Phase Control Thyristors (Stud Version), 110 A

TO-94 (TO-209AC)

FEATURES

- Center gate
- International standard case TO-94 (TO-209AC)
- Compression bonded encapsulation for heavy duty operations such as severe thermal cycling
- Hermetic glass-metal case with ceramic insulator (Glass-metal seal over 1200 V)
- Designed and qualified for industrial level
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

RoHS COMPLIANT

TYPICAL APPLICATIONS

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

PRIMARY CHARACTERISTICS	
$I_{T(AV)}$	110 A
V_{DRM}/V_{RRM}	400 V, 800 V, 1200 V, 1600 V
V_{TM}	1.52 V
I_{GT}	150 mA
T_J	-40 °C to +125 °C
Package	TO-94 (TO-209AC)
Circuit configuration	Single SCR

MAJOR RATINGS AND CHARACTERISTICS			
PARAMETER	TEST CONDITIONS	VALUES	UNITS
$I_{T(AV)}$		110	A
	T_C	90	°C
$I_{T(RMS)}$		175	A
I_{TSM}	50 Hz	2700	
	60 Hz	2830	
I^2t	50 Hz	36.4	kA^2s
	60 Hz	33.2	
V_{DRM}/V_{RRM}		400 to 1600	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-ST110S	04	400	500	20
	08	800	900	
	12	1200	1300	
	16	1600	1700	

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	TEST CONDITIONS			VALUES	UNITS
Maximum average on-state current at case temperature	$I_{T(AV)}$	180° conduction, half sine wave			110	A
					90	°C
Maximum RMS on-state current	$I_{T(RMS)}$	DC at 85 °C case temperature			175	A
Maximum peak, one-cycle non-repetitive surge current	I_{TSM}	t = 10 ms	No voltage reapplied	Sinusoidal half wave, initial $T_J = T_J$ maximum	2700	
		t = 8.3 ms			2830	
		t = 10 ms	100 % V_{RRM} reapplied		2270	
		t = 8.3 ms			2380	
Maximum I^2t for fusing	I^2t	t = 10 ms	No voltage reapplied		36.4	kA^2s
		t = 8.3 ms			33.2	
		t = 10 ms	100 % V_{RRM} reapplied		25.8	
		t = 8.3 ms			23.5	
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	t = 0.1 to 10 ms, no voltage reapplied			364	$kA^2\sqrt{s}$
Low level value of threshold voltage	$V_{T(TO)1}$	(16.7 % x π x $I_{T(AV)}$ < I < π x $I_{T(AV)}$), $T_J = T_J$ maximum			0.90	V
High level value of threshold voltage	$V_{T(TO)2}$	(I > π x $I_{T(AV)}$), $T_J = T_J$ maximum			0.92	
Low level value of on-state slope resistance	r_{t1}	(16.7 % x π x $I_{T(AV)}$ < I < π x $I_{T(AV)}$), $T_J = T_J$ maximum			1.79	mΩ
High level value of on-state slope resistance	r_{t2}	(I > π x $I_{T(AV)}$), $T_J = T_J$ maximum			1.81	
Maximum on-state voltage	V_{TM}	I_{pk} = 350 A, $T_J = T_J$ maximum, t_p = 10 ms sine pulse			1.52	V
Maximum holding current	I_H	T_J = 25 °C, anode supply 12 V resistive load			600	mA
Typical latching current	I_L				1000	

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 ≤ 80 % V_{DRM}	500	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	2.0	µs
Typical turn-off time	t_q	I_{TM} = 100 A, $T_J = T_J$ maximum, dI/dt = 10 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	20	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		5		W
Maximum average gate power	$P_{G(AV)}$	$T_J = T_J$ maximum, f = 50 Hz, d% = 50		1		
Maximum peak positive gate current	I_{GM}	$T_J = T_J$ maximum, $t_p \leq 5$ ms		2.0		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	Maximum required gate trigger/ current/voltage are the lowest value which will trigger all units 6 V anode to cathode applied	180	-	mA
		T_J = 25 °C		90	150	
		T_J = 125 °C		40	-	
DC gate voltage required to trigger	V_{GT}	T_J = -40 °C		2.9	-	V
		T_J = 25 °C		1.8	3.0	
		T_J = 125 °C		1.2	-	
DC gate current not to trigger	I_{GD}	$T_J = T_J$ maximum	Maximum gate current/voltage not to trigger is the maximum value which will not trigger any unit with rated V_{DRM} anode to cathode applied	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	0.195	K/W
Maximum thermal resistance, case to heatsink	R_{thCS}	Mounting surface, smooth, flat and greased	0.08	
Mounting torque, ± 10 %		Non-lubricated threads	15.5 (137)	Nm (lbf · in)
		Lubricated threads	14 (120)	
Approximate weight			130	g
Case style		See dimensions - link at the end of datasheet	TO-94 (TO-209AC)	

ΔR_{thJC} CONDUCTION				
CONDUCTION ANGLE	SINUSOIDAL CONDUCTION	RECTANGULAR CONDUCTION	TEST CONDITIONS	UNITS
180°	0.035	0.025	$T_J = T_J$ maximum	K/W
120°	0.041	0.042		
90°	0.052	0.056		
60°	0.076	0.079		
30°	0.126	0.127		

Note

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

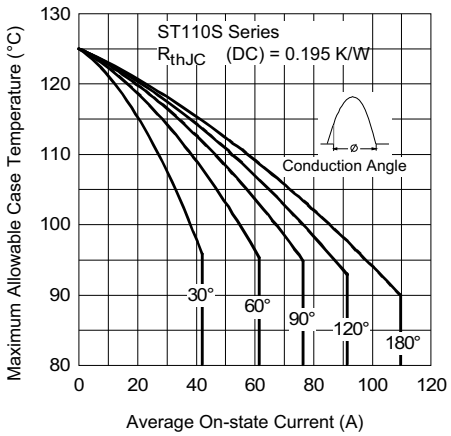


Fig. 1 - Current Ratings Characteristics

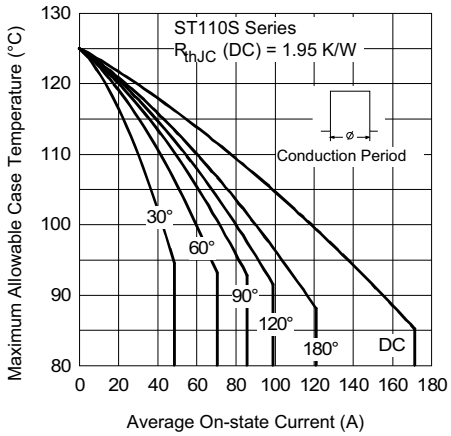


Fig. 2 - Current Ratings Characteristics

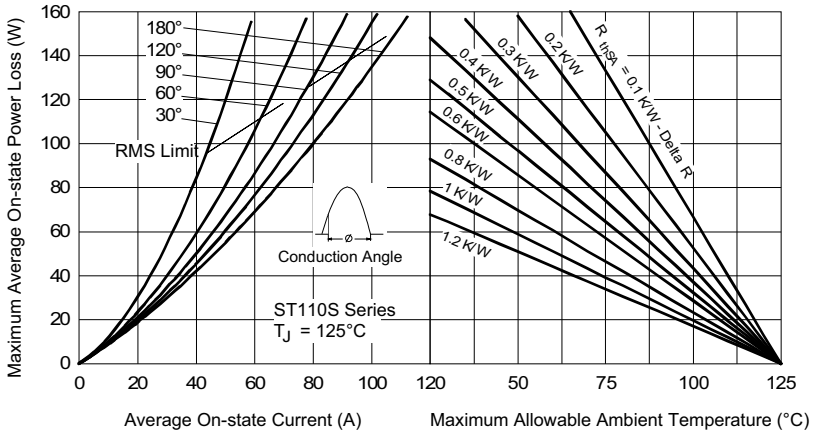


Fig. 3 - On-State Power Loss Characteristics

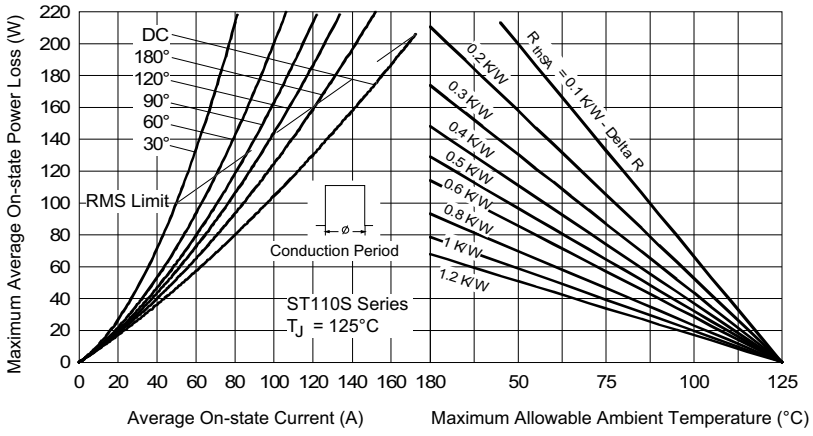


Fig. 4 - On-State Power Loss Characteristics

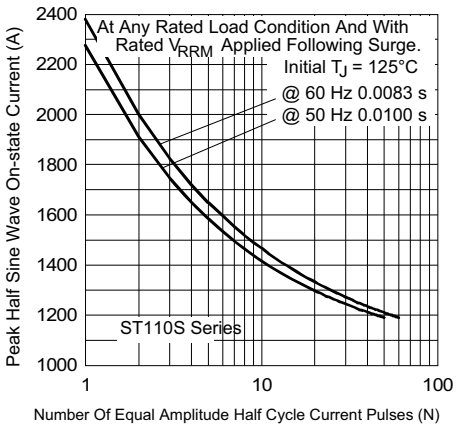


Fig. 5 - Maximum Non-Repetitive Surge Current

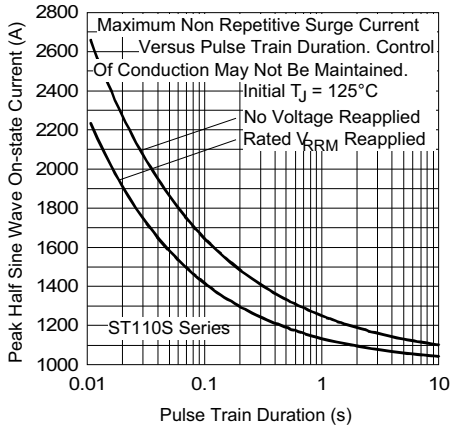


Fig. 6 - Maximum Non-Repetitive Surge Current

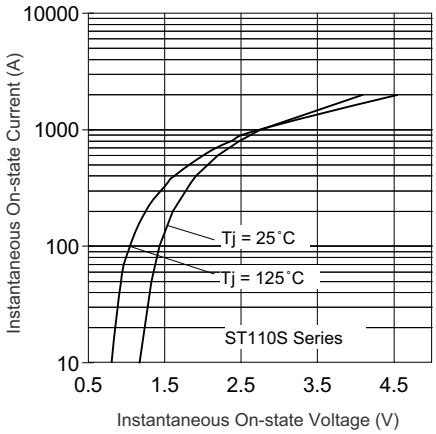


Fig. 7 - On-State Voltage Drop Characteristics

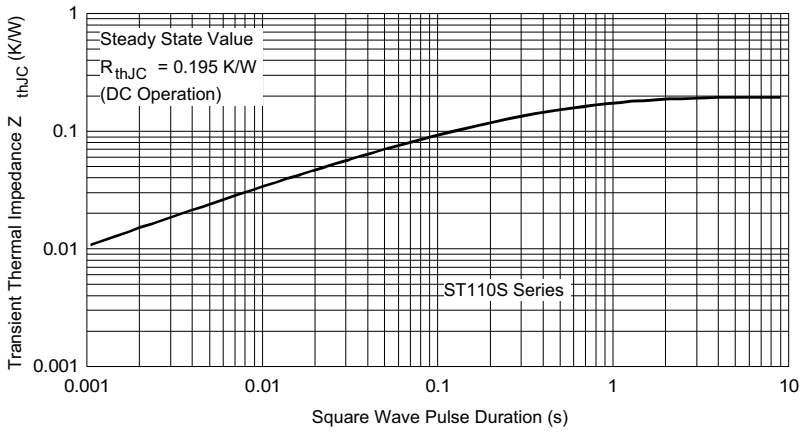


Fig. 8 - Thermal Impedance Z_{thJC} Characteristic

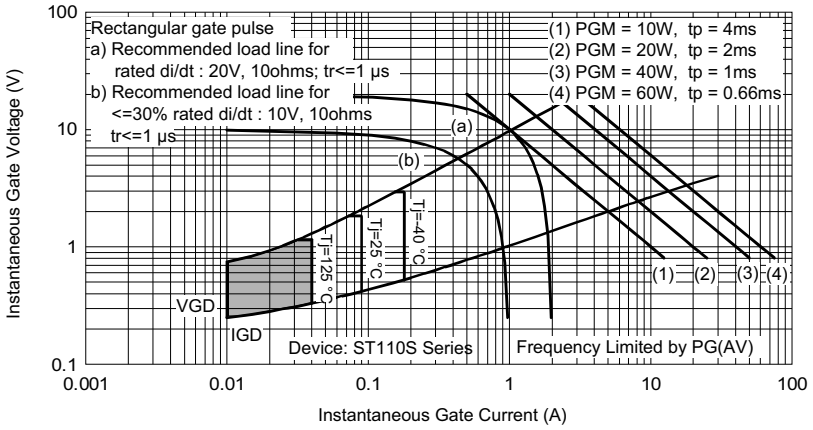


Fig. 9 - Gate Characteristics

ORDERING INFORMATION TABLE

Device code

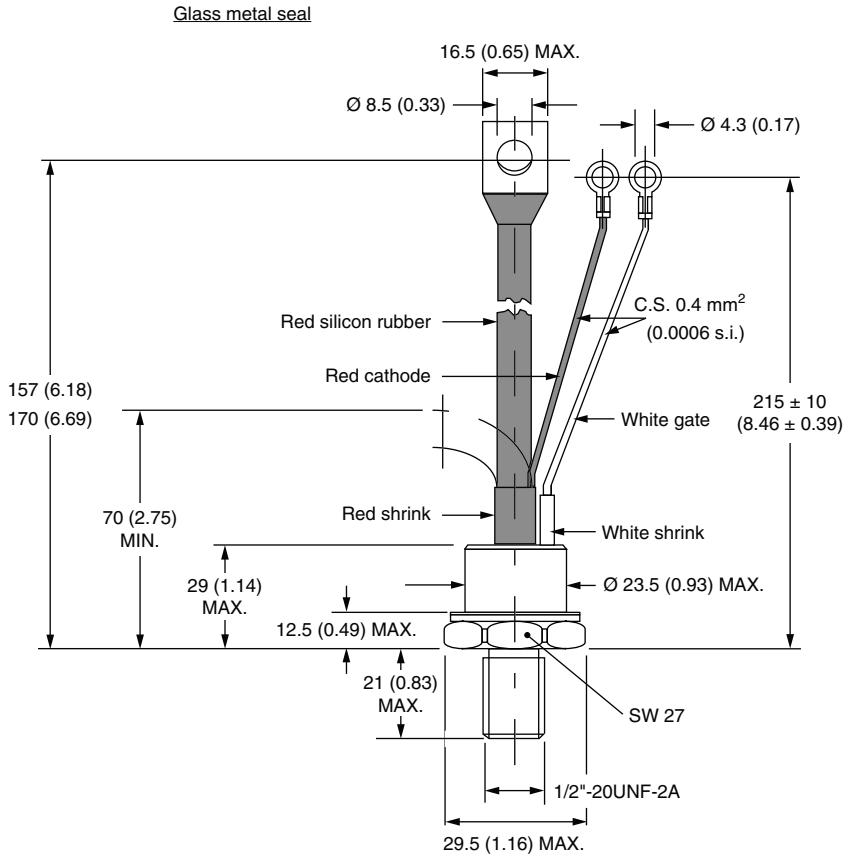
VS-	ST	11	0	S	16	P	0	V	L	PbF
1	2	3	4	5	6	7	8	9	10	11

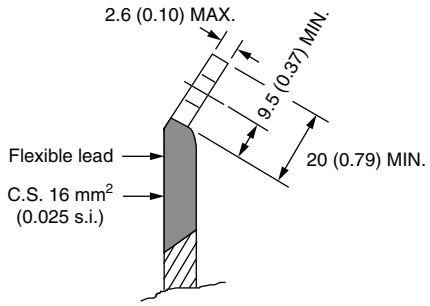
- **1** - Vishay Semiconductors product
- **2** - Thyristor
- **3** - Essential part marking
- **4** - 0 = converter grade
- **5** - S = compression bonding stud
- **6** - Voltage code x 100 = V_{RRM} (see Voltage Ratings table)
- **7** - P = stud base 20UNF threads
- **8** - 0 = eyelet terminals (gate and auxiliary cathode leads)
  1 = fast-on terminals (gate and auxiliary cathode leads)
  2 = flag terminals (for cathode and gate terminals)
- **9** - • V = glass-metal seal (only up to 1200 V)
  • None = ceramic housing (over 1200 V)
- **10** - Critical dV/dt:
  • None = 500 V/µs (standard value)
  • L = 1000 V/µs (special selection)
- **11** - None = standard production
  - PbF = lead (Pb)-free

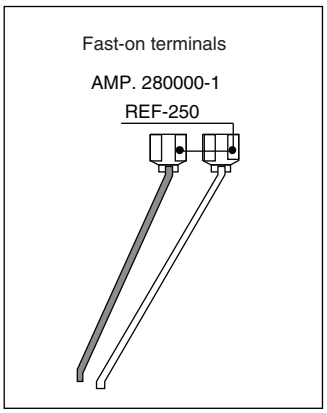
LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95078

TO-209AC (TO-94) for ST110S Series

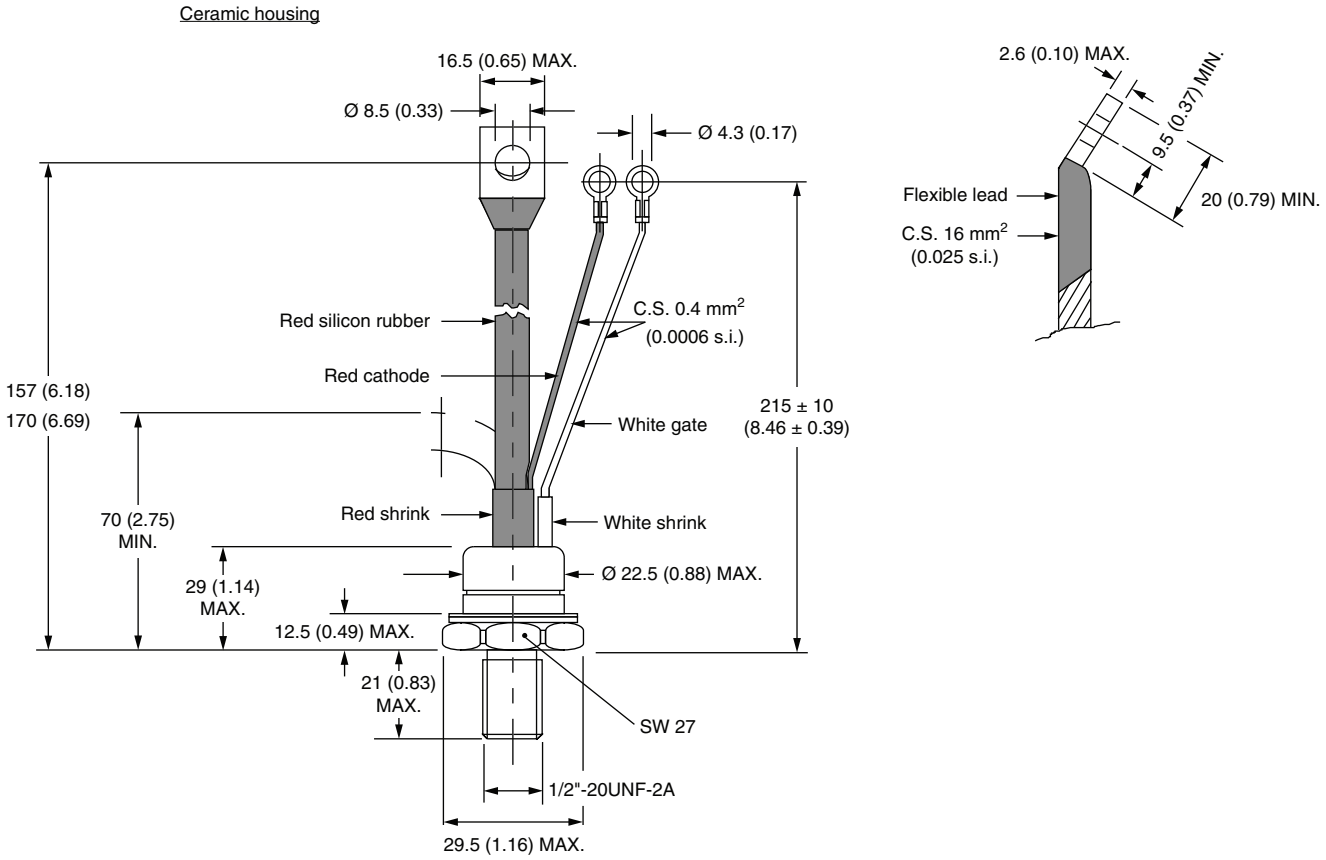
DIMENSIONS in millimeters (inches)







DIMENSIONS in millimeters (inches)



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.