V_{DRM}	= 8000	V
V_{DSM}	= 8500	V
$I_{T(AV)M}$	= 1200	A
$I_{T(RMS)}$	= 1880	A
I_{TSM}	= 35×10^3	A
$V_{(T0)}$	= 1.25	V
r_T	= 0.48	mW

Phase Control Thyristor

5STP 12N8500

Doc. No. 5SYA1044-02 Nov. 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 12N8500	5STP 12N8200	5STP 12N7800
V_{DSM}, V_{RSM}	f = 5 Hz, t_p = 10 ms	8500 V	8200 V	7800 V
V_{DRM}, V_{RRM}	f = 50 Hz, t_p = 10 ms	8000 V	7700 V	7300 V
V_{RSM}	t_p = 5 ms, single pulse	9000 V	8600 V	8200 V
dV/dt_{crit}	Exp. to 5360 V, T_{vj} = 90°C	2000 V/µs		

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Forward leakage current	I_{DSM}	V_{DSM}, T_{vj} = 90°C			1000	mA
Reverse leakage current	I_{RSM}	V_{RSM}, T_{vj} = 90°C			400	mA

Mechanical data

Maximum rated values [1)]

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 °C	35.3		36	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			1200	A
RMS on-state current	$I_{T(RMS)}$				1880	A
Peak non-repetitive surge current	I_{TSM}	tp = 10 ms, T_{vj} = 90 °C, $V_D = V_R$ = 0 V			35×10^3	A
Limiting load integral	I^2t				6.13×10^6	A^2s
Peak non-repetitive surge current	I_{TSM}	tp = 8.3 ms, T_{vj} = 90 °C, $V_D = V_R$ = 0 V			38×10^3	A
Limiting load integral	I^2t				5.99×10^6	A^2s

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
On-state voltage	V_T	I_T = 1500 A, T_{vj} = 90 °C			2	V
Threshold voltage	$V_{(T0)}$	I_T = 700 A - 2100 A, T_{vj}= 90 °C			1.25	V
Slope resistance	r_T				0.48	mΩ
Holding current	I_H	T_{vj} = 25 °C			150	mA
		T_{vj} = 90 °C			125	mA
Latching current	I_L	T_{vj} = 25 °C			600	mA
		T_{vj} = 90 °C			800	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} = 90 °C, I_{TRM} = 2000 A,	Cont. f = 50 Hz			250	A/µs
Critical rate of rise of on-state current	di/dt_{crit}	$V_D \leq$ 5360 V, I_{FG} = A, t_r = 0.5 µs	Cont. f = 1Hz			1000	A/µs
Circuit-commutated turn-off time	t_q	T_{vj} = 90°C, I_{TRM} = 2000 A, V_R = 200 V, di_T/dt = -1 A/µs, $V_D \leq 0.67 \cdot V_{DRM}$, dv_D/dt = 20V/µs		600			µs

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Recovery charge	Q_{rr}	T_{vj} = 90°C, I_{TRM} = A, V_R = 200 V, di_T/dt = -1 A/µs	2800		3400	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} = 90 °C	0.3			V
Gate non-trigger current	I_{GD}	V_D = 0.4 x V_{DRM}, T_{vjmax} = 90°C	10			mA

Thermal

Maximum rated values [1)]

Parameter	Symbol	Conditions	min	typ	max	Unit
Operating junction temperature range	T_{vj}				90	°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 = 81...108 kN			5.7	K/kW
	$R_{th(j-c)A}$	Anode-side cooled F_m = 81...108 kN			11.4	K/kW
	$R_{th(j-c)C}$	Cathode-side cooled F_m = 81...108 kN			11.4	K/kW
Thermal resistance case to heatsink	$R_{th(c-h)}$	Double-side cooled F_m = 81...108 kN			1	K/kW
	$R_{th(c-h)}$	Single-side cooled F_m = 81...108 kN			2	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)	3.400	1.260	0.680	0.350
τ_i(s)	0.8685	0.1572	0.0219	0.0078

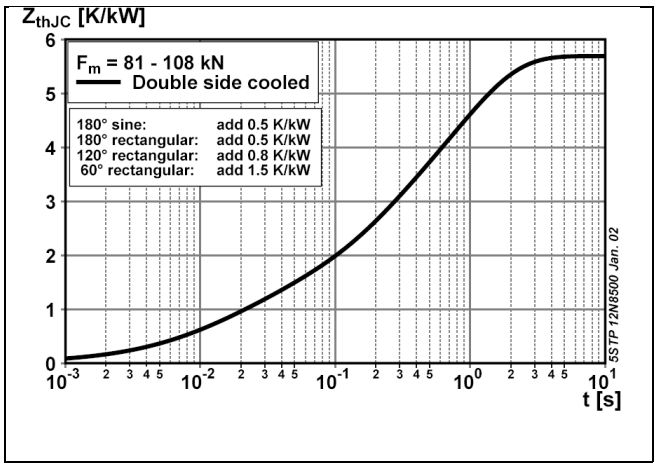

Fig. 1 Transient thermal impedance junction-to case.

On-state characteristic model:

$$VT = A + B \cdot iT + C \cdot \ln(iT + 1) + D \cdot \sqrt{IT}$$

Valid for i_T = 200 – 4000 A

A	B	C	D
1.9700e+0	-1.8000e-4	-3.0000e-1	6.2000e-2

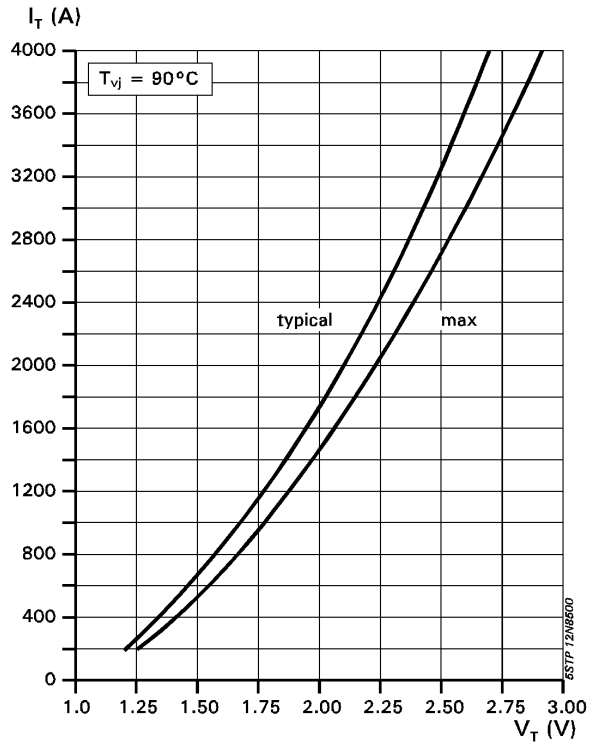

Fig. 2 On-state characteristics.
T_j=125°C, 10ms half sine

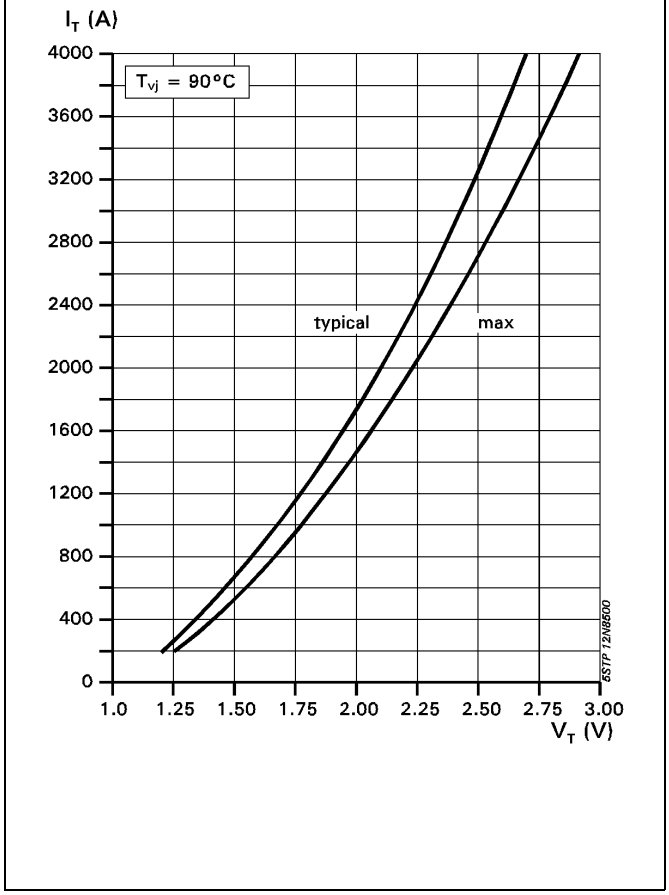

Fig. 3 Max. on-state voltage characteristics

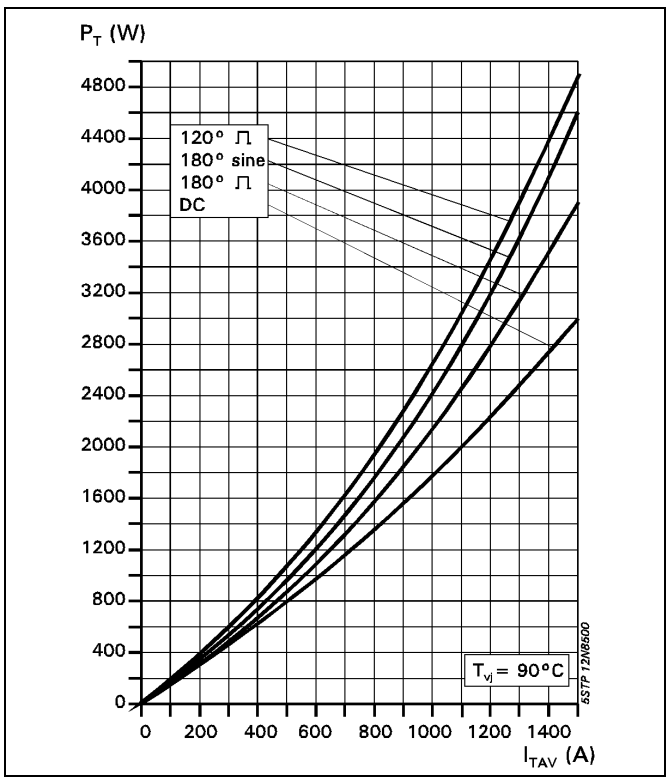

Fig. 4 On-state power dissipation vs. mean on-state current. Turn-on losses excluded.

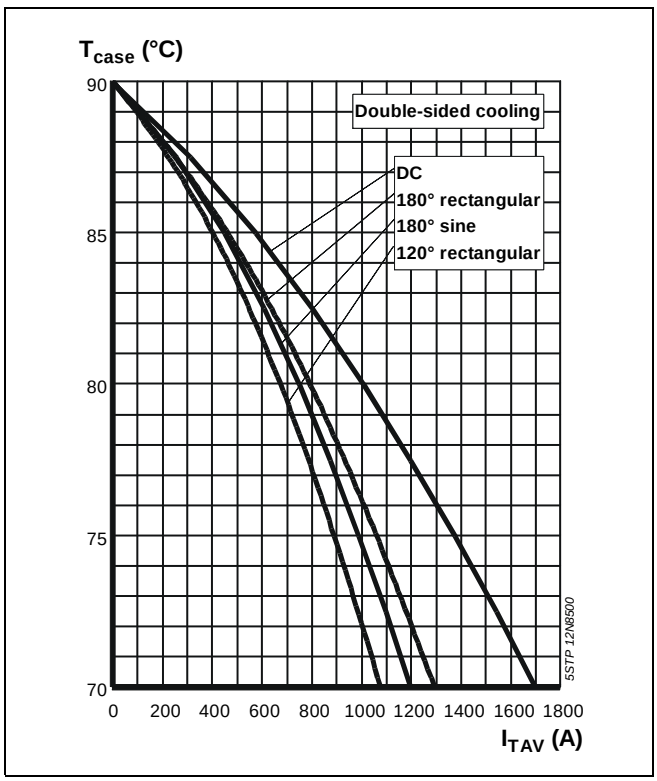

Fig. 5 Max. permissible case temperature vs. mean on-state current.

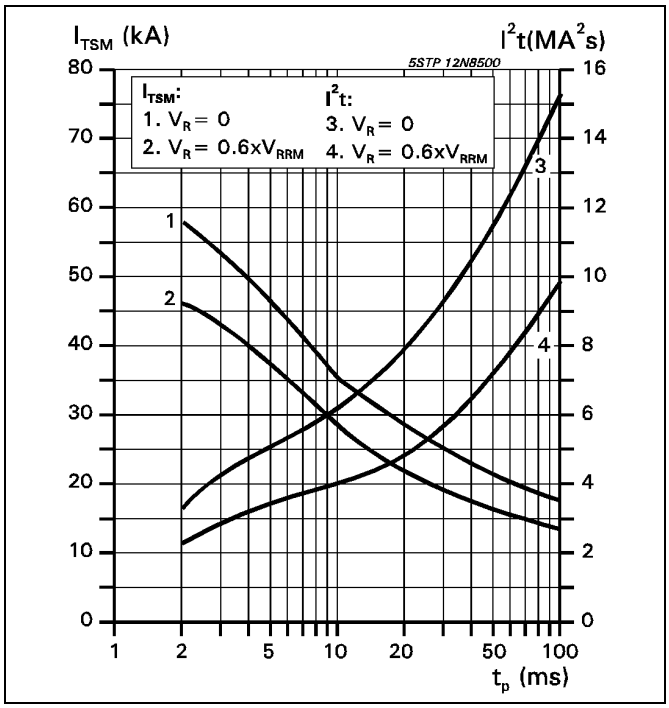

Fig. 6 Surge on-state current vs. pulse length. Half-sine wave.

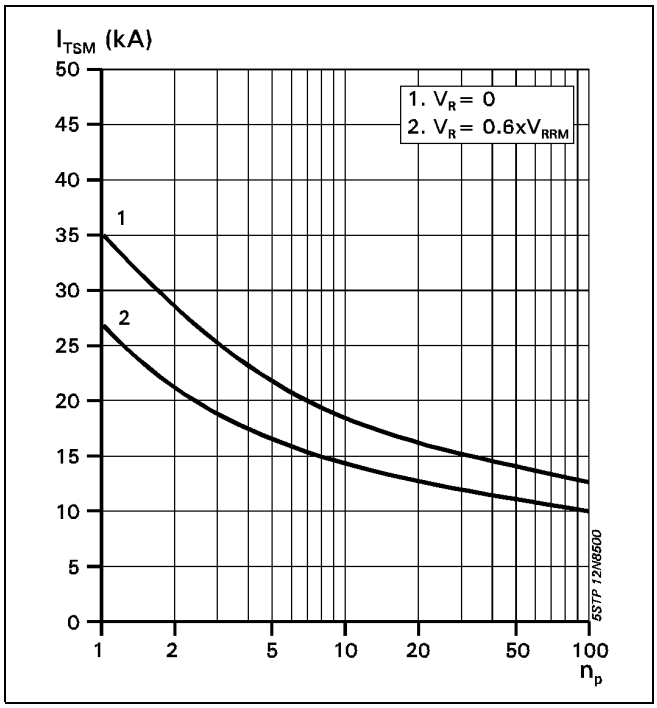

Fig. 7 Surge on-state current vs. number of pulses. Half-sine wave, 10 ms, 50Hz.

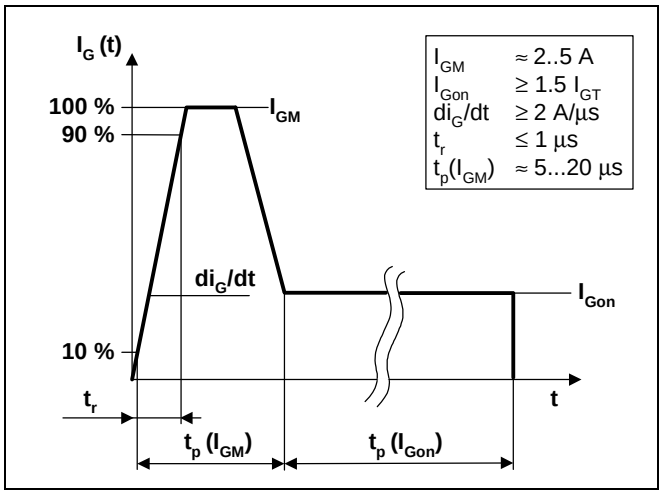

Fig. 8 Recommended gate current waveform.

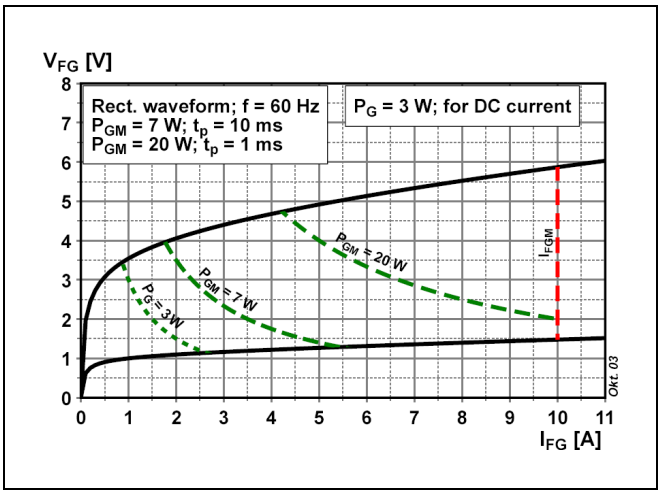

Fig. 9 Max. peak gate power loss.

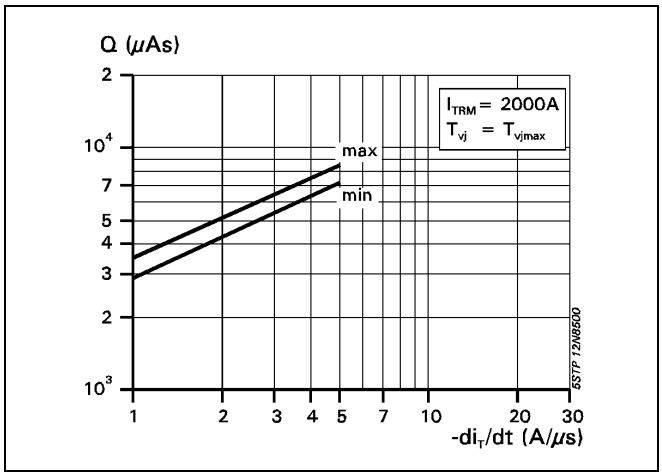

Fig. 10 Recovery charge vs. decay rate of on-state current.

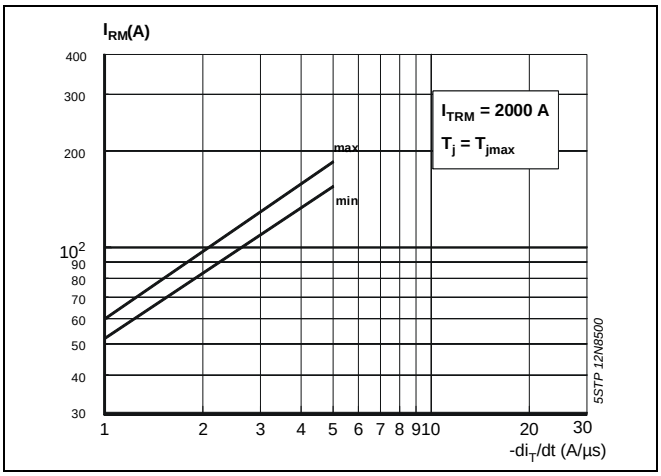

Fig. 11 Peak reverse recovery current vs. decay rate of on-state current.

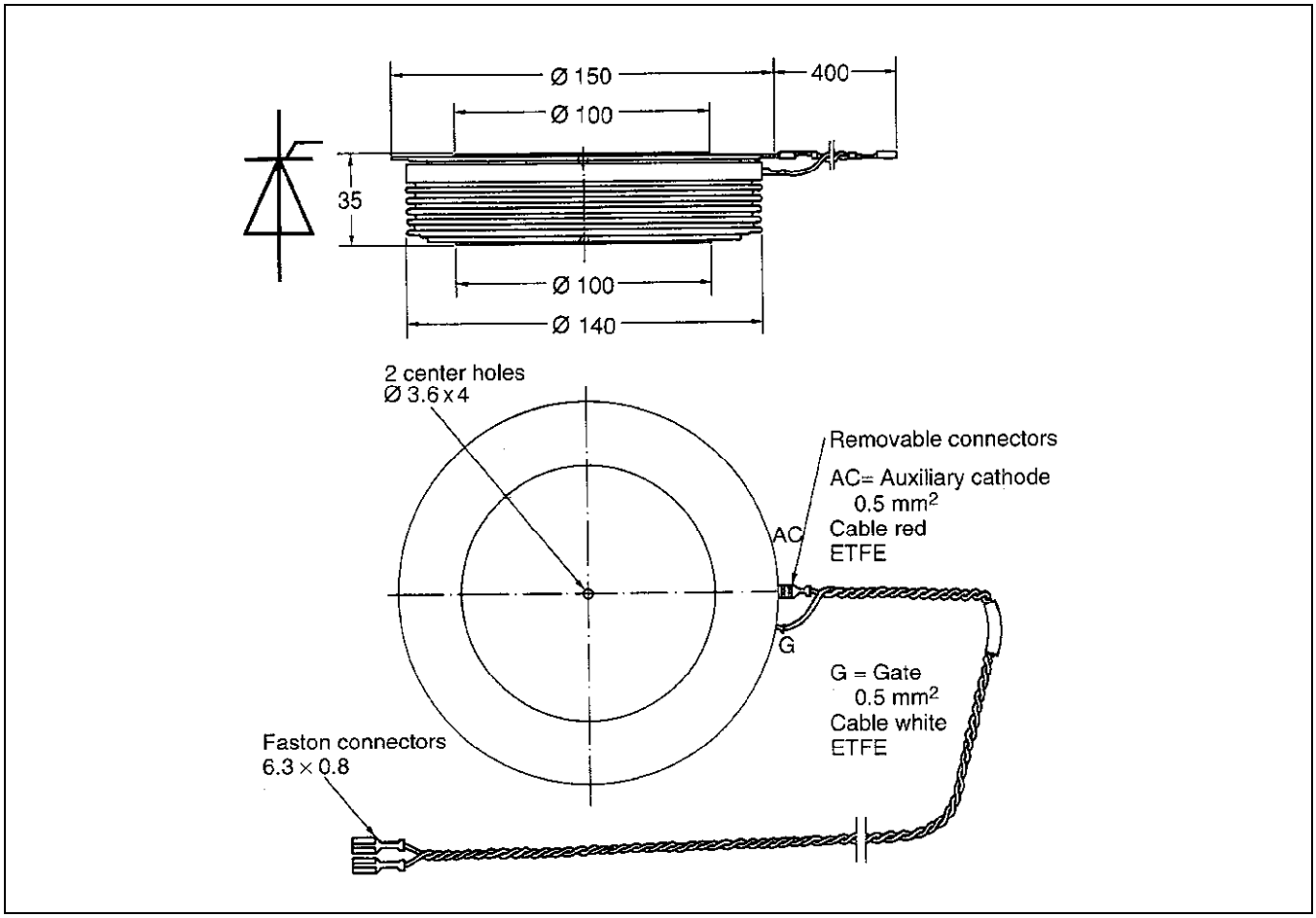

Fig. 12 Device Outline Drawing.

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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