

V_{DRM}	=	4500 V
I_{TGQM}	=	600 A
I_{TSM}	=	3×10^3 A
V_{T0}	=	1.9 V
r_{T}	=	3.5 m Ω
V_{Dclink}	=	2800 V

Asymmetric Gate turn-off Thyristor 5SGA 06D4502 PRELIMINARY

Doc. No. 5SYA1236-00 Jun. 04

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

Blocking

Maximum rated values ¹⁾

Parameter	Symbol	Conditions	min	typ	max	Unit
Repetitive peak off-state voltage	V_{DRM}	$V_{\text{GR}} \geq 2 \text{ V}$			4500	V
Repetitive peak reverse voltage	V_{RRM}				17	V
Permanent DC voltage for 100 FIT failure rate	V_{Dclink}	Ambient cosmic radiation at sea level in open air.			2800	V

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Repetitive peak off-state current	I_{DRM}	$V_{\text{D}} = V_{\text{DRM}}, V_{\text{GR}} \geq 2 \text{ V}$			20	mA
Repetitive peak reverse current	I_{RRM}	$V_{\text{R}} = V_{\text{RRM}}, R_{\text{GK}} = \infty \Omega$			50	mA

Mechanical data

Maximum rated values ¹⁾

Parameter	Symbol	Conditions	min	typ	max	Unit
Mounting force	F_{m}		10	11	12	kN

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Pole-piece diameter	D_{p}	$\pm 0.1 \text{ mm}$		34		mm
Housing thickness	H			26		mm
Weight	m				0.25	kg
Surface creepage distance	D_{s}	Anode to Gate	30			mm
Air strike distance	D_{a}	Anode to Gate	20.5			mm

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

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GTO Data

On-state

Maximum rated values ¹⁾

Parameter	Symbol	Conditions	min	typ	max	Unit
Max. average on-state current	$I_{T(AV)M}$	Half sine wave, $T_C = 85^\circ\text{C}$			210	A
Max. RMS on-state current	$I_{T(RMS)}$				330	A
Max. peak non-repetitive surge current	I_{TSM}	$t_p = 8.3\text{ ms}$, $T_{vj} = 125^\circ\text{C}$, sine wave After Surge: $V_D = V_R = 0\text{ V}$			3.1×10^3	A
Limiting load integral	I^2t				40×10^3	A^2s
Max. peak non-repetitive surge current	I_{TSM}	$t_p = 10\text{ ms}$, $T_{vj} = 125^\circ\text{C}$, sine wave After Surge: $V_D = V_R = 0\text{ V}$			3×10^3	A
Limiting load integral	I^2t				45×10^3	A^2s
Max. peak non-repetitive surge current	I_{TSM}	$t_p = 1\text{ ms}$, $T_{vj} = 125^\circ\text{C}$, sine wave After Surge: $V_D = V_R = 0\text{ V}$			6×10^3	A
Limiting load integral	I^2t				18×10^3	A^2s

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
On-state voltage	V_T	$I_T = 600\text{ A}$, $T_{vj} = 125^\circ\text{C}$			4	V
Threshold voltage	$V_{(T0)}$	$T_{vj} = 125^\circ\text{C}$ $I_T = 200 \dots 600\text{ A}$			1.9	V
Slope resistance	r_T				3.5	$\text{m}\Omega$
Holding current	I_H	$T_{vj} = 25^\circ\text{C}$			20	A

Turn-on switching

Maximum rated values ¹⁾

Parameter	Symbol	Conditions	min	typ	max	Unit
Critical rate of rise of on-state current	di_T/dt_{cr}	$T_{vj} = 125^\circ\text{C}$, $f = 200\text{ Hz}$ $I_T = 600\text{ A}$, $I_{GM} = 20\text{ A}$, $di_G/dt = 20\text{ A}/\mu\text{s}$, $f = 1\text{ Hz}$			400	$\text{A}/\mu\text{s}$
Critical rate of rise of on-state current	di_T/dt_{cr}				600	$\text{A}/\mu\text{s}$
Min. on-time	t_{on}		80			μs

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Turn-on delay time	t_d	$V_D = 0.5 V_{DRM}$, $T_{vj} = 125^\circ\text{C}$ $I_T = 600\text{ A}$, $di/dt = 200\text{ A}/\mu\text{s}$, $I_{GM} = 20\text{ A}$, $di_G/dt = 20\text{ A}/\mu\text{s}$, $C_S = 1\text{ }\mu\text{F}$, $R_S = 10\text{ }\Omega$			1.5	μs
Rise time	t_r				3	μs
Turn-on energy per pulse	E_{on}				0.8	J

Turn-off switching

Maximum rated values ¹⁾

Parameter	Symbol	Conditions	min	typ	max	Unit
Max. controllable turn-off current	I_{TGQM}	$V_{DM} \leq V_{DRM}$, $V_D = 0.5 V_{DRM}$ $di_{GQ}/dt = 20\text{ A}/\mu\text{s}$, $C_S = 1\text{ }\mu\text{F}$, $L_S \leq 0.15\text{ }\mu\text{H}$, RCD Snubber			600	A
Spike Voltage	V_{DSP}				≤ 650	V
Min. off-time	t_{off}		80			μs

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Storage time	t_S	$V_D = 0.5 V_{DRM}$, $T_{vj} = 125^\circ\text{C}$ $V_{DM} \leq V_{DRM}$, $di_{GQ}/dt = 20\text{ A}/\mu\text{s}$, $I_{TGQ} = I_{TGQM}$, $R_S = 10\text{ }\Omega$, $C_S = 1\text{ }\mu\text{F}$, $L_S = 0.15\text{ }\mu\text{H}$ RCD Snubber			15	μs
Fall time	t_f				5	μs
Turn-on energy per pulse	E_{off}				1.9	J
Peak turn-off gate current	I_{GQM}				300	A

Gate

Maximum rated values ¹⁾

Parameter	Symbol	Conditions	min	typ	max	Unit
Repetitive peak reverse voltage	V_{GRM}				17	V
Repetitive peak reverse current	I_{GRM}	$V_{GR} = V_{GRM}$			20	mA

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Gate trigger voltage	V_{GT}	$T_{vj} = 25^{\circ}\text{C}$,		1		V
Gate trigger current	I_{GT}	$V_D = 24\text{ V}$, $R_A = 0.1\ \Omega$		2		A

Thermal

Maximum rated values ¹⁾

Parameter	Symbol	Conditions	min	typ	max	Unit
Junction operating temperature	T_{vj}		0		125	$^{\circ}\text{C}$
Storage temperature range	T_{stg}		0		125	$^{\circ}\text{C}$

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Thermal resistance junction to case	$R_{th(jc)}$	Double side cooled			50	K/kW
	$R_{th(jc)A}$	Anode side cooled			85	K/kW
	$R_{th(jc)C}$	Cathode side cooled			122	K/kW
Thermal resistance case to heatsink (Double side cooled)	$R_{th(ch)}$	Single side cooled			16	K/kW
	$R_{th(ch)}$	Double side cooled			8	K/kW

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 (K/kW)	15.000	5.200	7.500	0.100
τ_i (s)	0.4610	0.0950	0.0120	0.0010

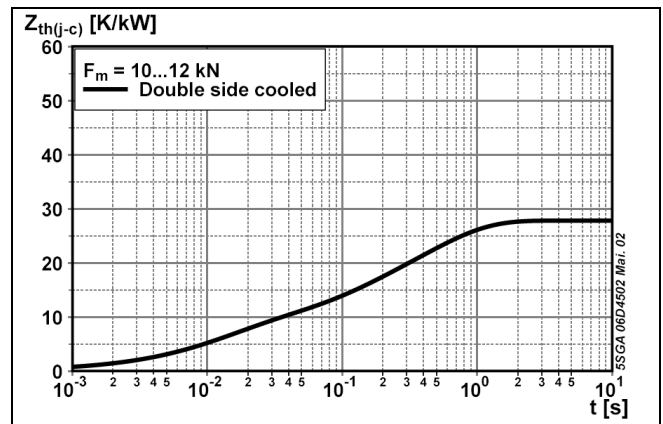


Fig. 1 Transient thermal impedance, junction to case.

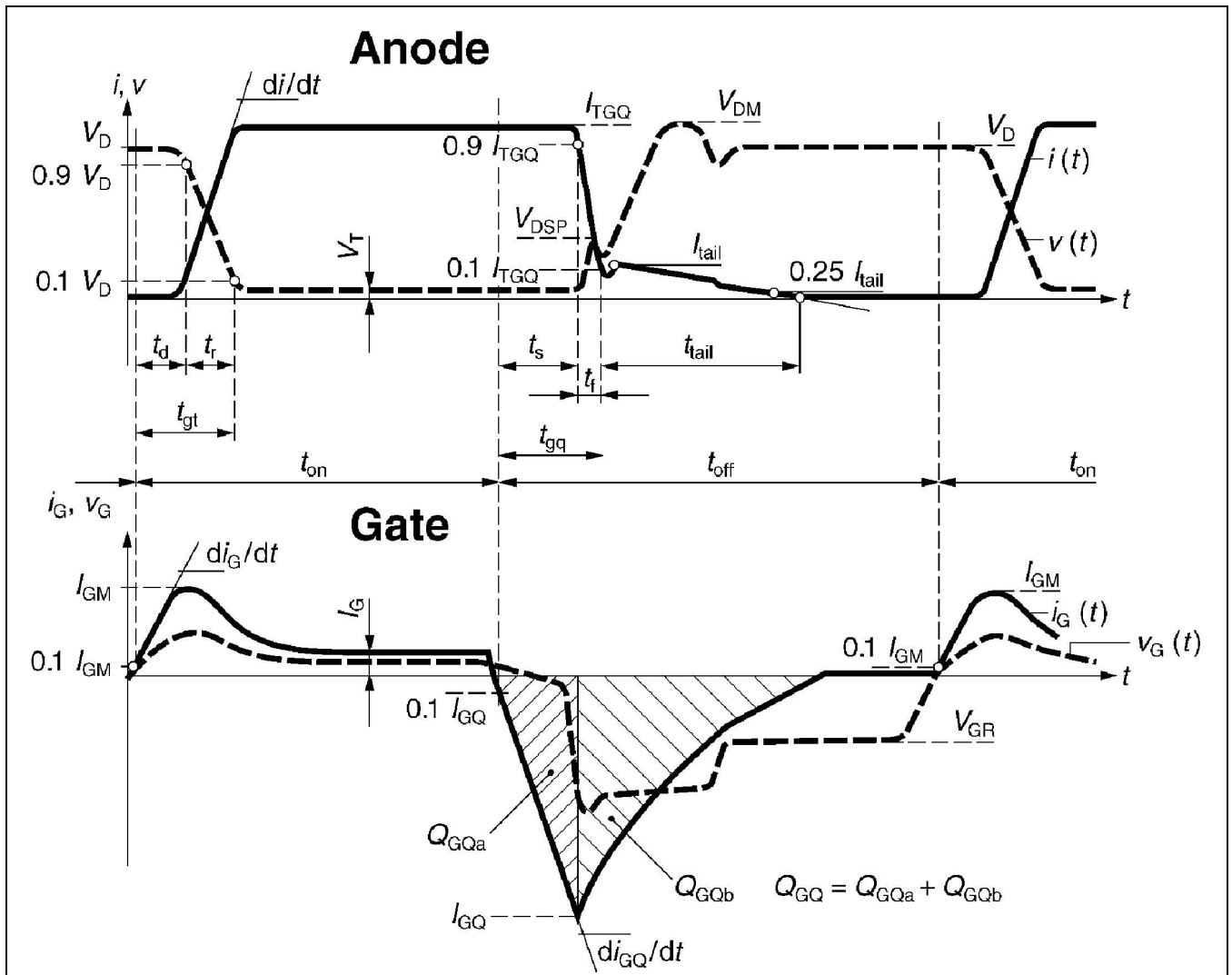


Fig. 2 General current and voltage waveforms with GTO-specific symbols.

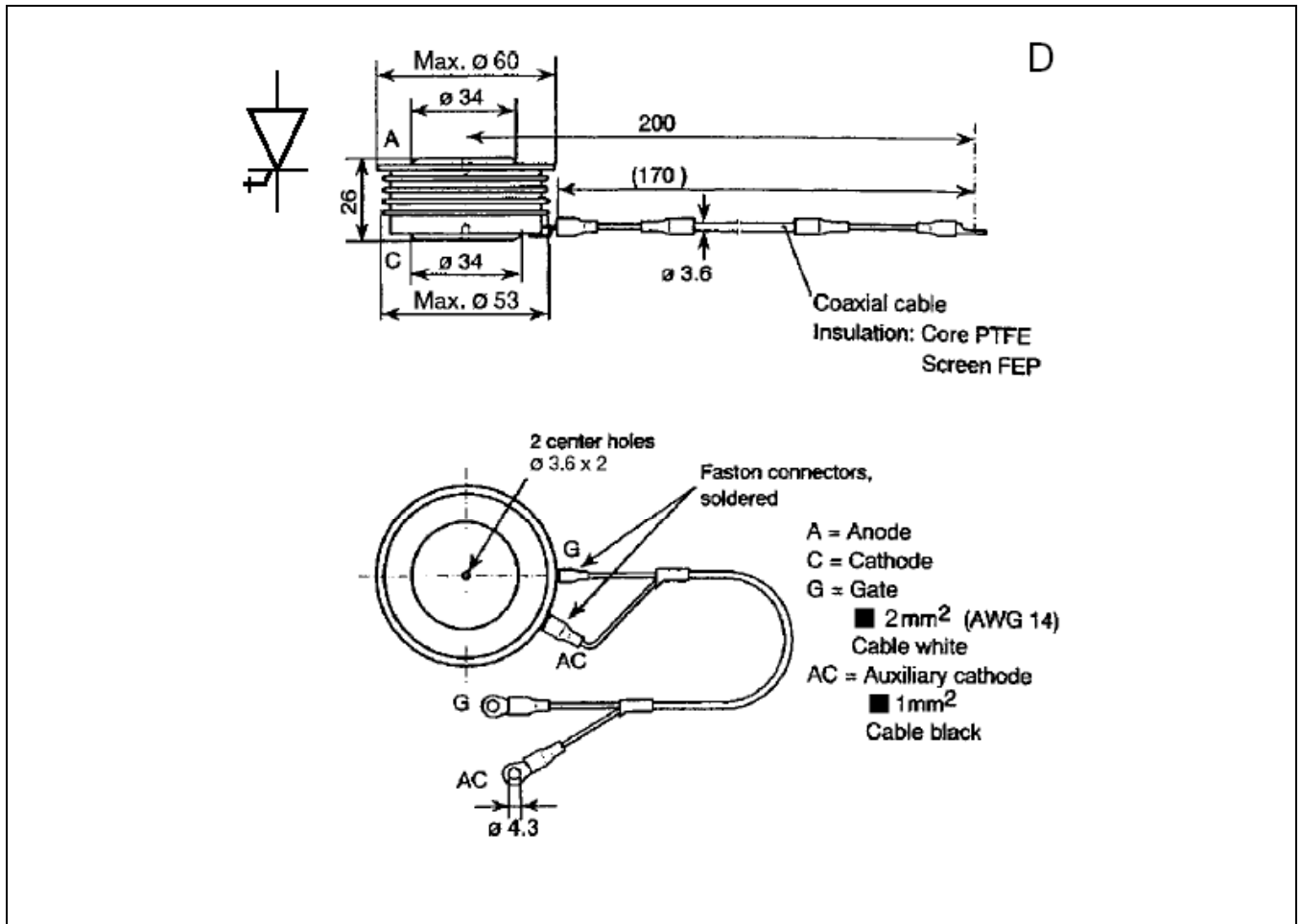


Fig. 3 Outline drawing. All dimensions are in millimeters and represent nominal values unless stated otherwise.

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 μ s and 1000 A respectively. However, gate voltage must remain negative during this time. Recommendation : $V_{GR} = 10...15$ V.

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