

DATA SHEET

THIN FILM CHIP RESISTORS
High precision - high stability

RT series

0.01% to 1%, TCR 5 to 50

sizes 0100/ 0201/ 0402/ 0603/ 0805/ 1206/ 1210/ 2010/ 2512

RoHS compliant



YAGEO





SCOPE

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

APPLICATIONS

- 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)

SERIES

RT XXXX F X X XX XXXX L

(2) (3) (4) (5)

(I) SIZE

RT0100 / 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 2~4 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 (1 to 9.76 Ω)	IR = I Ω IR5 = I.5 Ω 9R76 = 9.76 Ω
XXRX	10R = 10 Ω
(10 to 97.6 Ω)	97R6 = 97.6 Ω
XXXR (100 to 976 Ω)	100R = 100 Ω
XKXX	IK = 1,000 Ω
(1 to 9.76 KΩ)	9K76 = 9760 Ω
XMXX	$IM = 1,000,000 \Omega$
(I to 9.76 MΩ)	$9M76 = 9,760,000 \Omega$

Resistance rule of global part

ORDERING EXAMPLE

The ordering code of a RT0603 chip resistor, TC 50 value 56 Ω with ±0.5% tolerance, supplied in 7-inch tape reel is: 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





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)	<u>X</u> (4)	XXX (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 of	
		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: $1\Omega \le R \le 1.5 M\Omega$	
		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			

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Exceptions	LU ADUVE	Dacking	LOUE !	uenniuons.
		F 0		

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: 239040465609L or RT0603DRE0756RL.

Comparison table of traditional	
types and sizes	

(l)	(2)	(3)	<u>X</u> (4)
START WITH	SIZE CODE	TCR (ppm/°C)	
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		
1) Evan	nala:		

• Example:

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	1
I to 9.76 kΩ	2
10 to 97.6 kΩ	3
100 to 976 kΩ	4
I to 9.76 MΩ	5
10 to 97.6 MΩ	6

Example: ΙΩ 1008 or 108 **33** kΩ 3303 or 333 =

> $10 \, \mathrm{M}\Omega$ = 1006 or 106

NOTE

- 1. 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



4

9

MARKING

RT0100 / RT0201 / RT0402 / RESISTANCE VALUE IS NOT IN E-24 / E96 SERIES



No marking

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

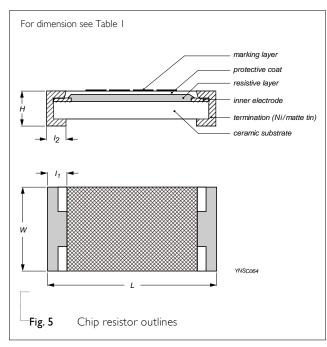
The resistors are constructed out of a high-grade ceramic body. Internal metal electrodes are added at each end and connected by a resistive layer. The resistive layer is adjusted to give the approximate required resistance and laser cutting of this resistive layer that achieves tolerance trims the value. 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)
RT0100	0.40±0.02	0.20±0.02	0.13±0.02	0.10±0.03	0.10±0.03
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





SERIES

ELECTRICAL CHARACTERISTICS

Table 2

140.			Marri	.,									
TYPE	Operating Temperature	Power Rating	Max. Work	Max. Overload	T.C.R. (ppm/°C))	Resis	tance Range (E	-24/E-96 series)(2) & Tolera	nce		Unit weigh (mg/pcs)
	Range	0	Vol. (1)	Vol.	urr · -,	±0.01%	±0.02%	±0.05%	±0.1%	±0.25%	±0.5%	±1.0%	,
D.T.O.O.O.	−55°C	1/22\4/	15)/	2017	±50				50R~5K	50R~5K	50R~5K	50R~5K	- 0.037
RT0100	to +125°C	1/32W	157	30V	±25				50R~5K	50R~5K	50R~5K	50R~5K	0.037
					±50				22~75K	22~75K	22~75K	22~75K	
	−55°C				±25				22~75K	22~75K	22~75K	22~75K	-
RT0201	to	1/20W	25V	50V	±15				22~5K	22~5K			0.169
1110201	+125°C	., 20	20.		±10				22~5K	22~5K			_
					±5								=
					±50	50,1~12K	50.1~12K	20~12K	4.7~500K		4.7~500K	47~500K	
					±25	50.1~12K	50.1~12K	20~12K	4.7~240K		4.7~240K		=
RT0402		1/16W	50V	100V	±15	20~12K	20~12K	20~12K	10~200K	10~200K			0.564
					±10	20~12K	20~12K	20~12K	10~200K	10~200K			_
	_				±5	20~10K	20~10K	20~10K	20~10K	20~10K			
					±50	50.1~30K	50.1~30K	4.7~100K	1~2M	I~2M	I~2M	I~2M	_
					±25	50.1~30K	50.1~30K	4.7~100K	1~IM	1~IM	I~IM	I~IM	- 2.120
RT0603		1/10W	75V	150V	±15	50.1~100K	50.1~100K	4.7~100K	4.7~680K	4.7~680K			2.128
	−55°C				±10 ±5	50.1~100K 20~30K	50.1~100K 20~30K	4.7~100K 20~30K	4.7~680K 20~30K	4.7~680K 20~30K			-
-	- to	-			±50	50.1~30K	50.1~30K	4.7~200K	1~3M	1~3M	I~3M	I~3M	
	+155°C				±25	50.1~30K	50.1~30K	4.7~200K	I~I,5M	1~1.5M	1~1.5M	1~1.5M	=
RT0805		1/8W	150V	300V	±15	50.1~200K	50.1~200K	4.7~200K	4.7~IM	4.7~IM			4.642
					±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	1~3M	1~3M	I~3M	1~3M	=
					±25	50.1~30K	50.1~30K	5.6~500K	I~I.5M	I~1.5M	I~1.5M	I~I.5M	
RT1206		1/4W	200V	400V	±15	50.1~500K	50.1~500K	5.6~500K	5.6~1.5M	5.6~1.5M			9.996
					±10 ±5	50.1~500K 20~100K	50.1~500K 20~100K	5.6~500K 20~100K	5.6~1.5M 20~100K	5.6~1.5M 20~100K			-
							20 TOOK	4.7~IM	4.7~IM	4.7~IM	4.7~IM	4.7~IM	
					±50 ±25			4.7~IM	4,7~IM	4.7~IM	4,7~IM	4.7~IM	=
DTIOIO		1/4\4/	2001/	400\/				100~100K	4.7~100K	4.7~100K			- 16.370
RT1210		1/4W	200V	400V	±15			100~100K	4.7~100K	4.7~100K			- 10.570
					±10				T,7 TOOK				_
	=				±5			47 184	47 184	47 114	47 184	47 114	
					±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	±15			100~100K	4.7~100K	4.7~100K			25.011
	to				±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	200V	400V	±15			100~100K	4.7~100K	4.7~100K			=
RT2512					±10			100~100K	4.7~100K	4.7~100K			- 40.351
					±5								_
					±50			10Ω~IM	10Ω~IM		10Ω~IM		=
		IW	200V	400V	-								=
					±25			10Ω~1M	10Ω~1M	1022~114	10Ω~IM	1022~114	

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



6 9

SERIES

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	RT0100	RT0201	RT0402	RT0603	RT0805	RT1206	RT1210	RT2010	RT2512
	DIMENSION									
Paper/PE taping reel (R)	7" (178 mm)	10,000	10,000	10,000	5,000	5,000	5,000	5,000		
	10" (254 mm)	20,000	20,000	20,000	10,000	10,000	10,000	10,000		
	13" (330 mm)	50,000	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: RT0100=1/32W 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:

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

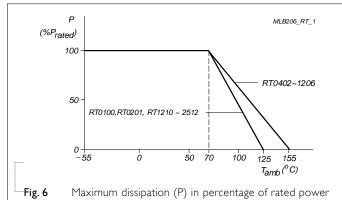
or max. working voltage whichever is less

Where

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

P=Rated power (W)

R=Resistance value (Ω)



as a function of the operating ambient temperature (T_{amb})

SERIES



Chip Resistor Surface Mount

TESTS AND REQUIREMENTS

Table 4 Test condition, procedure and requirements

TEST	TEST METHOD	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, rated voltage 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 10d. 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. Devices mounted	±(0.5%+0.05 Ω)
		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. rated voltage applied for 1.5 hours on and 0.5 hour off	±(0.5%+0.05 Ω)



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/	IEC 60115-1 4.33	Chips mounted on a glass epoxy resin PCB	±(0.25%+0.05 Ω)
Bending		(FR4)	No visible damage
		Bending: see table 5 for each size	RT0100±(0.5%+0.05 Ω)
		Bending time: 60±5 seconds	
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 P. no pus heat of consilir	1 (0 E9/ 1 0 0 E O)
Soldering Heat	IEC 60115-1 4.18	Condition B, no pre-heat of samples. Leadfree solder, 260 °C, 10 seconds	±(0.5%+0.05 Ω)
Joidel IIIg I Icat		immersion time Procedure 2 for SMD: devices fluxed and	No visible damage
		i locedure 2 for 31 ID, devices fluxed and	

SERIES

0100 to 2512

Table 5 Bending for sizes 0100 to 2512

TYPE	RT0100	RT0201	RT0402	RT0603	RT0805	RT1206	RT1210	RT2010	RT2512
Specification (mm)	5	5	5	3	3	2	2	2	2

cleaned with isopropanol



SERIES

0100 to 2512

REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 15	Mar. 13, 2023	-	- RT0402 extend resistance range
Version 14	Nov. 23, 2022	-	- Add unit weight information
Version 13	July 07, 2022	-	- RT0402/RT0603/RT0805/RT1206 Extend resistor range - Add RT0100
Version 12	Apr. 21, 2020	-	- Modified resistance range
Version 11	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, 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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RT0603BRD0710KL RT0603BRD0712K4L RT0603BRD072K67L RT0603BRD0749R9L RT0603FRE0710K2L RT0603FRE071K78L RT0603FRE072K7L RT0603FRE0733KL RT0603FRE07348RL RT0603FRE075K49L RT0603FRE076K2L RT0805BRD0722K6L RT0805BRD0724K9L RT0805BRD072K67L RT1206BRD07100KL RT1206BRD07100RL RT1206BRD0710K5L RT1206BRD0710KL RT1206BRD0712KL RT1206BRD0715KL RT1206BRD0720KL RT1206BRD0726K1L RT1206BRD072KL RT1206BRD07301RL RT1206BRD0730K1L RT1206BRD0731K6L RT1206BRD07357KL RT1206BRD073K01L RT1206BRD073K74L RT1206BRD07442RL RT1206BRD0744K2L RT1206BRD07475KL RT1206BRD0749K9L RT1206BRD0749R9L RT1206BRD074K99L RT1206BRD0756K2L RT1206BRD0775KL RT1210BRD07120RL RT0402BRD07100KL RT0402FRE0712K1L RT0603FRE0711KL RT0603FRE07150KL RT0603FRE0719K1L RT0603FRE072K21L RT0603FRE0768KL RT0603FRE078R25L RT0805BRD071K4L RT0805BRD072K74L RT0805BRD072K8L RT0805BRD0720KL RT0805BRD0722K1L RT0805BRD07402RL RT0805BRD0793R1L RT0402DRE078K87L RT0603BRD0710K5L RT0603FRE073K92L RT0603FRE0717K4L RT0603DRE071KL RT0603DRE07100KL RT0603BRD07267KL RT0603BRD07118KL RT0603BRD07196KL RT0603BRD0764K9L RT0805BRD071K1L RT0805BRD0712K1L RT0805BRD07121KL RT0805BRD0713KL RT0805BRD07154KL RT0805BRD07178KL RT0805BRD0727KL RT0805BRD07287KL RT0805BRD0747KL RT0805BRD0788K7L RT0805BRD079K09L RT0805BRD076K34L RT0805BRD0795K3L RT0603BRD0724KL RT0603FRE0712KL RT0805BRD07681KL RT0603BRD071K07L RT0603BRD071K65L RT0603BRD071K87L RT0603BRD075K49L RT0603BRD071K4L RT0603BRD071K37L RT0603FRE076K49L RT0805BRD071ML RT0402BRD071KL RT0402BRD071K5L RT0603BRD0712K7L RT0603BRD0714K7L RT0402BRD0747K5L RT0603FRE0724K9L RT0603BRD0712K1L RT1206BRD0782KL RT0603BRD0717K4L RT0805BRD07121RL RT0805BRD07232KL RT0805BRD076K04L RT0805FRE072K43L