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# Precision Resistor Series

## **Token Electronics Industry Co., Ltd.**

**Taiwan:** No.137, Sec. 1, Zhongxing Rd., Wugu District,  
New Taipei City, Taiwan, R.O.C. 24872  
Tel: +886 2981 0109 Fax: +886 2988 7487

**China:** 12F, Zhong Xing Industry Bld., Chuang Ye Road,  
Nan Shan District, Shen Zhen City,  
Guang Dong, China 518054  
Tel: +86 755 26055363; Fax: +86 755 26055365

[Web: www.token.com.tw](http://www.token.com.tw)

[Email: rfq@token.com.tw](mailto:rfq@token.com.tw)



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# Design Guide for Precision Resistive Devices

## ► Design Guide

### Design Guide for Precision Resistive Devices

#### Introduction

Even in this digital age, a number of measurement and instrumentation applications rely on the accuracy of the value of one or more resistors. To guarantee the performance of the system, the designer must understand what factors can affect the value of a precision device, and how the combined effect of these factors may be evaluated.

There are essentially three types of error source to be understood.

- The first is measurement errors, which limit the precision with which the actual resistance value can be known.
- Secondly, short-term change factors, reflecting uncertainty in the resistance value in a customer's recently assembled PCB.
- Thirdly, long-term change factors, reflecting value drift throughout the product's life.

The combination of all these factors is termed total excursion.

#### Measurement Errors

Care is often needed when measuring precision devices to keep the measurement uncertainty at a negligible level compared to the resistance error. In addition to controlling the measurement temperature and voltage, the connections may need to be four-terminal (Kelvin) and using screened cables. If very high values are encountered, the use of guarding techniques may be needed to eliminate surface leakage paths.

The instrument used must have sufficient resolution and traceable calibration to enable the measurement uncertainty to be quantified. If measurement uncertainty cannot be made negligible, it should be allowed for. For example, when checking the value of 0.01% tolerance resistor on a meter with 0.001% (10ppm) measurement uncertainty, acceptance limits of 0.009% should be used.

#### Long-Term Change Factors

Datasheets often quote a number of figures for the performance data to enable the designer to assess the maximum lifetime change in resistance value. In general, only one of these figures should be used – the one that most closely reflects operating conditions.

The shelf life figure applies where loading is negligible and the environment is benign. The load figure applies where power dissipation is the main factor, the long-term damp heat figure where humid environments may be encountered.

In all these tests the majority of the value change happens within the period of the test, as the value will tend to stabilize. For example, the 1,000-hour load figure is a good guide to the change predicted over a longer period of service. For greater precision, mathematical models exist to extrapolate from tested stability levels to long-term stability under application conditions.



### Short-Term Change Factors

The most basic factors are tolerance and temperature coefficient of resistance (TCR). The tolerance is simply the maximum percentage deviation of actual resistance value from nominal for resistors as delivered, measured at a specified temperature (normally 25°C). In some cases the measurement voltage is also specified.

The TCR specifies a limit on the variation of resistance with temperature. It is defined as the maximum average change in resistance value per degree centigrade between two defined temperatures, and expressed in ppm/°C. Unless otherwise stated, the tolerance and TCR figures are positive or negative, ie, "0.1%" means "±0.1%".

When defining the temperature range for a resistor it is necessary to consider the internal ambient temperature, the effect of nearby heat-generating components and the temperature rise due to dissipation in the resistor itself.

There are other factors that can affect resistance value measurements in some cases. For high-value and high-voltage parts, the value obtained can depend on the measurement voltage used. The maximum error from this source may be calculated from the voltage coefficient of resistance (VCR), which expresses this change in ppm/V. VCR is always negative. Customers may specify measurement voltages which reflect actual operating conditions to eliminate this error.

At the other extreme, very low-value resistors for current-sensing applications may generate thermal EMFs at junctions of dissimilar metals when a temperature difference arises through self-heating, or some other cause. This can be significant compared to the resistive volt drop and therefore generate an error. Designing for thermal symmetry across the resistor can normally eliminate this error source.

TCR and VCR both produce reversible changes in resistance value; the resistance would recover to its original value if measured at room temperature and standard measurement voltage. Other changes are permanent, and the first of these to consider is value shifts due to processing by the PCB assembler. This can be assessed by looking at the performance figure for resistance to solder heat in the datasheet.

**Clearly initial calibration can be used to eliminate tolerance and soldering process induced errors.**



# Glossary of Precision Resistor Terminology

## ▶ Resistor Terminology

### Glossary of Resistor Terminology

#### Absolute Tolerance

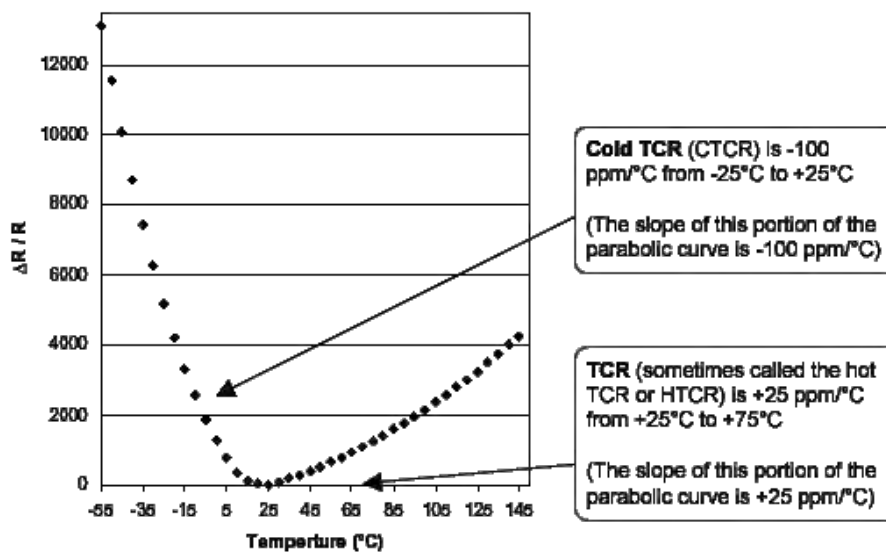
The tolerance of a resistor or a specific resistor in a network is also called the absolute tolerance.

#### Absolute TCR

The Temperature Coefficient of Resistance (TCR) of a resistor or a specific resistor in a network is also called the absolute TCR.

#### 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 ( $^{\circ}\text{C}$ ). For example, a resistor with a TCR of  $+100 \text{ ppm}/^{\circ}\text{C}$  will change  $+0.1\%$  total over a 10-degree change and  $+1\%$  total over a 100-degree change.



Typical Temperature Coefficient of Resistance (TCR)

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:

- $TCR \text{ (ppm/}^\circ\text{C)} = (R - R_0) / R_0 \times 1 / (T - T_0) \times 10^6$
- R: Measured resistance ( $\Omega$ ) at T °C; R<sub>0</sub>: Measured resistance ( $\Omega$ ) 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.

### Voltage Coefficient of Resistance (VCR)

The Voltage Coefficient is the change in resistance with applied voltage. This is entirely different and in addition to the effects of self-heating when power is applied. A resistor with a VCR of 100 ppm/V will change 0.1% over a 10 Volt change and 1% over a 100 Volt change. The rate of change in resistance value per 1 Volt in the prescribed voltage range is expressed by the following formula:

- $VCR \text{ (ppm/V)} = (R_0 - R) / R_0 \times 1 / (V_0 - V) \times 10^6$
- R: Measured resistance ( $\Omega$ ) at base voltage; V: Base voltage
- R<sub>0</sub>: Measured resistance ( $\Omega$ ) at upper voltage; V<sub>0</sub>: Upper voltage

### 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.

### 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. See the Derating curve entry in this glossary.

### 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

**Equation: Power (Watts) = (Current (Amps))<sup>2</sup> × 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

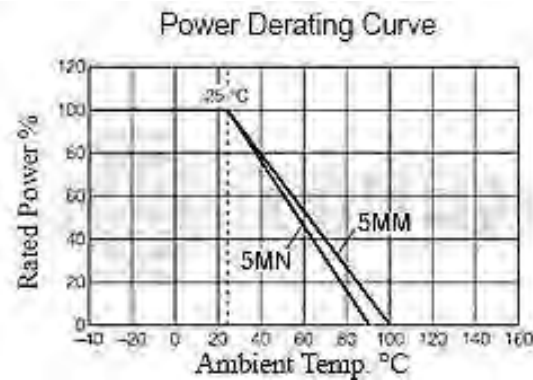
The maximum voltage applied continuously to a resistor at the rated ambient temperature. Rated voltage is calculated from the following formula, but it must not exceed the maximum working voltage.

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

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

## Derating Curve

The curve that describes the relationship between the resistors' operating temperature and the maximum value of continuous power permitted at that temperature. If the circuit designs permits, the choice of a high Ohmic value resistor or divider network will minimize this consideration and improve the resistor's performance because it will operate at lower power.



Typical Derating Curve

## Nominal Resistance

The adjective nominal (ultimately from Latin means "name") generally relates to the concept of names, and often to the difference between what something is in name (ideally or theoretically) and what it is in reality. Thus it may refer to: a value that is used as the name for an actual value of resistance which is close but not exactly the same.

## Dielectric Withstanding Voltage

The rated voltage that can be applied to a designated point between the resistive element and the outer coating, or the resistive element and the mounting surface, without causing dielectric breakdown.

## Noise

Noise is an unwanted AC signal from within the resistor. Resistive noise can have a devastating effect on low-level signals, charge amplifiers, high gain amplifiers, and other applications sensitive to noise. The best approach is to use resistor types with low or minimal noise in applications that are sensitive to noise.



# High Precision Network Voltage Divider (UPRND)

## ► Product Introduction

**Token's (UPRND) high precision voltage divider networks sharpen the edge of application accuracy.**

### Features :

- UPRND: Parallel dip type; UPRNS: Serial dip type.
- Any value available within resistance range.
- Lead (Pb)-free and RoHS compliant.
- Precision tolerance tight to A2( $\pm 0.02\%$ ).
- Metal film precision networks, excellent stability and reliability.
- Superior TCR narrowed to Absolute C7( $\pm 5$  ppm/ $^{\circ}\text{C}$ ), Relative C10( $\pm 2$  ppm/ $^{\circ}\text{C}$ ).

### Applications :

- Industrial, Precision Bypass, Divider.
- Medical, Test and Measurement Equipment.
- Electron Beam (EB) Applications Scanning.
- Recording Equipment, Electron Microscopes.
- Military, airborne, High precision instrumentation.
- Precision Amplifiers, Audio (High End Stereo Equipment).

The Precision Thin-Film Network technology provides a significant reduction of the resistive component's sensitivity to ambient temperature variations (TCR).

Designers can now guarantee a high degree of stability and accuracy in fixed-resistor applications using solutions based on Token's revolutionary Network technology. This technology allows customer orientated products, designed to satisfy challenging and specific technical requirements.

Precision Network Resistors UPRND Series meets Lead (Pb)-free and RoHS compliant. Known for providing design engineers with a comprehensive range of industrial-qualified resistive devices, Token Electronics has further expanded its precision product capabilities in Serial UPRNS and Parallel UPRND Series.

Providing design engineers with an economical power resistor with high quality performance, Token Electronics offers low cost industrial grade Parallel UPRND and Serial UPRNS Networks.

Token's UPRND/UPRNS Series are assembled by EE/RE 1/10 series to form a stable, high precision thin-film network. Characteristic of UPRND Series meet extreme low temperature coefficient.

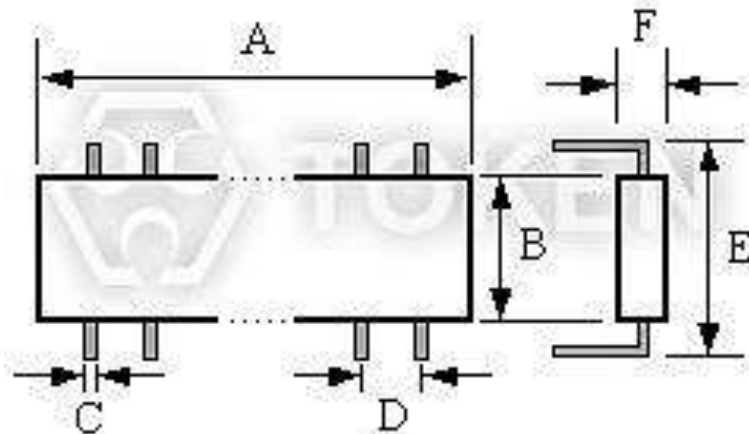
Parallel UPRND Series equate IRC, EBG Precision Devices with fast delivery and more competitive price. For non-standard technical requirements and special applications, please contact us. Besides, you can link to Token official website "[Precision Resistors](http://www.token.com.tw)" to get more information.



## ► Dimensions & Technical Characteristics

### Dimensions & Technical Characteristics (UPRND)

UPRND A(mm)±0.5	5.08	11.8
Number of Resistors #	2	4
Dimensions(Unit: mm)	A	5.08±0.5 ~ 11.8±0.5
	B	9.0±0.5
	C	0.6±0.05
	D	2.54±0.05
	E	11.5±0.5
	F	3.0±0.5
Rated Wattage of one element unit at 70°C (W)	0.1	
Maximum Working Voltage (V)	200	
Nominal Resistance Range of component element unit (Ω)	10 ~ 1M	
Absolute Tolerance (%)	A2(±0.02), A5(±0.05), B(±0.1), C(±0.25), D(±0.5), F(±1.0)	
Relative Tolerance (%)	T(±0.01), A2(±0.02), A5(±0.05), B(±0.1)	
Absolute Temperature Coefficient (ppm/°C)	C7(±5), C6(±10), C5(±15), C3(±25), C2(±50)	
Relative Temperature Coefficient (ppm/°C)	C10(±2), C9(±3), C7(±5), C6(±10), C5(±15)	
Working Temperature (°C)	-10 ~ +70	

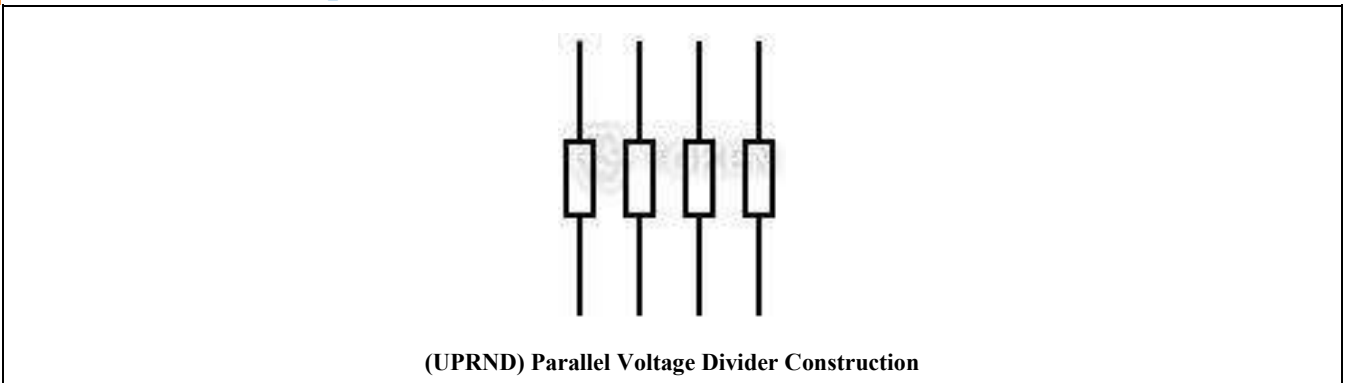


Parallel Voltage Divider (UPRND) Dimensions

- Remark: 1. Absolute value means all factors (Tolerance and Temperature Coefficient) of network component element units are independent.
- 2. Relative value means the maximum difference factor among component element units of Network Resistor.

## Examples for Construction

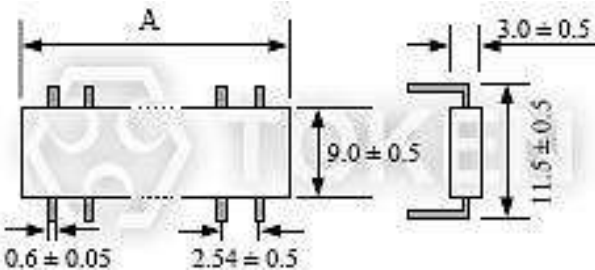
### Construction Examples (UPRND)

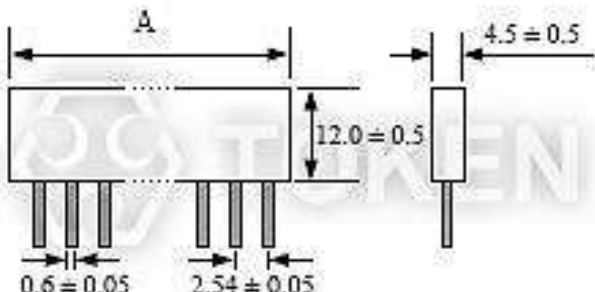


- 1. There are no standard nominal resistances for UPRNS/UPRND Series.
- 2. It can be required to Token's representatives if requirement beyond above specifications.
- 3. Customer can designate or specify the number of component elements of Network Resistor according with this specification of UPRNS/UPRND Series to meet your own needs.

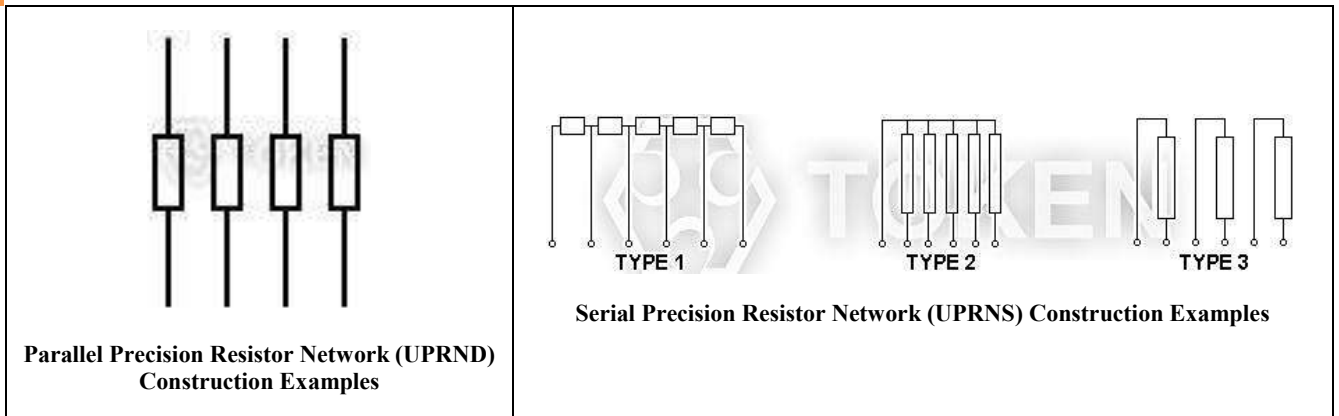
## UPRNS Versus UPRND Series

### Precision Resistor Network Dimensions UPRND Versus UPRNS

 Parallel Precision Resistor Networks (UPRND) Dimensions	(UPRND) Dimensions Unit: mm $A \pm 0.5$	Number of Resistors
	5.08	2
	11.8	4

 Serial Precision Resistor Networks (UPRNS) Dimensions	(UPRNS) Voltage Divider Resistor Networks Dimensions Unit: mm $A \pm 0.5$	Pins
	14.20	5
	16.9	6
	21.9	8
	24.1	9
	35	13
	42.3	16
	50.8	19

## Internal Connection UPRNS Versus UPRND



## Order Codes

### Order Codes (UPRND)

UPRND	4	100R	B		C5				
Part Number	Number of Resistors	Resistance Value ( $\Omega$ )		Resistance Tolerance (%)		Temperature coefficient (PPM/ $^{\circ}$ C)			
UPRND									
	2	10R	10	Absolute	A2	$\pm 0.02$	Absolute	C7	$\pm 5$
	4	100R	100		A5	$\pm 0.05$		C6	$\pm 10$
		1K	1K		B	$\pm 0.10$		C5	$\pm 15$
		1M	1M		C	$\pm 0.25$		C3	$\pm 25$
					D	$\pm 0.50$		C2	$\pm 50$
			F		$\pm 1.00$	C10		$\pm 2$	
				Relative	T	$\pm 0.01$	Relative	C9	$\pm 3$
					A2	$\pm 0.02$		C7	$\pm 5$
					A5	$\pm 0.05$		C6	$\pm 10$
				B	$\pm 0.10$	C5	$\pm 15$		

## ► General Information

### High Precision Devices Made in Token

Token is equipped to design and produce custom components to meet many design and reliability demands.

Token's line of high-reliability and precision products reflects a long-term commitment to our industrial and military customers. In addition to standard industry-grade resistor products, we also have many resistive products designed to meet various military source-controlled drawings.

We continually strive to meet the changing application requirements of the markets by developing new products and manufacturing technologies on an on-going basis.

### Enhanced Precision and Stability for Low-Cost Uses

Every component Token provides to the commercial, industrial, and military markets for cost-efficiency uses is backed by the comprehensive testing and failure analysis capabilities of our own technical staff, whom are industrial experts in understanding and meeting the requirements of the environment.

### Low TCR - Fast Approach to a Steady State

Token Electronics provides a precision Temperature Coefficient of Resistance TCR as low as 2 ppm/°C, If you must guarantee a smaller resistance change in your application. TCR is the best known parameter used to specify a resistor's stability, and is used to depict the resistive element's sensitivity to temperature change due to ambient temperature variations.

A resistor's TCR tells how much its value changes as its temperature changes. It is usually expressed in ppm/°C (parts per million per degree Centigrade) units.

### Long-Term Proven Service

Our technical expertise, our knowledge of the industry, our broad product offering, and our ability to work long-term are all part of Token's ongoing commitment to meeting the changing requirements of our most reliability-conscious customer, today and in the future.



# High Precision Network Voltage Divider (UPRNS)

## ► Product Introduction

Token's (UPRNS) high precision network voltage divider saves on resistors.

### Features :

- UPRNS: Serial dip type; UPRND: Parallel dip type.
- Any value available within resistance range.
- Lead (Pb)-free and RoHS compliant.
- Precision tolerance tight to A2( $\pm 0.02\%$ ).
- Metal film precision networks, excellent stability and reliability.
- Superior TCR narrowed to Absolute C7( $\pm 5$  ppm/ $^{\circ}\text{C}$ ), Relative C10( $\pm 2$  ppm/ $^{\circ}\text{C}$ ).

### Applications :

- Industrial, Military, Airborne.
- Electron Beam Applications (EB) Scanning,
- Recording Equipment, Electron Microscopes.
- Medical , Test And Measurement Equipment,
- Precision Divider, Bypass, High Precision Instrumentation,
- Audio (High End Stereo Equipment), Precision Amplifiers.

Precision thin film network technology outperforms all other resistor technologies available today for applications that require high precision and high stability. This technology has been pioneered and developed by Token, and products based on this technology are the most suitable for a wide range of applications.

This technology with any value available within resistance range allows customer orientated products, designed to satisfy challenging and specific technical requirements.



Precision Network Resistors UPRNS Series meets Lead (Pb)-free and RoHS compliant.

Providing design engineers with an economical power resistor with high quality performance, Token Electronics offers low cost industrial grade Serial UPRNS and Parallel UPRND networks.

Token's UPRNS/UPRND Series are assembled by EE/RE 1/10 series to form a stable, high precision divider networks. Characteristic of UPRNS Series meet extreme low temperature coefficient.

Serial UPRNS equate to IRC, EBG Precision Devices with fast delivery and more competitive price. For non-standard technical requirements and special applications, please contact us. Besides, you can link to Token official website "[Precision Resistors](http://www.token.com.tw)" to get more information.

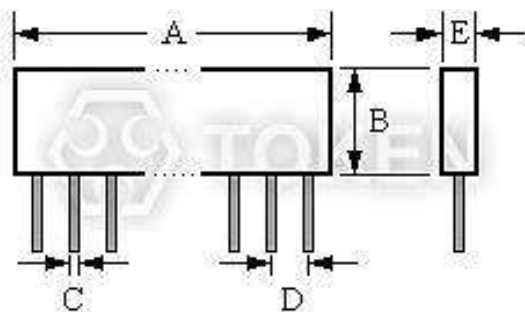




## ► Dimensions & Technical Characteristics

### Dimensions & Technical Characteristics (UPRNS)

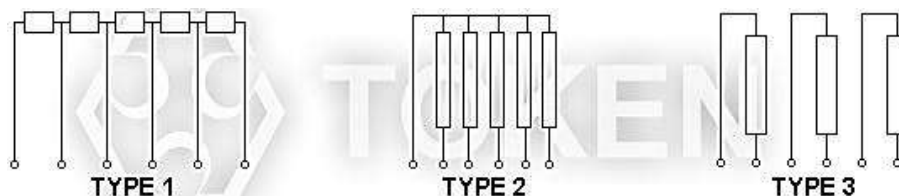
UPRNS A(mm) $\pm 0.5$	14.20	16.90	21.90	24.10	35.00	42.30	50.80
Number of Pins	5	6	8	9	13	16	19
Dimensions (Unit: mm)	A	14.20 $\pm 0.5$ ~ 50.80 $\pm 0.5$					
	B	12.0 $\pm 0.5$					
	C	0.6 $\pm 0.05$					
	D	2.54 $\pm 0.05$					
	E	4.0 $\pm 0.5$					
Rated Wattage of one element unit at 70°C (W)	0.1						
Maximum Working Voltage (V)	200						
Nominal Resistance Range of component element unit ( $\Omega$ )	10 ~ 1M						
Absolute Tolerance (%)	A2( $\pm 0.02$ ), A5( $\pm 0.05$ ), B( $\pm 0.1$ ), C( $\pm 0.25$ ), D( $\pm 0.5$ ), F( $\pm 1.0$ )						
Relative Tolerance (%)	T( $\pm 0.01$ ), A2( $\pm 0.02$ ), A5( $\pm 0.05$ ), B( $\pm 0.1$ )						
Absolute Temperature Coefficient (ppm/°C)	C7( $\pm 5$ ), C6( $\pm 10$ ), C5( $\pm 15$ ), C3( $\pm 25$ ), C2( $\pm 50$ )						
Relative Temperature Coefficient (ppm/°C)	C10( $\pm 2$ ), C9( $\pm 3$ ), C7( $\pm 5$ ), C6( $\pm 10$ ), C5( $\pm 15$ )						
Working Temperature (°C)	-10 ~ +70						



Serial Network (UPRNS) Dimensions

## ► Examples for Construction

### Construction Examples (UPRNS)

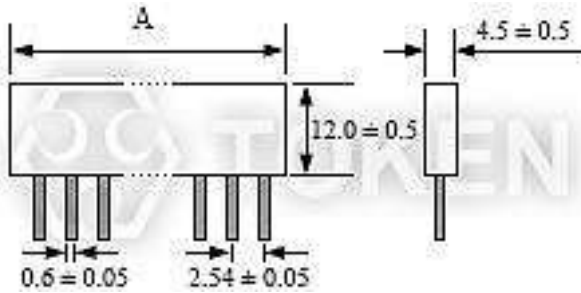


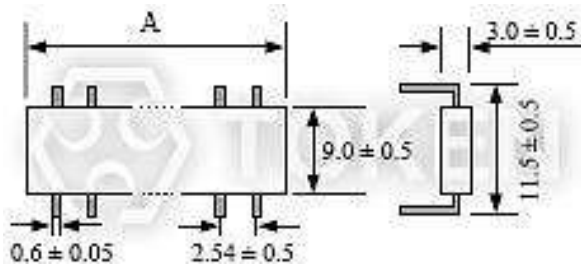
Serial Precision Voltage Divider (UPRNS) Construction Examples

- 1. There are no standard nominal resistances for UPRNS/UPRND Series.
- 2. It can be required to Token's representatives if requirement beyond above specifications.
- 3. Customer can designate or specify the number of component elements of Network Resistor according with this specification of UPRNS/UPRND Series to meet your own needs.

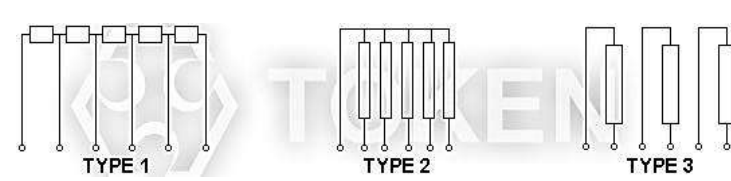
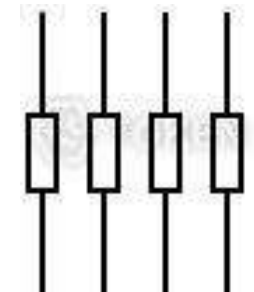
## ► UPRNS Versus UPRND Series

### Precision Resistors Network Dimensions UPRNS Versus UPRND

 <p>Serial Precision Resistor Networks (UPRNS) Dimensions</p>	(UPRNS) Dimensions Unit: mm $A \pm 0.5$	Pins
	14.20	5
	16.9	6
	21.9	8
	24.1	9
	35	13
	42.3	16
	50.8	19

 <p>Parallel Precision Resistor Networks (UPRND) Dimensions</p>	(UPRND) Voltage Divider Resistor Networks Dimensions Unit: mm $A \pm 0.5$	Number of Resistors
	5.08	2
	11.8	4

### Internal Connection UPRNS Versus UPRND

 <p>Serial Precision Resistor Network (UPRNS) Construction Examples</p>	 <p>Parallel Precision Resistor Network (UPRND) Construction Examples</p>
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## Order Codes

### Order Codes (UPRNS)

UPRNS	8	Type1	10R		B			C5		
Part Number	Number of Pins	Construction	Resistance Value ( $\Omega$ )		Resistance Tolerance (%)			Temperature coefficient (PPM/ $^{\circ}$ C)		
UPRNS		Type1	10R	10	Absolute	A2	$\pm 0.02$	Absolute	C7	$\pm 5$
	5	Type2	100R	100		A5	$\pm 0.05$		C6	$\pm 10$
	6	Type3	1K1	1.1K		B	$\pm 0.10$		C5	$\pm 15$
	8		C	$\pm 0.25$		C3	$\pm 25$			
	9		D	$\pm 0.50$		C2	$\pm 50$			
	13	1M	1M	Relative		F	$\pm 1.00$		Relative	C10
	16				T	$\pm 0.01$	C9	$\pm 3$		
	19				A2	$\pm 0.02$	C7	$\pm 5$		
					A5	$\pm 0.05$	C6	$\pm 10$		
				B	$\pm 0.10$	C5	$\pm 15$			



## ► General Information

### High Precision Devices Made in Token

Token is equipped to design and produce custom components to meet many design and reliability demands.

Token's line of high-reliability and precision products reflects a long-term commitment to our industrial and military customers. In addition to standard industry-grade resistor products, we also have many resistive products designed to meet various military source-controlled drawings.

We continually strive to meet the changing application requirements of the markets by developing new products and manufacturing technologies on an on-going basis.

### Enhanced Precision and Stability for Low-Cost Uses

Every component Token provides to the commercial, industrial, and military markets for cost-efficiency uses is backed by the comprehensive testing and failure analysis capabilities of our own technical staff, whom are industrial experts in understanding and meeting the requirements of the environment.

### Low TCR - Fast Approach to a Steady State

Token Electronics provides a precision Temperature Coefficient of Resistance TCR as low as 2 ppm/°C, If you must guarantee a smaller resistance change in your application. TCR is the best known parameter used to specify a resistor's stability, and is used to depict the resistive element's sensitivity to temperature change due to ambient temperature variations.

A resistor's TCR tells how much its value changes as its temperature changes. It is usually expressed in ppm/°C (parts per million per degree Centigrade) units.

### Long-Term Proven Service

Our technical expertise, our knowledge of the industry, our broad product offering, and our ability to work long-term are all part of Token's ongoing commitment to meeting the changing requirements of our most reliability-conscious customer, today and in the future.



# Low TCR Metal Film Resistors (EE)

## ► Product Introduction

Low TCR high precision resistors offer more precision design options.

### Features :

- Power Rating :0.125W ~ 1W.
- Precision tolerance tight to T( $\pm 0.01\%$ ).
- Precision metal film, excellent stability and reliability.
- Superior electrical TCR performances narrowed to C10 ( $\pm 2 \text{ ppm}/^\circ\text{C}$ ).
- Lead (Pb)-free and RoHS compliant, Covers all general type resistors.

### Applications :

- Medical electronics.
- Measuring and calibration equipment.
- High gain feedback applications.
- Precision Instruments, Avionics.
- Telecom.

Known for providing design engineers with a comprehensive range of military-qualified resistive precision devices, Token Electronics Advanced Metal Film has further expanded its military product capabilities.

These cost-effective high precision moulding resistors meets ROHS requirements, MIL-PRF-55182, and GJB244A-2001 quality standards.

EE Series manufactured by depositing a homogeneous film of metal alloy onto a high-grade ceramic body, the metal film resistors are moulded into cylinder shape to provide mechanical, electrical and climatic protection.

EE Series equate Vishay, IRC, EBG, and Panasonic Precision Devices with more competitive price and fast delivery. Contact us with your specific needs. Besides, you can link to Token official website "[Precision Resistors](http://www.token.com.tw)" to get more information.

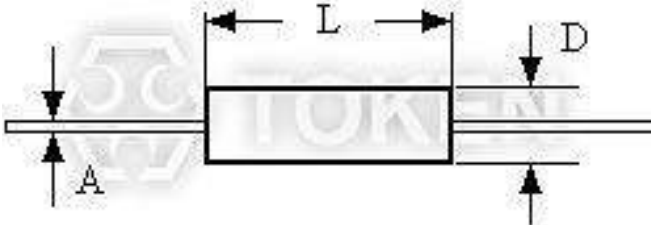
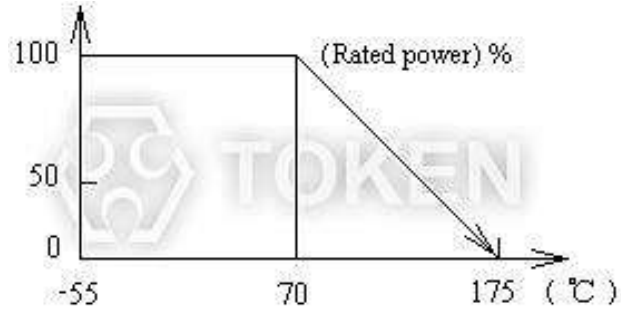
### Production Standard:

This is made referencing to Chinese National Quality Standard GJB244A-2001 standards and USA Military/Established Reliability MIL-PRF-55182 in environmental and dimensional requirements.



## ► Dimensions & Technical Characteristics

### Dimensions & Technical Characteristics (EE)

Type		EE1/20	EE1/10	EE1/8	EE1/4	EE1/2
Rated Wattage (W)	70°C	0.125	0.25	0.5	0.75	1.0
Max. Working Voltage (V)		200	200	250	300	350
Dimensions (Unit: mm)	L ± 0.3	4.3	6.8	10.2	15.1	18.4
	D ± 0.4	1.9	2.5	3.8	5.2	6.5
	A ± 0.05	0.40	0.60	0.60	0.60	0.80
Resistance Range (Ω)		10Ω ~ 2.5MΩ	10Ω ~ 10MΩ	10Ω ~ 10MΩ	10Ω ~ 10MΩ	10Ω ~ 10MΩ
Working Temperature Range		-55°C ~ +175°C				
Nominal Resistance Tolerance		A2(±0.02%), A5(±0.05%), B(±0.10%), C(±0.25%), D(±0.50%), F(±1.00%) between 10Ω to 350KΩ can be reached to T(±0.01%)				
Temperature Coefficient PPM Normal test range (+25°C ~ +85°C) Special require range (-10°C ~ +50°C)		C7(±5PPM/°C), C6(±10PPM/°C), C5(±15PPM/°C), C3(±25PPM/°C), C2(±50PPM/°C) between 10Ω to 350KΩ can be reached to C8(±4PPM/°C), C9(±3PPM/°C), or C10(±2PPM/°C)				
 <p>Precision (EE) Dimensions</p>			 <p>(EE) Power Derating Curve</p>			

● Remark: Please contact Token's Representatives if your requirement is not in above range.



## ► Mechanical and Electrical Test Conditions

### Mechanical and Electrical Test Conditions (EE)

Type	Item	Method	Requirement
Long Period	Life Time	GJB244A (MIL-PRF-55182) 4.8.18 Rated Wattage, 125 °C, 2000h, 10000h	GJB244A (MIL-PRF-55182) 3.24 $\Delta R \leq \pm(0.5\%R + 0.01\Omega)$ $\Delta R \leq \pm(2\%R + 0.01\Omega)$
	Humidity	GJB244A (MIL-PRF-55182) 4.8.18 -10°C ~ +65°C, RH < 90% Rated Wattage, Cycle 240h.	GJB244A (MIL-PRF-55182) 3.21 $\Delta R \leq \pm(0.4\%R + 0.01\Omega)$
	High Temp. Exposed	GJB244A 4.8.19 175°C 2000h	GJB244A (MIL-PRF-55182) 3.25 $\Delta R \leq \pm(2.0\%R + 0.01\Omega)$
Short Period	Dielectric Voltage	GJB244A (MIL-PRF-55182) 4.8.12/4.8.23/4.8.10	GJB244A (MIL-PRF-55182) 3.18/3.29/3.16 $\Delta R \leq \pm(0.15\%R + 0.01\Omega)$ no physical damage, arc, isolation break through
	Lead Strength, Impact, High Frequency Vibration	GJB244A (MIL-PRF-55182) 4.8.11/4.8.16/4.8.17	GJB244A (MIL-PRF-55182) 3.17/3.22/3.23 $\Delta R \leq \pm(0.20\%R + 0.01\Omega)$ no physical damage
	Solderability	GJB244A (MIL-PRF-55182) 4.8.14	GJB244A (MIL-PRF-55182) 3.20 $\Delta R \leq \pm(0.10\%R + 0.01\Omega)$ no physical damage

## ► Order Codes

### Order Codes (EE)

EE1/8	0.5W			10R		B		C6		P	
Part Number	Rated Power (W)			Resistance Value (Ω)		Resistance Tolerance (%)		Temperature coefficient (PPM/°C)		Package	
EE1/20	EE1/20	70°C	0.125	10R	10	T	±0.01	C2	±50	P	Bulk
EE1/10	EE1/10		0.25	100R	100	A2	±0.02	C3	±25		
EE1/8	EE1/8		0.5	1K1	1.1K	A5	±0.05	C5	±15		
EE1/4	EE1/4		0.75	110K	110K	B	±0.1	C6	±10		
EE1/2	EE1/2		1	1M1	1.1M	C	±0.25	C7	±5		
EE1/2				10M	10M	D	±0.5	C8	±4		
						F	±1.0	C9	±3		
								C10	±2		

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### Low TCR - Fast Approach to a Steady State

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### Long-Term Proven Service

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# Low Ohmic Ultra Precision Resistors (NE)

## ► Product Introduction

**Token advanced film (NE) low resistance ultra-precision resistors spell high precision.**

### Features :

- Token NE Series meets MIL-PRF-55182 and GJB244A-2001 quality standards.
- Controlled temperature coefficient and narrowed to C7 ( $\pm 5\text{PPM}/^\circ\text{C}$ ).
- Extensive stocking program at distributors and factory.
- Extreme precision tolerance tight to A5 ( $\pm 0.05\%$ ).
- Caps range of ultra low resistance  $0.05\Omega \sim 10\Omega$ .
- Excellent stability and High reliability.
- Industrial grades, RoHS Compliant.
- Metal film moulding type.

### Applications :

- Measuring and calibration equipment
- Industrial process control systems
- Space and aircraft electronics
- Test and measurement
- Telecom

A homogenous film of metal alloy is deposited on a high grade ceramic body. After a helical groove has been cut in the resistive layer, tinned connecting wires of electrolytic copper are welded to the end-caps.

The resistors are moulding which provides electrical, mechanical, and climatic protection.

Token has complete capability to develop specific reliability programs designed to customer requirements. Products equate Vishay, Ohmite, Caddock, IRC, EBG, and Panasonic Precision Devices with more competitive price and fast delivery.

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

### MIL-PRF-55182:

The NE series meets the electrical, environmental and dimensional requirements of MIL-PRF-55182.

Referencing to Chinese National Quality Standard GJB244A-2001.

### POWER RATING:

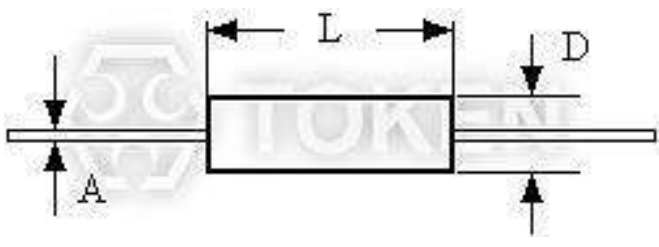
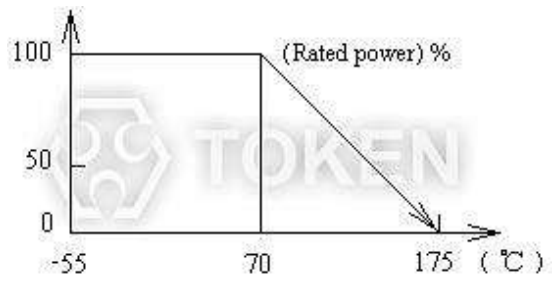
Power ratings are based on the following two conditions,

- $\pm 2.0\%$  maximum  $\Delta R$  in 10 000 h load life.
- $+175^\circ\text{C}$  maximum operating temperature.



## ► Dimensions & Technical Characteristics

### Dimensions & Technical Characteristics (NE)

Type		NE1/20	NE1/10	NE1/8	NE1/4	NE1/2
Rated Wattage (W)	70 °C	0.125 (1/8W)	0.25 (1/4W)	0.5 (1/2W)	0.75 W	1 W
Max. Working Voltage (V)		200V	200V	250V	300V	350V
Resistance Range (Ω)		0.05 ~ 10	0.05 ~ 10	0.05 ~ 10	0.05 ~ 10	0.05 ~ 10
Dimensions (Unit: mm)	L ± 0.3	4.3	6.8	10.2	15.1	18.4
	D ± 0.4	1.9	2.5	3.8	5.2	6.5
	A ± 0.05	0.40	0.60	0.60	0.60	0.80
Working Temperature Range		-55°C ~ +175°C				
Nominal Resistance Tolerance J(±5.0%) F(±1.0%) D(±0.5%) C(±0.25%) B(±0.10%) A5(±0.05%)		all resistance: J 0.05Ω≤R<1Ω: J / F 1Ω≤R<5Ω: B / C / D / F 5Ω≤R≤10Ω: A5 / B / C / D / F				
Temperature Coefficient PPM Normal test range(+25°C ~ +85°C)		0.05Ω≤R<1Ω: >±100PPM/°C 1Ω≤R<5Ω: C2(±50PPM/°C), C3(±25PPM/°C), C5(±15PPM/°C), C6(±10PPM/°C) 5Ω≤R≤10Ω: C2(±50PPM/°C), C3(±25PPM/°C), C5(±15PPM/°C), C6(±10PPM/°C), C7(±5PPM/°C)				
 <p>Mold Type (NE) Dimensions</p>		 <p>(NE) Power Derating Curve</p>				

● Remark: Please contact Token's Representatives if your requirement is not in above range.

## ► Mechanical and Electrical Test Conditions

### Mechanical and Electrical Test Conditions (NE)

Type	Item	Method	Requirement
Long Period	Life time	GJB244A (MIL-PRF-55182) 4.8.18 Rated Wattage, 125 °C, 2000h, 10000h	GJB244A (MIL-PRF-55182) 3.24 $\Delta R \leq \pm(0.5\%R + 0.01\Omega)$ $\Delta R \leq \pm(2\%R + 0.01\Omega)$
	Humidity	GJB244A (MIL-PRF-55182) 4.8.18 -10°C ~ +65°C, RH < 90% Rated Wattage, Cycle 240h.	GJB244A (MIL-PRF-55182) 3.21 $\Delta R \leq \pm(0.4\%R + 0.01\Omega)$
	High temp exposed	GJB244A 4.8.19 175°C 2000h	GJB244A (MIL-PRF-55182) 3.25 $\Delta R \leq \pm(2.0\%R + 0.01\Omega)$
Short Period	Dielectric voltage	GJB244A (MIL-PRF-55182) 4.8.12/4.8.23/4.8.10	GJB244A (MIL-PRF-55182) 3.18/3.29/3.16 $\Delta R \leq \pm(0.15\%R + 0.01\Omega)$ no physical damage, arc, isolation break through
	Lead strength Impact High frequency vibration	GJB244A (MIL-PRF-55182) 4.8.11/4.8.16/4.8.17	GJB244A (MIL-PRF-55182) 3.17/3.22/3.23 $\Delta R \leq \pm(0.20\%R + 0.01\Omega)$ no physical damage
	Solderability	GJB244A (MIL-PRF-55182) 4.8.14	GJB244A (MIL-PRF-55182) 3.20 $\Delta R \leq \pm(0.10\%R + 0.01\Omega)$ no physical damage

## ► Order Codes

### Order Codes (NE)

NE1/8	0.5W			10R		B		C6		P			
Part Number	Rated Power (W)			Resistance Value (Ω)		Resistance Tolerance (%)		Temperature coefficient (PPM/°C)		Package			
NE1/20	70°C		0.125	0R1	0.1Ω	A5	±0.05	C2	±50	P	Bulk		
NE1/10			0.25										
NE1/8			0.5	1R	1Ω	B	±0.10	C3	±25				
NE1/4			0.75	10R	10Ω	C	±0.25	C5	±15				
NE1/2					1.0			D	±0.50	C6	±10		
						J	±5.00						

## ► General Information

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### Low TCR - Fast Approach to a Steady State

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A resistor's TCR tells how much its value changes as its temperature changes. It is usually expressed in ppm/°C (parts per million per degree Centigrade) units.

### Long-Term Proven Service

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# Ultra Precision Resistors (RE)

## ► Product Introduction

### Token's Precision Military Established Resistors are Ten-Times More Accurate.

#### Features :

- Power rating from 0.125W to 1.5W.
- Military/Established Reliability and Stability.
- Extreme precision tolerance tight to  $\pm 0.01\%$ .
- Temperature coefficient narrowed to  $\pm 2\text{PPM}/^\circ\text{C}$ .
- Industrial grades, RoHS Compliant, metal film lacquer coated.
- Covers all general type precision resistive products.

#### Applications :

- Measuring and calibration equipment,
- Telecom, Industrial process control systems,
- Test and measurement, Space and aircraft electronics.

The (RE) Series from Token Electronics is capped ultra-precision metal-film resistors, as well as a complete selection of MIL-PRF-55182 and GJB244A-2001 quality standards. Token offers a low-cost alternative to traditional solutions for precision applications.

The (RE) is available in a resistance range of  $10\Omega \sim 10\text{M}\Omega$  with a precision tolerance of  $\pm 0.01\%$  and a temperature coefficient of resistance (TCR) of  $\pm 2\text{PPM}/^\circ\text{C}$ , although other tolerances and TCRs are available.

The resistance element in these devices is a precisely controlled thin film of metal alloy deposited on a high quality alumina substrate. Plated caps are force-fitted before the assembly is trimmed using advanced laser techniques to ensure excellent performance and low electrical noise. Leads are welded to the end caps prior to the resistor being coated with epoxy.

Products equate Vishay, Ohmite, Caddock, IRC, EBG, and Panasonic Precision Devices with more competitive price and fast delivery. Detailed precision (RE) specifications, both mechanical and electrical, please contact our sales representative or link to Token official website "[Precision Resistors](#)" for more information.

#### Production Standard:

Which is made referencing to Chinese National Quality Standard GJB244A-2001 standards, and USA Military/Established Reliability MIL-PRF-55182 in environmental and dimensional requirements.

#### Power Rating:

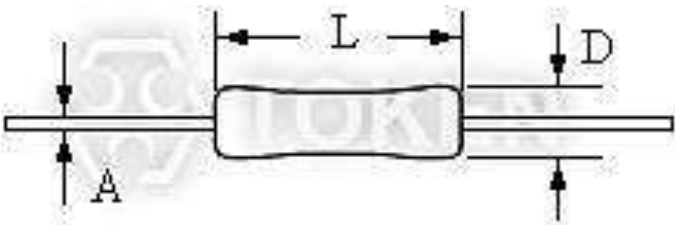
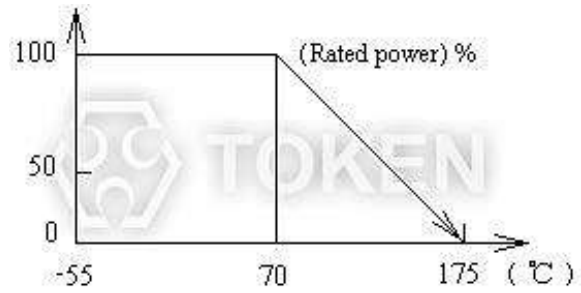
Power ratings are based on the following two conditions,

- $\pm 2.0\%$  maximum  $\Delta R$  in 10 000 h load life.
- $+175^\circ\text{C}$  maximum operating temperature.



## ► Dimensions & Technical Characteristics

### Dimensions & Technical Characteristics (RE)

Type		RE50	RE55	RE60	RE65	RE70	RE75
Rated Wattage (W)	70 °C	0.125	0.25	0.5	0.75	1.0	1.5
Max. Working Voltage (V)		200	200	250	300	350	500
Dimensions (Unit: mm)	L ± 0.3	4.0	6.7	9.8	12.5	14.1	17.8
	D ± 0.4	1.4	2.05	3.2	3.6	4.65	7.2
	A ± 0.05	0.40	0.60	0.60	0.60	0.80	0.80
Resistance Range (Ω)		1Ω ~ 3MΩ	0.05Ω ~ 10MΩ	0.05Ω ~ 10MΩ	0.05Ω ~ 10MΩ	0.05Ω ~ 10MΩ	0.05Ω ~ 10MΩ
Working Temperature Range		-55°C ~ +175°C					
Nominal Resistance Tolerance		A2 (±0.02%), A5 (±0.05%), B(±0.10%), C(±0.25%), D(±0.50%), F(±1.00%) between 10Ω to 350KΩ can be reached to T(±0.01%)					
Temperature Coefficient PPM		C7(±5PPM/°C), C6(±10PPM/°C), C5(±15PPM/°C), C3(±25PPM/°C), C2(±50PPM/°C), C1(±100PPM/°C)					
Normal test range(+25°C ~ +85°C)		between 10Ω to 350KΩ can be reached to C9(±3PPM/°C), C10(±2PPM/°C)					
Special require range(-10°C ~ +50°C)							
 <p>Coating Type (RE) Dimensions</p>				 <p>(RE) Power VS Temperature Curve</p>			

● Remark: Please contact Token's Representatives if your requirement is not in above range.

## ► Mechanical and Electrical Test Conditions

### Mechanical and Electrical Test Conditions (RE)

Type	Item	Method	Requirement
Long Period	Life Time	GJB244A (MIL-PRF-55182) 4.8.18 Rated Wattage, 125 °C, 2000h, 10000h	GJB244A (MIL-PRF-55182) 3.24 $\Delta R \leq \pm(0.5\%R + 0.01\Omega)$ $\Delta R \leq \pm(2\%R + 0.01\Omega)$
	Humidity	GJB244A (MIL-PRF-55182) 4.8.18 -10°C ~ +65°C, RH < 90% Rated Wattage, Cycle 240h.	GJB244A (MIL-PRF-55182) 3.21 $\Delta R \leq \pm(0.4\%R + 0.01\Omega)$
	High Temp Exposed	GJB244A 4.8.19 175°C 2000h	GJB244A (MIL-PRF-55182) 3.25 $\Delta R \leq \pm(2.0\%R + 0.01\Omega)$
Short Period	Dielectric Voltage	GJB244A (MIL-PRF-55182) 4.8.12/4.8.23/4.8.10	GJB244A (MIL-PRF-55182) 3.18/3.29/3.16 $\Delta R \leq \pm(0.15\%R + 0.01\Omega)$ no physical damage, arc, isolation break through
	Lead Strength, Impact, High Frequency Vibration	GJB244A (MIL-PRF-55182) 4.8.11/4.8.16/4.8.17	GJB244A (MIL-PRF-55182) 3.17/3.22/3.23 $\Delta R \leq \pm(0.20\%R + 0.01\Omega)$ no physical damage
	Solderability	GJB244A (MIL-PRF-55182) 4.8.14	GJB244A (MIL-PRF-55182) 3.20 $\Delta R \leq \pm(0.10\%R + 0.01\Omega)$ no physical damage

## ► Order Codes

### Order Codes (RE)

RE60	0.5W			10R		D		C5		P	
Part Number	Rated Power (W)			Resistance Value ( $\Omega$ )		Resistance Tolerance (%)		Temperature coefficient (PPM/°C)		Package	
										P	Bulk
RE50	RE50	70°C	0.125	10R	10	T	±0.01	C2	±50		
RE55	RE55		0.25	100R	100	A2	±0.02	C3	±25		
RE60	RE60		0.5	1K1	1.1K	A5	±0.05	C5	±15		
RE65	RE65		0.75	1M	1M	B	±0.1	C6	±10		
RE70	RE70		1.0	10M	10M	C	±0.25	C7	±5		
RE75	RE75		1.5			D	±0.50	C9	±3		
						F	±1.00	C10	±2		

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# General Purpose Precision Resistor (RJ)

## ▶ Product Introduction

**Token's precision resistor is designed as a low-cost alternative to traditional solutions for precision applications.**

### Features :

- High thermal conductivity and specific gravity rods.
- Power Rating : 0.16W~3W, precision tolerance tight to A5( $\pm 0.05$ ).
- Superior electrical TCR performances narrowed to C7( $\pm 5$ ) ppm/ $^{\circ}$ C.
- Epoxy coating, precision metal film, Lead (Pb)-free and RoHS compliant.

### Applications :

- Telecom,
- Measuring and Calibration Equipment,
- Industrial Process Control Systems,
- Audio,
- Video

The (RJ) series are manufactured using vacuum sputtering system to deposit multiple layers of mixed metals and passivative materials onto a carefully treated high grade ceramic substrate, the resistors are coated with layers of blue lacquer.

The metal-film technology is capable of supporting accuracy characteristics over a broad resistance range. Types include axial through-hole and metal film fusible resistor for special purpose.

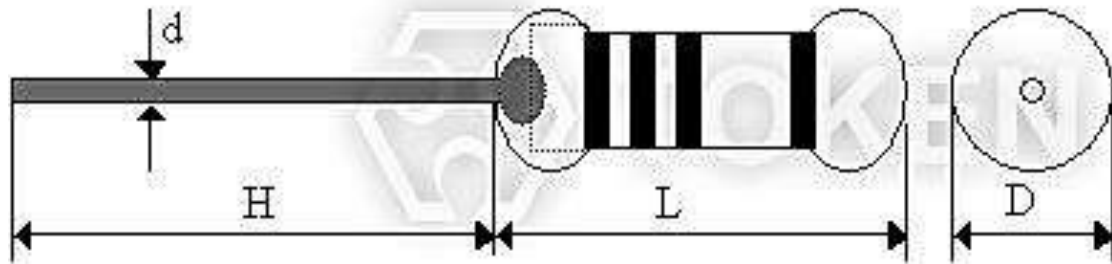
(RJ) Series equate Vishay, IRC, EBG, and Panasonic Precision Devices with more competitive price and fast delivery. Contact us with your specific needs. Besides, you can link to Token official website "[Precision Resistors](http://www.token.com.tw)" to get more information.



## ► Characteristics - Standard Size

### Characteristics - Standard Size (RJ)

Type	RJ72	RJ73	RJ74	RJ16	RJ17	RJ18	
MIL-R-10509F type	RN50	RN55	RN60	RN65	RN70	RN75	
Resistance range ( $\Omega$ )	0.1 ~ 22M						
Resistance tolerance (%)	A5 ( $\pm 0.05$ ), B ( $\pm 0.10$ ), C ( $\pm 0.25$ ), D ( $\pm 0.5$ ), F ( $\pm 1$ ), J ( $\pm 5.0$ )						
Temperature coefficient (ppm/ $^{\circ}\text{C}$ )	C7 ( $\pm 5$ ), C6 ( $\pm 10$ ), C5 ( $\pm 15$ ), C3 ( $\pm 25$ ), C2 ( $\pm 50$ ), C1 ( $\pm 100$ )						
Climatic category (LCT/UCT/days)	55 / 125 / 56						
Rated dissipation (W) $P_{70}$	0.16	0.25	0.5	1.0	2.0	3.0	
Operating voltage (V) $U_{\max}$	200	250	300	350	450	500	
Short time over load voltage (V) $U_{\max}$	400	500	600	700	900	1000	
Operating Temperature range	-55 $^{\circ}\text{C}$ to 125 $^{\circ}\text{C}$						
Insulation voltage	>500V						
Insulation resistance	>1G $\Omega$						
Dimensions (Unit: mm)	L (Max.)	3.8	6	10	12	16	26
	D (Max.)	2.0	2.5	3.5	4.5	5.5	8.6
	$d \pm 0.1$	0.4	0.5	0.6	0.7	0.8	0.8
	$H \pm 2$	24	24	26	26	26	26



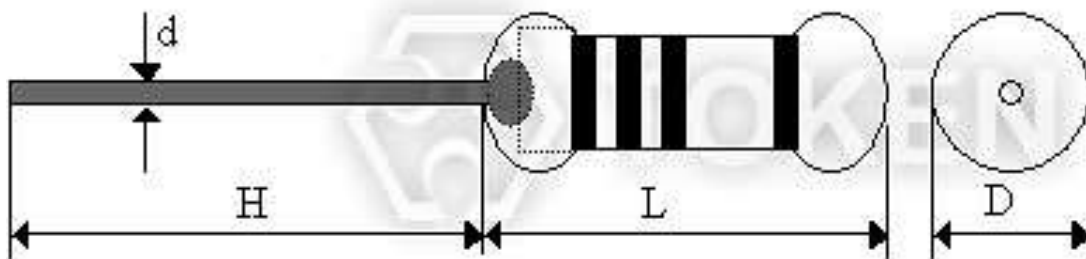
Standard Size (RJ) Dimensions



## ► Characteristics - Compact Size

### Characteristics - Compact Size (RJ)

Type	RJ73S	RJ74S	RJ16M	RJ16S	RJ17M	RJ17S	RJ18M	RJ18S	
MIL-R-10509F type	RN50	RN55	RN60	RN60	RN65	RN65	RN70	RN70	
Resistance range ( $\Omega$ )	0.1 ~ 22M								
Resistance tolerance (%)	A5 ( $\pm 0.05$ ), B ( $\pm 0.10$ ), C ( $\pm 0.25$ ), D ( $\pm 0.50$ ), F ( $\pm 1.0$ ), J ( $\pm 5.0$ )								
Temperature coefficient (ppm/ $^{\circ}$ C)	C7 ( $\pm 5$ ), C6 ( $\pm 10$ ), C5 ( $\pm 15$ ), C3 ( $\pm 25$ ), C2 ( $\pm 50$ ), C1 ( $\pm 100$ )								
Climatic category (LCT/UCT/days)	55 / 125 / 56								
Rated dissipation (W) $P_{70}$	0.25	0.5	1.0	1.0	2.0	2.0	3.0	3.0	
Operating voltage (V) $U_{max}$	250	300	350	350	400	400	450	450	
Short time over load voltage (V) $U_{max}$	500	600	700	700	800	800	900	900	
Operating Temperature range	-55 $^{\circ}$ C to 125 $^{\circ}$ C								
Insulation voltage	>500V								
Insulation resistance	>1G $\Omega$								
Dimensions (mm)	L (Max.)	3.8	6.0	6.3	10	10	12	12	16
	D (Max.)	2.0	2.54	2.54	3.5	3.5	4.5	4.5	5.5
	d $\pm 0.1$	0.5	0.6	0.6	0.6	0.7	0.8	0.8	0.8
	H $\pm 2$	24	24	24	26	26	26	26	26



Compact Size (RJ) Dimensions

- Notice: Resistance out of range, tolerance and temperature coefficient match are under request.

## Order Codes

### Order Codes (RJ)

RJ16	22R		B		C6		P	
Part Number	Resistance Value (Ω)		Resistance Tolerance (%)		Temperature Coefficient (PPM/°C)		Package	
RJ72							P	Bulk
RJ73	22R	22	A5	±0.05			TB	Taping Box
RJ74	220R	220	B	±0.10	C1	±100		
RJ73S	2K2	2.2K	C	±0.25	C2	±50		
RJ74S	22K	22K	D	±0.5	C3	±25		
RJ16M	2M2	2.2M	F	±1.0	C5	±15		
	22M	22M	J	±5.0	C6	±10		
					C7	±5		



## ► General Information

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### Enhanced Precision and Stability for Low-Cost Uses

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### Low TCR - Fast Approach to a Steady State

Token Electronics provides a precision Temperature Coefficient of Resistance TCR as low as 2 ppm/°C, If you must guarantee a smaller resistance change in your application. TCR is the best known parameter used to specify a resistor's stability, and is used to depict the resistive element's sensitivity to temperature change due to ambient temperature variations.

A resistor's TCR tells how much its value changes as its temperature changes. It is usually expressed in ppm/°C (parts per million per degree Centigrade) units.

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# Mold Military-Qualified Resistive Precision Resistor (RN)

## ▶ Product Introduction

### Military-qualified resistive precision resistors meet most demanding specs.

#### Features :

- Very low noise.
- Precision tight tolerances to B ( $\pm 0.10\%$ ).
- Military/Established Reliability and stability.
- Wide resistance ranges from  $10\Omega$  to  $5M\Omega$ .
- Controlled temperature coefficient to E ( $\pm 25$  ppm/ $^{\circ}\text{C}$ ).
- Covers all general type precision resistive products.
- Lead (Pb)-free and RoHS compliant.

#### Applications :

- Industrial process control systems,
- Measuring and calibration equipment,
- Telecom, Precision Instruments, Avionics,
- Test and measurement, Medical electronics.

Token (RN) series can be specified for all ultra-precision electronics designs, as well as a complete selection of MIL-PRF-55182 and GJB244A-2001 quality standards.

Production is strictly controlled and follows an extensive set of instructions established for reproducibility. A homogeneous film of metal alloy is deposited on a high grade ceramic body and conditioned to achieve the desired temperature stability.

Nickel plated steel terminations are firmly pressed on the metallized rods. A special laser is used to achieve the target value by smoothly cutting in the resistive layer without damaging the ceramics. A further conditioning is applied in order to stabilize the trimming result.

After a helical groove has been cut in the resistive layer, tinned connecting wires of electrolytic copper are welded to the end-caps. The resistors are moulded into cylinder shape which provides electrical, mechanical, and climatic protection.

Products equate Vishay, Ohmite, Caddock, IRC, EBG, and Panasonic Precision Devices with more competitive price and fast delivery. Commercial alternatives to military styles are available with higher power ratings. Detailed high precision (RN) specifications, both mechanical and electrical, contact our sales representative or link to Token official website "[Precision Resistors](http://www.token.com.tw)" for more information.

#### Production Standard:

This is made referencing to Chinese National Quality Standard GJB244A-2001 standards and USA Military/Established Reliability MIL-PRF-55182 in environmental and dimensional requirements.

#### Power Rating:

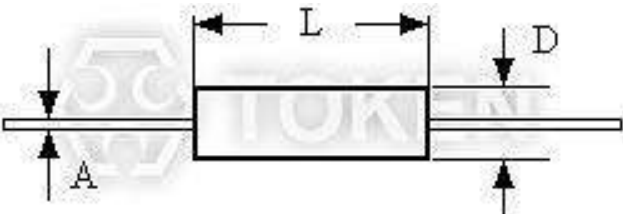
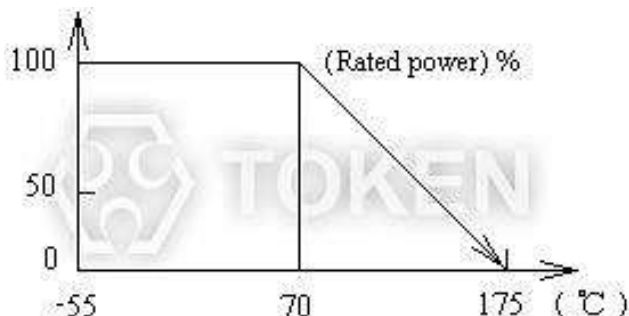
Power ratings are based on the following two conditions,

- $\pm 2.0\%$  maximum  $\Delta R$  in 10 000 h load life.
- $+175^{\circ}\text{C}$  maximum operating temperature.



## ► Dimensions & Technical Characteristics

### Dimensions & Technical Characteristics (RN)

TYPE		RN55	RN60	RN65	RN70
Rated Wattage (W)	70°C	0.125 (1/8W)	0.25 (1/4W)	0.5 (1/2W)	1W
	125°C	0.1	0.125	0.25	0.5
Max. Working Voltage (V)		200	250	300	350
Dimensions (Unit: mm)	L ± 0.3	6.8	10.0	15.1	18.4
	D ± 0.4	2.5	3.8	5.2	6.5
	A ± 0.05	0.60	0.60	0.60	0.80
MIL-Approved Resistance Range (Ω)		10Ω ~ 3MΩ	10Ω ~ 3MΩ	10Ω ~ 3MΩ	10Ω ~ 5MΩ
AWG Wire No.		22	22	22	20
Working Temperature Range		-55°C ~ +175°C			
Nominal Resistance Tolerance		B(±0.10%), C(±0.25%), D(±0.50%), F(±1.00%)			
Temperature Coefficient		C3(±25PPM/°C), C2(±50PPM/°C), C1(±100PPM/°C)			
 <p>Mold Type (RN) Dimensions</p>		 <p>(RN) Power Derating Curve</p>			

- Remark: 1. Temperature Coefficient PPM can be low to ±5PPM/°C, if applications only need operation in narrow precise temperature range within -55°C ~ +175°C. Please contact Token Representatives.
- 2. Please contact Token's Representatives if your requirement is not in above range.

## ► Mechanical and Electrical Test Conditions

### Mechanical and Electrical Test Conditions (RN)

Type	Item	Method	Requirement
Long Period	Life Time	GJB244A (MIL-PRF-55182) 4.8.18 Rated Wattage, 125°C, 2000h, 10000h	GJB244A (MIL-PRF-55182) 3.24 $\Delta R \leq \pm(0.5\%R + 0.01\Omega)$ $\Delta R \leq \pm(2\%R + 0.01\Omega)$
	Humidity	GJB244A (MIL-PRF-55182) 4.8.18 -10°C ~ +65°C, RH < 90% Rated Wattage, Cycle 240h.	GJB244A (MIL-PRF-55182) 3.21 $\Delta R \leq \pm(0.4\%R + 0.01\Omega)$
	High Temp. Exposed	GJB244A 4.8.19 175°C 2000h	GJB244A (MIL-PRF-55182) 3.25 $\Delta R \leq \pm(2.0\%R + 0.01\Omega)$
Short Period	Dielectric Voltage	GJB244A (MIL-PRF-55182) 4.8.12/4.8.23/4.8.10	GJB244A (MIL-PRF-55182) 3.18/3.29/3.16 $\Delta R \leq \pm(0.15\%R + 0.01\Omega)$ no physical damage, arc, isolation break through
	Lead Strength, Impact, High Frequency Vibration	GJB244A (MIL-PRF-55182) 4.8.11/4.8.16/4.8.17	GJB244A (MIL-PRF-55182) 3.17/3.22/3.23 $\Delta R \leq \pm(0.20\%R + 0.01\Omega)$ no physical damage
	Solderability	GJB244A (MIL-PRF-55182) 4.8.14	GJB244A (MIL-PRF-55182) 3.20 $\Delta R \leq \pm(0.10\%R + 0.01\Omega)$ no physical damage

## ► Order Codes

### Order Codes (RN)

RN65	0.5W			10R		D		C2		P	
Part Number	Rated Power (W)			Resistance Value ( $\Omega$ )		Resistance Tolerance (%)		Temperature coefficient (PPM/°C)		Package	
										P	Bulk
RN55	RN55	70°C	0.125	10R	10	B	±0.10	C1	±100		
RN60	RN60		0.25	100R	100	C	±0.25	C2	±50		
RN65	RN65		0.5	1K1	1.1K	D	±0.50	C3	±25		
RN70	RN70		0.75	11K	11K	F	±1.00				
	RN55	125°C	0.1	110K	110K						
	RN60		0.125	1M	1M						
	RN65		0.25								
	RN70		0.5								



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### Low TCR - Fast Approach to a Steady State

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# High Precision Resistors (UAR)

## ► Product Introduction

### ||| Token's low noise precision resistors define accuracy.

#### Features :

- Very tight tolerances: down to A2( $\pm 0.02\%$ ).
- Exceptionally low noise; typically  $0.05 \mu\text{V/V}$ .
- 0.125 W to 0.33 W at  $85^\circ\text{C}$ , Electrical Insulation  $> 1000 \text{ M}\Omega$ .
- Very Low temperature coefficient:  $\pm 3, \pm 5, \pm 10$  and  $\pm 15 \text{ ppm}/^\circ\text{C}$ .
- Excellent high frequency performance, industrial grades, RoHS Compliant.

#### Applications :

- All General Purpose Applications,
- Medical Electronics, Current Pulse Limiters,
- Precision Instruments,
- Telecom, Test and Measurement.

The high precision (UAR) resistor represents a significant technical advancement in resistive technology, combining low temperature coefficients with high environmental stabilities, and high frequency performance.

Laser beam trimming gives tolerance accuracies from 0.02 % to 1 %.

The precision (UAR) range effectively bridges the gap that has hitherto existed between the high precision, high stability networks or wire wound technology and conventional film technology.

Full lines equate Vishay, IRC, Ohmite, Caddock, and Panasonic precision resistors with fast delivery and more competitive price.

The metal film series is RoHS compliant with Pb-free terminations. Detailed specifications, both mechanical and electrical, please contact our sales representative. Besides, you can link to Token official website "[Precision Resistors](http://www.token.com.tw)" to get more information.

#### Mil-Std-202 Standard:

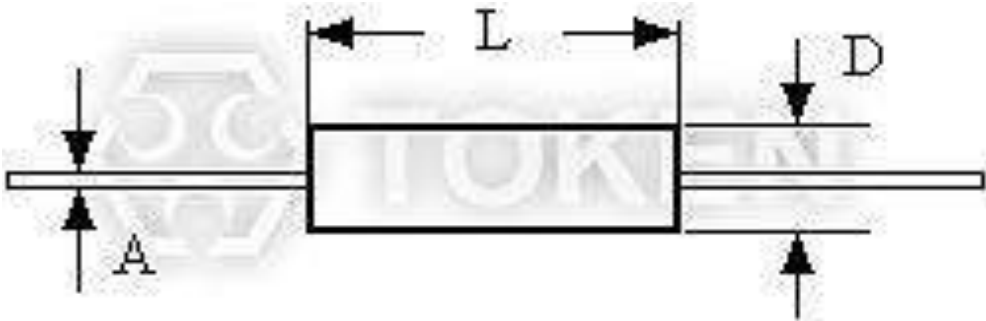
This standard establishes uniform methods for testing electronic and electrical component parts, including basic environmental tests to determine resistance to deleterious effects of natural elements and conditions surrounding military operations, and physical and electrical tests.



## ► Dimensions & Technical Characteristics

### Dimensions & Technical Characteristics (UAR)

Type		UAR1/4	UAR1/8	UAR1/10
Power Rating at 85°C (W)		0.33	0.25	0.125
Max. Working Voltage (V)		300	300	300
Resistance Range (Ω)		500.0~1.0M	100.0~1.0M	100.0~1.0M
Dimensions (Unit: mm)	L±0.3	14.8	10.0	6.8
	D±0.3	5.2	3.7	2.5
	A±0.05	0.60	0.60	0.60

(UAR) Dimensions

## ► Specification

### Specification (UAR)

Tolerance:	±0.02, ±0.05, ±0.10, ±0.25, ±0.5, ±1.0%
Temp. Coefficient:	±3, ±5, ±10, ±15ppm/°C
Standard Temperature Characteristic:	+25 to 85 °C
On Request:	-10 to +85 °C
Noise:	less than 0.05 μV/V
Voltage Coefficient:	less than 0.02 ppm/V
Non Linearity (3. Harm):	more than (-100)dB
Inductivity:	≤1MHz
Thermal Voltage to Copper:	1 ~ 3 μV/°C
Isolations Resistance:	10 <sup>10</sup> Ω

## ▶ Tests According MIL-STD-202

### Tests According MIL-STD-202 (UAR)

Temperature Cycling:	0.02%
Low Temp. Operation:	0.013%
Short Time Overload:	0.01%
Dielectric Strength:	0.01%
Load Life:	0.04%
Resistance to Soldering Heat:	0.012%
Moisture Test:	0.050%
Shock and Vibrations Test:	0.015%

## ▶ Order Codes

### Order Codes (UAR)

UAR1/8	210R		B		C6		P	
Part Number	Resistance Value (Ω)		Resistance Tolerance (%)		Temperature coefficient (PPM/°C)		Package	
	210R	210					P	Bulk
UAR1/4	2K1	2.1K	A2	±0.02	C5	±15		
UAR1/8	21K	21K	A5	±0.05	C6	±10		
UAR1/10			B	±0.10	C7	±5		
			C	±0.25	C9	±3		
			D	±0.5				
			F	±1.0				



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# Ultra Precision Resistor (UPR)

## ► Product Introduction

Token's wider Ohmic range precision resistor networks have more options.

### Features :

- Precision tolerance tight to  $T(\pm 0.01\%)$ .
- Superior TCR narrowed to C10 ( $\pm 2 \text{ ppm}/^\circ\text{C}$ ).
- Precision metal film networks, Lead (Pb)-free and RoHS compliant.
- Any value available within resistance range, excellent stability and reliability.

### Applications :

- Bridge Circuitry.
- Precision Amplifiers.
- Test and Measurement.
- Medical, Precision Bypass.
- Simulation Equipment, Divider.
- High Precision Instrumentation.
- Audio (High End Stereo Equipment).
- Commercial Avionics, Data Convertors.

Providing design engineers with an economical means of creating precision voltage dividers and set accurate amplifier gains for a wide range of applications, Token Electronics is offering its series of precision thin-film networks.

Constructed with Token EE/RE 1/10 series to form a stable, high precision and low temperature coefficient. The networks are protected from moisture by a proprietary passivation material.

Customer can specify Tolerance and Temperature Coefficient range designed to satisfy challenging and specific technical requirements. The resistance and TCR range makes these networks ideal for a number of applications, including test and measurement devices, commercial avionics and medical equipment or devices. Other applications for the networks are instrumentation amplifiers, measurement bridge circuitry, data convertors and precision analogue circuits.

The thin-film networks also can be designed with custom schematics to meet individual customer specifications. The networks provide excellent resistor precision and accuracy with resistor tolerances to  $\pm 0.01\%$ . They have TCR values to  $\pm 2 \text{ ppm}/^\circ\text{C}$ , providing superior performance over the military temperature range.

UPR Series equate IRC, EBG Precision Devices with fast delivery and more competitive price. For non-standard technical requirements and special applications, please contact us. Besides, you can link to Token official website "[Precision Resistors](http://www.token.com.tw)" to get more information.

### UPR Versus UPSC Series:

- UPSC Series have the advantage of compact body size.
- The electric characteristics of UPR and UPSC are the same.
- UPR Series have the advantage of wider resistance range  $10\Omega\sim 5\text{M}\Omega$ .

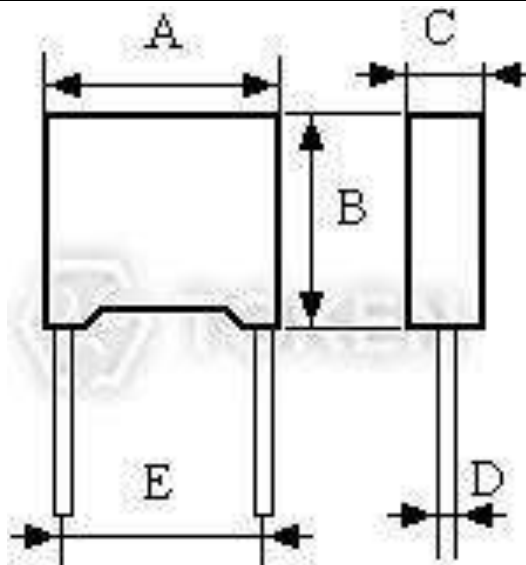




## ► Dimensions & Technical Characteristics

### Dimensions & Technical Characteristics (UPR)

Dimensions (Unit: mm)	A	10.5 ± 0.3
	B	9.1 ± 0.3
	C	4.0 ± 0.3
	D	0.6 ± 0.05
	E	7.62 ± 0.5
Working Temperature (°C)	-10 ~ +70	
Rated Wattage at 70°C (W)	0.2	
Maximum Working Voltage (V)	250	
Nominal Resistance Range (Ω)	10Ω ~ 5MΩ	100Ω ~ 500KΩ
Nominal Resistance Tolerance (%)	A2(±0.02), A5(±0.05), B(±0.1)	T(±0.01), A2(±0.02), A5(±0.05), B(±0.1)
Temperature Coefficient (ppm/°C) [TCR: +25°C ~ +85°C]	C9(±3), C7(±5), C6(±10), C5(±15), C3(±25)	C10(±2), C9(±3), C7(±5), C6(±10), C5(±15), C3(±25)

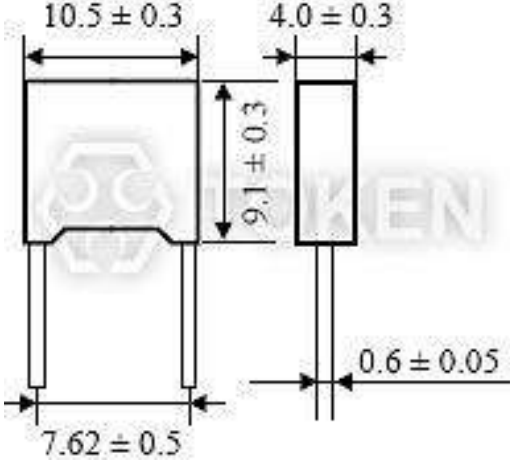
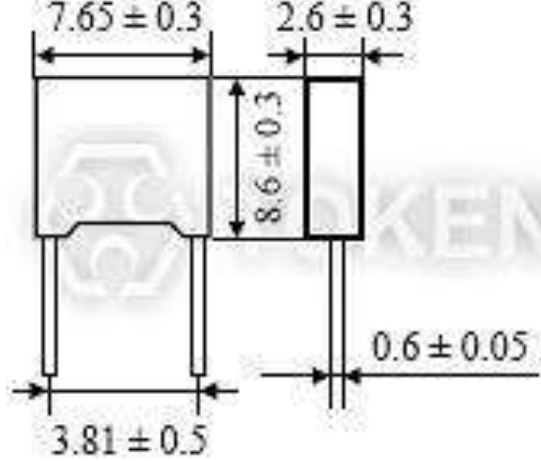


(UPR) Resistor Network Dimensions

- Remark: 1. Customer can specify Tolerance and Temperature Coefficient range to meet your own needs.
- 2. It can be required to Token's representatives if customer's requirement beyonds the range of Token's specifications.

## ► UPR Versus UPSC Series

### UPR Versus UPSC Series

Nominal Resistance Range ( $\Omega$ )		Nominal Resistance Tolerance (%)	Temperature Coefficient (ppm/ $^{\circ}$ C) [TCR: +25 $^{\circ}$ C ~ +85 $^{\circ}$ C]
UPR	UPSC		
10 $\Omega$ ~ 5M $\Omega$	40 $\Omega$ ~ 5M $\Omega$	A2 $\pm$ 0.02 A5 $\pm$ 0.05 B $\pm$ 0.1	C9 $\pm$ 3ppm/ $^{\circ}$ C C7 $\pm$ 5ppm/ $^{\circ}$ C C6 $\pm$ 10ppm/ $^{\circ}$ C C5 $\pm$ 15ppm/ $^{\circ}$ C C3 $\pm$ 25ppm/ $^{\circ}$ C
100 $\Omega$ ~ 500K $\Omega$	200 $\Omega$ ~ 500K $\Omega$	T $\pm$ 0.01 A2 $\pm$ 0.02 A5 $\pm$ 0.05 B $\pm$ 0.1	C10 $\pm$ 2ppm/ $^{\circ}$ C C9 $\pm$ 3ppm/ $^{\circ}$ C C7 $\pm$ 5ppm/ $^{\circ}$ C C6 $\pm$ 10ppm/ $^{\circ}$ C C5 $\pm$ 15ppm/ $^{\circ}$ C C3 $\pm$ 25ppm/ $^{\circ}$ C
 <p>(UPR) Wider Ohmic Range Networks Dimensions (Unit: mm)</p>		 <p>(UPSC) Compact Size Networks Dimensions (Unit: mm)</p>	

## Order Codes

### Order Codes (UPR) Resistance Value 10Ω ~ 5MΩ

UPR	100R		A5		C6		P	
Part Number	Resistance Value (Ω)		Resistance Tolerance (%)		Temperature coefficient (PPM/°C)		Package	
UPR							P	Bulk
10R	10		A2	±0.02	C3	±25		
100R	100		A5	±0.05	C5	±15		
1K	1K		B	±0.10	C6	±10		
1K1	1.1K				C7	±5		
11K	11K				C9	±3		
1M1	1.1M							

### Order Codes (UPR) Resistance Value 100Ω ~ 500KΩ

UPR	1K		A5		C6		P	
Part Number	Resistance Value (Ω)		Resistance Tolerance (%)		Temperature coefficient (PPM/°C)		Package	
UPR							P	Bulk
1K	1K		T	±0.01	C3	±25		
1K1	1.1K		A2	±0.02	C5	±15		
11K	11K		A5	±0.05	C6	±10		
110K	110K		B	±0.10	C7	±5		
					C9	±3		
					C10	±2		

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# Ultra Precision Resistor (UPSC)

## ► Product Introduction

Token's compact size ultra-precision resistor networks take accuracy pole position.

### Features :

- Precision tolerance tight to  $T(\pm 0.01\%)$ .
- Superior TCR narrowed to C10 ( $\pm 2 \text{ ppm}/^\circ\text{C}$ ).
- Metal film precision networks, Lead (Pb)-free and RoHS compliant.
- Any value available within resistance range, excellent stability and reliability.

### Applications :

- Precision Bypass.
- Simulation Equipment.
- Test and Measurement.
- Medical, Bridge Circuitry.
- Precision Amplifiers, Divider.
- High Precision Instrumentation.
- Audio (High End Stereo Equipment).
- Commercial Avionics, Data Convertors.

Following market demands for components to deliver ultra-precision applications in often very confined spaces, design engineers can now benefit from new technologies capable of Temperature Coefficient C10 ( $\pm 2 \text{ ppm}/^\circ\text{C}$ ), compact body size UPSC Networks.

Constructed with Token EE/RE 1/10 series to form a stable, high precision and low temperature coefficient network resistor, the networks are protected from moisture by a proprietary passivation material.

Customer can specify Tolerance and Temperature Coefficient range designed to satisfy challenging and specific technical requirements. The resistance and TCR range makes these (UPSC) series ideal for a number of applications, including test and measurement devices, commercial avionics and medical equipment or devices.

The thin-film (UPSC) also can be designed with custom schematics to meet individual customer specifications. The networks provide excellent resistor precision and accuracy with resistor tolerances to  $\pm 0.01\%$ . They have TCR values to  $\pm 2 \text{ ppm}/^\circ\text{C}$ , providing superior performance over the military temperature range.

UPSC Series equate IRC, EBG Precision Devices with more competitive price and fast delivery. For non-standard technical requirements and special applications, please contact our manufacturer or sales representatives. Besides, you can link to Token official website "[Precision Resistors](http://www.token.com.tw)" to get more information.

### UPR Versus UPSC Series:

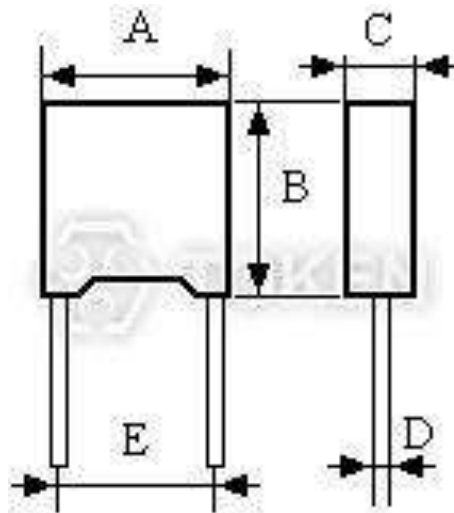
- UPSC Series have the advantage of compact body size.
- The electric characteristics of UPR and UPSC are the same.
- UPR Series have the advantage of wider resistance range  $10\Omega \sim 5M\Omega$ .



## ► Dimensions & Technical Characteristics

### Dimensions & Technical Characteristics (UPSC)

<b>Dimensions (Unit: mm)</b>	A	7.65± 0.3	
	B	8.6± 0.3	
	C	2.6± 0.3	
	D	0.6 ± 0.05	
	E	3.81± 0.5	
<b>Working Temperature (°C)</b>	-10 ~ +70		
<b>Rated Wattage at 70°C (W)</b>	0.2		
<b>Maximum Working Voltage (V)</b>	250		
<b>Nominal Resistance Range (Ω)</b>	40Ω ~ 5MΩ		200Ω ~ 500KΩ
<b>Nominal Resistance Tolerance (%)</b>	A2(±0.02), A5(±0.05), B(±0.1)		T(±0.01), A2(±0.02), A5(±0.05),B(±0.1)
<b>Temperature Coefficient (ppm/°C) [TCR: +25°C ~ +85°C]</b>	C9(±3), C7(±5), C6(±10), C5(±15), C3(±25)		C10(±2), C9(±3), C7(±5), C6(±10), C5(±15), C3(±25)



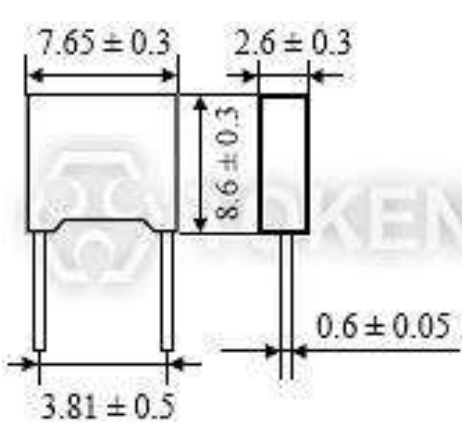
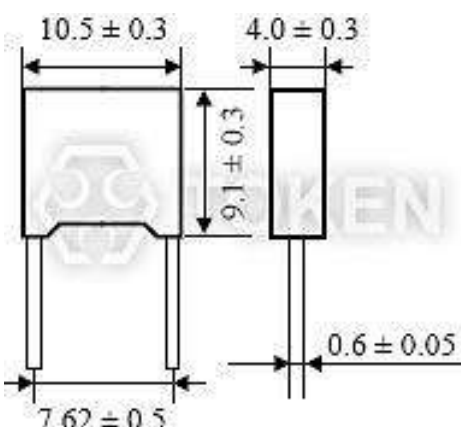
Resistor Network (UPSC) Dimensions

- Remark: 1. Customer can specify Tolerance and Temperature Coefficient range to meet your own needs.
- 2. It can be required to Token's representatives if customer's requirement beyond the range of Token's specifications.



## ► UPSC Versus UPR Series

### UPSC Versus UPR Series

Nominal Resistance Range ( $\Omega$ )		Nominal Resistance Tolerance (%)	Temperature Coefficient (ppm/ $^{\circ}$ C) [TCR: +25 $^{\circ}$ C ~ +85 $^{\circ}$ C]
UPSC	UPR		
40 $\Omega$ ~ 5M $\Omega$	10 $\Omega$ ~ 5M $\Omega$	A2 $\pm$ 0.02 A5 $\pm$ 0.05 B $\pm$ 0.1	C9 $\pm$ 3ppm/ $^{\circ}$ C C7 $\pm$ 5ppm/ $^{\circ}$ C C6 $\pm$ 10ppm/ $^{\circ}$ C C5 $\pm$ 15ppm/ $^{\circ}$ C C3 $\pm$ 25ppm/ $^{\circ}$ C
200 $\Omega$ ~ 500K $\Omega$	100 $\Omega$ ~ 500K $\Omega$	T $\pm$ 0.01 A2 $\pm$ 0.02 A5 $\pm$ 0.05 B $\pm$ 0.1	C10 $\pm$ 2ppm/ $^{\circ}$ C C9 $\pm$ 3ppm/ $^{\circ}$ C C7 $\pm$ 5ppm/ $^{\circ}$ C C6 $\pm$ 10ppm/ $^{\circ}$ C C5 $\pm$ 15ppm/ $^{\circ}$ C C3 $\pm$ 25ppm/ $^{\circ}$ C
 <p>(UPSC) Compact Size Networks Dimensions (Unit: mm)</p>		 <p>(UPR) Wider Ohmic Range Networks Dimensions (Unit: mm)</p>	

## Order Codes

### Order Codes (UPSC) Resistance Value 40Ω ~ 5MΩ

UPSC	530R		A5		C6		P	
Part Number	Resistance Value (Ω)		Resistance Tolerance (%)		Temperature coefficient (PPM/°C)		Package	
UPSC							P	Bulk
53R	53	A2	±0.02	C3	±25			
530R	530	A5	±0.05	C5	±15			
5K3	5.3K	B	±0.10	C6	±10			
53K	53K			C7	±5			
530K	530K			C9	±3			

### Order Codes (UPSC) Resistance Value 200Ω ~ 500KΩ

UPSC	10K		T		C6		P	
Part Number	Resistance Value (Ω)		Resistance Tolerance (%)		Temperature coefficient (PPM/°C)		Package	
UPSC							P	Bulk
200R	200	T	±0.01	C3	±25			
10K	10K	A2	±0.02	C5	±15			
100K	100K	A5	±0.05	C6	±10			
		B	±0.10	C7	±5			
				C9	±3			
				C10	±2			

## ► General Information

### High Precision Devices Made in Token

Token is equipped to design and produce custom components to meet many design and reliability demands.

Token's line of high-reliability and precision products reflects a long-term commitment to our industrial and military customers. In addition to standard industry-grade resistor products, we also have many resistive products designed to meet various military source-controlled drawings.

We continually strive to meet the changing application requirements of the markets by developing new products and manufacturing technologies on an on-going basis.

### Enhanced Precision and Stability for Low-Cost Uses

Every component Token provides to the commercial, industrial, and military markets for cost-efficiency uses is backed by the comprehensive testing and failure analysis capabilities of our own technical staff, whom are industrial experts in understanding and meeting the requirements of the environment.

### Low TCR - Fast Approach to a Steady State

Token Electronics provides a precision Temperature Coefficient of Resistance TCR as low as 2 ppm/°C, If you must guarantee a smaller resistance change in your application. TCR is the best known parameter used to specify a resistor's stability, and is used to depict the resistive element's sensitivity to temperature change due to ambient temperature variations.

A resistor's TCR tells how much its value changes as its temperature changes. It is usually expressed in ppm/°C (parts per million per degree Centigrade) units.

### Long-Term Proven Service

Our technical expertise, our knowledge of the industry, our broad product offering, and our ability to work long-term are all part of Token's ongoing commitment to meeting the changing requirements of our most reliability-conscious customer, today and in the future.

