

$V_{DSM}$	=	6500 V
$I_{TAVM}$	=	1370 A
$I_{TRMS}$	=	2160 A
$I_{TSM}$	=	21900 A
$V_{T0}$	=	1.18 V
$r_T$	=	0.632 m $\Omega$

## Phase Control Thyristor

# 5STP 12K6500

Doc. No. 5SYA1069-01 June 02

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

### Blocking

Maximum rated values <sup>1)</sup>

Symbol	Conditions	5STP 12K6500	5STP 12K6200	5STP 12K5800
$V_{DSM}, V_{RSM}$	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
$dV/dt_{crit}$	Exp. to 0.67 x $V_{DRM}$ , $T_{vj}$ = 125°C	2000 V/ $\mu$ s		

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Forward leakage current	$I_{DSM}$	$V_{DSM}$ , $T_{vj}$ = 125°C			600	mA
Reverse leakage current	$I_{RSM}$	$V_{RSM}$ , $T_{vj}$ = 125°C			600	mA

$V_{DRM}/V_{RRM}$  are equal to  $V_{DSM}/V_{RSM}$  values up to  $T_{vj}$  = 110°C

### Mechanical data

Maximum rated values <sup>1)</sup>

Parameter	Symbol	Conditions	min	typ	max	Unit
Mounting force	$F_M$		45	50	60	kN
Acceleration	a	Device unclamped			50	m/s <sup>2</sup>
Acceleration	a	Device clamped			100	m/s <sup>2</sup>

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Weight	m			1.15		kg
Surface creepage distance	$D_s$		45			mm
Air strike distance	$D_a$		24			mm

<sup>1)</sup> Maximum ratings are those values beyond which damage to the device may occur

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## On-state

Maximum rated values <sup>1)</sup>

Parameter	Symbol	Conditions	min	typ	max	Unit
Average on-state current	$I_{TAVM}$	Half sine wave, $T_c = 70^\circ\text{C}$			1370	A
RMS on-state current	$I_{TRMS}$				2160	A
Peak non-repetitive surge current	$I_{TSM}$	$t_p = 10\text{ ms}$ , $T_{vj} = 125^\circ\text{C}$ , $V_D = V_R = 0\text{ V}$			21900	A
Limiting load integral	$I^2t$				2400	$\text{kA}^2\text{s}$
Peak non-repetitive surge current	$I_{TSM}$	$t_p = 8.3\text{ ms}$ , $T_{vj} = 125^\circ\text{C}$ , $V_D = V_R = 0\text{ V}$			23350	A
Limiting load integral	$I^2t$				2260	$\text{kA}^2\text{s}$

### Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
On-state voltage	$V_T$	$I_T = 1500\text{ A}$ , $T_{vj} = 125^\circ\text{C}$			2.12	V
Threshold voltage	$V_{T0}$	$I_T = 800\text{ A} - 2000\text{ A}$ , $T_{vj} = 125^\circ\text{C}$			1.18	V
Slope resistance	$r_T$				0.632	$\text{m}\Omega$
Holding current	$I_H$	$T_{vj} = 25^\circ\text{C}$			125	mA
		$T_{vj} = 125^\circ\text{C}$			75	mA
Latching current	$I_L$	$T_{vj} = 25^\circ\text{C}$			600	mA
		$T_{vj} = 125^\circ\text{C}$			200	mA

## Switching

Maximum rated values <sup>1)</sup>

Parameter	Symbol	Conditions	min	typ	max	Unit
Critical rate of rise of on-state current	$di/dt_{crit}$	$T_{vj} = 125^\circ\text{C}$ , $I_{TRM} = 800\text{ A}$ , $V_D \leq 3250\text{ V}$ , $I_{FG} = 2\text{ A}$ , $t_r = 0.5\ \mu\text{s}$			400	$\text{A}/\mu\text{s}$
Critical rate of rise of on-state current	$di/dt_{crit}$		Cont. $f = 50\text{ Hz}$			1000
Circuit-commutated turn-off time	$t_q$	$T_{vj} = 125^\circ\text{C}$ , $I_{TRM} = 2000\text{ A}$ , $V_R = 200\text{ V}$ , $di_T/dt = -1\text{ A}/\mu\text{s}$ , $V_D \leq 0.67 \cdot V_{DRM}$ , $dV_D/dt = 20\text{ V}/\mu\text{s}$ ,	800			$\mu\text{s}$

### Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Recovery charge	$Q_{rr}$	$T_{vj} = 125^\circ\text{C}$ , $I_{TRM} = 2000\text{ A}$ , $V_R = 200\text{ V}$ , $di_T/dt = -1\text{ A}/\mu\text{s}$	1600		2600	$\mu\text{As}$
Delay time	$t_d$	$V_D = 0.4 \cdot V_{DRM}$ , $I_{FG} = 2\text{ A}$ , $t_r = 0.5\ \mu\text{s}$			3	$\mu\text{s}$

## Triggering

Maximum rated values <sup>1)</sup>

Parameter	Symbol	Conditions	min	typ	max	Unit
Peak forward gate voltage	V <sub>FGM</sub>				12	V
Peak forward gate current	I <sub>FGM</sub>				10	A
Peak reverse gate voltage	V <sub>RGM</sub>				10	V
Gate power loss	P <sub>G</sub>	For DC gate current			3	W
Average gate power loss	P <sub>GAV</sub>		see Fig. 9			

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Gate trigger voltage	V <sub>GT</sub>	T <sub>vj</sub> = 25°C			2.6	V
Gate trigger current	I <sub>GT</sub>	T <sub>vj</sub> = 25°C			400	mA
Gate non-trigger voltage	V <sub>GD</sub>	V <sub>D</sub> = 0.4 x V <sub>DRM</sub> , T <sub>vjmax</sub> = 125°C	0.3			V
Gate non-trigger current	I <sub>GD</sub>	V <sub>D</sub> = 0.4 x V <sub>DRM</sub> , T <sub>vjmax</sub> = 125°C	10			mA

## Thermal

Maximum rated values <sup>1)</sup>

Parameter	Symbol	Conditions	min	typ	max	Unit
Operating junction temperature range	T <sub>vj</sub>				125	°C
Storage temperature range	T <sub>stg</sub>		-40		140	°C

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Thermal resistance junction to case	R <sub>th(j-c)</sub>	Double-side cooled			11	K/kW
	R <sub>th(j-c)A</sub>	Anode-side cooled			22	K/kW
	R <sub>th(j-c)C</sub>	Cathode-side cooled			22	K/kW
Thermal resistance case to heatsink	R <sub>th(c-h)</sub>	Double-side cooled			2	K/kW
	R <sub>th(c-h)</sub>	Single-side cooled			4	K/kW

Analytical function for transient thermal impedance:

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

i	1	2	3	4
R <sub>i</sub> (K/kW)	7.3	2.42	0.81	0.4
τ <sub>i</sub> (s)	0.987943	0.09946	0.015662	0.004019

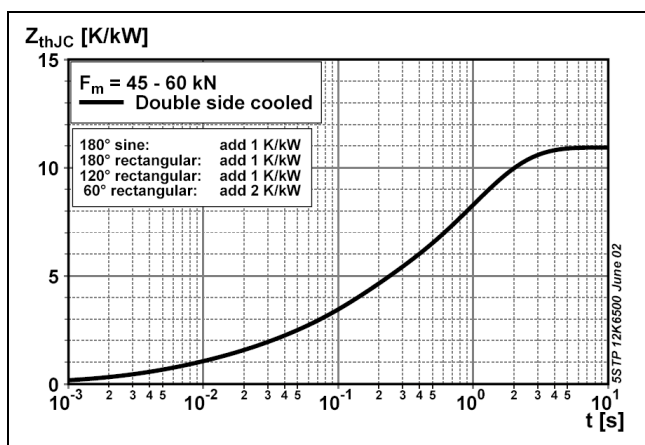


Fig. 1 Transient thermal impedance junction-to case.

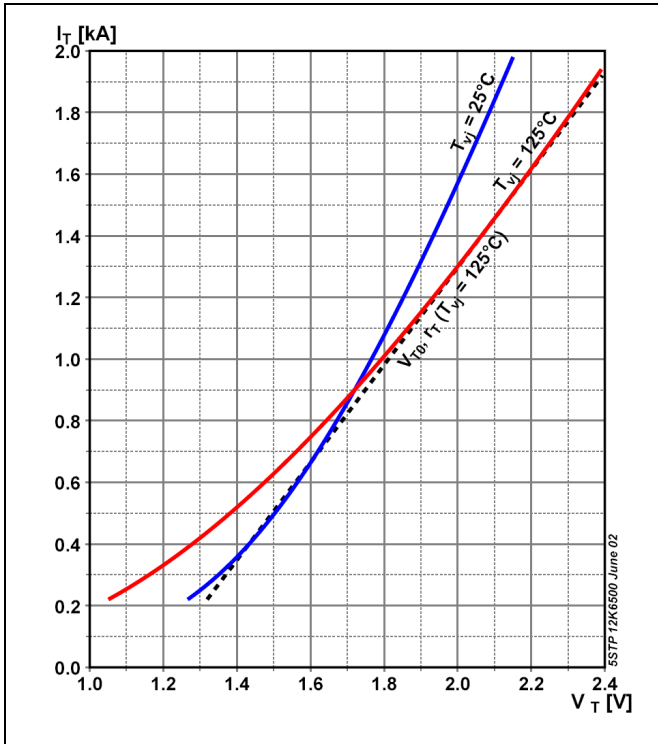


Fig. 2 Isothermal on-state characteristics

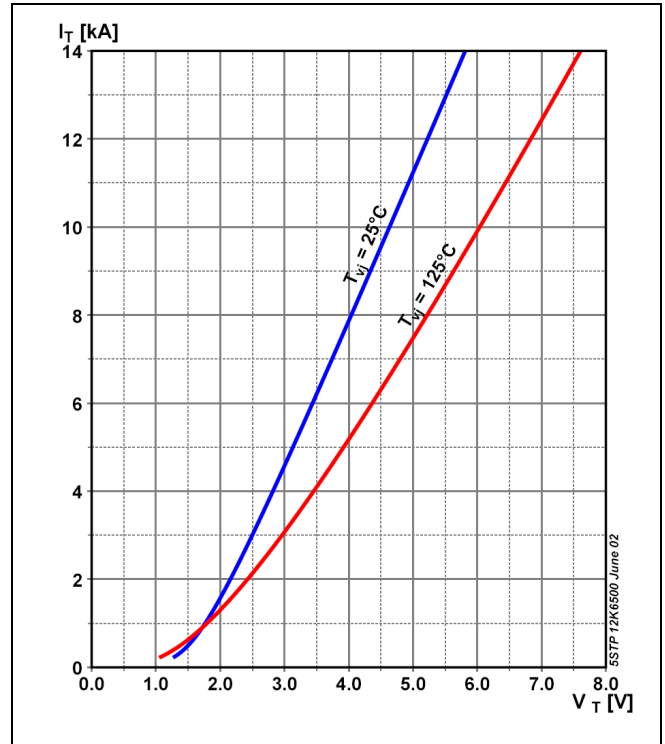


Fig. 3 Isothermal on-state characteristics

Isothermal on-state characteristic model:

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

T<sub>vj</sub> = 25°C, Valid for I<sub>T</sub> = 200 – 14000 A

A <sub>1</sub>	B <sub>1</sub>	C <sub>1</sub>	D <sub>1</sub>
1.1999e-5	3.0014e-4	2.3761e-1	-5.5612e-3

T<sub>vj</sub> = 125°C, Valid for I<sub>T</sub> = 200 – 14000 A

A <sub>2</sub>	B <sub>2</sub>	C <sub>2</sub>	D <sub>2</sub>
1.9773e-4	2.9592e-4	1.3114e-1	1.8702e-2

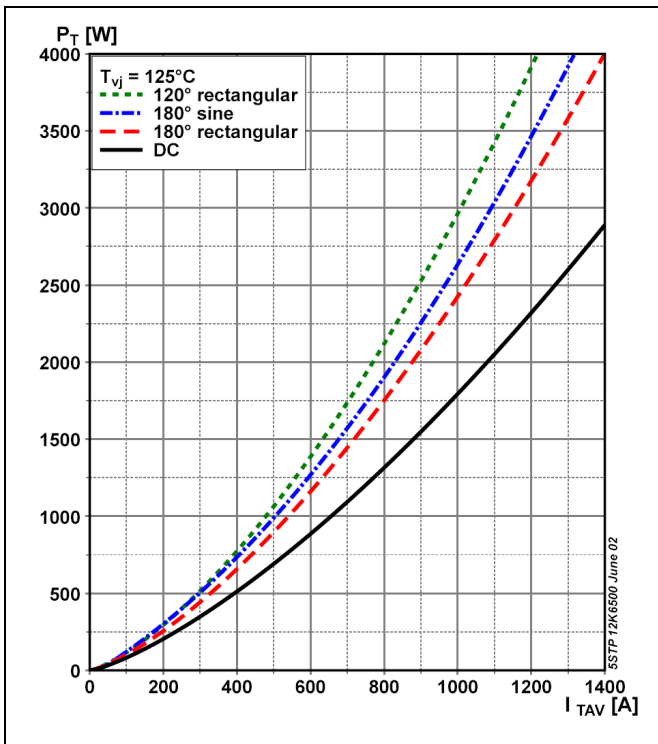


Fig. 4 On-state power dissipation vs. mean on-state current. Turn - on losses excluded.

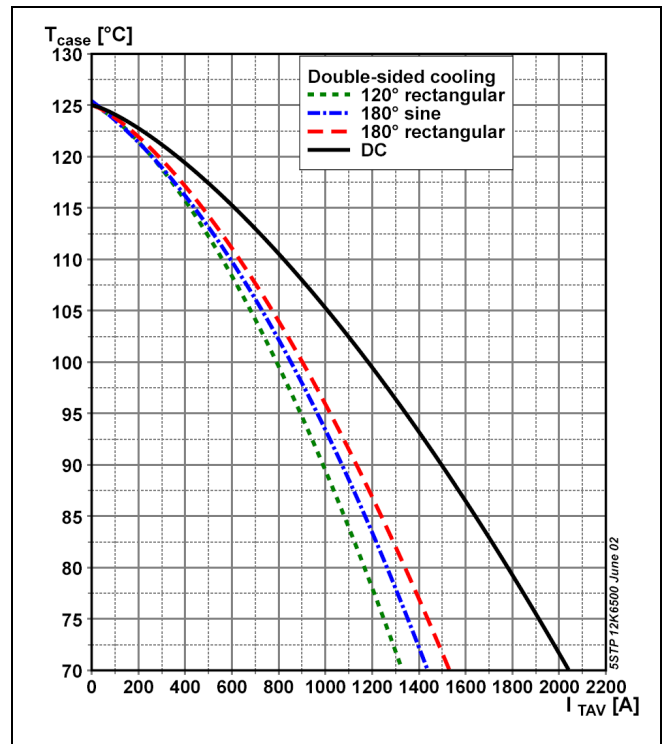


Fig. 5 Max. permissible case temperature vs. mean on-state current.

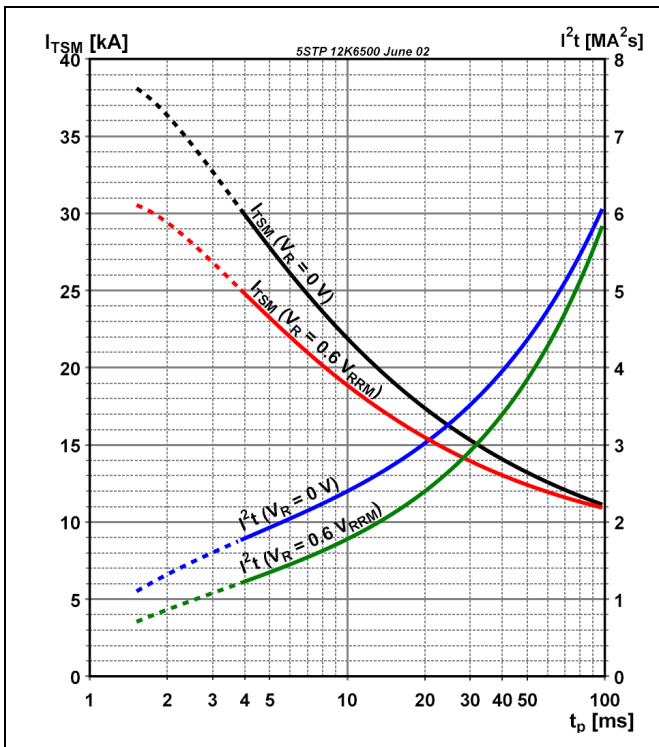


Fig. 6 Surge on-state current vs. pulse length. Half-sine wave.

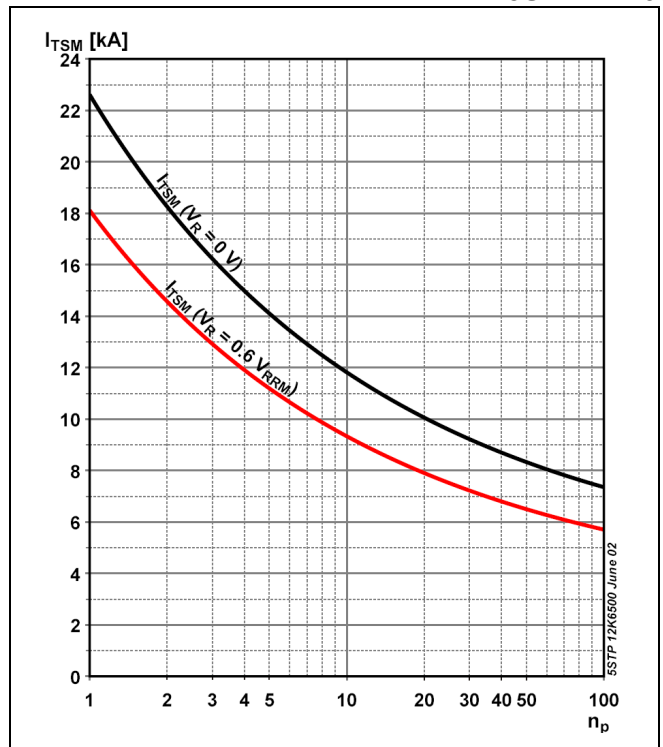


Fig. 7 Surge on-state current vs. number of pulses. Half-sine wave, 10 ms, 50Hz.

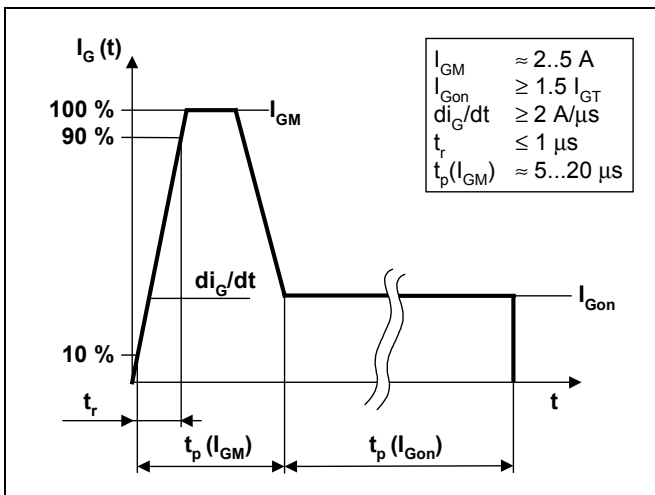


Fig. 8 Recommended gate current waveform.

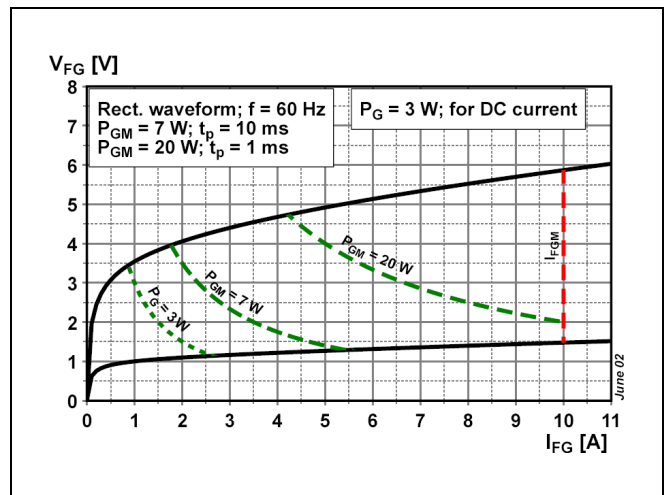


Fig. 9 Max. peak gate power loss.

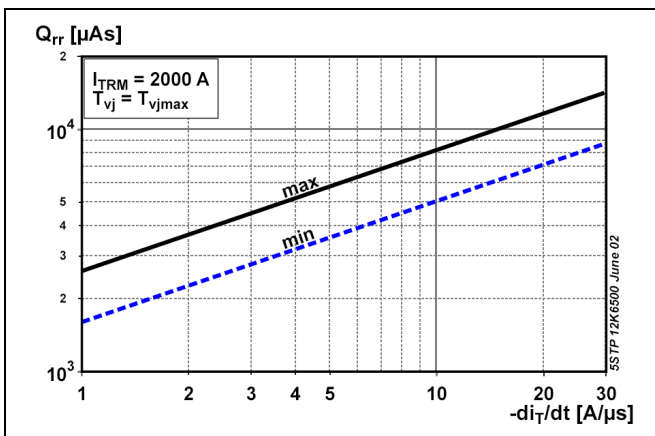


Fig. 10 Recovery charge vs. decay rate of on-state current.

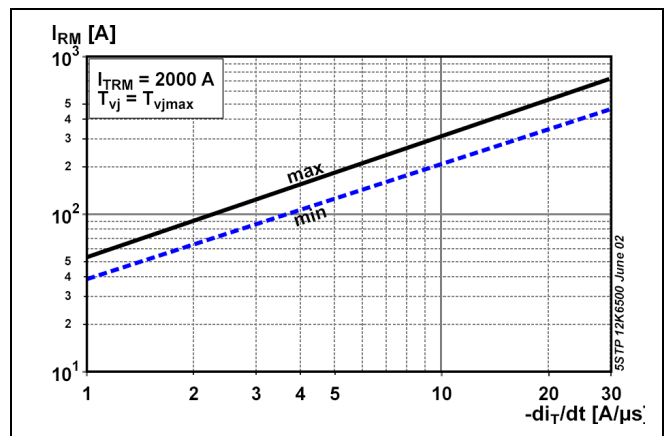


Fig. 11 Peak reverse recovery current vs. decay rate of on-state current.

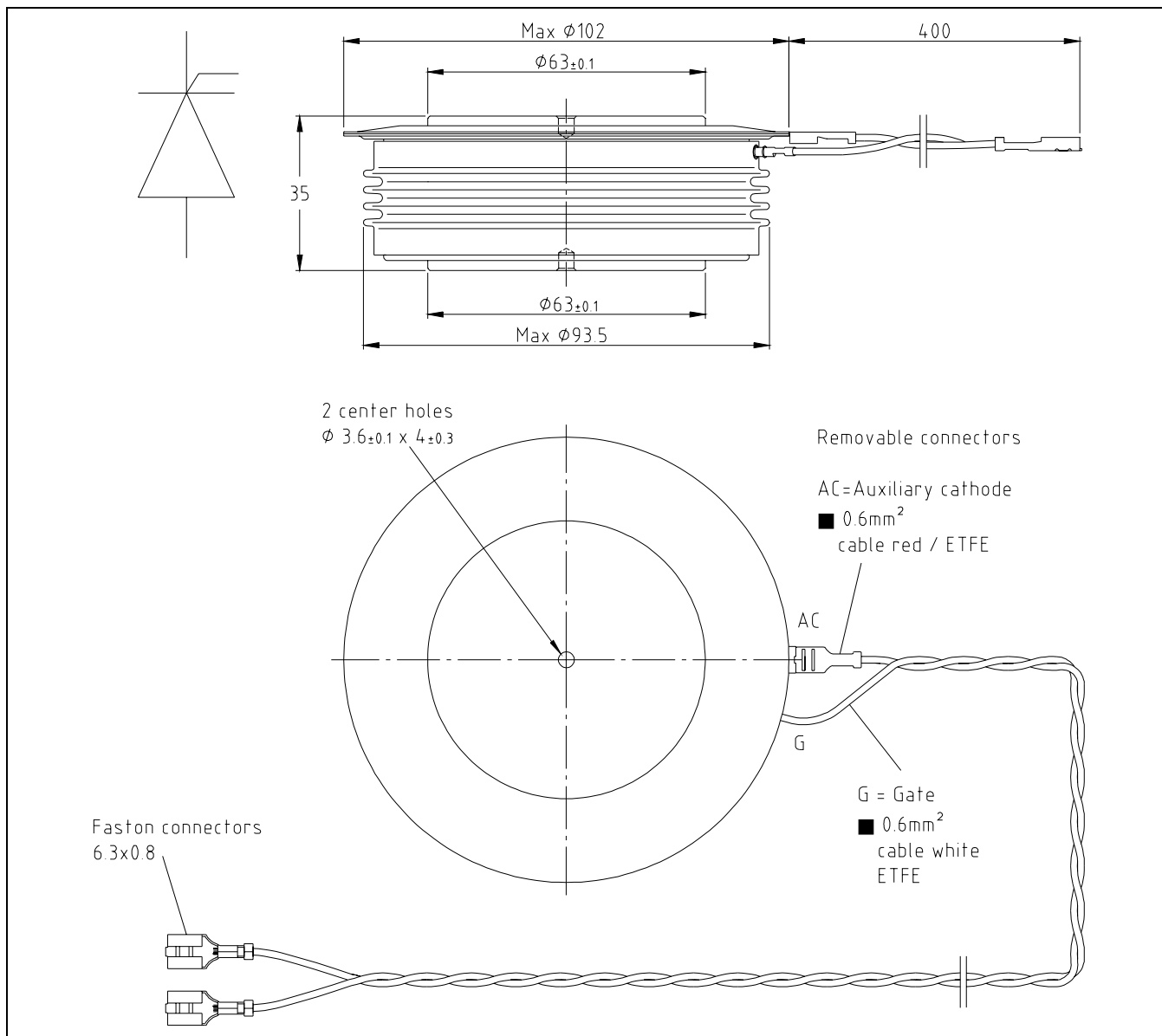


Fig. 12 Device Outline Drawing.

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