

$V_{DRM} = 6500 \text{ V}$
 $I_{T(AV)M} = 3460 \text{ A}$
 $I_{T(RMS)} = 5440 \text{ A}$
 $I_{TSM} = 71.4 \times 10^3 \text{ A}$
 $V_{T0} = 1.24 \text{ V}$
 $r_T = 0.162 \text{ m}\Omega$

Phase Control Thyristor

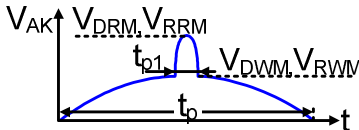
5STP 42U6500

Doc. No. 5SYA1043-03 May 07

- 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 42U6500	Unit
Max. surge peak forward and reverse blocking voltage	V_{DSM}, V_{RSM}	$t_p = 10 \text{ ms}, f = 5 \text{ Hz}$ $T_{vj} = 5 \dots 110^\circ\text{C}, \text{ Note 1}$	6500	V
Max repetitive peak forward and reverse blocking voltage	V_{DRM}, V_{RRM}	$f = 50 \text{ Hz}, t_p = 10 \text{ ms}, t_{p1} = 250 \mu\text{s}$ $T_{vj} = 5 \dots 110^\circ\text{C}, \text{ Note 1, Note 2}$	6500	V
Max crest working forward and reverse voltages	V_{DWM}, V_{RWM}		3300	V
Critical rate of rise of commutating voltage	dv/dt_{crit}	Exp. to 3750 V, $T_{vj} = 110^\circ\text{C}$	2000	V/ μs

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Forward leakage current	I_{DRM}	$V_{DRM}, T_{vj} = 110^\circ\text{C}$			700	mA
Reverse leakage current	I_{RRM}	$V_{RRM}, T_{vj} = 110^\circ\text{C}$			700	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		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	$F_M = 135 \text{ kN}, T_a = 25^\circ\text{C}$	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, $T_c = 70\text{ °C}$			3460	A
RMS on-state current	$I_{T(RMS)}$				5440	A
Peak non-repetitive surge current	I_{TSM}	$t_p = 10\text{ ms}$, $T_{vj} = 110\text{ °C}$, sine wave after surge: $V_D = V_R = 0\text{ V}$			71.4×10^3	A
Limiting load integral	I^2t				25.5×10^6	A^2s
Peak non-repetitive surge current	I_{TSM}	$t_p = 8.3\text{ ms}$, $T_{vj} = 110\text{ °C}$, sine wave after surge: $V_D = V_R = 0\text{ V}$			76.14×10^3	A
Limiting load integral	I^2t				24.6×10^6	A^2s

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
On-state voltage	V_T	$I_T = 3000\text{ A}$, $T_{vj} = 110\text{ °C}$			1.71	V
Threshold voltage	$V_{(T0)}$	$I_T = 2000\text{ A} - 6000\text{ A}$, $T_{vj} = 110\text{ °C}$			1.24	V
Slope resistance	r_T				0.162	$m\Omega$
Holding current	I_H	$T_{vj} = 25\text{ °C}$			200	mA
		$T_{vj} = 110\text{ °C}$			100	mA
Latching current	I_L	$T_{vj} = 25\text{ °C}$			900	mA
		$T_{vj} = 110\text{ °C}$			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}	$T_{vj} = 110\text{ °C}$, $I_{TRM} = 3000\text{ A}$, Cont. $f = 50\text{ Hz}$			250	$A/\mu s$
Critical rate of rise of on-state current	di/dt_{crit}	$V_D \leq 1880\text{ V}$, $I_{FG} = 2\text{ A}$, $t_r = 0.5\text{ }\mu s$ Cont. $f = 1\text{ Hz}$			1000	$A/\mu s$
Circuit-commutated turn-off time	t_q	$T_{vj} = 110\text{ °C}$, $I_{TRM} = 2000\text{ A}$, $V_R = 200\text{ V}$, $di_T/dt = -1.5\text{ A}/\mu s$, $V_D \leq 0.67 \cdot V_{DRM}$, $dv_D/dt = 20\text{ V}/\mu s$	800			μs

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Reverse recovery charge	Q_{rr}	$T_{vj} = 110\text{ °C}$, $I_{TRM} = 2000\text{ A}$, $V_R = 200\text{ V}$, $di_T/dt = -1.5\text{ A}/\mu s$	4000		5800	μAs
Reverse recovery current	I_{RM}		50		100	A
Gate turn-on delay time	t_{gd}	$T_{vj} = 25\text{ °C}$, $V_D = 0.4 \cdot V_{RM}$, $I_{FG} = 2\text{ A}$, $t_r = 0.5\text{ }\mu s$			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. 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 _{vjmax} = 110 °C	0.3			V
Gate non-trigger current	I _{GD}	V _D = 0.4 x V _{DRM} , T _{vjmax} = 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:

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

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

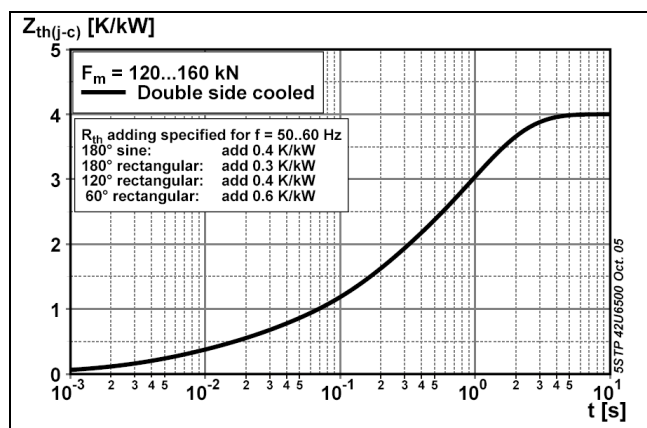


Fig. 1 Transient thermal impedance (junction-to-case) vs. time

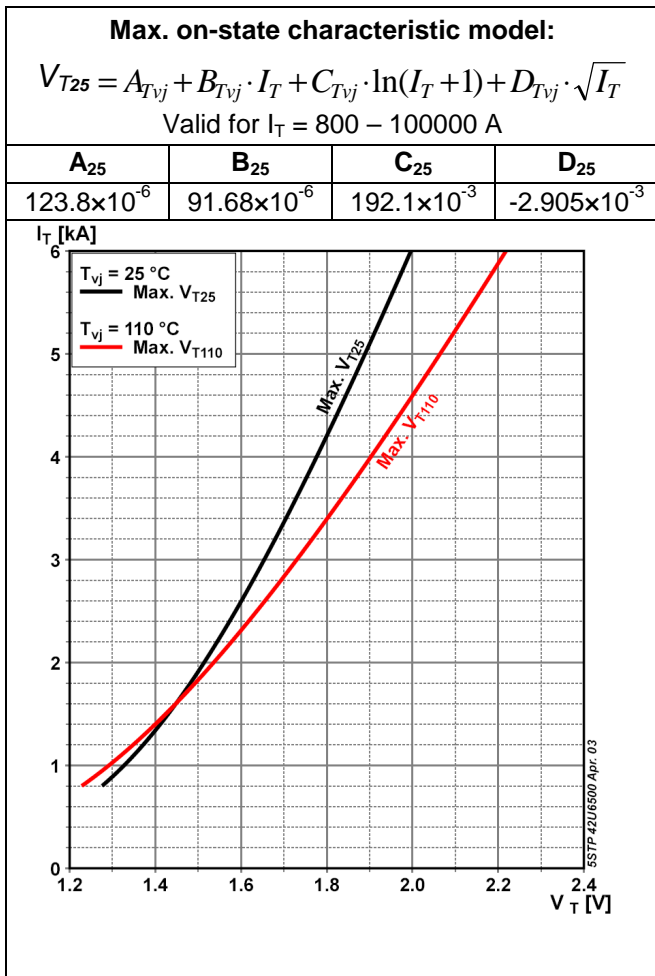


Fig. 2 On-state voltage characteristics

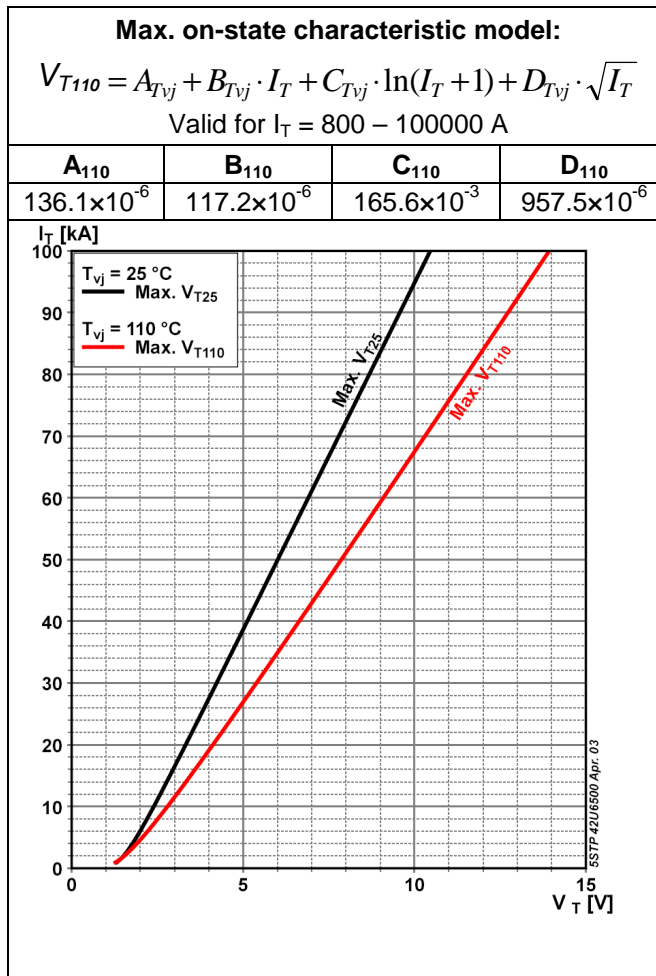


Fig. 3 On-state voltage characteristics

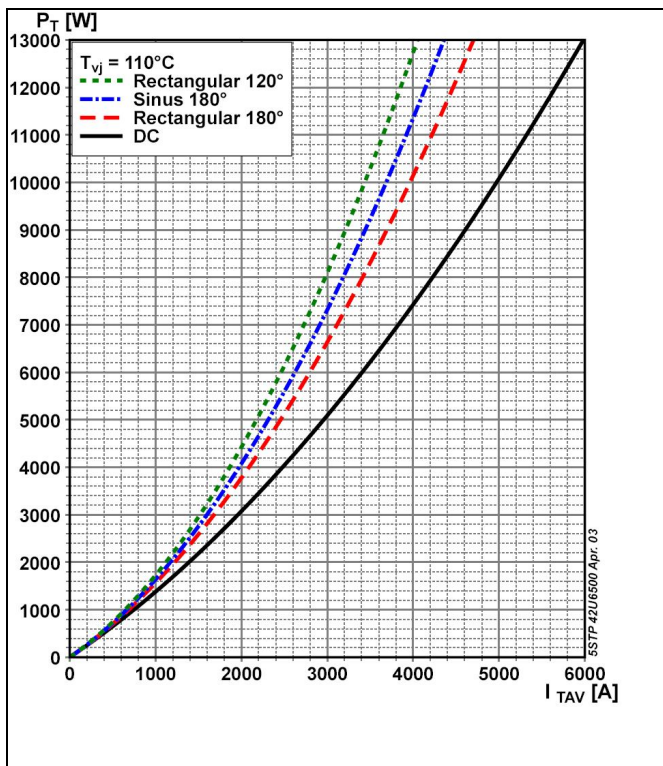


Fig. 4 On-state power dissipation vs. mean on-state current, turn-on losses excluded

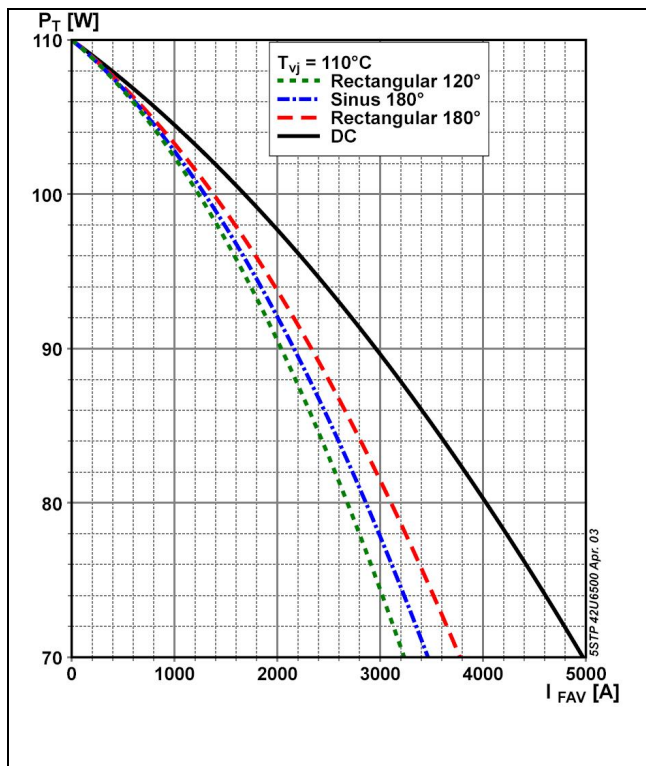


Fig. 5 Max. permissible case temperature vs. mean on-state current, switching losses ignored

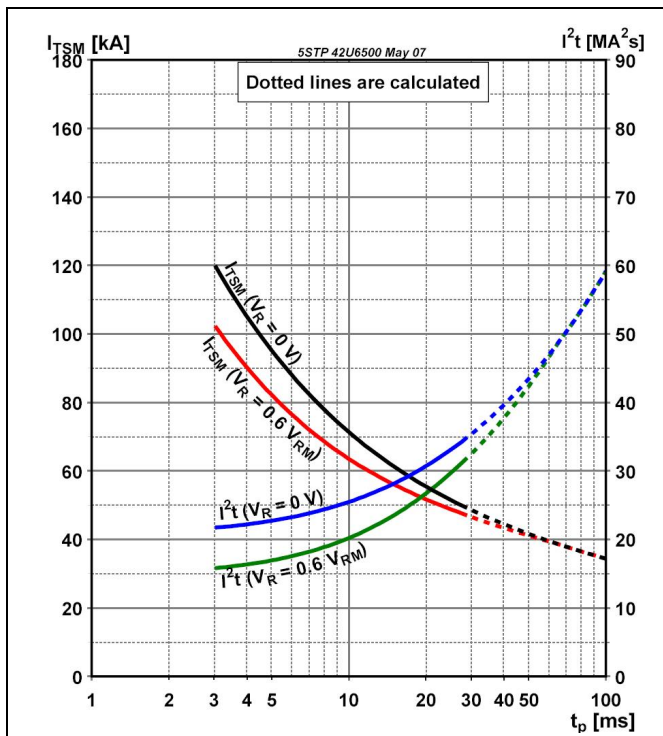


Fig. 6 Surge on-state current vs. pulse length, half-sine wave

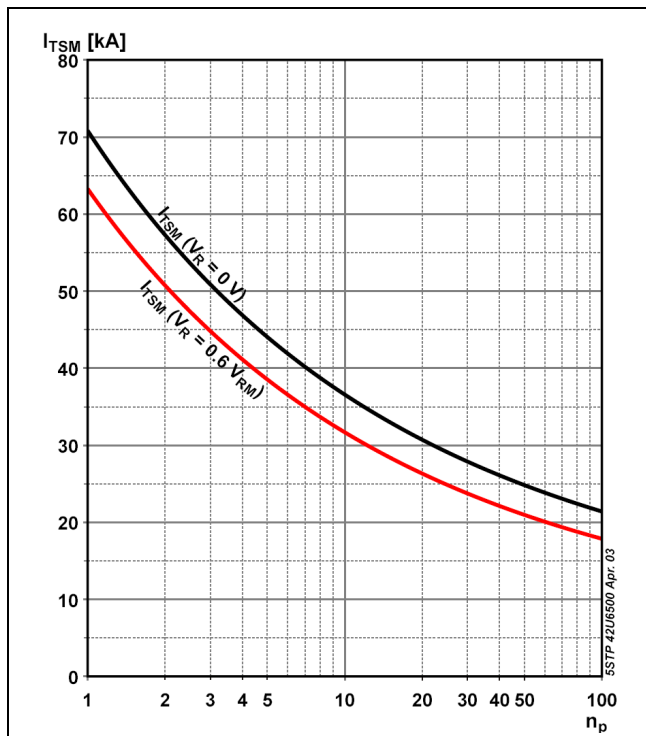


Fig. 7 Surge on-state current vs. number of pulses, half-sine wave, 10 ms, 50Hz

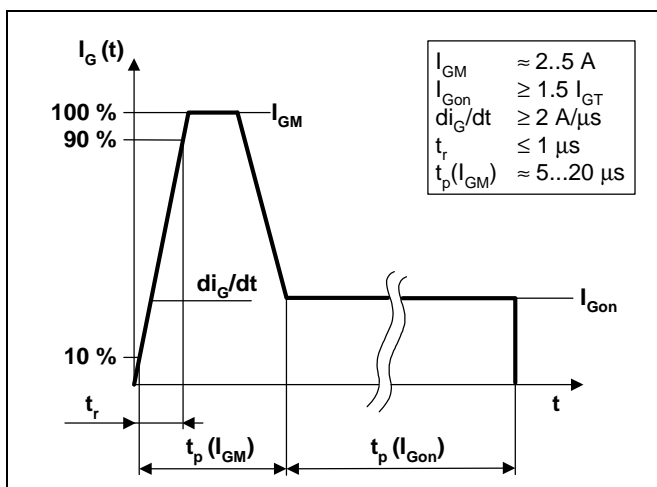


Fig. 8 Recommended gate current waveform

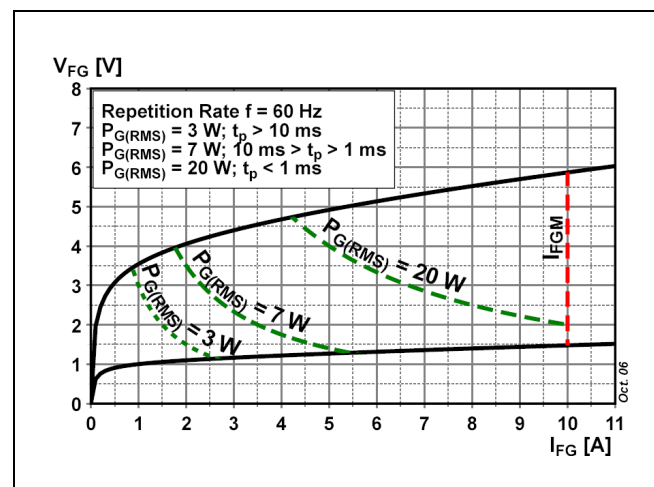


Fig. 9 Max. peak gate power loss

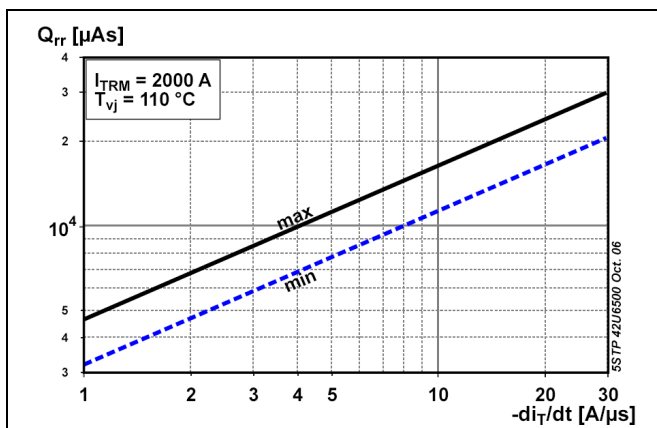


Fig. 10 Reverse recovery charge vs. decay rate of on-state current

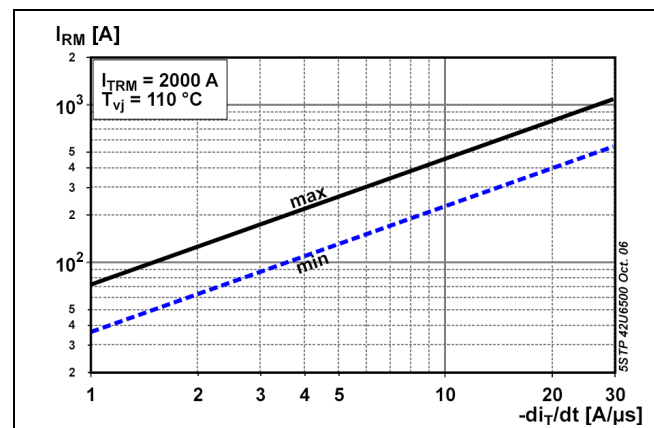


Fig. 11 Peak reverse recovery current vs. decay rate of on-state current

Turn-on and Turn-off losses

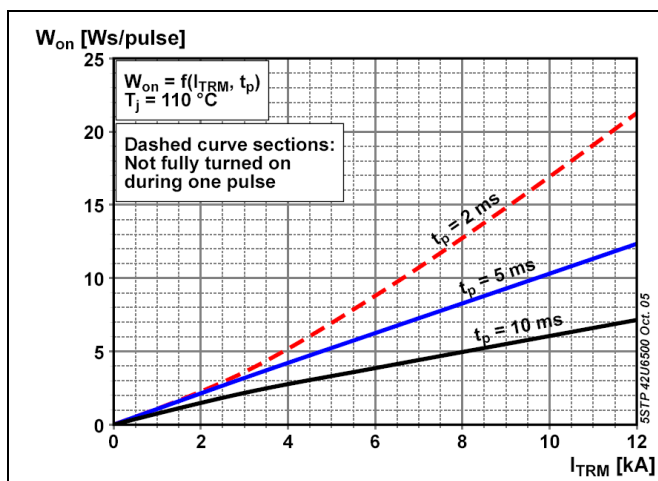


Fig. 12 Turn-on energy, half sinusoidal waves

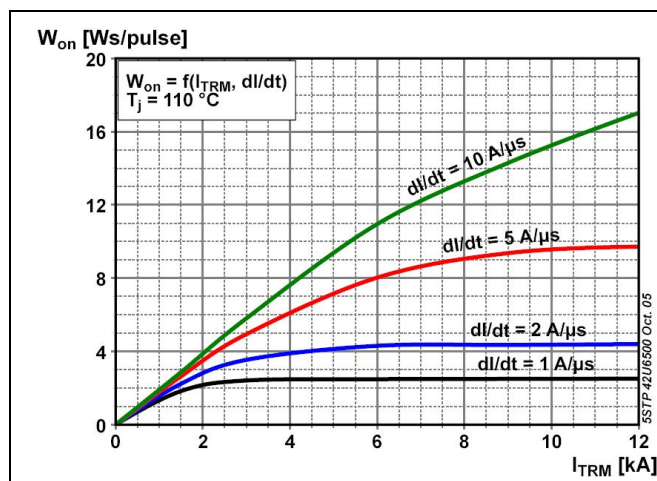


Fig. 13 Turn-on energy, rectangular waves

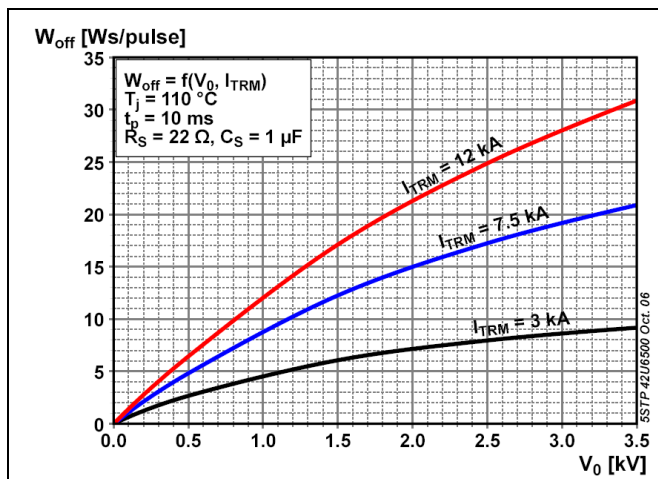


Fig. 14 Turn-off energy, half sinusoidal waves

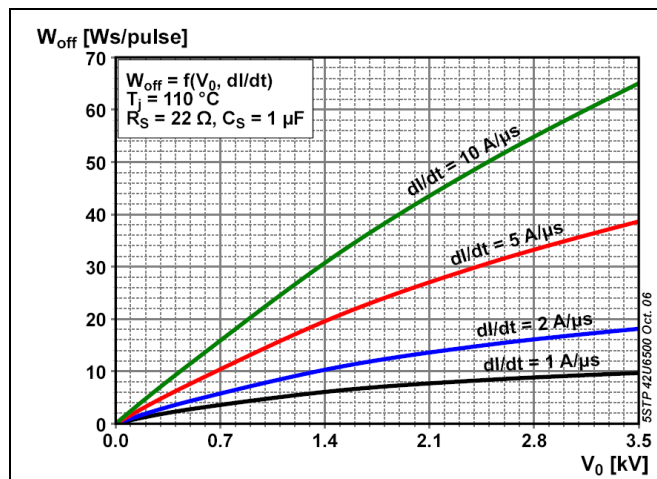


Fig. 15 Turn-off energy, rectangular waves

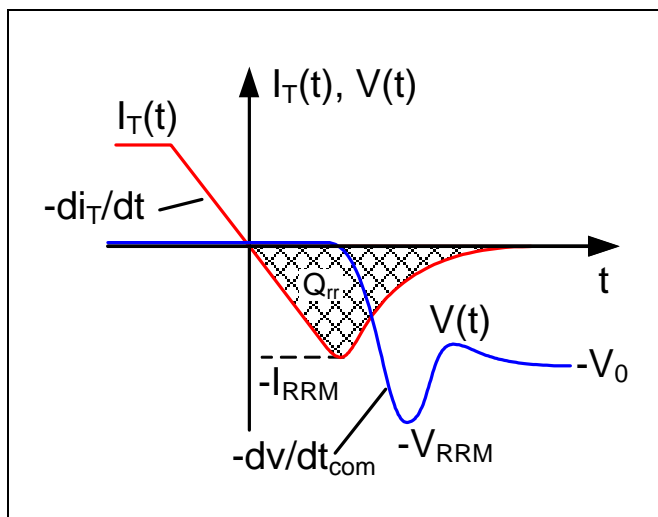


Fig. 16 Current and voltage waveforms at turn-off

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

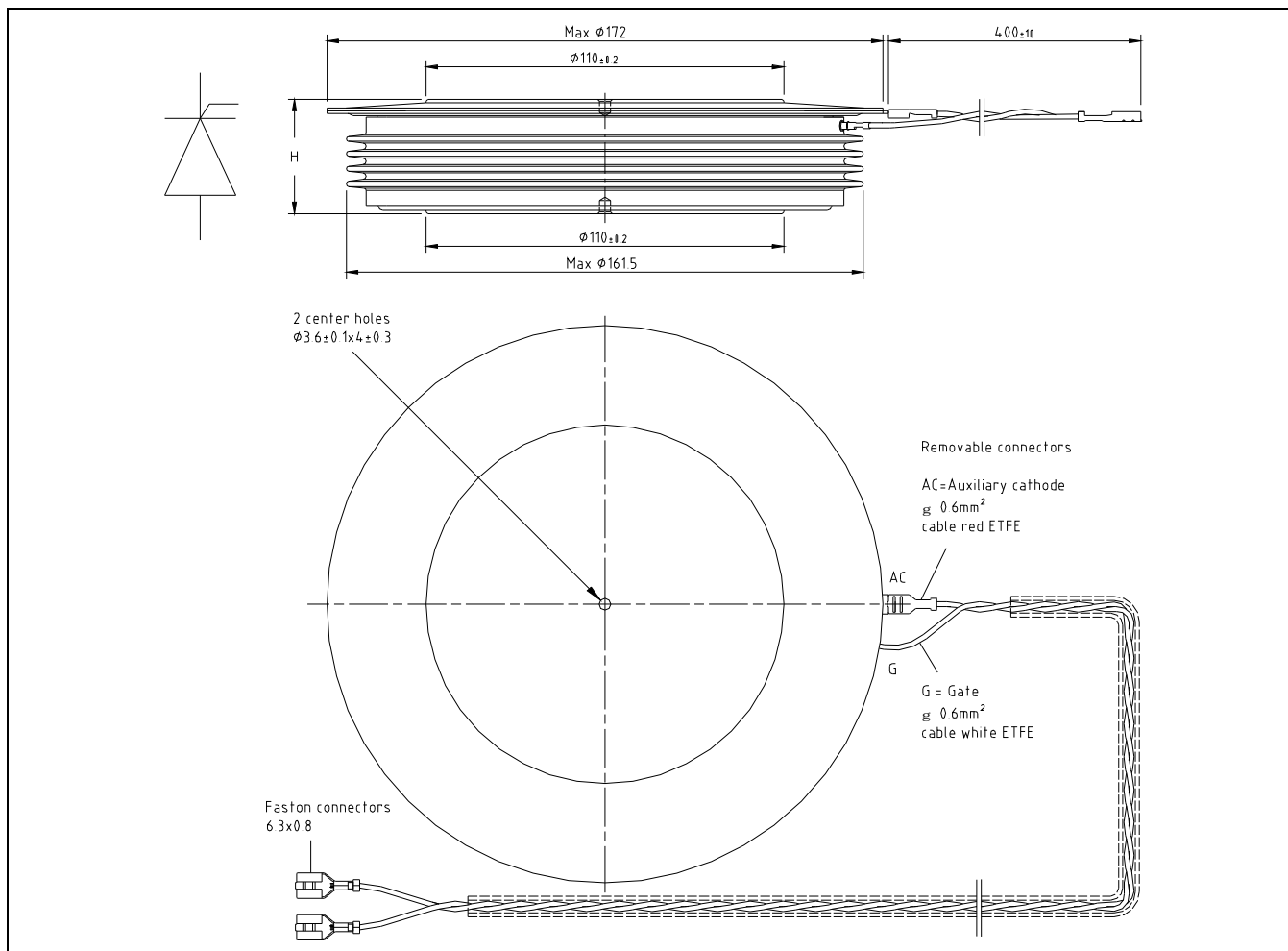


Fig. 18 Device Outline Drawing

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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