

$V_{\text{DRM}} = 2500 \text{ V}$
 $I_{\text{TGQM}} = 2000 \text{ A}$
 $I_{\text{TSM}} = 16 \text{ kA}$
 $V_{\text{T0}} = 1.66 \text{ V}$
 $r_{\text{T}} = 0.57 \text{ m}\Omega$
 $V_{\text{DClin}} = 1400 \text{ V}$

Gate turn-off Thyristor

5SGA 20H2501

Doc. No. 5SYA1205-01 Jun. 04

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

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Blocking

V_{DRM}	Repetitive peak off-state voltage	2500 V	$V_{\text{GR}} \geq 2\text{V}$
V_{RRM}	Repetitive peak reverse voltage	17 V	
I_{DRM}	Repetitive peak off-state current	$\leq 30 \text{ mA}$	$V_{\text{D}} = V_{\text{DRM}} \quad V_{\text{GR}} \geq 2\text{V}$
I_{RRM}	Repetitive peak reverse current	$\leq 50 \text{ mA}$	$V_{\text{R}} = V_{\text{RRM}} \quad R_{\text{GK}} = \infty$
V_{DClink}	Permanent DC voltage for 100 FIT failure rate	1400 V	$-40 \leq T_{\text{j}} \leq 125 \text{ }^{\circ}\text{C}$. Ambient cosmic radiation at sea level in open air.

Mechanical data (see Fig. 19)

F_{m}	Mounting force	min.	17	kN
		max.	24	kN
A	Acceleration:			
	Device unclamped		50	m/s^2
	Device clamped		200	m/s^2
M	Weight		0.8	kg
D_{s}	Surface creepage distance	$\geq$	22	mm
D_{a}	Air strike distance	$\geq$	13	mm

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GTO Data**On-state**

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I_{TAVM}	Max. average on-state current	830 A	Half sine wave, $T_C = 85^\circ\text{C}$	
I_{TRMS}	Max. RMS on-state current	1300 A		
I_{TSM}	Max. peak non-repetitive surge current	16 kA	$t_P = 10\text{ ms}$	$T_j = 125^\circ\text{C}$
		32 kA	$t_P = 1\text{ ms}$	After surge:
I^2t	Limiting load integral	$1.28 \cdot 10^6\text{ A}^2\text{s}$	$t_P = 10\text{ ms}$	$V_D = V_R = 0\text{V}$
		$0.51 \cdot 10^6\text{ A}^2\text{s}$	$t_P = 1\text{ ms}$	
V_T	On-state voltage	2.80 V	$I_T = 2000\text{ A}$	$T_j = 125^\circ\text{C}$
V_{T0}	Threshold voltage	1.66 V	$I_T = 200 - 2500\text{ A}$	
r_T	Slope resistance	0.57 m Ω		
I_H	Holding current	50 A	$T_j = 25^\circ\text{C}$	

Gate

V_{GT}	Gate trigger voltage	1.0 V	$V_D = 24\text{ V}$	$T_j = 25^\circ\text{C}$
I_{GT}	Gate trigger current	2.5 A	$R_A = 0.1\text{ }\Omega$	
V_{GRM}	Repetitive peak reverse voltage	17 V		
I_{GRM}	Repetitive peak reverse current	50 mA	$V_G = V_{GRM}$	

Turn-on switching

di/dt_{crit}	Max. rate of rise of on-state current	400 A/ μs	$f = 200\text{Hz}$	$I_T = 2000\text{ A}, T_j = 125^\circ\text{C}$
		700 A/ μs	$f = 1\text{Hz}$	$I_{GM} = 30\text{ A}, di_G/dt = 20\text{ A}/\mu\text{s}$
t_d	Delay time	1.5 μs	$V_D = 0.5 V_{DRM}$	$T_j = 125^\circ\text{C}$
t_r	Rise time	3.5 μs	$I_T = 2000\text{ A}$	$di/dt = 200\text{ A}/\mu\text{s}$
$t_{on(min)}$	Min. on-time	80 μs	$I_{GM} = 30\text{ A}$	$di_G/dt = 20\text{ A}/\mu\text{s}$
E_{on}	Turn-on energy per pulse	0.75 Ws	$C_S = 4\text{ }\mu\text{F}$	$R_S = 5\text{ }\Omega$

Turn-off switching

I_{TGQM}	Max controllable turn-off current	2000 A	$V_{DM} = V_{DRM}$	$di_{GQ}/dt = 30\text{ A}/\mu\text{s}$
			$C_S = 4\text{ }\mu\text{F}$	$L_S \leq 0.3\text{ }\mu\text{H}$
t_s	Storage time	22.0 μs	$V_D = \frac{1}{2} V_{DRM}$	$V_{DM} = V_{DRM}$
t_f	Fall time	2.0 μs	$T_j = 125^\circ\text{C}$	$di_{GQ}/dt = 30\text{ A}/\mu\text{s}$
$t_{off(min)}$	Min. off-time	80 μs	$I_{TGQ} = I_{TGQM}$	
E_{off}	Turn-off energy per pulse	3.5 Ws	$C_S = 4\text{ }\mu\text{F}$	$R_S = 5\text{ }\Omega$
I_{GQM}	Peak turn-off gate current	700 A	$L_S \leq 0.3\text{ }\mu\text{H}$	

Thermal

T_j	Storage and operating junction temperature range	-40...125°C	
R_{thJC}	Thermal resistance junction to case	30 K/kW	Anode side cooled
		39 K/kW	Cathode side cooled
		17 K/kW	Double side cooled
R_{thCH}	Thermal resistance case to heat sink	10 K/kW	Single side cooled
		5 K/kW	Double side cooled

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
τ_i (s)	0.9	0.26	0.002	0.001

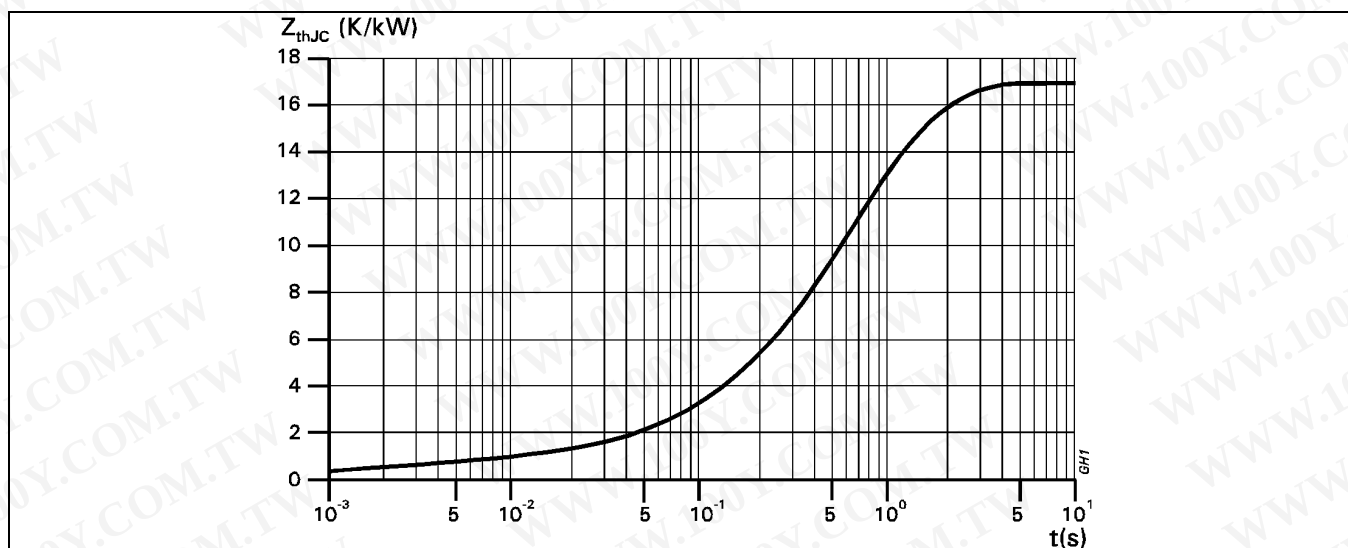


Fig. 1 Transient thermal impedance, junction to case.

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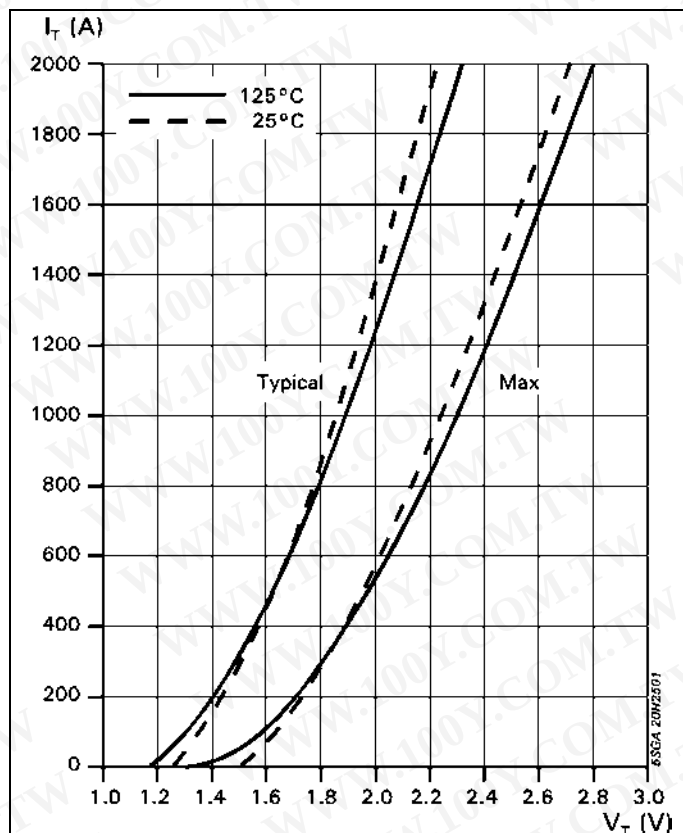


Fig. 2 On-state characteristics

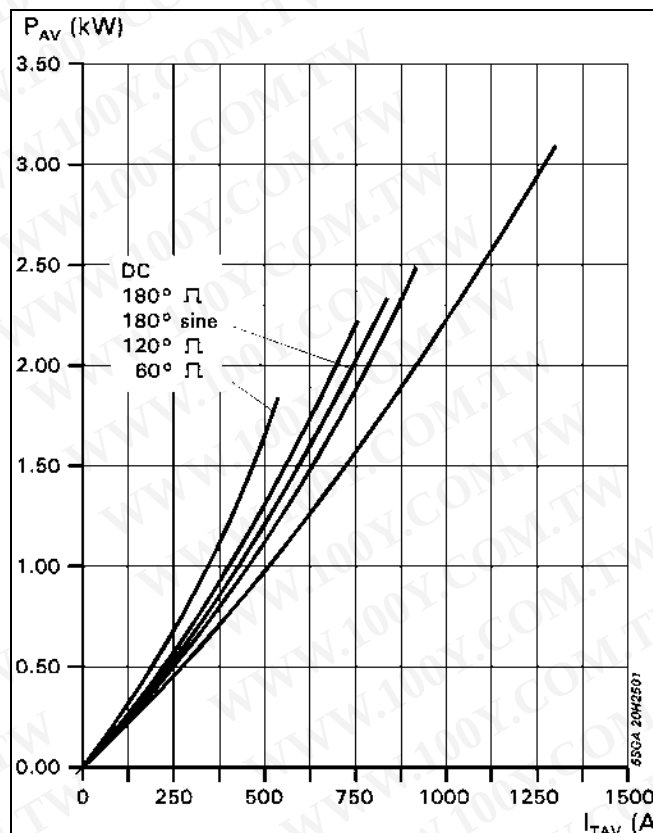


Fig. 3 Average on-state power dissipation vs. average on-state current.

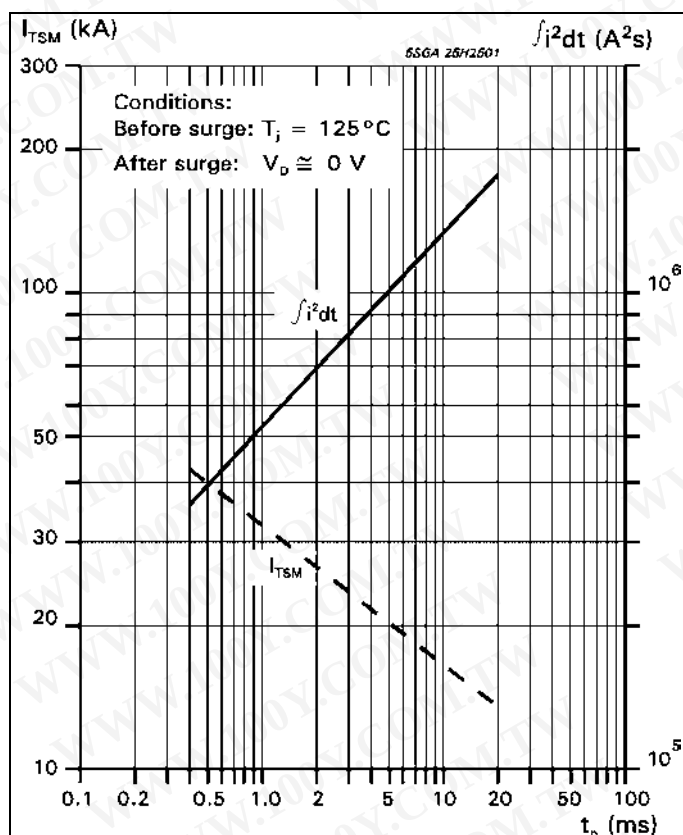


Fig. 4 Surge current and fusing integral vs. pulse width

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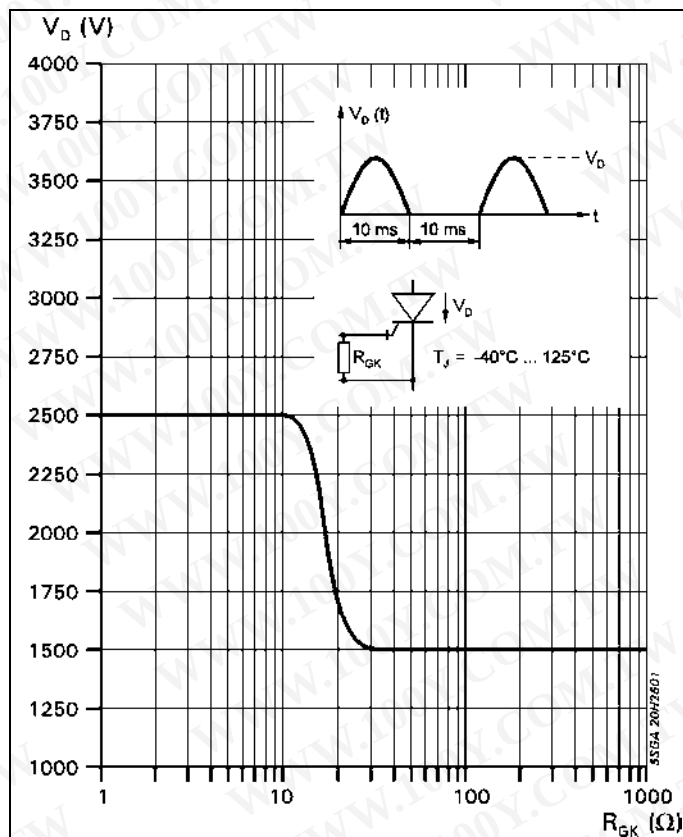


Fig. 5 Forward blocking voltage vs. gate-cathode resistance.

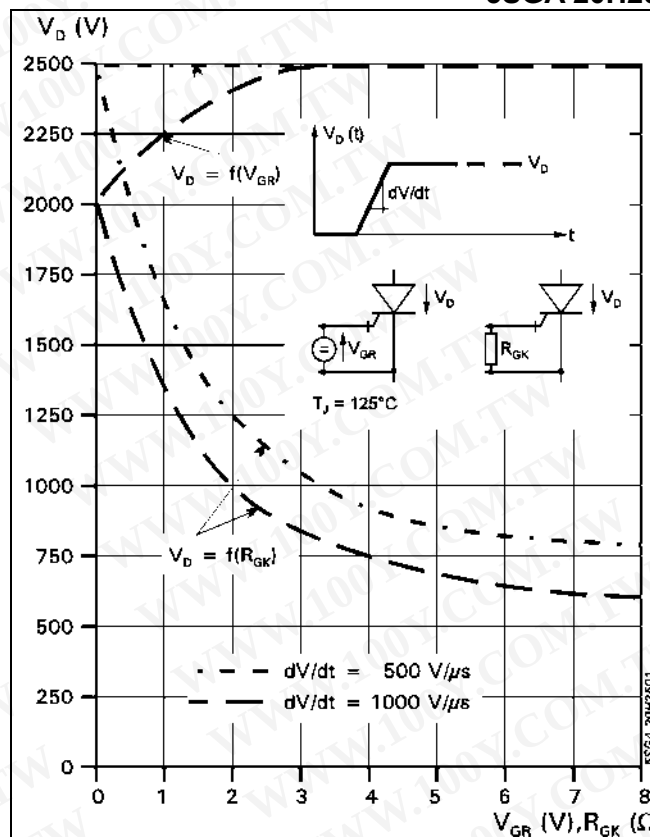


Fig. 6 Static dv/dt capability: Forward blocking voltage vs. neg. gate voltage or gate cathode resistance.

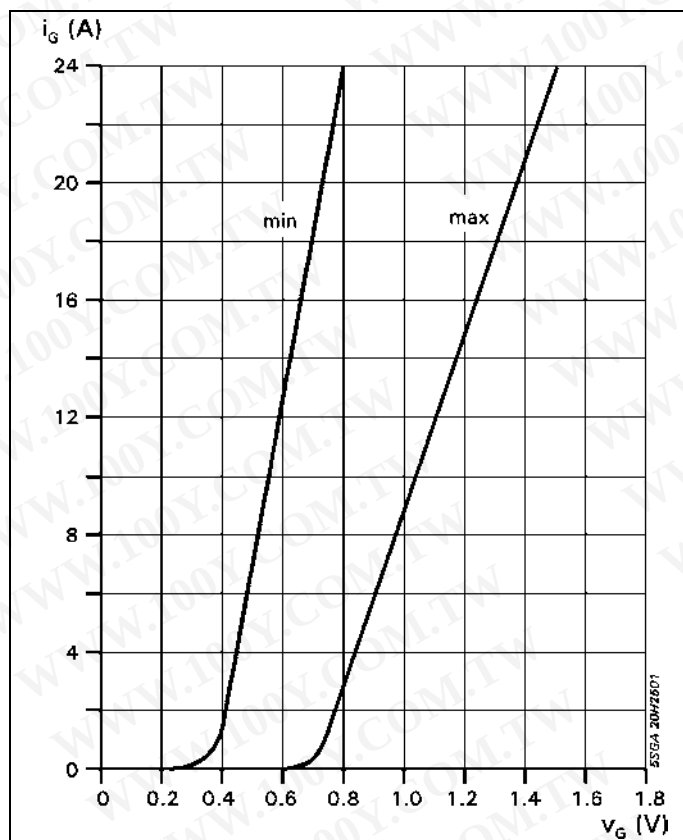


Fig. 7 Forward gate current vs. forward gate voltage.

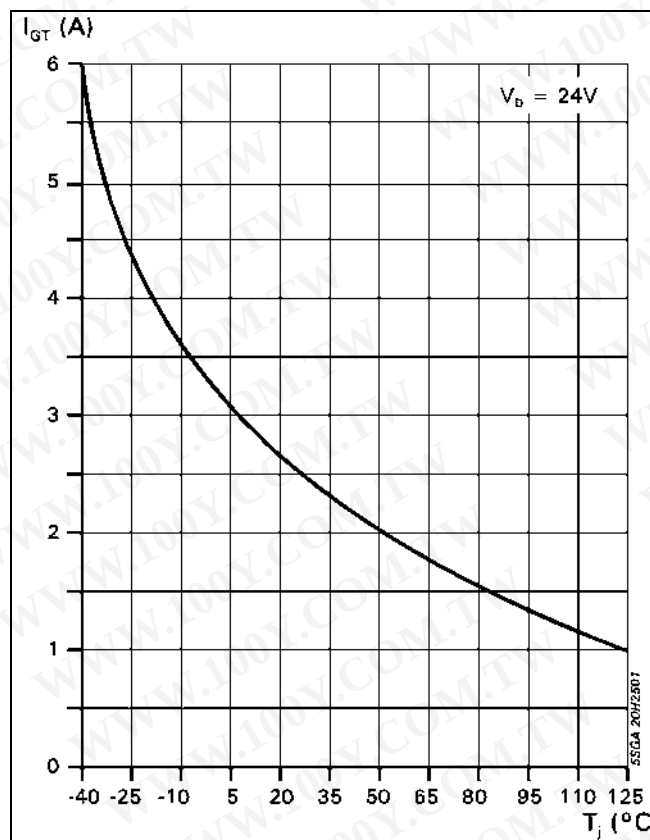


Fig. 8 Gate trigger current vs. junction temperature

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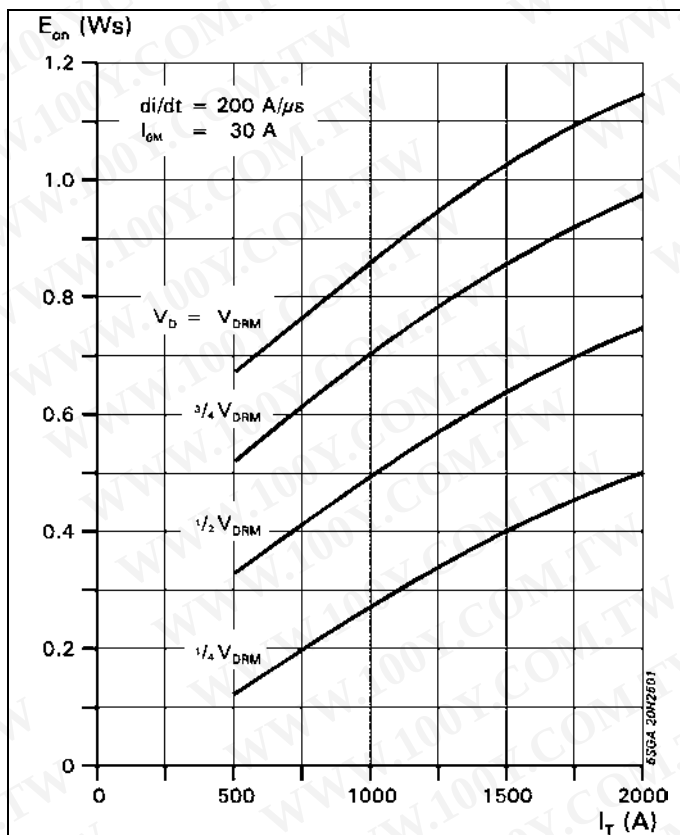


Fig. 9 Turn-on energy per pulse vs. on-state current and turn-on voltage.

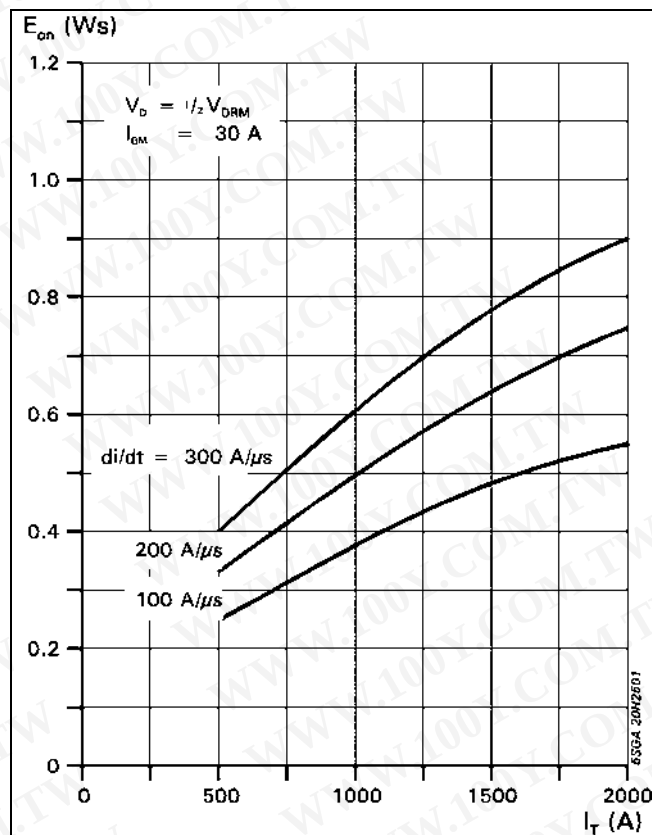


Fig. 10 Turn-on energy per pulse vs. on-state current and current rise rate

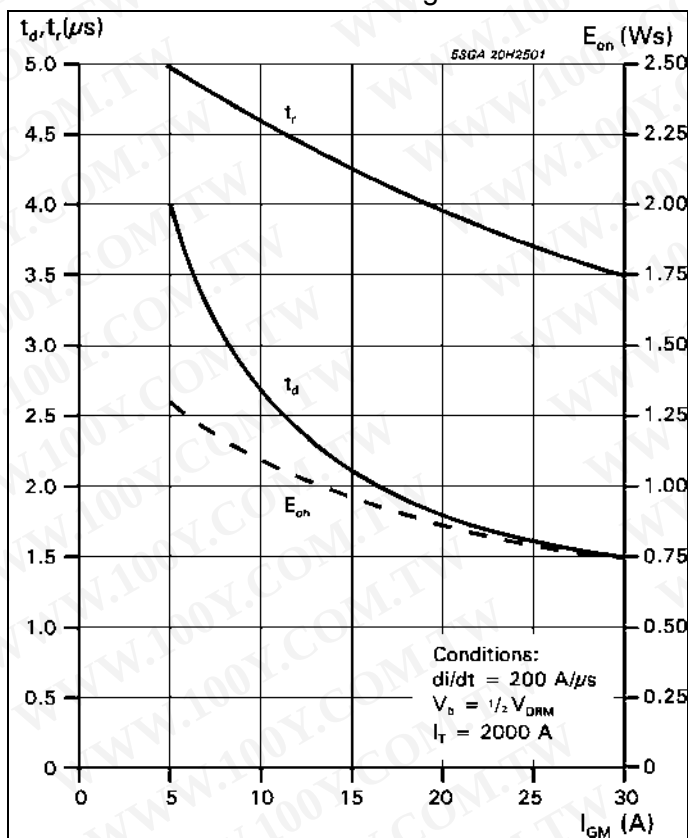


Fig. 11 Turn-on energy per pulse vs. on-state current and turn-on voltage.

Common Test conditions for figures 9, 10 and 11:

$$\begin{aligned} di_G/dt &= 20 \text{ A}/\mu\text{s} \\ C_S &= 4 \text{ } \mu\text{F} \\ R_S &= 5 \text{ } \Omega \\ T_J &= 125 \text{ } ^\circ\text{C} \end{aligned}$$

Definition of Turn-on energy:

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

Common Test conditions for figures 12, 13 and 15:

Definition of Turn-off energy:

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

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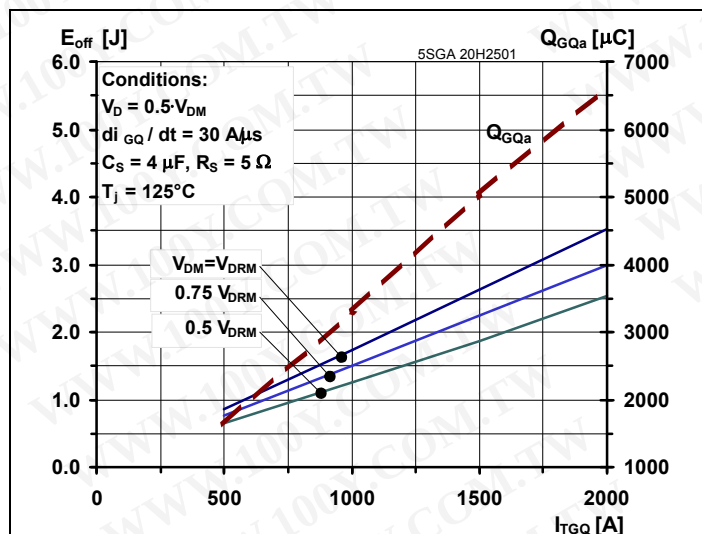


Fig. 12 Turn-off energy per pulse vs. turn-off current and peak turn-off voltage. Extracted gate charge vs. turn-off current.

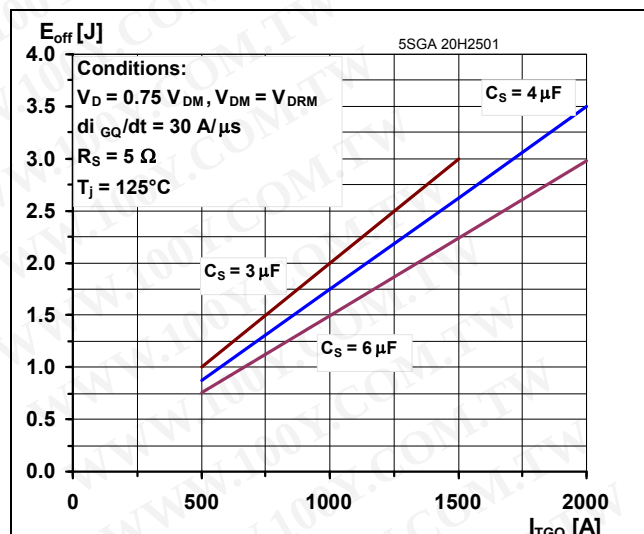


Fig. 13 Turn-off energy per pulse vs. turn-off current and snubber capacitance.

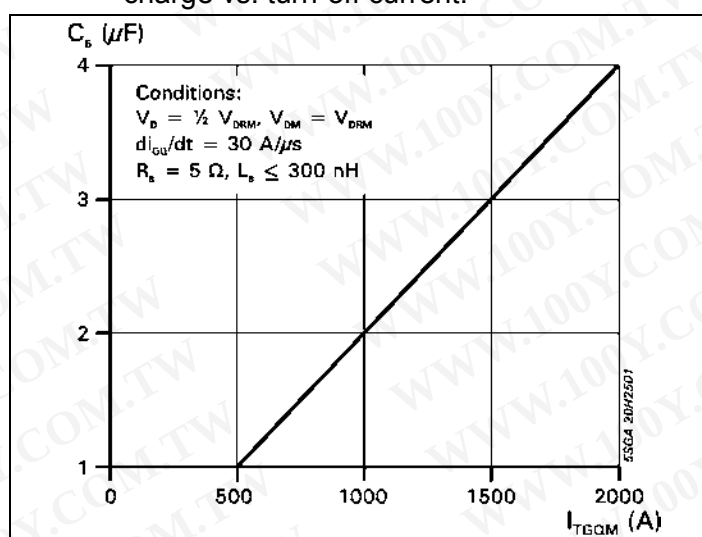


Fig. 14 Required snubber capacitor vs. max allowable turn-off current.

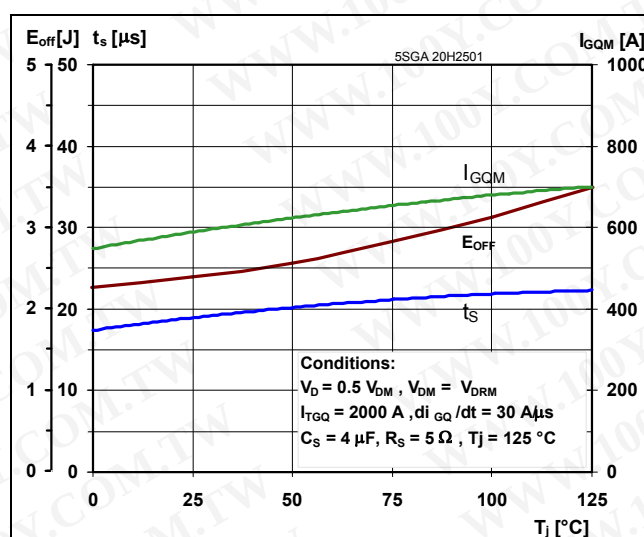


Fig. 15 Turn-off energy per pulse, storage time and peak turn-off gate current vs. junction temperature

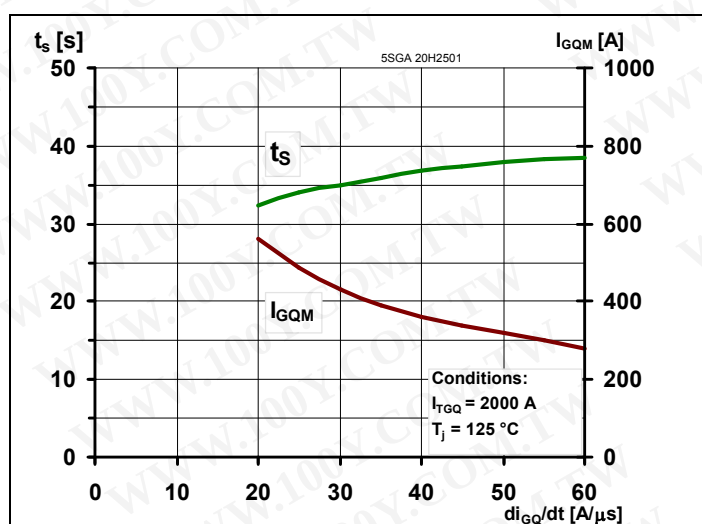


Fig. 16 Storage time and peak turn-off gate current vs. neg. gate current rise rate.

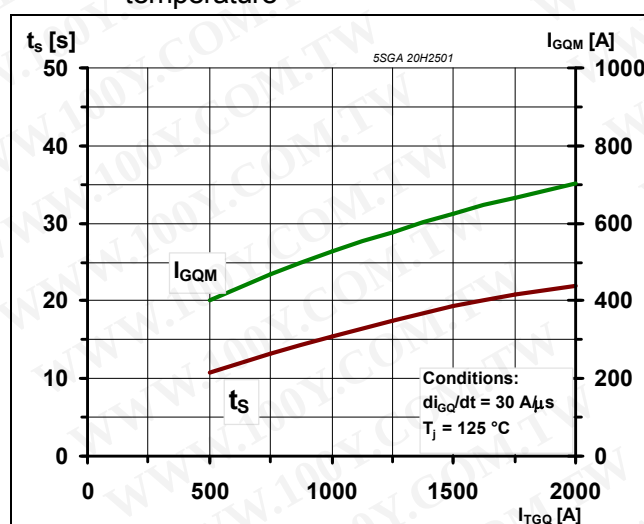


Fig. 17 Storage time and peak turn-off gate current vs. turn-off current

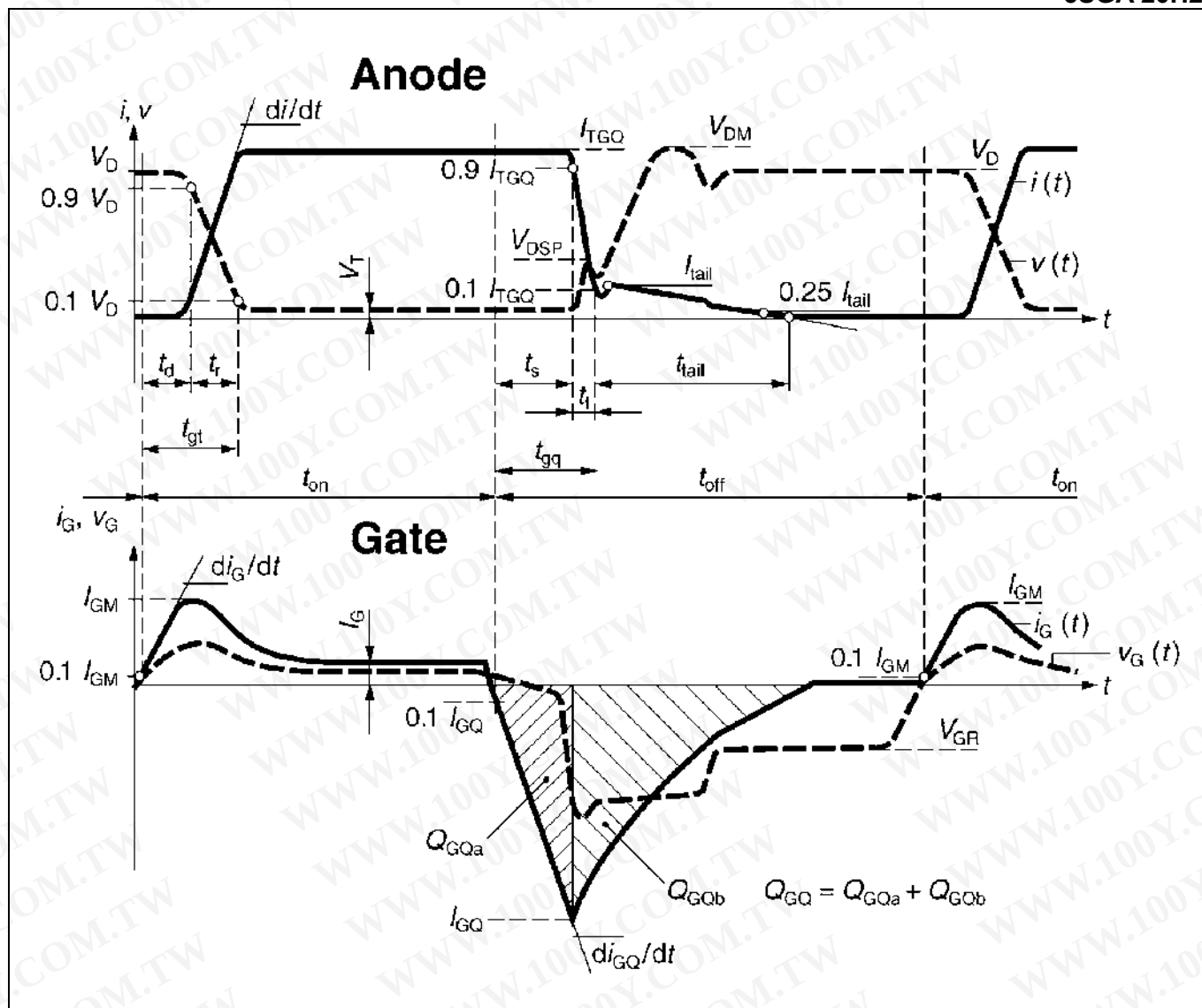


Fig. 18 General current and voltage waveforms with GTO-specific symbols

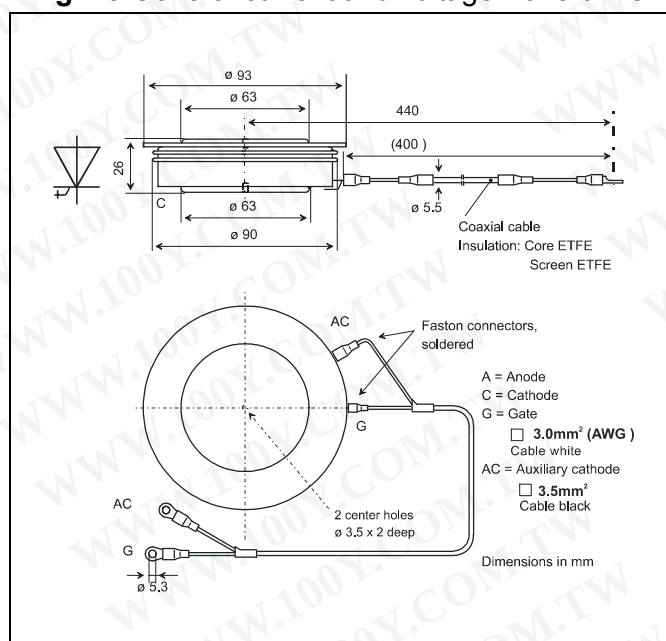


Fig. 19 Outline drawing. All dimensions are in millimeters and represent nominal values unless stated otherwise.

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Reverse avalanche capability

In operation with an antiparallel freewheeling diode, the GTO reverse voltage V_R may exceed the rate value V_{RRM} due to stray inductance and diode turn-on voltage spike at high di/dt . The GTO is then driven into reverse avalanche. This condition is not dangerous for the GTO provided avalanche time and current are below 10 μs and 1000 A respectively. However, gate voltage must remain negative during this time. Recommendation : $V_{GR} = 10 \dots 15$ V.

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