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# Chip Resistor Series

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# Surface Mount Component Application Notes

## ▶ Surface Mount Component Application Notes

### Surface Mount Component Application Notes

#### Safety Precautions

1. Avoid excessive bending of printed circuit boards in order to protect the resistors from abnormal stress.
2. When soldering with a soldering iron, never touch the body of chip resistor with the tip of the soldering iron. When using a soldering iron with a high temperature tip, finish soldering as quickly as possible (within three seconds at 350°C max.).
3. Take measures against mechanical stress during and after mounting of Chips, so as not to damage their electrodes and protective coatings. Be careful not to misplace the resistors on the land patterns. Otherwise, solder bridging may occur.
4. If a transient load like a pulse is expected to be applied, check and evaluate the operations of the resistors before use. Never exceed the rated power. Otherwise, the performance and reliability of the chip device may be damaged.
5. As the amount of applied solder becomes larger, the mechanical stress applied to the resistors increases, causing problems such as cracks and faulty characteristics. Avoid applying an excessive amount of solder.
6. Do not apply shock to the resistors or pinch them with a hard tool (e.g. pliers and tweezers). Otherwise, the protective coatings and body of chip device may be chipped, affecting their performance.
7. Do not use halogen-based or other high-activity flux. Otherwise, the residue may harm the resistors' performance and reliability.



### Precautions for use

1. Carefully position these products so that their temperatures will not exceed the category temperature range due to the effects of neighboring heat-generating components. Do not mount or place heat-generating components or inflammables, such as vinyl-coated wires, near these products.
2. Note that non-cleaning solder, halogen-based highly active flux, or water-soluble flux may deteriorate the performance or reliability of the products.
3. Carefully select a flux cleaning agent for use after soldering. An unsuitable agent may deteriorate the performance or reliability. In particular, when using water or a water-soluble cleaning agent, be careful not to leave water residues. Otherwise, the insulation performance may be deteriorated.
4. These products are not intended for use in the following special conditions. Before using the products, carefully check the effects on their quality and performance, and determine whether or not they can be used.
  - In salty air or air with a high concentration of corrosive gas, such as SO<sub>2</sub>, Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, or NO<sub>2</sub>.
  - Please take measures to avoid any of ESD environments. Smaller components are more sensitive to ESD.
  - Avoid any environment where strong electromagnetic waves exist.
  - In an environment where these products cause dew condensation.
  - In liquid, such as water, oil, chemicals, or organic solvent.
  - In direct sunlight, outdoors, or in dust.

### Precautions for storage

The performance of these products including the Solderability is guaranteed, provided that they remain packed as they were when delivered and stored at a temperature of 5°C to 35°C and a relative humidity of 45% to 85%.



# Surface Mount Terminology & Glossary

## ▶ Surface Mount Terminology & Glossary

### Surface Mount Terminology & Glossary

Selecting the optimum chip technology necessary to best match the performance requirements Surface mount resistors are main key of electronic components composed electronic circuit. Chips are developed with demands of diverse electronic circuits and used. To summarize the application technique about surface mount resistors use for electric machine and tools, especially, which need high density mount in these chips. To make the best fit selection of chip resistors, in general, confirm with the characteristic of that circuit, as following steps:

1. Single chip resistor or Composite chip resistor;
2. For single chip resistor, there is an option of thick-film chip or thin-film chip;
3. For composite chips, there is another option of chip resistor array (common terminal circuit) or chip resistor network (isolated circuit);
4. For applications required pulse withstanding, working voltage ratings (power wattage) is one of key factors.
5. For applications required stability and precision, look for Token's Electrical Specifications for TCR and Resistance Tolerance parameters.

Whether you're designing circuit for telecommunications, computers, consumer electronics or office equipment, Token has the right chips for your application.

### The Difference between Thin Film and Thick Film Chips

The principal difference between thick film and thin film resistors is not the actual thickness of the film, but rather how the film is applied to the chip substrate surface (SMD resistors) or the cylinder (axial resistors).

Thin film resistors are made by sputtering (a method of vacuum deposition) the resistive material onto an insulating substrate. The film is then etched in a similar manner to the old (subtractive) process for making printed circuit boards; that is, the surface is coated with a photo-sensitive material, and then covered by a pattern film, irradiated with ultraviolet light, and then the exposed photo-sensitive coating is developed, and underlying thin film is etched away.

Thick Film Resistor is manufactured by screen-printed a much thicker conductive paste of Ceramic and Metal, called Cermet, onto an alumina ceramic substrate. This composite of glass and conductive ceramic (cermet) material is then baked in an oven at about 850°C to form the film.

Thin film resistor has better TCR and tighter tolerance than thick film due to sputtering technology precision timing control while thick film resistor has better pulse withstanding ability than thin film because of the thickness of film.



## Temperature Coefficient of Resistance (TCR)

The Temperature Coefficient of Resistance (TCR) is expressed as the change in resistance in ppm (0.0001%) with each degree of change in temperature Celsius (°C). For example, a resistor with a TCR of +100 ppm/°C will change +0.1% total over a 10-degree change and +1% total over a 100-degree change.

The TCR value quoted on specification sheets is typically quoted as being referenced at +25°C and is the +25°C to +75°C slope of the TCR curve. TCR is typically not linear, but parabolic with temperature, as illustrated by the accompanying fig-1. Often the circuit designer treats the TCR as being linear unless very accurate measurements are needed. MIL STD 202 Method 304 is often referenced as a standard for measuring TCR. The following formula expresses the rate of change in resistance value per 1 °C in a prescribed temperature range:

- $TCR (ppm/°C) = (R - R_0) / R_0 \times 1 / (T - T_0) \times 10^6$
- R: Measured resistance (Ω) at T °C; R<sub>0</sub>: Measured resistance (Ω) at T<sub>0</sub> °C
- T: Measured test temperature (°C); T<sub>0</sub>: Measured test temperature (°C)

In the context of a resistor network, this TCR value is called the absolute TCR in that it defines the TRC of a specific resistor element.

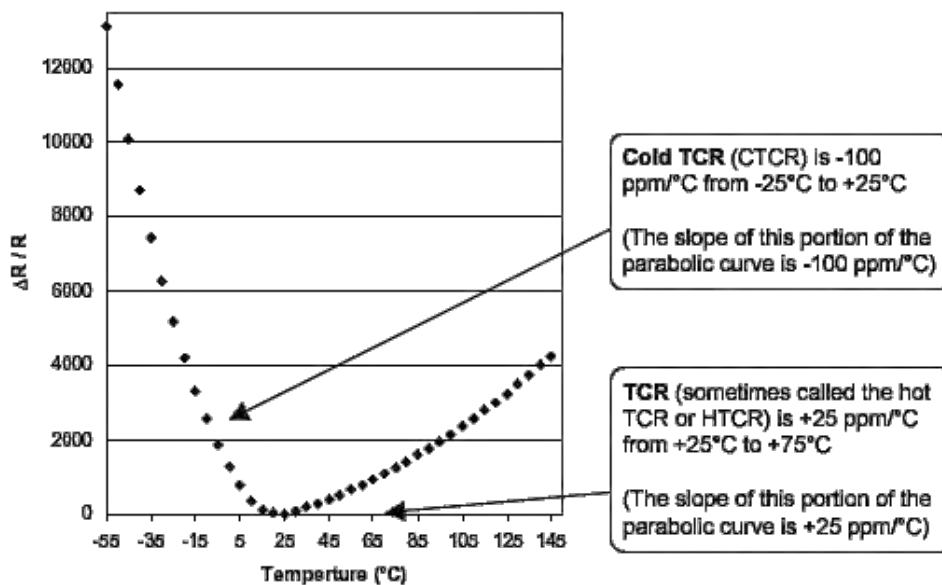


Fig-1 Typical TCR (Temperature Coefficient of Resistance) Curve

## Maximum Working Voltage

The maximum voltage applied continuously to a resistor or a resistor element. The maximum value of the applicable voltage is the rated voltage at the critical resistance value or lower. If the circuit designs permits, the choice of a high Ohmic value resistor or divider network will improve the resistor's performance because it will operate at lower power.



## ESD Sensitivity of Chips

The sensitivity level of resistors used in electronic equipment to an electrostatic discharge (ESD) varies from a few hundred volts to a few tens of kilovolts. Ways to make resistors more robust to ESD are suggested.

The most popular electronic assembly method today is the surface mount technology, SMT. Manufacturers of components responded to this trend by developing standard sizes of surface mounted chips. Miniaturization leads to the use of smaller sized SMT chips and this causes an increase in the sensitivity of electronic equipment to ESD. ESD voltage levels which do not affect larger resistor chips may be dangerous for smaller sizes because of their smaller heat capacity.

Therefore, resistance value by ESD characteristic tends to become large following on becoming small. Moreover, it is influenced by conductive mechanism of resistive material, resistance value trends to be influenced with the range from 100 Ω to 100k Ω, and the ESD characteristic is hard to be influenced by ESD in the domain where resistance value is lower than that range or a high domain.

## Power Rating

Power ratings are based on physical size, allowable change in resistance over life, thermal conductivity of materials, insulating and resistive materials, and ambient operating conditions. For best results, employ the largest physical size resistors at the less than their maximum rated temperature and power. Never use them continuously at their maximum rating unless you are prepared to accept the maximum allowed life cycle changes. If the circuit designs permits, the choice of a high Ohmic value resistor or divider network will minimize the power level and improve the resistor's performance as it is operating at a lower power level.

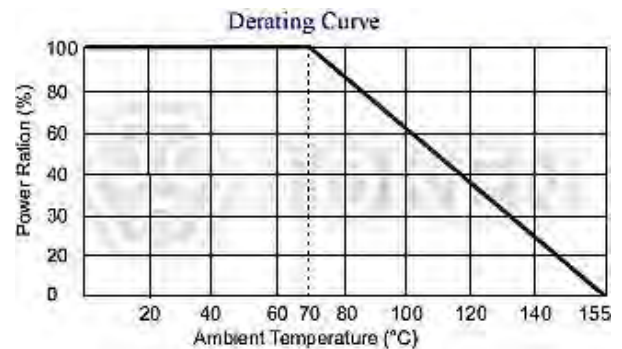


Fig-2 Power Derating Curve

## Rated Power

Rated power is the maximum value of power (watts), which can be continuously applied to a resistor at a rated ambient temperature. The basic mathematical relationship is

$$\text{Equation: Power (Watts)} = (\text{Current (Amps)})^2 \times \text{Resistance (Ohm)}.$$

If the circuit designs permits, the choice of a high Ohmic value resistor or divider network will minimize the power level and improve the resistor's performance because it is operating at a lower power and temperature level.

## Rated Voltage

The maximum voltage applied continuously to a resistor at the rated ambient temperature. Rated voltage is calculated from the following formula, but it must not exceed the maximum working voltage.

$$\text{Equation: Rated Voltage (V)} = (\text{Rated Power (W)} \times \text{Nominal Resistance Value (}\Omega\text{)})^{1/2}$$

High voltage resistors often are potted or operated in oil as the arc over voltage, in air, is approximately 10,000 volts per inch. Token's resistors feature higher voltage ratings due to their high square count and associated design characteristics.



# Anti-Corrosive Precision Chip Resistors (PR)

## ▶ Product Introduction

**Anti-corrosive thin film resistor of moisture-proof is ideal for high humidity precision applications.**

### Features :

- Tight Tolerance down to  $\pm 0.1\%$
- Wide R-Value Range  $10 \Omega \sim 1\text{Meg} \Omega$
- Extremely Low TCR down to  $\pm 25 \text{ PPM}/^\circ\text{C}$
- Special Passivated NiCr Film for Anti-Acid and Anti-Damp
- Long Term Life Stability with Advance Thin Film Technology
- Demonstrated the Anti-Corrosion Claims Characterized by  $\text{Ta}_2\text{N}$

### Applications :

- Telecommunication Device
- Automotive, Medical Equipment
- Outdoor Electronic Applications
- High-end Multimedia Electronics
- Automatic Equipment Controller
- High-end Computer, Industrial Equipment

Token Electronics has introduced a new line of SMD Anti-Corrosive Precision Resistors that eliminates moisture concerns associated with typical Nickel Chromium precision resistors. The PR Series is an ideal low-cost alternative for expensive and hard-to-find tantalum nitride chip resistors.

A proprietary passivation layer is introduced between the nichrome resistive element with a superior alumina substrate and the epoxy overcoat to ensure stable performance and long life in the harshest and wettest environments.

In MIL-STD-202F method moisture testing, the PR Series demonstrated excellent stability over time and no significant shift in resistance after the 1000 hour life test. Applications require operation in humid or high moisture environments or have experienced corrosion problems with standard Nichrome thin film resistors. For those applications, long term extended humidity testing is essential before a part can be considered for usage on a design.

Designated the (PR) SMD resistor, it is available in industry standard 0402, 0603, 0805, 1206, 2010, to 2512 sizes and has a resistance range from  $10 \Omega$  to  $1\text{M} \Omega$ , with tolerances tight to  $\pm 0.10\%$  and TCRs as low as  $25\text{ppm}/^\circ\text{C}$ . The PR Series has an operating temperature range of  $-55^\circ\text{C}$  to  $+155^\circ\text{C}$ . The PR chip also offers outstanding electrical stability and environmental stability performance that would be expected from a precision resistor.

The standard packaging is tape and reel in 4Kpc, 5Kpc, and 10Kpc quantities depending on part size. Most sizes and resistance values are also offered in stock, making them an outstanding choice to support quick turn shortages. Pricing varies with size, tolerance, and TCR and ranges in reel quantities.

The chip PR series is lead-free and RoHS compliant. Detailed specifications, both mechanical and electrical, please contact us with your specific needs, or link to Token official website "[Chip](#)



[Resistors](#) to get more information.



<http://www.token.com.tw>



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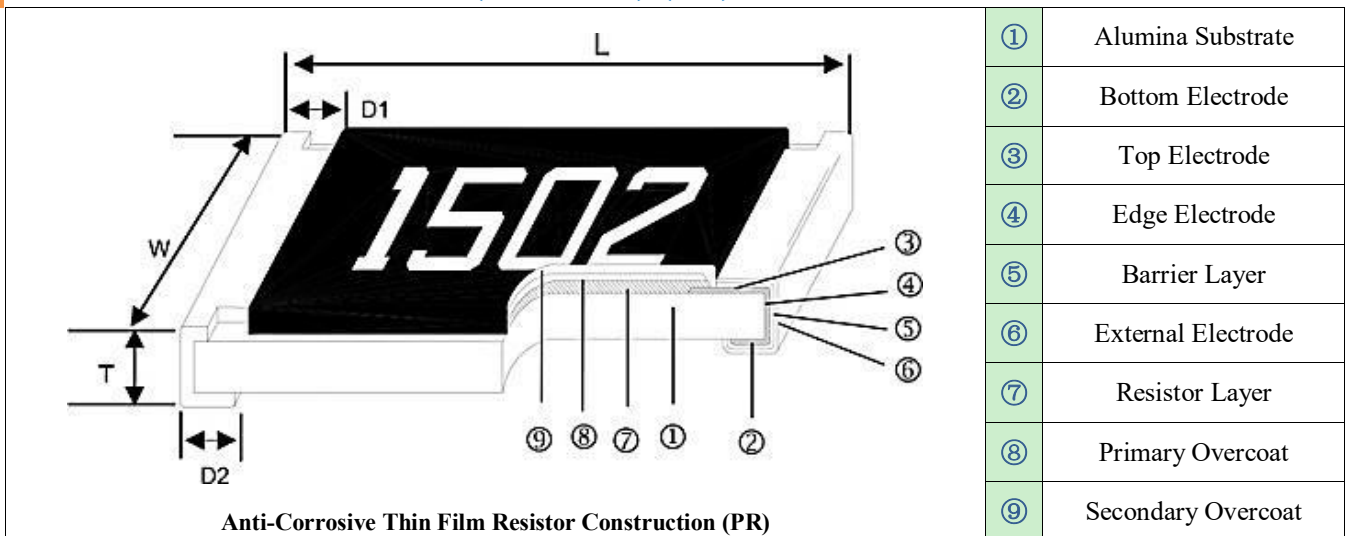


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## Construction & Dimensions

### Construction & Dimensions (Unit: mm) (PR)



Anti-Corrosive Thin Film Resistor Construction (PR)

Type	L (Unit: mm)	W (Unit: mm)	T (Unit: mm)	D1 (Unit: mm)	D2 (Unit: mm)	Weight(g)/1000pcs
PR02 (0402)	1.00±0.05	0.50±0.05	0.35±0.05	0.20±0.10	0.20±0.10	0.55
PR03 (0603)	1.55±0.10	0.80±0.10	0.45±0.10	0.30±0.20	0.30±0.20	1.85
PR05 (0805)	2.00±0.15	1.25±0.15	0.55±0.10	0.35±0.20	0.40±0.25	4.76
PR06 (1206)	3.05±0.15	1.55±0.15	0.55±0.10	0.42±0.20	0.35±0.25	9.11
PR10 (2010)	4.90±0.15	2.40±0.15	0.55±0.10	0.60±0.30	0.50±0.25	23.82
PR12 (2512)	6.30±0.15	3.10±0.15	0.55±0.10	0.60±0.30	0.50±0.25	38.46

## Electrical Spec.

### Standard Electrical Specifications (PR)

Type	Power Rating at 70°C	Operating Temp. Range	Max Operating Voltage	Max Overloading Voltage	Resistance Tolerance %	Resistance Range	TCR PPM/°C
PR02 (0402)	1/16W	-55 ~ +155°C	25V	50V	±0.1, ±0.25, ±0.5	49.9Ω~12KΩ	±15
						24.9Ω~24.9KΩ	±25, ±50
PR03 (0603)	1/16W	-55 ~ +155°C	50V	100V	±0.1, ±0.25, ±0.5	24.9Ω~332KΩ	±15, ±25, ±50
PR05 (0805)	1/10W	-55 ~ +155°C	100V	200V	±0.1, ±0.25, ±0.5	10Ω~1MΩ	±15, ±25, ±50
PR06 (1206)	1/8W	-55 ~ +155°C	150V	300V	±0.1, ±0.25, ±0.5	10Ω~1MΩ	±15, ±25, ±50
PR10 (2010)	1/4W	-55 ~ +155°C	150V	300V	±0.1, ±0.25, ±0.5	24.9Ω~1MΩ	±15
						10Ω~1.5MΩ	±25, ±50
PR12 (2512)	1/2W	-55 ~ +155°C	150V	300V	±0.1, ±0.25, ±0.5	24.9Ω~1MΩ	±15
						10Ω~1.5MΩ	±25, ±50

- Operating Voltage =  $\sqrt{(P * R)}$  , or Max. Operating Voltage listed in above table whichever is lower.
- Overloading Voltage =  $2.5 * \sqrt{(P * R)}$  , or Max. Overloading Voltage listed in above table whichever is lower.
- Optional specifications can be required.

### High Power Rating Electrical Specifications (PR)

Type	Power Rating at 70°C	Operating Temp. Range	Max Operating Voltage	Max Overloading Voltage	Resistance Tolerance %	Resistance Range	TCR PPM/°C
PR03 (0603)	1/10W	-55 ~ +155°C	75V	150V	±0.1, ±0.25, ±0.5	24.9Ω~220KΩ	±15, ±25, ±50
PR05 (0805)	1/8W	-55 ~ +155°C	150V	300V	±0.1, ±0.25, ±0.5	24.9Ω~680KΩ	±15, ±25, ±50
PR06 (1206)	1/4W	-55 ~ +155°C	200V	400V	±0.1, ±0.25, ±0.5	24.9Ω~1MΩ	±15, ±25, ±50

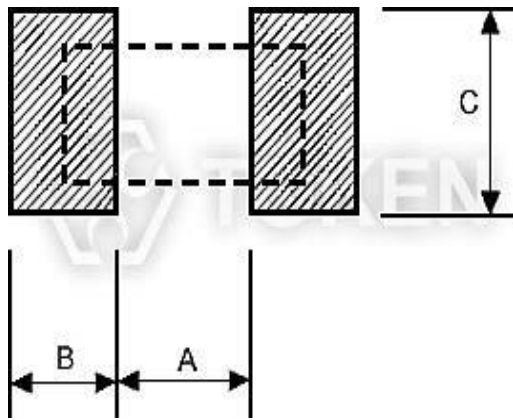
- Operating Voltage =  $\sqrt{(P * R)}$  , or Max. Operating Voltage listed in above table whichever is lower.
- Overloading Voltage =  $2.5 * \sqrt{(P * R)}$  , or Max. Overloading Voltage listed in above table whichever is lower.
- Optional specifications can be required.



## Recommend Conditions

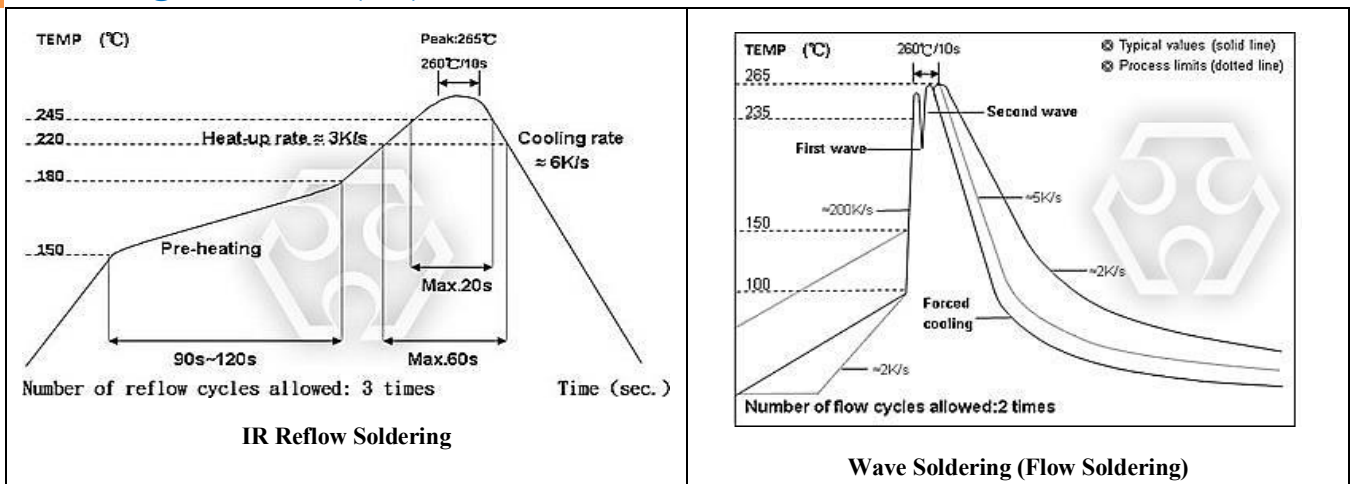
### Recommend Land Pattern (Unit: mm) (PR)

Codes	A	B	C
PR02 (0402)	0.50	0.50	0.60±0.2
PR03 (0603)	0.80	1.00	0.90±0.2
PR05 (0805)	1.00	1.00	1.35±0.2
PR06 (1206)	2.00	1.15	1.70±0.2
PR10 (2010)	3.60	1.40	2.50±0.2
PR12 (2512)	4.90	1.60	3.10±0.2



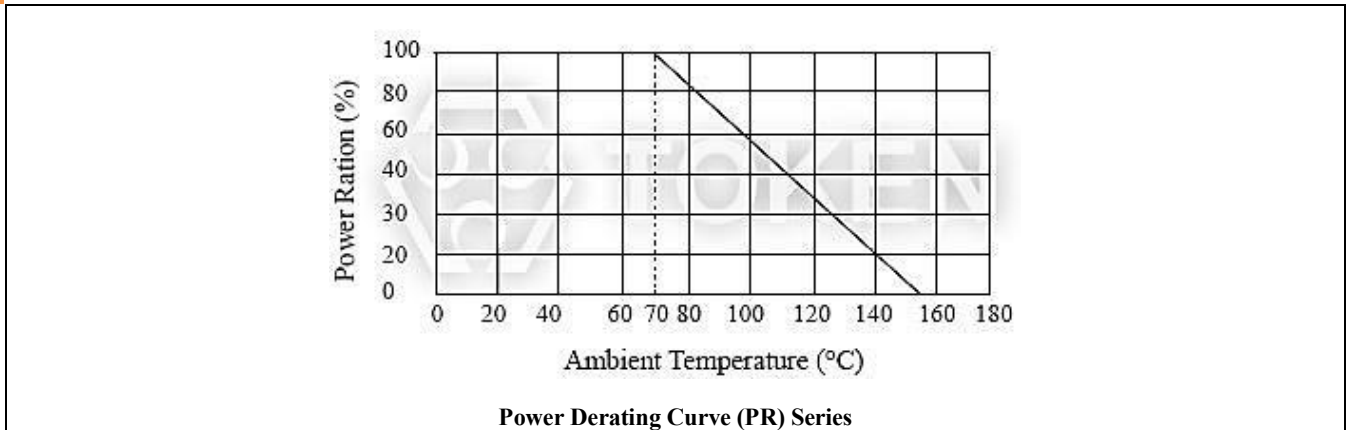
Recommend Land Pattern (PR)

### Soldering Condition (PR)



- (1) Time of IR reflow soldering at maximum temperature point 260°C : 10s
- (2) Time of wave soldering at maximum temperature point 260°C : 10s
- (3) Time of soldering iron at maximum temperature point 410°C : 5s

## Power Derating Curve (PR)



## Environmental Characteristics

### Environmental Characteristics (PR)

Test Item	Specification		Test Method
	Size 0603/0805/1206/2010/2512	Size 0402	
Short Time Overload	$\leq \pm 0.02\%$ $\leq \pm 0.2\%$ for high power rating	$\leq \pm 0.1\%$	JIS-C-5201-1 5.5 RCWV*2.5 or Max Overloading Voltage, 2 seconds
Thermal Shock	$\leq \pm 0.02\%$	$\leq \pm 0.1\%$	MIL-STD-202F Method 107G -55°C~125°C, 100 cycles
Load Life (Endurance)	$\leq \pm 0.05\%$ $\leq \pm 0.25\%$ for high power rating	$\leq \pm 0.25\%$	MIL-STD-202F Method 108A RCWV, 70°C, 1.5 hours ON, 0.5 hours OFF, total 1000 hours
Humidity (Steady State) (Damp Heat with Load)	$\leq \pm 0.05\%$ $\leq \pm 0.25\%$ for high power rating	$\leq \pm 0.5\%$	MIL-STD-202F Method 103B 40±2°C, 90~95%RH, RCWV 1.5 hours ON, 0.5 hours OFF, total 1000 hours
Resistance to Dry Heat	$\leq \pm 0.05\%$	$\leq \pm 0.5\%$	JIS-C-5202-7.2 1000 hours @ +155°C without load
Resistance to Soldering Heat	$\leq \pm 0.02\%$	$\leq \pm 0.1\%$	MIL-STD-202F Method 210E 260±5°C, 10±1seconds
Solderability	95%min coverage		MIL-STD-202F Method 208H 245°C±5°C, 3±0.5(sec)

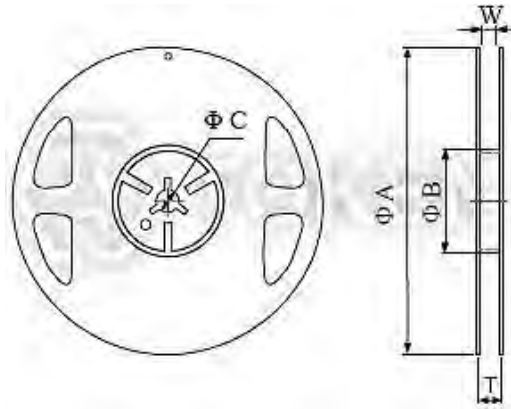
- Rated continuous Working Voltage (RCWV) =  $\sqrt{(\text{Power Rating} \times \text{Resistance Value } (\Omega))}$  or Max. Operating voltage whichever is lower.
- Storage Temperature: 15~28°C; Humidity < 80%RH;



## ► Packaging & Reel Tape

### Packaging Quantity & Reel Specifications (Unit: mm) (PR)

Codes	$\Phi A$ (Unit: mm)	$\Phi B$ (Unit: mm)	$\Phi C$ (Unit: mm)	W (Unit: mm)	T (Unit: mm)	Paper Tape (PCS)	Emboss Plastic Tape (PCS)
<b>PR02</b> (0402)	178.0±1.0	60.0±1.0	13.5±0.7	9.5±1.0	11.5±1.0	10,000	-
<b>PR03</b> (0603)	178.0±1.0	60.0±1.0	13.5±0.7	9.5±1.0	11.5±1.0	5,000	-
<b>PR05</b> (0805)	178.0±1.0	60.0±1.0	13.5±0.7	9.5±1.0	11.5±1.0	5,000	-
<b>PR06</b> (1206)	178.0±1.0	60.0±1.0	13.5±0.7	9.5±1.0	11.5±1.0	5,000	-
<b>PR10</b> (2010)	178.0±1.0	60.0±1.0	13.5±0.7	13.5±1.0	15.5±1.0	-	4,000
<b>PR12</b> (2512)	178.0±1.0	60.0±1.0	13.5±0.7	13.5±1.0	15.5±1.0	-	4,000

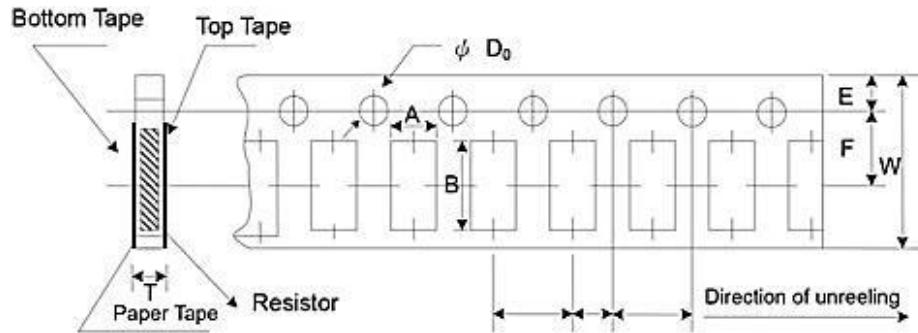


Reel Packaging (PR)



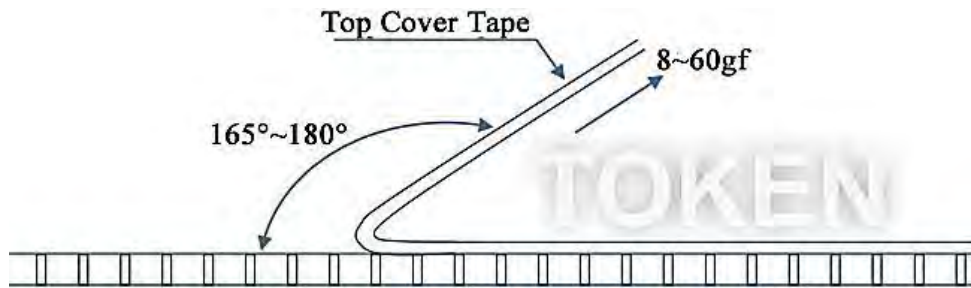
## Paper Tape Specifications (Unit: mm) (PR)

Codes	A (mm)	B (mm)	W (mm)	E (mm)	F (mm)	P <sub>0</sub> (mm)	P <sub>1</sub> (mm)	P <sub>2</sub> (mm)	ΦD <sub>0</sub> (mm)	T (mm)
PR02	0.70±0.05	1.16±0.05	8.00±0.10	1.75±0.05	3.5±0.05	4.00±0.10	2.00±0.05	2.00±0.05	1.55±0.05	0.40±0.03
PR03	1.10±0.05	1.90±0.05	8.00±0.10	1.75±0.05	3.5±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.55±0.05	0.60±0.03
PR05	1.60±0.05	2.37±0.05	8.00±0.10	1.75±0.05	3.5±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.55±0.05	0.75±0.05
PR06	2.00±0.05	3.55±0.05	8.00±0.10	1.75±0.05	3.5±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.55±0.05	0.75±0.05



Surface Mount Paper Tape Specifications (PR)

## Paper Tape Peel Force (PR)

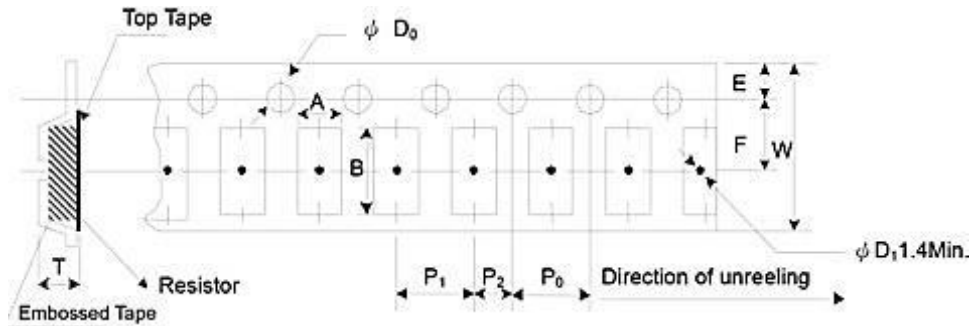


Paper Tape Peel Force

- (1) Peel force of top cover tape.
- (2) The peel speed shall be about 300 mm/min±5%
- (3) The peel force of top cover tape shall be between 8gf to 60gf.

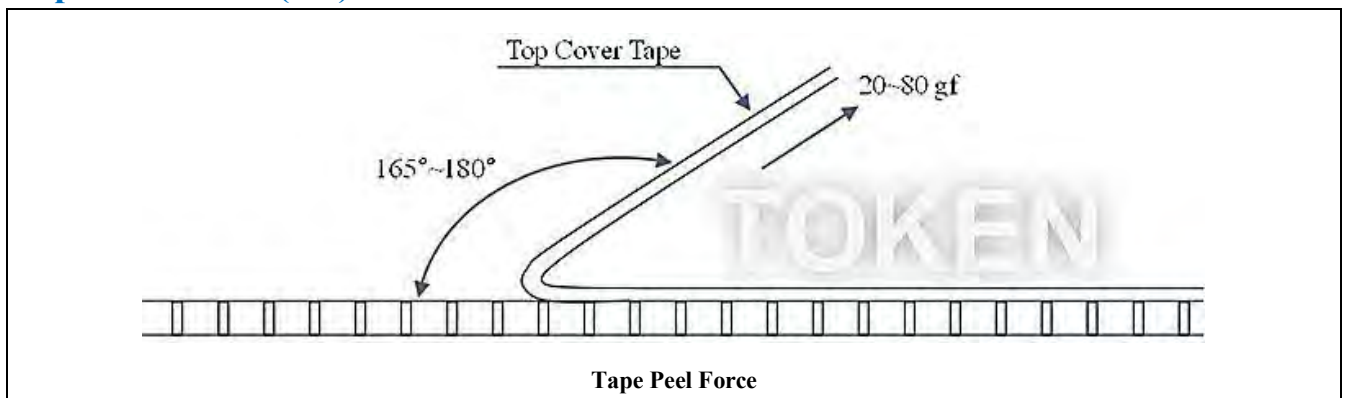
## Emboss Plastic Tape Specifications (Unit: mm) (PR)

Codes	A (mm)	B (mm)	W (mm)	E (mm)	F (mm)	P <sub>0</sub> (mm)	P <sub>1</sub> (mm)	P <sub>2</sub> (mm)	ΦD <sub>0</sub> (mm)	T (mm)
PR10	2.85±0.10	5.45±0.10	12.0±0.10	1.75±0.10	5.5±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.50±0.10	1.00±0.20
PR12	3.40±0.10	6.65±0.10	12.0±0.10	1.75±0.10	5.5±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.50±0.10	1.00±0.20



Surface Mount Emboss Plastic Tape Specifications (PR)

## Tape Peel Force (PR)



- (1) Peel force of top cover tape.
- (2) The peel speed shall be about 300 mm/min±5%
- (3) The peel force of top cover tape shall be between 20gf to 80gf.

## Order Codes

### Order Codes (PR)

PR	02	D	TR	C3	U	1002					
Part Number	Dimensions (L×W) (mm)		Package		TCR (ppm/°C)	Resistance (Ω)		Marking			
	02	EIA0402	P	Bulk		U	1/2		1000	100	
	03	EIA0603	TR	Taping Reel	C5	±5	V	1/4	2201	2200	Standard Marking for E96/E24
	05	EIA0805			C3	±25	W	1/8	1002	10000	
	06	EIA1206			C2	±50	X	1/10	4992	49900	
	10	EIA2010			Y	1/16	1003	100K			
	12	EIA2512				1004	1M	N	No Marking		

### 0805~2512 4 digits marking for Example Marking

Resistance	100Ω	2.2KΩ	10KΩ	49.9KΩ	100KΩ	1MΩ
Marking	1000	2201	1002	4992	1003	1004

### 0603: 3 digits Marking E24 Nominal Table

E24 code	10	11	12	13	15	16	18	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75	82	91
----------	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

- Example: 101=100Ω 102=1KΩ (1st and 2nd are E24 code and 3rd code is multiplier)
- Resistance tolerance 1% for 0603: 3 digits marking in E96 (E96 series except E24 series)
- Digits marking for Example: 13C=13K3Ω; 68B=4K99Ω; 68X=49.9Ω

### Marking Table E96 Nominal Table

code	02	03	04	06	07	08	09	10	11	13	14	15	16	17	19	20	21	22	23	24	25	26	27
E96	102	103	107	113	115	118	121	124	127	133	137	140	143	147	154	158	162	165	169	174	178	182	187
code	28	29	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
E96	191	196	205	210	215	221	226	232	237	243	249	255	261	267	274	280	287	294	301	309	316	324	332
code	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74
E96	340	348	357	365	374	383	392	402	412	422	432	442	453	464	475	487	499	511	523	536	549	562	576
code	75	76	77	78	79	80	81	82	83	84	86	87	88	89	90	91	92	93	94	95	96		
E96	590	604	619	634	649	665	681	698	715	732	768	787	806	825	845	866	887	909	931	953	976		

### Multiplier E96 Marking

Code	A	B	C	D	E	F	X	Y
Multiplier	10 <sup>0</sup>	10 <sup>1</sup>	10 <sup>2</sup>	10 <sup>3</sup>	10 <sup>4</sup>	10 <sup>5</sup>	10 <sup>-1</sup>	10 <sup>-2</sup>



### ► General Information

#### **Token Thin Film Chips Add Powerful New Options**

Token electronics provides the industry's most comprehensive range of precision thin film technologies for discrete, network, and integrated passive components used in instrumentation; automotive electronics; communications systems; and portable electronics applications. Ultra-reliable precision Nichrome resistive elements are available on ceramic or silicon substrates in a wide variety of surface mount resistors.

In response to market demands for increased precision and stability, Token has expanded range of nichrome thin-film chip resistors. Offering solutions to precision test and measurement and voltage regulation across industrial, military and medical monitoring equipment markets designed to offer superior humidity performance.

#### **Token Thick Film Chips Cut the Cost of Precision Resistors**

Token electronics has developed an extensive range of thick film / thin film resistive technologies for electronic circuits in power supplies; test and measurement; industrial electronics; telecommunications; audio circuits; automotive control systems; lighting controls; medical electronics; industrial equipment; and control systems applications.

In addition to this, proven thick film technologies from Token electronics provide a large range of standard resistive low Ohmic current sense products for critical battery management, and line termination. The enhanced performance of the chips is made possible by the precise use of the best resistance inks and a closely controlled production process.

#### **Token Chip Low Ohmic Resistors come in Smaller Sizes and Minimized Power Consumption**

Today's electronic devices are becoming smaller and smaller. As a result, designers are moving more towards surface mount components not only for new designs but also to design out large axial and other through-hole resistors.

In most cases this is a straight forward task as several resistor manufacturers offer chip resistors with performances to match axial parts. However in some cases, due to power rating or pulse withstanding requirements, this has been impossible. The requirement, in particular, for pulse withstand capability is growing due to the need to protect sensitive modern electronic systems. To meet this demand Token electronics have designed a Pulse Withstanding Chip Resistor (PWR Series).



# Thick Film Chip Resistors (FCR, RCA, RCN)

## ► Product Introduction

||| Token makes Flip Chip Resistor Networks Array a green old age.

### Features :

- Tight Tolerance down to  $\pm 0.1\%$
- Wide R-Value Range  $10\ \Omega \sim 1\text{Meg}\ \Omega$
- Extremely Low TCR down to  $\pm 25\ \text{PPM}/^\circ\text{C}$
- Special Passivated NiCr Film for Anti-Acid and Anti-Damp
- Long Term Life Stability with Advance Thin Film Technology
- Demonstrated the Anti-Corrosion Claims Characterized by  $\text{Ta}_2\text{N}$

### Applications :

- Telecommunication Device
- Automotive, Medical Equipment
- Outdoor Electronic Applications
- High-end Multimedia Electronics
- Automatic Equipment Controller
- High-end Computer, Industrial Equipment

Token has introduced precision surface-mount resistor networks, chip array, and flip-chips. Those no-lead packages are optimized to meet new automotive industry requirements for temperature and humidity, while offering high repeatability and stable performance for industrial, telecommunication, and consumer electronics.

Suitable for processing on automatic SMD assembly systems, those new devices are RoHS-compliant and compatible with lead (Pb)-free and tin/lead (Sn/Pb) reflow and vapor-phase soldering processes.



### Flip Chip Resistor FCR Series:

- The resistor flip chip configurations (FCR Series) are available in industry standard EIA0603, EIA0805, and EIA1206.
- Power Rating 1/10W, 1/8W, and 1/4W are available in max. voltage 100V, 300V, and 300V respectively.
- Resistance tolerance is tight to F( $\pm 1\%$ ), J( $\pm 5\%$ ) with resistance range  $1\ \Omega$  to  $10\text{M}\ \Omega$ .

### Resistor Chip Array RCA Series:

- Its small 1.6mm by 3.2mm package enables the design of high-density circuits.
- The resistor chip array (RCA Series) offers a low cost when compared to using four high-precision resistors.
- The devices feature precision ratio tolerances to F( $\pm 1\%$ ), G( $\pm 2\%$ ), and J( $\pm 5\%$ ) are available with resistance range  $10\ \Omega$  to  $1\text{M}\ \Omega$ .

### Resistor Networks RCN Series:

- The (RCN) resistor networks offer a resistance range from  $10\ \Omega$  to  $1\text{M}\ \Omega$  at operating temperature range  $-55\ ^\circ\text{C} \sim +125\ ^\circ\text{C}$ .
- All devices offer power ratings of 1/16W at  $+70\ ^\circ\text{C}$  per resistor, custom configurations of the devices are available.

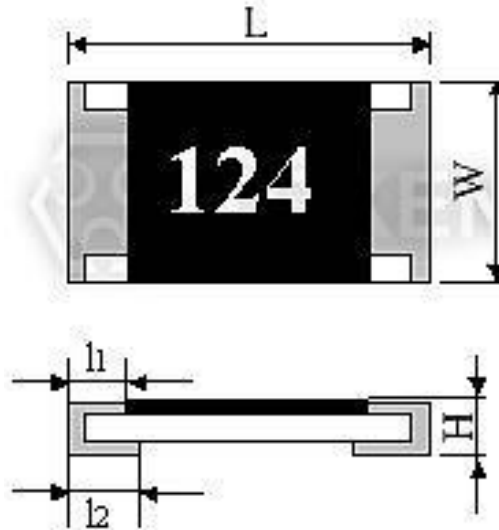
Full line products meet RoHS compliant. Detailed specifications, both mechanical and electrical, please contact our sales representative or link to Token official website "[Chip Resistors](http://www.token.com.tw)" for more information.



## ▶ FCR Dim

### Surface Mount Flip Resistor Dimensions (Unit: mm) (FCR)

Dimensions Type	L	W	H	L <sub>1</sub>	L <sub>2</sub>
FCR 03	1.60 ± 0.10	0.80 ± 0.10	0.45 ± 0.10	0.30 ± 0.20	0.30 ± 0.20
FCR 05	2.00 ± 0.15	1.25 ± 0.15	0.50 ± 0.10	0.40 ± 0.20	0.35 ± 0.15
FCR 06	3.10 ± 0.15	1.55 ± 0.15	0.55 ± 0.10	0.50 ± 0.25	0.50 ± 0.25

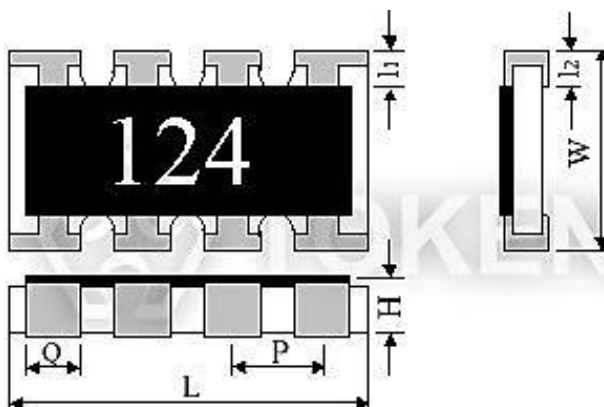


Thick Film Flip Chip Resistor (FCR) Dimensions

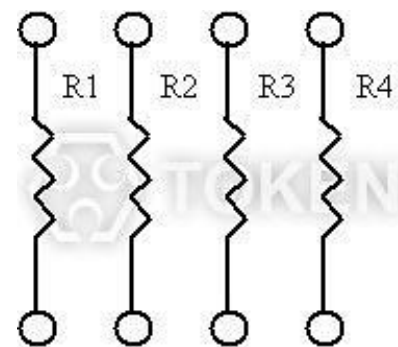
## ▶ RCA Dim.

### SMD Array Resistor Dimensions (Unit: mm) (RCA)

Dimensions Type	L	W	H	L <sub>1</sub>	L <sub>2</sub>	P	Q
RCA03-4D (0603)	3.2±0.2	1.6±0.15	0.5±0.1	0.30±0.15	0.35Max	0.8±0.1	0.5±0.1



Thick Film Resistor Chip Array (RCA) Dimensions



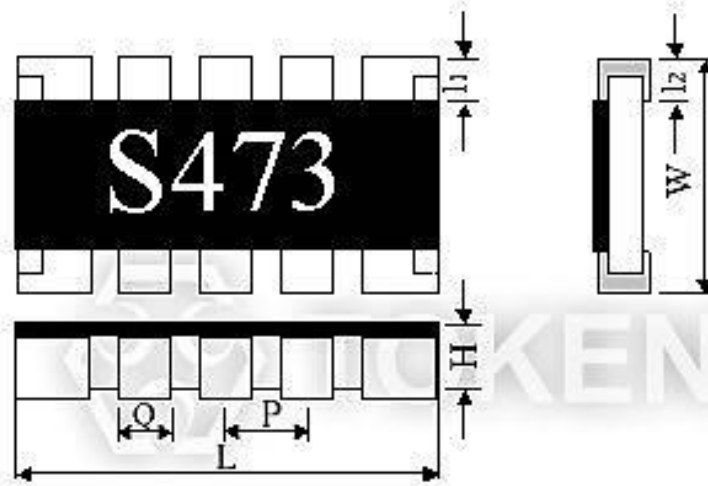
$$R1 = R2 = R3 = R4$$

Chip Array (RCA) Circuit

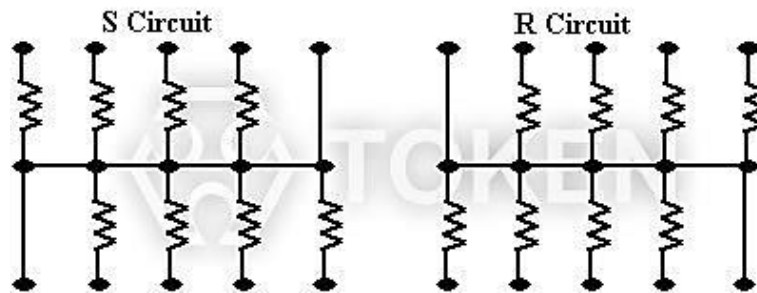
## RCN Dim.

### SMD Network Resistor Dimensions (Unit: mm) (RCN)

Dimensions Type	L	W	H	L <sub>1</sub>	L <sub>2</sub>	P	Q
RCN06-10R RCN06-10S	6.4 ± 0.2	3.1 ± 0.2	0.55 ± 0.1	0.5 ± 0.3	0.5 ± 0.2	1.27 ± 0.1	0.8 ± 0.2



Resistor Chip Networks (RCN) Dimensions



Chip Network (RCN) Circuit

## ► Electrical Spec.

### Electrical Specifications (FCR)

Type	Power Rating at 70°C	Max. RCWV	Max. Overload Voltage	Resistance Tolerance(%)	Resistance Range (Ω)		Standard Resistance Values
					Min.	Max.	
FCR03	1/10W	50V	100V	± 1% (F) ± 5% (J)	10Ω 1Ω	1MΩ 10MΩ	E-96 E-24
FCR05	1/8W	150V	300V	± 1% (F) ± 5% (J)	10Ω 1Ω	1MΩ 10MΩ	E-96 E-24
FCR06	1/4W	200V	300V	± 1% (F) ± 5% (J)	10Ω 1Ω	1MΩ 10MΩ	E-96 E-24

### Electrical Specifications (RCA)

Type	Rated Power at 70°C	Max. Working Voltage	Max. Overload Voltage	T.C.R. (ppm/°C)	Resistance Range(Ω)		Jumper Rated Current	Jumper Resistance Value	Operating Temperature Range
					F(±1%) E-96	G(±2%) J(±5%) E-24			
RCA03-4D (0603)	0.063	50V	100V	± 200	100~470K	10~1M	1A	50mΩ MAX	-55°C~ +125°C

### Electrical Specifications (RCN)

Type	Rated Power at 70°C	Max. Working Voltage	Max. Overload Voltage	T.C.R. (ppm/°C)	Resistance Range	Number of Terminals	Number of Elements	Operating Temperature Range
					J (±5%) E-12			
RCN06-10R RCN06-10S	1/16W	50V	100V	±200	10Ω~1MΩ	10	8	-55°C~ +125°C







## ► Environmental Characteristics

### Environmental Characteristics (FCR, RCA, RCN)

ITEM	SPECIFICATION	TEST METHOD
DC Resistance	J: $\pm 5\%$ , F: $\pm 1\%$	JIS C 5202 5.1
Temperature Coefficient of Resistance(TCR)	J: $\pm 200\text{ppm}/^{\circ}\text{C}$ F: $\pm 100\text{ppm}/^{\circ}\text{C}$	JIS C 5202 5.2 / IEC 115-1 4.8.4.2 T1 T2 Test temperature: $25^{\circ}\text{C} \rightarrow -55^{\circ}\text{C}$ $25^{\circ}\text{C} \rightarrow -55^{\circ}\text{C}$
Short Time Overload	J: $\Delta R \leq \pm (2\% + 0.1\Omega)$ F: $\Delta R \leq \pm (1\% + 0.05\Omega)$	JIS C 5202 5.5 / IEC 115-1 4.13 2.5xRated voltage (Max. Overload Voltage) for 5 sec. measure resistance after 30 minutes
Resistance to Solder Heat	J: $\Delta R \leq \pm (1\% + 0.1\Omega)$ F: $\Delta R \leq \pm (0.5\% + 0.05\Omega)$ No mechanical damage	JIS C 5202 6.4 / IEC 115-1 4.18 With $260 \pm 5^{\circ}\text{C}$ for $10 \pm 1$ sec.
Solderability	Over 95% of termination must be covered with solder	JIS C 5202 7.4 / IEC 115-1 4.17 After immersing flux, dip in the $235 \pm 5^{\circ}\text{C}$ molten solder bath for $2 \pm 0.5$ sec.
Temperature Cycle	J: $\Delta R \leq \pm (1\% + 0.1\Omega)$ F: $\Delta R \leq \pm (0.5\% + 0.05\Omega)$ No mechanical damage	JIS C 5202 7.4 / IEC 115-1 4.19 Repeat 5 cycles as follow $-55^{\circ}\text{C}$ (30minutes)+ $25^{\circ}\text{C}$ (10~15minutes) $+125^{\circ}\text{C}$ (30minutes)+ $25^{\circ}\text{C}$ (10~15minutes)
Terminal Strength	$\Delta R \leq \pm (0.5\% + 0.05\Omega)$ No mechanical damage	JIS C 5202 6.1 500g for 10 seconds
Load Life	J: $\Delta R \leq \pm (3\% + 0.1\Omega)$ F: $\Delta R \leq \pm (1\% + 0.05\Omega)$	JIS C 5202 7.10 / IEC 115-1 4.25.1 Permanent resistance change after 1000+48/-0 hours (1.5 hours ON, 0.5hour OFF) at RCWV or Max. Keep the element at $70 \pm 3^{\circ}\text{C}$ ambient
Load Life Humidity	J: $\Delta R \leq \pm (3\% + 0.1\Omega)$ F: $\Delta R \leq \pm (1\% + 0.05\Omega)$	JIS C 5202 7.9 / IEC 115-1 4.24.2 Maintain the temperature of the element at $40 \pm 2^{\circ}\text{C}$ and 90~95% RH with the rated voltage applied. Cycle ON for 1.5hours and Off for 0.5hour for 1000+48/-0 hours. After one hour, measure the resistance value.
Intermittent Overload	$\Delta R \leq \pm (5\% + 0.1\Omega)$ No mechanical damage	JIS C 5202 5.8 2.5xRated Voltage (Max. Overload Voltage), 1secON, 25sec OFF, test 10,000 cycles

## ▶ Marking

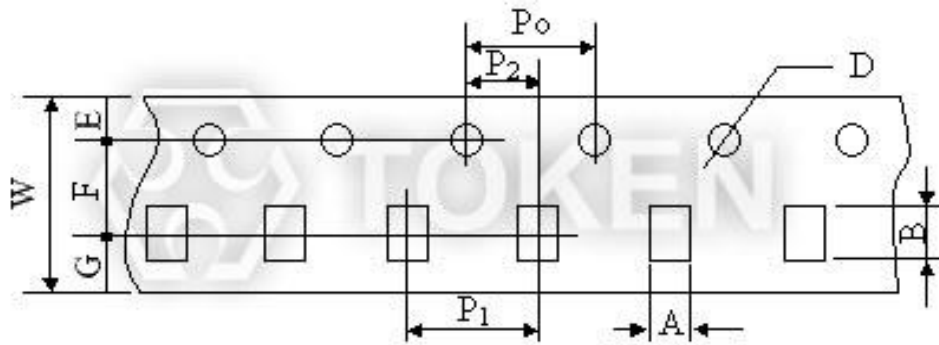
### Marking (FCR, RCA, RCN)

			
3 digit marking for E24 (J) 100 ~ 10Ω 122 ~ 1.2KΩ 473 ~ 47KΩ 105 ~ 1MΩ	4 digit marking for E96 (F) 22R1 ~ 22.1Ω 1020 ~ 102Ω 1542 ~ 15.4KΩ	3 digit marking for E96 (F) 02C 102 X 10 <sup>2</sup> = 10.2KΩ	15E 140 X 10 <sup>4</sup> = 1.4MΩ
<b>SMD Resistor Marking</b>			

## ▶ Tape & Packaging

### Tape Specifications (Unit: mm) (FCR, RCA, RCN)

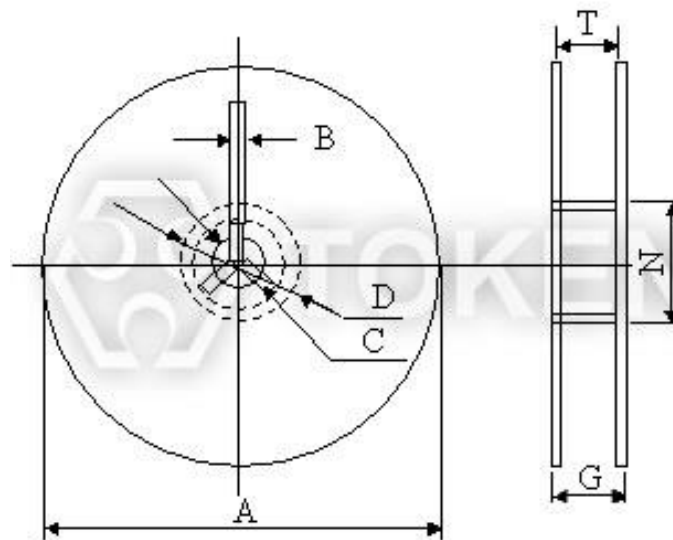
TYPE	A	B	W	F	E	P <sub>1</sub>	P <sub>2</sub>	P <sub>0</sub>	D	G
FCR03	1.10±0.20	1.90±0.20	8.0±0.3	3.50±0.05	1.75±0.10	4.0±0.1	2.00±0.05	4.0±0.1	1.5±0.1	2.75
FCR05	1.65±0.20	2.45±0.20	8.0±0.3	3.50±0.05	1.75±0.10	4.0±0.1	2.00±0.05	4.0±0.1	1.5±0.1	2.75
FCR06	2.00 <sup>+0.10</sup> <sub>-0.15</sub>	3.57 <sup>+0.10</sup> <sub>-0.15</sub>	8.0±0.3	3.50±0.05	1.75±0.10	4.0±0.1	2.00±0.05	4.0±0.1	1.5±0.1	2.75



SMD Surface Mount Tape Dimensions

### Reel Packaging (Unit: mm) (FCR, RCA, RCN)

Symbol	A	B	C	D	G	N	T
Dimension	178 ± 2.0	20 ± 0.5	13.0 ± 0.5	20 min.	100 ± 1.5	80.0 ± 0.5	14.9 max.



Reel Packaging Dimensions

## Order Codes

### Order Codes Flip SMD Resistors (FCR)

FCR	03		100			J		TR	
Part Number	Size (mm)		Nominal Resistance			Resistance Tolerance (%)		Package	
FCR	03	1.60×0.80	SMD Elements	3-Digit	E24 Series EX 10Ω=100 47Ω=470	F	±1%	TR	Taping Reel
	05	2.00×1.25		4-Digit	E96 Series EX 10.2Ω=10R2 10KΩ=1002	J	±5%	P	Bulk
	06	3.10×1.55	Jumper		000				

### Order Codes Resistor SMD Array (RCA)

RCA	03		-	4	D	101			J		TR			
Part Number	Size(mm)			Number of circuits	Electrode Structure		Nominal Resistance			Resistance Tolerance (%)		Package		
RCA	03	3.20×1.60		4	4 circuits	D	protruding electrode	SMD Elements	3-Digit	E24 Series EX 10Ω=100 47Ω=470	F	±1%	TR	Taping Reel
									4-Digit	E96 Series EX 10.2Ω=10R2 10KΩ=1002	G	±2%	P	Bulk
								Jumper		000	J	±5%		

### Order Codes SMD Resistor Networks (RCN)

RCN	06		-	10	R	103			J		TR		
Part Number	Size (mm)			Number of Terminals	Circuit Structure		Nominal Resistance			Resistance Tolerance (%)		Package	
RCN	06	6.40×3.10		10	R	circuit	3-Digit	E12 Series EX 10Ω=100 100Ω=101	J	±5%	TR	Taping Reel	
					S	circuit					P	Bulk	

### ► General Information

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In most cases this is a straight forward task as several resistor manufacturers offer chip resistors with performances to match axial parts. However in some cases, due to power rating or pulse withstanding requirements, this has been impossible. The requirement, in particular, for pulse withstand capability is growing due to the need to protect sensitive modern electronic systems. To meet this demand Token electronics have designed a Pulse Withstanding Chip Resistor (PWR Series).



# Thick Film Chip Resistors (HVR)

## ► Product Introduction

### ||| Thick-Film Chip Resistors operate at high voltages

#### Features :

- Reduced size of final equipment
- Miniature size HVR02(0402) available
- Excellent performance at high voltage
- Higher component and equipment reliability
- Pb-free terminations meet RoHS requirements
- Thick film chips with highly reliable multiplayer electrode construction

#### Applications :

- Inverter, Converters
- Automatic Equipment Controller
- High-Voltage Power Supplies, Circuit Protection Devices
- Medical Equipment (Defibrillators, High Pulse Equipment)
- Printer Equipment, Consumer Product, Outdoor Equipments
- Military Equipment (Night Vision Cameras, X-ray Equipment)

### New (HVR) High-voltage chip resistors deliver power ratings up to 4 KV.

Token electronics has introduced a thick-film chip resistor series with wide resistance range from 10Ω to 100MΩ. The (HVR) series of surface mount resistors feature high-voltage operation in standard 0402, 0603, 0805, 1206, 2010 and 2512 package sizes, making them well ideal for automatic handling methods.



The (HVR) resistors offer high voltage, extended surge ratings.

This pulse-withstanding chip resistor combines extended surge values with high-voltage ratings for high-power applications. The (HVR) series are designed for use in high-voltage power supplies, circuit protection devices, medical equipment (defibrillators), military equipment (night vision cameras, x-ray equipment), automotive industry, and High Pulse Equipments.

Token's (HVR) series features high grade alumina substrate wrap-around terminations with an electroplated nickel barrier (Ni) with Edge Electrode (NiCr), and either tin/lead or RoHS-compliant matte tin finish. In addition, the overall robust construction allows the chip resistor to operate in harsh, high-voltage environments.

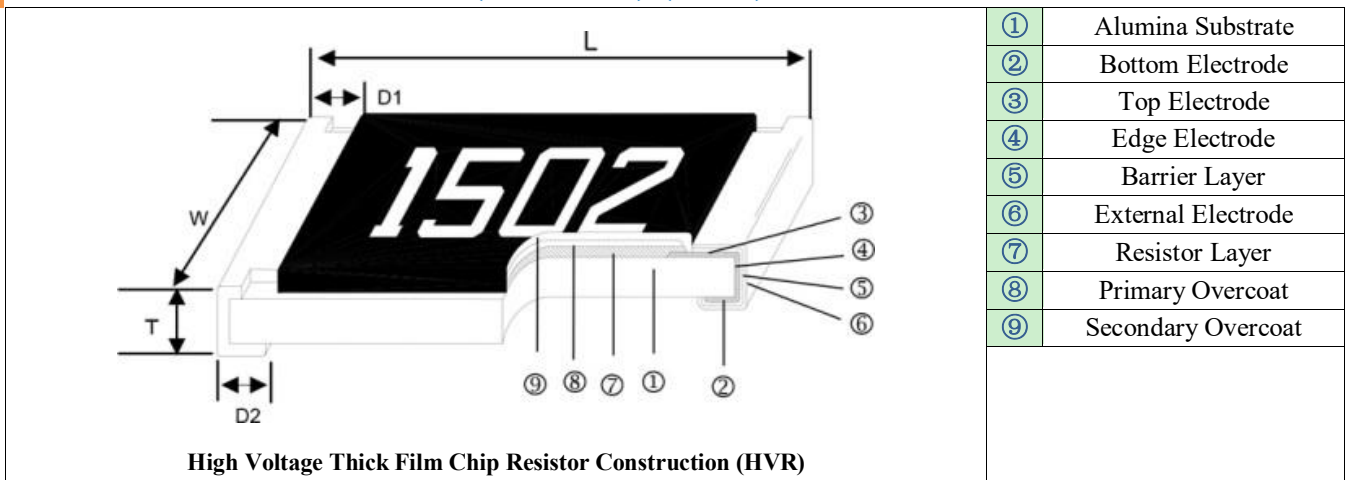
The (HVR) series feature tolerances of ±1%, and ±5%. Continuous voltage ratings are rated up to 3 KV, with maximum overload voltage to 4 KV. Power ratings for the HVR02 (0402), HVR03(0603), HVR05(0805), HVR06(1206), HVR0A(2010) and HVR12(2512) resistors are 1/16W, 1/10W, 1/8W, 1/4W, 1/2W and 1W, respectively, with an operating temperature range of -55°C to +155°C. Custom specifications are available.

The (HVR) series are available in taping packaging and RoHS compliant. For non-standard technical requirements and special applications, please contact us with your specific needs, or link to Token official website "[Chip Resistors](http://www.token.com.tw)" to get more information.



## Construction & Dimensions

### Construction & Dimensions (Unit: mm) (HVR)



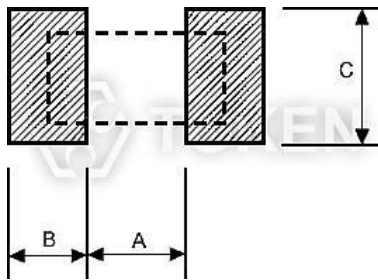
①	Alumina Substrate
②	Bottom Electrode
③	Top Electrode
④	Edge Electrode
⑤	Barrier Layer
⑥	External Electrode
⑦	Resistor Layer
⑧	Primary Overcoat
⑨	Secondary Overcoat

Type	L (Unit: mm)	W (Unit: mm)	T (Unit: mm)	D1 (Unit: mm)	D2 (Unit: mm)	Weight(g)/ 1000pcs
HVR02 (0402)	1.00±0.05	0.50±0.05	0.35±0.05	0.20±0.10	0.20±0.10	0.620
HVR03 (0603)	1.60±0.10	0.80±0.10	0.45±0.10	0.30±0.20	0.30±0.20	2.042
HVR05 (0805)	2.00±0.10	1.25±0.10	0.50±0.10	0.35±0.20	0.40±0.20	4.368
HVR06 (1206)	3.10±0.10	1.55±0.10	0.55±0.10	0.50±0.25	0.50±0.20	8.947
HVR0A (2010)	5.00±0.10	2.50±0.15	0.55±0.10	0.60±0.25	0.50±0.20	24.241
HVR12 (2512)	6.35±0.10	3.10±0.15	0.55±0.10	0.60±0.25	0.50±0.20	39.448

## Recommend Conditions

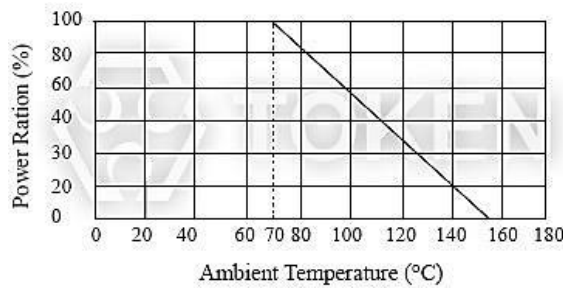
### Recommend Land Pattern (Unit: mm) (HVR)

Codes	A	B	C
HVR02 (0402)	0.50	0.45	0.60±0.2
HVR03 (0603)	0.90	0.60	0.90±0.2
HVR05 (0805)	1.20	0.70	1.30±0.2
HVR06 (1206)	2.00	0.90	1.60±0.2
HVR0A (2010)	3.80	0.90	2.80±0.2
HVR12 (2512)	3.80	1.60	3.50±0.2



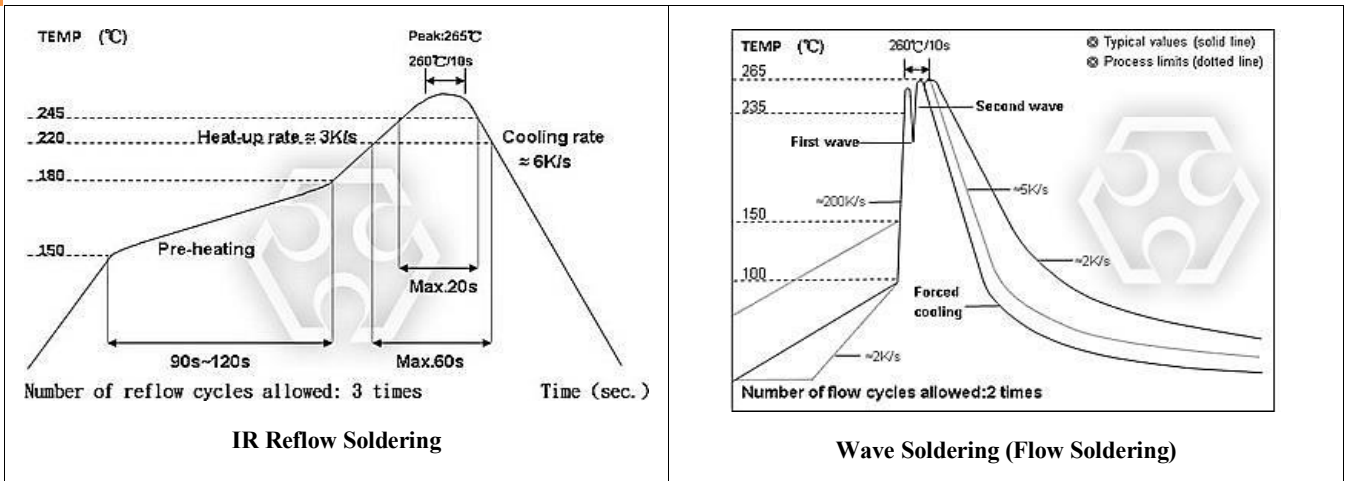
Recommend Land Pattern (HVR)

### Power Derating Curve (HVR)



Power Derating Curve (HVR) Series

### Soldering Condition (PR)



- (1) Time of IR reflow soldering at maximum temperature point 260°C : 10s
- (2) Time of wave soldering at maximum temperature point 260°C : 10s
- (3) Time of soldering iron at maximum temperature point 410°C : 5s



## Electrical Spec.

### Standard Electrical Specifications (HVR)

Type	Power Rating at 70 °C	Operating Temp. Range	Max Operating Voltage	Max Overloading Voltage	Resistance Tolerance	Resistance Range	TCR
HVR02 (0402)	1/16W	-55 ~ +155°C	100V	200V	±1.0%, ±5.0%	39KΩ~1MΩ	±100PPM/°C
					±1.0%	1.02MΩ~10MΩ	±200PPM/°C
					±5.0%	1.1MΩ~20MΩ	±200PPM/°C
					±5.0%	22MΩ~100MΩ	±400PPM/°C
HVR03 (0603)	1/10W	-55 ~ +155°C	200V	400V	±1.0%, ±5.0%	56KΩ~1MΩ	±100PPM/°C
					±1.0%	1.02MΩ~10MΩ	±200PPM/°C
					±5.0%	1.1MΩ~20MΩ	±200PPM/°C
					±5.0%	22MΩ~100MΩ	±400PPM/°C
HVR05 (0805)	1/8W	-55 ~ +155°C	400V	800V	±1.0%, ±5.0%	100KΩ~1MΩ	±100PPM/°C
					±1.0%	1.02MΩ~10MΩ	±200PPM/°C
					±5.0%	1.1MΩ~20MΩ	±200PPM/°C
					±5.0%	22MΩ~100MΩ	±400PPM/°C
HVR06 (1206)	1/4W	-55 ~ +155°C	500V	1000V	±1.0%, ±5.0%	100KΩ~1MΩ	±100PPM/°C
					±1.0%	1.02MΩ~10MΩ	±200PPM/°C
					±5.0%	1.1MΩ~20MΩ	±200PPM/°C
					±5.0%	22MΩ~100MΩ	±400PPM/°C
HVR0A (2010)	1/2W	-55 ~ +155°C	2000V	3000V	±1.0%, ±5.0%	51KΩ~1MΩ	±100PPM/°C
					±1.0%	1.02MΩ~10MΩ	±200PPM/°C
					±5.0%	1.1MΩ~20MΩ	±200PPM/°C
					±5.0%	22MΩ~100MΩ	±400PPM/°C
HVR12 (2512)	1W	-55 ~ +155°C	3000V	4000V	±1.0%, ±5.0%	30KΩ~1MΩ	±100PPM/°C
					±1.0%	1.02MΩ~10MΩ	±200PPM/°C
					±5.0%	1.1MΩ~20MΩ	±200PPM/°C
					±5.0%	22MΩ~100MΩ	±400PPM/°C

- Lower Resistance :( 1~10)Ω.
- Operating Voltage =  $\sqrt{P * R}$  , or Max. Operating Voltage listed in above table whichever is lower.
- Overloading Voltage =  $2.5 * \sqrt{P * R}$  , or Max. Overloading Voltage listed in above table whichever is lower.
- Optional specifications can be required.

## Environmental Characteristics

### Environmental Characteristics (HVR)

Item	Specification		Test Method
	Tol. 1%	Tol. 5%	
Dry Heat	$\pm(1\%+0.05\Omega)$	$\pm(1.5\%+0.10\Omega)$	JIS-C-5201-1 4.23 IEC-60115-1 4.23.2 At +155°C for 1000 hrs.
Endurance	$\pm(2\%+0.10\Omega)$	$\pm(3\%+0.10\Omega)$	JIS-C-5201-1 4.25 IEC-60115-1 4.25.1 70±2°C, Max. Working voltage for 1000 hrs with 1.5 hrs "ON" and 0.5 hrs "OFF".
Bending Strength	$\pm(1\%+0.05\Omega)$	$\pm(1\%+0.05\Omega)$	JIS-C-5201-1 4.33 IEC-60115-1 4.33 Bending once for 5 seconds, 2010, 2512 sizes: 2mm, other sizes: 3mm.
Short Time Overload	$\pm(1\%+0.05\Omega)$	$\pm(2\%+0.05\Omega)$	JIS-C-5201-1 4.13 IEC-60115-1 4.13 RCWV*2.5 or Max Overloading Voltage whichever is lower for 5 seconds.
Damp Heat with Load	$\pm(2\%+0.10\Omega)$	$\pm(3\%+0.10\Omega)$	JIS-C-5201-1 4.24 IEC-60115-1 4.24 40±2°C, 90~95% R.H. Max. Working voltage for 1000 hrs with 1.5 hrs "ON" and 0.5 hrs "OFF".
Resistance to Soldering Heat	$\pm(0.5\%+0.05\Omega)$	$\pm(1\%+0.05\Omega)$	JIS-C-5201-1 4.18 IEC-60115-1 4.18 260±5°C for 10 seconds.
Rapid Change of Temperature	$\pm(0.5\%+0.05\Omega)$	$\pm(1\%+0.05\Omega)$	JIS-C-5201-1 4.19 IEC-60115-1 4.19 -55°C to +155°C, 5 cycles.
Temperature Coefficient of Resistance	AS Spec		JIS-C-5201-1 4.8 IEC-60115-1 4.8 -55°C ~ +125°C, 25°C is the reference temperature.
Insulation Resistance	≥10GΩ		JIS-C-5201-1 4.6 IEC-60115-1 4.6 Max. Overload voltage for 1 minute.
Solderability	95% Min. coverage		JIS-C-5201-1 4.17 IEC-60115-1 4.17 245±5°C for 3 seconds.
Voltage Proof	No breakdown or flashover		JIS-C-5201-1 4.7 IEC-60115-1 4.7 HVR02: 150V for 1 minute; HVR03: 300V for 1 minute; HVR05/HVR06/HVR0A/HVR12: 500V for 1 minute
Leaching	Individual leaching area ≤5% total leaching area ≤10%		JIS-C-5201-1 4.18 IEC-60068-2-58 8.2.1 260±5°C for 30 seconds.

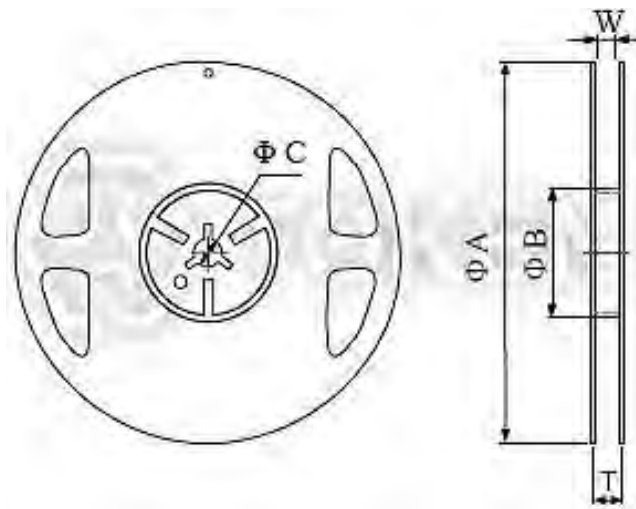
- Rated continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value } (\Omega)}$  or Max. Operating voltage whichever is lower.
- Storage Temperature: 15~28°C; Humidity < 80% RH;



## ► Packaging & Reel Tape

### Packaging Quantity & Reel Specifications (Unit: mm) (HVR)

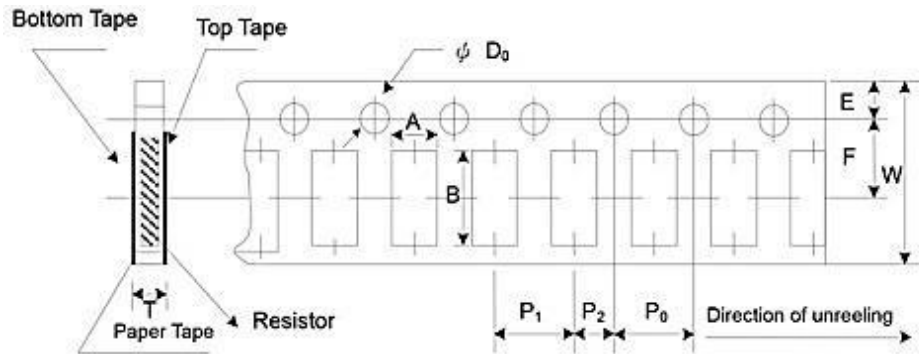
Codes	Packaging Quantity (KPCs)	Tape Width	Reel Diameter	ΦA (mm)	ΦB (mm)	ΦC (mm)	W (mm)	T (mm)	
HVR02	Paper	10K	8mm	7 inch	178.5±1.5	60 <sup>+1</sup>	13.0±0.2	9.0±0.5	12.5±0.5
		20K	8mm	10 inch	254±1	100±0.5	13.0±0.2	9.5±0.5	13.5±0.5
		40K	8mm	13 inch	330±1	100±0.5	13.0±0.2	9.5±0.5	13.5±0.5
HVR03 HVR05 HVR06	Paper	5K	8mm	7 inch	178.5±1.5	60 <sup>+1</sup>	13.0±0.2	9.0±0.5	12.5±0.5
		10K	8mm	10 inch	254±1	100±0.5	13.0±0.2	9.5±0.5	13.5±0.5
		20K	8mm	13 inch	330±1	100±0.5	13.0±0.2	9.5±0.5	13.5±0.5
HVR0A HVR12	Embossed	4K	12mm	7 inch	178.5±1.5	60 <sup>+1</sup>	13.0±0.5	13.0±0.5	15.5±0.5
		8K	12mm	10 inch	250±1	62±0.5	13.0±0.5	12.5±0.5	16.5±0.5



Reel Packaging (PR)

## Paper Tape Specifications (Unit: mm) (HVR)

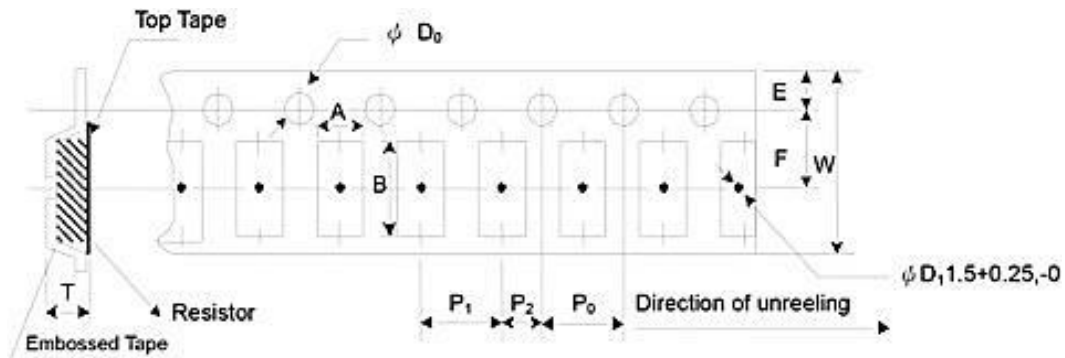
Codes	A (mm)	B (mm)	W (mm)	E (mm)	F (mm)	P <sub>0</sub> (mm)	P <sub>1</sub> (mm)	P <sub>2</sub> (mm)	ΦD <sub>0</sub> (mm)	T (mm)
HVR02	0.65±0.10	1.15±0.10	8.0±0.20	1.75±0.10	3.50±0.05	4.00±0.10	2.00±0.05	2.00±0.05	1.50 <sup>+0.1</sup>	0.45±0.1
HVR03	1.10±0.10	1.90±0.1	8.0±0.2	1.75±0.1	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50 <sup>+0.1</sup>	0.70±0.1
HVR05	1.60±0.10	2.40±0.2	8.0±0.2	1.75±0.1	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50 <sup>+0.1</sup>	0.85±0.1
HVR06	1.90±0.10	3.50±0.2	8.0±0.2	1.75±0.1	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50 <sup>+0.1</sup>	0.85±0.1



Paper Tape Specifications (HVR)

## Emboss Plastic Tape Specifications (Unit: mm) (HVR)

Codes	A (mm)	B (mm)	W (mm)	E (mm)	F (mm)	P <sub>0</sub> (mm)	P <sub>1</sub> (mm)	P <sub>2</sub> (mm)	ΦD <sub>0</sub> (mm)	T (mm)
HVR0A	2.8±0.10	5.5±0.10	12.0±0.3	1.75±0.1	5.5±0.05	4.00±0.10	4.00±0.1	2.00±0.05	1.50 <sup>+0.1</sup>	1.2
HVR12	3.5±0.10	6.7±0.10	12.0±0.3	1.75±0.1	5.5±0.05	4.00±0.10	4.00±0.1	2.00±0.05	1.50 <sup>+0.1</sup>	1.2



Embossed Plastic Tape (HVR)

## Order Codes

### Order Codes (HVR)

HVR	03	J	TR	E	V	1003
Part Number	Dimensions (L×W) (mm)	Resistance Tolerance (%)	Package	TCR (ppm/°C)	Power Rating(W)	Resistance (Ω)
02	EIA0402	F ±1 J ±5	TR Taping Reel	E ±100	T 1	4R70 4.7
03	EIA0603		P Bulk	F ±200	U 1/2	1000 100
05	EIA0805			H ±400	V 1/4	4700 470
06	EIA1206				W 1/8	4992 49.9K
0A	EIA2010				X 1/10	1003 100K
12	EIA2512				Y 1/16	1004 1M
						1005 10M

### 0805~2512 4 digits marking for Example Marking

Resistance	100Ω	2.2KΩ	10KΩ	49.9KΩ	100KΩ	1MΩ
Marking	1000	2201	1002	4992	1003	1004

### 0603: 3 digits Marking E24 Nominal Table

E24 code	10	11	12	13	15	16	18	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75	82	91
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- Example: 101=100Ω 102=1KΩ (1<sup>st</sup> and 2<sup>nd</sup> are E24 code and 3<sup>rd</sup> code is multiplier)
- Resistance tolerance 1% for 0603: 3 digits marking in E96 (E96 series except E24 series)
- Digits marking for Example: 13C=13K3Ω; 68B=4K99Ω; 68X=49.9Ω

### Marking Table E96 Nominal Table

code	02	03	04	06	07	08	09	10	11	13	14	15	16	17	19	20	21	22	23	24	25	26	27
E96	102	103	107	113	115	118	121	124	127	133	137	140	143	147	154	158	162	165	169	174	178	182	187
code	28	29	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
E96	191	196	205	210	215	221	226	232	237	243	249	255	261	267	274	280	287	294	301	309	316	324	332
code	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74
E96	340	348	357	365	374	383	392	402	412	422	432	442	453	464	475	487	499	511	523	536	549	562	576
code	75	76	77	78	79	80	81	82	83	84	86	87	88	89	90	91	92	93	94	95	96		
E96	590	604	619	634	649	665	681	698	715	732	768	787	806	825	845	866	887	909	931	953	976		

### Multiplier E96 Marking

Code	A	B	C	D	E	F	X	Y
Multiplier	10 <sup>0</sup>	10 <sup>1</sup>	10 <sup>2</sup>	10 <sup>3</sup>	10 <sup>4</sup>	10 <sup>5</sup>	10 <sup>-1</sup>	10 <sup>-2</sup>



### ► General Information

#### **Token Thin Film Chips Add Powerful New Options**

Token electronics provides the industry's most comprehensive range of precision thin film technologies for discrete, network, and integrated passive components used in instrumentation; automotive electronics; communications systems; and portable electronics applications. Ultra-reliable precision Nichrome resistive elements are available on ceramic or silicon substrates in a wide variety of surface mount resistors.

In response to market demands for increased precision and stability, Token has expanded range of nichrome thin-film chip resistors. Offering solutions to precision test and measurement and voltage regulation across industrial, military and medical monitoring equipment markets designed to offer superior humidity performance.

#### **Token Thick Film Chips Cut the Cost of Precision Resistors**

Token electronics has developed an extensive range of thick film / thin film resistive technologies for electronic circuits in power supplies; test and measurement; industrial electronics; telecommunications; audio circuits; automotive control systems; lighting controls; medical electronics; industrial equipment; and control systems applications.

In addition to this, proven thick film technologies from Token electronics provide a large range of standard resistive low Ohmic current sense products for critical battery management, and line termination. The enhanced performance of the chips is made possible by the precise use of the best resistance inks and a closely controlled production process.

#### **Token Chip Low Ohmic Resistors come in Smaller Sizes and Minimized Power Consumption**

Today's electronic devices are becoming smaller and smaller. As a result, designers are moving more towards surface mount components not only for new designs but also to design out large axial and other through-hole resistors.

In most cases this is a straight forward task as several resistor manufacturers offer chip resistors with performances to match axial parts. However in some cases, due to power rating or pulse withstanding requirements, this has been impossible. The requirement, in particular, for pulse withstand capability is growing due to the need to protect sensitive modern electronic systems. To meet this demand Token electronics have designed a Pulse Withstanding Chip Resistor (PWR Series).



# Pulse Withstanding Chip Resistor (PWR)

## ▶ Product Introduction

**Token (PWR) pulse withstanding chip resistors provide 50 percent increase in power dissipation.**

### Features :

- High Power Rating
- Tolerance from  $\pm 0.5\%$  ~  $\pm 5\%$
- Improved Working Voltage Ratings
- Standard Package sizes 0603 ~ 2512
- Excellent Pulse Withstanding Performance

### Applications :

- Power Supplies, Diagnostic Equipment
- Industrial Controls, LCD Video Monitors
- Portable Battery Chargers, Medical Devices
- Motor Controls and Line-Powered Equipment
- Metering (Testing/Measurement), Circuit Protection Devices

As electronic design engineers have increased the power density of their equipment, the demand for smaller surface mount single-chip circuit protection resistors has also increased. Token developed the PWR Series resistors to provide an economical alternative to bulky molded wire-wound components or multi-chip solutions while saving both PC board space and manufacturing costs.

To meet the increased demand for the PWR Series resistors, Token has developed a series of pulse withstanding chip resistors with improved power ratings in reduced surface mounted sizes. Designated the PWR Series, the SMD resistors deliver up to 50 percent higher power ratings than conventional surface mount resistors - up to 1.5W in a standard 2512 size chip.

Token is able to boost this power rating up to 50 percent through a combination of proprietary power film materials and advanced manufacturing processes. The PWR Series Resistors are available in four standard sizes (0603, 0805, 1206, 1210, 2010 and 2512) with power ratings from 0.125W to 1.5W, and maximum operating voltage ratings for 100V to 500V. Resistance range is from 10  $\Omega$  to 20 M $\Omega$ , with tolerance tight to 0.5 percent. The PWR meets restriction of hazardous substances RoHS directive and RoHS compliance.

Along with the increased power ratings, the PWR Series resistors also feature high surge and high voltage ratings, making them extremely stable in demanding surge and pulse environments. The PWR Series chip resistors are specified for use in power supplies, circuit protection devices, portable battery chargers, motor controls and line-powered equipment.

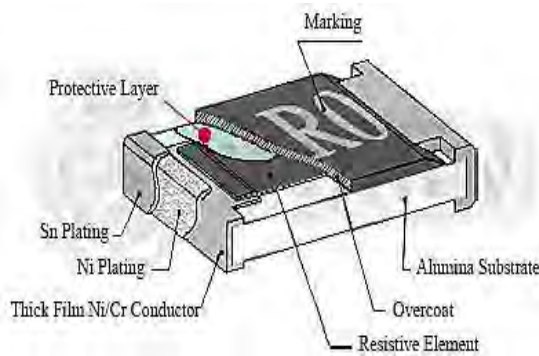
Token will also produce devices outside these specifications to meet specific customer requirements, please contact our sales or link to Token official website "[Chip Resistors](http://www.token.com.tw)" for more information.



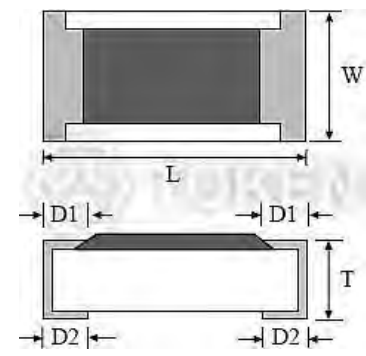
## ► Dimensions

### Dimensions (Unit: mm) (PWR)

Codes	L (Unit: mm)	W (Unit: mm)	T (Unit: mm)	D1 (Unit: mm)	D2 (Unit: mm)	Weight (g)/1000pcs
<b>PWR03 (0603)</b>	1.60±0.10	0.80±0.10	0.45±0.10	0.30±0.20	0.30±0.20	2,042
<b>PWR05 (0805)</b>	2.00±0.10	1.25±0.10	0.50±0.10	0.35±0.20	0.40±0.25	4,368
<b>PWR06 (1206)</b>	3.10±0.10	1.55±0.10	0.55±0.10	0.50±0.25	0.50±0.20	8,947
<b>PWR13 (1210)</b>	3.10±0.10	2.60±0.15	0.55±0.10	0.50±0.25	0.50±0.20	15,959
<b>PWR10 (2010)</b>	5.00±0.10	2.50±0.15	0.55±0.10	0.60±0.25	0.50±0.20	24,241
<b>PWR12 (2512)</b>	6.35±0.10	3.10±0.15	0.55±0.10	0.60±0.25	0.50±0.20	39,448



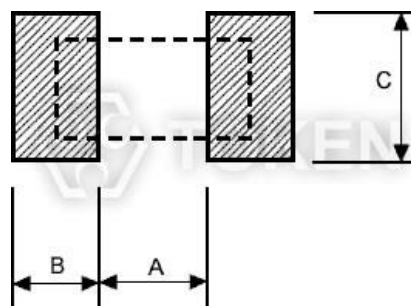
**Pulse Withstanding Chips (PWR) Construction**



**Dimensions (Unit: mm) (PWR)**

### Recommend Land Pattern (Unit: mm) (PWR)

Codes	A (mm)	B (mm)	C (mm)
<b>PWR03 (0603)</b>	0.90	0.60	0.90
<b>PWR05 (0805)</b>	1.20	0.70	1.30
<b>PWR06 (1206)</b>	2.00	0.90	1.60
<b>PWR13 (1210)</b>	2.00	0.90	2.80
<b>PWR10 (2010)</b>	3.80	0.90	2.80
<b>PWR12 (2512)</b>	3.80	1.60	3.50



**Recommend Land Pattern (PWR)**



## ► Electrical Spec.

### Standard Electrical Specifications (PWR)

Type	Power Rating at 70°C	Operating Temp. Range	Max Operating Voltage	Max Overloading Voltage	Resistance Tolerance (%)	Resistance Range (Ω)	TCR PPM/°C
PWR03 (0603)	1/10W	-55 ~ +155°C	50V	100V	±0.5%	10~294	±200
					±1%, ±5%	1~294	±200
					±0.5%, ±1%, ±5%	300~1M	±100
PWR05 (0805)	1/8W	-55 ~ +155°C	150V	300V	±0.5%	10~294	±200
					±1%, ±5%	1~294	±200
					±0.5%, ±1%, ±5%	300~20M	±100
PWR06 (1206)	1/3W	-55 ~ +155°C	200V	400V	±0.5%	10~20	±200
					±1%, ±5%	1~20	±200
					±0.5%, ±1%, ±5%	20.5~20M	±100
PWR13 (1210)	1/2W	-55 ~ +155°C	200V	400V	±0.5%	10~20	±200
					±1%, ±5%	1~20	±200
					±0.5%, ±1%, ±5%	20.5~20M	±100
PWR10 (2010)	3/4W	-55 ~ +155°C	400V	800V	±0.5%	10~20	±200
					±1%, ±5%	1~20	±200
					±0.5%, ±1%, ±5%	20.5~20M	±100
PWR12 (2512)	1.5W	-55 ~ +155°C	500V	1000V	±0.5%	10~20	±200
					±1%, ±5%	1~20	±200
					±0.5%, ±1%, ±5%	20.5~20M	±100

- Lower Resistance :( 1~10 ) Ω.
- Operating Voltage =  $\sqrt{P * R}$  , or Max. Operating Voltage listed in above table whichever is lower.
- Overloading Voltage =  $2.5 * \sqrt{P * R}$  , or Max. Overloading Voltage listed in above table whichever is lower.
- Optional specifications can be required.



## High Power Rating Electrical Specifications (PWR)

Type	Power Rating at 70°C	Operating Temp. Range	Max Operating Voltage	Max Overloading Voltage	Resistance Tolerance (%)	Resistance Range (Ω)	TCR PPM/°C
PWR03 (0603)	1/8W, 1/5W	-55 ~ +155°C	50V	100V	±0.5%	10~294	±200
					±1%, ±5%	1~294	±200
					±0.5%, ±1%, ±5%	300~1M	±100
PWR05 (0805)	1/4W	-55 ~ +155°C	150V	300V	±0.5%	10~294	±200
					±1%, ±5%	1~294	±200
					±0.5%, ±1%, ±5%	300~20M	±100
PWR06 (1206)	1/2W	-55 ~ +155°C	200V	400V	±0.5%	10~20	±200
					±1%, ±5%	1~20	±200
					±0.5%, ±1%, ±5%	20.5~20M	±100
PWR10 (2010)	1W	-55 ~ +155°C	400V	800V	±0.5%	10~20	±200
					±1%, ±5%	1~20	±200
					±0.5%, ±1%, ±5%	20.5~20M	±100

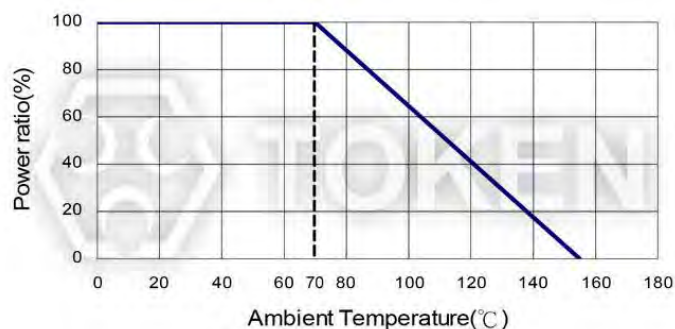
- Lower Resistance :( 1~10 ) Ω.
- Operating Voltage =  $\sqrt{P * R}$  , or Max. Operating Voltage listed in above table whichever is lower.
- Overloading Voltage =  $2.5 * \sqrt{P * R}$  , or Max. Overloading Voltage listed in above table whichever is lower.
- Optional specifications can be required.



## Environmental Characteristics

### Environmental Characteristics (PWR)

Test Item	Specification	Test Method
Short Time Overload	±0.5%	JIS-C-5201-1 4.13 IEC-60115-1 4.13 RCWV*2.5 or Max Overloading Voltage whichever is lower for 5 seconds
Leaching	Individual leaching area ≥5% Total leaching area ≥10%	JIS-C-5201-1 4.18 IEC-60068-2-58 8.2.1 -55°C~155°C, 5 cycles
Temperature Coefficient of Resistance	As Spec.	JIS-C-5201-1 4.8 IEC-60115-1 4.8 +25/-55/+25/+125/+25°C
Load Life (Endurance)	±(1%+0.05Ω)	JIS-C-5201-1 4.25 IEC-60115-1 4.25.1 RCWV, 70°C, 1.5 hours ON, 0.5 hours OFF, total 1000 hours
Humidity (Steady State) (Damp Heat with Load)	±(0.5%+0.05Ω)	JIS-C-5201-1 4.24 IEC-60115-1 4.24 40±2°C, 90~95%RH, RCWV 1.5 hours ON, 0.5 hours OFF, total 1000 hours
Resistance to Dry Heat	±0.5%	JIS-C-5202-7.2 96 hours @ +155°C without load
Low Temperature Operation	±0.5%	JIS-C-5202-7.1 1hour, -65°C followed by 45 minutes of RCWV
Dry Heat	±(0.5%+0.05Ω)	JIS-C-5201-1 4.23 IEC-60115-1 4.23.2 at +155°C for 1000 hrs. 2010, 2512 sizes: 2mm; Other sizes: 3mm
Bending Strength	±(1%+0.05Ω)	JIS-C-5201-1 4.33 IEC-60115-1 4.33 Bending once for 5 seconds. 2010, 2512 sizes: 2mm; Other sizes: 3mm
Resistance to Soldering Heat	±(0.5%+0.05Ω)	JIS-C-5201-1 4.18 IEC-60115-1 4.18 260±5°C, 10±1seconds
Solderability	95% min coverage	JIS-C-5201-1 4.17 IEC-60115-1 4.17 245°C±5°C for 3 seconds
Dielectric Withstand Voltage (Voltage Proof)	No breakdown or flashover	JIS-C-5201-1 4.7 IEC-60115-1 4.7 1.42 times Max. Operating Voltage for 1 minute
Insulation Resistance	>10GΩ	JIS-C-5201-1 4.6 IEC-60115-1 4.6 Max. Overload Voltage for 1 minute

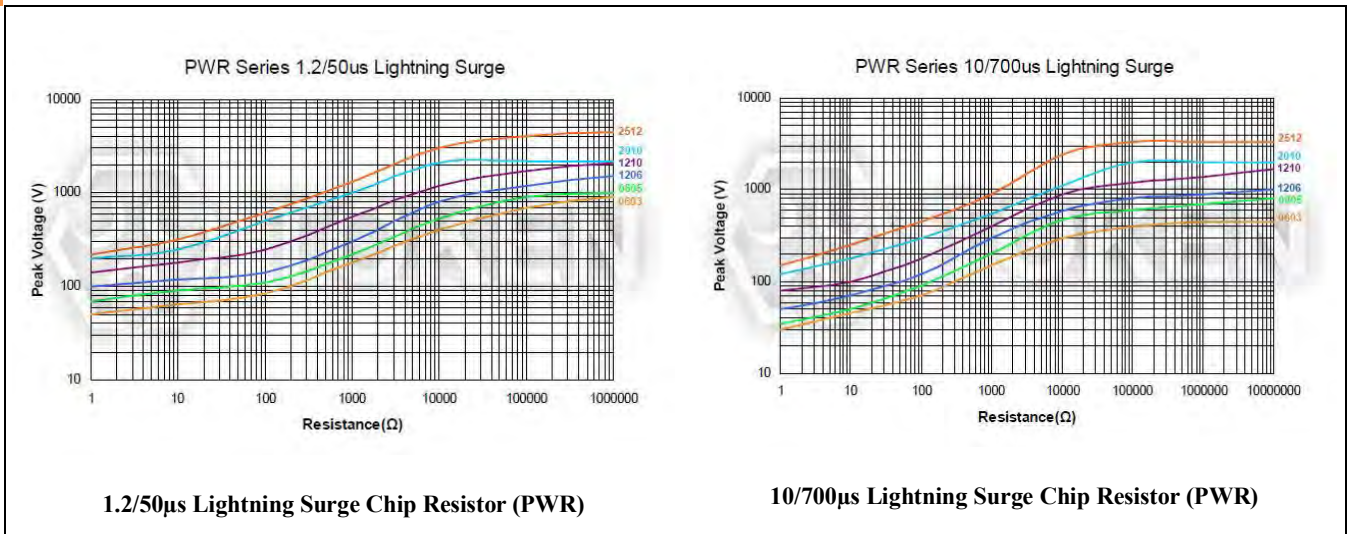


Power Derating Curve (PWR)

- Note: Storage Temperature: 25±3°C; Humidity: <80%RH
- Rated continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value} (\Omega)}$  or Max. Operating voltage whichever is lower.
- Storage Temperature: 15°C~28°C; Humidity < 80%RH;

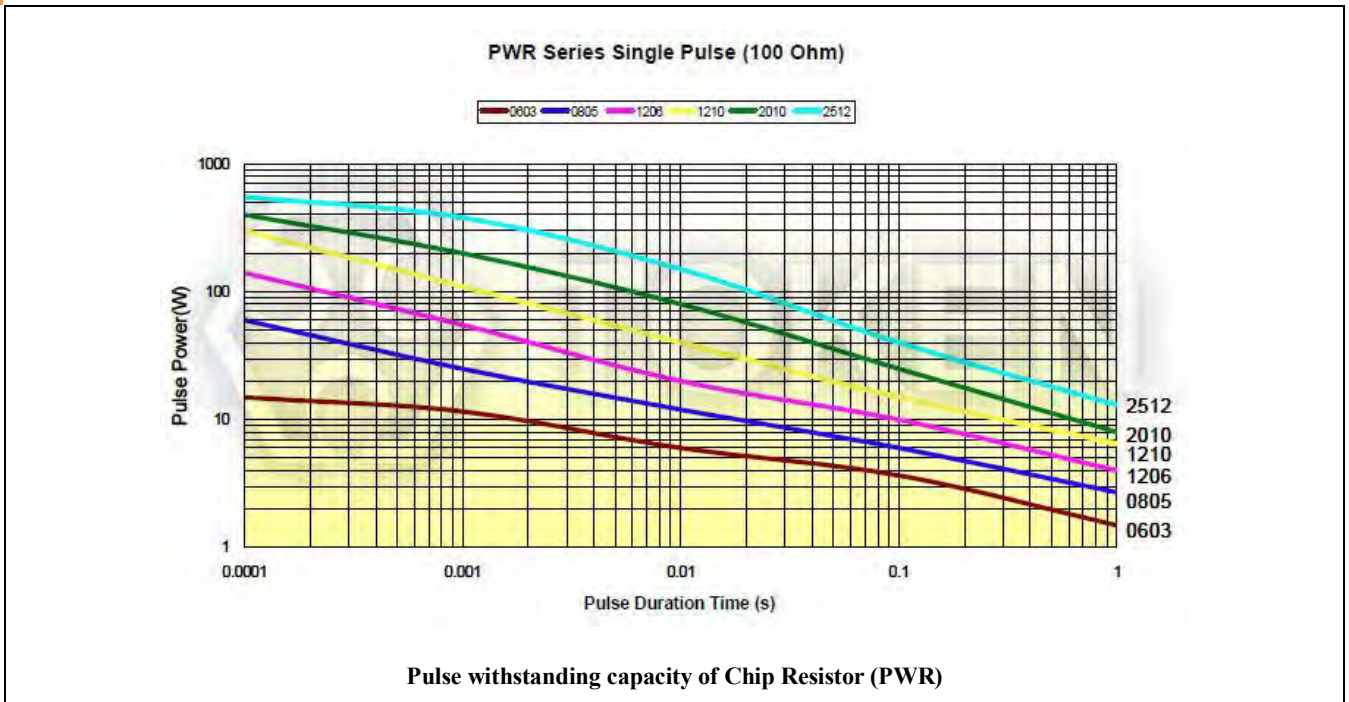
## Lightning Surge

### Lightning Surge of Pulse Withstanding Chip Resistor (PWR)



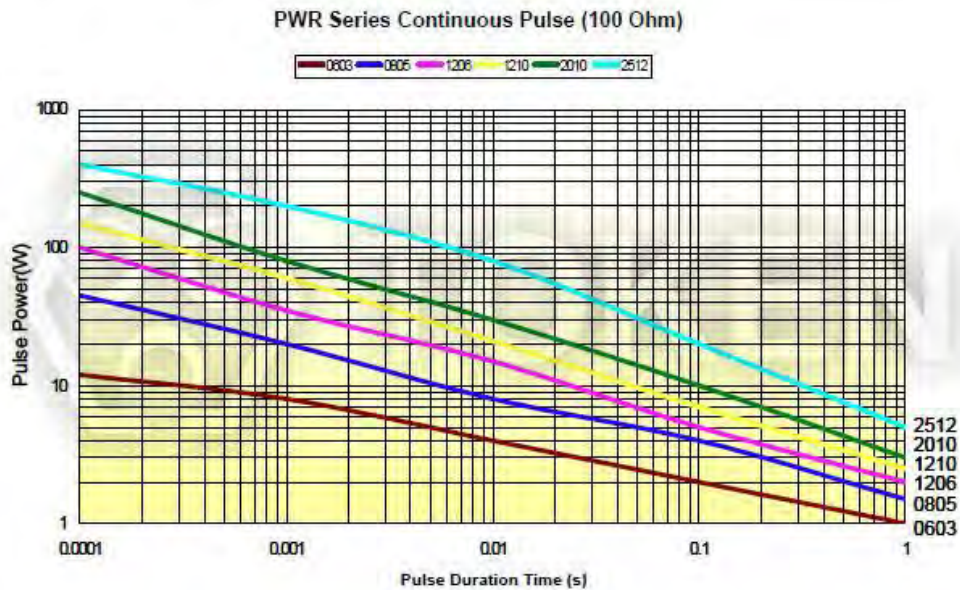
- Note: Lightning Surge of Pulse Withstanding Chip Resistors are tested in accordance with IEC 60 115-1 using both 10/700 $\mu$ s and 1.2/50 $\mu$ s pulse shapes. The limit of acceptance is a shift in resistance of less than 1% from the initial value.

### Pulse withstanding capacity of Pulse Withstanding Chip Resistor (PWR)



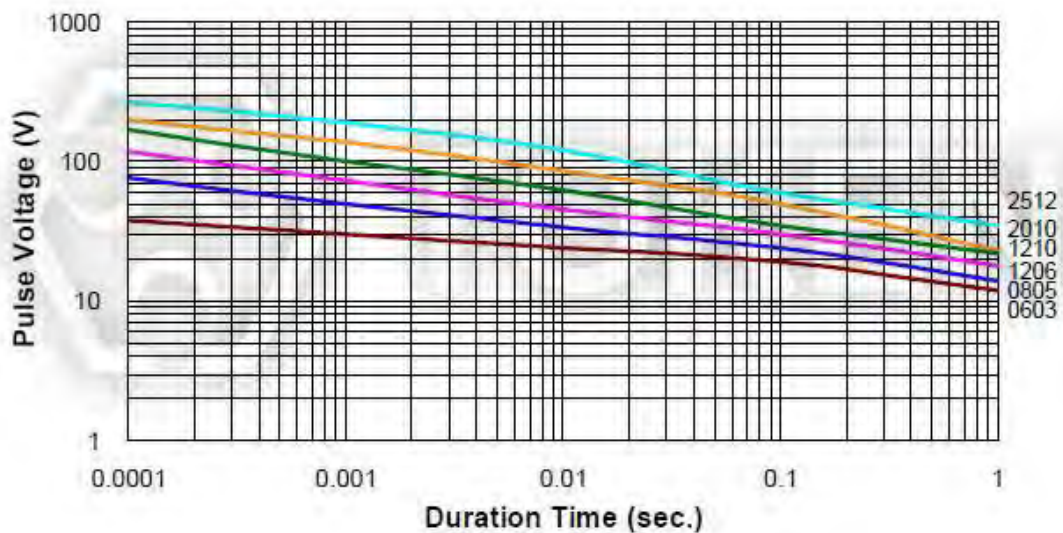
- Note: The single impulse graph is the result of 50 impulses of rectangular shape applied at one-minute intervals. The power applied was subject to the restrictions of the maximum permissible impulse voltage graph shown. The limit of acceptance was a shift in resistance of less than 1% from the initial value.

## Continuous Pulse of Pulse Withstanding Chip Resistor (PWR)



Continuous Pulse of Pulse Withstanding Chip Resistor (PWR)

## PWR Series Pulse Voltage (100 Ohm)



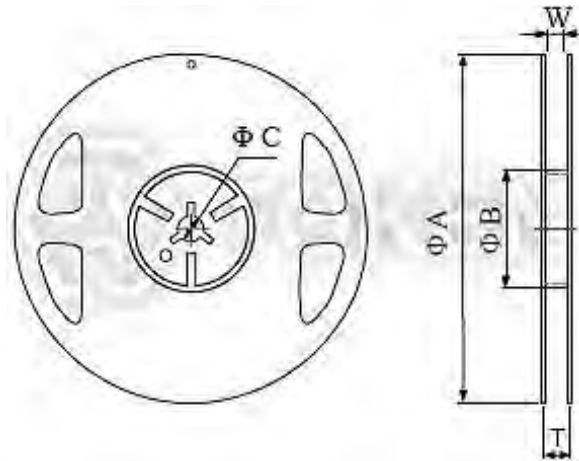
Pulse Voltage of Chip Resistor (PWR)

- Note: The continuous load graph was obtained by applying repetitive rectangular pulses where the pulse period was adjusted so that the average power dissipated in the resistor was equal to its rated power at 70°C. Again the limit of acceptance was a shift in resistance of less than 1% from the initial value.

## ► Packaging & Reel Tape

### Packaging Quantity & Reel Specifications (Unit: mm) (PWR)

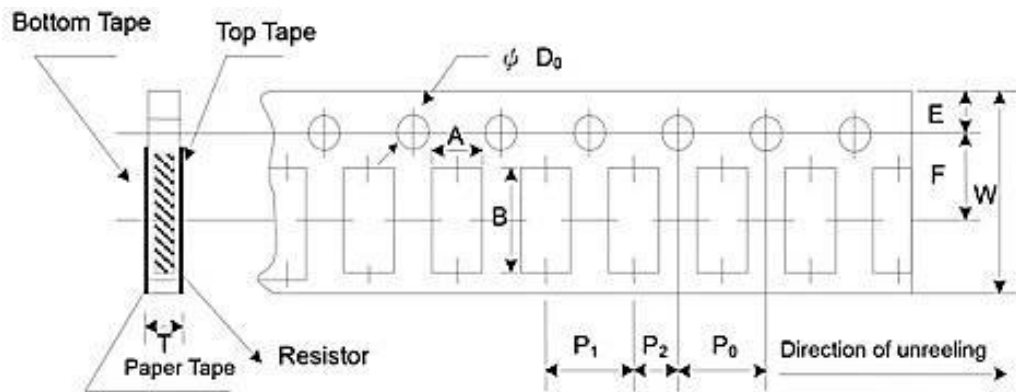
Codes	Packaging Quantity (KPs)	Tape Width	Reel Diameter	$\Phi A$ (mm)	$\Phi B$ (mm)	$\Phi C$ (mm)	W (mm)	T (mm)	
PWR03 PWR05 PWR06 PWR13	Paper	5K	8mm	7 inch	178.5±1.5	60 <sup>+1</sup>	13.0±0.2	9.0±0.5	12.5±0.5
		10K	8mm	10 inch	254±1	100±0.5	13.0±0.2	9.5±0.5	13.5±0.5
		20K	8mm	13 inch	330±1	100±0.5	13.0±0.2	9.5±0.5	13.5±0.5
PWR10 PWR12	Embossed	4K	12mm	7 inch	178.5±1.5	60 <sup>+1</sup>	13.0±0.5	13.0±0.5	15.5±0.5
		8K	12mm	10 inch	250±1	62±0.5	13.0±0.5	12.5±0.5	16.5±0.5



Packaging Quantity & Reel Specifications (PWR)

## Paper Tape Specifications (Unit: mm) (PWR)

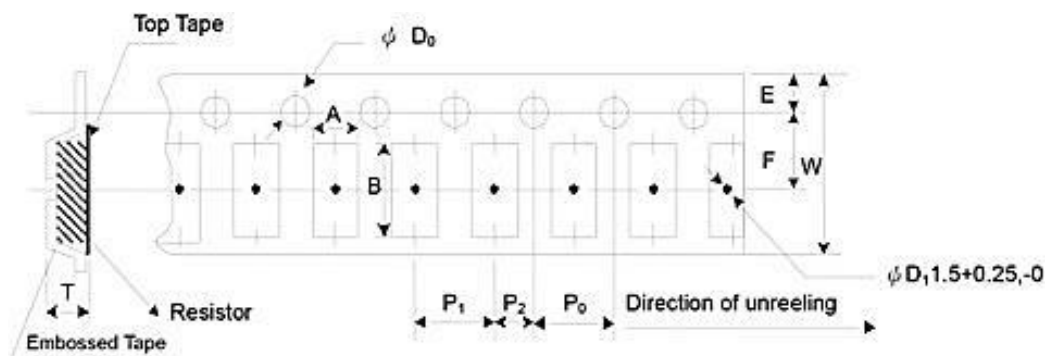
Codes	A (mm)	B (mm)	W (mm)	E (mm)	F (mm)	P <sub>0</sub> (mm)	P <sub>1</sub> (mm)	P <sub>2</sub> (mm)	ΦD <sub>0</sub> (mm)	T (mm)
PWR03	1.10±0.10	1.90±0.1	8.0±0.2	1.75±0.1	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50 <sup>+0.1,-0</sup>	0.70±0.1
PWR05	1.60±0.10	2.40±0.2	8.0±0.2	1.75±0.1	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50 <sup>+0.1,-0</sup>	0.85±0.1
PWR06	1.90±0.10	3.50±0.2	8.0±0.2	1.75±0.1	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50 <sup>+0.1,-0</sup>	0.85±0.1
PWR13	2.90±0.10	3.50±0.2	8.0±0.2	1.75±0.1	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50 <sup>+0.1,-0</sup>	0.85±0.1



Paper Tape Specifications (PWR)

## Emboss Plastic Tape Specifications (Unit: mm) (PWR)

Codes	A (mm)	B (mm)	W (mm)	E (mm)	F (mm)	P <sub>0</sub> (mm)	P <sub>1</sub> (mm)	P <sub>2</sub> (mm)	ΦD <sub>0</sub> (mm)	T (mm)
PWR10	2.8±0.10	5.5±0.10	12.0±0.3	1.75±0.1	5.5±0.05	4.00±0.10	4.00±0.1	2.00±0.05	1.50 <sup>+0.1,-0</sup>	1.2 <sup>+0</sup>
PWR12	3.5±0.10	6.7±0.10	12.0±0.3	1.75±0.1	5.5±0.05	4.00±0.10	4.00±0.1	2.00±0.05	1.50 <sup>+0.1,-0</sup>	1.2 <sup>+0</sup>



Embossed Plastic Tape (PWR)

## Application Notes

### Pulse Withstanding Chip Resistors (PWR) Application & Soldering Notes

Today's electronic devices are becoming smaller and smaller. The requirement, in particular, for pulse withstand capability is growing due to the need to protect sensitive modern electronic systems. To meet this demand Token Electronics have designed a Pulse Withstanding Chip Resistor (PWR Series). The enhanced performance of the chips is made possible by the precise use of the best resistance inks and a closely controlled production process.

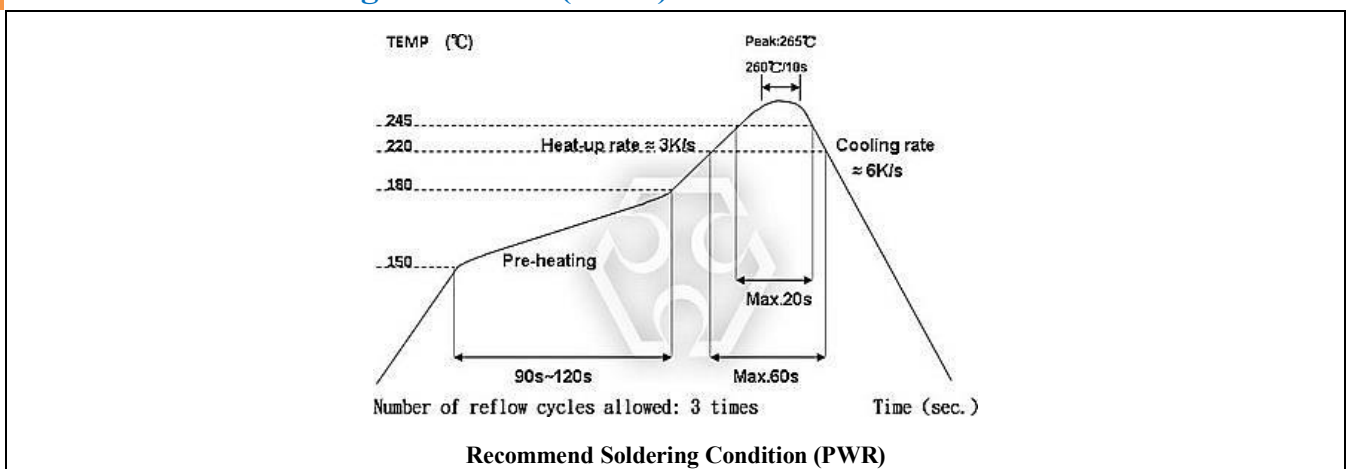
#### Application Notes:

- Applications vary from line protection for telecommunications to surge withstanding resistors for use in circuit breakers. Details of a typical telecomm and power supply application are given below.
- Telephone lines can be subjected to a large range of voltage disturbances, many of which can damage switching equipment. This has led to the need for circuit protection against both high voltage transients, usually of short duration caused by lightning strikes and overloads of longer duration, due to direct connection to mains power lines.
- These two faults are separated into primary and secondary protection.
  1. Primary protection handles the high voltage transients, and is usually located within the exchange.
  2. Secondary protection is usually built into the equipment to be protected, and deals with both current and voltage limiting.
- Voltage limiting prevents damage to the equipment and shock hazards, and current limiting prevents damage to wiring.
- To determine the suitability of a (PWR) series chip resistors for your application refer to the pulse withstanding data as given lighting surge performance using both 1.2/50 $\mu$ s and 10/700 $\mu$ s pulse shapes.

#### Soldering Notes:

- Electrical connection to a ceramic substrate or to a printed circuit board can be made by reflow or wave soldering of wrap-around terminations.
- Wrap-around terminations provide good leach properties and ensure reliable contact.
- Due to the robust construction, the (PWR) can be immersed in the solder bath for 30 seconds at 260 $^{\circ}$ C.
- This enables the resistor to be mounted on one side of a printed circuit board and wire-leaded components applied on the other side.
- (PWR) resistors themselves can operate at a maximum temperature of 155 $^{\circ}$ C.
- For soldered resistors, the joint temperature should not exceed 110 $^{\circ}$ C.
- This condition is met when the stated power levels at 70 $^{\circ}$ C and recommended pad and trace areas are used.
- Allowance should be made if smaller areas of copper are used.

### Recommend Soldering Condition (PWR)



- Time of IR reflow soldering at maximum temperature point 260 $^{\circ}$ C : 10s



## Order Codes

### Order Codes (PWR)

PWR	05	D	TR	C1	W	10R0						
Part Number	Dimensions		Package		TCR (ppm/°C)	Power Rating (W)		Resistance (Ω)		Marking		
	03	EIA0603	P	Bulk		C1	±100	A	1.5	10R0	10	Standard Marking for E96/E24
	05	EIA0805	TR	Taping Reel	C	±200	O	1/3	1000	100		
	06	EIA1206			D	±0.5%	Q	3/4	2201	2K2	N	
	13	EIA1210			F	±1%	T	1	1002	10K		
	10	EIA2010	J	±5%	U	1/2	1003	100K				
	12	EIA2512			V	1/4	1004	1M				
						P	1/5	1005	10M			
						W	1/8					
						X	1/10					

### 0805~2512 4 digits marking for Example Marking

Resistance	100Ω	2.2KΩ	10KΩ	49.9KΩ	100KΩ	1MΩ
Markin	1000	2201	1002	4992	1003	1004

### 0603: 3 digits Marking E24 Nominal Table

E24 code	10	11	12	13	15	16	18	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75	82	91
----------	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

- Example: 101=100Ω 102=1KΩ (1<sup>st</sup> and 2<sup>nd</sup> are E24 code and 3<sup>rd</sup> code is multiplier)
- Resistance tolerance 1% for 0603: 3 digits marking in E96 (E96 series except E24 series)
- Digits marking for Example: 13C=13K3Ω; 68B=4K99Ω; 68X=49.9Ω

### Marking Table E96 Nominal Table

code	02	03	04	06	07	08	09	10	11	13	14	15	16	17	19	20	21	22	23	24	25	26	27
E96	102	103	107	113	115	118	121	124	127	133	137	140	143	147	154	158	162	165	169	174	178	182	187
code	28	29	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
E96	191	196	205	210	215	221	226	232	237	243	249	255	261	267	274	280	287	294	301	309	316	324	332
code	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74
E96	340	348	357	365	374	383	392	402	412	422	432	442	453	464	475	487	499	511	523	536	549	562	576
code	75	76	77	78	79	80	81	82	83	84	86	87	88	89	90	91	92	93	94	95	96		
E96	590	604	619	634	649	665	681	698	715	732	768	787	806	825	845	866	887	909	931	953	976		

### Multiplier E96 Marking

Code	A	B	C	D	E	F	X	Y
Multiplier	10 <sup>0</sup>	10 <sup>1</sup>	10 <sup>2</sup>	10 <sup>3</sup>	10 <sup>4</sup>	10 <sup>5</sup>	10 <sup>-1</sup>	10 <sup>-2</sup>

### ► General Information

#### **Token Thin Film Chips Add Powerful New Options**

Token electronics provides the industry's most comprehensive range of precision thin film technologies for discrete, network, and integrated passive components used in instrumentation; automotive electronics; communications systems; and portable electronics applications. Ultra-reliable precision Nichrome resistive elements are available on ceramic or silicon substrates in a wide variety of surface mount resistors.

In response to market demands for increased precision and stability, Token has expanded range of nichrome thin-film chip resistors. Offering solutions to precision test and measurement and voltage regulation across industrial, military and medical monitoring equipment markets designed to offer superior humidity performance.

#### **Token Thick Film Chips Cut the Cost of Precision Resistors**

Token electronics has developed an extensive range of thick film / thin film resistive technologies for electronic circuits in power supplies; test and measurement; industrial electronics; telecommunications; audio circuits; automotive control systems; lighting controls; medical electronics; industrial equipment; and control systems applications.

In addition to this, proven thick film technologies from Token electronics provide a large range of standard resistive low Ohmic current sense products for critical battery management, and line termination. The enhanced performance of the chips is made possible by the precise use of the best resistance inks and a closely controlled production process.

#### **Token Chip Low Ohmic Resistors come in Smaller Sizes and Minimized Power Consumption**

Today's electronic devices are becoming smaller and smaller. As a result, designers are moving more towards surface mount components not only for new designs but also to design out large axial and other through-hole resistors.

In most cases this is a straight forward task as several resistor manufacturers offer chip resistors with performances to match axial parts. However in some cases, due to power rating or pulse withstanding requirements, this has been impossible. The requirement, in particular, for pulse withstand capability is growing due to the need to protect sensitive modern electronic systems. To meet this demand Token electronics have designed a Pulse Withstanding Chip Resistor (PWR Series).



# Precision Chip Resistor (AR)

## ► Product Introduction

Token's thin-film precision chip resistors (AR) take accuracy pole position and add powerful new options.

### Features :

- Miniature Size 0201 available
- Thin Film Passivated NiCr Chips
- Very Tight Tolerance Down to  $\pm 0.01\%$
- Wide Resistance Value Range 1  $\Omega$  - 3Mega  $\Omega$
- Extremely Low TCR Down to  $\pm 2\text{PPM}/^\circ\text{C}$
- Products with Pb-free Terminations Meet RoHS Requirements

### Applications :

- Converters
- Medical Equipment
- Automatic Equipment Controller
- Testing / Measurement Equipment
- Printer Equipment, Consumer Product
- Communication Device, Cell phone, GPS, PDA

In response to market demands for increased precision and stability, Token Passive Components has expanded its AR Series of nichrome thin-film chip resistors into three sectors, Standard, High-Precision, and High-Power resistor.

Offering a wide value range with closer tolerances and low TCR figures, Token offers a surface mount resistor with a defined total contour that provides high stability under temperature fluctuations of  $2\text{ppm}/^\circ\text{C}$  and with a tolerance down to  $\pm 0.01\%$ .

The AR Series offering solutions to precision test and measurement and voltage regulation across industrial, military and medical monitoring equipment markets proposing superior tight tolerance, low TCR, and high power rating performance.

The range now also offers additional chip sizes. Key features of the enhanced AR Series include the availability of all standard sizes from AR01(0201), AR02(0402), AR03(0603), AR05(0805), AR06(1206), AR13(1210), AR10(2010), to AR12(2512).

The AR benefits from an impervious internal passivation layer applied in addition to the normal protective coating. When constructing the AR Chip Series, a Ni/Cr thin-film material is selectively deposited on an alumina substrate, together with Ni and Sn metallic contacts at each end layer plating. The AR chips are heat treated to give the required temperature coefficient (TCR) and stability, and then a precisely controlled laser trim process adjusts the resistance value.

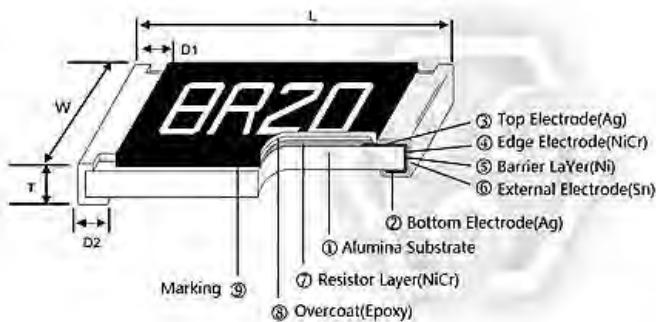
The AR Series is available in taping packaging and is RoHS compliant and lead free. For non-standard technical requirements and special applications, please contact us with your specific needs, or link to Token official website "[Chip Resistors](http://www.token.com.tw)" to get more information.



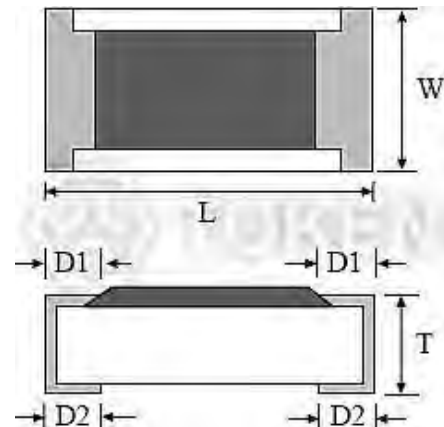
## ► Dimensions

### Dimensions (Unit: mm) (AR)

Codes	L (Unit: mm)	W (Unit: mm)	T (Unit: mm)	D1 (Unit: mm)	D2 (Unit: mm)	Weight (g) (1000pcs)
AR01 (0201)	0.58±0.05	0.29±0.05	0.23±0.05	0.12±0.05	0.15±0.05	0.14
AR02 (0402)	1.00±0.05	0.50±0.05	0.30±0.05	0.20±0.10	0.20±0.10	0.54
AR03 (0603)	1.55±0.10	0.80±0.10	0.45±0.10	0.30±0.20	0.30±0.20	1.83
AR05 (0805)	2.00±0.15	1.25±0.15	0.55±0.10	0.30±0.20	0.40±0.25	4.71
AR06 (1206)	3.05±0.15	1.55±0.15	0.55±0.10	0.42±0.20	0.35±0.25	9.02
AR13 (1210)	3.10±0.15	2.40±0.15	0.55±0.10	0.40±0.20	0.55±0.25	10
AR10 (2010)	4.90±0.15	2.40±0.15	0.55±0.10	0.60±0.30	0.50±0.25	23.61
AR12 (2512)	6.30±0.15	3.10±0.15	0.55±0.10	0.60±0.30	0.50±0.25	38.06



Precision Chip (AR) Construction



Precision Chip (AR) Dimensions

## Electrical Spec.

### Standard Electrical Specifications (AR)

Type	Power Rating at 70°C	Operating Temp. Range	Max Operating Voltage	Max Overloading Voltage	Resistance Tolerance (%)	Resistance Range (Ω)	TCR PPM/°C
AR01 (0201)	1/32W	-55 ~ +155°C	15V	30V	±0.5%	49.9~4.99K	±25
					±1%	49.9~33K	±50
AR02 (0402)	1/16W	-55 ~ +155°C	25V	50V	±0.05%	49.9~12K	±25, ±50
					±0.1%	10~255K	
					±0.25%, ±0.5%, ±1%	4.7~511K	
AR03 (0603)	1/16W	-55 ~ +155°C	50V	100V	±0.05%	4.7~332K	±25, ±50
					±0.1%	4.7~1M	
					±0.25%, ±0.5%, ±1%	1~1M	
AR05 (0805)	1/10W	-55 ~ +155°C	100V	200V	±0.05%	4.7~1M	±25, ±50
					±0.1%	4.7~2M	
					±0.25%, ±0.5%, ±1%	1~2M	
AR06 (1206)	1/8W	-55 ~ +155°C	150V	300V	±0.05%	4.7~1M	±25, ±50
					±0.1%	4.7~2.49M	
					±0.25%, ±0.5%, ±1%	1~2.49M	
AR13 (1210)	1/4W	-55 ~ +155°C	150V	300V	±0.05%	4.7~1M	±25, ±50
					±0.1%	4.7~2.49M	
					±0.25%, ±0.5%, ±1%	1~2.49M	
AR10 (2010)	1/4W	-55 ~ +155°C	150V	300V	±0.05%	4.7~1M	±25, ±50
					±0.1%	4.7~3M	
					±0.25%, ±0.5%, ±1%	1~3M	
AR12 (2512)	1/2W	-55 ~ +155°C	150V	300V	±0.05%	4.7~1M	±25, ±50
					±0.1%	4.7~3M	
					±0.25%, ±0.5%, ±1%	1~3M	

- Lower Resistance :( 1~10 ) Ω.
- Operating Voltage =  $\sqrt{(P * R)}$  , or Max. Operating Voltage listed in above table whichever is lower.
- Overloading Voltage =  $2.5 * \sqrt{(P * R)}$  , or Max. Overloading Voltage listed in above table whichever is lower.
- Optional specifications can be required.



## High-Precision Electrical Specifications (AR)

Type	Power Rating at 70°C	Operating Temp. Range	Max Operating Voltage	Max Overloading Voltage	Resistance Tolerance (%)	Resistance Range (Ω)	TCR PPM/°C
AR02 (0402)	1/16W	-55 ~ +155°C	25V	50V	±0.01%, ±0.05%, ±0.1%	49.9 ~ 4.99K	±2, ±3
					±0.01%, ±0.05%, ±0.1%, ±0.25%, ±0.5%, ±1%	49.9 ~ 4.99K	±5
					±0.01%, ±0.05%	49.9 ~ 12K	±10, ±15
					±0.1%, ±0.25%, ±0.5%, ±1%	49.9 ~ 60K	±10
					±0.1%, ±0.25%, ±0.5%, ±1%	49.9 ~ 69.8K	±15
AR03 (0603)	1/16W	-55 ~ +155°C	50V	100V	±0.01%, ±0.05%, ±0.1%	24.9 ~ 15K	±2, ±3
					±0.01%, ±0.05%, ±0.1%, ±0.25%, ±0.5%, ±1%	24.9 ~ 15K	±5
					±0.01%	24.9 ~ 100K	±10, ±15
					±0.05%	4.7 ~ 332K	±10, ±15
AR05 (0805)	1/10W	-55 ~ +155°C	100V	200V	±0.01%, ±0.05%, ±0.1%	24.9 ~ 30K	±2, ±3
					±0.01%, ±0.05%, ±0.1%, ±0.25%, ±0.5%, ±1%	24.9 ~ 30K	±5
					±0.01	24.9 ~ 200K	±10, ±15
					±0.05%, ±0.1%, ±0.25%, ±0.5%, ±1%	4.7 ~ 1M	±10, ±15
AR06 (1206)	1/8W	-55 ~ +155°C	150V	300V	±0.01%, ±0.05%, ±0.1%	24.9 ~ 49.9K	±2, ±3
					±0.01%, ±0.05%, ±0.1%, ±0.25%, ±0.5%, ±1%	24.9 ~ 49.9K	±5
					±0.01%	24.9 ~ 499K	±10, ±15
					±0.05%, ±0.1%, ±0.25%, ±0.5%, ±1%	4.7 ~ 1MK	±10, ±15
AR13 (1210)	1/4W	-55 ~ +155°C	150V	300V	±0.01%, ±0.05%, ±0.1%	24.9 ~ 49.9K	±2, ±3
					±0.01%, ±0.05%, ±0.1%, ±0.25%, ±0.5%, ±1%	24.9 ~ 49.9K	±5
					±0.01%	24.9 ~ 499K	±10, ±15
					±0.05%, ±0.1%, ±0.25%, ±0.5%, ±1%	4.7 ~ 1M	±10, ±15
AR10 (2010)	1/4W	-55 ~ +155°C	150V	300V	±0.01%, ±0.05%, ±0.1%	24.9 ~ 100K	±2, ±3
					±0.01%, ±0.05%, ±0.1%, ±0.25%, ±0.5%, ±1%	24.9 ~ 100K	±5
					±0.01%	24.9 ~ 499K	±10, ±15
					±0.05%, ±0.1%, ±0.25%, ±0.5%, ±1%	4.7 ~ 1M	±10, ±15
AR12 (2512)	1/2W	-55 ~ +155°C	150V	300V	±0.01%, ±0.05%, ±0.1%	24.9 ~ 100K	±2, ±3
					±0.01%, ±0.05%, ±0.1%, ±0.25%, ±0.5%, ±1%	24.9 ~ 100K	±5
					±0.01%	24.9 ~ 499K	±10, ±15
					±0.05%, ±0.1%, ±0.25%, ±0.5%, ±1%	4.7 ~ 1M	±10, ±15

- Lower Resistance : ( 1~10 ) Ω.
- Operating Voltage =  $\sqrt{P * R}$  , or Max. Operating Voltage listed in above table whichever is lower.
- Overloading Voltage =  $2.5 * \sqrt{P * R}$  , or Max. Overloading Voltage listed in above table whichever is lower.
- Optional specifications can be required.



## High-Power Rating Electrical Specifications (AR)

Type	Power Rating at 70°C	Operating Temp. Range	Max Operating Voltage	Max Overloading Voltage	Resistance Tolerance (%)	Resistance Range (Ω)	TCR PPM/°C
AR03 (0603)	1/10W	-55 ~ +155°C	75V	150V	±0.01%, ±0.05%, ±0.1%	24.9~15K	±2, ±3
					±0.01%, ±0.05%, ±0.1%, ±0.25%, ±0.5%, ±1%	24.9~15K	±5
					±0.01%	24.9~100K	±10, ±15, ±25, ±50
					±0.05%	4.7~332K	±10, ±15, ±25, ±50
					±0.1%, ±0.25%, ±0.5%, ±1%	4.7~332K	±10, ±15
	±0.1%, ±0.25%, ±0.5%, ±1%	4.7~1M	±25, ±50				
1/6W	-55 ~ +155°C	100V	150V	±0.05%, ±0.1%, ±0.25%, ±0.5%, ±1%	10~332K	±25, ±50	
AR05 (0805)	1/8W	-55 ~ +155°C	150V	300V	±0.01%, ±0.05%, ±0.1%	24.9~30K	±2, ±3
					±0.01%, ±0.05%, ±0.1%, ±0.25%, ±0.5%, ±1%	24.9~30K	±5
					±0.01%	24.9~200K	±10, ±15, ±25, ±50
					±0.05%	4.7~511K	±10, ±15, ±25, ±50
					±0.1%, ±0.25%, ±0.5%, ±1%	4.7~511K	±10
					±0.1%, ±0.25%, ±0.5%, ±1%	4.7~1M	±15
	±0.1%	4.7~1M	±25, ±50				
	±0.25%, ±0.5%, ±1%	1~1M	±25, ±50				
1/4W	-55 ~ +155°C	150V	300V	±0.05%, ±0.1%, ±0.25%, ±0.5%, ±1%	10~499K	±25, ±50	
AR06 (1206)	1/4W	-55 ~ +155°C	200V	400V	±0.01%, ±0.05%, ±0.1%	24.9~49.9K	±2, ±3
					±0.01%, ±0.05%, ±0.1%, ±0.25%, ±0.5%, ±1%	24.9~49.9K	±5
					±0.01%	24.9~499K	±10, ±15, ±25, ±50
					±0.05%, ±0.1%, ±0.25%, ±0.5%, ±1%	4.7~1M	±10, ±15, ±25, ±50
	1/3W	-55 ~ +155°C	200V	400V	±0.05%, ±0.1%, ±0.25%, ±0.5%, ±1%	10~1M	±25, ±50
AR13 (1210)	1/3W	-55 ~ +155°C	200V	400V	±0.01%, ±0.05%, ±0.1%	24.9~49.9K	±2, ±3
					±0.01%, ±0.05%, ±0.1%, ±0.25%, ±0.5%, ±1%	24.9~49.9K	±5
					±0.01%	24.9~499K	±10, ±15, ±25, ±50
					±0.05%, ±0.1%, ±0.25%, ±0.5%, ±1%	4.7~1M	±10, ±15, ±25, ±50
AR10 (2010)	1/3W	-55 ~ +155°C	200V	400V	±0.01%, ±0.05%, ±0.1%	24.9~49.9K	±2, ±3
					±0.01%, ±0.05%, ±0.1%, ±0.25%, ±0.5%, ±1%	24.9~49.9K	±5
					±0.01%	24.9~499K	±10, ±15, ±25, ±50
					±0.05%, ±0.1%, ±0.25%, ±0.5%, ±1%	4.7~1M	±10, ±15, ±25, ±50
AR12 (2512)	3/4W	-55 ~ +155°C	200V	400V	±0.01%	24.9~2K	±10, ±15, ±25, ±50
					±0.05%, ±0.1%	4.7~2K	±10, ±15, ±25, ±50
					±0.25%, ±0.5%, ±1%	1~2K	±10, ±15, ±25, ±50
	1W	-55 ~ +155°C	200V	400V	±0.1%	4.7~100	±25, ±50
				±0.25%, ±0.5%, ±1%	1~100	±25, ±50	

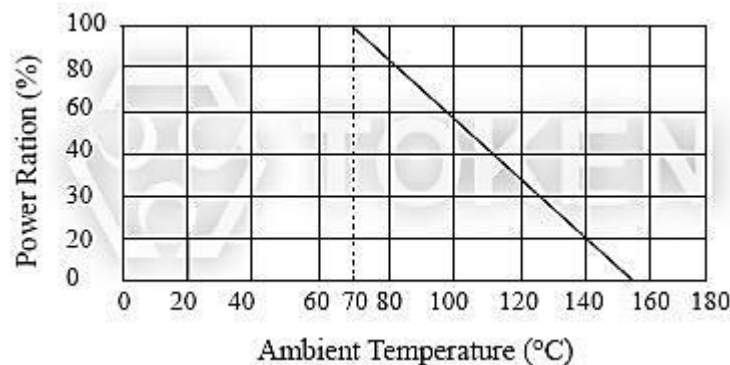
- Lower Resistance :( 1~10) Ω.
- Operating Voltage =  $\sqrt{(P * R)}$  , or Max. Operating Voltage listed in above table whichever is lower.
- Overloading Voltage =  $2.5 * \sqrt{(P * R)}$  , or Max. Overloading Voltage listed in above table whichever is lower.
- Optional specifications can be required.



## Environmental Characteristics

### Environmental Characteristics (AR)

Item	Specification		Test Method
	Tol.≤0.05%	Tol.>0.05%	
Temperature Coefficient of Resistance	AS Spec		MIL-STD-202F Method 304 +25/-55/+25/+125/+25°C
Short Time Overload	ΔR±0.05%	ΔR±0.5%	JIS-C-5202-5.5 RCWV*2.5 or Max Overloading Voltage whichever is lower for 5 seconds.
	ΔR±0.5% for high power rating		
Dielectric Withstand Voltage	By type		MIL-STD-202F Method 301 Apply Max Overload Voltage for 1 minute
Insulation Resistance	>1000M Ω		MIL-STD-202F Method 302 Apply 100VDC for 1minute
Thermal Shock	ΔR±0.05%	ΔR±0.25%	MIL-STD-202F Method 107G -55°C~150°C, 100cycles
Load Life (Endurance)	ΔR±0.05%	ΔR±0.2%	MIL-STD-202F Method 108A RCWV, 70°C, 1.5 hours ON, 0.5 hours OFF, 1000 hours
	>7KΩ ΔR±0.5%		
	ΔR±0.5% for high power rating		
humidity (Steady State ) (Damp Heat with Load)	ΔR±0.05%	ΔR±0.3%	MIL-STD-202F Method 103B 40°C, 90~95%RH, RCWV 1.5 hours ON, 0.5 hours OFF, total 1000 hours
	ΔR±0.5% for high power rating		
Resistance to dry heat	ΔR±0.05%	ΔR±0.2%	JIS-C-5202-7.2 96 hours @ +155°C without load
Low Temperature Operation	ΔR±0.05%	ΔR±0.2%	JIS-C-5202-7.1 1 hour, -65°C, followed by 45minutes of RCWV
	ΔR±0.5% for high power rating		
Bending Strength	ΔR±0.05%	ΔR±0.2%	JIS-C-5202-6.1.4 Bending Amplitude 3mm for 10seconds
Solderability	95%min coverage		MIL-STD-202F Method 208H 245°C±5°C, 2±0.5(sec)
Resistance to Soldering Heat	ΔR±0.05%	ΔR±0.2%	MIL-STD-202F Method 210E 260±5°C, 10±1 second



Power Derating Curve (AR)

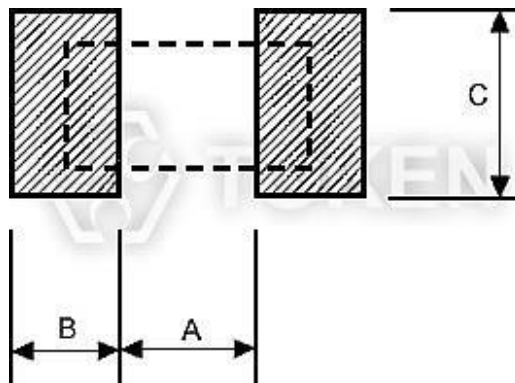
- Rated continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value } (\Omega)}$  or Max. Operating voltage whichever is lower.
- Storage Temperature: 15~28°C; Humidity < 80%RH;



## Recommend

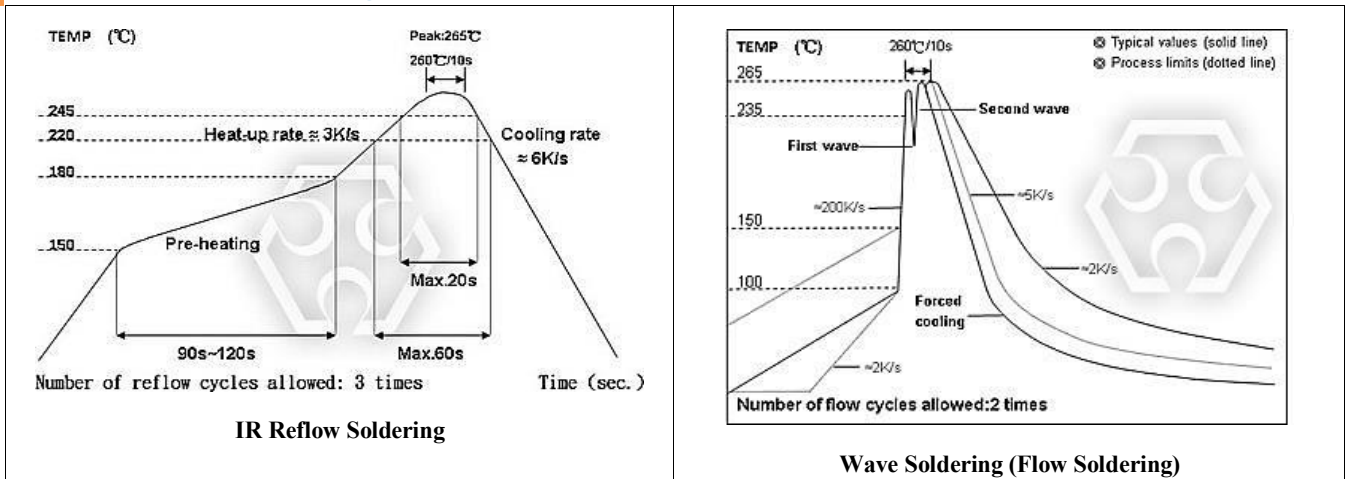
### Recommend Land Pattern (Unit: mm) (AR)

Codes	A	B	C
AR12	4.90	1.60	3.10±0.2
AR10	3.60	1.40	2.50±0.2
AR13	2.00	1.15	2.50±0.2
AR06	2.00	1.15	1.70±0.2
AR05	1.00	1.00	1.35±0.2
AR03	0.80	1.00	0.90±0.2
AR02	0.50	0.50	0.60±0.2
AR01	0.25	0.30	0.40±0.2



Recommend Land Pattern (AR)

### Recommend Soldering Condition (AR)

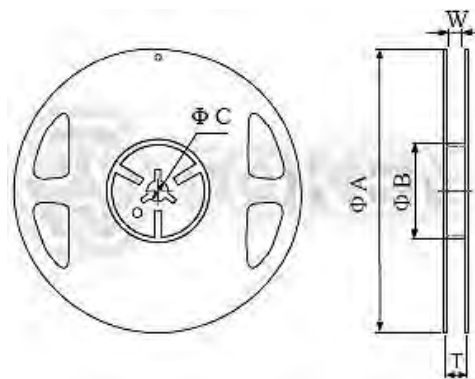


- (1) Time of IR reflow soldering at maximum temperature point 260°C : 10s
- (2) Time of wave soldering at maximum temperature point 260°C : 10s
- (3) Time of soldering iron at maximum temperature point 410°C : 5s

## ► Packaging & Reel Tape

### Packaging Quantity & Reel Specifications (Unit: mm) (AR)

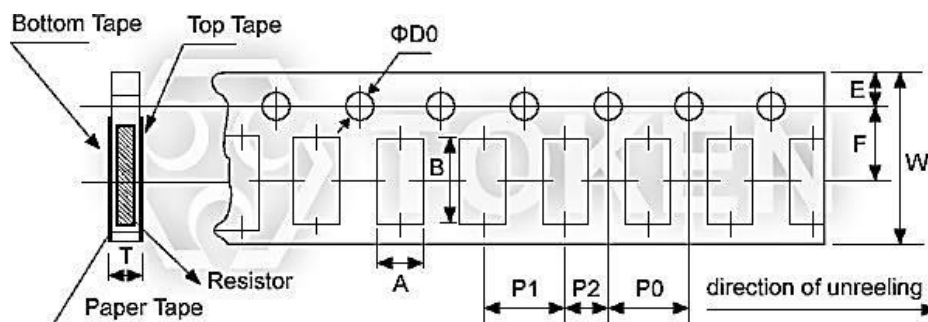
Codes	ΦA	ΦB	ΦC	W	T	Paper Tape(PCS)	Emboss Plastic Tape (PCS)
AR01	178.0±1.0	60.0±1.0	13.5±0.7	9.5±1.0	11.5±1.0	10,000	-
AR02	178.0±1.0	60.0±1.0	13.5±0.7	9.5±1.0	11.5±1.0	10,000	-
AR03	178.0±1.0	60.0±1.0	13.5±0.7	9.5±1.0	11.5±1.0	5,000	-
AR05	178.0±1.0	60.0±1.0	13.5±0.7	9.5±1.0	11.5±1.0	5,000	-
AR06	178.0±1.0	60.0±1.0	13.5±0.7	9.5±1.0	11.5±1.0	5,000	-
AR13	178.0±1.0	60.0±1.0	13.5±0.7	9.5±1.0	11.5±1.0	5,000	-
AR10	178.0±1.0	60.0±1.0	13.5±0.7	13.5±1.0	15.5±1.0	-	4,000
AR12	178.0±1.0	60.0±1.0	13.5±0.7	13.5±1.0	15.5±1.0	-	4,000



Reel Packaging (AR)

### Paper Tape Specifications (Unit: mm) (AR)

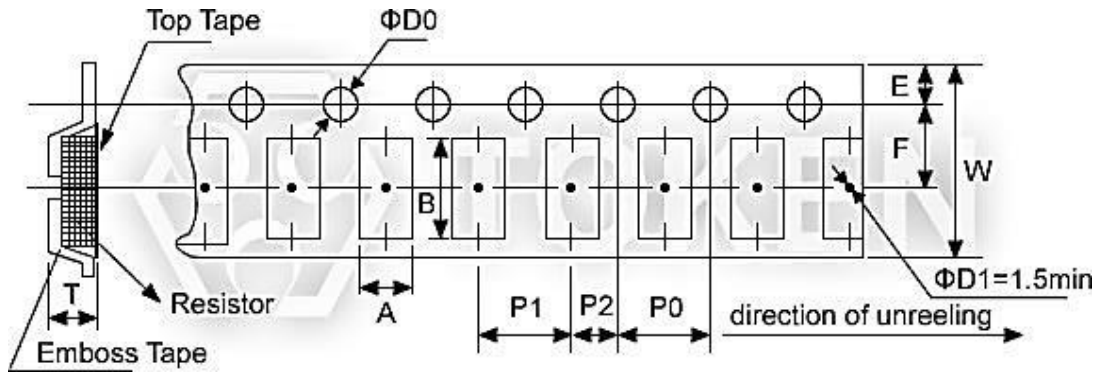
Codes	A	B	W	E	F	P0	P1	P2	ΦD0	T
AR01	0.40±0.05	0.70±0.05	8.00±0.10	1.75±0.05	3.5±0.05	4.00±0.10	2.00±0.05	2.00±0.05	1.55±0.05	0.265±0.05
AR02	0.70±0.05	1.16±0.05	8.00±0.10	1.75±0.05	3.5±0.05	4.00±0.10	2.00±0.05	2.00±0.05	1.55±0.05	0.40±0.03
AR03	1.10±0.05	1.90±0.05	8.00±0.10	1.75±0.05	3.5±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.55±0.05	0.60±0.03
AR05	1.60±0.05	2.37±0.05	8.00±0.10	1.75±0.05	3.5±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.55±0.05	0.75±0.05
AR06	2.00±0.05	3.55±0.05	8.00±0.10	1.75±0.05	3.5±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.55±0.05	0.75±0.05
AR13	2.75±0.05	3.40±0.05	8.00±0.10	1.75±0.05	3.5±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.60±0.10	0.75±0.05



Thin Film Precision Chip Resistors (AR) Paper Tape Specifications

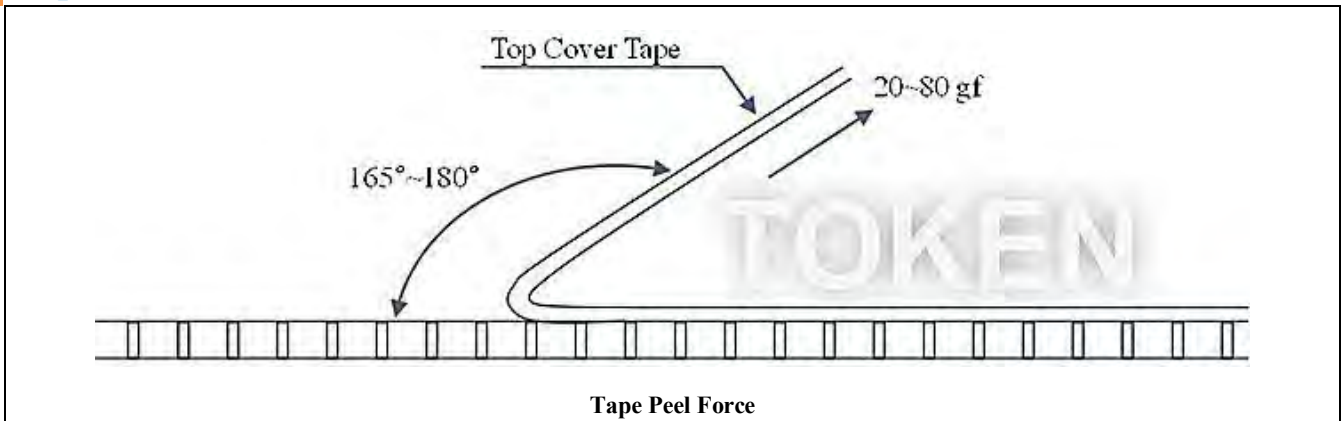
## Emboss Plastic Tape Specifications (Unit: mm) (AR)

Codes	A	B	W	E	F	P0	P1	P2	ΦD0	T
AR10	2.85±0.10	5.45±0.10	12.0±0.10	1.75±0.10	5.5±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.50±0.10	1.00±0.20
AR12	3.40±0.10	6.65±0.10	12.0±0.10	1.75±0.10	5.5±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.50±0.10	1.00±0.20



Surface Mount (AR) Emboss Plastic Tape Specifications

## Tape Peel Force (AR)



- (1) Peel force of top cover tape.
- (2) The peel speed shall be about 300 mm/min±5%
- (3) The peel force of top cover tape shall be between 20gf to 80gf.

## Order Codes

### Order Codes (AR)

AR	05	B	TR	C3	X	4700								
Part Number	Dimensions (L×W) (mm)		Package		TCR (ppm/°C)		Power Rating(W)		Resistance (Ω)		Marking			
			Resistance Tolerance (%)		P	Bulk					Standard Marking for E96/E24	N		
	01	EIA0201	T	±0.01	TR	Taping Reel	C7	±5	T	1W			4R70	4.7
	02	EIA0402	A5	±0.05			C6	±10	U	1/2			1000	100
	03	EIA0603	B	±0.10	C5	±15	O	1/3	4700	470				
	05	EIA0805	C	±0.25	C3	±25	V	1/4	4992	49.9K				
	06	EIA1206	D	±0.50	C2	±50	P	1/5	1003	100K				
	13	EIA1210	F	±1.00			W	1/8	1004	1M				
	10	EIA2010					X	1/10	1005	10M				
	12	EIA2512					Y	1/16						
						Z	1/32							

### 0805~2512 4 digits marking for Example Marking

Resistance	100Ω	2.2KΩ	10KΩ	49.9KΩ	100KΩ	1MΩ
Marking	1000	2201	1002	4992	1003	1004

### 0603: 3 digits Marking E24 Nominal Table

E24 code	10	11	12	13	15	16	18	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75	82	91
----------	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

- Example: 101=100Ω 102=1KΩ (1st and 2nd are E24 code and 3rd code is multiplier)
- Resistance tolerance 1% for 0603: 3 digits marking in E96 (E96 series except E24 series)
- Digits marking for Example: 13C=13K3Ω; 68B=4K99Ω; 68X=49.9Ω

### Marking Table E96 Nominal Table

code	02	03	04	06	07	08	09	10	11	13	14	15	16	17	19	20	21	22	23	24	25	26	27
E96	102	103	107	113	115	118	121	124	127	133	137	140	143	147	154	158	162	165	169	174	178	182	187
code	28	29	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
E96	191	196	205	210	215	221	226	232	237	243	249	255	261	267	274	280	287	294	301	309	316	324	332
code	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74
E96	340	348	357	365	374	383	392	402	412	422	432	442	453	464	475	487	499	511	523	536	549	562	576
code	75	76	77	78	79	80	81	82	83	84	86	87	88	89	90	91	92	93	94	95	96		
E96	590	604	619	634	649	665	681	698	715	732	768	787	806	825	845	866	887	909	931	953	976		

### Multiplier E96 Marking

Code	A	B	C	D	E	F	X	Y
Multiplier	10 <sup>0</sup>	10 <sup>1</sup>	10 <sup>2</sup>	10 <sup>3</sup>	10 <sup>4</sup>	10 <sup>5</sup>	10 <sup>-1</sup>	10 <sup>-2</sup>



## ► General Information

### **Token Thin Film Chips Add Powerful New Options**

Token electronics provides the industry's most comprehensive range of precision thin film technologies for discrete, network, and integrated passive components used in instrumentation; automotive electronics; communications systems; and portable electronics applications. Ultra-reliable precision Nichrome resistive elements are available on ceramic or silicon substrates in a wide variety of surface mount resistors.

In response to market demands for increased precision and stability, Token has expanded range of nichrome thin-film chip resistors. Offering solutions to precision test and measurement and voltage regulation across industrial, military and medical monitoring equipment markets designed to offer superior humidity performance.

### **Token Thick Film Chips Cut the Cost of Precision Resistors**

Token electronics has developed an extensive range of thick film / thin film resistive technologies for electronic circuits in power supplies; test and measurement; industrial electronics; telecommunications; audio circuits; automotive control systems; lighting controls; medical electronics; industrial equipment; and control systems applications.

In addition to this, proven thick film technologies from Token electronics provide a large range of standard resistive low Ohmic current sense products for critical battery management, and line termination. The enhanced performance of the chips is made possible by the precise use of the best resistance inks and a closely controlled production process.

### **Token Chip Low Ohmic Resistors come in Smaller Sizes and Minimized Power Consumption**

Today's electronic devices are becoming smaller and smaller. As a result, designers are moving more towards surface mount components not only for new designs but also to design out large axial and other through-hole resistors.

In most cases this is a straight forward task as several resistor manufacturers offer chip resistors with performances to match axial parts. However in some cases, due to power rating or pulse withstanding requirements, this has been impossible. The requirement, in particular, for pulse withstand capability is growing due to the need to protect sensitive modern electronic systems. To meet this demand Token electronics have designed a Pulse Withstanding Chip Resistor (PWR Series).



# Power Wire Wound Chip Resistors (SMW)

## ▶ Product Introduction

**Token SMD wirewound resistors, providing high precision power, excellent stability, and superior surge capability.**

### Features :

- Flameproof UL94V0 molded package, resistant to heat, humidity & insulation.
- All-welded wire wound structure, high-quality resistance wire, with excellent stability and surge capacity.
- Automatic surface mount special design. Excellent mechanical strength and electrical stability.
- Low thickness with non-inductive metal plate components. Reduce assembly costs.

When the current through the resistance element, the heat generated. And the temperature change causes mechanical changes by expansion or contraction in each material involved in the components. Thus, the ideal resistor element incorporates these natural phenomena into a self-balanced stability enhancement system which maintains its physical integrity through the resistor manufacturing process and eliminates the need to compensate for the effects of heat or stress during use.



Token Electronics (SMW) Chip Series Precision Power Wound Resistors are specifically designed to meet the ever-increasing surface mount resistor requirements and provide high precision power, compact, reliable, and rugged performance. Compared with the surface temperature rise of other SMD power resistors, (SMW) thermal design has been optimized to provide greater thermal efficiency.

Power wirewound Chip Resistor (SMW) series includes 2W, 3W and 5W three kinds of power. Resistance range from 0.1Ω to 680Ω and accuracy tolerance options are 1%, and 5% with low TCR and high overload capacity, suitable for surge and pulse applications.

When the first release of enhanced power handling capability, the 3W and 5W (5% tolerance) versions are SMD resistors, Token setting a new high power standard. At present, it is still one of the most powerful chip resistors on the market. Power wirewound Chip Resistors (SMW) series optimize thermal design to provide higher efficiency and higher surge capacity while reducing surface temperature rise and long-term thermal damage to PCB boards and adjacent electronic components.

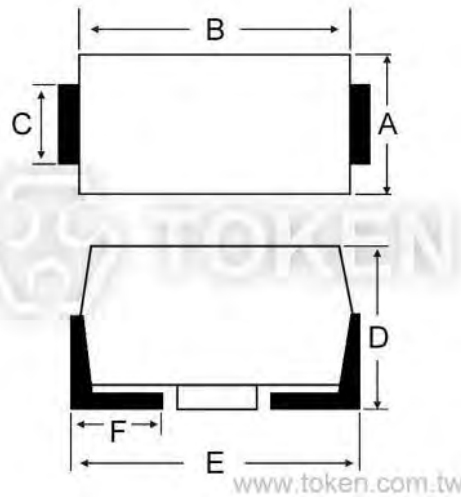
Surface Mount (SMW) Series is available in tape, RoHS compliant and 100% lead free. For conventional parameters, specifications outside the parameters, or technical requirements, please contact Token. Detailed specifications, both mechanical and electrical, please contact us with your specific needs, or link to Token official website "[Chip Resistors](#)" to get more information.



## ► Construction & Dimensions

### Construction & Dimensions (Unit: mm) (SMW)

Rated Wattage	A ±0.3	B ±0.3	C ±0.3	D ±0.3	E Max.	F ±0.3	Resistance Range (Ω)	Rated Wattage
2W	4.0	6.7	1.4	3.55	7.9	1.5	0.1 ~ 200	2W
3W	5.5	10.5	1.7	5.0	12	2.3	0.1 ~ 300	3W
5W	7.3	13.5	1.7	6.8	17	2.5	0.1 ~ 680	5W



Power Wire Wound Chip Resistor Dimensions (SMW)

**Note:**

- Rated Continuous Working Voltage (RCWV) =  $\sqrt{P \times R}$ , or Max. Operating Voltage listed in above table whichever is lower.
- Resistance or specifications outside the parameters can be on request.

## Electrical Spec.

### Electrical And Mechanical Performance (SMW)

Characteristics	Standards	Test Methods
Resistance Tolerance	$\pm 5\%$ (J) or $\pm 1\%$ (F)	-
TCR	$\pm 100\text{ppm}/^\circ\text{C}$	$-55^\circ\text{C} \sim 200^\circ\text{C}$
Power Rating Load	Surface temp. $275^\circ\text{C}$ Max.	Rated voltage for 30 minutes
Short Time Overload	$\pm(1\% + 0.05\Omega)$	5 times rated power with applied voltage not to exceed 2 times maximum continuous operating voltage for 5 seconds.
Dielectric Withstanding Voltage	No evidence of mechanical damage or insulation breakdown.	AC 500V for 1 minutes
Insulation Resistance	10,000M $\Omega$	DC 500V megger
Solder-ability	Minimum 95% coverage	$235 \pm 5^\circ\text{C}$ for 2 seconds
Resistance to Soldering Heat	No evidence of mechanical damage. $\pm(1\% + 0.05\Omega)$	$270 \pm 5^\circ\text{C}$ for $10 \pm 1$ seconds

### Environmental Characteristics (SMW)

Characteristics	Standards	Test Methods
Temp. Cycle	$\pm(1\% + 0.05\Omega)$	$-55^\circ\text{C}$ (30min.) $\rightarrow$ Room Temp. (3min.) $\rightarrow$ $+200^\circ\text{C}$ (30min.) $\rightarrow$ Room Temp. (3min.)/(5cycles)
Load Life	$\pm(2\% + 0.05\Omega)$	Rated power load 90 minutes ON 30 minutes OFF $70^\circ\text{C}$ 1000 hours
Moisture-proof Load Life	$\pm(2\% + 0.05\Omega)$	Rated power load 90 minutes ON 30 minutes OFF $40^\circ\text{C}$ 95% RH 500 hours

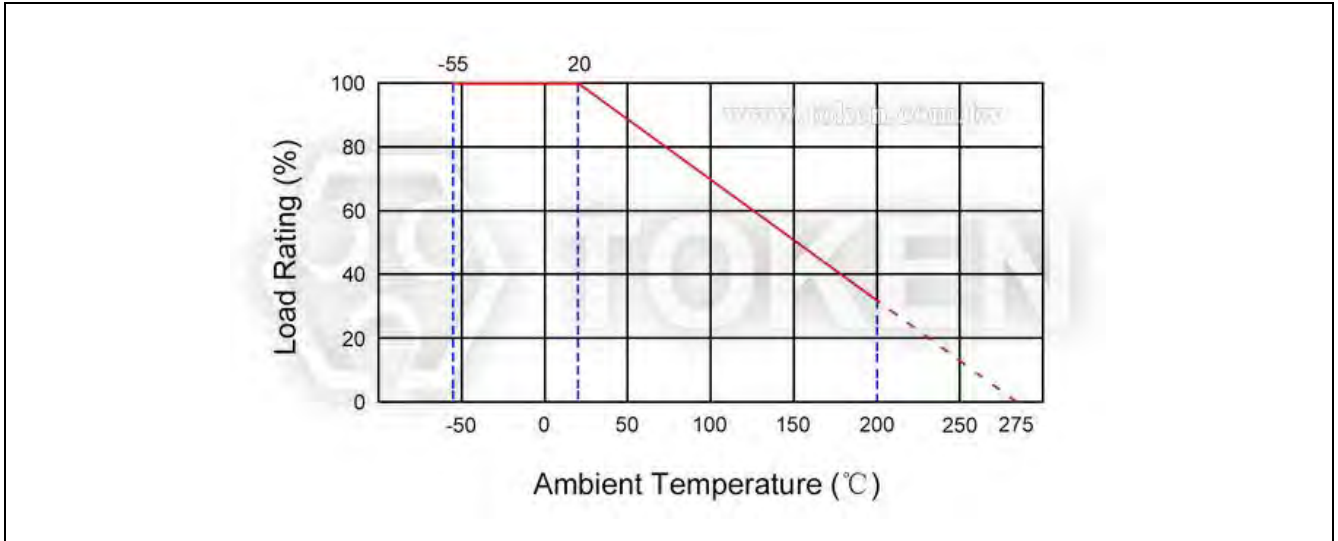




## Graph

### Derating Curve (SMW)

For resistors operated in ambient temperatures above 20°C, power rating must be derated in accordance with the curve below.



### Surface Temperature Rise (SMW)



## Order Codes

### Order Codes (SMW)

SMW	2W	10Ω		J	
Part Number	Rated Wattage (W)	Resistance (Ω)		Tolerance (%)	
SMW	2W	10	10Ω	F	±1.00%
	3W	1K1	1.1KΩ	J	±5.00%
	5W	110K	110KΩ		
		1M1	1.1MΩ		

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In addition to this, proven thick film technologies from Token electronics provide a large range of standard resistive low Ohmic current sense products for critical battery management, and line termination. The enhanced performance of the chips is made possible by the precise use of the best resistance inks and a closely controlled production process.

### Token Chip Low Ohmic Resistors come in Smaller Sizes and Minimized Power Consumption

Today's electronic devices are becoming smaller and smaller. As a result, designers are moving more towards surface mount components not only for new designs but also to design out large axial and other through-hole resistors.

In most cases this is a straight forward task as several resistor manufacturers offer chip resistors with performances to match axial parts. However in some cases, due to power rating or pulse withstanding requirements, this has been impossible. The requirement, in particular, for pulse withstand capability is growing due to the need to protect sensitive modern electronic systems. To meet this demand Token electronics have designed a Pulse Withstanding Chip Resistor (PWR Series).



# Power Metal Film Chip Resistors (SMF)

## ▶ Product Introduction

**Token advanced power metal film sputtering technology meets stability and high-precision requirements.**

### Features :

- Automatic surface mount special design. Lower assembly costs.
- Excellent electrical stability and mechanical strength.
- Flameproof UL94V0 Resin molded package.
- Heat resistant, moisture resistant, insulated.

### Applications :

- Consumer electronics, computers.
- Telecommunications, control equipment and so on.

In the metal layer to achieve a homogenous crystalline structure, Token Electronics' surface mount power type metal film package resistor (SMF) benefits from the key advantages of today's sputtering technology for the tight control of metal film thickness.

By photolithography, the same length and width of the resistive element can be controlled by the same precision and accuracy as the thickness of the sputtered metal film layer.

Surface Mounted Power Metal Film Resistors (SMF) have good accuracy tolerances, good stability and low TCR characteristics. In addition, due to the low voltage coefficient, the resistor has low noise characteristics and high linearity. Thus, in important circuits, (SMF) power chip resistors are commonly used in active filters or bridge circuits.

Token (SMF) power-type metal film molded resistors provide three power, 2W, 3W, and 5W. Resistance range of  $10\Omega \sim 2M\Omega$ , and the maximum working voltage up to 500V. The tolerance accuracy has two options  $\pm 1\%$  (F), and  $\pm 5\%$  (J) with temperature coefficient of  $\pm 100\text{ppm}/^\circ\text{C}$ .

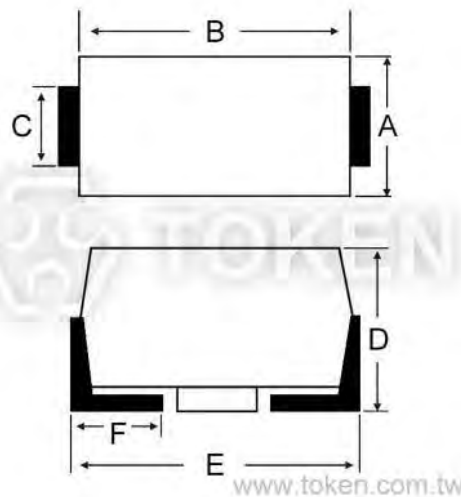
(SMF) series are available in tapes, RoHS compliant and 100% lead free. For conventional parameters, specifications outside the parameters, or technical requirements, please contact Token. Detailed specifications, both mechanical and electrical, please contact us with your specific needs, or link to Token official website "[Chip Resistors](http://www.token.com.tw)" to get more information.



## ► Construction & Dimensions

### Construction & Dimensions (Unit: mm) (SMF)

Rated Wattage	A ±0.3	B ±0.3	C ±0.3	D ±0.3	E Max.	F ±0.3	Resistance Range (Ω)	Max. Working Voltage (V)
2W	4.0	6.7	1.4	3.55	7.9	1.5	10 ~ 2M	300
3W	5.5	10.5	1.7	5.0	12	2.3	10 ~ 2M	500
5W	7.3	13.5	1.7	6.8	17	2.5	10 ~ 2M	500



Surface Mounted Power Metal Film Resistor Dimensions (SMF)

**Note:**

- Rated Continuous Working Voltage (RCWV) =  $\sqrt{P \times R}$ , or Max. Operating Voltage listed in above table whichever is lower.
- Resistance or specifications outside the parameters can be on request.

## Electrical Spec.

### Electrical And Mechanical Performance (SMF)

Characteristics	Standards	Test Methods
Resistance Tolerance	$\pm 5\%$ (J) or $\pm 1\%$ (F)	-
TCR	$\pm 100\text{ppm}/^\circ\text{C}$	$-55^\circ\text{C} \sim 200^\circ\text{C}$
Power Rating Load	Surface temp. $275^\circ\text{C}$ Max.	Rated voltage for 30 minutes
Short Time Overload	$\pm(1\% + 0.05\Omega)$	5 times rated power with applied voltage not to exceed 2 times maximum continuous operating voltage for 5 seconds.
Dielectric Withstanding Voltage	No evidence of mechanical damage or insulation breakdown.	AC 500V for 1 minutes
Insulation Resistance	10,000M $\Omega$	DC 500V megger
Solder-ability	Minimum 95% coverage	$235 \pm 5^\circ\text{C}$ for 2 seconds
Resistance to Soldering Heat	No evidence of mechanical damage. $\pm(1\% + 0.05\Omega)$	$270 \pm 5^\circ\text{C}$ for $10 \pm 1$ seconds

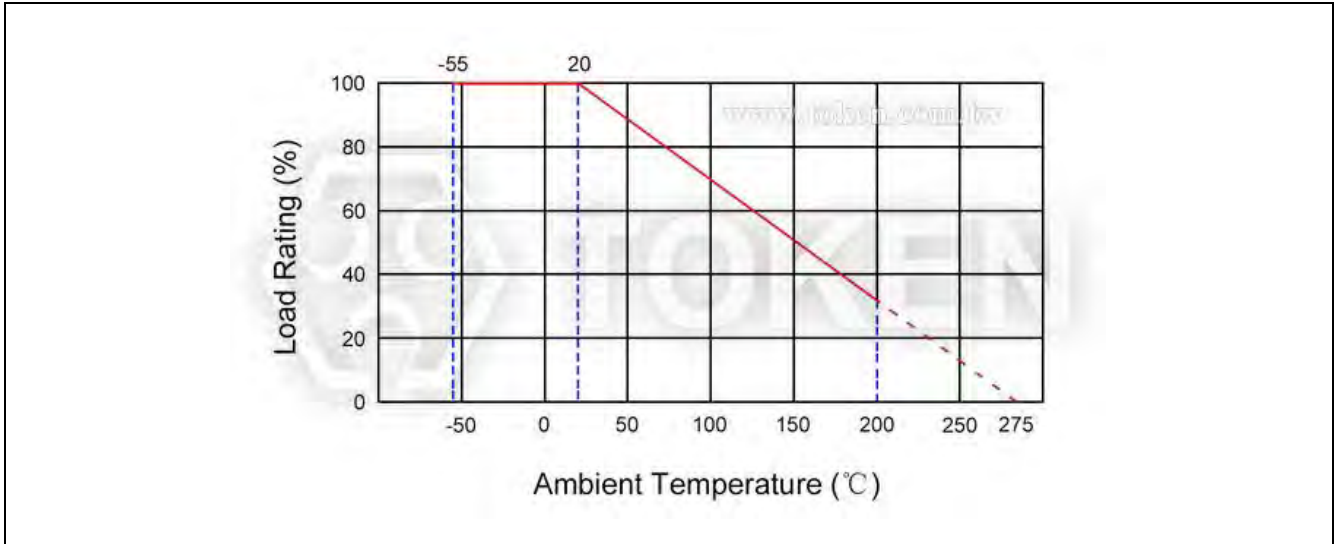
### Environmental Characteristics (SMF)

Characteristics	Standards	Test Methods
Temp. Cycle	$\pm(1\% + 0.05\Omega)$	$-55^\circ\text{C}$ (30min.) $\rightarrow$ Room Temp. (3min.) $\rightarrow$ $+200^\circ\text{C}$ (30min.) $\rightarrow$ Room Temp. (3min.)/(5cycles)
Load Life	$\pm(1\% + 0.05\Omega)$	Rated power load 90 minutes ON 30 minutes OFF $70^\circ\text{C}$ 1000 hours
Moisture-proof Load Life	$\pm(1\% + 0.05\Omega)$	Rated power load 90 minutes ON 30 minutes OFF $40^\circ\text{C}$ 95% RH 500 hours

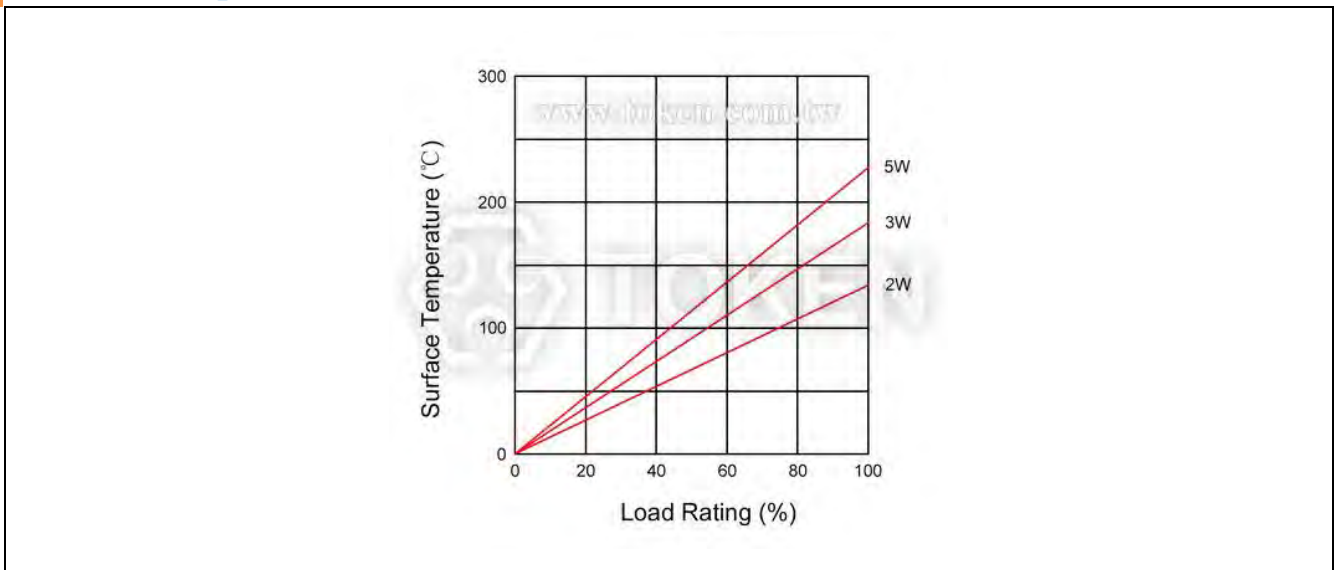
## Graph

### Derating Curve (SMF)

For resistors operated in ambient temperatures above 20°C, power rating must be derated in accordance with the curve below.



### Surface Temperature Rise (SMF)



## Order Codes

### Order Codes (SMF)

SMF	2W	10Ω		J	
Part Number	Rated Wattage (W)	Resistance (Ω)		Tolerance (%)	
SMF	2W	10	10Ω	F	±1.00%
	3W	1K1	1.1KΩ	J	±5.00%
	5W	110K	110KΩ		
		1M1	1.1MΩ		

## General Information

### Token Thin Film Chips Add Powerful New Options

Token electronics provides the industry's most comprehensive range of precision thin film technologies for discrete, network, and integrated passive components used in instrumentation; automotive electronics; communications systems; and portable electronics applications. Ultra-reliable precision Nichrome resistive elements are available on ceramic or silicon substrates in a wide variety of surface mount resistors.

In response to market demands for increased precision and stability, Token has expanded range of nichrome thin-film chip resistors. Offering solutions to precision test and measurement and voltage regulation across industrial, military and medical monitoring equipment markets designed to offer superior humidity performance.

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