



PROTON-ELECTROTEX RUSSIA

High power cycling capability
Low on-state and switching losses
Designed for traction and industrial applications

Phase Control Thyristor Chip Type TR40-500-24

Maximum allowable mean on-state current ¹⁾		I _{TAV}	500 A
Repetitive peak off-state voltage		V _{DRM}	2000...2400 V
Repetitive peak reverse voltage		V _{RRM}	
Turn-off time		t _q	250, 320, 400, 500 μs
V _{DRM} , V _{RRM} , V	2000	2200	2400
Voltage code	20	22	24
T _j , °C	-60...+125		

MAXIMUM ALLOWABLE RATINGS

Symbols and parameters		Units	Values	Test conditions	
ON-STATE					
I_{TAV}	Maximum allowable mean on-state current ¹⁾	A	500 647	$T_c=97\text{ }^{\circ}\text{C}$, Double side cooled $T_c=85\text{ }^{\circ}\text{C}$, Double side cooled 180° half-sine wave; 50 Hz	
I_{TRMS}	RMS on-state current ¹⁾	A	785	$T_c=97\text{ }^{\circ}\text{C}$, Double side cooled 180° half-sine wave; 50 Hz	
I_{TSM}	Surge on-state current ¹⁾	kA	12.5 14.0	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^{\circ}\text{C}$	180° half-sine wave; $t_p=10\text{ ms}$; single pulse; $V_D=V_R=0\text{ V}$; Gate pulse: $I_G=2\text{ A}$; $t_{GP}=50\text{ }\mu\text{s}$; $di_G/dt\geq 1\text{ A}/\mu\text{s}$
			13.0 15.0	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^{\circ}\text{C}$	180° half-sine wave; $t_p=8.3\text{ ms}$; single pulse; $V_D=V_R=0\text{ V}$; Gate pulse: $I_G=2\text{ A}$; $t_{GP}=50\text{ }\mu\text{s}$; $di_G/dt\geq 1\text{ A}/\mu\text{s}$
I^2t	Safety factor ¹⁾	$\text{A}^2\text{s}\cdot 10^3$	780 980	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^{\circ}\text{C}$	180° half-sine wave; $t_p=10\text{ ms}$; single pulse; $V_D=V_R=0\text{ V}$; Gate pulse: $I_G=2\text{ A}$; $t_{GP}=50\text{ }\mu\text{s}$; $di_G/dt\geq 1\text{ A}/\mu\text{s}$
			700 930	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^{\circ}\text{C}$	180° half-sine wave; $t_p=8.3\text{ ms}$; single pulse; $V_D=V_R=0\text{ V}$; Gate pulse: $I_G=2\text{ A}$; $t_{GP}=50\text{ }\mu\text{s}$; $di_G/dt\geq 1\text{ A}/\mu\text{s}$
BLOCKING					
V_{DRM}, V_{RRM}	Repetitive peak off-state and Repetitive peak reverse voltages	V	2000...2400	$T_{j\text{ min}} < T_j < T_{j\text{ max}}$; 180° half-sine wave; 50 Hz; Gate open	
V_{DSM}, V_{RSM}	Non-repetitive peak off-state and Non-repetitive peak reverse voltages	V	2100...2500	$T_{j\text{ min}} < T_j < T_{j\text{ max}}$; 180° half-sine wave; single pulse; Gate open	
V_D, V_R	Direct off-state and Direct reverse voltages	V	$0.6\cdot V_{DRM}$ $0.6\cdot V_{RRM}$	$T_j=T_{j\text{ max}}$; Gate open	

TRIGGERING				
I_{FGM}	Peak forward gate current	A	8	$T_j = T_{j \max}$
V_{RGM}	Peak reverse gate voltage	V	5	
P_G	Gate power dissipation	W	4	$T_j = T_{j \max}$ for DC gate current
SWITCHING				
$(di_T/dt)_{crit}$	Critical rate of rise of on-state current non-repetitive ($f=1$ Hz)	A/ μ s	1600	$T_j = T_{j \max}$; $V_D = 0.67 \cdot V_{DRM}$; $I_{TM} = 2100$ A; Gate pulse: $I_G = 2$ A; $t_{GP} = 50$ μ s; $di_G/dt \geq 2$ A/ μ s
THERMAL				
T_{stg}	Storage temperature	$^{\circ}$ C	-60...+50	
T_j	Operating junction temperature	$^{\circ}$ C	-60...+125	
MECHANICAL				
F	Mounting force ¹⁾	kN	14.0...16.0	
F_{cg}	Force on control gate	N	7.8	

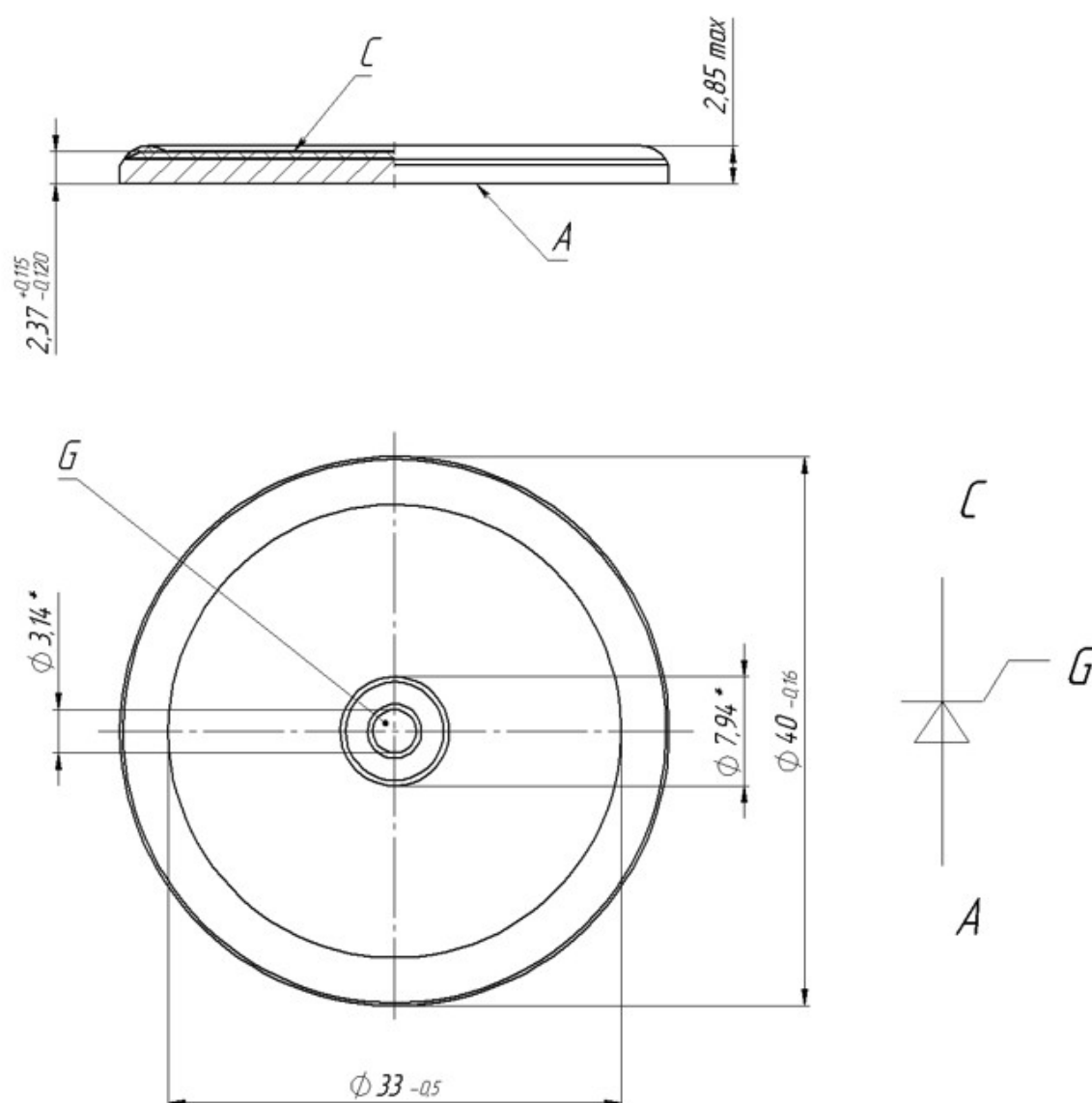
CHARACTERISTICS

Symbols and parameters		Units	Values	Conditions	
ON-STATE					
V _{TM}	Peak on-state voltage ¹⁾ , max	V	1.85	T _j =25 °C; I _{TM} =1570 A	
V _{T(TO)}	On-state threshold voltage, max	V	1.068	T _j =T _{j max} ;	
r _T	On-state slope resistance ¹⁾ , max	mΩ	0.626	0.5 π I _{TAV} < I _T < 1.5 π I _{TAV}	
I _L	Latching current, max	mA	1000	T _j =25 °C; V _D =12 V; Gate pulse: I _G =2 A; t _{GP} =50 μs; di _G /dt≥1 A/μs	
I _H	Holding current, max	mA	300	T _j =25 °C; V _D =12 V; Gate open	
BLOCKING					
I _{DRM} , I _{RRM}	Repetitive peak off-state and Repetitive peak reverse currents, max	mA	100	T _j =T _{j max} ; V _D =V _{DRM} ; V _R =V _{RRM}	
(dv _D /dt) _{crit}	Critical rate of rise of off-state voltage ²⁾ , min	V/μs	200, 320, 500, 1000, 1600, 2000, 2500	T _j =T _{j max} ; V _D =0.67·V _{DRM} ; Gate open	
TRIGGERING					
V _{GT}	Gate trigger direct voltage, max	V	3.00 2.50 1.50	T _j = T _{j min} T _j =25 °C T _j = T _{j max}	V _D =12 V; I _D =3 A; Direct gate current
I _{GT}	Gate trigger direct current, max	mA	500 300 150	T _j = T _{j min} T _j = 25 °C T _j = T _{j max}	
V _{GD}	Gate non-trigger direct voltage, min	V	0.55	T _j =T _{j max} ; V _D =0.67·V _{DRM} ;	
I _{GD}	Gate non-trigger direct current, min	mA	60.00	Direct gate current	
SWITCHING					
t _{gd}	Delay time, max	μs	1.25	T _j =25 °C; V _D =1000 V; I _{TM} =I _{TAV} ; di/dt=200 A/μs;	
t _{gt}	Turn-on time, max	μs	8.00	Gate pulse: I _G =2 A; V _G =20 V; t _{GP} =50 μs; di _G /dt=2 A/μs	
t _q	Turn-off time ³⁾ , max	μs	250, 320, 400, 500	dv _D /dt=50 V/μs; T _j =T _{j max} ; I _{TM} = I _{TAV} ; di _R /dt=-10 A/μs; V _R =100V; V _D =0.67·V _{DRM}	

THERMAL					
R _{thjc}	Thermal resistance, junction to case ¹⁾ , max	°C/W	0.030	Direct current	Double side cooled
R _{thjc-A}			0.066		Anode side cooled
R _{thjc-K}			0.054		Cathode side cooled
MECHANICAL					
m	Weight, max	g	26.70		

PART NUMBERING GUIDE						NOTES																											
TR	40	500	24	A2	E2	1) Depending on the specifications of the housing used. The specified values are relevant when using the Proton-Electrotex T.C1 housing. 2) Critical rate of rise of off-state voltage																											
1	2	3	4	5	6																												
1. Phase Control Thyristor Chip						<table><tr><th>Symbol of Group</th><th>P2</th><th>K2</th><th>E2</th><th>A2</th><th>T1</th><th>P1</th><th>M1</th></tr><tr><td>(dv₀/dt)_{crit}, V/μs</td><td>200</td><td>320</td><td>500</td><td>1000</td><td>1600</td><td>2000</td><td>2500</td></tr></table> 3) Turn-off time (dv _D /dt=50 V/μs) <table><tr><th>Symbol of Group</th><th>M2</th><th>K2</th><th>H2</th><th>E2</th></tr><tr><td>t_{qf}, μs</td><td>250</td><td>320</td><td>400</td><td>500</td></tr></table>		Symbol of Group	P2	K2	E2	A2	T1	P1	M1	(dv ₀ /dt) _{crit} , V/μs	200	320	500	1000	1600	2000	2500	Symbol of Group	M2	K2	H2	E2	t _{qf} , μs	250	320	400	500
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Symbol of Group	M2	K2	H2	E2																													
t _{qf} , μs	250	320	400	500																													
2. Maximum diameter, mm																																	
3. Mean on-state current, A																																	
4. Voltage code																																	
5. Critical rate of rise of off-state voltage, V/μs																																	
6. Turn-off time (dv _D /dt=50 V/μs)																																	

OVERALL DIMENSIONS



**Dimensions for reference*

All dimensions in millimeters

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