

Inverter Grade Thyristors (PUK Version), 620 A



TO-200AB (E-PUK)

FEATURES

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



RoHS
COMPLIANT

PRODUCT SUMMARY

PRODUCT SUMMARY	
Package	TO-200AB (E-PUK)
Diode variation	Single SCR
$I_{T(AV)}$	620 A
V_{DRM}/V_{RRM}	400 V, 800 V, 1000 V, 1200 V
V_{TM}	2.16 V
I_{TSM} at 50 Hz	7950 A
I_{TSM} at 60 Hz	8320 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
$I_{T(AV)}$		620	A
	T_{hs}	55	°C
$I_{T(RMS)}$		1180	A
	T_{hs}	25	°C
I_{TSM}	50 Hz	7950	A
	60 Hz	8320	
I^2t	50 Hz	316	kA ² s
	60 Hz	289	
V_{DRM}/V_{RRM}		400 to 1200	V
t_q	Range	10 to 30	µs
T_J		-40 to 125	°C

Note

- $t_q = 10 \mu s$ to $20 \mu s$ for 400 V to 800 V devices
- $t_q = 15 \mu s$ to $30 \mu s$ for 1000 V to 1200 V devices



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-ST303C..C	04	400	500	50
	08	800	900	
	10	1000	1100	
	12	1200	1300	

CURRENT CARRYING CAPABILITY							
FREQUENCY							UNITS
50 Hz	1314	1130	2070	1940	6930	6270	A
400 Hz	1260	1040	2190	1880	3440	2960	
1000 Hz	900	700	1900	1590	1850	1540	
2500 Hz	340	230	910	710	740	560	
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/ μ s
Heatsink temperature	40	55	40	55	40	55	$^{\circ}$ C
Equivalent values for RC circuit	10/0.47		10/0.47		10/0.47		Ω/μ F

ON-STATE CONDUCTION						
PARAMETER	SYMBOL	TEST CONDITIONS			VALUES	UNITS
Maximum average on-state current at heatsink temperature	$I_{T(AV)}$	180 $^{\circ}$ conduction, half sine wave double side (single side) cooled			620 (230)	A
					55 (85)	$^{\circ}$ C
Maximum RMS on-state current	$I_{T(RMS)}$	DC at 25 $^{\circ}$ C heatsink temperature double side cooled			1180	
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	7950	A
		t = 8.3 ms			8320	
		t = 10 ms	100 % V_{RRM} reapplied		6690	
		t = 8.3 ms			7000	
Maximum I^2t for fusing	I^2t	t = 10 ms	No voltage reapplied		316	kA 2 s
		t = 8.3 ms			289	
		t = 10 ms	100 % V_{RRM} reapplied		224	
		t = 8.3 ms			204	
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	t = 0.1 to 10 ms, no voltage reapplied			3160	kIA $^2\sqrt{s}$
Maximum peak on-state voltage	V_{TM}	$I_{TM} = 1255$ A, $T_J = T_J$ maximum, $t_p = 10$ ms sine wave pulse			2.16	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			1.44	
High level value of threshold voltage	$V_{T(TO)2}$	$I > \pi \times I_{T(AV)}$, $T_J = T_J$ maximum			1.48	
Low level value of forward slope resistance	r_{t1}	$(16.7\% \times \pi \times I_{T(AV)}) < I < \pi \times I_{T(AV)}$, $T_J = T_J$ maximum			0.57	m Ω
High level value of forward slope resistance	r_{t2}	$I > \pi \times I_{T(AV)}$, $T_J = T_J$ maximum			0.56	
Maximum holding current	I_H	$T_J = 25$ $^{\circ}$ C, $I_T > 30$ A			600	mA
Typical latching current	I_L	$T_J = 25$ $^{\circ}$ C, $V_A = 12$ V, $R_a = 6$ Ω , $I_G = 1$ A			1000	



SWITCHING				
PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Maximum non-repetitive rate of rise of turned on current	dl/dt	$T_J = T_J$ maximum, $V_{DRM} = \text{Rated } V_{DRM}$ $I_{TM} = 2 \times dl/dt$	1000	A/ μ s
Typical delay time	t_d	$T_J = 25^\circ\text{C}$, $V_{DM} = \text{Rated } V_{DRM}$, $I_{TM} = 50 \text{ A DC}$, $t_p = 1 \mu\text{s}$ Resistive load, gate pulse: 10 V, 5 Ω source	0.83	μ s
Maximum turn-off time ⁽¹⁾	minimum	$T_J = T_J$ maximum, $I_{TM} = 550 \text{ A}$, commutating $dl/dt = 40 \text{ A}/\mu\text{s}$ $V_R = 50 \text{ V}$, $t_p = 500 \mu\text{s}$, dV/dt : See table in device code	10	
	maximum		30	

Note

⁽¹⁾ $t_q = 10 \mu\text{s}$ to $20 \mu\text{s}$ for 400 V to 800 V devices; $t_q = 15 \mu\text{s}$ to $30 \mu\text{s}$ for 1000 V to 1200 V devices

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 % V_{DRM} , higher value available on request	500	V/ μ s
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
Maximum peak gate power	P_{GM}	$T_J = T_J$ maximum, $f = 50 \text{ Hz}$, $d\% = 50$	60	W
Maximum average gate power	$P_{G(AV)}$		10	
Maximum peak positive gate current	I_{GM}	$T_J = T_J$ maximum, $t_p \leq 5 \text{ ms}$	10	A
Maximum peak positive gate voltage	+ V_{GM}		20	V
Maximum peak negative gate voltage	- V_{GM}		5	
Maximum DC gate current required to trigger	I_{GT}	$T_J = 25^\circ\text{C}$, $V_A = 12 \text{ V}$, $R_a = 6 \Omega$	200	mA
Maximum DC gate voltage required to trigger	V_{GT}		3	V
Maximum DC gate current not to trigger	I_{GD}	$T_J = T_J$ maximum, rated V_{DRM} applied	20	mA
Maximum DC gate voltage not to trigger	V_{GD}		0.25	V

THERMAL AND MECHANICAL SPECIFICATIONS				
PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Maximum operating junction temperature range	T_J		-40 to 125	$^\circ\text{C}$
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	0.020	
		DC operation double side cooled	0.010	
Mounting force, $\pm 10 \%$			9800 (1000)	N (kg)
Approximate weight			83	g
Case style		See dimensions - link at the end of datasheet	TO-200AB (E-PUK)	



ΔR_{thJ-hs} CONDUCTION						
CONDUCTION ANGLE	SINUSOIDAL CONDUCTION		RECTANGULAR CONDUCTION		TEST CONDITIONS	UNITS
	SINGLE SIDE	DOUBLE SIDE	SINGLE SIDE	DOUBLE SIDE		
180°	0.010	0.010	0.007	0.007	T _J = T _J max.	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

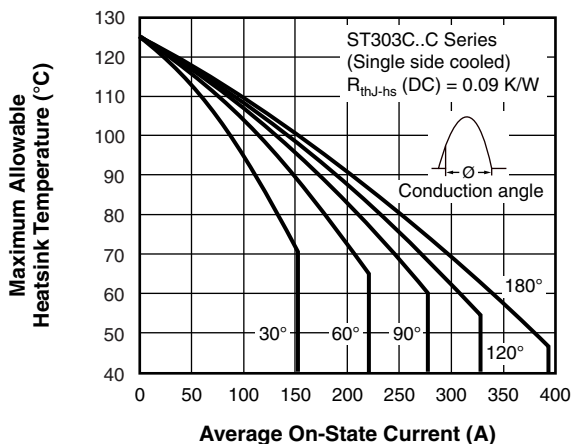


Fig. 1 - Current Ratings Characteristics

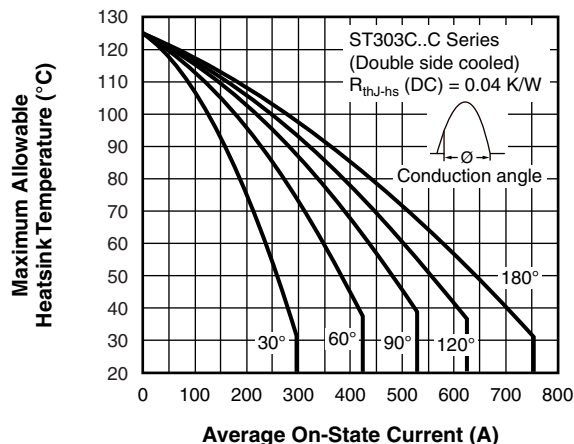


Fig. 3 - Current Ratings Characteristics

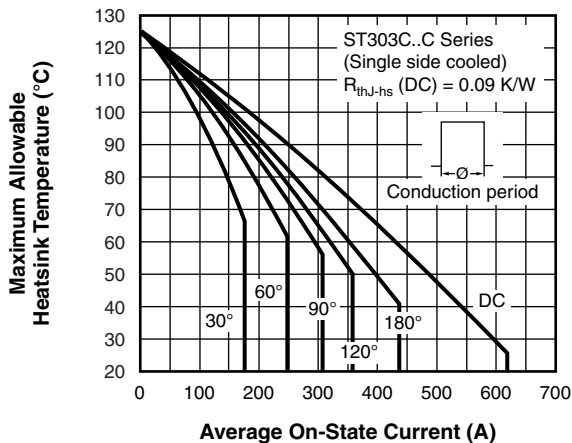


Fig. 2 - Current Ratings Characteristics

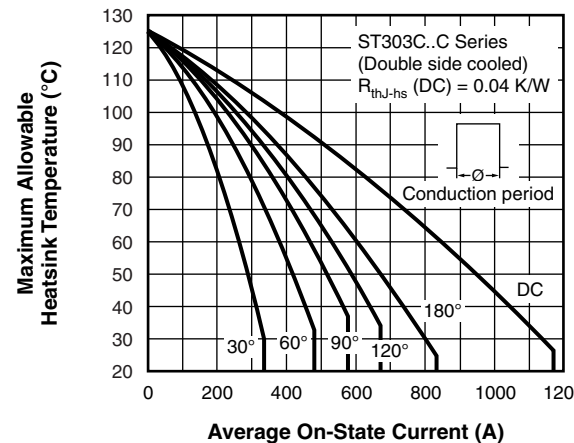


Fig. 4 - Current Ratings Characteristics

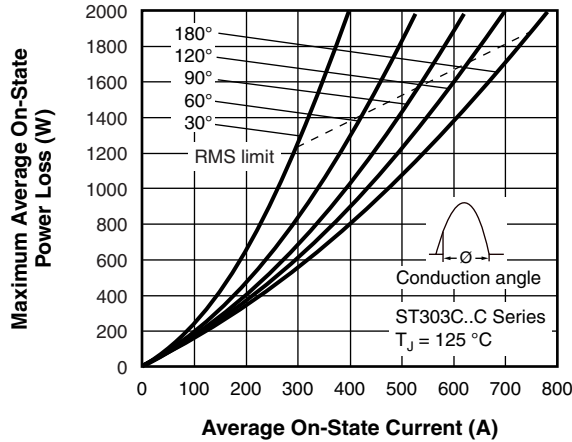


Fig. 5 - On-State Power Loss Characteristics

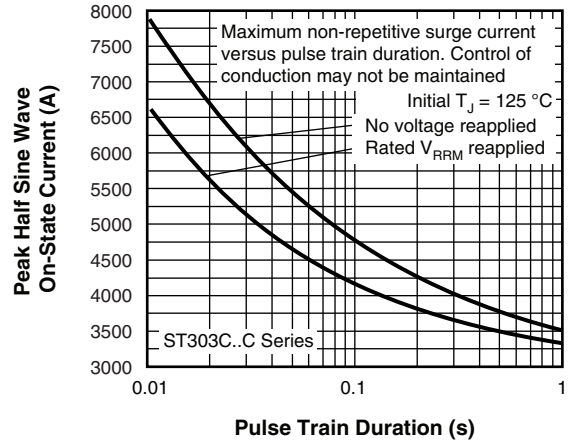


Fig. 8 - Maximum Non-Repetitive Surge Current Single and Double Side Cooled

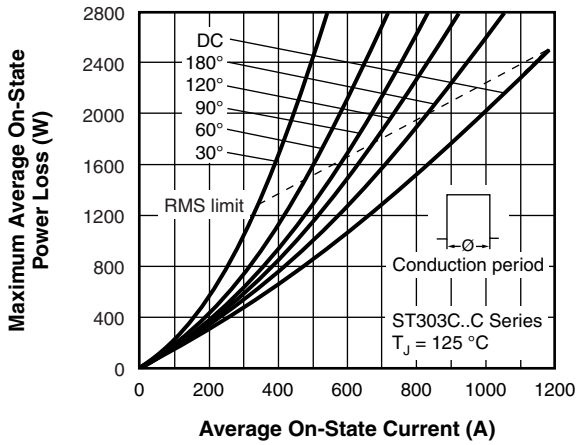


Fig. 6 - On-State Power Loss Characteristics

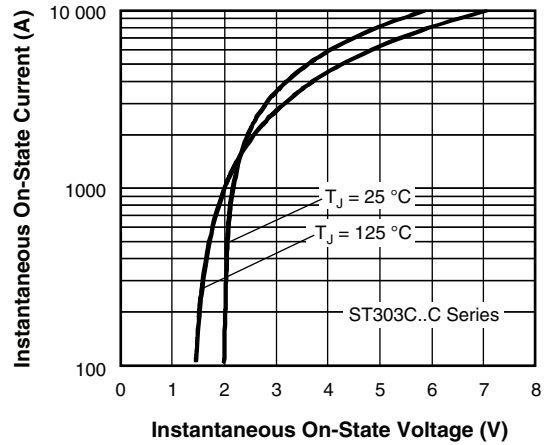


Fig. 9 - On-State Voltage Drop Characteristics

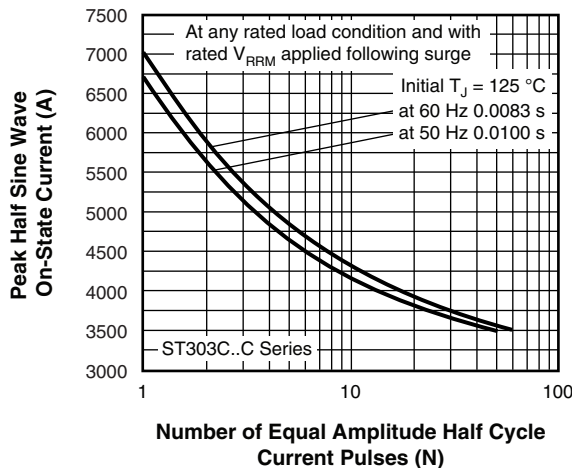


Fig. 7 - Maximum Non-Repetitive Surge Current Single and Double Side Cooled

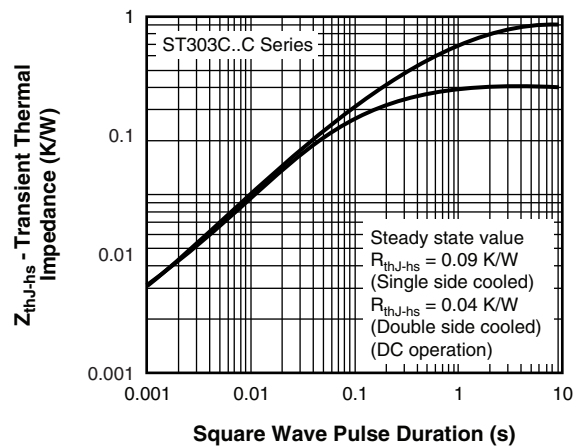


Fig. 10 - Thermal Impedance Z_{thJ-hs} Characteristics

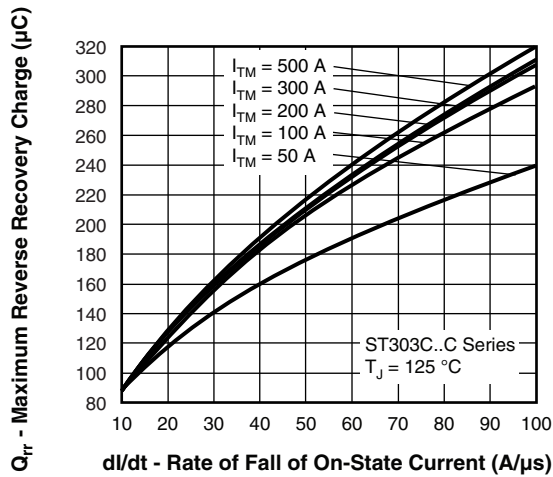


Fig. 11 - Reverse Recovered Charge Characteristics

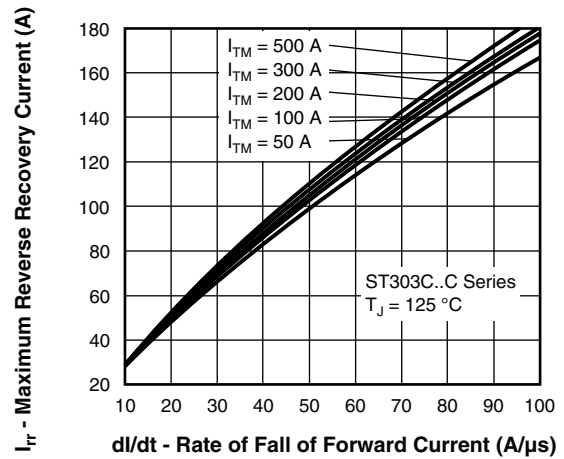


Fig. 12 - Reverse Recovered Current Characteristics

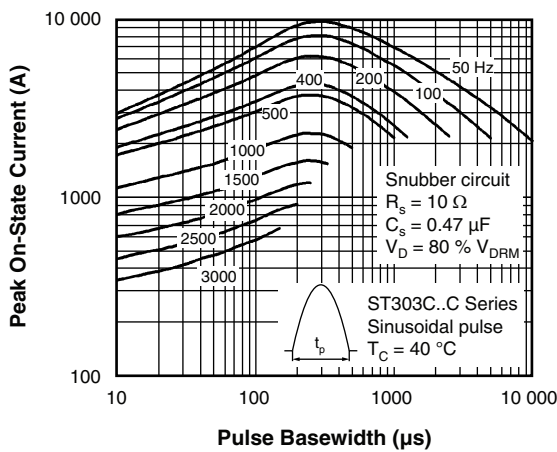


Fig. 13 - Frequency Characteristics

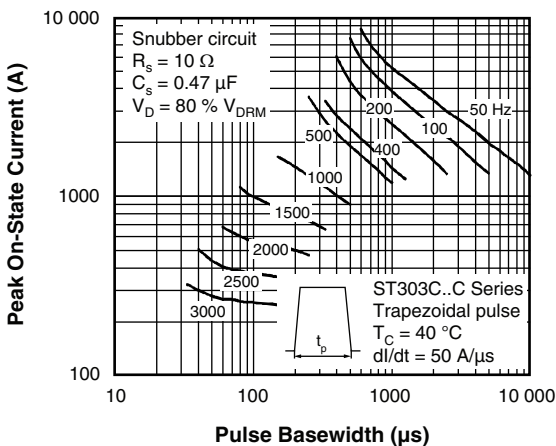
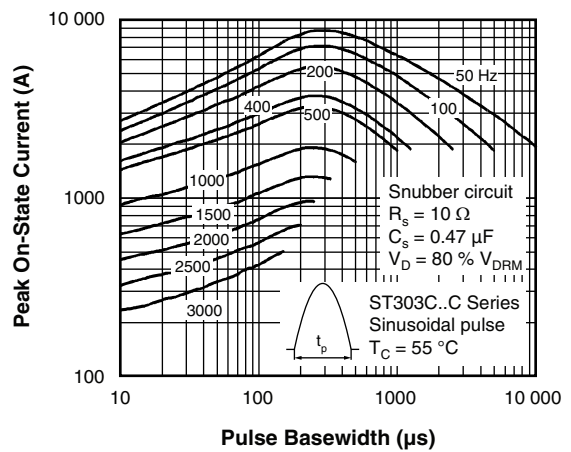
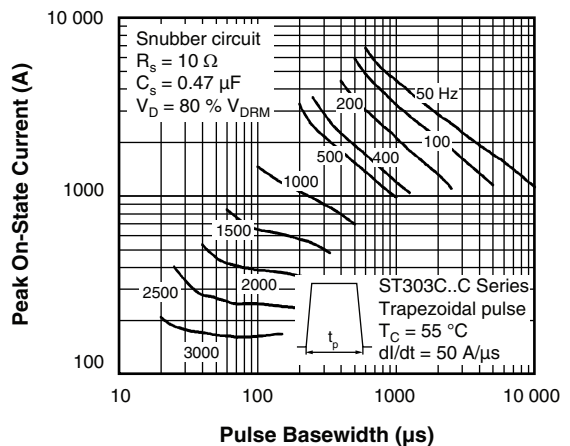


Fig. 14 - Frequency Characteristics



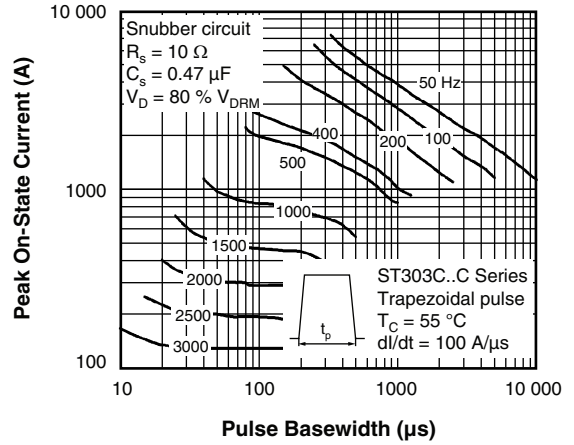
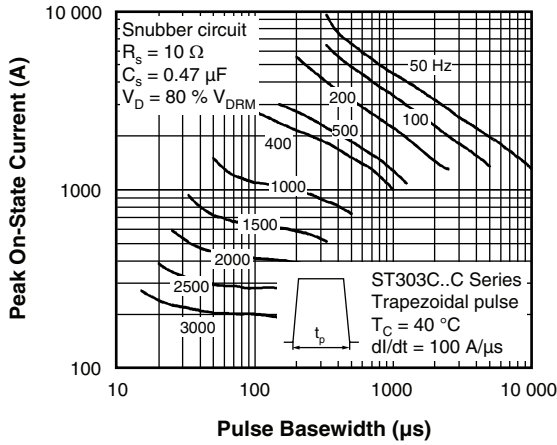


Fig. 15 - Frequency Characteristics

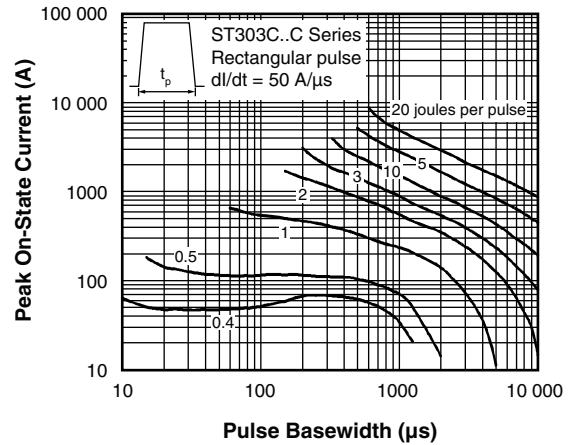
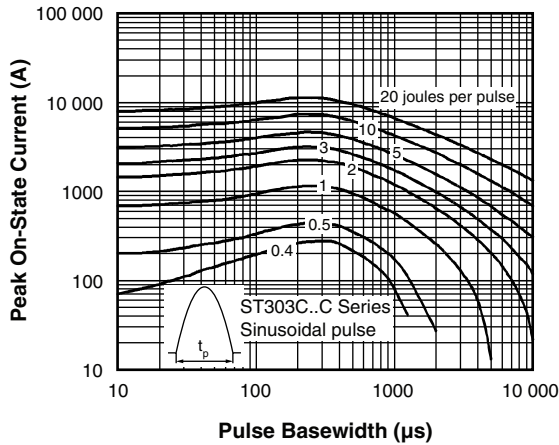


Fig. 16 - Maximum On-State Energy Power Loss Characteristics

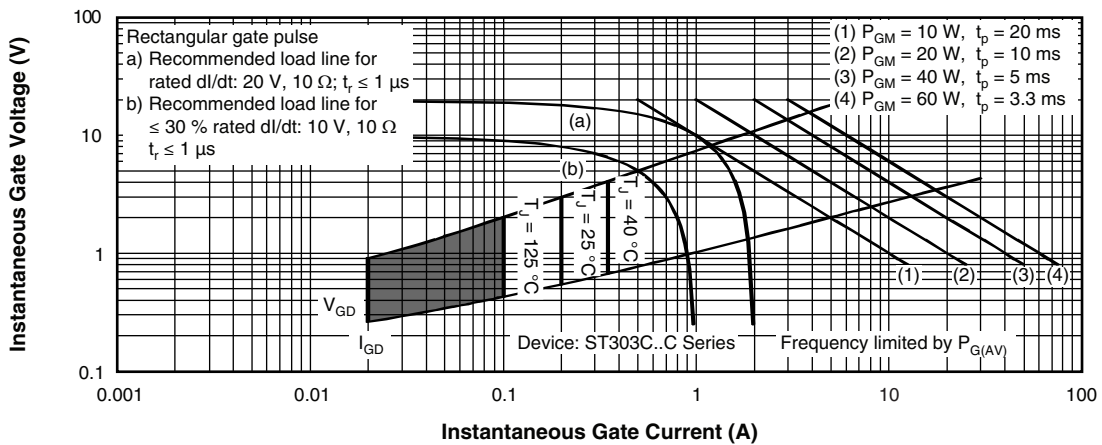


Fig. 17 - Gate Characteristics



ORDERING INFORMATION TABLE

Device code	VS-	ST	30	3	C	12	C	H	K	1	-
	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪

- 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 (E-PUK)
- 8** - Reapplied dV/dt code (for t_q test condition)
- 9** - t_q code
- 10** - 0 = Eyelet terminals
(gate and aux. cathode unsoldered leads)
1 = Fast-on terminals
(gate and aux. cathode unsoldered leads)
2 = Eyelet terminals
(gate and aux. cathode soldered leads)
3 = Fast-on terminals
(gate and aux. cathode soldered leads)
- 11** - Critical dV/dt:
 - None = 500 V/ μ s (standard value)
 - L = 1000 V/ μ s (special selection)

dV/dt - t_q combinations available						
		dV/dt (V/ μ s)				
		20	50	100	200	400
t_q (μ s) up to 800 V	10	CN	DN	EN	FN*	HN
	12	CM	DM	EM	FM	HM
	15	CL	DL	EL	FL*	HL
	20	CK	DK	EK	FK*	HK
t_q (μ s) only for 1000 V/1200 V	15	CL	-	-	-	-
	18	CP	DP	-	-	-
	20	CK	DK	EK	FK*	HK
	25	CJ	DJ	EJ	FJ*	HJ
	30	-	DH	EH	FH	HH

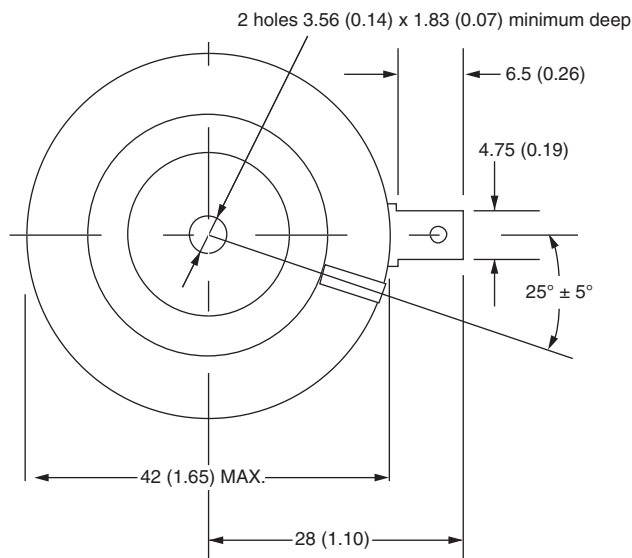
* Standard part number.
All other types available only on request.

LINKS TO RELATED DOCUMENTS	
Dimensions	http://www.vishay.com/doc?95075

TO-200AB (E-PUK)

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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