

# Thin Film Products Components

Thin film surface mount resistors



Current sensing surface mount resistors



Thick film surface mount resistors



Power choke coils

High frequency surface mount components

Sample kits



## Using Susumu's products means being "eco-friendly"

- The thin film process uses the least amount of resistive material among all the resistor producing processes.
- Compared to other resistor-producing processes, the thin film process employs fewer sintering and curing processes and as well as using a lower temperature. Therefore, it utilizes less power and has a smaller carbon footprint.
- Susumu's thin film products are small without losing functionality. They contribute to conserving the earth's resources.
- Because Susumu uses environmentally low impact processes and products, you can be assured that by using Susumu products, you are contributing to environmental protection.



## Susumu's products are made of "thin film" and are "eco-friendly"

Susumu's products are all RoHS compliant and totally lead-free even within the RoHS exempted areas where lead can be utilized. Some of Susumu's products are halogen-free as well.

■ The logos below are used for labeling products throughout this catalogue. \_\_\_\_\_



■ **About REACH** \_\_\_\_\_

- REACH was established by the European Chemical Agency (ECHA) in 2007 in order to manage the risk that chemicals pose to health and the environment. REACH stands for **R**egistration, **E**valuation, and **A**uthorization of **C**hemicals.

**73 Substances listed in SVHC.(Updated in Feb 2011)**

### Typical composition of RG/RM products

Materials	Weight (wt%)						RoHS restricted material composition						
	RG1005	RG1608	RG2012	RG3216	RM2012	RM3216	Heavy metal				PBB	PBBE	
							Cadmium	Lead	Mercury	Hexavalent Chromium			
Substrate	83.2	87	87.6	89.5	87.8	92.86	< 1ppm	< 1ppm	< 5ppm	< 1ppm	Not detected	Not detected	
Resistive material	0.02	0.02	0.02	0.02	0.02	0.02	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	
Inner electrode	0.65	0.13	0.11	0.15	0.15	0.1	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	
Intermediate electrode	8.33	5.82	5.58	4.83	5.87	2.96	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	
Outer electrode	5.45	3.81	3.66	3.16	3.84	1.94	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	
Protective coating	A						Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	
	B	2.35	2.88	2.67	2.06	1.95	1.87	< 2ppm	< 2ppm	< 2ppm	< 2ppm	< 5ppm	< 5ppm
	C							< 5ppm	< 10ppm	< 1ppm	< 6ppm	Not detected	Not detected
Marking ink	—	0.34	0.36	0.28	0.37	0.25	< 2ppm	7ppm	< 2ppm	< 2ppm	< 2ppm	Not detected	
Product weight	0.72mg	2.07mg	4.12mg	8.26mg	4.11mg	7.96mg							

Some of our products' life span is quite long, therefore contributes to the efficient use of resources.

Examples: RG series, **P.07** RM series **P.09**

- In addition to our reliable precision RR series, we also offer the RG series which has a life span that is 8 times longer than that of the RR series. Under normal temperature and humidity, the RG series is expected to drift less than 0.1% after 116 years.

### Comparison of RR vs. RG

Resistor type	Series name	Criteria	Years
Metal thin film chip resistor	RG series	0.1% drift	over 116 years
	RR series		14 years

Test conditions: 85°C, 85% RH, 10% of rated power, 90min. on; 30min. off

The use of thin film technology enabled Susumu to make smaller products resulting in the conservation of resources.

Examples: RL series Comparison with our conventional products, unit: mm

Power	Conventional size	RL	Area ratio
0.1W	1.6×0.8	1.0×0.5	about 1/2.5
1W	6.4×3.2	3.7×2.0	about 1/4
2W	11.5×7.0	7.5×2.0	about 1/5

Examples: RG series Comparison with our conventional products, unit: mm

Power	Conventional size	RGH	Area ratio
1/8W	1.6×0.8	1.0×0.5	about 1/4
1/4W	3.2×1.6	2.0×1.25	about 1/2

Together, the Susumu group companies are striving to manufacture environmentally friendly products in order to maintain the earth's sustainability.

### Susumu group's ISO 14001 certification status

Company	Facility	Certification date	Certification body	Certification #
Susumu Co. Ltd	Obama factory	2000.12.15	JQA	EM1184
	headquarters, all sales offices			
Yokohama Denshi Seiko	Niigata factory	2001.03.09	JQA	EM1388
Cyntec	Hsin-Chu (Taiwan)	2002.08.26	UL	A11463
	Suzhou (China)	2003.10.22	UL	A11463

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In order for customers to choose the best parts for their requirements, the following pages contain tables that provide an outline for each product series. For details, please refer to the specification pages or contact our sales office.  
All RoHS compliant products(with Sn termination) withstand threesoldering cycles at 260 °C or 10 seconds at 260 °C, have an MSL of 1, meet J-STD-020C, and compatible with SnPb soldering process.
- Selection guide . . . . . 05
- Table for E series resistant values; table for 3 letter designation of E96 resistive value; handling care for our products. . . . . 06
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- International sales offices . . . . . 29

Product group	New series name	Old series name	Rated power (W)							Resistance tolerance (%)							Environmental compliance					Specification pages
			1/32	1/20	1/16	1/10	1/8	1/6	1/4	±0.02	±0.05	±0.1	±0.25	±0.5	±1.0	±20	EU-RoHS	REACH SVHC 15	CHINA RoHS	Pb free	Halogen free	
Thin film surface mount resistors	Metal film chip resistors (ultra precision)																		07-08			
	RGseries	RGseries	●		●	●			●	●	●	●	●			●	●	●		●	●	
	RGseries	RGHseries					●	●	●				●			●	●	●	●	●		
	Metal film chip resistor networks																		09-10			
	RMseries	—		●	●	●					●	●	●			●	●	●		●	●	
	Metal film chip resistors (precision)																		11			
	RRseries	—		●	●	●	●		●			●	●	●		●	●	●		●	●	
Metal film trimmable chip resistors																		12				
RTseries	—		●	●	●										●	●	●		●	●		

Product group	New series name	Old series name	Rated power (W)													Resistance tolerance (%)				Environmental compliance					Specification pages				
			1/8	1/6	1/5	1/4	1/3	1/2	2/3	3/4	1	1.5	2	3	4	5	6	±0.5	±1.0	±2.0	±5.0	EU-RoHS	REACH SVHC 15	CHINA RoHS		Pb free	Halogen free		
Current sensing surface mount resistors	Low resistance chip resistors (long-side terminal)																		13-14										
	PRLseries	—					●		●								●	●		●	●	●	●	●	●	●	●	●	●
	RLseries	—																							●	●	●	●	
	Low resistance chip resistors (short-side terminal)																		15-16										
	RLseries	RLseries	●	●	●	●	●			●								●		●	●	●	●	●	●	●	●	●	●
	RLseries	RPseries			●	●																			●	●	●	●	
	Metal foil surface mount low resistance chip resistors (long-side terminal)																		17										
	KRLseries	—																											
	Metal foil surface mount low resistance chip resistors (short-side terminal)																		18										
	KRLseries	—					●	●																					
	Metal foil low resistance chip resistors (4 terminals type)																		19										
	KRLseries	—																											
	High Current Surface Mount Jumper Chip																		20										
	YJPseries	—																											
	Metal plate low resistance chip resistors																		21										
RLseries	—					●				●																			
Thick film low resistance chip resistors																		22											
RLTseries	—			●	●	●	●																						

※ 1 : This product is RoHS compliant but not completely lead-free. Plated nickel contains 10s of ppm level lead.  
 ※ 2 : All products except the RL0510 series are halogen-free. We are working on eliminating halogen from the RL0510 series.

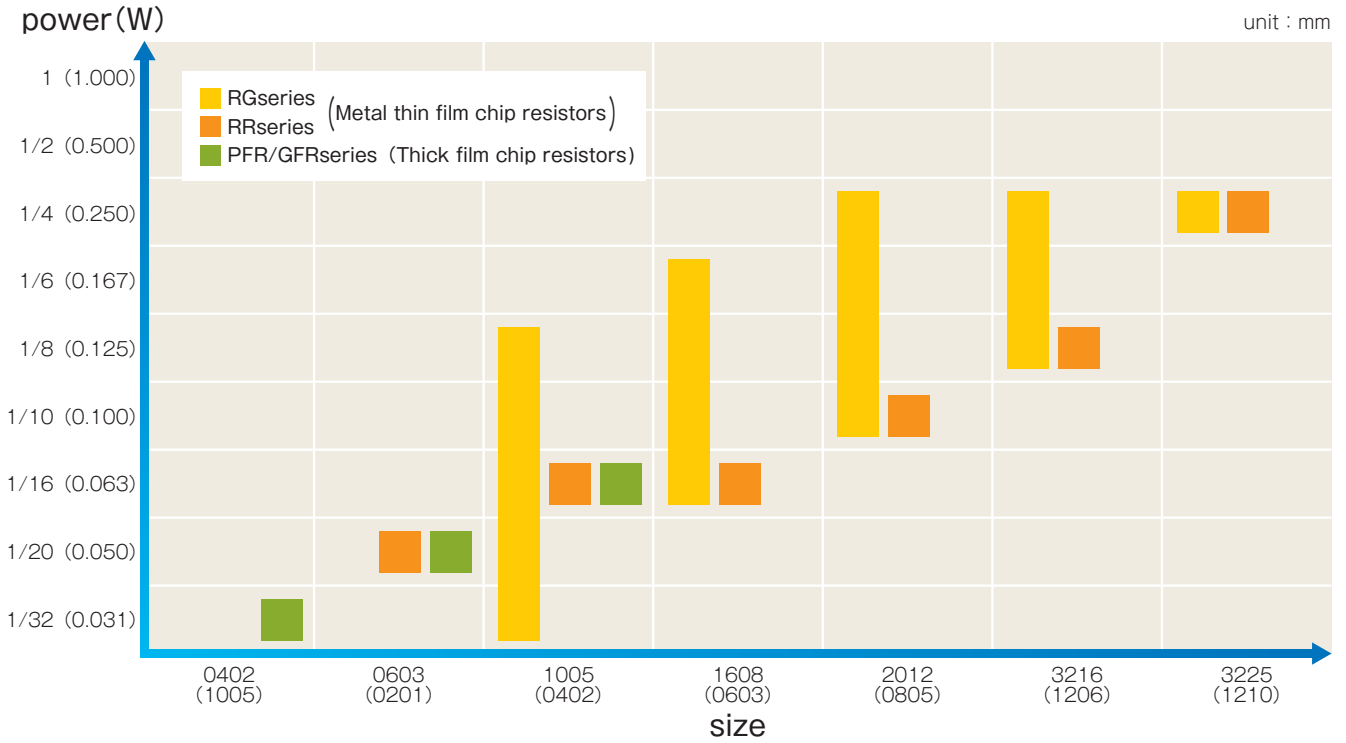
Product group	New series name	Old series name	Rated power (W)					Resistance tolerance (%)				Environmental compliance					Specification pages										
			1/32W	1/20W	1/16W	31mW/element	63mW/element	±0.5	±1.0	±2.0	±5.0	EU-RoHS	REACH SVHC 15	CHINA RoHS	Pb free	Halogen free											
Thick film surface mount resistors	Thick film chip resistors																										
	PFR · GFR series	—	●	●	●			●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●



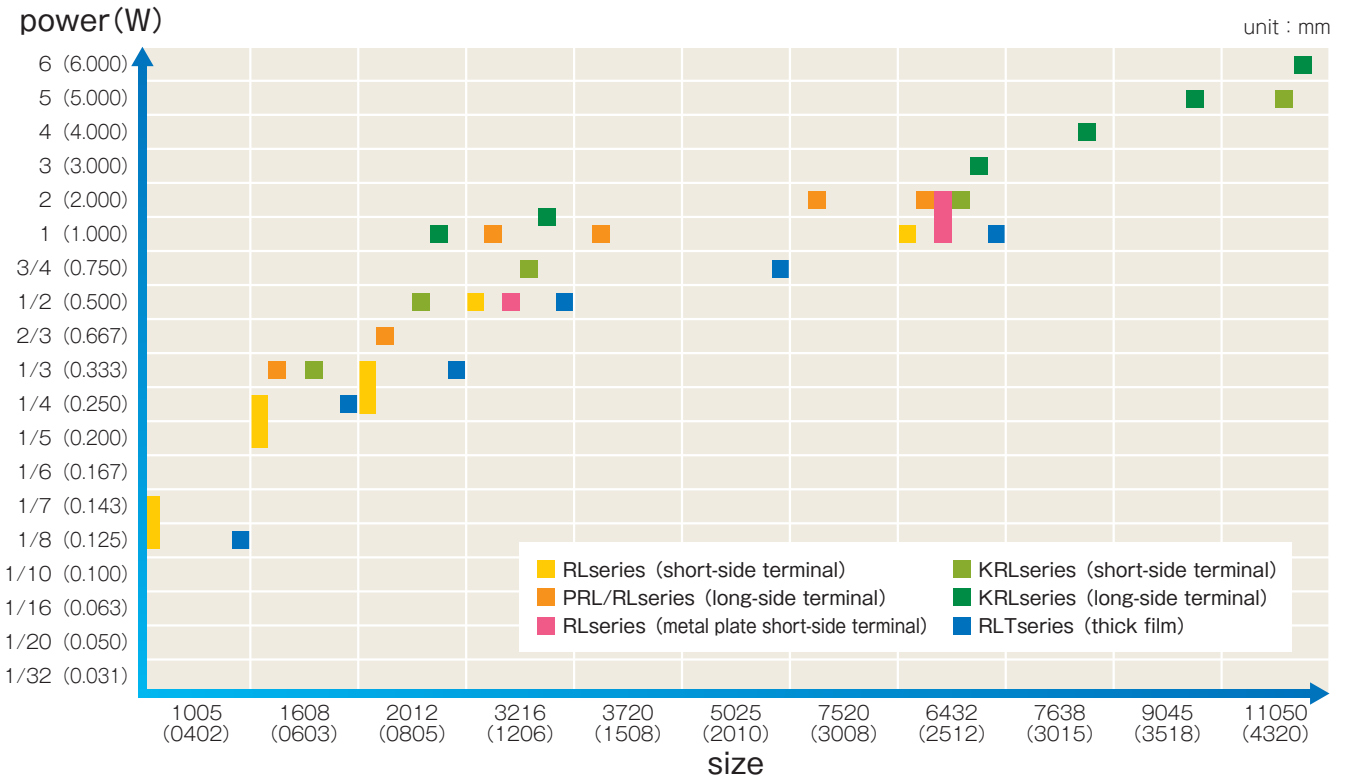
# Selection guide

We offer a variety of features among metal thin film chip resistors, thick film chip resistors, and current sensing surface mount resistors. In order to help customers choose the correct series of components, the following charts show the relationship of each component size to its rated power.

## Metal thin film chip resistors; thick film chip resistors



## Current sensing surface mount resistors



# E series resistance values (IEC designated series of resistance values)

series	Values														
E-6	1.00	1.50	2.20	3.30	4.70	6.80									
E-12	1.00	1.20	1.50	1.80	2.20	2.70	3.30	3.90	4.70	5.60	6.80	8.20			
E-24	1.00	1.10	1.20	1.30	1.50	1.60	1.80	2.00	2.20	2.40	2.70	3.00	3.30	3.60	3.90
	4.30	4.70	5.10	5.60	6.20	6.80	7.50	8.20	9.10						
E-96	1.00	1.02	1.05	1.07	1.10	1.13	1.15	1.18	1.21	1.24	1.27	1.30	1.33	1.37	1.40
	1.43	1.47	1.50	1.54	1.58	1.62	1.65	1.69	1.74	1.78	1.82	1.87	1.91	1.96	2.00
	2.05	2.10	2.15	2.21	2.26	2.32	2.37	2.43	2.49	2.55	2.61	2.67	2.74	2.80	2.87
	2.94	3.01	3.09	3.16	3.24	3.32	3.40	3.48	3.57	3.65	3.74	3.83	3.92	4.02	4.12
	4.22	4.32	4.42	4.53	4.64	4.75	4.87	4.99	5.11	5.23	5.36	5.49	5.62	5.76	5.90
	6.04	6.19	6.34	6.49	6.65	6.81	6.98	7.15	7.32	7.50	7.68	7.87	8.06	8.25	8.45
	8.66	8.87	9.09	9.31	9.53	9.76									

## Three-letter codes for resistance value (Codes for E96 series preferred numbers)

For RR0816 series and RG1608 series, Susumu uses special 3 letter codes to designate E96 values. (\*uses E24)

code	E96 value	code	E96 value	code	E96 value	code	E96 value	code	E96 value	code	E96 value	code	E96 value	code	E96 value
01	100*	13	133	25	178	37	237	49	316	61	422	73	562	85	750*
02	102	14	137	26	182	38	243	50	324	62	432	74	576	86	768
03	105	15	140	27	187	39	249	51	332	63	442	75	590	87	787
04	107	16	143	28	191	40	255	52	340	64	453	76	604	88	806
05	110	17	147	29	196	41	261	53	348	65	464	77	619	89	825
06	113	18	150*	30	200*	42	267	54	357	66	475	78	634	90	845
07	115	19	154	31	205	43	274	55	365	67	487	79	649	91	866
08	118	20	158	32	210	44	280	56	374	68	499	80	665	92	887
09	121	21	162	33	215	45	287	57	383	69	511	81	681	93	909
10	124	22	165	34	221	46	294	58	392	70	523	82	698	94	931
11	127	23	169	35	226	47	301	59	402	71	536	83	715	95	953
12	130*	24	174	36	232	48	309	60	412	72	549	84	732	96	976

code for power of 10

code	power
A	10 <sup>0</sup>
H	10 <sup>1</sup>
C	10 <sup>2</sup>
D	10 <sup>3</sup>
E	10 <sup>4</sup>
F	10 <sup>5</sup>
R	10 <sup>-1</sup>
S	10 <sup>-2</sup>

(example) 1780Ω : 178 × 10<sup>1</sup> → 25H

## Disclaimer and handling care of our products

### Disclaimer

- The contents of this catalogue are only for reference purposes and its contents may be changed without prior notification. Official specifications will be submitted to each customer. For ordering, please contact our sales representatives.
- The products listed in this catalogue are for general purpose electronic equipment. Please consult with us if you require specific qualities or reliability as in nuclear or aerospace applications.
- When you incorporate our products in your design, please utilize them within their specified operating conditions such as rated power and recommended operating temperature. We cannot guarantee our products and cannot take responsibility for the failure of our products if they are used under improper conditions or outside of the parameters of our specified conditions.
- No part of this publication may be reproduced by any means without the permission of Susumu Co. Ltd.

### Handling and care

#### < Consideration during mounting >

- Before, during and after mounting, take care not to damage the protective coating of the products. Damage to the protective coating may result in weakening the humidity tolerance.
- When using a soldering iron, the heat should be applied to the land pattern not directly to the component. The tip of the soldering iron should not touch the resistors directly. In addition, when the tip of the soldering iron is hot, please do soldering as quick as possible (Below 350°C within 3 seconds).
- Flux residue can cause corrosion and electro-migration resulting in the deterioration of humidity tolerance. If you utilize highly activated flux, such as flux containing chlorine, please consult with us prior to usage.
- Ionized foreign material contamination or residue can also cause corrosion and electro-migration resulting in the deterioration of humidity tolerance. Do not touch the components with bare hands prior to or after mounting.
- If the soldering operation takes place at very high temperatures and for a prolonged period of time, the terminal may dissolve into the solder.
- When mounted components are embedded into resin or polymer, the resin/polymer selection must consider heat tolerance, humidity tolerance, mechanical properties, and chemical or ion composition.

#### < Operating environment; condition >

- If these components are utilized for unusual conditions, the reliability and characteristics should be verified in advance. Such conditions include:
  - Exposure of the component to water, salt water, oils, acids, alkaline, or solvents
  - Exposure of the component to direct sunlight, outdoor weather conditions, or heavy dust
  - Exposure to frost
  - Possible exposure to corrosive air or gas such as a marine atmosphere, HCl, Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, and NO<sub>x</sub>.
- Usage under high temperatures and high humidity
- When components are used under high temperature conditions, assess the potential temperatures surrounding the components considering the other heat-producing neighboring components, and regulate your power usage following the specified derating curve.
- If the components are used under high humidity conditions or at temperatures below the dew point, the products can experience positive resistance drift or even an open circuit.
- Use our products under the rated power when the pulse current or voltage is applied. The peak voltage of the pulse should remain under the rated voltage.

# Metal thin film chip resistors (Ultra-precision)

■ RG series (This series now includes the former RGH series.)

AEC-Q200 Compliant



## Features

- Ultimate chip resistors: the result of all of our thin film technology expertise including inorganic passivation
- Resistance drift: less than +/-0.1% after 10000 hour accelerated reliability test
- +/-0.02% of resistance tolerance and +/-5ppm/°C of temperature coefficient of resistance
- Excellent tolerance to power surges

## Applications

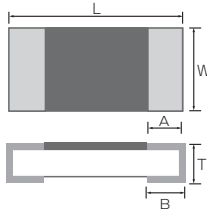
- Any applications that require precision resistors such as automotive electronics, industrial test and measurement equipment, and consumer electronics

## Specifications

\*Standard stock item: E-24 series with TCR P, Q, and R grades, as well as tolerance D and B grades. Other E-24 grades and E-96 series are made to order

unit : mm

### Dimensions



Dimension (inch)	RG1005 (0402) OLD:RGH1005-2B included	RG1608 (0603) OLD:RGH1608-2C included	RG2012 (0805) OLD:RGH2012-2E included	RG3216 (1206)
L	1.00±0.05	1.60±0.20	2.00±0.20	3.20±0.20
W	0.50±0.05	0.80±0.20	1.25±0.20	1.60±0.20
A	0.20±0.10	0.30±0.20	0.40±0.20	0.50±0.25
B	0.25±0.05	0.30±0.20	0.40±0.20	0.50±0.20
T	0.35±0.05	0.40±0.10	0.40±0.10	0.40±0.10

**NOTE** Obsolete : RGH1005-2B (0402) RGH:1608-2C (0603) RGH2012-2E (0805)  
Alternative P/N : RG1005 (0402) RG1608 (0603) RG2012 (0805)

### Electrical characteristics

Series name		RG1005				RG1608					
Rated power*1	High power application	1/8W (OLD : RGH1005-2B)				1/6W (OLD : RGH1608-2C)					
	Regular power application	1/16W				1/10W					
	High precision	1/32W				1/16W					
E series offered		E-24, E-96									
Resistance range (Ω)		10~46.4	47~97.6	100~2.94k	3k~100k	10~46.4	47~97.6	100~4.99k	5.1k~270k	274~332k	340~360k
Resistance tolerance (%)	±0.02% (P)	—	—	○	—	—	—	○	—	—	—
	±0.05% (W)	—	○	○	○	—	○	○	○	—	—
	±0.1% (B)	—	○	○	○	—	○	○	○	○	—
	±0.25% (C)	—	○	○	○	—	○	○	○	○	—
	±0.5% (D)	○	○	○	○	○	○	○	○	○	○
Temperature coefficient of resistance (ppm/°C)	±5 (V)	—	—	○	—	—	—	○	—	—	—
	±10 (N)	—	○	○	○	—	○	○	○	—	—
	±25 (P)	—	○	○	○	—	○	○	○	○	○
	±50 (Q)	—	—	—	—	○	—	—	—	—	—
	±100 (R)	○	—	—	—	—	—	—	—	—	—
Maximum voltage		50V				100V					
Operating temperature		-55°C~155°C				-55°C~155°C					
Packaging	5,000pcs	CodeT5				CodeT5					
	10,000pcs	CodeT10				—					

Series name		RG2012					RG3216			
Rated power*1	High power application	1/4W (OLD : RGH2012-2E)					—			
	Regular power application	1/8W					1/4W			
	High precision	1/10W					1/8W			
E series offered		E-24, E-96								
Resistance range (Ω)		10~46.4	47~97.6	100~10k	10.2k~475k	487k~1M	10~46.4	47~97.6	100~33.2k	34k~1M
Resistance tolerance (%)	±0.02% (P)	—	—	○	—	—	—	—	○	—
	±0.05% (W)	—	○	○	○	—	—	○	○	○
	±0.1% (B)	—	○	○	○	○	—	○	○	○
	±0.25% (C)	—	○	○	○	○	—	○	○	○
	±0.5% (D)	○	○	○	○	○	○	○	○	○
Temperature coefficient of resistance (ppm/°C)	±5 (V)	—	—	○	—	—	—	—	○	—
	±10 (N)	—	○	○	○	—	—	○	○	○
	±25 (P)	—	○	○	○	○	—	○	○	○
	±50 (Q)	○	—	—	—	—	○	—	—	—
	±100 (R)	—	—	—	—	—	—	—	—	—
Maximum voltage		150V					200V			
Operating temperature		-55°C~155°C					-55°C~155°C			
Packaging	5,000pcs	CodeT5					CodeT5			

\*1 Depending on customer's reliability requirements, power rating between high power and regular power can be selected.  
· Contact us for RG3225 with 1/2W rated power.

Thin film surface mount resistors

RG series (This series now includes the former RGH series.)

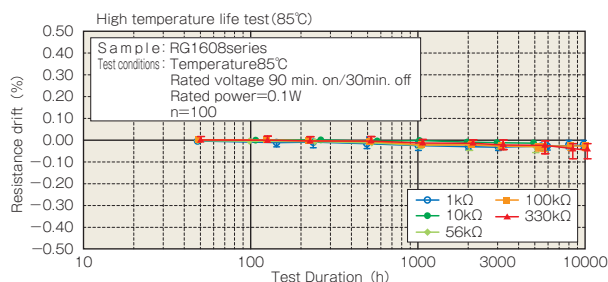


## Reliability characteristics

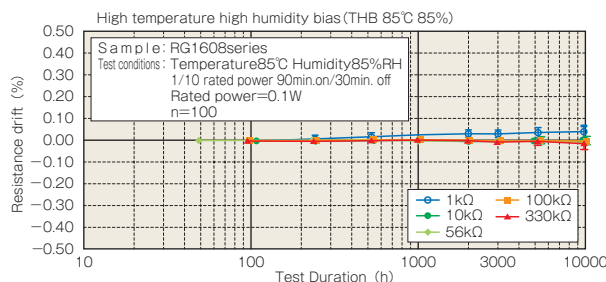
Item	Test Method	Specification: drift limits for each power rating						(Typical)
		Low		Regular		High		
		$\leq 47\Omega$	$\geq 47\Omega$	$\leq 47\Omega$	$\geq 47\Omega$	$\leq 47\Omega$	$\geq 47\Omega$	
Short time Overload	Applied voltage : 2.5 times. Test duration: 5 seconds. (When maximum operating voltage: 2 times or less)	$\pm 0.10\%$	$\pm 0.05\%$	$\pm 0.10\%$	$\pm 0.05\%$	-	$\pm 0.10\%$	$\pm (0.01\%)$
Load Life	Test temperature : 85°C (When high voltage : 70°C). Applied voltage : rated voltage. Repeat 1000 hours as follow : 90 mins on/30mins off.	$\pm 0.25\%$	$\pm 0.10\%$	$\pm 0.50\%$	$\pm 0.25\%$	-	$\pm 0.50\%$	$\pm (0.01\%)$
Moisture load life	Test condition: 85°C, 85% RH. Applied power : 1/10 rated power. Repeat 1000 hours as follow : 90 mins on/30mins off.	$\pm 0.25\%$	$\pm 0.10\%$	$\pm 0.50\%$	$\pm 0.25\%$	-	$\pm 0.50\%$	$\pm (0.05\%)$
Temperature Cycle	Repeat 1000 cycle as follow : -55°C (30 min.)/Room Temp.(2 min.) / +125°C (30min.)/Room Temp.(2min.)	$\pm 0.25\%$	$\pm 0.10\%$	$\pm 0.25\%$	$\pm 0.10\%$	-	$\pm 0.10\%$	$\pm (0.01\%)$
High temperature Exposure	+155°C for 1000 hours with no load	$\pm 0.25\%$	$\pm 0.10\%$	$\pm 0.25\%$	$\pm 0.10\%$	-	$\pm 0.10\%$	$\pm (0.01\%)$

## 10000 hour reliability test data

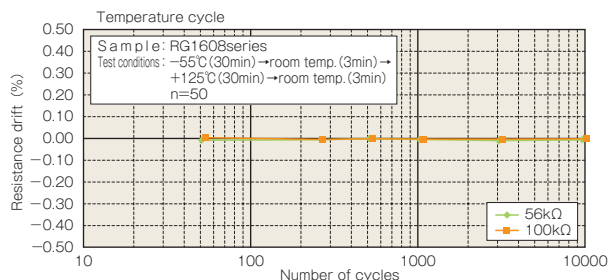
### Life test



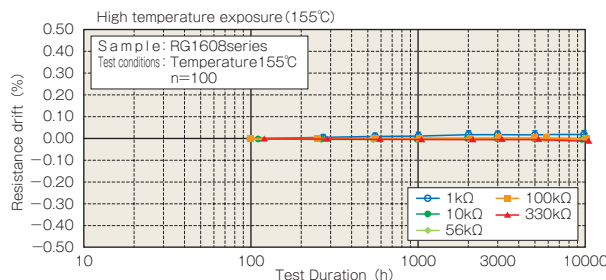
### High temperature high humidity bias test



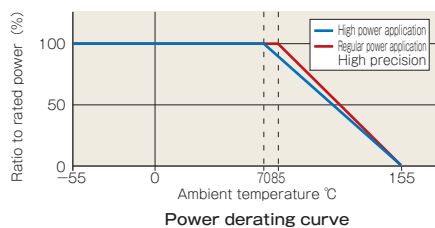
### Temperature cycle test



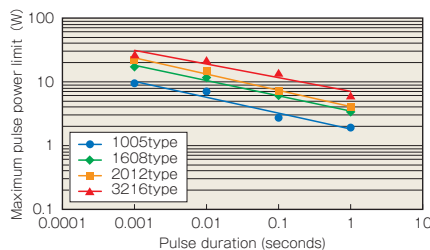
### High temperature exposure test



## Power derating characteristics



## Maximum pulse power limit



### Test procedure

Voltage pulse is applied to the test samples mounted on the test board.

After each pulse, resistance drift is measured. Pulse voltage is increased until the drift exceeds +/-0.5%. The power at that voltage is defined as the maximum pulse power.

## Part numbering system

(New name) **RG 1608**

**N-102-B-T5**

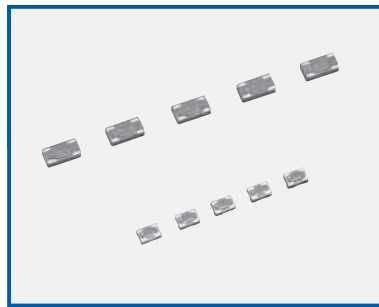
Packaging: T5 (5000pcs) T10 (10000pcs)  
 Resistance tolerance  
 Resistance value  
 (E-24:3digit, E-96:4digit, RG3216:all 4 digit)  
 Temperature coefficient of resistance  
 Power (2B:1/8W, 2C:1/6W, 2E:1/4W)  
 Size  
 Series code

(OLD P/N) **RGH 1608 2C-N-102-B-T5**

# Metal thin film resistor networks

■ RM series

AEC-Q200 Compliant



## Features

- Ultra accuracy: relative resistance tolerance +/-0.01%, relative TCR +/-1ppm/°C
- Ultra reliability: 10,000 hours of 85°C/85RH test or 10,000 of 155°C high temperature exposure test causes less than +/-0.1% resistance drift

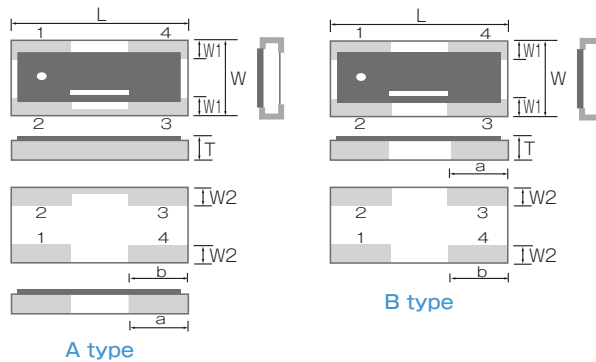
## Applications

- Applications that require a precise relative resistance ratio such as voltage dividers, and gain-setting circuits for amplifiers.

## Specifications

\* All products are made to order.

### Dimensions



Dimension (inch)	RM2012 (0805)	RM3216 (1206)
L	2.00±0.20	3.20±0.20
W	1.25±0.20	1.60±0.20
W1	0.40±0.20	0.40±0.25
W2	0.35±0.20	0.40±0.20
a	0.50±0.20	1.00±0.25
b	0.60±0.20	1.00±0.20
T	0.40±0.10	0.40±0.10

(unit : mm)

### Electrical characteristics

Series name	RM2012		RM3216		
Rated power	0.05W/Element, 0.1W/Package		0.063W/Element, 0.125W/Package		
Resistance range (Ω)	100 ~ < 300	300 ~ 100kΩ	100 ~ < 300	300 ~ 330kΩ	
Resistance tolerance (%)	±0.05 (w)	—	—	—	
	±0.1 (B)	○	○	○	
	±0.5 (D)	○	○	○	
Relative resistance tolerance (%)	±0.01 (L)	Resistance ratio=1		Resistance ratio=1	
	±0.02 (P)	Resistance ratio≤10		Resistance ratio≤10	
	±0.05 (W)	Resistance ratio≤100		Resistance ratio≤100	
Temperature coefficient of resistance (ppm/°C)	±10 (N)	—	○	—	○
	±25 (P)	○	○	○	○
Relative TCR (ppm/°C)	±1 (X)	Resistance ratio=1		Resistance ratio=1	
	±2 (W)	1<Resistance ratio≤3		1<Resistance ratio≤3	
	±5 (V)	Resistance ratio>3		Resistance ratio>3	
Maximum voltage /element	25V		50V		
Operating temperature	-55°C ~ 155°C		-55°C ~ 155°C		
Packaging	1,000pcs	Code10	Code10		
	5,000pcs	Code50	Code50		

\* Relative resistance tolerance is defined as the ratio of the actual R2/R1 against the specified R2/R1 as expressed:

$$\left[ \frac{\text{actual } R2/R1}{\text{specified } R2/R1} - 1 \right] \times 100$$

\* Relative TCR is defined as : (TCR of R2)-(TCR of R1)

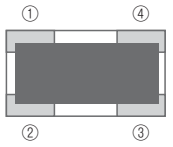
### Standard resistance value pairings

Ratio	R1 (Ω)	R2 (Ω)	Ratio	R1 (Ω)	R2 (Ω)	Ratio	R1 (Ω)	R2 (Ω)	Ratio	R1 (Ω)	R2 (Ω)	Ratio	R1 (Ω)	R2 (Ω)	Ratio	R1 (Ω)	R2 (Ω)
1 : 1	1k	1k	1 : 3	1k	3k	1 : 5	1k	5k	1 : 9	1k	9k	1 : 20	1k	20k	1 : 50	1k	50k
	10k	10k		10k	30k		2k	10k		10k	90k		2k	40k		2k	100k
	100k	100k		100k	300k		10k	50k		1k	10k		5k	100k		1k	100k
1 : 2	1k	2k	1 : 4	1k	4k	1 : 6	1k	6k	1 : 10	2k	20k	1 : 25	1k	25k	1 : 100	2k	200k
	10k	20k		10k	40k		10k	60k		10k	100k		2k	50k			
	100k	200k															

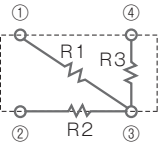


## Standard circuits

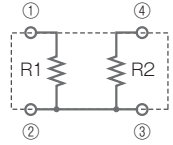
### 2012/3216Size



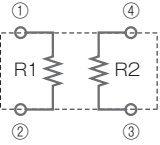
Outside appearance



Circuit diagram :  
3 element type

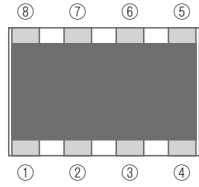


Circuit diagram :  
A type

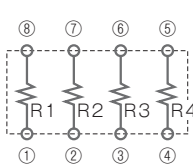


Circuit diagram :  
B type

### 3216Size 4 element type (array, network with different resistance values)

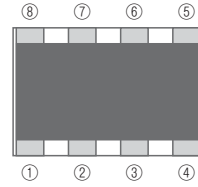


Outside appearance

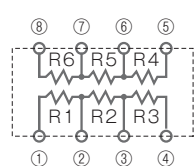


Circuit diagram

### 3216Size 6 element type



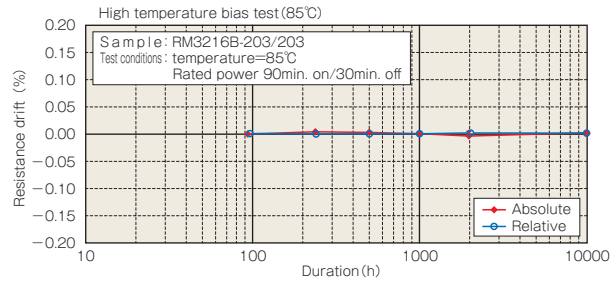
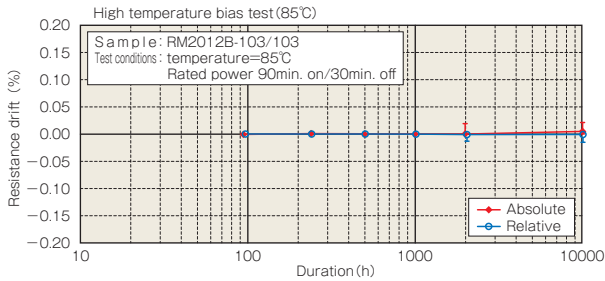
Outside appearance



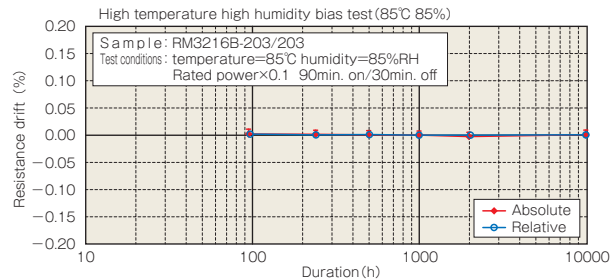
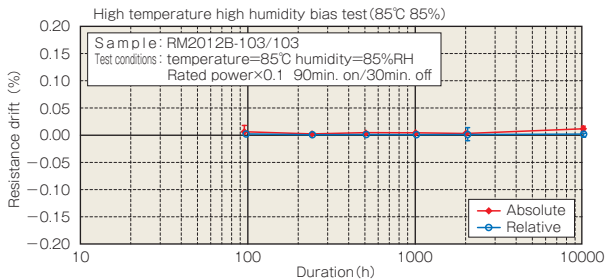
Circuit diagram

## 10000 hour reliability test data

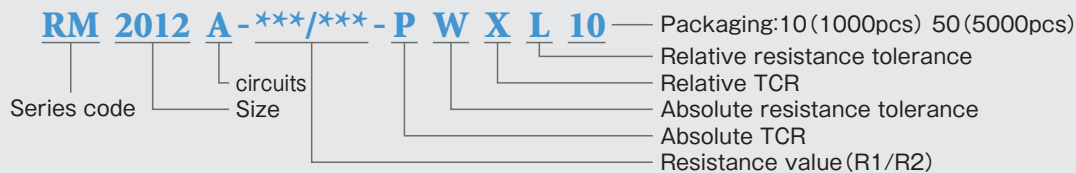
### Life test



### High temperature high humidity bias test



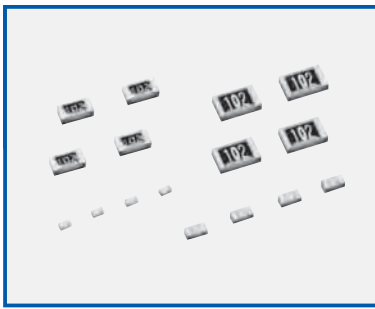
## Part numbering system



Please contact us for specific custom requirements for resistance values, resistance ratios, number of elements, circuitry and any others.

# Metal thin film chip resistors (precision)

■ RR series



## Features

- Excellent characteristics in resistance tolerance, temperature coefficient of resistance, current noise, and linearity

## Applications

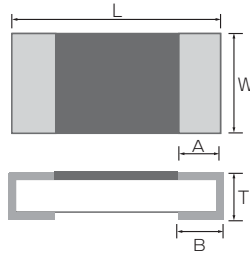
- Any electronics applications that require accuracy and reliability such as automotive electronics, industrial test and measurement, consumer electronics and many others.



## Specifications

\* Stocked items: E-24 series (TCR P and Q, resistance tolerance D), other E-24 and E-96 series are made to order.

### Dimensions



unit : mm

Dimension (inch)	RR0306 (0201)	RR0510 (0402)	RR0816 (0603)	RR1220 (0805)	RR1632 (1206)	RR2632 (1210)
L	0.60±0.05	1.00±0.05	1.60±0.20	2.00±0.20	3.20±0.20	3.20±0.20
W	0.30±0.05	0.50±0.05	0.80±0.20	1.25±0.20	1.60±0.20	2.60±0.20
A	0.12±0.05	0.20±0.10	0.30±0.20	0.40±0.20	0.50±0.20	0.50±0.20
B	0.12±0.05	0.25±0.05	0.30±0.20	0.40±0.20	0.45±0.20	0.45±0.20
T	0.23±0.03	0.35±0.05	0.40±0.10	0.40±0.10	0.40±0.10	0.40±0.10

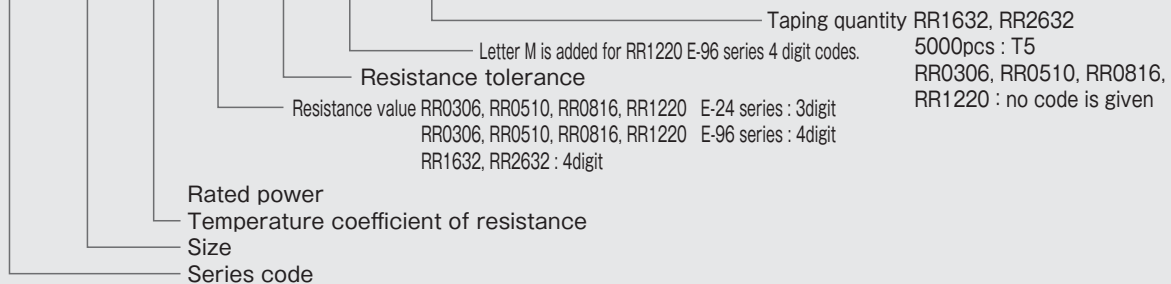
### Electrical characteristics

Series name	RR0306		RR0510		RR0816		RR1220		RR1632			RR2632		
power	1/20W		1/16W		1/16W		1/10W		1/8W			1/4W		
E series offered	E-24				E-24, E-96									
Resistance range (Ω)	10~30	33~22k	10~91	100~100k	10~91	100~360k	10~91	100~1M	10~47	51~1M	100~200k	10~47	51~1M	100~200k
Resistance tolerance (%)	±0.1% (B)	—	—	—	—	—	—	—	—	—	○	—	—	—
	±0.5% (D)	—	○	○	○	○	○	○	○	○	—	○	○	—
	±1.0% (F)	○	—	—	—	—	—	—	—	—	—	—	—	—
Temperature coefficient of resistance (ppm/°C)	±5 (V)	—	—	—	—	—	—	—	—	—	○	—	—	○
	±10 (N)	—	—	—	—	—	—	—	—	—	○	—	—	○
	±25 (P)	—	○	—	○	—	○	—	○	—	○	—	○	—
	±50 (Q)	—	—	—	—	○	—	○	—	○	—	—	○	—
	±100 (R)	○	—	○	—	—	—	—	—	—	—	—	—	—
Maximum voltage	15V		25V		75V		100V		150V			200V		
Operating temperature	-55°C ~ 125°C													
Packaging	5,000pcs	○	—	—	○	—	○	—	○	—	○	—	○	—
	10,000pcs	—	—	○	—	—	—	—	—	—	—	—	—	—

Contact us for the jumper resistor in RR0816 size (part number: RL0816-JMP)

## Part numbering system

**RR 0816 P - 102 - D - (M) - (T5) - (\*\*\*)** — Only given to 3 digit codes for RR0816 E-96 series



# Metal thin film trimmable chip resistors

■ RT series



## Features

- Patented trimming method ( patent# 1921853) allows high trimming accuracy, excellent reliability after trimming and short trimming time
- Small sizes down to 0.6mm x 0.3mm

## Applications

- Sensor circuits that require high precision such as automotive electronics
- PA modules in mobile phones
- Devices that require strong vibration tolerance such as microphones

Thin film surface mount resistors

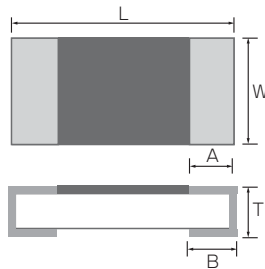
RT series

## Specifications

\* All made to order.

### Dimensions

unit : mm



Dimension (inch)	RT0603 (0201)	RT0510 (0402)	RT0816 (0603)	RT1220 (0805)
L	0.60±0.05	1.00±0.07	1.60±0.20	2.00±0.20
W	0.30±0.03	0.50±0.07	0.80±0.20	1.25±0.20
A	0.12±0.05	0.20±0.10	0.30±0.20	0.40±0.20
B	0.15±0.05	0.25±0.20	0.30±0.20	0.40±0.20
T	0.25±0.03	0.35±0.05	0.40±0.10	0.40±0.10

### Electrical characteristics

Series name	RT0603			RT0510			RT0816					RT1220								
power	1/20W			1/16W			1/16W					1/10W								
Initial resistance value (Ω)	150	330	1.5k	100	270	1.5k	100	330	1.0k	3.3k	10k	33	100	330	1.0k	3.3k	10k	33k	100k	
Targeted resistance value (Ω)	1.0k	1.9k	10k	820	2.1k	10k	2.7k	8.0k	8.8k	37k	40k	4.7k	8.2k	15k	15k	100k	120k	120k	220k	
Initial value tolerance (%)	±20% (M)			±20% (M)			±20% (M)					±20% (M)								
Temperature coefficient of resistance (ppm/°C)	±25 (P)	○	○	—	○	○	—	○	○	○	—	—	—	○	○	○	—	—	—	—
	±50 (Q)	—	—	—	—	—	—	—	—	—	—	○	—	—	—	—	—	—	—	
	±100 (R)	—	—	○	—	—	○	—	—	—	○	○	—	—	—	—	○	○	○	○
Maximum voltage	15V			25V			75V					100V								
Operating temperature	-55°C~125°C			-55°C~125°C			-55°C~125°C					-55°C~125°C								
Packaging	5,000pcs	—			—			○					○							
	10,000pcs	—			○			—					—							
	15,000pcs	○			—			—					—							

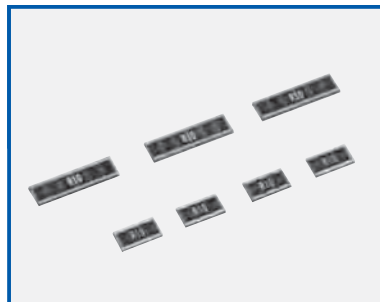
## Part numbering system

**RT 0816 P - 102 - M**

- Resistance tolerance
- Resistance value
- Temperature coefficient of resistance
- Size
- Series code

# Low resistance chip resistors (long side terminal type)

■ This series includes (some of) former PRL/RL series



## Features

- The distinctive structure that encourages heat dissipation and radiation limits the rise of the surface temperature, allows the realization of smaller sizes, and reduces influence of heat on surrounding components. Low ESL contributes to less noise. This product also withstands temperature cycles very well.

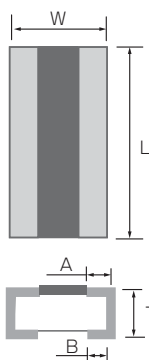
## Applications

- PCs, power sources, inverters, automotive electronics, adaptors and industrial machining equipment.

## Specifications

\*All made to order.

### Dimensions



Dimension (mm)	PRL0816 (0603)	PRL1220 (0805)	PRL1632 (1206)	PRL3264 (2512)	RL3720W (1508)	RL7520W (3008)
L	1.60±0.20	2.00±0.20	3.20±0.20	6.40±0.20	3.75±0.30	7.50±0.30
W	0.80±0.20	1.25±0.20	1.60±0.20	3.20±0.20	2.00±0.20	2.00±0.20
A	—	—	—	—	0.40±0.20	0.40±0.20
B	0.20±0.10	0.35±0.15	0.45±0.15	0.90±0.15	0.40±0.20	0.40±0.20
T	0.40±0.10	0.50±0.10	0.50±0.10	0.50±0.10	0.50±0.20	0.50±0.20

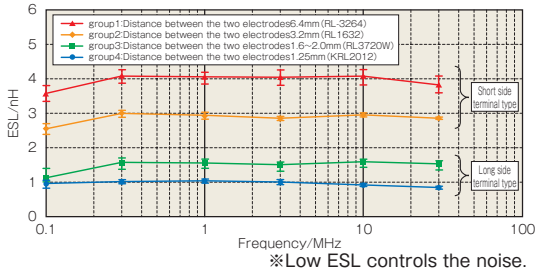
(unit : mm)

### Electrical characteristics

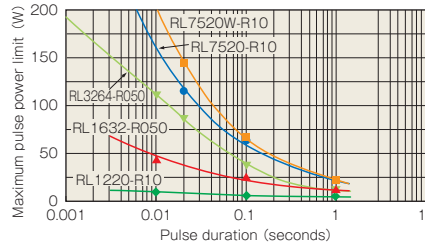
Series name	PRL0816		PRL1220			PRL1632		PRL3264			
Power	1/3W		2/3W			1W		2W			
E series offered	E-24		E-24			E-24		E-24			
Initial resistance value (Ω)	0.01 ~ 0.039	0.043 ~ 0.1	0.007 ~ 0.009	0.01 ~ 0.043	0.047 ~ 0.1	0.005 ~ 0.009	0.01 ~ 0.1	0.003 ~ 0.004	0.005 ~ 0.009	0.010 ~ 0.043	0.047 ~ 0.1
Resistance tolerance (%)	±0.5% (D)	○	—	○	○	—	○	—	—	—	○
	±1.0% (F)	○	○	—	○	○	○	—	—	○	○
	±2.0% (G)	—	—	○	○	○	○	—	○	○	○
	±5.0% (J)	—	—	—	—	—	—	○	—	—	—
Temperature coefficient of resistance (ppm/°C)	15mΩ or less 0~350ppm/°C 18m~27mΩ 0~200ppm/°C 33m~68mΩ ±100ppm/°C 75m~100mΩ ±50ppm/°C	7m~9mΩ 0~350ppm/°C 10m~18mΩ 0~200ppm/°C 20m~51mΩ ±100ppm/°C 56m~100mΩ ±50ppm/°C	9mΩ or less 0~350ppm/°C 10m~18mΩ 0~200ppm/°C 20m~51mΩ ±100ppm/°C 56m~100mΩ ±50ppm/°C								
Maximum voltage	$\sqrt{P \cdot R}$										
Operating temperature	-55°C ~ 125°C										
Packaging	○										

Series name	RL3720W				RL7520W			
power	1W				2W			
E series offered	E-24				E-24			
Initial resistance value (Ω)	0.001 ~ 0.004	0.005 ~ 0.009	0.010 ~ 0.091	0.1 ~ 1.0	0.001 ~ 0.004	0.005 ~ 0.009	0.010 ~ 0.091	0.1 ~ 0.47
Resistance tolerance (%)	±1.0% (F)	○	○	○	○	○	○	○
	±2.0% (G)	○	○	○	○	○	○	○
	±5.0% (J)	—	—	—	—	○	○	—
Temperature coefficient of resistance (ppm/°C)	0 ~ +50 (Q)	—	—	—	○	—	—	○
	0 ~ +100 (R)	—	—	—	○	—	○	○
	0 ~ +200 (S)	—	○	○	○	—	—	○
	0 ~ +350 (T)	○	○	○	—	—	—	○
	0 ~ +420 (T)	—	—	—	—	—	○	—
0 ~ +800 (T)	—	—	—	—	○	—	—	
Maximum voltage	$\sqrt{P \cdot R}$							
Operating temperature	-55°C ~ 125°C							
Packaging	○							

## ESL



## Resistance to power pulse



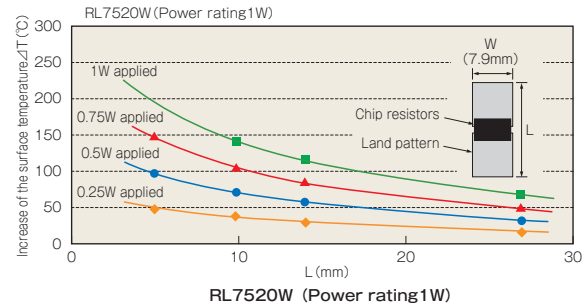
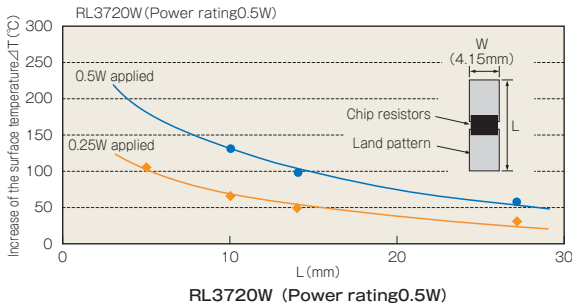
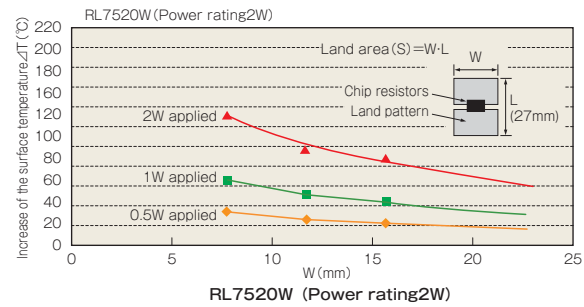
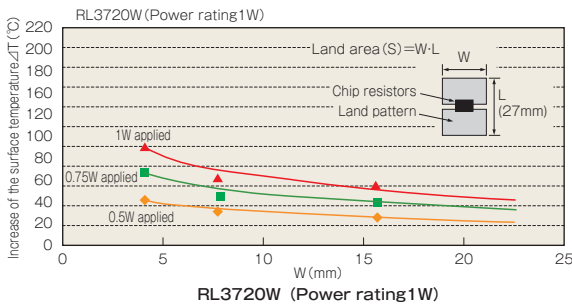
### Test procedure

Voltage pulse is applied to the test samples mounted on the test board. After each pulse, resistance drift is measured. Pulse voltage is increased until the drift exceeds +/-0.5%. The power at that voltage is defined as the maximum pulse power.

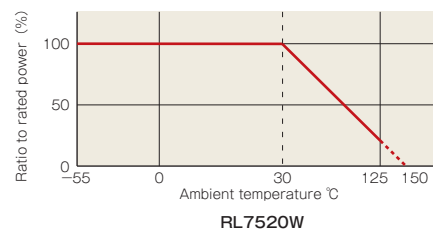
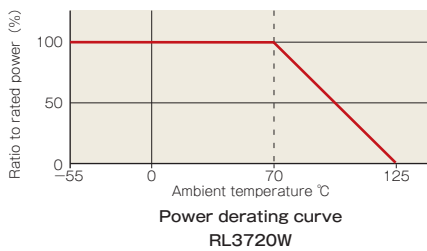
## Surface temperature data

### The high power type land pattern and surface temperature

These high-power low resistance chip resistors are designed to dissipate heat efficiently through the land patterns on circuit boards. The actual temperature of the surface of the resistor is dependent upon the dimensions and the shape of the land patterns.



## Power derating characteristics



## Part numbering system

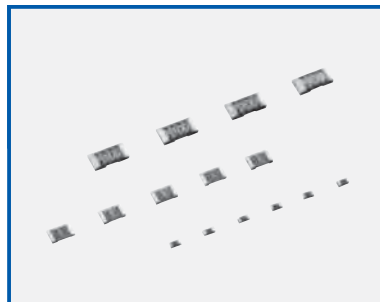
**PRL 1220 T-R10-F-(T5)**

- Series code
- Size
- Temperature coefficient of resistance
- Resistance value
- Resistance tolerance
- Packaging: T5 (5000pcs)

(OLD P/N) **RL 3720W T-R10-F**

# Low resistance chip resistors (short side terminal)

■ This series includes (some of) former RP and RPH series



## Features

- The distinctive structure that encourages heat dissipation and radiation limits the rise of the surface temperature, allows the realization of smaller sizes, and reduces the influence of heat on surrounding components.

## Applications

- PCs, power sources, mobile phones, automotive electronics, adaptor and industrial machining equipment.



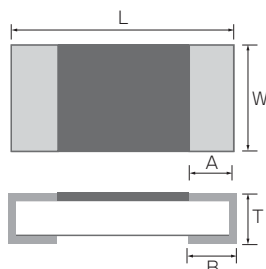
\*1 : Except for RL0510, RL1632, RL3264

## Specifications

\*All made to order.

### Dimensions

unit : mm



Dimension (inch)	RL0510 (0402) (OLD:RP1005 included)		RL0816 (0603) (OLD:RP1608,RPH1608 included)		RL1220 (0805) (OLD:RP2012 included)		RL1632 (1206)	RL3264 (2512)
	R≤0.2Ω	R>0.2Ω	R≤0.082Ω	R>0.091Ω	R≤0.068Ω	R>0.075Ω		
L	1.00±0.05		1.60±0.20		2.00±0.20		3.20±0.20	6.40±0.20
W	0.50±0.05		0.80±0.20		1.25±0.20		1.60±0.20	3.20±0.20
A	0.15±0.10		0.20±0.15		0.40±0.20		—	—
B	0.25±0.10	0.15±0.10	0.25±0.20	0.20±0.15	0.40±0.20		1.00±0.15	2.00±0.15
T	0.35+0.15/-0.10	0.35±0.10	0.45+0.15/-0.10	0.45±0.10	0.50±0.20	0.40±0.10	0.50±0.15	0.50±0.15

**NOTE** Obsoleted: RP1005, RP1608, RPH1608, RP2012  
Alternative P/N:RL0510, RL0816, RL1220

### Electrical characteristics

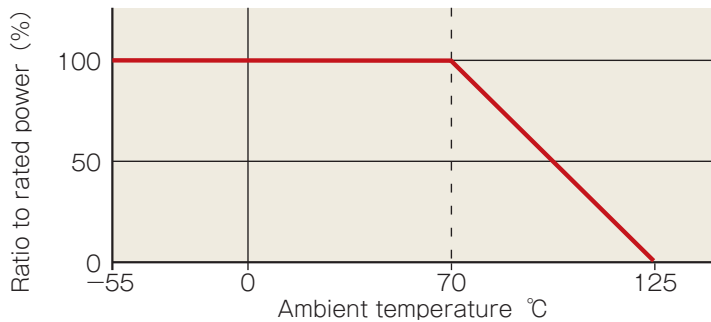
Series name	RL0510 (OLD : RP1005 included)			RL0816 (OLD:RP1608,RPH1608 included)			RL1220 (OLD:RP2012 included)			
Power	1/8W	1/6W (OLD : RP1005 included)	1/4W (OLD : RPH1608)	1/5W (OLD : RP1608)			1/4W	1/3W (OLD : RP2012)		
E series offered	E-24									
Resistance range (Ω)	R<0.05~0.1	0.1~4.7	5.1~47	R<0.02~0.1	0.1~6.8	7.5~68	0.01~0.039	0.043~0.091	0.1~10	11~100
Resistance tolerance (%)	±1.0 (F)	○	○	○	○	○	○	○	○	○
	±2.0 (G)	○	○	○	○	○	○	○	○	○
	±5.0 (J)	—	—	○	○	○	○	○	○	○
Temperature coefficient of resistance (ppm/°C)	0~+100(R)	—	—	—	○	—	—	—	○	—
	0~+200(S)	—	○	○	○	○	—	○	○	○
	0~+350(T)	○	—	—	○	—	○	○	—	—
Maximum voltage	$\sqrt{P \cdot R}$									
Operating temperature	-55 ~ 125°C									
Packaging	5,000pcs	—		○			○			
	10,000pcs	○		—			—			

Series name	RL1632					
Power	1/ 2W					
E series offered	E-24					
Resistance range (Ω)	0.01~0.016	0.018~0.024	0.027~0.03	0.033~0.051	0.056~0.47	0.51~4.7
Resistance tolerance (%)	±0.5 (D)	—	—	—	—	○
	±1.0 (F)	—	—	○	○	○
	±2.0 (G)	○	○	○	○	—
Temperature coefficient of resistance (ppm/°C)	0~+100(R)	—	—	—	○	○
	0~+200(S)	—	—	—	○	—
	0~+350(T)	—	○	○	—	—
	0~+500(T)	○	—	—	—	—
Maximum voltage	$\sqrt{P \cdot R}$					
Operating temperature	-55 ~ 125°C					
Packaging	5,000pcs ○					



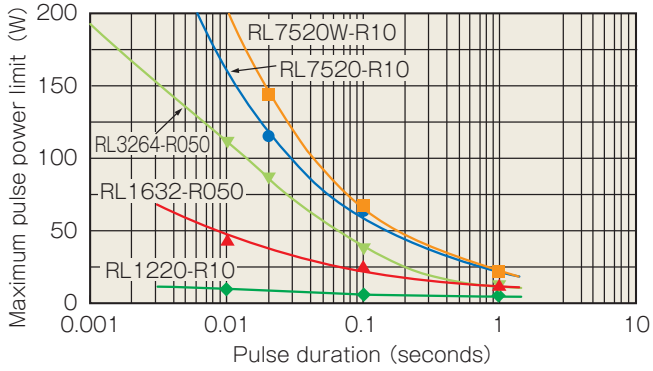
Series name	RL3264				
Power	1W				
E series offered	Standard stock item : E-24series E-12series				
Resistance range (Ω)	0.01~0.015	0.018~0.022	0.027	0.033~0.047	0.056~0.47
Resistance tolerance (%)	±0.1 (B)	—	—	—	—
	±0.5 (D)	—	—	—	—
	±1.0 (F)	—	—	○	○
	±2.0 (G)	○	○	○	○
	±5.0 (J)	—	—	—	—
Temperature coefficient of resistance (ppm/°C)	0~+100 (R)	—	—	—	○
	0~+200 (S)	—	—	○	—
	0~+350 (T)	—	○	○	—
	0~+500 (T)	○	—	—	—
Maximum voltage	$\sqrt{P \cdot R}$				
Operating temperature	-55~125°C				
Packaging	5,000pcs ○				

### Power derating characteristics



Power derating curve

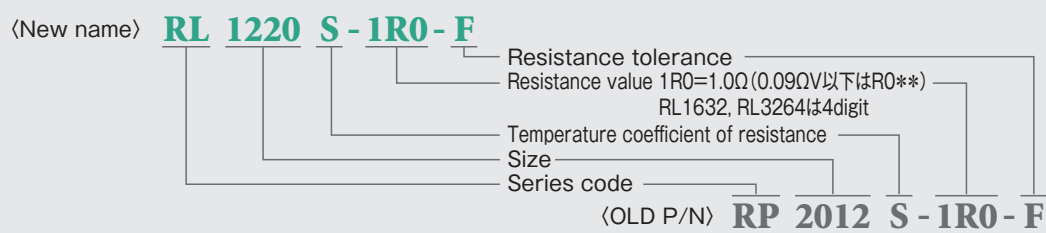
### Resistance to power pulse



#### Test procedure

Voltage pulse is applied to the test samples mounted on the test board. After each pulse, resistance drift is measured. Pulse voltage is increased until the drift exceeds +/-0.5%. The power at that voltage is defined as the maximum pulse power.

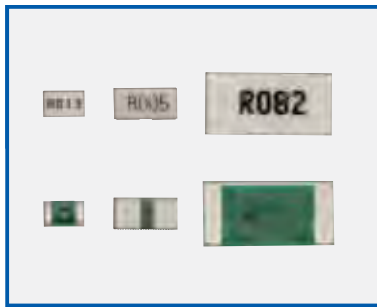
### Part numbering system



# Metal foil low resistance chip resistors (short-side terminals)

KRL series

AEC-Q200 Compliant



## Features

- The C type utilizes materials that withstand high temperatures and can be operated up to 175°C. The M type utilizes low emf materials that are stable up to 155°C. TCR is very stable for very low resistance: +/-100ppm/°C for 5mΩ ~ 9mΩ, and +/-50ppm/°C for 10mΩ ~ . Face down mounting allows for accurate current measurement. Long and short side terminal types, as well as power ratings from 1/3W to 5W are offered to meet customers' specific requirements. The protective outer coating is halogen free in consideration of the environment.

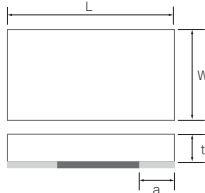
## Applications

- PCs, hard drive discs, audio visual equipments, power sources, inverters, automotive electronics, industrial machining equipments, industrial test and measurements, etc.

## Specifications

\*All made to order.

### Dimensions



Dimensions (mm)	KRL0816 (0603)	KRL1220 (0805)	KRL1632 (1206)	KRL3264 (2512)	KRL50110 (4320)
L	1.60±0.20	2.00±0.20	3.20±0.20	6.30±0.20	11.0±0.20
W	0.80±0.20	1.25±0.20	1.60±0.20	3.10±0.20	5.00±0.20
t	0.50±0.20	0.50±0.20	0.50±0.20	0.50±0.20	0.65±0.20
a (5.0~7.0mΩ)	-	0.40±0.20	1.10±0.20	1.90±0.20	3.60±0.30
a (8.0mΩ~)			0.50±0.20	1.00±0.20	2.36±0.30
a (9.0mΩ~)	0.30±0.20				

### Electrical characteristics

Series name	KRL0816	KRL1220		KRL1632		KRL3264		KRL50110		
Power	0.3W	1/2W		3/4W		2W		5W		
E series offered	E-12	E-12		1mΩ STEP	E-12	1mΩ STEP	E-12	1mΩ STEP	E-12	
Resistance range (Ω)	10m~100m	5m~9m	10m~100m	5m~9m	10m~500m	5m~9m	10m~1000m	5m~9m	10m~1000m	
Resistance tolerance (%)	±1.0(F)	○	-	○	-	○	-	○	-	○
	±2.0(G)	-	○	-	○	-	○	-	○	-
Temperature coefficient of resistance (ppm/°C)	±50	○	-	○	-	○	-	○	-	○
	±100	-	○	-	○	-	○	-	○	-
Operating temperature	C	-55°C~175°C								
	M	-55°C~155°C								
Rated ambient temperature (at terminals)	C	120°C or less								
	M	100°C or less								
Packaging	1,000pcs	○	○	○	○	○	○	○	○	
	5,000pcs	○	○	○	○	○	○	○	-	

## Part numbering system

**KRL 1220E-C-R010-F-T1**

— Packaging: T1 (1000pieces) T5 (5000pieces)

— Resistance tolerance

— Resistance value

— Operating temperature: C (High temperature type) M (Low emf type)

— Lap electrode type: D (Bottom electrode) E (U-shape electrode)

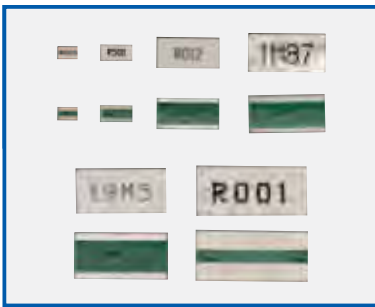
— Size

— Series code

# Metal foil low resistance chip resistors (long-side terminals)

KRL series

AEC-Q200 Compliant



## Features

- The C type utilizes materials that withstand high temperatures and can be operated up to 175°C. The M type utilizes low emf materials that are stable up to 155°C. TCR is very stable for very low resistance: +/-150ppm/°C for 1mΩ, +/-100ppm/°C for 2mΩ, and +/-50ppm/°C for 3mΩ. Face down mounting allows for accurate current measurement. Long and short side terminal types, as well as power ratings from 1W to 6W are offered to meet customers' specific requirements. The protective outer coating is halogen free in consideration of the environment.

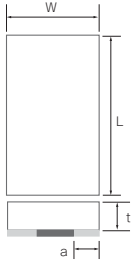
## Applications

- PCs, hard drive discs, audio visual equipments, power sources, inverters, automotive electronics, industrial machining equipments, industrial test and measurements, etc.

## Specifications

\* All made to order.

### Dimensions

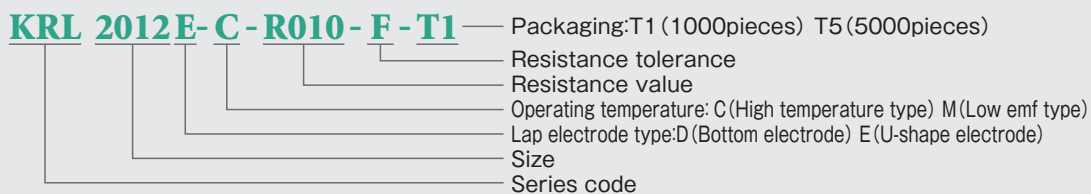


Dimensions (mm)	KRL2012	KRL3216	KRL6432	KRL7638	KRL9045	KRL11050
L	2.00±0.20	3.20±0.20	6.30±0.20	7.60±0.20	9.00±0.20	11.00±0.20
W	1.25±0.20	1.60±0.20	3.10±0.20	3.80±0.20	4.50±0.20	5.00±0.20
t	0.50±0.20	0.50±0.20	0.50±0.20	0.50±0.20	0.50±0.20	0.50±0.20
a (1.0mΩ)	0.55±0.20	0.55±0.20	1.20±0.20	1.35±0.20	1.60±0.20	1.60±0.20
a (2.0mΩ~)	0.30±0.20	0.30±0.20	0.50±0.20	0.60±0.20	0.70±0.20	0.80±0.20

### Electrical characteristics

Series name	KRL2012				KRL3216				KRL6432				KRL7638				KRL9045				KRL11050				
Power	1W				1.5W				3W				4W				5W				6W				
E series offered	1mΩ STEP		E-6		1mΩ STEP		E-6		1mΩ STEP		E-6		1mΩ STEP		E-6		1mΩ STEP		E-6		1mΩ STEP		E-6		
Resistance range (Ω)	1m	2m	3m~9m	10m~500m	1m	2m	3m~9m	10m~500m	1m	2m	3m~9m	10m~500m	1m	2m	3m~9m	10m~500m	1m	2m	3m~9m	10m~500m	1m	2m	3m~9m	10m~500m	
Resistance tolerance (%)	±1.0(F)	—	—	○	○	—	—	○	○	—	—	○	○	—	—	○	○	—	—	○	○	—	—	○	○
	±2.0(G)	—	○	—	—	—	○	—	—	—	○	—	—	—	○	—	—	—	○	—	—	—	○	—	—
	±5.0(J)	○	—	—	—	○	—	—	—	○	—	—	—	○	—	—	—	○	—	—	—	○	—	—	—
Temperature coefficient of resistance (ppm/°C)	±50	—	—	○	○	—	—	○	○	—	—	○	○	—	—	○	○	—	—	○	○	—	—	○	○
	±100	—	○	—	—	—	○	—	—	—	○	—	—	—	○	—	—	—	○	—	—	—	○	—	—
	±150	○	—	—	—	○	—	—	—	○	—	—	—	○	—	—	—	○	—	—	—	○	—	—	—
Operating temperature	C	-55°C ~ 175°C																							
	M	-55°C ~ 155°C																							
Rated ambient temperature (at terminals)	C	120°C or less																							
	M	100°C or less																							
Packaging	1,000pcs	○				○				○				○				○				○			
	5,000pcs	○				○				○				○				○				—			

## Part numbering system



Current sensing surface mount resistors

KRL series

# Metal foil low resistance chip resistors (4 terminals type)

■ KRL series



## Features

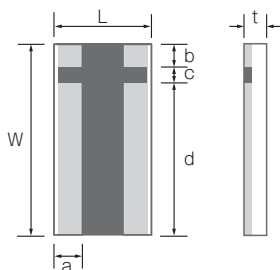
- According to the application, choose to suit high-temperature durable material or low emf materials (operating temperature~155°C) .
- Temperature Coefficient of Resistance at very low resistance value, 4~10mΩ : ±50ppm/°C, is extremely stable.
- Face down in the specification, you can achieve good detection accuracy.
- Rated power : 1W~2W.
- Exterior resin is halogen-free environment-friendly products.

## Applications

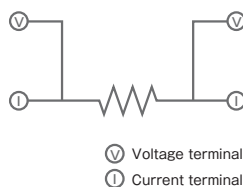
- Smart phones, mobile phones, PCs, hard drive discs, audio visual equipments, power sources, inverters, automotive electronics, industrial machining equipments, industrial test and measurements, etc.

## Specifications

### Dimensions



### Equivalent circuits

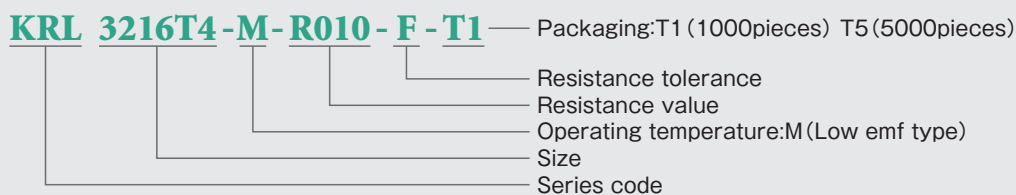


Dimensions (mm)	KRL3216T4 (1206)	KRL6432T4 (2512)
W	3.20±0.20	6.40±0.20
L	1.60±0.20	3.20±0.20
a	0.35±0.20	0.50±0.20
b	0.35±0.15	0.70±0.15
c	0.20±0.10	0.50±0.10
d	2.65±0.15	5.20±0.15
t	0.50±0.20	0.50±0.20

### Electrical characteristics

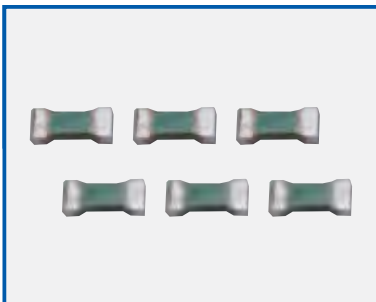
Series name	KRL3216T4						KRL6432T4					
	1W						2W					
E series offered	1mΩSTEP			E-6			1mΩSTEP			E-6		
Resistance range (Ω)	1m~2m	3m	4m~10m	100m	200m	500m	1m~2m	3m	4m~10m	100m	200m	500m
Resistance tolerance (%)	±1.0 (F)	—	○	○	○	○	—	○	○	○	○	○
	±2.0 (G)	○	—	—	—	—	○	—	—	—	—	—
Temperature coefficient of resistance (ppm/°C)	±50	—	—	○	○	○	—	—	○	○	○	○
	±100	○	○	—	—	—	○	○	—	—	—	—
Operating temperature	-55°C~155°C											
Rated ambient temperature	70°C											
Packaging	1,000pcs	○					○					
	5,000pcs	○					○					

## Part numbering system



# Metal foil low resistance chip resistors (High Current Surface Mount Jumper Chip)

■ YJP series



## Features

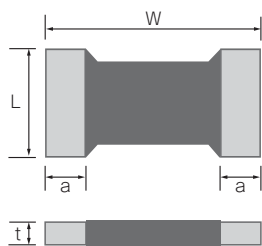
- Achieve a simplified circuit design, loop, switching the power supply line when the current change
- Resistance value is less than  $0.3\text{m}\Omega$  in the operating temperature range.
- Made it possible to surface mounting to facilitate the implementation by the replacement of Jumper lead
- Contribute to the reduction of power loss and voltage drop due to large current circuit
- Operating temperature :  $\sim 125^\circ\text{C}$ , high stability
- Exterior resin is halogen-free environment-friendly products.

## Applications

- Mobile phones, smart phones, automotive electronics, power sources, servers, PCs, etc.

## Specifications

### Dimensions



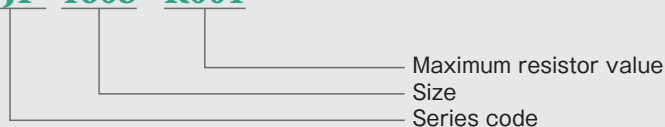
Dimensions (mm)	YJP 1608
L	$0.80 \pm 0.20$
W	$1.60 \pm 0.20$
t	$0.30 \pm 0.10$
a	$0.30 \pm 0.20$

### Electrical characteristics

Series name	YJP 1608
Resistance range ( $\Omega$ )	$0.2 \pm 0.1\text{m}\Omega$
	Maximum resistance is less than $0.3\text{m}\Omega$ under the operating temperature range
Rated maximum current	10A (constant current)
Operating temperature	$-40 \sim +125^\circ\text{C}$
Rated ambient temperature	$+70^\circ\text{C}$
Packaging	5,000pcs

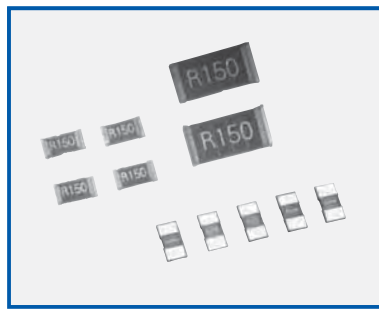
## Part numbering system

**YJP 1608 - R001**



# Metal plate low resistance chip resistors

■ RL series



## Features

- Operating temperature: stable up to 170°C
- Resistance tolerance: +/-1%, TCR +/-50ppm/°C
- Protective outer coating is halogen free in consideration of the environment.



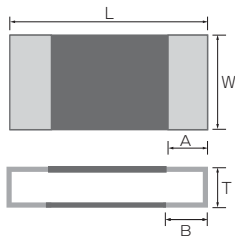
## Applications

- Power sources, servers, etc.

## Specifications

\*All made to order.

### Dimensions

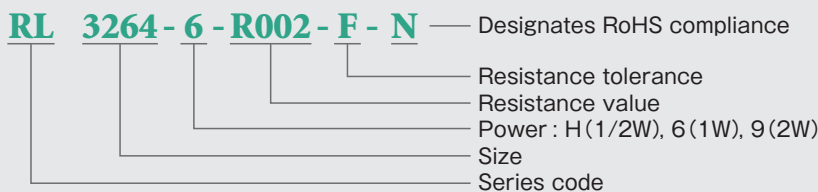


Dimension (mm)	RL-0816-3 (0603)	RL-1220-4 (0805)	RL1632H (1206)	RL1632L4 (1206)	RL-1632-6C (1206)	RL-3264-0W (2512)	RL-3264-6C (2512)	RL-3264-9W (2512)	RL3264L4 (2512)	RL-3637-0 (1514)
L	1.60±0.20	2.00±0.20	3.20±0.20	1.50±0.25	3.20±0.20	6.35±0.25	6.35±0.25	6.35±0.25	3.20±0.25	9.14±0.25
W	0.80±0.20	1.30±0.20	1.60±0.20	3.15±0.25	1.60±0.20	3.15±0.25	3.20±0.20	3.15±0.25	6.40±0.25	9.40±0.25
T	0.40±0.15	0.80±0.25	0.80±0.15	0.88±0.25	1.05±0.20 (5mΩ) 0.90±0.20 (10~40mΩ)	0.80±0.20	1.05±0.15 (3m~5mΩ, 7mΩ) 0.80±0.15 (6mΩ, R>8mΩ)	0.80±0.20	0.90±0.25	0.88±0.20
A	0.35±0.15	0.40±0.20	0.50±0.15	0.35±0.20	0.50±0.15	0.95±0.30	0.90±0.25	0.95±0.30	0.70±0.20	3.50±0.25(1mΩ) 2.20±0.25(≥2mΩ)
B	0.35±0.15	-	-	-	-	-	-	-	-	-

### Electrical characteristics

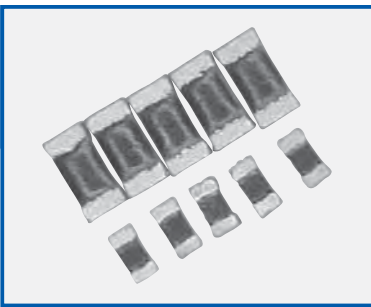
Series name	RL-0816-3	RL-1220-4	RL1632H	RL1632L4			RL-1632-6C	RL-3264-0W	RL-3264-6C	RL-3264-9W			RL3264L4			RL-3637-0							
Power	1/4W	1/2W	1/2W	1W			1W	3W	1W	2W			2W			3W							
Resistance range (Ω)	10m~20m	21m~50m	10m~50m	5m~10m	11m~150m	0.5m~0.75m	1~2m	3~4m	5m	5m	10m~40m	2~4m	5m~50m	3m~100m	1.2m	2~4m	5m~50m	1m	3m	5m~15m	1~<2m	2~10m	
Resistance tolerance (%)	±0.5(D)	-	-	-	-	-	-	-	○	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	±1.0(F)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	±2.0(G)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	±3.0(H)	-	-	-	-	-	○	○	○	-	-	-	-	-	-	-	-	○	○	○	-	-	-
	±5.0(J)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Temperature coefficient of resistance (ppm/°C)	±50	-	-	-	○	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	±100	-	-	○	○	-	-	-	-	-	○	-	○	○	-	-	○	-	-	-	-	-	○
	±150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	○	-	-
	±200	-	-	-	-	-	-	-	-	-	-	○	-	-	-	-	○	-	-	-	-	-	-
	0~150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	○	-
	0~250	-	○	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	0~300	-	-	-	-	-	-	-	-	-	○	-	-	-	-	-	-	-	-	-	-	-	-
	0~350	○	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	0~500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	○	-	-	-	-	-	-	-
	0~250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	○	-	-
0~400	-	-	-	-	-	-	○	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
0~700	-	-	-	-	-	○	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Maximum voltage												$\sqrt{P \cdot R}$											
Operating temperature	-55°C~125°C		-55°C~170°C					-55°C~155°C			-55°C~170°C												
Packaging	1,000pcs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	○	-
	2,000pcs	-	-	-	-	-	-	-	-	-	-	○	○	-	-	-	-	-	-	-	-	-	-
	4,000pcs	-	○	○	-	-	-	-	-	-	○	-	-	-	-	-	-	-	-	-	-	-	-
	5,000pcs	○	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

## Part numbering system



# Thick film chip resistors

■ RLT series



## Features

- Offering a variety of sizes (0306-3264) and power ratings (1/10W-2W)
- Current sensing thick film chip resistors

## Applications

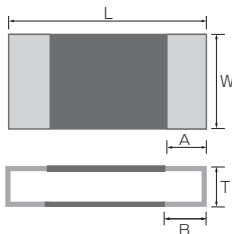
- PCs, HDDs, mobile phones, power sources, motors, etc.



## Specifications

\*E-24 series are standard stock items. E-96 series are made to order.

### Dimensions

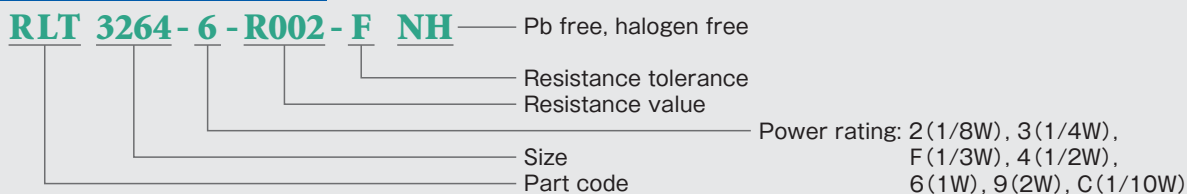


Dimension (mm)	RLT0306-C (0201)	RLT0510-2 (0402)	RLT0816-3 (0603)	RLT1220-F (0805)	RLT1632-4 (1206)	RLT3264-6 (2512)	RLT3264-9 (2512)
L	0.60±0.03	1.00±0.10	1.60±0.15	2.00±0.20	3.20±0.20	6.30±0.15	6.30±0.25
W	0.31±0.04	0.50±0.10	0.80±0.15	1.25±0.20	1.60±0.20	3.20±0.15	3.20±0.20
T	0.27±0.04	0.35±0.15/0.10	0.45±0.10	0.50±0.10	0.60±0.10	0.55±0.15	0.80±0.20
A	0.14±0.06	0.25±0.10	0.30±0.20	0.40±0.20	0.50±0.25	0.60±0.20	0.80±0.30
B	0.14±0.06	0.30±0.10	0.30±0.20	0.40±0.20	0.50±0.25	0.60±0.20	0.80±0.30

### Electrical characteristics

Series name	RLT0306-C		RLT0510-2		RLT0816-3		RLT1220-F		RLT1632-4		RLT3264-6		RLT3264-9	
Power	1/10W		1/8W		1/4W		1/3W		1/2W		1W		2W	
E series offered	-		E24	E24,E96	E24	E24,E96	E24,E96		E24	E24,E96	E24	E24,E96	-	
Resistance range (Ω)	0.5~1.0	1.0~2.0	0.065~<0.60	0.060~<1.0	0.05~<0.1	0.1~<1.0	0.05~<0.1	0.1~<1.0	0.05~<0.1	0.1~<1.0	0.05~<0.1	0.1~<1.0	0.05~<0.1	0.1~<0.55
Resistance tolerance (%)	±1.0(F)	○	○	○	○	○	○	○	○	○	○	○	○	○
	±2.0(G)	○	○	○	○	○	○	○	○	○	○	○	○	○
	±5.0(J)	○	○	○	○	○	○	○	○	○	○	○	○	○
Temperature coefficient of resistance (ppm/°C)	0~100	-	-	-	-	-	-	-	-	-	-	-	-	○
	0~150	-	-	-	-	-	-	-	-	-	-	-	○	-
	0~200	-	○	-	○	-	○	-	○	-	○	-	-	-
	0~250	-	-	-	-	-	-	-	○	-	-	-	-	-
	0~300	○	-	○	-	○	-	○	-	-	-	-	-	-
	0~800	-	-	-	-	-	-	-	-	-	-	-	-	-
Maximum voltage	$\sqrt{P \cdot R}$													
Operating temperature	-55°C ~ 125°C													
Packaging	2,000 pcs	-	-	-	-	-	-	-	-	-	-	○	-	○
	5,000 pcs	-	-	-	○	-	○	-	○	-	-	-	-	-
	10,000 pcs	○	-	○	-	-	-	-	-	-	-	-	-	-

## Part numbering system

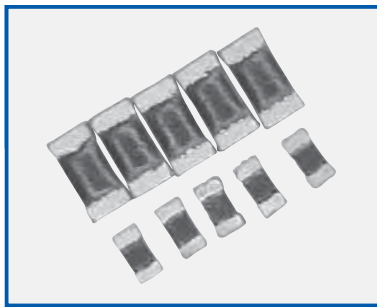


Current sensing surface mount resistors

RLT series

# Thick film chip resistors

■ PFR series and GFR series



## Features

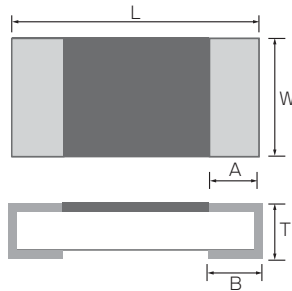
- TCR +/-100ppm/°C is realized for resistors over 1MΩ
- The same terminal structure as thin film counterparts assures reliability
- In consideration of the environment, the glass passivation is Pb free and the resin passivation is halogen free.



## Specifications

\*E-24 series are standard stock items. E-96 series are made to order.

### Dimensions



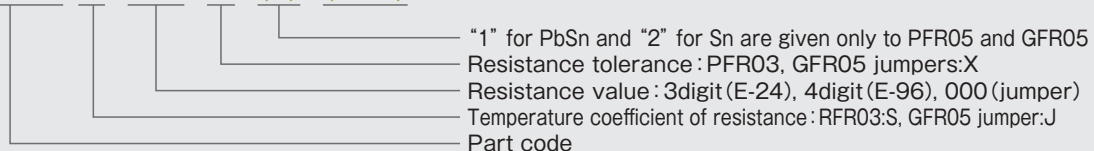
Dimension (mm)	PFR02S (01005S)	PFR03S (0201S)	PFR05, GFR05 (0402)
L	0.40±0.02	0.60±0.03	1.00±0.05
W	0.20±0.02	0.30±0.03	0.50±0.05
T	0.13±0.02	0.23±0.03	0.35±0.05
A	0.10±0.03	0.10±0.05	0.20±0.10
B	0.10±0.03	0.15±0.05	0.25±0.05

### Electrical characteristics

Series name	PFR02S				PFR03S					PFR05			GFR05				
	Jumper	1/32W			Jumper	1/20W				Jumper	1/16W		Jumper	1/16W			
E series offered	—	E-24	E-24, E96	E-24	—	E-24	E-24, E96			E-24	—	E-24, E-96		—	E-24, E-96		
Resistance range (Ω)	50m or less	1.0 ~ 9.1	10 ~ 91	100 ~ 1.62M	100 ~ 10M	50m or less	1.0 ~ 9.1	10 ~ 91	100 ~ 100K	100 ~ 1M	100 ~ 10M	50m or less	10 ~ 97.6	100 ~ 1M	1.02 ~ 10M	50m or less	10 ~ 10M
Resistance tolerance (%)	±0.5% (D)	—	—	—	—	—	—	○	—	—	—	—	○	○	—	—	○
	±1.0% (F)	—	—	○	○	—	○	○	—	○	—	—	○	○	○	—	○
	±2.0% (G)	—	—	—	○	—	—	—	—	○	—	—	—	—	—	—	—
	±5.0% (J)	—	○	—	—	○	—	—	—	—	○	—	—	—	—	—	—
Temperature coefficient of resistance (ppm/°C)	±50	—	—	—	—	—	—	—	—	—	—	—	—	○	—	—	—
	±100	—	—	—	—	—	—	—	—	—	—	—	○	—	○	—	—
	±200	—	—	—	○	○	—	—	○	○	○	—	—	—	—	—	○
	±300	—	—	○	—	—	—	○	—	—	—	—	—	—	—	—	—
	+600 ~ -200	—	○	—	—	—	○	—	—	—	—	—	—	—	—	—	—
Maximum voltage	0.5A	15V			1A	25V				1A	50V		1A	50V			
Operating temperature	-55°C ~ 125°C																
Packaging	10,000pcs	—				○					○			○			
	20,000pcs	○				—					—			—			

## Part numbering system

**PFR05 R - 102 - D - (2) - (T20)** — Packaging: Given to PFR02S 20,000/reel



Thick film surface mount resistors

PFR series and GFR series



# Power choke coils

■ PCMB series,



## Features

- Low profile (3.0 mm max) and small size (7.3mm x6.6mm)
- Occupying small board spaces
- Low loss and high saturating current.

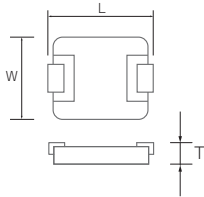
## Applications

- PCs, servers, power sources, mobile devices, flat screen TVs etc.

## Specifications

\* All made to order.

### Dimensions · Electrical characteristics



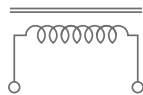
Rated current : the current that increases the temperature by 40°C  
 Saturating current : The current that reduces inductance by 30% (PCMB/PS/PST/PL).  
 ※ Contact us for details.

## Part numbering system

**PCMB \*\*\*\* - \*\*\* M N(S,T)**

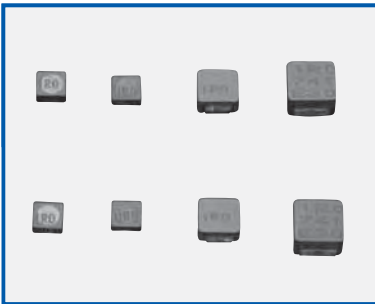
Material : refer to the table for electrical characteristics  
 Inductance tolerance M=±20%  
 Inductance value (R56=0.56 μH, R68=0.68 μH)  
 Size  
 (063T=6.6\*7.3\*3.0mm, 104T=10\*11.5\*4.0mm,  
 133E=12.6\*13.8\*3.5mm, 135T=12.6\*13.8\*5.0mm)  
 Part code

### Equivalent circuits



# Small choke coils

■ PCMB series, PS series



## Features

- Low DCR and large current for small sizes
- High efficiency and low loss

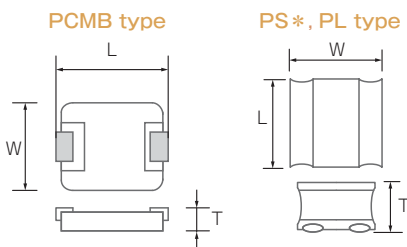
## Applications

- PCs, servers, power sources, mobile devices, flat screen TVs etc.

## Specifications

\* All made to order.

### Dimensions · Electrical characteristics



Rated current : the current that increases the temperature by 40°C  
 Saturating current : The current that reduces inductance by 20% (PCMB) or 30% (PCMB/PS/PST/PL)  
 ※ Contact us for details.

## Part numbering system

**PS 031\* - \*\*\* M (S)**

Material : refer to the table for electrical characteristics  
 Resistance tolerance : ±20%  
 Inductance value  
 Size : B (2.9mm\*2.9mm\*1.2mm), T (2.9mm\*2.9mm\*1.0mm)  
 Part code



# Precision chip attenuators

■ PAT series, RAT series

## Features

- Excellent noise characteristics, small stray/parasitic inductance and capacitance
- Excellent high frequency characteristics
- PAT0510S are the smallest and lightest thin film chip attenuators.



## Applications

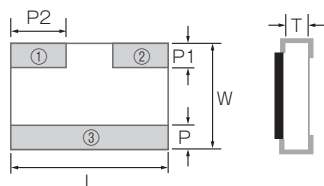
- Wireless communication devices, wireless communication modules, etc.

## Specifications

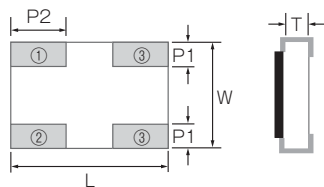
\*All made to order.

### Dimensions

PAT0816, PAT1220, PAT1632



RAT1010X, PAT0510S, PAT3042S

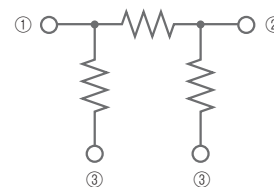


Back side

unit : mm

Dimension (inch)	RAT1010X (0404)	PAT0510S (0402)	PAT0816 (0603)	PAT1220 (0805)	PAT1632 (1206)	PAT3042S (1712)
L	1.00±0.05	1.00±0.05	1.60±0.10	2.00±0.10	3.20±0.20	4.20±0.20
W	1.00±0.05	0.50±0.05	0.80±0.10	1.25±0.10	1.60±0.20	3.00±0.20
P	0.25+0.05/-0.1	—	0.20±0.10	0.35±0.20	0.40±0.20	0.90±0.20
P1	0.25+0.05/-0.1	0.12±0.04	0.20±0.10	0.35±0.20	0.40±0.20	0.80±0.20
P2	0.33±0.10	0.27±0.05	0.50±0.10	0.60±0.20	1.00±0.20	0.50±0.20
T	0.42±0.05	0.34±0.05	0.40±0.10	0.40±0.10	0.40±0.10	0.80±0.15

### Equivalent circuits



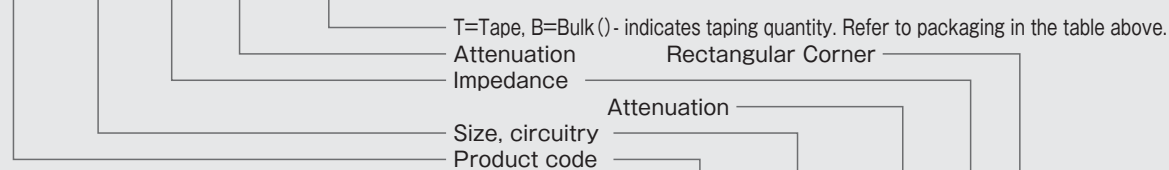
### Electrical characteristics

Series name	RAT1010X				PAT0510S			PAT0816			PAT1220	PAT1632		PAT3042S		
Attenuation	1~5dB	6~9dB	10dB	11~16dB	20dB	0~3dB	4~7dB	8~10dB	0~3dB	4~7dB	8~10dB	0~10dB	0~10dB	16dB	0~10dB	16, 20dB
Attenuation tolerance	±0.3dB	±0.4dB	±0.75dB	±0.8dB	±2.5dB	±0.3dB	±0.5dB	±1.0dB	±0.3dB	±0.5dB	±0.7dB	±0.3dB	±0.3dB	±0.5dB	±0.3dB	±0.5dB
Impedance	50Ω (C)				50Ω (C)	50Ω (C)			50Ω (C)		50Ω (C)	50Ω (C), 75Ω (D)				
VSWR	<1.3				<1.3	<1.3 (~6GHz), <1.5 (6~10GHz)			<1.3		<1.3	<1.2 (50Ω), <1.3 (75Ω)				
Operating frequency	~2.5GHz		~3GHz		DC~10GHz	DC~10GHz			DC~10GHz		DC~3GHz	~3GHz (50Ω), ~2GHz (75Ω)				
Rated power	40mW				32mW	63mW			100mW	125mW	250mW					
Rated operating temperature	—				70°C											
Operating temperature	-55°C~+125°C															
Packaging	10,000pcs/reel (no code)				10,000pcs/reel (T10)			5,000pcs/reel (T)			100pcs/bag, 1,000pcs/reel (T1), 5,000pcs/reel (T5)		50pcs/bag, 2,000pcs/reel (T2)			

- Contact us for 1.0 x 0.5mm GBA type PAT0510.
- Contact us for high power attenuators up to 10W.

## Part numbering system

**PAT 1632 - C - 3dB - T(5)**



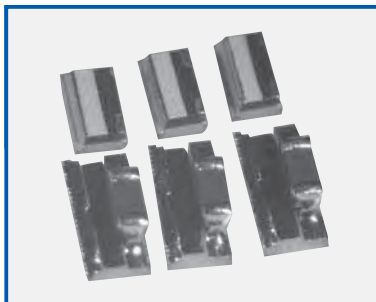
(OLD P/N) **RAT 1010X - 3dB - C - B**

High frequency surface mount components

PAT series, RAT series

# Temperature compensated chip attenuators

■ P \* V series



## Features

- For simplifying temperature drift compensation of GaAs high frequency amplifiers
- Excellent high frequency characteristics

## Applications

- Base station and others



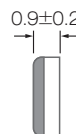
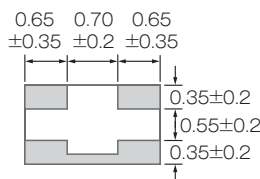
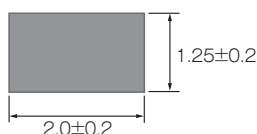
\* Except for Chinese RoHS

## Specifications

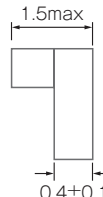
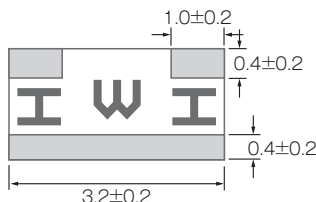
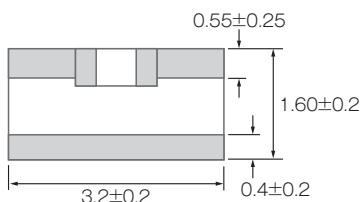
\* All made to order.

### Dimensions

PXV1220S



PBV1632S

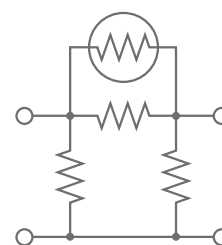


Front side

Back side

(unit:mm)

### Equivalent circuits



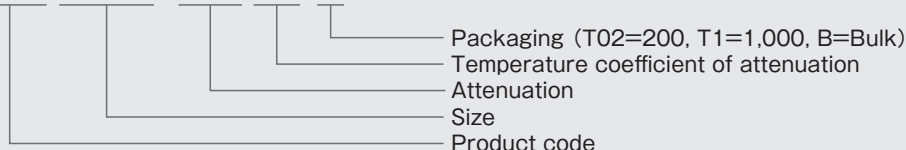
### Electrical characteristics

Series name	PXV1220S (0805)	PBV1632S (1206)
Attenuation	1, 2, 3, 4, 5, 6, 7, 8, 9, 10dB	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 16dB
Attenuation tolerance	±0.5dB (@25°C, no load)	
Impedance	50Ω	
VSWR	1.3max.	
Temperature coefficient of attenuation	N1 ~ N8 (1 ~ 3dB : N1 ~ N9)	N5 0.0041dB/dB*°C N6 0.0035dB/dB*°C N7 0.0026dB/dB*°C N8 0.0019dB/dB*°C
Operating frequency	DC ~ 3GHz	
Rated power	63mW	100mW
Operating temperature	-40°C ~ +100°C	
Packaging	100pcs/bag 200pcs/reel 1,000pcs/reel	min.20pcs/bag 1,000pcs/reel

· Refer to the data book for details.

## Part numbering system

PXV 1220S - 6dB N1 - T



High frequency surface mount components

P \* V series



# Sample Kits

For development, testing and prototyping, sample kits are available for metal thin film chip resistors, low resistance chip resistors, and chip inductors. We encourage our customers to give them a try.

## Electrical characteristics

Electrical characteristics	Rated power (W)						Resistance tolerance (%)			Temperature coefficient of resistance(ppm)	
	1/32	1/16	1/10	1/8	1/6	1/4	±0.05	±0.1	±0.5	±25	±10
Surface mount thin film resistors/metal thin film chip resistors											
RR0816PD-KIT		●							●	●	
RR1220PD-KIT			●						●	●	
RG1005PD-KIT	●	●		●					●	●	
RG1608PD-KIT		●	●		●				●	●	
RG2012PD-KIT			●	●		●			●	●	
RG1005PB-KIT	●	●		●				●		●	
RG1608PB-KIT		●	●		●			●		●	
RG2012PB-KIT			●	●		●		●		●	
RG1005NW-KIT	●	●		●			●				●
RG1608NW-KIT		●	●		●		●				●
RG2012NW-KIT			●	●		●	●				●

Product name	Rated power (W)				Resistance tolerance (%)
	1/3	1/2	1.0	2.0	±1.0
Current sensing surface mount resistors/low resistance chip resistors					
RL1220-KIT	●				●
RL3720W-KIT			●		●

## Part numbering system

**RG1005PD-KIT-BOX(FILE)**

— Packaging (BOX=BOX Type, FILE=FILE BOOK Type)  
 — Designates sample kits  
 — Product series name

Sample kits

Sample kits



# Overseas sales network and distributors

★ = Susumu's overseas subsidiary companies



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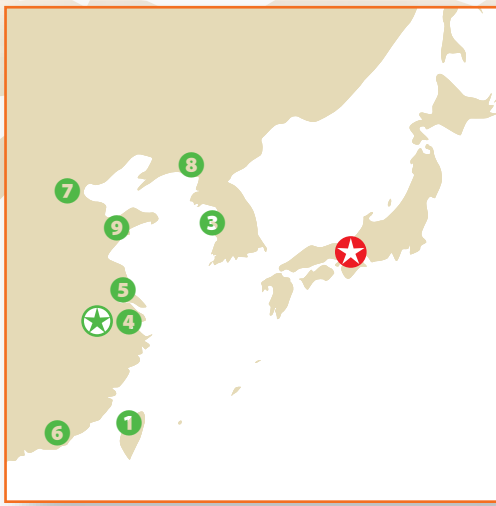
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