

ABB 5STP42U6500 Control Thyristor datasheet

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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

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V_{DRM}	=	6500 V
$I_{T(AV)M}$	=	4250 A
$I_{T(RMS)}$	=	6680 A
I_{TSM}	=	$86 \cdot 10^3$ A
V_{T0}	=	1.24 V
r_T	=	0.162 m Ω

Phase Control Thyristor

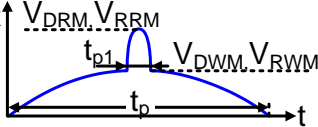
5STP 42U6500

Doc. No. 5SYA1043-07 Mar. 14

- Patented free-floating silicon technology
- Low on-state and switching losses
- Designed for traction, energy and industrial applications
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Blocking

Maximum rated values ¹⁾

Parameter	Symbol	Conditions	5STP 42U6500	Unit
Max. surge peak forward and reverse blocking voltage	V_{DSM}, V_{RSM}	$t_p = 10$ ms, $f = 5$ Hz $T_{vj} = 5 \dots 125$ °C, Note 1	6500	V
Max repetitive peak forward and reverse blocking voltage	V_{DRM}, V_{RRM}	$f = 50$ Hz, $t_p = 10$ ms, $t_{p1} = 250$ μ s, $T_{vj} = 5 \dots 125$ °C, Note 1, Note 2	6500	V
Max crest working forward and reverse voltages	V_{DWM}, V_{RWM}		4340	V
Critical rate of rise of commutating voltage	dv/dt_{crit}	Exp. to $0.67 \cdot V_{DRM}$, $T_{vj} = 125$ °C	2000	V/ μ s

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Forward leakage current	I_{DRM}	V_{DRM} , $T_{vj} = 125$ °C			800	mA
Reverse leakage current	I_{RRM}	V_{RRM} , $T_{vj} = 125$ °C			800	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 values ¹⁾

Parameter	Symbol	Conditions	min	typ	max	Unit
Mounting force	F_M		90	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	34.8		35.5	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, $T_c = 70\text{ °C}$			4250	A
RMS on-state current	$I_{T(RMS)}$				6680	A
Peak non-repetitive surge current	I_{TSM}	$t_p = 10\text{ ms}$, $T_{vj} = 125\text{ °C}$, sine half wave, $V_D = V_R = 0\text{ V}$, after surge			$86 \cdot 10^3$	A
Limiting load integral	I^2t				$36.98 \cdot 10^6$	A ² s
Peak non-repetitive surge current	I_{TSM}	$t_p = 10\text{ ms}$, $T_{vj} = 125\text{ °C}$, sine half wave, $V_R = 0.6 \cdot V_{RRM}$, after surge			$64 \cdot 10^3$	A
Limiting load integral	I^2t				$20.48 \cdot 10^6$	A ² s

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
On-state voltage	V_T	$I_T = 3000\text{ A}$, $T_{vj} = 125\text{ °C}$			1.71	V
Threshold voltage	$V_{(T0)}$	$I_T = 2000\text{ A} - 6000\text{ A}$, $T_{vj} = 125\text{ °C}$			1.24	V
Slope resistance	r_T				0.162	mΩ
Holding current	I_H	$T_{vj} = 25\text{ °C}$			200	mA
		$T_{vj} = 125\text{ °C}$			100	mA
Latching current	I_L	$T_{vj} = 25\text{ °C}$			900	mA
		$T_{vj} = 125\text{ °C}$			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}	$T_{vj} = 125\text{ °C}$, $I_{TRM} = 3000\text{ A}$, $V_D \leq 0.67 \cdot V_{DRM}$, $I_{FG} = 2\text{ A}$, $t_r = 0.5\text{ }\mu\text{s}$	Cont. $f = 50\text{ Hz}$		250	A/ μs
			Cont. $f = 1\text{ Hz}$		1000	A/ μs
Circuit-commutated turn-off time	t_q	$T_{vj} = 125\text{ °C}$, $I_{TRM} = 2000\text{ A}$, $V_R = 200\text{ V}$, $di_T/dt = -1.5\text{ A}/\mu\text{s}$, $V_D \leq 0.67 \cdot V_{DRM}$, $dV_D/dt = 20\text{ V}/\mu\text{s}$			970	μs

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Reverse recovery charge	Q_{rr}	$T_{vj} = 125\text{ °C}$, $I_{TRM} = 2000\text{ A}$, $V_R = 200\text{ V}$, $di_T/dt = -1.5\text{ A}/\mu\text{s}$	4500		7500	μAs
Reverse recovery current	I_{RM}		60		110	A
Gate turn-on delay time	t_{gd}	$T_{vj} = 25\text{ °C}$, $V_D = 0.4 \cdot V_{RM}$, $I_{FG} = 2\text{ A}$, $t_r = 0.5\text{ }\mu\text{s}$			3	μs

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. 7			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·V _{DRM} , T _{vjmax} = 125 °C			0.3	V
Gate non-trigger current	I _{GD}	V _D = 0.4·V _{DRM} , T _{vjmax} = 125 °C			10	mA

Thermal

Maximum rated values ¹⁾

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, Note 3	R _{th(j-c)}	Double-side cooled F _m = 90... 160 kN			4	K/kW
	R _{th(j-c)A}	Anode-side cooled F _m = 90... 160 kN			8	K/kW
	R _{th(j-c)C}	Cathode-side cooled F _m = 90... 160 kN			8	K/kW
Thermal resistance case to heatsink, Note 3	R _{th(c-h)}	Double-side cooled F _m = 90... 160 kN			0.8	K/kW
	R _{th(c-h)}	Single-side cooled F _m = 90... 160 kN			1.6	K/kW

Note 3: Recommended mounting force 120... 160kN.

For lower mounting force (90... 120kN), R_{th(j-c)} increases by 5% and R_{th(c-h)} increases by 30%.

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)	2.695	0.814	0.330	0.162
τ _i (s)	0.9692	0.1332	0.0177	0.0042

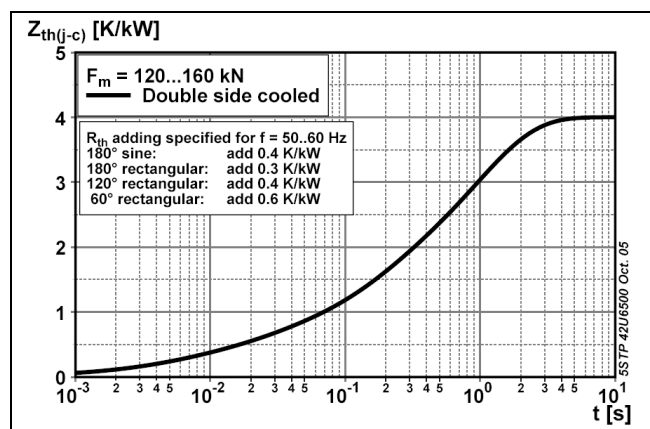


Fig. 1 Transient thermal impedance (junction-to-case) vs. time

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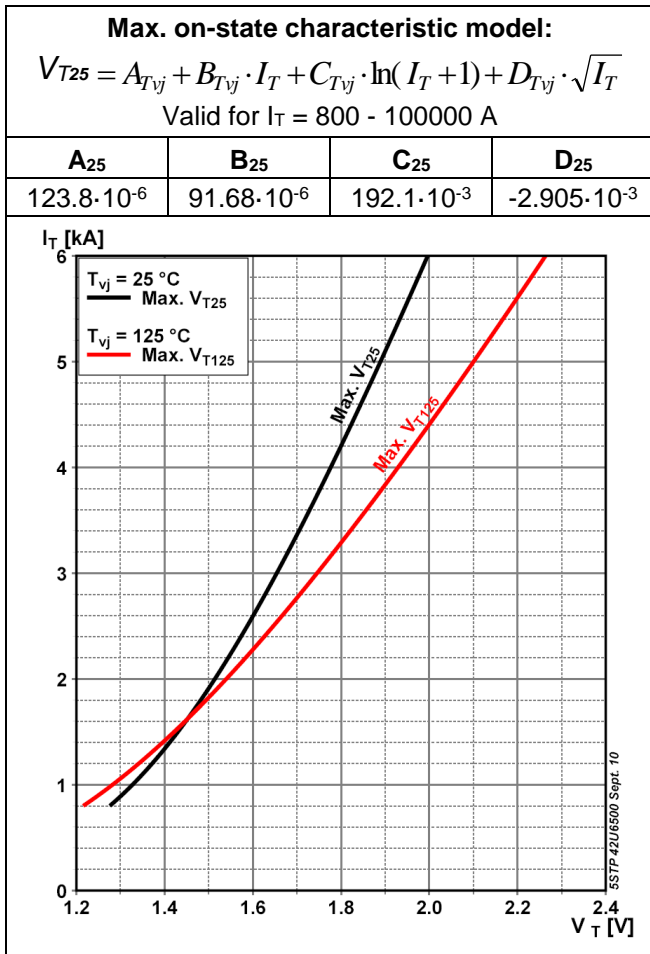


Fig. 2 On-state voltage characteristics

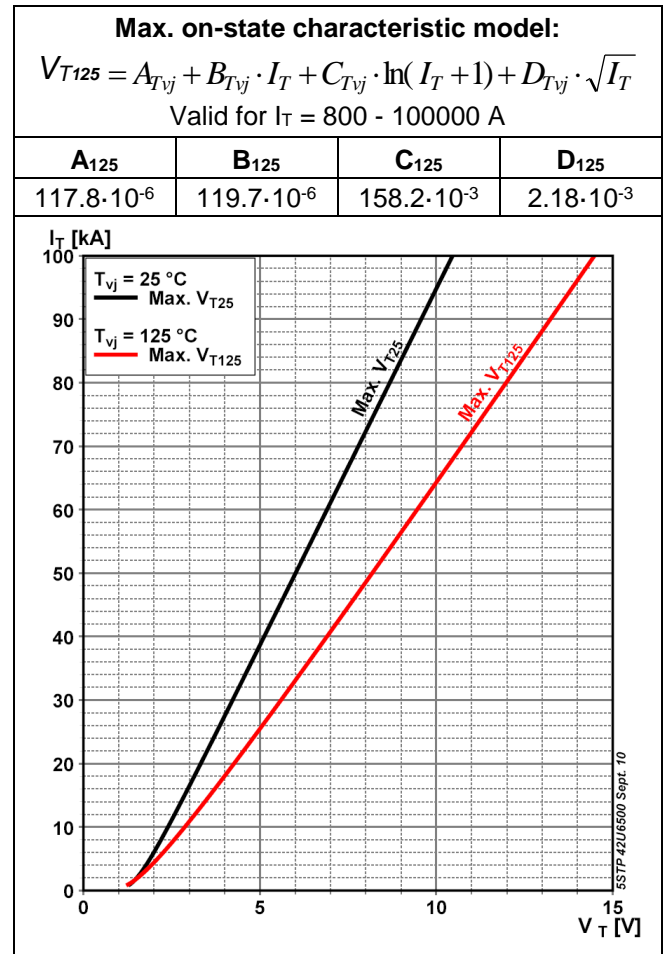


Fig. 3 On-state voltage characteristics

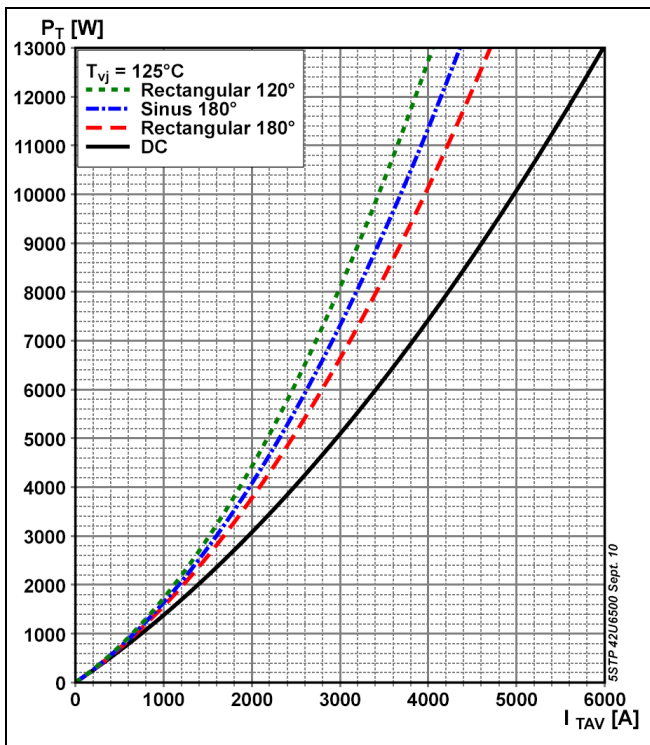


Fig. 4 On-state power dissipation vs. mean on-state current, turn-on losses excluded

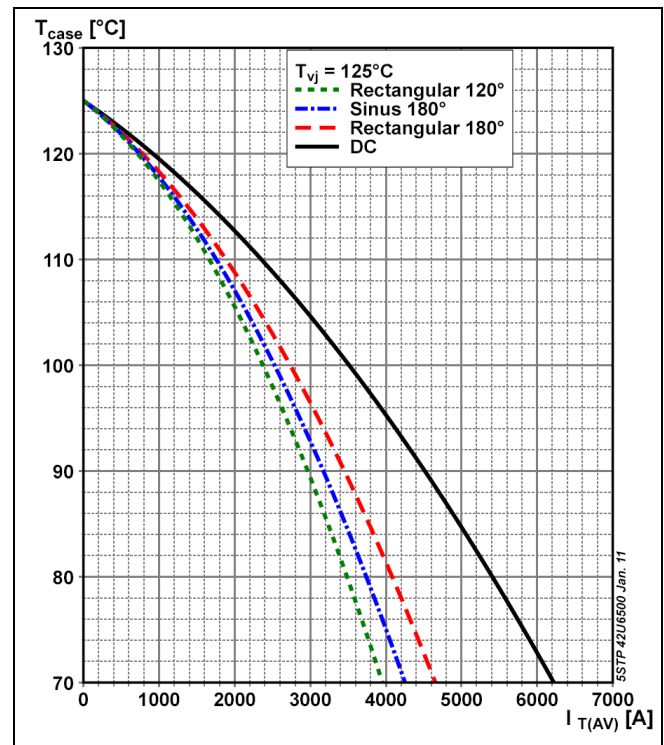


Fig. 5 Max. permissible case temperature vs. mean on-state current, switching losses ignored

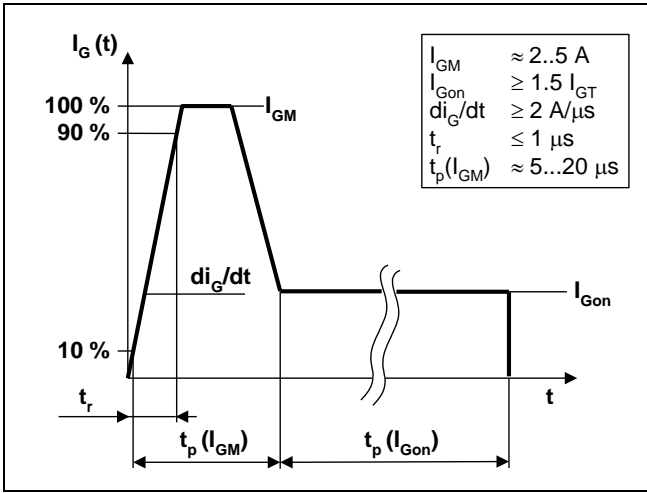


Fig. 6 Recommended gate current waveform

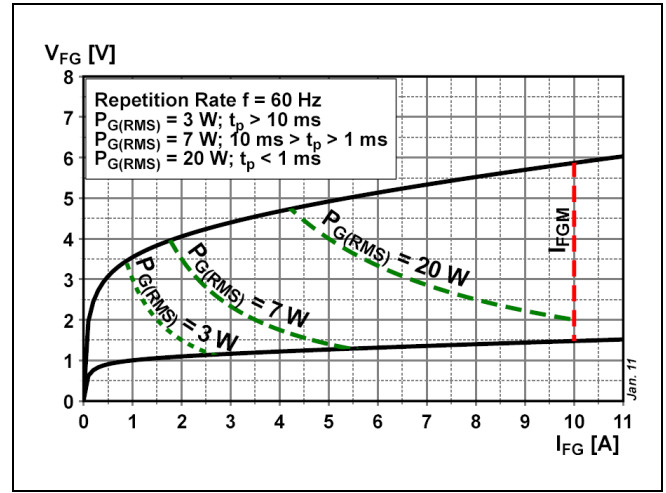


Fig. 7 Max. peak gate power loss

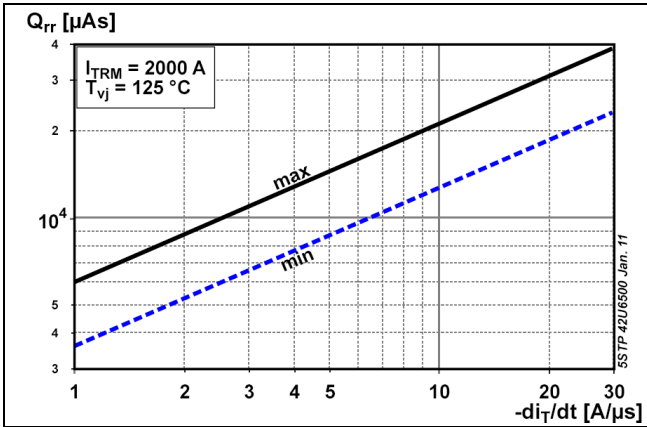


Fig. 8 Reverse recovery charge vs. decay rate of on-state current

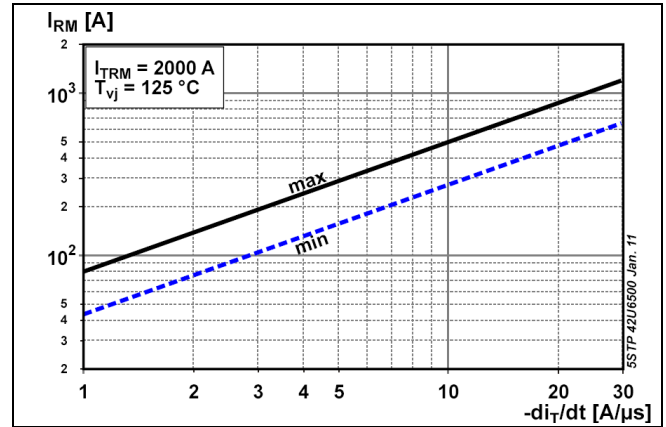


Fig. 9 Peak reverse recovery current vs. decay rate of on-state current

Turn-on and Turn-off losses

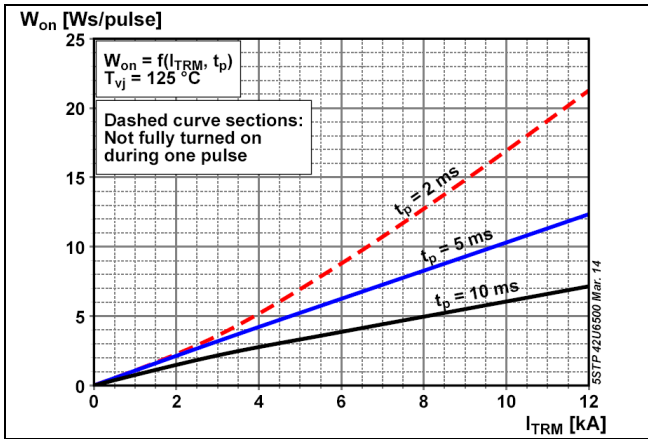


Fig. 10 Turn-on energy, half sinusoidal waves

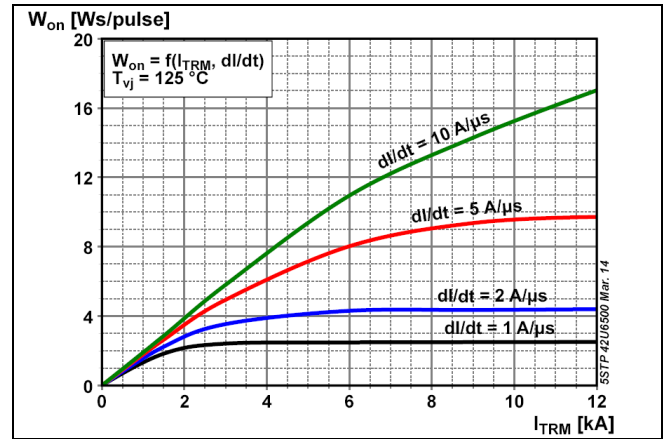


Fig. 11 Turn-on energy, rectangular waves

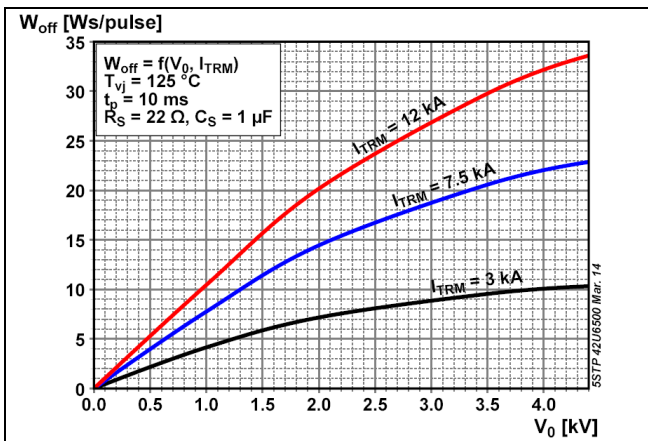


Fig. 12 Turn-off energy, half sinusoidal waves

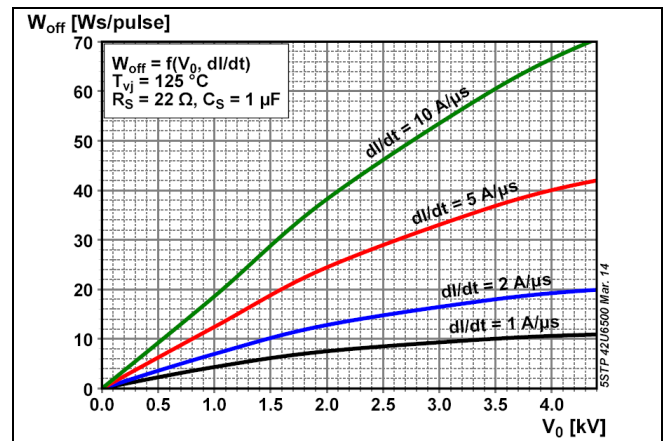


Fig. 13 Turn-off energy, rectangular waves

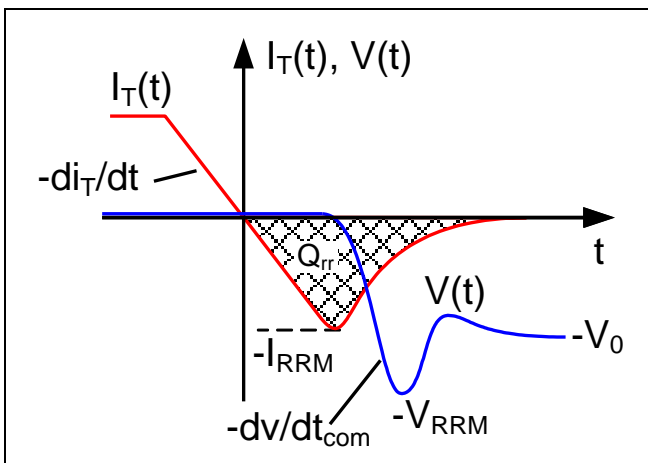


Fig. 14 Current and voltage waveforms at turn-off

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. 15 Relationships for power loss

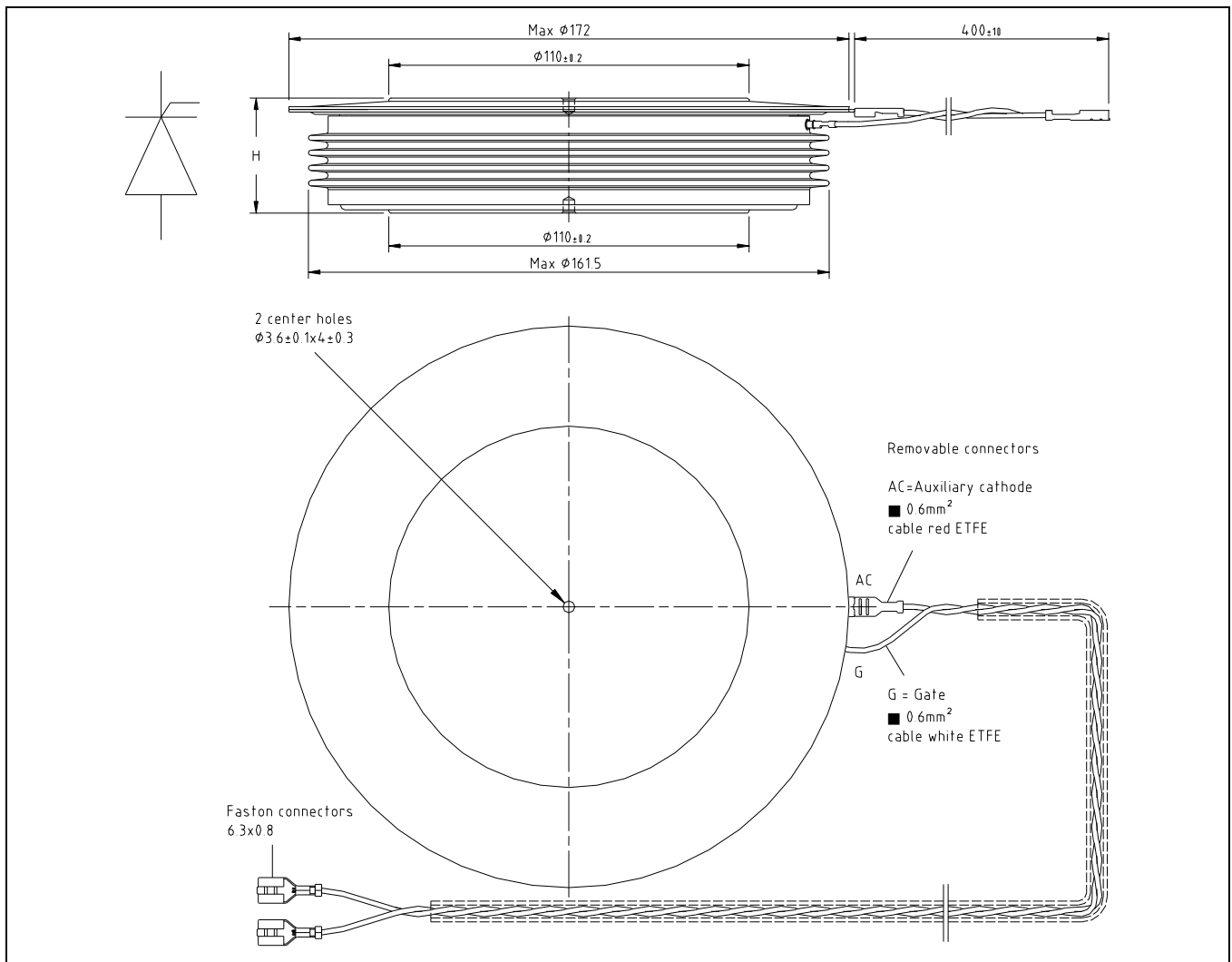


Fig. 16 Device Outline Drawing

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
5SYA 2102	Surge currents for Phase Control Thyristors
5SZK 9104	Specification of environmental class for pressure contact diodes, PCTs and GTO, STORAGE
5SZK 9105	Specification of environmental class for pressure contact diodes, PCTs and GTO, TRANSPORTATION
5SZK 9115	Specification of environmental class for presspack Diodes, PCTs and GTOs, OPERATION (Industry)
5SZK 9116	Specification of environmental class for presspack Diodes, PCTs and GTOs, OPERATION (Traction)

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