



## Phase Control Thyristors (Stud Version), 180 A



TO-93 (TO-209AB)

### FEATURES

- Hermetic glass-metal seal
- International standard case TO-93 (TO-209AB)
- 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

$I_{T(AV)}$	180 A
$V_{DRM}/V_{RRM}$	400 V, 800 V, 1000 V
$V_{TM}$	1.35 V
$I_{GT}$	65 mA
$T_J$	-40 °C to +125 °C
Package	TO-93 (TO-209AB)
Circuit configuration	Single SCR

### MAJOR RATINGS AND CHARACTERISTICS

PARAMETER	TEST CONDITIONS	VALUES	UNITS
$I_{T(AV)}$		180	A
	$T_C$	80	°C
$I_{T(RMS)}$		285	A
$I_{TSM}$	50 Hz	3800	
	60 Hz	4000	
$I^2t$	50 Hz	72	kA <sup>2</sup> s
	60 Hz	66	
$V_{DRM}/V_{RRM}$		400 to 1000	V
$t_q$	Typical	100	µs
$T_J$		-40 to +125	°C

### ELECTRICAL SPECIFICATIONS

#### VOLTAGE RATINGS

PART 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-180RKI VS-181RKI	40	400	500	30
	80	800	900	
	100	1000	1100	



<b>ABSOLUTE MAXIMUM RATINGS</b>					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Maximum average on-state current at case temperature	$I_{T(AV)}$	180° conduction, half sine wave		180	A
				80	°C
Maximum RMS on-state current	$I_{RMS}$	DC at 79 °C case temperature		285	
Maximum peak, one-cycle non-repetitive surge current	$I_{TSM}$	t = 10 ms	No voltage reappplied	3800	A
		t = 8.3 ms		4000	
		t = 10 ms	100 % $V_{RRM}$ reappplied	3500	
		t = 8.3 ms		3660	
Maximum $I^2t$ for fusing	$I^2t$	t = 10 ms	No voltage reappplied	72	kA <sup>2</sup> s
		t = 8.3 ms		66	
		t = 10 ms	100 % $V_{RRM}$ reappplied	61	
		t = 8.3 ms		56	
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	t = 0.1 ms to 10 ms, no voltage reappplied		720	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		0.83	V
High level value of threshold voltage	$V_{T(TO)2}$	(I $> \pi \times I_{T(AV)}$ ), $T_J = T_J$ maximum		0.89	
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		0.92	mΩ
High level value of on-state slope resistance	$r_{t2}$	(I $> \pi \times I_{T(AV)}$ ), $T_J = T_J$ maximum		0.81	
Maximum on-state voltage	$V_{TM}$	$I_{pk} = 570$ A, $T_J = T_J$ maximum, $t_p = 10$ ms sine pulse		1.35	V
Maximum holding current	$I_H$	$T_J = 25$ °C, anode supply 12 V resistive load		600	mA
Typical latching current	$I_L$			1000	

<b>SWITCHING</b>					
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 $\leq 80$ % $V_{DRM}$		300	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	$t_q$	$I_{TM} = 50$ A, $T_J = T_J$ maximum, $di/dt = 10$ A/μs, $V_R = 100$ V, $dV/dt = 20$ V/μs		100	

<b>BLOCKING</b>					
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		30	mA



TRIGGERING					
PARAMETER	SYMBOL	TEST CONDITIONS	VALUES		UNITS
			TYP.	MAX.	
Maximum peak gate power	$P_{GM}$	$T_J = T_J$ maximum, $t_p \leq 5$ ms	10		W
Maximum average gate power	$P_{G(AV)}$	$T_J = T_J$ maximum, $f = 50$ Hz, $d\% = 50$	2.0		
Maximum peak positive gate current	$I_{GM}$	$T_J = T_J$ maximum, $t_p \leq 5$ ms	3.0		A
Maximum peak positive gate voltage	$+V_{GM}$		20		V
Maximum peak negative gate voltage	$-V_{GM}$		5.0		
DC gate current required to trigger	$I_{GT}$	$T_J = -40$ °C	130	-	mA
		$T_J = 25$ °C	65	150	
		$T_J = 125$ °C	35	-	
DC gate voltage required to trigger	$V_{GT}$	$T_J = -40$ °C	2.0	-	V
		$T_J = 25$ °C	1.2	2.5	
		$T_J = 125$ °C	0.9	-	
DC gate current not to trigger	$I_{GD}$	$T_J = T_J$ maximum	10		mA
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	°C
Maximum storage temperature range	$T_{Stg}$		-40 to 150	
Maximum thermal resistance, junction to case	$R_{thJC}$	DC operation	0.15	K/W
Maximum thermal resistance, junction to ambient	$R_{thCS}$	Mounting surface, smooth, flat and greased	0.04	
Mounting force, $\pm 10$ %		Non-lubricated threads	31 (275)	N · m (lbf · in)
		Lubricated threads	24.5 (210)	
Approximate weight			280	g
Case style		See dimensions - link at the end of datasheet	TO-93 (TO-209AB)	

$\Delta R_{thJC}$ CONDUCTION				
CONDUCTION ANGLE	SINUSOIDAL CONDUCTION	RECTANGULAR CONDUCTION	TEST CONDITIONS	UNITS
180°	0.050	0.032	$T_J = T_J$ maximum	K/W
120°	0.063	0.059		
90°	0.080	0.082		
60°	0.118	0.124		
30°	0.225	0.228		

**Note**

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

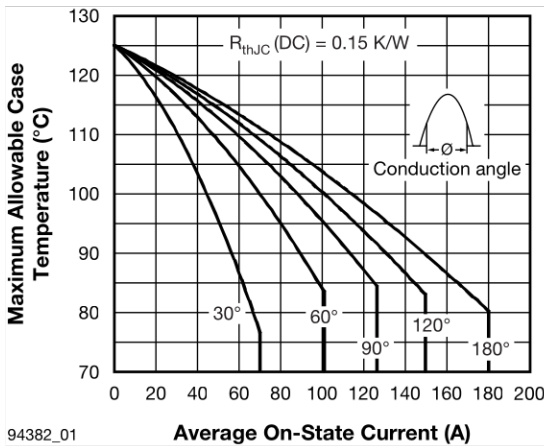


Fig. 1 - Current Ratings Characteristics

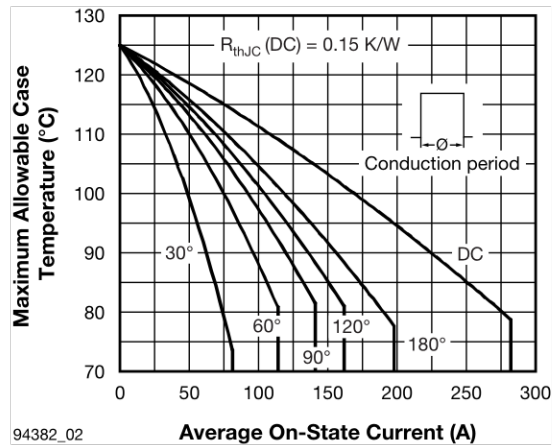


Fig. 2 - Current Ratings Characteristics

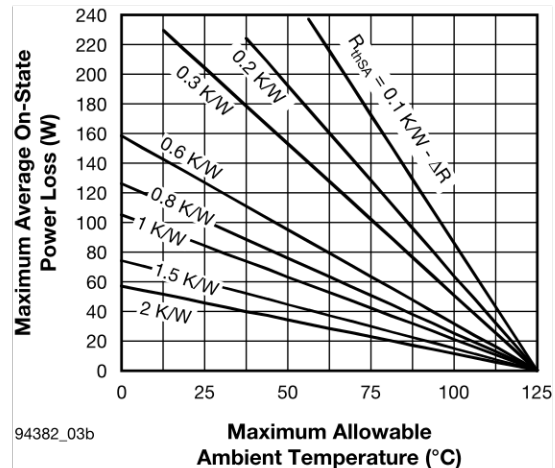
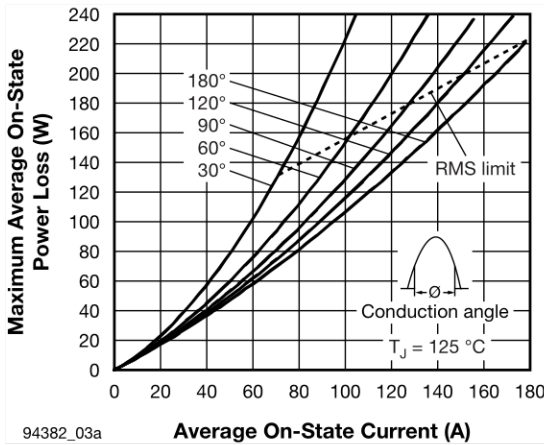


Fig. 3 - On-State Power Loss Characteristics

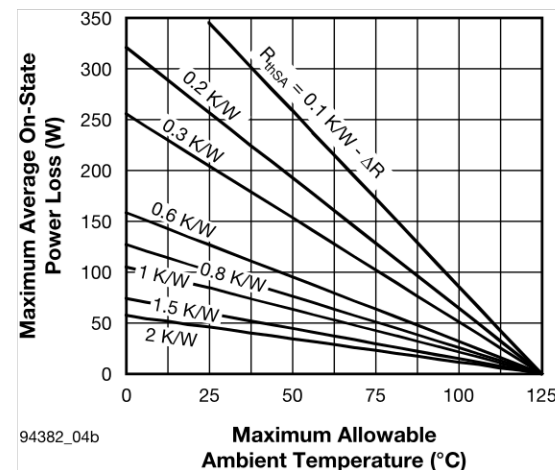
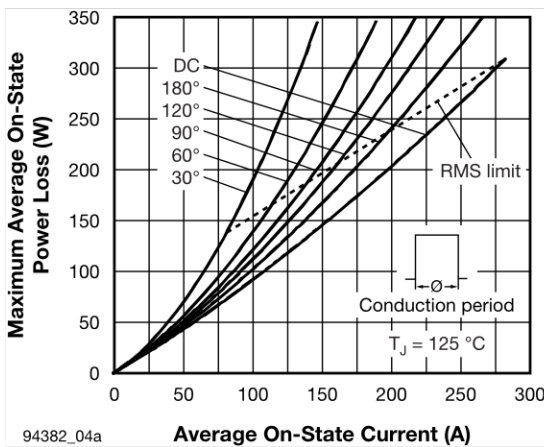


Fig. 4 - On-State Power Loss Characteristics

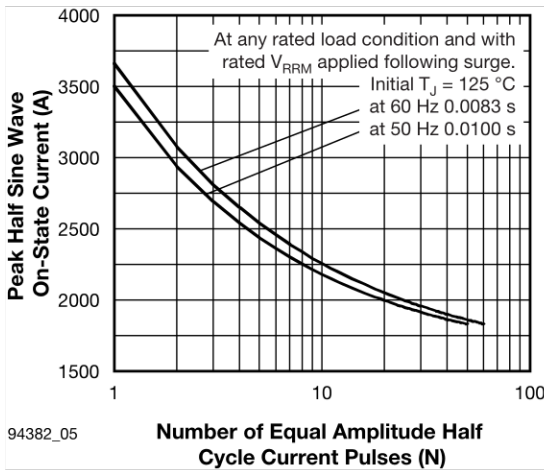


Fig. 5 - Maximum Non-Repetitive Surge Current

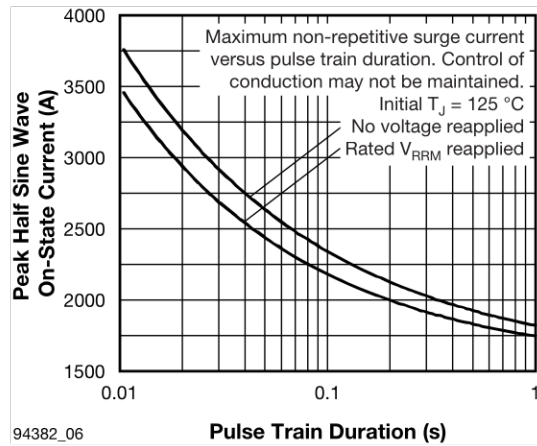


Fig. 6 - Maximum Non-Repetitive Surge Current

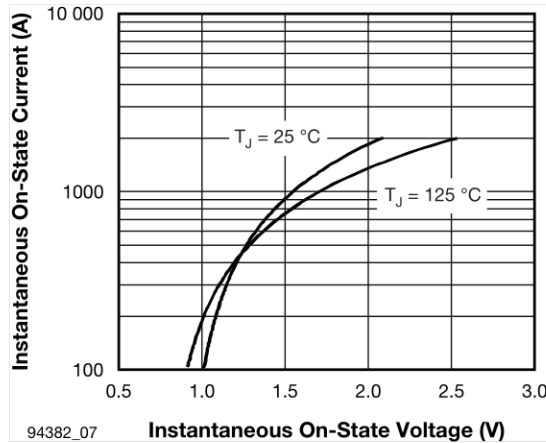


Fig. 7 - On-State Voltage Drop Characteristics

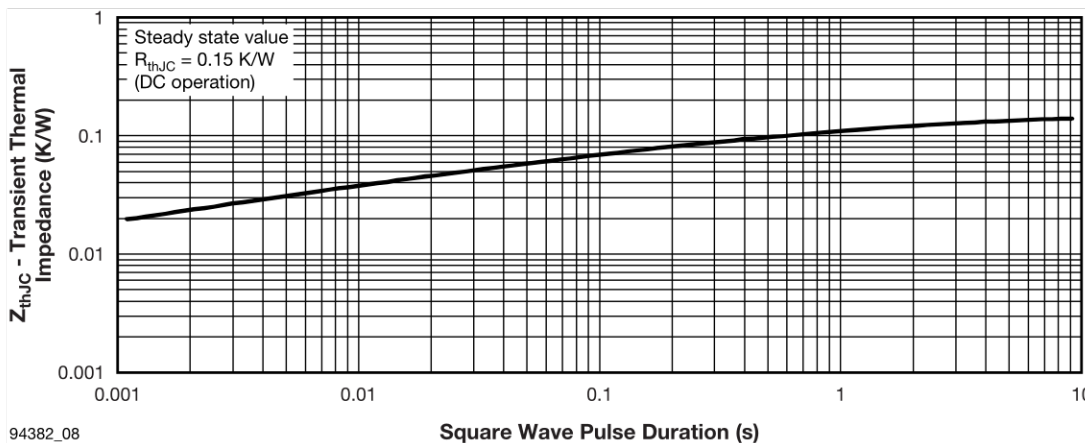


Fig. 8 - Thermal impedance  $Z_{thJC}$  Characteristics

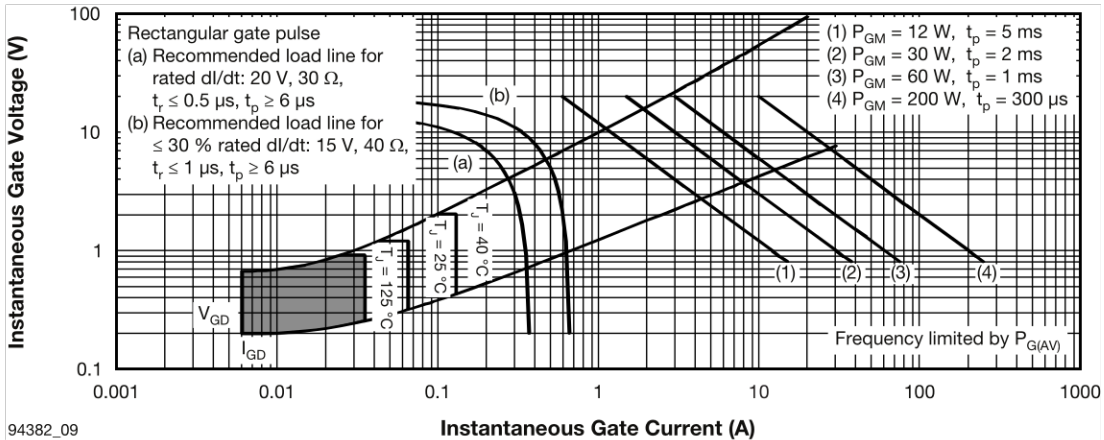


Fig. 9 - Gate Characteristics

**ORDERING INFORMATION TABLE**

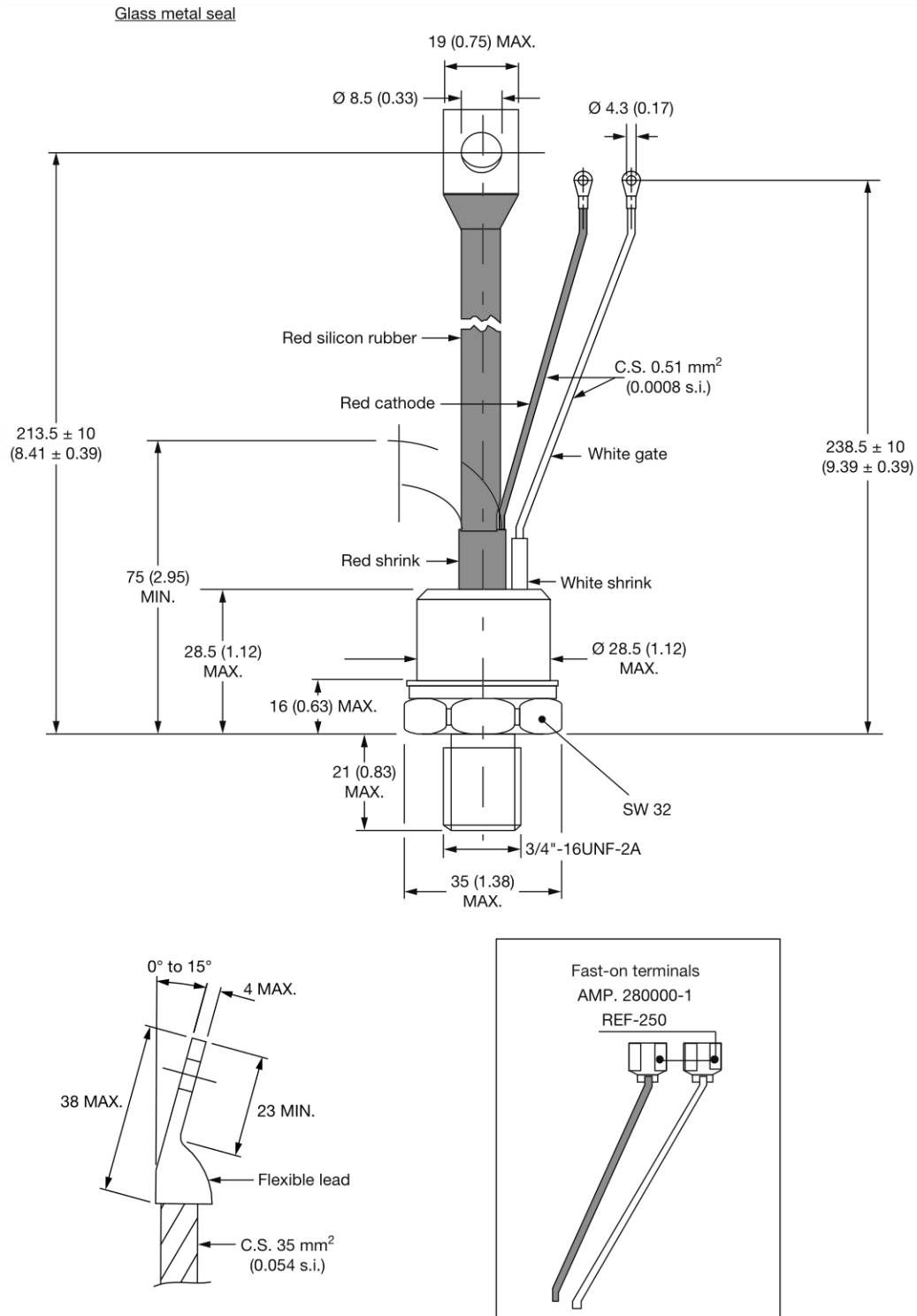
Device code	<b>VS-</b>	<b>18</b>	<b>1</b>	<b>RKI</b>	<b>100</b>	<b>PbF</b>
	①	②	③	④	⑤	⑥
<b>1</b>	-	Vishay Semiconductors product				
<b>2</b>	-	$I_{T(AV)}$ rated average output current (rounded/10)				
<b>3</b>	-	<ul style="list-style-type: none"> <li>• 0 = eyelet terminals (gate and auxiliary cathode leads)</li> <li>• 1 = fast-on terminals (gate and auxiliary cathode leads)</li> </ul>				
<b>4</b>	-	Thyristor				
<b>5</b>	-	Voltage code $\times 10 = V_{RRM}$ (see Voltage Ratings table)				
<b>6</b>	-	<ul style="list-style-type: none"> <li>• None = standard production</li> <li>• PbF = lead (Pb)-free</li> </ul>				

**LINKS TO RELATED DOCUMENTS**

Dimensions	<a href="http://www.vishay.com/doc?95077">www.vishay.com/doc?95077</a>
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## TO-209AB (TO-93)

**DIMENSIONS** in millimeters (inches)





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