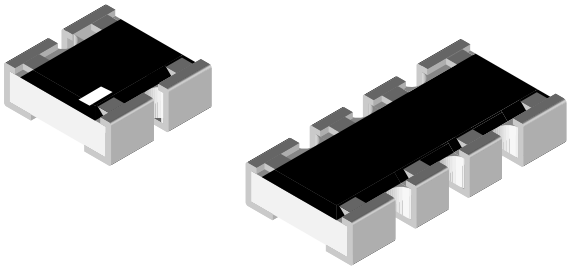
Precision Thin Film Chip Resistor Array



ACAS 0606 AT and ACAS 0612 AT precision automotive grade thin film chip resistor arrays with convex terminations combine the proven reliability of discrete chip resistors with the advantages of chip resistor arrays. Defined tolerance matching and TCR tracking makes this product perfectly suited for applications with outstanding requirements towards stable fixed resistor ratios. A small package enables the design of high density circuits in combination with reduction of assembly costs. Four equal resistor values or two pairs are available for the ACAS 0612 AT, whereas the ACAS 0606 AT is available either with two equal or two different resistor values.

FEATURES

- AEC-Q200 qualified
- 155 °C Film Temperature
- ESD capability 1000 V, human body model
- Advanced Thin Film Technology
- TCR tracking down to 10 ppm/K (± 5 ppm/K) and tolerance matching down to 0.1 % (± 0.05 %)
- RoHS compliant component, compatible with lead (Pb)-free and lead bearing soldering processes

RoHS COMPLIANT

AUTOMOTIVE GRADE

APPLICATIONS

- Precision analogue circuits
- Voltage divider
- Feedback circuits
- Signal conditioning

TECHNICAL SPECIFICATIONS

DESCRIPTION	ACAS 0606 AT	ACAS 0612 AT
EIA size	0606	0612
Metric size	RR1616MM	RR1632M
Configuration, isolated	2 x 0603	4 x 0603
Design: All equal values (AE) Two pairs of values (TP) Different values (DF)	 AE DF	 AE TP
Resistance values	47 Ω to 150 kΩ (1)	
Absolute tolerance	± 0.5 %; ± 0.25 %	
Tolerance matching (2)	0.5 % (equivalent to ± 0.25 %) 0.25 % (equivalent to ± 0.125 %) 0.1 % (equivalent to ± 0.05 %)	
Absolute temperature coefficient	± 50 ppm/K; ± 25 ppm/K	
Temperature coefficient tracking (2)	50 ppm/K (equivalent to ± 25 ppm/K) 25 ppm/K (equivalent to ± 12.5 ppm/K) 15 ppm/K (equivalent to ± 7.5 ppm/K) 10 ppm/K (equivalent to ± 5 ppm/K)	
Max. resistance ratio $R_{min.}/R_{max.}$	1:20 (3)	
Rated dissipation: P_{70} (4) Element Package	 0.125 W 0.2 W	 0.125 W 0.4 W
Operating voltage, $U_{max.}$ AC/DC	75 V	
Film temperature	155 °C	
Insulation voltage (U_{ins}) against ambient and between integrated resistors, continuous	75 V	

Notes

(1) Resistance values to be selected from E24 and E96

(2) In applications with defined resistance ratios like voltage dividers or feedback circuits, an array with a defined tracking of e.g. 10 ppm/K is required to replace discrete resistors with a temperature coefficient of resistance of ± 5 ppm/K. Furthermore, in order to achieve the same tolerance of ± 0.05 % of individual resistors, an array requires a matching of 0.1 %.

(3) Higher resistance ratio is available on request

(4) Please refer to APPLICATION INFORMATION, see below

APPLICATION INFORMATION

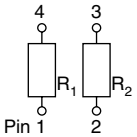
The power dissipation on the resistor generates a temperature rise against the local ambient, depending on the heat flow support of the printed-circuit board (thermal resistance). The rated dissipation applies only if the permitted film temperature is not exceeded. These resistors do not feature a limited lifetime when operated within the permissible limits.

MAXIMUM RESISTANCE CHANGE AT RATED POWER (1)					
DESCRIPTION		**ACAS 0606 AT**		**ACAS 0612 AT**	
Configuration, isolated		2 x 0603		4 x 0603	
Operation mode		Standard	Power	Standard	Power
Rated power per element, P_{70}		0.1 W	0.125 W	0.1 W	0.125 W
Rated power per package, P_{70}		0.15 W	0.2 W	0.3 W	0.4 W
Film temperature		125 °C	155 °C	125 °C	155 °C
Max. resistance change at P_{70}					
$\Delta R/R$ max., after:	1000 h	± 0.1 %	± 0.25 %	± 0.1 %	± 0.25 %
	8000 h	± 0.25 %	± 0.5 %	± 0.25 %	± 0.5 %
Max. relative resistance change (relative drift) at P_{70}					
$\Delta R/R$ max., after:	1000 h	0.1 % (2)	0.25 % (3)	0.1 % (2)	0.25 % (3)
	8000 h	0.25 % (3)	0.5 % (4)	0.25 % (3)	0.5 % (4)

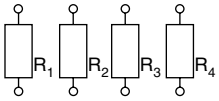
Notes

(1) Figures are given for arrays with equal values, design type AE
(2) Equivalent to ± 0.05 %
(3) Equivalent to ± 0.125 %
(4) Equivalent to ± 0.25 %

SKETCHES



ACAS 0606 AT



ACAS 0612 AT

Marking on ACAS 0606 AT: For different resistor values pin 1 is marked.

DESIGN		
TYPE	**ACAS 0606 AT**	**ACAS 0612 AT**
AE	$R_1 = R_2$	$R_1 = R_2 = R_3 = R_4$
TP		$R_1 = R_4 < R_2 = R_3$
DF	$R_1 < R_2$	

PART NUMBER AND PRODUCT DESCRIPTION (1)

PART NUMBER: ACASA1100A2200P5AT

A	C	A	S	A	1	1	0	0	A	2	2	0	0	P	5	A	T

MODEL	TERMINAL	SIZE	RESISTANCE VALUE (2)(3)	ACCURACY GRADE (4)	RESISTANCE VALUE (2)(3)	PACKAGING (5)	SPECIAL
ACA	**S** = Convex square	**N** = 0606 **A** = 0612	**3 digit resistance value R_1, R_4** **1 digit multiplier** MULTIPLIER **9** = $*10^{-1}$ **0** = $*10^{0}$ **1** = $*10^{1}$ **2** = $*10^{2}$ **3** = $*10^{3}$	TCR, Tracking, Tolerance and Matching **A, B, E, F** **J, K, N** or **P**	**3 digit resistance value R_1, R_4** **1 digit multiplier** MULTIPLIER **9** = $*10^{-1}$ **0** = $*10^{0}$ **1** = $*10^{1}$ **2** = $*10^{2}$ **3** = $*10^{3}$	**P1** **P5**	**AT** = Automotive

PRODUCT DESCRIPTION: ACAS 0612 110R A 220R AT P5

ACA	S	0612	110R	A	220R	AT	P5
MODEL	TERMINAL	SIZE	RESISTANCE VALUE R_1, R_4 (2)(3)	ACCURACY GRADE (4)	RESISTANCE VALUE R_1, R_4 (2)(3)	SPECIAL	PACKAGING (5)
ACA = Chip Array	**S** = Convex square	**0606** **0612**	**110R** = 110 Ω **1K1** = 1.1 kΩ **22K1** = 22.1 kΩ	TCR, Tracking, Tolerance and Matching **A, B, E, F** **J, K, N** or **P**	**220R** = 220 Ω **1K1** = 1.1 kΩ **22K1** = 22.1 kΩ	**AT** = Automotive	**P1** **P5**

Notes

(1) Products can be ordered using either the PART NUMBER or the PRODUCT DESCRIPTION

(2) $R_1 = R_4 \leq R_2 = R_3$

(3) Different resistance values are available on request

(4) Please refer to table TEMPERATURE COEFFICIENT AND RESISTANCE RANGE, see below

(5) Please refer to table PACKAGING, see below

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE

DESCRIPTION					RESISTANCE VALUE
ACCURACY GRADE	ABSOLUTE TCR	TCR TRACKING (6)	ABSOLUTE TOLERANCE	TOLERANCE MATCHING (6)	ACAS 0612 AT
A	± 25 ppm/K	10 ppm/K	± 0.25 %	0.1 %	47 Ω to 150 kΩ
B	± 25 ppm/K	10 ppm/K	± 0.5 %	0.25 %	47 Ω to 150 kΩ
E	± 25 ppm/K	15 ppm/K	± 0.25 %	0.1 %	47 Ω to 150 kΩ
F	± 25 ppm/K	15 ppm/K	± 0.5 %	0.25 %	47 Ω to 150 kΩ
J	± 25 ppm/K	25 ppm/K	± 0.25 %	0.1 %	47 Ω to 150 kΩ
K	± 25 ppm/K	25 ppm/K	± 0.5 %	0.25 %	47 Ω to 150 kΩ
N	± 50 ppm/K	25 ppm/K	± 0.5 %	0.5 %	47 Ω to 150 kΩ
P	± 50 ppm/K	50 ppm/K	± 0.5 %	0.5 %	47 Ω to 150 kΩ

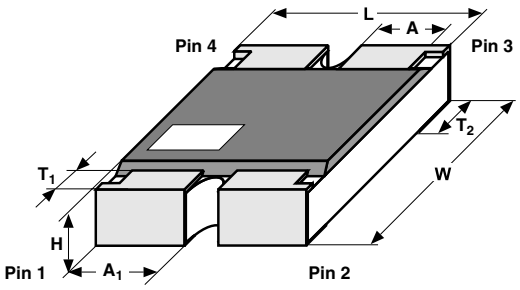
Note

(6) Please refer to TECHNICAL SPECIFICATIONS, Note (2), see above

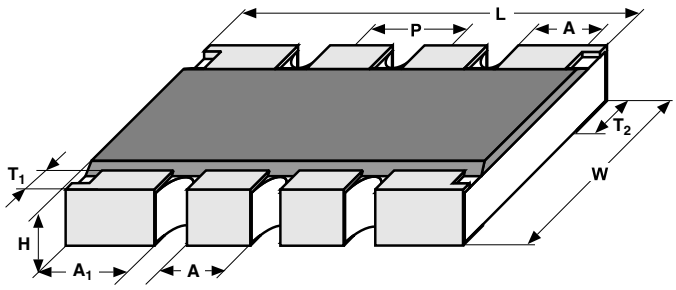
PACKAGING					
MODEL	TAPE WIDTH	DIAMETER	PIECES	PITCH	PACKAGING CODE
					PAPER TAPE
ACAS 0606 AT ACAS 0612 AT	8 mm	180 mm/7"	1000	4 mm	P1
	8 mm	180 mm/7"	5000	4 mm	P5

DIMENSIONS

ACAS 0606 AT

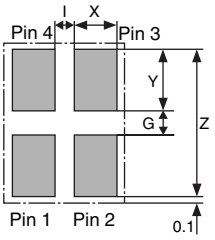


ACAS 0612 AT

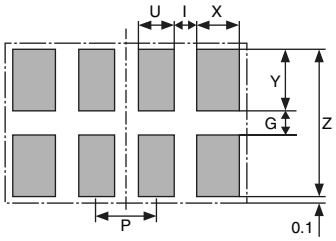


DIMENSIONS - chip resistor array, mass and relevant physical dimensions									
TYPE	W (mm)	L (mm)	H (mm)	P (mm)	A_1 (mm)	A (mm)	T_1 (mm)	T_2 (mm)	MASS (mg)
ACAS 0606 AT	1.5 ± 0.15	1.6 ± 0.15	0.45 ± 0.1	-	0.6 ± 0.15	0.4 ± 0.15	0.3 ± 0.15	0.4 ± 0.15	3.6
ACAS 0612 AT	1.5 ± 0.15	3.2 ± 0.15	0.45 ± 0.1	0.8 ± 0.1	0.6 ± 0.15	0.4 ± 0.15	0.3 ± 0.15	0.4 ± 0.15	6.8

PATTERN STYLES FOR CHIP RESISTOR ARRAYS



limits for solder resist



limits for solder resist

Dimensions in mm

RECOMMENDED SOLDER PAD DIMENSIONS FOR CHIP RESISTOR ARRAYS							
TYPE	G (mm)	Y (mm)	X (mm)	U (mm)	Z (mm)	I (mm)	P (mm)
ACAS 0606 AT	0.8	1.15	0.64	-	3.1	0.36	0.8
ACAS 0612 AT	0.8	1.15	0.64	0.44	3.1	0.36	0.8

DESCRIPTION

The production of the components is strictly controlled and follows an extensive set of instructions established for reproducibility. A homogeneous film of metal alloy is deposited on a high grade (96 % Al_2O_3) ceramic substrate using a mask to separate the adjacent resistors and conditioned to achieve the desired temperature coefficient. Specially designed inner contacts are realized on both sides. A special laser is used to achieve the target value by smoothly cutting a meander groove in the resistive layer without damaging the ceramics.

The resistor elements are covered by a protective coating designed for electrical, mechanical and climatic protection. The terminations receive a final pure tin on nickel plating.

The result of the determined production is verified by an extensive testing procedure and optical inspection performed on 100 % of the individual chip resistors. Only accepted products are laid directly into the paper tape in accordance with **IEC 60286-3 (3).**

ASSEMBLY

The resistors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using reflow or vapour phase as shown in **IEC 61760-1 (3)**. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions.

The suitability of conformal coatings, if applied, shall be qualified by appropriate means to ensure the long-term stability of the whole system. The resistors are RoHS compliant; the pure tin plating provides compatibility with lead (Pb)-free and lead-containing soldering processes. The permitted storage time is 20 years, whereas the solderability is specified for 2 years after production or requalification. The immunity of the plating against tin whisker growth has been proven under extensive testing.

All products comply with the **GADSL** (1) and the **CEFIC-EECA-EICTA** (2) list of legal restrictions on hazardous substances. This includes full compliance with the following directives:

- 2000/53/EC End of Vehicle life Directive (ELV) and Annex II (ELV II)
- 2002/95/EC Restriction of the use of Hazardous Substances directive (RoHS)
- 2002/96/EC Waste Electrical and Electronic Equipment Directive (WEEE)

APPROVALS

The chip resistor array is **AEC-Q200** qualified. Where applicable, the resistors are tested in accordance with **EN 140401-801** which refers to **EN 60115-1** and **EN 140400**.

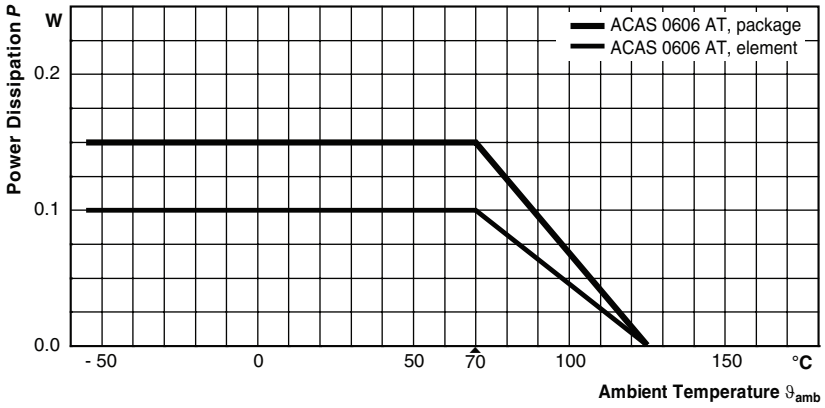
Notes

(1) Global Automotive Declarable Substance List, see www.gadsl.org

(2) CEFIC (European Chemical Industry Council), EECA (European Electronic Component Manufacturers Association), EICTA (European trade organisation representing the information and communications technology and consumer electronics), see www.eicta.org → issues → environment policy → chemicals → chemicals for electronics

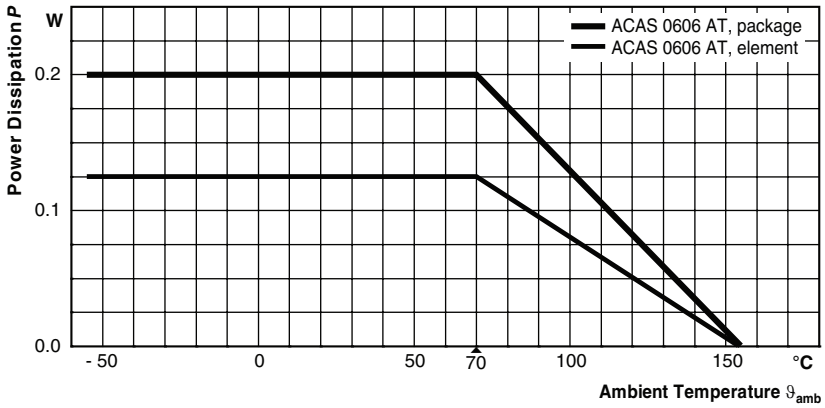
(3) The quoted IEC standards are also released as EN standards with the same number and identical contents

FUNCTIONAL PERFORMANCE

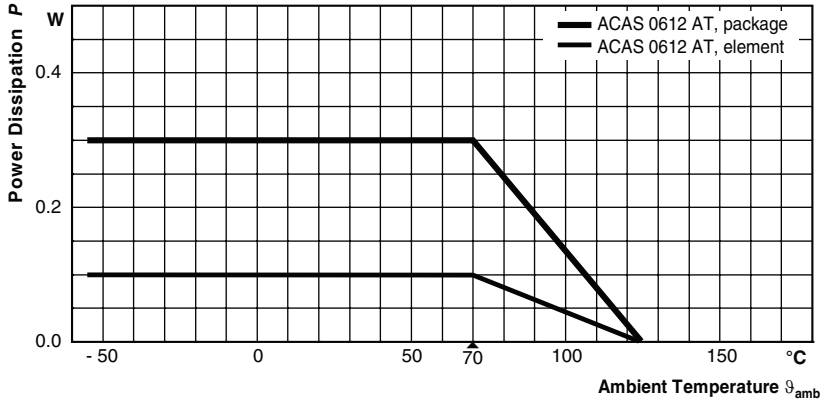


Derating - Standard Operation ACAS 0606 AT

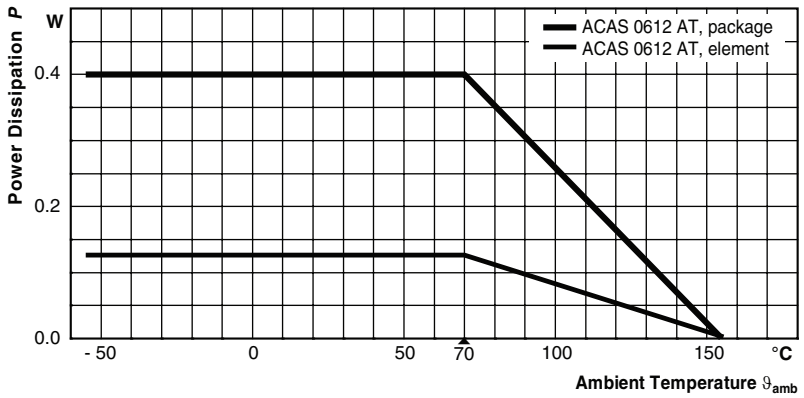
FUNCTIONAL PERFORMANCE



Derating - Power Operation ACAS 0606 AT



Derating - Standard Operation ACAS 0612 AT



Derating - Power Operation ACAS 0612 AT

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the following specifications:

EN 60115-1, Generic specification

EN 140400, Sectional specification

EN 140401-801, Detail specification

The testing also covers most of the requirements specified by EIA/IS-703 and JIS-C-5202.

The tests are carried out in accordance with **IEC 60068** (4) and under standard atmospheric conditions according to **IEC 60068-1** (4), 5.3. Climatic category LCT/UCT/56 (rated temperature range: Lower Category Temperature, Upper Category Temperature; damp heat, long term, 56 days) is valid.

Unless otherwise specified the following values apply:

Temperature: 15 °C to 35 °C

Relative humidity: 45 % to 75 %

Air pressure: 86 kPa to 106 kPa (860 mbar to 1060 mbar)

The requirements stated in the "Test Procedures and Requirements" table are based on the required tests and permitted limits of EN 140401-801 where applicable.

TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2 (4) TEST METHOD	TEST	PROCEDURE	REQUIREMENTS (1) PERMISSIBLE CHANGE (ΔR)
			Stability for product types:	
			ACAS 0606 AT	47 Ω to 150 kΩ
			ACAS 0612 AT	47 Ω to 150 kΩ
			Climatic category (LCT/UCT/duration)	- 55 °C/+ 125 °C/56 days
4.5	-	Resistance	-	± 0.5 %; ± 0.25 %
4.8.4.2	-	Temperature coefficient	At 20/LCT/ 20 °C and 20/UCT/20 °C	± 50 ppm/K; ± 25 ppm/K
4.25.1	-	Endurance at 70 °C: Standard operation mode	$U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$; 1.5 h on; 0.5 h off; 1000 h: Absolute	± (0.1 % R + 0.05 Ω)
			Relative (2)	0.1 % R + 0.05 Ω
			8000 h: Absolute	± (0.25 % R + 0.05 Ω)
			Relative (2)	0.25 % R + 0.05 Ω
		Endurance at 70 °C: Power operation mode	$U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$; 1.5 h on; 0.5 h off; 1000 h: Absolute	± (0.25 % R + 0.05 Ω)
			Relative (2)	0.25 % R + 0.05 Ω
			8000 h: Absolute	± (0.5 % R + 0.05 Ω)
			Relative (2)	0.5 % R + 0.05 Ω
4.25.3	-	Endurance at upper category temperature	125 °C; 1000 h: Absolute	± (0.25 % R + 0.05 Ω)
			Relative (2)	0.25 % R + 0.05 Ω)
			125 °C; 8000 h: Absolute	± (0.5 % R + 0.05 Ω)
			Relative (2)	0.5 % R + 0.05 Ω
			155 °C; 1000 h: Absolute	± (0.4 % R + 0.05 Ω)
			Relative (2)	0.4 % R + 0.05 Ω

TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2 [4] TEST METHOD	TEST	PROCEDURE	REQUIREMENTS [1] PERMISSIBLE CHANGE (ΔR)
			Stability for product types: **ACAS 0606 AT** **ACAS 0612 AT**	 47 Ω to 150 kΩ 47 Ω to 150 kΩ
4.24	78 (Cab)	Damp heat, steady state	(40 ± 2) °C; 56 days; (93 ± 3) % RH	± (0.25 % R + 0.05 Ω)
4.39	67 (Cy)	Damp heat, steady state, accelerated	(85 ± 2) °C (85 ± 5) % RH $U = 0.1 \times \sqrt{P_{70} \times R}$ ≤ 100 V; 1000 h	± (0.5 % R + 0.05 Ω)
4.13	-	Short time overload [3]	$U = 2.5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max.}$; 5 s	± (0.1 % R + 0.01 Ω) no visible damage
4.40	-	Electrostatic discharge (Human body model) [3]	IEC 61340-3-1; 3 pos. + 3 neg. (equivalent to MIL-STD-883, Method 3015); 1000 V	± (0.5 % R + 0.05 Ω)
4.19	14 (Na)	Rapid change of temperature	30 min at LCT and 30 min at UCT; 1000 cycles	± (0.25 % R + 0.05 Ω) no visible damage
4.18.2	58 (Td)	Resistance to soldering heat	Reflow method 2 (IR/forced gas convention); (260 ± 5) °C; (10 ± 1) s	± (0.1 % R + 0.01 Ω) no visible damage
4.17.2	58 (Td)	Solderability	Solder bath method; SnPb; non-activated flux accelerated aging 4 h/155 °C (215 ± 3) °C; (3 ± 0.3) s	Good tinning (≥ 95 % covered); no visible damage
			Solder bath method; SnAgCu; non-activated flux accelerated aging 4 h/155 °C (235 ± 3) °C; (2 ± 0.2) s	
4.32	21 (Ue_1)	Shear (adhesion)	45 N	No visible damage
4.33	21 (Ue_3)	Substrate bending	Depth 2 mm, 3 times	± (0.1 % R + 0.01 Ω) no visible damage; no open circuit in bent position
4.35	-	Flammability	IEC 60695-11-5, needle flame test; 10 s	No burning after 30 s
4.22	6 (Fc)	Vibration	Endurance by sweeping; 10 to 2000 Hz; no resonance; amplitude ≤ 1.5 mm or ≤ 200 m/s^2; 6 h	± (0.1 % R + 0.01 Ω); no visible damage
4.7	-	Voltage proof	$U_{rms} = U_{ins}$ 60 ± 5 s; against ambient, between adjacent resistors	No flashover or breakdown

Notes

[1] Figures are given for arrays with equal values, design type AE

[2] Relative drift values are equivalent to the half of its value with ± symbol, i.e. 0.1 % is equivalent to ± 0.05 %

[3] For a single element

[4] The quoted IEC standards are also released as EN standards with the same number and identical contents