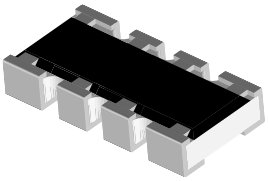
Precision Thin Film Chip Resistor Array



ACAC 0612 (concave terminations) and ACAS 0612 (convex terminations) thin film chip resistor arrays combine the proven reliability of precision thin film chip resistor products with the advantages of chip resistor arrays. Defined tolerance matching and TCR tracking make 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.

FEATURES

- Advanced thin film technology
- Two pairs or four equal resistor values
- TCR tracking down to 10 ppm/K (± 5 ppm/K)
- Tolerance matching down to 0.1 % (± 0.05 %)
- Pure Sn termination on Ni barrier layer
- Compliant to RoHS directive 2002/95/EC

RoHS COMPLIANT

APPLICATIONS

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

TECHNICAL SPECIFICATIONS	
DESCRIPTION	**ACAC 0612, ACAS 0612**
EIA size	0612
Metric size	RR 1632M
Configuration, isolated	4 x 0603
Design: All equal Two pairs	 AE TP
Resistance values	47 Ω to 221 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 $R_{min.}/R_{max.}$	1:5
Rated dissipation: P_{70} (3) Element Package, 4 x 0603	 0.1 W 0.3 W
Operating voltage	75 V
Permissibe film temperature	125 °C (4)
Insulation voltage (U_{ins}) against ambient and between isolated 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) Please refer to APPLICATION INFORMATION, see below

(4) For higher max. film temperature and AEC-Q200 qualification please refer to data sheet ACAS 0606 AT, ACAS 0612 AT - Precision available on our web site at www.vishay.com/doc?28770

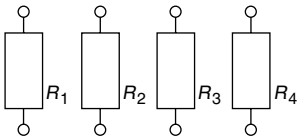
APPLICATION INFORMATION

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	**ACAC 0612, ACAS 0612**	
Configuration, isolated	4 x 0603	
Operation mode	Precision	Standard
Rated power per element, P_{70}	0.032 W	0.1 W
Rated power per packaging, P_{70}	0.1 W	0.3 W
Film temperature	85 °C	125 °C
Operating voltage, $U_{max.}$ AC/DC	25 V	75 V
Max. resistance change at P_{70} $\Delta R/R$ max., after:		
1000 h	± 0.1 %	± 0.25 %
8000 h	± 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)
8000 h	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



ACAC 0612, ACAS 0612

DESIGN	
TYPE	**ACAC 0612, ACAS 0612**
AE	$R_1 = R_2 = R_3 = R_4$
TP	$R_1 = R_4 < R_2 = R_3$

PART NUMBER AND PRODUCT DESCRIPTION (1)

PART NUMBER: ACASA1100A2200P500

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

MODEL	TERMINAL	SIZE	RESISTANCE VALUE (2)	ACCURACY GRADE (3)	RESISTANCE VALUE (2)	PACKAGING (4)	SPECIAL
ACA	**C** = Concave **S** = Convex square	**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_2, R_3** **1 digit multiplier** MULTIPLIER **9** = $*10^{-1}$ **0** = $*10^{0}$ **1** = $*10^{1}$ **2** = $*10^{2}$ **3** = $*10^{3}$	**P1** **P5**	**00** = Standard

PRODUCT DESCRIPTION: ACAS 0612 110R A 220R P5

ACA	S	0612	110R	A	220R	P5
MODEL	TERMINATION	SIZE	RESISTANCE VALUE R_1, R_4 (2)	ACCURACY GRADE (3)	RESISTANCE VALUE R_2, R_3 (2)	PACKAGING (4)
ACA = Chip array	**C** = Concave **S** = Convex square	**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	**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) Please refer to table TEMPERATURE COEFFICIENT AND RESISTANCE RANGE, see below

(4) Please refer to table PACKAGING, see next page

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE

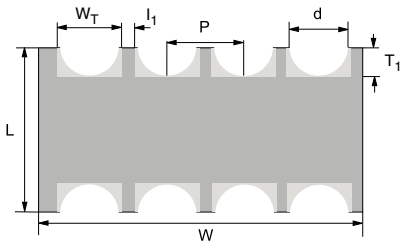
DESCRIPTION					RESISTANCE VALUE
ACCURACY GRADE	ABSOLUTE TCR	TCR TRACKING (5)	ABSOLUTE TOLERANCE	TOLERANCE MATCHING (5)	ACAC 0612, ACAS 0612
A	± 25 ppm/K	10 ppm/K	± 0.25 %	0.1 %	47 Ω to 221 kΩ
B	± 25 ppm/K	10 ppm/K	± 0.5 %	0.25 %	47 Ω to 221 kΩ
E	± 25 ppm/K	15 ppm/K	± 0.25 %	0.1 %	47 Ω to 221 kΩ
F	± 25 ppm/K	15 ppm/K	± 0.5 %	0.25 %	47 Ω to 221 kΩ
J	± 25 ppm/K	25 ppm/K	± 0.25 %	0.1 %	47 Ω to 221 kΩ
K	± 25 ppm/K	25 ppm/K	± 0.5 %	0.25 %	47 Ω to 221 kΩ
N	± 50 ppm/K	25 ppm/K	± 0.5 %	0.5 %	47 Ω to 221 kΩ
P	± 50 ppm/K	50 ppm/K	± 0.5 %	0.5 %	47 Ω to 221 kΩ

Note

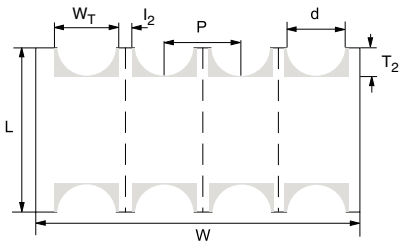
(5) Please refer to TECHNICAL SPECIFICATIONS, Note (2), see above

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

DIMENSIONS ACAC 0612



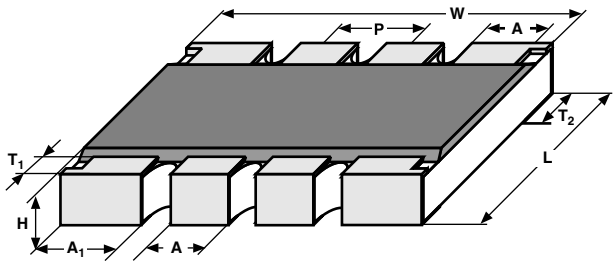
Top view



Bottom view

DIMENSIONS - Chip resistor array, mass and relevant physical dimensions											
TYPE	L (mm)	W (mm)	H (mm)	P (mm)	W_T (mm)	T_1 (mm)	T_2 (mm)	d (mm)	l_1 (mm)	l_2 (mm)	MASS (mg)
ACAC 0612	1.6 ± 0.15	3.2 ± 0.15	0.55 ± 0.1	0.8 ± 0.1	0.5 ± 0.15	0.3 ± 0.15	0.4 ± 0.15	0.3 ± 0.1	min. 0.15	min. 0.25	9.6

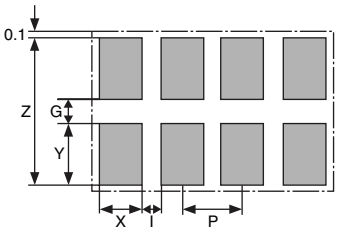
DIMENSIONS ACAS 0612



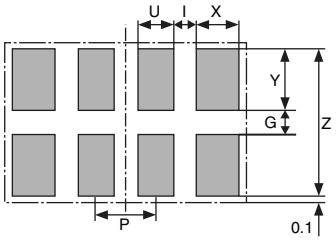
DIMENSIONS - Chip resistor array, mass and relevant physical dimensions									
TYPE	L (mm)	W (mm)	H (mm)	P (mm)	A_1 (mm)	A (mm)	T_1 (mm)	T_2 (mm)	MASS (mg)
ACAS 0612	1.5 ± 0.15	3.2 ± 0.15	0.45 ± 0.1	0.8 ± 0.1	0.6 ± 0.1	0.4 ± 0.1	0.3 ± 0.15	0.4 ± 0.15	6.6

PATTERN STYLES FOR CHIP RESISTOR ARRAYS

ACAC 0612



ACAS 0612



Dimensions in mm
limits for solder resist

RECOMMENDED SOLDER PAD DIMENSIONS FOR CHIP RESISTOR ARRAYS

TYPE	G (mm)	Y (mm)	X (mm)	U (mm)	Z (mm)	I (mm)	P (mm)
ACAC 0612	0.7	0.7	0.5	-	2.1	0.3	0.8
ACAS 0612	0.7	0.7	0.64	0.5	2.1	0.3	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]. For ACAC resistor arrays automatic soldering using wave can also be used. 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)

TESTS

Where applicable, the resistors are tested in accordance with **EN 140401-801** which refers to **EN 60115-1** and **EN 140400**.

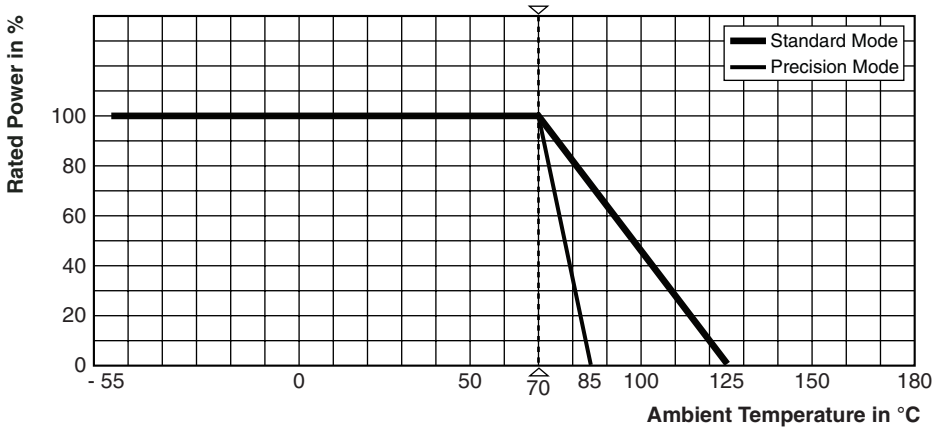
Notes

(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 → policy → environmental policy group → chemicals → jig → Joint Industry Guide (JIG-101 Ed 2.0)

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

FUNCTIONAL PERFORMANCE



For permissible resistance change please refer to table MAXIMUM RESISTANCE CHANGE AT RATED POWER

Derating

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** (1) and under standard atmospheric conditions according to **IEC 60068-1** (1), 5.3. Climatic category LCT/UCT/56 (rated temperature range: Lower Category Temperature, Upper Category Temperature; damp heat, long term, 56 days) is valid (LCT = - 55 °C/UCT = 125 °C).

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 (1) TEST METHOD	TEST	PROCEDURE	REQUIREMENTS (2) PERMISSIBLE CHANGE (ΔR)
			Stability for product types:	
			ACAC 0612	47 Ω to 221 kΩ
			ACAS 0612	47 Ω to 221 kΩ
4.5	-	Resistance	-	± 0.5 % *R*; ± 0.25 % *R*
4.8.4.2	-	Temperature coefficient	At (20/-55/20) °C and (20/125/20) °C	± 50 ppm/K; ± 25 ppm/K

TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2 (1) TEST METHOD	TEST	PROCEDURE	REQUIREMENTS (2) PERMISSIBLE CHANGE (ΔR)
			Stability for product types: **ACAC 0612** **ACAS 0612**	 47 Ω to 221 kΩ 47 Ω to 221 kΩ
4.25.1	-	Endurance at 70 °C: Precision operation mode	$U = \sqrt{P_{70} \times R}$ or U = Umax.; 1.5 h on; 0.5 h off; 1000 h: Absolute Relative (3) 8000 h: Absolute Relative (3)	 ± (0.1 % R + 0.05 Ω) 0.1 % R + 0.05 Ω ± (0.25 % R + 0.05 Ω) 0.25 % R + 0.05 Ω
		Endurance at 70 °C: Standard operation mode	$U = \sqrt{P_{70} \times R}$ or U = Umax.; 1.5 h on; 0.5 h off; 1000 h: Absolute Relative (3) 8000 h: Absolute Relative (3)	 ± (0.25 % R + 0.05 Ω) 0.25 % R + 0.05 Ω ± (0.5 % R + 0.05 Ω) 0.5 % R + 0.05 Ω
4.25.3	-	Endurance at upper category temperature	85 °C; 1000 h: Absolute Relative (3) 125 °C; 1000 h: Absolute Relative (3)	 ± (0.1 % R + 0.05 Ω) 0.1 % R + 0.05 Ω ± (0.25 % R + 0.05 Ω) 0.25 % R + 0.05 Ω
4.24	78 (Cab)	Damp heat, steady state	(40 ± 2) °C; 56 days; (93 ± 3) % RH	± (0.25 % R + 0.05 Ω)
4.13	-	Short time overload (4)	$U = 2.5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max.}$; 5 s	± (0.1 % R + 0.01 Ω) no visible damage
4.19	14 (Na)	Rapid change of temperature	30 min at - 55 °C and 30 min at 125 °C; 5 cycles	± (0.1 % R + 0.01 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 ageing 4 h/155 °C (215 ± 3) °C; (3 ± 0.3) s Solder bath method; SnAgCu; non-activated flux accelerated ageing 4 h/155 °C (235 ± 3) °C; (2 ± 0.2) s	Good tinning (≥ 95 % covered); no visible damage

TEST PROCEDURES AND REQUIREMENTS				
EN 60115-1 CLAUSE	**IEC 60068-2 (1) TEST METHOD**	**TEST**	**PROCEDURE**	**REQUIREMENTS (2) PERMISSIBLE CHANGE (ΔR)**
			Stability for product types: **ACAC 0612** **ACAS 0612**	 47 Ω to 221 kΩ 47 Ω to 221 kΩ
4.32	21 (Ue_3)	Shear (adhesion)	45 N	No visible damage
4.33	21 (Ue_1)	Substrate bending	Depth 2 mm, 3 times	± (0.1 % R + 0.01 Ω) no visible damage; no open circuit in bent position
4.7	-	Voltage proof	$U_{RMS} = U_{ins}$ (60 ± 5) s; against ambient, between adjacent resistors	No flashover or breakdown

Notes

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

(2) Figures are given for arrays with equal values, design type AE

(3) Relative values are equivalent to the half of its value with ± symbol, i.e. 0.1 % is equivalent to ± 0.05 %

(4) For a single element

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