



# Inverter Grade Thyristors (Hockey PUK Version), 390 A



TO-200AB (A-PUK)

### FEATURES

- Metal case with ceramic insulator
- All diffused design
- Center amplifying gate
- Guaranteed high dV/dt
- International standard case TO-200AB (A-PUK)
- Guaranteed high dI/dt
- High surge current capability
- Low thermal impedance
- High speed performance
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



RoHS  
COMPLIANT

PRODUCT SUMMARY	
Package	TO-200AB (A-PUK)
Diode variation	Single SCR
$I_{T(AV)}$	390 A
$V_{DRM}/V_{RRM}$	400 V, 800 V
$V_{TM}$	1.58 V
$I_{TSM}$ at 50 Hz	5260 A
$I_{TSM}$ at 60 Hz	5510 A
$I_{GT}$	200 mA
$T_C/T_{hs}$	55 °C

### TYPICAL APPLICATIONS

- Inverters
- Choppers
- Induction heating
- All types of force-commutated converters

MAJOR RATINGS AND CHARACTERISTICS			
PARAMETER	TEST CONDITIONS	VALUES	UNITS
$I_{T(AV)}$		390	A
	$T_{hs}$	55	°C
$I_{T(RMS)}$		745	A
	$T_{hs}$	25	°C
$I_{TSM}$	50 Hz	5850	A
	60 Hz	6130	
$I^2t$	50 Hz	171	kA <sup>2</sup> s
	60 Hz	156	
$V_{DRM}/V_{RRM}$		400 to 800	V
$t_q$	Range	10 to 30	µs
$T_J$		-40 to +125	°C

### ELECTRICAL SPECIFICATIONS

VOLTAGE RATINGS				
TYPE NUMBER	VOLTAGE CODE	$V_{DRM}/V_{RRM}$ , MAXIMUM REPETITIVE PEAK VOLTAGE V	$V_{RSM}$ , MAXIMUM NON-REPETITIVE PEAK VOLTAGE V	$I_{DRM}/I_{RRM}$ MAXIMUM AT $T_J = T_J$ MAXIMUM mA
VS-ST223C..C	04	400	500	40
	08	800	900	



CURRENT CARRYING CAPABILITY							
FREQUENCY							UNITS
50 Hz	930	800	1430	1220	5870	5240	A
400 Hz	910	770	1490	1300	3120	2740	
1000 Hz	780	650	1430	1260	1880	1640	
2500 Hz	490	400	1070	920	1000	860	
Recovery voltage $V_r$	50		50		50		V
Voltage before turn-on $V_d$	$V_{DRM}$		$V_{DRM}$		$V_{DRM}$		
Rise of on-state current $di/dt$	50		-		-		A/μs
Heatsink temperature	40	55	40	55	40	55	°C
Equivalent values for RC circuit	47/0.22		47/0.22		47/0.22		Ω/μF

ON-STATE CONDUCTION						
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			390 (150)	A
					55 (85)	°C
Maximum RMS on-state current	$I_{T(RMS)}$	DC at 25 °C heatsink temperature double side cooled			745	
Maximum peak, one half cycle, non-repetitive surge current	$I_{TSM}$	t = 10 ms	No voltage reapplied	Sinusoidal half wave, initial $T_J = T_J$ maximum	5850	A
					t = 8.3 ms	
		t = 10 ms	100 % $V_{RRM}$ reapplied		4920	
		t = 8.3 ms	5150			
Maximum $I^2t$ for fusing	$I^2t$	t = 10 ms	No voltage reapplied		171	kA <sup>2</sup> s
					t = 8.3 ms	
		t = 10 ms	100 % $V_{RRM}$ reapplied		121	
		t = 8.3 ms	110			
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	t = 0.1 to 10 ms, no voltage reapplied			1710	kA <sup>2</sup> √s
Maximum peak on-state voltage	$V_{TM}$	$I_{TM} = 600$ A, $T_J = T_J$ maximum, $t_p = 10$ ms sine wave pulse			1.58	V
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			1.05	
High level value of threshold voltage	$V_{T(TO)2}$	$I > \pi \times I_{T(AV)}$ , $T_J = T_J$ maximum			1.09	
Low level value of forward slope resistance	$r_{11}$	$(16.7 \% \times \pi \times I_{T(AV)}) < I < \pi \times I_{T(AV)}$ , $T_J = T_J$ maximum			0.88	mΩ
High level value of forward slope resistance	$r_{12}$	$I > \pi \times I_{T(AV)}$ , $T_J = T_J$ maximum			0.82	
Maximum holding current	$I_H$	$T_J = 25$ °C, $I_T > 30$ A			600	mA
Typical latching current	$I_L$	$T_J = 25$ °C, $V_A = 12$ V, $R_a = 6$ Ω, $I_G = 1$ A			1000	

SWITCHING					
PARAMETER	SYMBOL	TEST CONDITIONS	VALUES		UNITS
			MIN.	MAX.	
Maximum non-repetitive rate of rise of turned on current	$di/dt$	$T_J = T_J$ maximum, $V_{DRM} = \text{Rated } V_{DRM}$ , $I_{TM} = 2 \times di/dt$	1000		A/μs
Typical delay time	$t_d$	$T_J = 25$ °C, $V_{DM} = \text{Rated } V_{DRM}$ , $I_{TM} = 50$ A DC, $t_p = 1$ μs Resistive load, gate pulse: 10 V, 5 Ω source	0.78		μs
Maximum turn-off time	$t_q$	$T_J = T_J$ maximum, $I_{TM} = 300$ A, commutating $di/dt = 20$ A/μs $V_R = 50$ V, $t_p = 500$ μs, $dV/dt$ : See table in device code	10	30	



<b>BLOCKING</b>				
PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Maximum critical rate of rise of off-state voltage	dV/dt	T <sub>J</sub> = T <sub>J</sub> maximum, linear to 80 % V <sub>DRM</sub> , higher value available on request	500	V/μs
Maximum peak reverse and off-state leakage current	I <sub>RRM</sub> , I <sub>DRM</sub>	T <sub>J</sub> = T <sub>J</sub> maximum, rated V <sub>DRM</sub> /V <sub>RRM</sub> applied	40	mA

<b>TRIGGERING</b>				
PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Maximum peak gate power	P <sub>GM</sub>	T <sub>J</sub> = T <sub>J</sub> maximum, f = 50 Hz, d% = 50	60	W
Maximum average gate power	P <sub>G(AV)</sub>		10	
Maximum peak positive gate current	I <sub>GM</sub>	T <sub>J</sub> = T <sub>J</sub> maximum, t <sub>p</sub> ≤ 5 ms	10	A
Maximum peak positive gate voltage	+V <sub>GM</sub>		20	
Maximum peak negative gate voltage	-V <sub>GM</sub>		5	
Maximum DC gate current required to trigger	I <sub>GT</sub>	T <sub>J</sub> = 25 °C, V <sub>A</sub> = 12 V, R <sub>a</sub> = 6 Ω	200	mA
Maximum DC gate voltage required to trigger	V <sub>GT</sub>		3	
Maximum DC gate current not to trigger	I <sub>GD</sub>	T <sub>J</sub> = T <sub>J</sub> maximum, rated V <sub>DRM</sub> applied	20	mA
Maximum DC gate voltage not to trigger	V <sub>GD</sub>		0.25	

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

<b>ΔR<sub>thJ-hs</sub> 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 <sub>J</sub> = T <sub>J</sub> maximum	K/W
120°	0.019	0.019	0.019	0.019		
90°	0.024	0.024	0.026	0.026		
60°	0.035	0.035	0.036	0.037		
30°	0.060	0.060	0.060	0.061		

**Note**

- The table above shows the increment of thermal resistance R<sub>thJ-hs</sub> when devices operate at different conduction angles than DC

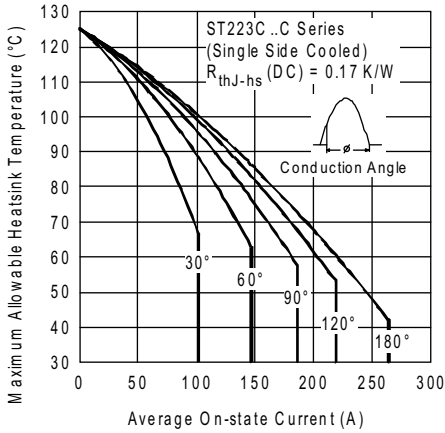


Fig. 1 - Current Ratings Characteristics

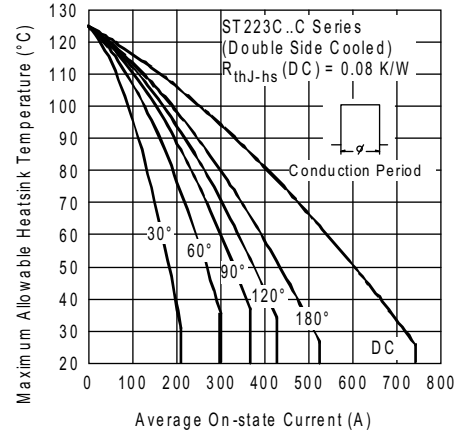


Fig. 4 - Current Ratings Characteristics

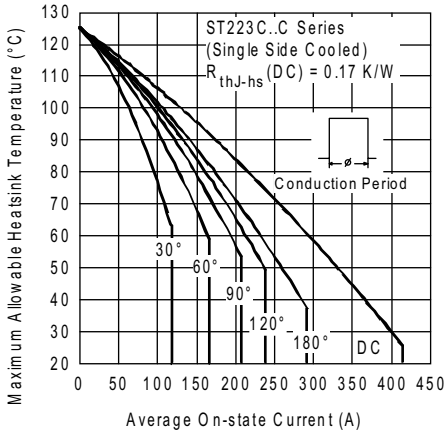


Fig. 2 - Current Ratings Characteristics

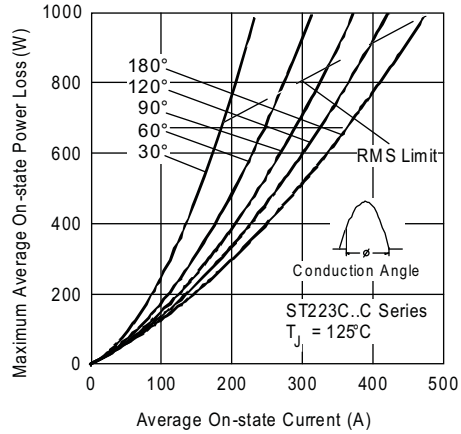


Fig. 5 - On-State Power Loss Characteristics

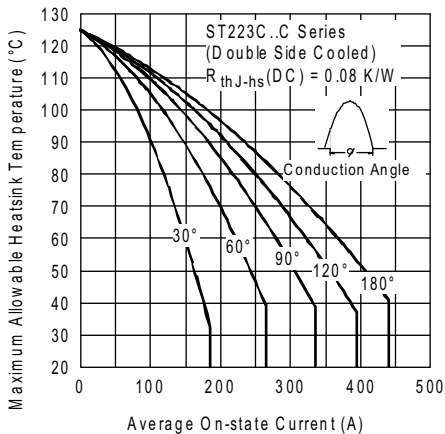


Fig. 3 - Current Ratings Characteristics

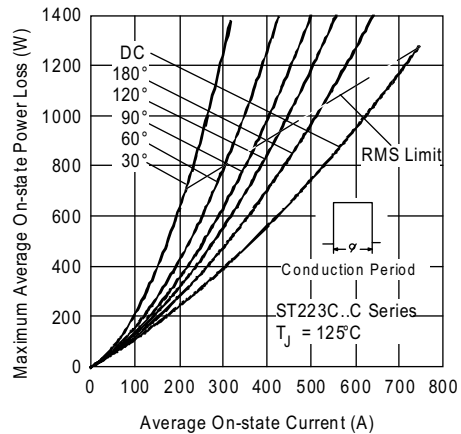


Fig. 6 - On-State Power Loss Characteristics

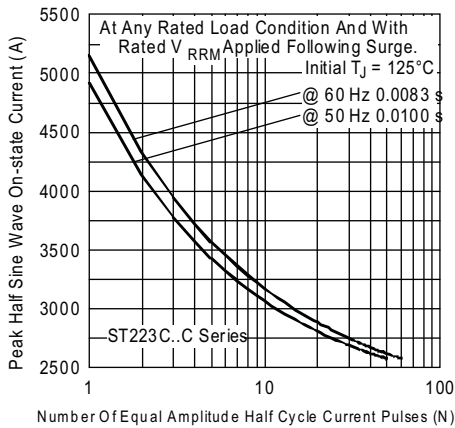


Fig. 7 - Maximum Non-Repetitive Surge Current Single and Double Side Cooled



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

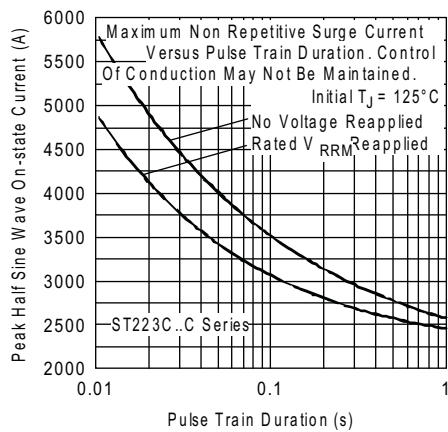


Fig. 8 - Maximum Non-Repetitive Surge Current Single and Double Side Cooled

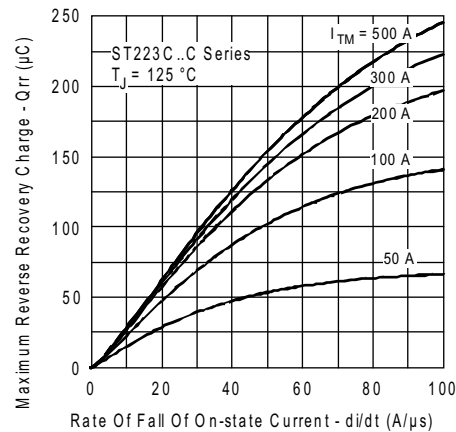


Fig. 11 - Reverse Recovered Charge Characteristics

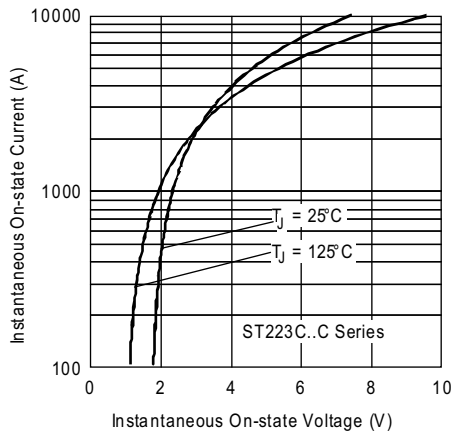


Fig. 9 - On-State Voltage Drop Characteristics

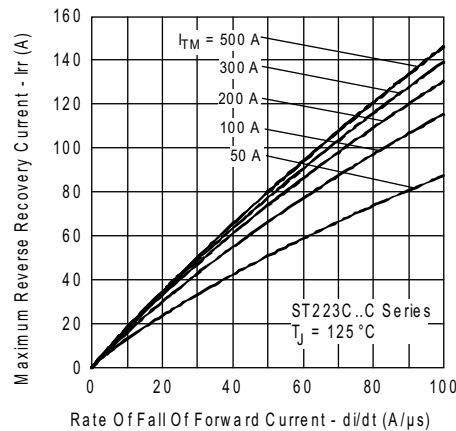


Fig. 12 - Reverse Recovered Current Characteristics

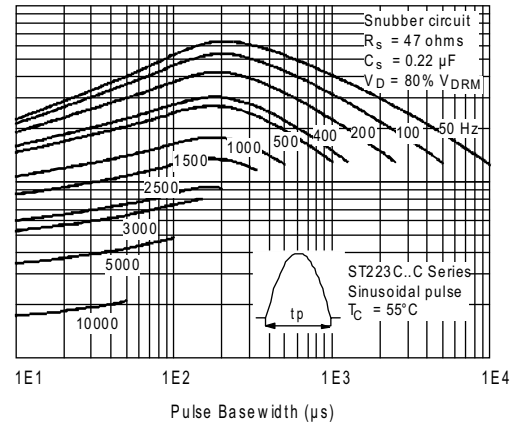
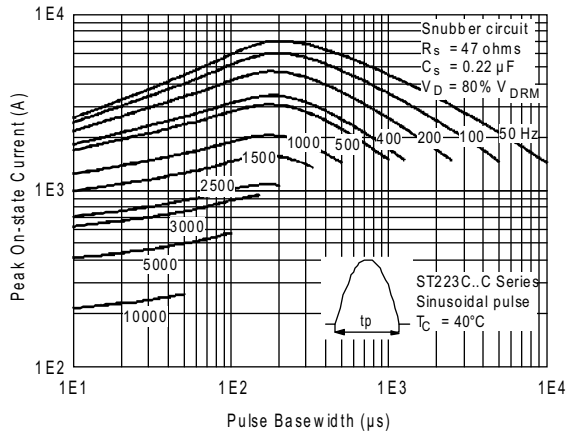


Fig. 13 - Frequency Characteristics

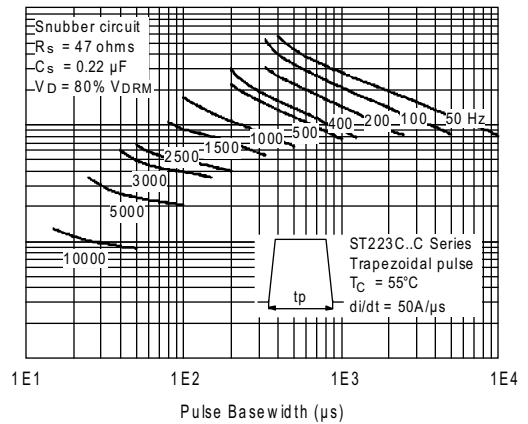
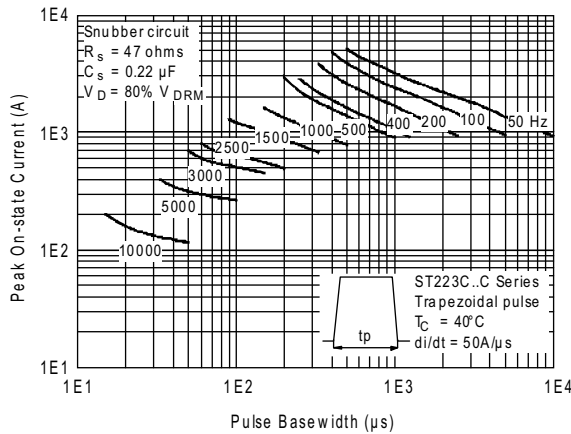


Fig. 14 - Frequency Characteristics

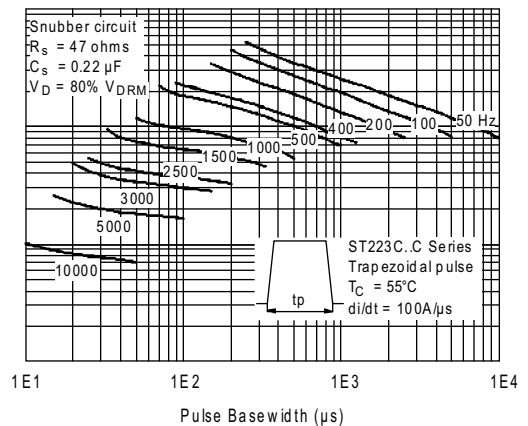


Fig. 15 - Frequency Characteristics



Fig. 16 - Maximum On-State Energy Power Loss Characteristics

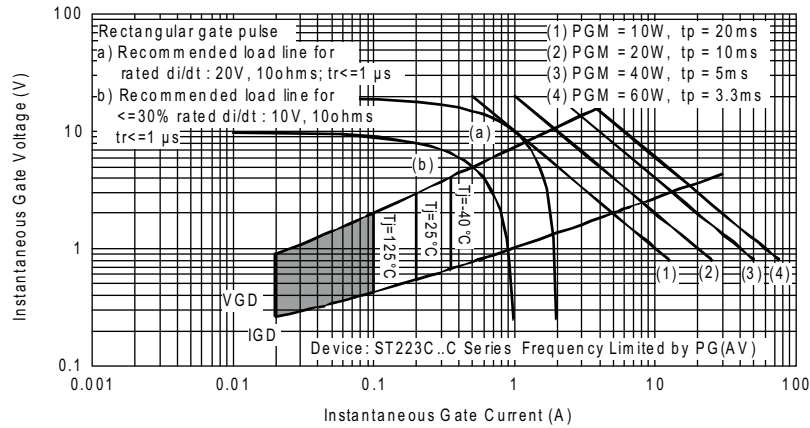
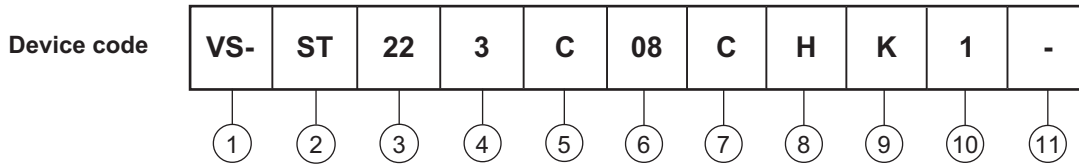


Fig. 17 - Gate Characteristics



**ORDERING INFORMATION TABLE**



- 1** - Vishay Semiconductors product
- 2** - Thyristor
- 3** - Essential part number
- 4** - 3 = Fast turn off
- 5** - C = Ceramic PUK
- 6** - Voltage code x 100 =  $V_{RRM}$  (see Voltage Ratings table)
- 7** - C = PUK case TO-200AB (A-PUK)
- 8** - Reapplied  $dV/dt$  code (for  $t_q$  test condition)
- 9** -  $t_q$  code
- 10** - 0 = Eyelet term.  
(gate and aux. cathode unsoldered leads)  
1 = Fast-on term.  
(gate and aux. cathode unsoldered leads)  
2 = Eyelet term.  
(gate and aux. cathode soldered leads)  
3 = Fast-on term.  
(gate and aux. cathode soldered leads)
- 11** - Critical  $dV/dt$ :
  - None = 500 V/ $\mu$ s (standard value)
  - L = 1000 V/ $\mu$ s (special selection)

<b><math>dV/dt - t_q</math> combinations available</b>					
<b><math>dV/dt</math> (V/<math>\mu</math>s)</b>	20	50	100	200	400
10	CN	DN	EN	<b>FN*</b>	--
12	CM	DM	EM	FM	--
15	CL	DL	EL	<b>FL*</b>	HL
18	CP	DP	EP	FP	HP
20	CK	DK	EK	FK	HK
25	--	--	--	--	HJ
30	--	--	--	--	HH

\* Standard part number.  
All other types available only on request.

<b>LINKS TO RELATED DOCUMENTS</b>	
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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## JONHON

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Телефон: 8 (812) 309-75-97 (многоканальный)

Факс: 8 (812) 320-03-32

Электронная почта: [ocean@oceanchips.ru](mailto:ocean@oceanchips.ru)

Web: <http://oceanchips.ru/>

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А