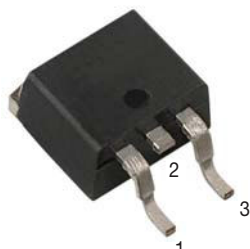
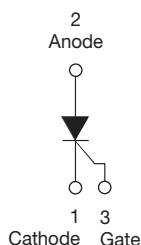


# Thyristor Surface Mount Phase Control SCR, 16 A


**TO-263AB (D²PAK)**


## FEATURES

- Meets MSL level 1, per J-STD-020, LF maximum peak of 260 °C
- Designed and qualified according JEDEC-JESD47
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?999912](http://www.vishay.com/doc?999912)


**RoHS**  
COMPLIANT

## APPLICATIONS

- Input rectification (soft start)
- Vishay input diodes, switches and output rectifiers which are in identical package outlines

## DESCRIPTION

The VS-16TTS16SPbF High Voltage Series of silicon controlled rectifiers are specifically designed for medium power switching and phase control applications. The glass passivation technology used has reliable operation up to 125 °C junction temperature.

## PRODUCT SUMMARY

Package	TO-263AB (D²PAK)
Diode variation	Single SCR
$I_{T(AV)}$	10 A
$V_{DRM}/V_{RRM}$	1600 V
$V_{TM}$	1.4 V
$I_{GT}$	60 mA
$T_J$	- 40 °C to 125 °C

## OUTPUT CURRENT IN TYPICAL APPLICATIONS

APPLICATIONS	SINGLE-PHASE BRIDGE	THREE-PHASE BRIDGE	UNITS
NEMA FR-4 or G-10 glass fabric-based epoxy with 4 oz. (140 µm) copper	2.5	3.5	A
Aluminum IMS, $R_{thCA} = 15$ °C/W	6.3	9.5	
Aluminum IMS with heatsink, $R_{thCA} = 5$ °C/W	14.0	18.5	

### Note

- $T_A = 55$  °C,  $T_J = 125$  °C, footprint 300 mm²

## MAJOR RATINGS AND CHARACTERISTICS

SYMBOL	CHARACTERISTICS	VALUES	UNITS
$I_{T(AV)}$	Sinusoidal waveform	10	A
$I_{RMS}$		16	
$V_{RRM}/V_{DRM}$		1600	V
$I_{TSM}$		200	A
$V_T$	10 A, $T_J = 25$ °C	1.4	V
$dV/dt$		500	V/µs
$dI/dt$		150	A/µs
$T_J$		- 40 to 125	°C

## VOLTAGE RATINGS

PART NUMBER	$V_{RRM}$ , MAXIMUM PEAK REVERSE VOLTAGE V	$V_{DRM}$ , MAXIMUM PEAK DIRECT VOLTAGE V	$I_{RRM}/I_{DRM}$ AT 125 °C mA
VS-16TTS16SPbF	1600	1600	10

**ABSOLUTE MAXIMUM RATINGS**

PARAMETER	SYMBOL	TEST CONDITIONS	VALUES		UNITS
			TYP.	MAX.	
Maximum average on-state current	$I_{T(AV)}$	$T_C = 93\text{ }^{\circ}\text{C}$ , 180° conduction, half sine wave	10		A
Maximum RMS on-state current	$I_{RMS}$		16		
Maximum peak, one-cycle, non-repetitive surge current	$I_{TSM}$	10 ms sine pulse, rated $V_{RRM}$ applied	170		
		10 ms sine pulse, no voltage reapplied	200		
Maximum $I^2t$ for fusing	$I^2t$	10 ms sine pulse, rated $V_{RRM}$ applied	144		$A^2s$
		10 ms sine pulse, no voltage reapplied	200		
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	$t = 0.1\text{ ms to }10\text{ ms}$ , no voltage reapplied	2000		$A^2\sqrt{s}$
Maximum on-state voltage drop	$V_{TM}$	10 A, $T_J = 25\text{ }^{\circ}\text{C}$	1.4		V
On-state slope resistance	$r_t$	$T_J = 125\text{ }^{\circ}\text{C}$	24.0		$m\Omega$
Threshold voltage	$V_{T(TO)}$		1.1		V
Maximum reverse and direct leakage current	$I_{RM}/I_{DM}$	$T_J = 25\text{ }^{\circ}\text{C}$	$V_R = \text{Rated } V_{RRM}/V_{DRM}$		0.5
		$T_J = 125\text{ }^{\circ}\text{C}$			10
Holding current	$I_H$	Anode supply = 6 V, resistive load, initial $I_T = 1\text{ A}$ , $T_J = 25\text{ }^{\circ}\text{C}$	100	150	mA
Maximum latching current	$I_L$	Anode supply = 6 V, resistive load, $T_J = 25\text{ }^{\circ}\text{C}$	200		
Maximum rate of rise of off-state voltage	$dV/dt$	$T_J = T_J\text{ max.}$ linear to 80 % $V_{DRM} = R_g - k = \text{Open}$	500		V/ $\mu s$
Maximum rate of rise of turned-on current	$dI/dt$		150		A/ $\mu s$

**TRIGGERING**

PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Maximum peak gate power	$P_{GM}$		8.0	W
Maximum average gate power	$P_{G(AV)}$		2.0	
Maximum peak positive gate current	+ $I_{GM}$		1.5	A
Maximum peak negative gate voltage	- $V_{GM}$		10	V
Maximum required DC gate current to trigger	$I_{GT}$	Anode supply = 6 V, resistive load, $T_J = -10\text{ }^{\circ}\text{C}$	90	mA
		Anode supply = 6 V, resistive load, $T_J = 25\text{ }^{\circ}\text{C}$	60	
		Anode supply = 6 V, resistive load, $T_J = 125\text{ }^{\circ}\text{C}$	35	
Maximum required DC gate voltage to trigger	$V_{GT}$	Anode supply = 6 V, resistive load, $T_J = -10\text{ }^{\circ}\text{C}$	3.0	V
		Anode supply = 6 V, resistive load, $T_J = 25\text{ }^{\circ}\text{C}$	2.0	
		Anode supply = 6 V, resistive load, $T_J = 125\text{ }^{\circ}\text{C}$	1.0	
Maximum DC gate voltage not to trigger	$V_{GD}$	$T_J = 125\text{ }^{\circ}\text{C}$ , $V_{DRM} = \text{Rated value}$	0.25	mA
Maximum DC gate current not to trigger	$I_{GD}$		2.0	

**SWITCHING**

PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Typical turn-on time	$t_{gt}$	$T_J = 25\text{ }^{\circ}\text{C}$	0.9	$\mu s$
Typical reverse recovery time	$t_{rr}$	$T_J = 125\text{ }^{\circ}\text{C}$	4	
Typical turn-off time	$t_q$		110	



THERMAL - MECHANICAL SPECIFICATIONS				
PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Maximum junction and storage temperature range	$T_J, T_{Stg}$		- 40 to 125	°C
Soldering temperature	$T_S$	For 10 s (1.6 mm from case)	260	
Maximum thermal resistance, junction to case	$R_{thJC}$	DC operation	1.3	°C/W
Typical thermal resistance, junction to ambient	$R_{thJA}$	PCB mount <sup>(1)</sup>	40	
Approximate weight			2	g
			0.07	oz.
Marking device		Case style D <sup>2</sup> PAK (SMD-220)	16TTS16S	

## Note

- <sup>(1)</sup> When mounted on 1" square (650 mm<sup>2</sup>) PCB of FR-4 or G-10 material 4 oz. (140 µm) copper 40 °C/W.  
For recommended footprint and soldering techniques refer to application note #AN-994.

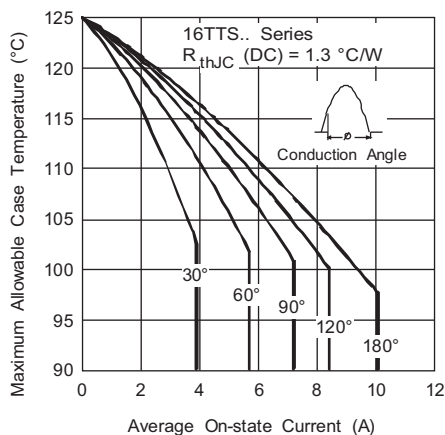


Fig. 1 - Current Rating Characteristics

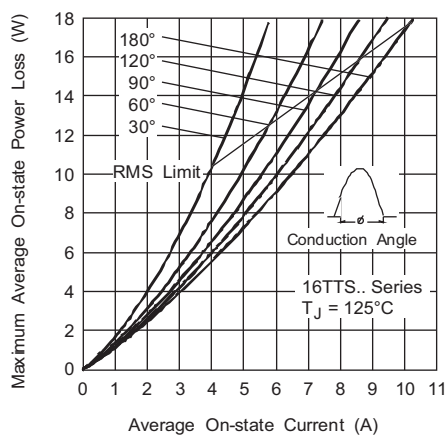


Fig. 3 - On-State Power Loss Characteristics

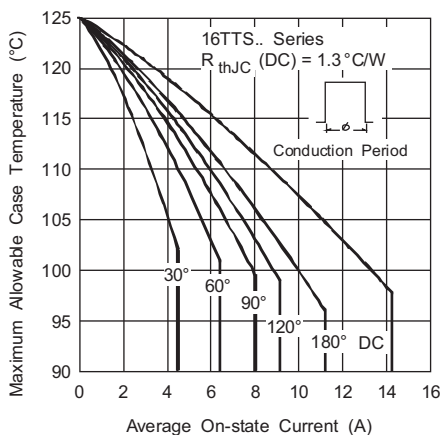


Fig. 2 - Current Rating Characteristics

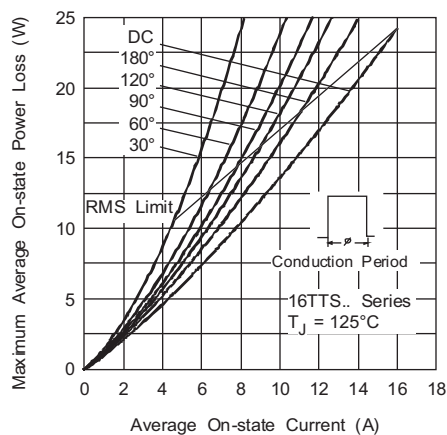


Fig. 4 - On-State Power Loss Characteristics

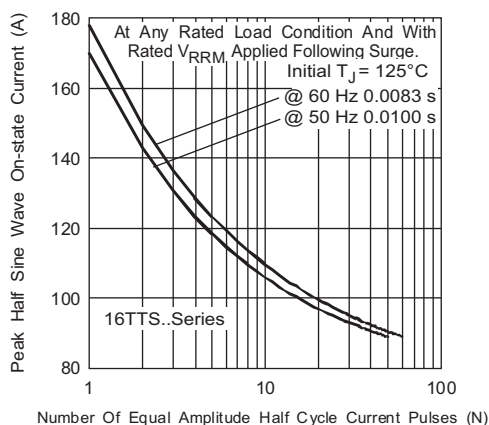


Fig. 5 - Maximum Non-Repetitive Surge Current

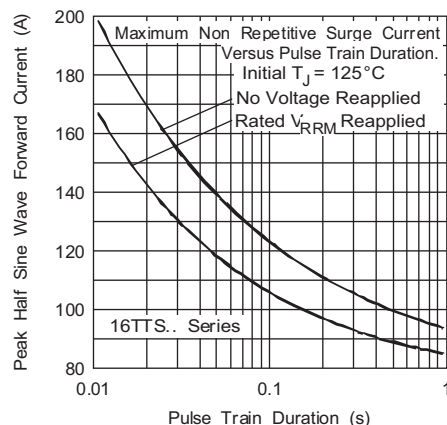


Fig. 6 - Maximum Non-Repetitive Surge Current

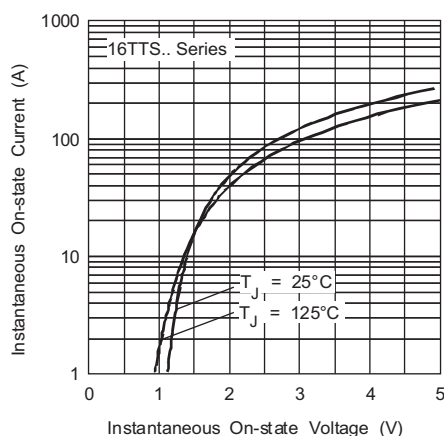
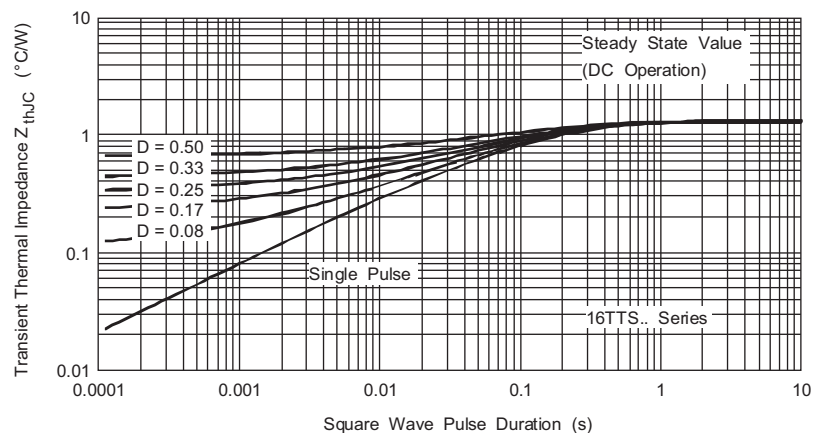


Fig. 7 - On-State Voltage Drop Characteristics


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

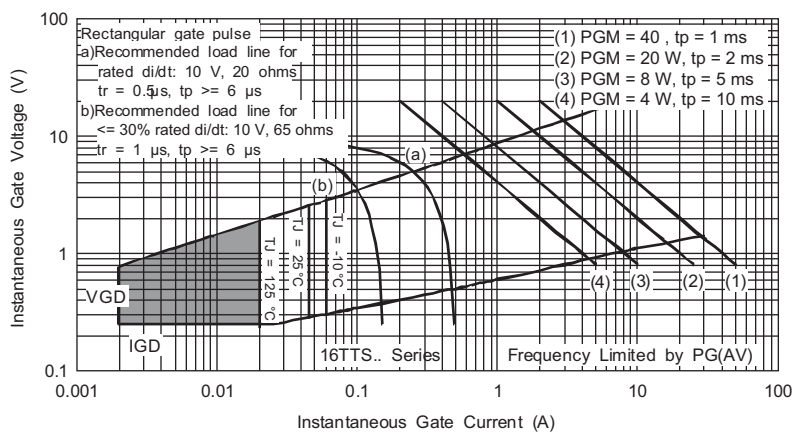


Fig. 9 - Gate Characteristics

## ORDERING INFORMATION TABLE

Device code

VS-	16	T	T	S	16	S	TRL	PbF
①	②	③	④	⑤	⑥	⑦	⑧	⑨

- 1** - Vishay Semiconductors product
- 2** - Current rating
- 3** - Circuit configuration:  
T = Single thyristor
- 4** - Package:  
T = TO-220AC
- 5** - Type of silicon:  
S = Standard recovery rectifier
- 6** - Voltage rating: Voltage code x 100 =  $V_{RRM}$  (16 = 1600 V)
- 7** - S = TO-220 D<sup>2</sup>PAK (SMD-220) version
- 8** -
  - None = Tube
  - TRL = Tape and reel (left oriented)
  - TRR = Tape and reel (right oriented)
- 9** - PbF = Lead (Pb)-free

## ORDERING INFORMATION (Example)

PREFERRED P/N	QUANTITY PER T/R	MINIMUM ORDER QUANTITY	PACKAGING DESCRIPTION
VS-16TTS16SPbF	50	1000	Antistatic plastic tubes
VS-16TTS16STRRPbF	800	800	13" diameter reel
VS-16TTS16STRLPbF	800	800	13" diameter reel

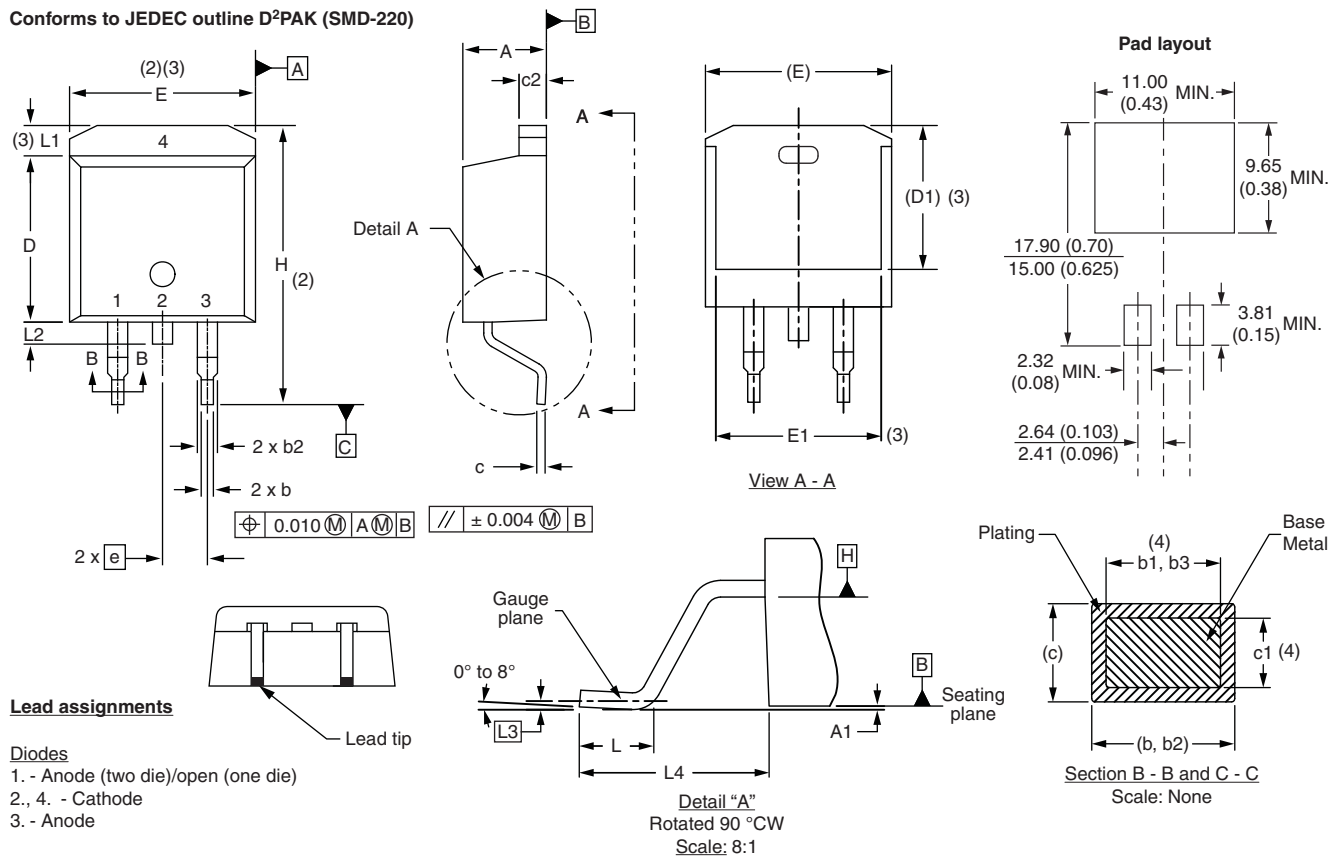
## LINKS TO RELATED DOCUMENTS

Dimensions	<a href="http://www.vishay.com/doc?95046">www.vishay.com/doc?95046</a>
Part marking information	<a href="http://www.vishay.com/doc?95054">www.vishay.com/doc?95054</a>
Packaging information	<a href="http://www.vishay.com/doc?95032">www.vishay.com/doc?95032</a>

### D<sup>2</sup>PAK

#### DIMENSIONS in millimeters and inches

Conforms to JEDEC outline D<sup>2</sup>PAK (SMD-220)



SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	0.160	0.190	
A1	0.00	0.254	0.000	0.010	
b	0.51	0.99	0.020	0.039	
b1	0.51	0.89	0.020	0.035	4
b2	1.14	1.78	0.045	0.070	
b3	1.14	1.73	0.045	0.068	4
c	0.38	0.74	0.015	0.029	
c1	0.38	0.58	0.015	0.023	4
c2	1.14	1.65	0.045	0.065	
D	8.51	9.65	0.335	0.380	2

SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
D1	6.86	8.00	0.270	0.315	3
E	9.65	10.67	0.380	0.420	2, 3
E1	7.90	8.80	0.311	0.346	3
e	2.54 BSC		0.100 BSC		
H	14.61	15.88	0.575	0.625	
L	1.78	2.79	0.070	0.110	
L1	-	1.65	-	0.066	3
L2	1.27	1.78	0.050	0.070	
L3	0.25 BSC		0.010 BSC		
L4	4.78	5.28	0.188	0.208	

#### Notes

- (1) Dimensioning and tolerancing per ASME Y14.5 M-1994
- (2) Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm (0.005") per side. These dimensions are measured at the outmost extremes of the plastic body
- (3) Thermal pad contour optional within dimension E, L1, D1 and E1
- (4) Dimension b1 and c1 apply to base metal only
- (5) Datum A and B to be determined at datum plane H
- (6) Controlling dimension: inch
- (7) Outline conforms to JEDEC outline TO-263AB



## 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.

## Material Category Policy

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.**

**Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.**

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.**