Innovative Service Around the Globe YAGEO

DATA SHEET

GENERAL PURPOSE CHIP RESISTORS

RC0603

5%, 1%, 0.5%

RoHS compliant

Product specification – June 29, 2012 V.5

YAGEO Phycomp

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 & 12NC

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

D = ±0.5%
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) DEFAULTCODE

Letter L is the system default code for ordering only. (Note)

Resistance rule of global part number

Resistance code rule	Example
0R	0R = Jumper
XRXX (1 to 9.76 Ω)	1R = 1 Ω 1R5 = 1.5 Ω 9R76 = 9.76 Ω
XXRX (10 to 97.6 Ω)	10R = 10 Ω 97R6 = 97.6 Ω
XXXR (100 to 976 Ω)	100R = 100 Ω
XKXX (1 to 9.76 KΩ)	1K = 1,000 Ω 9K76 = 9760 Ω
XMXX (1 to 9.76 MΩ)	1M = 1,000,000 Ω 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-0756RL.

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 / 12NC can be added (both are on customer request)

PHYCOMP BRAND ordering codes

Both GLOBAL PART NUMBER (preferred) and 12NC (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.

12NC CODE

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

TYPE/ 0603	START IN (1)	TOL. (%)	RESISTANCE RANGE	PAPER / PE TAPE ON REEL (units) (2)		
				5,000	10,000/not preferred	20,000
RC21	2322	±5%	1 to 10 MΩ	702 60xxx	702 70xxx	702 81xxx
RC22	2322	±1%	1 to 10 MΩ	704 6xxxx	704 7xxxx	704 8xxxx
HRC21	2350	±5%	11 to 22 MΩ	522 10xxx	-	-
Jumper	2322	-	0 Ω	702 96001	702 97001	702 92002

(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 12NC".

(4) "L" is optional symbol (Note).

Last digit of 12NC

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

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 / 12NC can be added (both are on customer request)

MARKING

RC0603

Fig. 1 Value = 10 KΩ

E-24 series: 3 digits

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

Fig. 2 Value = 12.4 KΩ

Fig. 3 E-24 1% Value = 56 KΩ

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

DIMENSIONS

Table 1

TYPE	RC0603
L (mm)	1.60 ±0.10
W (mm)	0.80 ±0.10
H (mm)	0.45 ±0.10
I_1 (mm)	0.25 ±0.15
I_2 (mm)	0.25 ±0.15

OUTLINES

For dimension see Table 1

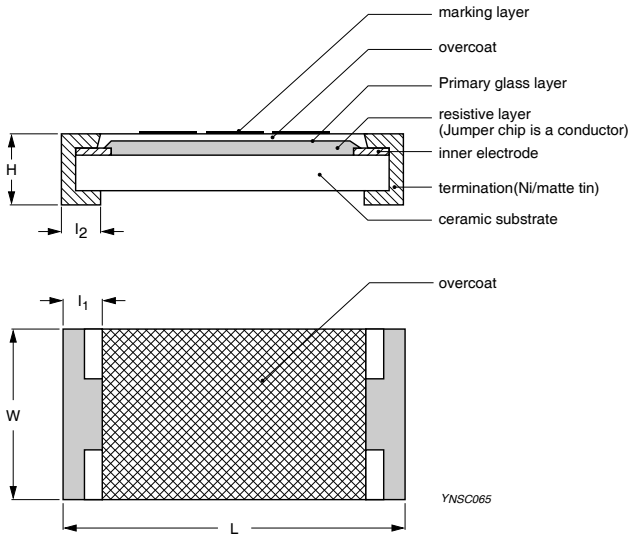

Fig. 4 Chip resistor outlines

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
	0.5% (E24/E96)	10 Ω to 1 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

1. 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)

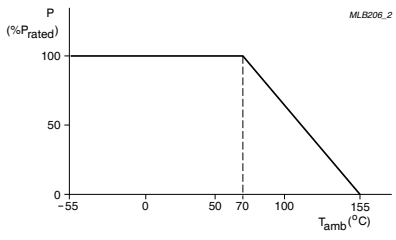

Fig. 5 Maximum dissipation (P) in percentage of rated power as a function of the operating ambient temperature (T_{amb})

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:** $T.C.R=\frac{R_2-R_1}{R_1(t_2-t_1)}\times 10^6$ (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%, 0.5% 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%, 0.5% 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%, 0.5% 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%, 0.5% 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%, 0.5% 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) <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%, 0.5% 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 Type: RC0603 Voltage (DC): 100 V	≥10 GΩ
Dielectric Withstand Voltage	IEC 60115-1 4.7	Maximum voltage (V_{rms}) applied for 1 minute Type: RC0603 Voltage (AC): 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 (Vrms) applied	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
Humidity	IEC 60115-1 4.21	Steady state for 1000 hours at 40 °C / 95% R.H. RCWV applied for 1.5 hours on and 0.5 hour off	±(1.0%+0.05 Ω) for 1%, 0.5% 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	±(1.0%+0.05 Ω) for 1%, 0.5% tol. ±(2.0%+0.05 Ω) for 5% tol. <100 mΩ for Jumper
Solderability - Wetting	IPC/JEDEC J-STD-002B test B	Electrical Test not required Magnification 50X SMD conditions: 1st step: method B, aging 4 hours at 155 °C dry heat 2nd step: leadfree solder bath at 245±3 °C Dipping time: 3±0.5 seconds	Well tinned (≥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	±(0.5%+0.05 Ω) for 1%, 0.5 tol. ±(1.0%+0.05 Ω) for 5% tol. <50 mΩ for Jumper No visible damage

REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 5	June 29, 2012		- Add 0.5% tolerance for RC0603 - update test method
Version 4	Apr 24, 2009	-	- Test Items and methods updated - Test requirements upgraded
Version 3	Jul 15, 2008	-	- 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	-	- 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.