



PROTON-ELECTROTEX RUSSIA

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

Phase Control Thyristor Chip Type TR24-320-18

Maximum allowable mean on-state current ¹⁾							I _{TAV}			320 A					
Repetitive peak off-state voltage							V _{DRM}			400...1800 V					
Repetitive peak reverse voltage							V _{RRM}								
Turn-off time							t _q			125, 160, 200, 250, 320, 400, 500 μs					
V _{DRM} , V _{RRM} , V	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1800	
Voltage code	4	5	6	7	8	9	10	11	12	13	14	15	16	18	
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	320 338	$T_c=88\text{ }^{\circ}\text{C}$, 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	502	$T_c=88\text{ }^{\circ}\text{C}$, Double side cooled 180° half-sine wave; 50 Hz	
I_{TSM}	Surge on-state current ¹⁾	kA	5.0 6.0	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^{\circ}\text{C}$	180° half-sine wave; $t_p=10\text{ ms}$; single pulse; $V_D=V_R=0\text{ V}$; Gate pulse: $I_G=2\text{ A}$; $t_{GP}=50\text{ }\mu\text{s}$; $di_G/dt\geq 1\text{ A}/\mu\text{s}$
			5.5 6.5	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^{\circ}\text{C}$	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⁾	$\text{A}^2\text{s}\cdot 10^3$	120 180	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^{\circ}\text{C}$	180° half-sine wave; $t_p=10\text{ ms}$; single pulse; $V_D=V_R=0\text{ V}$; Gate pulse: $I_G=2\text{ A}$; $t_{GP}=50\text{ }\mu\text{s}$; $di_G/dt\geq 1\text{ A}/\mu\text{s}$
			120 170	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^{\circ}\text{C}$	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	400...1800	$T_{j\text{ min}} < T_j < T_{j\text{ max}}$; 180° half-sine wave; 50 Hz; Gate open	
V_{DSM}, V_{RSM}	Non-repetitive peak off-state and Non-repetitive peak reverse voltages	V	500...1900	$T_{j\text{ min}} < T_j < T_{j\text{ max}}$; 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	5	$T_j = T_{j\ max}$
V_{RGM}	Peak reverse gate voltage	V	5	
P_G	Gate power dissipation	W	3	$T_j = T_{j\ max}$ for DC gate current
SWITCHING				
$(di_T/dt)_{crit}$	Critical rate of rise of on-state current non-repetitive ($f=1\ Hz$)	A/ μs	800	$T_j = T_{j\ max}$; $V_D = 0.67 \cdot V_{DRM}$; $I_{TM} = 640\ A$; Gate pulse: $I_G = 2\ A$; $t_{GP} = 50\ \mu s$; $di_G/dt \geq 2\ A/\mu s$
THERMAL				
T_{stg}	Storage temperature	$^{\circ}C$	$-60...+50$	
T_j	Operating junction temperature	$^{\circ}C$	$-60...+125$	
MECHANICAL				
F	Mounting force ¹⁾	kN	5.0...7.0	
F_{cg}	Force on control gate	N	7.8	

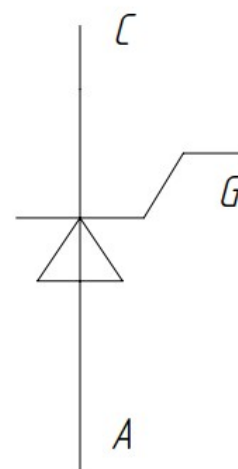
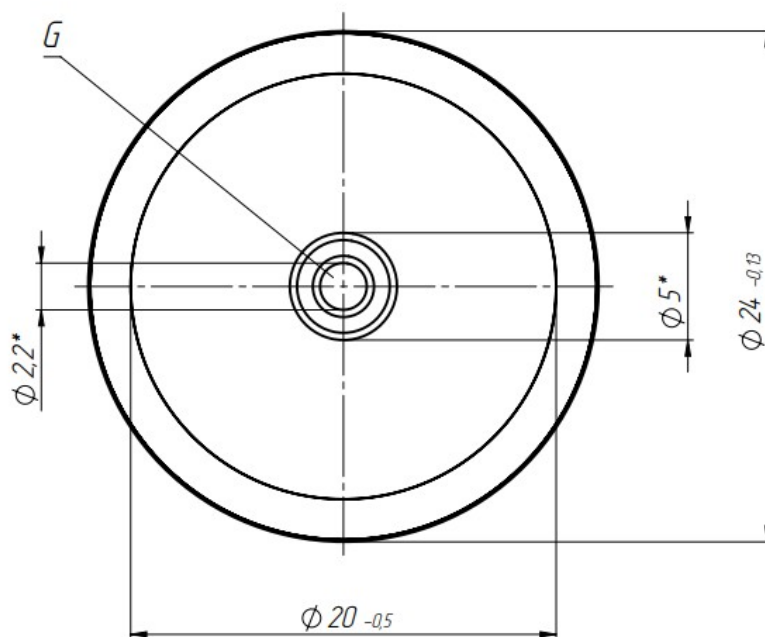
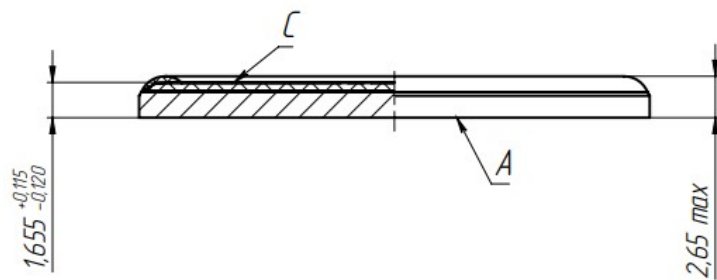
CHARACTERISTICS

Symbols and parameters		Units	Values	Conditions	
ON-STATE					
V _{TM}	Peak on-state voltage ¹⁾ , max	V	1.75	T _j =25 °C; I _{TM} =1005 A	
V _{T(TO)}	On-state threshold voltage, max	V	0.980	T _j =T _{j max} ;	
r _T	On-state slope resistance ¹⁾ , max	mΩ	0.856	0.5 π I _{TAV} < I _T < 1.5 π I _{TAV}	
I _L	Latching current, max	mA	500	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	250	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	50	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	400 250 150	T _j = T _{j min} T _j = 25 °C T _j = T _{j max}	
V _{GD}	Gate non-trigger direct voltage, min	V	0.70	T _j =T _{j max} ; V _D =0.67·V _{DRM} ;	
I _{GD}	Gate non-trigger direct current, min	mA	65.00	Direct gate current	
SWITCHING					
t _{gd}	Delay time, max	μs	1.10	T _j =25 °C; V _D =1000 V; I _{TM} =I _{TAV} ; di/dt=200 A/μs;	
t _{gt}	Turn-on time, max	μs	3.00	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	125, 160, 200, 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	0.070	Direct current	Double side cooled
R _{thjc-A}			0.154		Anode side cooled
R _{thjc-K}			0.126		Cathode side cooled
MECHANICAL					
m	Weight, max	g	6.60		

PART NUMBERING GUIDE						NOTES																	
TR	24	320	18	A2	E2	¹⁾ Depending on the specifications of the housing used. The specified values are relevant when using the Proton-Electrotex T.A1 housing. ²⁾ Critical rate of rise of off-state voltage																	
1	2	3	4	5	6																		
1. Phase Control Thyristor Chip 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)						<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>$(dv_D/dt)_{crit}$, 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)		Symbol of Group	P2	K2	E2	A2	T1	P1	M1	$(dv_D/dt)_{crit}$, V/μs	200	320	500	1000	1600	2000	2500
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OVERALL DIMENSIONS



**Dimensions for reference*

All dimensions in millimeters

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