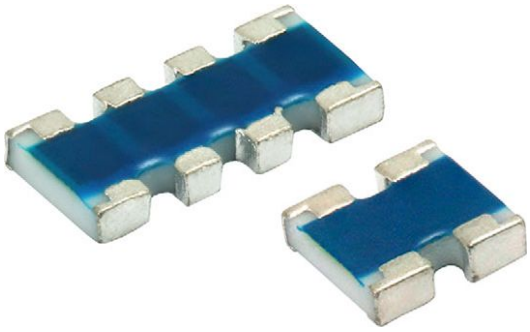
Precision Thin Film Chip Resistor Array
Superior Moisture Resistivity



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 relative tolerance (matching) and relative TCR (tracking) make this product perfectly suited for applications with outstanding requirements towards stable fixed resistor ratios. The ACAS AT is available with equal or different resistor values. Find out more about Vishay Automotive Grade product requirements at: www.vishay.com/doc?49924

FEATURES

- Superior moisture resistivity, $|\Delta R/R| < 0.5$ % (85 °C; 85 % RH; 1000 h)
- Rated dissipation P_{70} up to 125 mW per resistor
- ESD stability 1000 V, human body model
- Relative TCR down to ± 5 ppm/K (tracking)
- Relative tolerance down to ± 0.05 % (matching)
- AEC-Q200 qualified
- Advanced sulfur resistance verified according to ASTM B 809
- Different resistance values freely selectable
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

APPLICATIONS

- Automotive
- Industrial equipment
- Precision analogue circuits
- Voltage divider
- Feedback circuits
- Signal conditioning

TECHNICAL SPECIFICATIONS

DESCRIPTION	ACAS 0606 AT	ACAS 0612 AT
Imperial size	0606	0612
Metric size code	RR1616M	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 range	47 Ω to 150 kΩ (1)	
Absolute tolerance	± 0.1 %	
Relative tolerance	± 0.05 %	
Absolute temperature coefficient	± 25 ppm/K; ± 15 ppm/K; ± 10 ppm/K	
Relative temperature coefficient	± 15 ppm/K; ± 10 ppm/K; ± 5 ppm/K	
Max. resistance ratio $R_{min.}/R_{max.}$	1:100	
Rated dissipation: P_{70} (2) Element Package	 0.125 W 0.2 W	 0.125 W 0.4 W
Operating voltage, $U_{max.}$ AC_{RMS}/DC	100 V	
Permissible film temperature, $\vartheta_{F\ max.}$ (2)	155 °C	
Operating temperature range	-55 °C to 155 °C	
Internal thermal resistance (2)	39 K/W	20 K/W
Insulation voltage (U_{ins}) against ambient and between integrated resistors, continuous	100 V	

Notes

- The relative figures of tolerance, TCR and drift are related to a medial axis between the maximum and minimum permissible deviation of the resistor array. For detailed information please refer to the application note: Increasing Accuracy in Feedback Circuits and Voltage Dividers with Thin Film Chip Resistor Arrays (www.vishay.com/doc?28194)

(1) Resistance values to be selected from E24; E192

(2) Please refer to APPLICATION INFORMATION

For technical questions, contact: thinfilmarray@vishay.com

APPLICATION INFORMATION

When the resistor dissipates power, a temperature rise above the ambient temperature occurs, dependent on the thermal resistance of the assembled resistor together with the printed circuit board. The rated dissipation applies only if the permitted film temperature is not exceeded.

Please consider the application note “Thermal Management in Surface-Mounted Resistor Applications” (www.vishay.com/doc?28844) for information on the general nature of thermal resistance.

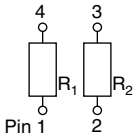
These resistors do not feature a limited lifetime when operated within the permissible limits. However, resistance value drift increasing over operating time may result in exceeding a limit acceptable to the specific application, thereby establishing a functional lifetime.

MAXIMUM RESISTANCE CHANGE AT RATED DISSIPATION			
OPERATION MODE		**STANDARD**	**POWER**
Rated dissipation per element, P_{70}	**ACAS 0606 AT**	0.100 W	0.125 W
	ACAS 0612 AT	0.100 W	0.125 W
Rated dissipation per packaging, P_{70}	**ACAS 0606 AT**	0.150 W	0.200 W
	ACAS 0612 AT	0.300 W	0.400 W
Operating temperature range		-55 °C to 125 °C	-55 °C to 155 °C
Permissible film temperature, $\vartheta_{F\ max.}$		125 °C	155 °C
Max. resistance change at P_{70} for resistance range, $\lvert\Delta R/R\rvert$ after:	**ACAS 0606 AT**	47 Ω to 150 kΩ	47 Ω to 150 kΩ
	ACAS 0612 AT	47 Ω to 150 kΩ	47 Ω to 150 kΩ
	1000 h	≤ 0.1 %	≤ 0.25 %
	8000 h	≤ 0.25 %	≤ 0.5 %
Max. relative resistance change (relative drift) at P_{70} for resistance range, $\lvert\Delta R/R\rvert$ after:	**ACAS 0606 AT**	47 Ω to 150 kΩ	47 Ω to 150 kΩ
	ACAS 0612 AT	47 Ω to 150 kΩ	47 Ω to 150 kΩ
	1000 h	≤ 0.05 %	≤ 0.125 %
	8000 h	≤ 0.125 %	≤ 0.25 %

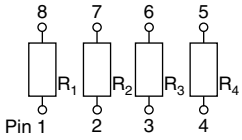
Notes

- Figures are given for arrays with equal values, design type AE
- The presented operation modes do not refer to different types of resistors, but actually show examples of different loads, that lead to different film temperatures and different achievable load-life stability (drift) of the resistance value. A suitable low thermal resistance of the circuit board assembly must be safeguarded in order to maintain the film temperature of the resistors within the specified limits. Please consider the application note “Thermal Management in Surface-Mounted Resistor Applications” (www.vishay.com/doc?28844) for information on the general nature of thermal resistance.

CIRCUITS



ACAS 0606 AT



ACAS 0612 AT

Marking on ACAS 0606 AT: for types with different resistor values pin 1 is marked.

DESIGN		
	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	$R_1 < R_2$	

Note

- Customized ACAS 0612 AT with four different ohmic values on request

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE

TYPE / SIZE	ACCURACY GRADE	ABSOLUTE		RELATIVE		RESISTANCE
		TCR	TOLERANCE	TCR	TOLERANCE	
ACAS 0606 AT ACAS 0612 AT	S	± 25 ppm/K	± 0.1 %	± 15 ppm/K	± 0.05 %	47 Ω to 150 kΩ
	T	± 15 ppm/K	± 0.1 %	± 10 ppm/K	± 0.05 %	47 Ω to 150 kΩ
	U	± 10 ppm/K	± 0.1 %	± 5 ppm/K	± 0.05 %	47 Ω to 100 kΩ

Notes

- Relative TCR down to ± 2.5 ppm/K on request
- Relative tolerance for resistance values < 80 Ω on request
- Resistance ratios $R_{min.}/R_{max.}$ higher than 1:20 only available up to 100 kΩ per element for accuracy grade S

PACKAGING

TYPE / SIZE	CODE	QUANTITY	PACKAGING STYLE	WIDTH	PITCH	PACKAGING DIMENSIONS
ACAS 0606 AT ACAS 0612 AT	P1	1000	Paper tape according IEC 60286-3, Type 1a	8 mm	4 mm	Ø 180 mm / 7"
	P5	5000				

PART NUMBER AND PRODUCT DESCRIPTION

Part Number: ACASA1100S2200P5AT

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

TYPE	TERMINAL	SIZE	RESISTANCE (1)	ACCURACY GRADE	RESISTANCE (1)	PACKAGING	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 **S**, **T**, or **U**	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**	**AT** = automotive

Product Description: ACAS 0612 110R S 220R AT P5

ACA	S	0612	110R	S	220R	AT	P5
TYPE	TERMINAL	SIZE	RESISTANCE R_1, R_4 (1)	ACCURACY GRADE	RESISTANCE R_2, R_3 (1)	SPECIAL	PACKAGING
ACA = chip array	**S** = convex square	**0606** **0612**	**110R** = 110 Ω **1K1** = 1.1 kΩ **22K1** = 22.1 kΩ	TCR, tracking, tolerance and matching **S**, **T**, or **U**	**220R** = 220 Ω **1K1** = 1.1 kΩ **22K1** = 22.1 kΩ	**AT** = automotive	**P1** **P5**

Notes

- Products can be ordered using either the PART NUMBER or the PRODUCT DESCRIPTION

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

DESCRIPTION

Production 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 ceramic substrate (Al_2O_3) using a mask to separate the adjacent resistors and conditioned to achieve the desired temperature coefficient. Specially designed inner contacts are deposited 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 matte 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, Type 1a** [(1)].

ASSEMBLY

The resistors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using reflow or vapor phase as shown in **IEC 61760-1** [(1)]. 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, potting compounds and their processes, 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 matte 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.

MATERIALS

Vishay acknowledges the following systems for the regulation of hazardous substances:

- IEC 62474, Material Declaration for Products of and for the Electrotechnical Industry, with the list of declarable substances given therein [(2)]
- The Global Automotive Declarable Substance List (GADSL) [(3)]
- The REACH regulation (1907/2006/EC) and the related list of substances with very high concern (SVHC) [(4)] for its supply chain

The products do not contain any of the banned substances as per IEC 62474, GADSL, or the SVHC list, see www.vishay.com/how/leadfree.

Hence the products fully comply with the following directives:

- 2000/53/EC End-of-Life Vehicle Directive (ELV) and Annex II (ELV II)
- 2011/65/EU Restriction of the Use of Hazardous Substances Directive (RoHS) with amendment 2015/863/EU
- 2012/19/EU Waste Electrical and Electronic Equipment Directive (WEEE)

Vishay pursues the elimination of conflict minerals from its supply chain, see the Conflict Minerals Policy at www.vishay.com/doc?49037.

APPROVALS

Where applicable the resistors are tested within the IECQ-CECC Quality Assessment System for Electronic Components to the detail specification **EN 140401-801** which refers to **EN 60115-1**, **EN 60115-8**, and the variety of environmental test procedures of the **IEC 60068** [(1)] series. The detail specification refers to the climatic categories 55/125/56.

Vishay Beyschlag has achieved **"Approval of Manufacturer"** in accordance with **IECQ 03-1**. The release certificate for **"Technology Approval Schedule"** in accordance with **CECC 240001** based on **IECQ 03-3-1** is granted for the Vishay BEYSCHLAG manufacturing process.

The resistor arrays are qualified according to AEC-Q200.

RELATED PRODUCTS

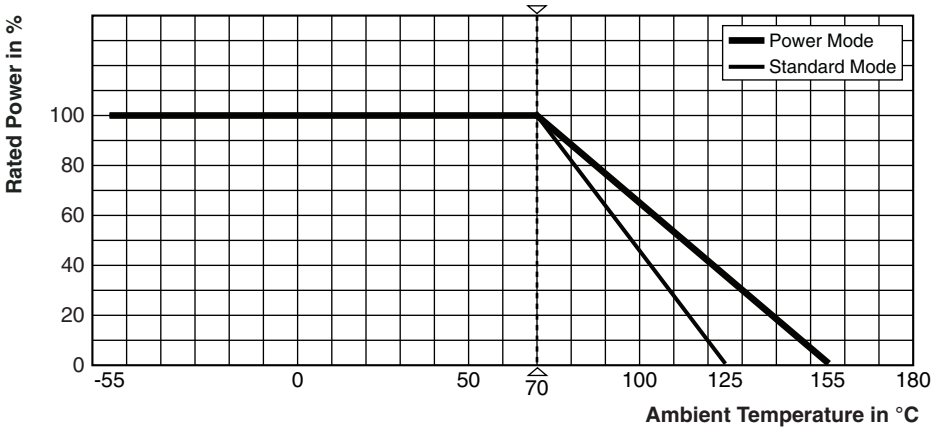
For automotive products with gold terminations for conductive gluing see the datasheet:

- Precision Gold Terminated Thin Film Chip Resistor Arrays for Conductive Gluing (www.vishay.com/doc?28876)

Notes

(1) The quoted IEC standards are also released as EN standards with the same number and identical contents
(2) The IEC 62474 list of declarable substances is maintained in a dedicated database, which is available at http://std.iec.ch/iec62474
(3) The Global Automotive Declarable Substance List (GADSL) is maintained by the American Chemistry Council and available at www.gadsl.org
(4) The SVHC list is maintained by the European Chemical Agency (ECHA) and available at http://echa.europa.eu/candidate-list-table

FUNCTIONAL PERFORMANCE



Derating

TESTS AND REQUIREMENTS

All tests are carried out in accordance with the following specifications:

EN 60115-1, generic specification

EN 60115-8 (successor of EN 140400), sectional specification

EN 140401-801, detail specification

IEC 60068-2-xx, test methods

The parameters stated in the Test Procedures and Requirements table are based on the required tests and permitted limits of EN 140401-801. The table presents only the most important tests, for the full test schedule refer to the documents listed above. However, some additional tests and a number of improvements against those minimum requirements have been included.

The testing also covers most of the requirements specified by EIA/ECA-703 and JIS-C-5201-1.

The tests are carried out under standard atmospheric conditions in accordance with IEC 60068-1, 4.3, whereupon the following values are applied:

Temperature: 15 °C to 35 °C

Relative humidity: 25 % to 75 %

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

A climatic category LCT / UCT / 56 is applied, defined by the lower category temperature (LCT), the upper category temperature (UCT), and the duration of exposure in the damp heat, steady state test (56 days).

The components are mounted for testing on printed circuit boards in accordance with EN 60115-8, 2.4.2, unless otherwise specified.

TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2 (1) TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (2) (ΔR)
			Stability for product types:	
			ACAS 0606 AT **ACAS 0612 AT**	47 Ω to 150 kΩ 47 Ω to 150 kΩ
4.5	-	Resistance	-	± 0.1 %
4.8	-	Temperature coefficient	At (20/-55/ 20) °C and (20/155/20) °C	± 25 ppm/K; ± 15 ppm/K; ± 10 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; whichever is the less severe; 1000 h: Absolute Relative 8000 h: Absolute Relative	 ± (0.1 % R + 0.05 Ω) ± (0.05 % R + 0.05 Ω) ± (0.25 % R + 0.05 Ω) ± (0.125 % 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; whichever is the less severe; 1000 h: Absolute Relative 8000 h: Absolute Relative	 ± (0.25 % R + 0.05 Ω) ± (0.125 % R + 0.05 Ω) ± (0.5 % R + 0.05 Ω) ± (0.25 % R + 0.05 Ω)
4.25.3	-	Endurance at upper category temperature	125 °C; 1000 h: Absolute Relative 125 °C; 8000 h: Absolute Relative 155 °C; 1000 h: Absolute Relative	 ± (0.25 % R + 0.05 Ω) ± (0.125 % R + 0.05 Ω) ± (0.5 % R + 0.05 Ω) ± (0.25 % R + 0.05 Ω) ± (0.4 % R + 0.05 Ω) ± (0.2 % 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)

TEST PROCEDURES AND REQUIREMENTS				
EN 60115-1 CLAUSE	**IEC 60068-2 (1) TEST METHOD**	**TEST**	**PROCEDURE**	**REQUIREMENTS PERMISSIBLE CHANGE (2) (ΔR)**
			Stability for product types: **ACAS 0606 AT** **ACAS 0612 AT**	 47 Ω to 150 kΩ 47 Ω to 150 kΩ
4.37	67 (Cy)	Damp heat, steady state, accelerated	(85 ± 2) °C (85 ± 5) % RH $U = \sqrt{0.1 \times P_{70} \times R}$; $U \leq 0.3 \times U_{max.}$; 1000 h	± (0.5 % R + 0.05 Ω)
4.13	-	Short time overload (3) Standard operation mode	$U = 2.5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max.}$; 5 s	± (0.1 % R + 0.01 Ω) no visible damage
4.38	-	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 -55 °C and 30 min at 125 °C; 1000 cycles	± (0.25 % R + 0.05 Ω) no visible damage
4.18	58 (Td)	Resistance to soldering heat	Reflow method 2 (IR/forced gas convection); (260 ± 5) °C; (10 ± 1) s	± (0.1 % R + 0.01 Ω) no visible damage
4.17	58 (Td)	Solderability	Solder bath method; SnPb; non-activated flux accelerated aging 4 h/155 °C (215 ± 3) °C; (3 ± 0.3) s Solder bath method; SnAgCu; non-activated flux accelerated aging 4 h/155 °C (235 ± 3) °C; (2 ± 0.2) s	Good tinning (≥ 95 % covered); no visible damage
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
4.35	-	Flammability	IEC 60695-11-5, needle flame test; 10 s	No burning after 30 s
4.22	6 (Fc)	Vibration	Endurance by sweeping; 10 Hz to 2000 Hz; no resonance; amplitude ≤ 1.5 mm or ≤ 200 m/s^2; 7.5 h	± (0.1 % R + 0.01 Ω) no visible damage
4.7	-	Voltage proof	$U_{RMS} = U_{ins}$ 60 s ± 5 s; against ambient, between adjacent resistors	No flashover or breakdown

Notes

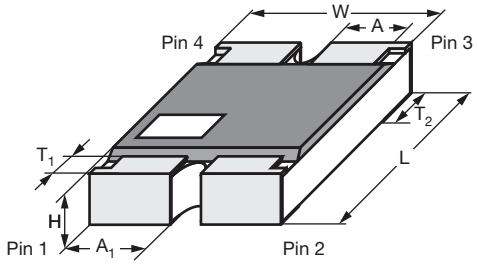
(1) The quoted IEC standards are also released as EN standards with the same number and identical contents

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

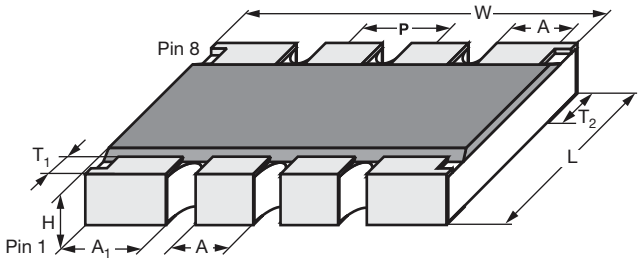
(3) For a single element

DIMENSIONS

ACAS 0606 AT

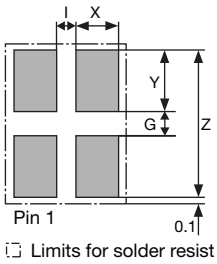


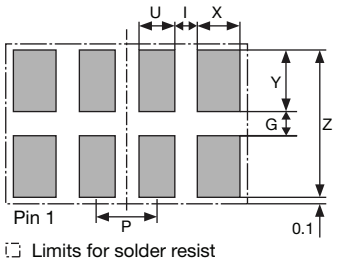
ACAS 0612 AT



DIMENSION AND MASS									
TYPE / SIZE	L (mm)	W (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 ± 0.1	0.4 ± 0.1	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 ± 0.1	0.4 ± 0.1	0.3 ± 0.15	0.4 ± 0.15	6.8

PATTERN STYLES FOR CHIP RESISTOR ARRAYS





Dimensions in mm

RECOMMENDED SOLDER PAD DIMENSIONS							
TYPE / SIZE	G (mm)	Y (mm)	X (mm)	U (mm)	Z (mm)	I (mm)	P (mm)
ACAS 0606 AT	0.7	0.7	0.64	-	2.1	0.3	0.8
ACAS 0612 AT	0.7	0.7	0.64	0.5	2.1	0.3	0.8

Notes

- The given solder pad dimensions reflect the considerations for board design and assembly as outlined e.g. in standards IEC 61188-5-x [(1)], or in publication IPC-7351

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

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