



# 5STP 21H4200

Old part no. TV 989-2100-42

## Phase Control Thyristor

### Properties

- High operational capability
- Possibility of serial and parallel connection

### Applications

- Controlled rectifiers
- AC drives

### Key Parameters

$V_{DRM}$ , $V_{RRM}$	= 4 200	V
$I_{TAVm}$	= 2 192	A
$I_{TSM}$	= 32 000	A
$V_{TO}$	= 1.249	V
$r_T$	= 0.191	mΩ

### Types

	$V_{RRM}$ , $V_{DRM}$
5STP 21H4200	4 200 V
5STP 21H3600	3 600 V
Conditions:	$T_j = -40 \div 125^\circ\text{C}$ , half sine waveform, $f = 50\text{ Hz}$ , note 1

### Mechanical Data

$F_m$	Mounting force	$50 \pm 5 \text{ kN}$
$m$	Weight	0.93 kg
$D_s$	Surface creepage distance	36 mm
$D_a$	Air strike distance	15 mm

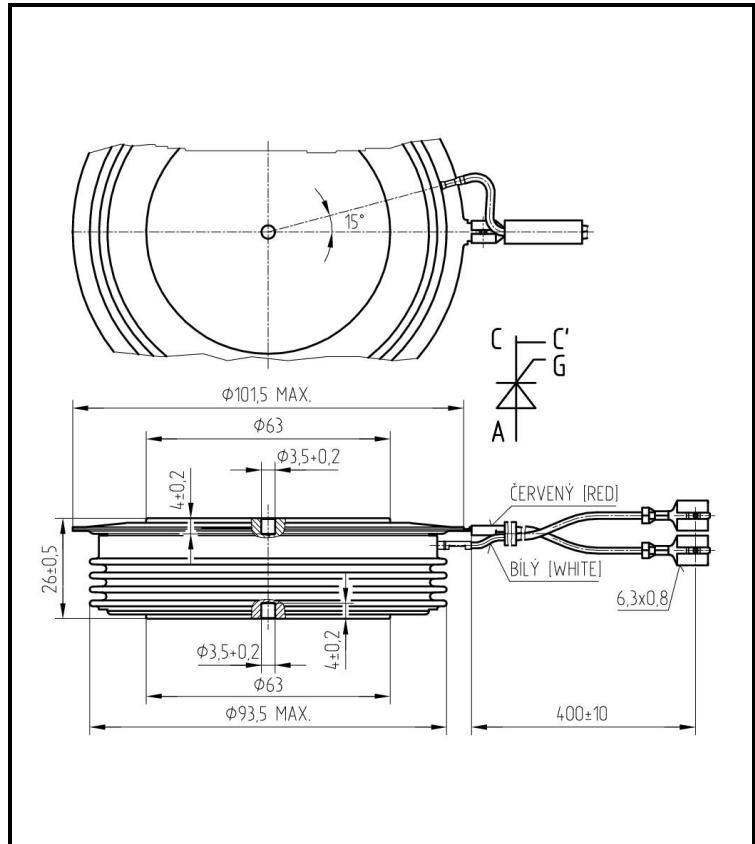


Fig. 1 Case

<b>Maximum Ratings</b>			<b>Maximum Limits</b>	<b>Unit</b>
$V_{RRM}$	<b>Repetitive peak reverse and off-state voltage</b>	5STP 21H4200	4 200	V
$V_{DRM}$	$T_j = -40 \div 125^\circ\text{C}$ , note 1	5STP 21H3600	3 600	
$V_{RSM}$	<b>Non-repetitive peak reverse and off-state voltage</b>		5STP 21H4200	4 300
$V_{DSM}$			5STP 21H3600	3 700
$T_j = 25 \div 125^\circ\text{C}$				
$I_{TRMS}$	<b>RMS on-state current</b> $T_c = 70^\circ\text{C}$ , half sine waveform, $f = 50\text{ Hz}$		3 443	A
$I_{TAVm}$	<b>Average on-state current</b> $T_c = 70^\circ\text{C}$ , half sine waveform, $f = 50\text{ Hz}$		2 192	A
$I_{TSM}$	<b>Peak non-repetitive surge</b> half sine pulse, $V_R = 0\text{ V}$	$t_p = 10\text{ ms}$ $t_p = 8.3\text{ ms}$	32 000 34 200	A
$\int I^2 t$	<b>Limiting load integral</b> half sine pulse, $V_R = 0\text{ V}$	$t_p = 10\text{ ms}$ $t_p = 8.3\text{ ms}$	5 120 000 4 850 000	$\text{A}^2\text{s}$
$(di_T/dt)_{cr}$	<b>Critical rate of rise of on-state current</b> $I_T = I_{TAVm}$ , half sine waveform, $f = 50\text{ Hz}$ , $V_D = 2/3 V_{DRM}$ , $t_r = 0.3\text{ }\mu\text{s}$ , $I_{GT} = 2\text{ A}$		150	$\text{A}/\mu\text{s}$
$(dv_D/dt)_{cr}$	<b>Critical rate of rise of off-state voltage</b> $V_D = 2/3 V_{DRM}$		1 000	$\text{V}/\mu\text{s}$
$P_{GAVm}$	<b>Maximum average gate power losses</b>		5	W
$I_{FGM}$	<b>Peak gate current</b>		10	A
$V_{FGM}$	<b>Peak gate voltage</b>		12	V
$V_{RGM}$	<b>Reverse peak gate voltage</b>		10	V
$T_{jmin} - T_{jmax}$	<b>Operating temperature range</b>		-40 $\div$ 125	$^\circ\text{C}$
$T_{stgmin} - T_{stgmax}$	<b>Storage temperature range</b>		-40 $\div$ 125	$^\circ\text{C}$

Unless otherwise specified  $T_j = 125^\circ\text{C}$

Note 1: De-rating factor of 0.13%  $V_{RRM}$  or  $V_{DRM}$  per  $^\circ\text{C}$  is applicable for  $T_j$  below 25  $^\circ\text{C}$

Characteristics		Value			Unit
		min.	typ.	max.	
$V_{TM}$	<b>Maximum peak on-state voltage</b> $I_{TM} = 4\,000\text{ A}$			2.030	V
$V_{TO}$ $r_T$	<b>Threshold voltage</b> <b>Slope resistance</b> $I_{T1} = 3\,299\text{ A}, I_{T2} = 9\,896\text{ A}$			1.249 0.191	V $\text{m}\Omega$
$I_{DM}$	<b>Peak off-state current</b> $V_D = V_{DRM}$			200	mA
$I_{RM}$	<b>Peak reverse current</b> $V_R = V_{RRM}$			200	mA
$t_{gd}$	<b>Delay time</b> $T_j = 25\text{ }^\circ\text{C}, V_D = 0.4\text{ }V_{DRM}, I_{TM} = I_{TAVm}, t_r = 0.3\text{ }\mu\text{s}, I_{GT} = 2\text{ A}$			3	$\mu\text{s}$
$t_q$	<b>Turn-off time</b> $I_T = 2\,000\text{ A}, di_T/dt = 12.5\text{ A}/\mu\text{s}, V_D = 2/3\text{ }V_{DRM}, dv_D/dt = 50\text{ V}/\mu\text{s}$		700		$\mu\text{s}$
$Q_{rr}$	<b>Recovery charge</b> <i>the same conditions as at <math>t_q</math></i>		3 400		$\mu\text{C}$
$I_H$	<b>Holding current</b>	$T_j = 25\text{ }^\circ\text{C}$ $T_j = 125\text{ }^\circ\text{C}$		170 90	mA
$I_L$	<b>Latching current</b>	$T_j = 25\text{ }^\circ\text{C}$ $T_j = 125\text{ }^\circ\text{C}$		1 500 1 000	mA
$V_{GT}$	<b>Gate trigger voltage</b> $V_D = 12\text{ V}, I_T = 4\text{ A}$	$T_j = -40\text{ }^\circ\text{C}$ $T_j = 25\text{ }^\circ\text{C}$ $T_j = 125\text{ }^\circ\text{C}$		4 3 2	V
$I_{GT}$	<b>Gate trigger current</b> $V_D = 12\text{ V}, I_T = 4\text{ A}$	$T_j = -40\text{ }^\circ\text{C}$ $T_j = 25\text{ }^\circ\text{C}$ $T_j = 125\text{ }^\circ\text{C}$	0.25 10	500 300 200	mA

Unless otherwise specified  $T_i = 125^\circ\text{C}$

<b>Thermal Parameters</b>		<b>Value</b>	<b>Unit</b>
$R_{thjc}$	Thermal resistance junction to case <i>double side cooling</i>	10.0	K/kW
	<i>anode side cooling</i>	16.0	
	<i>cathode side cooling</i>	26.5	
$R_{thch}$	Thermal resistance case to heatsink <i>double side cooling</i>	3.0	K/kW
	<i>single side cooling</i>	6.0	

**Transient Thermal Impedance**

**Analytical function for transient thermal impedance**

$$Z_{thjc} = \sum_{i=1}^5 R_i (1 - \exp(-t/\tau_i))$$

Conditions:

$F_m = 50 \pm 5 \text{ kN}$ , Double side cooled

**Correction for periodic waveforms**

180° sine: add 1.0 K/kW

180° rectangular: add 1.0 K/kW

120° rectangular: add 1.5 K/kW

60° rectangular: add 3.0 K/kW

<i>i</i>	1	2	3	4	5
$\tau_i (\text{ s })$	0.4871	0.1468	0.0677	0.0079	0.0021
$R_i (\text{ K/kW })$	6.73	1.44	0.65	0.84	0.32

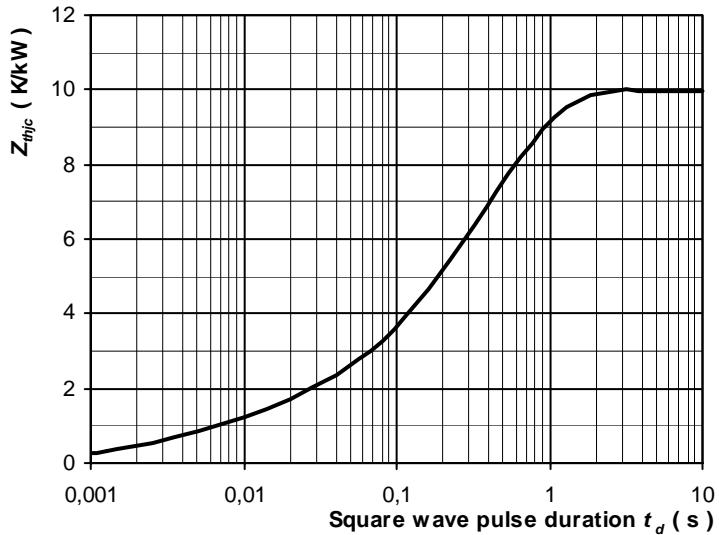


Fig. 2 Dependence transient thermal impedance junction to case on square pulse

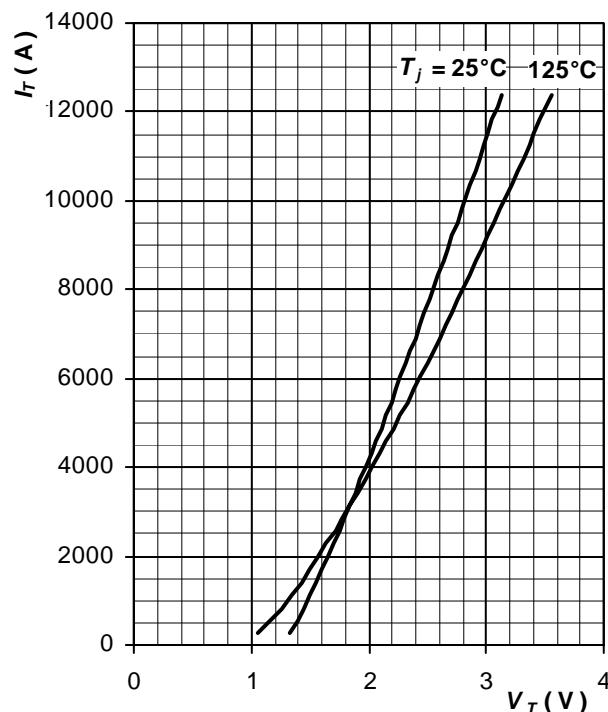


Fig. 3 Maximum on-state characteristics

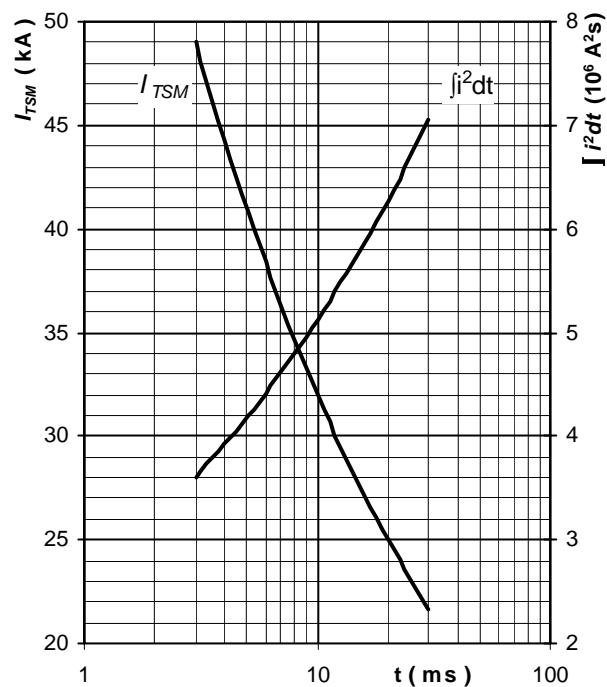


Fig. 4 Surge on-state current vs. pulse length, half sine wave, single pulse,  
 $V_R = 0 \text{ V}$ ,  $T_j = T_{jmax}$

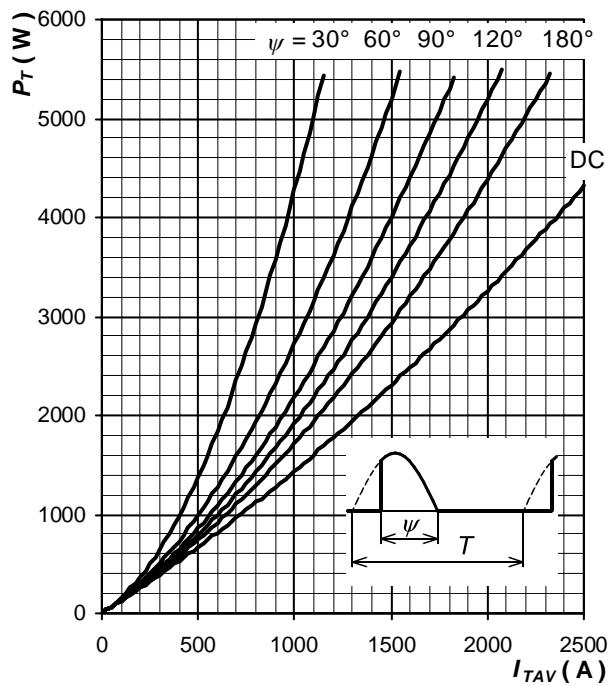


Fig. 5 On-state power loss vs. average on-state current, sine waveform,  $f = 50$  Hz,  $T = 1/f$

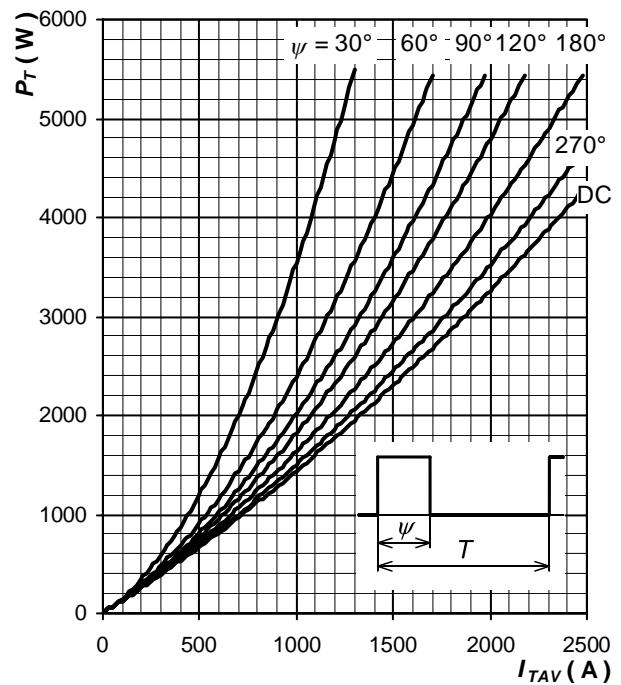


Fig. 6 On-state power loss vs. average on-state current, square waveform,  $f = 50$  Hz,  $T = 1/f$

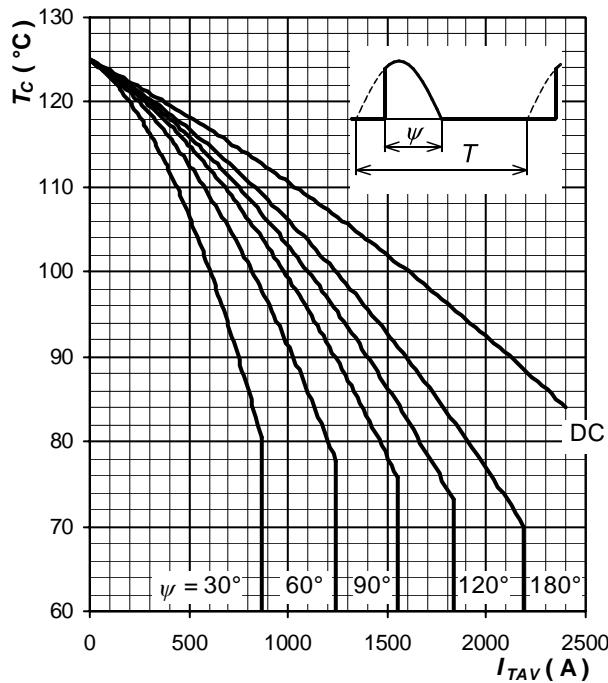


Fig. 7 Max. case temperature vs. aver. on-state current, sine waveform,  $f = 50$  Hz,  $T = 1/f$

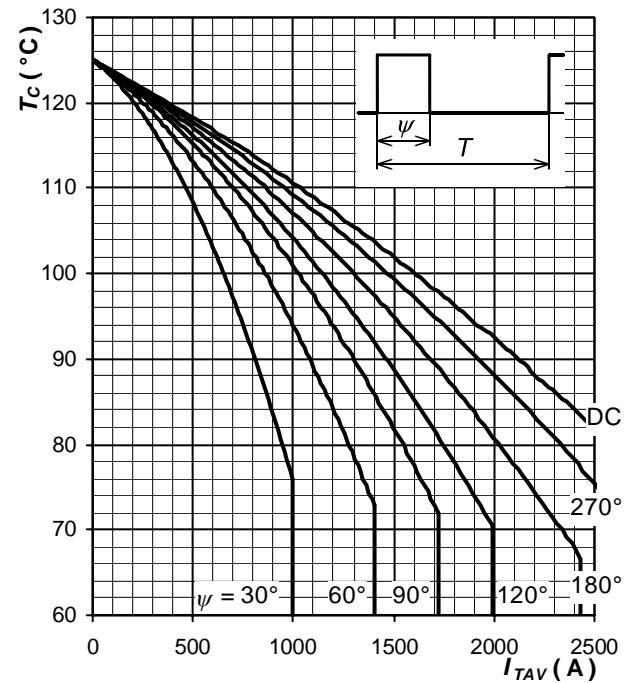


Fig. 8 Max. case temperature vs. aver. on-state current, square waveform,  $f = 50$  Hz,  $T = 1/f$

Notes: