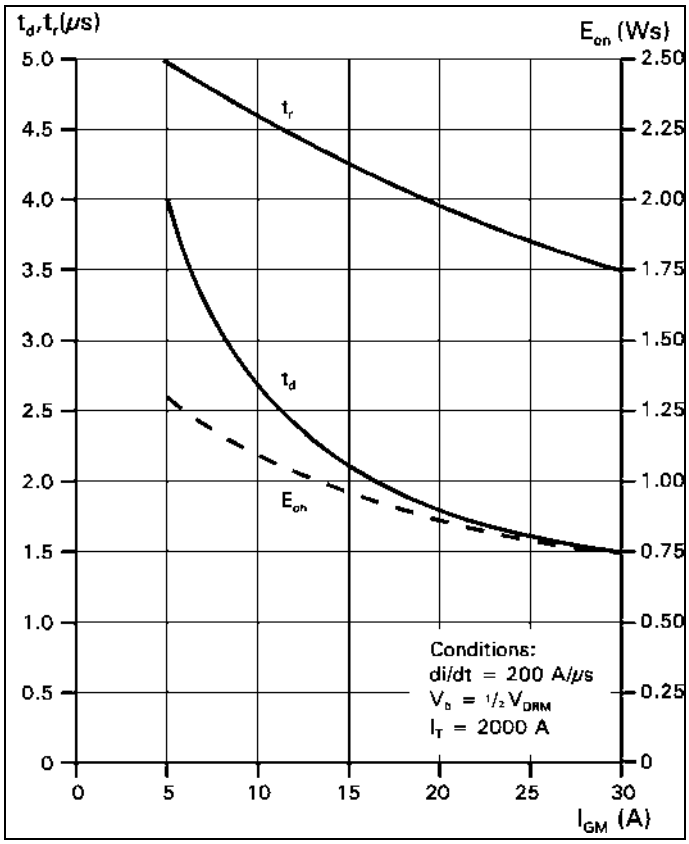



**Fig. 11** Turn-on energy per pulse vs. on-state current and turn-on voltage.

Common Test conditions for figures 9, 10 and 11:

| | |
|---|---|
| $di_G/dt$ | = 20 A/µs |
| $C_S$ | = 4 µF |
| $R_S$ | = 5 Ω |
| Tj | = 125 °C |

Definition of Turn-on energy:

$$E_{on} = \int_0^{20\,\mu s} V_D \times I_T dt \quad (t = 0, I_G = 0.1 \times I_{GM})$$

Common Test conditions for figures 12, 13 and 15:

Definition of Turn-off energy:

$$E_{off} = \int_0^{40\,\mu s} V_D \times I_T dt \quad (t = 0, I_T = 0.9 \times I_{TGQ})$$

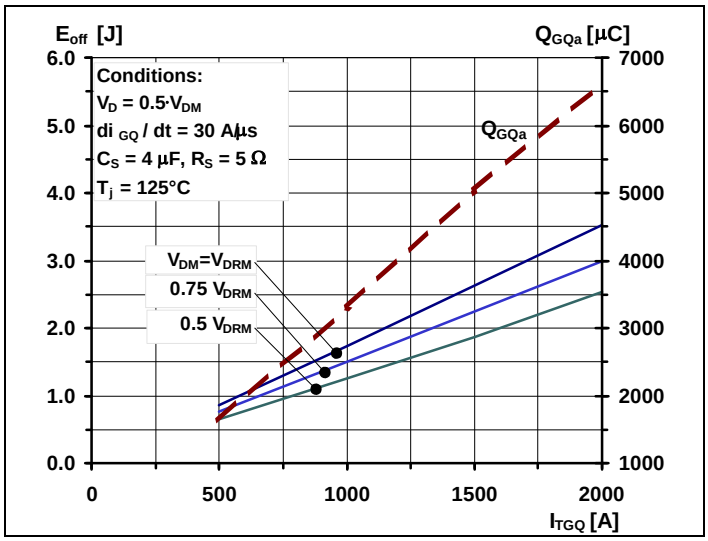



**Fig. 12** Turn-off energy per pulse vs. turn-off current and peak turn-off voltage. Extracted gate charge vs. turn-off current.

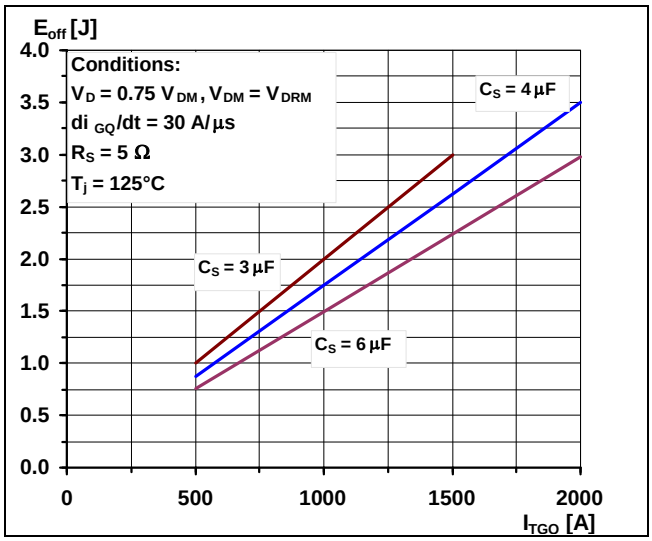



**Fig. 13** Turn-off energy per pulse vs. turn-off current and snubber capacitance.

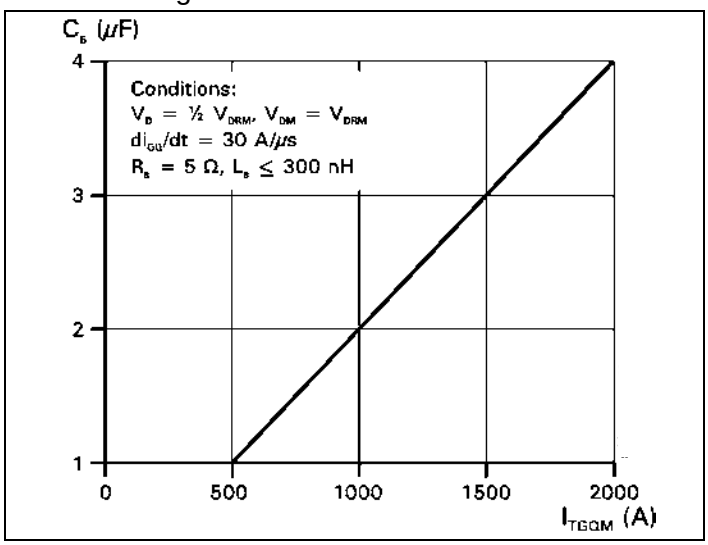



**Fig. 14** Required snubber capacitor vs. max allowable turn-off current.

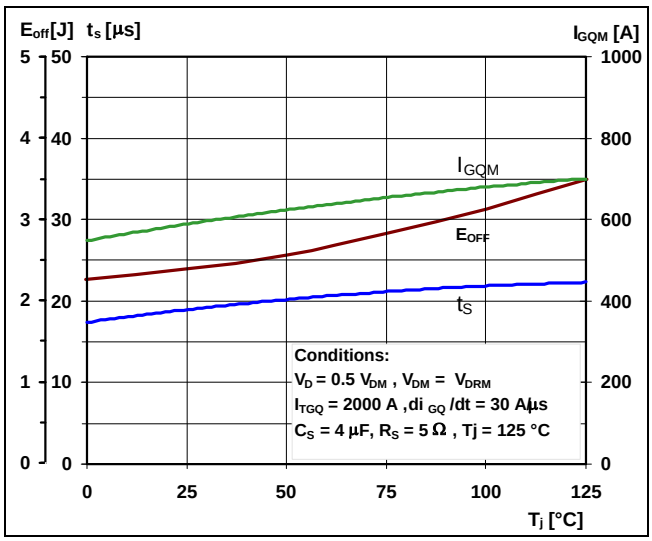



**Fig. 15** Turn-off energy per pulse, storage time and peak turn-off gate current vs. junction temperature

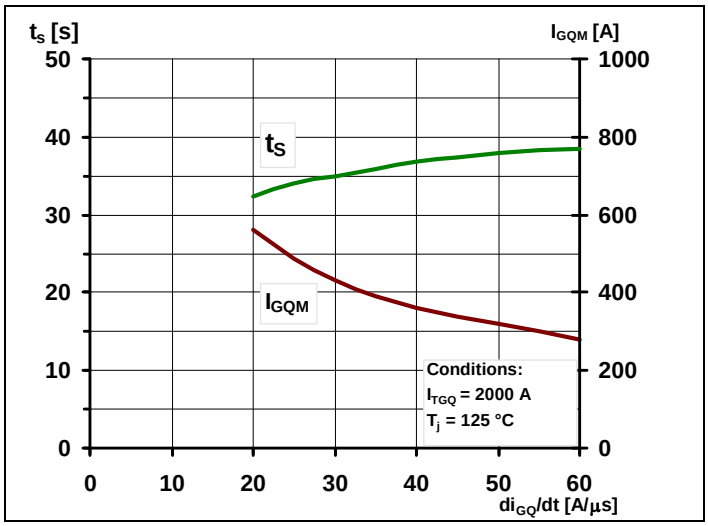



**Fig. 16** Storage time and peak turn-off gate current vs. neg. gate current rise rate.

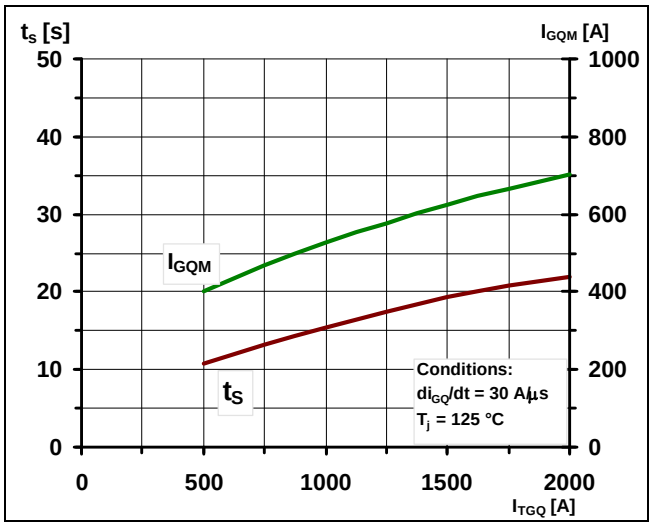



**Fig. 17** Storage time and peak turn-off gate current vs. turn-off current

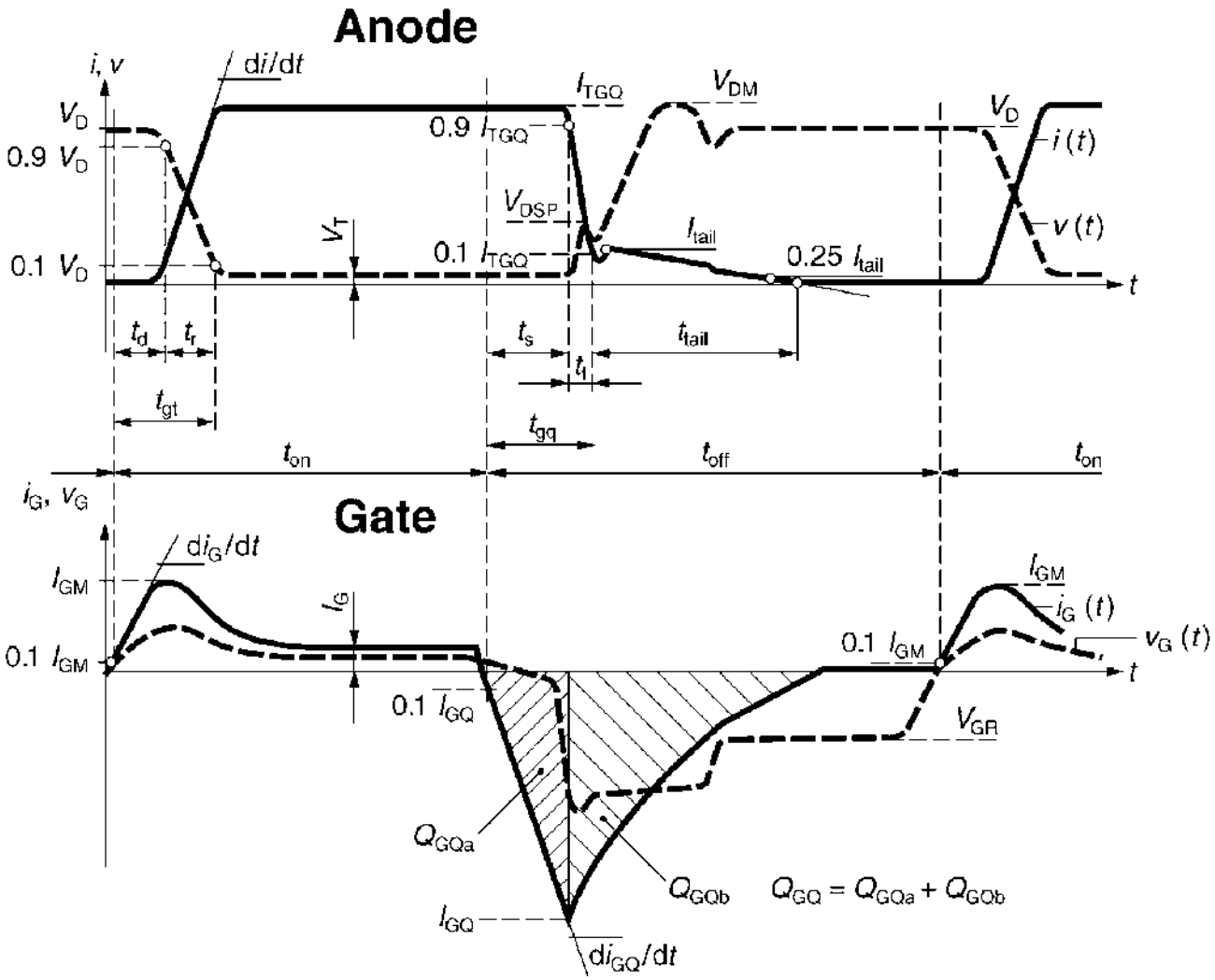



**Fig. 18** General current and voltage waveforms with GTO-specific symbols