

## Phase Control Thyristors (Stud Version), 200 A



TO-93 (TO-209AB)

### FEATURES

- Center amplifying gate
- International standard case TO-93 (TO-209AB)
- Glass-metal seal up to 1200 V
- Compression bonded encapsulation for heavy duty operations such as severe thermal cycling
- 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

PRIMARY CHARACTERISTICS	
$I_{T(AV)}$	200 A
$V_{DRM}/V_{RRM}$	400 V, 800 V, 1200 V
$V_{TM}$	1.75 V
$I_{GT}$	150 mA
$T_J$	-40 °C to +125 °C
Package	TO-93 (TO-209AB)
Circuit configuration	Single SCR

### TYPICAL APPLICATIONS

- DC motor controls
- Controlled DC power supplies
- AC controllers

MAJOR RATINGS AND CHARACTERISTICS			
PARAMETER	TEST CONDITIONS	VALUES	UNITS
$I_{T(AV)}$		200	A
	$T_C$	85	°C
$I_{T(RMS)}$		314	A
$I_{TSM}$	50 Hz	5000	A
	60 Hz	5230	
$I^2t$	50 Hz	125	kA <sup>2</sup> s
	60 Hz	114	
$V_{DRM}/V_{RRM}$		400 to 1200	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-ST180S	04	400	500	30
	08	800	900	
	12	1200	1300	



ABSOLUTE MAXIMUM RATINGS						
PARAMETER	SYMBOL	TEST CONDITIONS			VALUES	UNITS
Maximum average on-state current at case temperature	I <sub>T(AV)</sub>	180° conduction, half sine wave			200	A
					85	°C
Maximum RMS on-state current	I <sub>T(RMS)</sub>	DC at 76 °C case temperature			314	A
Maximum peak, one-cycle non-repetitive surge current	I <sub>TSM</sub>	t = 10 ms	No voltage reapplied	Sinusoidal half wave, initial T <sub>J</sub> = T <sub>J</sub> maximum	5000	
		t = 8.3 ms			5230	
		t = 10 ms	100 % V <sub>RRM</sub> reapplied		4200	
		t = 8.3 ms			4400	
Maximum I <sup>2</sup> t for fusing	I <sup>2</sup> t	t = 10 ms	No voltage reapplied		125	kA <sup>2</sup> s
		t = 8.3 ms			114	
		t = 10 ms	100 % V <sub>RRM</sub> reapplied		88	
		t = 8.3 ms			81	
Maximum I <sup>2</sup> √t for fusing	I <sup>2</sup> √t	t = 0.1 to 10 ms, no voltage reapplied			1250	kA <sup>2</sup> √s
Low level value of threshold voltage	V <sub>T(TO)1</sub>	(16.7 % × π × I <sub>T(AV)</sub> < I < π × I <sub>T(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum			1.08	V
High level value of threshold voltage	V <sub>T(TO)2</sub>	(I > π × I <sub>T(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum			1.14	
Low level value of on-state slope resistance	r <sub>t1</sub>	(16.7 % × π × I <sub>T(AV)</sub> < I < π × I <sub>T(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum			1.18	mΩ
High level value of on-state slope resistance	r <sub>t2</sub>	(I > π × I <sub>T(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum			1.14	
Maximum on-state voltage	V <sub>TM</sub>	I <sub>pk</sub> = 570 A, T <sub>J</sub> = 125 °C, t <sub>p</sub> = 10 ms sine pulse			1.75	V
Maximum holding current	I <sub>H</sub>	T <sub>J</sub> = T <sub>J</sub> maximum, anode supply 12 V resistive load			600	mA
Maximum (typical) latching current	I <sub>L</sub>				1000 (300)	

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	$t_q$	$I_{TM} = 300$ A, $T_J = T_J$ maximum, $di/dt = 20$ A/μs, $V_R = 50$ V, $dV/dt = 20$ V/μs, gate 0 V 100 Ω, $t_p = 500$ μs	100	

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	30	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		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	180	-	mA
		T <sub>J</sub> = 25 °C		90	150	
		T <sub>J</sub> = 125 °C		40	-	
DC gate voltage required to trigger	V <sub>GT</sub>	T <sub>J</sub> = - 40 °C		2.9	-	V
		T <sub>J</sub> = 25 °C		1.8	3.0	
		T <sub>J</sub> = 125 °C		1.2	-	
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 case	$R_{thJC}$	DC operation	0.105	K/W
Maximum thermal resistance, case to heatsink	$R_{thC-hs}$	Mounting surface, smooth, flat and greased	0.04	
Mounting torque, $\pm 10$ %		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°	0.015	0.012	$T_J = T_J$ maximum	K/W
120°	0.019	0.020		
90°	0.025	0.027		
60°	0.036	0.037		
30°	0.060	0.060		

**Note**

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

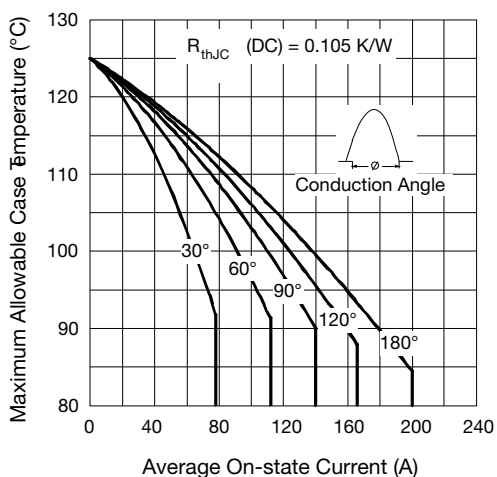


Fig. 1 - Current Ratings Characteristics

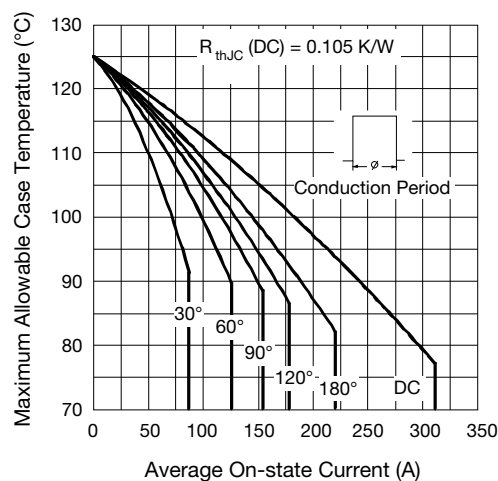


Fig. 2 - Current Ratings Characteristics

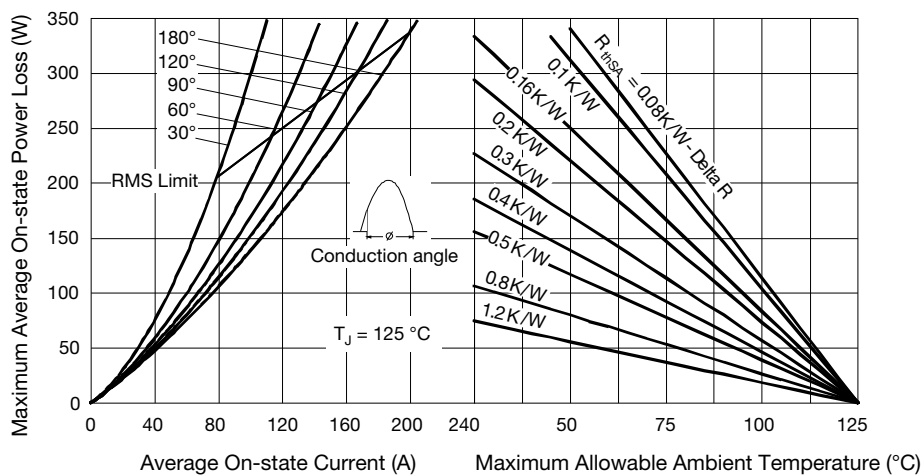


Fig. 3 - On-State Power Loss Characteristics

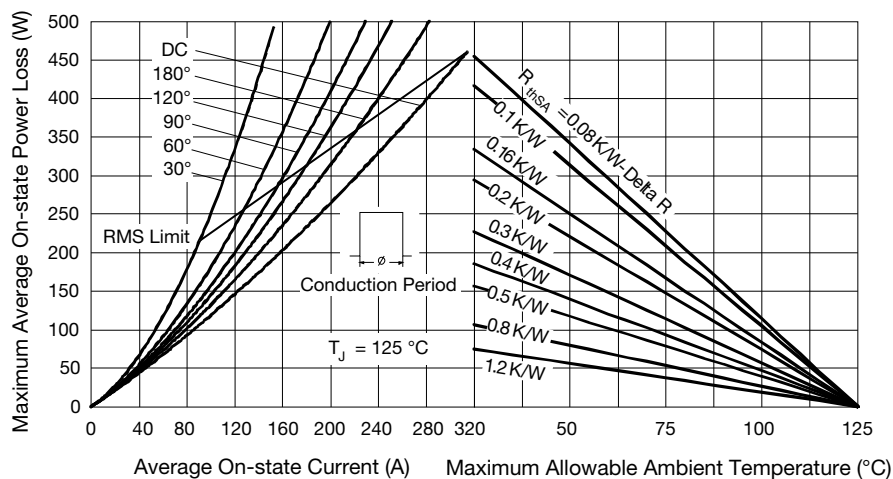


Fig. 4 - On-State Power Loss Characteristics

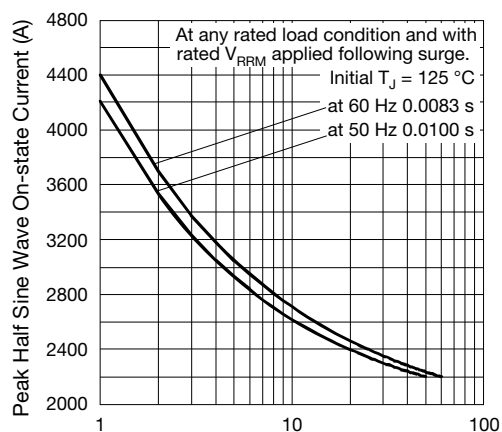


Fig. 5 - Maximum Non-Repetitive Surge Current

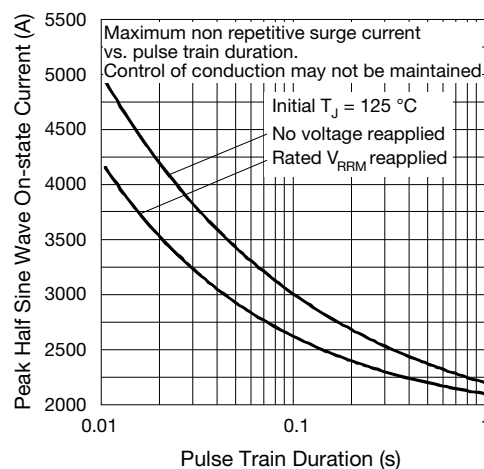


Fig. 6 - Maximum Non-Repetitive Surge Current

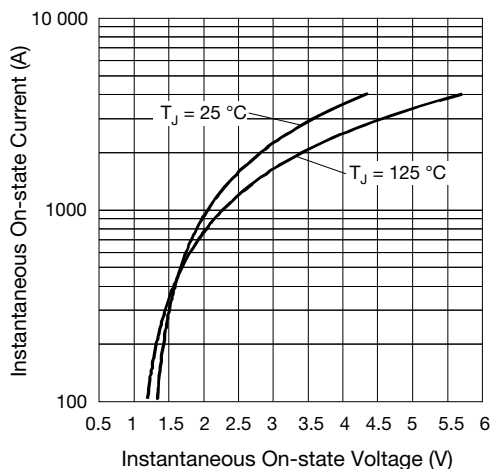
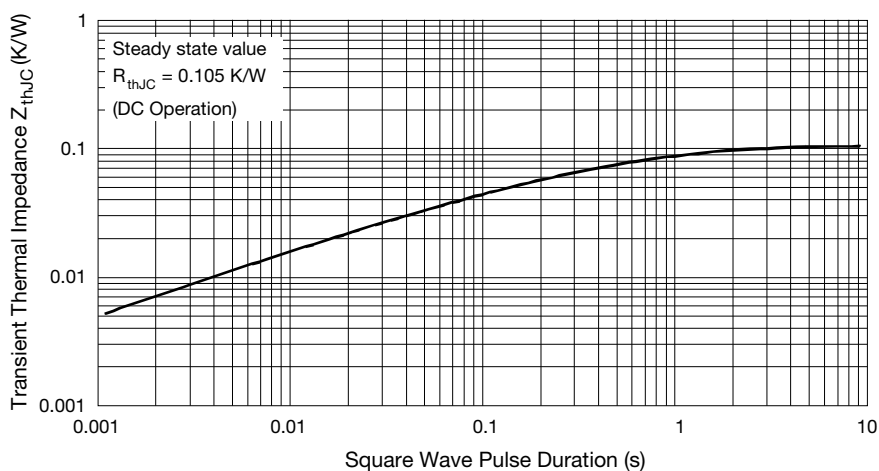


Fig. 7 - On-State Voltage Drop Characteristics


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

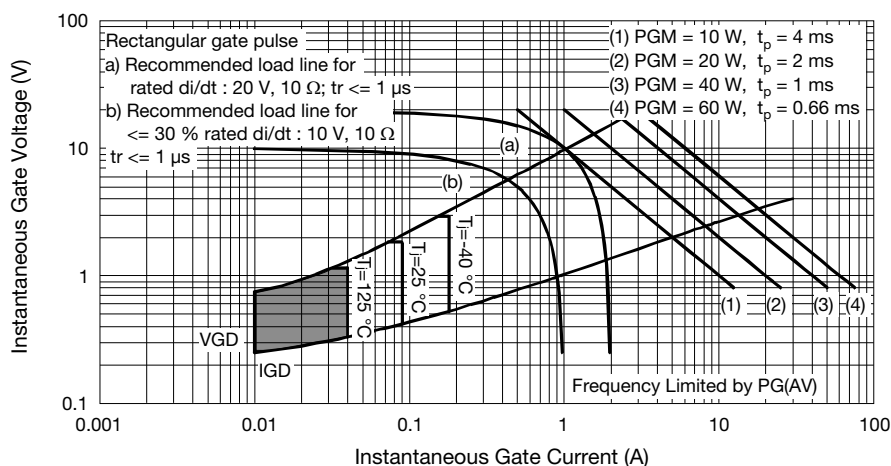


Fig. 9 - Gate Characteristics

## ORDERING INFORMATION TABLE

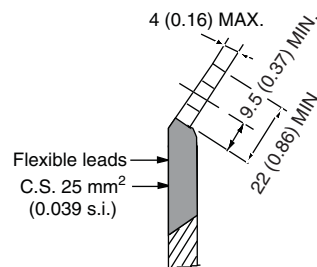
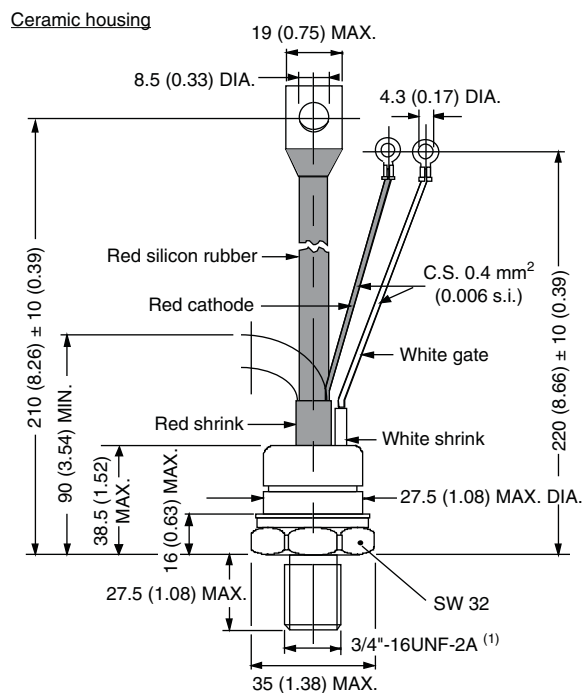
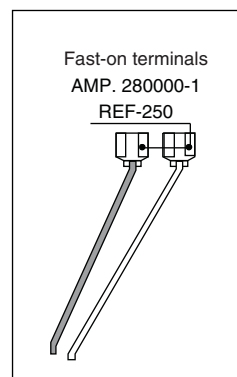
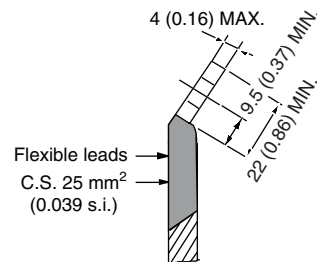
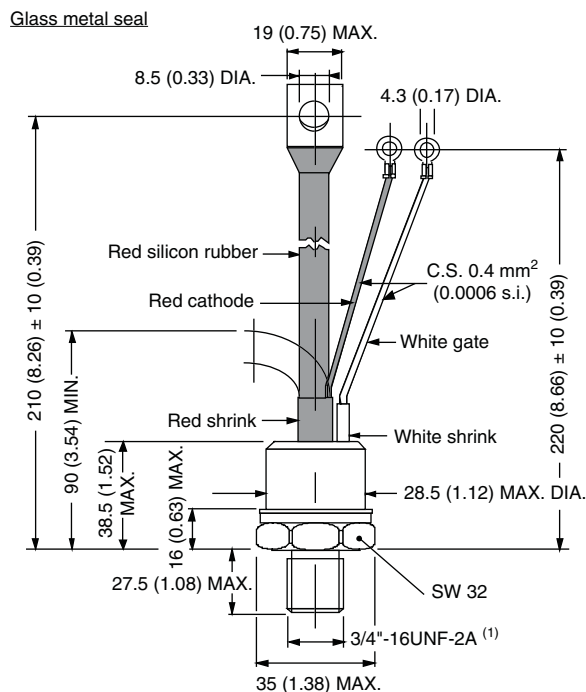
Device code	VS-	ST	18	0	S	20	P	0	V	PbF
	1	2	3	4	5	6	7	8	9	10
1	Vishay Semiconductors product									
2	Thyristor									
3	Essential part number									
4	0 = converter grade									
5	S = compression bonding stud									
6	Voltage code x 100 = V <sub>RRM</sub> (see Voltage Ratings table)									
7	P = stud base 3/4"-16UNF2A threads									
8	0 = eyelet terminals (gate and auxiliary cathode leads) 1 = fast-on terminals (gate and auxiliary cathode leads)									
9	V = glass-metal seal (only up to 1200 V)									
10	None = standard production PbF = lead (Pb)-free									

## LINKS TO RELATED DOCUMENTS

Dimensions	<a href="http://www.vishay.com/doc?95082">www.vishay.com/doc?95082</a>
------------	--

# TO-209AB (TO-93)

**DIMENSIONS** in millimeters (inches)



### Note

(1) For metric device: M16 x 1.5 - length 21 (0.83) maximum



## Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.