

## Inverter Grade Thyristors (Hockey PUK Version), 940 A



TO-200AC (B-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-200AC (B-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](http://www.vishay.com/doc?99912)



**RoHS  
COMPLIANT**

PRODUCT SUMMARY	
Package	TO-200AC (B-PUK)
Diode variation	Single SCR
$I_{T(AV)}$	940 A
$V_{DRM}/V_{RRM}$	400 V, 800 V
$V_{TM}$	1.63 V
$I_{TSM}$ at 50 Hz	20 000 A
$I_{TSM}$ at 60 Hz	20 950 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
$I_{T(AV)}$		940	A
	$T_{hs}$	55	°C
$I_{T(RMS)}$		1900	A
	$T_{hs}$	25	°C
$I_{TSM}$	50 Hz	20 000	A
	60 Hz	20 950	
$I^2t$	50 Hz	2000	kA <sup>2</sup> s
	60 Hz	1820	
$V_{DRM}/V_{RRM}$		400 to 800	V
$t_q$	Range	10 to 20	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-ST733C..L	04	400	500	75
	08	800	900	



CURRENT CARRYING CAPABILITY							
FREQUENCY							UNITS
50 Hz	2200	1900	3580	3100	6800	5920	A
400 Hz	2050	1660	3600	3130	3750	3240	
1000 Hz	1370	1070	2900	2450	2120	1780	
2500 Hz	500	370	1220	980	960	770	
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	10/0.47		10/0.47		10/0.47		Ω/μF

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		940 (350)	A
				55 (85)	°C
Maximum RMS on-state current	$I_{T(RMS)}$	DC at 25 °C heatsink temperature double side cooled		1900	A
Maximum peak, one half cycle, non-repetitive surge current	$I_{TSM}$	t = 10 ms	No voltage reappplied	20 000	
		t = 8.3 ms		20 950	
		t = 10 ms	100 % $V_{RRM}$ reappplied	16 800	
		t = 8.3 ms		17 600	
Maximum $I^2t$ for fusing	$I^2t$	t = 10 ms	No voltage reappplied	2000	kA <sup>2</sup> s
		t = 8.3 ms		1820	
		t = 10 ms	100 % $V_{RRM}$ reappplied	1410	
		t = 8.3 ms		1290	
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	t = 0.1 ms to 10 ms, no voltage reappplied		20 000	kA <sup>2</sup> √s
Maximum peak on-state voltage	$V_{TM}$	$I_{TM} = 1700$ A, $T_J = T_J$ maximum, $t_p = 10$ ms sine wave pulse		1.63	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		1.09	
High level value of threshold voltage	$V_{T(TO)2}$	$(I > \pi \times I_{T(AV)})$ , $T_J = T_J$ maximum		1.20	
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		0.32	mΩ
High level value of forward slope resistance	$r_{t2}$	$(I > \pi \times I_{T(AV)})$ , $T_J = T_J$ maximum		0.29	
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	



<b>SWITCHING</b>				
PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Maximum non-repetitive rate of rise of turned-on current	dl/dt	T <sub>J</sub> = T <sub>J</sub> maximum, V <sub>DRM</sub> = Rated V <sub>DRM</sub> , I <sub>TM</sub> = 2 x dl/dt Gate pulse: 20 V 20 Ω, 10 μs 0.5 μs rise time	1000	A/μs
Typical delay time	t <sub>d</sub>	T <sub>J</sub> = 25 °C, V <sub>DM</sub> = Rated V <sub>DRM</sub> , I <sub>TM</sub> = 50 A DC, t <sub>p</sub> = 1 μs Resistive load, gate pulse: 10 V, 5 Ω source	1.5	μs
Maximum turn-off time	minimum	T <sub>J</sub> = T <sub>J</sub> maximum, I <sub>TM</sub> = 550 A, commutating dl/dt = 40 A/μs, V <sub>R</sub> = 50 V, t <sub>p</sub> = 500 μs, dV/dt: see table in device code	10	
	maximum		20	

<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	75	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	V
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	V
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	V

<b>THERMAL AND MECHANICAL SPECIFICATIONS</b>				
PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Maximum operating junction 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	0.073	K/W
		DC operation double side cooled	0.031	
Maximum thermal resistance, case to heatsink	R <sub>thC-hs</sub>	DC operation single side cooled	0.011	
		DC operation double side cooled	0.005	
Mounting force, ± 10 %			14 700 (1500)	N (kg)
Approximate weight			255	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°	0.009	0.009	0.006	0.006	T <sub>J</sub> = T <sub>J</sub> maximum	K/W
120°	0.011	0.011	0.011	0.011		
90°	0.014	0.014	0.015	0.015		
60°	0.020	0.021	0.021	0.022		
30°	0.036	0.036	0.036	0.036		

**Note**

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

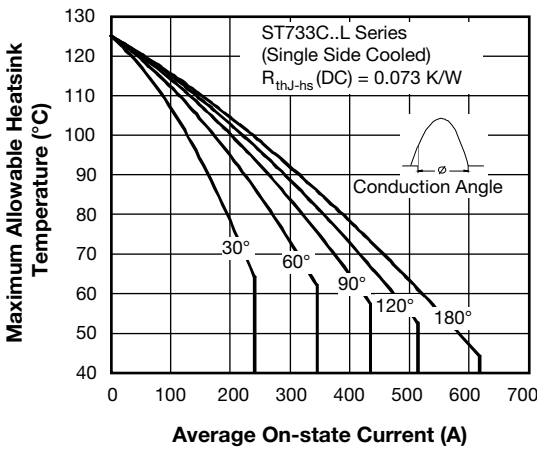


Fig. 1 - Current Ratings Characteristics

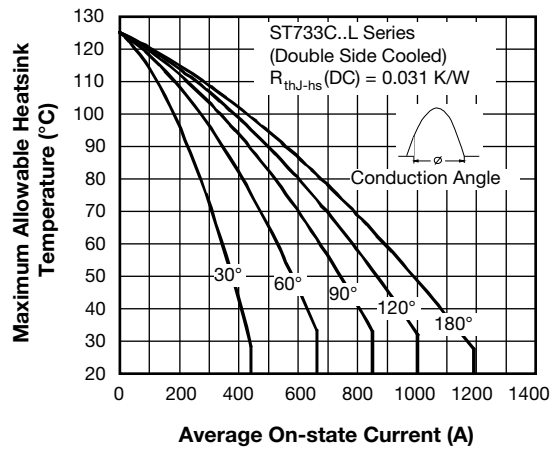


Fig. 3 - Current Ratings Characteristics

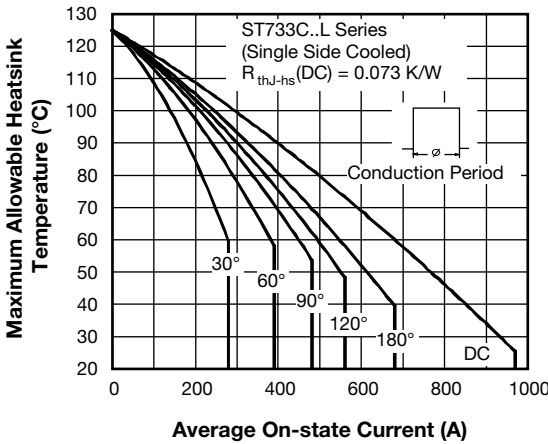


Fig. 2 - Current Ratings Characteristics

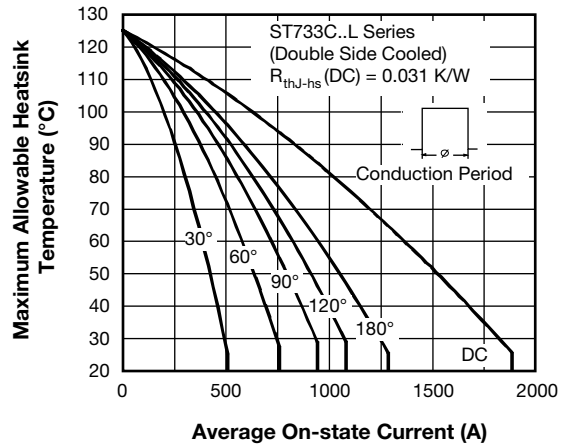


Fig. 4 - Current Ratings Characteristics

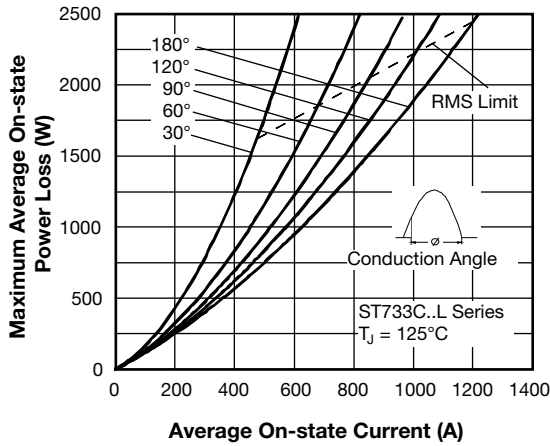


Fig. 5 - On-State Power Loss Characteristics

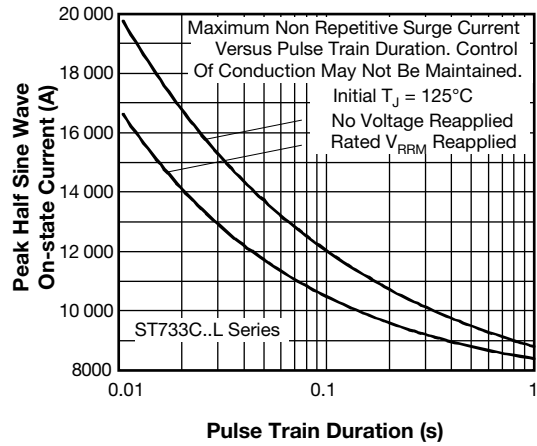


Fig. 8 - Maximum Non-Repetitive Surge Current Single and Double Side Cooled

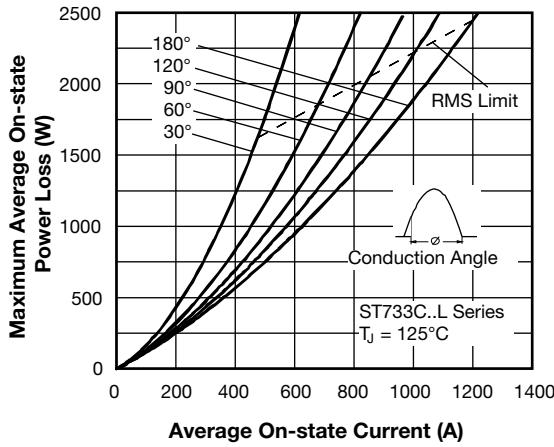


Fig. 6 - On-State Power Loss Characteristics

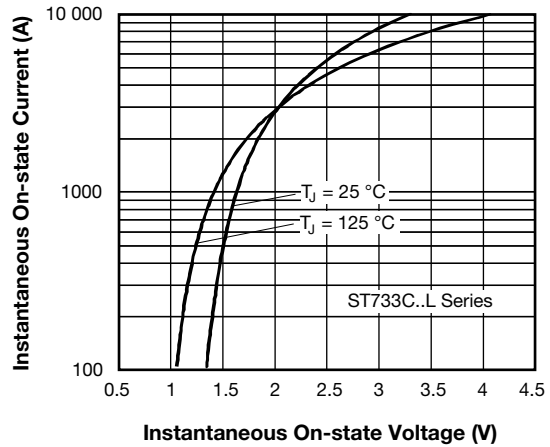


Fig. 9 - On-State Voltage Drop Characteristics

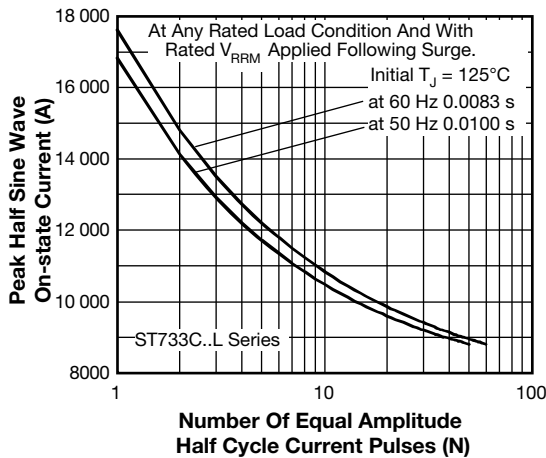


Fig. 7 - Maximum Non-Repetitive Surge Current Single and Double Side Cooled

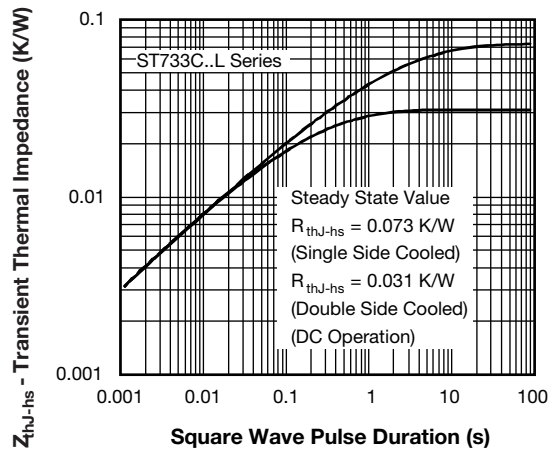


Fig. 10 - Thermal Impedance  $Z_{thJC}$  Characteristics

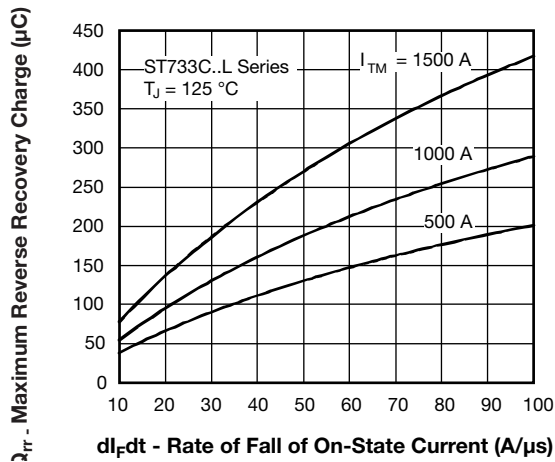


Fig. 11 - Reverse Recovered Charge Characteristics

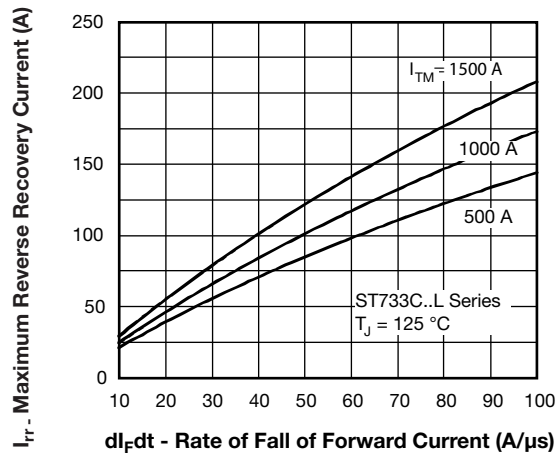


Fig. 12 - Reverse Recovered Current Characteristics

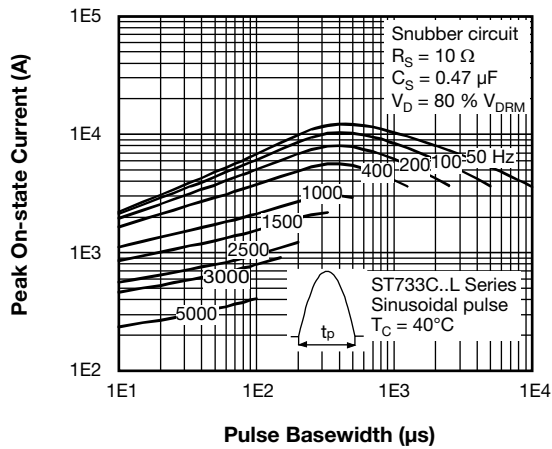


Fig. 13 - Frequency Characteristics

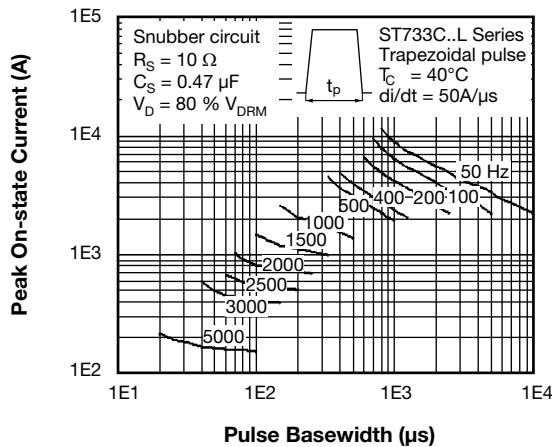
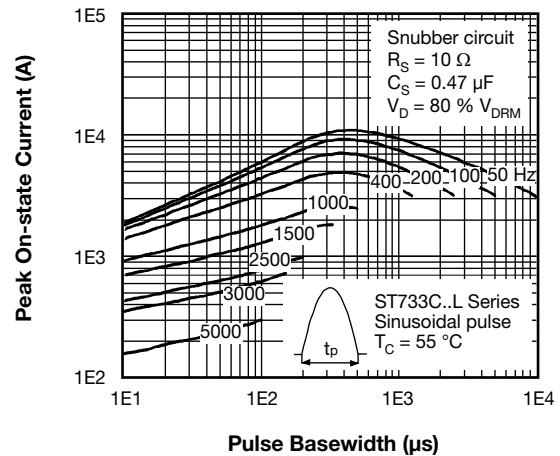
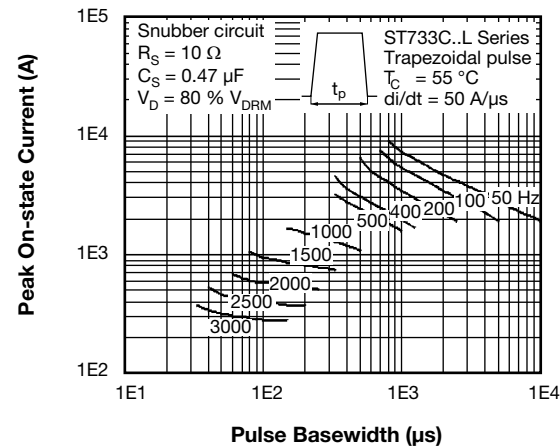


Fig. 14 - Frequency Characteristics



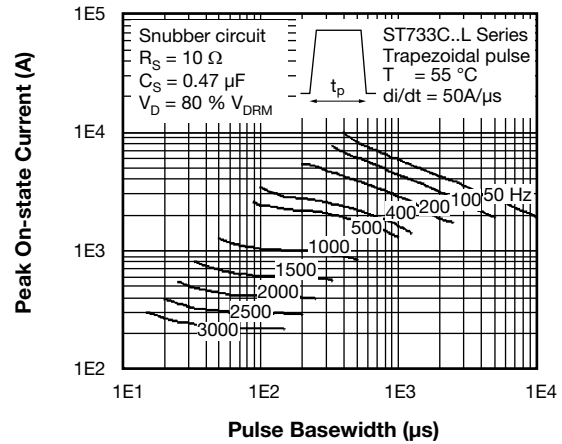
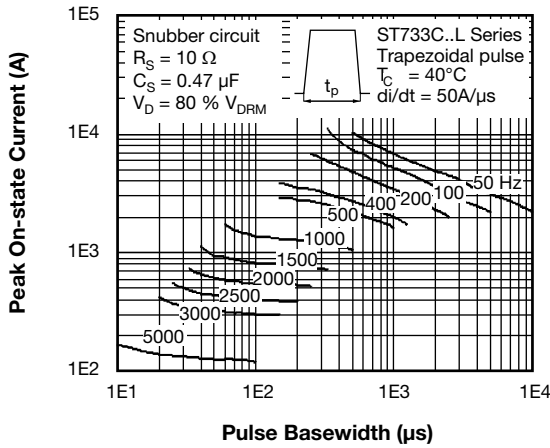


Fig. 15 - Frequency Characteristics

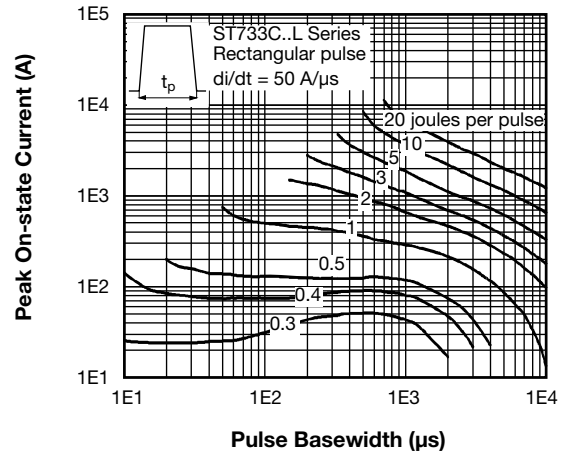
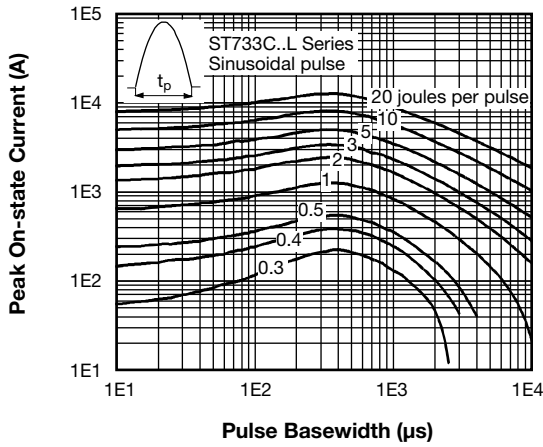


Fig. 16 - Maximum On-State Energy Power Loss Characteristics

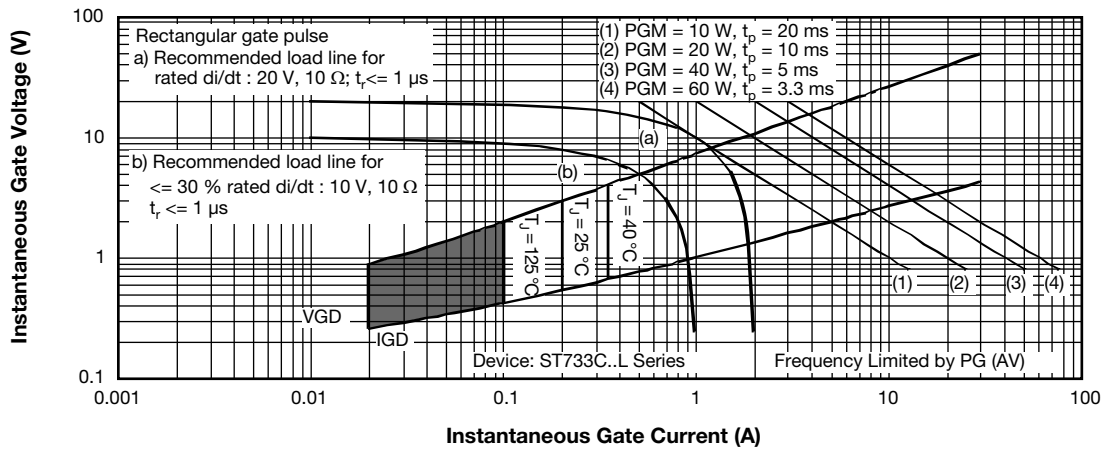


Fig. 17 - Gate Characteristics



## ORDERING INFORMATION TABLE

Device code	<b>VS-</b>	<b>ST</b>	<b>73</b>	<b>3</b>	<b>C</b>	<b>08</b>	<b>L</b>	<b>H</b>	<b>K</b>	<b>1</b>	<b>-</b>
	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** - L = PUK case TO-200AC (B-PUK)
- 8** - Reapplied dV/dt code (for  $t_q$  test condition)
- 9** -  $t_q$  code
- 10** - 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)
- 11** - Critical dV/dt:
  - None = 500 V/ $\mu$ s (standard value)
  - L = 1000 V/ $\mu$ s (special selection)

dV/dt - $t_q$ combinations available						
	dV/dt (V/ $\mu$ s)	20	50	100	200	400
$t_q$ ( $\mu$ s)	10	CN	DN	EN	-	-
	12	CM	DM	EM	FM*	-
	15	CL	DL	EL	FL*	HL
	18	CP	DP	EP	FP	HP
	20	CK	DK	EK	FK	H

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

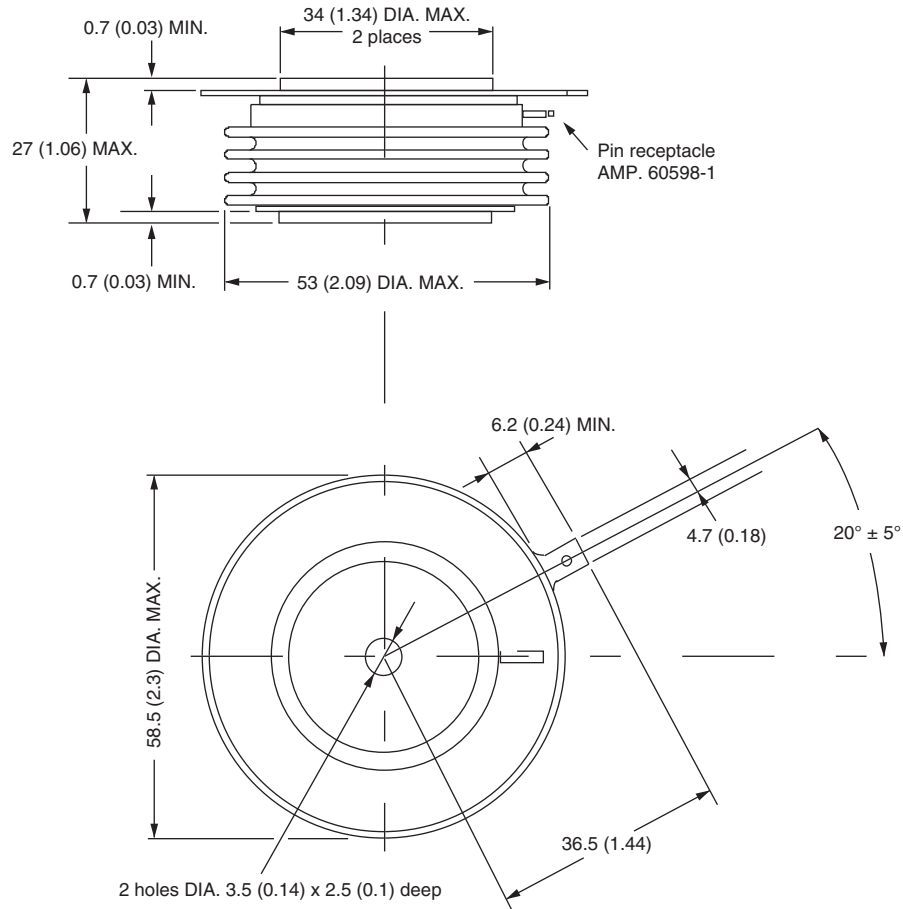
LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95076">www.vishay.com/doc?95076</a>



## 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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