

Susumu Group Companies

Thin Film Products



Thin Film Power

The Art of Combination
Components 2006 vol.1

Susumu World Group Companies



About the Susumu Group

Susumu was established in 1964 as a pioneer to mass produce thin film components for general purposes. For forty years Susumu has been continuously supplying thin film resistors to computer, telecommunication, peripheral, test equipment, automotive, and multimedia consumers. Recently chip inductors and current sensors were added to our long list of thin film products in order to meet the demand for higher speed, higher frequency, digital and the expanding wireless markets. All products are original in the field of electronic components, derived from our innovative thin film core technology. This core technology allow us to develop miniaturized, reliable, precision, and lower power consumption packages with affordable prices.



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Thin Film Technology was established in 1987 in North Mankato, Minnesota, U.S.A. by Susumu for providing thin film resistors to the computer industry. Since then, TFT has developed transmission line delay lines for high speed applications in an ISO 9001 certified factory. These compact, high accuracy delay lines provide high speed timing solutions for microprocessor, automated test equipment, and telecommunications systems. TFT has expanded these popular delay lines into surface mount and chip style packages. TFT is also responsible for expanding thin film component applications in North America by promoting it's sister companies' products, including chip resistors, arrays, attenuators, and inductors. TFT's mission is to provide superior thin film components to every PC board of our customers, hence, thin film on board.

YDS is the most senior member in the Susumu Group. Established in 1940 in Yokohama, Japan. Their first product was a precision carbon film resistor. Gradually, YDS expanded the carbon film technology into attenuators and rotary variable attenuators. In 1975 their technology migrated to thin film. Now YDS concentrates on thin film components for high frequency applications: thin film based chip resistors, chip networks, chip attenuators, SMT temperature variable attenuators, power resistors and power attenuators. YDS is committed to continuously provide thin film value to world wide customers.

Cyntec is the youngest in the Susumu group, established in 1991 as a joint venture between Susumu Co. and Delta Electronics inc. in Taiwan. Cyntec currently concentrates on two product lines including a thin film platinum temperature sensor and thin film chip arrays in an ISO 9002 and QS9000 certified factory, serving the automotive and information technology markets. Cyntec's mission is to develop, market, and produce environmentally friendly high precision electronic components from the view point of energy savings and pollution control.

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● Current-detection components

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On Environment

Thin Film products by Susumu is environmentally friendly by nature.

■ Completely lead free: Our thin film products do not contain any lead even in the areas that are not restricted by RoHS.

The lead free products are designated as **Completely lead free** in the catalogue.

Typical RG/RM construction and composition

Structure	weight % of each structure						Composition of RoHS restricted materials					
	RG1005	RG1608	RG2012	RG3216	RM2012	RM3216	Heavy metals				PBB	PBBE
							Cadmium and its compounds	Lead and its compounds	Mercury and its compounds	Hexavalent chromium		
Substrate	83.2	87	87.6	89.5	87.8	92.86	<1ppm	<1ppm	<5ppm	<1ppm	not detected	not detected
Resistor	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
Mid 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 (Sn100%)	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	<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
Weight	0.72mg	2.07mg	4.12mg	8.26mg	4.11mg	7.96mg						

■ Products' extremely long life contributes to conserving resources.

Extremely long life products: RG series (page 8), RM series (page 10)

- Thin film resistors are high precision and very reliable by nature. New RG series boasts 8 times longer life compared to our conventional thin film resistors. Under normal usage (normal temp. and humidity), the expected resistance drift is less than 0.1% after 116 years

Comparison to our conventional product

Product series	Type	Judgment Criteria	Years
RG series	Highly reliable thin film chip resistor	0.1% resistance drift	over 116 years
RR series	Thin film chip resistor		14 years

Test Condition: 85°C, 85%RH, 10% rated voltage bias, 90 min. on/30min. off

■ Thin film enables us to make components smaller, contributing conserving resources.

Example 1: RL series

Power	Conventional type	RL	area %
0.1W	1.6×0.8	0.6×0.3	14%
1W	6.4×3.2	3.7×2.0	36%
2W	11.5×7.0	7.5×2.0	19%

Comparison to our conventional product (unit: mm)

Example 2: RGH series

Power	Conventional type	RGH	area %
1/8W	1.6×0.8	1.0×0.5	39%
1/4W	3.2×1.6	2.0×1.25	48%

Comparison to our conventional product (unit: mm)

SSM Group Companies, as a whole group, strive to create environmentally friendly components.

SSM Group ISO14001 certification status

Company Name	Facilities	Certification date	Certifying body	Cert. #
Susumu Co., Ltd.	Obama Factory	2000.12.15	JQA	EM1184
	Headquarter, Sales offices			
Yokohama Denshi Seiko Co., Ltd.	Niigata Factory	2001.03.09	JQA	EM1388
Thin Film Technology Corp.	Mankato facility	2000.03.24	UL	A8561
Cyntec Co., Ltd.	Hsin-Chu (Taiwan)	2002.08.26	UL	A8561
	Suzhou (China)	2003.10.22	UKAS	140858

RoHS compliant products

All our products are RoHS compliant. RoHS compliant products are designated as **RoHS compliant** in the catalogue.

● Ordering and differentiation of RoHS compliant products

We offer RoHS compliant products in all of our product series. Some of these products have RoHS compliant specific part numbers and some do not.

<Ordering>

- ① Use RoHS compliant specific part numbers or regular part numbers if only lead free products are offered.
- ② Please add a message that you are requiring RoHS compliant parts when ordering products that do not have RoHS compliant specific part numbers. Contact our sales office for details.

<Differentiation of RoHS compliant products from lead containing products>

RoHS compliant products labels have double broken lines at the bottom of the labels

Example of the label

RG2012P-102-D	
Q.TY	5000pcs
INSPECTED r	MADE IN JAPAN
SUSUMU CO.,LTD.	
S042501	N: (BAR CODE)
C: (BAR CODE)	Q: (BAR CODE)

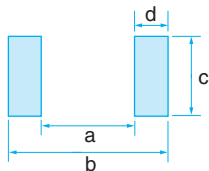
Double line indication RoHS compliant products

					RoHS compliant products			
Page		sub category	RoHS compliant	Completely lead free	RoHS compliant only offered	Both offered	Specific part #	Differentiation
8	RG series		○	○	○	—	—	—
10	RM series		○	○	○	—	—	—
12	RGH series		○	○	○	—	—	—
13,14	RR series		○	○		○		double lined label
15,38	RN series		○	○		○		double lined label
16	RA series		○	○	○	—	—	—
17	RT series		○	○		○		double lined label
18	RP series		○			○		double lined label
19,20,21,22	RL series		○			○		double lined label
19	PRL series		○		○	—	—	—
21	RL-3264 series		○	○		○	○	specific part #
23	PCMC series		○	○	○			—
26	PFR・GFR series	PFR03	○		○			—
		other	○			○	○	specific part #
24,25	RS series	RS064R, 062R	○		○			—
		other	○			○		Internal part #
27	RF series		○	○		○		double lined label
28	SA series		○		—			—
29	HPL, TFL series		○	○				double lined label
30	HTC series		○	○				double lined label
31	LC filter		○	○	○		—	—
32	band pass filter		○	○	○		—	—
33	FL*B series		○			○	○	specific part #
34	EF2A series		○	○	○			—
35	P*V series	PXV1220, PBX1632	○			○		double lined label
			○			○		double lined label
36	PAT series	RAT1010	○			○	○	specific part #
		other	○	○		○		double lined label
37	PS series		○	○	○			—
39	GL series		○			○	○	specific part #
40	CL1 series		○	○	○			—
	CL2 series		○	○		○	○	specific part #
41	DS series		○			○	○	specific part #
42	DL series		○		—	○	○	specific part #

Design Supportive Data

Recommended land pattern (Dimension: mm)

Recommended land pattern A



Series	a	b	c	d	Page
RP1005, RL0510	0.5	1.9	0.7	—	18,20
RP1608, RL0816	0.7	3	1.6	—	18,20
RP2012, RL1220	1	4	2.4	—	18,20
RL3720	1.2	27	4.2	—	19
RL3720W	1.2	27	7.9	—	19
RL7520W	1.2	27	15.8	—	19
PRL0816	0.4	—	2	1	19
PRL1220	0.55	—	2.5	1.2	19
PRL1632	0.7	—	4	1.4	19
PRL3264	1.6	—	7.5	2	19
RL1632	—	1.2	2	1.6	21
RL3264	—	2.4	4	3	21
RL1632H, RL1632	1.4	—	1.78	1.37	21
RL-3264-6	—	8	4	3.35	21

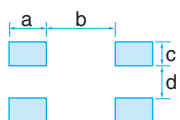
Series	a	b	c	d	Page
RN732X	1.2	—	1.2	0.6	14
RR1632	2.4	—	1.6	0.6	13,14
RR2632	2.4	—	2.6	0.6	13,14
PFR (GFR) 03	0.3	1	0.3~0.7	—	26
PFR (GFR) 05	0.5	1.5	0.4~0.8	—	26
EF2A51A	0.84	1.524	0.55	0.38	34

Series	a	b	c	d	Page
PCMC063T	3.7	7.4	3.5	—	23
PCMC104T	4.5	11.5	4	—	23
PCMC133E	8	14.5	5	—	23
PCMC135T	8	14.5	5	—	23

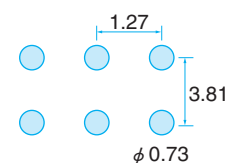
Chip Size	a	b	c	d
06*03	0.28	0.76	0.34	—
1.0*0.5	0.5	1.6	0.6	—
1.6*0.8	1	3	1.2	—
2.0*1.25	1.2	4	1.65	—
3.2*1.6	2.2	5	2	—

Series	Page
RG Series	8
RGH Series	12
RR Series (except RR1632, RR2632)	13,14
RT Series	17
TFL Series	29
HPL Series	29
HTC Series	30

Recommended land pattern B

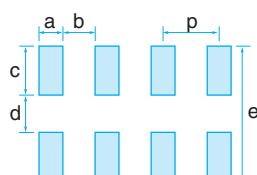


Series	a	b	c	d	Page
RM2012	0.4~0.8	0.7~0.9	0.4~0.6	0.6~0.7	10
RM3216	0.6~0.8	1.4~1.6	0.9~1.1	0.6~0.8	10
RN1632	1.1	1.2	0.7	0.8	13
RL1632L4	1	2.2	1.1	0.5	22
RL2550L4	3.4	2.6	1.8	0.7	22
RL3264L4	4.2	2.2	2.4	0.8	22

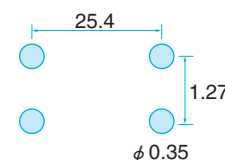


Series	Page
FL Series	33

Recommended land pattern C

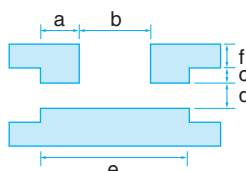


Series	a	b	c	d	e	p	Page
RS064R	0.2	—	—	0.3	0.9	0.4	24
RS064R (K)	0.2	—	—	0.3	0.9	0.5	24
RS4N	0.25	—	—	0.5	1.5~2.0	0.5	24
RA1632	0.25~0.3	0.5~0.55	0.9	0.6	—	—	16
RS062R (2 electrodes on one side)	0.3	—	—	0.3	0.9	0.5	24
RS2N (2 electrodes on one side)	0.25	—	—	0.5	1.8	0.65	24
RS8A (5 electrodes on one side)	0.3	—	—	1	3.6	0.635	25
RS8M (8 electrodes on one side)	0.25	—	—	1	3.6	0.5	25



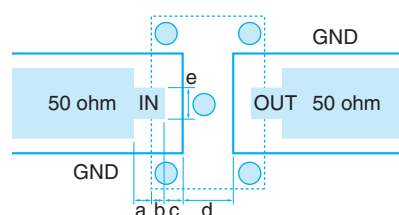
Series	Page
CL1L5	40
CL2LA	40

Recommended land pattern D



Series	a	b	c	d	e	f	Page
PAT0510	0.2~0.4	0.3	0.25	0.5	0.7~1.1	0~0.3	36
PAT0816	0.4	0.8	0.2	0.4	1.6	0.2~0.4	36
PAT1220	0.6	0.8	0.3	0.3	2	0.2~0.5	36
PAT1632	1	1.2	0.4	0.8	3.2	0.2~0.5	36
PAT3042S	0.5	3.2	0.9	1.2	4.2	0.2~0.5	36
PXV1220S	0.6	0.8	0.3	0.3	2	0.2~0.5	35
PBV1632S	1	1.2	0.4	0.8	3.2	0.2~0.5	35
RN1632F	1	1.2	0.4	0.8	3.2	0.2~0.5	35

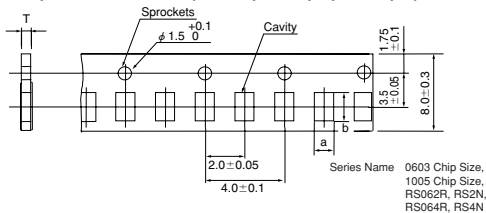
Recommended land pattern E



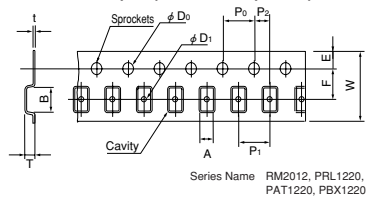
Series	a	b	c	d	e	Page
TBF-0510	0.2	0.15	0.3	1.1	0.3	32
TBF-1608	0.2	0.15	0.125	0.25	0.4	32
TBF-2012	0.2	0.15	0.3	0.35	0.3	32

Tape Specification (Dimension: mm)

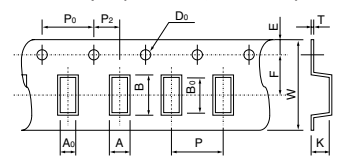
Tape dimensions (2mm pitch paper tape)



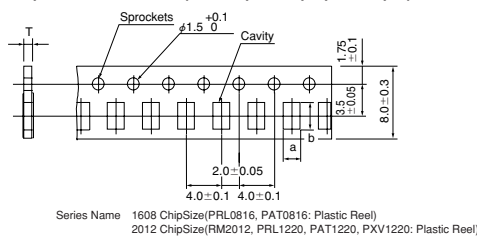
Plastic Tape (2012 ChipSize)



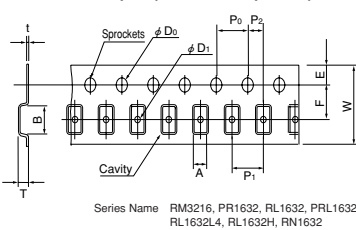
Plastic Tape (RL3720, RL7520)



Tape dimensions (4mm pitch paper tape)



Plastic Tape (3216 ChipSize)

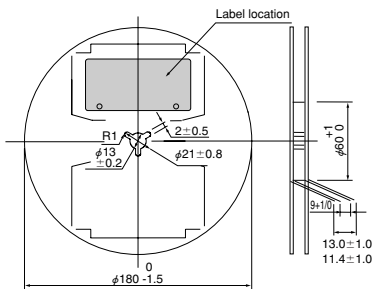


Code	Dimension Specification	
	2012	3216
A	1.6±0.2	2.0±0.2
B	2.4±0.2	3.6±0.2
W	8.0±0.3	8.0±0.3
F	3.5±0.05	3.5±0.05
E	1.75±0.1	1.75±0.1
P ₀	4.0±0.1	4.0±0.1
P ₁	4.0±0.1	4.0±0.1
P ₂	2.0±0.05	2.0±0.05
D ₀	1.55±0.05	1.55±0.05
D ₁	—	1.05±0.05
T	≤1.5	≤1.5
t	≤0.3	≤0.3

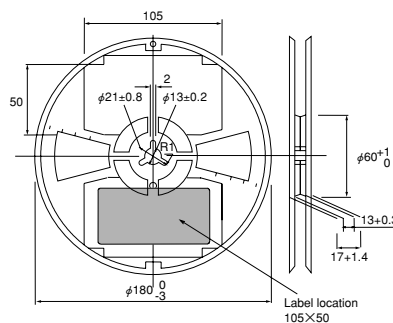
Code	Dimension Specification	
	RL3720	RL7520
A	2.6±0.2	2.6±0.2
A ₀	2.4±0.1	2.4±0.1
B	4.45±0.2	8.2±0.2
B ₀	4.25±0.2	8.0±0.2
E	1.75±0.1	1.75±0.1
F	5.5±0.05	7.5±0.1
W	12.0±0.2	16.0±0.3
D ₀	1.55±0.05	1.55±0.05
K	0.7±0.1	0.7±0.1
T	0.3±0.05	0.3±0.05
P ₀	4.0±0.1	4.0±0.1
P ₁	4.0±0.1	4.0±0.1
P ₂	2.0±0.05	2.0±0.1

Reel Specification (Dimension: mm)

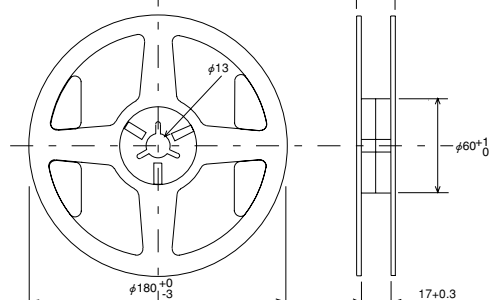
RG series, RGH series, RM series, RR series, TFL series, HPL series, RT series, HTC series, RP series, RL0510,0816,1220, RS series, PAT series



RL3720 (W) series



RL7520 (W) series



Power Derating

●Rated Power

The standard ambient temperature is 30°C. When an ambient temperature exceeds 30°C, the maximum load power is calculated by multiplying the rated power with the ratio derived from the power derating curve

〈Rated voltage〉

The rated voltage is the corresponding voltage of DC or AC (commercially used frequency) current to the rated power given by:

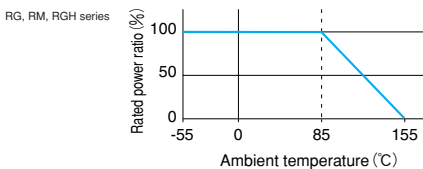
$$E = \sqrt{R \times P}$$

E: Rated voltage (V)
P: Rated power (W)
R: Rated resistance (Ω)

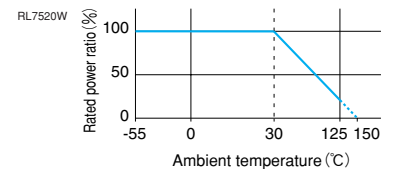
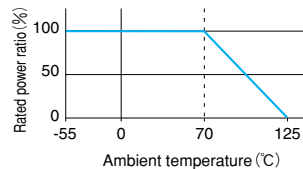
〈Rated current〉

The DC current that increases the temperature by 20°C by inductance. If the ambient temperature exceeds 70°C, the current should be derated according to the power derating curve below.

$$(\text{Power}) = (\text{Current})^2 \times (\text{Resistance})$$

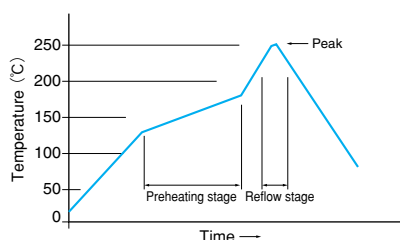


RR series, RT series, RN-RA series, PFR-GFR series, RS series, RL0510-0816-1220-3720-3720W, PAT series, RAT1010, P=V series, PS series, BL-GL-CL series, HPL0603-0510, TFL0510-0816



Recommended Reflow

●Recommended reflow temperature profile



●Part's surface temperature

Pre-heat	130~180°C	60~90sec.
reflow	Over 220°C	30~90sec.
peak temperature	240~250°C	within 10sec.

●Solder composition : Sn-Ag-Cu solder

●Repetition : up to 2 times (Cooling between the two reflow is required.)



SSM
THIN FILM TECHNOLOGY

Tight resistance tolerance of $\pm 0.02\%$ and temperature coefficient of resistance of $\pm 5\text{ppm}/^\circ\text{C}$ are achieved. Under high temperature and humid condition of 85°C and $85\%\text{RH}$, and at 155°C (duration:8000 hours for both tests), superior reliability of only less than $\pm 0.1\%$ of change in resistance value is realized.

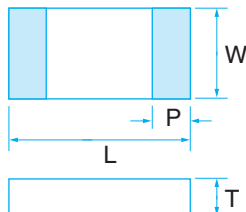


RoHS compliant

Completely lead free

SPECIFICATIONS

Mechanical



Dimension (Inch Size)	RG1005 (0402)	RG1608 (0603)	RG2012 (0805)	RG3216 (1206)
L	1.0±0.05	1.6±0.2	2.0±0.2	3.2±0.2
W	0.5±0.05	0.8±0.2	1.25±0.2	1.6±0.2
P	0.2±0.10	0.3±0.2	0.4±0.2	0.5±0.25
T	0.35±0.05	0.4±0.1	0.4±0.1	0.4±0.1

(unit : mm)

Electrical

Type		RG1005				RG1608					
Power	general	1/16W				1/10W					
	Ultra-reliability	1/32W				1/16W					
Tolerance %(code)		±0.5(D)	±0.05(W), ±0.1(B) ±0.25(C), ±0.5(D)	±0.02(P), ±0.05(W), ±0.1(B), ±0.25(C), ±0.5(D)	±0.05(W), ±0.1(B), ±0.25(C), ±0.5(D)	±0.5(D)	±0.05(W), ±0.1(B) ±0.25(C), ±0.5(D)	±0.02(P), ±0.05(W), ±0.1(B), ±0.25(C), ±0.5(D)	±0.05(W), ±0.1(B), ±0.25(C), ±0.5(D)	±0.1(B) ±0.5(D)	±0.5(D)
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
TCR ppm /°C(code)		±100 (R)	±10 (N) ±25 (P)	±10 (N) ±25 (P)	±10 (N) ±25 (P)	±50 (Q)	±10 (N) ±25 (P)	±10 (N) ±25 (P)	±10 (N) ±25 (P)	±25 (P)	±25 (P)
Max Operating Voltage		25V				75V					
Resistance Value		E-24, E-96									
Operating Temp. Range		-55°C~155°C									
Package		1,000pcs/reel (T1:P,W), 5,000pcs/reel (T5:B), 10,000pcs/reel (T10:B,C,D)				1,000pcs/reel (T1:P,W,B), 5,000pcs/reel(T5:B,C,D)					

Type		RG2012					RG3216		
Power	general	1/8W					1/4W		
	Ultra-reliability	1/10W					1/8W		
Tolerance %(code)		±0.5(D)	±0.05(W), ±0.1(B) ±0.25(C), ±0.5(D)	±0.02(P), ±0.05(W), ±0.1(B), ±0.25(C), ±0.5(D)	±0.05(W), ±0.1(B), ±0.25(C), ±0.5(D)	±0.1(B) ±0.5(D)	±0.05(W), ±0.1(B) ±0.25(C), ±0.5(D)	±0.02(P), ±0.05(W), ±0.1(B), ±0.25(C), ±0.5(D)	±0.05(W), ±0.1(B) ±0.25(C), ±0.5(D)
Resistance Range(Ω)		10~46.4	47~97.6	100~10k	10.2k~475k	487k~1M	47~97.6	100~33.2k	34k~1M
TCR ppm /°C(code)		±50 (Q)	±10 (N) ±25 (P)	±10 (N) ±25 (P)	±10 (N) ±25 (P)	±25 (P)	±10 (N) ±25 (P)	±10 (N) ±25 (P)	±10 (N) ±25 (P)
Max Operating Voltage		100V					150V		
Resistance Value		E-24, E-96							
Operating Temp. Range		-55°C~155°C							
Package		1,000pcs/reel (T1:P,W,B), 5,000pcs/reel(T5:B,C,D)							

· Please contact us for Resistance tolerance $\pm 0.01\%$. · Please contact us for RG3226 series with power of 1/2W

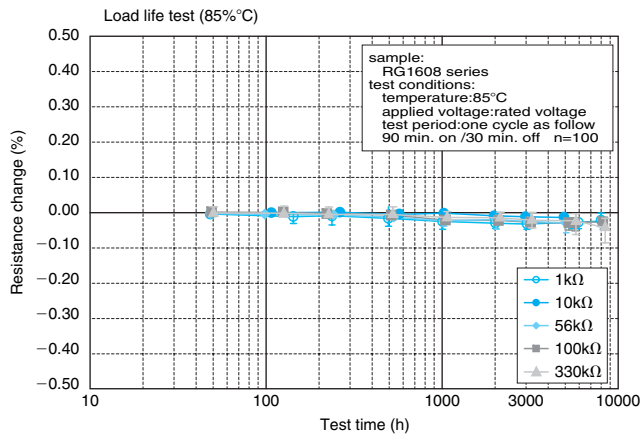
Reliability

Item	Test Method	Specification		Typical
		Ultra-reliability	general	Ultra-reliability
Short time overload	Applied voltage: $2.5 \times$ rated voltage or $2 \times$ maximum operating voltage which ever is less test duration: 5 seconds	$\pm(0.05\%+0.01\Omega)$	$\pm(0.05\%+0.01\Omega)$	$\pm(0.01\%+0.01\Omega)$
Load Life	Test Temperature.: 85°C Applied voltage: rated voltage Test period: repeat 1000 cycle as follow: 90 min. on/30 min. off cycled	$\pm(0.1\%+0.01\Omega)$	$\pm(0.25\%+0.05\Omega)$	$\pm(0.01\%+0.01\Omega)$
Moisture load life	Test condition: $85^{\circ}\text{C}85\%\text{RH}$ Applied power: 1/10 rated Power Test period: repeat 1000 cycle as follow: 90 min. on/30 min. off cycled	$\pm(0.1\%+0.01\Omega)$	$\pm(0.25\%+0.05\Omega)$	$\pm(0.05\%+0.01\Omega)$
Temperature cycle	Repeat 1000 cycle as follow: -55°C (30 min.)/Room Tem.(2 min.)/ $+125^{\circ}\text{C}$ (30 min.)/ Room Tem.(2 min.)	$\pm(0.1\%+0.01\Omega)$	$\pm(0.25\%+0.05\Omega)$	$\pm(0.01\%+0.01\Omega)$
High temperature exposure	$+155^{\circ}\text{C}$ for 1000 hours with no load	$\pm(0.1\%+0.01\Omega)$	$\pm(0.25\%+0.05\Omega)$	$\pm(0.01\%+0.01\Omega)$

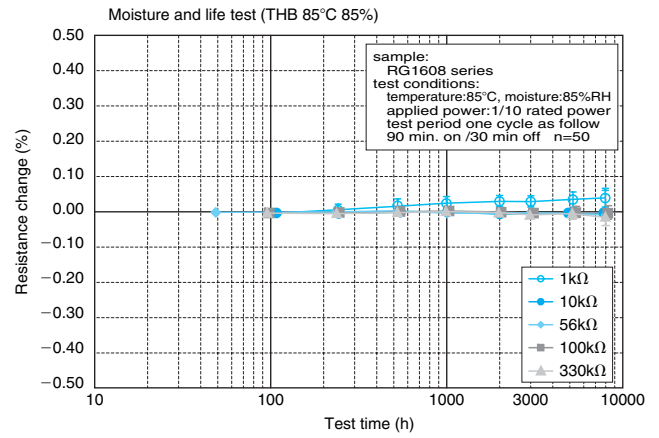


The result of each reliability test for 8000 hours

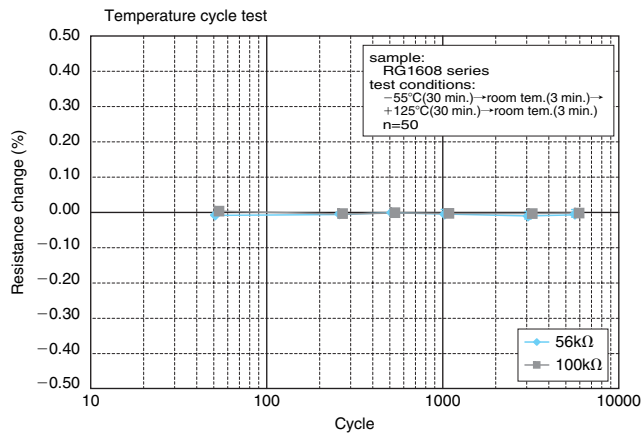
Load life test



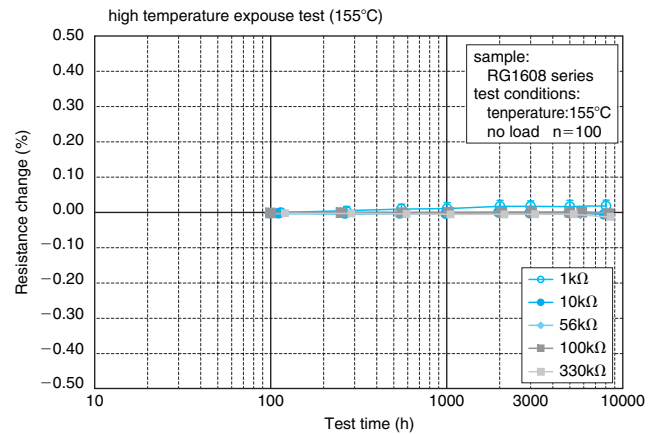
Moisture and life test



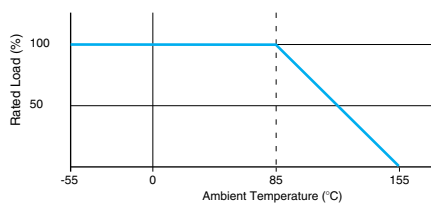
Temperature cycle test



High temperature exposure test



CHARACTERISTIC of Power Temperature Derating Curve



PART NUMBER

RG 1608 N - 102 - B - T5

Package (T1,T5,T10)

Resistance Tolerance

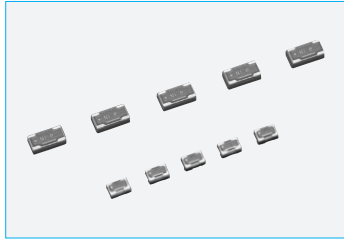
Resistance

(E-24: in a 3 digit number,
E-96: in a 4 digit number 4 digits for all RG3216)

Temperature Coefficient of Resistance

Dimensions

Part Code



RM series, ultra-precision & ultra-reliability metal film chip network resistors



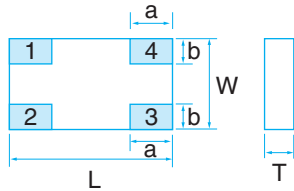
Tight tracking resistance tolerance of $\pm 0.01\%$ and tracking temperature coefficient of resistance of $\pm 1\text{ppm}/^\circ\text{C}$ are achieved. Under high temperature and humid condition of 85°C and $85\%\text{RH}$, and at 155°C (duration:8000 hours for both tests), superior reliability of only less than $\pm 0.1\%$ of change in resistance value is realized.

RoHS compliant

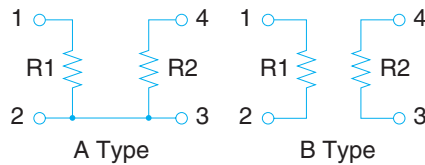
Completely lead free

SPECIFICATIONS

Mechanical



Equivalent circuits



Dimension (Inch Size)	RM2012 (0805)	RM3216 (1206)
L	2.0 ± 0.2	3.2 ± 0.2
W	1.25 ± 0.2	1.6 ± 0.2
T	0.4 ± 0.1	0.4 ± 0.1
a	0.6 ± 0.2	1.0 ± 0.2
b	0.35 ± 0.2	0.4 ± 0.2

(unit : mm)

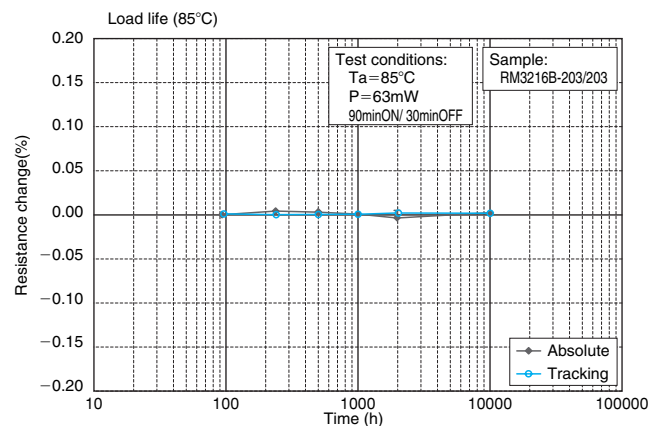
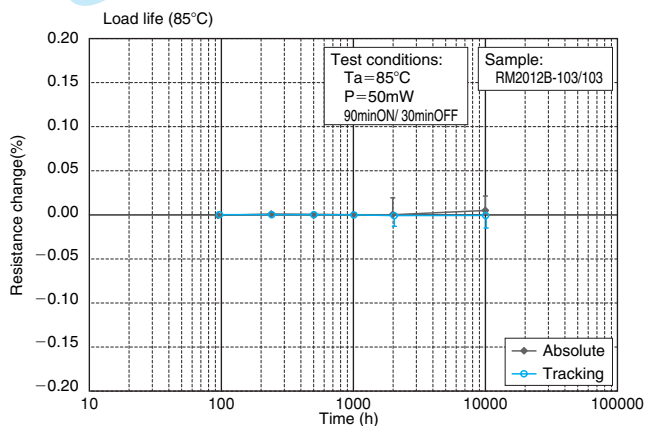
Electrical

Type	RM 2012		RM 3216	
Power	0.05W/element, 0.1W/package		0.063W/element, 0.125W/package	
Resistance Range (Ω)	100~100k Ω		500~330k Ω	
Absolute Tol. %(code)	$\pm 0.1(\text{B}), \pm 0.5(\text{D})$ ($100 \leq R < 2\text{k}\Omega$)	$\pm 0.05(\text{W}), 0.1(\text{B}), \pm 0.5(\text{D})$ ($2\text{k}\Omega \leq R \leq 100\text{k}\Omega$)	$\pm 0.1(\text{B}), \pm 0.5(\text{D})$ ($100 \leq R < 2\text{k}\Omega$)	$\pm 0.05(\text{W}), 0.1(\text{B}), \pm 0.5(\text{D})$ ($2\text{k}\Omega \leq R < 330\text{k}\Omega$)
Tracking Tol. %(code)	$\pm 0.01(\text{L}), \pm 0.02(\text{P}), \pm 0.05(\text{W})$ (ratio=1) $\pm 0.02(\text{P}), \pm 0.05(\text{W})$ ($1 < \text{ratio} \leq 10$) $\pm 0.05(\text{W})$ ($100 \geq \text{ratio} > 10$)		$\pm 0.01(\text{L}), \pm 0.02(\text{P}), \pm 0.05(\text{W})$ (ratio=1) $\pm 0.02(\text{P}), \pm 0.05(\text{W})$ ($1 < \text{ratio} \leq 10$) $\pm 0.05(\text{W})$ ($100 \geq \text{ratio} > 10$)	
Absolute TCR ppm/ $^\circ\text{C}$ (code)	$\pm 25(\text{P})$ ($100 \leq R < 300\Omega$)	$\pm 10(\text{N}), \pm 25(\text{P})$ ($300 \leq R \leq 100\text{k}\Omega$)	$\pm 25(\text{P})$ ($100 \leq R < 300\Omega$)	$\pm 10(\text{N}), \pm 25(\text{P})$ ($300 \leq R \leq 330\text{k}\Omega$)
Tracking TCR ppm/ $^\circ\text{C}$ (code)	$\pm 1(\text{X}), \pm 5(\text{V})$ (ratio=1) $\pm 2(\text{W}), \pm 5(\text{V})$ ($1 < \text{ratio} \leq 3$) $\pm 5(\text{V})$ ($100 \geq \text{ratio} > 3$)		$\pm 1(\text{X}), \pm 5(\text{V})$ (ratio=1) $\pm 2(\text{W}), \pm 5(\text{V})$ ($1 < \text{ratio} \leq 3$) $\pm 5(\text{V})$ ($100 \geq \text{ratio} > 3$)	

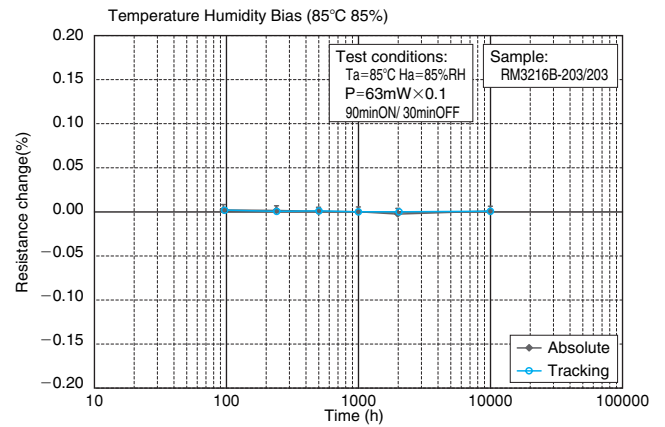
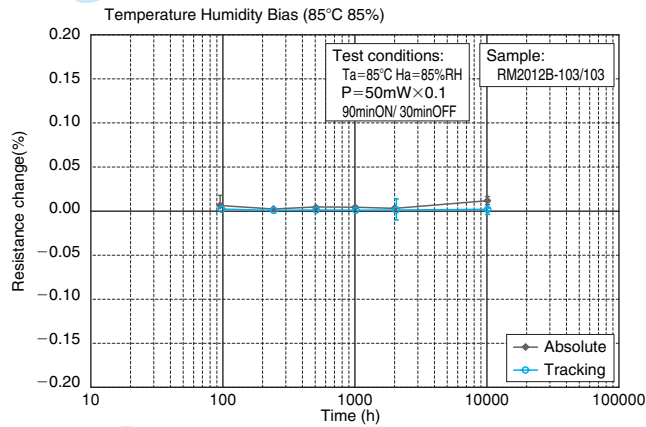
- Please contact us for TCR $\pm 5\text{ppm}/^\circ\text{C}$ for 300Ω or more in RM2012, RM3216
- Standard combination of resistance values
 - Identical resistance values R1=R2=1k Ω , 10k Ω , 100k Ω
 - Different resistance values R1=1k Ω , R2=2k Ω , 3k Ω , 4k Ω , 5k Ω , 6k Ω , 9k Ω , 10k Ω , 20k Ω , 25k Ω , 50k Ω , 100k Ω
 - R1=2k Ω , R2=10k Ω , 20k Ω , 40k Ω , 50k Ω , 100k Ω , 200k Ω
 - R1=10k Ω , R2=20k Ω , 30k Ω , 40k Ω , 50k Ω , 60k Ω , 90k Ω , 100k Ω
- Please contact us for other variety than these sizes and customized specifications.

The result of each reliability test

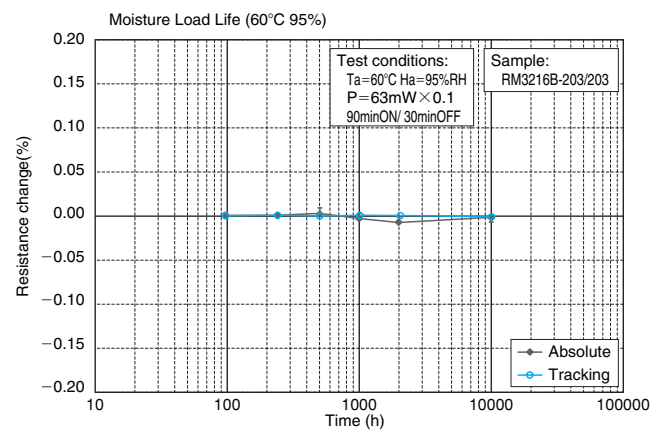
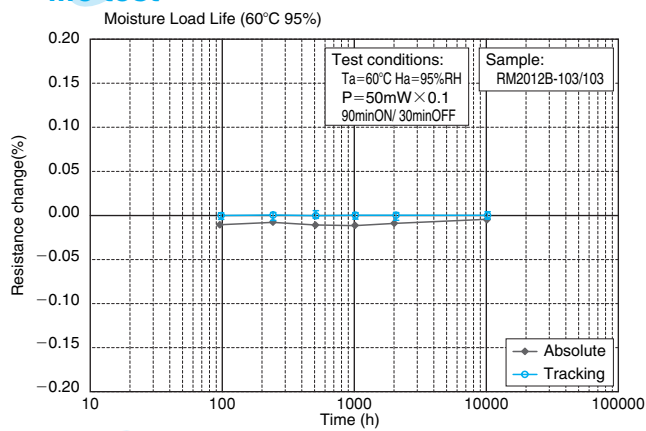
Load life test



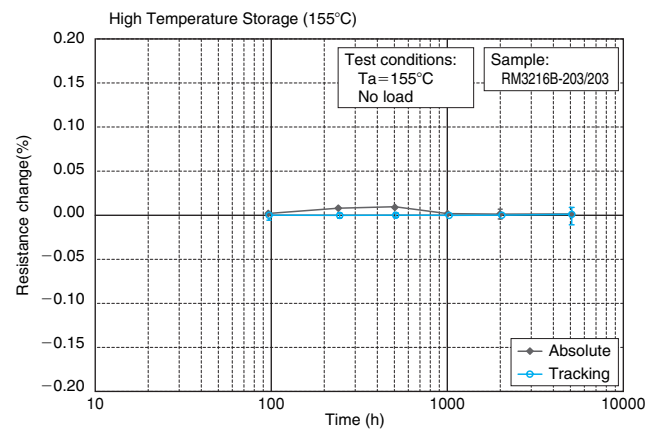
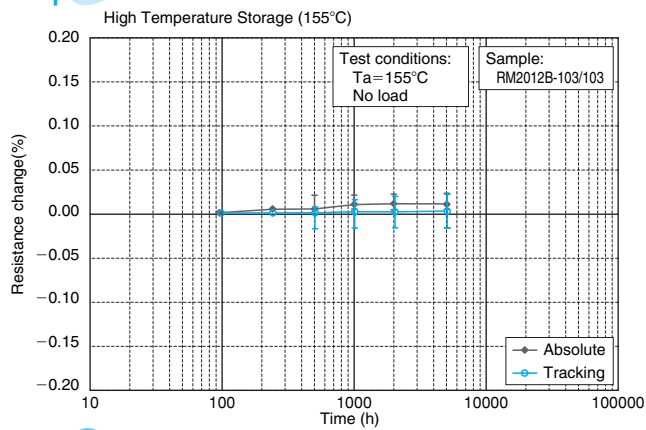
Moisture and life test



Moisture and life test



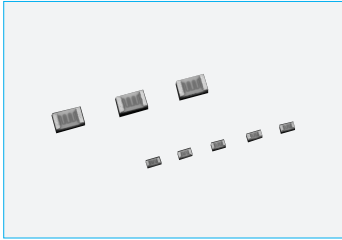
High temperature exposure test



PART NUMBER

RM 2012 A - */** - P W X L 10**

- Package (10=1,000pcs, 50=5,000pcs)
- Tracking Resistance Tolerance
- Tracking Temperature Coefficient of Resistance
- Resistance Tolerance
- Temperature Coefficient of Resistance
- Resistance
- Circuit
- Dimensions
- Part Code



RGH series, high-power and high-precision metal film chip resistors NEW



Resistors with high power in small size are realized as 1/4W for 2.0×1.25mm(0805)size, 1/8W for 1.0×0.5mm(0402)size.

Tight resistance tolerance of $\pm 0.1\%$ and temperature coefficient of resistance of $\pm 25\text{ppm}/^{\circ}\text{C}$ are achieved.

Operating temperature range: $-55\sim 155^{\circ}\text{C}$

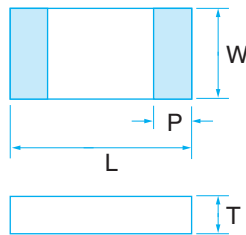
RoHS compliant

Completely lead free



SPECIFICATIONS

Mechanical



Dimension (Inch Size)	RGH1005-2B	RGH2012-2E
L	1.0 ± 0.05	2.0 ± 0.2
W	0.5 ± 0.05	1.25 ± 0.2
P	0.2 ± 0.10	0.4 ± 0.2
T	0.35 ± 0.05	0.4 ± 0.1

(unit : mm)

Electrical

Type	RGH1005-2B	RGH2012-2E
Power	1/8W	1/4W
Tolerance % (code)	$\pm 0.1\%(B), \pm 0.5\%(D)$	$\pm 0.1\%(B), \pm 0.5\%(D)$
Resistance range (Ω)	47~100k	47~470k
TCR ppm/ $^{\circ}\text{C}$ (code)	$\pm 25\text{ppm}/^{\circ}\text{C}(P)$	$\pm 25\text{ppm}/^{\circ}\text{C}(P)$
Max Operating Voltage	75V	125V
Resistance value	E-24,E-96	E-24,E-96
Operating Temp. Range	$-55\sim 155^{\circ}\text{C}$	$-55\sim 155^{\circ}\text{C}$
Package	10,000	5,000

· RGH1608 with 1/6W power consumption are available to meet your needs.



PART NUMBER

RGH 1005 - 2B - P - 102 - B

Resistance Tolerance

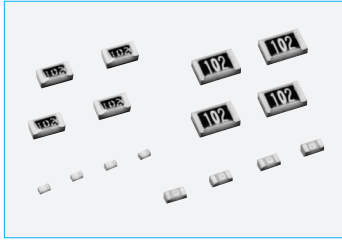
Resistance(E-24:in a 3 digit,E-96:in a 4 digit)

Temperature coefficient of resistance

Power(2B for 1/8W, 2E for 1/4W)

Dimension

Part Code



RR series, high-precision metal film chip resistors



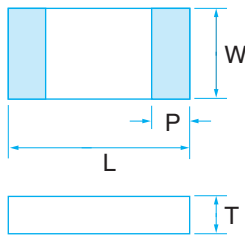
Thin Film Technology has achieved high performance chip resistors with low price and reliable supply. The parts offer excellent performance and tolerance in TCR, current noise, linearity, for high frequency circuit applications. Precise dimensions minimize errors during mounting. Tight tolerance allow for cost saving due to circuit simplification and elimination of trim pots for adjustment.

RoHS compliant

Completely lead free

SPECIFICATIONS

Mechanical



Dimension (Inch Size)	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
P	0.12±0.05	0.20±0.10	0.30±0.20	0.40±0.20	0.50±0.20	0.50±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

(unit : mm)

Electrical

Type	RR0306		RR0510		RR0816		RR1220		RR1632		RR2632	
Power	1/20W		1/16W		1/16W		1/10W		1/8W		1/4W	
Tolerance %(code)	±1.0% (F)	±0.5% (D)	±0.5%(D)		±0.5%(D)		±0.5%(D)		±0.5% (D)			
Resistance Range (Ω)	10~ 30	33~ 22K	10~ 97.6	100~ 100K	10~ 97.6	100~ 360K	10~ 97.6	100~ 1M	10~49.9	51~1M	10~49.9	51~2M
TCR ppm /°C(code)	±100 (R)	±25 (P)	±100 (R)	±25 (P)	±50 (Q)	±25 (P)	±50 (Q)	±25 (P)	±50 (Q)	±25 (P)	±50 (Q)	±25 (P)
Resistance Value	E-24		E-24/E-96		E-24/E-96		E-24/E-96		E-24/E-96		E-24/E-96	
Max Operating Voltage	15V		25V		75V		100V		150V		200V	
Package	5,000pcs/reel		10,000pcs/reel		5,000pcs/reel		5,000pcs/reel		5,000pcs/reel		1,000· 5,000pcs/reel	

· Contact us also for RL0816—JMP jumper resistor whose dimensions are the same as those of RR0816.

PART NUMBER

RR 0816 P - 102 - D - (M) - (T5) - (*)**

To be added as for E-96 series value of RR0816 as 3 letters code

Taping quantity unit

RR1632,RR2632:“T1” to be added for 1000pcs/reel

“T5” to be added for 5000pcs/reel

RR0306,RR0510,RR0816,RR1220: No marking

“M” to be added as for E-96 series value of RR1220

Resistance Tolerance

Resistance value

RR0306,RR0510,RR0816,RR1220:3 digits for E-24 series

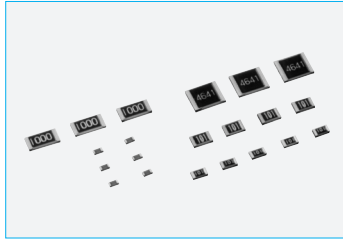
RR0306,RR0510,RR0816,RR1220:4 digits for E-96 series

RR1632,RR2632:4 digits for all values

Temperature Coefficient of Resistance

Dimensions

Part Code



RR series, RN series, ultra-precision metal film chip resistors



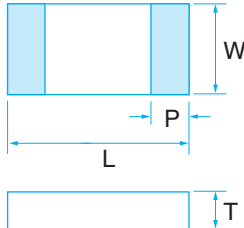
Available for resistance tolerance of $\pm 0.1\%$, temperature coefficient of resistance of $\pm 5\text{ppm}/^\circ\text{C}$

RoHS compliant

Completely lead free

SPECIFICATIONS

Mechanical



Dimension (Inch Size)	RR0816	RR1220 RN73	RR1632	RR2632
L	1.60 ± 0.20	2.00 ± 0.20	3.20 ± 0.20	3.20 ± 0.20
W	0.80 ± 0.20	1.25 ± 0.20	1.60 ± 0.20	2.60 ± 0.20
P	0.30 ± 0.20	0.40 ± 0.20	0.50 ± 0.20	0.50 ± 0.20
T	0.40 ± 0.10	0.40 ± 0.10	0.40 ± 0.10	0.40 ± 0.10

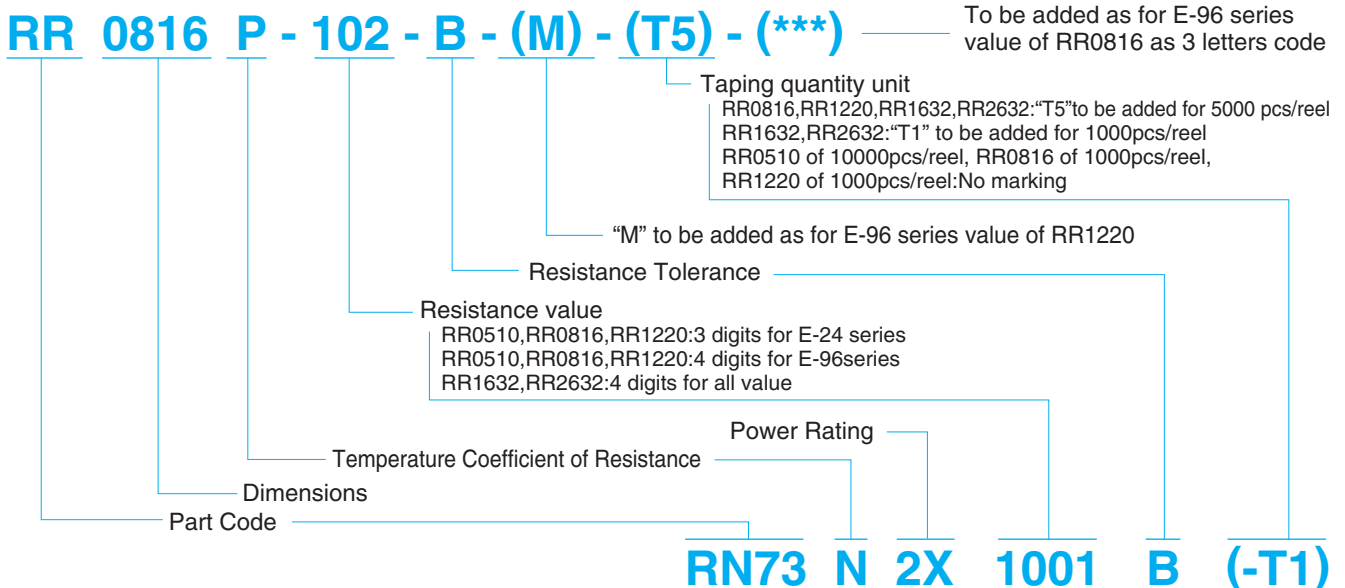
(unit : mm)

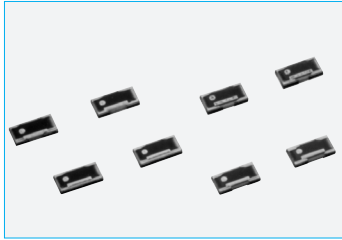
Electrical

Type	RR0816	RN73	RR1220	RR1632	RR2632
Power	1/16W	1/10W		1/8W	1/4W
Tolerance %(code)	$\pm 0.1\%$ (B)	$\pm 0.1\%$ (B)	$\pm 0.1\%$ (B)	$\pm 0.1\%$ (B)	$\pm 0.1\%$ (B)
Resistance Range(Ω)	100~332k	511~100k	100~100k	100~1M	100~200k 100~200k 51~1M 100~330k 100~330k 51~2M
TCR ppm / $^\circ\text{C}$ (code)	± 25 (P)	± 5 (V)	± 10 (N)	± 25 (P)	± 5 (V)
Resistance Value	E-24/E-96	E-24/E-96	E-24/E-96	E-24/E-96	E-24/E-96
Max Operating Voltage	75V	100V	100V	150V	200V
Package	1,000·5,000(T5)	1,000(T1)·5,000(T5) pcs/reel	1,000·5,000(T5) pcs/reel	1,000(T1)·5,000(T5) pcs/reel	1,000(T1)·5,000(T5) pcs/reel

· RR1632 and RR2632 with resistance value less than 100 Ω are also available.

PART NUMBER





RN series, ultra-precision chip network resistors

SSM
THIN FILM TECHNOLOGY

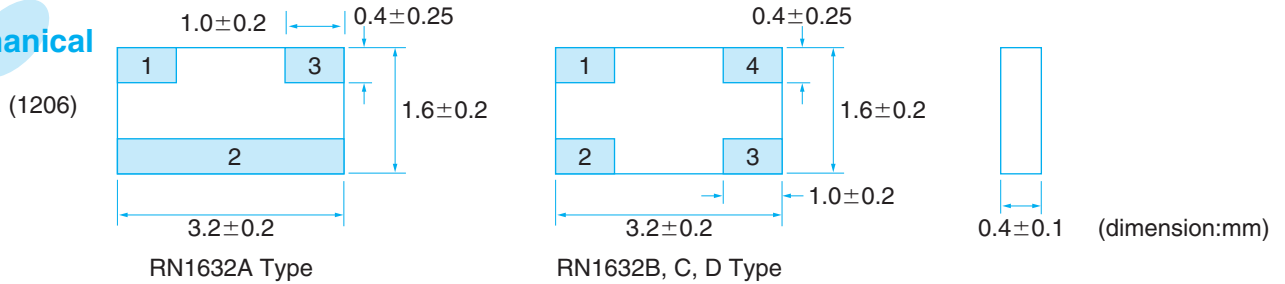
These 1206 chip resistor networks are available with either 2 or 3 resistors, and offer better performance than SIP networks. The surface mount package allow for less parasitic capacitance/inductance and even lower noise performance. Typical application: Voltage dividers.

RoHS compliant

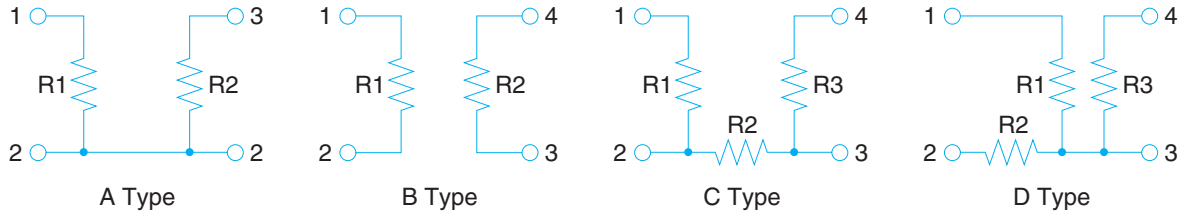
Completely lead free

SPECIFICATIONS

Mechanical



Equivalent circuits



Electrical

Type	RN1632A	RN1632B	RN1632C	RN1632D
Resistance Range(Ω)	100~51K	100~51K	100~33K	100~33K
Absolute Tol. %(code)	±0.5%(D), ±0.1%(B)	±0.5%(D), ±0.1%(B)	±0.5%(D), ±0.1%(B)	±0.5%(D), ±0.1%(B)
Tracking Tol. %(code)	±0.2%(C), ±0.1%(B)	±0.2%(C), ±0.1%(B)	±0.2%(C), ±0.1%(B)	±0.2%(C), ±0.1%(B)
Absolute TCR ppm /°C(code)	±25ppm/°C	±25ppm/°C	±25ppm/°C	±25ppm/°C
Tracking TCR ppm /°C(code)	±10ppm/°C(N), ±5ppm/°C(V)	±10ppm/°C(N), ±5ppm/°C(V)	±10ppm/°C(N), ±5ppm/°C(V)	±10ppm/°C(N), ±5ppm/°C(V)
Power Rating	63mW/element	63mW/element	42mW/element	42mW/element
Operating Temp. Range	-55°C~+125°C			
Package	1,000(T1),5,000(T5)pcs/reel			

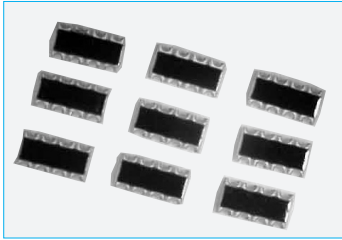
· 2.0×1.25mm size chip resistor for A and B type is available. · Certain combinations of resistance values may incur initial costs.

PART NUMBER

RN 1632 A - **/ - B - V B (-T1)**

Quantity in a reel
Tracking Resistance Tolerance
Tracking Temperature Coefficient of Resistance
Resistance Tolerance
Resistance
Circuit
Dimensions
Part Code

For circuits A and B two resistance values are shown, while for circuits C and D resistance values are individually shown as N **.



RA series, precision metal film chip resistors



These thin film resistor networks are in a surface mount chip array configuration, with electrodes fabricated into concave features. Tight resistance tolerance of 0.1% & 0.5% can save additional circuit elements.

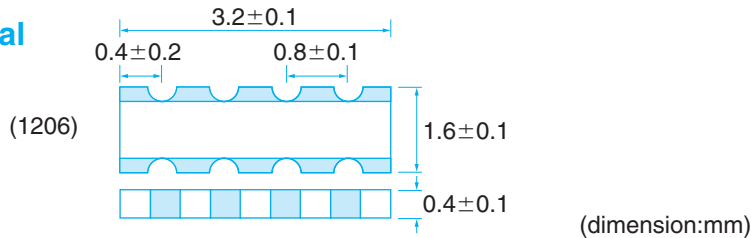
RoHS compliant

Completely lead free

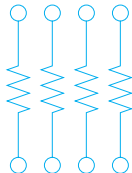


SPECIFICATIONS

Mechanical



Equivalent circuit



Electrical

Type	RA 1632
Resistance Range(Ω)	100~20k (Four elements are the same ohmic value)
Absolute Tol. %(code)	±0.1% (code:B), ±0.5% (code:D)
Tracking Tol. %(code)	±0.1% (code:B), ±0.2% (code:C)
Absolute TCR ppm /°C(code)	±25ppm/°C (code:P)
Tracking TCR ppm /°C(code)	±5ppm/°C (code:V), ±10ppm/°C (code:N)
Power Rating	30mW/element, 120mW/product
Operating Temp. Range	-55~+125°C
Package	1,000(T1),5,000(T5)pcs/reel

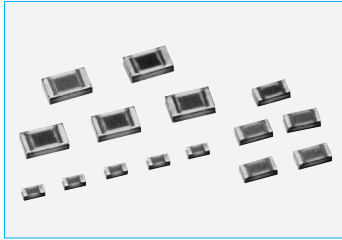
- Contact us for mixed resistance values in a package.
- Certain resistance values may incur initial costs.



PART NUMBER

RA	1632	10k	- B -	V	B (-T1)	
						Package (T1:1000pcs/reel,T5:5000pcs/reel)
						Tracking Resistance Tolerance
						Tracking Temperature Coefficient of Resistance
						Resistance Tolerance
						Resistance (The letter k denotes a thousand in ohmic values.)
						Dimensions
						Part Code

- The specification of a different resistance value or a specific-purpose circuit will assign an individual part code.



RT series, high-precision trimmable chip resistors



A one-step trimmable thin film component for in-circuit resistor tuning. This component has excellent temperature characteristics, exhibits excellent performance in circuit noise and the third harmonic distortion, and needs no moisture proofing treatment after trimming.(Patent1921853)

NEW First in the market 0201 trimmable chip resistor

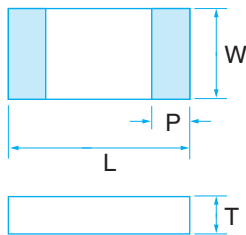
RoHS compliant

Completely lead free



SPECIFICATIONS

Mechanical



Dimension (Inch Size)	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±0.05	0.50±0.07	0.80±0.20	1.25±0.20
P	0.12±0.05	0.20±0.10	0.30±0.20	0.40±0.20
T	0.23±0.05	0.35±0.05	0.40±0.10	0.40±0.10

(unit : mm)

Equivalent circuit



Electrical

Type	RT0603			RT0510			RT0816					RT1220								
Initial resistance value(Ω)	150	330	1.5k	100	270	1.5K	100	330	1K	3.3K	10K	33	100	330	1K	3.3K	10K	33K	100K	
Upper resistance limit(Ω)	1.0k	2.2k	10k	820	2.1K	10K	2.7K	8.0K	8.8K	37K	40K	4.7K	8.2K	15K	15K	100K	120K	120K	220K	
TCR ppm /°C(code)	±25 (P)		±100 (R)	±25 (P)		±100 (R)	±25 (P)			±100 (R)		±50 (Q)	±25 (P)			±100 (R)				
Resistance Tolerance (code)	±20% (M)			±20% (M)			±20% (M)					±20% (M)								
Power	1/20W			1/16W			1/16W					1/10W								
Max Operating Voltage	15V			25V			75V					100V								
Max Applied Voltage	30V			50V			150V					200V								
Package	15,000pcs/reel			10,000pcs/reel			5,000pcs/reel					5,000pcs/reel								

· The RT0510 type with 50Ω initial resistance value is also available.



PART NUMBER

RT 0816 P - 102 - M

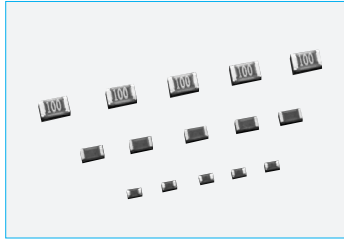
Resistance Tolerance

Resistance

Temperature Coefficient of Resistance

Dimensions

Part Code



RP series, high-power metal film chip resistors



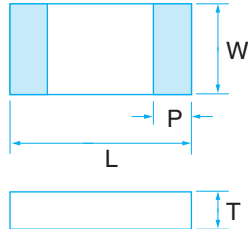
Resistors with high power in small size are realized as 1/3W for 2.0 x 1.25mm(0805) size, 1/5W for 1.6 x 0.8mm(0603) size and 1/6W for 1.0 x 0.5mm(0402 size). A tight resistance tolerance at $\pm 1\%$ is achieved.

RoHS compliant



SPECIFICATIONS

Mechanical



Dimension (Inch Size)	RP1005 (0402)	RP1608 (0603)	RP2012 (0805)
L	1.0 ± 0.05	1.6 ± 0.2	2.0 ± 0.2
W	0.5 ± 0.05	0.8 ± 0.2	1.25 ± 0.2
P	0.2 ± 0.10	0.3 ± 0.2	0.4 ± 0.2
T	0.35 ± 0.05	0.4 ± 0.1	0.4 ± 0.1

(unit : mm)

Electrical

Type	RP1005	RP1608	RP2012	
Power	1/6W	1/5W	1/3W	
Tolerance %(code)	±1%(F),±2%(G),±5%(J)	±1%(F),±2%(G),±5%(J)	±1%(F),±2%(G),±5%(J)	
Resistance Range (Ω)	0.1~47	0.1~68	0.1~10	11~100
TCR ppm /°C(code)	0 ~+200 (S)	0 ~+200 (S)	0 ~+350 (T)	0 ~+200 (S)
Resistance Value	E-24	E-24	E-24	
Max Operating Voltage for an element	$\sqrt{P \cdot R}$	$\sqrt{P \cdot R}$	$\sqrt{P \cdot R}$	
Operating Temp. Rating	-40~125°C			
Package	10,000pcs/reel	5,000pcs/reel	5,000pcs/reel	

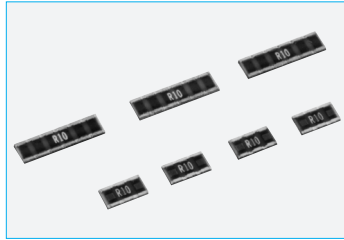
- Please contact us for specific resistance to surge voltage.
- Please contact us for 0.1 Ω or lower(TCR 0 - +350ppm/°C) resistance value.



PART NUMBER

RP 1608 S - 102 - F

- Resistance Tolerance
- Resistance
- Temperature Coefficient of Resistance
- Dimensions
- Part Code



RL series, PRL series ^{NEW} low resistance value chip resistors with long-side electrodes for high-precision current detection.



Excellent performance in resistance tolerance, noise, long term stability and heat dissipation. Our unique structure enables further miniaturization. This low resistance value chip resistor is useful in many current sensing applications. We offer 1/2, 1, 2 watt power handling thin film resistors.

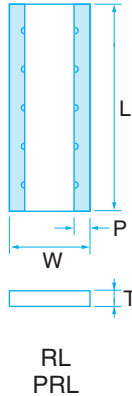
^{NEW} PRL1632 are realized as 1W for 3.2×1.6mm(1206)

RoHS compliant



SPECIFICATIONS

Mechanical



Dimension (Inch Size)	RL3720 (1508)	RL3720W (1508)	RL7520W (3008)
L	3.75±0.30	3.75±0.30	7.50±0.30
W	2.00±0.20	2.00±0.20	2.00±0.20
P	0.40±0.20	0.40±0.20	0.40±0.20
T	0.40±0.10	0.40+0.15/-0.10	0.40+0.15/-0.10

(unit : mm)

Dimension (Inch Size)	PRL0816 (0603)	PRL1220 (0805)	PRL1632 (1206)	PRL3264 (2512)
L	1.6±0.2	2.0±0.2	3.2±0.2	6.4±0.2
W	0.8±0.2	1.25±0.2	1.6±0.2	3.2±0.2
P	0.225±0.15	0.35±0.15	0.45±0.15	0.9±0.15
T	0.5±0.15	0.5±0.15	0.5±0.15	0.5±0.15

(unit : mm)

Electrical

Type	RL3720			RL3720W				RL7520W		
Power	1/2W			1W				2W		
Tolerance %(code)	±1%(F) ±2%(G)			±1%(F) ±2%(G)				±1%(F) ±2%(G)		
Resistance Range (Ω)	0.01~0.018	0.022~0.068	0.1~2.2	0.001~0.004	0.005~0.009	0.010~0.091	0.1~1.0	0.001~0.009	0.010~0.091	0.1~0.47
TCR ppm /°C(code)	0~350 (T)	0~200 (S)	0~100 (R)	0~350 (T)	0~200 (S)	0~200 (S)	0~50(Q) 0~100(R)	0~200 (S)	0~100 (R)	0~50(Q) 0~100(R)
Resistance Value	E-6			—		E-24		—	E-24	
Package	4000pcs/reel									

Type	PRL0816		PRL1220			PRL1632		PRL3264			
Power	1/3W		2/3W			1W		2W			
Tolerance %(code)	±1%(F)	±0.5%(D) ±1%(F)	±2%(G)	±1%(F) ±2%(G)	±0.5%(D) ±1%(F)±2%(G)	±1%(F) ±2%(G)	±0.5%(D) ±1%(F)±2%(G)	±5%(J)	±2%(G)	±1%(F) ±2%(G)	±0.5%(D) ±1%(F)±2%(G)
Resistance Range (Ω)	10m~39m, 25m	43m~100m, 50m	7m~9m	10m~43m	47m~100m	5m~9m	10m~100m, 25m	3m~4m	5m~9m	10m~43m, 25m	47m~100m, 50m
TCR ppm /°C(code)	15mΩ≥ : 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≥ : 0~350ppm/°C 10m~18mΩ : 0~200ppm/°C 20m~51mΩ : ±100ppm/°C 56m~100mΩ : ±50ppm/°C				
Resistance Value	E-24										
Package	1,000pcs/reel(T1) 5,000pcs/reel(T5)										

· PRL series with resistance value more than 100m ohm are also available.

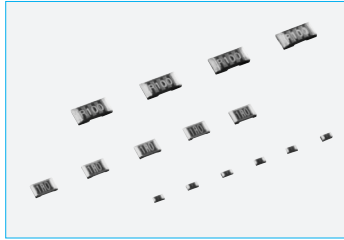


PART NUMBER

RL 3720W T - R10 - F - (T1) — Taping Quantity Unit: PRL: T1(1000pcs) T5(5000pcs)

Resistance Value: RLseries: 3 digits, PRL series : 4 digits

Temperature Coefficient of Resistance: To be added as for RLseries



RL series, low resistance value chip resistors with short-side electrodes for high-precision current detection.



These thin film low resistance value chip resistors are offered in international standard sizes. They exhibit excellent performance in resistance, noise performance, surface heat distribution and a lower surface temperature. Useful in many current sensing applications. Available in 1/10, 1/8 and 1/4 watt package.

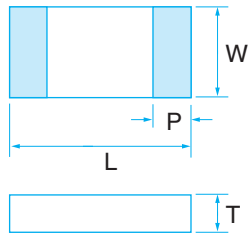
NEW Smallest in the market 0201 low resistance value chip resistor.

RoHS compliant



SPECIFICATIONS

Mechanical



Dimension (Inch Size)	RL0603 (0201)	RL0510 (0402)	RL0816 (0603)	RL1220 (0805)
L	0.60±0.05	1.00±0.10	1.60±0.10	2.00±0.20
W	0.30±0.05	0.50±0.10	0.80±0.10	1.25±0.20
P	0.12±0.05	0.20±0.10	0.20±0.15	0.40±0.20
T	0.23±0.05	0.35±0.10	0.45±0.10	0.40±0.20

(unit : mm)

Equivalent circuit



Electrical

Type	RL0603	RL0510	RL0816		RL1220		
Power	1/10W	1/8W	1/8W		1/4W		
Tolerance %(code)	±2%(G) ±5%(J)	±1%(F) ±2%(G)	±1%(F) ±2%(G)	±1%(F)	±1%(F) ±2%(G)		
Resistance Range(Ω)	0.1~4.7	0.05~4.7	0.02~0.091	0.1~6.8	0.01~0.039	0.043~0.091	0.1~10
TCR ppm /°C(code)	0~200 (S)		0~200 (S)	0~100 (R)	0~350 (T)	0~200 (S)	0~100 (R)
Resistance Value	E-24						
Package	10,000pcs/reel			5,000pcs/reel			

· Please contact us for tolerance ±1% in RL0603.

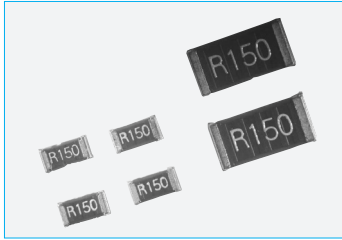
· Please contact us for tolerance ±0.5% for 0.1Ω or more in RL0816, as well as ±0.5% for 0.047Ω or more in RL1220.



PART NUMBER

RL 1220 S - 1R0 - F





RL series, low resistance value chip resistors with short-side electrodes for high-precision current detection.



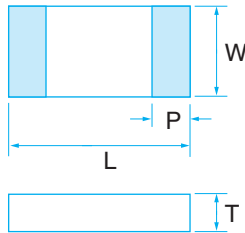
These low resistance value chip resistors are offered in international standard sizes. They exhibit excellent performance in resistance, noise performance, surface heat distribution and a lower surface temperature. Useful in many current sensing applications. Available in 1/2 and 1 watt package.

RoHS compliant



SPECIFICATIONS

Mechanical



Dimension (Inch Size)	RL1632	RL3264	RL1632H	RL-1632-6 NEW	RL-3264-6	RL-3264-9 NEW
L	3.20±0.20	6.40±0.20	3.20±0.20	3.20±0.33	6.50±0.33	6.50±0.33
W	1.60±0.20	3.20±0.20	1.60±0.20	1.60±0.33	3.20±0.20	3.20±0.20
P	1.00±0.15	2.00±0.15	0.50±0.15	0.95±0.20	2.50±0.15(1mΩ) 1.90±0.15(2mΩ) 1.0±0.15(≥3mΩ)	2.50±0.15(1mΩ) 1.90±0.15(2,3mΩ)
T	0.50±0.15	0.50±0.15	0.80±0.15	0.50±0.15	0.70±0.15(1mΩ) 0.65±0.15(2mΩ) 0.95±0.15(3mΩ) 0.80±0.15(≥4mΩ)	0.70±0.15(1mΩ) 0.65±0.15(2mΩ) 0.50±0.15(3mΩ)

(unit : mm)

Electrical

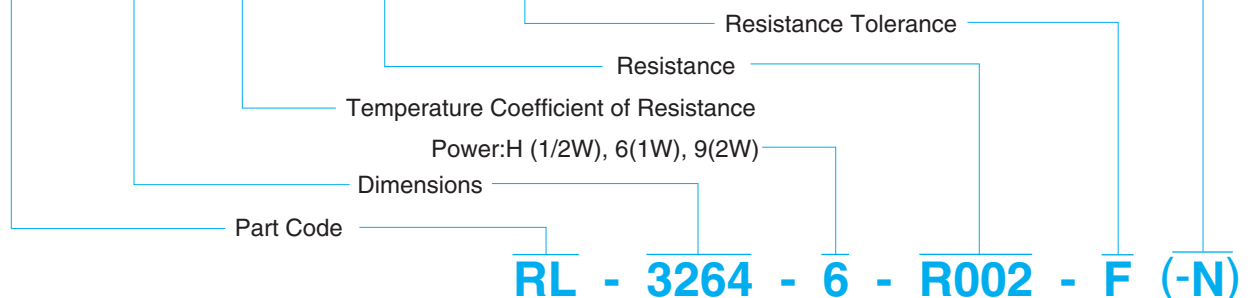
Type	RL1632					RL3264					RL1632H Fixed metal foil	RL-1632-6 New Fixed metal foil	RL-3264-6 Fixed metal foil				RL-3264-9 New Fixed metal foil	
Power	1/2W					1W					1/2W	1W	1W				2W	
Tolerance %(code)	±2%(G)		±1%(F) ±2%(G)			±2%(G)		±1%(F) ±2%(G)			±1%(F) ±2%(G) ±5%(J)	±5%(J)	±5%(J)	±1%(F) ±5%(J)	±1%(F) ±5%(J)	±1%(F) ±2%(G) ±5%(J)		
Resistance Range (Ω)	0.01~0.015	0.018~0.022	0.027	0.033~0.047	0.051~4.7	0.01~0.015	0.018~0.022	0.027	0.033~0.047	0.056~0.47	5m~0.15	1~4m	1,2m	3,4,5m	5.1~10m	11~47m	1,2,3m	
TCR ppm /°C(code)	0~+500 (T)	0~+350 (T)	0~+200 (S)	±100 (R)	0~+500 (T)	0~+350 (T)	0~+200 (S)	±100 (R)	±100(10mΩ≥) ±50(10mΩ<)			±100	±100	±100	±100	±50	±200(1mΩ) ±100(2,3mΩ)	
Resistance Value	E-24					E-12					1mΩ step (9mΩ≥) E-24 (10mΩ≤)	1mΩ step	—		E-24		—	
Package	5,000pcs/reel					5,000pcs/reel					2,000pcs/reel							

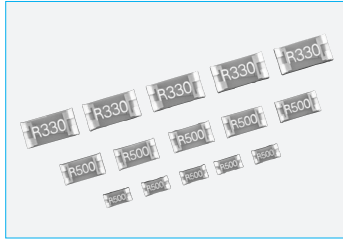


PART NUMBER

RL 1632 S - R033 - F

Given to the RoHS compliant products of RL1632H, RL-1632-6, RL-3264-3264-6(9)





High-precision current-detection elements

RL-L series: four-terminal type

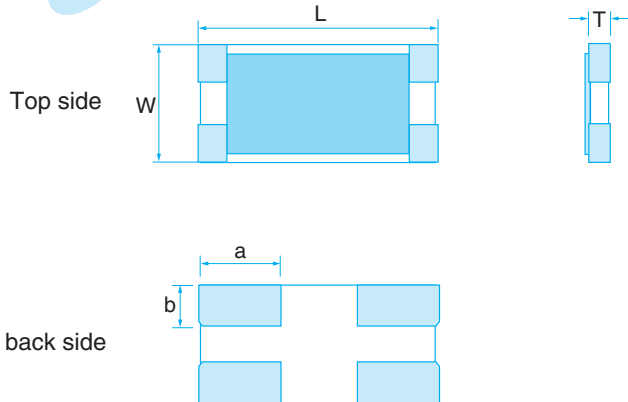


Newly released: A four-terminal structure with separate voltage- and current-terminals assures high-precision TCR of 50ppm/°C and 0.5% tolerance.

RoHS compliant

SPECIFICATIONS

Mechanical



Dimension (Inch Size)	RL1632L4 (1206)	RL2550L4 (2010)	RL3264L4 (2512)
L	3.2±0.2	5.0±0.2	6.4±0.2
W	1.6±0.2	2.5±0.2	3.2±0.2
T	0.5±0.15	0.5±0.15	0.5±0.15
a	1.0±0.2	1.7±0.2	2.1±0.2
b	0.55±0.2	0.9±0.2	1.2±0.2

(unit : mm)

Equivalent circuit



V=Voltage Terminal
I=Current Terminal

Electrical

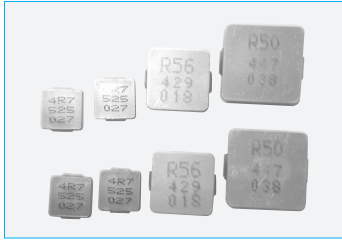
Type	RL1632L4	RL2550L4	RL3264L4		
Power	1/2W	3/4W	1W		
Tolerance %(code)	±0.5%(D) ±1%(F)				
Resistance Range (Ω)	10~500m		3~5m	6~500m	
TCR ppm /°C(code)	±50ppm/°C		±100ppm/°C	±50ppm/°C	
Terminal Resistance (Ω)	10~47m	50~500m	3~8m	10~47m	50~500m
	5 M or less	20 M or less	1 M or less	5 M or less	20 M or less
Resistance Value (Ω)	E-12 series 50, 500m		E-12 series 3, 4, 5, 6, 7, 8, 50, 500m		
Package	5,000pcs/reel				

· Contact us for even lower resistance values.

PART NUMBER

RL 1632 L4 - R033 - F

Resistance Tolerance
Current-detection Resistance Values
Number of Terminals
Dimensions
Part Code



Power Choke Coil

PCMC series NEW



- Small size of 7.3mm×6.6mm and low tap of 3.0mm max
- Excellent loss characteristics and high saturation current

Applications

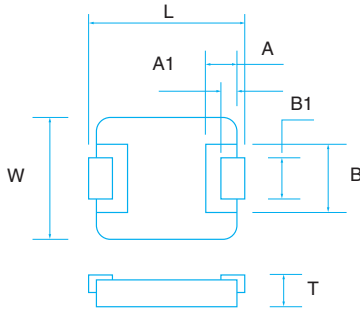
- *High speed drive DC/DC inverter for server, router etc.
- *CPU power for note PC and desktop PC

RoHS compliant

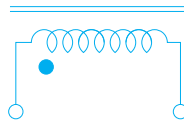
Completely lead free

SPECIFICATIONS

Mechanical



Equivalent circuit



Dimension (Inch Size)	NEW PCMC063 (2926)	PCMC104 (4539)	PCMC133 (5450)	PCMC135 (5450)
L	7.3max.	11.5max.	13.8max.	13.8max.
W	6.6±0.2	10±0.2	12.6±0.2	12.6±0.2
T	3.0max.	4.0max.	3.5max.	5.0max.
A	2.0±0.1	2.5±0.1	2.5±0.1	2.5±0.1
A1	1.3±0.3	2.0±0.5	2.0±0.5	2.0±0.5
B	3.6±0.2	5.0±0.2	6.0±0.2	6.0±0.2
B1	3.0±0.3	3.0±0.2	4.0±0.5	4.0±0.5

(unit : mm)

Electrical

	L0(μH)	Rdc(mΩ)		DC characteristics	
	Inductance	Typical	MAX.	(1) Δ=40℃	(2) ΔL/LO=20%
PCMC063T NEW	0.10	1.5	1.7	32.5	60.0
	0.20	2.4	3.0	24.0	41.0
	0.22	1.9	2.5	26.0	52.0
	0.33	3.5	3.9	20.0	30.0
	0.47	4.0	4.2	17.5	26.0
	0.68	5.0	5.5	15.5	25.0
	0.82	6.7	8.0	13.0	24.0
	1.00	9.0	10.0	11.0	22.0
	1.20	10.0	12.0	10.0	20.0
	1.50	14.0	15.0	9.0	18.0
	2.20	18.0	20.0	8.0	14.0
	3.30	28.0	30.0	6.0	13.5
	4.70	37.0	40.0	5.5	10.0

	L0(μH)	Rdc(mΩ)		DC characteristics	
	Inductance	Typical	MAX.	(1) Δ=40℃	(2) ΔL/LO=20%
PCMC104T	0.15	0.5	0.8	25.0	75.0
	0.36	1.1	1.3	20.0	60.0
	0.56	1.6	1.8	15.0	50.0
	1.00	3.0	3.5	15.0	40.0
PCMC133E	0.33	1.3	1.5	36.5	62.0
	0.47	1.7	2.0	32.0	55.0
	0.56	1.8	2.2	29.0	50.0
	0.68	2.3	2.5	28.0	49.0
PCMC135T	0.15	0.55	0.7	45.0	110.0
	0.36	0.77	1.1	41.0	75.0
	0.47	1.1	1.3	38.0	65.0
	0.50	1.2	1.5	36.0	55.0
	0.56	1.2	1.5	36.0	55.0
	0.68	1.5	1.7	34.0	54.0
	0.82	1.8	2.1	31.0	53.0
	1.00	2.1	2.5	29.0	50.0
	1.50	3.4	4.1	23.0	48.0
	2.20	4.0	5.0	20.0	35.0
	3.30	7.7	9.2	15.0	32.0

* The data is measured at 25℃

* DC characteristics(1) signify current value at temperature raise of 40℃

* DC characteristics(2) signify current value at inductance change of 20%

· Please ask as for other inductance values if required

· Package:1,000pcs/reel for PCMC063T, 500pcs/reel for others

PART NUMBER

PCMC 104T - R56 M N

Materials

Inductance tolerance M=±20%

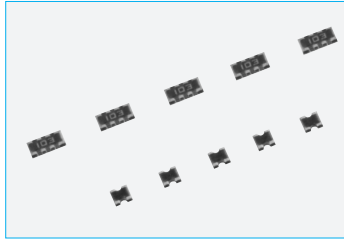
Inductance value (R56=0.56μH, R68=0.68μH)

Dimensions (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





RS series, micro array resistor network.



Ultra small size chip resistors array with 4 elements in 0201 size.

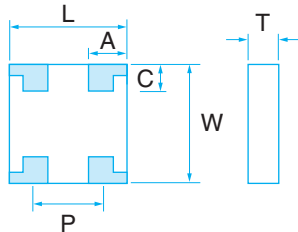
NEW 0603 size double-element ultra small chip resistor array, RS062R series
0603 size quadruple-element small chip resistor array with 0.5mm electrode pitch.

RoHS compliant

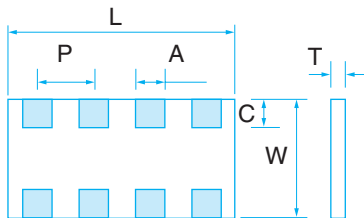


SPECIFICATIONS

Mechanical



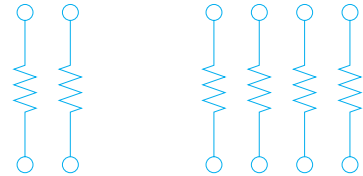
RS2N, RS062R



RS4N, RS064R

(dimension:mm)

Equivalent circuit



RS2N, RS062R RS4N, RS064R, RS064R(K)

Dimension (Inch Size)	NEW RS062R (0302)	RS2N (0404)	RS064R (0602)	NEW RS064R(K) (0602)	RS4N (0804)
L	0.8±0.1	1.0±0.05	1.4±0.1	1.8±0.1	2.0±0.1
W	0.6±0.1	1.0±0.05	0.6±0.1	0.6±0.1	1.0±0.1
T	0.35±0.1	0.4±0.1	0.35±0.1	0.35±0.1	0.4±0.1
A	0.30±0.1	0.33±0.1	0.2±0.1	0.2±0.1	0.35±0.1
P	0.5 Typ	0.65 Typ	0.4 Typ	0.5 Typ	0.5 Typ
C	0.15±0.1	0.15±0.1	0.1±0.1	0.1±0.1	0.22±0.1

(unit : mm)

Electrical

Type	RS062R NEW		RS2N		RS064R, RS064R(K) NEW		RS4N
Power	31mW/element	—	63mW/element	—	32mW/element	—	63mW/element
Resistance Range (Ω)	10~1M	Jumper	10~1M	Jumper	10~1M	Jumper	10~1M
Tolerance %(code)	±5.0% (J)	—	±5.0% (J)	—	±5.0% (J)	—	±5.0% (J)
TCR ppm /°C(code)	±200ppm/°C	—	±250ppm/°C	—	±200ppm/°C	—	±250ppm/°C
Max Operating Voltage	12.5V	1A	25V	1A	12.5V	1A	25V
Resistance Value	E-24	—	E-24	—	E-24	—	E-24
Package	10,000pcs/reel						

· Contact us for lead free glass coat products.



PART NUMBER

RS064R - 1001 - J - 2 (N) (K)

Given to the RS064R products with 0.5mm electrode pitch.

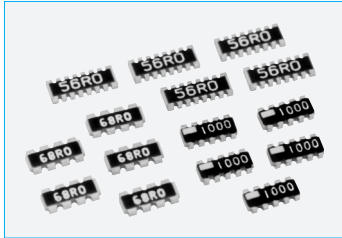
RS062R, RS064 : "RoHS" to be added for N

Outline Type (2=flat)

Resistance Tolerance (J=±5%, X=Jumper)

Resistance (00R0=Jumper, 1001=1kΩ)

Part Code



RS series, high-integration array resistor networks

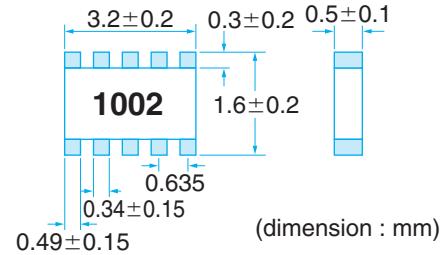
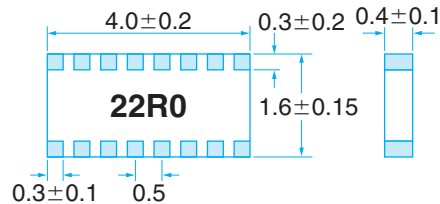


This highly integrated network contains four or eight resistance elements in one chip.

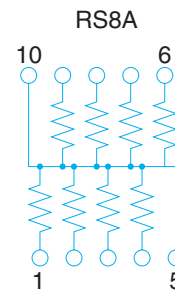
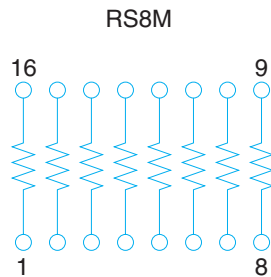
RoHS compliant

SPECIFICATIONS

Mechanical



Equivalent circuit



Electrical

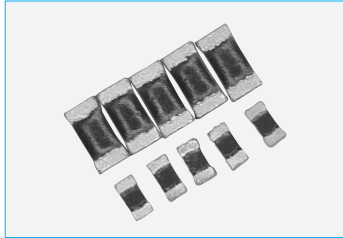
Type	RS8M	RS8A
Power	— 63mW/element	63mW/element
Resistance Range(Ω)	Jumper 10~47K	22~100K
Tolerance % (code)	— ±5.0 (J)	±5.0 (J)
TCR ppm /°C(code)	— ±250ppm	±250ppm
Max Operating Voltage	— 25V	50V
Resistance Value	— E-24	E-24
Package	4,000pcs/reel	5,000pcs/reel

· Contact us for lead free glass coat products.

PART NUMBER

RS8M - 1002 - J 2

Flat Electrode
Resistance Tolerance
Resistance
Part Code



PFR/GFR series, Thick Film chip resistors



A temperature coefficient of resistance of $\pm 100\text{ppm}/^\circ\text{C}$ has been achieved for resistance value greater than $1\text{M}\Omega$.
High reliability is maintained: the electrode construction is the same as our thin film chip resistors.

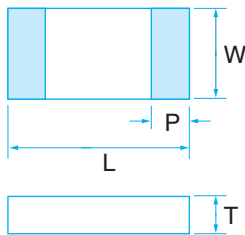
NEW PFR03 series with ultra small size chip resistor.

RoHS compliant



SPECIFICATIONS

Mechanical



Dimension (Inch Size)	PFR03 (0201)	PFR05,GFR05 (0402)
L	0.60 ± 0.03	1.00 ± 0.05
W	0.30 ± 0.03	0.50 ± 0.05
P	0.12 ± 0.05	0.20 ± 0.10
T	0.23 ± 0.03	0.35 ± 0.05

(unit : mm)

Electrical

Type	PFR03						PFR05			GFR05	
Power	1/20W					Jumper	1/16W			Jumper	1/16W
Tolerance %(code)	±1%(F)		±5%(J)	±2%(G)±5%(J)		—	±0.5%(D) ±1%(F)		±1%(F)	—	±1%(F) ±5%(J)
Resistance Range(Ω)	10~91	100~1M	3.0~9.1	10~91	100~10M	50m or less	10~97.6	100~1M	1.02M~10M	50m or less	10~10M
TCR ppm /°C(code)	±300 (S)	±200 (S)	+600~ -200(S)	±300 (S)	±200 (S)	—	±100 (R)	±50 (Q)	±100 (R)	—	±200 (S)
Resistance Value	E-24/E-96		E-24			—	E-24/E-96			—	E-24/E-96
Max Operating Voltage	25V					1A	50V			—	50V
Package	15,000pcs/reel or 10,000pcs/reel						10,000pcs/reel			10,000pcs/reel	

- Please contact us for values lower in resistance than the 10Ω GFR05 series.
- Contact us for lead free glass coat products.



PART NUMBER

PFR05 R - 102 - D - (2) - (T15)

Package : PFR03 "T15" to be added for 15,000pcs/reel

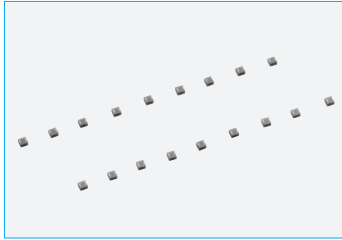
Electrode materials : 1(Pb/Sn), 2(Sn)

Resistance Tolerance J(jumper)

Resistance : E-24, E-96, jumper

Temperature Coefficient of Resistance J(jumper)

Part Code



RF series, high-precision, high-frequency chip resistors.



For wire bonding application, we have realized extremely small package size, 0.5mm×0.5mm. A reflection characteristic of -15dB is guaranteed at frequencies up to 15GHz. Ideal for transmitting/receiving applications in optical communications devices.

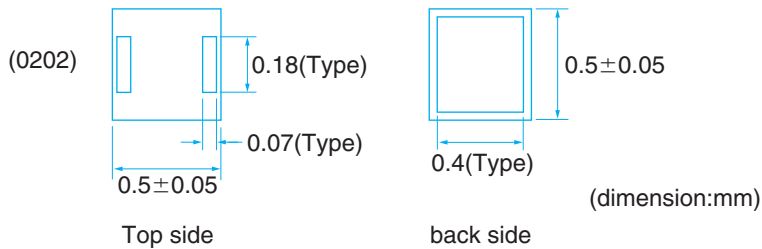
RoHS compliant

Completely lead free



SPECIFICATIONS

Mechanical



Electrical

Type	RF0505	
Resistance (Ω)	50	100
Tolerance %(code)	±5%(J)	
TCR ppm /°C(code)	±100ppm/°C (R)	
Power Rating	1/16W	
Max rated Operating Temperature	+70°C	
Max Operating Temperature	+125°C	
Frequency characteristics	DC ~15GHz Reflection characteristic -15dB max	
Plated electrodes and bottom side	Au-plated(1.5μm thickness)	

· Other resistance values, structure of electrode are available.



PART NUMBER

RF 0505 R - 500 - J

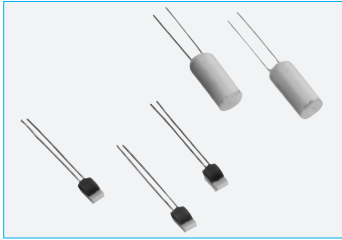
Resistance Tolerance

Resistance

Temperature Coefficient of Resistance

Dimensions

Part Code



SA series, high-precision, Pt-film thermal sensors.



Resistance tolerance of $\pm 0.06\%$ (class A). Suitable for high-precision temperature measurements up to 500°C . Available in various package for specific needs.

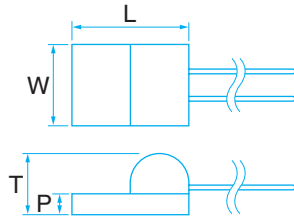


SPECIFICATIONS

RoHS compliant

Mechanical

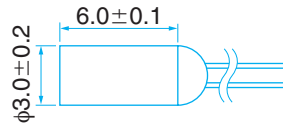
SA***□0
(glass coat)



Dimension (Inch Size)	SA101□0 (0907)	SA102□0 (1208)
L	2.40 ± 0.15	3.00 ± 0.15
W	1.70 ± 0.15	2.00 ± 0.15
P	0.40 ± 0.20	0.40 ± 0.20
T	1.25 ± 0.20	1.25 ± 0.20

(unit : mm)

SA101□1
(ceramic tube)



(dimension:mm)

Electrical

Type	SA***□0		SA101□1
Resistance (Ω)	100	1,000	100
Tolerance %(code)	$\pm 0.06\%$, $\pm 0.12\%$, $\pm 0.24\%$ (6) (0) (1)		$\pm 0.06\%$, $\pm 0.12\%$, $\pm 0.24\%$
TCR ppm/ $^{\circ}\text{C}$ (code)	3,850ppm/ $^{\circ}\text{C}$		3,850ppm/ $^{\circ}\text{C}$
TCR Tolerance	$\pm 100\text{ppm}/^{\circ}\text{C}$		$\pm 100\text{ppm}/^{\circ}\text{C}$
Response time 90% in air 1m/sec	10sec.	15sec.	30sec.
Dissipation Constant Self-heating	$2.5\text{mW}/^{\circ}\text{C}$	$2\text{mW}/^{\circ}\text{C}$	$5.0\text{mW}/^{\circ}\text{C}$
Max Applied Current	1mA		1mA
Operating Temp. Range	$-55 \sim 500^{\circ}\text{C}$		$-55 \sim 500^{\circ}\text{C}$

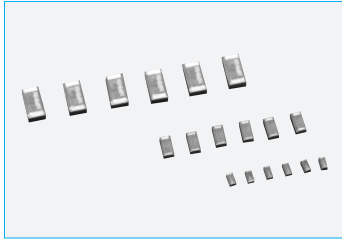
·Contact us for TO92 package(operating Temp.: $-50 \sim 150^{\circ}\text{C}$) and electric wire (operating Temp. : $-20 \sim 105^{\circ}\text{C}$)



PART NUMBER

SA 101 1 1

Dimensions
(0=glass coat, 1=ceramic tube)
Resistance Tolerance
Resistance
Part Code



HPL, TFL series, high-precision, thin-film chip inductors.



These 0805, 0402 and 0201 size chip inductors are adjustment free due to their tight tolerance. Additionally, this part also offers a high self-resonance frequency of 1 GHz and high Q value and a very excellent rated current.

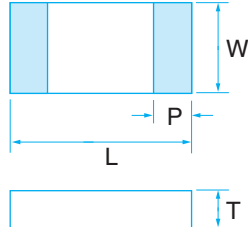
RoHS compliant

Completely lead free



SPECIFICATIONS

Mechanical



Dimension (Inch Size)	HPL0603 (0201)	HPL1005 TFL0510 ⁽⁰⁴⁰²⁾	TFL0816 (0603)
L	0.60±0.05	1.00±0.10	1.60±0.10
W	0.30±0.05	0.50±0.10	0.80±0.10
P	0.07±0.05	0.15±0.10	0.30±0.20
T	0.28±0.05	0.40±0.10	0.45±0.10

(unit : mm)

Electrical

Type	HPL0603		HPL1005	
inductance value	E-24		E-24	
inductance range (nH)	1.0~5.6	6.8~27	1.0~9.1	10~39
inductance tolerance	±0.1nH, ±0.2nH	±2%	±0.1nH, ±0.2nH	±2%
Q value (at 300MHz)	10	8~10	20~15	15~13
Q value (at 800MHz) typ.	14~17	14~16	35~25	25~20
Q value (at 1.5GHz) typ.	18~25	18~20	50~30	30~25
Self resonance Frequency(GHz)	10~6.0	3.5	7.0~4.0	3.5
DC resistance(Ω)	0.1~0.8	0.8~1.5	0.01~0.4	0.5~0.8
Rated Current(A)	0.5~0.2	0.2~0.15	1.8~0.34	0.3~0.24
Package	10,000pcs/reel			

Equivalent circuit



HPL
TFL

Measured at 500MHz in case of HPL0603, at 300MHz in case of HPL1005

Type	TFL0510						TFL0816				
inductance value	E-24						E-12				
inductance range (nH)	1.0~1.2	1.3~2.2	2.4~3.9	4.3~9.1	10~16	18~39	1.0~4.7	5.6~8.2	10~27	33~68	82~100
inductance tolerance	±0.1nH,±0.2nH		±0.2nH		±2%	±3%	±0.2nH		±2%	±2%	
Q value (at 300MHz)	10					*10	20	15	15	*15	*10
Q value (at 800MHz) typ.	21						34~30		30~25	25	15
Q value (at 1.5GHz) typ.	25			25~20	20	**20	38~35		35~30	**	
Self resonance Frequency(GHz)	7.0			5.5~4.0	4.0	2.0~1.5	6.0~5.0	5.0~4.0	4.0~2.0	1.5~1.0	1.0
DC resistance(Ω)	0.1	0.15~0.20	0.20~0.40	0.60~1.50	1.50~2.55	2.55~4.00	0.10~0.25	0.50	1.0~2.0	2.0~4.5	6.0~8.5
Rated Current(A)	1.2	0.93~0.60	0.58~0.42	0.34~0.21	0.21~0.16	0.16~0.12	1.0~0.6	0.40	0.3~0.2	0.2~0.14	0.12~0.1
Package	10,000pcs/reel						5,000pcs/reel				

* Measured at 200MHz in case of 33,36,39nH(TFL0510) and 33-100nH(TFL0816)

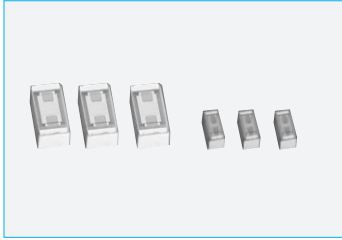
** No measuring in case of 33,36,39nH(TFL0510) and 33-100nH(TFL0816)



PART NUMBER

HPL 0603 - 1N0 (-E02)

Superior tolerance (ME6=TFL0510±0.1nH,
E02=HPL series in superior tolerance)
Inductance value
Dimensions
Part Code



HTC series, high-precision, thin-film chip capacitors. Now under development



Capacitance tolerance as tight as $\pm 0.035\text{PF}$, and low equivalent series resistance.
Chip sizes of 0402 and 0201 are available.
Space saving face down mounting is possible.

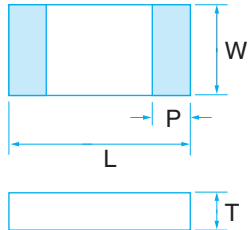
RoHS compliant

Completely lead free



SPECIFICATIONS

Mechanical



Dimension (Inch Size)	HTC0603 (0201)	HTC1005 (0402)
L	0.60 ± 0.05	1.00 ± 0.10
W	0.30 ± 0.05	0.50 ± 0.10
P	0.07 ± 0.05	0.15 ± 0.10
T	0.28 ± 0.03	0.38 ± 0.10

(unit : mm)

Equivalent circuit



Electrical

Type	HTC0603				HTC1005		
Capacitance Range (pF)	0.1~0.45	0.5~0.7	0.8~1.0	1.2~1.8	0.1~0.7	0.75~1.0	1.2~10
Capacitance Value	0.05pF step	0.1pF step		E-12	0.05pF step		E-12
Capacitance tolerance	±0.035pF		±5%		±0.035pF	±5%	
Temperature coefficient of capacitance(ppm/°C)	0±60ppm/°C						
Rated Voltage (V)	25V						
Operating Temp. Range(°C)	-40~85°C						
Package	5,000(T5), 10,000pcs						



PART NUMBER

HTC 0603 - 1E - R30 - J (-T5)

Given to 5,000 piece reels

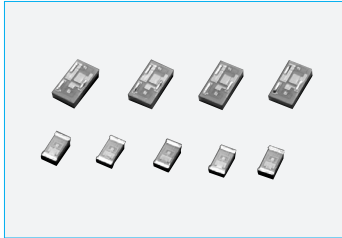
Tolerance of capacitance : J($\pm 5\%$), T35($\pm 0.035\text{pF}$)

Capacitance : R30(0.30pF)

Rated Voltage : 1E(25V)

Dimensions

Part Code



Thin Film Chip L,C filter

Now under development



Excellent loss characteristic
Small size and low tap

RoHS compliant

Completely lead free



FEATURES

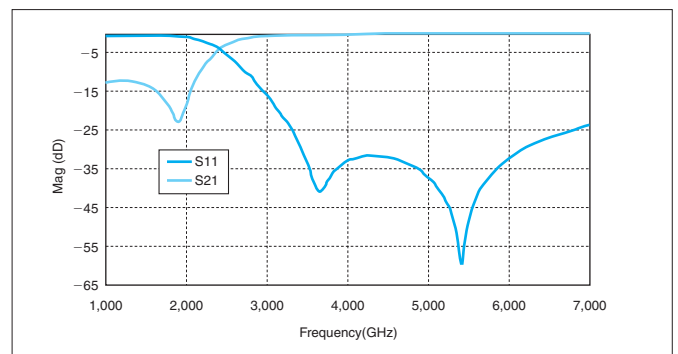
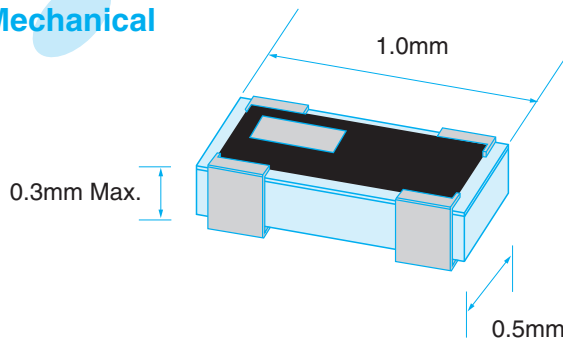
Realized high performance LPF for GSM/DCS in chip size 1.0×0.5×0.3mm



Example of application and its Characteristic

Low-Pass Filter (LPF) for DCS

Mechanical

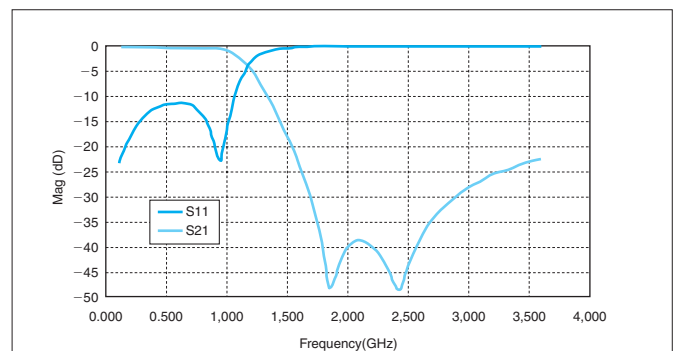
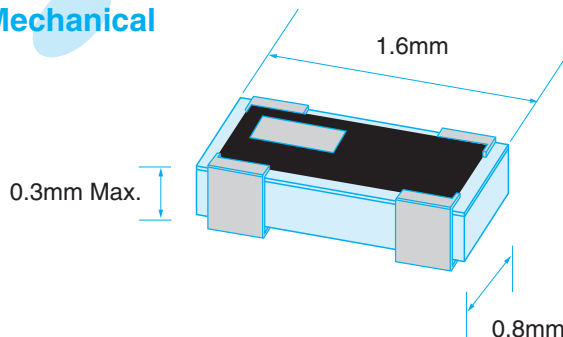


Electrical

	fo [MHz]	Loss [dB]fo	ATT [dB]2fo	ATT [dB]3fo
specification	1710-1910	<0.8	>30	>25
Simulation		<0.76	>29.5	>38.0

Low-Pass Filter (LPF) for GSM

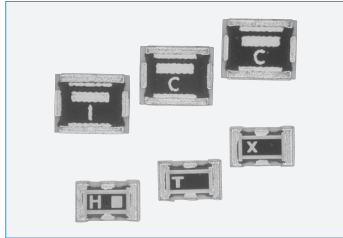
Mechanical



Electrical

	fo [MHz]	Loss [dB]fo	ATT [dB]2fo	ATT [dB]3fo	ATT1805-1830
specification	824-915	<0.80	>25	>25	>40
Simulation		<0.71	>27.3	>33.3	>42.9

· Please contact us for 0201 chip in high frequency.



Thin Film Chip LC Filter

TBF series (Band-Pass Filter) ,^{NEW}

TDP series (Diplexer) , TBL series (Balun)



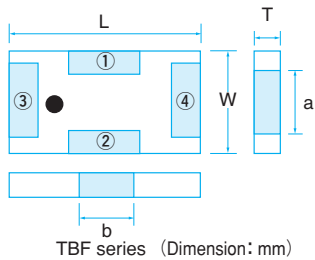
Low top max. 0.4mm and small size.
Excellent loss characteristics.

RoHS compliant

Completely lead free

SPECIFICATIONS

Mechanical

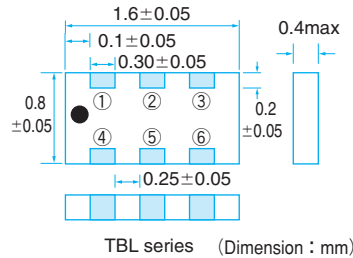


Dimension (Inch Size)	TBF0510	TBF1608	TBF2012
L	1.0±0.05	1.6±0.1	2.0±0.1
W	0.5±0.05	0.8±0.1	1.25±0.1
T	0.5 max.	0.4 max.	0.4 max.
a	0.2±0.05	0.6±0.1	0.75±0.1
b	0.3±0.05	0.4±0.1	0.4±0.1

(unit : mm)

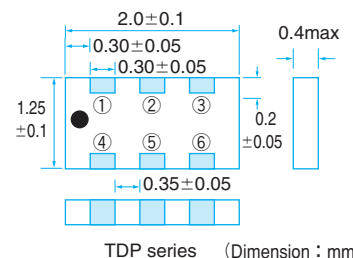
TBFseries

	TBF0510	TBF1608	TBF2012
①	GND	Input	Output
②	GND	Output	Input
③	Input	GND	GND
④	Output	GND	GND



TBL series

	TBL1608-245-M2	TBL1608-245-L1
①	GND or DC feed	NC
②	NC	GND or DC feed
③	Unbalance Port	Balance Port
④	Balance Port	Unbalance Port
⑤	NC	GND or DC feed
⑥	Balance Port	Balance Port



TDP series

	TDP series
①	LB(HB)
②	GND
③	HB(LB)
④	GND
⑤	Com
⑥	GND

Electrical

TBF series

Type	TBF-0510-181-F1	TBF-0816-245-R1	TBF-2012-245-R1
Application	For DCS	For Bluetooth, W-LAN	For Bluetooth, W-LAN
F0 (MHz)	1810	2450	2450
Band (MHz)	1710~1910	2400~2500	2400~2500
Insertion Loss	2.0dB at 25°C 2.3dB at -40~85°C	1.7dB at 25°C 1.9dB at -40~85°C	1.5dB at 25°C 1.6dB at -40~85°C
Attenuation	20.0dB at 855~955MHz 10.0dB at 2565~2865MHz	20.0dB at 1710~1910MHz 30.0dB at 4800~5000MHz 30.0dB at 7200~7500MHz	30.0dB at 880~960MHz 25.0dB at 1710~1910MHz 30.0dB at 4800~5000MHz 30.0dB at 7200~7500MHz
VSWR in BW	2.0 Max.		
Impedance	50Ω		
Power	500mW Max.		

TDP series

Type	TDP-2012-217-G1	TDP-2012-205-W2
Application	For CDMA	For W-LAN
Pass Band	Low: 824~960MHz High: 1710~2170MHz	2400~2500MHz 4900~5950MHz
Insertion Loss	Low: 0.70dB at 824~915MHz 0.85dB at 925~960MHz High: 0.75dB at 1710~1910MHz 0.85dB at 1910~2170MHz	0.50dB at 25°C 0.8dB at -40~85°C 0.80dB at 25°C 1.1dB at -40~85°C
Attenuation	Low: 20dB at 1648~1830MHz 25dB at 2400~2500MHz 20dB at 2472~2745MHz 20dB at 3296~3660MHz High: 10dB at 3240~3820MHz 10dB at 5130~5730MHz 10dB at 6840~7640MHz	20dB at 4800~6000MHz 20dB at 7200~7500MHz 25dB at 1800~2500MHz 25dB at 9800~11900MHz
VSWR in BW	Low: 2.0 Max. High: 2.0 Max.	2.0 Max. 2.0 Max.
Impedance	50Ω	

TBL series

Type	TBL-1608-245-M2
Application	For Bluetooth, W-LAN
F0 (MHz)	2450
Band (MHz)	2400~2500
Unbalance Port Impedance	50Ω
balance Port Impedance	100Ω
Phase	180±10 deg
Insertion Loss	1.0dB Max. at 25°C
VSWR in BW	2.0 Max.
Power	500mW Max.



PART NUMBER

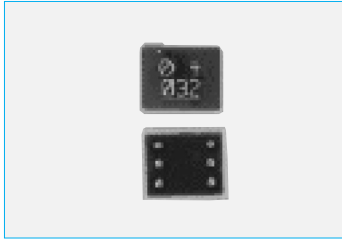
TBL 1608 - 245 - M2

Type(see electrical characteristics table)

Center Frequency F0

Dimension

Part Code



Ball-Grid-Array Thin Film Low-Pass Filter

FL *B5BC series NEW

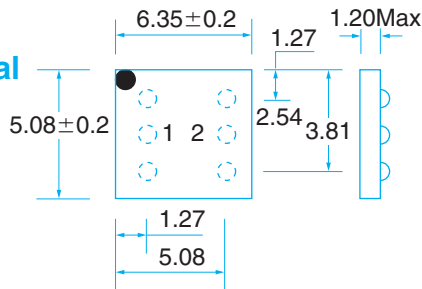


Low pass filter up to 10GHz with very low reflection.
Ball-grid-array termination for surface mount application.

RoHS compliant

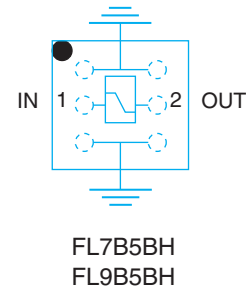
SPECIFICATIONS

Mechanical



FL7B5BH
FL9B5BH (Dimension:mm)

Equivalent circuit

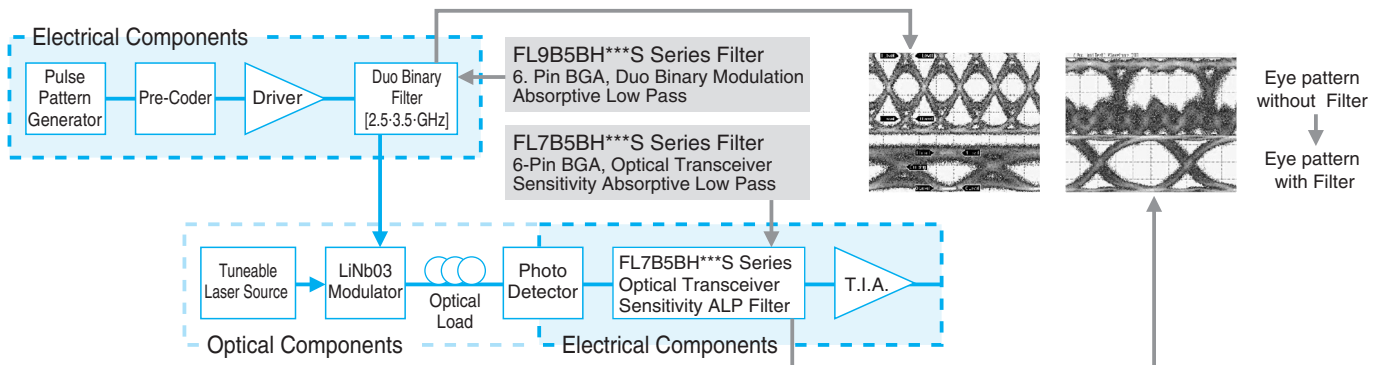


Electrical

Type	FL7B5BH	FL9B5BH
Cut Off Frequency f_0 (-3dB)	6.0GHz~10.0GHz(0.5GHz step)	2.5GHz~4.0GHz(0.25GHz step)
Attenuation(typical)	-10dB at $2f_0$	-10dB at $3f_0$
Reflection(typical)	S11 >12dB at F_0 , >10dB at $2f_0$ S22 >10dB at F_0	>15dB at F_0 , >10dB at $2f_0$ >13dB at F_0
Rated current (A)	100m	
Operating Temp. Range	-40°C~+85°C	

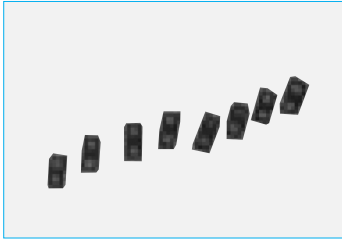
Application/ Features

Transmission & reception on optical fiber communication



PART NUMBER

FL	9B	5	B	H	030	S	(-C)	
								Given to RoHS compliant products
								serial code (S=Single)
								Cut Off Frequency f_0 (0.28=2.75GHz, 0.33=3.25GHz, 0.38=3.75GHz, 0.30=3.00GHz, 0.60=6.00GHz, 0.65=6.50GHz, 0.70=7.00GHz, 0.75=7.50GHz)
								Electrode Type (H=6pin BGA)
								Filter Function (B=Bessel)
								Impedance (5=50Ω)
								Filter order/return function (7=7th, 9=9th/B=Absorptive)
								Part Code



Equalizer

EF2A51A Series Now under development



These equalizers maintain high speed data (2.5Gb/s~12.5Gb/s) attenuation level at -3dB, -6dB, -9dB, -12dB up to 10GHz.

Applications

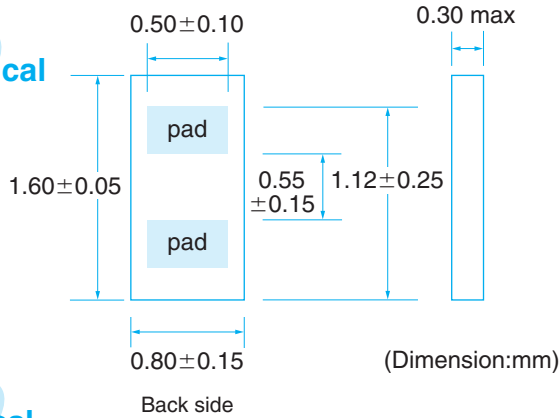
High speed communication cable, optical module, test and measurement equipment etc.

RoHS compliant

Completely lead free

SPECIFICATIONS

Mechanical



Equivalent circuit

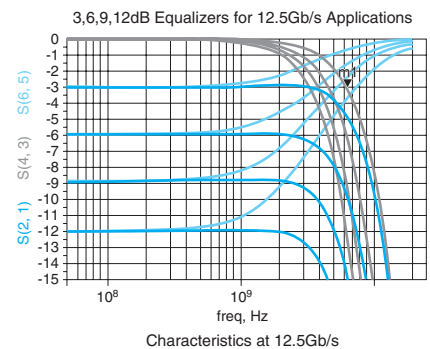
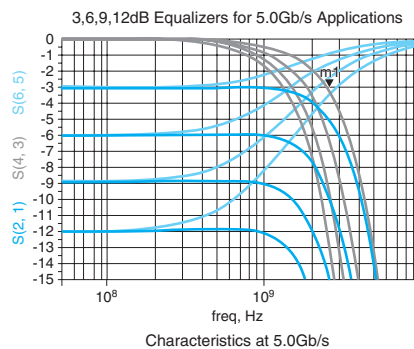
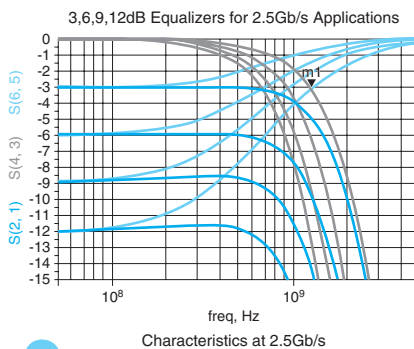


Electrical

Type	EF2A51A
Attenuation (at 50MHz)	-3, -6, -9, -12dB (± 1 dB)
Band	~10GHz (-1dB max)
Impedance	50 Ω
Rated current (A)	100m
Operating temperature	-40~85°C

Details of specifications may be discussed for specific application

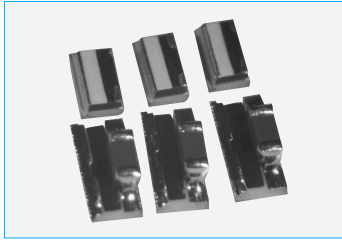
Examples of characteristics



PART NUMBER

EF2 A 5 1A 050 E ** B

- EF2: Part Code
- A: Circuit (A=RC shunt)
- 5: Impedance (5=50 Ω)
- 1A: Dimensions (1A=1608 package)
- 050: data speed (031=3.125Gb/s, 063=6.25Gb/s, 125=12.5Gb/s)
- E: Attenuation at 50MHz (E=-3dB, K=-6dB, Q=-9dB, T=-12dB)
- ** B: Ripple characteristics (10=1dB of Max Ripple)
- B: Bessel Loss Function



P*V series, thermal sensitive chip attenuators.



These thermo-variable attenuators have opposite temperature characteristics of GaAs MOSFET amplifiers and compensate the temperature caused gain fluctuation of such amplifiers.

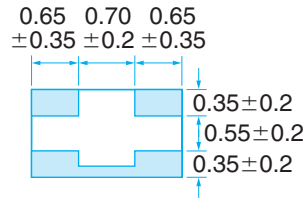
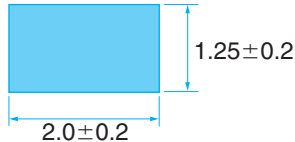
RoHS compliant



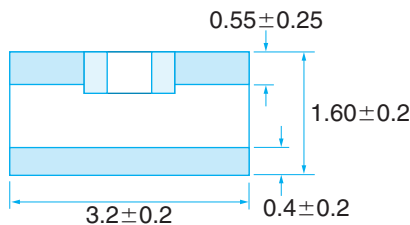
SPECIFICATIONS

Mechanical

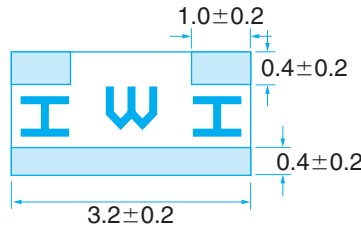
PXV1220S
(0805)



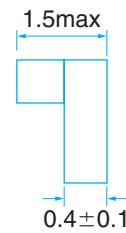
PBV1632S
(1206)



Top side

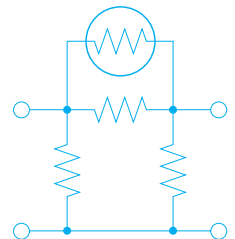


back side



(dimension:mm)

Equivalent circuit



Electrical

Type	PXV1220S	PBV1632S
Attenuation	1, 2, 3, 4, 5, 6, 7, 8, 9, 10dB	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 16dB
Attenuation tolerance	$\pm 0.5\text{dB}$ (@25°C, no load)	
Impedance	50 Ω	
VSWR	1.3 or less	
Temperature coefficient of Attenuation	ex : 6dB N1 0.0119dB/dB*°C N5 0.0041dB/dB*°C N2 0.0088dB/dB*°C N6 0.0035dB/dB*°C N3 0.0062dB/dB*°C N7 0.0026dB/dB*°C N4 0.0047dB/dB*°C N8 0.0019dB/dB*°C (N1~N8 Nin types available for 1 to 3 dB)	
Frequency Range	DC ~3GHz	
Power Rating	63mW	100mW
Operating Temp. Range	-40°C~+100°C	
Package	100pcs/package 1,000pcs/reel	min.20pcs/package 1,000pcs/reel

· Contact us for data book in details.



PART NUMBER

PXV 1220S - 6dB

N1 - T

Package(T=Tape, B=Bulk)

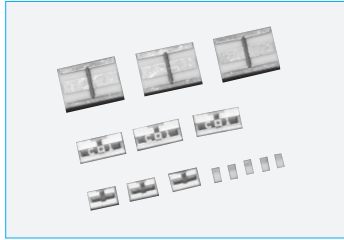
Temperature coefficient of Attenuation

Attenuation

Dimensions

Part Code

"Not for shipment to or sale in the United States"



PAT series, RAT series, high-precision chip attenuators



These 3042, 1632, 1220, 1010 and 0510 size chip attenuators exhibit excellent high frequency characteristics. The surface mount package is ideal for low noise, low inductance and parasitic capacitance applications. Thin film metalization provides for very stable characteristics over temperature and time.

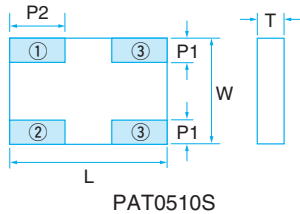
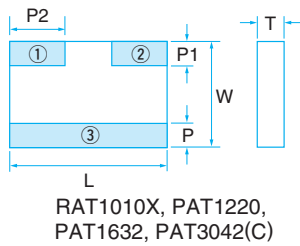
NEW Smallest in the market
lightest in the market.

PAT0510S, Thin-film chip attenuator that is the smallest and

RoHS compliant

SPECIFICATIONS

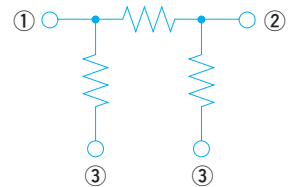
Mechanical



Dimension (Inch Size)	RAT1010X (0404)	PAT0510S (0402)	PAT0816 (0603)	PAT1220 (0805)	PAT1632 (1206)	PAT3042S(C) (1712)
L	1.00±0.05	1.00±0.05	1.60±0.20	2.00±0.10	3.20±0.20	4.20±0.20
W	1.00±0.05	0.50±0.05	0.80±0.20	1.25±0.10	1.60±0.20	3.00±0.20
P	0.15±0.10	—	0.80±0.20	0.40±0.20	0.40±0.25	0.80±0.20
P1	0.15±0.10	0.15±0.10	0.15±0.10	0.40±0.20	0.55±0.25	0.95±0.20
P2	0.33±0.10	0.27±0.10	0.50±0.20	0.50±0.20	1.00±0.25	—
T	0.35±0.10	0.35±0.05	0.40±0.15	0.40±0.10	0.40±0.10	0.80±0.15

(unit : mm)

Equivalent circuit



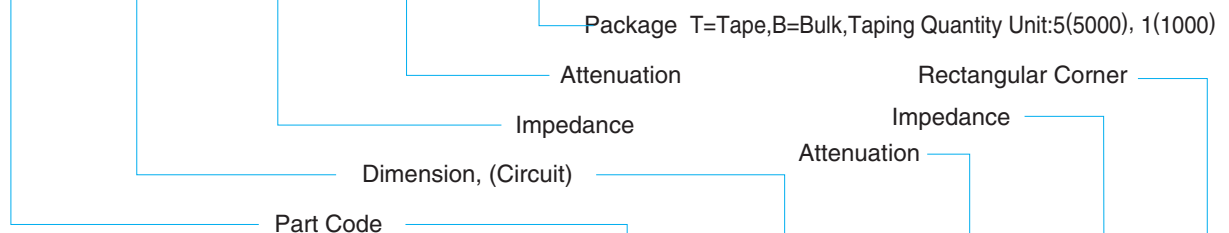
Electrical

Type	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	±0.7dB	±0.3dB	±0.5dB	±1.0dB	±0.3dB	±0.3dB	±0.5dB	±0.3dB	±0.5dB
Impedance	50Ω(C)					50Ω(C)			50Ω(C)			50Ω(C)		50Ω(C), 75Ω(D)		
VSWR	<1.3					<1.3			<1.3			<1.3		<1.2(50Ω), <1.3(75Ω)		
Frequency Range	~2.5GHz	~3GHz				DC ~10GHz			DC ~10GHz			DC ~3GHz		~3GHz(50Ω), ~2GHz(75Ω)		
Power Rating	40mW					32mW			63mW		100mW	125mW		250mW		
Rated Operating Temperature	—					70℃										
Operating Temp Range	-55℃~ +125℃															
Package	10,000pcs/reel					10,000pcs/reel(T10)			5,000pcs/reel(T)			100pcs/package 1,000pcs/reel(T1), 5,000pcs/reel(T5)		50pcs/package 2,000pcs/reel(T2)		

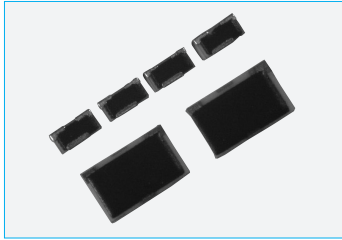
- PAT0510 series of 0402 chip with BGA are also available.
- Please contact us for power rating of up to 10W.

PART NUMBER

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



RAT 1010X - 3dB - C - B



High Precision Power Splitter

PS Series



Power splitter with excellent high frequency characteristics for applications from DC~20GHz Bit error is restrained by keeping high frequency digital signal stable Offer standard type with ground and custom type designed to customer' specification.

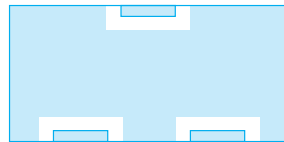
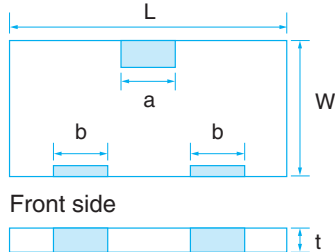
RoHS compliant

Completely lead free



SPECIFICATIONS

Mechanical

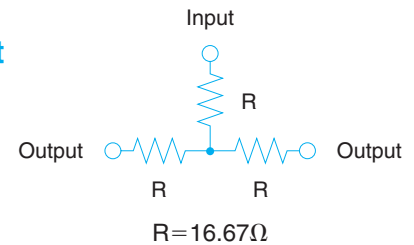


No ground for custom type

Dimension (Inch Size)	PS1608(G) (0603)	PS2012(G) (0805)	PS3216(G) (1206)	PS5025(G) (2010)
L	1.6±0.2	2.0±0.2	3.2±0.2	5.0±0.2
W	0.8±0.2	1.25±0.2	1.6±0.2	2.5±0.2
a	0.4±0.1	0.4±0.1	0.3±0.1	0.35±0.1
b	0.3±0.1	0.3±0.1	0.35±0.1	0.65±0.1
t	0.4±0.1	0.4±0.1	0.4±0.1	0.8±0.15

(unit : mm)

Equivalent circuit



Electrical

Standard type

Type	PS1608G	PS2012G	PS3216G	PS5025G
Operating frequency	DC~20GHz	DC~17.5GHz	DC~15GHz	DC~10GHz
Insertion loss	6±0.5dB(DC~10GHz) 6±1.0dB(10GHz~20GHz)	6±0.5dB(DC~10GHz) 6±1.0dB(10GHz~17.5GHz)	6±0.5dB(DC~10GHz) 6±1.0dB(10GHz~15GHz)	6±0.5dB(DC~7.5GHz) 6±1.0dB(7.5GHz~10GHz)
Split deviation	max.0.3dB			
VSWR	1.3(DC~10GHz) 1.5(10GHz~20GHz)	1.3(DC~10GHz) 1.5(10GHz~17.5GHz)	1.3(DC~10GHz) 1.5(10GHz~15GHz)	1.3(DC~7.5GHz) 1.5(7.5GHz~10GHz)
Input power	100mW	125mW	250mW	500mW
Max overload power	200mW	250mW	500mW	1000mW
Operating temperature	-40~125°C			
Package	1,000~5,000pcs/reel			

*Standard type with ground on back side can gain stable performance regardless of circuit characteristics

*Custom type without ground on back side can be designed according to specific circuit

- Please ask as for chip custom type with dimension of 1.0*0.5mm
- Simplified pattern can be realized as ground is not required on the surface of circuit



PART NUMBER

PS 1608 G T2 - R50 - T1(T5)

Package (T1:1,000pcs/reel, T5:5,000pcs/reel)

Impedance (50Ω)

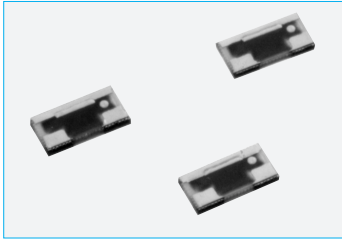
Number of output terminal (T2=2 terminals)

Type(G=standard)

Dimensions

Part Code





Positive Emitter Coupled Logic(PECL) Chip Terminators



Suitable for output applications in emitter coupled logic for high-speed signal transmission.

Minimized reflection permits high-speed data processing.

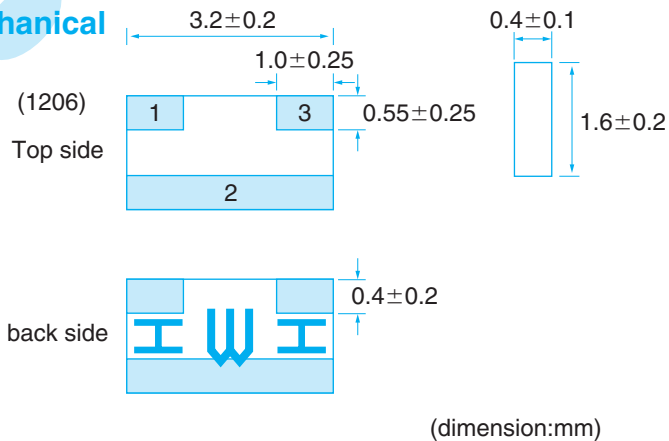
RoHS compliant

Completely lead free

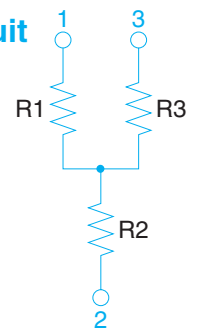


SPECIFICATIONS

Mechanical



Equivalent circuit

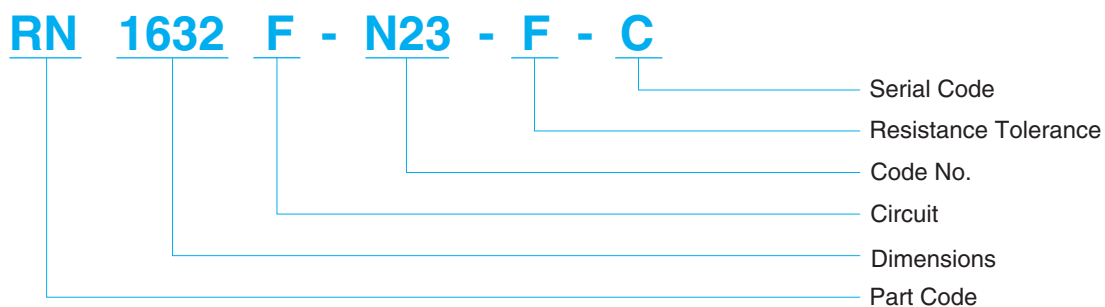


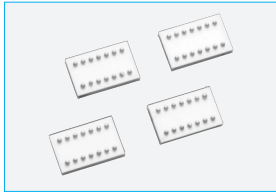
Electrical

Type	RN1632F
Resistance (Ω)	R1=50, R2=46.4, R3=50 ; typical
Tolerance %(code)	±1.0%(F)
TCR ppm /°C(code)	±50ppm/°C
Power Rating	42mW/element ; 125mW/package
Rated Operating Temperature	-55°C~+125°C
Package	5,000pcs/reel



PART NUMBER





BL1L series, ball-grid-array thin film delay lines



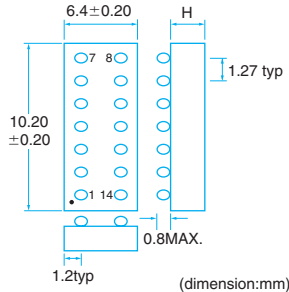
Now under development These delay lines offer the same excellent frequency performance as GL delay lines but come in a solder bump configuration that takes up less board space than the GL series. As with all of TFT's delay lines, these feature stripline conductors on ceramic for high speed, high stability performance.

RoHS compliant



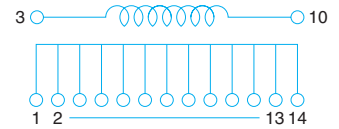
SPECIFICATIONS

Mechanical



Time Delay	H	Code
0.1~0.9n sec	1.70max	L
1.0~1.8n sec	2.30max	M
1.9~2.7n sec	2.80max	N
2.8~3.5n sec	2.90max	O

Equivalent circuit

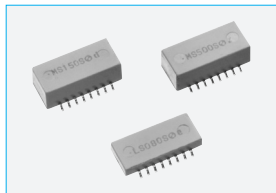
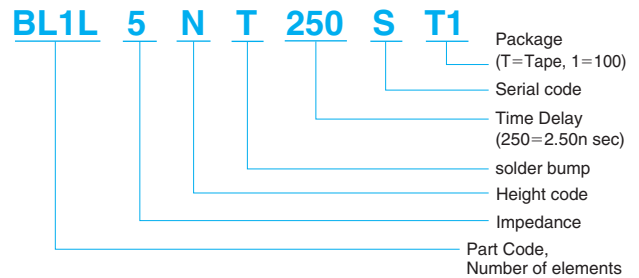


Electrical

Type	BL1L5
Time Delay	0.1~3.5n sec.(0.1n sec. Step)
Time Delay Tolerance	±0.05n sec.
Characteristic Impedance	50±5Ω
Rated Current	100mA
DC Resistance	1.0Ω/n sec. Max.
Insulation resistance	100Ω(DC50V)
Operating Tem. Range	-40~85°C
Storage Tem. Range	-55~125°C

Contact us for RoHS compliant products

PART NUMBER



GL1L/GL2L series, SOP (small outline package) thin film differential delay lines



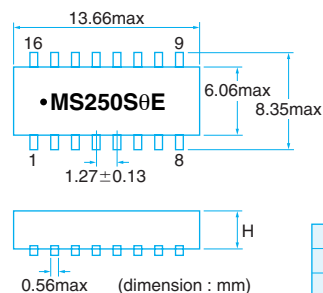
These delay lines offer the same excellent frequency performance as SIP delay lines but come in a gullwinged surface mount package. The differential SMT is useful for PECL application, and contains two identical transmission lines matched for the time delay. Featuring a stripline shielded construction, these parts offer very low EMI/RFI, and are ideal for high frequency/tight tolerance timing and deskew applications.

RoHS compliant



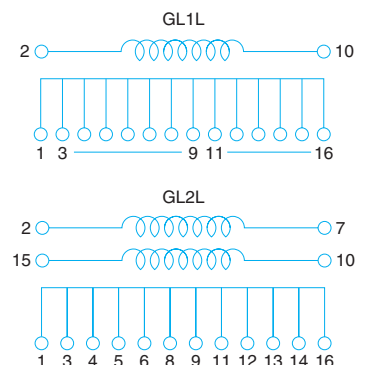
SPECIFICATIONS

Mechanical



Time Delay	H	Code
0.1~1.0ns	2.37max	L
1.1~5.0ns	4.85max	M

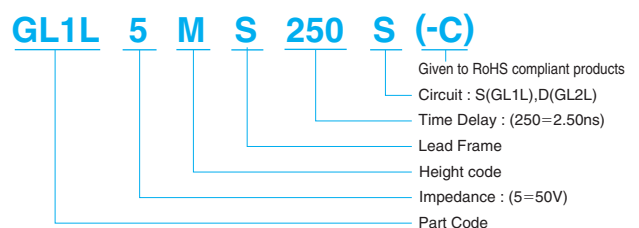
Equivalent circuit

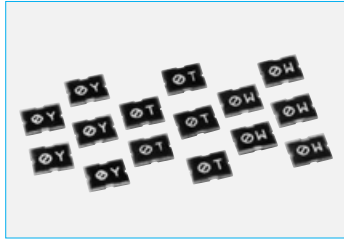


Electrical

Type	GL1L	GL2L
Time Delay	0.1~5.0ns(0.1ns step)	0.1~3.0ns(0.1ns step) 3.5~4.5ns(0.5ns step)
Time Delay Tolerance	±0.05ns	±0.05ns(0.1~2.9ns) -0.5/+0.1ns(3.0ns) ±0.1ns(3.5~4.5ns)
Temp. coefficient of Td	0~150ppm/°C	
Characteristic Impedance	50±5Ω	
Rise/fall time	200ps/ns	
Rated Current	100mA	
Operating Temperature	-25~85°C	

PART NUMBER





CL1L, CL2L series, surface-mount thin film delay lines



This series permits ultra-precision timing adjustment from 20 to 200 picoseconds with accuracy of $\pm$ picoseconds for ultrahigh-speed signal processing applications.
Differential delay line: CL2L

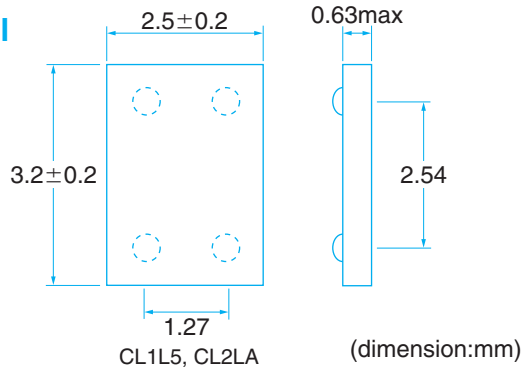
RoHS compliant

Completely lead free

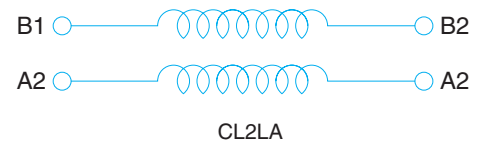
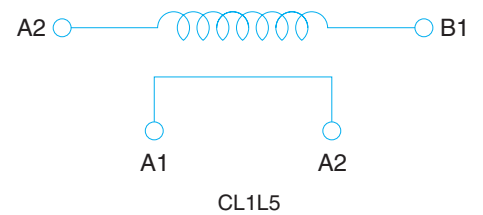


SPECIFICATIONS

Mechanical



Equivalent circuit



Electrical

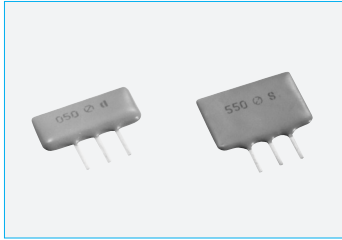
Type	CL1L5	CL2LA
Time Delay	40~200ps(20ps step)	
Time Delay Tolerance	$\pm 10\%$	
Temp. coefficient of Td	$\pm 100\text{ppm}/^\circ\text{C}$	
Characteristic Impedance	$50\Omega \pm 10\%$	$100\Omega \pm 10\%$
DC Resistance	0.3Ω (100ps or less) $3.0\Omega/\text{ns}$ max(100ps or more)	1.0 Ω Max.
Insertion loss	0.5dB or less (at 0.75GHz)	0.5dB or less (at 1.0GHz)
Rated Current	100mA	
Operating temperature	$-40^\circ\text{C} \sim 85^\circ\text{C}$	



PART NUMBER

CL 1L 5 A T 020 L T1 (-C)

- Given to RoHS compliant CL2LA series products
- Package(T1:1,000pcs, T5:500pcs, TA:1,000pcs)
- Serial code (L=CL1L5A, D=CL2LA)
- Time Delay (020=200ps)
- Termination type (T)
- Height code (A)
- Impedance (5=50 Ω , A=100 Ω)
- Number of elements (1L=CL1L5, 2L=CL2LA)
- Part Code, Number of elements



DS1L series, SIP thin film delay lines



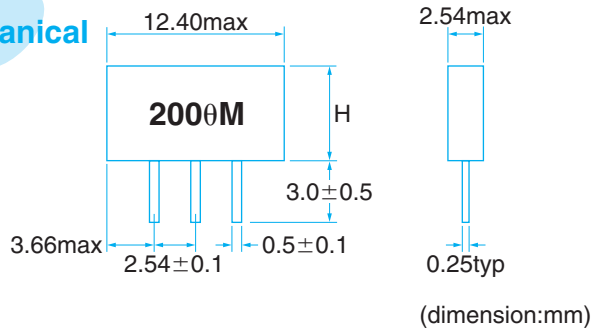
These delay lines provide timing control to 10 nanosecond in a SIP solder lead three pin package. Thin film on ceramic construction provide for high reliability and high bandwidth performance.

RoHS compliant



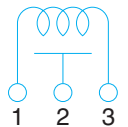
SPECIFICATIONS

Mechanical



Time Delay	H	Form
0.1~5.0ns	6.35max	D
5.5~10.0ns	9.20max	V

Equivalent circuit



Electrical

Type	DS1L
Time Delay range	0.1~2.0ns (0.10ns step)
	2.25~5.0ns (0.25ns step)
	5.5~10.0ns (0.50ns step)
Time Delay Tolerance	±0.050ns (0.10~0.20ns)
	±0.125ns (2.25~5.00ns)
	±0.250ns (5.00~10.0ns)
Characteristic Impedance	50±5 Ω

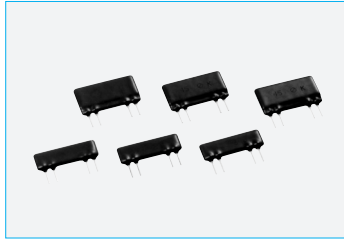
Type	DS1L
DC Resistance	1.0 Ω/ns max
Rated Current	100mA
Temp. coefficient of Td	<150ppm/°C
Insulation resistance	>100M Ω 50V
Operating temperature	-10~+85°C
Storage Temperature	-40~+125°C



PART NUMBER

DS1L 5 DJ 200 S (-C)

- Given to RoHS compliant products
- Serial code
- Time Delay(200=2.0ns)
- Lead Frame
- Impedance(5=50Ω)
- Part Code, Number of elements



DL1L series, SIP thin film delay lines



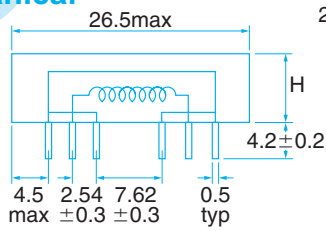
Performance to 5 GHz. For many high frequency applications, discrete, tight tolerance(± 50 picosecond) delay lines can be used to help solve your TTL, and ECL timing and clock deskew needs.

RoHS compliant

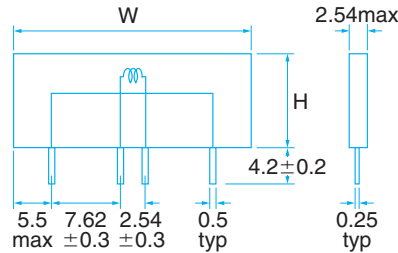
SPECIFICATIONS

Mechanical

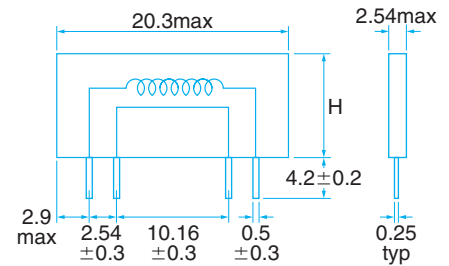
(dimension : mm)



DL1L5(W, X, Y, Z)



DL1L5(3, 4, 5, O)



DL1L8

DL1L5(W, X, Y, Z)

Time Delay	H	Code
0.1~0.5ns	7.60max	W
0.6~2.6ns	10.10max	X
2.7~3.5ns	14.00max	Y
3.6~5.1ns	16.45max	Z

DL1L5(3, 4, 5, O)

Time Delay	H	W	Code
0.1~1.3ns	7.50max	26.50max	3
1.4~2.5ns	10.10max		4
2.6~3.4ns	12.70max	27.90max	5
3.6~10ns	15.50max		O

DL1L8

Time Delay	Time Delay Tolerance	H	Code
0.1~1.2ns	± 0.05 ns	12.00max	B
1.3~2.6ns	± 0.05 ns		
2.8ns	± 0.10 ns		F
3.0~5.0ns	± 0.25 ns		

Electrical

Type	DL1L5(W, X, Y, Z)	DL1L5(3, 4, 5, O)			DL1L8
Time Delay Range	0.1~5.1ns (0.1ns step)	0.1~2.50ns (0.1ns step)	2.6~4.90ns (0.2ns step)	5.0~10.0ns (0.5ns step)	0.1~2.6ns(0.1ns step) 3.0~5.0ns(0.5ns step)
Time Delay Tolerance	±0.050ns	0.05ns	±0.100ns	±0.250ns	above table
Characteristic Impedance	50±5Ω				75±7.5Ω
Retune Loss	20dB min				20dB min
DC Resistance	0.1~0.5ns : 0.5Ωmax	0.1~1.0ns : 0.8Ωmax 1.1~10ns : 0.8Ωmax/ 1ns			0.1~1.0ns : <1.7Ω
	0.6~2.6ns : 1.0Ωmax				0.1~5.0ns : <1.7Ω/ns
	2.7~3.5ns : 2.0Ωmax				
	3.6~5.1ns : 3.0Ωmax				
Rise / fall time	1ns or less	1ns or less	2ns or less		>1ns
Rated Current	100mA				
Operating temperature	-40~+85°C				-10~+85°C

PART NUMBER

DL1L 5 X K 260 S (-C)

- Given to RoHS compliant products
- Serial code
- Time Delay(260=2.6ns)
- Lead Frame
- Height code
- Impedance(5=50 Ω ,8=75 Ω)
- Part Code

STANDARD RESISTANCE VALUES

Please refer to the following table of the standard E-Series application for resistors.

SERIES	SIGNIFICANT FIGURES														
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 4.30	1.10 4.70	1.20 5.10	1.30 5.60	1.50 6.20	1.60 6.80	1.80 7.50	2.00 8.20	2.20 9.10	2.40	2.70	3.00	3.30	3.60	3.90
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									

Preferred value of resistance shall be composed by significant figures shown in the above table and multipliers including $\times 10\Omega$, $\times 100\Omega$, $\times 1,000\Omega$, $\times 10,000\Omega$, and $\times 100,000\Omega$.

- specifications in this catalogue are subject to change for future improvement without prior notice
- the contents of this catalogue are current as of March 2006
- The Susumu World Group companies, including Susumu Company Ltd., Thin Film Technology Corporation, Yokohama Denshi Seiko Company, Ltd., and Cyntec Company Ltd., do not recommend the use of their products in any life support applications where failure or malfunction of the product can or may cause failure of a life support device or system, or effect in any manner its safety or effectiveness. Should the customer use a product in a life support application then, in that event, the Susumu World Group companies disclaim any and all express or implied warranties as to fitness for any particular purpose or as to merchantability.
- This is Catalog 2006 Volume 1

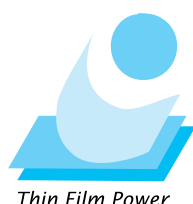
Caution for mounting the product

<Caution for mounting the product>

- (1) Please be careful not to scratch the protection coating while (pre/after) mounting. Any scratches may lead to the deterioration on durability against moisture.
- (2) When soldering by soldering iron, heating should be done on a land so that the tip of soldering iron will not touch the component itself. Also, if soldering is done at high temperature, please do soldering as short time as possible (less than 3 seconds under 350°C is preferable).
- (3) Remaining flux may lead to deterioration of durability against moisture due to corrosion and occurrence of electrolyte. Specially, if high activating flux, such as chlorine related one, is used, please check its characteristics before using it.
- (4) Adherence and remaining of ionized impurity also may lead to deterioration of durability against moisture due to corrosion and occurrence of electrolyte. Please be careful of not to touch the components with sweated bare hand pre/after mounting.
- (5) High temperature and long soldering may cause the poor soldering on electrode.
- (6) In case of placing resistors in resin after mounting, please pay special attention to the selection for it. It is recommended to check durability against heat and moisture, good shock absorption, and not-containing ionized impurity.

<Environment and conditions of usage>

- (1) Usage and conditions under special environment, it is recommended to confirm the specification and reliability of products. Below conditions are considered as special environments.
 - ① Places where products are immersed in such liquids as water, salt water, oil, acid, and an organic solvent. Or, there is possibility of splash of these liquids.
 - ② Direct sunlight, exposure at outdoor, and dusty environment.
 - ③ A place where condensation is expected.
 - ④ A place where the exposure to toxic gas (sea breeze, HCl , Cl_2 , SO_2 , H_2S , N_4H_3 , NO_x , etc.) is expected.
- (2) When using the product under high temperature and high humidity
 - ① When using the product under high temperature environment, including generation of heat under consideration, please derate the maximum load in accordance with the derating curve stated on the specification.
 - ② When conducting in high moisture environment or the state of condensation, it may lead to the increase in resistance value or break.
- (3) Dissipation, Pulse loading
Please use the product under rated power. Also please set the maximum voltage under rated voltage upon pulse loading.



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