

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



TO-200AC (B-PUK)

### FEATURES

- Center amplifying gate
- Metal case with ceramic insulator
- International standard case TO-200AC (B-PUK)
- High profile hockey 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-200AC (B-PUK)
Diode variation	Single SCR
$I_{T(AV)}$	650 A
$V_{DRM}/V_{RRM}$	400 V, 800 V, 1200 V, 1400 V, 1600 V, 1800 V, 2000 V
$V_{TM}$	1.90 V
$I_{GT}$	100 mA
$T_J$	-40 °C to 125 °C

### MAJOR RATINGS AND CHARACTERISTICS

PARAMETER	TEST CONDITIONS	VALUES	UNITS
$I_{T(AV)}$		650	A
	$T_{hs}$	55	°C
$I_{T(RMS)}$		1230	A
	$T_{hs}$	25	°C
$I_{TSM}$	50 Hz	9000	A
	60 Hz	9420	
$I^2t$	50 Hz	405	kA <sup>2</sup> s
	60 Hz	370	
$V_{DRM}/V_{RRM}$		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-ST330C..L	04	400	500	50
	08	800	900	
	12	1200	1300	
	14	1400	1500	
	16	1600	1700	
	18	1800	1900	
	20	2000	2100	

ABSOLUTE MAXIMUM RATINGS					
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 (314)	A
Maximum RMS on-state current	$I_{T(RMS)}$	DC at 25 °C heatsink temperature double side cooled		55 (75)	°C
Maximum peak, one-cycle non-repetitive surge current	$I_{TSM}$	t = 10 ms	No voltage reapplied	1230	A
		t = 8.3 ms	No voltage reapplied	9000	
		t = 10 ms	100 % $V_{RRM}$ reapplied	9420	
		t = 8.3 ms	100 % $V_{RRM}$ reapplied	7570	
Maximum $I^2t$ for fusing	$I^2t$	t = 10 ms	No voltage reapplied	7920	kA <sup>2</sup> s
		t = 8.3 ms	No voltage reapplied	405	
		t = 10 ms	100 % $V_{RRM}$ reapplied	370	
		t = 8.3 ms	100 % $V_{RRM}$ reapplied	287	
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	t = 0.1 to 10 ms, no voltage reapplied		262	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		4050	kA <sup>2</sup> √s
High level value of threshold voltage	$V_{T(TO)2}$	(I > $\pi \times I_{T(AV)}$ ), $T_J = T_J$ maximum		0.91	V
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		0.93	mΩ
High level value of on-state slope resistance	$r_{t2}$	(I > $\pi \times I_{T(AV)}$ ), $T_J = T_J$ maximum		0.57	V
Maximum on-state voltage	$V_{TM}$	$I_{pk} = 1730$ A, $T_J = T_J$ maximum, $t_p = 10$ ms sine pulse		1.90	V
Maximum holding current	$I_H$	$T_J = 25$ °C, anode supply 12 V resistive load		600	mA
Typical latching current	$I_L$			1000	mA

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	μs

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	50	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> = 125 °C		50	-	
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> = 125 °C		1.1	-	
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		

THERMAL AND MECHANICAL SPECIFICATIONS				
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	0.11	K/W
		DC operation double side cooled	0.06	
Maximum thermal resistance, case to heatsink	$R_{thC-hs}$	DC operation single side cooled	0.011	
		DC operation double side cooled	0.005	
Mounting force, $\pm 10$ %			9800 (1000)	N (kg)
Approximate weight			250	g
Case style		See dimensions - link at the end of datasheet	TO-200AC (B-PUK)	

$\Delta R_{thJ-hs}$ CONDUCTION						
CONDUCTION ANGLE	SINUSOIDAL CONDUCTION		RECTANGULAR CONDUCTION		TEST CONDITIONS	UNITS
	SINGLE SIDE	DOUBLE SIDE	SINGLE SIDE	DOUBLE SIDE		
180°	0.012	0.010	0.008	0.008	T <sub>J</sub> = T <sub>J</sub> maximum	K/W
120°	0.014	0.015	0.014	0.014		
90°	0.018	0.018	0.019	0.019		
60°	0.026	0.027	0.027	0.028		
30°	0.045	0.046	0.046	0.046		

**Note**

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

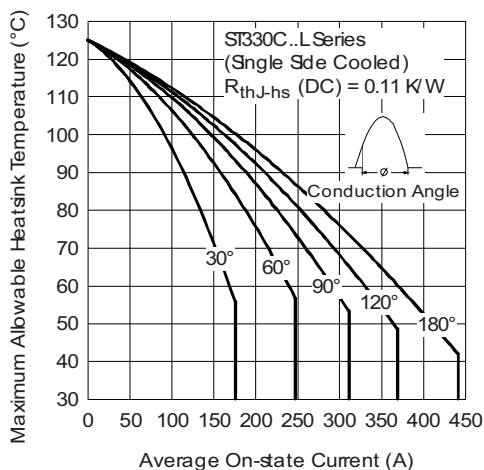


Fig. 1 - Current Ratings Characteristics

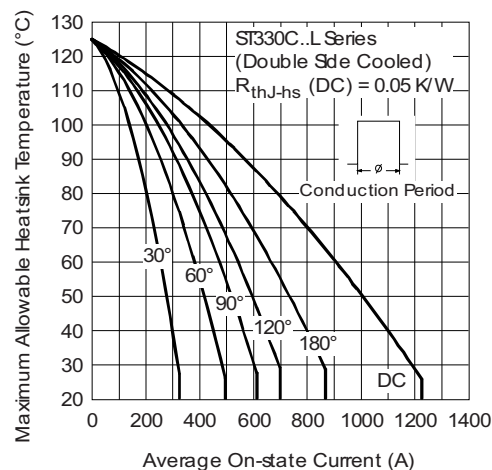


Fig. 4 - Current Ratings Characteristics

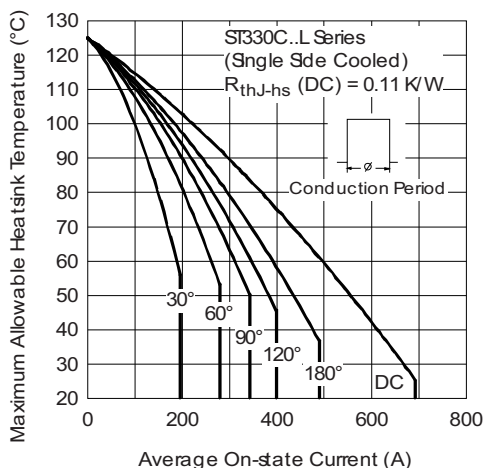


Fig. 2 - Current Ratings Characteristics

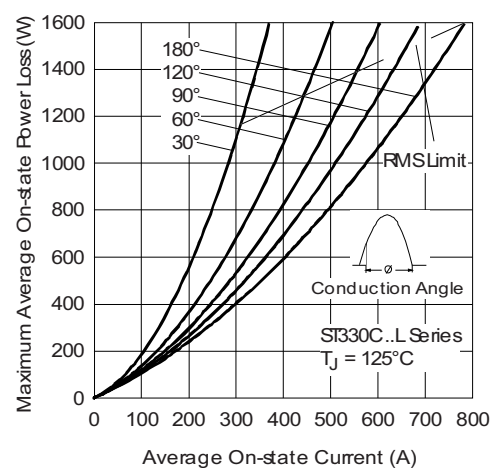


Fig. 5 - On-State Power Loss Characteristics

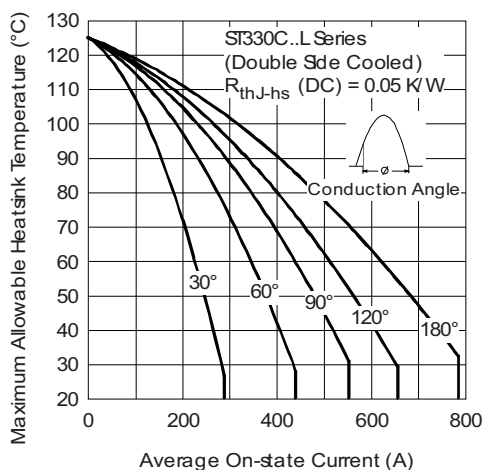


Fig. 3 - Current Ratings Characteristics

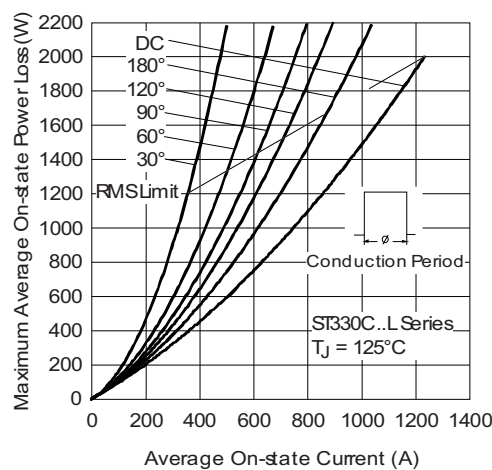


Fig. 6 - On-State Power Loss Characteristics

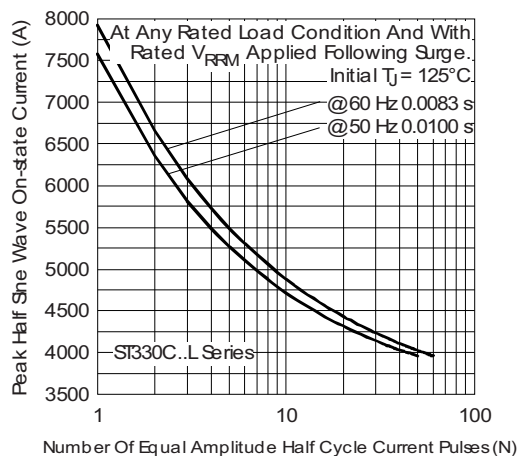


Fig. 7 - Maximum Non-Repetitive Surge Current  
Single and Double Side Cooled

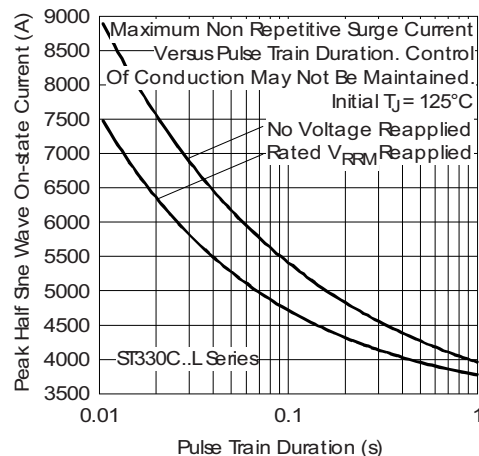


Fig. 8 - Maximum Non-Repetitive Surge Current  
Single and Double Side Cooled

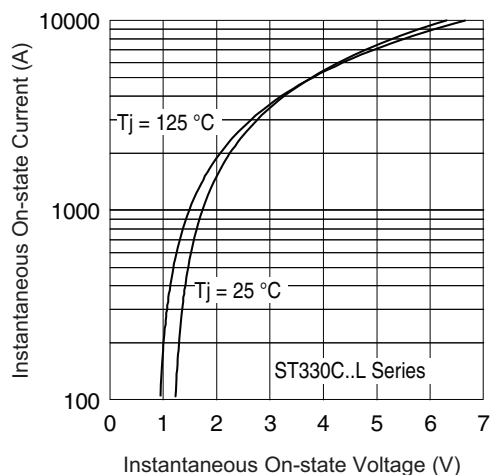


Fig. 9 - On-State Voltage Drop Characteristics

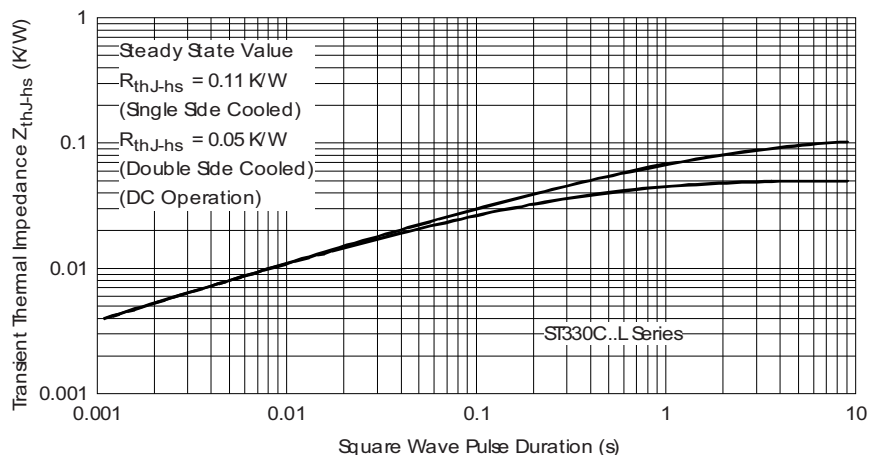


Fig. 10 - Thermal Impedance  $Z_{thJ-hs}$  Characteristics

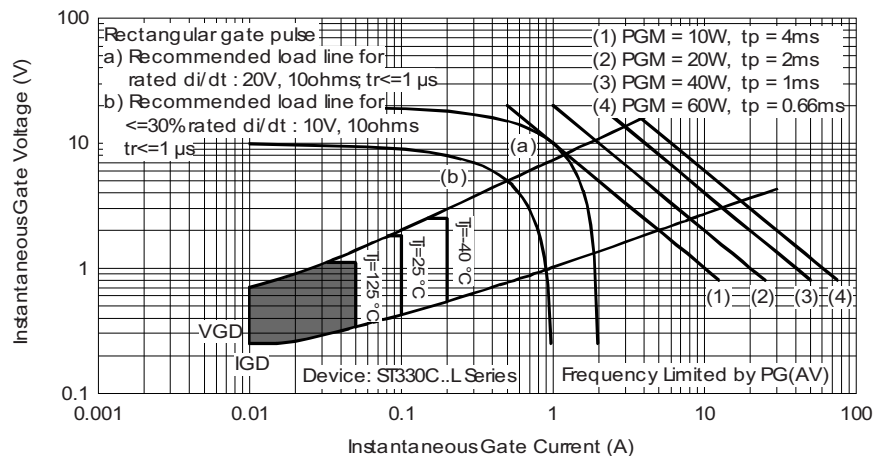


Fig. 11 - Gate Characteristics

## ORDERING INFORMATION TABLE

Device code	VS-	ST	33	0	C	16	L	1	-
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

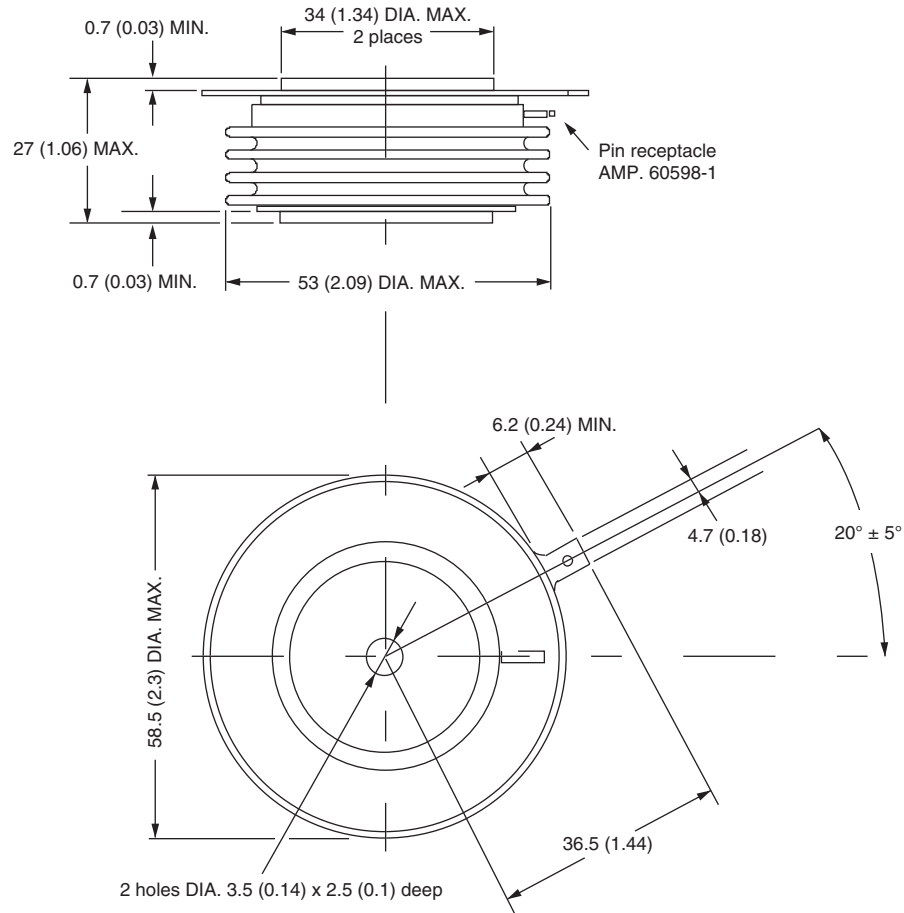
- 1** - Vishay Semiconductors product
- 2** - Thyristor
- 3** - Essential part number
- 4** - 0 = Converter grade
- 5** - C = Ceramic PUK
- 6** - Voltage code x 100 =  $V_{RRM}$  (see Voltage Ratings table)
- 7** - L = PUK case TO-200AC (B-PUK)
- 8** - 0 = Eyelet terminals (gate and auxiliary cathode 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/ $\mu s$  (standard selection)  
• L = 1000 V/ $\mu s$  (special selection)

LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95076">www.vishay.com/doc?95076</a>

## TO-200AC (B-PUK)

### DIMENSIONS in millimeters (inches)

Creepage distance: 36.33 (1.430) minimum  
Strike distance: 17.43 (0.686) 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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