V_{RM}	=	5200 V
$I_{T(AV)M}$	=	1980 A
$I_{T(RMS)}$	=	3100 A
I_{TSM}	=	42×10^3 A
V_{T0}	=	1.06 V
r_T	=	0.219 mΩ

Bi-Directional Control Thyristor

5STB 25U5200

Preliminary

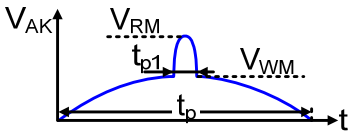
Doc. No. 5SYA1038-03 Aug. 10

- **Two thyristors integrated into one wafer**
- **Patented free-floating silicon technology**
- **Designed for energy management and industrial applications**
- **Optimum power handling capability**
- **Interdigitated amplifying gate**

The electrical and thermal data are valid for one-thyristor-half of the device (unless otherwise stated)

Blocking

Maximum rated values [1)]

Parameter	Symbol	Conditions	5STB 25U5200	Unit
Max. surge peak forward blocking voltage	V_{SM}	t_p = 10 ms, f = 5 Hz T_{vj} = 5…110°C, Note 1	5200	V
Max repetitive peak forward blocking voltage	V_{RM}	f = 50 Hz, t_p = 10 ms, t_{p1} = 250 µs, T_{vj} = 5…110°C, Note 1	5200	V
Max crest working forward voltages	V_{WM}		2600	V
Critical rate of rise of off-state voltage	dv/dt_{crit}	Exp. to 2950 V, T_{vj} = 110°C	2000	V/µs

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Max reverse leakage current	$I_{R(M)}$	V_{RM}, T_{vj} = 110 °C			400	mA

Note 1: Voltage de-rating factor of 0.11% per °C is applicable for Tvj below +5 °C
Note 2: Recommended minimum ratio of V_{DRM} / V_{DWM} or V_{RRM} / V_{RWM} = 2. See App. Note 5SYA 2051.

Mechanical data

Maximum rated values [1)]

Parameter	Symbol	Conditions	min	typ	max	Unit
Mounting force	F_M		120	135	160	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				3.6	kg
Housing thickness	H	F_M = 135 kN, T_a = 25 °C	34.6		35.2	mm
Surface creepage distance	D_S		53			mm
Air strike distance	D_a		22			mm

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

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 °C			1980	A
RMS on-state current	$I_{T(RMS)}$				3100	A
RMS on-state current	$I_{T(RMS)}$	Full sine wave, T_c = 70°C			4400	A
Peak non-repetitive surge current	I_{TSM}	t_p = 10 ms, T_{vj} = 110 °C, sine wave after surge: $V_D = V_R$= 0 V			42.0×10^3	A
Limiting load integral	I^2t				8.82×10^6	A^2s
Peak non-repetitive surge current	I_{TSM}	t_p = 8.3 ms, T_{vj} = 110 °C, sine wave after surge: $V_D = V_R$= 0 V			45.0×10^3	A
Limiting load integral	I^2t				8.40×10^6	A^2s

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
On-state voltage	V_T	I_T = 3000 A, T_{vj} = 110 °C			1.7	V
Threshold voltage	V_{T0}	I_T = 1300 A - 4000 A, T_{vj}= 110 °C			1.06	V
Slope resistance	r_T				0.219	mΩ
Holding current	I_H	T_{vj} = 25 °C			125	mA
		T_{vj} = 110 °C			70	mA
Latching current	I_L	T_{vj} = 25 °C			900	mA
		T_{vj} = 110 °C			700	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} = 110 °C, I_{TRM} = 3000 A,	Cont. f = 50 Hz			250	A/µs
Critical rate of rise of on-state current	di/dt_{crit}	$V_D \leq$ 2950 V, I_{FG} = 2 A, t_r = 0.5 µs	Cont. f = 1Hz			1000	A/µs
Circuit commutated turn-off time	t_q	T_{vj} = 110 °C, I_{TRM} = 2000 A, V_R = 200 V, di_T/dt = -1.5 A/µs, $V_D \leq 0.67 \cdot V_{RM}$, dv_D/dt = 20 V/µs,		800			µs
Critical rate of rise of commutating voltage	dv/dt_{com}	T_{vj} = 110 °C, $V_R \leq 0.67 \cdot V_{RM}$				500	V/µs

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Reverse recovery charge	Q_{rr}	T_{vj} = 110 °C, I_{TRM} = 2000 A, V_R = 200 V, di_T/dt = -1.5 A/µs	3200		5000	µAs
Reverse recovery current	I_{RM}		55		85	A
Gate turn-on delay time	t_{gd}	T_{vj} = 25 °C, $V_D = 0.4 \cdot V_{RM}$, I_{FG} = 2 A, t_r = 0.5 µs			3	µs

Triggering

Maximum rated values [1)]

Parameter	Symbol	Conditions	min	typ	max	Unit
Peak forward gate voltage	V_{FGM}				12	V
Max. rated peak forward gate current	I_{FGM}				10	A
Peak reverse gate voltage	V_{RGM}				10	V
Max. rated gate power loss	P_G	For DC gate current			3	W
Max. rated peak forward gate power	$P_{GM(AV)}$		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_{RM}, T_{vj} = 110 °C	0.3			V
Gate non-trigger current	I_{GD}	V_D = 0.4 x V_{RM}	10			mA

Thermal

Maximum rated values [1)]

Parameter	Symbol	Conditions	min	typ	max	Unit
Operating junction temperature range	T_{vj}				110	°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 = 120...160 kN			8.5	K/kW
(Valid for one thyristor half no heat flow to the second half.)	$R_{th(j-c)}$	Single-side cooled F_m = 120...160 kN			17	K/kW
Thermal resistance case to heatsink	$R_{th(c-h)}$	Double-side cooled F_m = 120...160 kN			1.6	K/kW
	$R_{th(c-h)}$	Single-side cooled F_m = 120...160 kN			3.2	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)	5.748	1.731	0.688	0.333
τ_i(s)	0.9531	0.1240	0.0144	0.0031

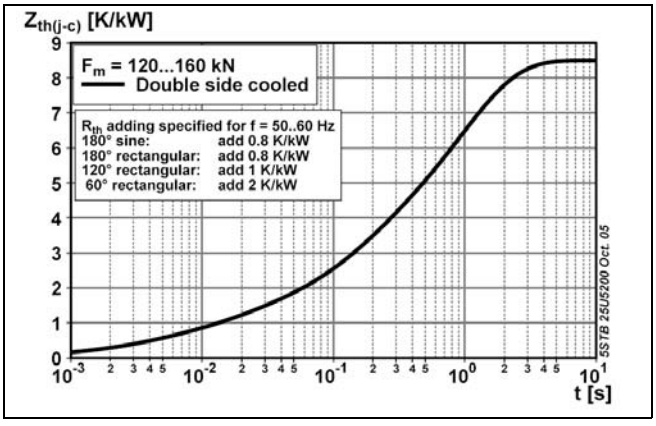


Fig. 1 Transient thermal impedance (junction-to-case) vs. time

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 = 500 – 80000 A

A_{25}	B_{25}	C_{25}	D_{25}
200.7×10^{-6}	116.9×10^{-6}	176.4×10^{-3}	-2.518×10^{-3}

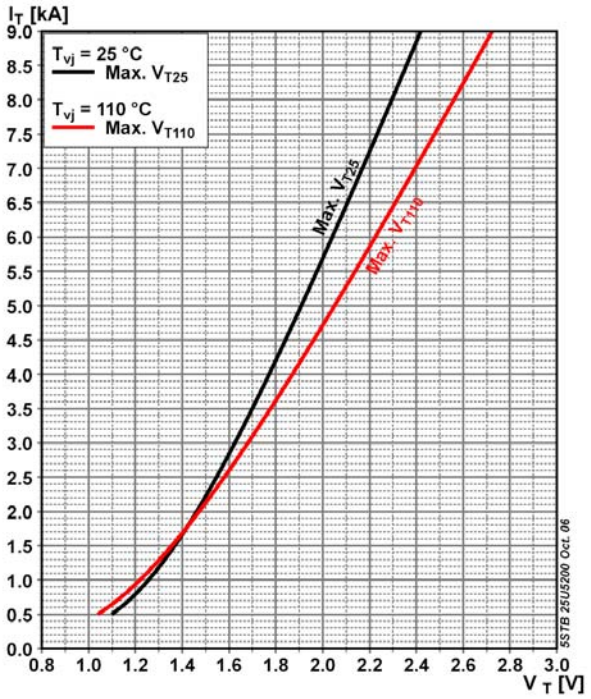


Fig. 2 On-state voltage characteristics

Max. on-state characteristic model:

$$V_{T110} = A_{Tvj} + B_{Tvj} \cdot I_T + C_{Tvj} \cdot \ln(I_T + 1) + D_{Tvj} \cdot \sqrt{I_T}$$

Valid for I_T = 500 – 80000 A

A_{110}	B_{110}	C_{110}	D_{110}
157.1×10^{-6}	145.6×10^{-6}	155.6×10^{-3}	-27.48×10^{-6}

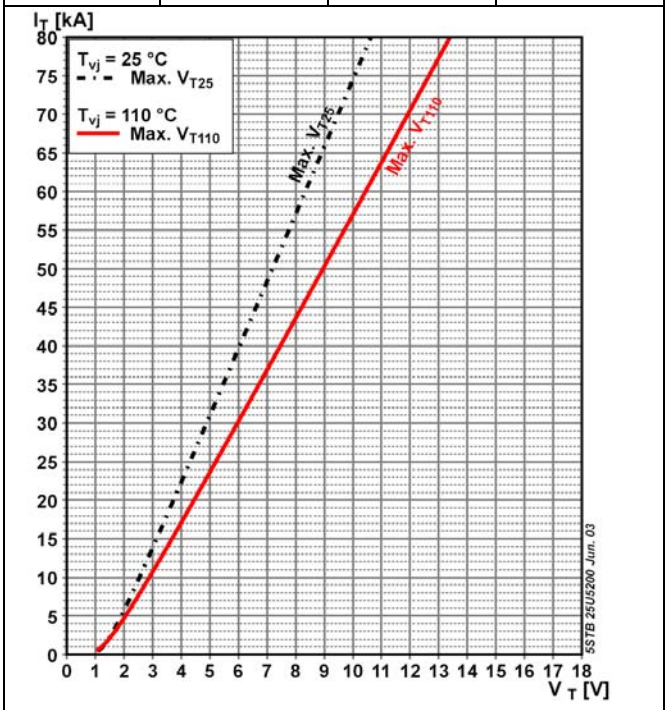


Fig. 3 On-state voltage characteristics

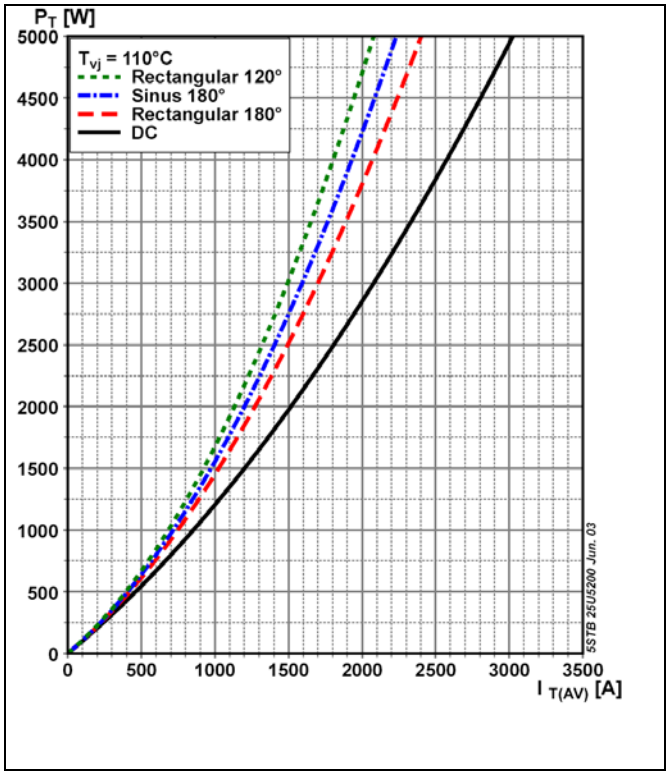


Fig. 4 On-state power dissipation vs. mean on-state current. Turn-on losses excluded.

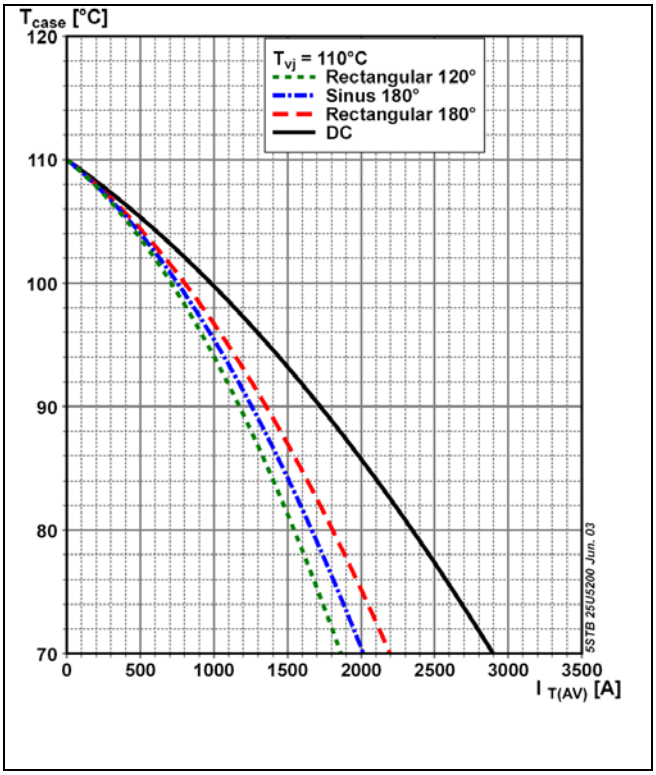


Fig. 5 Max. permissible case temperature vs. mean on-state current. Switching losses ignored.

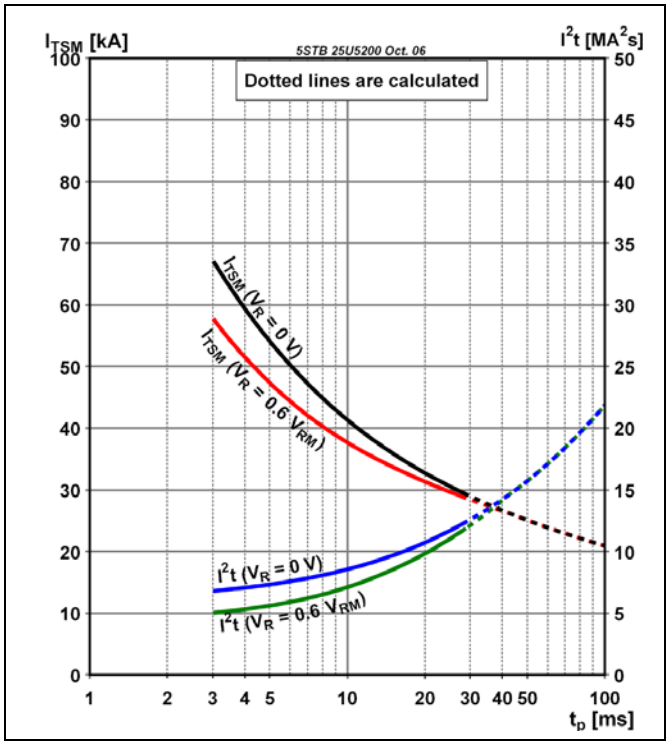


Fig. 6 Surge on-state current vs. pulse length. Half-sine wave.

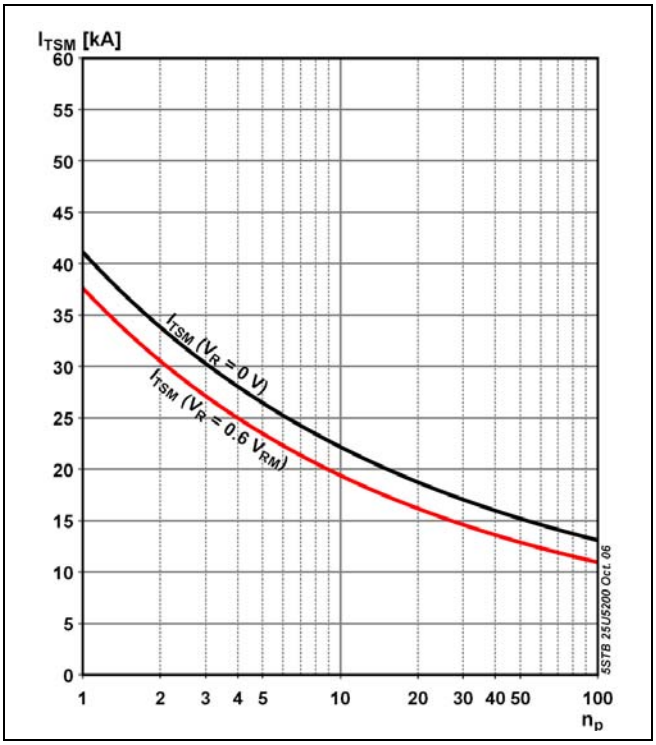


Fig. 7 Surge on-state current vs. number of pulses. Half-sine wave, 10 ms, 50Hz.

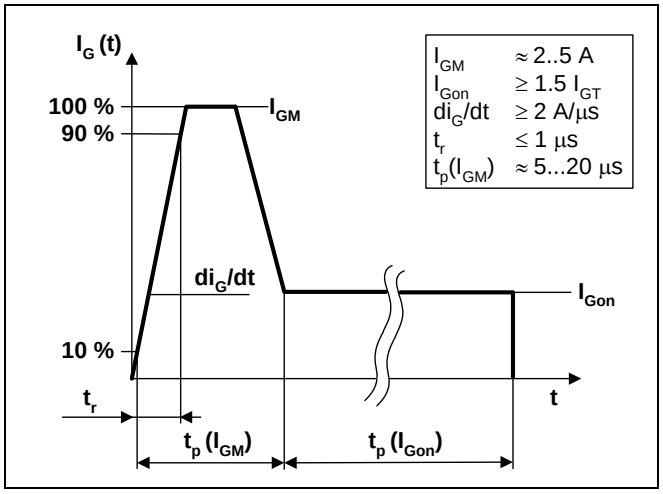


Fig. 8 Recommended gate current waveform

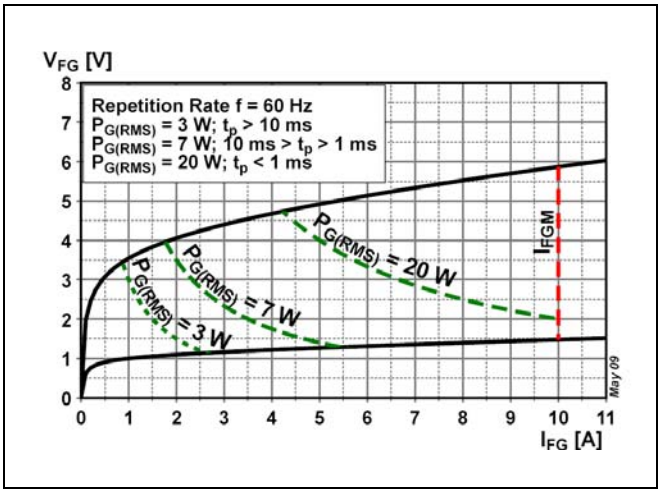


Fig. 9 Max. peak gate power loss

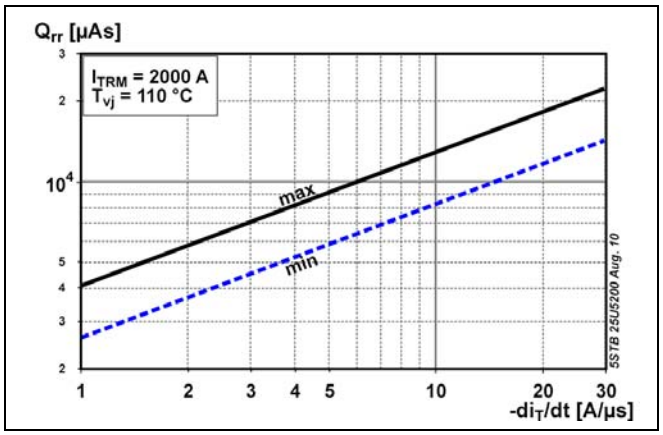


Fig. 10 Reverse recovery charge vs. decay rate of on-state current

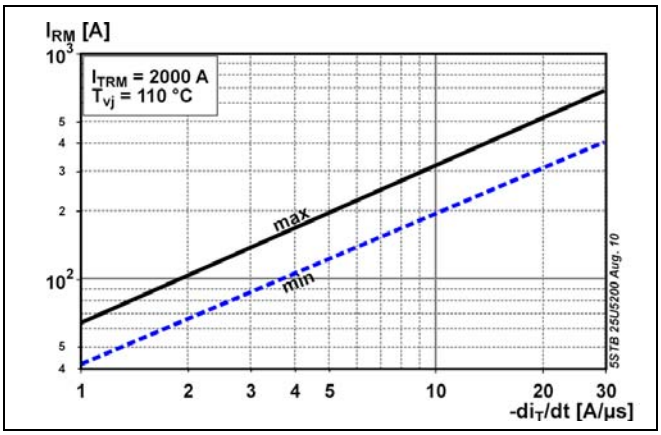


Fig. 11 Peak reverse recovery current vs. decay rate of on-state current

Turn-on and Turn-off losses

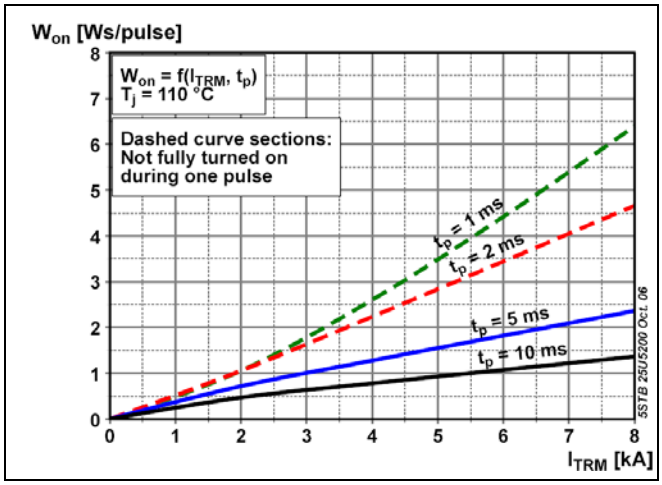


Fig. 12 Turn-on energy, half sinusoidal waves

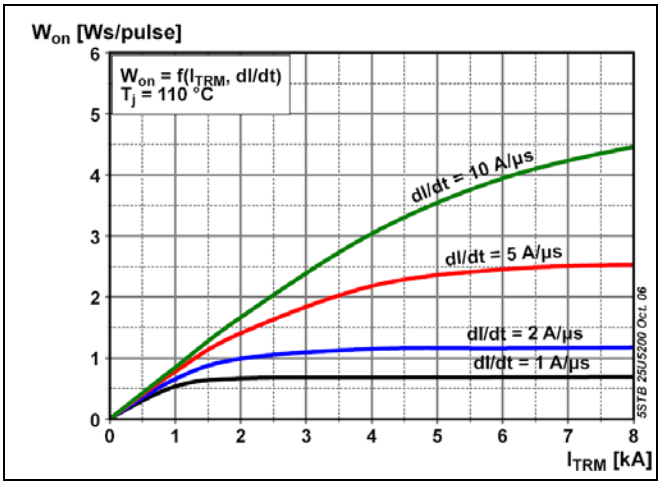


Fig. 13 Turn-on energy, rectangular waves

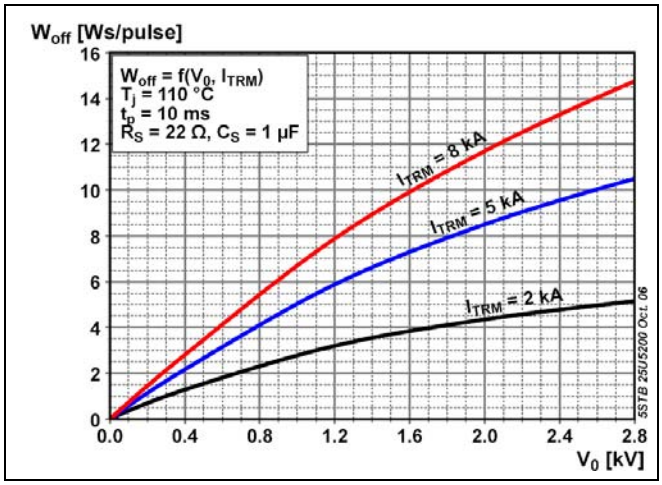


Fig. 14 Turn-off energy, half sinusoidal waves

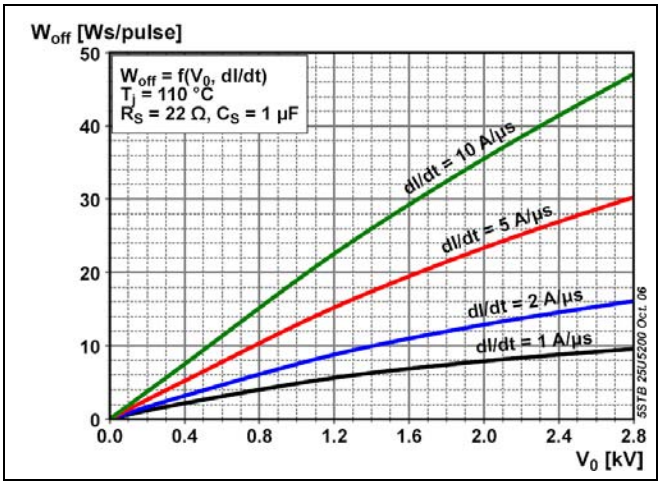


Fig. 15 Turn-off energy, rectangular waves

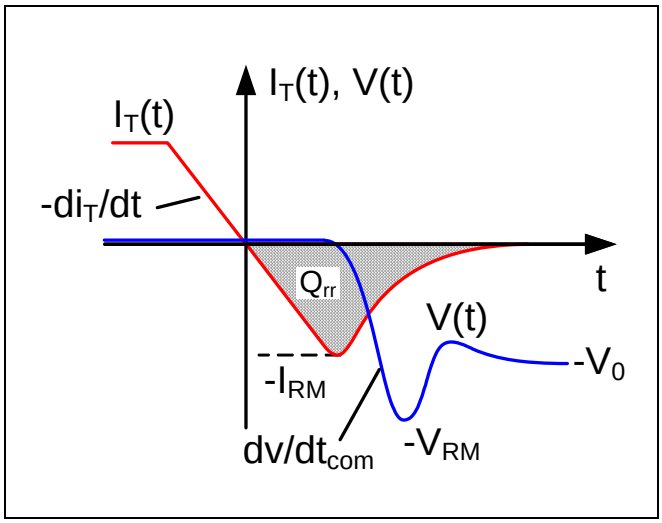


Fig. 16 Current and voltage waveforms at turn-off

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

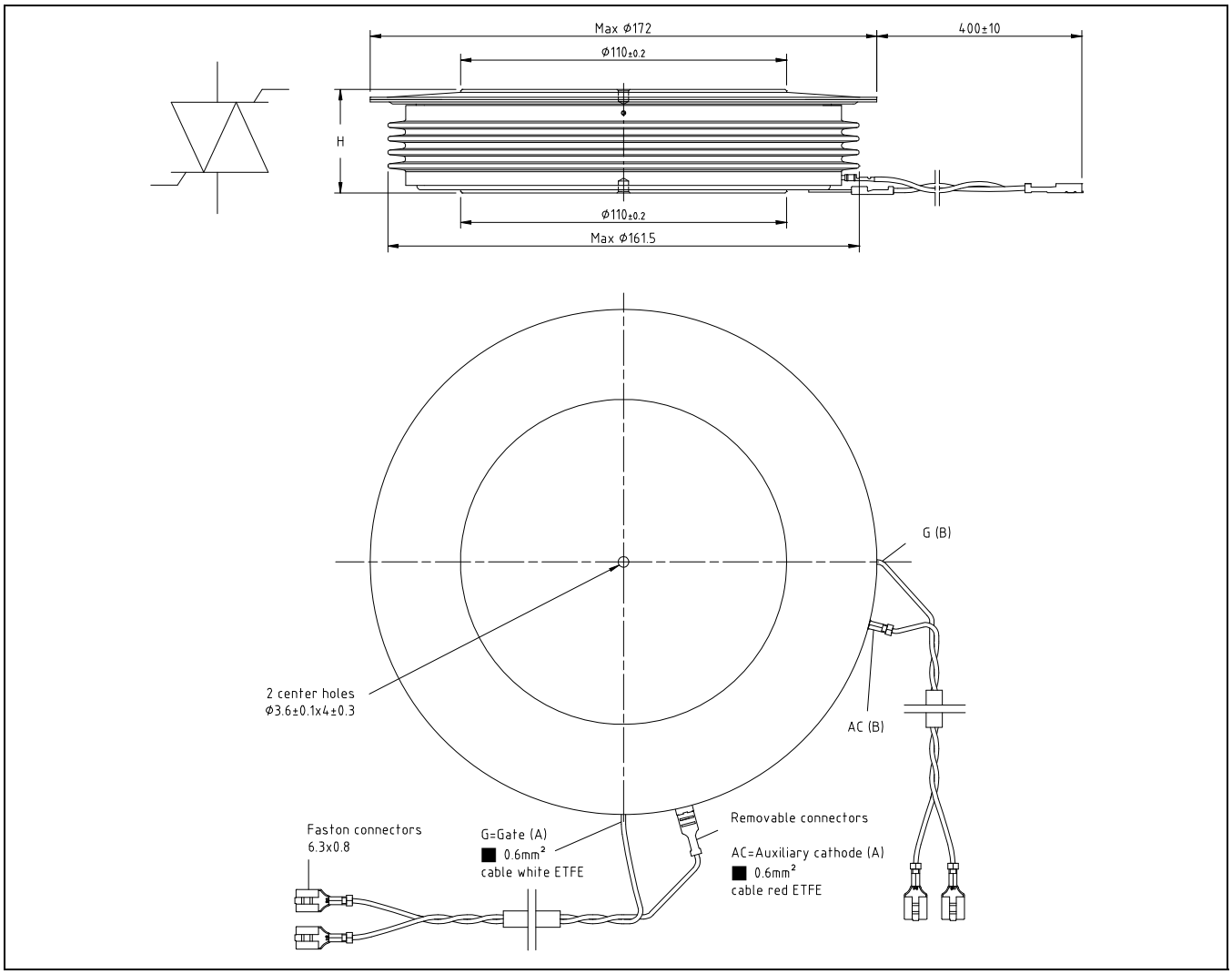


Fig. 18 Device Outline Drawing

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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ABB Switzerland Ltd
Semiconductors
Fabrikstrasse 3
CH-5600 Lenzburg, Switzerland

Telephone +41 (0)58 586 1419
Fax +41 (0)58 586 1306
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