V_{DRM}	= 5600	V
V_{DSM}	= 6500	V
$I_{T(AV)M}$	= 3460	A
$I_{T(RMS)}$	= 5440	A
I_{TSM}	= 71.4×10^3	A
$V_{(T0)}$	= 1.24	V
r_T	= 0.162	mΩ

Phase Control Thyristor

5STP 42U6500

Doc. No. 5SYA1043-02 Oct. 04

- **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)]

Symbol	Conditions	5STP 42U6500	5STP 42U6200	5STP 42U5800
V_{DSM}, V_{RSM}	f = 5 Hz, t_p = 10 ms	6500 V	6200 V	5800 V
V_{DRM}, V_{RRM}	f = 50 Hz, t_p = 10 ms	5600 V	5300 V	4900 V
V_{RSM}	t_p = 5 ms, single pulse	7000 V	6700 V	6300 V
dV/dt_{crit}	Exp. to 3750 V, T_{vj} = 110°C	2000 V/µs		

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Forward leakage current	I_{DSM}	V_{DSM}, T_{vj} = 110°C			700	mA
Reverse leakage current	I_{RSM}	V_{RSM}, T_{vj} = 110°C			700	mA

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	34.8		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

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			3460	A
RMS on-state current	$I_{T(RMS)}$				5440	A
Peak non-repetitive surge current	I_{TSM}	tp = 10 ms, T_{vj} = 110 °C, $V_D = V_R$ = 0 V			71.4×10^3	A
Limiting load integral	I^2t				25.48×10^6	A^2s
Peak non-repetitive surge current	I_{TSM}	tp = 8.3 ms, T_{vj} = 110 °C, $V_D = V_R$ = 0 V			76.14×10^3	A
Limiting load integral	I^2t				24.64×10^6	A^2s

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
On-state voltage	V_T	I_T = 3000 A, T_{vj} = 110 °C			1.71	V
Threshold voltage	$V_{(T0)}$	I_T = 2000 A - 6000 A, T_{vj}= 110 °C			1.24	V
Slope resistance	r_T				0.162	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}	$V_D \le$ 1880 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} = 3000 A, V_R = 200 V, di_T/dt = -1 A/µs, $V_D \le 0.67 \cdot V_{DRM}$, dv_D/dt = 20V/µs		800			µs

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Recovery charge	Q_{rr}	T_{vj} = 110°C, I_{TRM} = 3000 A, V_R = 200 V, di_T/dt = -1 A/µs	4200		5200	µAs
Gate turn-on delay time	t_{gd}	$V_D = 0.4 \cdot V_{RM}$, I_{FG} = 2 A, t_r = 0.5 µs, T_{vj} = 25 °C			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			

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:

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

i	1	2	3	4
$R_{th\,i}$(K/kW)	2.695	0.814	0.330	0.162
τ_i(s)	0.9692	0.1332	0.0177	0.0042

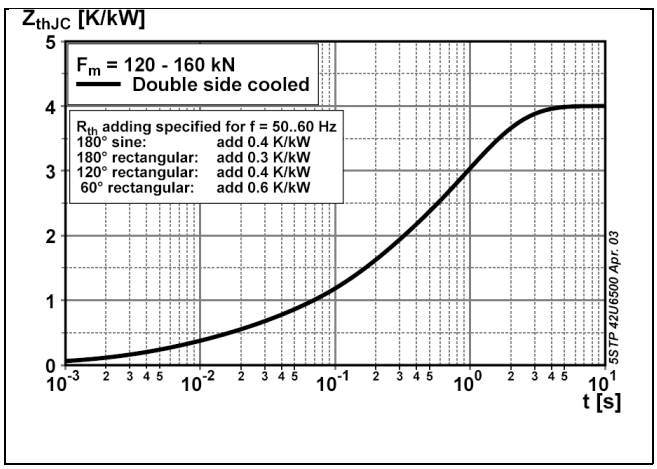

Fig. 1 Transient thermal impedance junction-to case.

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 = 800 – 100000 A

A_{25}	B_{25}	C_{25}	D_{25}
123.80×10^{-6}	91.68×10^{-6}	192.1×10^{-3}	-2.91×10^{-3}

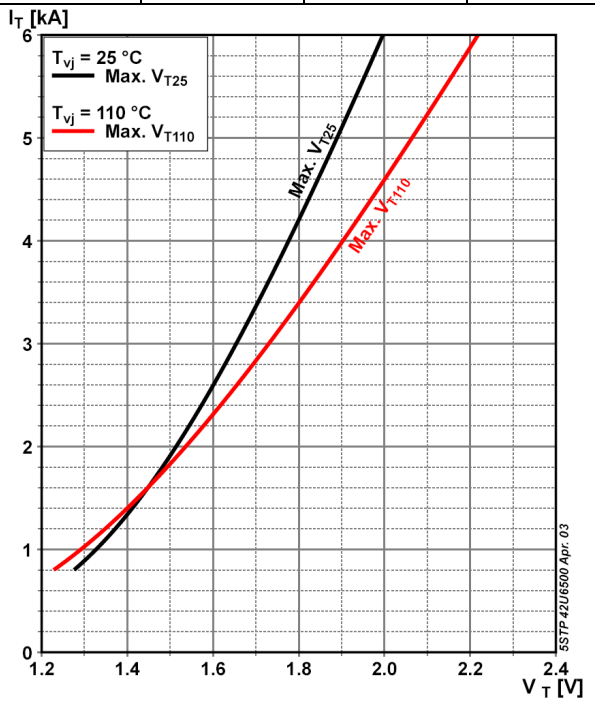

Fig. 2 Max. on-state voltage characteristics

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 = 800 – 100000 A

A_{110}	B_{110}	C_{110}	D_{110}
136.10×10^{-6}	117.20×10^{-6}	165.60×10^{-3}	957.50×10^{-6}

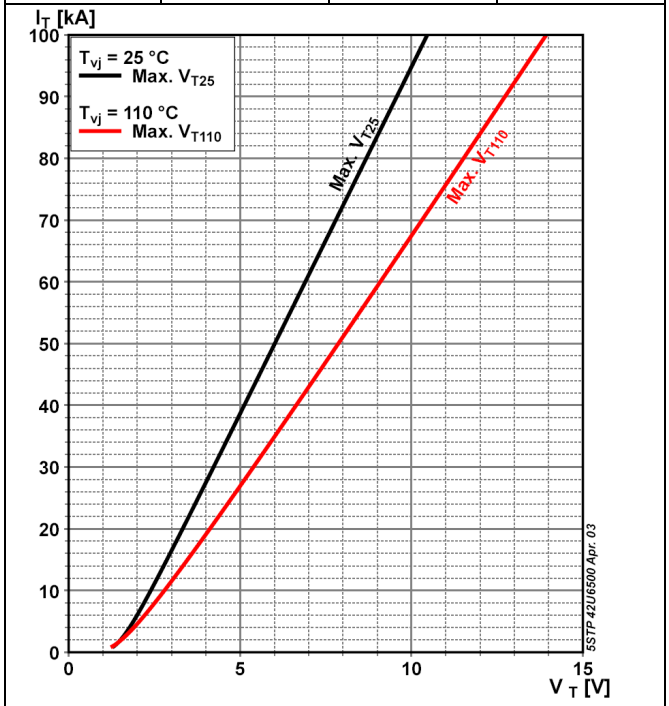

Fig. 3 Max. on-state voltage characteristics

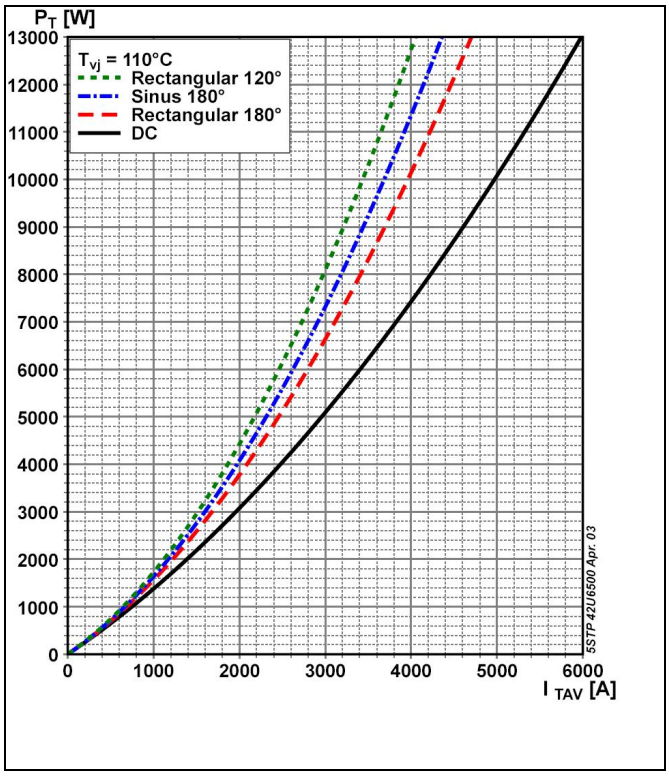

Fig. 4 On-state power dissipation vs. mean on-state current. Turn-on losses excluded.

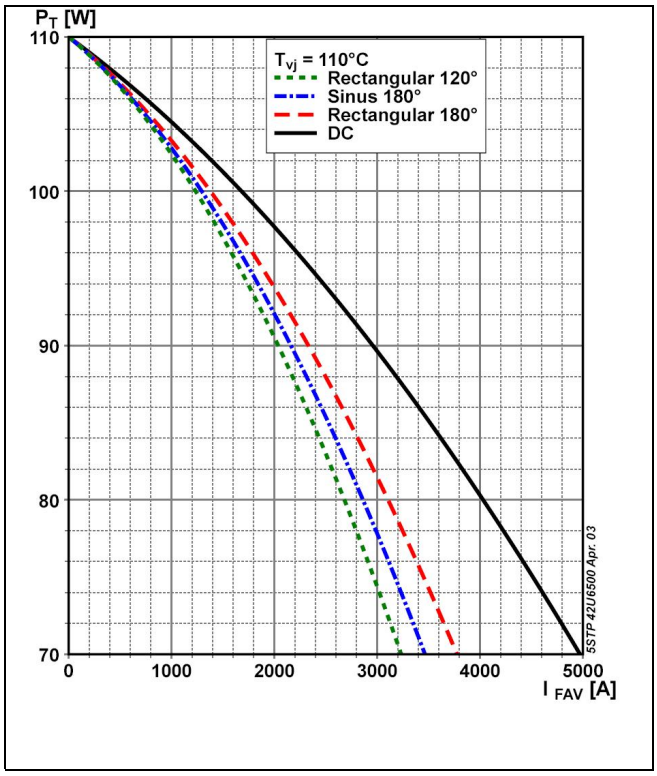

Fig. 5 Max. permissible case temperature vs. mean on-state current.

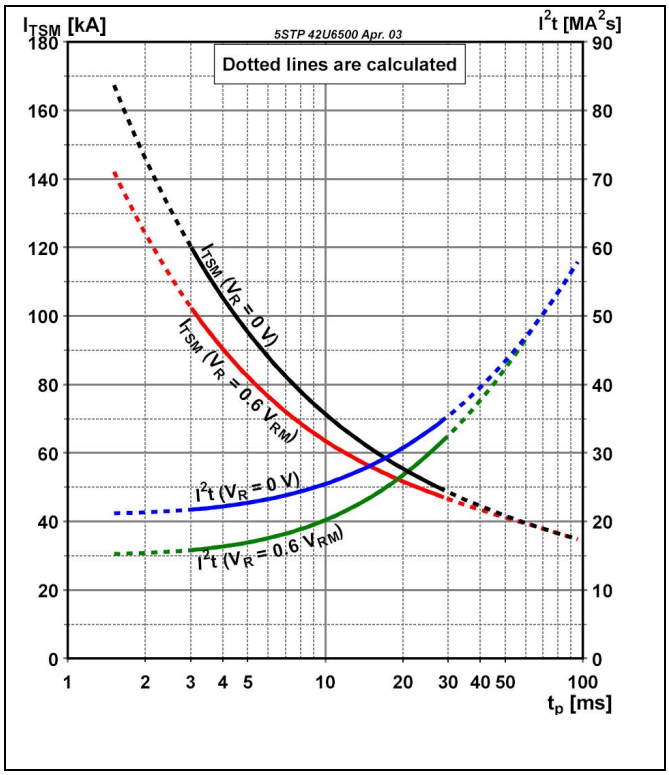

Fig. 6 Surge on-state current vs. pulse length. Half-sine wave.

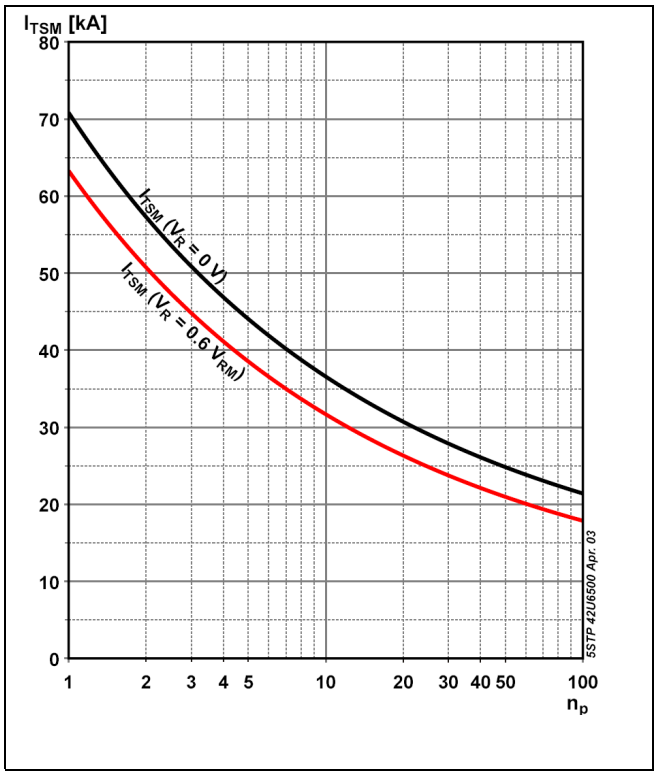

Fig. 7 Surge on-state current vs. number of pulses. Half-sine wave, 10 ms, 50Hz.

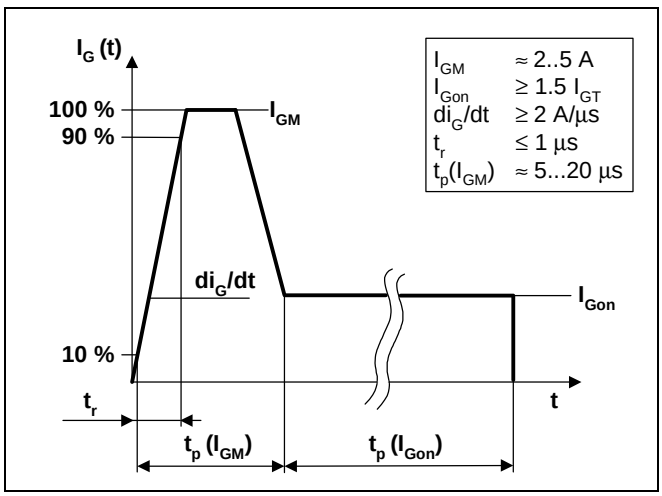

Fig. 8 Recommended gate current waveform.

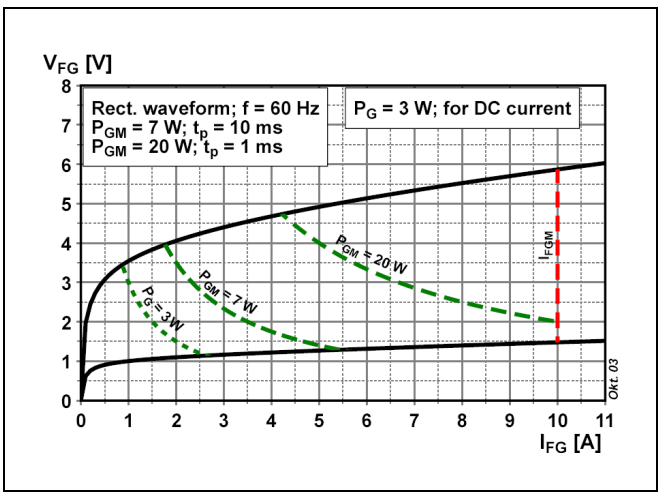

Fig. 9 Max. peak gate power loss.

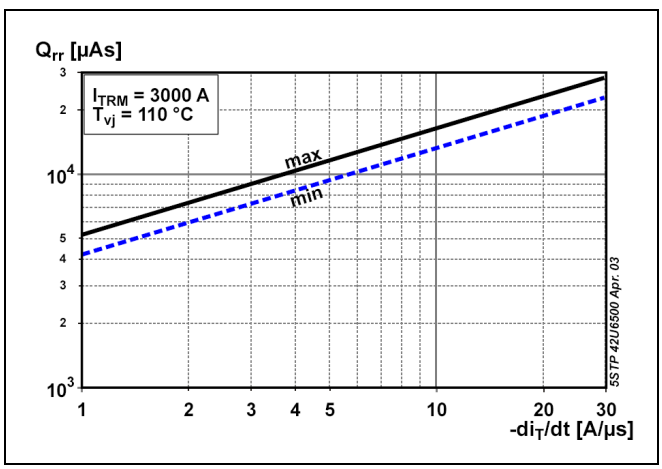

Fig. 10 Recovery charge vs. decay rate of on-state current.

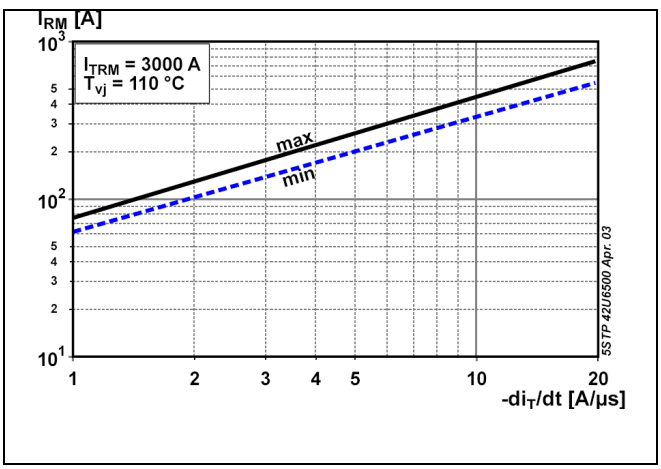

Fig. 11 Peak reverse recovery current vs. decay rate of on-state current.

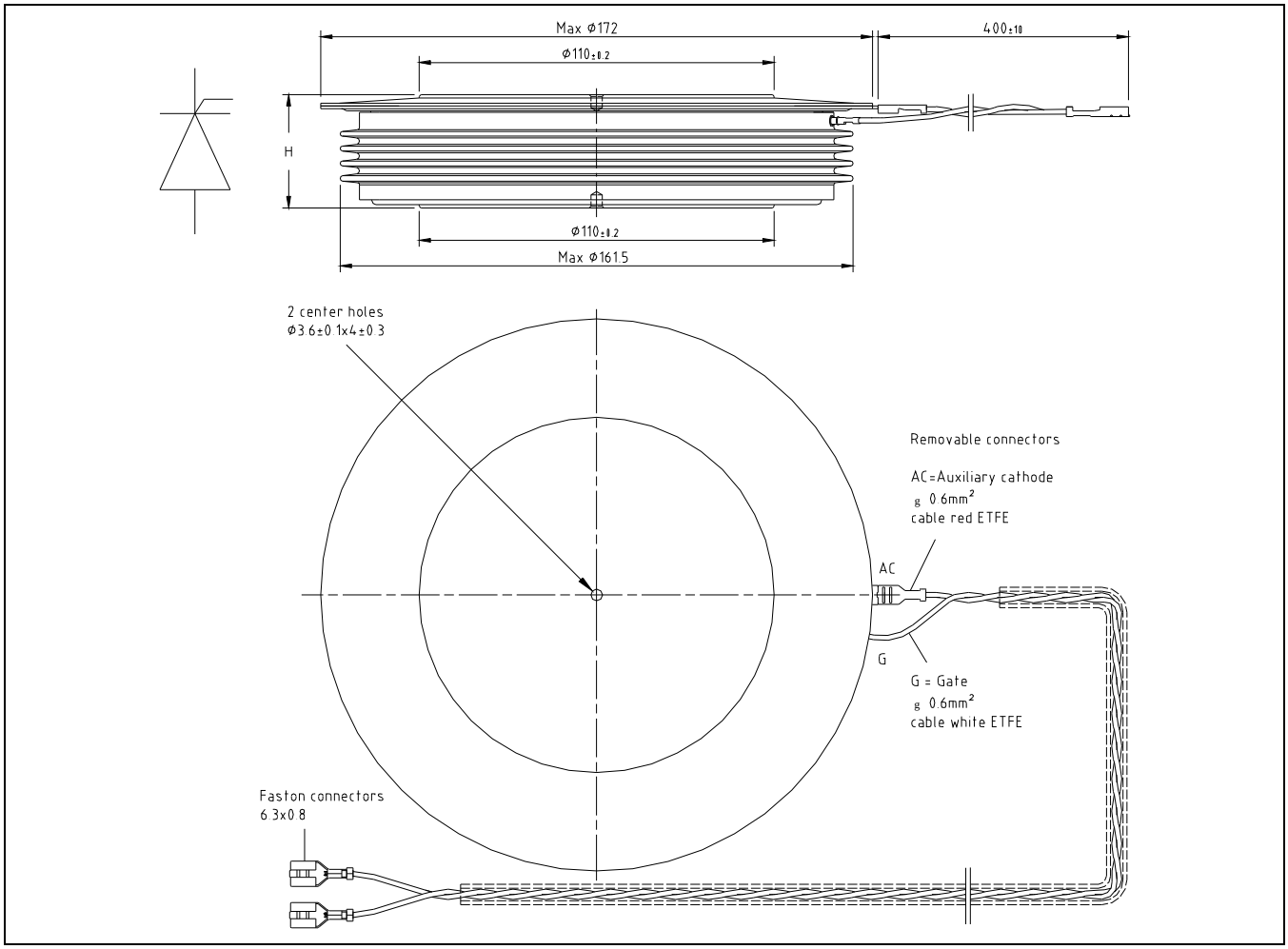

Fig. 12 Device Outline Drawing.

Related application notes:

Doc. Nr	Titel
5SYA2020	Design of RC-Snubber for Phase Control Applications
5SYA2034	Gate-drive Recommendations for PCT's
5SYA 2036	Recommendations regarding mechanical clamping of Press Pack High Power Semiconductors

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