

# DATA SHEET

## CHIP RESISTORS with AU-TERMINATIONS

RC01/02H/21/22H  
5%; 1%  
sizes 1206 and 0603



## Chip resistors with Au-terminations sizes 1206 and 0603

## RC01/02H/21/22H 1%; 5%

### FEATURES

- Reduced size of final equipment
- Low assembly costs
- Higher component and equipment reliability
- New Ni/Au terminations provide special application for hybrid board gluing and can replace AgPd terminations.

### APPLICATIONS

- Power supply in small equipment
- Digital multi-meter
- Telecommunication
- Computer
- Automotive industry.

### DESCRIPTION

The resistors are constructed on a high grade ceramic body (aluminium oxide). Internal metal electrodes are added at each end and connected

by a resistive paste which is applied to the top surface of the substrate.

The composition of the paste is adjusted to give the approximate resistance required and the value is trimmed to within tolerance, by laser cutting of this resistive layer.

To ensure the product insulation and performance, the protective overcoat layer is printed upon the resistor layer. Finally, the two external end terminations are added. For ease of soldering the outerlayer of these end terminations is of Ni-Au alloy.

### QUICK REFERENCE DATA

DESCRIPTION	VALUE			
	RC01	RC02H	RC21	RC22H
Size code	1206		0603	
Resistance range	1 $\Omega$ to 10 M $\Omega$			
Resistance tolerance and E-series	$\pm 5\%$ ; E24 series	$\pm 1\%$ ; E24/E96 series	$\pm 5\%$ ; E24 series	$\pm 1\%$ ; E96 series
Temperature coefficient: 1 $\Omega \leq R \leq 10 \Omega$ 10 $\Omega < R \leq 10 \text{ M}\Omega$	250 $\pm$ 250 $\leq \pm 200$	250 $\pm$ 250 $\leq \pm 100$	250 $\pm$ 250 $\leq \pm 200$	250 $\pm$ 250 $\leq \pm 100$
Maximum dissipation at T <sub>amb</sub> = 70 °C	0.25 W		0.063 W	
Maximum permissible voltage	200 V (DC or RMS)		50 V (DC or RMS)	
Climatic category (IEC 60068)	55/155/56			
Basic specification	IEC 60115-8			

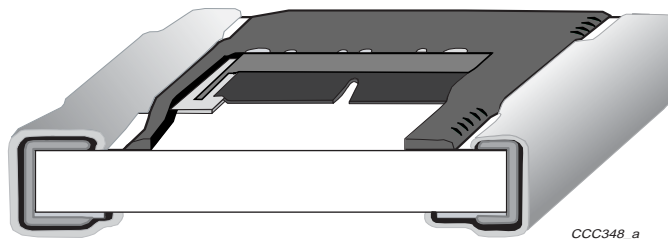


Fig.1 Outline.

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### ORDERING INFORMATION

**Table 1** Ordering code indicating resistor type and packing

TYPE	RESISTANCE VALUE	TOLERANCE (%)	ORDERING CODE 2322 ... ..	
			PAPER TAPE ON REEL	
			5000 units	10000 units
RC01	1 $\Omega$ to 10 M $\Omega$	$\pm 5$	711 11...	711 12...
RC02H	1 $\Omega$ to 10 M $\Omega$	$\pm 1$	729 1...	729 2...
RC21	1 $\Omega$ to 10 M $\Omega$	$\pm 5$	702 11...	702 12...
RC22H	1 $\Omega$ to 10 M $\Omega$	$\pm 1$	704 1...	704 2...

### Ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 2322.
- The subsequent 5 digits indicate the resistor type and packing; see Table 1.
- The remaining 3 or 4 digits indicate the resistance value:
  - The first 2 or 3 digits indicate the resistance value.
  - The last digit indicates the resistance decade in accordance with Table 2.

**Table 2** Last digit of 12NC

RESISTANCE DECADE	LAST DIGIT
1 to 9.76 $\Omega$	8
10 to 97.6 $\Omega$	9
100 to 976 $\Omega$	1
1 to 976 k $\Omega$	2
10 to 97.6 k $\Omega$	3
100 to 976 k $\Omega$	4
1 to 9.76 M $\Omega$	5
10 M $\Omega$	6

### ORDERING EXAMPLE

The ordering code of an RC01 resistor, Au-termination, value 1000  $\Omega$ , 5%, supplied on paper tape of 5000 units per reel is: 2322 711 11102.

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### FUNCTIONAL DESCRIPTION

#### Product characterization

Standard values of nominal resistance are taken from the E24 series or E96 series for resistors with a tolerance of  $\pm 5\%$  or  $\pm 1\%$ . The values of the E24/96 series are in accordance with "IEC publication 60063".

#### Limiting values

TYPE	LIMITING VOLTAGE <sup>(1)</sup> (V)	LIMITING POWER (W)
RC01	200	0.25
RC02H	200	0.25
RC21	50	0.063
RC22H	50	0.063

#### Note

1. This is the maximum voltage that may be continuously applied to the resistor element, see "IEC publication 60115-8".

### DERATING

The power that the resistor can dissipate depends on the operating temperature; see Fig.2.

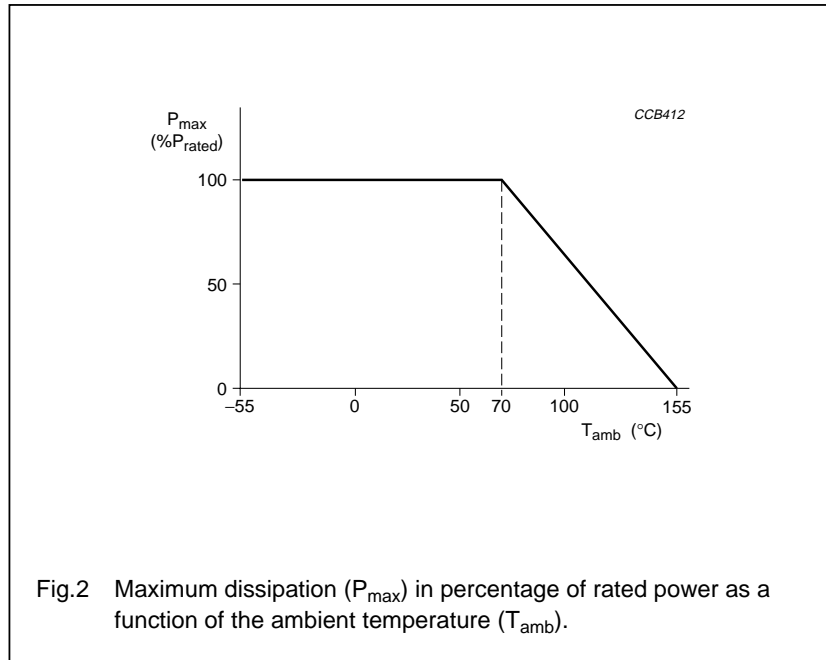


Fig.2 Maximum dissipation ( $P_{max}$ ) in percentage of rated power as a function of the ambient temperature ( $T_{amb}$ ).

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### MECHANICAL DATA

#### Mass per 100 units

TYPE	MASS (g)
RC01	1.0
RC02H	1.0
RC21	0.25
RC22H	0.25

#### Marking

All resistors within the E24 series are marked with a 3-digit code and a 4-digit code for resistors of the E96 series, on the protective coat to designate the nominal resistance value.

#### 3-DIGIT MARKING

For values of 10  $\Omega$  or greater the first 2 digits are significant, the third indicates the number of zeros to follow.

#### Example

MARKING	RESISTANCE
220	22 $\Omega$
823	82 k $\Omega$
0	jumper

#### 4-DIGIT MARKING

For values of 1 k $\Omega$  or greater the first 3 digits apply to the resistance value and the fourth indicates the number of zeros to follow.

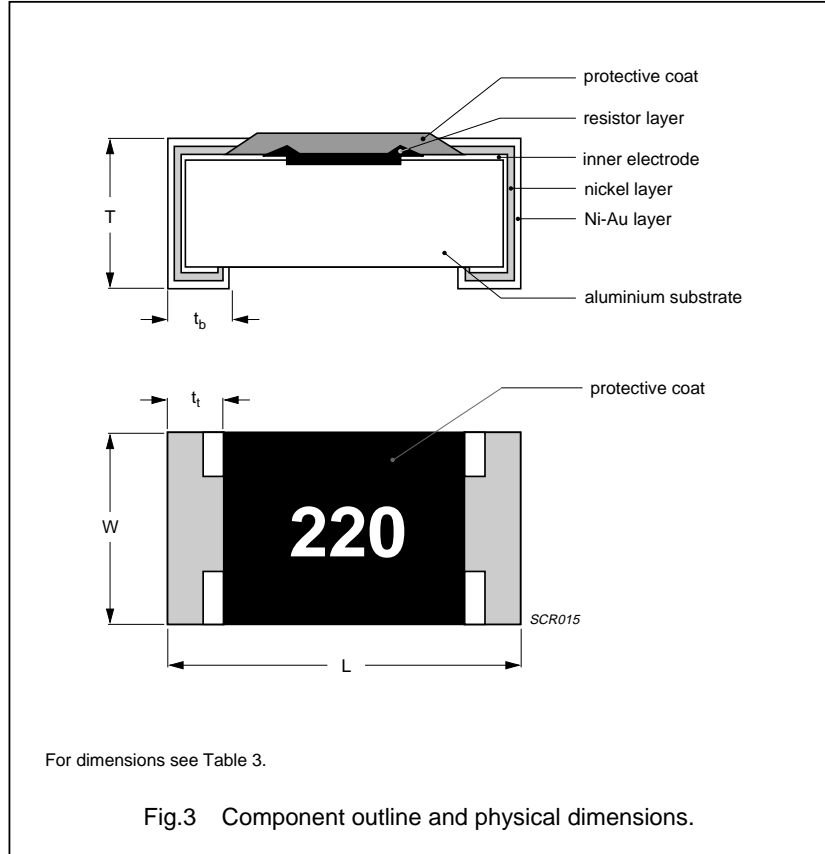
#### Example

MARKING	RESISTANCE
2200	220 $\Omega$
4021	4.02 k $\Omega$
1503	150 k $\Omega$

#### PACKAGE MARKING

The packing is also marked and includes resistance value, tolerance, catalogue number, quantity, production period, batch number and source code.

### OUTLINES



**Table 3** Chip resistor types and relevant physical dimensions; see Fig.3

TYPE	L (mm)	W (mm)	T (mm)	t <sub>t</sub> (mm)	t <sub>b</sub> (mm)
RC01	3.10 ±0.10	1.60 ±0.10	0.55 ±0.10	0.45 ±0.20	0.40 ±0.20
RC02H	3.10 ±0.10	1.60 ±0.10	0.55 ±0.10	0.45 ±0.20	0.40 ±0.20
RC21	1.60 ±0.10	0.80 ±0.10	0.45 ±0.10	0.25 ±0.15	0.25 ±0.20
RC22H	1.60 ±0.10	0.80 ±0.10	0.45 ±0.10	0.25 ±0.15	0.25 ±0.20

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### TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the schedule of "IEC publication 60115-8", category **LCT/UCT/56** (rated temperature range: Lower **Category** Temperature, Upper **Category** Temperature; damp heat, long term, **56** days). The testing also covers the requirements specified by EIA and EIAJ.

The tests are carried out in accordance with IEC publication

60068, "Recommended basic climatic and mechanical robustness testing procedure for electronic components" and under standard atmospheric conditions according to "IEC 60068-1", subclause 5.3.

Unless otherwise specified the following values apply:

Temperature: 15 °C to 35 °C

Relative humidity: 25% to 75%

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

In Table 4 the tests and requirements are listed with reference to the relevant clauses of "IEC publications 60115-8 and 60068"; a short description of the test procedure is also given. In some instances deviations from the IEC recommendations were necessary for our method of specifying.

All soldering tests are performed with mildly activated flux.

**Table 4** Test procedures and requirements

IEC 60115-8 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
<b>Tests in accordance with the schedule of IEC publication 60115-8</b>				
4.4.1		visual examination		no holes; clean surface; no visible damage
4.5		resistance	<b>RC01, RC21:</b> applied voltage (+0/-10%) R < 10 Ω: 0.1 V 10 Ω ≤ R < 100 Ω: 0.3 V 100 Ω ≤ R < 1 kΩ: 1 V 1 kΩ ≤ R < 10 kΩ: 3 V 10 kΩ ≤ R < 100 kΩ: 10 V 100 kΩ ≤ R < 1 MΩ: 25 V R ≥ 1 MΩ: 50 V	R – R <sub>nom</sub> : max. ±5%
4.5		resistance	<b>RC02H, RC22H:</b> applied voltage (+0/-10%) R < 10 Ω: 0.1 V 10 Ω ≤ R < 100 Ω: 0.3 V 100 Ω ≤ R < 1 kΩ: 1 V 1 kΩ ≤ R < 10 kΩ: 3 V 10 kΩ ≤ R < 100 kΩ: 10 V 100 kΩ ≤ R < 1 MΩ: 25 V	R – R <sub>nom</sub> : max. ±1%
4.18	20 (Tb)	resistance to soldering heat	unmounted chips; 10 ±1 s; 260 ±5 °C	no visible damage ΔR/R max.: ±(0.5% + 0.05 Ω)

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IEC 60115-8 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.29	45 (Xa)	component solvent resistance	isopropyl alcohol or H <sub>2</sub> O followed by brushing in accordance with "MIL 202 F"	no visible damage
4.17	20 (Ta)	solderability	unmounted chips completely immersed for 2 ±0.5 s in a solder bath at 235 ±2 °C	good tinning (≥95% covered); no visible damage
4.7		voltage proof on insulation	maximum voltage (RMS) during 1 minute, metal block method	no breakdown or flashover
4.13		short time overload	room temperature; P = 6.25 × P <sub>n</sub> ; 5 s (V ≤ 2 × V <sub>max</sub> )	ΔR/R max.: ±(1% + 0.05 Ω)
4.33		bending	resistors mounted on a 90 mm glass epoxy resin PCB (FR4); bending: <b>RC01</b> : 2 mm <b>RC02H</b> : 2 mm <b>RC21</b> : 3 mm <b>RC22H</b> : 3 mm	no visible damage ΔR/R max.: ±(1% + 0.05 Ω) ΔR/R max.: ±(0.5% + 0.05 Ω) ΔR/R max.: ±(1% + 0.05 Ω) ΔR/R max.: ±(0.5% + 0.05 Ω)
4.19	14 (Na)	rapid change of temperature	30 minutes at LCT and 30 minutes at UCT; 5 cycles	no visible damage ΔR/R max.: ±(0.5% + 0.05 Ω)
4.24.2	3 (Ca)	damp heat (steady state)	56 days; 40 ±2 °C; 93 +2/-3% RH; loaded with 0.01 P <sub>n</sub> : <b>RC01, RC21</b> : R ≤ 1 MΩ <b>RC01, RC21</b> : R > 1 MΩ <b>RC02H, RC022H</b> : R ≤ 1 MΩ <b>RC02H, RC022H</b> : R > 1 MΩ	ΔR/R max.: ±(1.5% + 0.1 Ω) ΔR/R max.: ±(3.0% + 0.1 Ω) ΔR/R max.: ±(1.0% + 0.05 Ω) ΔR/R max.: ±(1.5% + 0.05 Ω)
4.25.1		endurance	1000 +48/-0 hours; 70 ±2 °C; loaded with P <sub>n</sub> or V <sub>max</sub> : 1.5 hours on, 0.5 hours off: <b>RC01, RC21</b> : R ≤ 1 MΩ <b>RC01, RC21</b> : R > 1 MΩ <b>RC02H, RC022H</b> : R ≤ 1 MΩ <b>RC02H, RC022H</b> : R > 1 MΩ	ΔR/R max.: ±(1.5% + 0.1 Ω) ΔR/R max.: ±(3.0% + 0.1 Ω) ΔR/R max.: ±(1.0% + 0.05 Ω) ΔR/R max.: ±(1.5% + 0.05 Ω)
4.23.2	27 (Ba)	endurance at upper category temperature	1000 +48/-0 hours; no load: <b>RC01, RC21</b> : R ≤ 1 MΩ <b>RC01, RC21</b> : R > 1 MΩ <b>RC02H, RC022H</b> : R ≤ 1 MΩ <b>RC02H, RC022H</b> : R > 1 MΩ	ΔR/R max.: ±(1.5% + 0.1 Ω) ΔR/R max.: ±(3.0% + 0.1 Ω) ΔR/R max.: ±(1.0% + 0.05 Ω) ΔR/R max.: ±(1.5% + 0.05 Ω)

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## RC01/02H/21/22H 1%; 5%

IEC 60115-8 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.8.4.2		temperature coefficient	at 20/LCT/20 °C and 20/UCT/20 °C $1 \Omega \leq R \leq 10 \Omega$ <b>RC01, RC21:</b> $10 \Omega < R \leq 10 \text{ M}\Omega$ <b>RC02H, RC22H:</b> $10 \Omega < R \leq 10 \text{ M}\Omega$	$\leq \pm 250 \pm 250$ $\leq \pm 200$ $\leq \pm 100$
<b>Other tests in accordance with IEC 60115 clauses and IEC 60068 test method</b>				
4.6.1.1		insulation resistance	voltage (DC) after 1 minute, metal block method:	$R_{\text{ins}}$ min.: $10^3 \text{ M}\Omega$
4.12		noise	IEC publication 60195 (measured with Quantech-equipment) $R \leq 100 \Omega$ $100 \Omega < R \leq 1 \text{ k}\Omega$ $1 \text{ k}\Omega < R \leq 10 \text{ k}\Omega$ $10 \text{ k}\Omega < R \leq 100 \text{ k}\Omega$ $100 \text{ k}\Omega < R \leq 1 \text{ M}\Omega$ $1 \text{ M}\Omega < R \leq 10 \text{ M}\Omega$	max. $0.316 \mu\text{V/V}$ (-10 dB) max. $1 \mu\text{V/V}$ (0 dB) max. $3 \mu\text{V/V}$ (9.54 dB) max. $6 \mu\text{V/V}$ (15.56 dB) max. $10 \mu\text{V/V}$ (20 dB) max. $32 \mu\text{V/V}$ (30.10 dB)
<b>Other applicable tests</b>				
(JIS) C 5202 7.9		resistance to damp heat (steady state)	1000 +48/-0 hours; $40 \pm 2 \text{ }^\circ\text{C}$ ; 93 +2/-3% RH; loaded with $P_n$ or $V_{\text{max}}$ ; 1.5 hours on and 0.5 hours off: <b>RC01, RC21:</b> $R \leq 1 \text{ M}\Omega$ <b>RC01, RC21:</b> $R > 1 \text{ M}\Omega$ <b>RC02H, RC22H:</b> $R \leq 1 \text{ M}\Omega$ <b>RC02H, RC22H:</b> $R > 1 \text{ M}\Omega$	$\Delta R/R$ max.: $\pm(3\% + 0.1 \Omega)$ $\Delta R/R$ max.: $\pm(5\% + 0.1 \Omega)$ $\Delta R/R$ max.: $\pm(2\% + 0.1 \Omega)$ $\Delta R/R$ max.: $\pm(3\% + 0.1 \Omega)$
EIA/IS 703 4.5		load humidity	1000 +48/-0 hours; $85 \pm 2 \text{ }^\circ\text{C}$ ; 85 +5% RH; loaded with $00.1 P_n$ or $V_{\text{max}}$ ; <b>RC01, RC21:</b> $R \leq 1 \text{ M}\Omega$ <b>RC01, RC21:</b> $R > 1 \text{ M}\Omega$ <b>RC02H, RC22H:</b> $R \leq 1 \text{ M}\Omega$ <b>RC02H, RC22H:</b> $R > 1 \text{ M}\Omega$	$\Delta R/R$ max.: $\pm(3\% + 0.1 \Omega)$ $\Delta R/R$ max.: $\pm(5\% + 0.1 \Omega)$ $\Delta R/R$ max.: $\pm(2\% + 0.1 \Omega)$ $\Delta R/R$ max.: $\pm(3\% + 0.1 \Omega)$
		shock termination test	$-40 \text{ }^\circ\text{C}/+150 \text{ }^\circ\text{C}$ ; 30 s on/30 s off; 500 cycles	no visual damage



**Chip resistors with Au-terminations  
sizes 1206 and 0603****RC01/02H/21/22H  
1%; 5%****REVISION HISTORY**

<b>Revision</b>	<b>Date</b>	<b>Change Notification</b>	<b>Description</b>
Rev.3	2001 Apr 27	-	- Converted to Phycomp brand
Rev.4	2001 Oct 14	-	- Table 3: 'length' and 'width' changed; Table 4: 'bending' changed
Rev.5	2003 Jul 07	-	- Updated company logo - Table 1: RC01, RC02H, RC22H ordering code revised - Marking code revised