



# Phase Control Thyristors (Hockey PUK Version), 650 A



E-PUK (TO-200AB)

### FEATURES

- Center amplifying gate
- Metal case with ceramic insulator
- International standard case E-PUK (TO-200AB)
- 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

PRIMARY CHARACTERISTICS	
$I_{T(AV)}$	650 A
$V_{DRM}/V_{RRM}$	400 V, 800 V, 1200 V, 1600 V, 1800 V, 2000 V
$V_{TM}$	2.18 V
$I_{GT}$	100 mA
$T_J$	-40 °C to +125 °C
Package	E-PUK (TO-200AB)
Circuit configuration	Single SCR

MAJOR RATINGS AND CHARACTERISTICS			
PARAMETER	TEST CONDITIONS	VALUES	UNITS
$I_{T(AV)}$		650	A
	$T_{hs}$	55	°C
$I_{T(RMS)}$		1290	A
	$T_{hs}$	25	°C
$I_{TSM}$	50 Hz	8000	A
	60 Hz	8380	
$I^2t$	50 Hz	320	kA <sup>2</sup> s
	60 Hz	292	
$V_{DRM}/V_{RRM}$		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-ST300C..C	04	400	500	50
	08	800	900	
	12	1200	1300	
	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		650 (320)	A
				55 (75)	°C
Maximum RMS on-state current	$I_{T(RMS)}$	DC at 25 °C heatsink temperature double side cooled		1290	A
Maximum peak, one-cycle non-repetitive surge current	$I_{TSM}$	t = 10 ms	No voltage reapplied	8000	
		t = 8.3 ms	No voltage reapplied	8380	
		t = 10 ms	100 % $V_{RRM}$ reapplied	6730	
		t = 8.3 ms	100 % $V_{RRM}$ reapplied	7040	
Maximum $I^2t$ for fusing	$I^2t$	t = 10 ms	No voltage reapplied	320	kA <sup>2</sup> s
		t = 8.3 ms	No voltage reapplied	292	
		t = 10 ms	100 % $V_{RRM}$ reapplied	226	
		t = 8.3 ms	100 % $V_{RRM}$ reapplied	207	
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	t = 0.1 to 10 ms, no voltage reapplied		3200	kA <sup>2</sup> √s
Low level value of threshold voltage	$V_{T(TO)1}$	(16.7 % $\times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)}$ ), $T_J = T_J$ maximum		0.97	V
High level value of threshold voltage	$V_{T(TO)2}$	(I $> \pi \times I_{T(AV)}$ ), $T_J = T_J$ maximum		0.98	
Low level value of on-state slope resistance	$r_{t1}$	(16.7 % $\times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)}$ ), $T_J = T_J$ maximum		0.74	mΩ
High level value of on-state slope resistance	$r_{t2}$	(I $> \pi \times I_{T(AV)}$ ), $T_J = T_J$ maximum		0.73	
Maximum on-state voltage	$V_{TM}$	$I_{pk} = 1635$ A, $T_J = T_J$ maximum, $t_p = 10$ ms sine pulse		2.18	V
Maximum holding current	$I_H$	$T_J = 25$ °C, anode supply 12 V resistive load		600	mA
Typical latching current	$I_L$			1000	

<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 $\leq 80$ % $V_{DRM}$		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, $di/dt = 40$ 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		50	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	200	-	mA
		$T_J = 25$ °C	100	200	
		$T_J = 125$ °C	50	-	
DC gate voltage required to trigger	$V_{GT}$	$T_J = -40$ °C	2.5	-	V
		$T_J = 25$ °C	1.8	3.0	
		$T_J = 125$ °C	1.1	-	
DC gate current not to trigger	$I_{GD}$	$T_J = T_J$ maximum	10.0		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 junction 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	0.09	K/W
		DC operation double side cooled	0.04	
Maximum thermal resistance, case to heatsink	$R_{thC-hs}$	DC operation single side cooled	0.02	
		DC operation double side cooled	0.01	
Mounting force, $\pm 10$ %			9800 (1000)	N (kg)
Approximate weight			83	g
Case style		See dimensions - link at the end of datasheet	E-PUK (TO-200AB)	

<b><math>\Delta R_{thJ-hs}</math> CONDUCTION</b>						
CONDUCTION ANGLE	SINUSOIDAL CONDUCTION		RECTANGULAR CONDUCTION		TEST CONDITIONS	UNITS
	SINGLE SIDE	DOUBLE SIDE	SINGLE SIDE	DOUBLE SIDE		
180°	0.010	0.011	0.007	0.007	$T_J = T_J$ maximum	K/W
120°	0.012	0.012	0.012	0.013		
90°	0.015	0.015	0.016	0.017		
60°	0.022	0.022	0.023	0.023		
30°	0.036	0.036	0.036	0.037		

**Note**

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

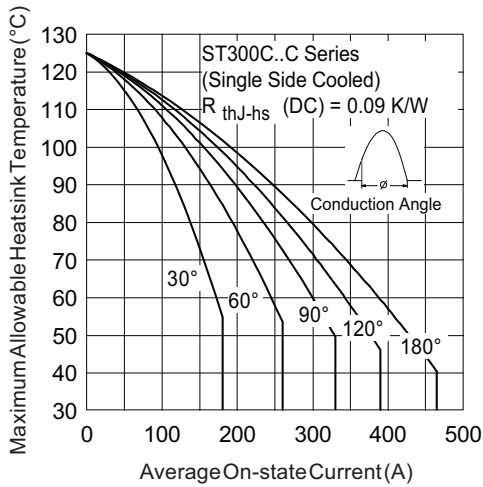


Fig. 1 - Current Ratings Characteristics

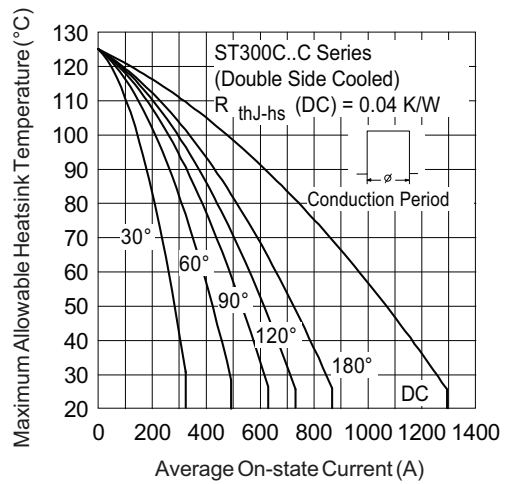


Fig. 4 - Current Ratings Characteristics

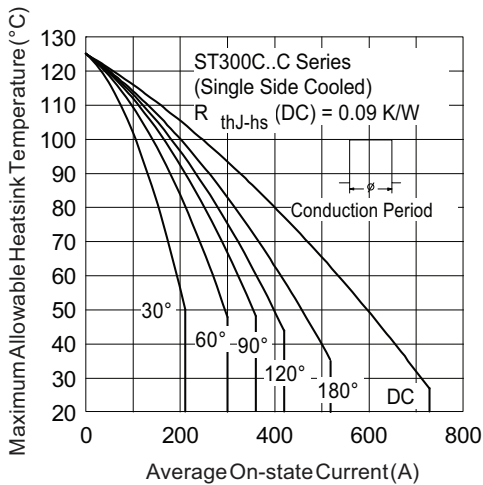


Fig. 2 - Current Ratings Characteristics

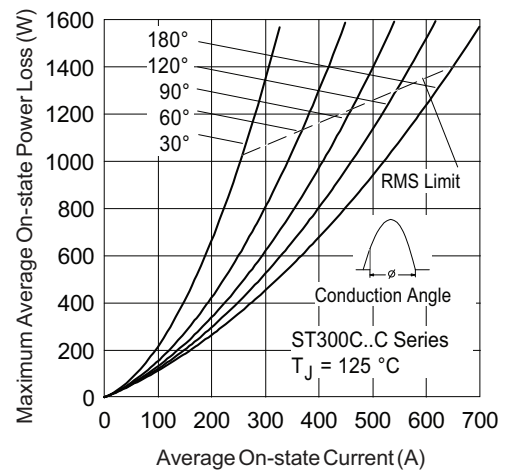


Fig. 5 - On-State Power Loss Characteristics

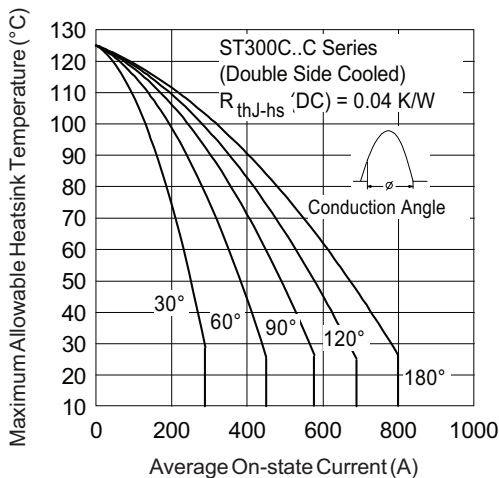


Fig. 3 - Current Ratings Characteristics

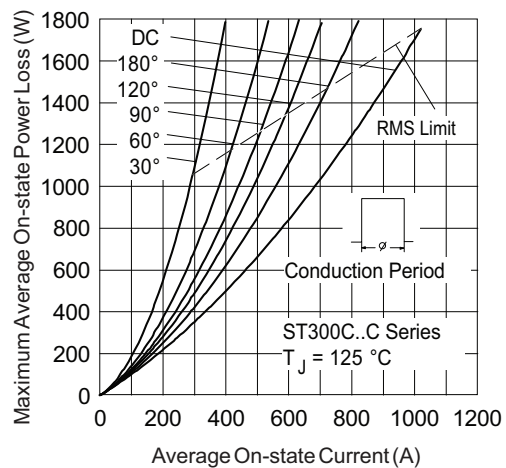


Fig. 6 - On-State Power Loss Characteristics

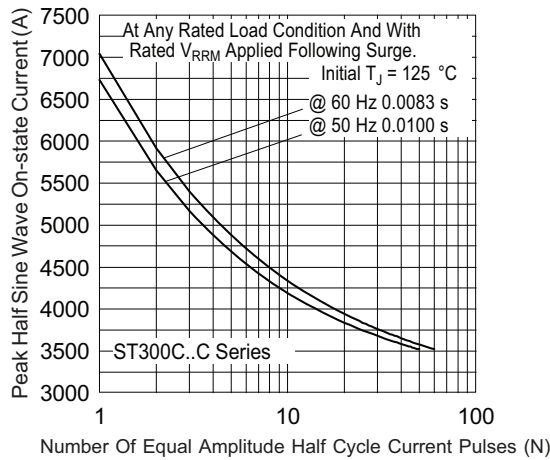


Fig. 7 - Maximum Non-Repetitive Surge Current Single and Double Side Cooled

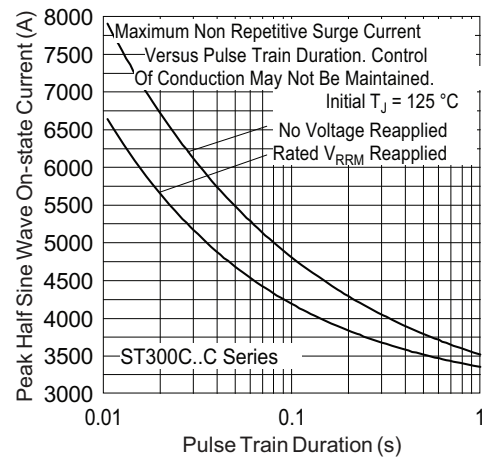


Fig. 8 - Maximum Non-Repetitive Surge Current Single and Double Side Cooled

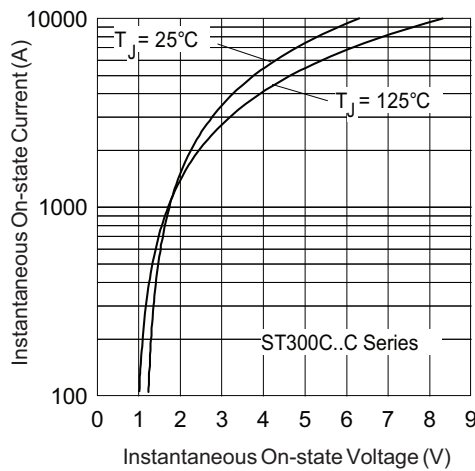


Fig. 9 - On-State Voltage Drop Characteristics

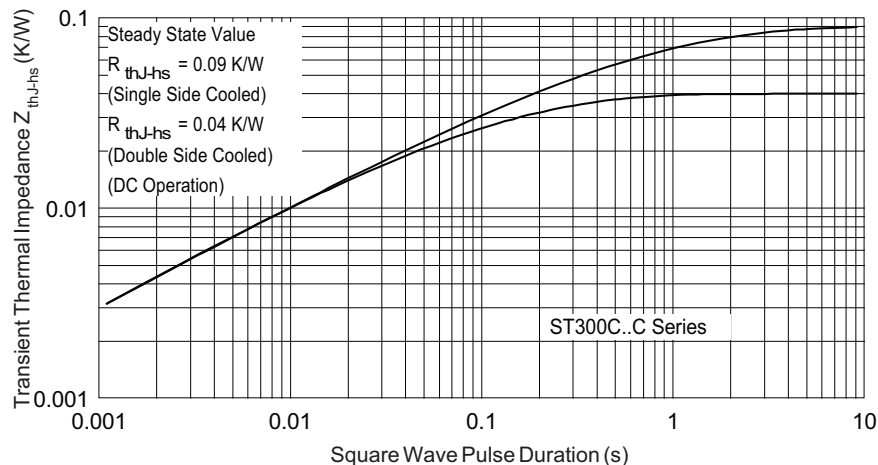


Fig. 10 - Thermal Impedance  $Z_{thJ-hs}$  Characteristics



Fig. 11 - Gate Characteristics

**ORDERING INFORMATION TABLE**

Device code	<b>VS-</b>	<b>ST</b>	<b>30</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 E-PUK (TO-200AB)
- 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 value)  
 • L = 1000 V/μs (special selection)

LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95075">www.vishay.com/doc?95075</a>



## E-PUK (TO-200AB)

**DIMENSIONS** in millimeters (inches)

Anode to gate  
Creepage distance: 11.18 (0.44) minimum  
Strike distance: 7.62 (0.30) 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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