

## Phase Control Thyristors (Hockey PUK Version), 960 A



E-PUK (TO-200AB)



**RoHS**  
COMPLIANT

### FEATURES

- Center amplifying gate
- Metal case with ceramic insulator
- International standard case E-PUK (TO-200AB)
- Extended temperature range
- Low profile hockey PUK to increase current-carrying capability
- 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)

### TYPICAL APPLICATIONS

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

PRIMARY CHARACTERISTICS	
$I_{T(AV)}$	960 A
$V_{DRM}/V_{RRM}$	400 V, 600 V
$V_{TM}$	1.58 V
$I_{GT}$	100 mA
$T_J$	-40 °C to +150 °C
Package	E-PUK (TO-200AB)
Circuit configuration	Single SCR

MAJOR RATINGS AND CHARACTERISTICS			
PARAMETER	TEST CONDITIONS	VALUES	UNITS
$I_{T(AV)}$		960	A
	$T_{hs}$	80	°C
$I_{T(RMS)}$		2220	A
	$T_{hs}$	25	°C
$I_{TSM}$	50 Hz	12 500	A
	60 Hz	13 000	
$I^2t$	50 Hz	782	kA <sup>2</sup> s
	60 Hz	713	
$V_{DRM}/V_{RRM}$		400 to 600	V
$t_q$	Typical	100	µs
$T_J$		-40 to 150	°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-ST380CH..C	04	400	500	100
	06	600	700	



ABSOLUTE MAXIMUM RATINGS						
PARAMETER	SYMBOL	TEST CONDITIONS			VALUES	UNITS
Maximum average on-state current at heatsink temperature	I <sub>T(AV)</sub>	180° conduction, half sine wave double side (single side) cooled			960 (440)	A
					80 (110)	°C
Maximum RMS on-state current	I <sub>T(RMS)</sub>	DC at 25 °C heatsink temperature double side cooled			2220	A
Maximum peak, one-cycle non-repetitive surge current	I <sub>TSM</sub>	t = 10 ms	No voltage reapplied	Sinusoidal half wave, initial T <sub>J</sub> = T <sub>J</sub> maximum	12 500	
		t = 8.3 ms			13 000	
		t = 10 ms	100 % V <sub>RRM</sub> reapplied		10 500	
		t = 8.3 ms			11 000	
Maximum I <sup>2</sup> t for fusing	I <sup>2</sup> t	t = 10 ms	No voltage reapplied		782	kA <sup>2</sup> s
		t = 8.3 ms			713	
		t = 10 ms	100 % V <sub>RRM</sub> reapplied		553	
		t = 8.3 ms			505	
Maximum I <sup>2</sup> √t for fusing	I <sup>2</sup> √t	t = 0.1 to 10 ms, no voltage reapplied			7820	kA <sup>2</sup> √s
Low level value of threshold voltage	V <sub>T(TO)1</sub>	(16.7 % × π × I <sub>T(AV)</sub> < I < π × I <sub>T(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum			0.85	V
High level value of threshold voltage	V <sub>T(TO)2</sub>	(I > π × I <sub>T(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum			0.88	
Low level value of on-state slope resistance	r <sub>t1</sub>	(16.7 % × π × I <sub>T(AV)</sub> < I < π × I <sub>T(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum			0.25	mΩ
High level value of on-state slope resistance	r <sub>t2</sub>	(I > π × I <sub>T(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum			0.24	
Maximum on-state voltage	V <sub>TM</sub>	I <sub>pk</sub> = 2900 A, T <sub>J</sub> = T <sub>J</sub> maximum, t <sub>p</sub> = 10 ms sine pulse			1.58	V
Maximum holding current	I <sub>H</sub>	T <sub>J</sub> = 25 °C, anode supply 12 V resistive load			600	mA
Typical latching current	I <sub>L</sub>				1000	

SWITCHING				
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	$t_q$	$I_{TM} = 550$ 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	

BLOCKING				
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	100	mA



TRIGGERING						
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES		UNITS
				TYP.	MAX.	
Maximum peak gate power	P <sub>GM</sub>	T <sub>J</sub> = T <sub>J</sub> maximum, t <sub>p</sub> ≤ 5 ms		10.0		W
Maximum average gate power	P <sub>G(AV)</sub>	T <sub>J</sub> = T <sub>J</sub> maximum, f = 50 Hz, d% = 50		2.0		
Maximum peak positive gate current	I <sub>GM</sub>	T <sub>J</sub> = T <sub>J</sub> maximum, t <sub>p</sub> ≤ 5 ms		3.0		A
Maximum peak positive gate voltage	+ V <sub>GM</sub>	T <sub>J</sub> = T <sub>J</sub> maximum, t <sub>p</sub> ≤ 5 ms		20		V
Maximum peak negative gate voltage	- V <sub>GM</sub>			5.0		
DC gate current required to trigger	I <sub>GT</sub>	T <sub>J</sub> = -40 °C	Maximum required gate trigger/ current/voltage are the lowest value which will trigger all units 12 V anode to cathode applied	200	-	mA
		T <sub>J</sub> = 25 °C		100	200	
		T <sub>J</sub> = 150 °C		40	-	
DC gate voltage required to trigger	V <sub>GT</sub>	T <sub>J</sub> = -40 °C		2.5	-	V
		T <sub>J</sub> = 25 °C		1.8	3.0	
		T <sub>J</sub> = 150 °C		1.0	-	
DC gate current not to trigger	I <sub>GD</sub>	T <sub>J</sub> = T <sub>J</sub> maximum	Maximum gate current/voltage not to trigger is the maximum value which will not trigger any unit with rated V <sub>DRM</sub> anode to cathode applied	10		mA
DC gate voltage not to trigger	V <sub>GD</sub>			0.25		V

THERMAL AND MECHANICAL SPECIFICATIONS				
PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Maximum operating junction temperature range	$T_J$		-40 to 150	°C
Maximum storage temperature range	$T_{Stg}$			
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)	

$\Delta R_{thJ-hs}$ CONDUCTION						
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 <sub>J</sub> = T <sub>J</sub> 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

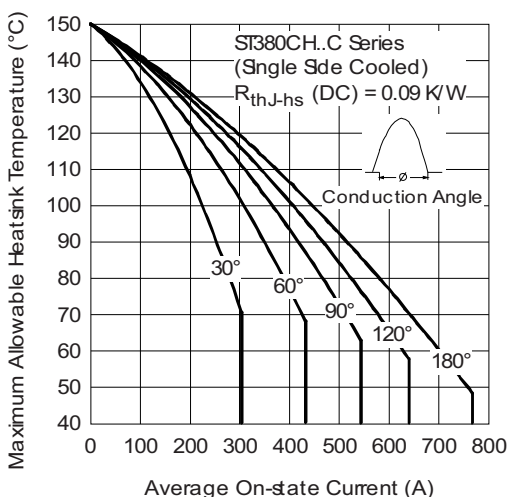


Fig. 1 - Current Ratings Characteristics

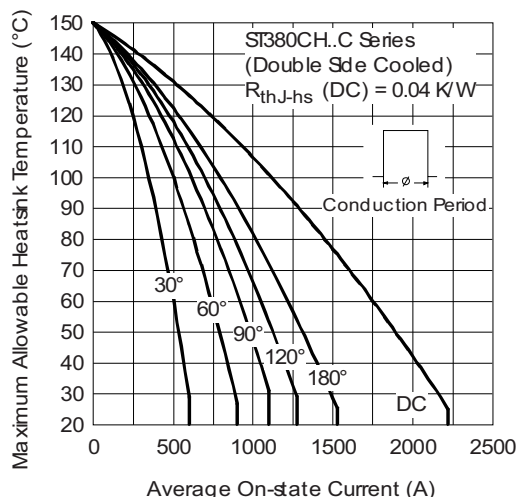


Fig. 4 - Current Ratings Characteristics

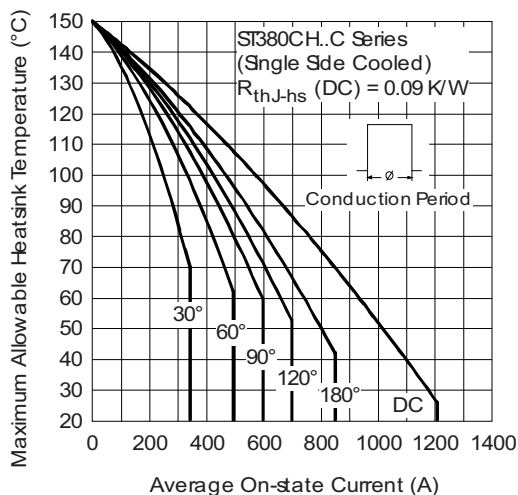


Fig. 2 - Current Ratings Characteristics

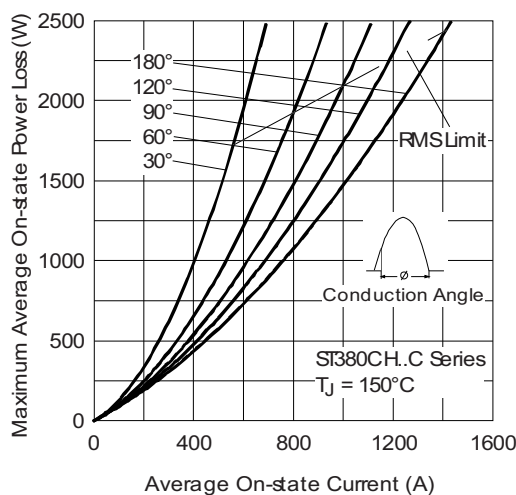


Fig. 5 - On-State Power Loss Characteristics

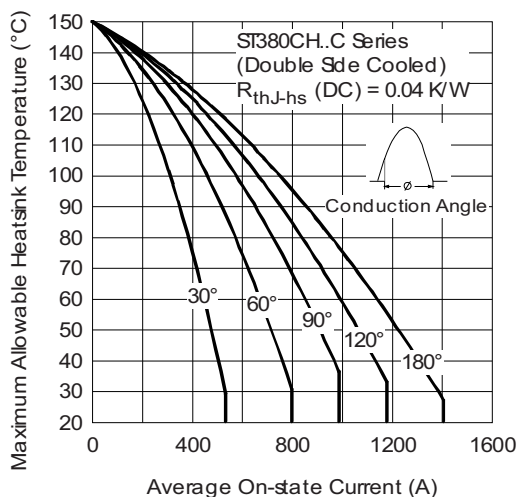


Fig. 3 - Current Ratings Characteristics

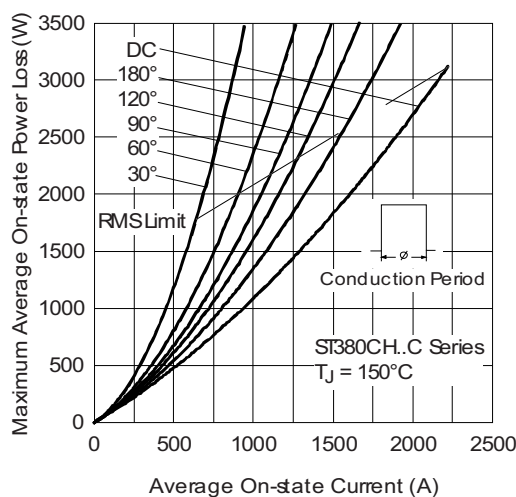


Fig. 6 - On-State Power Loss Characteristics

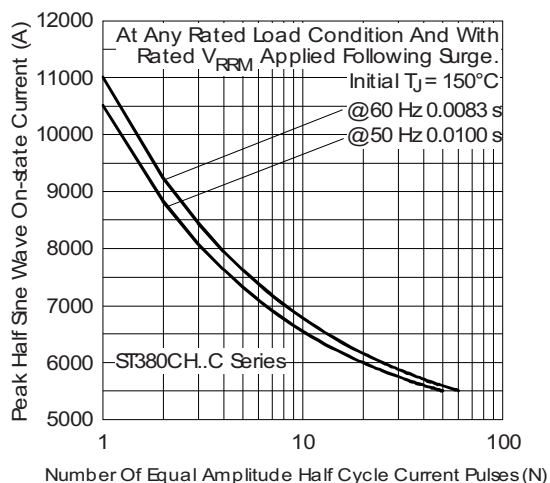


Fig. 7 - Maximum Non-Repetitive Surge Current  
Single and Double Side Cooled

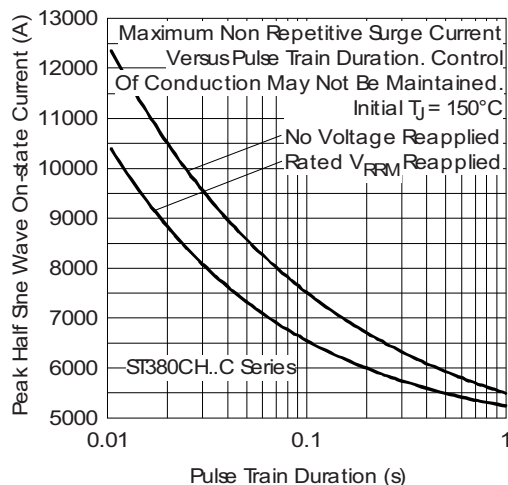


Fig. 8 - Maximum Non-Repetitive Surge Current  
Single and Double Side Cooled

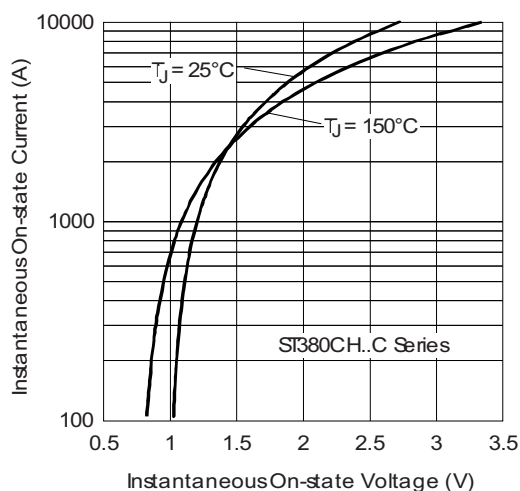


Fig. 9 - On-State Voltage Drop Characteristics

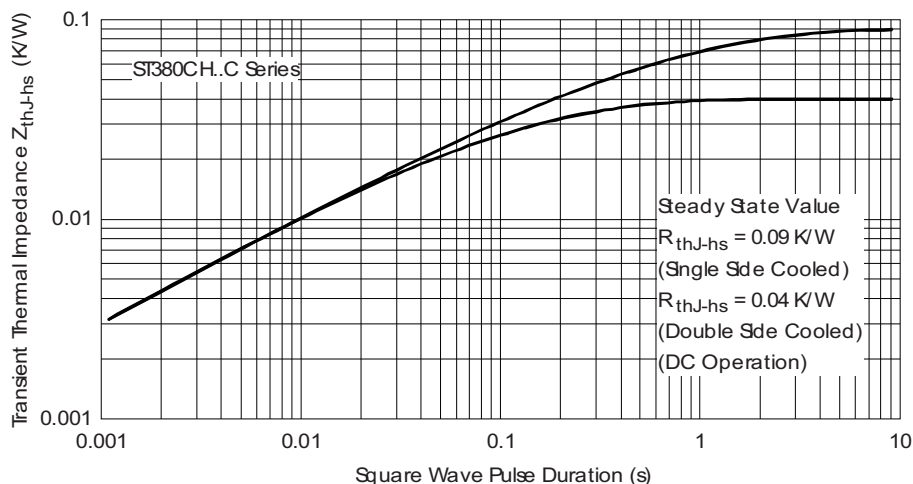


Fig. 10 - Thermal Impedance  $Z_{thJ-hs}$  Characteristics

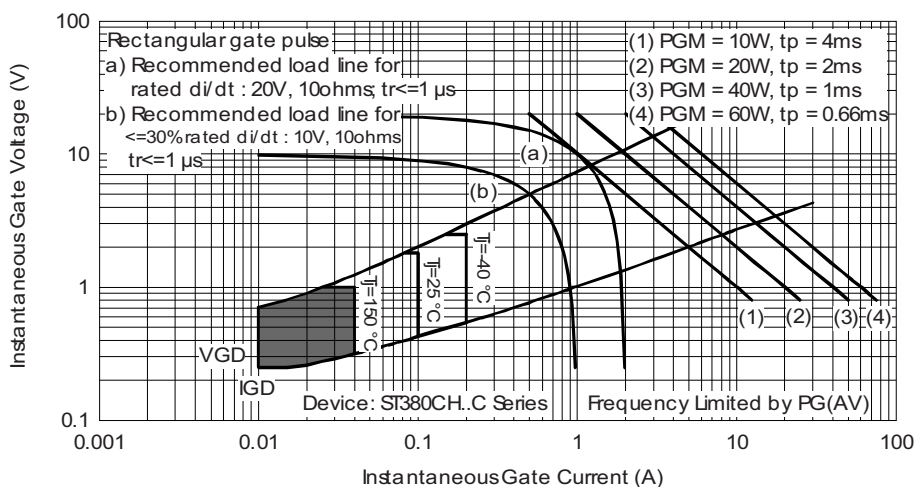


Fig. 11 - Gate Characteristics

## ORDERING INFORMATION TABLE

Device code	VS-	ST	38	0	CH	06	C	1	-
	1	2	3	4	5	6	7	8	9
1	Vishay Semiconductors product								
2	Thyristor								
3	Essential part number								
4	0 = converter grade								
5	CH = ceramic PUK, high temperature								
6	Voltage code x 100 = $V_{RRM}$ (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/ $\mu s$ (standard selection)								
	• L = 1000 V/ $\mu s$ (special selection)								

## LINKS TO RELATED DOCUMENTS

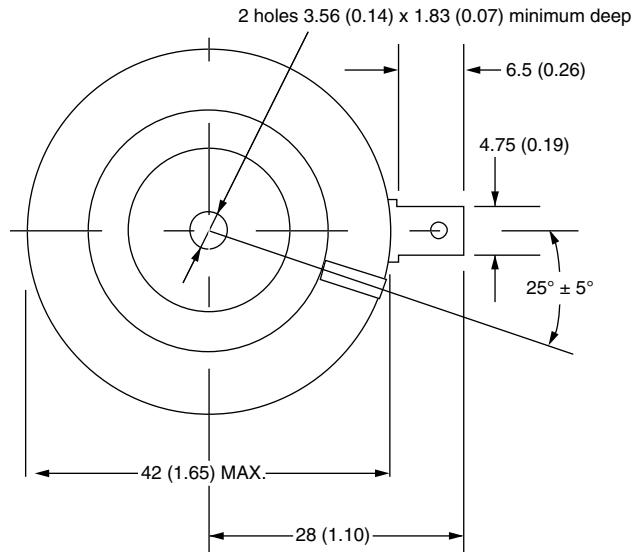
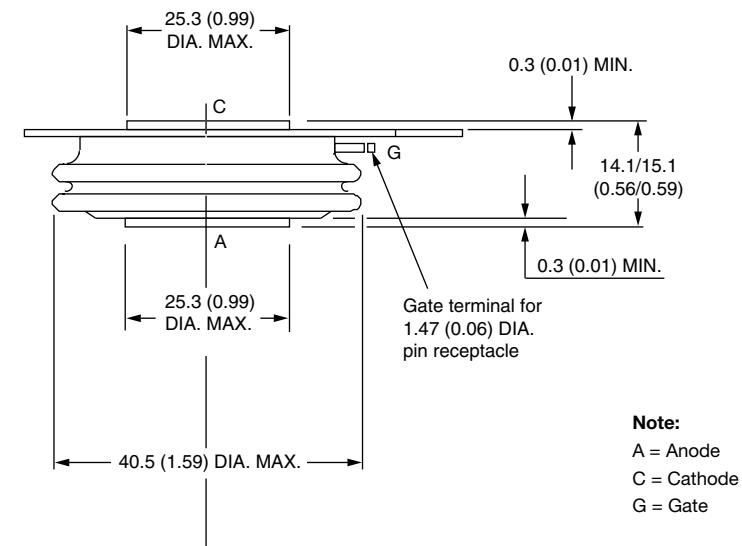
Dimensions	<a href="http://www.vishay.com/doc?95075">http://www.vishay.com/doc?95075</a>
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## E-PUK (TO-200AB)

### 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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