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# **DIRECT**

## **Electronics Tech.**

# **(HI82) Ultra-Precision High Voltage Film Resistors**

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## ▶ Product Introduction

**Up to 10TΩ, (HI82) sets a new standard for high value, ultra-stable precision high voltage resistors.**

### (HI82) Family Members:

- (HI82D) Precision High-Voltage High-Value Resistor series, resistance range from 1mΩ to 10TΩ, precision tolerance from 30% to 0.25%, rated power has 1w/1.2w/3w selectable.
- (HI82H) Conventional Precision High-Voltage High Resistance Resistor series, various precision tolerance 1%/2%/5%/10%/20%/30%/50% available, four kinds of rated power 0.5w/0.7/1w/2w selectable, resistance from 1MΩ to 1TΩ.
- (HI82T) High Power Voltage Resistor series, maximum operating voltage up to 35KV, 30W high rated power to 0.125W, resistance range from 1Ω to 500MΩ, tolerance range 0.5% to 5%.

### Features :

- High voltage thick film precision technology resistor.
- Resistance up to 10TΩ. Low TCR, low VCR.
- Radial leads, variable lead spacing by bending.
- Climatic protection by silicone coating

### Applications :

- Impulse voltage generators,
- Arc furnace damping, Energy research,
- Pulse modulators, Radar Pulse-forming networks,
- Capacitor crowbar circuits, High voltage snubber circuits,

The high performance high-voltage applications require the use of high voltage resistors in applications with long-term stability and good temperature coefficient. Token Electronics has introduced ultra-stable high-precision HI82 high voltage resistors to meet these needs.

Token's unique precision full film and serpentine transfer pattern (serpentine patterns design), using a specific high speed fine-line thick film dispensing system, developed a series of high voltage application resistor components with excellent performance. Especially in smaller sizes and higher resistance-value components.

Through the use of alloy ruthenium paste material, and 95% high aluminum planar ceramic chip, Token can control the manufacture of very precise precision and stabilize the performance parameters of important high-voltage operating temperature range. (HI82) thick film resistor combined with close tracking design, with low current noise, linear current voltage, low TCR, high temperature durability, wide resistance range, long-term stability, and low-cost advantages.

Token HI82 ultra-precision high-voltage resistors conform with RoHS and lead-free standards and provide more competitive prices and fast delivery service. For technical specifications and special applications, please contact your Token's sales representative, or link to Token official website "[High Voltage Resistors](http://www.token.com.tw)" to get more information.



**► Dimensions**

**Composition Structure (HI82)**

	<b>Membrane Material (a)</b>	Ruthenium Paste
	<b>Base Material (b)</b>	95% Aluminum Oxide, Al <sub>2</sub> O <sub>3</sub>
	<b>Encapsulating Material (c)</b>	High Temperature Silicone Resin

**Ultra-precision high value voltage Resistor Dimensions (Unit: mm)**

HI82D Ultra-precision high-voltage high-value resistor						
Part Number	L ±1mm	H ±1mm	T ±0.5mm	P ±2mm	I ±3mm	d ±0.1mm
HI82D-1W	30.0	6.0	1.4	27.5	20	0.4
HI82D-1BW	40.0	6.0	1.4	37.8	20	0.4
HI82D-3W	50.0	12.5	1.4	47.8	20	0.4

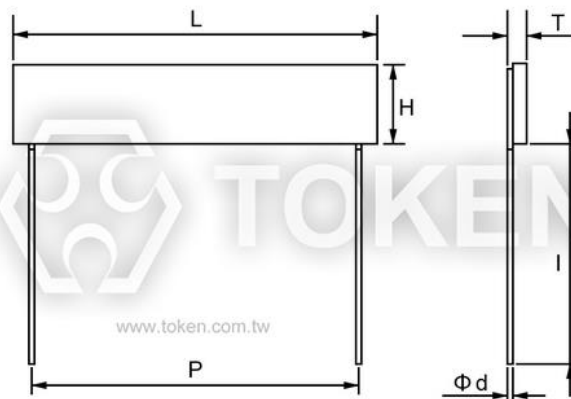
Note: L = Length, H = Width, T = Thickness, I = Length of steel wire, d = Wire diameter °  
 P = Standard lead spacing ( Other spacing possible by bending ) °

HI82H Conventional precision high-voltage high-resistance resistor						
Part Number	L ±1mm	H ±1mm	T ±0.5mm	P ±2mm	I ±3mm	d ±0.1mm
HI82H-05W	3.2	2.5	0.9	2.0	20	0.4
HI82H-07W	3.8	5.0	1.0	2.5	20	0.4
HI82H-1W	6.3	3.5	1.0	5.5	20	0.4
HI82H-2W	10.2	5.1	1.0	9.5	20	0.4

Note: L = Length, H = Width, T = Thickness, I = Length of steel wire, d = Wire diameter °  
 P = Standard lead spacing ( Other spacing possible by bending ) °

HI82T High-power voltage resistor						
Part Number	L ± 1mm	H ± 1mm	T ± 0.5mm	P ± 2mm	I ± 3mm	d ± 0.1mm
HI82T-0125W	8	3.5	2	5.7	10	0.6
HI82T-025W	10	5	2	7.7	10	0.6
HI82T-04W	25	5	2	22.5	20	0.6
HI82T-05W	35	5	2	32	20	0.6
HI82T-1W	30	8	2	27	20	0.6
HI82T-2SW	25	10	2	22	20	0.6
HI82T-2NW	22	18	2	19	20	0.6
HI82T-2BW	45	10	3	41.5	20	0.8
HI82T-3W	60	10	3	56.5	20	0.8
HI82T-5W	80	20	4	76.5	40	1.0
HI82T-10W	97	23	4	93.5	40	1.0
HI82T-20W	100	35	4	96.5	40	1.0
HI82T-30W	100	48	4	96.5	40	1.0

Note: L = Length, H = Width, T = Thickness, I = Length of steel wire, d = Wire diameter °  
 P = Standard lead spacing ( Other spacing possible by bending ) °



Ultra-precision high value voltage Resistor Dimensions (Unit: mm)

### ► HI82D Electrical Charcs.

#### Technical Characteristics - (HI82D)

Part Number	Power Rating P <sub>70</sub> (W)	Working Voltage Max. (V)	Resistance Range (Ω)	Tolerance (%)	TCR <sup>(1)</sup> (ppm/ °C)	VCR <sup>(2)</sup> (ppm/V)
HI82D-1W	1.0	10KV	1M - 100M	0.25/0.5/5/10	25/50/100	2ppm/V
			100M - 1G	1/2/5/10/20	50/100/250	5ppm/V
			1G - 100G	5/10/20/30	250/500	20ppm/V
			100G - 1T	5/10/20/30	500/1000	100ppm/V
HI82D-1BW	1.2	20KV	1M - 100M	0.25/0.5/5/10	25/50/100	1ppm/V
			100M - 1G	1/2/5/10/20	50/100/250	2ppm/V
			1G - 100G	5/10/20/30	250/500	10ppm/V
			100G - 1T	5/10/20/30	500/1000	50ppm/V
HI82D-3W	3.0	30KV	1M - 100M	0.25/0.5/5/10	25/50/100	1ppm/V
			100M - 1G	1/2/5/10/20	25/50/100	1ppm/V
			1G - 100G	5/10/20/30	100/250	5ppm/V
			100G - 1T	5/10/20/30	250/500	25ppm/V
			1T - 10T	10/20/30	500/1000	100ppm/V

Note:

- <sup>(1)</sup> TCR 25/50: Temperature range +25°C ~ +85°C ; <sup>(2)</sup> The voltage coefficient is measured between 10V and 100V.
- Operating Voltage =  $\sqrt{(P * R)}$  , or Max. Operating Voltage listed in above table whichever is lower.
- Optional specifications on request.

#### Environmental Characteristic

Continuous operating voltage	V = $\sqrt{(P * R)}$ , or Max. Operating Voltage listed in above table whichever is lower.	
Measuring voltage	Standard measuring voltage is 10V (50V for values >1G). Different voltages on request.	
TCR ppm/°C	Temperature range +25°C ~ +125°C	
	TCR25/50	
	Values above 1G: +25°C ~ +85°C.	
Operating temp. range	-55°C ~ +125°C	
Climatic category to EN 60068-1	55/125/56	
Humidity-/contact protection	Lacquer coating. Resistant to most solvents. Isopropyl alcohol recommended for cleaning; Do not use acetone or methylene chloride. Avoid mechanical stress to coating.	
Stability: Storage 125°C/1000Hrs	≤10G	>10G
	<1%	<2%
Stability at Max. voltage/1000Hrs	≤10G	>10G
	<1%	<2%

### ► HI82H Electrical Characs.

#### Technical Characteristics - (HI82H)

Part Number	Power Rating P <sub>70</sub> (W)	Working Voltage Max. (V)		Resistance Range (Ω)	Tolerance (%)	TCR <sup>(1)</sup> (ppm/°C)	VCR <sup>(2)</sup> (ppm/V)
		trimmed	untrimmed				
HI82H-05W	0.5	300	1000	1M - 100M	1/2/5/10	TC25/50/100	<50ppm/V
				>100M - 500M	2/5/10/20	TC50/100/250	<100ppm/V
				>500M - 1G	5/10/20	TC100/250	<100ppm/V
				>1G - 10G	5/10/20/30	TC250/500	<500ppm/V
				>10G - 100G	5/10/20/30	TC500/1000	<1000ppm/V
HI82H-07W	0.7	300	500	1M - 100M	2/5/10	TC50/100	<50ppm/V
				>100M - 500M	5/10/20	TC100/250	<100ppm/V
				>500M - 1G	5/10/20	TC100/250	<100ppm/V
				>1G - 10G	10/20/30	TC250/500	<500ppm/V
				>10G - 100G	10/20/30	TC500/1000	<1000ppm/V
HI82H-1W	1.0	1200	2500	1M - 100M	1/.../10	TC25/50/100	<10ppm/V
				>100M - 500M	1/2/5/10/20	TC25/50/100	<25ppm/V
				>500M - 1G	1/2/5/10/20	TC100/250	<25ppm/V
				>1G - 10G	2/5/10/20	TC100/250	<100ppm/V
				>10G - 100G	5/10/20/30	TC250/500	<250ppm/V
HI82H-2W	2.0	4000	6000	1M - 100M	1/.../10	TC25/50/100	<5ppm/V
				>100M - 500M	1/2/5/10/20	TC25/50/100	<10ppm/V
				>500M - 1G	1/2/5/10/20	TC25/50/100	<10ppm/V
				>1G - 10G	2/5/10/20	TC50/100	<25ppm/V
				>10G - 100G	5/10/20/30	TC100/250	<100ppm/V
>100G - 1T	5/10/20/30	TC250/500	<250ppm/V				

Note:

- <sup>(1)</sup> TCR 25/50: Temperature range +25°C ~ +85°C ; <sup>(2)</sup> The voltage coefficient is measured between 10V and 100V.
- Operating Voltage =  $\sqrt{(P * R)}$  , or Max. Operating Voltage listed in above table whichever is lower.
- Optional specifications on request.

#### Environmental Characteristic

Continuous Operating Voltage	V = $\sqrt{(P * R)}$ , or Max. Operating Voltage listed in above table whichever is lower.		
Measuring Voltage	Standard measuring voltage is 10V (50V for values >1G). Different voltages on request.		
TCR ppm/°C	Temperature range +25°C ~ +125°C		
	TCR25/50 Values above 1G: +25°C ~ +85°C.		
Operating Temperature Range	-55°C ~ +125°C		
Climatic Category to EN 60068-1	55/125/56		
Humidity-/Contact Protection	Lacquer coating. Resistant to most solvents. Isopropyl alcohol recommended for cleaning; Do not use acetone or methylene chloride. Avoid mechanical stress to coating.		
Stability: Storage 125°C/1000Hrs.	≤1G	≤10G	>10G
	<1%	<2%	<5%
Stability at Max. voltage/1000Hrs.	≤1G	≤10G	>10G
	<0.5%	<1%	<2%

### ► HI82T Electrical Charcs.

#### Technical Characteristics - (HI82T)

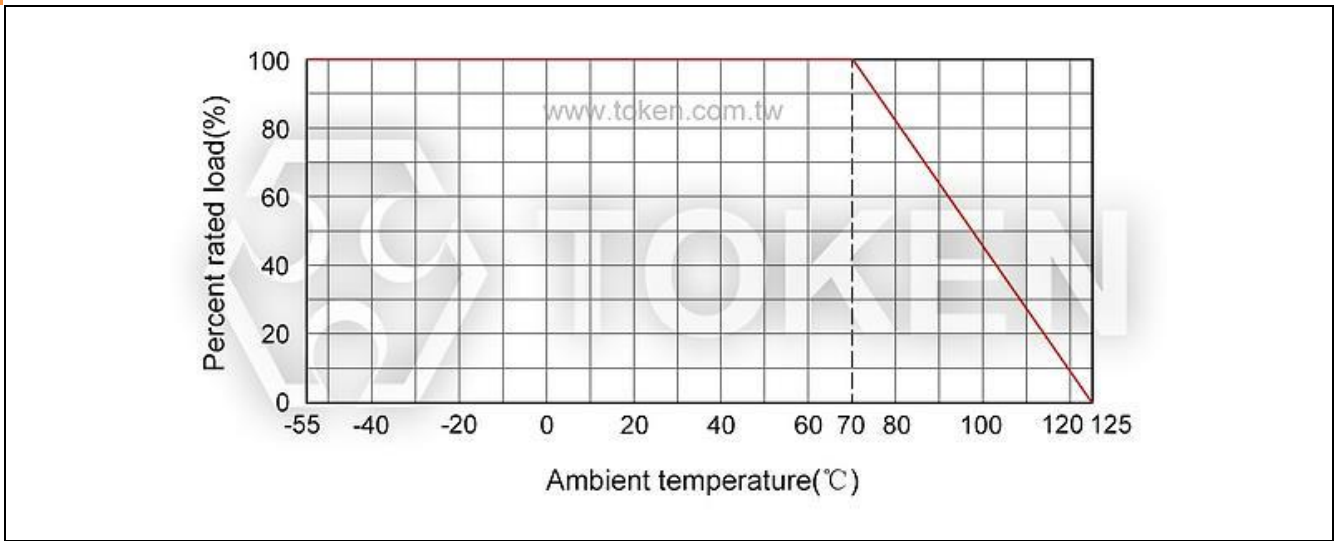
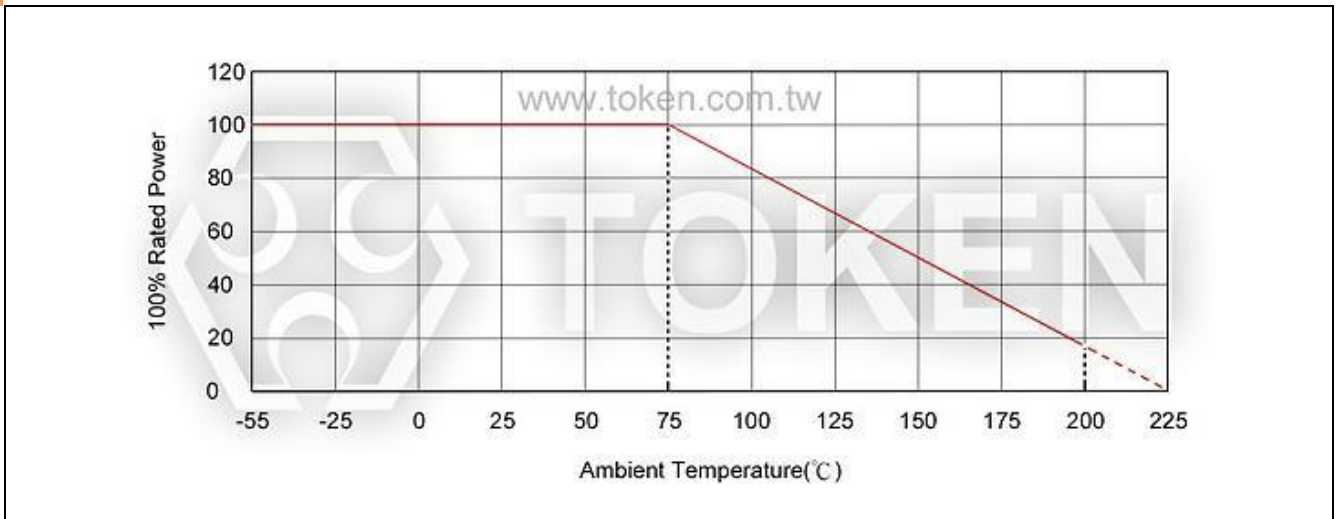
Part Number	Power Rating P <sub>75</sub> (W)	Working Voltage Max. (V)	Resistance Range (Ω)	Tolerance (%)	TCR
HI82T-0125W	1/8W	2KV	1 ~ 500M	±0.5% ~ ±5%	±100ppm/°C
HI82T-025W	1/4W	4KV	1 ~ 500M		
HI82T-04W	2/5W	10KV	1 ~ 500M		
HI82T-05W	1/2W	15KV	1 ~ 500M		
HI82T-1W	1W	15KV	1 ~ 500M		
HI82T-2SW	2W	20KV	1 ~ 500M		
HI82T-2NW	2W	20KV	1 ~ 500M		
HI82T-2BW	2W	20KV	1 ~ 500M		
HI82T-3W	3W	25KV	1 ~ 500M		
HI82T-5W	5W	30KV	1 ~ 500M		
HI82T-10W	10W	35KV	1 ~ 500M		
HI82T-20W	20W	35KV	1 ~ 500M		
HI82T-30W	30W	35KV	1 ~ 500M		

Note :

- TCR @25°C (25°C ~ +105°C). TCR ±15ppm/°C on request.
- Operating Voltage =  $\sqrt{(P * R)}$  , or Max. Operating Voltage listed in above table whichever is lower.
- Optional specifications on request.

#### Environmental Characteristic

Continuous Operating Voltage	V = $\sqrt{(P * R)}$ , or Max. Operating Voltage listed in above table whichever is lower.		
Measuring Voltage	Standard measuring voltage is 10V (50V for values >1G). Different voltages on request.		
TCR ppm/°C	Temperature range +25°C ~ +105°C		
	TCR 25/50		
	Values above 1G: +25°C ~ +105°C.		
Operating Temperature Range	-55°C ~ +225°C		
Climatic Category to EN 60068-1	55/125/56		
Insulation withstand voltage	1000VDC		
Insulation resistance	≥ 10GΩ		
Humidity-/Contact Protection	Lacquer coating. Resistant to most solvents. Isopropyl alcohol recommended for cleaning; Do not use acetone or methylene chloride. Avoid mechanical stress to coating.		
Stability: Storage 125°C/1000Hrs.	≤1G	≤10G	>10G
	<1%	<2%	<5%
Stability at Max. voltage/1000Hrs.	≤1G	≤10G	>10G
	<0.5%	<1%	<2%

**▶ Power Derating Curve****Power Derating Curve - (HI82D & HI82H)****Power Derating Curve - (HI82T)**



**▶ Advance Technique****Advance Technique of Non-Inductive & Serpentine Pattern (HI82)****Non-Inductive Performance:**

- HI82 Non-Inductive Design which uses a serpentine resistive pattern that offers for zigzagging lines to carry current in opposite directions, thereby achieving maximum neutralization of flux fields over the entire length of the resistor.
- This efficient non-inductive construction without derating of any performance advantages is ideal for applications where high frequency is required.

**Serpentine Pattern Screen Printing Design:**

- Type High Voltage HI82 Precision Resistors combine Token's Non-Inductive serpentine pattern, high thru-put screen printed silicone coating.
- The alignment of the gap in the serpentine resistor pattern with the gap in the coating pattern provides a complete encapsulation of the resistor element.
- The cap and lead assemblies are pressed onto the resistor core, finishing the resistor and providing rugged terminal attachment.

### ▶ Order Codes

#### Order Codes (HI82D) - Ultra-Precision High-Voltage High Value Resistors

HI82D	1W		1G		F		E	
Part Number	Rated Power (W)		Resistance Value ( $\Omega$ )		Resistance Tolerance (%)		TCR (ppm/ $^{\circ}$ C)	
HI82D	1W	1.0W	1M1	1.1M $\Omega$	C	$\pm 0.25\%$	C	$\pm 25\text{ppm}/^{\circ}\text{C}$
	1BW	1.2W	110M	110M $\Omega$	D	$\pm 0.5\%$	D	$\pm 50\text{ppm}/^{\circ}\text{C}$
	3W	3.0W	1G5	1.5G $\Omega$	F	$\pm 1\%$	E	$\pm 100\text{ppm}/^{\circ}\text{C}$
			10G	10G $\Omega$	J	$\pm 5\%$	L	$\pm 250\text{ppm}/^{\circ}\text{C}$
					K	$\pm 10\%$	I	$\pm 500\text{ppm}/^{\circ}\text{C}$
					M	$\pm 20\%$	R	$\pm 1000\text{ppm}/^{\circ}\text{C}$
					N	$\pm 30\%$		

#### Order Codes (HI82H) - Conventional Precision High-Voltage High-Resistance Resistors

HI82H	2W		1G		F		E	
Part Number	Rated Power (W)		Resistance Value ( $\Omega$ )		Resistance Tolerance (%)		TCR (ppm/ $^{\circ}$ C)	
HI82H	05W	0.5W	1M1	1.1M $\Omega$	F	$\pm 1\%$	C	$\pm 25\text{ppm}/^{\circ}\text{C}$
	07W	0.7W	110M	110M $\Omega$	G	$\pm 2\%$	D	$\pm 50\text{ppm}/^{\circ}\text{C}$
	1W	1.0W	1G5	1.5G $\Omega$	J	$\pm 5\%$	E	$\pm 100\text{ppm}/^{\circ}\text{C}$
	2W	2.0W	10G	10G $\Omega$	K	$\pm 10\%$	L	$\pm 250\text{ppm}/^{\circ}\text{C}$
			1T	1T $\Omega$	M	$\pm 20\%$	I	$\pm 500\text{ppm}/^{\circ}\text{C}$
					N	$\pm 30\%$	R	$\pm 1000\text{ppm}/^{\circ}\text{C}$

#### Order Codes (HI82T) - High-Power Voltage Resistors

HI82T	30W		500M		F		E	
Part Number	Rated Power (W)		Resistance Value ( $\Omega$ )		Resistance Tolerance (%)		TCR (ppm/ $^{\circ}$ C)	
HI82T	0125W	1/8W	10	10 $\Omega$	D	$\pm 0.5\%$	E	$\pm 100\text{ppm}/^{\circ}\text{C}$
	04W	2/5W	1M1	1.1M $\Omega$	F	$\pm 1\%$	C5	$\pm 15\text{ppm}/^{\circ}\text{C}$ on request
	2BW	2W	110M	110M $\Omega$	J	$\pm 5\%$		
	10W	10W	500M	500M $\Omega$				
	30W	30W						

- Note: If no requirements for TCR, (HI82D), (HI82H) and (HI82T) measuring voltage and taping are given, the standard value(highest value in table) will be supplied, measuring voltage of 10V.

## ► General Information

### Cost Effective Complete Selection of High Voltage Components

Token high voltage series can be specified for use in industrial and general purpose high voltage systems, as well as a complete selection of high resistance, Hi-Meg, high-voltage, high frequency, and bulk ceramic resistors for higher average power dissipation. These High Resistance, High Frequency, High Resistance resistors combine the proven performance of Token resistance system with new cost efficient design elements and high voltage applications.

Detailed specifications, both mechanical and electrical, please contact our sales representative for more information.

### High Voltage Applications

Resistors produced from Serpentine Pattern Screen Printing Design or bulk ceramic materials have displayed several key advantages in demanding high-voltage situations, including both continuous-wave and pulse applications. These include radar and broadcast transmitters, x-ray systems, defibrillators, lasers, and high-voltage semiconductor process equipment applications, where resistors must handle peak voltage anywhere from 8KV to 75KV.

Typical applications include current limit in capacitor charge/discharge, crowbar, and tube-arc circuits. In these uses, bulk ceramic resistors provide low inductance, high average power per unit size, stability at high voltage, and durability at extreme peak-power levels. Film resistors typically cannot withstand high-voltage pulse applications.

### RF/Digital Loads and High-Frequency Applications

Token Non-Inductive Voltage Resistors are used extensively for high-frequency RF loads in broadcast and communication equipment because of their non-inductive characteristics. They provide excellent non-inductive power-handling capacity at frequencies up to the gigahertz range, with no sacrifice in power dissipation.

Film resistors may provide the needed non-inductive characteristics required by such RF applications, but they have size limitations and present reliability problems due to potential film burnout. This is especially true in advanced digital applications such as digital radio and TV transmitters involving pulses at high frequencies.

### Application Notes

- Due to the high voltage which can appear between the end cap and any adjacent metal part, resistors should be mounted at an adequate distance from other conductors.
- An appropriate number of resistors may be screwed together as a stick to provide an assembly which will be capable to withstanding any desired voltage, providing no individual resistor is subject to a greater stress or power dissipation than is recommended in its data sheet, and that appropriate anticorona devices are fitted.
- The axial termination should not be bent closer than twice the diameter of the terminal wire from the body of the resistor.

When resistors are required to be potted, the preferred encapsulant is a silicone compound.

### Oil Immersion

For some high voltage applications it is required to immerse the components in oil or gas to reduce the effects of corona and surface tracking. A special lacquer protected version of the resistor is available, suitable for immersion in transformer oil or SF6.

