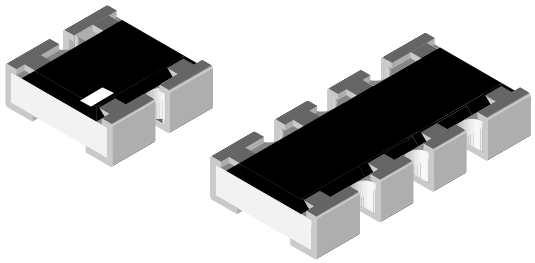
# Precision Thin Film Chip Resistor Array
# Superior Moisture Resistivity



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's automotive grade product requirements at: www.vishay.com/applications

## FEATURES

AUTOMOTIVE GRADE

Pb RoHS COMPLIANT

- 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
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912

## 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 | RR1616M | RR1632M |
| Configuration, isolated | 2 x 0603 | 4 x 0603 |
| Design:<br>All equal values (AE)<br>Two pairs of values (TP)<br>Different values (DF) | <br>AE<br><br>DF | <br>AE<br>TP<br> |
| Resistance values | 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 $R_{min.}/R_{max.}$ | 1:20 | |
| Rated dissipation: $P_{70}$<br>Element<br>Package | <br>0.125 W<br>0.2 W | <br>0.125 W<br>0.4 W |
| Operating voltage, $U_{max.}$ AC/DC | 75 V | |
| Operating temperature range | - 55 °C to 155 °C | |
| Permissible film temperature | 155 °C | |
| Insulation voltage ($U_{ins}$) against ambient and between integrated resistors, continuous | 75 V | |

**Notes**

- The relative figures of tolerance, TCR and drift are related to a medial axis between the maximum and minimum permissable 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.



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## APPLICATION INFORMATION

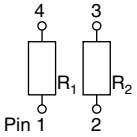
The power dissipation on the resistor generates a temperature rise against the local ambient, depending on the heat flow support of the printed-circuit board (thermal resistance). The rated dissipation applies only if the permitted film temperature is not exceeded. These resistors do not feature a limited 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 | ± 0.05 % | ± 0.125 % | ± 0.05 % | ± 0.125 % |
| | 8000 h | ± 0.125 % | ± 0.25 % | ± 0.125 % | ± 0.25 % |

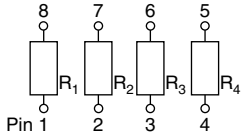
**Note**

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

## 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 | $R_1 < R_2$ | |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## 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| MODEL/ SIZE | TERMINAL | SIZE | RESISTANCE (1) | ACCURACY GRADE (2) | RESISTANCE (1) | PACKAGING | Special |
|---|---|---|---|---|---|---|---|
| **ACA** | **S** = Convex square | **N** = 0606<br>**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>**S**, **T**, or **U** | **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** | **AT** = Automotive |

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

| ACA | S | 0612 | 110R | S | 220R | AT | P5 |
|---|---|---|---|---|---|---|---|
| MODEL/ SIZE | TERMINAL | SIZE | RESISTANCE $R_1$, $R_4$ (1) | ACCURACY GRADE (2) | RESISTANCE $R_2$, $R_3$ (1) | SPECIAL | PACKAGING |
| **ACA** = Chip Array | **S** = Convex square | **0606**<br>**0612** | **110R** = 110 Ω<br>**1K1** = 1.1 kΩ<br>**22K1** = 22.1 kΩ | TCR, Tracking, Tolerance and Matching<br>**S**, **T**, or **U** | **220R** = 220 Ω<br>**1K1** = 1.1 kΩ<br>**22K1** = 22.1 kΩ | **AT** = Automotive | **P1**<br>**P5** |

**Notes**

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

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

(2) For historical temperature coefficient and resistance ranges please refer to the end of the data sheet.

## TEMPERATURE COEFFICIENT AND RESISTANCE RANGE

| TYPE | ACCURACY GRADE | ABSOLUTE | | RELATIVE | | RESISTANCE VALUE |
|---|---|---|---|---|---|---|
| | | TCR | TOLERANCE | TCR | TOLERANCE | |
| ACAS 0606 AT<br>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**

- For historical temperature coefficent and resistance range please refer to the end of the data sheet.
- Relative TCR (tracking) down to ± 2.5 ppm/K on request.
- Relative tolerance for resistance values < 80 Ω on request.



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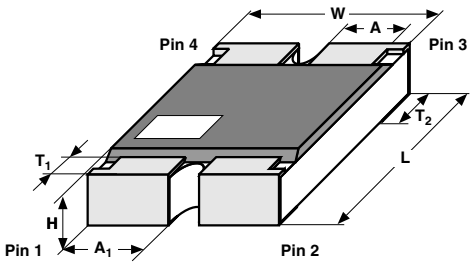
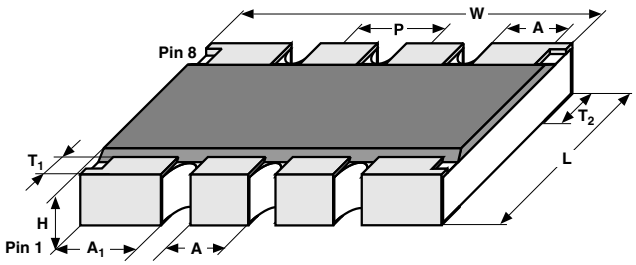
| PACKAGING | | | | | | |
|---|---|---|---|---|---|---|
| TYPE | CODE | QUANTITY | PACKAGING STYLE | WIDTH | PITCH | REEL DIAMETER |
| ACAS 0606 AT<br>ACAS 0612 AT | P1 | 1000 | Tape and reel cardboard tape acc. IEC 60286-3 Type I | 8 mm | 4 mm | 180 mm/7" |
| | P5 | 5000 | | | | |

## DIMENSIONS

**ACAS 0606 AT**

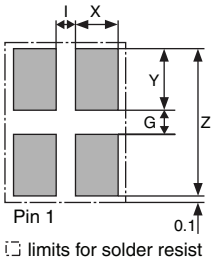


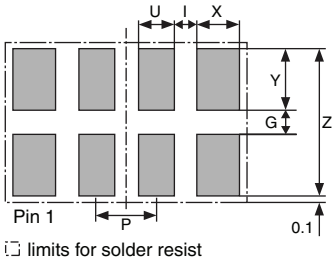

**ACAS 0612 AT**




| DIMENSION AND MASS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| TYPE | 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 | 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 |



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## 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 ($Al_2O_3$) 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 Life Vehicle Directive (ELV) and Annex II (ELV II)
- 2011/65/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**.

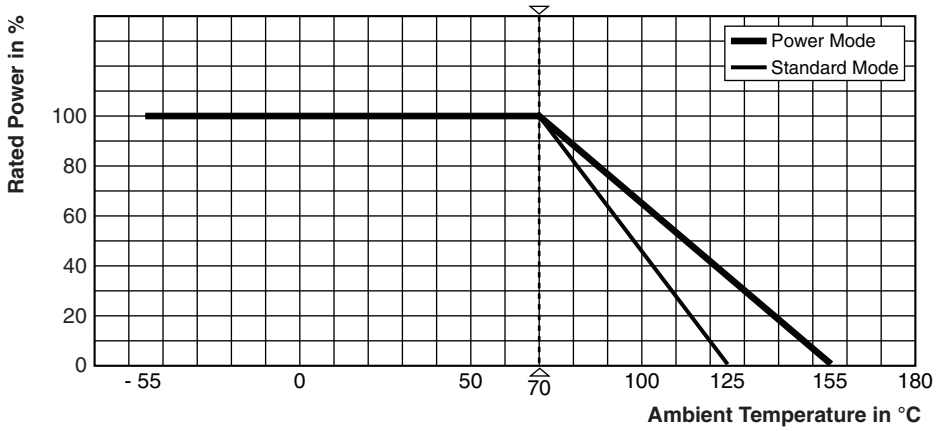
**Notes**

(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 → 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, above

**Derating**



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## 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 are carried out 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 PERMISSIBLE CHANGE (2) ($\Delta R$) |
|---|---|---|---|---|
| | | | Stability for product types: | |
| | | | **ACAS 0606 AT**<br>**ACAS 0612 AT** | **47 Ω to 150 kΩ**<br>**47 Ω to 150 kΩ** |
| 4.5 | - | Resistance | - | ± 0.1 % |
| 4.8.4.2 | - | Temperature coefficient | At (20/- 55/ 20) °C and (20/125/20) °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;<br>1000 h:<br>Absolute<br>Relative<br>8000 h:<br>Absolute<br>Relative | <br><br><br><br>± (0.1 % $R$ + 0.05 Ω)<br>± (0.05 % $R$ + 0.05 Ω)<br><br>± (0.25 % $R$ + 0.05 Ω)<br>± (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;<br>1000 h:<br>Absolute<br>Relative<br>8000 h:<br>Absolute<br>Relative | <br><br><br><br>± (0.25 % $R$ + 0.05 Ω)<br>± (0.125 % $R$ + 0.05 Ω)<br><br>± (0.5 % $R$ + 0.05 Ω)<br>± (0.25 % $R$ + 0.05 Ω) |
| 4.25.3 | - | Endurance at upper category temperature | 125 °C; 1000 h:<br>Absolute<br>Relative<br>125 °C; 8000 h:<br>Absolute<br>Relative<br>155 °C; 1000 h:<br>Absolute<br>Relative | <br><br>± (0.25 % $R$ + 0.05 Ω)<br>± (0.125 % $R$ + 0.05 Ω)<br><br>± (0.5 % $R$ + 0.05 Ω)<br>± (0.25 % $R$ + 0.05 Ω)<br><br>± (0.4 % R + 0.05 Ω)<br>± (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) |
| 4.39 | 67 (Cy) | Damp heat, steady state, accelerated | (85 ± 2) °C<br>(85 ± 5) % RH<br>$U = \sqrt{0.1 \times P_{70} \times R}$;<br>$U \leq 0.3 \times U_{max.}$;<br>1000 h | ± (0.5 % $R$ + 0.05 Ω) |



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## TEST PROCEDURES AND REQUIREMENTS

| EN 60115-1 CLAUSE | IEC 60068-2 [1] TEST METHOD | TEST | PROCEDURE | REQUIREMENTS PERMISSIBLE CHANGE [2] ($\Delta R$) |
|---|---|---|---|---|
| | | | Stability for product types:<br>**ACAS 0606 AT**<br>**ACAS 0612 AT** | <br>**47 Ω to 150 kΩ**<br>**47 Ω to 150 kΩ** |
| 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 |
| 4.40 | - | 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 - 55 °C and 30 min at 125 °C; 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 convection); (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<br>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.

## HISTORICAL TEMPERATURE COEFFICIENT AND RESISTANCE RANGES

| DESCRIPTION | | | | | RESISTANCE VALUE |
|---|---|---|---|---|---|
| ACCURACY GRADE | ABSOLUTE TCR | TCR TRACKING | ABSOLUTE TOLERANCE | TOLERANCE MATCHING | ACAS 0606 AT<br>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**

- Special temperature coefficent and resistance combinations remain available. For optimized availability please refer to the table TEMPERATURE COEFFICENT AND RESISTANCE.



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Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
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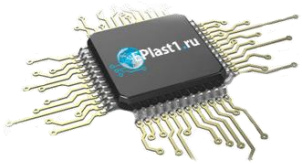
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits,General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.




**Как с нами связаться**

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