

DATA SHEET

THIN FILM CHIP RESISTORS High precision - high stability

> RT series 0.01% TO 1%, TCR 5 TO 50 sizes 0201/0402/0603/0805/1206/

1210/2010/2512

RoHS compliant



YAGEO Phi(comp



SCOPE

This specification describes RT series high precision - high stability chip resistors with lead-free terminations made by thin film process.

<u>APPLICATIONS</u>

- Converters
- · Printing equipment
- Server board
- Telecom
- Consumer

FEATURES

- Halogen Free Epoxy
- RoHS compliant
- Reducing environmentally hazardous wastes
- High component and equipment reliability
- Saving of PCB space
- None forbidden-materials used in products/production

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)

RT XXXX F X X XX XXXX L

(1) (2) (3) (4) (5) (6) (7

(I) SIZE

0201/0402/0603/0805/1206/1210/2010/2512

(2) TOLERANCE

 $L = \pm 0.01\%$

 $P = \pm 0.02\%$

 $W = \pm 0.05\%$

 $B = \pm 0.1\%$

 $C = \pm 0.25\%$

 $D = \pm 0.5\%$

 $F = \pm 1\%$

(3) PACKAGING TYPE

R = Paper/PE taping reel

K = Embossed taping reel

(4) TEMPERATURE COEFFICIENT OF RESISTANCE

 $A = 5 ppm/^{\circ}C$

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

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

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

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

(5) TAPING REEL

07 = 7 inch dia. Reel

10 = 10 inch dia. Reel

13 = 13 inch dia, Reel

7W= 7 inch dia. Reel with high power (1W for 2512)

(6) RESISTANCE VALUE

There are $2\sim4$ digits indicated the resistor value. Letter R/K/M is decimal point. Detailed resistance rules show in table of "Resistance rule of global part number".

(7) DEFAULT CODE

Letter L is system default code for order only (Note)

number Resistance code rule	Example
XRXX (I to 9.76 Ω)	IR = I Ω IR5 = I.5 Ω 9R76 = 9.76 Ω
XXRX (10 to 97.6 Ω)	IOR = IO Ω 97R6 = 97.6 Ω
XXXR (100 to 976 Ω)	100R = 100 Ω
XKXX (1 to 9.76 KΩ)	IK = 1,000 Ω 9K76 = 9760 Ω
XMXX (1 to 9.76 MO)	$IM = 1,000,000 \Omega$ $9M76 = 9.760,000 \Omega$

Resistance rule of global part

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: RT0603DRE0756RL.

NOTE

- All our RSMD products meet RoHS compliant and Halogen Free. "LFP" of the internal 2D reel label mentions "Lead Free Process"
- 2. On customized label, "LFP" or specific symbol can be printed



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.

12NC CODE

2390 (I)	X (2)	XX (3)	X (4)	XXXX (5)	L (6)
START WITH (I)	TCR ⁽²⁾ (ppm/°C)	PACKING CODE BY SIZE (inch) (3)	TOL. ⁽⁴⁾ (%)	RESISTANCE RANGE	DEFAULT CODE (NOTE)
2390	$8 = \pm 10$	0402: 07 = 7" reel	$7 = \pm 1$	The remaining 4 digits	Letter L is
	$7 = \pm 15$	47 = 13" reel	$6 = \pm 0.5$	represent the resistance	,
	$6 = \pm 25$	0603: 04 = 7" reel	$5 = \pm 0.25$	value with the last digit indicating the multiplier	
	$4 = \pm 50$	24 = 10" reel	$4 = \pm 0.1$	as shown in the table o	
		44 = 13" reel	$3 = \pm 0.05$	"Last digit of 12NC".	(Note)
		0805: 01 = 7" reel		$0402:4.7\Omega \le R \le 240K\Omega$!
		41 = 13" reel		0603: I $\Omega \le R \le IM\Omega$	
		1206: 11 = 7" reel		0805: $I\Omega \le R \le 1.5 M\Omega$	
		51 = 13" reel		1206: $I\Omega \le R \le 1.5 M\Omega$	
		1210: 12 = 7" reel		$1210:4.7\Omega \le R \le 1 M\Omega$	
		52 = 13" reel		$2010: 4.7\Omega \le R \le 1 M\Omega$	
		2010: 15 = 7" reel		2512: $4.7\Omega \le R \le 1 M\Omega$	
		2512: 18 = 7" reel			

Comparison table of traditional types and sizes										
TF (I)	X (2)	X (3)	<u>X</u> (4)							
START WITH	SIZE CODE	TCR (ppm/°C)	TOL. (%)							
TF	3 = 0402	$4 = \pm 10$	$0 = \pm 1$							
	2 = 0603	$3 = \pm 15$	$I = \pm 0.5$							
	I = 0805	$I = \pm 25$	$2 = \pm 0.25$							
	0 = 1206	$2 = \pm 50$	$3 = \pm 0.1$							
	5 = 1210		$4 = \pm 0.05$							
	7 = 2010									
	6 = 2512									
U Exar	nple:									

TF321 = RT0402, TC50, $\pm 0.5\%$ tolerance

Resistance decade (3)	Last digit
I to 9.76 Ω	8
10 to 97.6 Ω	9
100 to 976 Ω	I
I to 9.76 kΩ	2
10 to 97.6 $k\Omega$	3
100 to 976 kΩ	4
I to 9.76 $M\Omega$	5
10 to 97.6 MΩ	6

Example:	ΙΩ	=	1008 or 108
	33 kΩ	=	3303 or 333
	IO MO	=	1006 or 106

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 $\pm 0.5\%$ tolerance, supplied in tape of 5,000 units per reel is: 239040465609L or RT0603DRE0756RL.

NOTE

- I. All our RSMD products meet RoHS compliant and Halogen Free. "LFP" of the internal 2D reel label mentions "Lead Free Process"
- 2. On customized label, "LFP" or specific symbol can be printed



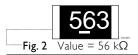
RT

MARKING

RT0201 / RT0402 / RESISTANCE VALUE IS NOT IN E-24 / E96 SERIES



RT0603

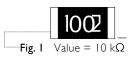


E-24 series: exception values 10/11/13/15/20/75 of E-24 series, one short bar under marking letter



E-96 series: including values 10/11/13/15/20/75 of E-24 series, 3 digits

RT0805 / RT1206 / RT1210 / RT2010 / RT2512



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

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

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

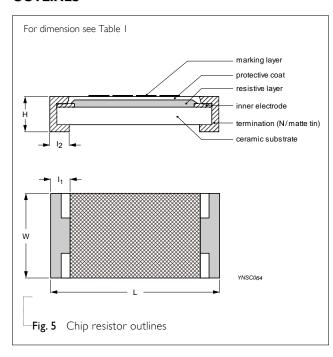
CONSTRUCTION

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)	I _I (mm)	I ₂ (mm)				
RT0201	0.60 ±0.03	0.30 ±0.03	0.23 ±0.03	0.10 ±0.05	0.15 ±0.05				
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



Product specification

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Chip Resistor Surface Mount | RT | SERIES | 0201 to 2512 (RoHS Compliant)

ELECTRICAL CHARACTERISTICS

Table 2

TYPE	Operating Temperature	Power Rating	Max. Work		Dielectric Withstand	T.C.R. (ppm/°C			Resist	ance Range	(E-24/E-96	series)(2)	& Tolerand
	Range	Kaung	Vol. (I)	Vol.	Vol.	(ppm/ C	±0.01%	±0.02%	±0.05%	±0.1%	±0.25%	±0.5%	±1.0%
						±50				22~75K	22~75K	22~75K	22~75K
	−55°C					±25				22~75K	22~75K	22~75K	22~75K
RT0201	-55 C	1/20W	25V	50V	50V	±15				22~5K	22~5K		
	+125°C	., 2011	20 ,	301	301	±10				22~5K	22~5K		
						±5							
						±50	50.1~12K	50.1~12K	20~12K		4.7~240K		
						±25	50.1~12K	50.1~12K	20~12K		4.7~240K		
RT0402		1/16W	50\/	100V	75V	±15	20~12K	20~12K	20~12K	20~200K			
		1710**	301	100 V	754	±10	20~12K	20~12K	20~12K		20~200K		
						±5	20~10K	20~10K	20~10K	20~10K	20~10K		
	_					±50	50.1~30K	50.1~30K	4.7~100K	I~IM	I~IM	~ M	I~IM
						±25	50.1~30K	50.1~30K	4.7~100K	I~IM	I~IM	I~IM	1~1M
RT0603		1/10W	75V	150V	100V	±15	50.1~100K	50.1~100K	4.7~100K	4.7~680K	4.7~680K		
		171011	751	130 1	1001	±10	50.1~100K	50.1~100K	4.7~100K	4.7~680K	4.7~680K		
	−55°C					±5	20~30K	20~30K	20~30K	20~30K	20~30K		
	to					±50	50.1~30K	50.1~30K	4.7~200K	I~1.5M	I~I.5M	I~I.5M	I~1.5M
	+155°C					±25	50.1~30K	50.1~30K	4.7~200K	I~I.5M	I~I.5M	I~I.5M	I~I.5M
RT0805		1/8W	150V	300V	200V	±15	50.1~200K	50.1~200K	4.7~200K	4.7~IM	4.7~IM		
						±10	50.1~200K	50.1~200K	4.7~200K	4.7~IM	4.7~IM		
						±5	20~50K	20~50K	20~50K	20~50K	20~50K		
	=					±50	50.1~30K	50.1~30K	5.6~500K	1~1.5M	I~I.5M	1~1.5M	I~1.5M
						±25	50.1~30K	50.1~30K	5.6~500K	1~1.5M	1~1.5M	1~1.5M	I~1.5M
RT1206		1/4W	200V	400V	300V	±15	50.1~500K	50.1~500K	5.6~500K	5.6~1.5M	5.6~1.5M		
						±10	50.1~500K	50.1~500K	5.6~500K	5.6~1.5M	5.6~1.5M		
						±5	20~100K	20~100K	20~100K	20~100K	20~100K		
						±50			4.7~IM	4.7~IM	4.7~IM	4.7~IM	4.7~IM
						±25			4.7~IM	4.7~IM	4.7~IM	4.7~IM	4.7~IM
RT1210		1/4W	200V	400V	400V	±15			100~100K	4.7~100K	4.7~100K		
						±10			100~100K	4.7~100K	4.7~100K		
						±5							
	-					±50			4.7~IM	4.7~IM	4.7~IM	4.7~IM	4.7~IM
						±25			4.7~IM	4.7~IM	4.7~IM	4.7~IM	4.7~IM
RT2010	−55°C	1/2W	200V	400V	400V	±15			100~100K	4.7~100K	4.7~100K		
	-55 C to	1/2//	2001	100 (1001	±10			100~100K	4.7~100K	4.7~100K		
	+125°C					±5							
	=					±50			4.7~IM	4.7~IM	4.7~IM	4.7~IM	4.7~IM
						±25			4.7~IM	4.7~IM	4.7~IM	4.7~IM	4.7~IM
		3/4W	2001/	400V	400V	±15			100~100K		4.7~100K		
RT2512		JI I V V	200 V	100 V	100 4	±10			100~100K	4.7~100K			
2312													
						±5							
		IW	200V	400V	400V	±50			10Ω~IM	10Q~IM	10Ω~IM	10Q~IM	10Q~1M
				'	1	±25			10Ω~1M	10Ω~IM	10Ω~IM	10Ω~IM	10Ω~IM

NOTE

- 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



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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	RT0201	RT0402	RT0603	RT0805	RT1206	RT1210	RT2010	RT2512
Paper/PE taping reel (R)	7" (178 mm)	10,000	10,000	5,000	5,000	5,000	5,000		
	10" (254 mm)	20,000	20,000	10,000	10,000	10,000	10,000		
	13" (330 mm)	50,000	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 "Chip resistors packing"

FUNCTIONAL DESCRIPTION

POWER RATING

Each type rated power at 70°C: RT0201=1/20W, RT0402=1/16W, RT0603=1/10W, RT0805=1/8W, RT1206=1/4W, RT1210=1/4W, RT2010=1/2W, RT2512=3/4W, IW

RATED VOLTAGE

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

$$V = \sqrt{(P \times R)}$$

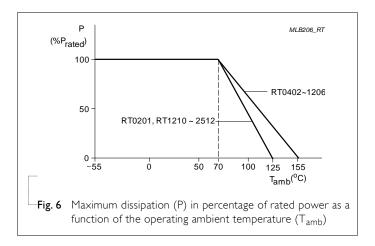
or max. working voltage whichever is less

Where

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

P=Rated power (W)

R=Resistance value (Ω)



TESTS AND REQUIREMENTS

Table 4 Test condition, procedure and requirements

TEST TEST METHOD P		PROCEDURE	REQUIREMENTS		
Temperature Coefficient of	MIL-STD-202 Method 304	At +25/–55 °C and +25/+125 °C	Refer to table 2		
Resistance (T.C.R.)		Formula:			
(1.0)		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 _I =resistance at reference temperature in ohms			
		R ₂ =resistance at test temperature in ohms			
Life/Endurance	IEC 60115-1 4.25.1 MIL-STD-202 Method 108A	At 70±5 °C for 1,000 hours, RCWV applied for 1.5 hours on, 0.5 hour off, still air required	±(0.5%+0.05 Ω)		
High Temperature Exposure	IEC 60068-2-2	1000 hours at maximum operating temperature depending on specification, unpowered	±(0.5%+0.05 Ω)		
Moisture Resistance	MIL-STD-202 Method 106G	Each temperature / humidity cycle is defined at 8 hours, 3 cycles / 24 hours for IOd. with 25 °C / 65 °C 95% R.H, without steps 7a & 7b, unpowered	±(0.5%+0.05 Ω)		
		Parts mounted on test-boards, without condensation on parts			
		Measurement at 24±2 hours after test conclusion			
Thermal Shock	MIL-STD-202 Method 107G	-55/+125 °C Number of cycles required is 300.	$\pm (0.5\% + 0.05~\Omega)$ for 10 K Ω to 10 M Ω		
		Devices mounted	$\pm (0.5\% + 0.05 \ \Omega)$ for others		
		Maximum transfer time is 20 seconds. Dwell time is 15 minutes, Air – Air			
Humidity (steady state)	IEC 60115-1 4.24.2	Steady state for 1000 hours at 40 °C / 95% R.H. RCWV applied for 1.5 hours on and 0.5 hour off	±(0.5%+0.05 Ω)		
(Secardy States)					

Chip Resistor Surface Mount RT SERIES 0201 to 2512 (RoHS Compliant)

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Short Time Overload	IEC60115-1 4.13	2.5 times of rated voltage or maximum	±(0.5%+0.05 Ω)
		overload voltage whichever is less for 5 sec at room temperature	No visible damage
Board Flex/ Bending	IEC 60115-1 4.33	Chips mounted on a 90mm glass epoxy resin	±(0.25%+0.05 Ω)
bending		PCB (FR4)	No visible damage
		Bending: see table 6 for each size Bending time: 60±5 seconds	
Insulation Resistance	IEC 60115-1 4.6	Rated continuous overload voltage (RCOV) for I minute	≥10 GΩ
		Details see below table 5	
Dielectric Withstand Voltage	IEC 60115-1 4.7	Maximum voltage (V _{rms}) applied for 1 minute	No breakdown or flashover
Solderability		Electrical Test not required	Well tinned (≥95%
- Wetting	J-STD-002 test B	Magnification 50X	covered)
		SMD conditions:	No visible damage
		I 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	
- Leaching	J-STD-002 test D	Leadfree solder, 260 °C, 30 seconds immersion time	No visible damage
- Resistance to	IEC 60115-1 4.18	Condition B, no pre-heat of samples.	±(0.5%+0.05 Ω)
Soldering Heat		Leadfree solder, 260 °C, 10 seconds immersion time	No visible damage
		Procedure 2 for SMD: devices fluxed and cleaned with isopropanol	

Table 5	Criteria	of rated	continued	working	voltage	and a	overload volt	age

TYPE	RT0201	RT0402	RT0603	RT0805	RT1206	RT1210	RT2010	RT2512
Voltage (DC/unit: V); (AC/ unit: V _{rms})	50	100	100	300	500	500	500	500

7	Table	6	Ranc	ling	for	sizes	020	٦١ -	to ?	51	7
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TYPE	RT0201	RT0402	RT0603	RT0805	RT1206	RT1210	RT2010	RT2512
Specification (mm)	5	5	3	3	2	2	2	2

Chip Resistor Surface Mount RT SERIES 0201 to 2512 (RoHS Compliant)

REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 12	Apr. 21, 2020	-	- Modified resistance range
Version II	July 2, 2019	-	- Add IW for 2512
Version 10	Jun. 12, 2019	=	- Extend resistor value
Version 9	Sep. 12, 2017	=	- Add ±0.02% tol. for 0402 to 1206
Version 8	May 31, 2017	-	- Add 10" packing
Version 7	Jan. 17, 2017	-	- Add ±0.01% tol. for 0402 to 1206
Version 6	May. 11, 2015	-	- Extend resistor value
Version 5	Aug. 22, 2014	-	- Add RT0201
			- RT0402/0603/0805/1206: resistance range and operating temperature range updated
			- Fig. 6 updated
Version 4	Oct 21, 2009	-	- Test Items and methods updated
			- Test requirements upgraded
Version 3	Jul 11, 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, TFx115_2, TFx1225_2, TFx131_3, TFx1405_1, TFx20_1_2, TFx215_2, TFx2225_2, TFx231_2, TFx2405_1, and combine into a document.
			- Test method and procedure updated
			- PE tape added (paper tape will be replaced by PE tape)

[&]quot;Yageo reserves all the rights for revising the content of this datasheet without further notification, as long as the products itself are unchanged. Any product change will be announced by PCN."