

## Phase Control Thyristors (Hockey PUK Version), 410 A


**TO-200AB (A-PUK)**
**FEATURES**

- Center amplifying gate
- Metal case with ceramic insulator
- International standard case TO-200AB (A-PUK)
- Designed and qualified for industrial level
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS  
COMPLIANT**
**TYPICAL APPLICATIONS**

- DC motor controls
- Controlled DC power supplies
- AC controllers

PRODUCT SUMMARY	
Package	TO-200AB (A-PUK)
Diode variation	Single SCR
$I_{T(AV)}$	410 A
$V_{DRM}/V_{RRM}$	400 V, 800 V, 1200 V, 1400 V, 1600 V, 1800 V, 2000 V
$V_{TM}$	1.69 V
$I_{GT}$	90 mA
$T_J$	-40 °C to 125 °C

MAJOR RATINGS AND CHARACTERISTICS			
PARAMETER	TEST CONDITIONS	VALUES	UNITS
$I_{T(AV)}$		410	A
	$T_{hs}$	55	°C
$I_{T(RMS)}$		780	A
	$T_{hs}$	25	°C
$I_{TSM}$	50 Hz	5700	A
	60 Hz	5970	
$I^2t$	50 Hz	163	kA <sup>2</sup> s
	60 Hz	149	
$V_{DRM}/V_{RRM}$		400 to 2000	V
$t_q$	Typical	100	µs
$T_J$		-40 to 125	°C

**ELECTRICAL SPECIFICATIONS**

VOLTAGE RATINGS				
TYPE NUMBER	VOLTAGE CODE	$V_{DRM}/V_{RRM}$ , MAXIMUM REPETITIVE PEAK AND OFF-STATE VOLTAGE V	$V_{RSM}$ , MAXIMUM NON-REPETITIVE PEAK VOLTAGE V	$I_{DRM}/I_{RRM}$ , MAXIMUM AT $T_J = T_J$ MAXIMUM mA
VS-ST230C..C	04	400	500	30
	08	800	900	
	12	1200	1300	
	14	1400	1500	
	16	1600	1700	
	18	1800	1900	
	20	2000	2100	



<b>ABSOLUTE MAXIMUM RATINGS</b>					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Maximum average on-state current at heatsink temperature	$I_{T(AV)}$	180° conduction, half sine wave double side (single side) cooled		410 (165)	A
				55 (85)	°C
Maximum RMS on-state current	$I_{T(RMS)}$	DC at 25 °C heatsink temperature double side cooled		780	
Maximum peak, one-cycle non-repetitive surge current	$I_{TSM}$	t = 10 ms	No voltage reapplied	5700	A
		t = 8.3 ms		5970	
		t = 10 ms	100 % $V_{RRM}$ reapplied	4800	
		t = 8.3 ms		5000	
Maximum $I^2t$ for fusing	$I^2t$	t = 10 ms	No voltage reapplied	163	kA <sup>2</sup> s
		t = 8.3 ms		148	
		t = 10 ms	100 % $V_{RRM}$ reapplied	115	
		t = 8.3 ms		105	
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	t = 0.1 to 10 ms, no voltage reapplied		1630	kA <sup>2</sup> √s
Low level value of threshold voltage	$V_{T(TO)1}$	(16.7 % × π × $I_{T(AV)}$ < I < π × $I_{T(AV)}$ ), $T_J = T_J$ maximum		0.92	V
High level value of threshold voltage	$V_{T(TO)2}$	(I > π × $I_{T(AV)}$ ), $T_J = T_J$ maximum		0.98	
Low level value of on-state slope resistance	$r_{t1}$	(16.7 % × π × $I_{T(AV)}$ < I < π × $I_{T(AV)}$ ), $T_J = T_J$ maximum		0.88	mΩ
High level value of on-state slope resistance	$r_{t2}$	(I > π × $I_{T(AV)}$ ), $T_J = T_J$ maximum		0.81	
Maximum on-state voltage	$V_{TM}$	$I_{pk} = 880$ A, $T_J = T_J$ maximum, $t_p = 10$ ms sine pulse		1.69	V
Maximum holding current	$I_H$	$T_J = 25$ °C, anode supply 12 V resistive load		600	mA
Maximum (typical) latching current	$I_L$			1000 (300)	

<b>SWITCHING</b>					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Maximum non-repetitive rate of rise of turned-on current	$di/dt$	Gate drive 20 V, 20 Ω, $t_r \leq 1$ μs $T_J = T_J$ maximum, anode voltage ≤ 80 % $V_{DRM}$		1000	A/μs
Typical delay time	$t_d$	Gate current 1 A, $di_g/dt = 1$ A/μs $V_d = 0.67$ % $V_{DRM}$ , $T_J = 25$ °C		1.0	μs
Typical turn-off time	$t_q$	$I_{TM} = 300$ A, $T_J = T_J$ maximum, $di/dt = 20$ A/μs, $V_R = 50$ V, $dV/dt = 20$ V/μs, gate 0 V 100 Ω, $t_p = 500$ μs		100	

<b>BLOCKING</b>					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Maximum critical rate of rise of off-state voltage	$dV/dt$	$T_J = T_J$ maximum linear to 80 % rated $V_{DRM}$		500	V/μs
Maximum peak reverse and off-state leakage current	$I_{RRM}, I_{DRM}$	$T_J = T_J$ maximum, rated $V_{DRM}/V_{RRM}$ applied		30	mA



<b>TRIGGERING</b>							
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES		UNITS	
				TYP.	MAX.		
Maximum peak gate power	$P_{GM}$	$T_J = T_J$ maximum, $t_p \leq 5$ ms		10.0		W	
Maximum average gate power	$P_{G(AV)}$	$T_J = T_J$ maximum, $f = 50$ Hz, $d\% = 50$		2.0			
Maximum peak positive gate current	$I_{GM}$	$T_J = T_J$ maximum, $t_p \leq 5$ ms		3.0		A	
Maximum peak positive gate voltage	$+V_{GM}$	$T_J = T_J$ maximum, $t_p \leq 5$ ms		20		V	
Maximum peak negative gate voltage	$-V_{GM}$			5.0			
DC gate current required to trigger	$I_{GT}$	$T_J = -40$ °C		Maximum required gate trigger/ current/voltage are the lowest value which will trigger all units 12 V anode to cathode applied	180	-	mA
		$T_J = 25$ °C			90	150	
		$T_J = 125$ °C			40	-	
DC gate voltage required to trigger	$V_{GT}$	$T_J = -40$ °C			2.9	-	V
		$T_J = 25$ °C			1.8	3.0	
		$T_J = 125$ °C			1.2	-	
DC gate current not to trigger	$I_{GD}$	$T_J = T_J$ maximum		10		mA	
DC gate voltage not to trigger	$V_{GD}$			0.25		V	

<b>THERMAL AND MECHANICAL SPECIFICATIONS</b>				
PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Maximum operating temperature range	$T_J$		- 40 to 125	°C
Maximum storage temperature range	$T_{Stg}$		- 40 to 150	
Maximum thermal resistance, junction to heatsink	$R_{thJ-hs}$	DC operation single side cooled	0.17	K/W
		DC operation double side cooled	0.08	
Maximum thermal resistance, case to heatsink	$R_{thC-hs}$	DC operation single side cooled	0.033	
		DC operation double side cooled	0.017	
Mounting force, $\pm 10$ %			4900 (500)	N (kg)
Approximate weight			50	g
Case style		See dimensions - link at the end of datasheet	TO-200AB (A-PUK)	

<b><math>\Delta R_{thJc}</math> CONDUCTION</b>						
CONDUCTION ANGLE	SINUSOIDAL CONDUCTION		RECTANGULAR CONDUCTION		TEST CONDITIONS	UNITS
	SINGLE SIDE	DOUBLE SIDE	SINGLE SIDE	DOUBLE SIDE		
180°	0.015	0.017	0.011	0.011	$T_J = T_J$ maximum	K/W
120°	0.018	0.019	0.019	0.019		
90°	0.024	0.024	0.026	0.026		
60°	0.035	0.035	0.036	0.036		
30°	0.060	0.060	0.060	0.061		

**Note**

- The table above shows the increment of thermal resistance  $R_{thJc}$  when devices operate at different conduction angles than DC

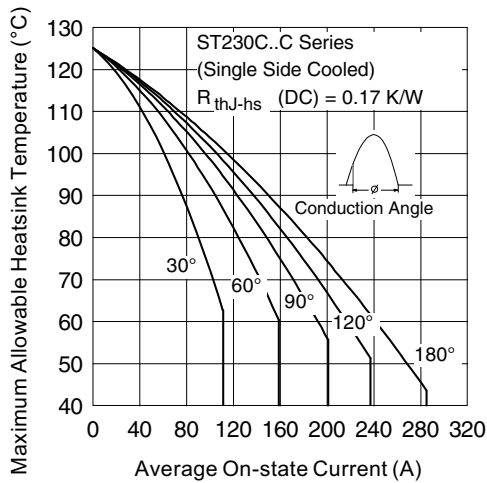


Fig. 1 - Current Ratings Characteristics

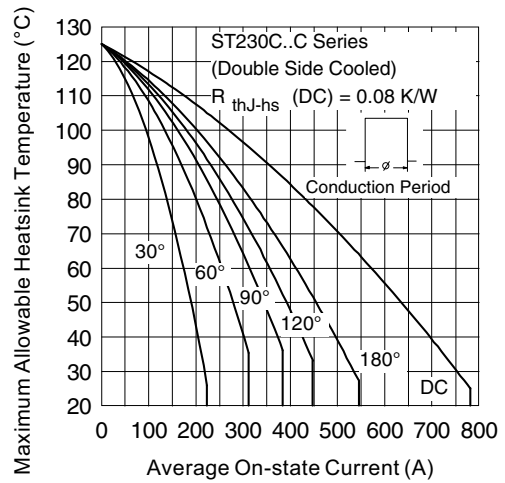


Fig. 4 - Current Ratings Characteristics

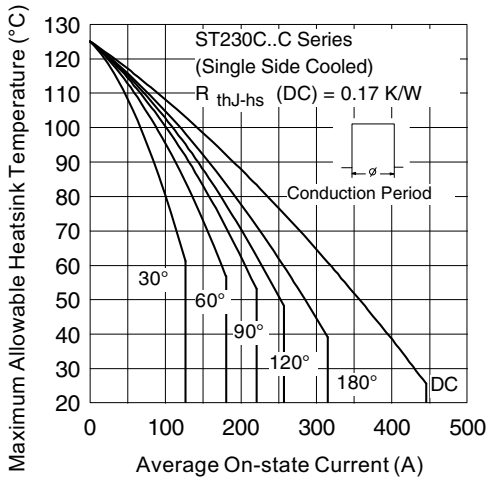


Fig. 2 - Current Ratings Characteristics

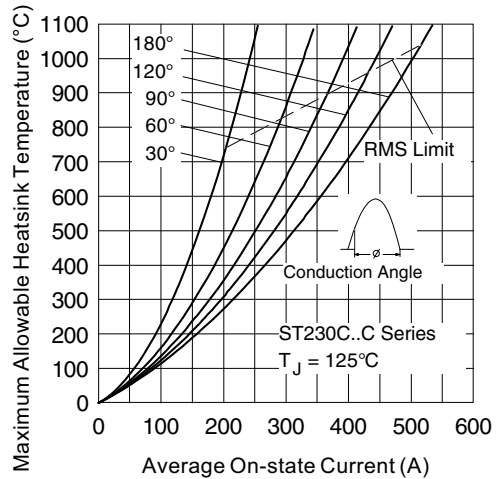


Fig. 5 - On-State Power Loss Characteristics

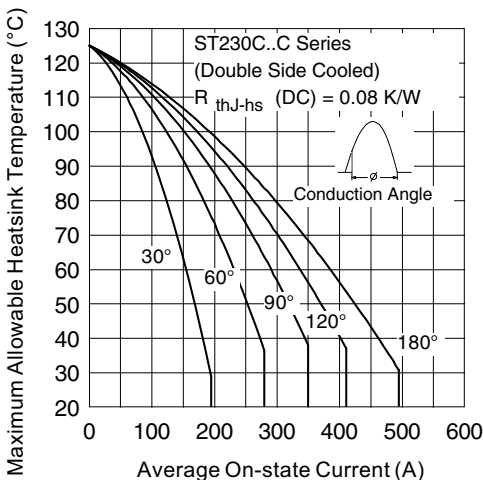


Fig. 3 - Current Ratings Characteristics

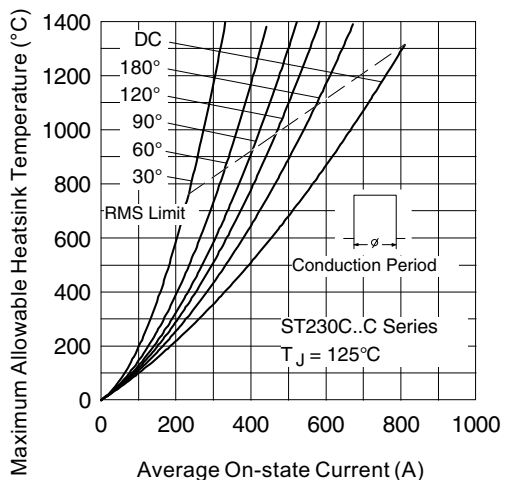


Fig. 6 - On-State Power Loss Characteristics

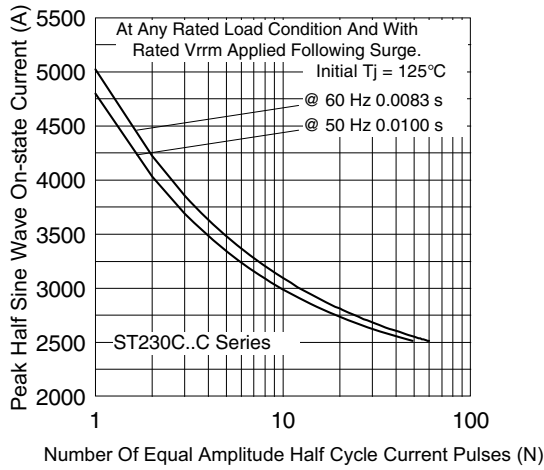


Fig. 7 - Maximum Non-Repetitive Surge Current Single and Double Side Cooled

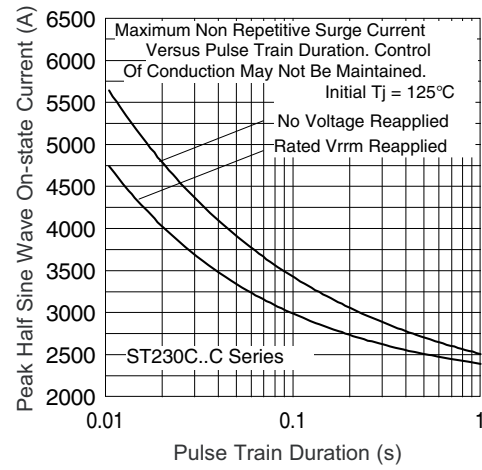


Fig. 8 - Maximum Non-Repetitive Surge Current Single and Double Side Cooled



Fig. 9 - On-State Voltage Drop Characteristics



Fig. 10 - Thermal Impedance  $Z_{thJ-hs}$  Characteristics

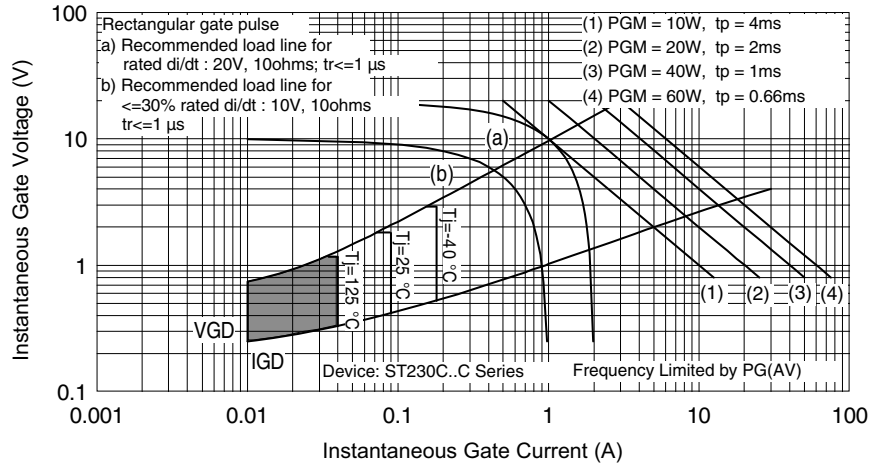


Fig. 11 - Gate Characteristics

**ORDERING INFORMATION TABLE**

Device code	<b>VS-</b>	<b>ST</b>	<b>23</b>	<b>0</b>	<b>C</b>	<b>20</b>	<b>C</b>	<b>1</b>	<b>-</b>
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

- 1** - Vishay Semiconductors product
- 2** - Thyristor
- 3** - Essential part number
- 4** - 0 = Converter grade
- 5** - C = Ceramic PUK
- 6** - Voltage code x 100 = V<sub>RRM</sub> (see Voltage Ratings table)
- 7** - C = PUK case TO-200AB (A-PUK)
- 8** - 0 = Eyelet terminals (gate and auxiliary cathode unsoldered leads)  
 1 = Fast-on terminals (gate and auxiliary cathode unsoldered leads)  
 2 = Eyelet terminals (gate and auxiliary cathode soldered leads)  
 3 = Fast-on terminals (gate and auxiliary cathode soldered leads)
- 9** - Critical dV/dt: • None = 500 V/μs (Standard selection)  
 • L = 1000 V/μs (Special selection)

LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95074">www.vishay.com/doc?95074</a>

## TO-200AB (A-PUK)

### DIMENSIONS in millimeters (inches)

Anode to gate  
 Creepage distance: 7.62 (0.30) minimum  
 Strike distance: 7.12 (0.28) minimum



Quote between upper and lower pole pieces has to be considered after application of mounting force (see thermal and mechanical specification)



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