

V_{RM}	=	6500 V
$I_{T(AV)M}$	=	1405 A
$I_{T(RMS)}$	=	2205 A
I_{TSM}	=	22×10^3 A
V_{TO}	=	1.2 V
r_T	=	0.6 mΩ

Bi-Directional Control Thyristor

5STB 13N6500

Doc. No. 5SYA1035-04 Aug. 10

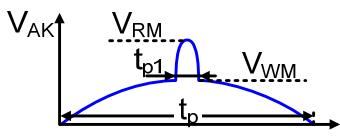
- Two thyristors integrated into one wafer
- Patented free-floating silicon technology
- Designed for energy management and industrial applications
- Optimum power handling capability
- Interdigitated amplifying gate

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

Blocking

Maximum rated values¹⁾

Parameter	Symbol	Conditions	5STB 13N6500	Unit
Max. surge peak forward blocking voltage	V_{SM}	$t_p = 10$ ms, $f = 5$ Hz $T_{vj} = 5 \dots 125^\circ\text{C}$, Note 1	6500	V
Max repetitive peak forward blocking voltage	V_{RM}	$f = 50$ Hz, $t_p = 10$ ms, $t_{p1} = 250$ μs, $T_{vj} = 5 \dots 125^\circ\text{C}$, Note 1	6500	V
Max crest working forward voltages	V_{WM}		3300	V
Critical rate of rise of off-state voltage	dv/dt_{crit}	Exp. to 3750 V, $T_{vj} = 125^\circ\text{C}$	2000	V/μs



Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Max reverse leakage current	$I_{R(M)}$	$V_{RM}, T_{vj} = 125^\circ\text{C}$			400	mA

Note 1: Voltage de-rating factor of 0.11% per °C is applicable for T_{vj} 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 values¹⁾

Parameter	Symbol	Conditions	min	typ	max	Unit
Mounting force	F_M		81	90	108	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				2.9	kg
Housing thickness	H	$F_M = 90$ kN, $T_a = 25^\circ\text{C}$	35		35.6	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

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On-state

Maximum rated values¹⁾

Parameter	Symbol	Conditions	min	typ	max	Unit
Average on-state current	$I_{T(AV)M}$	Half sine wave, $T_c = 70^\circ\text{C}$			1405	A
RMS on-state current	$I_{T(RMS)}$				2205	A
RMS on-state current	$I_{T(RMS)}$	$t_p = 10 \text{ ms}, T_{vj} = 125^\circ\text{C}$, sine wave after surge: $V_D = V_R = 0 \text{ V}$			3120	A
Peak non-repetitive surge current	I_{TSM}				22.0×10^3	A
Limiting load integral	I^2t	$t_p = 8.3 \text{ ms}, T_{vj} = 125^\circ\text{C}$, sine wave after surge: $V_D = V_R = 0 \text{ V}$			2.42×10^6	A^2s
Peak non-repetitive surge current	I_{TSM}				24.0×10^3	A
Limiting load integral	I^2t				2.39×10^6	A^2s

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
On-state voltage	V_T	$I_T = 3000 \text{ A}, T_{vj} = 125^\circ\text{C}$			2.95	V
Threshold voltage	V_{T0}	$I_T = 670 \text{ A} - 2000 \text{ A}, T_{vj} = 125^\circ\text{C}$			1.2	V
Slope resistance	r_T				0.6	$\text{m}\Omega$
Holding current	I_H	$T_{vj} = 25^\circ\text{C}$			300	mA
		$T_{vj} = 125^\circ\text{C}$			175	mA
Latching current	I_L	$T_{vj} = 25^\circ\text{C}$			500	mA
		$T_{vj} = 125^\circ\text{C}$			300	mA

Switching

Maximum rated values¹⁾

Parameter	Symbol	Conditions	min	typ	max	Unit
Critical rate of rise of on-state current	di/dt_{crit}	$T_{vj} = 125^\circ\text{C}, I_{TRM} = 2000 \text{ A}, f = 50 \text{ Hz}$			250	$\text{A}/\mu\text{s}$
Critical rate of rise of on-state current	di/dt_{crit}	$V_D \leq 3750 \text{ V}, I_{FG} = 2 \text{ A}, t_r = 0.5 \mu\text{s}$			500	$\text{A}/\mu\text{s}$
Circuit commutated turn-off time	t_q	$T_{vj} = 125^\circ\text{C}, I_{TRM} = 2000 \text{ A}, V_R = 200 \text{ V}, di_T/dt = -1.5 \text{ A}/\mu\text{s}, V_D \leq 0.67 \cdot V_{RM}, dv_D/dt = 20 \text{ V}/\mu\text{s}$	800			μs
Critical rate of rise of commuting voltage	dv/dt_{com}	$T_{vj} = 125^\circ\text{C}, V_R \leq 0.67 \cdot V_{RM}$			500	$\text{V}/\mu\text{s}$

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Reverse recovery charge	Q_{rr}	$T_{vj} = 125^\circ\text{C}, I_{TRM} = 2000 \text{ A}, V_R = 200 \text{ V}, di_T/dt = -1.5 \text{ A}/\mu\text{s}$	2400		3800	μAs
			45		65	A
Gate turn-on delay time	t_{gd}	$T_{vj} = 25^\circ\text{C}, V_D = 0.4 \cdot V_{RM}, I_{FG} = 2 \text{ A}, t_r = 0.5 \mu\text{s}$			3	μs

Triggering

Maximum rated values¹⁾

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} = 125 °C	0.3			V
Gate non-trigger current	I _{GD}	V _D = 0.4 x V _{RM}	10			mA

Thermal

Maximum rated values¹⁾

Parameter	Symbol	Conditions	min	typ	max	Unit
Operating junction temperature range	T _{vj}				125	°C
Storage temperature range	T _{stg}		-40		140	°C

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Thermal resistance junction to case (Valid for one thyristor half no heat flow to the second half.)	R _{th(j-c)}	Double-side cooled F _m = 81...108 kN			11.4	K/kW
	R _{th(j-c)}	Single-side cooled F _m = 81...108 kN			22.8	K/kW
Thermal resistance case to heatsink	R _{th(c-h)}	Double-side cooled F _m = 81...108 kN			2	K/kW
	R _{th(c-h)}	Single-side cooled F _m = 81...108 kN			4	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)	6.770	2.510	1.340	0.780
τ _i (s)	0.8651	0.1558	0.0212	0.0075

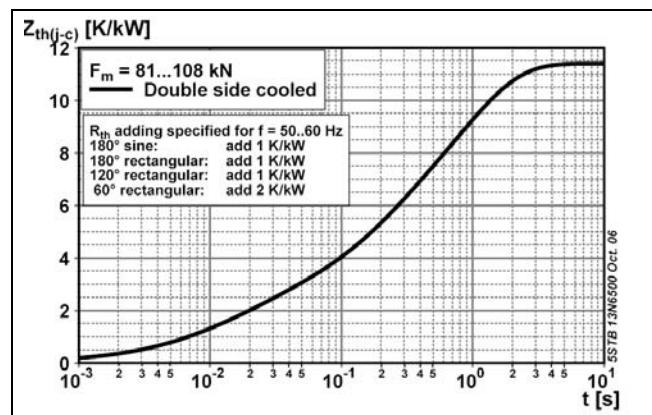


Fig. 1 Transient thermal impedance (junction-to-case) vs. time

On-state characteristic model:

$$V_{T\max} = A + B \cdot I_T + C \cdot \ln(I_T + 1) + D \cdot \sqrt{I_T}$$

Valid for $I_T = 200 - 2000$ A

A	B	C	D
1.328	257.0×10^{-6}	-92.0×10^{-3}	28.0×10^{-3}

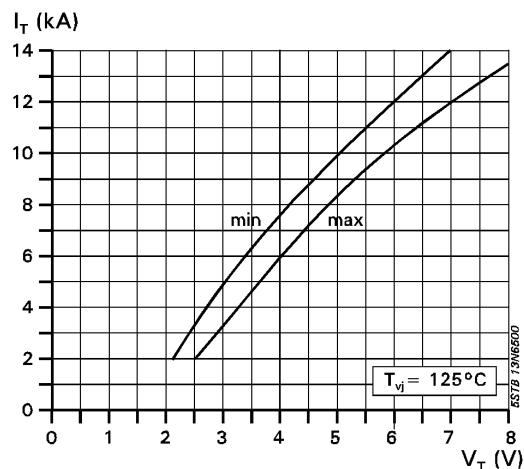


Fig. 2 On-state characteristics,
 $T_j = 125^\circ\text{C}$, 10ms half sine

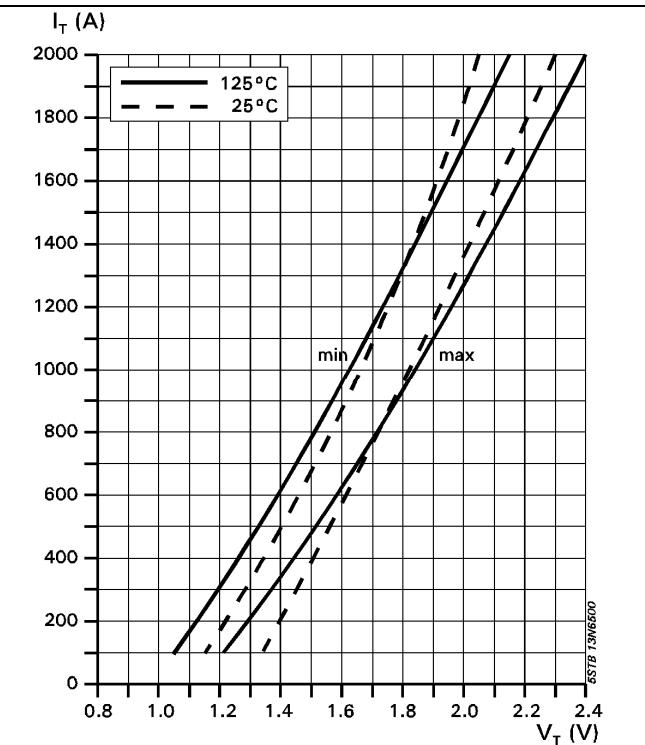


Fig. 3 On-state voltage characteristics

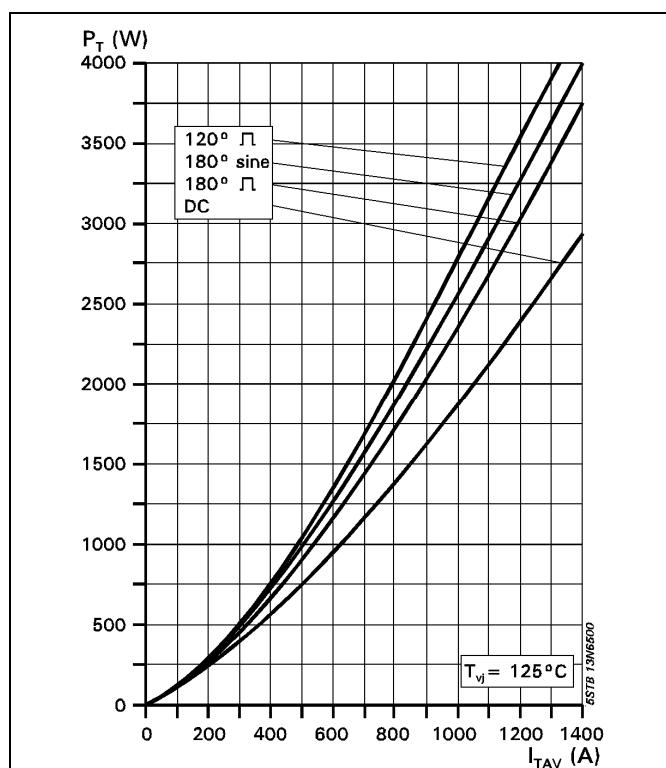


Fig. 4 On-state power dissipation vs. mean on-state current. Switching losses excluded.

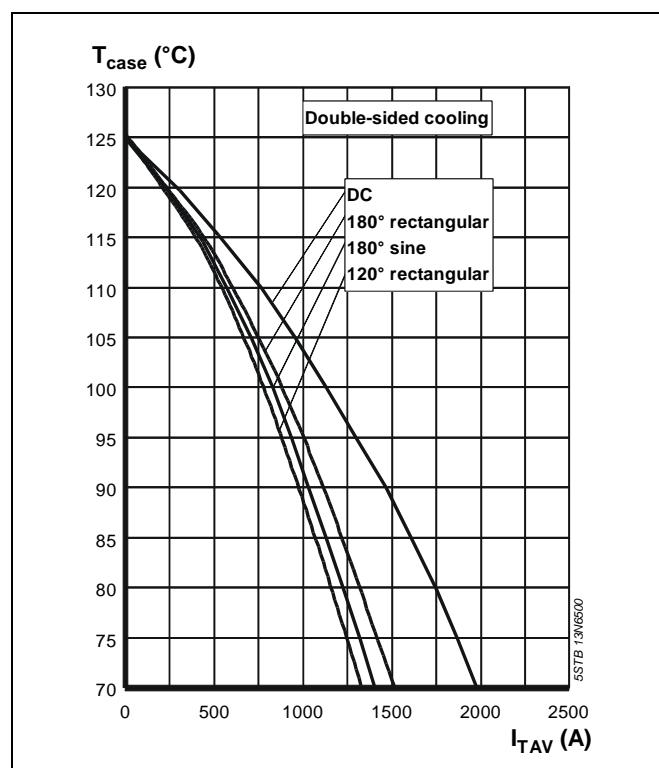


Fig. 5 Max. permissible case temperature vs. mean on-state current. Switching losses ignored.

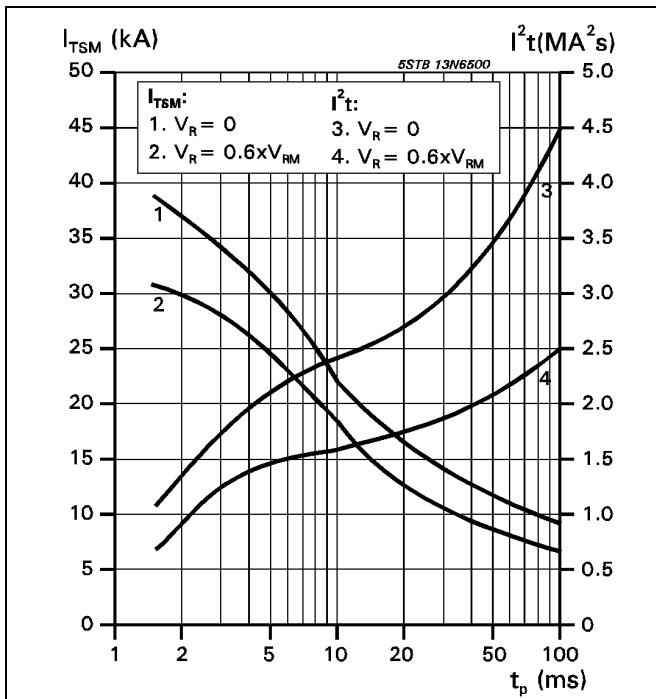


Fig. 6 Surge on-state current vs. pulse length.
Half-sine wave.

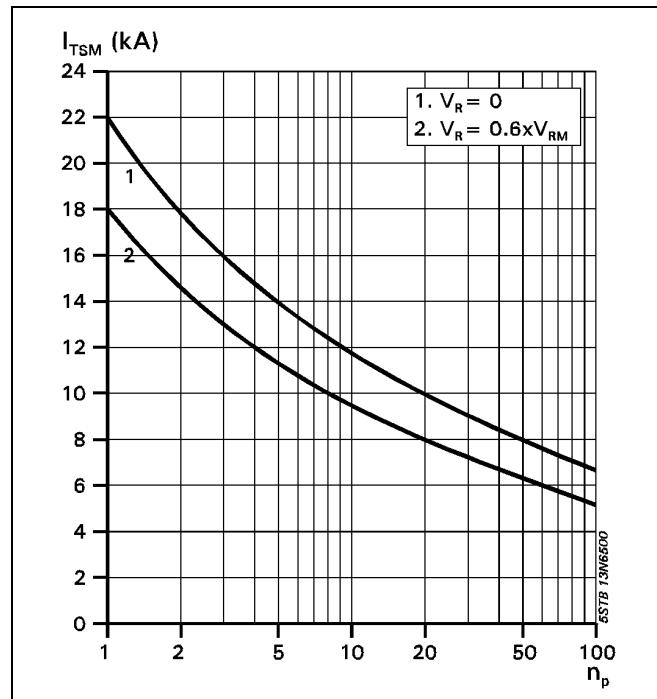


Fig. 7 Surge on-state current vs. number of pulses.
Half-sine wave, 10 ms, 50Hz.

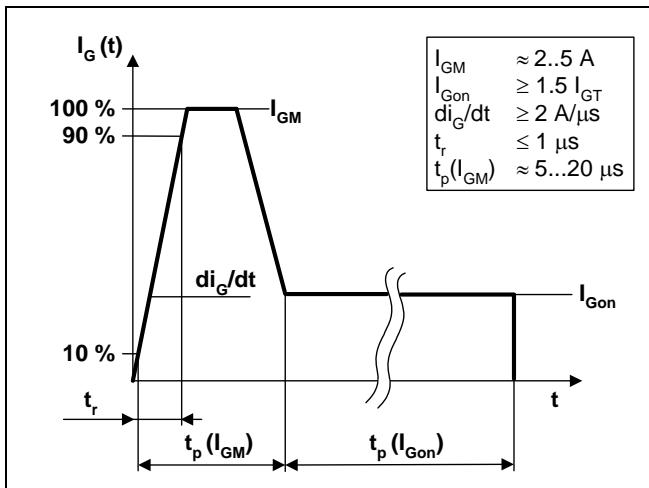


Fig. 8 Recommended gate current waveform

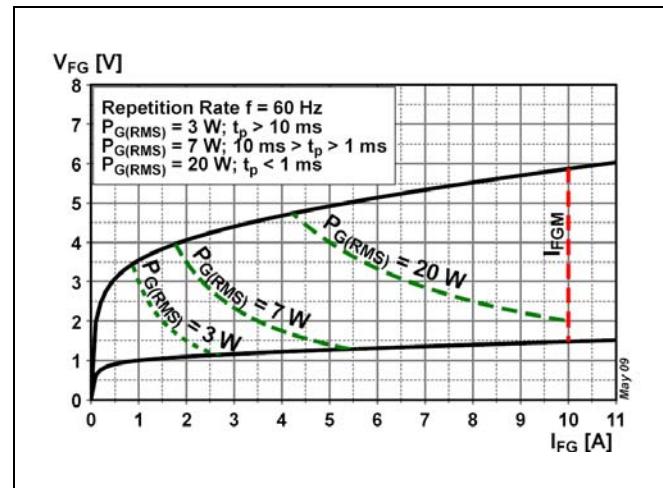


Fig. 9 Max. peak gate power loss

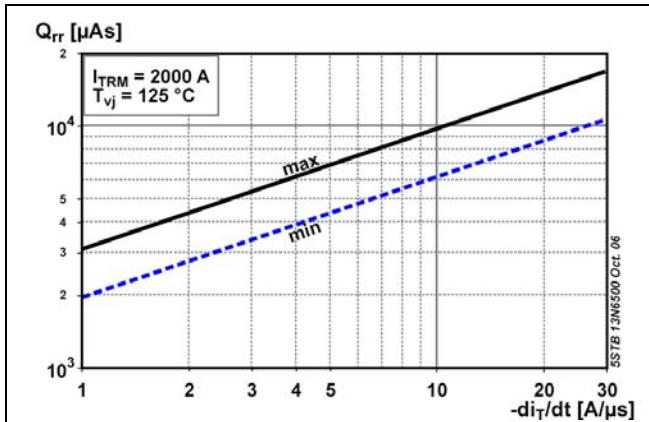


Fig. 10 Reverse recovery charge vs. decay rate of on-state current

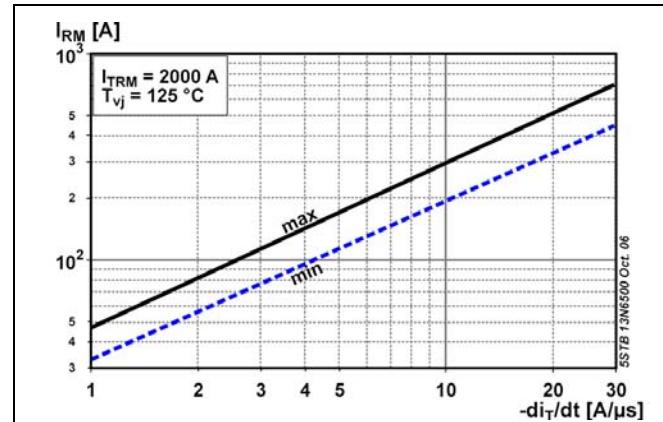
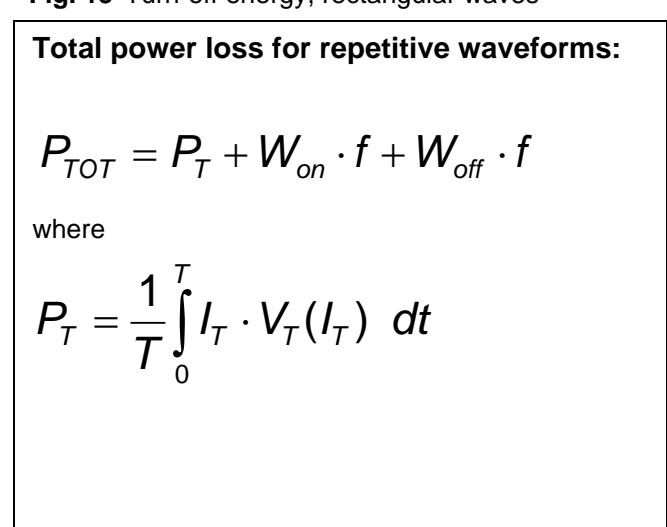
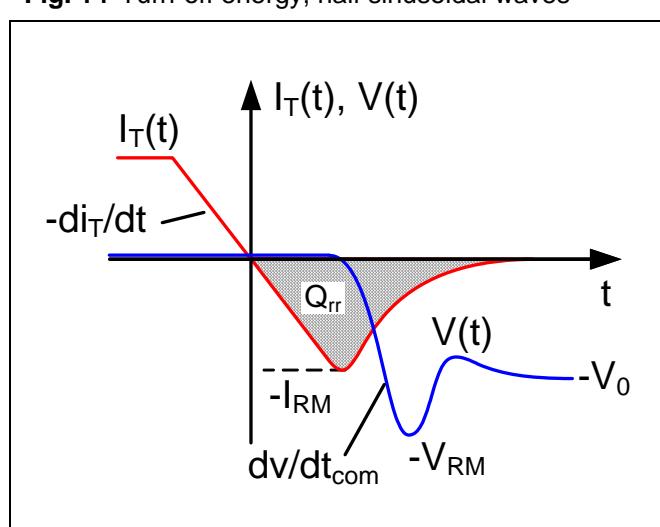
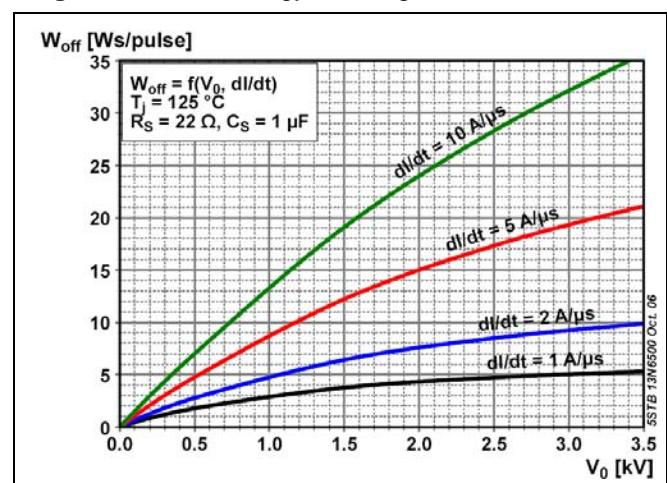
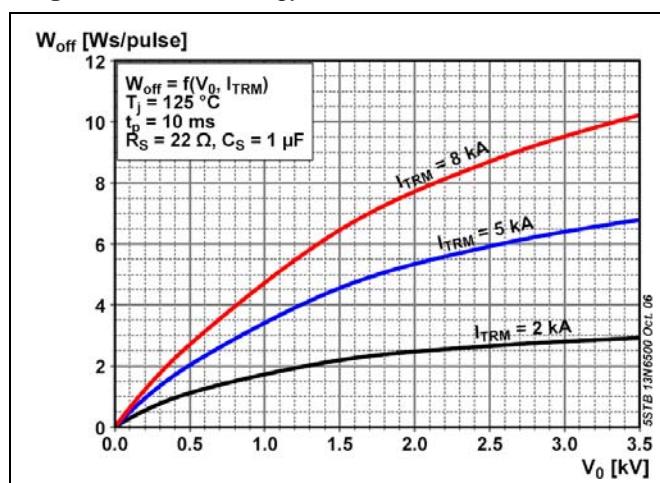
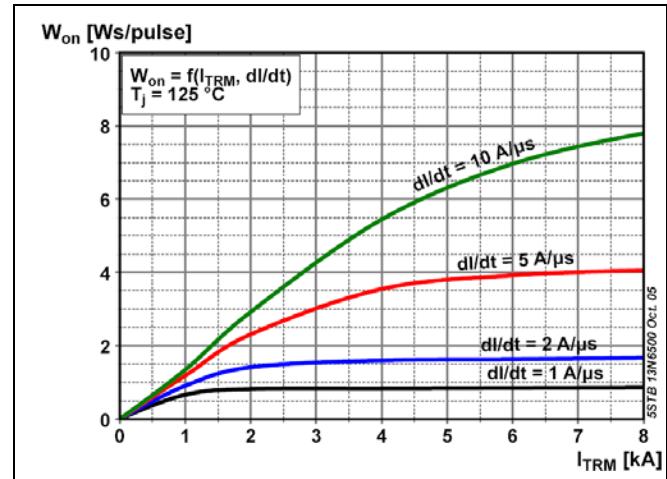
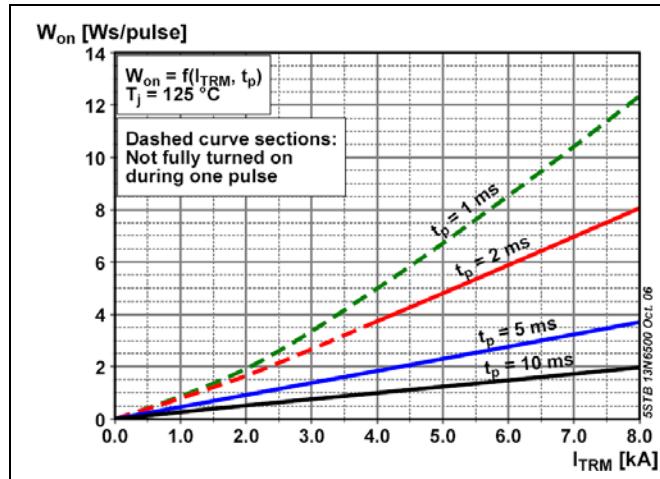


Fig. 11 Peak reverse recovery current vs. decay rate of on-state current

Turn-on and Turn-off losses



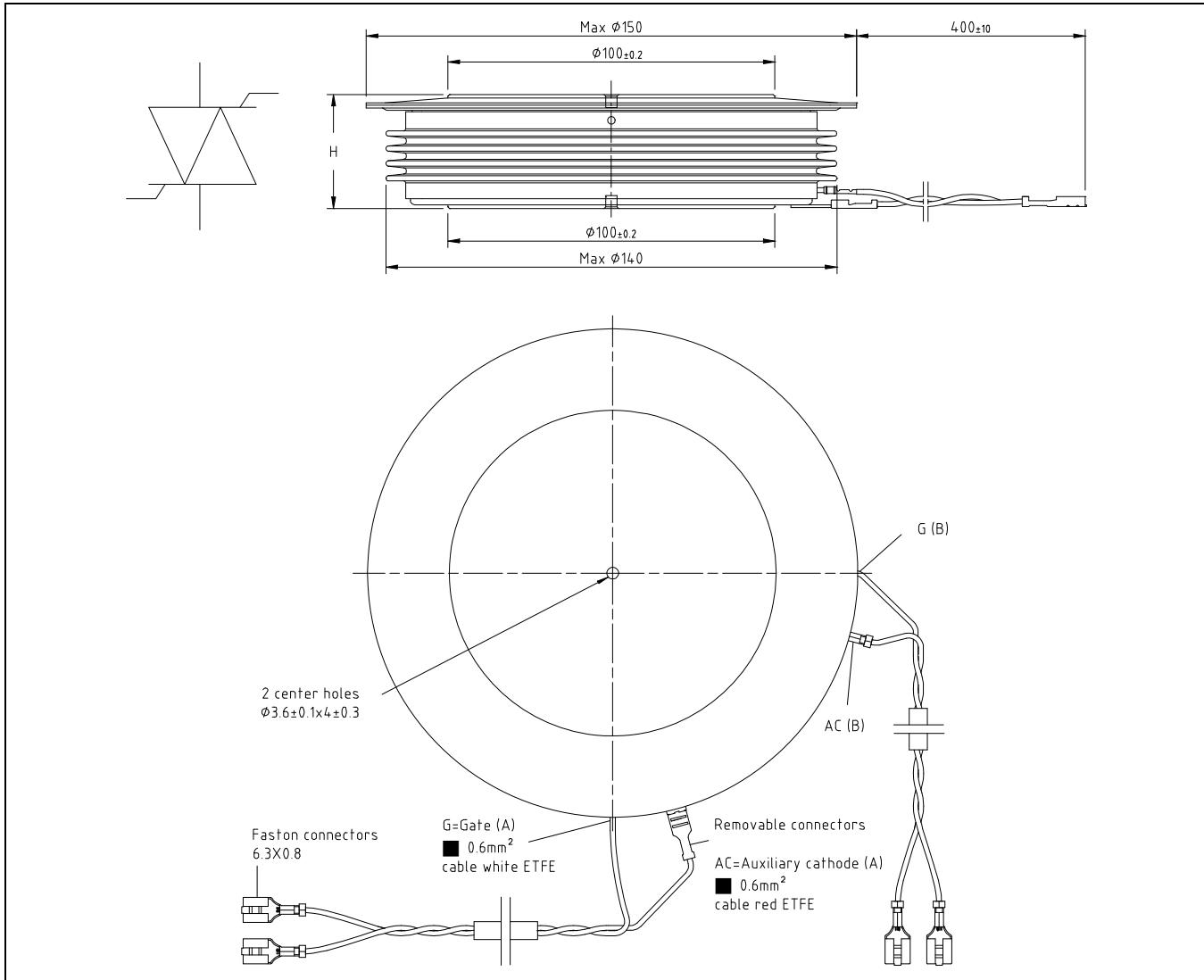


Fig. 18 Device Outline Drawing

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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