V_{DRM}	=	**5200** V	
$I_{T(AV)M}$	=	**4120** A	
$I_{T(RMS)}$	=	**6470** A	
I_{TSM}	=	**85.2×10^3** A	
V_{T0}	=	**1.04** V	
r_T	=	**0.115** mW	

Phase Control Thyristor

# 5STP 52U5200

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

Blocking
Maximum rated values [1]

Parameter	Symbol	Conditions	5STP 52U5200	Unit
Max. surge peak forward and reverse blocking voltage	V_{DSM}, V_{RSM}	t_p = 10 ms, f = 5 Hz T_{vj} = 5…110°C, Note 1	5200	V
Max repetitive peak forward and reverse blocking voltage	V_{DRM}, V_{RRM}	f = 50 Hz, t_p = 10 ms, t_{p1} = 250 µs, T_{vj} = 5…110°C, Note 1, Note 2	5200	V
Max crest working forward and reverse voltages	V_{DWM}, V_{RWM}		2600	V
Critical rate of rise of commutating voltage	dv/dt_{crit}	Exp. to 2950 V, T_{vj} = 110°C	2000	V/µs
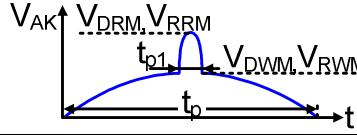
Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Forward leakage current	I_{DRM}	V_{DRM}, T_{vj} = 110°C			600	mA
Reverse leakage current	I_{RRM}	V_{RRM}, T_{vj} = 110°C			600	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	34.5		35.3	mm
Surface creepage distance	D_S		56			mm
Air strike distance	D_a		22			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, $T_c = 70$ °C			4120	A
RMS on-state current	$I_{T(RMS)}$				6470	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			85.2×10^3	A
Limiting load integral	I^2t				36.3×10^6	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			90.3×10^3	A
Limiting load integral	I^2t				33.85×10^6	A^2s

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
On-state voltage	V_T	$I_T = 3000$ A, $T_{vj} = 110$ °C			1.38	V
Threshold voltage	$V_{(T0)}$	$I_T = 2000$ A - 6000 A, $T_{vj} = 110$ °C			1.04	V
Slope resistance	r_T				0.115	mΩ
Holding current	I_H	$T_{vj} = 25$ °C			200	mA
		$T_{vj} = 110$ °C			100	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}	$V_D \leq 0.67\ V_{DRM}$, $I_{FG} = 2$ 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, $V_D \leq 0.67 \cdot V_{DRM}$, $dv_D/dt = 20$ V/µs		700			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	2000		7000	µAs
Reverse recovery current	I_{RM}		55		95	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

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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_{vj} = 110 °C	0.3			V
Gate non-trigger current	I_{GD}	V_D = 0.4 x V_{DRM}, T_{vj} = 110°C	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			4	K/kW
	$R_{th(j-c)A}$	Anode-side cooled F_m = 120...160 kN			8	K/kW
	$R_{th(j-c)C}$	Cathode-side cooled F_m = 120...160 kN			8	K/kW
Thermal resistance case to heatsink	$R_{th(c-h)}$	Double-side cooled F_m = 120...160 kN			0.8	K/kW
	$R_{th(c-h)}$	Single-side cooled F_m = 120...160 kN			1.6	K/kW

Analytical function for transient thermal impedance:

$$Z_{th(j-c)}(t) = \sum_{i=1}^{n} R_i \left(1 - e^{-t/t_i}\right)$$

i	1	2	3	4
R_i(K/kW)	2.701	0.816	0.326	0.160
τ_i(s)	0.9478	0.1249	0.0146	0.0032
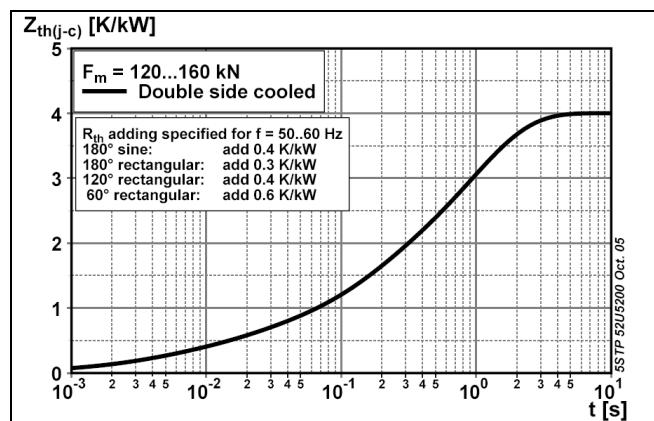
Fig. 1 Transient thermal impedance (junction-to-case) vs. time

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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 = 300 – 100000 A			
A_{25}	**B_{25}**	**C_{25}**	**D_{25}**
69.79×10^{-6}	67.25×10^{-6}	160.0×10^{-3}	-2.171×10^{-3}

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 = 300 – 100000 A			
A_{110}	**B_{110}**	**C_{110}**	**D_{110}**
20.86×10^{-6}	66.73×10^{-6}	130.7×10^{-3}	2.434×10^{-3}
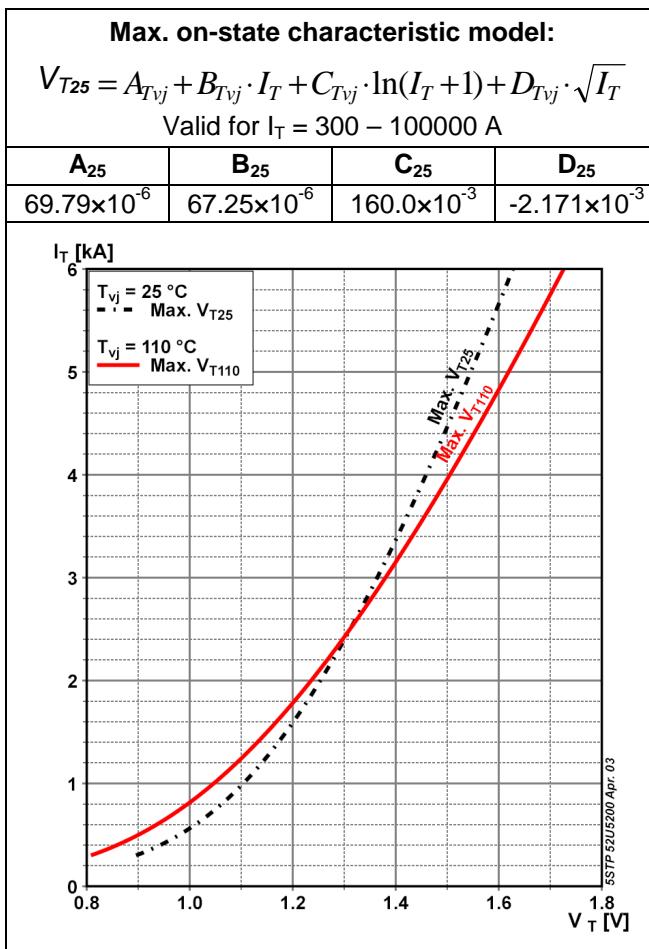
Fig. 2   On-state voltage characteristics
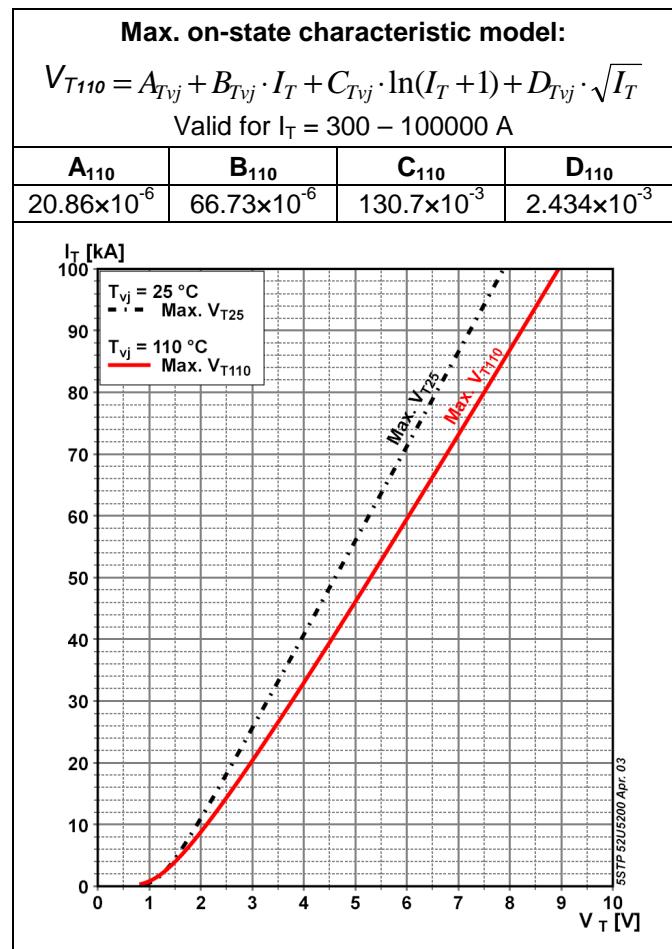
Fig. 3   On-state voltage characteristics
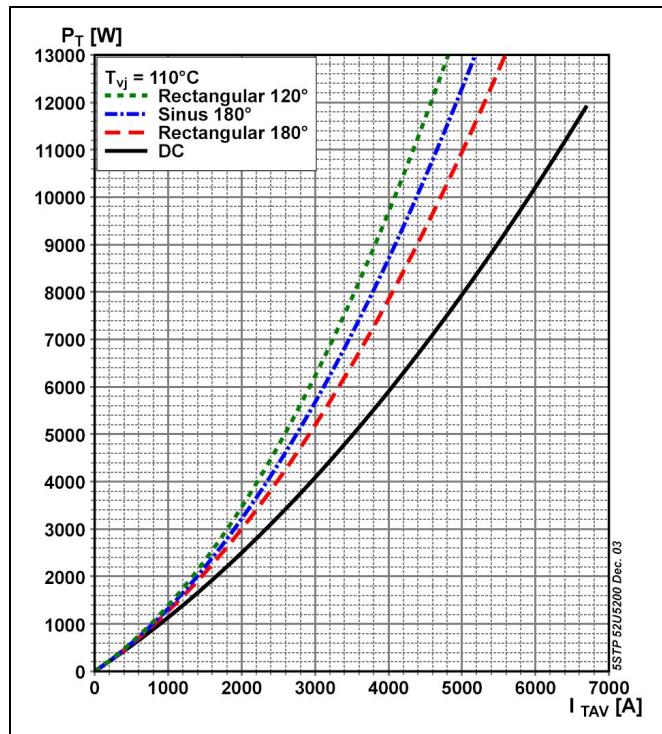
Fig. 4   On-state power dissipation vs. mean on-state current, turn-on losses excluded
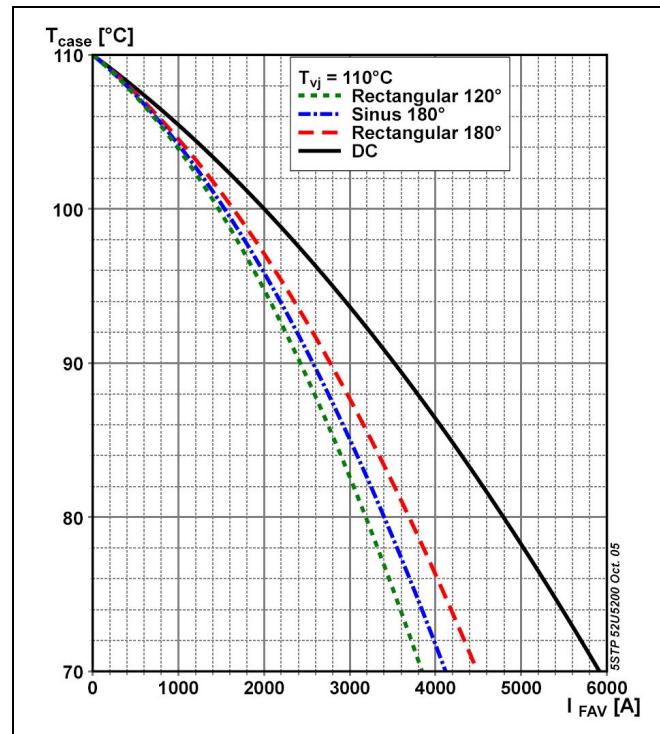
Fig. 5   Max. permissible case temperature vs. mean on-state current, switching losses ignored

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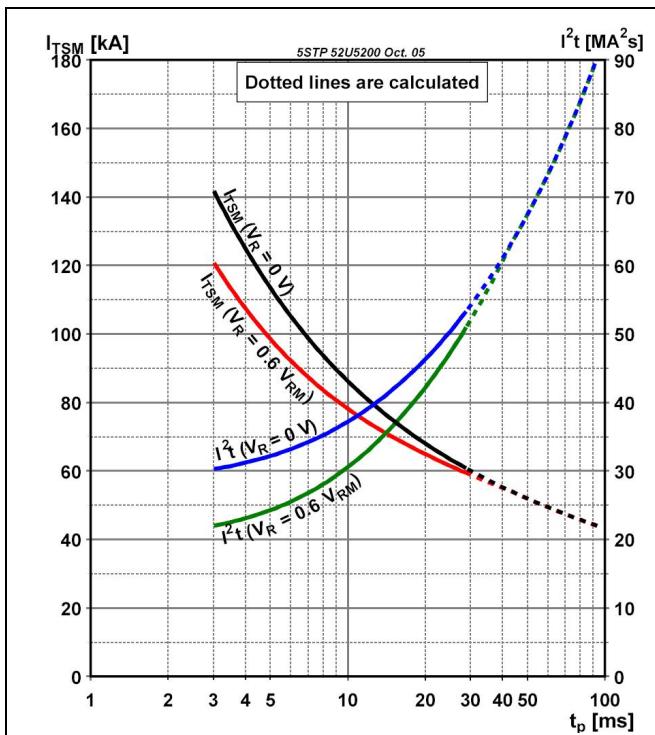
Fig. 6 Surge on-state current vs. pulse length, half-sine wave
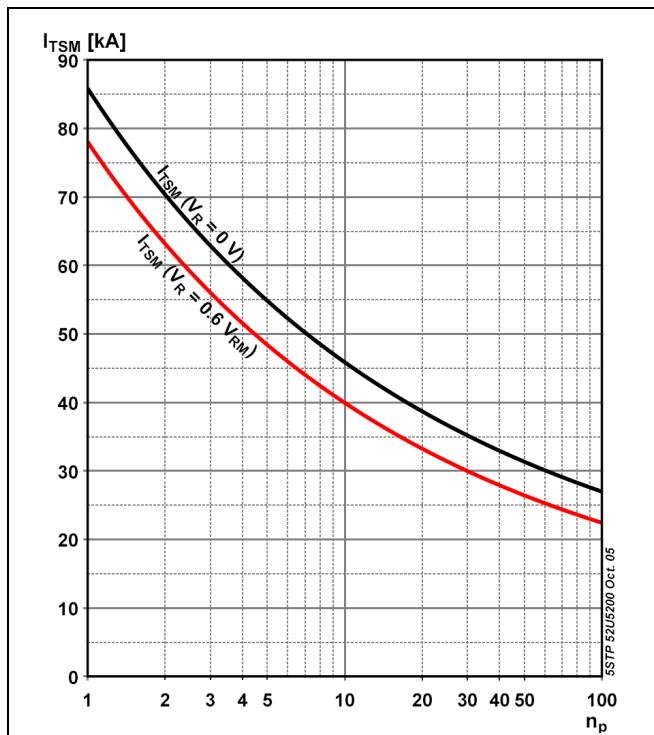
**Fig. 7** Surge on-state current vs. number of pulses, half-sine wave, 10 ms, 50Hz
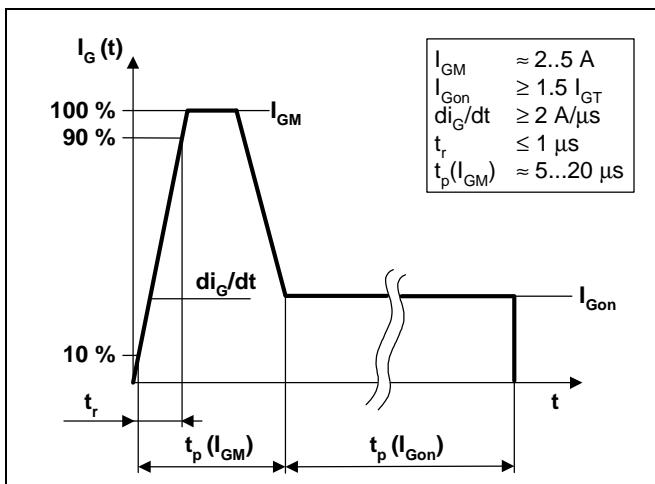
**Fig. 8** Recommended gate current waveform
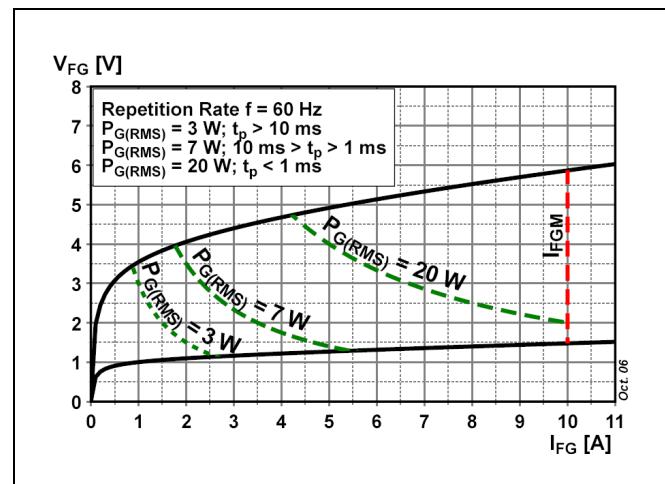
Fig. 9 Max. peak gate power loss
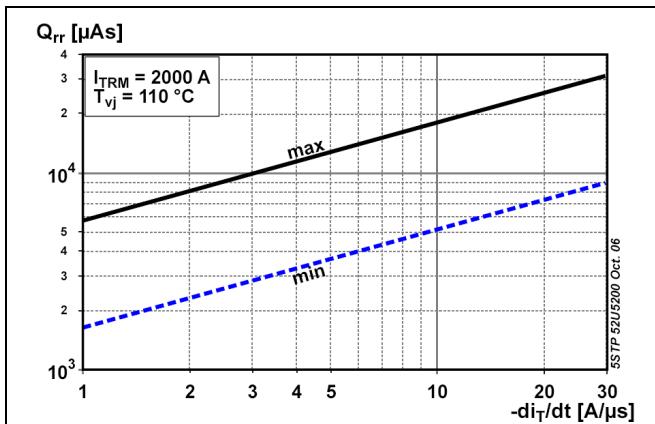
Fig. 10 Reverse recovery charge vs. decay rate of on-state current
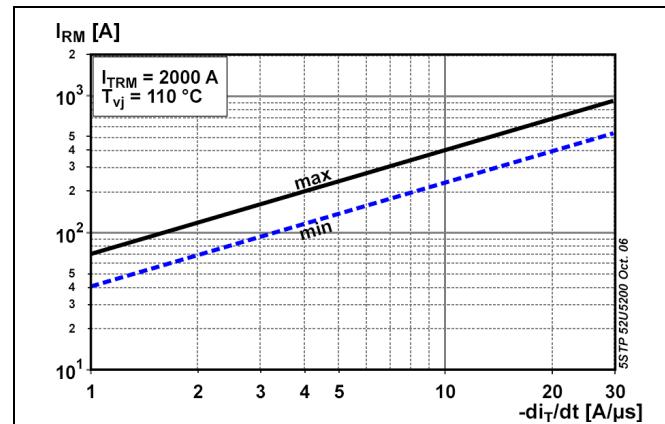
Fig. 11 Peak reverse recovery current vs. decay rate of on-state current

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Turn-on and Turn-off losses
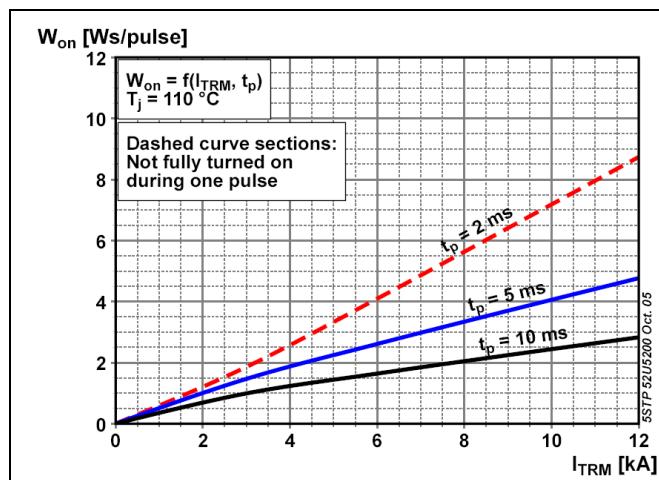
Fig. 12 Turn-on energy, half sinusoidal waves

W_on [Ws/pulse]

$W_{on} = f(I_{TRM}, t_p)$
$T_j = 110\ °C$

Dashed curve sections:
Not fully turned on
during one pulse

$t_p = 2\ ms$
$t_p = 5\ ms$
$t_p = 10\ ms$

I_{TRM} [kA]

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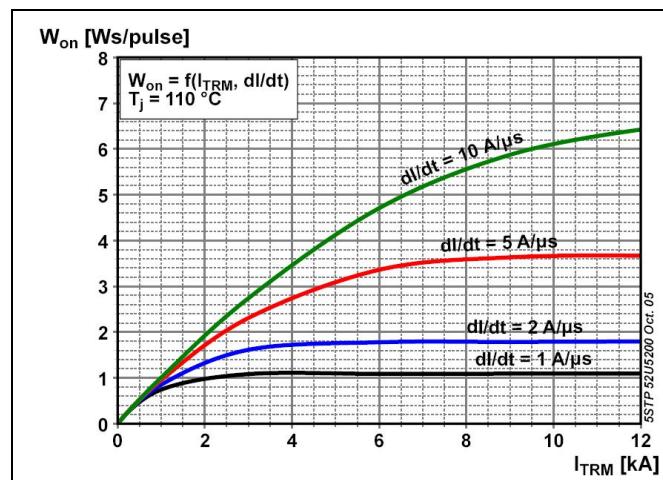
Fig. 13 Turn-on energy, rectangular waves

W_on [Ws/pulse]

$W_{on} = f(I_{TRM}, dI/dt)$
$T_j = 110\ °C$

dI/dt = 10 A/µs
dI/dt = 5 A/µs
dI/dt = 2 A/µs
dI/dt = 1 A/µs

I_{TRM} [kA]

5STP 52U5200 Oct. 05
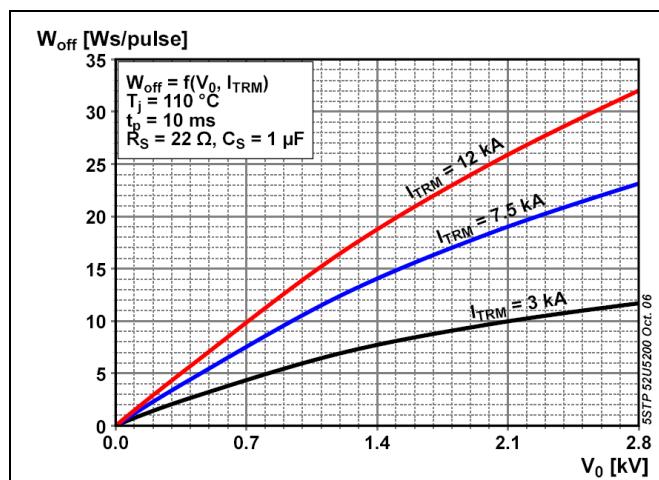
Fig. 14 Turn-off energy, half sinusoidal waves

W_off [Ws/pulse]

$W_{off} = f(V_0, I_{TRM})$
$T_j = 110\ °C$
$t_p = 10\ ms$
$R_S = 22\ \Omega, C_S = 1\ µF$

$I_{TRM} = 12\ kA$
$I_{TRM} = 7.5\ kA$
$I_{TRM} = 3\ kA$

V_0 [kV]

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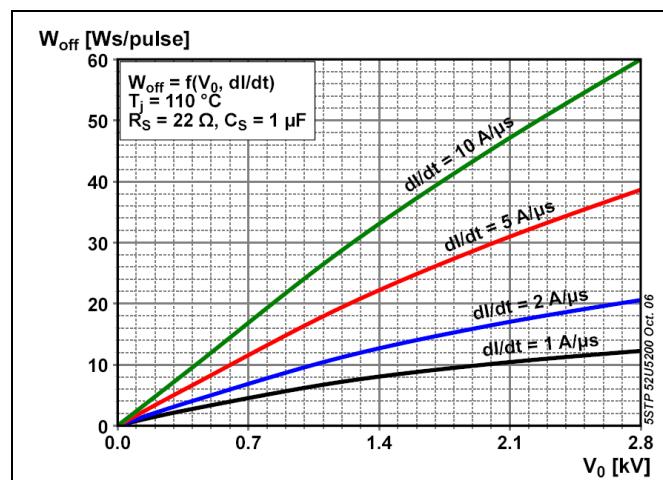
Fig. 15 Turn-off energy, rectangular waves

W_off [Ws/pulse]

$W_{off} = f(V_0, dI/dt)$
$T_j = 110\ °C$
$R_S = 22\ \Omega, C_S = 1\ µF$

dI/dt = 10 A/µs
dI/dt = 5 A/µs
dI/dt = 2 A/µs
dI/dt = 1 A/µs

V_0 [kV]

5STP 52U5200 Oct. 06

$I_T(t)$, $V(t)$

$I_T(t)$
$-di_T/dt$
Q_{rr}
t
$-I_{RRM}$
$V(t)$
$-V_0$
$-dv/dt_{com}$
$-V_{RRM}$
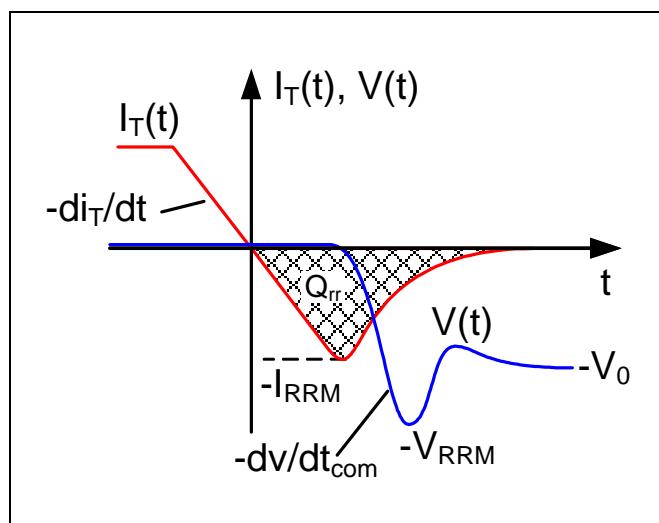
**Fig. 16** Current and voltage waveforms at turn-off

Total power loss for repetitive waveforms:

$$P_{TOT} = P_T + W_{on} \cdot f + W_{off} \cdot f$$

where

$$P_T = \frac{1}{T}\int_0^T I_T \cdot V_T(I_T)\ dt$$
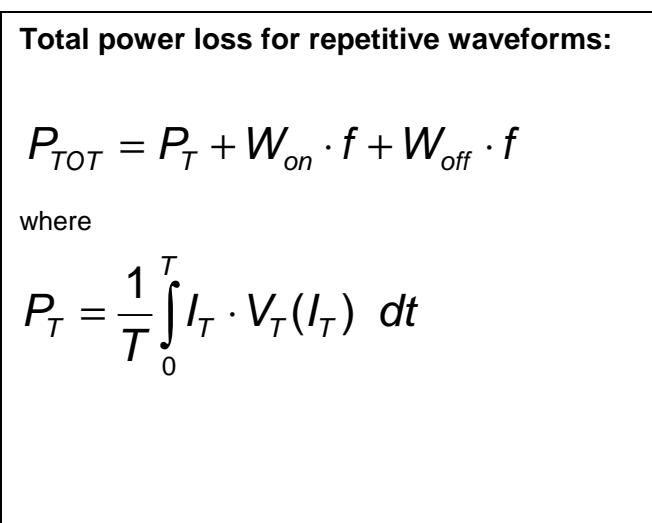
**Fig. 17** Relationships for power loss

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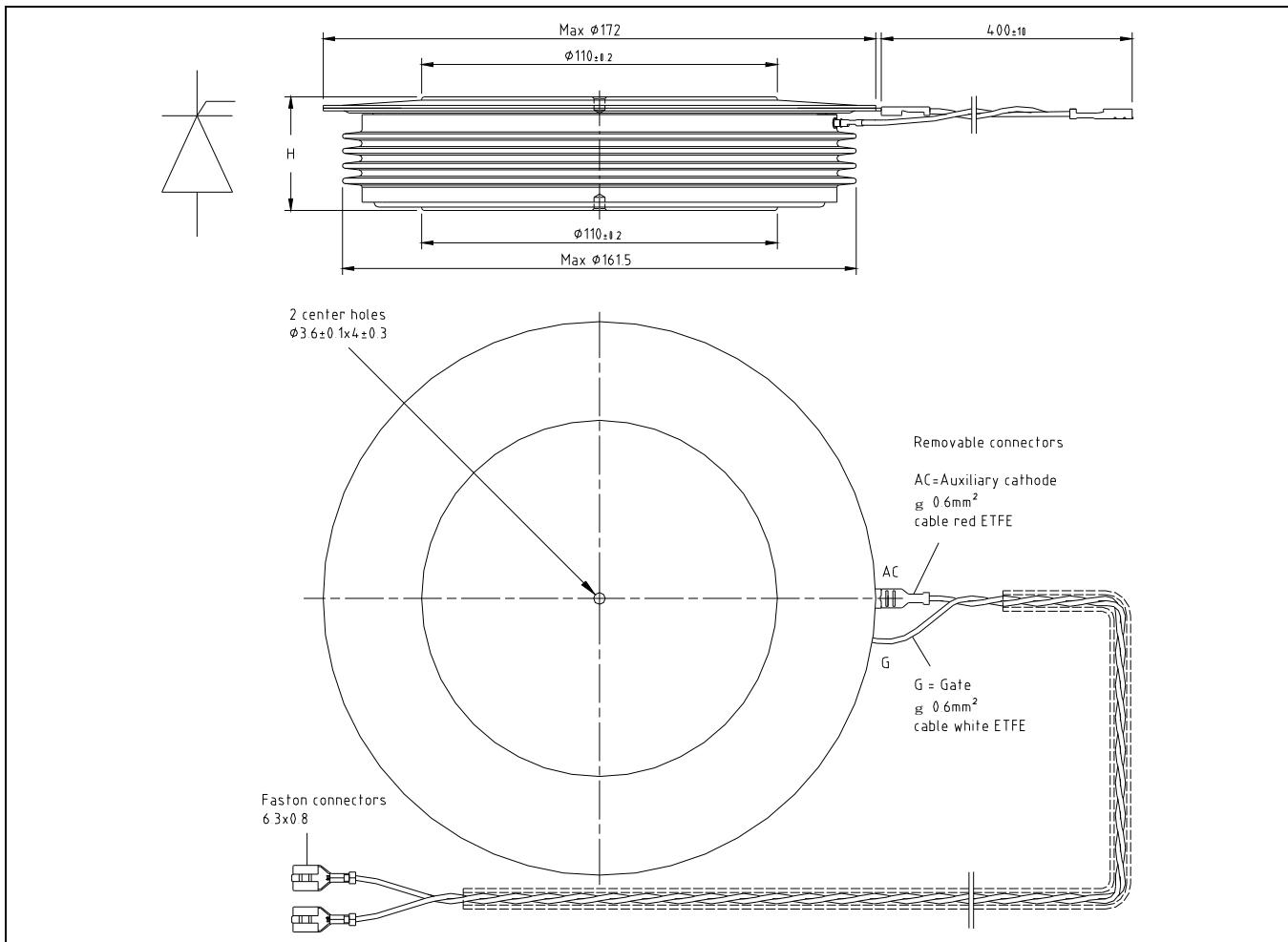
Fig. 18 Device Outline Drawing

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

Please refer to http://www.abb.com/semiconductors for current version of documents.