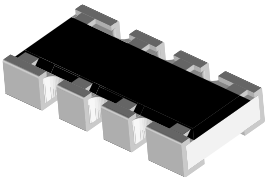
## Precision Thin Film Chip Resistor Array



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:<br>All equal<br>Two pairs | <br>AE<br>TP |
| Resistance values | 47 Ω to 221 kΩ (1) |
| Absolute tolerance | ± 0.5 %; ± 0.25 % |
| Tolerance matching (2) | 0.5 % (equivalent to ± 0.25 %)<br>0.25 % (equivalent to ± 0.125 %)<br>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)<br>25 ppm/K (equivalent to ± 12.5 ppm/K)<br>15 ppm/K (equivalent to ± 7.5 ppm/K)<br>10 ppm/K (equivalent to ± 5 ppm/K) |
| Max. resistance ratio $R_{min.}/R_{max.}$ | 1:5 |
| Rated dissipation: $P_{70}$ (3)<br>Element<br>Package, 4 x 0603 | <br>0.1 W<br>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

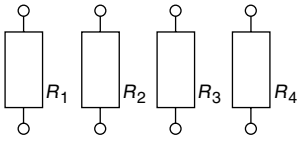
## APPLICATION INFORMATION

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<br>**S** = Convex square | **A** = 0612 | **3 digit resistance value $R_1$, $R_4$**<br>**1 digit multiplier**<br>MULTIPLIER<br>**9** = $*10^{-1}$<br>**0** = $*10^{0}$<br>**1** = $*10^{1}$<br>**2** = $*10^{2}$<br>**3** = $*10^{3}$ | TCR, tracking, tolerance and matching<br>**A, B, E, F, J, K, N** or **P** | **3 digit resistance value $R_2$, $R_3$**<br>**1 digit multiplier**<br>MULTIPLIER<br>**9** = $*10^{-1}$<br>**0** = $*10^{0}$<br>**1** = $*10^{1}$<br>**2** = $*10^{2}$<br>**3** = $*10^{3}$ | **P1**<br>**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<br>**S** = Convex square | **0612** | **110R** = 110 Ω<br>**1K1** = 1.1 kΩ<br>**22K1** = 22.1 kΩ | TCR, tracking, tolerance and matching<br>**A, B, E, F, J, K, N** or **P** | **220R** = 220 Ω<br>**1K1** = 1.1 kΩ<br>**22K1** = 22.1 kΩ | **P1**<br>**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

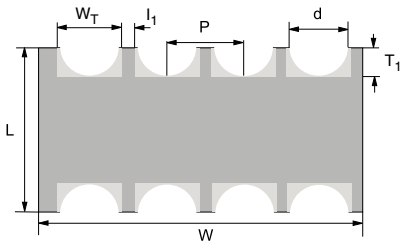
| DESCRIPTION | | | | | RESISTANCE VALUE |
|---|---|---|---|---|---|
| ACCURACY GRADE | ABSOLUTE TCR | TCR TRACKING (5) | ABSOLUTE TOLERANCE | TOLERANCE MATCHING (5) | ACAC 0612, ACAS 0612 |
| A | ± 25 ppm/K | 10 ppm/K | ± 0.25 % | 0.1 % | 47 Ω to 221 kΩ |
| B | ± 25 ppm/K | 10 ppm/K | ± 0.5 % | 0.25 % | 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**

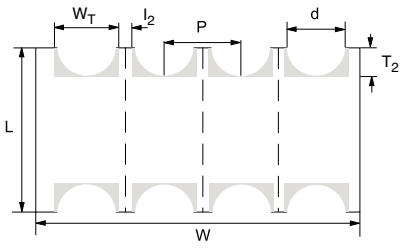
(5) Please refer to TECHNICAL SPECIFICATIONS, Note (2), see above

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

## DIMENSIONS ACAC 0612



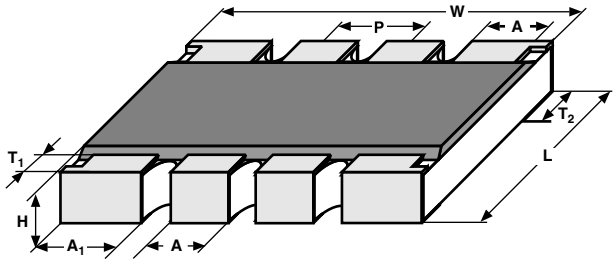

Top view




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) | $I_1$ (mm) | $I_2$ (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 |

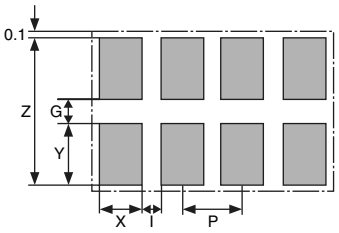
## DIMENSIONS ACAS 0612



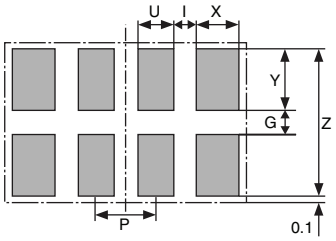

| DIMENSIONS - Chip resistor array, mass and relevant physical dimensions | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| TYPE | L (mm) | W (mm) | H (mm) | P (mm) | $A_1$ (mm) | A (mm) | $T_1$ (mm) | $T_2$ (mm) | MASS (mg) |
| ACAS 0612 | 1.5 ± 0.15 | 3.2 ± 0.15 | 0.45 ± 0.1 | 0.8 ± 0.1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

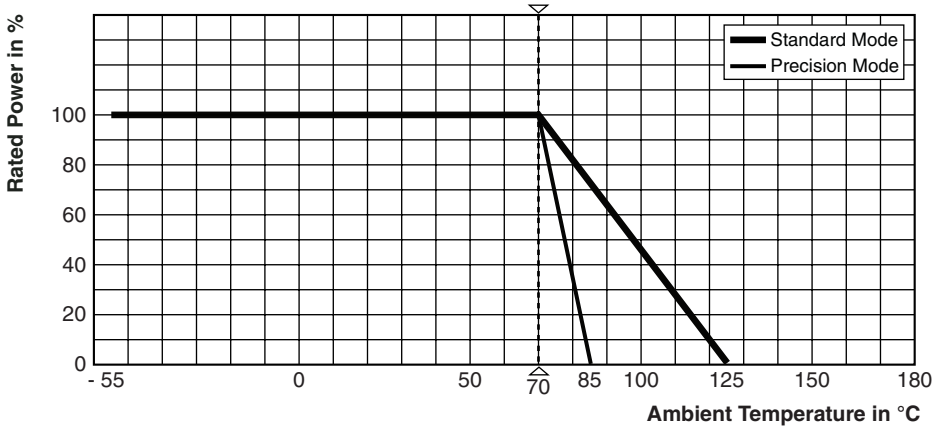
**Notes**

(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 ($\Delta R$) |
|---|---|---|---|---|
| | | | 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 ($\Delta R$) |
|---|---|---|---|---|
| | | | Stability for product types:<br>**ACAC 0612**<br>**ACAS 0612** | <br>47 Ω to 221 kΩ<br>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;<br>1000 h:<br>Absolute<br>Relative (3)<br>8000 h:<br>Absolute<br>Relative (3) | <br><br>± (0.1 % $R$ + 0.05 Ω)<br>0.1 % $R$ + 0.05 Ω<br><br>± (0.25 % $R$ + 0.05 Ω)<br>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;<br>1000 h:<br>Absolute<br>Relative (3)<br>8000 h:<br>Absolute<br>Relative (3) | <br><br>± (0.25 % $R$ + 0.05 Ω)<br>0.25 % $R$ + 0.05 Ω<br><br>± (0.5 % $R$ + 0.05 Ω)<br>0.5 % $R$ + 0.05 Ω |
| 4.25.3 | - | Endurance at upper category temperature | 85 °C; 1000 h:<br>Absolute<br>Relative (3)<br>125 °C; 1000 h:<br>Absolute<br>Relative (3) | <br>± (0.1 % $R$ + 0.05 Ω)<br>0.1 % $R$ + 0.05 Ω<br><br>± (0.25 % $R$ + 0.05 Ω)<br>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)<br>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)<br>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)<br>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<br>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 ($\Delta R$)** |
| | | | Stability for product types:<br>**ACAC 0612**<br>**ACAS 0612** | <br>47 Ω to 221 kΩ<br>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)<br>no visible damage;<br>no open circuit in bent position |
| 4.7 | - | Voltage proof | $U_{RMS} = U_{ins}$<br>(60 ± 5) s; against ambient,<br>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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