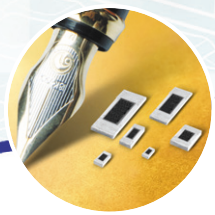
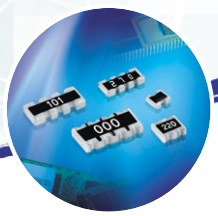
November 2009

RoHs+Halogen Compliant
ecoparts

THICK-FILM CHIP RESISTOR





SAMSUNG
ELECTRO-MECHANICS

SAMSUNG

We, Samsung, declare that our component Chip Resistor is produced in accordance with EU RoHS directive.

1. RoHS Compliance and restriction of Br

The following restricted materials are not used in packaging materials as well as products in compliance with the law and restriction.

- Cd, Pb, Hg, Cr+6, As, Br and the compounds, PCB, asbestos
- Bromic materials : PBBs, PBBOs, PBDO, PBDE, PBB

2. No use of materials breaking Ozone layer

The following ODS materials are not used in our fabrication process.

- ODS material : Freon, Haron, 1-1-1 TCE, CCl4, HCFC

If you want more detailed Information,Please Visit Samsung Electro-mechanics Website http://www.sem.samsung.com


Certificate of Registration

QUALITY MANAGEMENT SYSTEM - ISO/TS 16949:2002


ENVIRONMENTAL MANAGEMENT SYSTEM CERTIFICATE

Samsung High Tech Electro-mechanics (Tianjin) Co., Ltd.

GB/T24001-2004 / ISO 14001: 2004


CERTIFICATE OF REGISTRATION

Samsung High Tech Electro-mechanics (Tianjin) Co., Ltd.

GB/T28001-2001


ISO 9001

Samsung High Tech Electro-Mechanics (Tianjin) Co., Ltd.

ISO 9001:2000

TL 9000-H, R3.0/R3.5

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Operation Notes

Applications

• Chip resistors are designed for general electronic devices such as home appliances, computer, mobile communications, digital circuit, etc. If you require our products with high reliability-performing at more than 125℃ or below -55℃- for medical equipments, aircraft, high speed machines, military usage, and items that can affect human life or if you need to use in specific conditions (corrosive gas atmosphere like H_2S etc.), please contact us beforehand.

• Normal operation temperature ranges (℃) as follows.
-1608, 2012, 3216(general, precision) : -55℃~+155℃
-Others (rectangular, array, trimmable) : -55℃~+125℃

• Although resistor body is coated, sharp excessive impact should be avoided to prevent damages and adverse effects on characteristics (resistor value, open circuited, T.C.R.).

Mounting

Please give more attention not to press the chip owing to the nozzle's improper height when it is mounted on PCB.
(Excessive pressure may cause exterior damage, change in resistance, circuit open, etc.)

Soldering

Our products have Ag electrodes protected by double layer.

• 1st Ni coating
- This prevents Ag electrode from leaching and enhances the bonding with Sn.

• 2nd Sn coating
- This is made of Sn 100% with melting point 232℃ to prevent it from melting when solder cream melts, and to enhance the bonding. Commercial solder creams are made of Sn-3.0Ag-0.5Cu with melting point 217℃.

Safety precautions

This products are designed and produced for application in ordinary electronic equipment (AV equipment, OA equipment, telecommunication equipment, ··· etc)
if the products are to be used in devices requiring extremely hig reliability (Medical equipment , transport equipment, aircraft / spacocraft, nuclear power controllers, fuel controllers, car equipment including car accessor, safety device, etc)

a) Installation of protection circuits or other protective devices to improve system safery.

b) Installation of redundant circuits or other productive devices to improve system safery.

Storage

To maintain proper quality of chip components, the following precautions are required for storage environment, method and period.

•Storage Environment
- Make sure that the ambient temperature is within 5℃~40℃ and the ambient humidity is within 20~70%RH.
- Chip components may be deformed, if the temperature of packaged components exceeds 40℃.
- Do not store where the soldering properties can be deteriorated by harmful gas such as sulphurous gas, chlorine gas, etc.
- Bulk packed chip components should be used as soon as the seal is opened, thus preventing the solderability from deteriorating.
- The remaining unused chips should be put in the original bag and sealed again or store in a desiccator containing a desiccating agent.

•Storage Time Period
Stored chip components should be used within 6 months after receiving the components. If 6 months or more have elapsed, please check the solderability before actually using.

Cleaning

After Soldering Cleaning, soldering flux & Ionic cleaning liquid should be avoided on product.
If any possibility on product, please take a test before usage.

Caution for Chip Resistor Seperation from PCB.

Chip resistor installation on PCB is similar phenomenon on chocolate chip on top of cake.
PCB has enough flexibility on outer force but Chip resistor can be defected without any bending.
(By chip resistor use of Ceramic, solder, metal)
Therefore, when separate from Chip resistor on PCB, be ware of any crack of chip.

Others

• Manual work
Whenever separating chip resistor from PCB, do not re-use the chip resistor for circuit safety.
Chip resistor can be electrical specification change by soldering Iron after separation.
Re-use of separated chip resistor should be prohibited.

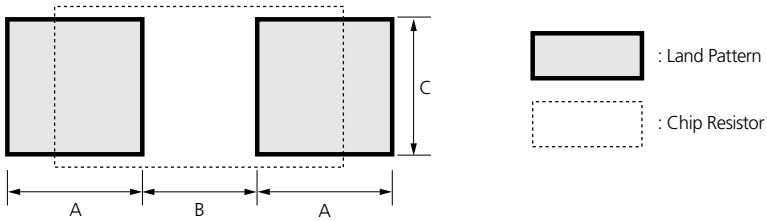
• Do not use more than rated voltage.
(Please check the contents of each product)

Example of Land Pattern Design

Abstract

• When designing P.C.B, the shape and size of the solder lands must allow for the proper amount of solder under the resistor.
The amount of solder at the end terminations has a direct effect on the probability that the chip will crack.
The greater amount of solder, the amont of stress on the chip, and the more likely that it will break.
Use the following illustrations as guidelines for proper 'solder lands design'.

For Rectangular Type



• Flow soldering (UNIT: mm)

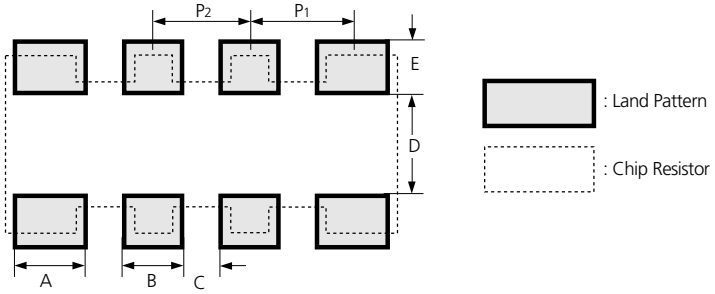
Type	A	B	2A+B	C
1005	0.7	0.5	1.9	0.5
1608	0.9	0.8	2.6	0.8
2012	1.0	1.4	3.4	1.3
3216	1.4	1.8	4.6	1.6
3225	1.4	1.8	4.6	2.6
5025	1.5	3.3	6.3	2.5
6432	1.5	4.6	7.6	3.2

• Reflow soldering (UNIT: mm)

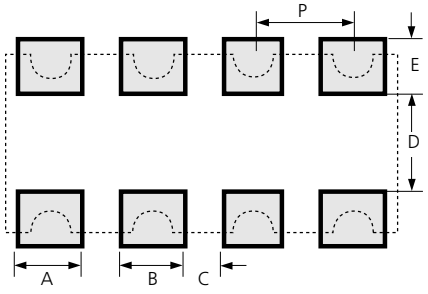
Type	A	B	2A+B	C
0603	0.37	0.28	1.02	0.29
1005	0.6	0.5	1.7	0.5
1608	0.8	0.8	2.4	0.8
2012	0.9	1.4	3.2	1.2
3216	1.3	1.8	4.4	1.5
3225	1.3	1.8	4.4	2.4
5025	1.4	3.3	6.1	2.4
6432	1.4	4.6	7.4	3.0

For Array Type

• Convex type



• Concave type



(UNIT: mm)

Type	A	B	C	D	E	P1	P2
10AT	0.4	0.4	0.25	0.5	0.5	0.65	-
102P	0.4	0.4	0.25	0.5	0.5	0.65	
104P	0.4	0.3	0.2	0.5	0.5	0.55	0.5
164P	0.7	0.5	0.3	0.9	0.8	0.9	0.8

(UNIT: mm)

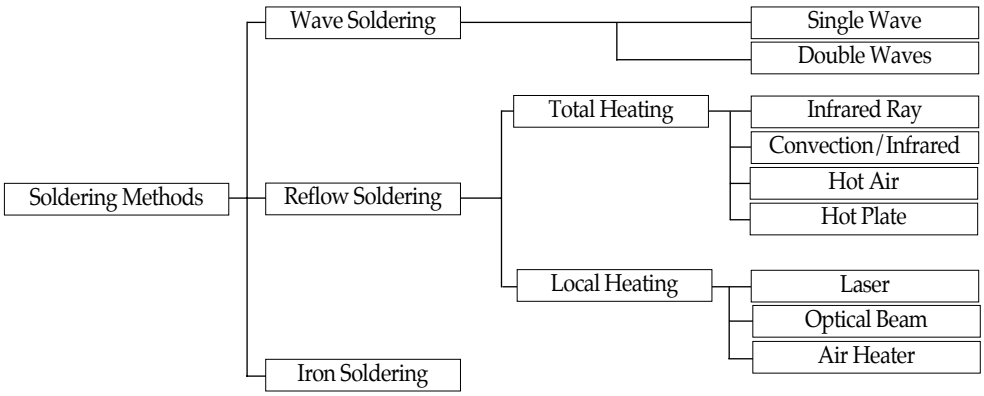
Type	A	B	C	D	E	P
102P	0.3	0.3	0.2	0.5	0.4	0.5
104P	0.3	0.3	0.2	0.5	0.4	0.5
162P	0.5	0.3	0.4	0.8	0.8	0.8
164P	0.5	0.3	0.4	0.8	0.8	0.8

• Please refer to this land pattern when you design P.C.B. if you want.
This pattern can't guarantee any characteristic of your product.

Recommended Soldering Conditions

Abstract

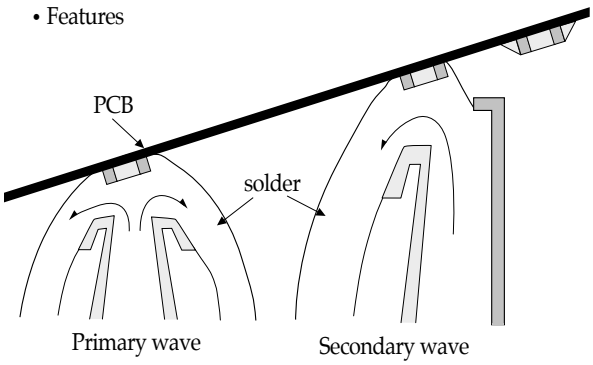
• There are 3 soldering methods.
- Flow(wave) soldering.
- Reflow soldering. (Reflow soldering is broadly divided into the total heating method and local heating method.)
- Iron soldering.



Since Chip resistors come into direct contact with melted solder during soldering, it exposed to potentially mechanical stress caused by the sudden temperature change. The chip resistors may also be subject to silver migration, and to contamination by the flux. Because of these factors, soldering technique is critical.

Flow(wave) Soldering

• Features



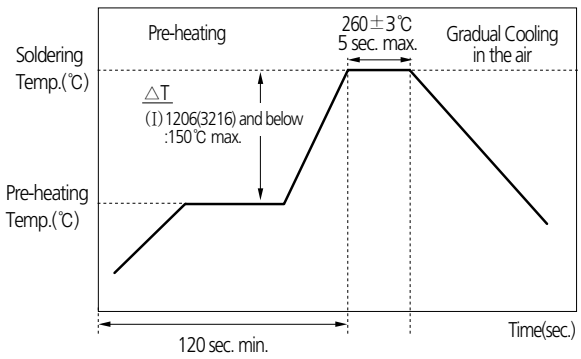
There are two types of soldering methods in flow(wave) soldering. One is single wave soldering, the other is a double wave soldering. However, double waves soldering is mainly used. This method is designed so that the continuous and multiple dipping processes by waves of solder having completely different primary and secondary characteristics and waveforms.
With the primary wave, a comparatively strong jet flow is used to remove the flux gas and to solder.
With the secondary wave, it is used to remove excessive solder.
With the primary wave, the solder flows into a very small gap between components and air bubbles remaining on the soldered joint are removed.
With the secondary wave, the peel back is used to prevent bridging.

• Preheating

If a chip component is heated suddenly during soldering, it may be cracked by the thermal shock caused by the temperature difference between the surface and the inside of the chip. To prevent this, a full preheating is necessary. In case of wave soldering, the temperature difference between solder and surface of the component is kept within 150℃. Also when cooling is done by dipping into solvent, care should be taken to keep the temperature difference within 150℃.

• Standard Soldering Condition

Soldering must be carried out without exceeding the approved soldering temperature and time shown within the shaded area of the right graph. An excessively long soldering time or high soldering temperature results in leaching of the outer terminations. When a PCB is warped, mechanical stress applied to the chip will be increased and might be a cause of chip crack, especially if there is big amount of solder on the chip. So, care should be taken not to use excessive amount of solder on the PCB. For the flow(wave) soldering, the solder amount can be controlled by land size.

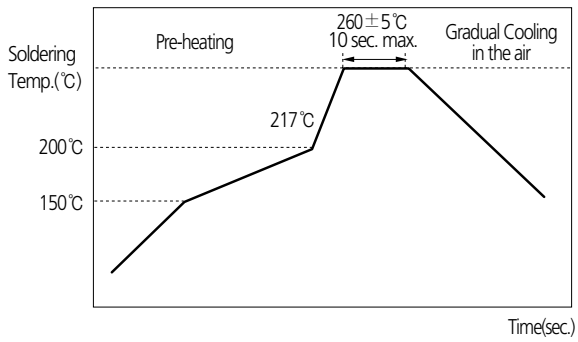


< Flow Soldering>

Reflow Soldering

• Pre-heating and cooling
In the reflow soldering method, a full pre-heating at the proper temperature is necessary to dry and activate solder paste. Tomb-stoning can be reduced by preheating at 150~180℃ for more than 1 minute. Also when cooling is done by dipping into solvent, care should be taken to keep the temperature difference within 150℃.

• Standard Reflow Soldering Condition
Soldering must be carried out without exceeding the approved soldering temperature and time shown within the shaded area of the right graph. This prevents the terminations from leaching and characteristics from deteriorating. When soldering is repeated, the allowed time is the accumulated time.



< Reflow Soldering>

• Standard solder amount
When a PCB is warped, mechanical stress applied to the chip should be reduced, and for doing so, care should be taken not to use excessive amount of solder on the PCB. In case of the reflow method, the thickness of the coated solder paste is controlled to prevent excessive solder. The thickness of solder paste should be 100~300㎛.

• Tombstoning and Prevention
When reflow soldering, or especially vapor phase soldering (VPS), small chip components of less than RC3216 type may break away from solder and stand on end. This is commonly known as tombstoning or the Manhattan phenomenon.

- Cause of tomstoning
PCB: Form and size of land, component layout and material
Chip component: Form, size, weight and solder wetting properties
Solder paste: Particle form, particle diameter, degree of activation and coated amount
Machine: Pre-heating condition, unbalance heat system and mechanical vibration

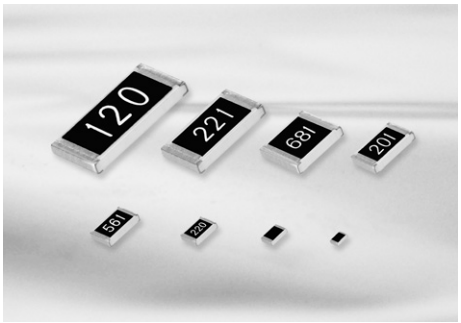
- Preventing tombstoning
Keep land size as small as possible.
Pre-heat (Pre-heating temperature: 150~180℃, Pre-heating time: More than 1 minute)
Keep the amount of solder paste low.
Keep position deviation at a minimum when mounting chips.
When soldering, reduce thermal unbalance at both electrode of a chip.

Iron Soldering

When using a soldering iron or any other soldering operation, the permissible temperature and time should not be exceeded that in the reflow soldering. In other to prevent the external terminations from leaching and characteristics from deteriorating, the tip of the soldering iron should not touch the chip component (ceramic element, resin case, etc.). Soldering with a soldering iron and correcting with a soldering iron can be performed right the following conditions.

Item	Condition
Temperature at tip	350℃ Max.
Soldering iron output	20-Watt Max.
End of soldering iron	ø3mm Max.
Note	Do not directly touch the chip by the tip of the iron.

General Purpose



Feature

- Very small, thin, and light weight.
- Both flow and reflow soldering are applicable.
- Owing to the reduced lead inductance, the high frequency characteristic is excellent.
- Suitable size and packaging for surface mount assembly.

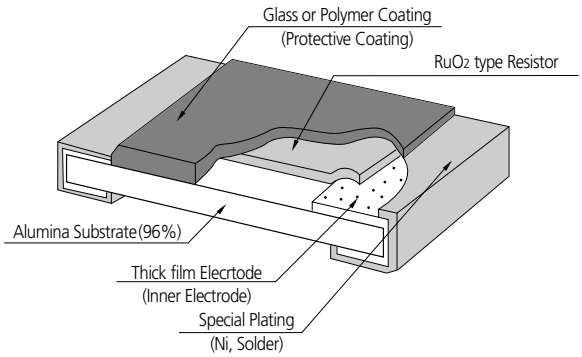
The product of lead-free terminal is RoHS compliant.
PhO(lead oxide) is included in the glass of our product which is prescribed on RoHS appendix as an exception.

Application

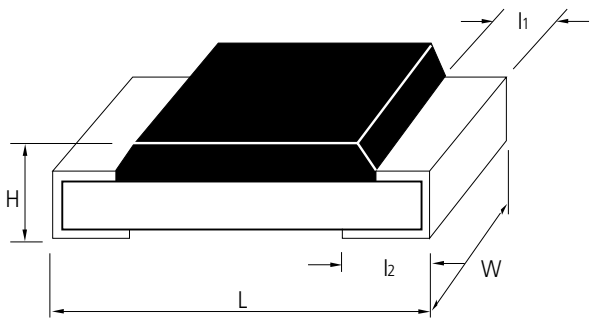
- General purpose
- Home Appliances
  (DVD, Digital TV,CAMCODER, VTR, Digital Camera, Audio,Tunner)
- For Computers & Communications
  (Notebook, Memory Module, Mobile, Network Equipment, etc)

Structure and Dimensions

• Structure



• Dimensions



(UNIT: mm)

Type	Inch	Power(W)	L	W	H	I_1	I_2	Average Weight
RC0603	0201	1/20	0.60±0.03	0.30±0.03	0.23±0.03	0.1±0.05	0.15±0.05	0.15㎎
RC1005	0402	1/16	1.00±0.05	0.50±0.05	0.35±0.05	0.20±0.10	0.25±0.10	0.6㎎
RC1608	0603	1/10	1.60±0.10	0.80±0.15	0.45±0.10	0.30±0.20	0.35±0.10	2.1㎎
RC2012	0805	1/8	2.00±0.20	1.25±0.15	0.50±0.10	0.40±0.20	0.35±0.20	4.9㎎
RC3216	1206	1/4	3.20±0.20	1.60±0.15	0.55±0.10	0.45±0.20	0.40±0.20	9.5㎎
RC3225	1210	1/3	3.20±0.20	2.55±0.20	0.55±0.10	0.45±0.20	0.40±0.20	16㎎
RC5025	2010	2/3	5.00±0.20	2.50±0.20	0.55±0.10	0.60±0.20	0.60±0.20	26㎎
RC6432	2512	1	6.30±0.20	3.20±0.20	0.55±0.10	0.60±0.20	0.60±0.20	41㎎

Parts Numbering System

• The part number system shall be in the following format

RC Code Designation	2012 Dimension & Size Code	J Tolerance	100 Resistance Value	CS Packaging Code
RC: Chip Resistor	0603: 0.6×0.3(㎜) - 0201(inch) 1005: 1.0×0.5(㎜) - 0402(inch) 1608: 1.6×0.8(㎜) - 0603(inch) 2012: 2.0×1.2(㎜) - 0805(inch) 3216: 3.2×1.6(㎜) - 1206(inch) 3225: 3.2×2.5(㎜) - 1210(inch) 5025: 5.0×2.5(㎜) - 2010(inch) 6432: 6.4×3.2(㎜) - 2512(inch)	G : ±2% J : ±5% K : ±10% ※Jumper:' J'	3 or 4 digits coding system (IEC coding system) 3digits (E-24 series) 4digits (E-96 series)	GS: Bulk Packaging CS: Tape Packaging 7" ES: Tape Packaging 10" FS: Tape Packaging 13" AS: Tape Packaging 13"

Specification

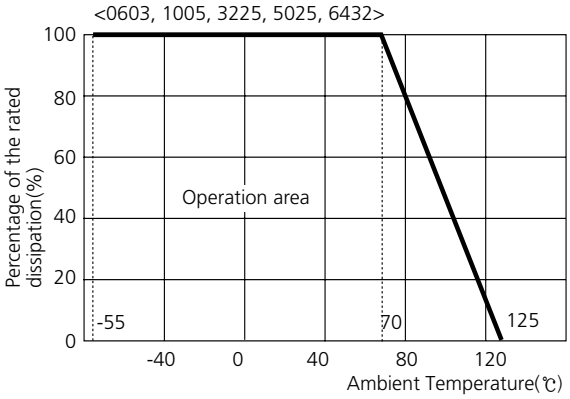
Type	Power Rating (W)	Working Voltage (MAX)	Overload Voltage (MAX)	TCR (ppm/℃)	Resistance Range (Ω) G(±2%) E-48	Resistance Range (Ω) J(±5%) E-24	Resistance Range (Ω) K(±10%) E-12	Rated Ambient Temperature	Rated Working Temperature
RC 0603	1/20	25(V)	50(V)	1Ω≤R<10Ω +300/-200ppm	1Ω~1MΩ	1Ω~10MΩ	1Ω~10MΩ	70℃	-55℃~+125℃
RC 1005	1/16	50(V)	100(V)						
RC 1608	1/10			10Ω≤R≤1MΩ ±100ppm (0603:±250ppm)					-55℃~+155℃
RC 2012	1/8	150(V)	300(V)						
RC 3216	1/4	200(V)	400(V)						
RC 3225	1/3								
RC 5025	2/3			1MΩ<R≤10MΩ ±300ppm					-55℃~+125℃
RC 6432	1								

• Rated voltage (V) = $\sqrt{\text{Rated power(W)} \times \text{Normal resistance value (R)}}$
Rated voltage should be lower than (MAX) working voltage.

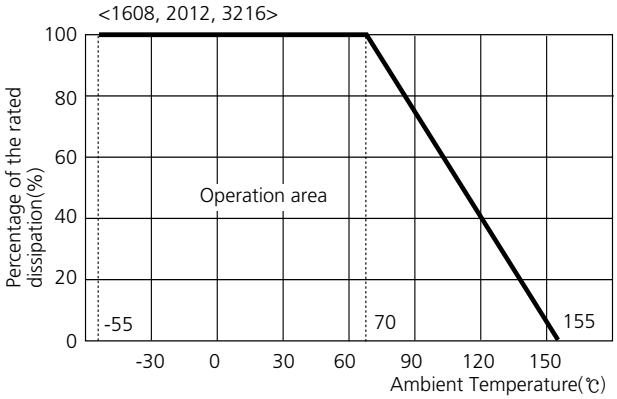
Power Derating Curve

The rated power is the maximum continuous loading power at 70℃ ambient temperature.
For ambient temperature above 70℃, the loading power follows the below power derating curve.
(The load current shall be derated according to derating curve in case of the 'Jumper')

<0603, 1005, 3225, 5025, 6432>



<1608, 2012, 3216>



Jumper Resistors

Type	Resistance	Current Rating	Rated Ambient Temperature	Rated Working Temperature
RC 0603	50mΩ Max.	0.5(A)	70℃	-55℃~+125℃
RC 1005		1.0(A)		
RC 1608				
RC 2012		2.0(A)		
RC 3216				
RC 3225				
RC 5025				
RC 6432				

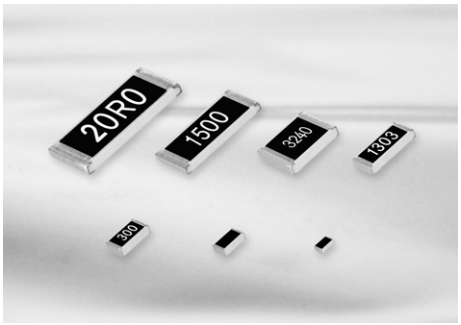
Marking

3 digits indication (E-24 series)

- Left 2 digits represent significant figures.
- Last 1 digit represent exponential number of 10.
- Example: 103
  Left 2 digits: 10
  Last 1 digit: 3
  $103 = 10 \times 10^3 \Omega$
  $= 10000\Omega = 10k\Omega$

- Jumper chip is printed as 000
- Resistance below 10 Ω is expressed using "R"
  ex) 7R5=7.5 Ω
- 0603, 1005 type: No marking.

Precision



Feature

- Low tolerance (±1%)
- Both flow and reflow soldering are applicable.
- Suitable size and packaging for surface mount assembly.
- Owing to the reduced lead inductance, the high frequency characteristic is excellent.

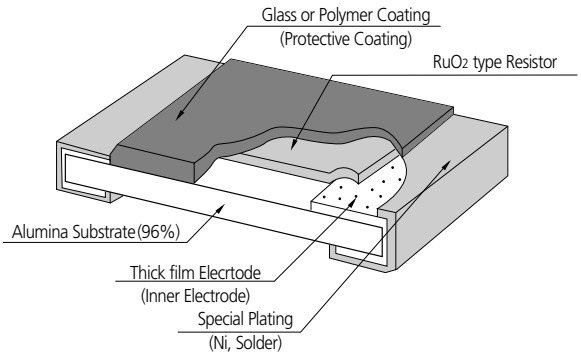
The product of lead-free terminal is RoHS compliant.
PhO(lead oxide) is included in the glass of our product which is prescribed on RoHS appendix as an exception.

Application

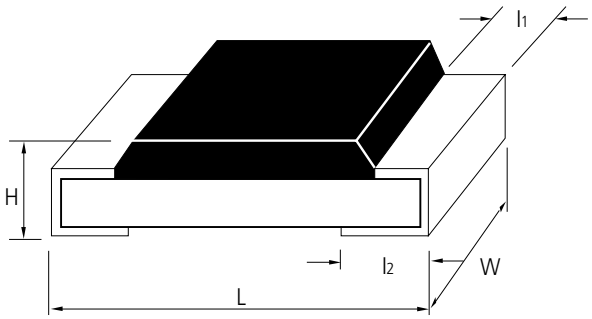
- Circuit for high precision resistance and reliability.
- For signal control part
- For tunning circuit.

Structure and Dimensions

• Structure



• Dimensions



(UNIT: mm)

Type	Inch	Power(W)	L	W	H	I_1	I_2	Average Weight
RC 0603	0201	1/20	0.60±0.03	0.30±0.03	0.23±0.03	0.10±0.05	0.15±0.05	0.15㎎
RC 1005	0402	1/16	1.00±0.05	0.50±0.05	0.35±0.05	0.20±0.10	0.25±0.10	0.6㎎
RC 1608	0603	1/10	1.60±0.10	0.80±0.15	0.45±0.10	0.30±0.20	0.35±0.10	2.1㎎
RC 2012	0805	1/8	2.00±0.20	1.25±0.15	0.50±0.10	0.40±0.20	0.35±0.20	4.9㎎
RC 3216	1206	1/4	3.20±0.20	1.60±0.15	0.55±0.10	0.45±0.20	0.40±0.20	9.5㎎
RC 3225	1210	1/3	3.20±0.20	2.55±0.20	0.55±0.10	0.45±0.20	0.40±0.20	16㎎
RC 5025	2010	2/3	5.00±0.20	2.50±0.20	0.55±0.10	0.60±0.20	0.60±0.20	26㎎
RC 6432	2512	1	6.30±0.20	3.20±0.20	0.55±0.10	0.60±0.20	0.60±0.20	41㎎

Parts Numbering System

• The part number system shall be in the following format

R C	1005	F	2370	CS
Code Designation	Dimension & Size Code	Tolerance	Resistance Value	Packaging Code
RC: Chip Resistor	0603: 0.6×0.3(㎜) - 0201(inch) 1005: 1.0×0.5(㎜) - 0402(inch) 1608: 1.6×0.8(㎜) - 0603(inch) 2012: 2.0×1.2(㎜) - 0805(inch) 3216: 3.2×1.6(㎜) - 1206(inch) 3225: 3.2×2.5(㎜) - 1210(inch) 5025: 5.0×2.5(㎜) - 2010(inch) 6432: 6.4×3.2(㎜) - 2512(inch)	F: ±1%	3 or 4 digits coding system (IEC coding system) 3digits (E-24 series) 4digits (E-96 series)	GS: Bulk Packaging CS: Tape Packaging 7" ES: Tape Packaging 10" FS: Tape Packaging 13" AS: Tape Packaging 13"

Specification

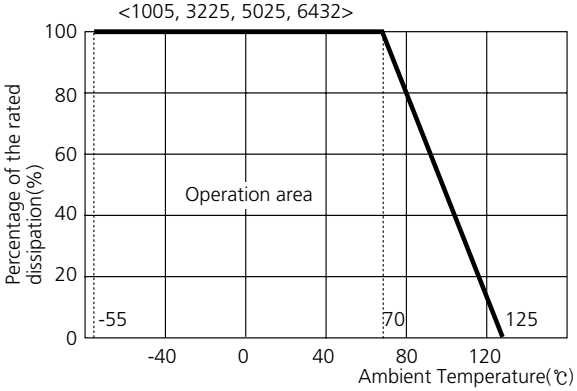
Type	Power Rating (W)	Working Voltage (MAX)	Overload Voltage (MAX)	TCR (ppm/℃)	Resistance Range (Ω) F(±1%) E-96, E-24	Rated Ambient Temperature	Rated Working Temperature
RC0603	1/20	25(V)	50(V)	±250ppm	1Ω~10MΩ	70℃	-55℃~+125℃
RC 1005	1/16	50(V)	100(V)	±100ppm			
RC 1608	1/10						-55℃~+155℃
RC 2012	1/8	150(V)	300(V)				
RC 3216	1/4	200(V)	400(V)				
RC 3225	1/3						-55℃~+125℃
RC 5025	2/3						
RC 6432	1						

• Rated voltage (V) = $\sqrt{\text{Rated power(W)} \times \text{Normal resistance value (R)}}$
Rated voltage should be lower than (MAX) working voltage.

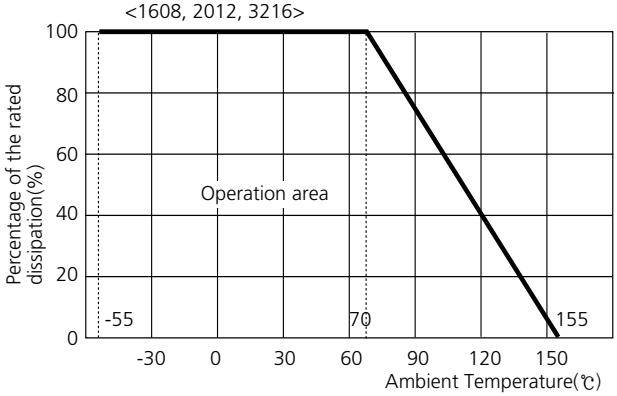
Power Derating Curve

The rated power is the maximum continuous loading power at 70℃ ambient temperature.
For ambient temperature above 70℃, the loading power follows the below power derating curve.

<1005, 3225, 5025, 6432>



<1608, 2012, 3216>



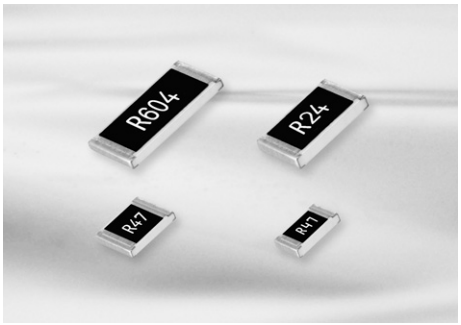
Marking

• 3 digits indication (E-24 series)	• 4 digits indication (E-96 series)
- Left 2 digits represent significant figures. - Last 1 digit represents exponential number of 10. - Example: 103 Left 2 digits: 10 Last 1 digit: 3 $103 = 10 \times 10^3 \Omega$ $= 10000\Omega = 10k\Omega$	- Left 3 digits represent significant figures. - Last 1 digit represents exponential number of 10. - Example: 1002 Left 3 digits: 100 Last 1 digit: 2 $1002 = 100 \times 10^2 \Omega$ $= 10000\Omega = 10k\Omega$
103	1002
• 0603, 1005 type: No marking.	• 0603, 1005, 1608 type: No marking.

IEC Code System (E-96, E-24)

E-96	E-24	E-96	E-24	E-96	E-24	E-96	E-24
100	10	178		316		562	56
102		182	18	324	33	576	
105		187		332		590	
107		191		340		604	
110	11	196		348		619	
113		200	20	357	36	634	62
115		205		365		649	
118		210		374		665	
121	12	215		383	39	681	68
124		221	22	392		698	
127		226		402		715	
130	13	232		412		732	
133		237		422		750	75
137		243	24	432	43	768	
140		249		442		787	
143		255		453		806	
147		261		464		825	82
150	15	267		475	47	845	
154		274	27	487		866	
158		280		499		887	
162	16	287		511	51	909	
165		294		523		931	91
169		301	30	536		953	
174		309		549		976	

Low Ohms



Feature

- Under 1 ohms, precision resistance.
- Both flow and reflow soldering are applicable.
- Owing to the reduced lead inductance, the high frequency characteristic is excellent.

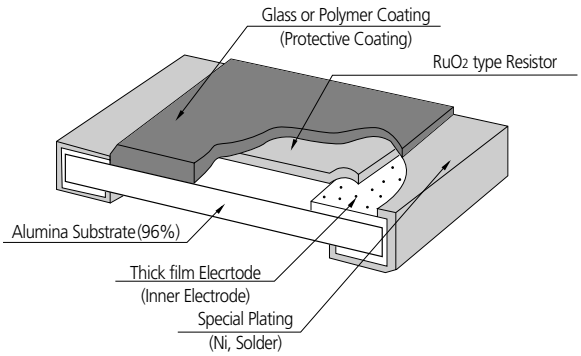
The product of lead-free terminal is RoHS compliant.
PhO(lead oxide) is included in the glass of our product which is prescribed on RoHS appendix as an exception.

Application

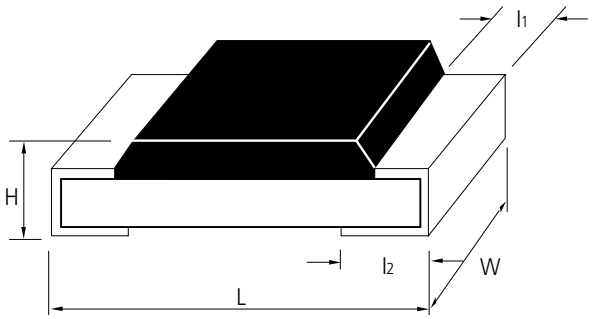
- Current detect.
- Safe circuit through protecting over-current flow.
- Power supplying part.
- Motor controlling, DC power charger, etc.

Structure and Dimensions

• Structure



• Dimensions



(UNIT: mm)

Type	Inch	Power(W)	L	W	H	I_1	I_2	Average Weight
RC1005	0402	1/16	1.00±0.05	0.50±0.05	0.35±0.05	0.20±0.10	0.25±0.10	0.6㎎
RC1608	0603	1/10	1.60±0.10	0.80±0.15	0.45±0.10	0.30±0.20	0.35±0.10	2.1㎎
RC2012	0805	1/8	2.00±0.20	1.25±0.15	0.50±0.10	0.40±0.20	0.35±0.20	4.9㎎
RC3216	1206	1/4	3.20±0.20	1.60±0.15	0.55±0.10	0.45±0.20	0.40±0.20	9.5㎎
RC3225	1210	1/3	3.20±0.20	2.55±0.20	0.55±0.10	0.45±0.20	0.40±0.20	16㎎
RC5025	2010	2/3	5.00±0.20	2.50±0.20	0.55±0.10	0.60±0.20	0.60±0.20	26㎎
RC6432	2512	1	6.30±0.20	3.20±0.20	0.55±0.10	0.60±0.20	0.60±0.20	41㎎

Parts Numbering System

• The part number system shall be in the following format

R C	6432	J	R68	CS
Code Designation	Dimension & Size Code	Tolerance	Resistance Value	Packaging Code
RC: Chip Resistor	1005: 1.0×0.5(㎜) - 0402(inch) 1608: 1.6×0.8(㎜) - 0603(inch) 2012: 2.0×1.2(㎜) - 0805(inch) 3216: 3.2×1.6(㎜) - 1206(inch) 3225: 3.2×2.5(㎜) - 1210(inch) 5025: 5.0×2.5(㎜) - 2010(inch) 6432: 6.4×3.2(㎜) - 2512(inch)	F: ±1% G: ±2% J: ±5%	3 or 4 digits coding system (E-24 series)	GS: Bulk Packaging CS: Tape Packaging 7" ES: Tape Packaging 10" FS: Tape Packaging 13" AS: Tape Packaging 13"

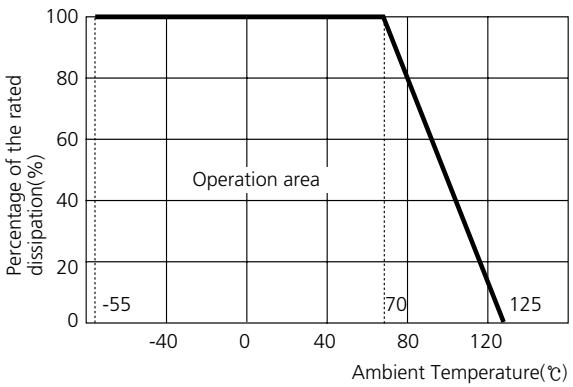
Specification

Type	Power Rating (W)	Working Voltage (V, MAX)	Overload Voltage (V, MAX)	TCR (ppm/℃)	Resistance Range (Ω) F(±1%) E-24	Resistance Range (Ω) G(±2%) E-24	Resistance Range (Ω) J(±5%) E-24	Rated Ambient Temperature	Rated Working Temperature
RC1005	1/16	0.25	0.63	0.1 Ω≤R<0.15 Ω : 400(+300,-200) ppm/℃ 0.15 Ω≤R<1.0 Ω : 0~250 ppm/℃	0.1~0.98			70℃	-55℃~+125℃
RC1608	1/10	0.32	0.79						
RC2012	1/8	0.35	0.88						
RC3216	1/4	0.50	1.25						
RC3225	1/3	0.58	1.44						
RC5025	2/3	0.82	2.04						
RC6432	1	1.00	2.50						

• Rated voltage (V) = $\sqrt{\text{Rated power(W)} \times \text{Normal resistance value (R)}}$
Rated voltage should be lower than (MAX) working voltage.

Power Derating Curve

The rated power is the maximum continuous loading power at 70℃ ambient temperature.
For ambient temperature above 70℃, the loading power follows the below power derating curve.



Marking

E-24 series

3 digits indication	4 digits indication
- R means decimal point. - Other digits represent significant value. - Example: R22 Left 1 digit: R Last 2 digits: 22 R22 = 0.22 Ω	- R means decimal point. - Other digits represent significant value. -Example: R075 Left 1 digit: R Last 3 digits:075 R075 = 0.075 Ω
	

Resistance Value Table

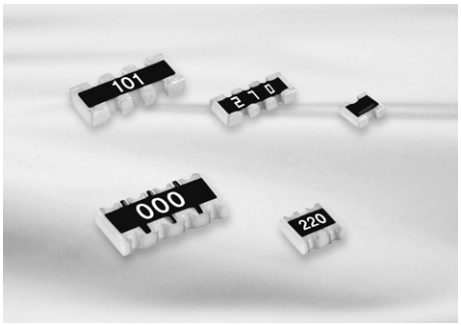
• E-24 series

Code	R-value
R039	0.039 Ω
R043	0.043 Ω
R047	0.047 Ω
R051	0.051 Ω
R056	0.056 Ω
R062	0.062 Ω
R068	0.068 Ω
R075	0.075 Ω
R082	0.082 Ω
R091	0.091 Ω

Code	R-value
R10	0.10 Ω
R11	0.11 Ω
R12	0.12 Ω
R13	0.13 Ω
R15	0.15 Ω
R16	0.16 Ω
R18	0.18 Ω
R20	0.20 Ω
R22	0.22 Ω
R24	0.24 Ω
R27	0.27 Ω
R30	0.30 Ω

Code	R-value
R33	0.33 Ω
R36	0.36 Ω
R39	0.39 Ω
R43	0.43 Ω
R47	0.47 Ω
R51	0.51 Ω
R56	0.56 Ω
R62	0.62 Ω
R68	0.68 Ω
R75	0.75 Ω
R82	0.82 Ω
R91	0.91 Ω

Array



Feature

- Reducing SMD surface area (40% reduced).
- Reducing SMD costs (75% reduced).
- Both flow and reflow soldering are applicable.
- Convex & concave type.

The product of lead-free terminal is RoHS compliant.
PhO(lead oxide) is included in the glass of our product which is prescribed on RoHS appendix as an exception.

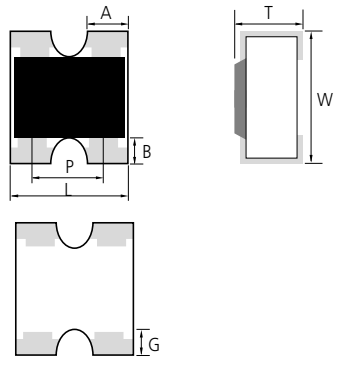
Application

- For semiconductor devices.
- For computers, digital circuits.

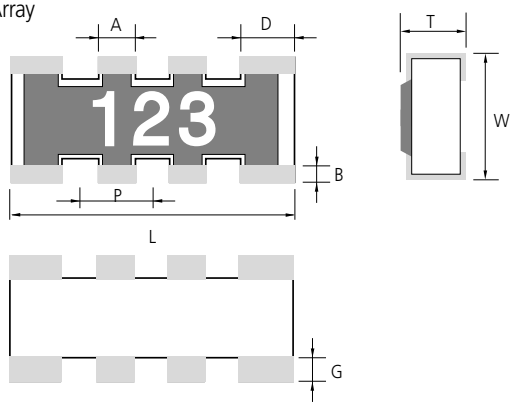
Structure and Dimensions

(1) CONVEX TERMINAL TYPE

• 2 Array



• 4 Array

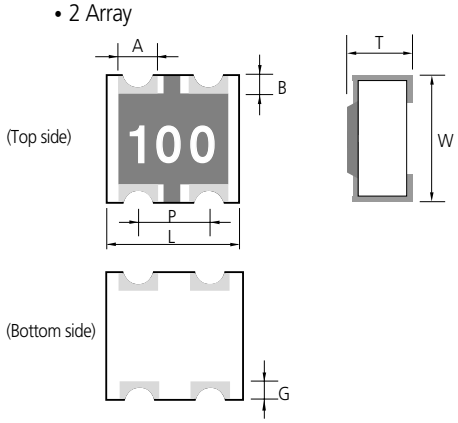


(UNIT: mm)

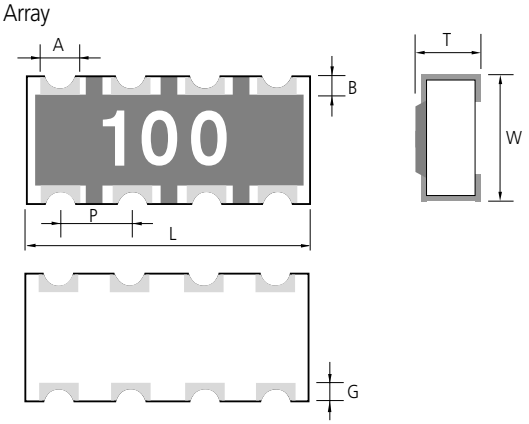
Type	L	W	T	A	D	B	G	P	Average Weight
RP102P	1.00±0.10	1.00±0.10	0.35±0.10	0.33±0.05	-	0.20±0.10	0.25±0.10	0.65±0.10	1.1㎎
RP104P	2.00±0.10	1.00±0.10	0.35±0.10	0.30±0.15	0.40±0.15	0.15±0.10	0.25±0.15	0.50±0.15	2.2㎎
RP164P	3.20±0.10	1.60±0.10	0.50±0.10	0.40±0.15	0.60±0.15	0.30±0.15	0.30±0.15	0.80±0.15	8.9㎎

(2) CONCAVE TERMINAL TYPE

• 2 Array



• 4 Array



(UNIT: mm)

Type	L	W	T	A	B	G	P	Unit Weight
RN102P	1.00±0.10	1.00±0.10	0.35±0.10	0.30±0.10	0.15±0.10	0.25±0.15	0.5±0.10	1.2㎎
RN104P	2.00±0.10	1.00±0.10	0.40±0.10	0.30±0.10	0.15±0.10	0.25±0.15	0.5±0.10	2.8㎎
RN162P	1.60±0.10	1.60±0.10	0.60±0.10	0.45±0.10	0.30±0.15	0.40±0.15	0.80±0.10	4.7㎎
RN164P	3.20±0.10	1.60±0.10	0.60±0.10	0.45±0.10	0.30±0.15	0.40±0.15	0.80±0.10	9.9㎎

Parts Numbering System

• The part number system shall be in the following format

RN	16	4P	J	100	FS
Code Designation	Dimension	Resistors	Tolerance	Resistance Value	Packaging Code
RP: Convex type array RN: Concave type array	10: 1005 16: 1608	2P: 2 Pieces 4P: 4 Pieces	J: ±5% ※Jumper:' J'	3 digit coding system (IEC coding system) E-24 series	CS : Tape Packaging 7" ES : Tape Packaging 10" FS : Tape Packaging 13" AS : Tape Packaging 13"

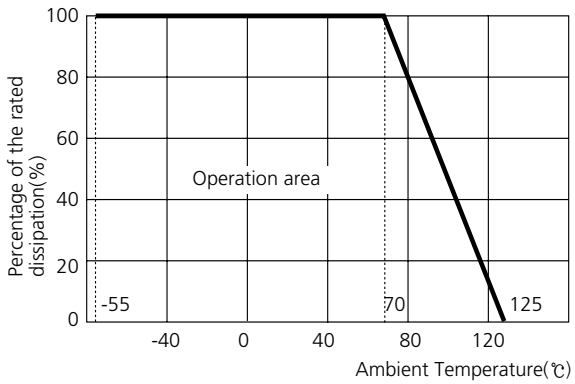
Specification

Type	Power Rating (W)	Working Voltage (MAX)	Overload Voltage (MAX)	TCR (ppm/℃)	Resistance Range (Ω)	Rated Ambient Temperature	Rated Working Temperature
102P, 104P	1/16	25(V)	50(V)	±250ppm	1Ω~1MΩ	70℃	-55℃~+125℃
162P, 164P		50(V)	100(V)	±200ppm			

• Rated voltage (V) = $\sqrt{\text{Rated power(W)} \times \text{Normal resistance value (R)}}$
Rated voltage should be lower than (MAX) working voltage.

Power Derating Curve

The rated power is the maximum continuous loading power at 70℃ ambient temperature.
For ambient temperature above 70℃, the loading power follows the below power derating curve.
(The load current shall be derated according to Derating curve in case of the 'Jumper')



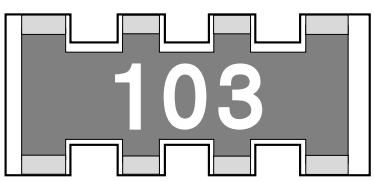
Jumper Resistors

Type	Resistance	Current Rating	Rated Ambient Temperature	Rated Working Temperature
102P, 104P 162P, 164P	50mΩ Max.	1.0(A)	70℃	-55℃~+125℃

Marking

• 3 digits indication(E-24 series)

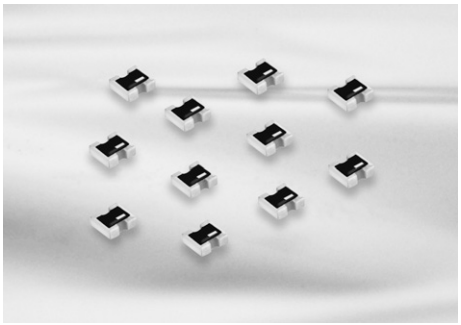
- Left 2 digits represent significant figures.
- Last 1 digit represents exponential number of 10.
- Example: 103
  Left 2 digit: 10
  Last 1 digits: 3
  $103 = 10 \times 10^3 = 10000\ \Omega = 10k\Omega$



※Jumper chip is printed as "000".

• RP102P, RN102P, RN104P type : No marking.

Attenuator



Feature

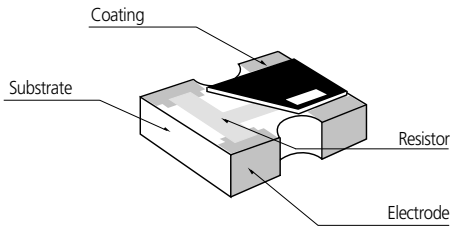
- The RP10AT is small-size chip Attenuator, suitable for high density surface mounting.
- Unbalanced π type attenuator circuit in one chip(1.0 mm x 1.0 mm)
- Mounting occupation area reduction : about 50 % reduction
- Mounting cost reduction : Mounting times 3 times → 1 time
- Attenuation : 0 dB to 10 dB

Application

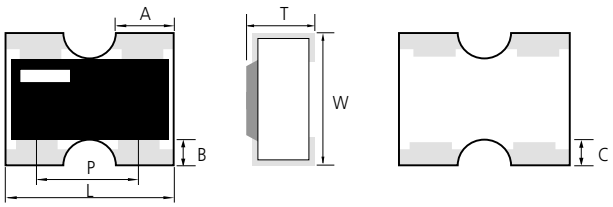
- Attenuation / level control / impedance matching of high frequency signals of communication equipment; cellular phones(GSM, CDMA, etc.), PHS, PDA, for example.

Structure and Dimensions

- Structure



- Dimensions



(UNIT: mm)

Type	Power(W)	L	W	T	A	B	C	P	Average Weight
RP10AT	0.04W / package	1.00±0.10	1.00±0.10	0.35±0.10	0.33±0.05	0.20±0.10	0.25±0.10	0.65±0.10	1.1㎎

Parts Numbering System

- The part number system shall be in the following format

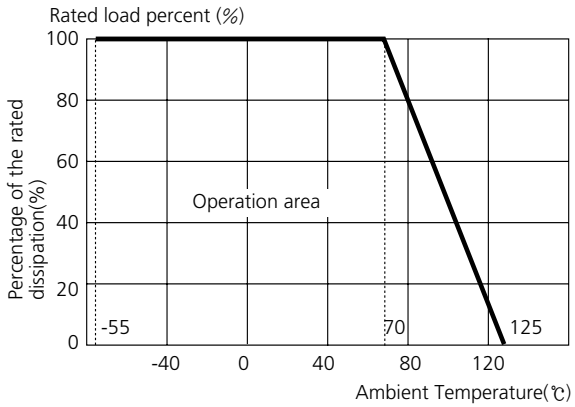
RP	10AT	L	A	03	CS
Code Designation	Dimensions & Circuit Configuration	Attenuation Value Tolerance	Characteristices Impedance	Attenuation Value	Packing Type
RP:Convex type	10:1.0x1.0(mm)-0404(inch) AT:Unbalanced π-type Attenuator	L : ± 0.3 dB H : ± 0.5 dB	A : 50 ohm	3 dB EX) 0 →0dB	CS:Tape Packaging 7"

Specification

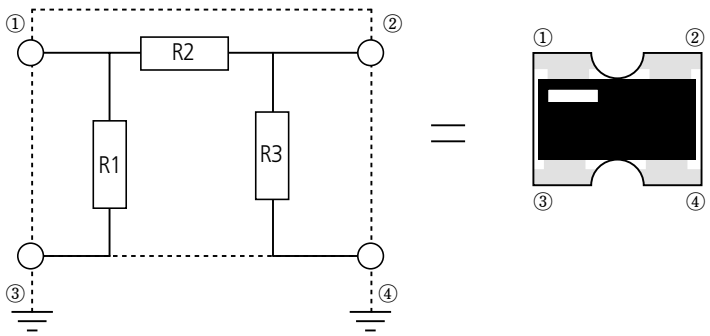
Item	Specifications
Attenuation Value	0 dB, 1 dB, 2 dB, 3 dB, 4 dB, 5 dB, 6 dB, 7 dB, 8 dB, 9 dB, 10dB
Attenuation Value Tolerance	0 dB, 1 dB, 2 dB, 3 dB, 4 dB, 5 dB : ± 0.3 dB 6 dB, 7 dB, 8 dB, 9 dB, 10dB : ± 0.5 dB
Characteristic Impendance	50 Ω
Power Rating	0.04W / package
Frequency Range	DC to 3 GHz
VSWR (Voltage Standing Wave Ratio)	1.3 max
Number of terminals	4 terminals
Category Temperature Range (Operating Temperature Range)	-55 ℃ to +125 ℃

Power Derating Curve

The rated power is the maximum continuous loading power at 70℃ ambient temperature.
For ambient temperature above 70℃, the loading power follows the below power derating curve.



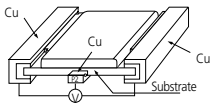
Equivalent Circuit Configuration



Characteristics Performance

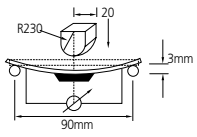
Electrical Characteristic

Item		Requirements Specification		Test Methods	
		Resistor	Jumper	Resistor	Jumper
Direct Current Resistance		Within the regulated resistance tolerance.	50mΩ Max.	JIS C 5201-1 4.5 Voltage apply Within 5 sec. Test temp: 20℃, 65RH Test board: <FIG. 1>	
Temperature Characteristic		■ J-Grade 1Ω ≤R＜10Ω :+300/-200ppm/℃ 10Ω ≤R≤1MΩ :±100ppm/℃(0603±250ppm) 1MΩ ＜R≤10MΩ :±300ppm/℃ ■ F-Grade 1Ω ≤R≤10MΩ :±100ppm/℃(0603±250ppm)		JIS C 5201-1 4.8 Test Temperature(℃) 20℃ → -55℃ / 20℃ → 125℃ T.C.R(ppm/℃)=(R-R_{20})/R_{20}×1/(T-T_{20})×10^6 ※T=test Temperature, T_{20}=20℃ R=Resistance at T, R_{20}=Resistane at T_{20} Test board: <FIG. 1>	
Shot-time Overload	⊿R	Less than ±(1%+0.1Ω) of the initial value.	50mΩ Max.	JIS C 5201-1 4.13 Apply 2.5 times rated voltage for 5 sec. Wait 60 minutes at room temperature. Measure the resistance value. Test board: <FIG. 1>	Max Surge Current
	Visual	No evidence of mechanical damage.			
Intermittent Overload	⊿R	Less than ±(3%+0.1Ω) of the initial value.	50mΩ Max.	JIS C 5201-1 4.13 2.5 times of rated voltage . 1 second ON, 25 second OFF. 10,000 cycles. Test board: <FIG. 1>	Max Surge Current
	Visual	No evidence of mechanical damage.			
Dielectric Withstanding Voltage		No evidence of mechanical damage.		JIS C 5201-1 4.7 Apply Voltage for 1 minute 0603: 50V 1005, 1608: 100V Other: 500V	
Insulation Resistance		Over 1,000MΩ			



Mechanical Characteristic

Item		Requirements Specification		Test Methods	
		Resistor	Jumper	Resistor	Jumper
Solderability		Coverage: ≥95% each termination. No crack of termination parts and ceramic exposure of surface by melting.		IEC60068-2-58 Rosin Flux: Rosin 25%, Methanol 75% Solder Temp.: 245+5/-0℃ Dipping time: 2±0.5 sec.(Both side dipping)	
Bending Test	⊿R	Less than±(0.5%+0.05Ω)of the initial value.	50mΩ Max.	JIS C 5201-1 4.33 After soldering resistor on the PCB, 3mm of bending shall be applied for 10 sec. Test board: <FIG. 2>	
	Visual	No evidence of mechanical damage.			
Adhesive strength of termination		· No mechanical damage or sign of disconnection		JIS C 5201-1(4.16) - Test strengh : 5N (500g · f), 0603 : 2N - Test time : Applying pressure for 10 seconds	
Resistance to Soldering Heat	⊿R	Less than±(1%+0.05Ω)of the initial value.	50mΩ Max.	JIS C 5201-1 4.18 - Flow soldering :260±5℃,10 sec .max.(both side dipping) - Reflow soldering :260±5℃, 10 sec. max. over 230℃, 30~40 sec.	
	Visual	No evidence of mechanical damage.			
Anti-Vibration Test	⊿R	Less than±(1%+0.05Ω)of the initial value.	50mΩ Max.	JIS C 5201-1 4.22 2 hours each in X, Y and Z axis(total 6 hours) 10 to 55Hz sweep in 1 minute at 1.5mm amplitude.	
	Visual	No evidence of mechanical damage.			



Environmental Characteristic

Item		Requirements Specification		Test Methods	
		Resistor	Jumper	Resistor	Jumper
Temperature Cycle	⊿R	Less than ±(1%+0.1 Ω) of the initial value.	50mΩ Max.	JIS C 5201-1 4.19 Perform 100 cycles as follows. Test Condition: -55 ℃/30min ↔125 ℃/30min sweep time: 5 min Test board: <FIG. 1>	
	Visual	No evidence of mechanical damage.			
Load Life	⊿R	Less than ±(3%+0.1 Ω) of the initial value.	50mΩ Max.	JIS C 5201-1 4.25 Test Voltage: rated voltage Test temp.: 70±2 ℃ Time: 1,000^{+48} hours(90 min; ON, 30 min; OFF) Test board: <FIG. 1>	
	Visual	No evidence of mechanical damage.			
Low Temp. Exposure	⊿R	Less than ±(3%+0.1 Ω) of the initial value.	50mΩ Max.	JIS C 5201-1 4.23 Dwell in -55 ℃ chamber without loading for 1,000^{+48} hours. Stabilize for 60 minute at room temperature. Measure value. Test board: <FIG. 1>	
	Visual	No evidence of mechanical damage.			
High Temp. Exposure	⊿R	Less than ±(3%+0.1 Ω) of the initial value.	50mΩ Max.	JIS C 5201-1 4.23 Dwell in 125 ℃±2 ℃ or 155 ℃±2 ℃ chamber without loading for 1,000^{+48} hours. Stabilize for 60 minute at room temperature. Measure value. Test board: <FIG. 1>	
	Visual	No evidence of mechanical damage.			
Moisture Resistance	⊿R	Less than ±(3%+0.1 Ω) of the initial value.	50mΩ Max.	JIS C 5201-1 4.14 Test Voltage: rated voltage Test temp.: 40±2 ℃ Time: 1,000^{+48} hours(90 min; ON, 30 min; OFF) Humidity: 90~95% RH Stabilize for 1 hrs & Measure. Test board: <FIG. 1>	
	Visual	No evidence of mechanical damage.			

※These characteristics apply to 1 Ω ~10M Ω. In case of other resistance range, please contact us.
※The next is specification in our company for flow soldering and test boards.

Flow soldering Conditions

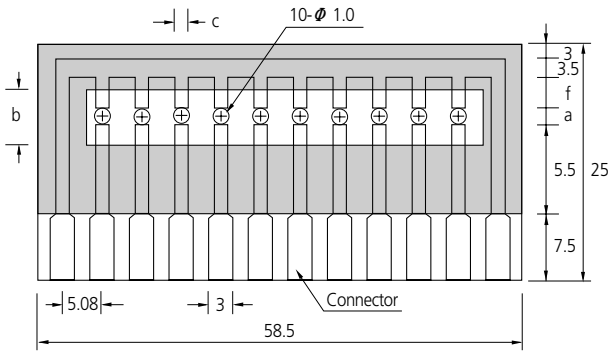
Item	Specification	Dipping
Flux	ROSIN 25%, IPA 75%	Time: 5~10 sec.
Solder	Sn-3.0Ag-0.5Cu	Time: 10 sec max. Temp.: 260±5℃.

Test Board

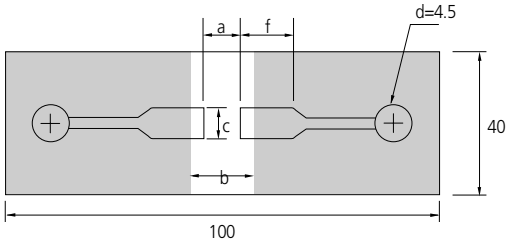
• This is the test board in order to test 'Direct Current Resistance', 'Temperature Characteristic', 'Short-time Overload', 'Temperature Cycle', 'Load Life', 'Low Temperature Exposure', and so on.

<FIG. 1>

Description		Dimension(mm)			
Type	Power	a	b	c	f
RC 0603	1/20	0.3	1.1	0.45	5.2
RC 1005	1/16	0.6	1.9	0.7	4.9
RC 1608	1/10	1.0	3.0	1.2	4.5
RC 2012	1/8	1.2	4.0	1.65	4.3
RC 3216	1/4	2.2	5.0	2.0	3.3
RC 3225	1/3	2.2	5.0	2.9	3.3
RC 5025	2/3	3.6	7.0	3.0	3.0
RC 6432	1	5.2	8.0	3.5	2.5



• This is the test board for 'Bending Test'. <FIG. 2>



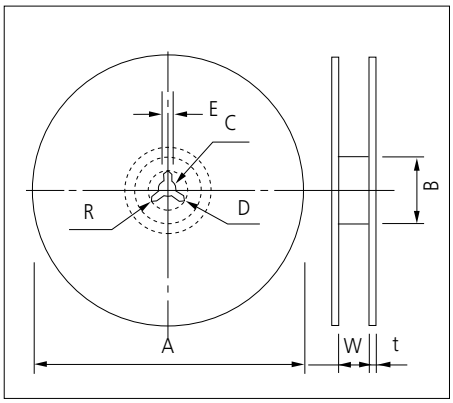
Description		Dimension(mm)			
Type	Power	a	b	c	f
RC 0603	1/20	0.3	1.1	0.45	5.2
RC 1005	1/16	0.6	1.9	0.7	4.9
RC 1608	1/10	1.0	3.0	1.2	4.5
RC 2012	1/8	1.2	4.0	1.65	4.3
RC 3216	1/4	2.2	5.0	2.0	3.3
RC 3225	1/3	2.2	5.0	2.9	3.3
RC 5025	2/3	3.6	7.0	3.0	3.0
RC 6432	1	5.2	8.0	3.5	2.5

Packaging

Taping Type

• Reel dimensions

(UNIT: mm)

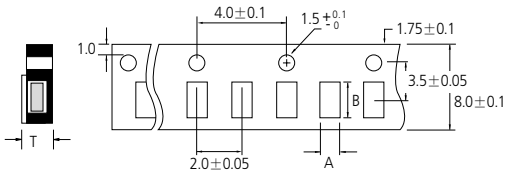
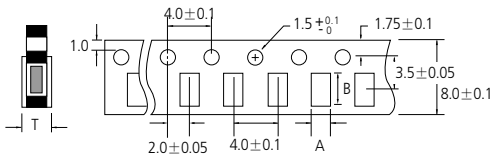
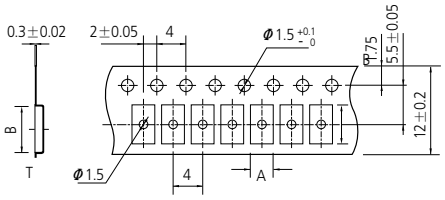


Symbol	Tape Width	A	B	C	D
7" Reel	8mm	Ø180+0/-3	Ø60+1/-0	Ø13±0.3	Ø25±0.5
	12mm	Ø180+0/-3	Ø60+1/-0	Ø13±0.3	Ø25±0.5
10" Reel	8mm	Ø258±2.0	Ø80±1.0	Ø13±0.3	Ø25±0.5
13" Reel	8mm	Ø330±2.0	Ø80±1.0	Ø13±0.3	Ø25±0.5
	12mm	Ø330±2.0	Ø80±1.0	Ø13±0.3	Ø25±0.5

Symbol	Tape Width	E	W	t	R
7" Reel	8mm	2.0±0.5	9±0.5	1.2±0.2	1.0
	12mm	2.0±0.5	13±0.5	1.2±0.2	1.0
10" Reel	8mm	2.0±0.5	9±0.5	1.8±0.2	1.0
13" Reel	8mm	2.0±0.5	9±0.5	2.2±0.2	1.0
	12mm	2.0±0.5	13±0.5	2.2±0.2	1.0

• Tape dimensions

(UNIT: mm)

Type	Pitch	Width	Dimensions
Press Pocket or Punched Paper	2mm	8mm	
Punched Paper	4mm	8mm	
Embossed Tape	4mm	12mm	

	A	B	T
0603	0.38±0.05	0.68±0.05	0.5 Max
1005	0.70±0.10	1.20±0.10	0.6 Max
RP102	1.17±0.10	1.17±0.10	0.6 Max
RP10AT	1.20±0.10	1.20±0.10	0.6 Max
RN102	1.20±0.10	1.20±0.10	0.6 Max
RP104	1.20±0.10	2.20±0.10	0.6 Max
RN104	1.20±0.10	2.20±0.10	0.8 Max

-0603: Press pocket.

	A	B	T
1608	1.10±0.20	1.90±0.20	0.8 Max
2012	1.65±0.20	2.40±0.20	1.1 Max
3216	2.00±0.20	3.60±0.20	
3225	2.90±0.20	3.60±0.20	
RN162	1.90±0.20	1.90±0.20	
RP164	2.00±0.20	3.60±0.20	
RN164	2.00±0.20	3.60±0.20	

	A	B	T
5025	2.80±0.20	5.30±0.20	1.1 Max
6432	3.50±0.20	6.75±0.20	

Packaging Table

TYPE	inch	Taping Packaging				
		Packaging Code	Reels	Tape	Quantity	Average Weight (g)
0603	0201	CS	7"	Press pocket	15,000	140
		AS	13"		60,000	570
1005	0402	CS	7"	Punched Paper	10,000	101
		ES	10"		30,000	379
		AS	13"		40,000	507
1608	0603	CS	7"		5,000	123
		ES	10"		10,000	350
		FS	13"		15,000	497
		AS			20,000	580
2012	0805	CS	7"		5,000	150
		ES	10"		10,000	397
		FS	13"		15,000	565
		AS			20,000	679
3216	1206	CS	7"		5,000	165
		ES	10"		10,000	417
		FS	13"		15,000	605
		AS			20,000	734
3225	1210	CS	7"		5,000	188
		ES	10"		10,000	463
		FS	13"		15,000	674
		AS			20,000	825
5025	2010	CS	7"	Embossed Tape	4,000	200
6432	2512	CS	7"		4,000	260
		AS	13"		15,000	1,041
102P	0402×2	CS	7"	Punched Paper	10,000	110
		AS	13"		40,000	495
104P	0402×4	CS	7"		10,000	135
		AS	13"		40,000	615
162P	0603×2	CS	7"		5,000	160
164P	0603×4	CS	7"		5,000	163
		FS	13"		15,000	1,041
		AS			20,000	713

- General type, Precision, Low ohms, High ohms.
- Packaging style can be modified when you want.

Standard Resistance Value

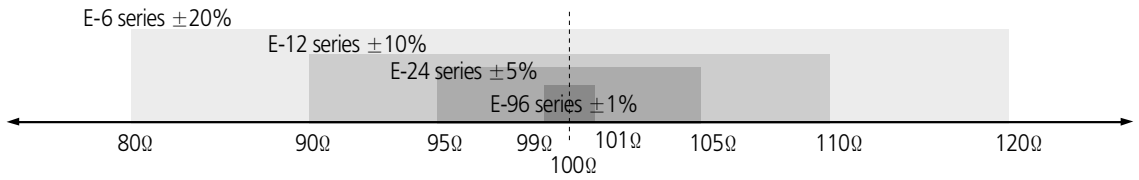
Tolerance Code Table

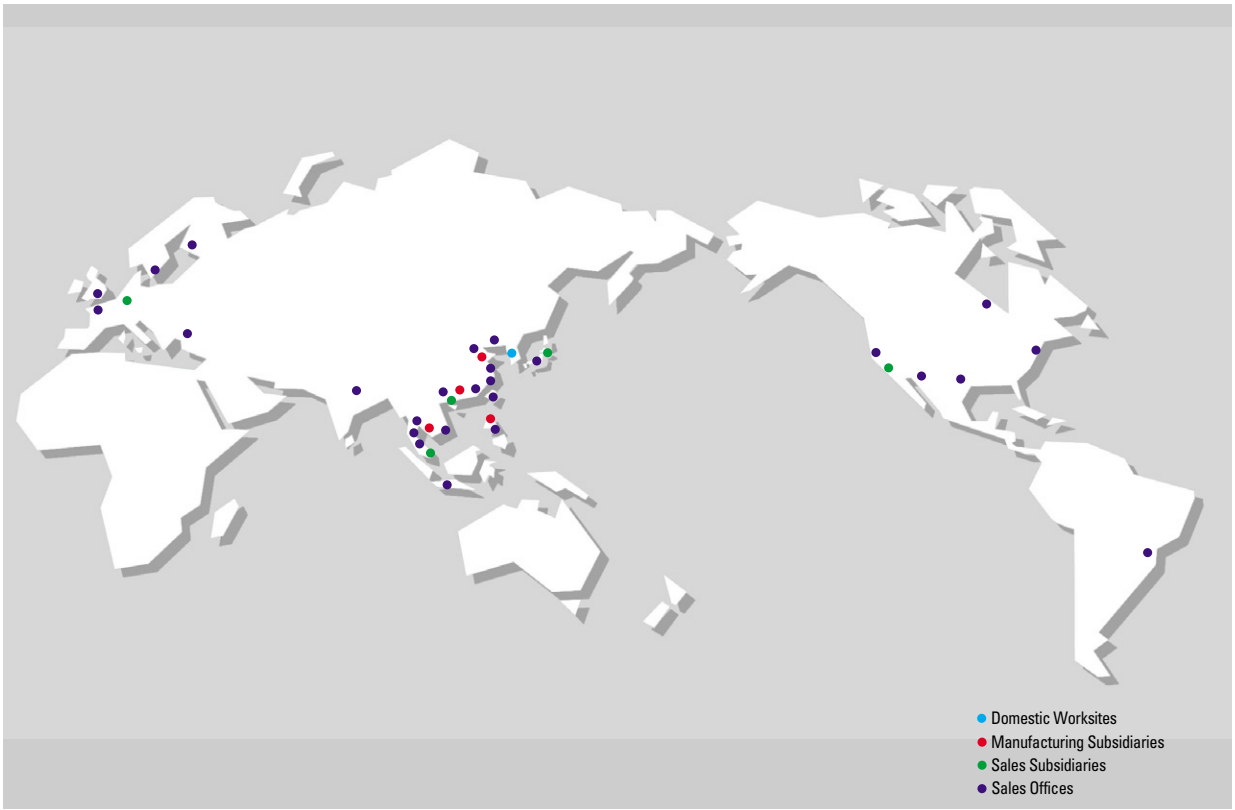
Tolerance Code	D	F	G	J	K	M
Digit Number	4 digit			3 digit		
IEC-Code System	E-192	E-96	E-48	E-24	E-12	E-6
Specification	±0.5%	±1%	±2%	±5%	±10%	±20%

Significant Figure of Resistance Value

E-192	E-96	E-48	E-24	E-192	E-96	E-48	E-24	E-192	E-96	E-48	E-24	E-192	E-96	E-48	E-24
100	100	100	10	178	178	178		316	316	316		562	562	562	56
101				180			18	320				569			
102	102			182	182			324	324			576	576		
104				184				328				583			
105	105	105		187	187	187		332	332	332	33	590	590	590	
106				189				336				597			
107	107			191	191			340	340			604	604		
109				193				344				612			
110	110	110	11	196	196	196		348	348	348		619	619	619	
111				198				352				626			62
113	113			200	200		20	357	357			634	634		
114				203				361			36	642			
115	115	115		205	205	205		365	365	365		649	649	649	
117				208				370				657			
118	118			210	210			374	374			665	665		
120			12	213				379				673			
121	121	121		215	215	215		383	383	383		681	681	681	68
123				218				388				690			
124	124			221	221		22	392	392		39	698	698		
126				223				397				706			
127	127	127		226	226	226		402	402	402		715	715	715	
129				229				407				723			
130	130		13	232	232			412	412			732	732		
132				234				417				741			
133	133	133		237	237	237		422	422	422		750	750	750	75
135				240			24	427				759			
137	137			243	243			432	432		43	768	768		
138				246				437				777			
140	140	140		249	249	249		442	442	442		787	787	787	
142				252				448				796			
143	143			255	255			453	453			806	806		
145				258				459				816			
147	147	147		261	261	261		464	464	464		825	825	825	82
149				264				470			47	835			
150	150		15	267	267			475	475			845	845		
152				271			27	481				856			
154	154	154		274	274	274		487	487	487		866	866	866	
156				277				493				876			
158	158			280	280			499	499			887	887		
160			16	284				505				898			
162	162	162		287	287	287		511	511	511	51	909	909	909	
164				291				517				920			91
165	165			294	294			523	523			931	931		
167				298				530				942			
169	169	169		301	301	301	30	536	536	536		953	953	953	
172				305				542				965			
174	174			309	309			549	549			976	976		
176				312				556				988			

• Example





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