

DATA SHEET

THIN FILM CHIP RESISTORS

High precision - high stability

RT series

0.05% TO 1%, TC 10 TO 50

sizes 0402/0603/0805/1206/
1210/2010/2512

RoHS compliant



SCOPE

This specification describes RT0402 to RT2512 high precision - high stability chip resistors with lead-free terminations made by thin film process.

APPLICATIONS

- Converters
- Printer equipment
- Server board
- Telecom
- Consumer

FEATURES

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

RT XXXX F X X XX XXXX L
(1) (2) (3) (4) (5) (6) (7)

(1) SIZE

0402 / 0603 / 0805 / 1206 / 1210 / 2010 / 2512

(2) TOLERANCE

W = $\pm 0.05\%$

B = $\pm 0.1\%$

C = $\pm 0.25\%$

D = $\pm 0.5\%$

F = $\pm 1\%$

(3) PACKAGING TYPE

R = Paper/PE taping reel

K = Embossed taping reel

(4) TEMPERATURE COEFFICIENT OF RESISTANCE

B = 10 ppm/ $^{\circ}\text{C}$

C = 15 ppm/ $^{\circ}\text{C}$

D = 25 ppm/ $^{\circ}\text{C}$

E = 50 ppm/ $^{\circ}\text{C}$

(5) TAPING REEL

07 = 7 inch dia. Reel

10 = 10 inch dia. Reel

13 = 13 inch dia. Reel

(6) 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".

(7) OPTIONAL CODE

L = optional symbol (Note)

Resistance rule of global part number	
Resistance code rule	Example
XXXX (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
XXXXR (100 to 976 Ω)	100R = 100 Ω
XKXX (1 to 9.76 K Ω)	1K = 1,000 Ω 9K76 = 9760 Ω
XMXX (1 to 9.76 M Ω)	1M = 1,000,000 Ω 9M76 = 9,760,000 Ω

ORDERING EXAMPLE

The ordering code of a RT0603 chip resistor, TC 50 value 56 Ω with $\pm 0.5\%$ tolerance, supplied in 7-inch tape reel is: RT0603DRE0756R(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. For matching traditional types with size codes, please refer to "Comparison table of traditional types and sizes".

GLOBAL PART NUMBER (PREFERRED)

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

I2NC CODE

2390 (1)	X (2)	XX (3)	X (4)	XXXX (5)	L (6)
START WITH (1)	TCR (2) (ppm/°C)	PACKING CODE BY SIZE (inch) (3)	TOL. (4) (%)	RESISTANCE RANGE	SYMBOL (NOTE)
2390	8 = ±10 7 = ±15 6 = ±25 4 = ±50	0402: 07 = 7" reel 27 = 10" reel 47 = 13" reel 0603: 04 = 7" reel 24 = 10" reel 44 = 13" reel 0805: 01 = 7" reel 21 = 10" reel 41 = 13" reel 1206: 11 = 7" reel 31 = 10" reel 51 = 13" reel 1210: 12 = 7" reel 32 = 10" reel 52 = 13" reel 2010: 15 = 7" reel 2512: 18 = 7" reel	7 = ±1 6 = ±0.5 5 = ±0.25 4 = ±0.1 3 = ±0.05	The remaining 4 digits represent the resistance value with the last digit indicating the multiplier as shown in the table of "Last digit of I2NC". 0402: $10\Omega \leq R < 121K\Omega$ 0603: $5.1\Omega \leq R \leq 681K\Omega$ 0805: $5.1\Omega \leq R \leq 1.5M\Omega$ 1206: $5.1\Omega \leq R \leq 1.5M\Omega$ 1210: $5.1\Omega \leq R \leq 1.5M\Omega$ 2010: $10\Omega \leq R \leq 1M\Omega$ 2512: $10\Omega \leq R \leq 1M\Omega$	"L" is optional symbol.

Exceptions to above packing code definitions:

0805 TC50 with 1%, supplied in 13" reel, the packing code is 02.

0603 TC50 with 1%, supplied in 13" reel, the packing code is 03.

2512 TC15, in 7" reel, the packing code is 35.

2010 TC15, in 7" reel, the packing code is 31.

ORDERING EXAMPLE

The ordering code of a TF221 resistor, TC50, value 56 Ω , with ±0.5% tolerance, supplied in tape of 5,000 units per reel is: 239040465609(L) or RT0603DRE0756R(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)

Comparison table of traditional types and sizes

TF (1)	X (2)	X (3)	X (4)
START WITH	SIZE CODE	TCR (ppm/°C)	TOL. (%)
TF	3 = 0402 2 = 0603 1 = 0805 0 = 1206 5 = 1210 7 = 2010 6 = 2512	4 = ±10 3 = ±15 1 = ±25 2 = ±50	0 = ±1 1 = ±0.5 2 = ±0.25 3 = ±0.1 4 = ±0.05

Example:

TF321 = RT0402, TC50, ±0.5% tolerance

Resistance decade (3)	Last digit
1 to 9.76 Ω	8
10 to 97.6 Ω	9
100 to 976 Ω	1
1 to 9.76 k Ω	2
10 to 97.6 k Ω	3
100 to 976 k Ω	4
1 to 9.76 M Ω	5
10 to 97.6 M Ω	6

Example: 1 Ω = 1008 or 108
33 k Ω = 3303 or 333
10 M Ω = 1006 or 106

MARKING

RT0805 / RT1206 / RT1210 / RT2010 / RT2512



Fig. 1 Value = 10 kΩ

Either resistance in E-24 or E-96: 4 digits

First three digits for significant figure and 4th digit for number of zeros

RT0603



Fig. 2 Value = 12 kΩ

E-24 series: 3 digits

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



Fig. 3 Value = 12.4 kΩ

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

RT0402 / RESISTANCE VALUE IS NOT IN E-24 / E96 SERIES



Fig. 4

No marking

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

CONSTRUCTION

The resistors are constructed out of a high-grade ceramic body. Internal metal electrodes are added at each end and connected by a resistive layer. The resistive layer is adjusted to give the approximate required resistance and laser cutting of this resistive layer that achieves tolerance trims the value. The resistive layer is covered with a protective coat and printed with the resistance value. Finally, the two external terminations (matte tin) are added. See fig. 5.

DIMENSION

Table I For outlines see fig. 5

TYPE	L (mm)	W (mm)	H (mm)	l ₁ (mm)	l ₂ (mm)
RT0402	1.00 ±0.10	0.50 ±0.05	0.30 ±0.05	0.20 ±0.10	0.25 ±0.10
RT0603	1.60 ±0.10	0.80 ±0.10	0.45 ±0.10	0.25 ±0.15	0.25 ±0.15
RT0805	2.00 ±0.10	1.25 ±0.10	0.50 ±0.10	0.35 ±0.20	0.35 ±0.20
RT1206	3.10 ±0.10	1.60 ±0.10	0.55 ±0.10	0.45 ±0.20	0.40 ±0.20
RT1210	3.10 ±0.10	2.60 ±0.15	0.55 ±0.10	0.50 ±0.20	0.50 ±0.20
RT2010	5.00 ±0.10	2.50 ±0.15	0.55 ±0.10	0.60 ±0.20	0.50 ±0.20
RT2512	6.35 ±0.10	3.20 ±0.15	0.55 ±0.10	0.60 ±0.20	0.50 ±0.20

OUTLINES

For dimension see Table I

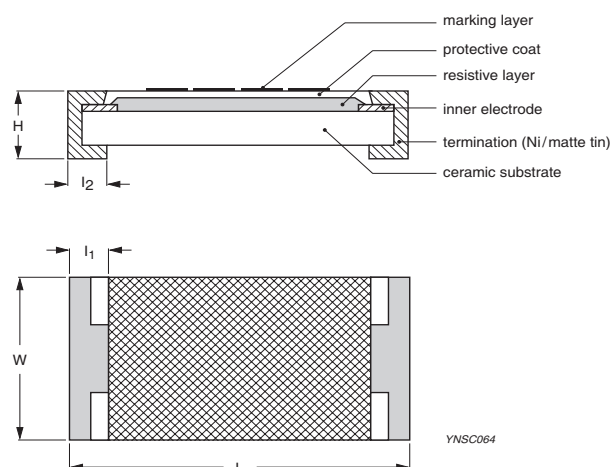


Fig. 5 Chip resistor outlines

ELECTRICAL CHARACTERISTICS

Table 2

TYPE	Operating Temperature Range	Power Rating	Max. Work Vol. ⁽¹⁾	Max. Overload Vol.	Dielectric Withstand Vol.	T.C.R. (ppm/°C)	Resistance Range (E-24/E-96 series) ⁽²⁾ & Tolerance				
							±0.05%	±0.1%	±0.25%	±0.5%	±1.0%
RT0402	-55 °C to +125 °C	1/16W	50V	100V	75V	±50	---	10~121k	10~121k	10~121k	10~121k
						±25	---	10~121k	10~121k	10~121k	---
						±15	---	10~100k	10~100k	---	---
						±10	---	10~100k	10~100k	---	---
RT0603	-55 °C to +125 °C	1/10W	75V	150V	100V	±50	---	10~681k	1~681k	1~681k	1~681k
						±25	1k~47k	10~681k	10~681k	10~681k	---
						±15	1k~47k	10~100k	10~100k	---	---
						±10	1k~47k	10~100k	10~100k	---	---
RT0805	-55 °C to +125 °C	1/8W	150V	300V	200V	±50	---	10~1.5M	1~1.5M	1~1.5M	1~1.5M
						±25	100~100k	10~1.5M	10~1.5M	10~1.5M	---
						±15	100~100k	10~100k	10~100k	---	---
						±10	100~100k	10~100k	10~100k	---	---
RT1206	-55 °C to +125 °C	1/8W	200V	400V	300V	±50	---	10~1.5M	1~1.5M	1~1.5M	1~1.5M
						±25	100~100k	10~1.5M	10~1.5M	10~1.5M	---
						±15	100~100k	10~100k	10~100k	---	---
						±10	100~100k	10~100k	10~100k	---	---
RT1210	-55 °C to +125 °C	1/4W	200V	400V	400V	±50	---	10~1M	1~1M	1~1M	1~1M
						±25	100~100k	10~1M	10~1M	10~1M	---
						±15	100~100k	10~100k	10~100k	---	---
						±10	100~100k	10~100k	10~100k	---	---
RT2010	-55 °C to +125 °C	1/2W	200V	400V	400V	±50	---	10~1M	10~1M	10~1M	10~1M
						±25	100~100k	10~1M	10~1M	10~1M	---
						±15	100~100k	10~100k	10~100k	---	---
						±10	100~100k	10~100k	10~100k	---	---
RT2512	-55 °C to +125 °C	3/4W	200V	400V	400V	±50	---	10~1M	10~1M	10~1M	10~1M
						±25	100~100k	10~1M	10~1M	10~1M	---
						±15	100~100k	10~100k	10~100k	---	---
						±10	100~100k	10~100k	10~100k	---	---

NOTES

1. The maximum working voltage that may be continuously applied to the resistor element, see "IEC publication 60115-8"
2. Value of E-192 series is on request

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

PACKING STYLE	REEL DIMENSION	RT0402	RT0603	RT0805	RT1206	RT1210	RT2010	RT2512
Paper/PE taping reel (R)	7" (178 mm)	10,000	5,000	5,000	5,000	5,000	---	---
	10" (254 mm)	20,000	10,000	10,000	10,000	10,000	---	---
	13" (330 mm)	50,000	20,000	20,000	20,000	20,000	---	---
Embossed taping reel (K)	7" (178 mm)	---	---	---	---	---	4,000	4,000

NOTE

1. For Paper/Embossed tape and reel specification/dimensions, please see the special data sheet “Packing” document.

FUNCTIONAL DESCRIPTION**POWER RATING**

Each type rated power at 70°C:

RT0402=1/16 W, RT0603=1/10 W, RT0805=1/8 W,
RT1206=1/8 W, RT1210=1/4 W, RT2010=1/2 W,
RT2512=3/4 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)

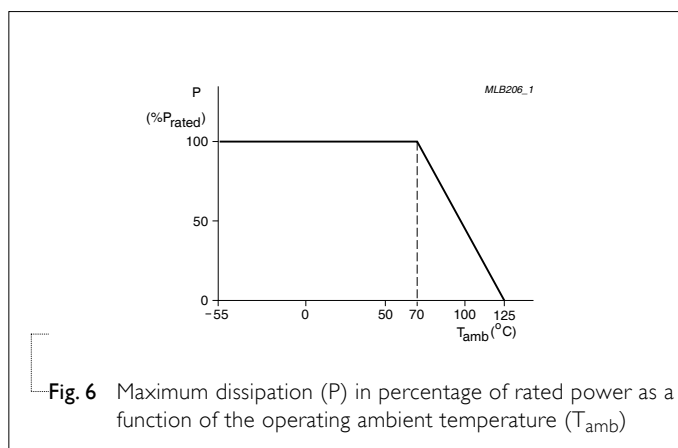


Fig. 6 Maximum dissipation (P) in percentage of rated power as a function of the operating ambient temperature (T_{amb})

TESTS AND REQUIREMENTS**Table 4** Test condition, procedure and requirements

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Life/ Operational Life/ Endurance	MIL-STD-202G-method 108A	1,000 hours at 70±5 °C applied RCWV	±(0.5%+0.05 Ω)
	IEC 60115-1 4.25.1	1.5 hours on, 0.5 hour off, still air required	
	JIS C 5202-7.10		
High Temperature Exposure/ Endurance at upper category temperature	MIL-STD-202G-method 108A	1,000 hours at maximum operating temperature	±(0.5%+0.05 Ω)
	IEC 60115-1 4.25.3	depending on specification, unpowered	
	JIS C 5202-7.11	No direct impingement of forced air to the parts Tolerances: 125±3 °C	
Moisture Resistance	MIL-STD-202G-method 106F	Each temperature / humidity cycle is defined at 8	±(0.5%+0.05 Ω)
	IEC 60115-1 4.24.2	hours (method 106F), 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	
Thermal Shock	MIL-STD-202G-method 107G	-55/+125 °C	±(0.5%+0.05Ω) for 10 KΩ to 10 MΩ ±(0.5%+0.05Ω) for others
		Note: Number of cycles required is 300. Devices unmounted	
		Maximum transfer time is 20 seconds. Dwell time is 15 minutes. Air – Air	
Short time overload	MIL-R-55342D-para 4.7.5	2.5 times RCWV or maximum overload voltage	±(0.5%+0.05Ω) No visible damage
	IEC60115-1 4.13	whichever is less for 5 sec at room temperature	
Board Flex/ Bending	IEC60115-1 4.33	Device mounted on PCBoard as described, only 1	±(0.5%+0.05Ω) No visible damage
		board bending required	
		3 mm bending Bending time: 60±5 seconds Ohmic value checked during bending	

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Solderability			
- Wetting	IPC/JEDECJ-STD-002B test B IEC 60068-2-58	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 (≥95% covered) No visible damage
- Leaching	IPC/JEDECJ-STD-002B test D IEC 60068-2-58	Leadfree solder, 260 °C, 30 seconds immersion time	No visible damage
- Resistance to Soldering Heat	MIL-STD-202G-method 210F IEC 60068-2-58	Condition B, no pre-heat of samples. Leadfree solder, 270 °C, 10 seconds immersion time Procedure 2 for SMD: devices fluxed and cleaned with isopropanol	±(0.5%+0.05Ω) No visible damage

REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 3	May 30, 2008	-	- Change to dual brand datasheet that describe RT0402 to RT2512 with RoHS compliant - Description of "Halogen Free Epoxy" added - Define global part number - Modify electrical characteristic.
Version 2	Dec 26, 2005	-	- New datasheet for thin film high precision - high stability chip resistors sizes of 0201/0402/0603/0805/1206/1210/2010/2512, 1%, 0.5%, 0.25%, 0.1%, 0.05%, TC25/50 with lead-free terminations - Replace the 0402 to 1210 parts of pdf files: TFX10_1_1, TFX11_5_2, TFX12_25_2, TFX13_1_3, TFX14_05_1, TFX20_1_2, TFX21_5_2, TFX22_25_2, TFX23_1_2, TFX24_05_1, and combine into a document. - Test method and procedure updated - PE tape added (paper tape will be replaced by PE tape)

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