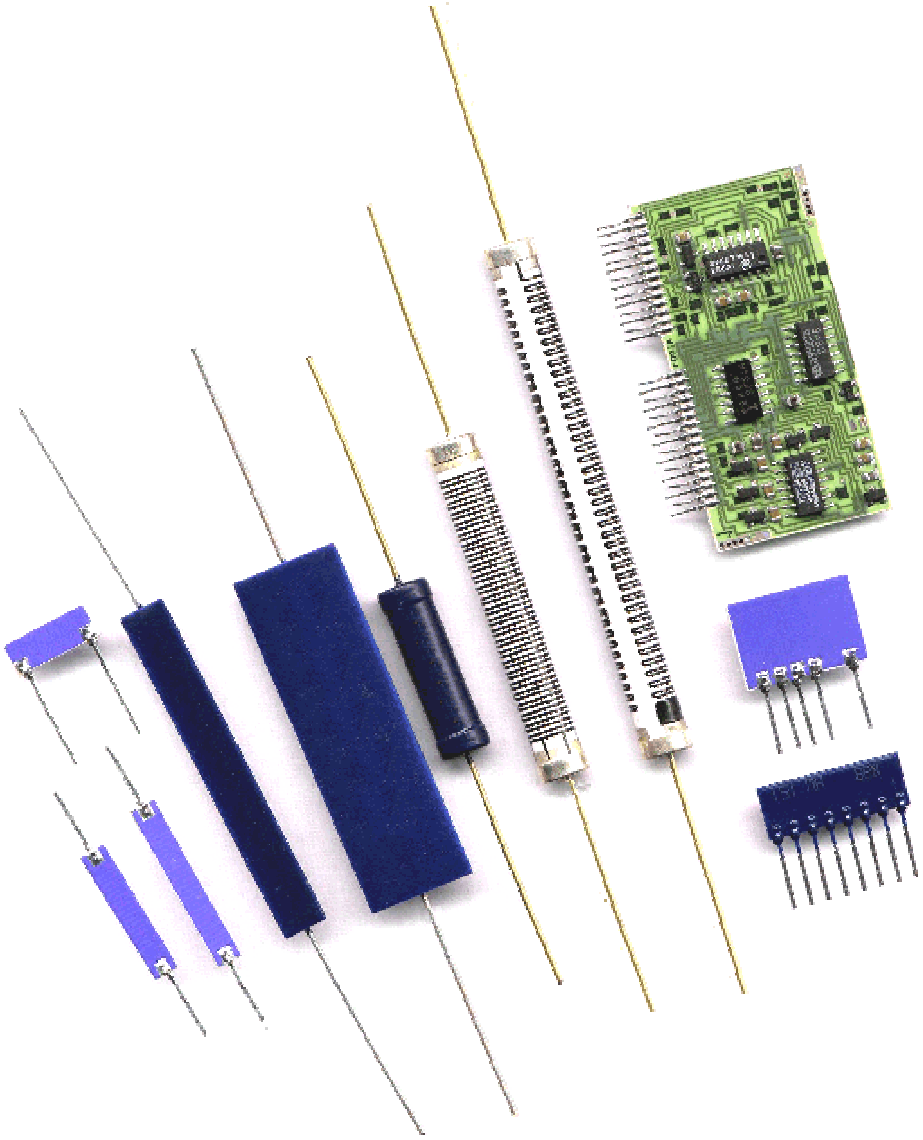
nicrom
electronic

High Performance Thick Film Resistors

GENERAL CATALOG 2004



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High Performance Thick Film Resistors

Nicrom Electronic was founded in 1993 by engineers with more than 30 years of experience in the fields of Thick Film and Thin Film technology. Our purpose is to design and produce High Performance Resistor Products for special and custom High Voltage, High Power, High Precision and Low TC applications where our experience plays a leading role.

The development of our products begins with a careful selection and tests of the materials to guarantee a conservative produceability of high performance and quality. Special designs and process technologies allow to reach performances that can't be reached in any other way and provide technical solutions for our most demanding customers.

Our factory is placed in the south of Switzerland, an area with low hills and rolling countryside 25 km away from the airport of Lugano-Agno. An ideal location to take advantages of the economical and political stability of Switzerland.

Since the foundation Nicrom Electronic has deepened its knowledge in the fields of Ultra-High Voltage Resistors and Dividers and Power Resistors on Steel Carrier for Automotive industry. Nicrom Electronic's superior state-of-the-art Thick Film Technology offers ohmic values from 0.01 Ohm to 100 Gig; voltage ratings to 600 kV; wattage ratings to 1000 Watts, tolerances to ±0.05% and TCR to ±5 ppm/C. Million Resistors have been successfully manufactured during the past 11 years and our products are shipped daily all over the world.

Application fields: Automotive, High-Voltage Power Supply, Medical Applications (HV-Resistors for X-Ray systems), Measurement Circuits, TWT Power Supplies, Electron Microscopes, X-ray systems, high resolution CRT displays, Radar Systems, Electrostatic Applications, …

How to Order Nicrom Standard Products

Ohm Value Codes	
1	= R
10^3	= K
10^6	= M
10^9	= G
Example :	
2K6	= 2.6 KΩ

Tolerance Codes	
± 20 %	= M
± 10 %	= K
± 5 %	= J
± 2 %	= G
± 1 %	= F
± 0.5 %	= D
± 0.25 %	= C
± 0.1 %	= B
± 0.05 %	= A

Temperature Coefficient Codes	
± 100 ppm / ℃	= S
± 50 ppm / ℃	= F
± 25 ppm / ℃	= E
± 15 ppm / ℃	= A
± 10 ppm / ℃	= T
± 5 ppm / ℃	= U

High Voltage Resistors Example :

100.3	2M5	G	T

100	= Model
.3	= Type
2M5	= Resistor Value (2.5 MΩ)
G	= Tolerance (± 2 %)
T	= Temperature Coefficient (± 10 ppm / ℃)

High Voltage Divider Example :

300.5	500M	F	E	1:3000	C	A

300	= Model
.5	= Type
500M	= Total Resistance Value 500 MΩ
F	= Absolute Tolerance ± 1%
E	= Absolute Temperature Coefficient ± 25 ppm/℃
1:3000	= Ratio
C	= Ratio Tolerance ± 0,25%
A	= Ratio Temperature Coefficient ± 15 ppm/℃

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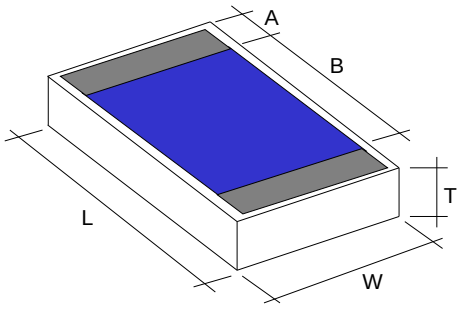
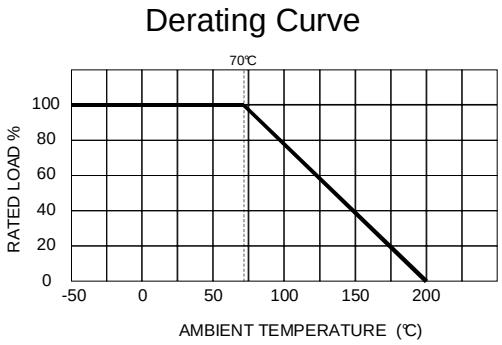
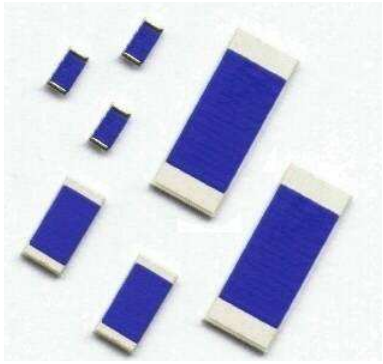
High Voltage Chip Resistors / Low Noise Chip Resistors
Series HVC

High Voltage Chip Resistors HVC Series combine proprietary Fine Line Thick Film Technology and design to achieve a new level of high voltage ratings and stability in SMD chip resistors. Nicrom's technology features a longer, high aspect ratio trace of lower resistivity film compared to traditional thick film chip resistors.

Compared to standard chip resistors Nicrom's HVC Series provides unmatched performances and design efficiency resulting in lower voltage coefficients and temperature coefficients, lower noise, tighter tolerances, higher stability, higher resistance values and higher voltage ratings. Wire bondable gold terminations and custom configurations available.







Model-Size	Wattage @ 70℃	Max. Continuous Oper. Voltage	Dimensions in millimeters [Dimensions in inches]				
			L	W	T (max.)	A	B (min.)
0603	0.10	600	1.60 ± 0.20 [0.063 ± 0.008]	0.80 ± 0.10 [0.031 ± 0.004]	0.50 [0.020]	0.25 ± 0.10 [0.010 ± 0.004]	0.80 [0.032]
1206	0.30	1'500	3.25 ± 0.20 [0.128 ± 0.008]	1.60 ± 0.20 [0.063 ± 0.008	0.70 [0.028]	0.45 ± 0.20 [0.018 ± 0.008]	1.95 [0.077]
2010	0.50	2'200	5.10 ± 0.20 [0.200 ± 0.008]	2.50 ± 0.20 [0.098 ± 0.008]	0.80 [0.032]	0.55 ± 0.20 [0.022 ± 0.008]	3.70 [0.146]
2512	1.00	3'000	6.40 ± 0.20 [0.252 ± 0.008]	3.20 ± 0.20 [0.126 ± 0.008]	0.80 [0.032	0.65 ± 0.20 [0.026 ± 0.008]	5.00 [0.200]
5020	2.00	5'000	12.70 ± 0.20 [0.500 ± 0.008]	5.08 ± 0.20 [0.200 ± 0.008]	0.80 [0.032	2.00 ± 0.30 [0.079 ± 0.012]	8.00 [0.315]

Characteristics

Resistance Values	from 1KΩ to as high as 100GΩ on all models (to 1TΩ on request)		
Tolerances	0.05%, 0.1%, 0.25%, 0.5%, 1%, 2%, 5%, 10%, 20% (0.05% available to 10G, 0.25% to 100G on request)		
Temperature Coefficients	5, 10, 15, 25, 50 and 100 ppm/℃ (10 ppm/℃ availab le to 10G, 25 ppm/℃ to 100G on request)		
Operating Temperature	-55 … + 200℃	(extended temperature range to 350℃ available)	
Insulation Resistance	> 10'000 MΩ	500 Volt 25 ℃ 75% relative humidity	
Dielectric Strength	> 1'000 Volt	25 ℃ 75% relative humidity	
Thermal Shock	Δ R/R < 0.1% typ., 0.50% max.	MIL Std. 202, method 107 Cond. C	IEC 68 - 2 -14
Overload	Δ R/R < 0.1% typ., 0.50% max.	1,5 x Pnom, 5 sec (do not exceed max. voltage)	
Moisture Resistance	Δ R/R < 0.1% typ., 0.50% max.	MIL Std. 202, method 106	IEC 68 - 2 - 3
Load Life	Δ R/R < 0.1% typ., 0.50% max.	1000 hours at rated power	IEC 115 - 1
Encapsulation	Screen Printed Silicone	Core Material	Al_2O_3 (96%)
Solder Pads Material	Silver (PdAg) / Bondable Gold / Tinned	Resistor Material	Ruthenium Oxide

Voltage Coefficients of Resistance

Type	Resistance Range	VCR (- ppm/V)*
0603	1K .. 3M	< 16.00
	3M .. 30M	< 80.00
	30M .. 300M	< 150.00
1206	1K .. 10M	< 3.20
	10M .. 100M	< 15.00
	100M .. 1G	< 29.00
2010	1K .. 20M	< 1.30
	20M .. 200M	< 6.00
	200M .. 2G	< 12.00

Type	Resistance Range	VCR (- ppm/V)*
2512	1K .. 30M	< 0.80
	30M .. 300M	< 4.00
	300M .. 3G	< 7.00
5020	1K .. 40M	< 0.40
	40M .. 400M	< 2.00
	400M .. 4G	< 3.60

*Typical values. Voltage coefficient of resistance strongly depends on the resistance value, consult factory for details.

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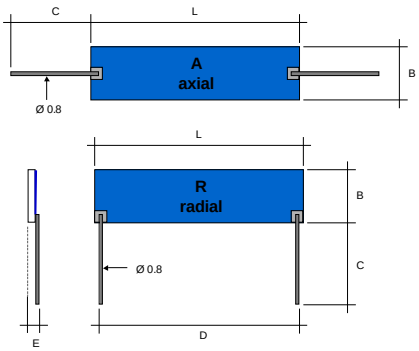
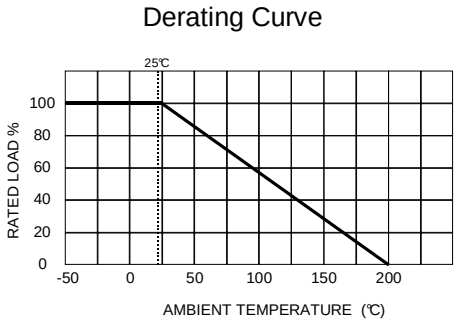
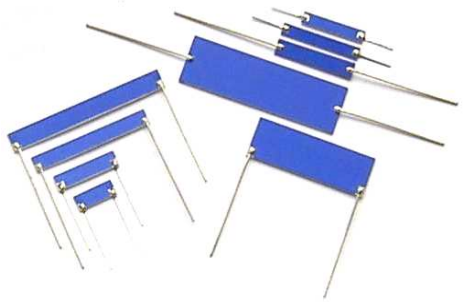
High Voltage Resistors Series 90, 100 and 200
Precision, Non-Inductive, Low TC

High Voltage Resistors Series 90, 100 and 200 combine proprietary non-inductive resistance system and design to achieve low temperature coefficient, low voltage coefficients, high stability and increased high operating voltages.

Precision High Voltage Resistors Series 90, 100 and 200 are designed to meet the demanding requirements of TWT power supplies, electron microscopes, X-ray systems, high resolution CRT displays and geophysical instruments. SMD Chip versions available on request.







Model	Wattage	Max. Continuous Oper. Voltage	Dimensions in millimeters ± 0.50 [Dimensions in inches ± 0.02] L	B	C (max.)	D	E (max.)
90.1	0.80	7'000	20.32 [0.80]	3.81 [0.15]	10.00 [0.40]	17.78 [0.70]	2.00 [0.08]
90.2	1.00	11'000	25.40 [1.00]	3.81 [0.15]	10.00 [0.40]	22.86 [0.90]	2.00 [0.08]
90.3	1.50	20'000	38.10 [1.50]	3.81 [0.15]	10.00 [0.40]	35.56 [1.40]	2.00 [0.08]
90.4	2.00	30'000	50.80 [2.00]	5.08 [0.20]	10.00 [0.40]	48.26 [1.90]	2.00 [0.08]
100.1	1.00	7'000	20.32 [0.80]	5.08 [0.20]	35.00 [1.40]	17.78 [0.70]	2.50 [0.10]
100.2	1.30	11'000	25.40 [1.00]	5.08 [0.20]	35.00 [1.40]	22.86 [0.90]	2.50 [0.10]
100.3	2.00	20'000	38.10 [1.50]	5.08 [0.20]	35.00 [1.40]	35.56 [1.40]	2.50 [0.10]
100.4	3.00	30'000	50.80 [2.00]	6.35 [0.25]	35.00 [1.40]	48.26 [1.90]	2.50 [0.10]
200.1	1.00	5'000	12.70 [0.50]	5.08 [0.20]	10.00 [0.40]	10.16 [0.40]	2.00 [0.08]
200.2	2.00	11'000	25.40 [1.00]	7.62 [0.30]	35.00 [1.40]	22.86 [0.90]	2.50 [0.10]
200.3	3.00	20'000	38.10 [1.50]	12.70 [0.50]	35.00 [1.40]	35.56 [1.40]	2.50 [0.10]
200.4	4.50	30'000	50.80 [2.00]	15.24 [0.60]	35.00 [1.40]	48.26 [1.90]	2.50 [0.10]
200.5	6.50	45'000	76.20 [3.00]	15.24 [0.60]	35.00 [1.40]	73.66 [2.90]	3.00 [0.12]
200.7	9.00	60'000	101.60 [4.00]	15.24 [0.60]	35.00 [1.40]	99.06 [3.90]	3.00 [0.12]

Characteristics

Resistance Values	from 1KΩ to as high as 100GΩ on all models (to 1TΩ on request)		
Tolerances	0.05%, 0.1%, 0.25%, 0.5%, 1%, 2%, 5%, 10% (0.05% available to 10G, 0.25% to 100G, other on request)		
Temperature Coefficients	5, 10, 15, 25, 50 and 100 ppm/℃ (10 ppm/℃ availab le to 10G, 25 ppm/℃ to 100G, other on request)		
Operating Temperature	-55 .. +200℃	(extended temperature range to 350℃ available)	
Insulation Resistance	> 10'000 MΩ	500 Volt 25 ℃ 75% relative humidity	
Dielectric Strength	> 1'000 Volt	25 ℃ 75% relative humidity	
Thermal Shock	Δ R/R < 0.1% typ., 0.20% max.	MIL Std. 202, method 107 Cond. C	IEC 68 - 2 -14
Overload	Δ R/R < 0.1% typ., 0.25% max.	1,5 x Pnom, 5 sec (do not exceed max. voltage)	
Moisture Resistance	Δ R/R < 0.1% typ., 0.25% max.	MIL Std. 202, method 106	IEC 68 - 2 - 3
Load Life	Δ R/R < 0.1% typ., 0.25% max.	1000 hours at rated power	IEC 115 - 1
Encapsulation	Screen Printed Silicone	Core Material	Al_2O_3 (96%)
Lead Material	Tinned Copper / SMD versions available	Resistor Material	Ruthenium Oxide

Voltage Coefficients of Resistance

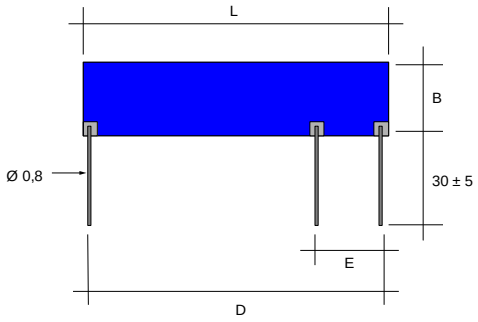
Type	Resistance Range	VCR (- ppm/V)*	Type	Resistance Range	VCR (- ppm/V)*	Type	Resistance Range	VCR (- ppm/V)*
90.1	1K .. 100M 100M .. 1G	< 0.80 < 1.50	**100.2**	1K .. 250M 250M .. 3.5G	< 0.70 < 1.80	**200.3**	1K .. 1G 1G .. 10G	< 0.20 < 0.40
90.2	1K .. 150M 150M .. 1.5G	< 0.65 < 1.20	**100.3**	1K .. 400M 400M .. 5G	< 0.45 < 1.20	**200.4**	1K .. 1G 1G .. 20G	< 0.10 < 0.30
90.3	1K .. 300M 300M .. 4G	< 0.50 < 0.90	**100.4**	1K .. 600M 600M .. 10G	< 0.35 < 0.70	**200.5**	1K .. 1.5G 1.5G .. 30G	< 0.07 < 0.20
90.4	1K .. 500M 500M .. 7G	< 0.35 < 0.80	**200.1**	1K .. 250M 250M .. 3G	< 2.00 < 3.70	**200.7**	1K .. 2G 2G .. 40G	< 0.05 < 0.15
100.1	1K .. 200M 200M .. 2.5G	< 0.90 < 2.50	**200.2**	1K .. 500M 500M .. 7G	< 0.35 < 0.90	* typical values, contact factory for details		

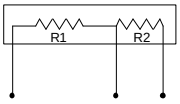
High Voltage Divider Series 300
High Precision, Low TC

NEW !!
to 55'000 V

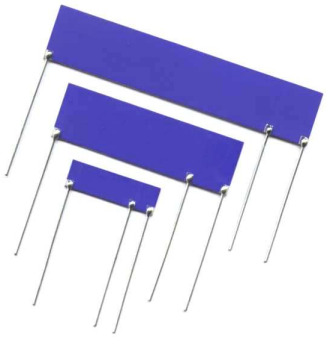
High Voltage Dividers Series 300 introduce Nicrom Electronic's exclusive advanced proprietary high voltage resistor technology which increases the allowable working voltage over the length of the high voltage section.
Precision High Voltage Dividers Series 300 provide tighter ratio temperature coefficients and tighter ratio tolerances than have previously been available in standard high voltage divider products.

These specifications can provide important improvements in performance in many types of advanced electronic systems, including TWT power supplies, radar systems, X-ray systems, analytical equipment and high resolution CRT displays.
Precision High Voltage Dividers Series 300 are available in a broad range of custom resistance values, voltage ratios, voltage ratings, ratio tolerances and ratio temperature coefficients.





$$\text{Ratio} = \frac{R2}{R1 + R2}$$



Model	Wattage	Max. Operating Voltage	Dimensions in millimeters ± 0.50 [Dimensions in inches ± 0.02]			
			L	B	D	E
300.2	0.75	12'000	25.4 [1.00]	7.62 [0.30]	22.86 [0.90]	5.08 [0.20]
300.3	1.50	18'000	38.1 [1.50]	12.7 [0.50]	35.56 [1.40]	7.62 [0.30]
300.4	2.50	24'000	50.8 [2.00]	15.24 [0.60]	48.26 [1.90]	10.16 [0.40]
300.5	3.50	40'000	76.2 [3.00]	15.24 [0.60]	73.66 [2.90]	10.16 [0.40]
300.7	4.50	55'000	101.6 [4.00]	15.24 [0.60]	99.06 [3.90]	10.16 [0.40]

Characteristics

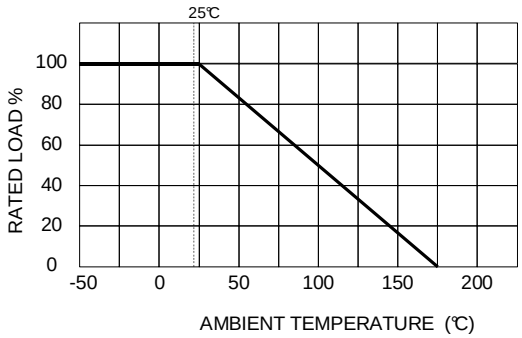
Resistance Values	from 1KΩ to as high as 100GΩ on all models	Ratios	1:100 to 1:10'000 on request
Absolute Tolerances	0.05%, 0.1%, 0.25%, 0.5%, 1%, 2%, 5%, 10% (0.05% avail. to 10G, 0.25% to 100G, other on request)		
Ratio Tolerances	0.05%, 0.1%, 0.25%, 0.5%, 1% (0.02% on request)		
Absolute TC	5, 10, 15, 25, 50 and 100 ppm/℃ (10 ppm/℃ availab le to 10G, 25 ppm/℃ to 100G, other on request)		
Ratio TC	5 ppm/℃, 10 ppm/℃, 15 ppm/℃, 25 ppm/℃ or 50 ppm /℃		
Operating Temperature	-55 … +175℃	(extended temperature range to 300℃ available)	
Insulation Resistance	> 10'000 MΩ	500 Volt 25 ℃ 75% Relative humidity	
Dielectric Strength	> 1'000 Volt	25 ℃ 75% Relative humidity	
Thermal Schock	Δ R/R < 0.1% typ., 0.20% max.	MIL Std. 202, method 107 Cond. C	IEC 68 - 2 -14
Overload	Δ R/R < 0.1% typ., 0.25% max.	1,5 x Pnom, 5 sec (do not exceed max. voltage)	
Moisture Resistance	Δ R/R < 0.1% typ., 0.25% max.	MIL Std. 202, method 106	IEC 68 - 2 - 3
Load Life	Δ R/R < 0.05% typ., 0.25% max.	1000 hours at rated power	IEC 115 - 1
Encapsulation	Screen Printed Silicone	Substrate Material	Al_2O_3 (96%)
Lead Material	Tinned Copper	Resistor Material	Ruthenium Oxide

Voltage Coefficients of Resistance

Type	Resistance Range	VCR (-ppm/V)*
300.2	1K .. 500M 500M .. 7G	< 0.35 < 0.90
300.3	1K .. 1G 1G .. 10G	< 0.20 < 0.40
300.4	1K .. 1G 1G .. 20G	< 0.10 < 0.30
300.5	1K .. 1.5G 1.5G .. 30G	< 0.07 < 0.20
300.7	1K .. 2G 2G .. 40G	< 0.05 < 0.15

* typical values, contact factory for details

Derating Curve



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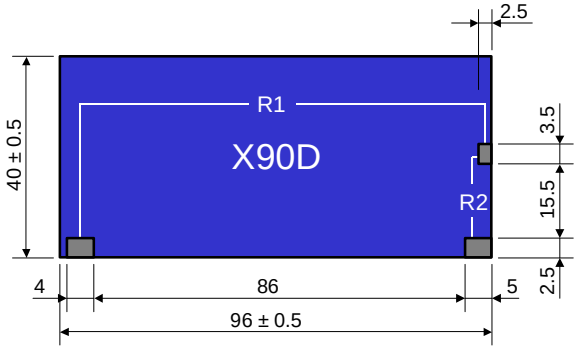
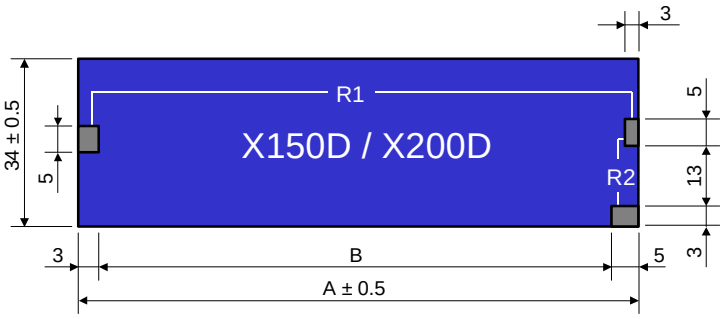
High Voltage Dividers and Resistors Type XHVD
High Precision, Low TC

Precision High Voltage Dividers and Resistors Type XHVD extend Nicrom Electronic's advanced proprietary high voltage resistor technology to larger devices than have previously been available on the market. These new resistors and dividers provide tight ratio temperature coefficients and tight ratio tolerances combined with extremely high working voltage. These specifications can provide important improvements in performance in many types of advanced electronic systems, including TWT power supplies, radar systems, X-ray systems, analytical equipment and high resolution CRT displays.

Precision High Voltage Dividers and Resistors Type XHVD are available in a broad range of custom resistance values, voltage ratios, voltage ratings, ratio tolerances and ratio temperature coefficients.
A Single Resistor version is also available (X90, X150 and X200). The electrical and physical characteristics are the same with the exception of R2 and its solder pad which are omitted.
Custom versions with double voltage division (for example 1:2'000:100) or other custom characteristics and configurations are available on request. Consult factory for details.





Characteristics

Operating Voltage :	X90/D = 75 kV X150/D = 100 kV X200/D = 125 kV	(Nominal Voltage) Used in insulating mineral oil or epoxy	
Nominal Power :	X90/D = 30 Watt X150/D = 35 Watt X200/D = 45 Watt	Used in insulating mineral oil or epoxy	
Overload Voltage :	X90/D = 90 kV X150/D = 120 kV X200/D = 150 kV	15 Minutes Used in insulating mineral oil or epoxy	
Short Term Overload :	X90/D = 110 kV X150/D = 150 kV X200/D = 200 kV	Peak Voltage Used in insulating mineral oil or epoxy	
Main Resistance Value :	from 1KΩ to as high as 100GΩ		
Ratio :	1:1'000 to 1:20'000	X90D, X150D and X200D	
Absolute Tolerances :	0.05%, 0.1%, 0.25%, 0.5%, 1%		
Ratio Tolerances :	0.05%, 0.1%, 0.25%, 0.5%, 1%	X90D, X150D and X200D	
Absolute TC :	5, 10, 15, 25, 50, 100 ppm/℃	(Temperature Coefficient)	
Ratio TC :	5, 10, 15, 25, 50 ppm/℃	X90D, X150D and X200D	
Operating Temperature :	Oil +20℃ ... +70℃	other on request	
Storage Temperature :	-30℃ … +150℃		
Insulation Resistance :	> 10'000 MΩ	500 Volt 25 ℃ 75% relative humidity	
Dielectric Strength :	> 1'000 Volt	25 ℃ 75% relative humidity	
Thermal Shock :	Δ R/R < 0.1% typ., 0.25% max.	MIL Std. 202, method 107 Cond. C	IEC 68 - 2 -14
Overload :	Δ R/R < 0.1% typ., 0.25% max.	1,5 x Pnom 15 min. (do not exceed peak voltage)	
Moisture Resistance :	Not applicable	(if used in oil or epoxy)	
Load Life :	Δ R/R < 0.1% typ., 0.25% max.	1000 hour @ Nominal Power	IEC 115 - 1
Absolute VCR :	1K .. 3G < 0.06 ppm/V 3G .. 30G < 0.15 ppm/V	Voltage Coefficient of Resistance (typical values, contact factory for details)	
Ratio Definition :	R2 / (R1 + R2)	X150D and X200D	
Encapsulation :	Screen Printed Silicon if used in Oil / Without encapsulation if used in Epoxy		
Solder Pads :	Palladium - Silver Option : 3 soldered wires, 50 mm length, diameter 1.3 mm (Type AWG 26 UL AWM Style 1007 CSA TR 64)		
Other Dimensions :	Type X150/D A = 127 mm B = 119 mm Type X200/D A = 160 mm B = 152 mm		

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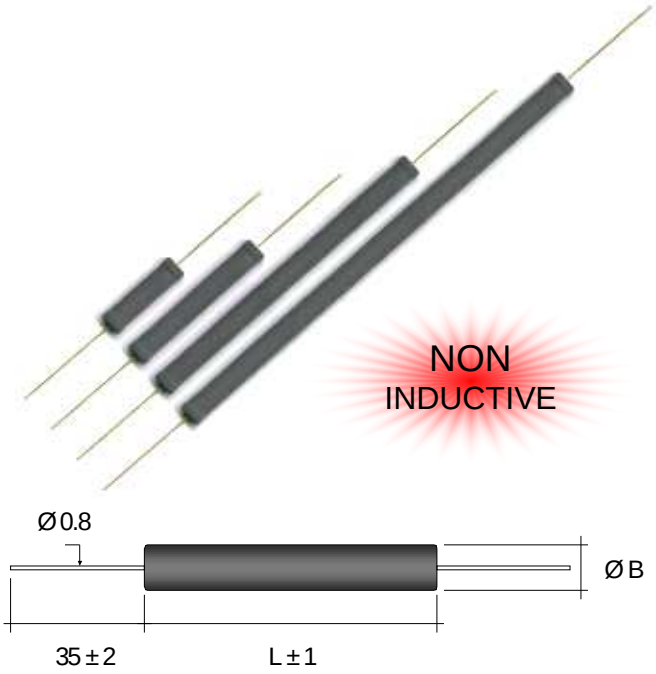
High Voltage Resistors Series 400
Precision, Non-Inductive, Low TC

High Voltage Resistors Series 400 have been developed to meet the precision temperature stability requirements of high accuracy and high voltage systems, combining proprietary non-inductive resistance system and design to achieve low temperature coefficient, low voltage coefficients, high stability and increased high operating voltages.
Low TC Precision High Voltage Resistors Series 400 are designed to meet the demanding requirements of TWT power supplies, electron microscopes, X-ray systems, high resolution CRT displays and geophysical instruments.



Model	Wattage	Max. Oper. Voltage	Dimensions in millimeters ± 0.50 [Dimensions in inches ± 0.02]	
			L	B
400.2	3.80	15'000	27.00 [1.07]	8.00 [0.32]
400.3	5.00	21'000	37.00 [1.46]	8.00 [0.32]
400.5	7.50	30'000	52.00 [2.05]	8.00 [0.32]
400.7	10.00	45'000	77.00 [3.03]	8.00 [0.32]
400.10	13.50	60'000	102.00 [4.02]	8.30 [0.33]
400.12	16.00	72'000	122.00 [4.80]	8.50 [0.34]
400.15	20.00	90'000	152.00 [5.98]	8.50 [0.34]

Characteristics

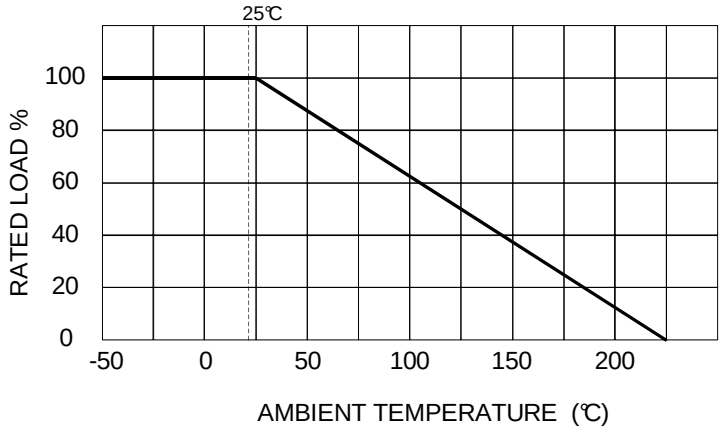
Resistance Values	from 1KΩ to as high as 100GΩ on all models (to 1TΩ on request)		
Tolerances	0.05%, 0.1%, 0.25%, 0.5%, 1%, 2%, 5%, 10% (0.05% avail. to 10G, 0.25% to 100G, other on request)		
Temperature Coefficients	5, 10, 15, 25, 50 and 100 ppm/℃ (10 ppm/℃ availabl e to 10G, 25 ppm/℃ to 100G, other on request)		
Operating Temperature	-55 .. +225℃	(extended temperature range to 350℃ available)	
Insulation Resistance	> 10'000 MΩ	500 Volt 25 ℃ 75% relative humidity	
Dielectric Strength	> 1'000 Volt	25 ℃ 75% relative humidity	
Thermal Shock	Δ R/R < 0.1% typ., 0.20% max.	MIL Std. 202, method 107 Cond. C	IEC 68 - 2 -14
Overload	Δ R/R < 0.1% typ., 0.25% max.	1,5 x Pnom, 5 sec (do not exceed max. voltage)	
Moisture Resistance	Δ R/R < 0.1% typ., 0.25% max.	MIL Std. 202, method 106	IEC 68 - 2 - 3
Load Life	Δ R/R < 0.1% typ., 0.25% max.	1000 hours at rated power	IEC 115 - 1
Encapsulation	Silicone Conformal Coating	Core Material	Al_2O_3 (96%)
Lead Material	Gold Plated	Resistor Material	Ruthenium Oxide

Voltage Coefficients of Resistance

Type	Resistance Range	VCR (-ppm/V)*
400.2	1K .. 500M 500M .. 5G	< 0.40 < 0.75
400.3	1K .. 1G 1G .. 10G	< 0.20 < 0.40
400.5	1K .. 1G5 1G5 .. 15G	< 0.15 < 0.30
400.7	1K .. 2G5 2G5 .. 25G	< 0.10 < 0.15
400.10	1K .. 3G 3G ..30G	< 0.08 < 0.12
400.12	1K .. 4G 4G .. 40G	< 0.06 < 0.10
400.15	1K .. 5G 5G .. 50G	< 0.04 < 0.08

* typical values, contact factory for details

Derating Curve



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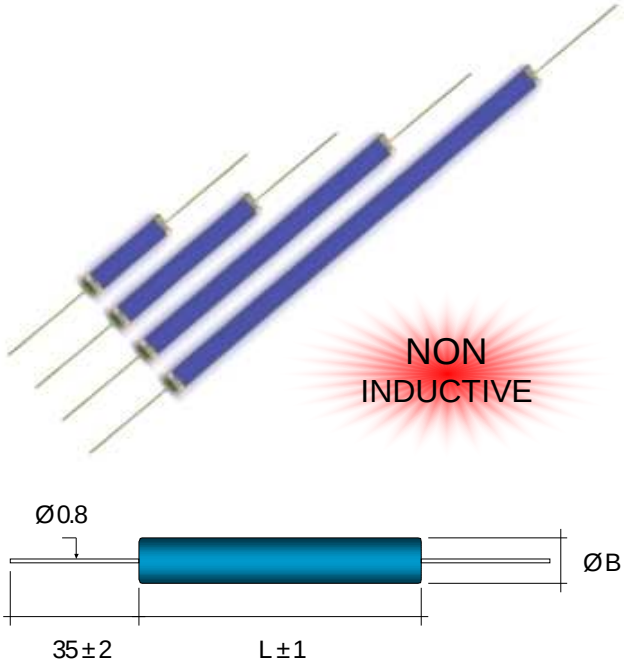
High Voltage Resistors Series 400 MX
Precision, Non-Inductive, Low TC

High Voltage Resistors Series 400 MX have been specifically developed for use in high performance industrial and laboratory high voltage systems. These precision high voltage resistors combine proprietary non-inductive resistance system and design to achieve low temperature coefficient, low voltage coefficients, high stability and increased high operating voltages.
Low TC Precision High Voltage Resistors Series 400 MX are intended for use in low outgasing applications, SF6 and oil. Typical applications are medical systems like X-ray as well as power supplies or instruments.



Model	Wattage	Max. Oper. Voltage	Dimensions in millimeters ± 0.50 [Dimensions in inches ± 0.02]	
			L	B
MX400.2	3.80	15'000	27.00 [1.07]	8.00 [0.32]
MX400.3	5.00	21'000	37.00 [1.46]	8.00 [0.32]
MX400.5	7.50	30'000	52.00 [2.05]	8.00 [0.32]
MX400.7	10.00	45'000	77.00 [3.03]	8.00 [0.32]
MX400.10	13.50	60'000	102.00 [4.02]	8.00 [0.32]
MX400.12	16.00	72'000	122.00 [4.80]	8.00 [0.32]
MX400.15	20.00	90'000	152.00 [5.98]	8.00 [0.32]

Characteristics

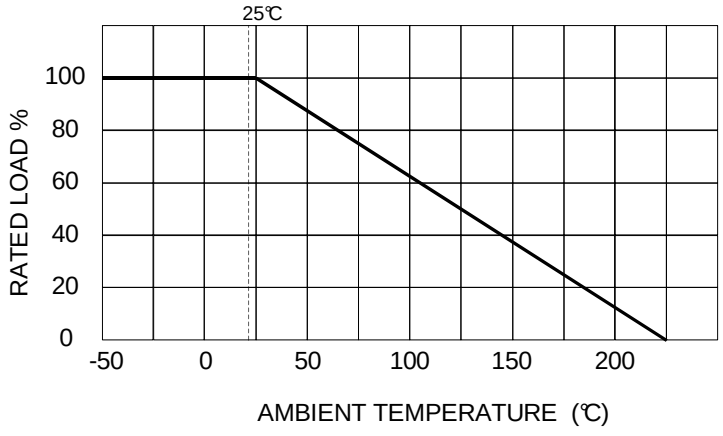
Resistance Values	from 1KΩ to as high as 100GΩ on all models (to 1TΩ on request)		
Tolerances	0.05%, 0.1%, 0.25%, 0.5%, 1%, 2%, 5%, 10% (0.05% avail. to 10G, 0.25% to 100G, other on request)		
Temperature Coefficients	5, 10, 15, 25, 50 and 100 ppm/℃ (10 ppm/℃ availab le to 10G, 25 ppm/℃ to 100G, other on request)		
Operating Temperature	-55 .. +225℃	(extended temperature range to 350℃ available)	
Insulation Resistance	> 10'000 MΩ	500 Volt 25 ℃ 75% relative humidity	
Dielectric Strength	> 1'000 Volt	25 ℃ 75% relative humidity	
Thermal Shock	Δ R/R < 0.1% typ., 0.20% max.	MIL Std. 202, method 107 Cond. C	IEC 68 - 2 -14
Overload	Δ R/R < 0.1% typ., 0.25% max.	1,5 x Pnom, 5 sec (do not exceed max. voltage)	
Moisture Resistance	Δ R/R < 0.1% typ., 0.25% max.	MIL Std. 202, method 106	IEC 68 - 2 - 3
Load Life	Δ R/R < 0.1% typ., 0.25% max.	1000 hours at rated power	IEC 115 - 1
Encapsulation	Screen Printed Silicone	Core Material	Al_2O_3 (96%)
Lead Material	Gold Plated	Resistor Material	Ruthenium Oxide

Voltage Coefficients of Resistance

Model	Resistance Range	VCR (-ppm/V)*
MX400.2	1K .. 500M 500M .. 5G	< 0.40 < 0.75
MX400.3	1K .. 1G 1G .. 10G	< 0.20 < 0.40
MX400.5	1K .. 1G5 1G5 .. 15G	< 0.15 < 0.30
MX400.7	1K .. 2G5 2G5 .. 25G	< 0.10 < 0.15
MX400.10	1K .. 3G 3G ..30G	< 0.08 < 0.12
MX400.12	1K .. 4G 4G .. 40G	< 0.06 < 0.10
MX400.15	1K .. 5G 5G .. 50G	< 0.04 < 0.08

* typical values, contact factory for details

Derating Curve



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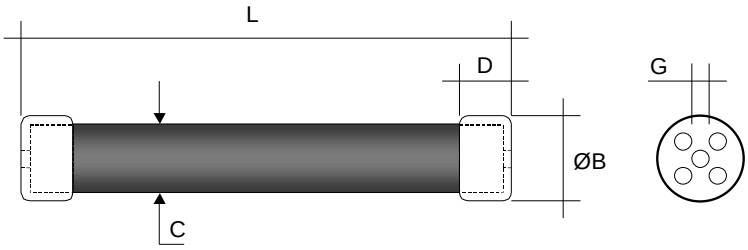
High Voltage Power Resistors Series 500
Precision, Non-Inductive, Low TC

High Voltage Power Resistors Series 500 combine proprietary non-inductive resistance system and design to achieve low temperature coefficient, low voltage coefficients, high stability, increased high operating voltages and high power ratings.

These Precision High Voltage Power Resistors are designed to meet the demanding requirements of TWT power supplies, electron microscopes, X-ray systems, high resolution CRT displays, geophysical instruments and power transmission lines.



Model	Wattage	Max. Operating Voltage	Dimensions in millimeters ± 1.00 [Dimensions in inches ± 0.04]				
			L (max.)	B	C	D	G
500.10	15.00	35'000	81.00 [3.19]	14.00 [0.55]	13.50 [0.53]	10.00 [0.40]	M4
500.20	25.00	80'000	156.00 [6.14]	14.00 [0.55]	13.50 [0.53]	10.00 [0.40]	M4
500.50	55.00	70'000	160.00 [6.30]	31.50 [1.24]	30.50 [1.20]	17.00 [0.67]	M8
500.70	75.00	100'000	210.00 [8.27]	31.50 [1.24]	30.50 [1.20]	17.00 [0.67]	M8
500.100	110.00	150'000	310.00 [12.20]	31.50 [1.24]	30.50 [1.20]	17.00 [0.67]	M8

Characteristics

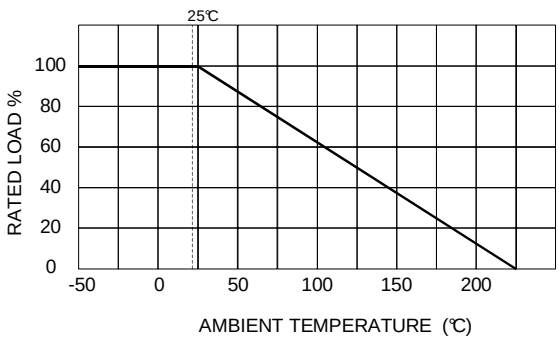
Resistance Values	from 1KΩ to as high as 100GΩ on all models (to 1TΩ on request)		
Tolerances	0.05%, 0.1%, 0.25%, 0.5%, 1%, 2%, 5%, 10% (0.05% avail. to 10G, 0.25% to 100G, other on request)		
Temperature Coefficients	5, 10, 15, 25, 50 and 100 ppm/℃ (10 ppm/℃ availab le to 10G, 25 ppm/℃ to 100G, other on request)		
Operating Temperature	-55 .. +225℃	(extended temperature range to 350℃ available)	
Insulation Resistance	> 10'000 MΩ	500 Volt 25 ℃ 75% relative humidity	
Dielectric Strength	> 1'000 Volt	25 ℃ 75% relative humidity	
Thermal Shock	Δ R/R < 0.1% typ., 0.20% max.	MIL Std. 202, method 107 Cond. C	IEC 68 - 2 -14
Overload	Δ R/R < 0.1% typ., 0.25% max.	1,5 x Pnom, 5 sec (do not exceed max. voltage)	
Moisture Resistance	Δ R/R < 0.1% typ., 0.25% max.	MIL Std. 202, method 106	IEC 68 - 2 - 3
Load Life	Δ R/R < 0.1% typ., 0.50% max.	1000 hours at rated power	IEC 115 - 1
Encapsulation	Silicone Conformal Coating	Core Material	Al_2O_3 (96%)
Lead Material	Brass Caps (lug terminations avail.)	Resistor Material	Ruthenium Oxide

Voltage Coefficients of Resistance

Type	Resistance Range	VCR (-ppm/V)*
500.10	1K .. 1G5 1G5 .. 15G	< 0.09 < 0.18
500.20	1K .. 3G5 3G5 .. 35G	< 0.04 < 0.08
500.50	1K .. 2G5 2G5 .. 25G	< 0.04 < 0.07
500.70	1K .. 3G5 3G5 .. 35G	< 0.03 < 0.05
500.100	1K .. 6G 6G .. 60G	< 0.02 < 0.03

* typical values, contact factory for details

Derating Curve



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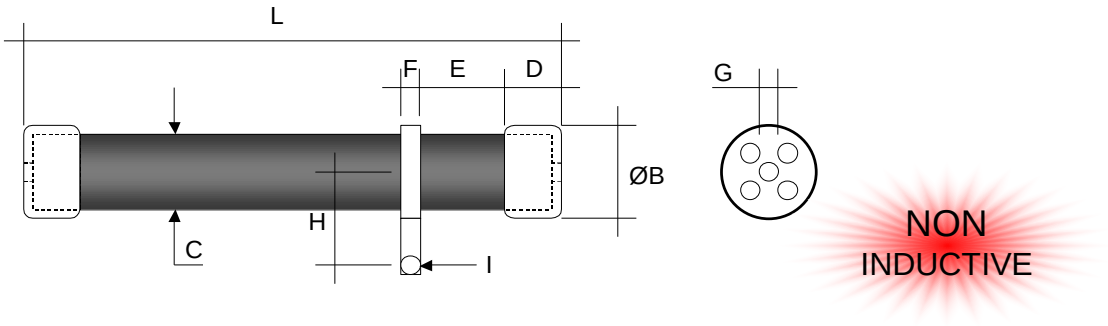
High Voltage Dividers Series 600
Precision, Non-Inductive, Low TC

High Voltage Dividers Series 600 combine proprietary non-inductive resistance system and design to achieve low ratio temperature coefficient, low voltage coefficients, tight ratio tolerances, high stability and increased high operating voltages.

These Precision High Voltage Dividers can provide important improvements in performance in many types of advanced electronic systems, including power supplies, radar systems, X-ray systems, analytical equipment and geophysical instruments.



Model	Wattage	Max. Operating Voltage	Dimensions in millimeters ± 1.00 [Dimensions in inches ± 0.04]								
			L (max.)	B	C	D	E	F	H	I	G
600.20	15.00	70'000	156.00 [6.14]	14.00 [0.55]	13.50 [0.53]	10.00 [0.40]	6.50 [0.26]	5.00 [0.20]	18.50 [0.73]	3.20 [0.26]	M4
600.100	75.00	120'000	310.00 [12.20]	31.50 [1.24]	30.50 [1.20]	17.00 [0.67]	40.00 [1.58]	7.00 [0.27]	31.5 [1.24]	3.20 [0.26]	M8

Characteristics

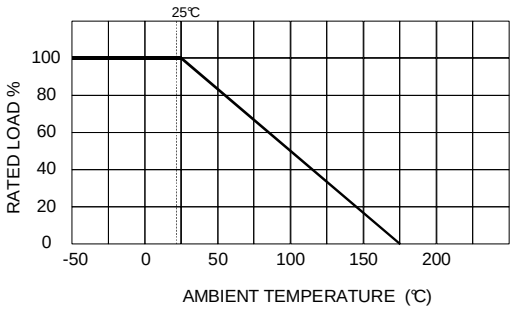
Resistance Values	from 1KΩ to as high as 100GΩ on all models (to 1TΩ on request)		
Ratios	from 1:100 to 1:10'000, other on request		
Absolute Tolerances	0.05%, 0.1%, 0.25%, 0.5%, 1%, 2%, 5% (0.05% avail. to 10G, 0.25% to 100G, other on request)		
Ratio Tolerances	0.05%, 0.1%, 0.25%, 0.5%, 1% (other on request)		
Absolute Temp. Coeff.	5, 10, 15, 25, 50 and 100 ppm/℃ (10 ppm/℃ availab le to 10G, 25 ppm/℃ to 100G, other on request)		
Ratio Temp. Coeff.	5, 10, 15, 25 and 50 ppm/℃		
Operating Temperature	-55 .. +175℃	(extended temperature range to 350℃ available)	
Insulation Resistance	> 10'000 MΩ	500 Volt 25 ℃ 75% relative humidity	
Dielectric Strength	> 1'000 Volt	25 ℃ 75% relative humidity	
Thermal Shock	Δ R/R < 0.1% typ., 0.20% max.	MIL Std. 202, method 107 Cond. C	IEC 68 - 2 -14
Overload	Δ R/R < 0.1% typ., 0.25% max.	1,5 x Pnom, 5 sec (do not exceed max. voltage)	
Moisture Resistance	Δ R/R < 0.1% typ., 0.25% max.	MIL Std. 202, method 106	IEC 68 - 2 - 3
Load Life	Δ R/R < 0.1% typ., 0.25% max.	1000 hours at rated power	IEC 115 - 1
Encapsulation	Silicone Conformal Coating	Core Material	Al_2O_3 (96%)
Lead Material	Brass Caps (lug terminations avail.)	Resistor Material	Ruthenium Oxide

Voltage Coefficients of Resistance

Type	Resistance Range	VCR (-ppm/V)*
600.20	1K .. 3G5	< 0.04
	3G5 .. 35G	< 0.08
600.100	1K .. 6G	< 0.02
	6G .. 60G	< 0.03

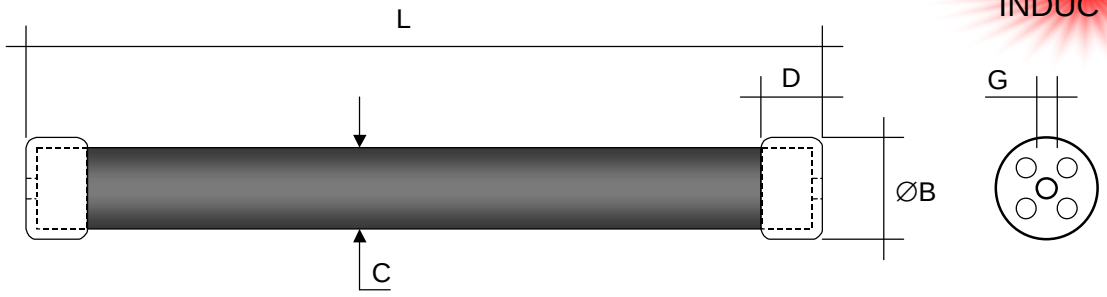
* typical values, contact factory for details

Derating Curve



Ultra High Voltage Resistors Series 1000
Precision, Non-Inductive, Low TC

NON INDUCTIVE



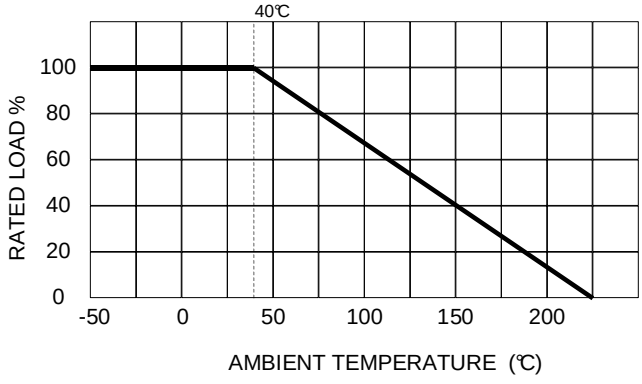
Type	P 40 ℃ (watt)	U (kV)	L	B (max.)	C	D	G
1000.150	150	200	470	40	38	18	M8
1000.200	200	250	600	40	38	18	M8
1000.250	250	300	800	50	48	18	M8
1000.300	300	400	1000	50	48	18	M8

Dimensions in mm

Characteristics

Design / Technology	Exclusive Non-Inductive Design with Uniform Voltage Distribution / Thick Film		
Resistance Values	from 1MΩ to as high as 100GΩ		
Tolerances	10%, 5%, 2%, 1%, 0.5%, 0.25%, 0.1% or 0.05% (other on request)		
Temperature Coefficients	100 ppm/℃, 50 ppm/℃, 25 ppm/℃ or 15 ppm/℃, (10 ppm/℃ and 5 ppm/℃ on request)		
Voltage Coefficient	< 0.003 ppm/V typ.		
Operating Temperature	-55 … + 225℃	(extended temperature range to 350℃ available)	
Insulation Resistance	> 10'000 MΩ	500 Volt 25 ℃ 75% Relative humidity	
Thermal Shock	Δ R/R 0,2% max	MIL Std. 202, method 107 Cond. C	IEC 68 - 2 -14
Overload	Δ R/R 0,25% max	1,5 x Pnom, 5 sec (do not exceed max. voltage)	
Moisture Resistance	Δ R/R 0,25% max	MIL Std. 202, method 106	IEC 68 - 2 - 3
Load Life	Δ R/R 0,2% max	1000 hours at rated power	IEC 115 - 1
Encapsulation	High Temperature Silicone Conformal		
Lead Material	Brass Caps		

Derating Curve



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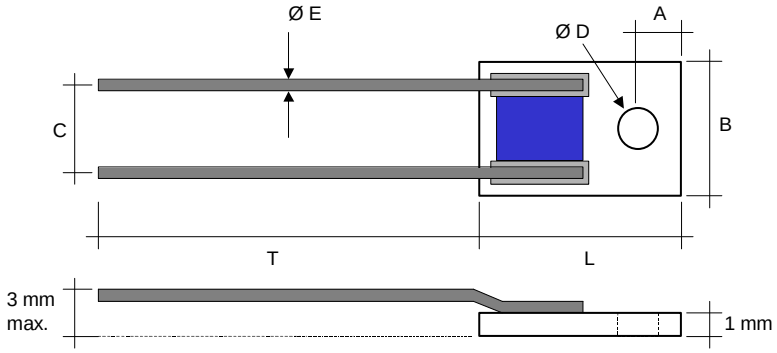
High Power Resistors in TO Packages
Steel Carrier, Non-Inductive



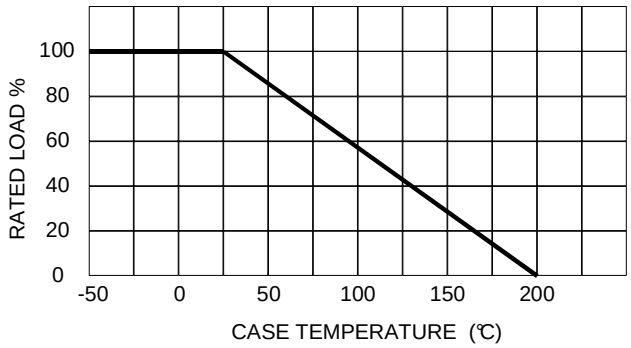
Type	Max. Voltage	L	B	T	C	E	D	A
TO-126	300 Volt	11.80	9.00	30	5.08	0.8	2.5	2.5
TO-220	300 Volt	16.50	11.00	30	5.08	0.8	3	3
TO-247	350 Volt	21.00	16.00	30	10.16	0.8	3.5	4

Dimensions in mm (max.)

Characteristics

Power Rating :	TO-126 =	**2 W** in free air @ 25 ℃ (do not exceed 200℃ surface t emperature) **30 W** on heat sink (see derating curve)		
	TO-220 =	**3.5 W** in free air @ 25 ℃ (do not exceed 200℃ surface t emperature) **60 W** on heat sink (see derating curve)		
	TO-247 =	**6 W** in free air @ 25 ℃ (do not exceed 200℃ surface t emperature) **120 W** on heat sink (see derating curve)		
Resistance Value :		0.05 Ohm up to 10 KOhm		
Temperature Coefficient :		50 ppm/℃, 100 ppm/℃		
Tolerance :		1%, 2%, 5%		
Operating Temperature :		-55 ℃ ... +200 ℃		
Insulation Resistance :		> 1'000 MΩ	Between two terminals and mounting surface	
Dielectric Strength :		> 750 Volt	25 ℃ 75% Relative humidity	
Thermal Shock :		Δ R/R 0,3% max	MIL Std. 202, method 107 Cond. C	IEC 68 - 2 -14
Overload :		Δ R/R 0,3% max	2,5 x Pnom, 5 sec (do not exceed max. voltage)	
Moisture Resistance :		Δ R/R 0,5% max	MIL Std. 202, method 106	IEC 68 - 2 - 3
Load Life :		Δ R/R 1% max	1000 hours at rated power *	IEC 115 - 1
Encapsulation :		Screen Printed Silicone	Substrate Material :	Stainless Steel
Lead Material :		Tinned Copper	Resistor Material :	Ruthenium Oxide

Derating Curve



The case temperature is to be used for purposes of establishing the maximum applied power. The case temperature measurement is made with the thermocouple contacting the bottom insulated mounting surface of the package (center of bottom surface), the device mounted on a heat sink, thermal grease applied at a mounting torque of up to 90 N-m (8 in-lbs) max.

* Power rating depend upon case temperature

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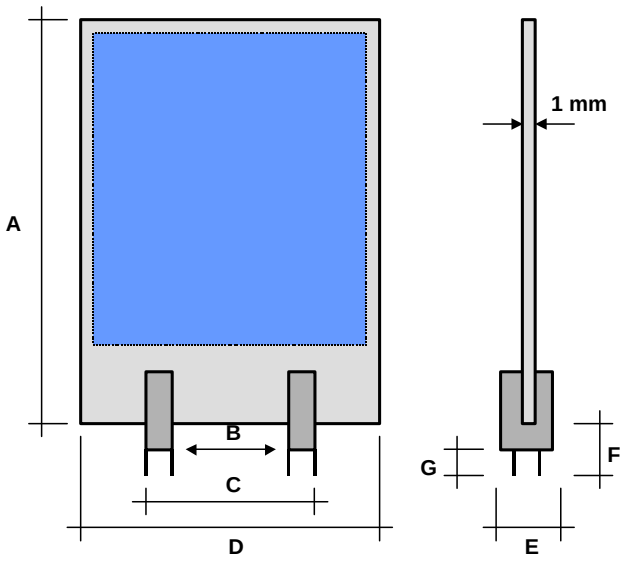
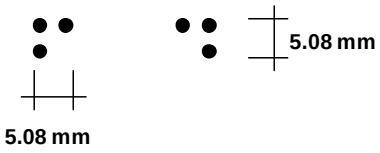
High Power Planar Resistors Series TP
Steel Carrier, Non-Inductive



Terminal Details :



Features :

- » Low Inductance
- » Easy to Install (no Heat Sink required)
- » High Power Density (2 Watts/ cm^2)
- » Excellent Pulse withstanding Capabilities
- » Very Robust Construction

Series TP is a plate resistor system utilizing thick film ruthenium oxide, on hi-temp/ hi-voltage dielectric insulated steel substrate, protected by a glass passivation layer.
These resistors offer low inductance and very high power densities. Being PC-board mountable without heat sink, they are economic to install and best suited for applications under 300V.

Model	Power Ratings	Max. Oprating Voltage	Dimensions in millimeters ± 1.00 [Dimensions in inches ± 0.04]						
			A	B	C	D	E	F	G
TP-50	50 Watts	300 Volts	64.00 [2.52]	25.40 [1.00]	35.56 [1.40]	45 [1.77]	10 [0.40]	10 [0.40]	5 [0.20]
TP-100	100 Watts	300 Volts	85.00 [3.35]	33.02 [1.30]	43.18 [1.70]	65 [2.56]	10 [0.40]	10 [0.40]	5 [0.20]

Characteristics

Resistance Value :	1 Ohm up to 10 Kohm		
Temperature Coefficient :	150 ppm/℃		
Tolerance :	1%, 2%, 5%, 10%, 20% *		
Power Rating :	Based on 25℃ free air.		
Inductance :	< 50 nH @ MHz (typ.)		
Derating :	Linearly from 100% @ +25℃ to 0% @ +300℃.		
Insulation Resistance :	> 1'000 MΩ	Between two terminals and steel plate	
Dielectric Strength :	> 500 Volt	25 ℃ 75% Relative humidity	
Overload :	Δ R/R 1%	5 x Pnom, as long as the 1 sec. average does not exceed Pnom.	
Moisture Resistance :	Δ R/R 1%	MIL Std. 202, method 106	IEC 68 - 2 - 3
Load Life :	Δ R/R 2%	2000 hours at rated power *	IEC 115 - 1
Encapsulation :	Screen Printed Glass	Substrate Material :	Stainless Steel
Lead Material :	Tinned Steel	Resistor Material :	Ruthenium Oxide

* Note : 20% values are not laser trimmed and offer enhanced surge handling.

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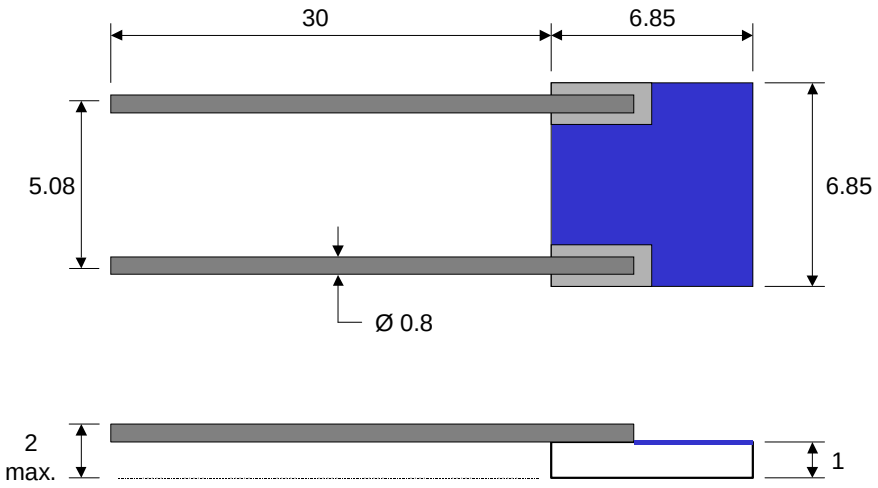
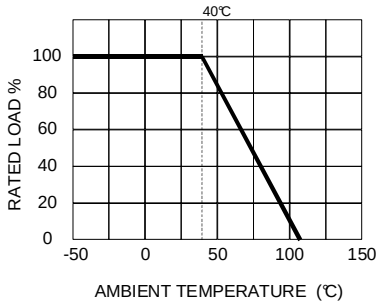
Series N685 TNK / MK Low TC Power Film Resistors



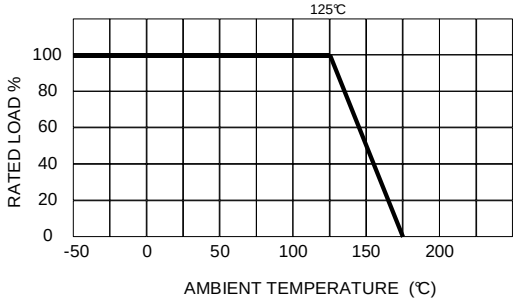
Characteristics

Version	TNK	MK	
Operating Temperature	0 to +105 ℃	-55 to +175 ℃	
Nominal Power	0.75 Watt (at 40 ℃)	0.75 Watt (at 125℃)	
Max. Voltage	300 Volt	2000 Volt	
Resistance Range	1 K to 1 Meg	1 Ohm to 350 Meg	
Tolerance	1% to 0.01%	1% to 0.1%	
Temperature Coefficient	5, 10, 15, 25 ppm/℃	50 ppm/℃	(1 ohm to 5 ohm 100ppm/℃)
Overload	0.15%	0.2% max	2.5 x Pnom ,(do not exceed 1.3 x Vmax)
Insulation Resistance	>10'000 MOhm		
Dielectric Strength	>500 Volt		25℃ 75% relative humidity
Thermal Shock	0.1% max	0.2% max	MIL Std. 202, method 107 Cond.C
Moisture Resistance	0.25 % max	0.5% max	MIL Std. 202, method 106
Load Life	0.05% max	0.25% max	1000 Hours at rated power
Encapsulation	Screen Printed Silicon		
Lead Material	Tinned Copper		

Derating Curve TNK



Derating Curve MK



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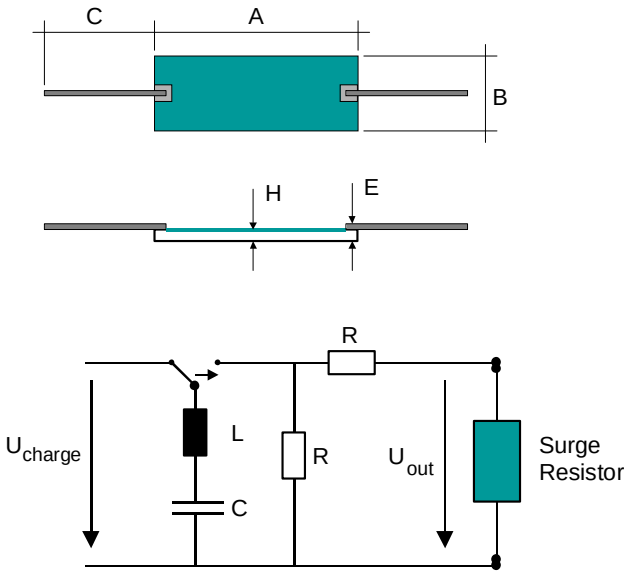
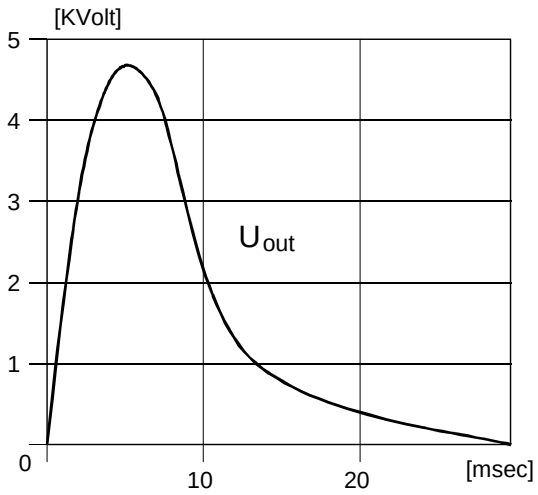
Series NI03 Surge Power Resistors





TEST VDE 0750

Type	U (KVolt)	Energy (J) *	Power (W)	A	B	C	H	E
NI03.1	3	6	0.5	9	5.5	10	0.7	1.1
NI03.2	3.5	9	0.5	11	5.5	10	0.7	1.1
NI03.3	4	11	0.75	13	5.5	10	0.7	1.1
NI03.4	7	33	1	21	8	10	0.9	1.3
NI03.5	7	44	1.5	21	10.5	10	0.9	1.3
NI03.6	11	55	2	26	10.5	10	0.9	1.3

Dimensions in mm

Pulse Duration	**10 msec ***	1 msec	0.1 msec
Energy (Typical)	**100 %**	35 %	15 %
Example NI03.6	**55 Joule**	20 Joule	8 Joule

Characteristics

Applications :	Medical Surge Protection Ideal to replace standard Carbon Composition Resistors
Resistance Value :	100 Ohm up to 100 KOhm
Temperature Coefficient :	100 ppm/℃
Tolerance :	1%, 2%, 5%, 10%
Operating Temperature :	-55 ℃ ... +200 ℃
Test :	VDE 0750 (Pulse Duration 10 msec)
Encapsulation :	Screen Printed Glass
Custom dimensions, values, tolerances and characteristics available.	

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