

DATA SHEET

GENERAL PURPOSE CHIP RESISTORS

RC0603
5%, 1%
RoHS compliant



SCOPE

This specification describes RC0603 series chip resistors with lead-free terminations made by thick film process.

APPLICATIONS

- All general purpose application

FEATURES

- RoHS compliant
 - Products with lead free terminations meet RoHS requirements
 - Pb-glass contained in electrodes, resistor element and glass are exempted by RoHS
- Reducing environmentally hazardous wastes
- High component and equipment reliability
- Saving of PCB space
- None forbidden-materials used in products/production
- Halogen Free Epoxy

ORDERING INFORMATION - GLOBAL PART NUMBER & I2NC

Both part numbers are identified by the series, size, tolerance, packing type, temperature coefficient, taping reel and resistance value.

YAGEO BRAND ordering code

GLOBAL PART NUMBER (PREFERRED)

RC0603 X R - XX XXXX L
 (1) (2) (3) (4) (5) (6)

(1) TOLERANCE

F = ±1%
 J = ±5% (for Jumper ordering, use code of J)

(2) PACKAGING TYPE

R = Paper / PE taping reel

(3) TEMPERATURE COEFFICIENT OF RESISTANCE

- = Base on spec

(4) TAPING REEL

07 = 7 inch dia. Reel
 10 = 10 inch dia. Reel
 13 = 13 inch dia. Reel

(5) RESISTANCE VALUE

There are 2~4 digits indicated the resistor value. Letter R/K/M is decimal point, no need to mention the last zero after R/K/M, e.g.1K2, not 1K20.
 Detailed resistance rules show in table of "Resistance rule of global part number".

(6) OPTIONAL CODE

L = optional symbol (Note)

| Resistance rule of global part number | |
|---------------------------------------|--------------------|
| Resistance code rule | Example |
| OR | OR = Jumper |
| XRX | 1R = 1 Ω |
| (1 to 9.76 Ω) | 1R5 = 1.5 Ω |
| | 9R76 = 9.76 Ω |
| XXRX | 10R = 10 Ω |
| (10 to 97.6 Ω) | 97R6 = 97.6 Ω |
| XXXXR | 100R = 100 Ω |
| (100 to 976 Ω) | |
| XKXX | 1K = 1,000 Ω |
| (1 to 9.76 KΩ) | 9K76 = 9760 Ω |
| XMXX | 1M = 1,000,000 Ω |
| (1 to 9.76 MΩ) | 9M76 = 9,760,000 Ω |

ORDERING EXAMPLE

The ordering code of a RC0603 chip resistor, value 56 Ω with ±1% tolerance, supplied in 7-inch tape reel is: RC0603FR-0756R(L).

NOTE

1. All our RSMD products meet RoHS compliant. "LFP" of the internal 2D reel label mentions "Lead Free Process"
2. On customized label, "LFP" or specific symbol printed and the optional "L" at the end of GLOBAL PART NUMBER / I2NC can be added (both are on customer request)

PHYCOMP BRAND ordering codes

Both GLOBAL PART NUMBER (preferred) and I2NC (traditional) codes are acceptable to order Phycomp brand products.

GLOBAL PART NUMBER (PREFERRED)

For detailed information of GLOBAL PART NUMBER and ordering example, please refer to page 2.

I2NC CODE

2322 / 2350 **XXX XXXXX L**
 (1) (2) (3) (4)

| TYPE/ START 0603 IN ⁽¹⁾ | TOL. (%) | RESISTANCE RANGE | PAPER / PE TAPE ON REEL (units) ⁽²⁾ | | |
|---------------------------------------|-------------|---------------------|--|----------------------|-----------|
| | | | 5,000 | 10,000/not preferred | 20,000 |
| RC21 | ±5% | 1 to 10 MΩ | 702 60xxx | 702 70xxx | 702 81xxx |
| RC22 | ±1% | 1 to 10 MΩ | 704 6xxxx | 704 7xxxx | 704 8xxxx |
| HRC21 | ±5% | 11 to 22 MΩ | 522 10xxx | - | - |
| Jumper | - | 0 Ω | 702 96001 | 702 97001 | 702 92002 |

| Resistance decade ⁽³⁾ | Last digit |
|----------------------------------|------------|
| 0.01 to 0.0976 Ω | 0 |
| 0.1 to 0.976 Ω | 7 |
| 1 to 9.76 Ω | 8 |
| 10 to 97.6 Ω | 9 |
| 100 to 976 Ω | 1 |
| 1 to 9.76 KΩ | 2 |
| 10 to 97.6 KΩ | 3 |
| 100 to 976 KΩ | 4 |
| 1 to 9.76 MΩ | 5 |
| 10 to 97.6 MΩ | 6 |

- (1) The resistors have a 12-digit ordering code starting with 2322 / 2350.
- (2) The subsequent 4 or 5 digits indicate the resistor tolerance and packaging.
- (3) The remaining 4 or 3 digits represent the resistance value with the last digit indicating the multiplier as shown in the table of "Last digit of I2NC".
- (4) "L" is optional symbol ^(Note).

Example:

| | | |
|--------|---|-------------|
| 0.02 Ω | = | 0200 or 200 |
| 0.3 Ω | = | 3007 or 307 |
| 1 Ω | = | 1008 or 108 |
| 33 KΩ | = | 3303 or 333 |
| 10 MΩ | = | 1006 or 106 |

ORDERING EXAMPLE

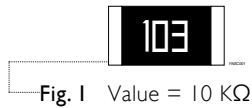
The ordering code of a RC22 resistor, value 56 Ω with ±1% tolerance, supplied in tape of 5,000 units per reel is: 232270465609(L) or RC0603FR-0756R(L).

NOTE

- 1. All our RSMD products are RoHS compliant. "LFP" of the internal 2D reel label mentions "Lead Free Process"
- 2. On customized label, "LFP" or specific symbol printed and the optional "L" at the end of GLOBAL PART NUMBER / I2NC can be added (both are on customer request)

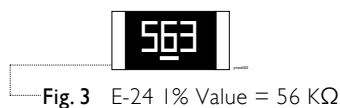
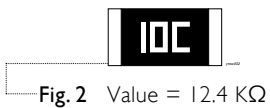
MARKING

RC0603



E-24 series: 3 digits

First two digits for significant figure and 3rd digit for number of zeros



E-96 series: 3 digits for 0603 ±1% EIA-96 marking method

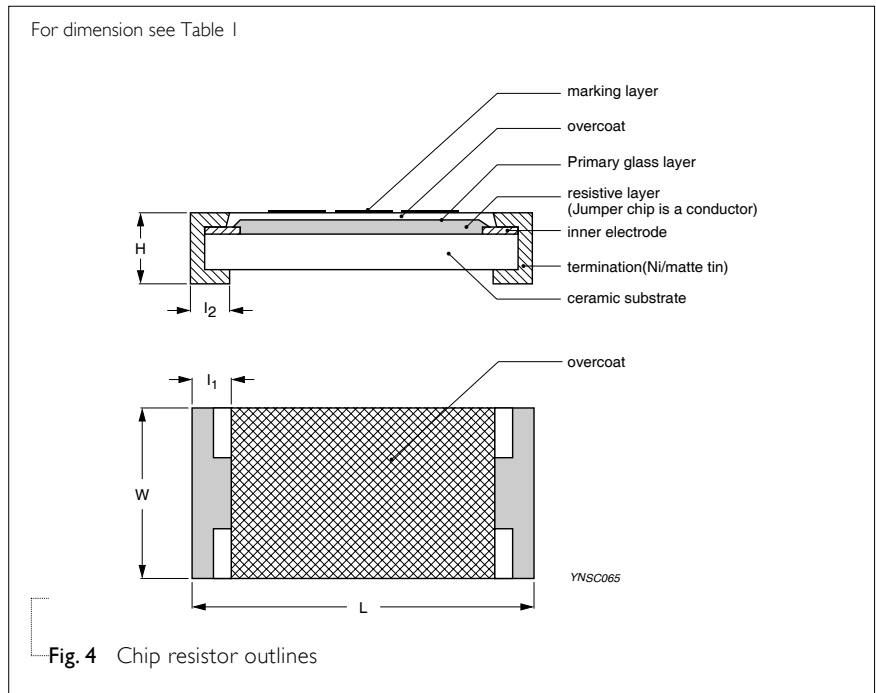
For 0603 ±1% E-24 series, one short bar under marking letter

For further marking information, please see special data sheet “Chip resistors marking”.

CONSTRUCTION

The resistor is constructed on top of a high-grade ceramic body. Internal metal electrodes are added on each end to make the contacts to the thick film resistive element. The composition of the resistive element is a noble metal imbedded into a glass and covered by a second glass to prevent environment influences. The resistor is laser trimmed to the rated resistance value. The resistor is covered with a protective epoxy coat, finally the two external terminations (matte tin on Ni-barrier) are added. See fig.4

OUTLINES



DIMENSIONS

Table I

| TYPE | RC0603 |
|---------------------|------------|
| L (mm) | 1.60 ±0.10 |
| W (mm) | 0.80 ±0.10 |
| H (mm) | 0.45 ±0.10 |
| l ₁ (mm) | 0.25 ±0.15 |
| l ₂ (mm) | 0.25 ±0.15 |

ELECTRICAL CHARACTERISTICS

Table 2

| CHARACTERISTICS | RC0603 1/10 W | |
|---------------------------------|---------------------------|-------------|
| Operating Temperature Range | -55 °C to +155 °C | |
| Maximum Working Voltage | 50 V | |
| Maximum Overload Voltage | 100 V | |
| Dielectric Withstanding Voltage | 100 V | |
| Resistance Range | 5% (E24) 1 Ω to 22 MΩ | |
| | 1% (E24/E96) 1 Ω to 10 MΩ | |
| | Zero Ohm Jumper < 0.05 Ω | |
| Temperature Coefficient | 1 Ω ≤ R ≤ 10Ω | ±200 ppm/°C |
| | 10 MΩ < R ≤ 22 MΩ | ±200 ppm/°C |
| | 10 Ω < R ≤ 10 MΩ | ±100 ppm/°C |
| Jumper Criteria | Rated Current | 1.0 A |
| | Maximum Current | 2.0 A |

FOOTPRINT AND SOLDERING PROFILES

For recommended footprint and soldering profiles, please see the special data sheet “Chip resistors mounting”.

PACKING STYLE AND PACKAGING QUANTITY

Table 3 Packing style and packaging quantity

| PRODUCT TYPE | PACKING STYLE | REEL DIMENSION | QUANTITY PER REEL |
|--------------|-----------------------|----------------|-------------------|
| RC0603 | Paper Taping Reel (R) | 7" (178 mm) | 5,000 units |
| | | 10" (254 mm) | 10,000 units |
| | | 13" (330 mm) | 20,000 units |

NOTE

I. For paper tape and reel specification/dimensions, please see the special data sheet “Chip resistors packing”.

FUNCTIONAL DESCRIPTION

POWER RATING

RC0603 rated power at 70°C is 1/10 W

RATED VOLTAGE

The DC or AC (rms) continuous working voltage corresponding to the rated power is determined by the following formula:

$V = \sqrt{P \times R}$
 or max. working voltage whichever is less

Where

V=Continuous rated DC or AC (rms) working voltage (V)

P=Rated power (W)

R=Resistance value (Ω)

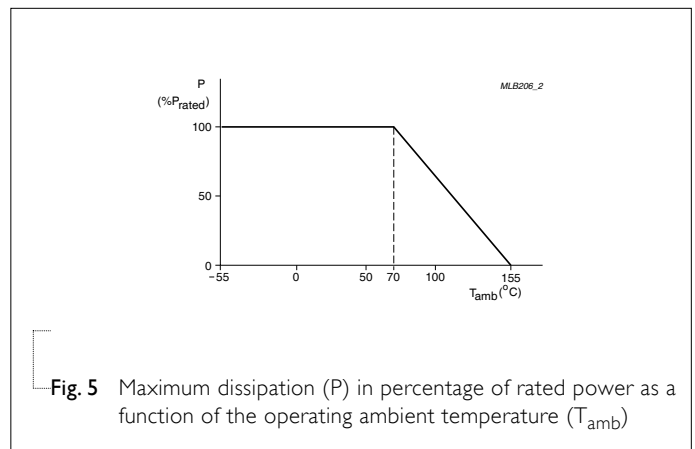


Fig. 5 Maximum dissipation (P) in percentage of rated power as a function of the operating ambient temperature (T_{amb})

TESTS AND REQUIREMENTS

Table 4 Test condition, procedure and requirements

| TEST | TEST METHOD | PROCEDURE | REQUIREMENTS |
|---|--------------------------|--|--|
| Temperature Coefficient of Resistance (T.C.R.) | IEC 60115-1 4.8 | At +25/-55 °C and +25/+125 °C Formula: $T.C.R = \frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6 \text{ (ppm/°C)}$ Where t ₁ =+25 °C or specified room temperature t ₂ =-55 °C or +125 °C test temperature R ₁ =resistance at reference temperature in ohms R ₂ =resistance at test temperature in ohms | Refer to table 2 |
| Life/Endurance | IEC 60115-1 4.25.1 | 1,000 hours at 70±5 °C applied RCWV 1.5 hours on, 0.5 hour off, still air required | ±(1.0%+0.05 Ω) for 1% tol. ±(3.0%+0.05 Ω) for 5% tol. <100 mΩ for Jumper |
| High Temperature Exposure/Endurance at Upper Category Temperature | IEC 60068-2-2 | 1,000 hours at 155±5 °C, unpowered | ±(1.0%+0.05 Ω) for 1% tol. ±(2.0%+0.05 Ω) for 5% tol. <50 mΩ for Jumper |
| Moisture Resistance | MIL-STD-202G Method-106G | Each temperature / humidity cycle is defined at 8 hours, 3 cycles / 24 hours for 10d. with 25 °C / 65 °C 95% R.H, without steps 7a & 7b, unpowered Parts mounted on test-boards, without condensation on parts Measurement at 24±2 hours after test conclusion | ±(0.5%+0.05 Ω) for 1% tol. ±(2.0%+0.05 Ω) for 5% tol. <100 mΩ for Jumper |
| Thermal Shock | MIL-STD-202G Method-107G | -55/+125 °C Number of cycles required is 300. Devices unmounted Maximum transfer time is 20 seconds. Dwell time is 15 minutes. Air – Air | ±(0.5%+0.05 Ω) for 1% tol. ±(1%+0.05 Ω) for 5% tol. <50 mΩ for Jumper |
| Short Time Overload | IEC60115-1 4.13 | 2.5 times of rated voltage or maximum overload voltage whichever is less for 5 sec at room temperature | ±(1.0%+0.05 Ω) for 1% tol. ±(2.0%+0.05 Ω) for 5% tol. <50 mΩ for Jumper No visible damage |

| TEST | TEST METHOD | PROCEDURE | REQUIREMENTS | | | | | | | | | | | | | | |
|------------------------------------|----------------------|---|---|-----------------|-------|-----------|-------|------------------|-------|------------------|-------|--------------------|-------|-------------------|-------|------------------|-------|
| Board Flex/ Bending | IEC 60068-2-21 | Chips mounted on a 90mm glass epoxy resin PCB (FR4) 3 mm bending Bending time: 60±5 seconds | ±(1.0%+0.05 Ω) for 1%, 5% tol. <50 mΩ for Jumper No visible damage | | | | | | | | | | | | | | |
| Low Temperature Operation | IEC 60068-2-1 | The resistor shall be subjected to a DC rated voltage for 1.5 h-on, 0.5 h-off, at -55±3 °C This constitutes shall be repeated for 96 hours However the applied voltage shall not exceed the maximum operating voltage | ±(0.5%+0.05 Ω) for 1% tol . ±(1.0%+0.05 Ω) for 5% tol. No visible damage | | | | | | | | | | | | | | |
| Insulation Resistance | IEC 60115-1 4.6 | Rated continuous overload voltage (RCOV) for 1 minute <u>Type</u> RC0603 <u>Voltage (DC)</u> 100 V | ≥10 GΩ | | | | | | | | | | | | | | |
| Dielectric Withstand Voltage | IEC 60115-1 4.7 | Maximum voltage (V _{rms}) applied for 1 minute <u>Type</u> RC0603 <u>Voltage (AC)</u> 100 V _{rms} | No breakdown or flashover | | | | | | | | | | | | | | |
| Resistance to Solvent | IPC/JEDEC J-STD-020D | Isopropylalcohol (C3H7OH) followed by brushing | No smeared | | | | | | | | | | | | | | |
| Noise | IEC 60115-1 4.12 | Maximum voltage (V _{rms}) applied | <table border="1"> <thead> <tr> <th>Resistors range</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>R < 100 Ω</td> <td>10 dB</td> </tr> <tr> <td>100 Ω ≤ R < 1 KΩ</td> <td>20 dB</td> </tr> <tr> <td>1 KΩ ≤ R < 10 KΩ</td> <td>30 dB</td> </tr> <tr> <td>10 KΩ ≤ R < 100 KΩ</td> <td>40 dB</td> </tr> <tr> <td>100 KΩ ≤ R < 1 MΩ</td> <td>46 dB</td> </tr> <tr> <td>1 MΩ ≤ R ≤ 22 MΩ</td> <td>48 dB</td> </tr> </tbody> </table> | Resistors range | Value | R < 100 Ω | 10 dB | 100 Ω ≤ R < 1 KΩ | 20 dB | 1 KΩ ≤ R < 10 KΩ | 30 dB | 10 KΩ ≤ R < 100 KΩ | 40 dB | 100 KΩ ≤ R < 1 MΩ | 46 dB | 1 MΩ ≤ R ≤ 22 MΩ | 48 dB |
| Resistors range | Value | | | | | | | | | | | | | | | | |
| R < 100 Ω | 10 dB | | | | | | | | | | | | | | | | |
| 100 Ω ≤ R < 1 KΩ | 20 dB | | | | | | | | | | | | | | | | |
| 1 KΩ ≤ R < 10 KΩ | 30 dB | | | | | | | | | | | | | | | | |
| 10 KΩ ≤ R < 100 KΩ | 40 dB | | | | | | | | | | | | | | | | |
| 100 KΩ ≤ R < 1 MΩ | 46 dB | | | | | | | | | | | | | | | | |
| 1 MΩ ≤ R ≤ 22 MΩ | 48 dB | | | | | | | | | | | | | | | | |
| Biased Humidity (steady state) | IEC 60115-1 4.37 | Steady state for 1000 hours at 85 °C / 85% R.H. Biased voltage: U = 10% of Pn (V) Max = U _{max} . No condensation on the devices, circulating air | ±(1.0%+0.05 Ω) for 1% tol. ±(2.0%+0.05 Ω) for 5% tol. <100 mΩ for Jumper | | | | | | | | | | | | | | |

| TEST | TEST METHOD | PROCEDURE | REQUIREMENTS |
|--------------------------------|-----------------------------|---|---|
| Intermittent Overload | IEC 60115-1 4.39 | 2.5 times of rated voltage or maximum overload voltage whichever is less for 1 second on and 25 seconds off; total 10,000 cycles | $\pm(1.0\%+0.05 \Omega)$ for 1% tol. $\pm(2.0\%+0.05 \Omega)$ for 5% tol. <100 m Ω for Jumper |
| Solderability - Wetting | IPC/JEDEC J-STD-002B test B | Electrical Test not required Magnification 50X SMD conditions: 1 st step: method B, aging 4 hours at 155 °C dry heat 2 nd step: leadfree solder bath at 245±3 °C Dipping time: 3±0.5 seconds | Well tinned ($\geq 95\%$ covered) No visible damage |
| - Leaching | IPC/JEDEC J-STD-002B test D | Leadfree solder, 260 °C, 30 seconds immersion time | No visible damage |
| - Resistance to Soldering Heat | IEC 60068-2-58 | Condition B, no pre-heat of samples Leadfree solder, 260 °C, 10 seconds immersion time Procedure 2 for SMD: devices fluxed and cleaned with isopropanol | $\pm(0.5\%+0.05 \Omega)$ for 1% tol . $\pm(1.0\%+0.05 \Omega)$ for 5% tol. <50 m Ω for Jumper No visible damage |

REVISION HISTORY

| REVISION | DATE | CHANGE NOTIFICATION | DESCRIPTION |
|-----------|--------------|---------------------|--|
| Version 4 | Apr 24, 2009 | - | <ul style="list-style-type: none"> - Test Items and methods updated - Test requirements upgraded |
| Version 3 | Jul 15, 2008 | - | <ul style="list-style-type: none"> - Change to dual brand datasheet that describe RC0603 with RoHS compliant - Description of "Halogen Free Epoxy" added - Define global part number |
| Version 2 | Aug 19, 2004 | - | |
| Version 1 | Aug 02, 2004 | - | <ul style="list-style-type: none"> - New datasheet for 0603 thick film 1% and 5% with lead-free terminations - Replace the 0603 part of pdf files: RC01_11_21_31_5, RC02_12_22_32_10, and HRC21_5_4 - Test method and procedure updated - PE tape added (paper tape will be replaced by PE tape) - High ohmic products combined into standard products. |

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